University of Southeastern Philippines

MECC-125

Finance & Accounting for Engineer$

As taught by

Dr. Simon R Mouer, PE, PhD
Professor, College of Engineering

Chapters (Lessons) 1 – 6   material partially published under ©2003
Chapters (Lessons) 7 – 18 material partially published under ©2004

Book form [Chapters (Lessons) 1 – 18] published under ©2004

This richly illustrated material is primarily intended for university-level courses with instructor guidance and explanations. Future versions are planned that will be more self-explanatory and useful to a wider audience.

Available in printed form (black & white, or color)
and on CDROM (including interactive files)

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Finance & Accounting for Engineers

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Lesson Plan 7 – Deleted – (Material relocated)

Lesson Plan 8 – Deleted – (Material relocated)

Lesson Plan 9

Interest	
Definitions	Uniform series (normal)
Simple interest	Derivation
Derivation	A useful identity
Example	Example
Homework	Homework
Compound interest	Uniform series (full)
Derivation	Derivation
Examples	An alternate solution
Homework	Uniform series (offset)
Effective interest rate	Arithmetic gradient series
Derivation	Derivation
Effective vs. nominal rates	Example
	Geometric gradient series
Continuous compounding	Derivation
Infinite Series	Example

Spreadsheet solutions to interest problems

Introduction
Compound interest
Cascading solutions
Equal-principal series
Uniform series

Lesson Plan 10 – Deleted – (Material relocated)

Lesson Plan 11 & 12 – Financial Justification of Projects

Lesson Plan 11
Marketable Product Lifecycle
Methods of Financial Analysis
Project Estimate (Deferred to Lesson 18)   Minimum Acceptable Rate of Return (MARR)
Net Present Value (NPV)   Homework (Group)
Benefit-Cost Ratio (B/C)   Effects of Inflation
Internal Rate of Return (IRR)   Homework
        Homework: NPV, B/C, IRR   Estimating Benefits (B/C ratio)

Lesson Plan 12 (Lecture 11 continuation (as necessary))

Lesson Plan 13 – Inflation & Financial Analysis

Lesson Plan 13	Calculating an Inflation Index
Article – Cost of Living	Filipino CPU Tables
Article – Inflation & Deflation	Understanding Inflation
US CPI Tables	Homework Assignment 13
US Inflation Index (1927 – 2002)	

Lesson Plan 14 – Economic Cycles & Comparative Analysis

Lesson Plan 14	Comparative Analysis
Economic Cycles	Homework: 14

Lesson Plan 15 – Payback Period, Equivalent Uniform Sum & Replacement Analysis

Lesson Plan 15	Replacement Analysis
Payback Period	Homework Assignment 15
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Lesson Plan 16 – Depreciation & Taxes

Lesson Plan 16	Depreciation & Tax
Income Tax	Capital Budgeting
Inconsistent Business & Tax Models	Homework Assignment 16

Lesson Plan 17 – Operating Budget & Breakeven Analysis

Lesson Plan 17
Break-Even Analysis
Homework: Assignment 17

Lesson Plan 18 – Objective Decision Analysis & Estimates

Lesson Plan 18
Objective Decision Analysis
Estimates

LESSON PLAN 0 – 1 hour

1. ADMINISTRATIVE ISSUES

1.1 Personal introductions

1.2 Time to complete: 21 lecture-days total time – 1 lecture day in Xmas holidays = 20 lecture-days:

    16 lecture-days @ 2 hrs/day = 34 lecture hours
     2 lecture days @ 2 hrs/day for mid-term exam (1 lecture-day) and final exam (1 lecture-day)
     1 lecture day @ 2 hrs/day for pre- and post test review
    <u> 1</u> lecture day @ 2 hrs/day for group project presentations
    20

1.3 Typical Class Session

Administrative
  Attendance sign-in sheet
  Lesson plan distribution
  Answers to prior homework assignment
  Questions/comments on prior reading assignment

Lecture topic 1st hour:
Lecture topic 2nd hour

Typical Lecture:
  Topic introduction
  Module location in course
  Relevancy issues
  Model assumptions/derivations
  Technical considerations and details
  Application/examples
  Discussions/Feedback
  Reading assignment
  Homework assignment

2. STUDENT INTERNALIZATION

Reading assignments	Complete each reading assignment before the next class
Homework assignments	Complete each homework assignment on assigned due date
Group project (1)	Feasibility study of a capital project (group's choice).
Individual Projects (3):	Book Report on some aspect of project financing, engineering cost management, finance & account8ing, or project feasibility
	Sources: text books, Internet articles, library books, bookstore books not already on dead list.
Class participation	Answer instructor's questions, ask questions, join in discussions **attend classes**, attend group/team meetings
Tests	Midterm, Final Open book & notes, individual effort; Tests may be monitored or take home, or both.

Grading

Item	Test 1	Test 2	Home work	Individual reports	Group project	Class participation	Σ
Importance	1	1	1	1	1	1	6
Weight	1/6	1/6	1/6	1/6	1/6	1/6	1
% weight	16.67%	16.67%	16.67%	16.67%	16.67%	16.67%	100%
SCORE	(	% correct	)	*	(	% complete	)	*

Composite score:

$$\left. \begin{array}{cccccc} \text{weight} & \text{weight} & \text{weight} & \text{weight} & \text{weight} & \text{weight} \\ x & x & x & x & x & x \\ \text{score} & \text{score} & \text{score} & \text{score} & \text{score} & \text{score} \end{array} \right\} \; \Sigma = \text{ composite score}$$

COMPOSITE SCORE	100-98	97-95	94-92	91-89	88-86	85-83	82-80	79-77	76-75	<75
GRADE	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	5.00

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R É S U M É

ACADEMIC   PhD   Engineering Management California Coast University   *2001*
   Major: engineering management
   Minor: human resources and marketing
   Dissertation: An evaluation of the efficacy of qualification- based selection
      procedures for architectural and engineering services

   MS   Engineering   Univ. of Texas at Austin   *1998*
   Major: construction engineering and project management
   Minor: statistics
   Report: Plan for research into arch./engr. services selection method

   MS   Engineering Mechanics   Univ. of Texas at Arlington   *1971*
   Major: engineering mechanics
   Minor: mathematics
   Thesis: Stiffness matrix of a twisted beam

   BS   Civil Engineering   Louisiana Tech University   *1966*
   Major: civil and structural engineering
   Minor: mathematics

LICENSES   Registered Professional Engineer Texas
   Registered Professional Engineer Louisiana
   Certified Flight Instructor   USA

LANGUAGES   English (native), Spanish (fluently read, write, speak), Arabic (speak some)

EXPERIENCE   *Nov 01 – Present* **Professor**, School of Engineering, University of Southeastern Philippines

   Dec 98 – Nov 01 **Retired**

   Jan 96 – Dec 98 **Research Consultant**, University of Texas @ Austin, Texas

   Nov 94 – Dec 96 **CEO**, M7, inc., Fairfax, Virginia

   Apr 92 - Oct 94 **Division Chief**, Prog. & Rep. Div., USACE Transatlantic Div., Winchester, Virginia

   Oct 89 - Apr 92 **Deputy Chief**, US-Egypt Joint Management Engineer Team, Ismailia, EGYPT

   Apr 84 - Oct 89 **Senior Negotiator,** USACE Middle East/Africa Proj. Ofc, Winchester, Virginia

   Jan 84 - Apr 84 **Resident Engineer,** USACE Sudan Resident Office, Khartoum, SUDAN

   June 83 - Jan 84 **Construction Coordinator,** USACE Middle East Div., Winchester, Virginia

   Jan 83 - Jun 83 **Project Engineer,** USACE Kuwait Projects Office, KUWAIT

   Jan 78 - Jan 82 **Branch Chief**, Prog., Sched. & Log. Br., Al Batin District, USACE, SAUDI ARABIA

   May 71 - Jan 78 **Chief**, Red River Unit, New Orleans Dist., USACE, New Orleans, Louisiana

   1970 – 1971 **Graduate Research Assistant,** University of Texas @ Arlington, Texas

   Jun 68 - May 71 **Structural Engineer,** Ling-Temco-Vought Aerospace, Inc. Dallas, Texas

   Jun 66 - Jun 68 **Methods & Research Engineer,** Brown Engineering Co., Huntsville, Alabama

INDIVIDUAL PROJECT REPORT FORMAT

Option 1: (preferred option) **three reports**

(1st report due 6th week, 2nd report due 13th week, 3rd report due 20th week)

General Instructions for Report

Type your report. Use double-space or 1-1/2 line spacing. Any semi-formal font is acceptable, such as Times New Roman, Arial, Bookman, Century Schoolbook, or other document-type font. Maximum of 5 pages, minimum of 1 page.

Format of Report:

1. Title page: Include the following information

    MECC 125 Accounting for Engineers

    Individual Project Report Number 1 (or 2 or 3)

    Date of Report

    Your Name

2. Table of Contents (Optional)

3. Reference Cite

    Author (Last name Initials), year published (e.g. 1998), Title (italics or bold), Publisher, Where published, (number of pages)

    Example: Day AD, 1998, *Project Management-do's and don'ts*, Wiley, NY (185 p.).

4. Topical Outline by Chapter or Section

    For each chapter (or section if no chapters) give the chapter title (or a one-line topic description, if no chapter title)

    Summarize in one or two short paragraph the essence of the chapter.

5. Main points and Summary.

    In one or two paragraphs, state in your own words the main points of the book, reference or document, and summarize the author's conclusions.

6. Your Conclusions

    In one or two paragraph, state your impressions and conclusions about the book, reference, or document, and its usefulness to project managers.

Option 2: Substitute a Xerox copy of a book for 1 report   (1 Xerox copy = 1 report)

Option 3: Substitute 1 used book for 2 reports   (1 used book   = 2 reports)

Option 4: Substitute 1 new book for 3 reports: (1 new book   = 3 reports)

Report	Original	Copy	Author	Title
			DEAD LIST - 2003 *(Do not duplicate any 'x'd or grayed area in the columns to the left)*	
			Author	Title
		x	Ford JK	A Framework for Financial Analysis
		x	Marshal D	A survey of Accounting
		x	Ingraham RW, Petersen RJ, Martin SW	Accounting & Financial Reporting for Governmental and Nonprofit Organizations: Basic Concepts
		x	Garner CW	Accounting and Budgeting in Public and Nonprofit Organizations
	x		Bertol	Accounting for management Use
	x		Hoggett j, Edward L	Accounting in Australia
	x		Fess PE, Niswonger CR	Accounting Principals
x			Crow KA	Achieving Target Cost/Design to Cost Objectives
	x		Guerrero PP, Peralta JF	Advanced Accounting a procedural approach vol 1
	x		Deano-Mejorada NA	Advanced Accounting Part II
x			Baker, et al	Advanced Financial Accounting, 4th Ed.
		x	Higgins, RC	Analysis for Financial Management
	x		Santos, Roque	Basic Auditing Practice 2nd Ed.
	x		Guitierrez R, Pura JM, Garcia RM	Business Organizations and Management - 2 copies
	x		Miranda GS	Commercial Banking (1995)
	x		Passion DS	Cost Accounting, Part 2
x			Matz A, Usry MF, Macuja EP	Cost Accounting: Planning & Control Vol I
x			Lowery J	Cost Management of Civil Engineering Works
	x		Frias SA, Farjado CL	Elementary Accounting (partnership & corporation)
x			Leland TB	Engineering Economy
	x		Matias Aerola	Engineering Economy
	x		sta Maria HB	Engineering Economy
	x		Thusen GJ, Fabrycky WJ	Engineering Economy
x			DeGarmo EP, Canada JR, Sullivan WG	Engineering Economy, 1979
	x		Miranda GS	Essentials of Money, Credit, & Banking
x			Conrado TV	Financial Accounting
x			Meigs W, Meigs R	Financial Accounting 3rd Ed.
x			Hermanson RH, Edwards JD, Rayburn LG	Financial Accounting 4th Ed.
	x		Valex CT, Peralta JF	Financial Accounting, Vol I, 2002 Ed.
		x	Viscione, JA	Financial Analysis - *Principles and Procedures*
x			Larson KD	Fundamental Accounting Principles, 1990
x			Stephen AR, Randolph WW, Bradford DJ	Fundamentals of Corporate Finance
	x		Pobre HP, Magno AB	Government Accounting - a self-instructional approach
	x		Viray-Vicente MA	Government Accounting Module Part II Expenditure Accounting
		x	Paarlberg D	Great Myths of Economics
		x	Dev Acad of Philippines	How to Develop Feasibility Studies
x			Hendrickson C	http://www.ce.cmu.edu/~cth/pmbook

Report	Original	Copy	DEAD LIST - 2003 (continued) (Do not duplicate any 'x'd or grayed area in the columns to the left)	
			Author	**Title**
x			Dyckman TR, Davis CJ, Dukes RE	Intermediate Accounting 5th Ed.
	x		Pasion DS	Intermediate Accounting (Financial Accounting)
	x		Mejorada ND	Introduction to Management Accounting (for non-accounting majors)
x			Drury	Introduction to Cost Accounting & Elements of Cost
x			Charles TH, Gary LS, William OS	Introduction to Management Accounting, 2002
	x		Lorenzana CC	Management - theory and practice
	x		Peralata JF	Management Accounting-an introduction
	x		Andres TD	Management by Filipino Values
		x	Nat'l Gov't Agencies	Manual on the New Government Accounting System (Vol I)
		x	Nat'l Gov't Agencies	Manual on the New Government Accounting System (Vol II)
	x	x	Filamor RM	Principles of Cost Accounting - *Job order cost system 2 orig + 1 copy*
x			Valdepenas V	Project Development manual (1984)
x			Senares RA	Project Study - Road Construction with Feasibility Study (1996)
		x	Fulks DL	Schaum's easy Outlines: Principles of Accounting
		x	Myddelton D	The Essence of Financial management (1995)
x			Dixon RL, Arnett	The McGraw-Hill Thirty-Six Hour Accounting Course
		x	Lomash, S	Value Management (1998)

NOTE TO STUDENTS: You may borrow any available book above (original or copy) from the instructor for reading and writing a report, providing no prior report is listed in the dead-list, above.

If you borrow a book from the instructor, you must return it in the same condition it was when you borrowed it. Failure to return a book – or replace it if lost, damaged, mutilated, or destroyed- will result in your final grade being withheld.

Feasibility Study Processes

Resources	Process	Duration
Marketing	Identify potential revenue stream	
Politcal group	Identify potential benefits	
Executive	Decision: perform feasibility study	1 day to 1 month
	NO - stop	
	YES - continue	
Exec, Budget cmte	Budget feasibility study	1 day to 1 year
Exec. F&A	Fund feasibilty study	1 day to 1 month
Exec., Program Mgr	Select Project Manager	1 day to 1 month
PM, functional heads	Select feasibility team members	
PM, Executive	Accomplish in-house?	1 week
	YES - skip AE selection process	
	NO - select AE	
	AE SELECTION PROCESS	
PM	Write AE scope of work	1 day to write plus 1 week
Procurement	Solicit interest	45 days
PM,Procure, Engr.	Rank candidates	1 week
PM,Procure, Engr.	Select best qualified	1 day
PM	Negotiate Fee	1 week
PM, F&A	Commit contract funds	3 days
Procurement	Award AE contract	1 week
PM, AE	Develop end-use rough scope	2 weeks
PM, AE	Identify & visit potential sites	2 weeks
PM, AE, Estimator	make ROM cost estimates	2 weeks
PM, AE, Marketing	Calculate rough ROI or B/C ratios	1 week
PM, AE	Compare alternatives	2 weeks
PM, AE	Recommendations/rankings	1 week
	Feasibility report	1 week
	Decision to proceed to planning	1 to 6 months
	No - stop	
	Yes - continue to planning	

GROUP PROJECT MILESTONES

PROJECT PHASE	DRAFT TARGET	DESCRIPTION
Form Group/Team	Week 3	Internalize cost management principles put forth in this class
Project Selection	Week 4	Choose some proposed facility or product (actual or invented) which will (or should have) required financial justification before project implementation.
Facility function	Week 5	Define the purpose of the proposed facility
Alternatives	Week 6	Propose at least three alternatives, plus a fourth alternative of do nothing. Alternatives may be in location and or configuration.
Configuration	Week 7	Define the configuration of each alternative sufficiently to estimate ROM costs.
Financing	Week 8	Establish how the project is to be financed (i.e., bonds, loans, taxes, grants, donations, etc.)
Expenses	Week 9	Estimate the expenditure stream to bring the project on-line
Revenues	Week 10	For each alternative estimate how the project will generate a revenue stream
Benefits	Week 10	If the project has no revenues, estimate the benefits to the owners over the useful life of the proposed facility or product.
ROI	Week 11	Estimate the return on investment (ROI).
B/C ratio	Week 11	If the project has no revenue stream, estimate the benefit-cost ratio (B/C ratio)
MARR	Week 12	Set the minimum rate of return (MARR)
Before-tax analysis	Week 13	Perform the financial analysis without regard to taxes
Estimate taxes	Week 14	Estimate the taxes to be incurred once the project is operational
After-tax analysis	Week 15	Perform the financial analysis including taxes
Presentation	Apr 3	Present study to the class and the instructor (last class period)
Feasibility Report	Apr 3	Submit Feasibility study to Instructor for grade

Group & Individual Project   Time Schedule

Week	01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22
	November December . January . February . March . Apr
Date	15 22 29 06 13 20 27 03 10 17 24 31 07 14 21 28 06 13 20 27 03 06

1st day   Final   Grades
                                                                                                Exam   Due

Individual Projects: *1st Project*   *2nd Project*   *3rd Project*

Individual Projects:	1st Project	2nd Project	3rd Project
Select subject/topic/book	..2.	..9.	.16.
Instructor approval	..3.	.10.	.17.
Review read	..4.	11.	.18.
Write report	..5.	.12.	.19.
Submit Report	..6.	13.	20.

MECC 125 Accounting for Engineers

Fall Semester 2003 Schedule

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Month	Nov-03			Dec-03				Jan-04					Feb-04				Mar-04				Apr '04	
Date	15	22	29	6	13	20	27	3	10	17	24	31	7	14	21	28	6	13	20	27	3	6
Class	1	2	3	4	5	6		7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Lecture 1st hr	0	1	2	3	4	4		5	6	6	T	R	8	10	12	14	16	18	20	T	R	
Lecture 2nd hr	1	2	3	4	4	5		6	6	R	T	7	9	11	13	15	17	19	R	T	P	
Individual projects due:					1							2							3			

Group Project Progress:

Vertical-text column labels:
- Week 7: **Xmas Holidays**
- Week 11: **Midterm Exam**
- Week 20: **Final Exams**
- Week 21: **Group Presentations**
- Week 22: **Last day for grades**

Group Project Progress	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Form group	▓	▓					a				d									n	o	s
Project selection		▓	▓				s				|									a	u	t
Facility function			▓	▓							t									l	p	
Alternatives				▓	▓		H				e											d
Configuration					▓	▓	o	▓			r									E	P	a
Financing						▓	l	▓	▓		m									x	r	y
Expenses							i	▓	▓											a	e	
Revenues							d		▓	▓	E	▓								m	s	f
Benefits							a			▓	x										e	o
ROI							y				a	▓	▓								n	r
B/C ratio							s				m		▓	▓							t	
MARR														▓	▓						a	g
Before tax analysis															▓	▓					t	r
Estimate taxes																▓	▓				i	a
After tax analysis																	▓	▓			o	d
Presentation	▓																	▓	▓		n	e
Feasibility report	▓																			▓	s	s

DR. MOUER'S HOMEPAGE

Web Publications

(click on the topic to view)

	[Résumé](#)	
Academics	**Themes, Tools & Minor Works**	**Major Works**
[Matrix Structural Analysis Downloads](#)	[Socio-economic Evolution](#)	[Transcendent Reality](#)
[Project Management Downloads](#)	[Objectives Decision Matrix](#)	[Transcendent Evolution](#)
[Finance & Accounting for Engineers Downloads](#)	**My Family**	

The following works are available by special request:

Leadership-Management Evaluator (modified after Grid Management)	Statistical Dilemmas	Temperament Evaluator (modified after Keirsey)

e-mail requests and comments to:
smouer@skyinet.net

::: Web board for Seminar :::

	6	MECC-125 Replacement & Miscellaneous.xls	Dr. Mouer	03.08	0
	5	MECC-125 tax.xls	Dr. Mouer	03.08	0
	4	MECC-125 Incremental.xls	Dr. Mouer	02.23	2
	3	MECC125-Inflation.xls file	Dr. Mouer	02.15	3
	2	MECC125-Methods of Financial Analysis	Dr. Mouer	02.07	2
	1	MECC-125: Spreadsheet.xls file	Dr. Mouer	01.28	3

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Subject+Content ▾ [   ] FIND

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HOMEWORK

DUE ONE WEEK AFTER ASSIGNMENT

DISCUSSED IN CLASS ON DUE DATE

There will be about 10 homework assignments for the course, more or less.

All homework assignments must be completed and handed-in on time for 100% credit.

Homework may be scored

HOMEWORK CREDIT:

Assignment handed in on-time: full credit for assignment

Credit for homework turned in after it is discussed in class:

One week late:	1/2 credit
Two weeks late:	1/4 credit
Three weeks late:	1/8 credit
Four weeks late:	1/16 credit

EXAMPLE:

		Credit				
		full	**1/2**	**1/4**	**1/8**	**1/16**
Assignment Score	100%	100%	50%	25%	12%	6%
Assignment Score	80%	80%	40%	12%	6%	3%

Grading			**Home**	**Individual**	**Group**	**Class**				
Item	**Test 1**	**Test 2**	**work**	**reports**	**project**	**participation**	**Σ**			
Importance	1	1	**1**	1	1	1	6			
Weight	1/6	1/6	**1/6**	1/6	1/6	1/6	1			
% weight	16.67%	16.67%	**16.67%**	16.67%	16.67%	16.67%	100%			
COMPOSITE SCORE	100-98	97-95	94-92	91-89	88-86	**85-83**	82-80	79-77	76-75	<75
Grade	1.00	1.25	1.50	1.75	2.00	**2.25**	2.50	2.75	3.00	5.00

Best grade you could earn if you fail to hand-in any homework

PARTICIPATION

CLASSROOM ATTENDANCE   TEAM MEETING ATTENDANCE   **Participation in open discussions**

No classroom interruptions: Cell phone ringing   Side-talking in class   Disturbances

SCHOOL POLICY ON ATTENDANCE: Maximum 20% absences (including excused absences)

Approx. 20 class-days yields maximum 4 absences

ACCEPTABLE EXCUSES: <u>Serious</u> personal illness or contagious disease (submit a note from a physician)
Illness of an immediate family member for which you are the primary care-giver
Rebel hostilities or civil disturbance that prevent your travel to USEP

All absences	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Class participation score	100%	95%	90%	85%	80%	75%	70%	65%	60%	50%	45%

Unexcused absences	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Adjustment to <u>final composite score</u> %					0%	-5%	-10%	-15%	-20%	-25%	FAILURE

Grading Item	Test 1	Test 2	**Home** work	**Individual** reports	**Group** project	**Class** participation	Σ
Importance	1	1	1	1	1	**1**	6
Weight	1/6	1/6	1/6	1/6	1/6	**1/6**	1
% weight	16.67%	16.67%	16.67%	16.67%	16.67%	16.67%	100%

FINAL COMPOSITE SCORE	100-98	97-95	94-92	91-89	88-86	**85-83**	82-80	79-77	76-75	<75
Grade	1.00	1.25	1.50	1.75	2.00	**2.25**	2.50	2.75	3.00	5.00

Best grade you could earn if you earn zero for participation.

LESSON PLAN   00
COURSE OUTLINE

MAJOR TOPICAL COVERAGE

Macro economic overview   **Commercial**
Accounting concepts   **Government**
Cost management concepts   **Equipment replacement concepts**
Borrowing concepts   **Project cost estimates**
Investment concepts   **Interest rates**
Operating budgets   **Inflation**
Project cost management   **Taxes**

Specific Topics

Income/Revenue
    Types of revenues
        Earned Income
        Unearned
        Imputed Income
Expenses
    Direct costs
        Cost centers
        Engineering & Design costs
        Manufacturing costs
        Product costs
        Project costs
        Labor costs
    Indirect costs
    Taxes paid
    Imputed Expenses
        Depreciation
Profit
Accounting
    Cost Account Classifications
    Cost account numbers
    Work breakdown structure
    Single Entry accounting
    Double Entry Accounting
General Accepted Accounting Principals (GAAP)
Liabilities & Assets
    Balance Sheet

Financial statements
    Quarterly/Annual Income
    Quarterly/Annual Expenses
Capital facility projects
    Feasibility studies
    Revenue/cost Analysis
        Return on Investment (ROI)
    Benefit / cost Analysis
        Cost-Benefit ratio
Equivalent costs
Cash flow analysis
Present value concepts
Uniform series
Interest rates
    simple interest
    compound interest
    annuities
    rate of return
    internal rate of return
    minimum attractive rate of return (MARR)
Incremental analysis
Depreciation/Amortization
Inflation
    Nature of
    Common year value
    Accounting for

REFERENCES:
1. Granof MH, Bell PW, 1991, **Financial Accounting**: *principles and issues*, 4th ed., Simon & Schuster, NJ (747 pages).
2. Newman DG, 1996, **Engineering Economic Analysis**, 6th ed., Engineering Press, CA (720 pages).
3. Newman DG, 1996, **Student's Quick Study Guide**, *Engineering Economic Analysis*, 6th ed., Engineering Press, CA (295 pages).

SYLLABUS
MECC-125 Accounting For Engineers

GENERAL NOTES:
1. Most class lecture material pre-posted on internet, or available on CD-ROM
2. Individual projects consist of 3 reports on related material outside of classroom (i.e., books, internet publications)
3. Group project is a Feasibility study of a project of your choosing, incorporating the topics and techniques to be discussed in this course.
4. Syllabus structured for either one 2-hr class per week, or multiple 1-hr classes per week.

Lesson	Hour	Topic
1	1	PERSONAL INTRODUCTIONS, course outline and syllabus, class participation requirements, grading system, typical class routines, other administrative issues. HOMEWORK: *personal résumé*
	2	TOPICAL OUTLINE OF COURSE, individual project requirements and schedule, group project requirements and schedule, book report format, alternate individual projects, class discussion of additional related topics to cover (depending on class progress and time constraints). HOMEWORK: *Essay on why accounting is important to engineers*.
2	3	FEASIBILITY: lecture and guided classroom discussion on definitions, concepts, and example feasibility phase studies for group project.
	4	SOCIOECONOMIC: lecture and guided classroom discussion on parallel historic development of social and economic systems. HOMEWORK: *Essay on where Mindanao stands in socio-economic development*.
3	5	WEALTH:, lecture and guided class discussion on definition, concepts and examples of different forms of wealth; tangible and intangible forms, renewable and consumable forms, marketable (income-producing) forms, education and training as wealth
	6	MONEY: lecture and guided class discussion on definition, concepts, history and examples of money, types of currency (commodity, credit, fiat, M1, M2, M3, L) and examples of each. HOMEWORK: *Group formation - member suggestions*.
4	7	RISK: lecture and guided class discussion on definitions, concepts, examples and sources of financial risk to wealth accumulation, business contracts, loan repayments, currency transactions, security of goods, security of person, security of distribution channels, competing ownership claims, government policy towards business and enterprise, Acts of God, Force Majeure, Business transactions. HOMEWORK: *Essay on economic issues affecting capital investment in Mindanao*.
	8	
5	9	INTEREST: lecture and guided class discussion on definitions, concepts, examples, religious objections to interest (Bible, Quran), and business justification for interest (time value of money concepts, compensation for risk, inflation hedge, profit for effort, knowledge and skill).
	10	MEASURING WEALTH: lecture and guided class discussion on definitions, concepts and examples of accounting principles (fundamental accounting equation, assets, liabilities, equities, double entry accounting history, debits, credits, owner equity, T-accounts, double-entry transactions.) GROUP HOMEWORK: *some specific thought-provoking accounting issues*
6	11	DOUBLE ENTRY ACCOUNTING: lecture and guided class discussion of accounting principles (detail discussion of homework assignment, additional examples of double-entry accounts, handling indirect and overheads in double-entry bookkeeping (distribution between projects)., GROUP HOMEWORK: *various thought-provoking questions on the classroom example*.
	12	FINANCIAL REPORTING: lecture and guided classroom discussion on definitions, concepts, construction, examples and interpretations of financial statements (balance sheet, income statement, other reporting documents), current assets, long-lived assets, current liabilities, non-current liabilities, shares, owner equity, revenues, expenses, retained earnings

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Lesson	Hour	Topic
7	13	DOUBLE ENTRY ACCOUNTING: review & answers to homework assignments on double-entry bookkeeping exercises.
	14	GAAP: lecture and guided classroom discussion on concepts, limitations, examples and interpretations of important Generally Accepted Accounting Principles (GAAP). HOMEWORK: *applications*
8	15	INDIRECT & OVERHEAD COSTS: lecture and guided classroom discussion on definitions, concepts, construction, examples and how to account for indirect and overhead costs, how to apportion to projects. HOMEWORK: *applications*
	16	COST ACCOUNTING SYSTEMS: lecture and guided classroom discussion on definitions, concepts, construction, examples and interpretations of cost accounting systems and work breakdown systems. HOMEWORK: *applications*
9	17	EARNED-VALUE: lecture and guided classroom discussion on concepts, examples and interpretations of project performance measurement and analysis using cumulative cost curves, baseline comparisons, forecasts, and earned-value analysis. HOMEWORK: *applications*
	18	Review for Mid-term Exam
10	19	**Mid-Term Exam**
	20	
11	21	Results of Mid-term Exam and answers to exam
	22	INTEREST: lecture and guided classroom discussion on definitions, concepts, derivations, formulas, calculations, applications, and examples of simple interest, compound interest, equivalent interest, nominal interest, and associated cash flow diagrams. HOMEWORK: *applications*
12	23	INTEREST: lecture and guided classroom discussion on definitions, concepts, derivations, formulas, calculations, applications, and examples of uniform series interest and associated cash flow diagrams. HOMEWORK: *applications*
	24	INTEREST: lecture and guided classroom discussion on definitions, concepts, derivations, formulas, calculations, applications, and examples of arithmetic series interest and associated cash flow diagrams. HOMEWORK: *applications*
13	25	INTEREST: lecture and guided classroom discussion on definitions, concepts, derivations, calculations and examples of geometric series interest and associated cash flow diagrams. HOMEWORK: *applications*
	26	INFLATION: lecture and guided classroom discussion on definitions, history, concepts, causes and effects of inflation as a monetary phenomena, and the necessity to compare costs in the same base year.
14	27	INFLATION MEASUREMENT: lecture and guided classroom discussion on definitions, concepts, calculations and examples of measures of inflations, such as consumer price index (CPI), cost of living index(COL), constructing an inflation adjustment index. HOMEWORK: *Calculate Philippine inflation adjustment Index from Philippine CPI*
	28	INFLATION ADJUSTMENT: lecture and guided classroom discussion on definitions, concepts, calculations and examples of using the Fisher equation to calculate the real interest rate versus the equivalent or nominal interest rates and the rate of inflation. HOMEWORK: *applications*
15	29	MULTI-CYCLIC EFFECTS: : lecture and guided classroom discussion on definitions, concepts, calculations and examples of the cumulative effect of naturally occurring cycles in financial, commercial and business transactions which may be an underlying cause of boom and bust cycles associated with inflation-deflation cycles.

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Lesson	Hour	Topic
15	30	FINANCIAL JUSTIFICATION OF PROJECTS: lecture and guided classroom discussion on definitions, concepts, calculations and examples of the analysis of irregular cash flows associated with the capital expenditure and revenue cash flows using present value (PV), future value (FV), net present value (NPV), minimum acceptable rate of return (MARR), components of the MARR (time-value-of-money, risk, and inflation), and other *time-value-of-money* concepts used in the financial justification of projects. HOMEWORK*: applications*
16	31	FINANCIAL JUSTIFICATION OF PROJECTS (continued): lecture and guided classroom discussion on definitions, concepts, calculations and examples of the analysis of irregular cash flows associated with the capital expenditure and revenue cash flows using present value (PV), internal rate of return (IRR), benefit-cost ratios (B/C), and other *time-value-of-money* concepts used in the financial justification of projects. HOMEWORK*: applications*
	32	BENEFITS: lecture and guided classroom discussion on a general approach to identifying and calculating short, medium and long-term benefits reasonably associated with government or not-for-profit projects.
17	33	DEPRECIATION & TAXES: lecture and guided classroom discussion on definitions, concepts, calculations and examples of depreciation (straight line, sum-of-digits, double declining balance, and MACRS), and taxes (tax rates and tax margins), and factoring taxes into the financial justification of projects. HOMEWORK*: applications*
	34	EQUIVALENT ANNUAL UNIFORM SUMS: : lecture and guided classroom discussion on definitions, concepts, calculations and examples of replacing irregular cash flows with equivalent annual uniform sums which more readily facilitate analysis and understanding and executive-level acceptance of rather regular annual operating costs. HOMEWORK*: applications*
18	35	REPLACEMENT ANALYSIS: lecture and guided classroom discussion on definitions, concepts, calculations and examples of replacement analysis using the equivalent annual uniform cost concept of the defender and contender (challenger). HOMEWORK*: applications*
	36	PAYBACK PERIOD: : lecture and guided classroom discussion on definitions, concepts, derivations, calculations and examples of calculating the optimum period (payback period) for a phased project of two or three phases using time value of money concepts. HOMEWORK*: applications*
19		OPERATING BUDGET: lecture and guided classroom discussion on definitions, concepts, and examples of the structure and preparation of annual operating budgets, and financial performance analysis using the annual operating budget.
		Review for Final Exam
20	37	**Final Exam**
	38	
21	39	Results of Final Exam and answers to exam
	40	Group project presentations
22	41	Group project presentations
	42	Group project presentations

End

READING ASSIGNMENT:

Table – A Simplified Model of the Evolution of State
Economic Systems
Chart – World Population Rank
Chart – World GDP Rank
Chart – World Productivity Rank

Backup Tables: World Population Rank
Backup Tables: World GDP Rank
Backup Tables: World Productivity Rank

Article – In Round 2-It's the Dollar versus the Euro
Chart – Economic Blocs Ranked by productivity
Backup Table: Economic Blocs Ranked by Productivity

Article - Japan's Crisis
Article - Japan's Economy at Risk of Collapse

HOMEWORK: Due next week.

1. **Résumé**   Submit your professional experience and courses taken relevant to this course.

2. **Essay**   In your opinion, why is (or is not) cost accounting or cost management important to Engineers? (1 type-written page)

3. **Topics**   Suggest any additional relevant topics that you would like to see added to the course.

4. **Group**   Consider which group (3 to 5 persons/group) you would like to be in for the group project.

LESSON PLAN   1
2 hours
A MACRO-ECONOMIC OVERVIEW

HOMEWORK DUE: now due:
1. **Résumé**
2. **Essay** opinion
3. **(Optional) Topics to add to course**

Groups – Begin to form groups. If you know your group, please sit together. Turn in a list of your group membership.

LECTURE:

Table – A Simplified Model of the Evolution of State

Economic Systems

Chart – World Population Rank

Chart – World GDP Rank

Chart – World Productivity Rank

      Backup Tables: World Population Rank
      Backup Tables: World GDP Rank
      Backup Tables: World Productivity Rank

Article – In Round 2-It's the Dollar versus the Euro

Chart – Economic Blocs Ranked by productivity

      Backup Table: Economic Blocs Ranked by Productivity

Article - Japan's Crisis

Article - Japan's Economy at Risk of Collapse

HOMEWORK ASSIGNMENT – (see last page in Lesson Plan)

A SIMPLIFIED MODEL OF THE EVOLUTION OF STATE AS A POLITICAL ENTITY

SOCIAL UNIT	COMPONENTS	MEASURE OF RELATION	BOND	HEAD	CHARACTERISTICS	COMMENTS
FAMILY	**Parents**	1st degree of consanguinity	Emotional: Familial Filial	Father	Total dependency on parent, or person in-loco-parentis	Some small family groups still exist in very remote and isolated locations
	Children			Mother		
	Related individuals					
	Occasional unrelated person					
CLAN	**Related families**	1st, 2nd, 3rd … degrees of consanguinity	Emotional: Familial Clannish	Elder	Intra-clan cooperative	Quite common in most of the world. Internal turmoil and dissention is often associated with strong competing clans.
	Occasional unrelated family			Sheik	Extended family support	
	Related individuals			Leader	Occasional barter	
	Occasional unrelated individual					
TRIBE	**Related clans**	Multiple degrees of consanguinity	Emotional: Familial Clannish Tribalism	Council of elders	Communal dependency	Common in Africa and most 3rd world countries. Weak central government is usually associated with strong inter-tribal rivalry.
	Occasional unrelated clan			Chieftain	Some division of labor	
	Occasional unrelated family			Prince	Intra-tribal barter	
	Related individuals			Governor	Inter-tribal trade	
	Occasional unrelated person				Rudimentary money	
STATE	Related tribes	**Territorial** The state tries to weaken family, clan and tribal loyalties	Police force & instilled allegiance to the state	King	**Currency (money) system**	Most of the recognized countries of the world are states – but not all have the essential elements of a state
	Unrelated tribes			Emperor	Well-developed intrastate trade	
	Related clans			President	Interstate trade	
	Unrelated clans			Prime Minister	Government institutions	
	Related families				Well-developed division of labor	
	Unrelated families				Elaborate legal systems – rule of law	
	Individual				Elaborate political systems	

HOMEWORK ASSIGNMENT (Due next week)

In your opinion:

1. In the above model, where would you put the Philippines, and why?

2. A common language is one sign of a strong state. How does the Philippines rate (weak to strong) in having a common language?
    Why is that so, and is it a concern?
     If you deem it a problem, what is your solution?

3. The US$ is the de-facto international currency, although other currencies, such as the Euro-dollar, are vying for that distinction.
    The Philippine peso has been declining fairly regularly against the US dollar.
    Is that good or bad?
    What do you think is the cause?
    Should anything be done about it?
    If so, what?

ECONOMIC SYSTEMS

- **Capitalism**
    - Private property
    - Private Industry and commerce
    - Laissez-Faire government
- **Socialism**
    - The state provides minimum needs (cradle to grave)
    - Private industry heavily regulated
    - Many state-owned enterprises
- **Communism**
    - Communal property only
    - Equal share independent of effort
    - No private industry
- **Communalism**
    - Extended families
    - Strong allegiance to tribes, clans & families (but not very numerous in numbers)
    - Weak sense of community responsibility (generally poor sanitation and health)
    - Weak sense of private property rights
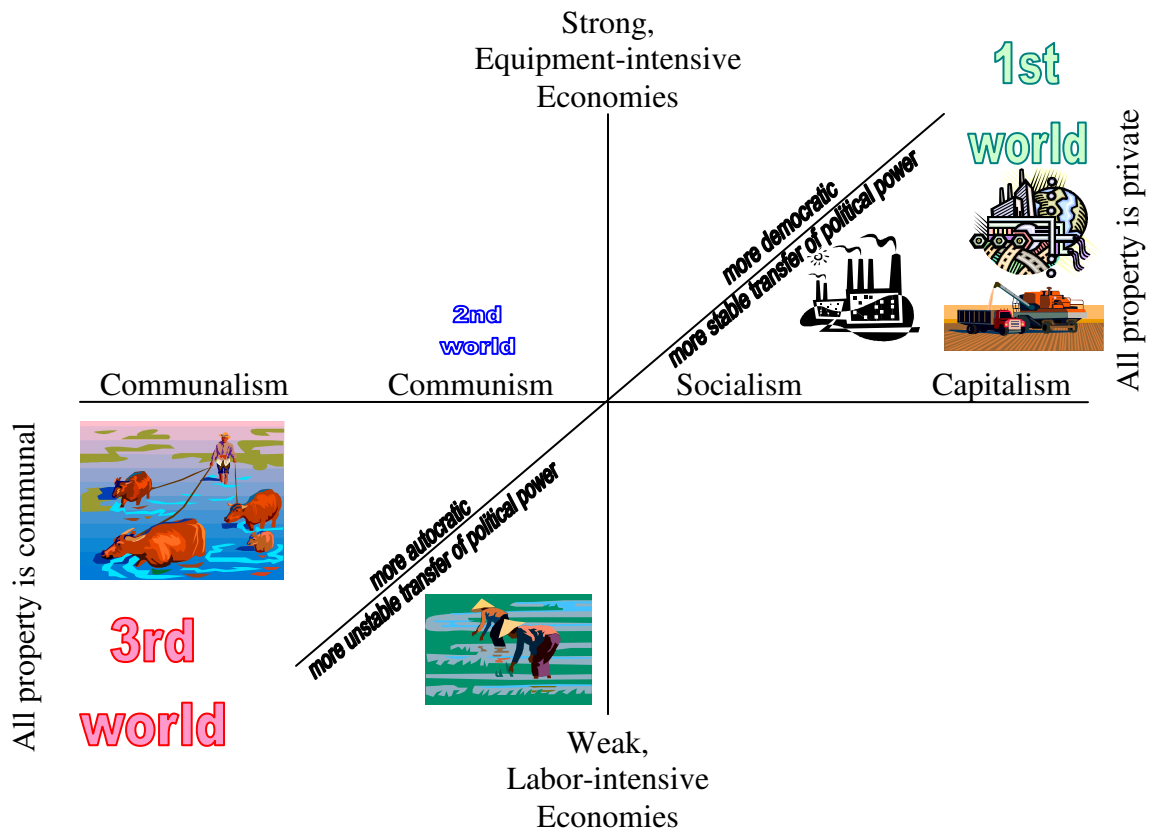
World Population Rank
1995 Data

Populatiom, millions (y-axis): 0, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1,000, 1,100, 1,200

Rank by population (x-axis): 1, 11, 21, 31, 41, 51, 61, 71, 81, 91, 101, 111, 121
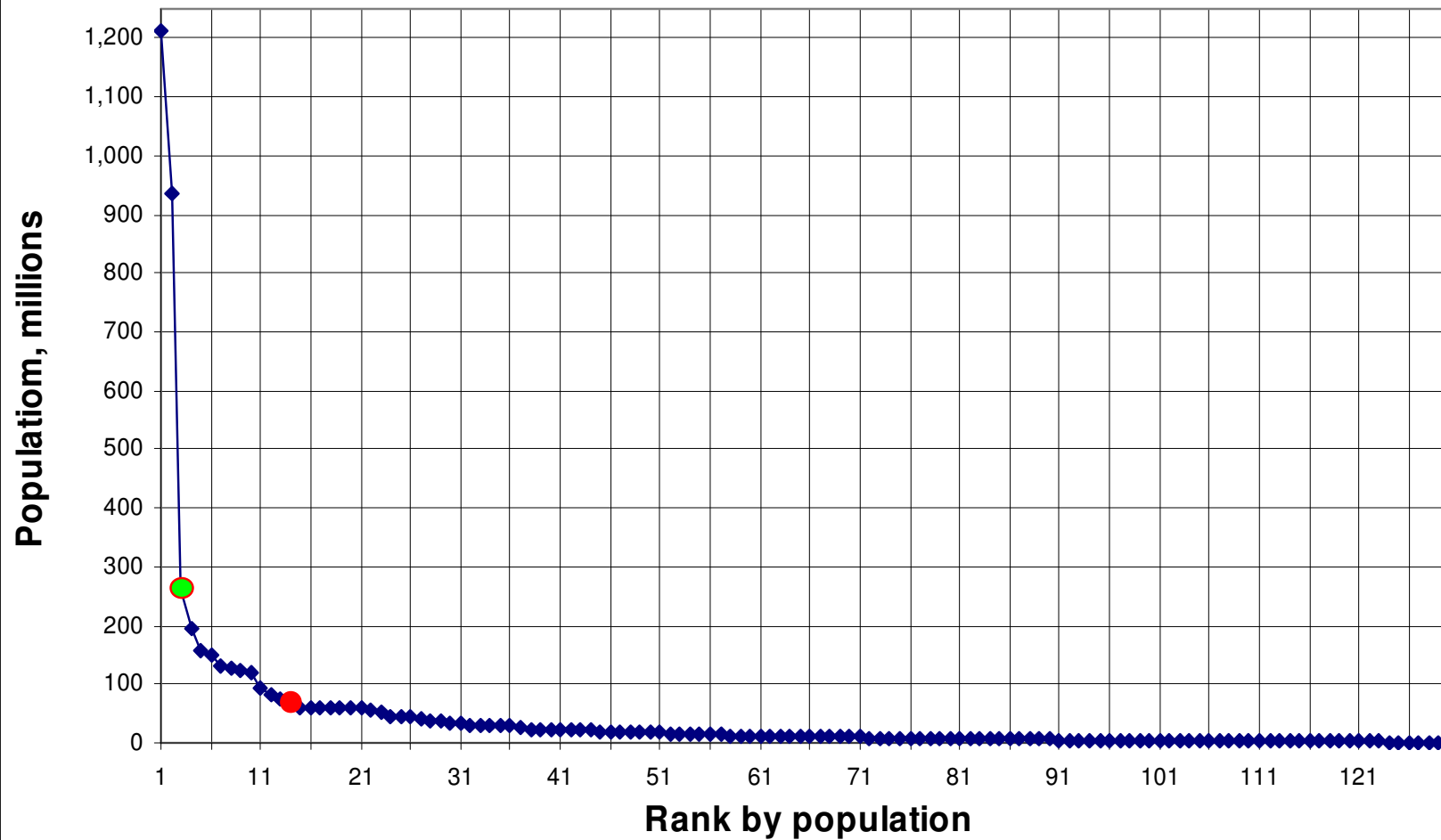
World Rank by GDP

1995 Data ($_{1987}$)
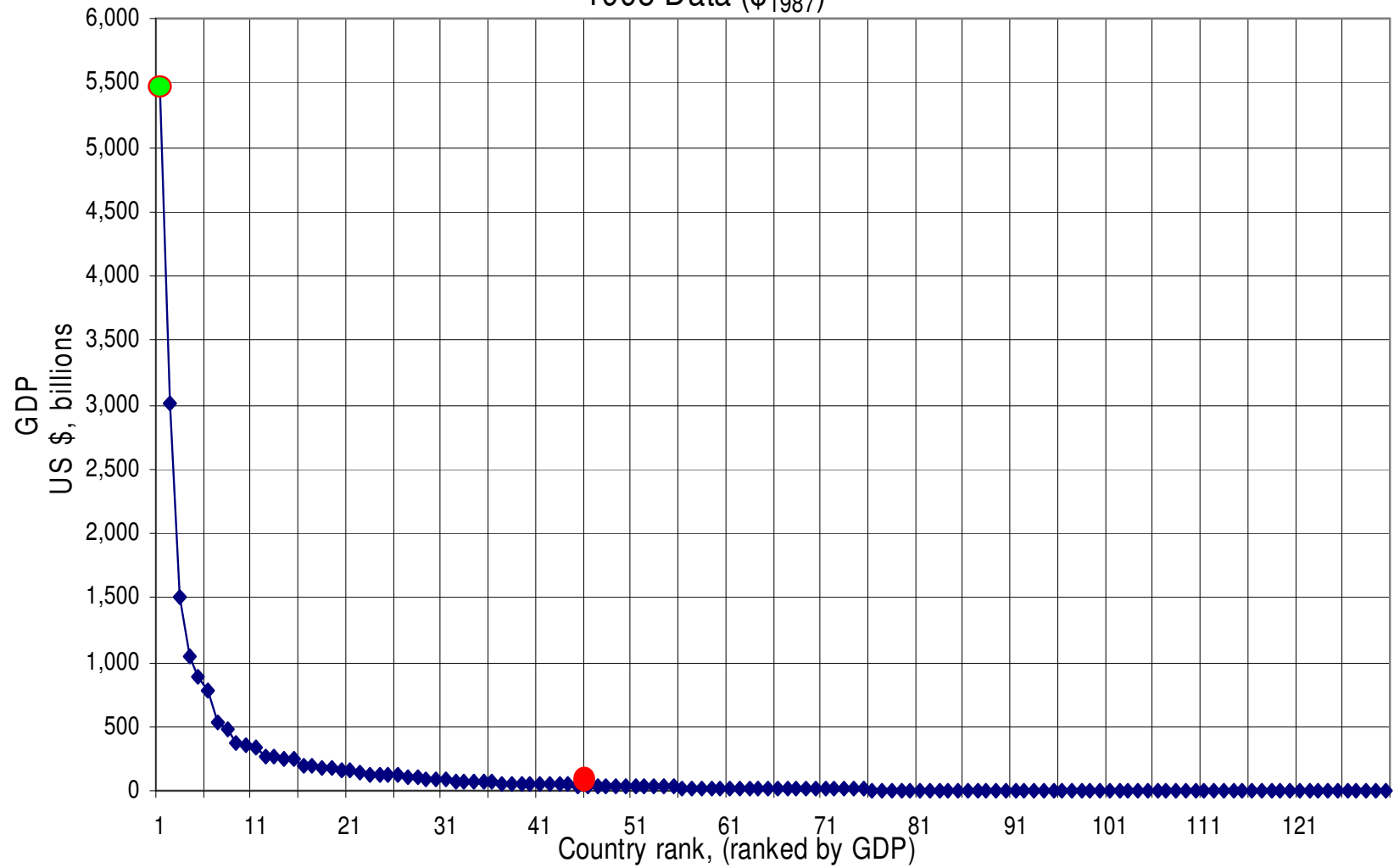
Productivity (GDP/Population)
1995 Data ($_{1987}$)
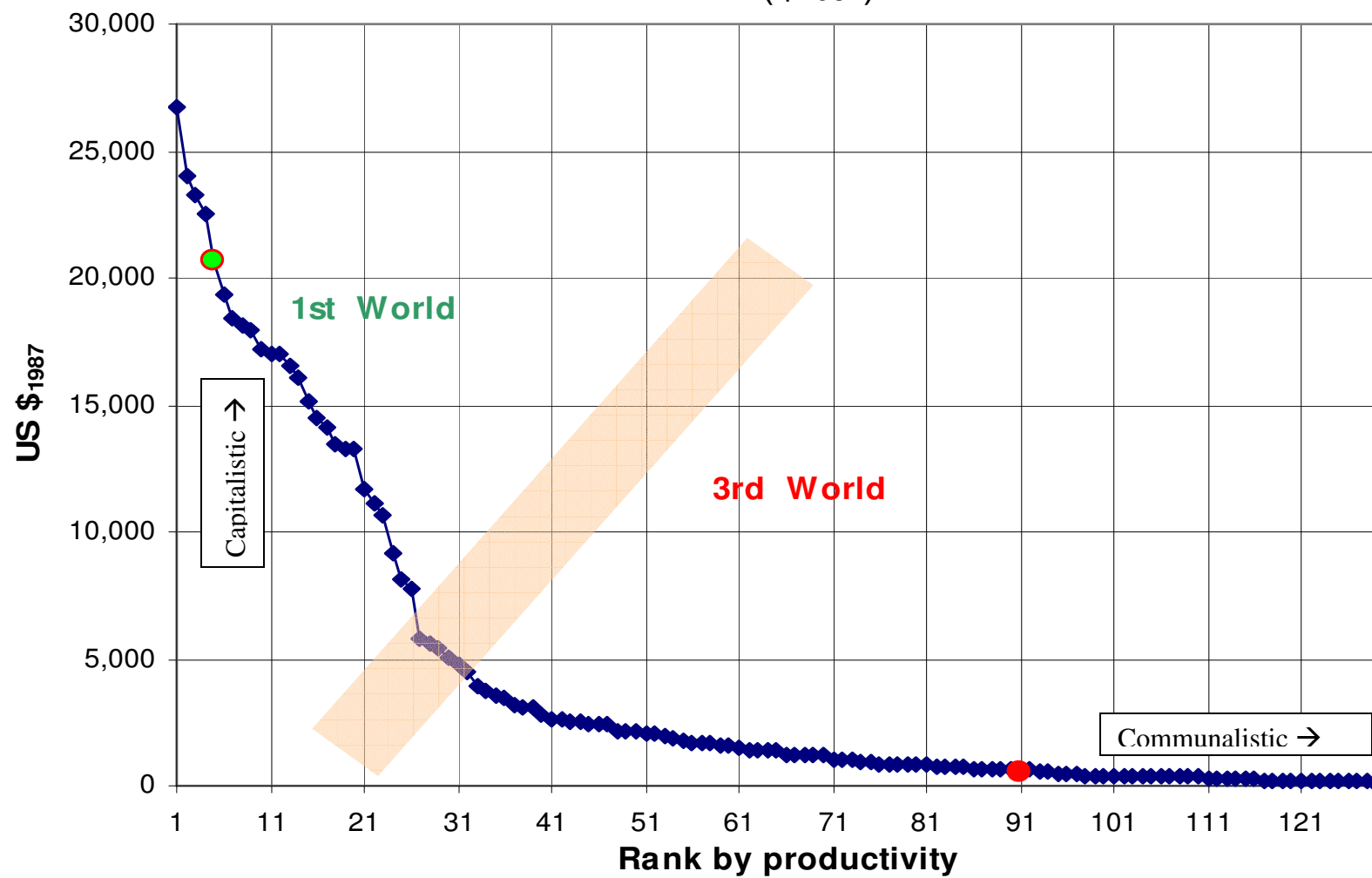
WORLD RANK BY POPULATION
as of 1995 (in 1987 US$)

Rank by Prod	Rank by Pop	Rank by GDP		GDP95 Million $	%world	POPULN Million	%world	Productivity GDP / Pop	Ratio %GDP_{world} / %POP_{world}	EU
97	1	7	China	532,915	2.71	1,211.68	21.82	440	0.12	
100	2	9	India	378,600	1.93	935.74	16.85	405	0.11	
5	**3**	**1**	**United States**	**5,452,500**	**27.77**	**263.43**	**4.74**	**20,698**	**5.86**	
88	4	23	Indonesia	129,367	0.66	193.75	3.49	668	0.19	
50	5	11	Brazil	332,616	1.69	155.82	2.81	2,135	0.60	
57	6	15	Russia	246,882	1.26	148.14	2.67	1,667	0.47	
102	7	44	Pakistan	49,589	0.25	129.81	2.34	382	0.11	
111	8	49	Nigeria	39,349	0.2	126.72	2.28	311	0.09	
2	9	2	Japan	3,007,183	15.32	125.2	2.25	24,019	6.79	
121	10	56	Bangladesh	24,297	0.12	120.43	2.17	202	0.06	
58	11	21	Mexico	155,313	0.79	94.85	1.71	1,637	0.46	
7	12	3	Germany	1,500,645	7.64	81.64	1.47	18,381	5.20	1
77	13	35	Vietnam	64,511	0.33	74.54	1.34	865	0.25	
91	14	46	Philippines	43,129	0.22	70.27	1.27	614	0.17	
54	15	26	Turkey	116,506	0.59	61.64	1.11	1,890	0.54	28
38	16	16	Iran	190,341	0.97	61.28	1.1	3,106	0.88	
55	17	27	Thailand	106,017	0.54	59.4	1.07	1,785	0.51	
83	18	45	Egypt	43,732	0.22	59.23	1.07	738	0.21	
15	19	5	Italy	884,506	4.51	58.3	1.05	15,172	4.29	3
18	20	6	United Kingdom	786,052	4	58.26	1.05	13,492	3.82	4
9	21	4	France	1,041,766	5.31	58.15	1.05	17,915	5.07	2
129	22	89	Ethiopia	5,969	0.03	56.68	1.02	105	0.03	
73	23	40	Ukraine	51,756	0.26	51.64	0.93	1,002	0.28	
113	24	69	Burma	13,382	0.07	46.53	0.84	288	0.08	
28	25	14	Korea, South	252,132	1.28	44.85	0.81	5,622	1.59	
126	26	83	Zaire	6,845	0.03	43.9	0.79	156	0.04	
48	27	31	South Africa	90,156	0.46	41.24	0.74	2,186	0.62	
24	28	10	Spain	357,489	1.82	39.21	0.71	9,117	2.58	5
56	29	34	Poland	65,974	0.34	38.59	0.69	1,710	0.48	12
63	30	42	Colombia	50,581	0.26	35.1	0.63	1,441	0.41	
34	31	24	Argentina	129,107	0.66	34.77	0.63	3,713	1.05	
108	32	73	Kenya	10,195	0.05	30.52	0.55	334	0.09	
127	33	98	Tanzania	4,527	0.02	30.34	0.55	149	0.04	
14	34	8	Canada	477,338	2.43	29.61	0.53	16,121	4.56	
105	35	72	Sudan	10,360	0.05	29.1	0.52	356	0.10	
46	36	32	Algeria	69,633	0.35	28.55	0.51	2,439	0.69	
79	37	58	Morocco	23,001	0.12	27.11	0.49	848	0.24	
70	38	54	Peru	27,890	0.14	23.53	0.42	1,185	0.34	
93	39	67	Uzbekistan	13,793	0.07	22.84	0.41	604	0.17	
69	40	55	Rumania	27,881	0.14	22.68	0.41	1,229	0.35	27
122	41	99	Nepal	4,369	0.02	21.92	0.39	199	0.06	
41	42	38	Venezuela	57,371	0.29	21.64	0.39	2,651	0.75	
25	43	18	Taiwan	174,106	0.89	21.3	0.38	8,172	2.31	
103	44	79	Uganda	7,969	0.04	21.3	0.38	374	0.11	
84	45	65	Iraq	14,475	0.07	20.45	0.37	708	0.20	
39	46	36	Malaysia	62,397	0.32	20.14	0.36	3,098	0.88	
16	47	13	Australia	261,363	1.33	18.05	0.33	14,480	4.10	
29	48	29	Saudi Arabia	96,701	0.49	17.88	0.32	5,408	1.53	
98	49	81	Ghana	7,191	0.04	17.45	0.31	412	0.12	
130	50	121	Mozambique	1,652	0.01	17.42	0.31	95	0.03	
80	51	68	Kazakstan	13,742	0.07	16.99	0.31	809	0.23	
10	52	12	Netherlands	265,482	1.35	15.45	0.28	17,183	4.86	6
124	53	104	Madagascar	2,787	0.01	14.76	0.27	189	0.05	
85	54	74	Cote d'Ivoire (Ivory Coa	10,028	0.05	14.23	0.26	705	0.20	
43	55	50	Chile	36,009	0.18	14.2	0.26	2,536	0.72	
66	56	62	Syria	17,592	0.09	14.19	0.26	1,240	0.35	
90	57	77	Cameroon	8,451	0.04	13.28	0.24	636	0.18	
87	58	76	Yemen	8,742	0.04	13.05	0.23	670	0.19	
94	59	85	Zimbabwe	6,623	0.03	11.53	0.21	574	0.16	
67	60	66	Ecuador	14,207	0.07	11.46	0.21	1,240	0.35	
31	61	41	Portugal	51,401	0.26	10.8	0.19	4,759	1.35	
123	62	118	Mali	2,146	0.01	10.79	0.19	199	0.06	
75	63	75	Guatemala	9,715	0.05	10.62	0.19	915	0.26	
30	64	39	Greece	53,230	0.27	10.46	0.19	5,089	1.44	13

Rank by				GDP95	%world	POPULN	%world	Productivity GDP /	Ratio %GDP$_{world}$ %POP$_{world}$	EU
Prod	Pop	GDP		Million $		Million		Pop		
37	65	52	Czech Republic	32,671	0.17	10.33	0.19	3,163	0.90	14
59	66	63	Belarus	16,408	0.08	10.24	0.18	1,602	0.45	31
49	67	61	Hungary	22,235	0.11	10.22	0.18	2,176	0.62	17
118	68	110	Burkina	2,343	0.01	10.18	0.18	230	0.07	
13	69	20	Belgium	166,940	0.85	10.11	0.18	16,512	4.67	8
128	70	125	Malawi	1,390	0.01	9.79	0.18	142	0.04	
117	71	117	Zambia	2,175	0.01	9.37	0.17	232	0.07	
116	72	108	Niger	2,438	0.01	9.15	0.16	266	0.08	
62	73	70	Tunisia	12,848	0.07	8.9	0.16	1,444	0.41	
6	74	19	Sweden	171,065	0.87	8.83	0.16	19,373	5.48	7
44	75	60	Bulgaria	22,307	0.11	8.8	0.16	2,535	0.72	26
12	76	22	Austria	144,703	0.74	8.53	0.15	16,964	4.80	9
92	77	93	Senegal	5,091	0.03	8.35	0.15	610	0.17	
114	78	114	Rwanda	2,280	0.01	7.95	0.14	287	0.08	
78	79	84	Dominican Republic	6,720	0.03	7.91	0.14	850	0.24	
107	80	105	Azerbaijan	2,644	0.01	7.5	0.14	353	0.10	
82	81	90	Bolivia	5,857	0.03	7.41	0.13	790	0.22	
119	82	122	Haiti	1,594	0.01	7.18	0.13	222	0.06	
1	83	17	Switzerland	188,082	0.96	7.04	0.13	26,716	7.56	43
106	84	109	Guinea	2,379	0.01	6.7	0.12	355	0.10	
125	85	129	Chad	1,077	0.01	6.36	0.11	169	0.05	
120	86	127	Burundi	1,313	0.01	6.3	0.11	208	0.06	
22	87	33	Hong Kong	69,098	0.35	6.19	0.11	11,163	3.16	
76	88	91	Honduras	5,231	0.03	5.95	0.11	879	0.25	
115	89	123	Tajikistan	1,568	0.01	5.84	0.11	268	0.08	
71	90	88	El Salvador	6,113	0.03	5.77	0.1	1,059	0.30	
112	91	120	Benin	1,717	0.01	5.56	0.1	309	0.09	
23	92	37	Israel	58,840	0.3	5.54	0.1	10,621	3.00	
99	93	116	Georgia	2,247	0.01	5.46	0.1	412	0.12	
65	94	80	Jordan	7,535	0.04	5.44	0.1	1,385	0.39	
40	95	64	Slovakia	14,903	0.08	5.36	0.1	2,780	0.79	18
4	96	25	Denmark	117,631	0.6	5.23	0.09	22,492	6.36	10
32	97	57	Libya	23,552	0.12	5.21	0.09	4,521	1.28	
8	98	30	Finland	92,833	0.47	5.11	0.09	18,167	5.14	11
104	99	119	Laos	1,770	0.01	4.88	0.09	363	0.10	
72	100	94	Paraguay	5,057	0.03	4.83	0.09	1,047	0.30	
95	101	113	Kyrgyzstan	2,293	0.01	4.67	0.08	491	0.14	
81	102	101	Nicaragua	3,609	0.02	4.54	0.08	795	0.23	
86	103	103	Moldova	3,064	0.02	4.49	0.08	682	0.19	37
3	104	28	Norway	101,565	0.52	4.36	0.08	23,295	6.59	39
109	105	126	Togo	1,370	0.01	4.14	0.07	331	0.09	
89	106	106	Armenia	2,510	0.01	3.76	0.07	668	0.19	
68	107	97	Lithuania	4,597	0.02	3.71	0.07	1,239	0.35	21
26	108	53	Puerto Rico	28,304	0.14	3.67	0.07	7,712	2.18	
17	109	43	Ireland	50,362	0.26	3.58	0.06	14,068	3.98	15
21	110	47	New Zealand	41,240	0.21	3.54	0.06	11,650	3.30	
96	111	124	Albania	1,520	0.01	3.44	0.06	442	0.13	29
53	112	86	Costa Rica	6,419	0.03	3.33	0.06	1,928	0.55	
110	113	128	Central African Republic	1,091	0.01	3.31	0.06	330	0.09	
42	114	78	Uruguay	8,280	0.04	3.19	0.06	2,596	0.73	
19	115	48	Singapore	39,775	0.2	2.99	0.05	13,303	3.76	
101	116	130	Liberia	1,075	0.01	2.76	0.05	390	0.11	
47	117	87	Panama	6,334	0.03	2.63	0.05	2,408	0.68	
74	118	107	Congo	2,461	0.01	2.59	0.05	950	0.27	
64	119	102	Jamaica	3,530	0.02	2.53	0.05	1,395	0.40	
51	120	92	Latvia	5,114	0.03	2.51	0.05	2,037	0.58	20
27	121	71	Oman	12,453	0.06	2.16	0.04	5,765	1.63	
36	122	82	Slovenia	6,913	0.04	1.98	0.04	3,492	0.99	19
11	123	51	United Arab Emirates	32,794	0.17	1.93	0.03	16,992	4.81	16
20	124	59	Kuwait	22,400	0.11	1.69	0.03	13,254	3.75	
61	125	112	Namibia	2,296	0.01	1.54	0.03	1,491	0.42	
45	126	100	Estonia	3,766	0.02	1.53	0.03	2,461	0.70	22
60	127	111	Botswana	2,327	0.01	1.46	0.03	1,594	0.45	
35	128	96	Gabon	4,732	0.02	1.32	0.02	3,585	1.01	
33	129	95	Trinidad and Tobago	4,992	0.03	1.28	0.02	3,900	1.10	
52	130	115	Mauritius	2,270	0.01	1.12	0.02	2,027	0.57	
			Total	**19,633,684**	**100**	**5,554**	**100**	**3,535**		

WORLD RANK BY GDP
as of 1995 (in 1987 US$)

Rank by Prod	Rank by Pop	Rank by GDP		GDP95 Million $	%world	POPULN Million	%world	Productivity GDP / Pop	Ratio %GDP_world / %POP_world	EU
5	3	1	United States	5,452,500	27.77	263.43	4.74	20,698	5.86	
2	9	2	Japan	3,007,183	15.32	125.2	2.25	24,019	6.79	
7	12	3	Germany	1,500,645	7.64	81.64	1.47	18,381	5.20	1
9	21	4	France	1,041,766	5.31	58.15	1.05	17,915	5.07	2
15	19	5	Italy	884,506	4.51	58.3	1.05	15,172	4.29	3
18	20	6	United Kingdom	786,052	4	58.26	1.05	13,492	3.82	4
97	1	7	China	532,915	2.71	1,211.68	21.82	440	0.12	
14	34	8	Canada	477,338	2.43	29.61	0.53	16,121	4.56	
100	2	9	India	378,600	1.93	935.74	16.85	405	0.11	
24	28	10	Spain	357,489	1.82	39.21	0.71	9,117	2.58	5
50	5	11	Brazil	332,616	1.69	155.82	2.81	2,135	0.60	
10	52	12	Netherlands	265,482	1.35	15.45	0.28	17,183	4.86	6
16	47	13	Australia	261,363	1.33	18.05	0.33	14,480	4.10	
28	25	14	Korea, South	252,132	1.28	44.85	0.81	5,622	1.59	
57	6	15	Russia	246,882	1.26	148.14	2.67	1,667	0.47	
38	16	16	Iran	190,341	0.97	61.28	1.1	3,106	0.88	
1	83	17	Switzerland	188,082	0.96	7.04	0.13	26,716	7.56	43
25	43	18	Taiwan	174,106	0.89	21.3	0.38	8,172	2.31	
6	74	19	Sweden	171,065	0.87	8.83	0.16	19,373	5.48	7
13	69	20	Belgium	166,940	0.85	10.11	0.18	16,512	4.67	8
58	11	21	Mexico	155,313	0.79	94.85	1.71	1,637	0.46	
12	76	22	Austria	144,703	0.74	8.53	0.15	16,964	4.80	9
88	4	23	Indonesia	129,367	0.66	193.75	3.49	668	0.19	
34	31	24	Argentina	129,107	0.66	34.77	0.63	3,713	1.05	
4	96	25	Denmark	117,631	0.6	5.23	0.09	22,492	6.36	10
54	15	26	Turkey	116,506	0.59	61.64	1.11	1,890	0.54	28
55	17	27	Thailand	106,017	0.54	59.4	1.07	1,785	0.51	
3	104	28	Norway	101,565	0.52	4.36	0.08	23,295	6.59	39
29	48	29	Saudi Arabia	96,701	0.49	17.88	0.32	5,408	1.53	
8	98	30	Finland	92,833	0.47	5.11	0.09	18,167	5.14	11
48	27	31	South Africa	90,156	0.46	41.24	0.74	2,186	0.62	
46	36	32	Algeria	69,633	0.35	28.55	0.51	2,439	0.69	
22	87	33	Hong Kong	69,098	0.35	6.19	0.11	11,163	3.16	
56	29	34	Poland	65,974	0.34	38.59	0.69	1,710	0.48	12
77	13	35	Vietnam	64,511	0.33	74.54	1.34	865	0.25	
39	46	36	Malaysia	62,397	0.32	20.14	0.36	3,098	0.88	
23	92	37	Israel	58,840	0.3	5.54	0.1	10,621	3.00	
41	42	38	Venezuela	57,371	0.29	21.64	0.39	2,651	0.75	
30	64	39	Greece	53,230	0.27	10.46	0.19	5,089	1.44	13
73	23	40	Ukraine	51,756	0.26	51.64	0.93	1,002	0.28	
31	61	41	Portugal	51,401	0.26	10.8	0.19	4,759	1.35	
63	30	42	Colombia	50,581	0.26	35.1	0.63	1,441	0.41	
17	109	43	Ireland	50,362	0.26	3.58	0.06	14,068	3.98	15
102	7	44	Pakistan	49,589	0.25	129.81	2.34	382	0.11	
83	18	45	Egypt	43,732	0.22	59.23	1.07	738	0.21	
91	14	46	Philippines	43,129	0.22	70.27	1.27	614	0.17	
21	110	47	New Zealand	41,240	0.21	3.54	0.06	11,650	3.30	
19	115	48	Singapore	39,775	0.2	2.99	0.05	13,303	3.76	
111	8	49	Nigeria	39,349	0.2	126.72	2.28	311	0.09	
43	55	50	Chile	36,009	0.18	14.2	0.26	2,536	0.72	
11	123	51	United Arab Emirates	32,794	0.17	1.93	0.03	16,992	4.81	16
37	65	52	Czech Republic	32,671	0.17	10.33	0.19	3,163	0.90	14
26	108	53	Puerto Rico	28,304	0.14	3.67	0.07	7,712	2.18	
70	38	54	Peru	27,890	0.14	23.53	0.42	1,185	0.34	
69	40	55	Rumania	27,881	0.14	22.68	0.41	1,229	0.35	27
121	10	56	Bangladesh	24,297	0.12	120.43	2.17	202	0.06	
32	97	57	Libya	23,552	0.12	5.21	0.09	4,521	1.28	
79	37	58	Morocco	23,001	0.12	27.11	0.49	848	0.24	
20	124	59	Kuwait	22,400	0.11	1.69	0.03	13,254	3.75	
44	75	60	Bulgaria	22,307	0.11	8.8	0.16	2,535	0.72	26
49	67	61	Hungary	22,235	0.11	10.22	0.18	2,176	0.62	17
66	56	62	Syria	17,592	0.09	14.19	0.26	1,240	0.35	
59	66	63	Belarus	16,408	0.08	10.24	0.18	1,602	0.45	31
40	95	64	Slovakia	14,903	0.08	5.36	0.1	2,780	0.79	18

Rank by				GDP95 Million $	%world	POPULN Million	%world	Productivity GDP / Pop	Ratio %GDP_world %POP_world	EU
Prod	Pop	GDP								
84	45	65	Iraq	14,475	0.07	20.45	0.37	708	0.20	
67	60	66	Ecuador	14,207	0.07	11.46	0.21	1,240	0.35	
93	39	67	Uzbekistan	13,793	0.07	22.84	0.41	604	0.17	
80	51	68	Kazakstan	13,742	0.07	16.99	0.31	809	0.23	
113	24	69	Burma	13,382	0.07	46.53	0.84	288	0.08	
62	73	70	Tunisia	12,848	0.07	8.9	0.16	1,444	0.41	
27	121	71	Oman	12,453	0.06	2.16	0.04	5,765	1.63	
105	35	72	Sudan	10,360	0.05	29.1	0.52	356	0.10	
108	32	73	Kenya	10,195	0.05	30.52	0.55	334	0.09	
85	54	74	Cote d'Ivoire (Ivory Coa	10,028	0.05	14.23	0.26	705	0.20	
75	63	75	Guatemala	9,715	0.05	10.62	0.19	915	0.26	
87	58	76	Yemen	8,742	0.04	13.05	0.23	670	0.19	
90	57	77	Cameroon	8,451	0.04	13.28	0.24	636	0.18	
42	114	78	Uruguay	8,280	0.04	3.19	0.06	2,596	0.73	
103	44	79	Uganda	7,969	0.04	21.3	0.38	374	0.11	
65	94	80	Jordan	7,535	0.04	5.44	0.1	1,385	0.39	
98	49	81	Ghana	7,191	0.04	17.45	0.31	412	0.12	
36	122	82	Slovenia	6,913	0.04	1.98	0.04	3,492	0.99	19
126	26	83	Zaire	6,845	0.03	43.9	0.79	156	0.04	
78	79	84	Dominican Republic	6,720	0.03	7.91	0.14	850	0.24	
94	59	85	Zimbabwe	6,623	0.03	11.53	0.21	574	0.16	
53	112	86	Costa Rica	6,419	0.03	3.33	0.06	1,928	0.55	
47	117	87	Panama	6,334	0.03	2.63	0.05	2,408	0.68	
71	90	88	El Salvador	6,113	0.03	5.77	0.1	1,059	0.30	
129	22	89	Ethiopia	5,969	0.03	56.68	1.02	105	0.03	
82	81	90	Bolivia	5,857	0.03	7.41	0.13	790	0.22	
76	88	91	Honduras	5,231	0.03	5.95	0.11	879	0.25	
51	120	92	Latvia	5,114	0.03	2.51	0.05	2,037	0.58	20
92	77	93	Senegal	5,091	0.03	8.35	0.15	610	0.17	
72	100	94	Paraguay	5,057	0.03	4.83	0.09	1,047	0.30	
33	129	95	Trinidad and Tobago	4,992	0.03	1.28	0.02	3,900	1.10	
35	128	96	Gabon	4,732	0.02	1.32	0.02	3,585	1.01	
68	107	97	Lithuania	4,597	0.02	3.71	0.07	1,239	0.35	21
127	33	98	Tanzania	4,527	0.02	30.34	0.55	149	0.04	
122	41	99	Nepal	4,369	0.02	21.92	0.39	199	0.06	
45	126	100	Estonia	3,766	0.02	1.53	0.03	2,461	0.70	22
81	102	101	Nicaragua	3,609	0.02	4.54	0.08	795	0.23	
64	119	102	Jamaica	3,530	0.02	2.53	0.05	1,395	0.40	
86	103	103	Moldova	3,064	0.02	4.49	0.08	682	0.19	37
124	53	104	Madagascar	2,787	0.01	14.76	0.27	189	0.05	
107	80	105	Azerbaijan	2,644	0.01	7.5	0.14	353	0.10	
89	106	106	Armenia	2,510	0.01	3.76	0.07	668	0.19	
74	118	107	Congo	2,461	0.01	2.59	0.05	950	0.27	
116	72	108	Niger	2,438	0.01	9.15	0.16	266	0.08	
106	84	109	Guinea	2,379	0.01	6.7	0.12	355	0.10	
118	68	110	Burkina	2,343	0.01	10.18	0.18	230	0.07	
60	127	111	Botswana	2,327	0.01	1.46	0.03	1,594	0.45	
61	125	112	Namibia	2,296	0.01	1.54	0.03	1,491	0.42	
95	101	113	Kyrgyzstan	2,293	0.01	4.67	0.08	491	0.14	
114	78	114	Rwanda	2,280	0.01	7.95	0.14	287	0.08	
52	130	115	Mauritius	2,270	0.01	1.12	0.02	2,027	0.57	
99	93	116	Georgia	2,247	0.01	5.46	0.1	412	0.12	
117	71	117	Zambia	2,175	0.01	9.37	0.17	232	0.07	
123	62	118	Mali	2,146	0.01	10.79	0.19	199	0.06	
104	99	119	Laos	1,770	0.01	4.88	0.09	363	0.10	
112	91	120	Benin	1,717	0.01	5.56	0.1	309	0.09	
130	50	121	Mozambique	1,652	0.01	17.42	0.31	95	0.03	
119	82	122	Haiti	1,594	0.01	7.18	0.13	222	0.06	
115	89	123	Tajikistan	1,568	0.01	5.84	0.11	268	0.08	
96	111	124	Albania	1,520	0.01	3.44	0.06	442	0.13	29
128	70	125	Malawi	1,390	0.01	9.79	0.18	142	0.04	
109	105	126	Togo	1,370	0.01	4.14	0.07	331	0.09	
120	86	127	Burundi	1,313	0.01	6.3	0.11	208	0.06	
110	113	128	Central African Republic	1,091	0.01	3.31	0.06	330	0.09	
125	85	129	Chad	1,077	0.01	6.36	0.11	169	0.05	
101	116	130	Liberia	1,075	0.01	2.76	0.05	390	0.11	
			Total	**19,633,684**	**100**	**5,554**	**100**	**3,535**		

WORLD RANK BY PRODUCTIVITY
as of 1995 (in 1987 US$)

Rank by				GDP95 Million $	%world	POPULN Million	%world	Productivity GDP / Pop	Ratio %GDP$_{world}$ / %POP$_{world}$	EU
Prod	Pop	GDP								
1	83	17	Switzerland	188,082	0.96	7.04	0.13	26,716	7.56	43
2	9	2	Japan	3,007,183	15.32	125.2	2.25	24,019	6.79	
3	104	28	Norway	101,565	0.52	4.36	0.08	23,295	6.59	39
4	96	25	Denmark	117,631	0.6	5.23	0.09	22,492	6.36	10
5	**3**	**1**	**United States**	**5,452,500**	**27.77**	**263.43**	**4.74**	**20,698**	**5.86**	
6	74	19	Sweden	171,065	0.87	8.83	0.16	19,373	5.48	7
7	12	3	Germany	1,500,645	7.64	81.64	1.47	18,381	5.20	1
8	98	30	Finland	92,833	0.47	5.11	0.09	18,167	5.14	11
9	21	4	France	1,041,766	5.31	58.15	1.05	17,915	5.07	2
10	52	12	Netherlands	265,482	1.35	15.45	0.28	17,183	4.86	6
11	123	51	United Arab Emirates	32,794	0.17	1.93	0.03	16,992	4.81	16
12	76	22	Austria	144,703	0.74	8.53	0.15	16,964	4.80	9
13	69	20	Belgium	166,940	0.85	10.11	0.18	16,512	4.67	8
14	34	8	Canada	477,338	2.43	29.61	0.53	16,121	4.56	
15	19	5	Italy	884,506	4.51	58.3	1.05	15,172	4.29	3
16	47	13	Australia	261,363	1.33	18.05	0.33	14,480	4.10	
17	109	43	Ireland	50,362	0.26	3.58	0.06	14,068	3.98	15
18	20	6	United Kingdom	786,052	4	58.26	1.05	13,492	3.82	4
19	115	48	Singapore	39,775	0.2	2.99	0.05	13,303	3.76	
20	124	59	Kuwait	22,400	0.11	1.69	0.03	13,254	3.75	
21	110	47	New Zealand	41,240	0.21	3.54	0.06	11,650	3.30	
22	87	33	Hong Kong	69,098	0.35	6.19	0.11	11,163	3.16	
23	92	37	Israel	58,840	0.3	5.54	0.1	10,621	3.00	
24	28	10	Spain	357,489	1.82	39.21	0.71	9,117	2.58	5
25	43	18	Taiwan	174,106	0.89	21.3	0.38	8,172	2.31	
26	108	53	Puerto Rico	28,304	0.14	3.67	0.07	7,712	2.18	
27	121	71	Oman	12,453	0.06	2.16	0.04	5,765	1.63	
28	25	14	Korea, South	252,132	1.28	44.85	0.81	5,622	1.59	
29	48	29	Saudi Arabia	96,701	0.49	17.88	0.32	5,408	1.53	
30	64	39	Greece	53,230	0.27	10.46	0.19	5,089	1.44	13
31	61	41	Portugal	51,401	0.26	10.8	0.19	4,759	1.35	
32	97	57	Libya	23,552	0.12	5.21	0.09	4,521	1.28	
33	129	95	Trinidad and Tobago	4,992	0.03	1.28	0.02	3,900	1.10	
34	31	24	Argentina	129,107	0.66	34.77	0.63	3,713	1.05	
35	128	96	Gabon	4,732	0.02	1.32	0.02	3,585	1.01	
36	122	82	Slovenia	6,913	0.04	1.98	0.04	3,492	0.99	19
37	65	52	Czech Republic	32,671	0.17	10.33	0.19	3,163	0.90	14
38	16	16	Iran	190,341	0.97	61.28	1.1	3,106	0.88	
39	46	36	Malaysia	62,397	0.32	20.14	0.36	3,098	0.88	
40	95	64	Slovakia	14,903	0.08	5.36	0.1	2,780	0.79	18
41	42	38	Venezuela	57,371	0.29	21.64	0.39	2,651	0.75	
42	114	78	Uruguay	8,280	0.04	3.19	0.06	2,596	0.73	
43	55	50	Chile	36,009	0.18	14.2	0.26	2,536	0.72	
44	75	60	Bulgaria	22,307	0.11	8.8	0.16	2,535	0.72	26
45	126	100	Estonia	3,766	0.02	1.53	0.03	2,461	0.70	22
46	36	32	Algeria	69,633	0.35	28.55	0.51	2,439	0.69	
47	117	87	Panama	6,334	0.03	2.63	0.05	2,408	0.68	
48	27	31	South Africa	90,156	0.46	41.24	0.74	2,186	0.62	
49	67	61	Hungary	22,235	0.11	10.22	0.18	2,176	0.62	17
50	5	11	Brazil	332,616	1.69	155.82	2.81	2,135	0.60	
51	120	92	Latvia	5,114	0.03	2.51	0.05	2,037	0.58	20
52	130	115	Mauritius	2,270	0.01	1.12	0.02	2,027	0.57	
53	112	86	Costa Rica	6,419	0.03	3.33	0.06	1,928	0.55	
54	15	26	Turkey	116,506	0.59	61.64	1.11	1,890	0.54	28
55	17	27	Thailand	106,017	0.54	59.4	1.07	1,785	0.51	
56	29	34	Poland	65,974	0.34	38.59	0.69	1,710	0.48	12
57	6	15	Russia	246,882	1.26	148.14	2.67	1,667	0.47	
58	11	21	Mexico	155,313	0.79	94.85	1.71	1,637	0.46	
59	66	63	Belarus	16,408	0.08	10.24	0.18	1,602	0.45	31
60	127	111	Botswana	2,327	0.01	1.46	0.03	1,594	0.45	
61	125	112	Namibia	2,296	0.01	1.54	0.03	1,491	0.42	
62	73	70	Tunisia	12,848	0.07	8.9	0.16	1,444	0.41	
63	30	42	Colombia	50,581	0.26	35.1	0.63	1,441	0.41	
64	119	102	Jamaica	3,530	0.02	2.53	0.05	1,395	0.40	

	Rank by			GDP95	%world	POPULN	%world	Productivity GDP /	Ratio %GDP$_{world}$ %POP$_{world}$	EU
Prod	Pop	GDP		Million $		Million		Pop		
65	94	80	Jordan	7,535	0.04	5.44	0.1	1,385	0.39	
66	56	62	Syria	17,592	0.09	14.19	0.26	1,240	0.35	
67	60	66	Ecuador	14,207	0.07	11.46	0.21	1,240	0.35	
68	107	97	Lithuania	4,597	0.02	3.71	0.07	1,239	0.35	21
69	40	55	Rumania	27,881	0.14	22.68	0.41	1,229	0.35	27
70	38	54	Peru	27,890	0.14	23.53	0.42	1,185	0.34	
71	90	88	El Salvador	6,113	0.03	5.77	0.1	1,059	0.30	
72	100	94	Paraguay	5,057	0.03	4.83	0.09	1,047	0.30	
73	23	40	Ukraine	51,756	0.26	51.64	0.93	1,002	0.28	
74	118	107	Congo	2,461	0.01	2.59	0.05	950	0.27	
75	63	75	Guatemala	9,715	0.05	10.62	0.19	915	0.26	
76	88	91	Honduras	5,231	0.03	5.95	0.11	879	0.25	
77	13	35	Vietnam	64,511	0.33	74.54	1.34	865	0.25	
78	79	84	Dominican Republic	6,720	0.03	7.91	0.14	850	0.24	
79	37	58	Morocco	23,001	0.12	27.11	0.49	848	0.24	
80	51	68	Kazakstan	13,742	0.07	16.99	0.31	809	0.23	
81	102	101	Nicaragua	3,609	0.02	4.54	0.08	795	0.23	
82	81	90	Bolivia	5,857	0.03	7.41	0.13	790	0.22	
83	18	45	Egypt	43,732	0.22	59.23	1.07	738	0.21	
84	45	65	Iraq	14,475	0.07	20.45	0.37	708	0.20	
85	54	74	Cote d'Ivoire (Ivory Coa	10,028	0.05	14.23	0.26	705	0.20	
86	103	103	Moldova	3,064	0.02	4.49	0.08	682	0.19	37
87	58	76	Yemen	8,742	0.04	13.05	0.23	670	0.19	
88	4	23	Indonesia	129,367	0.66	193.75	3.49	668	0.19	
89	106	106	Armenia	2,510	0.01	3.76	0.07	668	0.19	
90	57	77	Cameroon	8,451	0.04	13.28	0.24	636	0.18	
91	14	46	Philippines	43,129	0.22	70.27	1.27	614	0.17	
92	77	93	Senegal	5,091	0.03	8.35	0.15	610	0.17	
93	39	67	Uzbekistan	13,793	0.07	22.84	0.41	604	0.17	
94	59	85	Zimbabwe	6,623	0.03	11.53	0.21	574	0.16	
95	101	113	Kyrgyzstan	2,293	0.01	4.67	0.08	491	0.14	
96	111	124	Albania	1,520	0.01	3.44	0.06	442	0.13	29
97	1	7	China	532,915	2.71	1,211.68	21.82	440	0.12	
98	49	81	Ghana	7,191	0.04	17.45	0.31	412	0.12	
99	93	116	Georgia	2,247	0.01	5.46	0.1	412	0.12	
100	2	9	India	378,600	1.93	935.74	16.85	405	0.11	
101	116	130	Liberia	1,075	0.01	2.76	0.05	390	0.11	
102	7	44	Pakistan	49,589	0.25	129.81	2.34	382	0.11	
103	44	79	Uganda	7,969	0.04	21.3	0.38	374	0.11	
104	99	119	Laos	1,770	0.01	4.88	0.09	363	0.10	
105	35	72	Sudan	10,360	0.05	29.1	0.52	356	0.10	
106	84	109	Guinea	2,379	0.01	6.7	0.12	355	0.10	
107	80	105	Azerbaijan	2,644	0.01	7.5	0.14	353	0.10	
108	32	73	Kenya	10,195	0.05	30.52	0.55	334	0.09	
109	105	126	Togo	1,370	0.01	4.14	0.07	331	0.09	
110	113	128	Central African Republic	1,091	0.01	3.31	0.06	330	0.09	
111	8	49	Nigeria	39,349	0.2	126.72	2.28	311	0.09	
112	91	120	Benin	1,717	0.01	5.56	0.1	309	0.09	
113	24	69	Burma	13,382	0.07	46.53	0.84	288	0.08	
114	78	114	Rwanda	2,280	0.01	7.95	0.14	287	0.08	
115	89	123	Tajikistan	1,568	0.01	5.84	0.11	268	0.08	
116	72	108	Niger	2,438	0.01	9.15	0.16	266	0.08	
117	71	117	Zambia	2,175	0.01	9.37	0.17	232	0.07	
118	68	110	Burkina	2,343	0.01	10.18	0.18	230	0.07	
119	82	122	Haiti	1,594	0.01	7.18	0.13	222	0.06	
120	86	127	Burundi	1,313	0.01	6.3	0.11	208	0.06	
121	10	56	Bangladesh	24,297	0.12	120.43	2.17	202	0.06	
122	41	99	Nepal	4,369	0.02	21.92	0.39	199	0.06	
123	62	118	Mali	2,146	0.01	10.79	0.19	199	0.06	
124	53	104	Madagascar	2,787	0.01	14.76	0.27	189	0.05	
125	85	129	Chad	1,077	0.01	6.36	0.11	169	0.05	
126	26	83	Zaire	6,845	0.03	43.9	0.79	156	0.04	
127	33	98	Tanzania	4,527	0.02	30.34	0.55	149	0.04	
128	70	125	Malawi	1,390	0.01	9.79	0.18	142	0.04	
129	22	89	Ethiopia	5,969	0.03	56.68	1.02	105	0.03	
130	50	121	Mozambique	1,652	0.01	17.42	0.31	95	0.03	
			Total	19,633,684	100	5,554	100	3,535		

In Round 2, It's the Dollar vs. Euro

U.S. will make Europeans pay for failing to back war on Iraq

April 23 — Jacques Chirac of France wants in. He called the president the other day to say so. Like the has-been *don* in "The Godfather," Chirac just wants to "wet his beak." A French contract to rewire Baghdad's phone system, perhaps. (After all, Alcatel of France built the old one). In the movie, Robert De Niro's response to a similar plea is to blow the old dude away.

> **… the most troublesome clash of civilizations …
> may not be … Islamic fundamentalists vs. the West
> … but the United States against Europe.**

GEORGE W. BUSH isn't going to do that. I'm told he responded politely. Though a typical Gallic opportunist, Chirac may still have his uses, depending on how eager he really is to suck up. But Bush isn't going to rush to ask him—let alone the European Union or the United Nations—to join us in the back booth of post-Saddam Iraq. The thinking in and around the White House is: We're Boss now, and it's going to stay that way for a … while.

Mankind is at one of those hinge moments in history, in which every big-power decision, phone call and diplomatic move has the potential to echo loudly down the years. The forces set in motion by 9/11 essentially destroyed a global structure that had lasted since 1947. A new world is being created. Ironically, the most troublesome clash of civilizations in it may not be the one the academics expected: not Islamic fundamentalists vs. the West in the first instance, but the United States against Europe.

To oversimplify, but only slightly, it's the dollar vs. the euro.

> **[The US is] wary—very wary—of Europe
> and its bureaucratic ally, the United Nations.**

And just because Newt Gingrich attacked the State Department the other day, don't assume that Secretary of State Colin Powell is on the other side. He's not. The much ballyhooed war between Foggy Bottom and the Pentagon is exaggerated. Yes, mid-level diplomats at State, leaking to their favorite reporters, seethe at the influence of Defense Secretary Donald Rumsfeld and his coterie of neocons. Yes, the neocons view the lifers at State as naïve accommodationists. But Powell, I'm told by White House officials, is firmly with the president in being wary—very wary—of Europe and its bureaucratic ally, the United Nations.

Powell made that plain in an interview on public TV. As if to respond to Gingrich's accusation that State had been too meek in its diplomatic dealings, Powell blandly said that France would suffer "consequences" for its role in trying to undermine American efforts to win global backing for the forcible removal of Saddam Hussein. As with much else in life and politics, those consequences will involve money.

Nobody in an official capacity on either side of the Atlantic wants to say this in so many words. We say that the war isn't over, that it's our job—and only our job—to continue the search for weapons of mass destruction and to bring stability to Iraq with an interim government. The Europeans and the United Nations insist that they should resume the task of searching for WMDs. Until that issue is settled, they say, international sanctions can't formally end. (France is only proposing to "suspend" them.)

> **… the dispute [is about] … who gets to sell—and buy—Iraqi oil, and what form of currency will be used to denominate the value of the sales**

In fact, the dispute isn't about WMDs at all. It's about something else entirely: who gets to sell—and buy—Iraqi oil, and what form of currency will be used to denominate the value of the sales. That decision, in turn, will help decide who controls Iraq, which, in turn, will represent yet another skirmish in a growing global economic conflict. We want a secular, American-influenced pan-ethnic entity of some kind to control the massive oil fields (Iraq's vast but only real source of wealth). We want that entity to be permitted to sell the oil to whomever it wants, denominated in dollars. We want those revenues—which would quickly mount into the billions—to be funneled into the rebuilding of the country, essentially (at least initially) by American companies. Somewhere along the line, British, Australian and perhaps even Polish companies would get cut in. (Poland provided troops.) President Bush doesn't dare sell the war as a job generator, but it may, in fact, produce more than a few.

The Europeans and the United Nations want the inspections regime to resume because as long as it is in place, the U.N. "oil-for-food" program remains in effect. Not only does France benefit directly—its banks hold the deposits and its companies have been involved in the oil sales—the entire EU does as well, if for no other reason than many of the recent sales were counted not in dollars but in euros. The United Nations benefits because it has collected more than a billion dollars in fees for administering the program. As long as the 1990 sanctions remain in effect, Iraq can't "legally" sell its oil on the world market. At least, to this point, tankers won't load it without U.N. permission, because they can't get insurance for doing so.

> **Under the old UN Food for Oil program French banks held the Iraqi oil revenues – in euros, and the UN has collected more than a billion dollars for administering the program.**

Sometime in the next few weeks, push will come to shove. There are storage tanks full of Iraqi crude waiting in Turkish ports. For now, Rumsfeld and Powell are playing "bad cop, bad cop." "This isn't on the president's radar screen right now," an aide told me. "Powell is totally on board, though. He is as angry at the French as anyone else, maybe more. There may come a time when the smart thing to do is turn the whole Iraq situation over to the U.N. This is not that time." Meanwhile, if the rest of the world tries to block any and all Iraq oil sales, it's possible that American companies will find a way to become the customer of first and last resort.

And we'll pay in dollars.

> **… if the rest of the world tries to block … Iraq oil sales, … American companies will … become the customer of first and last resort – in [US] dollars.**

End

WORLD Economic Blocs by Productivity
as of 1995 (in 1987 US$)

Rank by			Economic Bloc	GDP 95 Million $	%world	POPULN Million	%world	Productivity GDP/ Pop	UNITED NATION General Assembly Votes	Security counsel seats Perm	Rotating
Prod	Pop	GDP									
2	9	2	Japan	3,007,183	15	125	2	24,019	1		
5	3	1	United States	5,452,500	28	263	5	20,698	1	1	
(20)	(3)	(1)	European Union	5,821,671	30	439	8	13,261	22	2	2
			Subtotal	14,281,354	73	828	15	17,255			
			Next 30 (>2,000 prod)	2,914,895	15	581	10	5,018	15	0	0
			The Rest of the World (<	2,437,436	12	4,145	75	588	90	1	1
			World Totals	19,633,685	100	5,554	100	3,535	129	4	3

			European Union						EU		
4	96	25	Denmark	117,631	0.6	5.2	0.09	22,492	10	1	
6	74	19	Sweden	171,065	0.87	8.8	0.16	19,373	7	1	
7	12	3	Germany	1,500,645	7.64	81.6	1.47	18,381	1	1	1
8	98	30	Finland	92,833	0.47	5.1	0.09	18,167	11	1	
9	21	4	France	1,041,766	5.31	58.2	1.05	17,915	2	1	1
10	52	12	Netherlands	265,482	1.35	15.5	0.28	17,183	6	1	
11	123	51	United Arab Emirates	32,794	0.17	1.9	0.03	16,992	16	1	
12	76	22	Austria	144,703	0.74	8.5	0.15	16,964	9	1	
13	69	20	Belgium	166,940	0.85	10.1	0.18	16,512	8	1	
15	19	5	Italy	884,506	4.51	58.3	1.05	15,172	3	1	
17	109	43	Ireland	50,362	0.26	3.6	0.06	14,068	15	1	
18	20	6	United Kingdom	786,052	4	58.3	1.05	13,492	4	1	1
24	28	10	Spain	357,489	1.82	39.2	0.71	9,117	5	1	1
30	64	39	Greece	53,230	0.27	10.5	0.19	5,089	13	1	
36	122	82	Slovenia	6,913	0.04	2.0	0.04	3,492	19	1	
37	65	52	Czech Republic	32,671	0.17	10.33	0.19	3,163	14	1	
40	95	64	Slovakia	14,903	0.08	5.4	0.1	2,780	18	1	
45	126	100	Estonia	3,766	0.02	1.5	0.03	2,461	22	1	
49	67	61	Hungary	22,235	0.11	10.2	0.18	2,176	17	1	
51	120	92	Latvia	5,114	0.03	2.5	0.05	2,037	20	1	
56	29	34	Poland	65,974	0.34	38.6	0.69	1,710	12	1	
68	107	97	Lithuania	4,597	0.02	3.7	0.07	1,239	21	1	
			Cypress						23		
			Malta						24		
			Luxemburg						25		

			Next 30 (>2,000 prod)								
1	83	17	Switzerland	188,082	0.96	7.0	0.13	26,716	43	1	
3	104	28	Norway	101,565	0.52	4.4	0.08	23,295	39	1	
14	34	8	Canada	477,338	2.43	29.6	0.53	16,121		1	
16	47	13	Australia	261,363	1.33	18.1	0.33	14,480		1	
19	115	48	Singapore	39,775	0.2	2.99	0.05	13,303		1	
20	124	59	Kuwait	22,400	0.11	1.69	0.03	13,254		1	
21	110	47	New Zealand	41,240	0.21	3.54	0.06	11,650		1	
22	87	33	Hong Kong	69,098	0.35	6.19	0.11	11,163		1	
23	92	37	Israel	58,840	0.3	5.54	0.1	10,621		1	
25	43	18	Taiwan	174,106	0.89	21.3	0.38	8,172		1	
26	108	53	Puerto Rico	28,304	0.14	3.67	0.07	7,712			
27	121	71	Oman	12,453	0.06	2.16	0.04	5,765		1	
28	25	14	Korea, South	252,132	1.28	44.9	0.81	5,622		1	
29	48	29	Saudi Arabia	96,701	0.49	17.88	0.32	5,408		1	
31	61	41	Portugal	51,401	0.26	10.8	0.19	4,759		1	
32	97	57	Libya	23,552	0.12	5.21	0.09	4,521		1	
33	129	95	Trinidad and Tobago	4,992	0.03	1.28	0.02	3,900		1	
34	31	24	Argentina	129,107	0.66	34.8	0.63	3,713		1	
35	128	96	Gabon	4,732	0.02	1.32	0.02	3,585		1	
38	16	16	Iran	190,341	0.97	61.3	1.1	3,106		1	
39	46	36	Malaysia	62,397	0.32	20.14	0.36	3,098		1	
41	42	38	Venezuela	57,371	0.29	21.64	0.39	2,651		1	
42	114	78	Uruguay	8,280	0.04	3.19	0.06	2,596		1	
43	55	50	Chile	36,009	0.18	14.2	0.26	2,536		1	
44	75	60	Bulgaria	22,307	0.11	8.8	0.16	2,535	26	1	
46	36	32	Algeria	69,633	0.35	28.55	0.51	2,439		1	
47	117	87	Panama	6,334	0.03	2.63	0.05	2,408		1	
48	27	31	South Africa	90,156	0.46	41.24	0.74	2,186		1	
50	5	11	Brazil	332,616	1.69	155.8	2.81	2,135		1	
52	130	115	Mauritius	2,270	0.01	1.12	0.02	2,027		1	

The Rest of the World (<100m GDP)

as of 1995   (in 1987 US$)

Rank by			Economic Bloc	GDP 95 Million $	%world	POPULN Million	%world	Productivity GDP/ Pop		General Assembly Votes	Security counsel seats	
Prod	Pop	GDP									Perm	Rotating
53	112	86	Costa Rica	6,419	0.03	3.33	0.06	1,928		1		
54	15	26	Turkey	116,506	0.59	61.6	1.11	1,890	28	1		
55	17	27	Thailand	106,017	0.54	59.4	1.07	1,785		1		
57	6	15	Russia	246,882	1.26	148.1	2.67	1,667		1	1	
58	11	21	Mexico	155,313	0.79	94.9	1.71	1,637		1		
59	66	63	Belarus	16,408	0.08	10.2	0.18	1,602	31	1		
60	127	111	Botswana	2,327	0.01	1.46	0.03	1,594		1		
61	125	112	Namibia	2,296	0.01	1.54	0.03	1,491		1		
62	73	70	Tunisia	12,848	0.07	8.9	0.16	1,444		1		
63	30	42	Colombia	50,581	0.26	35.1	0.63	1,441		1		
64	119	102	Jamaica	3,530	0.02	2.53	0.05	1,395		1		
65	94	80	Jordan	7,535	0.04	5.44	0.1	1,385		1		
66	56	62	Syria	17,592	0.09	14.19	0.26	1,240		1		
67	60	66	Ecuador	14,207	0.07	11.46	0.21	1,240		1		
69	40	55	Rumania	27,881	0.14	22.7	0.41	1,229	27	1		
70	38	54	Peru	27,890	0.14	23.53	0.42	1,185		1		
71	90	88	El Salvador	6,113	0.03	5.77	0.1	1,059		1		
72	100	94	Paraguay	5,057	0.03	4.83	0.09	1,047		1		
73	23	40	Ukraine	51,756	0.26	51.6	0.93	1,002		1		
74	118	107	Congo	2,461	0.01	2.59	0.05	950		1		
75	63	75	Guatemala	9,715	0.05	10.62	0.19	915		1		
76	88	91	Honduras	5,231	0.03	5.95	0.11	879		1		
77	13	35	Vietnam	64,511	0.33	74.54	1.34	865		1		
78	79	84	Dominican Republic	6,720	0.03	7.91	0.14	850		1		
79	37	58	Morocco	23,001	0.12	27.11	0.49	848		1		
80	51	68	Kazakstan	13,742	0.07	16.99	0.31	809		1		
81	102	101	Nicaragua	3,609	0.02	4.54	0.08	795		1		
82	81	90	Bolivia	5,857	0.03	7.41	0.13	790		1		
83	18	45	Egypt	43,732	0.22	59.23	1.07	738		1		
84	45	65	Iraq	14,475	0.07	20.45	0.37	708		1		
85	54	74	Cote d'Ivoire (Ivory Coa	10,028	0.05	14.23	0.26	705		1		
86	103	103	Moldova	3,064	0.02	4.5	0.08	682	37	1		
87	58	76	Yemen	8,742	0.04	13.05	0.23	670		1		
88	4	23	Indonesia	129,367	0.66	193.8	3.49	668		1		
89	106	106	Armenia	2,510	0.01	3.76	0.07	668		1		
90	57	77	Cameroon	8,451	0.04	13.28	0.24	636		1		
91	14	46	Philippines	43,129	0.22	70.27	1.27	614		1		
92	77	93	Senegal	5,091	0.03	8.35	0.15	610		1		
93	39	67	Uzbekistan	13,793	0.07	22.84	0.41	604		1		
94	59	85	Zimbabwe	6,623	0.03	11.53	0.21	574		1		
95	101	113	Kyrgyzstan	2,293	0.01	4.67	0.08	491		1		
96	111	124	Albania	1,520	0.01	3.4	0.06	442	29	1		
97	1	7	China	532,915	2.71	1,211.7	21.82	440		1		1
98	49	81	Ghana	7,191	0.04	17.45	0.31	412		1		
99	93	116	Georgia	2,247	0.01	5.46	0.1	412		1		
100	2	9	India	378,600	1.93	935.7	16.85	405		1		
101	116	130	Liberia	1,075	0.01	2.76	0.05	390		1		
102	7	44	Pakistan	49,589	0.25	129.81	2.34	382		1		
103	44	79	Uganda	7,969	0.04	21.3	0.38	374		1		
104	99	119	Laos	1,770	0.01	4.88	0.09	363		1		
105	35	72	Sudan	10,360	0.05	29.1	0.52	356		1		
106	84	109	Guinea	2,379	0.01	6.7	0.12	355		1		
107	80	105	Azerbaijan	2,644	0.01	7.5	0.14	353		1		
108	32	73	Kenya	10,195	0.05	30.52	0.55	334		1		
109	105	126	Togo	1,370	0.01	4.14	0.07	331		1		
110	113	128	Central African Republic	1,091	0.01	3.31	0.06	330		1		
111	8	49	Nigeria	39,349	0.2	126.72	2.28	311		1		
112	91	120	Benin	1,717	0.01	5.56	0.1	309		1		
113	24	69	Burma	13,382	0.07	46.53	0.84	288		1		
114	78	114	Rwanda	2,280	0.01	7.95	0.14	287		1		
115	89	123	Tajikistan	1,568	0.01	5.84	0.11	268		1		
116	72	108	Niger	2,438	0.01	9.15	0.16	266		1		
117	71	117	Zambia	2,175	0.01	9.37	0.17	232		1		
118	68	110	Burkina	2,343	0.01	10.18	0.18	230		1		
119	82	122	Haiti	1,594	0.01	7.18	0.13	222		1		
120	86	127	Burundi	1,313	0.01	6.3	0.11	208		1		
121	10	56	Bangladesh	24,297	0.12	120.43	2.17	202		1		
122	41	99	Nepal	4,369	0.02	21.92	0.39	199		1		
123	62	118	Mali	2,146	0.01	10.79	0.19	199		1		
124	53	104	Madagascar	2,787	0.01	14.76	0.27	189		1		
125	85	129	Chad	1,077	0.01	6.36	0.11	169		1		
126	26	83	Zaire	6,845	0.03	43.9	0.79	156		1		
127	33	98	Tanzania	4,527	0.02	30.34	0.55	149		1		
128	70	125	Malawi	1,390	0.01	9.79	0.18	142		1		
129	22	89	Ethiopia	5,969	0.03	56.68	1.02	105		1		
130	50	121	Mozambique	1,652	0.01	17.42	0.31	95		1		

Japan's crisis defies easy solutions

Junko Kimura / Getty Images file

The Japanese Chamber of Commerce and Industry has supported putting
more rickshaws on Tokyo streets to help stimulate the local economy.

By Tom Costello
CNBC

TOKYO, Dec. 11 —   Policy makers here have been talking about allowing the
yen to weaken — perhaps to 150 or 160 against the dollar — as a way to stimulate
the economy. The government doesn't have many options left. Interest rates are
already near zero, and the government's huge debts restrict its ability to spend its
way out of this crisis. Almost all the choices involve sacrifice on the part of the
Japanese.

 IT'S 7 A.M. AT Tokyo station. And true to its reputation, the bullet train is on time for the run
to Kyoto. The train passes through Tokyo, and a banking center in disarray. Through small
industrial towns that are home to thousands of failing companies. And on past Mt. Fuji and the
nation's heartland, where change is met with skepticism. At 170 mph, it is a journey through an
economy in crisis.

     "I think if we are going to face the real crisis, this is probably the gravest crisis in Japan's
history especially after the Meiji's restoration," said Akio Mikuni, the founder of Japan's leading
credit rating agency that bears his name.

      The Meiji restoration was a 19th century turning point when a young emperor forced Japan
to move from a feudal, shogun-ruled society — to a modern, industrialized, world power.

     Today, many Japanese say their country is again in need of restoration.

     Unemployment, once close to zero, is at post-war highs and expected to grow, with the
country coddling hundreds of thousands of companies that are all but bankrupt. From
construction firms to grocery stores and retail chains, they are known as "zombie" companies,

kept alive by government welfare. But allowing them to fail and default on their bank loans could bring down the country's banking system.

No one knows for sure, but it's thought that Japanese banks may be carrying as much as $1 trillion in bad loans. That's equal to 24 percent of this country's economic output. If those zombie companies were allowed to fail and taxpayers forced to pay for the bank bailout, it could leave 1 million people out of work.

"In Japan, 70 percent of the total corporate population is losing money," said Mikuni, "whereas years ago, only 30 percent of the companies were losing money."

And economist Tag Murphy, who is the co-author with Mikuni of the book "The Policy Trap," says the Japanese "banking system is, by western accounting standards, largely bankrupt."

For almost 50 years, Japan's banks have been — in essence — an arm of the government: supporting companies with credit lines determined by bureaucrats.

In post-war Japan, the goal was to grow the industrial base quickly. What mattered was production, not profits. But soon, over-production led to falling profits and failing companies.

Today, those bad loans have Japan's biggest banks in danger of collapsing.

The U.S. credit rating agency Fitch, Inc. believes Japan will be forced to nationalize at least some banks to nurse them back to health. But in doing so, western accounting experts say, they'd better institute tougher accounting standards and place more emphasis on profits. "I think Japan is in danger of being the Argentina of the new century," said Kirk Patterson, the dean of Temple University's Tokyo campus.

Patterson is concerned that Japan simply doesn't have the fortitude to move quickly and allow those zombie companies, and some banks, to fail.

"Foreigners are always looking for the corner: make a few policy changes and they'll turn the corner; the improved economy is just around the corner," he said. "But Japan is one long slow curve. You can make the curve slightly more or less acute, but there is not going to be dramatic change."

Japan's leading banks have recently announced plans to start writing off some bad loans. And the government is talking about creating a Japanese version of the U.S. Resolution Trust Corp. — the agency that bailed out America's savings and loan industry in the 1980s. There's talk of letting companies fail and allowing unemployment to rise.

End

Japan's economy at risk of collapse

Tokyo's stock market is down 76 percent from its peak.

CNBC's Tom Costello provides an overview of the challenges confronting the world's second largest economy.

"WHAT WE NEED is an acute sense of crisis," said business school professor Hirotaka Takeuchi. "And that sense being held by the majority of the Japanese."

The scope of the crisis is daunting. The Japanese economy hasn't grown in more than 12-years. The stock market, down 76 percent from its peak, is hovering near a 19-year low. The country's budget deficit is now 140 percent of GDP — the highest of any developed nation.

And, to add insult to injury, the nation's assets are deflating. Prices, including home values, are coming down.

At the heart of it all: a banking crisis that makes America's 1980s savings and loan industry scandal look like chump change. Japanese banks are thought to be carrying $1 trillion in bad loans on their books.

"Simply postponing that problem will not solve it; time will not heal this," said Robert Feldman, chief economist for Morgan Stanley in Tokyo. "I think the rest of the world has seen 10 to 12 years of not addressing the problem. And if you talk to Japanese — who are even more cynical than foreign investors — they will say that no matter who is the prime minister, who is in the cabinet, the bureaucracy will always get them."

Indeed, Japan has seemed paralyzed: unable or unwilling to implement the kind of reform the world says it must if it is to keep its economy from imploding.

And the world is now pinning its hopes on two outsiders to take on an entrenched political bureaucracy. Prime Minister Junichiro Koizumi and his economics minister Heizo Takenaka are reformers who are trying to patch together a plan to clean up the banks' balance sheets.

But in a shrinking economy, new bad debts pile up almost as quickly as the banks clear out the old ones. As many as 200,000 Japanese companies have all but failed.

They're being kept on life support by the banks, and a socialist government afraid that allowing the companies to fail and default on their loans will kill the banks and put huge numbers of Japanese out of work.

So the economy limps along. The irony here in Japan is that despite this economic crisis, there are no bread lines. There are no unemployment queues. This country still enjoys one of the highest standards of living in the world. For the average Japanese, there isn't much pain.

CNBC in Japan

"Although there is clearly a large hole in the bottom of the ship and people are drowning in regions of Japan, if you look at the people on deck and in the first class cabins — they're still drinking champagne" said Noriko Hama, an economist at the highly regarded Mitsubishi think tank.

And he believes Japan's ruling party and bureaucrats will stifle any attempt at reform.

"Reforms and politicians in Japan are almost a contradiction in terms," he said.

Japan's Economy at a Glance

- GDP: Grew by 1.5 percent in the third quarter
- Unemployment: Rose to a record 5.5 percent in Oct.
- Deflation: Consumer prices have fallen for 37 consecutive months
- Industrial production: Fell by 0.3 percent in Oct.
- Retail sales: Fell by 1.9 percent in Sept.

MSNBC

In fact, Japan's economic model hasn't changed much since the end of World War II. Then, the national imperative was to rebuild a devastated industrial infrastructure. Bank and corporate profits took a back seat to production by the likes of Toyota, Honda, Nissan and Sony. Japan exported its way to prosperity. But the model didn't change.

Today, the economy is weighed down by over-production, failed companies, failing banks, rising unemployment, and deflating assets.

"What we need is not a bandaid approach of putting bandaids all over the place," said Takeuchi. "We really need surgery and in a big way."

Takeuchi, a former Harvard University lecturer, says time is running out for Japan to reform its government, its banks, corporations, social welfare net, and bureaucracy. In short, he says, Japan needs a revolution.

"But if we do go back to the old way of doing things, that's the end of this country," he said. "I truly believe that."

Howard Baker, U.S. ambassador to Tokyo, agrees. He's spent much of the past 18 months on the job conveying Washington's message that Japan must move quickly toward reform.

"I do it regularly — to the point where the Japanese grit their teeth when I approach," he said. "But the other day I came back and I wrote the reporting cable back to State and Treasury and I ended it by saying: 'I told them what you said, but to be honest, they ain't gonna do that'."

Japan's solution will most certainly be uniquely Japanese. But the country today is at a crossroads. And the world is watching to see which way it turns.

HOMEWORK ASSIGNMENT 1

READING ASSIGNMENT:
Read the following tables, articles, or outlines in Lesson Plan 2.
Be prepared to discuss in class next week:

Lecture Plan 2 - Wealth & Money, and accompanying article on Money & Currency

HOMEWORK ASSIGNMENT:
Credit: due date - full, + 1 week - ¾, + 2 weeks - ½, + 3 weeks - ¼, + 4 weeks – $^1/_8$

GROUP HOMEWORK: (Due in 2 week - written response)

Answer the following questions about the two articles on the Japanese economy:

1. The two articles on Japan appear to point to two major causes for Japan's economic woes. One of the causes is over-production. Name the other cause.

2. According to some, Japan is in a deflationary mode. We will discuss the mechanisms of inflation and deflation in a future lecture. For now, provide your opinion as to the economic mode (inflation or deflation) of the Philippines. Why do you think this is so? Is it a problem? If so, should something be done about it?

3. According to some reports, Japan may have a trillion US dollars in bad debt within its banking sector. What is your opinion of the size of possible hidden bad debt within the Philippine banking sector.   Why do you think this is so?   Is it a problem?   If so, should something be done about it?

INDIVIDUAL HOMEWORK (Due in 1 week)
In your opinion:
1. In the model set forth in *Table – A Simplified Model of the Evolution of State*, where would you put the Philippines, and why?

2. A common language is one sign of a strong state. How does the Philippines rate (weak to strong) in having a common language? Why is that so, and is it a concern?   If you deem it a problem, what is your solution?

3. The US$ is the de-facto international currency, although other currencies, such as the Euro-dollar, are vying for that distinction.
    The exchange rate of the Philippine peso has been weakening fairly regularly against the US dollar. Is that good or bad? What do you think is the cause?
    Should anything be done about it? If so, what?

4. According to the charts on *World Population Rank, World GDP Rank, World Productivity Rank*, and the back-up tables, the Philippines ranks what in population? What in GDP? And what in productivity (as measured by GDP/Population). Why do you think the Philippines, ranks so low in productivity? How could it be improved?

5. What is the theme or driving cause proposed in the article *In Round 2-It's the Dollar versus the Euro*? Regardless of how the contenders fare in the battle for supremacy, will the ultimate winner make any difference to the Philippines? Why?

6. In the table: *Economic Blocs Ranked by Productivity*, how many United Nations seats are potentially available to the European Union, assuming its member states ever vote as a bloc? How many seats on the UN Security counsel seats does the European Union potentially have that could dominate the UN Security Council? The prevailing US view on the United Nations is that it is biased towards the EU and the 3rd world, which, in part, explains why the US isn't to keen to obtain UN approval for its international policy. Where do you think the Philippines should stand in this contention between the US and the EU? Why?

LESSON PLAN   2 – 1 hour +

Group Formation

Form groups of 3 to 5 persons per group.

Group purpose:

1) Group project
2) Homework collaboration
3) Copy and dissemination of lecture and course material

Lecture: Wealth and Money

… but money answereth all things. **Hebrew Bible**. *Ecclesiastes 10:19*

The love of money is the root of all evil. **Bible: New Testament**. *1 Timothy 6:10.*

The want of money is the root of all evil. **Samuel Butler** *(1835–1902), English author.*

*Money is to modern society as blood is to the body – to be useful and serve a meaningful societal purpose, it must circulate and serve to exchange commodities among the members of society, much as our blood exchanges nutrients among our organs and cells. – **Dr. Mouer** (2002)*

The nature of wealth (*wealth = assets. It can be accumulated generation to generation*)

    Tangible

        Durable

            Land

            Precious metals: gold, silver, platinum, … (bullion, coin)

            Metals and chemical stocks, ores, mines

            Facilities (castles, buildings, houses, farms, ranches, smelters, shops)

            Storable crops (wheat, corn, barley, rye, rice, oats)

            Markets & shops: grocery and storable food stocks

            Clothing, apparel and footwear stocks

            Infrastructure (roads, highways, bridges, fueling stations, fresh water)

            Vehicles (airplanes, trains, ships, trucks, cars)

            Military & weapons (armies, navies, air forces, marines, bombs,
                artillery, rifles, laser cannons, guided missiles, nuclear devices)

            Money (currency, credits, accounts payable, notes, bonds, annuities)

        Non-durable

            Perishable crops (tomatoes, celery, lettuce, bananas, fresh meats)

            Popularity (music, songs, celebrity status)

    Intangible

        Knowledge (science, arts, engineering, universities)

        Organization (business institutions, government, guilds, unions, religions)

        Skills (engineers, plumbers, electricians, carpenters, ironworkers, miners)

        Intellectual properties (patents, copyrights, secret formulas)

The types of money:

    Commodity – Intrinsic or inherent value of the physical components of the currency
        Examples: gold coin, silver coin, copper coin

    Credit – little or no inherent value, but exchangeable for gold or silver
        Examples: gold notes, silver notes, British pound sterling

    Fiat – little or no inherent value of the physical components of currency, and not
        exchangeable. **Examples:** all modern paper money ($, €, £, ₣, ¥, ₽, Pts, …)

1

Early Forms of Money

Before paper and coins were introduced as permanent forms of money, people used a variety of other objects to serve as money for trading goods. Examples of early forms of money, as shown here, include rice (China), dogs' teeth (Papua New Guinea), small tools (China), quartz pebbles (Ghana), gambling counters (Hong Kong), cowrie shells (India), metal disks (Tibet), and limestone disks (Yap Island).

Dorling Kindersley

Money, abstract unit of account in terms of which the value of goods, services, and obligations can be measured. By extension, the term may designate anything that is generally accepted as a means of payment. Almost all economic activity is concerned with the making and spending of money incomes. Historically, a great variety of objects have served as money, among them stones, shells, ivory, wampum beads, tobacco, furs, and dried fish, but from the earliest times precious metals have been favored because of ease of handling, durability, divisibility, and high intrinsic value. Money does not, however, depend on its value as a commodity. Paper currency, first issued about 300 years ago, was usually backed by some standard commodity of intrinsic value into which it could be freely converted on demand. By contrast, fiat money is inconvertible money made legal tender by the decree of the government. The world's first durable plastic currency was introduced by Australia in a special issue in 1988 and in a regular issue in 1992. Plastic bills are more resistant to counterfeiting than paper. The U.S. monetary system was based on BIMETALLISM during most of the 19th cent., but a full gold standard was in effect in the early 20th cent. It provided for free coinage of gold and full convertibility of currency into gold coin. The Gold Reserve Act of 1934 and later measures reduced the U.S. dollar's dependence on gold, and in 1971 the U.S. abandoned gold convertibility altogether. For years international payments were settled by CENTRAL BANK gold movements, but a new system was adopted in the 1970s (see INTERNATIONAL MONETARY SYSTEM). Most U.S. currency in circulation today consists of Federal Reserve notes, but currency and coin are less widely used as a means of payment than checks and electronic transfers, and since the mid-1980s DEBIT CARDS have become increasingly common. In the U.S. the money supply, or total amount of money in the economy, is measured in different ways: M1 includes cash plus checking-account deposits; the broader measures, M2 and M3, add MONEY-MARKET FUNDS, savings, time deposits, and other items. The money supply, a key economic barometer, is influenced by the actions of the FEDERAL RESERVE SYSTEM.

Coin, piece of metal, usually a disk of gold, silver, nickel, bronze, copper, or a combination of such metals, issued by a government for use as MONEY. State coinage, said to have originated in Lydia in the 7th cent. B.C., enabled governments to make coins whose nominal value exceeded their value as metals. The first U.S. MINT was established in 1792. Beginning in 1965, the U.S. Treasury stopped putting silver in newly minted dimes and quarters, and reduced the amount of silver in the half-dollar. A 1970 act eliminated all silver from the half-dollar and dollar coins. U.S. law provides, however, that special mintings of both coins, containing 60% copper and 40% silver, be made for collectors.

Greco-Roman Coins

These ancient coins commemorate, clockwise from top left: Julius Caesar, Cleopatra VII (two different coins), and Ptolemy XIII. Although early Greek coins portrayed mostly gods or goddesses, Ptolemy I, the patriarch of the Ptolemaic Dynasty, issued a coin in about 300 BC exhibiting his own portrait. In subsequent centuries Greek and Roman coin minters followed Ptolemy's example and rendered realistic, and often unflattering, images of their emperors.

Geoge Rainbird/Robert Harding Picture Library

Money-market fund, type of MUTUAL FUND that invests in high-yielding, short-term money-market instruments, such as U.S. government securities, COMMERCIAL PAPER, and certificates of deposit. Returns of money-market funds usually parallel the movement of short-term interest rates. Some funds buy only U.S. government securities, such as Treasury bills, while general-purpose funds invest in various types of short-term paper. They became enormously popular with investors in the early 1980s because of their high yields, relative safety, and high liquidity. Much of the money-market growth came at the expense of banks and thrift institutions. With the drop in interest rates in the late 1980s, many investors moved from money-market funds to stock mutual funds and other investments.

commercial paper, type of short-term NEGOTIABLE INSTRUMENT, usually an unsecured promissory note, that calls for the payment of money at a specified date. Because it is not backed by collateral, commercial paper is usually issued by major firms with strong credit ratings. An important source of cash for the issuing firm, it is usually payable at a lower rate of interest than the prime discount rate. The commercial paper market expanded greatly after the mid-1970s, reaching $140 billion by 1981, double the amount of four years earlier. The trend was accompanied by the rise of MONEY-MARKET FUNDS, a major buyer of commercial paper, and a resulting loss of corporate loan business by banks (see BANKING).

central bank, financial institution designed to regulate and control a nation's fiscal and monetary activities. Usually state-owned, central banks issue notes to be used as legal tender, maintain adequate reserve backing for the nation's banks, and control the flow of money and precious metals. By regulating the supply of MONEY and CREDIT they influence INTEREST rates and, to some extent, the whole national economy. Most central banks are modeled after the Bank of England (1694), the first to fill a central banking role. Other notable central banks include the U.S. FEDERAL RESERVE SYSTEM, the Bank of Canada, France's Banque de France, and Germany's Deutsche Bundesbank.

Federal Reserve System, central banking system of the U.S., established by the Federal Reserve Act (1913). The act created 12 regional Federal Reserve banks, supervised by a Federal Reserve Board. All national banks must belong to the system, and state banks may if they meet certain requirements. Member banks hold the bulk of the deposits of all commercial banks in the country. The Board of Governors of the Federal Reserve System is composed of seven members appointed to staggered 14-year terms by the president, who also names one of the governors as chairman but has no power to remove any member. The Federal Open Market Committee directs purchases and sales by the reserve banks of U.S. government securities in the open market. The most important duties of the Federal Reserve authorities involve the maintenance of national monetary and credit conditions through lending to member banks, open-market operations, fixing reserve requirements, and establishing discount rates. In a sense, each Federal Reserve bank is a "banker's bank," with member banks using their reserve accounts much as bank depositors use their checking accounts. By controlling the credit market, the Federal Reserve System influences the nation's economic life. It can expand or contract the MONEY supply by buying or selling U.S. securities and by raising or lowering reserve requirements (the amount that member banks must set aside as reserves). Other important functions include the issuance of currency and coins and the setting of margin requirements (credit limits) in the stock exchanges. See also CENTRAL BANK.

credit, granting of goods, services, or money in return for a promise of future payment, usually accompanied by an INTEREST charge. The two basic forms of credit are business and consumer. The chief function of business credit is the transfer of capital from those who own it to those who can use it, in the expectation that the profit from its use will exceed the interest payable on the loan.

Consumer credit permits the purchase of retail goods and services with little or no down payment in cash. In installment buying and selling, the consumer agrees to make payments at specific intervals in set amounts. CREDIT CARDS are issued by local and national retailers and by banks. Cardholders usually pay an annual fee and a monthly interest charge on the unpaid balance. The major bank cards also provide short-term personal loans. See DEBT.

debt (dèt), obligation in services, money, or goods owed by one party (the debtor) to another (the creditor). A debt usually involves the payment of INTEREST. If a debtor fails to pay, a court may assign payment out of the debtor's property. In ancient times debt was associated with slavery, because the insolvent debtor and his household were often turned over to the creditor to perform compulsory services. Imprisonment for debt, which once filled prisons, was ended as such in England and the U.S. by laws enacted in the 19th cent., although imprisonment on related charges, such as concealment of assets, may still occur. The laws of BANKRUPTCY govern the distribution a debtor's assets to the creditors.

double entry accounting *noun*
A method of bookkeeping in which a transaction is entered both as a debit to one account and a credit to another account, so that the totals of debits and credits are equal.[1] Double-entry bookkeeping began in the commercial city-states of medieval Italy and was well developed by the time of the earliest preserved double-entry books, from 1340 in Genoa. The first published accounting work was written in 1494 by the Venetian monk Luca Pacioli. Although it disseminated rather than created knowledge about double-entry bookkeeping, Pacioli's work summarized principles that have remained essentially unchanged. Additional accounting works were published during the 16th century in Italian, German, Dutch, French, and English, and these works included early formulations of the concepts of assets, liabilities, and income.

"You shall not charge interest on anything you lend to a fellow countryman … You may charge interest on a loan to a foreigner." **Bible**, Deuteronomy 23: 19, 20

"God has permitted trade and forbidden usury." **Quran**, Sura II, 275

interest, charge for the use of money, usually figured as a percentage of the principal and computed annually. Such charges have been made since ancient times, and they fell early into disrepute. The Jews and the Christian church forbade interest charges, or usury, as it was called, within their own groups. Gradually the distinction was made between low interest rates and high ones, which came to be known, and condemned, as usury. In the U.S. state usury laws set ceilings on interest, but in 1981, when rates soared to record highs, many legislatures increased or abolished such ceilings in order to attract lenders. High interest rates can dampen the economy by making it more difficult for consumers, businesses, and home buyers to secure loans, as happened in 1981 when the prime rate—the rate that banks charge their best customers—climbed past 20%, with most other rates a few points lower. Economists differed over the causes of such extraordinary rates, but inflationary expectations, federal budget deficits, and the restrictive monetary policies of the FEDERAL RESERVE SYSTEM were important factors.

bankruptcy (bàngk¹rùpt´sê), legal proceeding to deal with the liabilities of an insolvent debtor (individual or business). Its purpose is to distribute the bankrupt's assets equitably among the creditors and, in most cases, to free the bankrupt from further liability. Bankruptcy may be instituted by the debtor (voluntary) or by the creditors (involuntary).

credit card, card or document used to obtain consumer credit when purchasing an article or service. Credit cards may be issued by a local retailer, a national retailer, or a third party, e.g., a bank or financial services company. Typically, cards issued by a retailer may be used only in its stores; third-party cards, such as those issued by a bank in association with Visa or MasterCard, are general-purpose cards and may be used at a variety of establishments. Through the revolving charge plan, cardholders can postpone payment by accepting a monthly interest charge. Consumers may also use the general-purpose cards to obtain short-term personal loans, often called cash advances. Credit-card issuers get revenue from fees paid by stores that accept their cards, from yearly fees paid by cardholders, and from interest charged on unpaid credit balances. The late 1980s and early 90s saw a dramatic increase in the number of credit cards issued by nonbanks, including the financial arms of telephone companies, automobile manufacturers, and national retailers. **Charge cards,** such as American Express, require the consumer to pay for all purchases at the end of the billing period. See also DEBIT CARD.

debit card, card that allows the cost of goods or services that are purchased to be deducted directly from the purchaser's checking account. Increasingly common in the 1990s as alternatives to CREDIT CARDS, debit cards have been promoted as safer than cash and more convenient than personal checks. They are typically issued by large credit card companies through their participating banks. Similar cards have also been used to distribute welfare benefits to recipients in some locales.

business cycle, a fluctuation in economic activity characterized by a period of growth, which peaks and begins a downturn, followed by a period of negative growth (recession), which ends in a trough. French physician Clement Juglar first proposed that such cycles were an economic norm in 1862. There is no conclusive explanation of the underlying causes of business cycles, but many attempts to moderate them by altering monetary and fiscal policy have been made. Such 20th-cent. theorists as John Maurice Clark and Joseph SCHUMPETER have attempted to cure economic instability rather than merely describe it as a natural phenomenon, as 19th-century theorists did.

inflation (în-flâ¹shen), in economics, a persistent and relatively large increase in the general price level of goods and services. It results from an increase in the amount of circulating currency beyond the needs of trade. The oversupply of currency thus created, in accordance with the law of SUPPLY AND DEMAND, decreases the value of money, or, more accurately, increases the prices of goods and services. Inflation may occur in times of economic or political upheaval, and it commonly occurs during war, when governments borrow and when there is a limited supply of consumer goods. Under less extreme circumstances, inflation stimulates business and helps wages to rise, but usually not as fast as prices; hence, real wages diminish. As a rule, annual price increases of less than 2% or 3% have not been considered inflationary. The 1970s brought the onset of worldwide inflation (often occurring as STAGFLATION), commonly attributed to the soaring cost of petroleum. Double-digit inflation (i.e., 10% or more) became common in many countries and caused severe economic dislocations. In the early 1980s, however, recession lowered the inflation rate in the U.S., and it has remained relatively moderate since then. The opposite of inflation is **deflation,** a time of falling prices, curtailed business activity, and high unemployment (see DEPRESSION).

depression (dî-prèsh¹en), in economics, a period of economic crisis in commerce, finance, and industry, characterized by falling prices, restriction of credit, reduced production, numerous bankruptcies, and high unemployment. A less severe crisis is usually known as a downturn, or **recession**; in the U.S. a recession is technically defined as two consecutive quarterly declines in the GROSS NATIONAL PRODUCT. A short period in which fear takes hold of the minds of the business community is more properly called a PANIC. Depressions now tend to become worldwide in scope because of the international nature of trade and credit. Such was the case in the most severe economic reversal of the 20th cent., the GREAT DEPRESSION of the 1930s, which began in the U.S. and spread abroad. Since that time, governments have acted to stabilize economic conditions in an effort to prevent depressions, using tax and fiscal measures as well as tighter controls over BANKING and the STOCK EXCHANGES. Job-training programs and increased public welfare are other steps taken to alleviate economic slumps.

steam engine, machine for converting heat energy into mechanical energy, using steam as the conversion medium. When water is boiled into steam its volume increases about 1,600 times, producing a force that can be used to move a piston back and forth in a cylinder. The piston is attached to a crankshaft that converts the piston's back-and-forth motion into rotary motion for driving machinery. From the Greek inventor HERO OF ALEXANDRIA to the Englishman Thomas NEWCOMEN, many persons contributed to the work of harnessing steam. However, James WATT's steam engine (patented 1769) offered the first practical solution by providing a separate chamber for condensing the steam and by using steam pressure to move the piston in both directions. These and other improvements by Watt prepared the steam engine for a major role in manufacturing and transportation during the INDUSTRIAL REVOLUTION. Today steam engines have been largely replaced by more efficient devices, e.g., the steam TURBINE, the electric MOTOR, the INTERNAL-COMBUSTION ENGINE, and the DIESEL ENGINE.

Industrial Revolution, term usually applied to the <mark>social and economic changes that mark the transition from a stable agricultural and commercial society to a modern industrial society</mark>. Historically, it is used to refer primarily to the period in <mark>British history from c.1750 to c.1850</mark>. Dramatic changes in the social and economic structure took place as <mark>inventions and new technology created the factory system of large-scale machine production and greater economic specialization</mark>. The laboring population, formerly employed mainly in agriculture, increasingly gathered in great urban factory centers. The same process occurred at later times and in different degrees in other countries. The crucial development of the Industrial Revolution in Britain was the use of steam for power, made possible by the <mark>STEAM ENGINE</mark> (1769) of James WATT. <mark>Cotton textiles</mark> was the key industry early in this period. The presence of large quantities of coal and iron proved a decisive factor in Britain's rapid industrial growth. <mark>Canals and roads were built</mark>, and the advent of the <mark>railroad and steamship</mark> widened the market for manufactured goods. New periods of development came with <mark>electricity and the gasoline engine,</mark> but by 1850 the revolution was accomplished, with industry having become a dominant factor in British life.

The <mark>effects of the Industrial Revolution were worldwide</mark>. France (after 1830), Germany (after 1850), and the U.S. (after the Civil War) were transformed by industrialization. Europeans introduced the revolution to Asia at about the turn of the century, but only Japan eventually grew into an industrial giant. The RUSSIAN REVOLUTION had as a basic aim the introduction of industrialism. The Industrial Revolution has changed the face of nations, providing the <mark>economic base for population expansion and improvement in living standards</mark>, and it remains a primary goal of less developed countries. But with it have also come a host of <mark>problems, including labor-management conflicts, worker boredom, and environmental pollution</mark>.

capitalism (kàp¹î-tl-îz´em), economic system characterized by <mark>private ownership of property and of the means of production</mark>. Generally the capitalist, or private enterprise, system embodies the concepts of individual initiative, competition, SUPPLY AND DEMAND, and the profit motive. <mark>Capitalism and SOCIALISM are the two major economic systems in the world</mark>. The modern importance of capitalism dates from the INDUSTRIAL REVOLUTION, which started in the 18th century when <mark>bankers, merchants, and industrialists began to displace landowners in importance</mark>, especially in Britain. By the early 20th cent. <mark>capitalism had created vast credit, manufacturing, and distributing institutions, and the social and economic effects of the system had largely transformed world culture</mark>. However, it was also held responsible for various abuses, notably the exploitation of labor. Complete freedom of economic action has been circumscribed since the late 1800s by the growth of strong labor UNIONS, the NATIONALIZATION in some countries of certain basic industries, and ANTITRUST LAWS limiting the power of MONOPOLIES, as well as by social reforms, ENVIRONMENTALISM, and legislation ensuring product safety. See also LAISSEZ-FAIRE.

socialism (so¹she-lîz´em), general term for the political and economic theory that <mark>advocates collective or government ownership and management of the means of production and distribution of goods</mark>. It arose in the late 18th and early 19th cent. as a reaction to the hardships caused by CAPITALISM and the INDUSTRIAL REVOLUTION. The *Communist Manifesto* (1848), by Karl MARX and Friedrich ENGELS, argued the inevitability of a proletarian-led international revolution. After the 1917 RUSSIAN REVOLUTION international socialism and COMMUNISM split irrevocably. Present-day socialist parties play an important role in Western European electoral politics. Usually called democratic socialist parties, they have favored a variable economic mix of capitalism and state control. In the THIRD WORLD, socialist programs have stressed land reform and centralized economic planning, often through a one-party state, but since the 1980s there has been a movement toward reduced state control of the economy.

unemployment, inability of able-bodied workers to find work for seasonal, technological, economic, or educational reasons; the official U.S. unemployment rate, however, is designed to measure those who actively seek work but cannot find it, and does not show how many people of working age do not have jobs. In the GREAT DEPRESSION (1930s) 25% of the work force was unemployed in the U.S., Britain, and Germany. U.S. unemployment was relatively low in the 1950s and 60s, averaging about 4%, but it rose through the 1970s and was greater than 10% in 1982, the highest rate since 1940. The rate was considerably higher among nonwhite minorities and the young, approaching 50% among African-American teenagers in urban areas. By 1990 the average unemployment rate had dropped to almost 5%; it fluctuated between 5% and 7% in the early 1990s.

Supply and demand, in classical economics, factors that are said to determine price and that may be thought of as the guiding forces in an economy based on private property. Supply refers to the varying amounts of a good that producers will supply at different prices; in general, a higher price yields a greater supply. Demand refers to the quantity of a good that consumers want (and are able to buy) at any given price. According to the law of demand, demand decreases as the price rises. In a perfectly competitive market, the upward-sloping supply curve and the downward-sloping demand curve yield a supply-and-demand schedule that, where the curves intersect, reveals the equilibrium, or market, price of an item. In reality, however, monopolies, government regulation, and other factors combine to limit the effect of supply and demand.

Third World, name applied to the technologically less-advanced, or developing, nations of Asia, Africa, and Latin America. The term was originally used to distinguish these countries from the Western nations and those that formed the Eastern bloc and usually excludes China.

International monetary system, rules and procedures by which different national currencies are exchanged for each other in world trade. The first formal international monetary system of modern times was the gold standard, in effect during the late 19th and early 20th cent. Gold served as an instrument of exchange and the only standard of value. The international gold standard broke down in 1914, however, partly because of its inherent lack of liquidity. It was replaced by a gold-bullion standard, but that, too, was abandoned in the 1930s. In the decades following World War II, international trade was conducted under a gold-exchange standard. Under this system, nations fixed the value of their currencies not to gold but to some foreign currency, which was in turn fixed to and redeemable in gold. Most nations fixed their currencies to the U.S. dollar. During the 1960s, however, a severe drain on U.S. gold reserves led to the introduction (1968) of the so-called two-tier system. In the official tier, the value of gold was set at $35 an ounce; in the free-market tier, the price was free to fluctuate according to supply and demand. At the same time, the International Monetary Fund (IMF) created SPECIAL DRAWING RIGHTS as a new reserve currency. In the early 1970s new troubles plagued the international monetary system, resulting in the temporary adoption of "floating" exchange rates based largely on SUPPLY AND DEMAND. Finally, under a 1976 agreement IMF members accepted a system of controlled floating rates and took steps to diminish the importance of gold in international transactions, including elimination of the official price. Since the 1970s the U.S. dollar, Japanese yen, German Deutchmark, and the EUROPEAN MONETARY SYSTEM's European Currency Unit have played the most important roles in international trade. See FOREIGN EXCHANGE.

Balance of payments, <mark>relation between all payments in and out of a country over a given period</mark>. It is an outgrowth of the concept of BALANCE OF TRADE, which it includes; it also <mark>includes the movement of government and private capital between countries (e.g., investments and debt payments)</mark>. The <mark>INTERNATIONAL MONETARY FUND was created (1945) to deal with problems relating to the balance of payments</mark>. The U.S., which has generally experienced an unfavorable balance of payments since the late 1950s, sought to improve the balance in the early 1970s through DEVALUATION of the dollar. The increase in imported oil prices (1973–74) and U.S. monetary policies in the 1980s, however, had a negative effect on the balance of payments.

Money of the World

Most nations have their own system of money and print their own currency. Made of paper, these pieces of currency have very little intrinsic value. As fiat money, however, the paper bills represent a specific monetary value decreed by the government and accepted by the people. The bills pictured here are examples of fiat money from all over the world.

George Chan/Photo Researchers, Inc.

George Chan/Photo Researchers, Inc.

foreign exchange, <mark>methods and instruments used to adjust the payment of debts between two nations that employ different currency systems</mark>. A nation's <mark>BALANCE OF PAYMENTS has an important effect on the exchange rate of its currency.</mark> The rate of exchange is the price in local currency of one unit of foreign currency and is <mark>determined by the relative supply and demand of the currencies in the foreign exchange market</mark>. The chief demand for foreign exchange comes from importers and exporters, purchasers of foreign securities, government agencies, and international corporations. Exchange rates were traditionally fixed under the gold standard and later by international agreements, but in 1973 the major industrial nations of the <mark>West adopted a system of "floating" rates that allows for fluctuation within a limited range</mark>.

International Bank for Reconstruction and Development or **World Bank**, <mark>specialized agency of the UN</mark> founded in 1945. It <mark>makes loans to member nations</mark> and, under government guarantee, to private investors, for the purpose of facilitating productive investment, encouraging foreign trade, and discharging burdens of international debt. <mark>All members of the bank must also belong to the International Monetary Fund</mark>. The bank conducts its business largely through the International Finance Corporation (1956) and International Development Association (1960).

Money Supply, amount of money freely circulating in an economy. Money supply is made up of currency (paper bills and coins) and bank deposits. The United States divides money into four categories known as measures: M1, M2, M3, and L.

This breakdown measures the money supply by degree of liquidity. Liquidity refers to how easy it is to convert money into cash—the most liquid form of money. Checking accounts represent the next most liquid form because money in a checking account can be easily withdrawn by writing a check. Savings accounts are slightly more difficult to access than checking accounts and therefore are less liquid. Certificates of deposit are less liquid still because often funds cannot be withdrawn before a specified date without a penalty.

Each measure of money includes a portion of the money supply that is more liquid than the next measure—that is, M1 is more liquid than M2. The measures are cumulative; each measure includes the forms of money (cash, savings accounts, U.S. treasury bonds, etc.) counted in the previous measure, plus additional, less liquid forms. For example, M2 includes M1 plus certain additions.

Definitions of different money supply measures include a number of technical items, but, in a general sense, M1 is the most liquid and includes cash, travelers checks, and demand deposits—checking accounts from which money can be withdrawn on demand. In 1994 M1 in the United States averaged over $1.1 trillion on a daily basis. M2 is less liquid. It consists of M1 plus savings deposits of $100,000 or less. M3 consists of M2 plus savings deposits of more than $100,000. L consists of M3 plus government securities, such as savings bonds and treasury notes.

In the United States, money supply is manipulated by the Federal Reserve Bank with one of three methods: buying and selling government securities; raising or lowering banks' required reserve ratio (percentage of their total deposits that banks must maintain at Federal Reserve banks); and raising or lowering the discount rate (interest rate banks pay to borrow money from the Federal Reserve).

Money supply is an important aspect of government monetary policy. Governments use monetary policy, along with fiscal policy (which is concerned with taxation and spending), to maintain economic growth, high employment, and low inflation. In the United States, monetary policy is determined by the Federal Reserve's Board of Governors.

Economists disagree on the ultimate effects of changes in the money supply. Two important schools of economic thought are Keynesianism and monetarism. Keynesians believe that an increased money supply can lead to increased employment and output On the other hand, monetarists argue that an increased money supply ultimately only affects prices, leading to inflation, and that output is not increased.

Monetary standard, type of standard money used in the monetary system. Modern standards have been either *commodity* standards, in which either gold or silver has been chiefly used as standard money, or *fiat* standards, consisting of inconvertible currency paper units. A number of Latin American countries have used the dollar-exchange standard. Silver standards have been used in modern times chiefly in the Orient. A bimetallic standard has been used in some countries, under which either gold or silver coins were the standard currency. Such systems were rarely successful, largely because of Gresham's law, which describes the tendency for cheaper money to drive more valuable money out of circulation.

Most monetary systems of the world at the present time are *fiat* systems; they do not allow free convertibility of the currency into a metallic standard, and money is given value by government fiat or edict rather than by its nominal gold or silver content. Modern systems are also described as managed currencies, because the value of the currency units depends to a considerable extent on government management and policies. It is a recurrent problem whether the value of inconvertible-credit currency can be maintained at a fairly stable level for extended periods of time.

READING ASSIGNMENT:

Read the articles, materials, or outlines in Lesson Plan 3.
Be prepared to discuss in class next week:

Lecture Plan 3 - Wealth, Risk. & Interest
Article – Bad Credit

HOMEWORK ASSIGNMENT:
Credit: due date - full, + 1 week - ¾, + 2 weeks - ½, + 3 weeks - ¼, + 4 weeks – $\frac{1}{8}$

GROUP HOMEWORK:

(Be prepared to discuss in class next week. Written response due in 2 weeks.)

1. Compile a history of the rate of exchange of the Peso versus the US dollar for the past 10 years.

INDIVIDUAL HOMEWORK (Due in 1 week)

1. Define the following terms:

     a. M1

     b. M2

     c. M3

     d. L

2. What are the three different types of currency?

     a.

     b.

     c.

3. What kind of currency is the Philippine Peso?

LESSON PLAN   3 – 1 hour +

WEALTH, RISK & INTEREST

MANY FORMS OF WEALTH BESIDES CURRENCY – marketable assets are wealth and can range from real estate to knowledge, skills, and ideas – almost anything marketable, undeveloped and unimproved, to developed and improved.

WEALTH BRINGS MANY SERIOUS RISKS - & COSTS TO MITIGATE RISKS:
Personal wealth risks
 Robbery, theft, murder, personal injury, death
 Loss (bank failure), fraud (stock manipulation), waste (exorbitant lifestyle)
Counterfeiting
 Currency transactions
 Trademarks & copyrights
  Audio & video CD piracy
  Computer software piracy
  Clothing apparel imitations
  Brand name imitation:
   Walt Disney & Looney Tune characters
   Levi Strauss, Gucci, Lee, Rolex, Sony, Panasonic, Aiwa

Security – maintaining possession (pirates, thieves, burglars, con-artists, robbers)
 Secure shipping lanes
  Piracy on the high seas
 Secure & serviceable highways and road systems
 Secure distribution channels
 Secure retail outlets

Competing ownership claims
 Mining and mineral rights – who owns them?
  Disputes between governing authority and occupants
 Oil exploration, drilling, and production rights – who controls them?
  Spratly Islands – contested by China, Taiwan, Vietnam, Malaysia, Philippines, Brunei
  South Sudan – civil war between Moslem north and Christian south (political system & oil)
  Chechnya – Russians versus Chechnyans
  US versus Iraq -
  Drilling and production technology – who possesses it?

Establishing and maintaining boundaries on real property assets
 Untitled and unmarked lands
  Titled property - owner occupation versus squatter's rights

Who governs *(weak and/or corrupt central government)*
 Capitalist versus socialists versus communists
 Autocracy versus democracy
 Nationalism versus Tribalism
  Southeast Asia: - China, Vietnam, Thailand, Malaysia, Philippines, Indonesia, Sri Lanka
  South & Central America: Columbia, Mexico, Guatemala, Honduras; Africa:

Government policy and attitude toward investment and business
    Taxes and tax rates and tax holidays
    Pro- or anti- business regulation
    Strong or weak labor laws and/or enforcement actions

RISK	POSSIBLE RISK MITIGATION MEASURES
Acts of God	*(usually excluded from insurance coverage)*
Extreme weather	*Insure where possible and economically feasible*
Typhoons	Avoid typhoon-prone areas, design to 100 year storm
Torrential rains	Design to standard storm
Tornados	Design to high wind loads
Hail	Design roof appropriately
Lightning	Provide lightning arrestors and rods
Floods	Design to standard flood
Tsunami	Avoid coastal areas and locations prone to Tsunamis
Earthquake	Design according to earthquake zone
Avalanche	Construct avalanche barriers and channels, avoid avalanche-prone areas
Volcano	Avoid active volcano areas,
Eruption	Flee, abandon project
Pyrochlastic flow	Flee, abandon project
Lava flow	Construct dikes, levees and channels to control flow
Blow out	Abandon area immediately (usually catastrophic)
Wild fires	Insure where possible and economically feasible Provide fire-breaks, reliable water source, fireproofing
Meteors	Prayer

Force Majeure

War	Avoid areas of contention, abandon areas of active conflict
Rebellion	Avoid areas of contention, abandon areas of active conflict
Insurrection	Avoid areas of contention, abandon areas of active conflict
Civil unrest	Close down, lock up, employ extra security
Riots	Close down, lock up, employ extra security
Strikes	Employ extra security, negotiate grievances fairly
Crimes against property	Insurance, hidden cameras, night watchmen, roving guards
Crimes against persons	Screen visitors/employees for weapons, background checks
Sabotage & theft	Secure inventories and equipment, background checks

Business/commerce/industry risks
Competitive product(s) undercutting price and endangering profit

Excessive warranty claims	Under-capitalization
Product litigation	Unexpected government regulation
Product obsolescence	Environmental activists
Market saturation	Sabotage
Marketing strategy errors	Adverse publicity
	Failure to repay loans

Justification for Interest

Reward for undertaking risks

    Very significant opportunity for loss,

    The higher the risk of loss, the higher the rate of interest demanded

Inflation hedge

    Inflation is a *monetary* phenomena (it is the currency itself that loses its purchasing power)

    Fisher equation (1933) defined the relationship between the rates of inflation, the real rate of interest,

    and the nominal, or contract, rate of interest as follows:

$$(1 + i) = (1 + r)(1 + \rho) \qquad\qquad \text{where: } r = \text{real rate of interest}$$

$$i = r + \rho + r\rho \qquad \cong r + \rho \qquad\qquad \rho = \text{rate of inflation}$$

$$r = (i - \rho) / (1 + \rho) \qquad\qquad i = \text{contracted or nominal rate of interest}$$

Even if the real rate of interest is zero, the contract rate of interest should be no less than the rate of inflation.

EXAMPLE: You loan your friend \$100, to be repaid in one year at no (nominal) interest. The rate of inflation for the year is 5%. At the end of the year, your friend gives you a \$100-dollar bill. What is the real rate of interest?

    $i = 0$, $\rho = 5\%$

    $r = (0 - 5\%) / (1 + 5\%) \cong -5\%$ That \$100-dollar bill you loaned your friend a year ago will only buy \$95 worth of goods today at last year's prices.

Profit for effort, knowledge, and skill:

      Effort in providing credit service

      Knowledge in economics, financing, accounting, business, banking

      Skill in accumulating currency in sufficient quantities to loan to others

Interest Rates: real vs nominal, various inflation

ρ

-5%
0%
5%
10%
15%
20%
25%
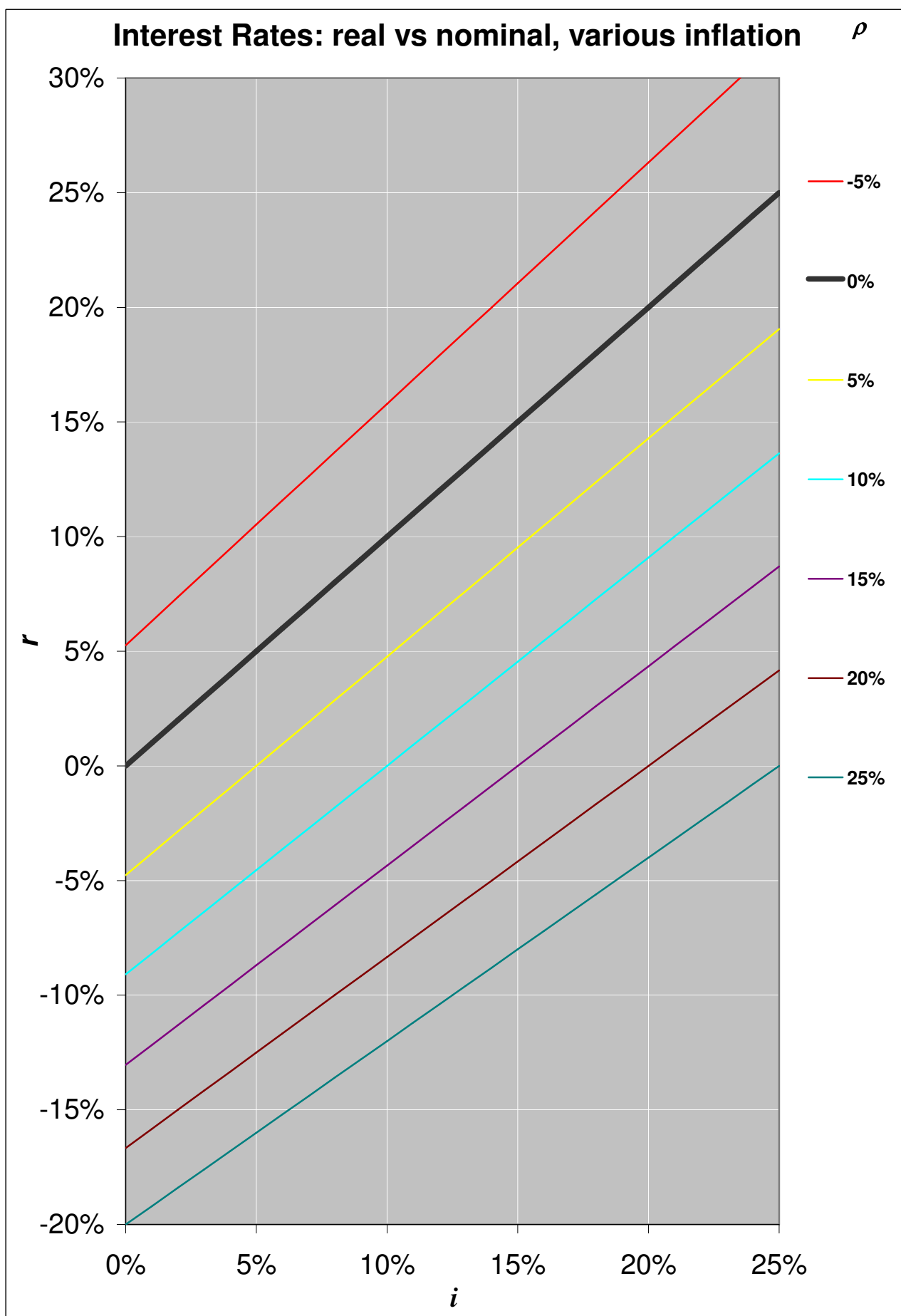
Bad Credit

**Companies, and those who invest in them, complain about
the accuracy and timeliness of credit ratings.
Is the SEC listening?**

By Jennifer Barrett
NEWSWEEK WEB EXCLUSIVE

Nov. 29 — Wall Street analysts were not the only ones criticized for giving Enron a higher grade than it deserved. The major credit-rating agencies also came under fire for not downgrading the energy company's debt rating until just days before it sought bankruptcy protection last December. The agencies in turn blamed Enron executives for failing to provide information on partnerships that helped hide the company's ballooning debt. But a growing number of critics are complaining about the overall timeliness and accuracy of credit ratings, which grade the risk level of a company's debt.

THE LETTER-GRADE ratings—which range from 'AAA' for financially stable companies to 'D' for a company in default, for example—are used by investors as a measure of a company's financial health and by banks to determine the amount of interest a company pays on its debt.

But a recent survey by the Association of Financial Professionals (AFP) shows that nearly one-third (29 percent) of financial executives who work for companies with rated debt believe their companies' ratings are inaccurate. Thirty-eight percent believe that changes in their company's ratings have not been timely—and the same percentage of financial practitioners who use ratings for investment decisions agree. One problem, say critics, is a lack of competition. Three major agencies control the market now: Moody's Investors Service, Standard & Poor's and Fitch Ratings. Ninety percent of the 715 surveyed (which included both corporate financial executives at companies with rated debt as well as financial practitioners who use ratings for investment decisions) believe that the Securities and Exchange Commission should take additional action to improve its oversight of the agencies and allow for more competition. In hearings this month, the SEC began considering such changes. NEWSWEEK's Jennifer Barrett spoke with AFP president and CEO Jim Kaitz, who testified before the SEC last week, on improving the process for rating Corporate America's credit-worthiness.

NEWSWEEK: What's wrong with the credit ratings industry now?

Jim Kaitz: In our survey, what really comes through are the issues of accuracy and timeliness in ratings. A number of respondents—both from companies that have had an upgrade and from companies that have been downgraded—said that the ratings are not timely.

How would you fix that?

There should be some sort of periodic SEC review of these agencies. And removing the barriers to entry for other ratings agencies is also a critical issue. Only three agencies have been designated as Nationally Recognized Statistical Rating Organizations. There needs to be a clarification of the designation process at the SEC so that other agencies better understand what the process entails.

Do you think the SEC is likely to adopt these changes?

I think the SEC absolutely takes this issue seriously. They have to issue a report to Congress in January. I think the ball is in their court right now.

At least two small agencies have complained that they filed applications years ago, but have yet to receive "nationally recognized" status. If competition is so important, why hasn't the SEC already made it easier for other entrants to gain the same status as the major agencies?

Enron was the trigger in terms of getting Congressional interest in this. It's a confluence of the economy, of some companies obviously having some major problems. We are in a position now where everyone is looking to increase investor confidence in our financial markets. I don't think it is so much that the smaller players have been squeezed out. But the SEC does need to remove some of the barriers to the process.

What would that entail?

In order to be nationally recognized you have to get a letter from the SEC. It is a very unclear and convoluted methodology now to be recognized as an NRSRO. I think the SEC would acknowledge that. Under the new Congressional mandate, they will be addressing the issue of clarifying the process for entry for other credit ratings agencies.

How much of a difference would it make if smaller ratings agencies could achieve nationally recognized status?

There is nothing more important than the agencies' reputations and the integrity of their ratings. The issue here is not necessarily getting smaller agencies, but you want to remove the barriers because competition is good. Competition should help to make the process more efficient and more accurate. You can't make a blanket statement that just because there will be more competitors in the market that all these issues will go away. But our system of capitalism works on the concept that competition will enhance performance. If you know there is a potential threat from a competitor you will do a better job for the customer.

How could this affect the average investor?

The economy has slowed. President Bush and Congress are talking about economic stimulus. It is critically important that we boost investor confidence in the financial markets now. And the credit rating agencies play a major role both for those companies that issue debt and also—and maybe more importantly—for investors. They need to know that the credit [bonds] they buy is worth what the agencies say it is.

There has been a lot more focus on Wall Street analysts than on credit-rating agencies over the past year. Should investors have been paying more attention to credit ratings?

I think you have to focus on both. Maybe there is not as much consciousness about credit ratings agencies because people are focusing so much on those Wall Street analysts now, but for investors, these agencies play a major and important role too.

HOMEWORK ASSIGNMENT 3

READING ASSIGNMENT:
> Read ahead all the material in the next Lesson Plan

> Lesson 4 – Accounting Principals and Double Entry bookkeeping

HOMEWORK ASSIGNMENT:
Credit: due date - full, + 1 week - ¾, + 2 weeks - ½, + 3 weeks - ¼, + 4 weeks – $^1/_8$

GROUP HOMEWORK:
(Be prepared to discuss in class next week. Written response due in 2 weeks.)

1. One of the classic risks for lenders of capital, to either a business or to a person, is the possibility of not being repaid. How often do you think that businesses or persons who obtain loans in the Philippines default on their loan repayments?

2. One of the ways that lenders protect themselves from loss is to secure a loan with some marketable property which could be sized and sold if the borrower defaults. For new cars and for real estate, the loan may be specifically tied to the property being purchased, and payment by the lender is direct to the seller, and not to the borrower, with a mortgage or lien filed against the purchased item. What is your opinion on the practice of securing loans in this manner?

INDIVIDUAL HOMEWORK (Due in 1 week)

1. Money is not the only form of wealth. Most people have far more wealth than they might think at first glance. Compile a list of your personal assets, both tangible and intangible, and make an "educated" guess at their possible present or future value in Philippine pesos.

2. According to the Article *Bad Credit*, investors want more accurate reporting on what?

3. In most 1st world countries, an individual seeking a loan will undergo a screening process and have a composite score that represents the potential borrower's credit risk to the lender. If this credit score is too risky, the lender will not approve the loan. What is your opinion of this practice? Is it good or bad (from who's perspective)?

4. Write a 1 to 3-page typed essay on Mindanao concerning and identifying <u>risk issues</u> affecting capital investment, trade or commerce. Give your opinion on how to mitigate these risks. Also, give your opinion on the morality of charging interest for the business use of capital.

LESSON PLAN   4 – 2 hours +
(Revised)

Accounting principals – an overview of accounting

The Fundament Accounting Equation

Assets – Liabilities = Owner Equity

More often expressed in actual usage as follows:

Equities

Assets = Liabilities + Owner Equity

The *credit* and *debit* double-entry bookkeeping system

Every financial transaction has both a *credit entry* and a *debit entry*, so that sum of the debit column and the sum of the credit column are equal.

EXAMPLE: Borrow $50,000 from ABC bank

TRANSACTION:	BORROW $5000		
POSTING ACTION	DEBIT	CREDIT	ACCOUNT
Asset increase	$50,000		Cash
Liability increase		$50,000	Loans taken

Assets	≡	wealth
Liabilities	≡	obligations
Owner Equity	≡	shares & retained earnings

T-account depiction

Transaction	debit	credit
Asset increase	(+)	
Asset decrease		(–)
Liability increase		(+)
Liability decrease	(–)	
Owner equity increase		(+)
Owner equity decrease	(–)	

T-account depictions: (a T-account shows the debits and credit transactions for an account.)

Account: **Cash** *(Asset)*		
Transaction	*debit*	*credit*
ABC Loan	$50,000	

Account: **ABC Bank, Inc.** *(Liability)*		
Transaction	*debit*	*credit*
ABC Loan		$50,000

In the example above, the $50,000 loan is an *asset* in that it increased the *cash* account, and a *liability* because it also increased the debt of the company, which it is obligated to repay at some point.

Owner equity is a special kind of liability, because it is a liability of the company to the owners of the company or association – the shareholders. Shareholders initially capitalized the company with assets (usually money, but other assets could be used, such as buildings or equipment). This initial capitalization (and subsequent recapitalizations) is recorded as a credit (liability), because individual owners may partially or wholly withdraw their contributions to the company or association. Owner equity includes stock (corporate) shares and non-stock (non-corporate) shares. Owner equity also includes *retained earnings*, which have the potential for distribution to the shareholders.

EXAMPLE 1: A group of ten engineers decide to form the XYZ company to provide specialized engineering services to the petrochemical industry. Each of the ten contributes $50,000 in cash, for a total capitalization of $500,000.

Transaction 1: Capitalization
T-account depictions: (*Assets* are increased, and *Liabilities* are increased)

Account: Cash	(*Assets*)			*Account:* Shares *(Owner equity)*		
Transaction	*debit*	*credit*		*Transaction*	*debit*	*credit*
Capitalization	$500,000			Capitalization		$500,000

Transaction 2: The XYZ company pays $25,000 for general office and booking services.

T-account depictions: (*Assets* are decreased, and *Liabilities* are decreased)

Account: Cash	(*Assets*)			*Account:* Payables *(Liabilities)*		
Transaction	*debit*	*credit*		*Transaction*	*debit*	*credit*
Office services		$25,000		Office services	$25,000	

Transaction 3: The XYZ company purchases $25,000 cash worth of computers from IBM.

T-account depictions: (*Assets* are increased, and *Liabilities* are increased)

Account: Capital Equipment	(*Assets*)			*Account:* Payables *(Liabilities)*		
Transaction	*debit*	*credit*		*Transaction*	*debit*	*credit*
IBM Computers	$25,000			IBM		$25,000

Transaction 4: IBM invoices XYZ for $25,000 for the computers purchased. XYZ pays the invoice.

T-account depictions: (*Assets* are decreased, and *Liabilities* are decreased)

Account: Cash	(*Assets*)			*Account:* Payables *(Liabilities)*		
Transaction	*debit*	*credit*		*Transaction*	*debit*	*credit*
IBM		$25,000		IBM	$25,000	

Transaction 5: XYZ subcontracts to GDF for services on Global Oil project and incurs billings of $100,000.

T-account depictions: (*Assets* are increased, and *Liabilities* are increased)

Account: Receivables *(Assets)*		
Transaction	*debit*	*credit*
Global Oil proj. *(direct costs)*	$100,000	

Account: Payables *(Liabilities)*		
Transaction	*debit*	*credit*
GDF subcontract.		$100,000

Transaction 6: XYZ pays the $90,000 costs incurred on the project for Global Oil.

T-account depictions: (*Assets* are decreased, and *Liabilities* are decreased)

Account: Cash *(Assets)*		
Transaction	*debit*	*credit*
GDF subcontract		$ 90,000

Account: Payables *(Liabilities)*		
Transaction	*debit*	*credit*
GDF subcontract	$90,000	

Transaction 7: XYZ apportions overheads and profit expectations to Global Oil project

T-account depictions: (*Assets* are increased, and *Liabilities* are increased)

Account: Receivables *(Assets)*		
Transaction	*debit*	*credit*
Global Oil project *(distributed OH & P)*	$75,000	

Account: Overheads & profit *(L & OE)*		
Transaction	*debit*	*credit*
Office services		$25,000
Computer Depreciation		$ 5,000
Profit expectation		$45,000

Transaction 8: The XYZ company bills Global Oil, Inc. $200,000. Global oil pays XYZ $180,000.

T-account depictions: (Asset to asset transfer – *Cash* (increased), *Receivables* (decreased))

Account: Cash *(Assets)*		
Transaction	*debit*	*credit*
Global Oil paym.	$180,000	

Account: Receivables *(Assets)*		
Transaction	*debit*	*credit*
Global Oil paym		$180,000

Transaction 9: The XYZ calculates its tax obligations as $20,000 (federal, state, city, property, etc.)

T-account depictions: (*Owner equity* to *Liability* transfer – *OE* (decreased), *Payables* (increased))

Account: Taxes *(Liabilities)*		
Transaction	*debit*	*credit*
Tax reserve	$20,000	

Account: Payables *(Liabilities)*		
Transaction	*debit*	*credit*
Tax reserve		$20,000

ACCOUNT BALANCES

Account: Cash (*Assets*)

Transaction	debit	credit
1) Capitalization	$500,000	
2) Office services		$ 25,000
4) IBM Computers		$ 25,000
6) Payment to GDF		$ 90,000
8) Global Oil Paym	$180,000	
Balance:	$540,000	

Account: Payables *(Liabilities)*

Transaction	debit	credit
2) Office services	$ 25,000	
3) IBM		$ 25,000
4) IBM	$ 25,000	
5) GDF subcontract		$100,000
6) Payment to GDF	$ 90,000	
9) Taxes		$ 20,000
Balance:		$ 30,000

Account: Receivables *(Assets)*

Transaction	debit	credit
5) GDF subcontract	$100,000	
7) Distributed OH	$ 75,000	
8) Global Oil Paym		$180,000
Balance:	$10,000	

Account: Global Oil Proj *(Liabilities)*

Transaction	debit	credit
7) OH costs applied		$75,000

Account: Capital equipment *(Assets)*

Transaction	debit	credit
3) IBM computers	$ 25,000	
7) Depreciation		$ 5,000
Balance:	$ 20,000	

Account: Taxes (*Liabilities*)

Transaction	debit	credit
9)Tax reserve	$20,000	
Balance:		$20,000

INCOME STATEMENT: XYZ Company (**before** taxes are paid)

Revenues		Expenses		Income:)
Global Oil	$180,000	Office services:	$ 25,000	(Revenues – Expenses)
		Depreciation:	$ 5,000	
		Proj. costs	$100,000	
Total	**$180,000**	**Total**	**$130,000 (pre-tax)**	**$ 50,000 (pre-tax)**
				$ 20,000 Tax (est.)
				$ 30,000 (after tax)

BALANCE SHEET: XYZ Company (**before** taxes are paid)

ASSETS	*Credits*	*Debits*	*Balance*
Cash	$540,000		
Capital Equip. (computers)	$ 20,000		
Receivables	$ 20,000		
TOTAL ASSETS			$580,000
LIABILITIES			
Payables *(including taxes)*		$ 30,000	
OWNER EQUITY			
Capital shares		$500,000	
Retained Earnings *(before taxes)*		$ 50,000	
LIABILITIES + OWNER EQUITY			$580,000

RETURN ON INVESTMENT (ROI)

ROI = (Income at end of year) / (Investment at beginning of year)

Before tax:

ROI = 50,000 / 500,000 = 10%

After Tax:

ROI = 30,000 / 500,000 = 6%

INCOME STATEMENT: XYZ Company (**after** taxes are paid)

Revenues		Expenses		Income:
Global Oil	$180,000	Office services:	$ 25,000	(Revenues – Expenses)
		Depreciation:	$ 5,000	
		Proj. costs	$100,000	
		Taxes	$ 20,000	
Total	**$180,000**	**Total**	**$150,000 (post-tax)**	**$ 30,000**
				$ 0 Tax
			liability	
				$ 30,000 (after tax)

BALANCE SHEET: XYZ Company (**after** taxes are paid)

ASSETS	*Credits*	*Debits*	*Balance*
Cash	$520,000		
Capital Equip. (computers)	$ 20,000		
Receivables	$ 20,000		
TOTAL ASSETS			$560,000
LIABILITIES			
Payables		$ 10,000	
OWNER EQUITY			
Capital shares		$500,000	
Retained Earnings *(before taxes)*		$ 50,000	
LIABILITIES + OWNER EQUITY			$560,000

RETURN ON INVESTMENT (ROI)

ROI = (Income at end of year) / (Investment at beginning of year)

Before tax:

ROI = 50,000 / 500,000 = 10%

After Tax:

ROI = 30,000 / 500,000 = 6%

6

EXAMPLE 1 (expanded): A group of ten engineers decide to form the XYZ company to provide specialized engineering services to the petrochemical industry. Each of the ten contributes $50,000 in cash, for a total capitalization of $500,000. Below are the finacial transaction for the year.

FINANCIAL TRANSACTIONS

1 Capitalization

Account: (Assets)	Cash		Account: (Owner Equity)	Shares	
Transaction	Debit	Credit	Transaction	Debit	Credit
Capitalization	$500,000		Capitalization		$500,000

2 The XYZ company contracts for $25,000 of general office and bookkeeping services

2a Assign cost to Global Oil project

Account: (Liabilities)	Payables		Account: (Assets)	Global Oil Account	
Transaction	Debit	Credit	Transaction	Debit	Credit
Office services rendered		$25,000	Office services rendered	$25,000	

2b The XYZ company pays for the general office and bookkeeping services

Account: (Assets)	Cash		Account: (Liabilities)	Payables	
Transaction	Debit	Credit	Transaction	Debit	Credit
Office services paid		$25,000	Office services paid	$25,000	

3 : The XYZ company purchases $25,000 cash worth of computers from IBM

Account: (Assets)	Capital Equipment		Account: (Liabilities)	Payables	
Transaction	Debit	Credit	Transaction	Debit	Credit
IBM delivers computers	$25,000		IBM delivers computers		$25,000

4 IBM invoices XYZ for $25,000 for the computers purchased. XYZ pays the invoice.

Account: (Assets)	Cash		Account: (Liabilities)	Payables	
Transaction	Debit	Credit	Transaction	Debit	Credit
Pay for IBM computers		$25,000	Pay for IBM computers	$25,000	

5 GDF company performs services for Global Oil project, bills XYZ $100,000

Account: (Liabilities)	Payables		Account: (Asset)	Global Oil Account	
Transaction	Debit	Credit	Transaction	Debit	Credit
Assign GDF billings to Global		$100,000	Assign GDF billings to Glob	$100,000	

6 XYZ pays the $90,000 to GDF for costs incurred on the project for Global Oil

Account: (Assets)	Cash		Account: (Liabilities)	Payables	
Transaction	Debit	Credit	Transaction	Debit	Credit
Pay GDF		$90,000	Pay GDF	$90,000	

7a Depreciate Computers by $5,000 and assign to Global Project

Account: (Assets)	Capital Equipment		Account: (Assets)	Global Oil Account	
Transaction	Debit	Credit	Transaction	Debit	Credit
Distr OH to Global proj		$5,000	Distr OH to Global proj	$5,000	

7b Realize profit expectations from Global

Account: (Owner Equity)	Retained Earnings		Account: (Assets)	Global Oil Account	
Transaction	Debit	Credit	Transaction	Debit	Credit
Global Oil Paym on account		$50,000	Global Oil Paym on account	$50,000	

9 The XYZ calculates its tax obligation on its income (estimated at 40% of $35,000)

7c

Account: (Liabilities)	Payables		Account: (Assets)	Global Oil Account	
Transaction	Debit	Credit	Transaction	Debit	Credit
Tax reserve		$20,000	Tax reserve	$20,000	

7d Bill Global Oil Co.

Account: (Assets)	Global Oil Account		Account: (Assets)	Receivables	
Transaction	Debit	Credit	Transaction	Debit	Credit
Bill Global Oil Co.		$200,000	Bill Global Oil Co.	$200,000	

8 The XYZ company bills Global Oil, Inc. $200,000. Global oil pays XYZ $180,000					
Account: (Assets)	**Cash**		**Account:** (Assets)	**Receivables**	
Transaction	*Debit*	*Credit*	*Transaction*	*Debit*	*Credit*
Global Oil Paym on accoun	$180,000		Global Oil Paym on accoun		$180,000

ACCOUNT BALANCES:

Account: (Assets)	**Cash**		**Account:** (Liabilities)	**Payables**	
Transaction	*Debit*	*Credit*	*Transaction*	*Debit*	*Credit*
1 Capitalization shares)	$500,000		**2a** Office services rendered		$25,000
2b Office services paid		$25,000	**2b** Office services paid	$25,000	
4 IBM bill paid		$25,000	**3** IBM delivers computers		$25,000
6 GDF payments		$90,000	**4** IBM bill paid	$25,000	
8 Global Oil payments	$180,000		**5** Global Proj costs (GDF)		$100,000
Totals	$680,000	$140,000	**6** Pay GDF	$90,000	
			7c Tax reserve		$20,000
			Totals	$140,000	$170,000
Balance:	*$540,000*				
			Balance:		$30,000

Account: (Assets)	**Global Oil Project**				
Transaction	*Debit*	*Credit*			
2a Office services apportione	$25,000				
5 GDF costs	$100,000		**Account:** (Owner Equity))	**Retained Earnings**	
7a Depreciation of computers	$5,000		*Transaction*	*Debit*	*Credit*
7b Profit expectations	$50,000		**7c** Profit evpectations		$50,000
7c Tax reserve	$20,000				
8 Global Billing		$200,000			
Totals	$200,000	$200,000	Totals	$0	$50,000
Balance:	*$0*		*Balance:*		*$50,000*

Account: (Assets)	**Receivables**		**Account:** (Assets)	**Capital Equipment**	
Transaction	*Debit*	*Credit*	*Transaction*	*Debit*	*Credit*
5 Global proj Billing	$200,000		**3** IBM Computers delivered	$25,000	
8 Global Oil paym		$180,000	**7a** Depreciation		$5,000
Totals	$200,000	$180,000	Totals	$25,000	$5,000
Balance:	*$20,000*		*Balance:*	*$20,000*	

INCOME STATEMENT: XYZ Company		
Revenues		
Global Oil Co	$180,000	
TOTAL REVENUES	**$180,000**	
Expenses		
Office services	$25,000	
Depreciation	$5,000	
Project costs	$100,000	
TOTAL EXPENSES	**$130,000**	
Income (revenues-expenses)		ROI
before tax	**$50,000**	10%
Taxes (estimated)	$20,000	
after tax	**$30,000**	6%

BALANCE SHEET: XYZ Company		
Assets	*Debit*	*Credit*
Cash	$540,000	
Capital equipment	$20,000	
Receivables-Global Oil	$20,000	
Liabilities		
Payables-GDF/Taxes)		$30,000
Owner Equity		
Capital shares		$500,000
Retained Earnings		$50,000
TOTALS	**$580,000**	**$580,000**

HOMEWORK ASSIGNMENT 4

READING ASSIGNMENT:
Read ahead all the material in the next Lesson Plan

Lesson 5 –
Article - Accounting & Bookkeeping
Tables - GAAP

HOMEWORK ASSIGNMENT:
Credit: due date - full, + 1 week - ¾, + 2 weeks - ½, + 3 weeks - ¼, + 4 weeks – $^1/_8$

GROUP HOMEWORK:
(Be prepared to discuss in class next week. Written response due in 2 weeks.)

1. The XYZ company incurred $100,000 of expenses in executing the project for Global Oil, which it paid before billing Global Oil. Suppose XYZ, instead of capitalizing to $500,000, only capitalized to $50,000.

    a. What ramifications might that have on its ability execute project work for Global?

    b. What actions might XYZ take to work around capitalization of only $50,000?

2. The pre-tax return-on-investment (ROI) (ROI = retained earnings / capital shares) is only 10%, and the after-tax ROI is only 6%. Suppose the bond market was earning 8%.

    a. How might that affect the shareholders' decision to continue in business?

    b. What are some actions XYZ might take to improve its ROI performance in the future?

3. Capital Equipment (IBM computers) was depreciated by $5,000.

    a. What, in your opinion and experience, is the purpose of such depreciation?

    b. What would be a reasonable "useful life" for a computer purchased new?

    c. What causes the *economic* useful life of a computer to be less than its *actual* operational life?

4. Company overheads and indirect costs all had to be apportioned to just one project – Global Oil.

    a. What other costs are normally associated with indirect and overheads?

    b. Suppose that XYZ executed and two additional, similar-sized projects: one with World Chemical Company, and one with Bigg Oil & Gas.

        i. What affect would these two additional projects have on the distribution of overhead and indirect costs?

        ii. What combined effect would the additional projects have on the ROI?

5. The $50,000 reported in Owner Equity on the balance sheet will only be realized if in fact Global Oil pays the $20,000 balance due on its account. Suppose that Global Oil fails to pay the balance due. What ramifications will that have on the retained earnings amount of $50,000?

6.   Part of the Retained earnings consists of $20,000 of receivables. Do you think it is ethical for XYZ to include $20,000 of uncollected receivables in Owner Equity?

7.   What is your opinion about XYZ passing its tax obligation off to its customer(s)? Is this a normal practice?

8   If in fact XYZ passes its taxes on to Global Oil, does it really suffer a reduction in ROI due to taxes?

9. Suppose the government granted a tax relief of $20,000 to XYZ corporation. Should XYZ reduce its billing to Global Oil in turn? In reality, do you think they would?

INDIVIDUAL HOMEWORK (Due in 1 week)

1. Instead of assigning XYZ operating costs directly to the Global Oil project, collect them into one account called "OHIP" (Overheads, Indirects, and Profit), and after all of them are completed, transfer the total of the OHIP to the Global Oil Account. Show each transaction using T-accounts and the double-entry (debits and credits) accounting system. Operating costs are: office & bookkeeping services, computer depreciation, profit expectation, and taxes.

LESSON PLAN   5 – 2 hours

Accounting & Bookkeeping

Introduction
History
Accounting Information
Accounting Principles
Regulations & Standards

Generally Accepted Accounting Principles (GAAP)

Financial reporting standards
Performance measurement standards

Management Accounting

Internal cost management – no GAAP standards
No reporting requirements except per income tax regulations

Tax Accounting

In accordance with Internal Revenue rules

Audit

Compliance standards

Sampling

Cash Method versus Accrual Method

Homework Assignment (see last page in Lesson material)

Accounting and Bookkeeping

I INTRODUCTION

Accounting and Bookkeeping, the process of identifying, measuring, recording, and communicating economic information about an organization or other entity, in order to permit informed judgments by users of the information. Bookkeeping encompasses the record-keeping aspect of accounting and therefore provides much of the data to which accounting principles are applied in the preparation of financial statements and other financial information.

Personal record keeping often uses a simple single-entry system, in which amounts are recorded in column form. Such entries include the date of the transaction, its nature, and the amount of money involved. Record keeping of organizations, however, is based on a double-entry system, whereby each transaction is recorded on the basis of its dual impact on the organization's financial position or operating results or both. Information relating to the financial position of an enterprise is presented in a balance sheet, while disclosures about operating results are displayed in an income statement. Data relating to an organization's liquidity and changes in its financial structure are shown in a statement of changes in financial position. Such financial statements are prepared to provide information about past performance, which in turn becomes a basis for readers to try to project what might happen in the future.

II HISTORY

Bookkeeping and record-keeping methods, created in response to the development of trade and commerce, are preserved from ancient and medieval sources. Double-entry bookkeeping began in the commercial city-states of medieval Italy and was well developed by the time of the earliest preserved double-entry books, from 1340 in Genoa.

The first published accounting work was written in 1494 by the Venetian monk Luca Pacioli. Although it disseminated rather than created knowledge about double-entry bookkeeping, Pacioli's work summarized principles that have remained essentially unchanged. Additional accounting works were published during the 16th century in Italian, German, Dutch, French, and English, and these works included early formulations of the concepts of assets, liabilities, and income.

The Industrial Revolution created a need for accounting techniques that were adequate to handle mechanization, factory-manufacturing operations, and the mass production of goods and services. With the emergence in the mid-19th century of large, publicly held business corporations, owned by absentee stockholders and administered by professional managers, the role of accounting was further redefined.

Bookkeeping, which is a vital part of all accounting systems, was in the mid-20th century increasingly carried out by machines. The widespread use of computers broadened the scope of bookkeeping, and the term *data processing* now frequently encompasses bookkeeping.

III ACCOUNTING INFORMATION

Accounting information can be classified into two categories: financial accounting or public information and managerial accounting or private information. Financial accounting includes information disseminated to parties that are not part of the enterprise proper—stockholders, creditors, customers, suppliers, regulatory commissions, financial analysts, and trade associations—although the information is also of interest to the company's officers and managers. Such information relates to the financial position, liquidity (that is, ability to convert to cash), and profitability of an enterprise.

Managerial accounting deals with cost-profit-volume relationships, efficiency and productivity, planning and control, pricing decisions, capital budgeting, and similar matters. This information is not generally disseminated outside the company. Whereas the general-purpose financial statements of financial accounting are assumed to meet basic information needs of most external users, managerial accounting provides a wide variety of specialized reports for division managers, department heads, project directors, section supervisors, and other managers.

A   **Specialized Accounting**   Of the various specialized areas of accounting that exist, the three most important are auditing, income taxation, and non-business organizations. Auditing is the examination, by an independent accountant, of the financial data, accounting records, business documents, and other pertinent documents of an organization in order to attest to the accuracy of its financial statements. Businesses and not-for-profit organizations in the United States engage certified public accountants (CPAs) to perform audit examinations. Large private and public enterprises sometimes also maintain an internal audit staff to conduct audit-like examinations, including some that are more concerned with operating efficiency and managerial effectiveness than with the accuracy of the accounting data.

The second specialized area of accounting is income taxation. Preparing an income-tax form entails collecting information and presenting data in a coherent manner; therefore, both individuals and businesses frequently hire accountants to determine their taxes. Tax rules, however, are not identical with accounting theory and practices. Tax regulations are based on laws that are enacted by legislative bodies, interpreted by the courts, and enforced by designated administrative bodies. Much of the information required in figuring taxes, however, is also needed in accounting, and many techniques of computing are common to both areas.

A third area of specialization is accounting for non-business organizations, such as universities, hospitals, churches, trade and professional associations, and government agencies. These organizations differ from business enterprises in that they receive resources on some non-reciprocating basis (that is, without paying for such resources), they do not have a profit orientation, and they have no defined ownership interests as such. As a result, these organizations call for differences in record keeping, in accounting measurements, and in the format of their financial statements.

B   **Financial Reporting**   Traditionally, the function of financial reporting was to provide proprietors with information about the companies that they owned and operated. Once the delegation of managerial responsibilities to hired personnel became a common practice, financial reporting began to focus on stewardship, that is, on the managers' accountability to the owners. Its purpose then was to document how effectively the owners' assets were managed, in terms of both capital preservation and profit generation.

After businesses were commonly organized as corporations, the appearance of large multinational corporations and the widespread employment of professional managers by absentee owners brought about a change in the focus of financial reporting. Although the stewardship orientation has not become obsolete, financial reporting in the mid-20th century is somewhat more geared toward the needs of investors. Because both individual and institutional investors view ownership of corporate stock as only one of various investment alternatives, they seek much more future-oriented information than was supplied under the traditional stewardship concept. As investors relied more on the potential of financial statements to predict the results of investment and disinvestment decisions, accounting became more sensitive to their needs. One important result was an expansion of the information supplied in financial statements.

The proliferation of footnotes to financial statements is a particularly visible example. Such footnotes disclose information that is not already included in the body of the financial statement. One footnote usually identifies the accounting methods adopted when acceptable alternative methods also exist, or when the unique nature of the company's business justifies an otherwise unconventional approach.

Footnotes also disclose information about lease commitments, contingent liabilities, pension plans, stock options, and foreign currency translation, as well as details about long-term debt (such as interest rates and maturity dates). A company having a widely distributed ownership usually includes among its footnotes the income it earned in each quarter, quarterly stock market prices of its outstanding shares of common stock, and information about the relative sales and profit contribution of its different industry segments.

IV   ACCOUNTING PRINCIPLES

Accounting as it exists today may be viewed as a system of assumptions, doctrines, tenets, and conventions, all encompassed by the phrase "generally accepted accounting principles." Many of these principles developed gradually, as did much of common law; only the accounting developments of recent decades are prescribed in statutory law. Following are several fundamental accounting concepts.

The *entity concept* states that the item or activity (entity) that is to receive an accounting must be clearly defined, and that the relationship assumed to exist between the entity and external parties must be clearly understood.

The *going-concern* assumption states that it is expected that the entity will continue to operate indefinitely.

The *historical-cost principle* requires that economic resources be recorded in terms of the amounts of money exchanged; when a transaction occurs, the exchange price is by its nature a measure of the value of the economic resources that are exchanged.

The *realization concept* states that accounting takes place only for those economic events to which the entity is a party. This principle therefore rules out recognizing a gain based on the appreciated market value of a still-owned asset.

The *matching principle* states that income is calculated by matching a period's revenues with the expenses incurred in order to bring about that revenue.

The *accrual principle* defines revenues and expenses as the inflow and outflow of all assets—as distinct from the flow only of cash assets—in the course of operating the enterprise.

The *consistency criterion* states that the accounting procedures used at a given time should conform with the procedures previously used for that activity. Such consistency allows data of different periods to be compared.

The *disclosure principle* requires that financial statements present the most useful amount of relevant information—namely, all information that is necessary in order not to be misleading.

The *substance-over-form* standard emphasizes the economic substance of events even though their legal form may suggest a different result. An example is the practice of consolidating the financial statements of one company with those of another in which it has more than a 50 percent ownership interest.

The *conservatism doctrine* states that when exposure to uncertainty and risk is significant, accounting measurement and disclosure should take a cautious and prudent stance until evidence shows sufficient lessening of the uncertainty and risk.

A   The Balance Sheet   Of the two traditional types of financial statements, the balance sheet relates to an entity's position, and the income statement relates to its activity. The balance sheet provides information about an organization's assets, liabilities, and owners' equity as of a particular date (such as the last day of the accounting or fiscal period). The format of the balance sheet reflects the basic accounting equation: Assets equal equities. Assets are economic resources that provide potential future service to the organization. Equities consist of the organization's liabilities together with the equity interest of its owners. (For example, a certain house is an asset worth $70,000; its unpaid mortgage is a liability of $45,000, and the equity of its owners is $25,000.)

Assets are categorized as current or long-lived. **Current assets** are usually those that management could reasonably be expected to convert into cash within one year; they include cash, receivables, merchandise inventory, and short-term investments in stocks and bonds. **Long-lived assets** encompass the physical plant—notably land, buildings, machinery, motor vehicles, computers, furniture, and fixtures. Long-lived assets also include real estate being held for speculation and intangibles such as patents and trademarks.

Liabilities are obligations that the organization must remit to other parties, such as creditors and employees. **Current liabilities** usually are amounts that are expected to be paid within one year, including salaries and wages, taxes, short-term loans, and money owed to suppliers of goods and services.

Noncurrent liabilities are usually debts that will come due beyond one year—such as bonds, mortgages, and long-term loans. Whereas liabilities are the claims of outside parties on the assets of the organization, the **owners' equity** is the investment interest of the owners in the organization's assets. When an enterprise is operated as a sole proprietorship or as a partnership, the balance sheet may disclose the amount of each owner's equity. When the organization is a corporation, the balance sheet shows the equity of the owners— that is, the stockholders—as consisting of two elements: (1) the amount originally invested by the stockholders; and (2) the corporation's cumulative reinvested income, or retained earnings (that is, income not distributed to stockholders as dividends), in which the stockholders have equity.

B   **The Income Statement**   The traditional activity-oriented financial statement issued by business enterprises is the income statement. Prepared for a well-defined time interval, such as three months or one year, this statement summarizes the enterprise's revenues, expenses, gains, and losses. Revenues are transactions that represent the inflow of assets as a result of operations—that is, assets received from selling goods and rendering services. Expenses are transactions involving the outflow of assets in order to generate revenue, such as wages, rent, interest, and taxes.

A revenue transaction is recorded during the fiscal period in which it occurs. An expense appears in the income statement of the period in which revenues presumably resulted from the particular expense. To illustrate, wages paid by a merchandising or service company are recognized as an immediate expense because they are presumed to generate revenue during the same period in which they occurred. If, however, the wages are paid to process merchandise that will not be sold until a later fiscal period, they would not be considered an immediate expense. Instead, the cost of these wages will be treated as part of the cost of the resulting inventory asset; the effect of this cost on income is thus deferred until the asset is sold and revenue is realized.

In addition to disclosing revenues and expenses (the principal components of income), the income statement also lists gains and losses from other kinds of transactions, such as the sale of plant assets (for example, a factory building) or the early repayment of long-term debt. Extraordinary—that is, unusual and infrequent—developments are also specifically disclosed.

C   **Other Financial Statements**   The income statement excludes the amount of assets withdrawn by the owners; in a corporation such withdrawn assets are called dividends. A separate activity-oriented statement, the statement of retained earnings, discloses income and redistribution to owners.

A third important activity-oriented financial statement is the statement of cash flows. This statement provides information not otherwise available in either an income statement or a balance sheet; it presents the sources and the uses of the enterprise's funds by operating activities, investing activities, and financing activities. The statement identifies the cash generated or used by operations; the cash exchanged to buy and sell plant and equipment; the cash proceeds from stock issuances and long-term borrowings; and the cash used to pay dividends, to purchase the company's outstanding shares of its own stock, and to pay off debts.

D   **Bookkeeping and Accounting Cycle**   Modern accounting entails a seven-step accounting cycle. The first three steps fall under the bookkeeping function—that is, the systematic compiling and recording of financial transactions. Business documents provide the bookkeeping input; such documents include invoices, payroll time cards, bank checks, and receiving reports. Special journals (daily logs) are used to record recurring transactions; these include a sales journal, a purchases journal, a cash-receipts journal, and a cash-disbursements journal. Transactions that cannot be accommodated by a special journal are recorded in a general journal.

D1   **Step One**
Recording a transaction in a journal marks the starting point for the double-entry bookkeeping system. In this system the financial structure of an organization is analyzed as consisting of many interrelated aspects, each of which is called an account (for example, the "wages payable" account). Every transaction is identified in two aspects or dimensions, referred to as its debit (or left side) and credit (or right side) aspects, and each of these two aspects has its own effect on the financial structure. Depending on their nature, certain accounts are increased with debits and decreased with credits; other accounts are increased with credits and decreased with debits. For example, the purchase of merchandise for cash increases the merchandise account (a debit) and decreases the cash account (a credit). If merchandise is purchased on the

4

promise of future payment, a liability would be created, and the journal entry would record an increase in the merchandise account (a debit) and an increase in the liability account (a credit). Recognition of wages earned by employees entails recording an increase in the wage-expense account (a debit) and an increase in the liability account (a credit). The subsequent payment of the wages would be a decrease in the cash account (a credit) and a decrease in the liability account (a debit).

D2 Step Two

In the next step in the accounting cycle, the amounts that appear in the various journals are transferred to the organization's general ledger—a procedure called posting. (A ledger is a book having one page for each account in the organization's financial structure. The page for each account shows its debits on the left side and its credits on the right side, so that the balance—that is, the net credit or debit—of each account can be determined.)

In addition to the general ledger, a subsidiary ledger is used to provide information in greater detail about the accounts in the general ledger. For example, the general ledger contains one account showing the entire amount owed to the enterprise by all its customers; the subsidiary ledger breaks this amount down on a customer-by-customer basis, with a separate subsidiary account for each customer. Subsidiary accounts may also be kept for the wages paid to each employee, for each building or machine owned by the company, and for amounts owed to each of the enterprise's creditors.

D3 Step Three

Posting data to the ledgers is followed by listing the balances of all the accounts and calculating whether the sum of all the debit balances agrees with the sum of all the credit balances (because every transaction has been listed once as a debit and once as a credit). This determination is called a trial balance. This procedure and those that follow it take place at the end of the fiscal period. Once the trial balance has been successfully prepared, the bookkeeping portion of the accounting cycle is concluded.

D4 Step Four

Once bookkeeping procedures have been completed, the accountant prepares certain adjustments to recognize events that, although they did not occur in conventional form, are in substance already completed transactions. The following are the most common circumstances that require adjustments: accrued revenue (for example, interest earned but not yet received); accrued expense (wage cost incurred but not yet paid); unearned revenue (earning subscription revenue that had been collected in advance); prepaid expense (expiration of a prepaid insurance premium); depreciation (recognizing the cost of a machine as expense spread over its useful economic life); inventory (recording the cost of goods sold on the basis of a period's purchases and the change between beginning and ending inventory balances); and receivables (recognizing bad-debt expenses on the basis of expected uncollected amounts).

D5 Steps Five and Six

Once the adjustments are calculated, the accountant prepares an adjusted trial balance—one that combines the original trial balance with the effects of the adjustments (step five). With the balances in all the accounts thus updated, financial statements are then prepared (step six). The balances in the accounts are the data that make up the organization's financial statements.

D6 Step Seven
The final step is to close noncumulative accounts. This procedure involves a series of bookkeeping debits and credits to transfer sums from income-statement accounts into owners' equity accounts. Such transfers reduce to zero the balances of noncumulative accounts so that these accounts can receive new debit and credit amounts that relate to the activity of the next business period.

V   REGULATIONS AND STANDARDS

Until 1973, accounting principles in the United States had traditionally been established by certified public accountants. Such persons are accountants licensed by their state governments on the basis of educational background, a rigorous certification examination, and, in some jurisdictions, relevant field experience. In 1973, the seven-member Financial Accounting Standards Board was created as an independent standard-setting organization. Regulations for auditors are promulgated by the American Institute of Certified Public Accountants. United States companies whose stocks or bonds are traded by the general public must conform to rules set by the Securities and Exchange Commission, a federal government agency. Tax laws and regulations are administered at the federal level by the Internal Revenue Service and at the local level by state and municipal government agencies. The United States has no standard-setting body for managerial accounting. From 1971 to 1980, however, the federal Cost Accounting Standards Board established accounting rules for contracts with parties that sell goods and services to the government. The nongovernmental Institute of Management Accounting, although not active in issuing technical standards, does administer a program qualifying candidates for a certificate in management accounting (CMA). The Institute of Internal Auditors has a program enabling an accountant to be designated a certified internal auditor (CIA).

Accounting has a well-defined body of knowledge and rather definitive procedures. Nevertheless, standard setters continue to refine existing techniques and develop new approaches. Such activity is needed in part because of innovative business practices, newly enacted laws, and socioeconomic changes. Better insights, new concepts, and enhanced perceptions have also influenced the development of accounting theory and practices.

Generally Accepted Accounting Principals (GAAP)

◆ Financial Statements

◆ FASB Statement of Financial Accounting Concepts (SFAC) No. 5
"Recognition and Measurement in Financial Statements of Business Enterprises" Issued: December 1984

Statement	Paragraph	Topics
SFAC No.5	13	A **full set of financial statements** for a period should show: ◆ **Financial position** at the end of the period ◆ **Earnings (net income)** for the period ◆ Comprehensive income (total nonowner changes in equity) for the period ◆ **Cash flows** during the period ◆ Investments by and distributions to owners during the period
SFAC No.5	39	**Comprehensive income** is a broad measure of the effects of transactions and other events on an equity, comprising all recognized changes in equity (net assets) of the entity during a period from transactions and other events and circumstances except those resulting from investments by owners and distributions to owners.

◆ Primary Financial Statements

◆ **Balance Sheet**: Reports the financial position at the end of the period.
◆ **Income Statement**: Reports the results of operations for the period.
◆ **Statement of Cash Flows**: Reports cash inflows and outflows during the period.
◆ **Statement of Stockholders' Equity**: Reports the changes in stockholders' equity during the period.

◆ Components of Balance Sheet

◆ **Assets**: Represents future economic benefits.
◆ **Liabilities**:   Represents future economic sacrifices.
◆ **Stockholders' Equity**: Represents the residual portion of the assets after subtracting liabilities.
                    (Stockholders' Equity = Assets - Liabilities)

◆ **Accounting Equation**
        Assets = Liabilities + Stockholders' Equity

◆ Components of Income Statement

◆ **Revenues**
◆ **Expenses**
◆ **Net Income = Revenues - Expenses**

◆ Components of the Statement of Cash Flows

◆ Cash Flows from Operating Activities
◆ Cash Flows from Investing Activities
◆ Cash Flows from Financing Activities

◆ Components of the Statement of Stockholders' Equity

◆ Common Stock
◆ Preferred Stock
◆ Additional Paid-in Capital (Paid-in capital in excess of par value)
◆ Retained Earnings

Ratios for Financial Statement Analysis

◆ Profitability Analysis Ratios

◆ Return on Investment (ROI)

$$\text{Return on Investment (ROI)} = \frac{\text{Net Income}}{\text{Owner Equity}}$$

◆ Return on Assets (ROA)

$$\text{Return on Assets (ROA)} = \frac{\text{Net Income}}{\text{Average Total Assets}}$$

Average Total Assets = (Beginning Total Assets + Ending Total Assets) / 2

◆ Return on Equity (ROE)

$$\text{Return on Equity (ROE)} = \frac{\text{Net Income}}{\text{Average Stockholders' Equity}}$$

Average Stockholders' Equity
= (Beginning Stockholders' Equity + Ending Stockholders' Equity) / 2

◆ Return on Common Equity (ROCE)

$$\text{Return on Common Equity (ROCE)} = \frac{\text{Net Income}}{\text{Average Common Stockholders' Equity}}$$

Average Common Stockholders' Equity
= (Beginning Common Stockholders' Equity + Ending Common Stockholders' Equity) / 2

◆ Profit Margin

$$\text{Profit Margin} = \frac{\text{Net Income}}{\text{Sales}}$$

◆ Earnings Per Share (EPS)

$$\text{Earnings Per Share (EPS)} = \frac{\text{Net Income}}{\text{Weighted Average Number of Common Shares Outstanding}}$$

Liquidity Analysis Ratios

Current Ratio

$$\text{Current Ratio} = \frac{\text{Current Assets}}{\text{Current Liabilities}}$$

Quick Ratio

$$\text{Quick Ratio} = \frac{\text{Quick Assets}}{\text{Current Liabilities}}$$

Quick Assets = Current Assets - Inventories

Net Working Capital Ratio

$$\text{Net Working Capital Ratio} = \frac{\text{Net Working Capital}}{\text{Total Assets}}$$

Net Working Capital = Current Assets - Current Liabilities

Activity Analysis Ratios

Asset Turnover Ratio

$$\text{Asset Turnover} = \frac{\text{Sales}}{\text{Average Total Assets}}$$

Average Total Assets = (Beginning Total Assets + Ending Total Assets) / 2

Accounts Receivable Turnover Ratio

$$\text{Accounts Receivable Turnover} = \frac{\text{Sales}}{\text{Average Accounts Receivable}}$$

Average Accounts Receivable
= (Beginning Accounts Receivable + Ending Accounts Receivable) / 2

Inventory Turnover Ratio

$$\text{Inventory Turnover} = \frac{\text{Cost of Goods Sold}}{\text{Average Inventories}}$$

Average Inventories = (Beginning Inventories + Ending Inventories) / 2

Capital Structure Analysis Ratios

Debt to Equity Ratio

$$\text{Debt to Equity} = \frac{\text{Total Liabilities}}{\text{Total Stockholders' Equity}}$$

Average Stockholders' Equity
= (Beginning Stockholders' Equity + Ending Stockholders' Equity) / 2

Interest Coverage Ratio

$$\text{Interest Coverage} = \frac{\text{Income Before Interest and Income Tax Expenses}}{\text{Interest Expense}}$$

Income Before Interest and Income Tax Expenses
= Income Before Income Taxes + Interest Expense

Capital Market Analysis Ratios

Price Earnings (PE) Ratio

$$\text{Price Earnings (PE) Ratio} = \frac{\text{Market Price of Common Share}}{\text{Earnings Per Share}}$$

Market to Book Ratio

$$\text{Market to Book Ratio} = \frac{\text{Market Price Per Common Share}}{\text{Book Value of Equity Per Common Share}}$$

Dividend Yield

$$\text{Dividend Yield} = \frac{\text{Annual Dividends Per Common Share}}{\text{Market Price Per Common Share}}$$

ROA = Profit Margin x Asset Turnover

$$\text{ROA} = \frac{\text{Net Income}}{\text{Average Total Assets}} = \frac{\text{Net Income}}{\text{Sales}} \ \text{X} \ \frac{\text{Sales}}{\text{Average Total Assets}}$$

Profit Margin = Net Income / Sales
Asset Turnover = Sales / Average Total Assets

Cash Method versus Accrual Method

When is a transaction recordable as earnings or income – cash or cash equivalent? When a short-term obligation arises? When a payment is imminent? Or when silver (cash) has changed palms?

In the commercial world, and in government also, it is often convenient (and quite legitimate) to consider short-term (less than one year) maturities and receivables as cash equivalents and treated as earnings or income. Conversely, it is often just as convenient to treat short-term obligations and payables as expenses. When this is done, the transaction *recognition* method is known as the *accrual* method.

The opposite of the Accrual method is the Cash method

'Cash Method' does not recognize an earning on an income transaction until cash (or its equivalent, a check or electronic transfer) has been made. Only at that time is a double-entry transaction is recorded.

Which one is better? For most individuals and small businesses, the cash method is simpler, more logical, more easily defined, and therefore probably better. But for certain industries, and large businesses, the accrual method may be more revealing and meaningful to potential investors. The downside to accruals is that far more record keeping or calculations may be required, along with more policy stated on when and how to make the accruals. The US Internal Revenue Service allows individual and business entities to choose between the cash method and accrual method.

Example: A contractor has submitted a progress-payment invoice in December 2002 to the owner for $40,000. The owner's engineer has processed and approved the invoice for payment. However, the owner's disbursement office has closed for end-of-month/year accounts processing, and won't actually issue a check to the contractor until January 2003.

If both the owner and the contractor are on a fiscal year that coincides with the calendar year, then either or both may opt to treat the invoice as an accrual – as if actually paid in December. The owner is likely to elect the accrual method, even though no funds have actually flowed, to take advantage of the $40,000 expense, which could lower his 2002 income tax liability. The contractor would probably not want to accrue the pending payment in order to lessen his 2002 income and resultant tax liability.

However, if either party has a large difference in expected profits from 2002 to 2003, that might affect their decision.

For example, suppose the owner already had sufficient losses for 2002 tax purposes. He might elect to defer the $40,000 expense into 2003 instead of accruing it to 2002, if he expected higher profits (and a higher tax liability) in 2003.

For income tax purposes, both the contractor and owner are required to choose either the accrual method or the cash method for the entire tax year, and may not mix them during the year.

HOMEWORK ASSIGNMENT 5

READING ASSIGNMENT:
> Read ahead all the material in the next Lesson Plan

> Lesson 6 –
> Direct & Indirect costs
> Cost accounting codes & Work Breakdown Structure (WBS)
> Scheduling primer
> Earned Value

HOMEWORK ASSIGNMENT:
Credit: due date - full, + 1 week - ¾, + 2 weeks - ½, + 3 weeks - ¼, + 4 weeks – $^1/_8$

> **GROUP HOMEWORK:**
> (Be prepared to discuss in class next week. Written response due in 2 weeks.)

1. Now that you have some experience with it, do you see any advantage for engineers to understand double-entry bookkeeping? Why (or why not)?

2. Generally Accepted Accounting Procedures (GAAP) exists for the benefit of <u>investors</u> - to give some uniformity to the financial reports issued by corporations to induce investors to buy their stocks and bonds. However, corporations and companies do not necessarily manage their business affairs or make business decisions based on such financial reports. Do you think they should? Why (or why not)?

3. Many investors have soured on the stock market due to the corporate accounting scandals (e.g., ENRON) and excessive actions of corporate officers, such as 100 million dollar salaries, very large unpaid corporate loans and the so-called "golden parachute" termination clauses in their executive contracts.

    There is however, a management philosophy called "*Servant Leader.*" In this concept, the management does not consider itself a privileged group, but rather charged with a mission to further the interests of the stakeholders, both internal and external.

    TDI, a mechanical contractor in the US doing in excess of $100 million dollars of business annually. Its top corporate officers could easily be earning million dollar salaries. Instead, as servant-leaders, they draw only $200,000 annual salary. What do you think of the servant-leader concept? Do you think if more corporations had such management philosophy investors might be more inclined to

4. If you have a business, or think you might one day, which method of accounting would you prefer – *cash*? Or *accrual*? Why?

INDIVIDUAL HOMEWORK (Due in 1 week)

1. Explain the following accounting principles:

    a. *entity concept*

    b. *going-concern*

    c. *historical-cost principle*

    d. *realization concept*

    e. *matching principle*

    f. *accrual principle*

    g. *consistency criterion*

    h. *disclosure principle*

    i. *substance-over-form*

    j. *conservatism doctrine*

Lesson Plan 6 – 2 Hours

HOMEWORK DUE:

Individual homework	**Group homework**
Meaning of Accounting Principles	Class discussion on Group Homework 5

LECTURE SUBJECTS:

Direct and indirect Costs

Cost accounting codes & Work breakdown structure (WBS)

Scheduling Primer

Earned Value Analysis

HOMEWORK ASSIGNMENT: (see last page of lesson material)

Direct & Indirect Costs

Project or Cost-center Cost

Indirects/Overhead (Company Wide)	**Direct** (Project or Cost-center specific)

Indirects/Overhead (Company Wide)

Project share of all costs charged to company indirect or overhead accounts

Share based on ratio of project direct cost divided by sum of all project direct costs, times total company overheads & Indirects)G&A). Often expressed as a percent of the project cost.

$$\% = \frac{P1}{(P1 + P2 + P3 + \dots)} \quad \frac{(G\&A)}{P1}$$

Direct (Project or Cost-center specific)

Task Specific	**Overheads/Indirects**
Task-specific Labor	Project Office
Task-specific Equipment	Project Supervision
Task-specific Materials	Project-level staff
Task-specific Contracts	Project-level equipment
	Project-level Materials
	Project-level contracts

Typical Company Overheads

Company Office space rent/amortization
Company utility costs
Company autos, boats, and aircraft
Executive salaries
Company-level clerical and staff
Unsuccessful bidding costs
Company-level furniture
Company-level equipment amortization
Executive stock options
Taxes
Profit

WBS (Work Breakdown Structure)

F&A Cost Codes

Company Indirects/Overheads & Profit
  Project
    Groups
      Tasks (CPM Network)
        Subtasks (Subnets)
          Details
            ...

Unallowable costs (government)

Yacht
Bad Loans to Officers
Other cost center cost allocations
...
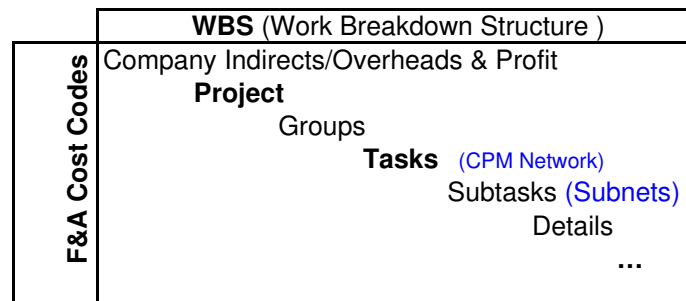
%	$	**Technical Labor Hourly Breakdown**
	$25.00	Hourly Salary
100%	$25.00	Fringe benefits (Life Ins, Health Ins, Vacation pay)
5%	$1.25	Salary Indirects (Unemployment Ins, Labor fines,…)
	$51.25	**Direct labor cost**
150%	$76.88	Company Indirects & Overheads
5%	$2.56	Supv. & Admin
	$130.69	Subtotal
15%	$19.60	Profit
	$150.44	**Billable hourly charge**

Typical Project Cost Breakdown

		%	$	Description
Planning	2%			
Design	8%			
Contracting	1%			
Constr. Mgt	14%		$1,000,000	Direct Costs (Labor, Material, Equipment, Contracts)
	25%	25%	$250,000	Project-level overheads & Indirects
Direct Cost			**$1,250,000**	**Subtotal - Project** (P1)
(5% to 500%) G&A		75%	$937,500	Company-level Indirects & Overheads
			$2,187,500	Subtotal - Company
Profit		15%	$328,125	Profit
		201%	**$2,515,625**	**Total Cost to Owner**

Project or Cost-center Cost Management

```
Cost Code:   aaa    bbb    ccc    ddd    eee    fff    …
              |      |      |      |      |     Detail level cost identifiers
              |      |      |      |     Subtask level cost identifiers
              |      |      |     Task level cost identifiers
              |      |     Group - sub-project level cost groupings
              |     Project level cost code
             Company-level costs
```

Work Breakdown Structure

Cost Code	LEVEL	Project											
aaa	0	Company Rollup											
	1	Project share of company Indirect/Overheads & Profit											
bbb	2	Project-level Direct Rollup											
	3	Project-specific Overheads/Indirects Rollup											
	4	Labor / Equip / Mat'ls / Contract											
		Project Direct Costs											
ccc	5	**Group 1**	**Group 2**	**Group 3**	**Group 4**	…							
		Group 1 Rollup	Group 2 Rollup	Group 3 Rollup	Group 4 Rollup	…							
	6	Group 1 labor / Group 1 Equip / Group 1 Mat'ls / Group 1 contracts	Group 2 labor / Group 2 Equip / Group 2 Mat'ls / Group 2 contracts	Group 3 labor / Group 3 Equip / Group 3 Mat'ls / Group 3 contracts	Group 4 labor / Group 4 Equip / Group 4 Mat'ls / Group 4 contracts	…							
ddd	7	**Task 1** / **Task 2** / …	**Task 1** / **Task 2** / …	**Task 1** / **Task 2** / …	**Task 1** / **Task 2** / …	…							
		Rollup	Rollup	Rollup	Rollup	…							
	8	Labor / Equip / Mat'ls / Contract	Labor / Equip / Mat'ls / Contract	Labor / Equip / Mat'ls / Contract	Labor / Equip / Mat'ls / Contract	…							
eee	9	**Subtasks** / Rollup	**Subtasks** / Rollup	**Subtasks** / Rollup	**Subtasks** / Rollup	…							
	10	Labor / Equip / Mat'ls / Contract	Labor / Equip / Mat'ls / Contract	Labor / Equip / Mat'ls / Contract	Labor / Equip / Mat'ls / Contract	…							
fff	11	**Details**	**Details**	**Details**	**Details**	…							
	12	Labor / Equip / Mat'ls / Contract	Labor / Equip / Mat'ls / Contract	Labor / Equip / Mat'ls / Contract	Labor / Equip / Mat'ls / Contract	…							

. . .

TIME MANAGEMENT

Scheduling Techniques

Gantt Chart: Activity progress represented by time-scaled bars *(Henry Gantt 1861-1919, Am. Engineer)*.

Network Analysis System (NAS): Another name for *critical path method.*

Critical Path Method (CPM): A scheduling technique that reveals paths of criticality denoted by the amount of *total float* in each path.

Arrow Diagramming Method (ADM): A graphical diagramming method denoting an *activity* as part of an arrow, and sequencing logic (relations) by the tail or head of the arrow.

Precedence Diagramming Method (PDM): A graphical diagramming method denoting an *activity* as a box, and sequencing logic (relations) as arrows leading to/from other activities.

Program Evaluation Review Technique (PERT): A critical path method in which activity *durations* are estimated using probability theory.

Definitions

Activity   An executable action or series of actions that occur over a finite time span
                      Also, the lowest level of action(s) tracked by a CPM schedule

~~**Activity-on-the arrow**~~   A misnomer that mistakenly assumes that the entire arrow in an activity in an arrow diagram is the activity (It is the activity *plus* the relation).

~~**Activity-on-the-node**~~   A misnomer that mistakenly assumes the box representing an activity in a precedent diagram is a node.

Task   A sub-activity required to accomplish an *activity*

Sub-task   Distinct executable segments of a task

Event   A happening at a point in time, such as the start or finish of an activity or node

Duration   The time it takes to execute an *activity* from start to finish

Dummy   An activity or node in ADM necessary to display or code logical sequencing

Node   And activity's beginning or ending event in ADM

Precedent   An activity or event logically constrained to occur earlier in time than a succeeding activity or event

Successor   An activity or event logically constrained to occur later in time than a preceding activity or event

Relation(ship)   The logical sequencing between two activities. There are four types of relations:

  Finish-Start   (FS) The preceding activity must finish before the succeeding activity can start

  Finish-Finish (FF) The preceding activity must finish before the succeeding activity can finish

  Start-Start   (SS) The preceding activity must start before the succeeding activity can start

  Start-Finish   (SF) The preceding activity must start before the succeeding activity can finish

Lag / Lead   The amount of time that the start or finish event of one activity requires before the start or finish event of another activity.

Network   A sequenced group of activities representing a project, or a portion of a project

Logic Diagram   A graphical diagram displaying the logical sequencing of activities

Time-scaled Diagram A graphical diagram displaying the activities as time-scaled arrows or boxes

Milestone A reportable event

Forward Pass Analyzing a CPM network for earliest start and finish events for activities or nodes

Backward Pass Analyzing a CPM network for latest start and finish events for activities or nodes

Critical Path The sequential path of activities where *total float* of each activity is zero

Early Start (ES) The earliest time that an activity or event could logically start

Early Finish (EF) The earliest time that an activity or event could logically finish

Late Finish (LF) The latest time that an activity or event could logically finish

Late Start (LS) The latest time that an activity or event could logically start

Total Float The time span by which an activity or event is logically ahead or behind schedule

   Start Float Late Start minus Early Start

   Finish Float Late Finish minus Early Finish

Slack Another name for total float

Free Float The amount of time a predecessor activity can delay completion before affecting a successor activity

Calendar A table relating work times and non-work times to sequential calendar time

Constraint The arbitrary earliest or latest calendar time an event is allowed to occur

   Not Earlier Than

      Start an activity or event *no earlier than* a specified calendar time

      Finish an activity or event *no earlier than* a specified calendar time

   Not Later Than

      Start an activity or event *no later than* a specified calendar time

      Finish an activity or event *no later* than a specified calendar time

   Exactly on

      Start activity or event *exactly on* a specified calendar time

      Finish activity or event *exactly on* a specified calendar time

Resources An item used or consumed to accomplish the activities in a network

   Renewable: A resource with limited production capability that can be reused

      Manpower Examples: employees, contracted labor, experts, …

      Equipment Bulldozers, cranes, backhoes, trucks, computers, …

   Consumable: A resource that is consumed

      Material Examples: aggregates, office supplies, cement, lumber, …

      Money Examples: Funds appropriated, funds budgeted, …

Work Breakdown Structure (WBS) A table of activities and tasks related to the cost accounting system to track costs and effort at various levels of the executing organization.

Arrow Diagramming Technique
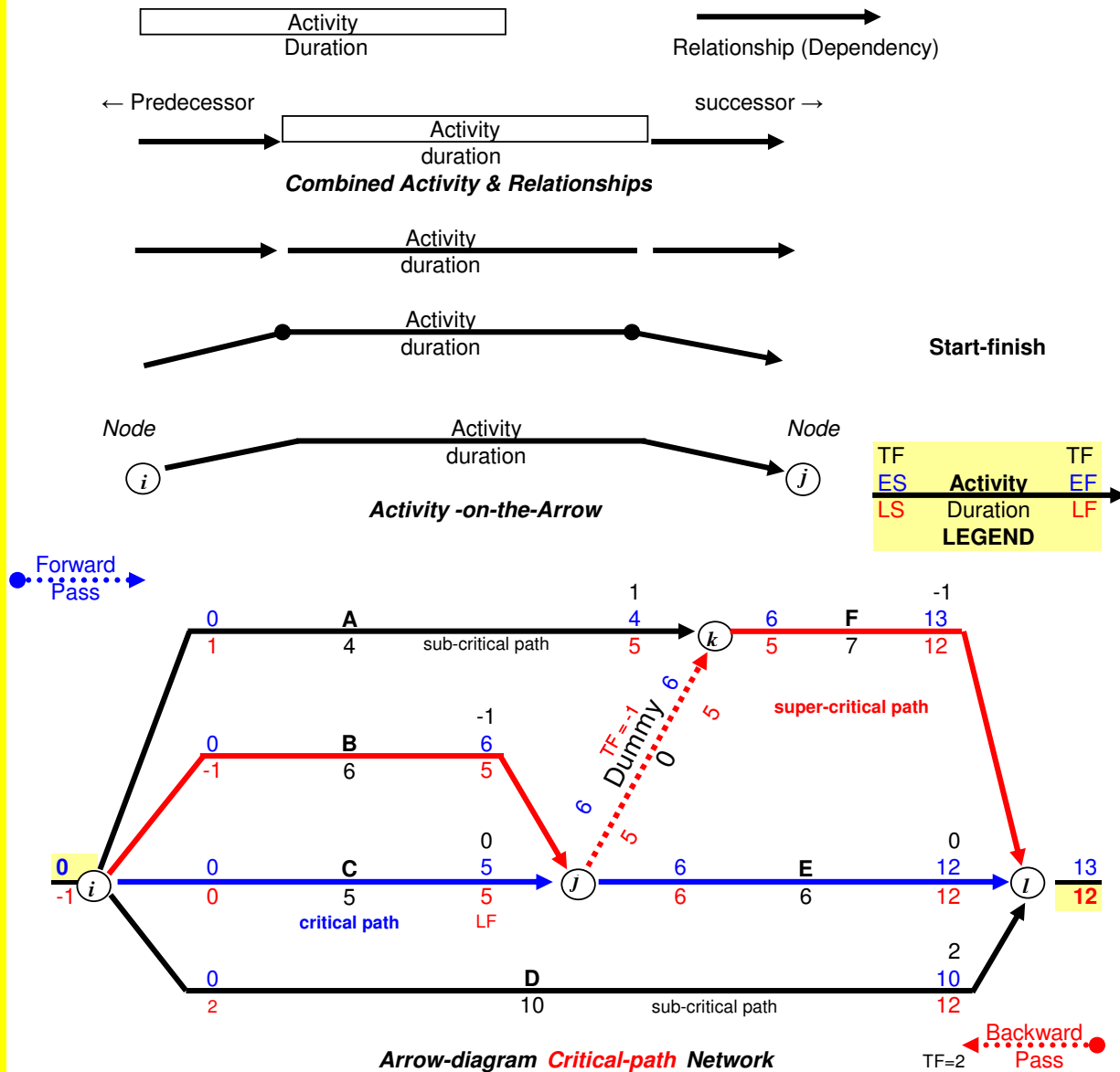
Activity
Duration

Relationship (Dependency) →

← Predecessor   successor →

Activity
duration

Combined Activity & Relationships

Activity
duration

Activity
duration

Start-finish

Node   Activity / duration   *Node*

i j

Activity -on-the-Arrow

TF		TF
ES	**Activity**	EF
LS	Duration	LF
	LEGEND	

Forward Pass

1
0   **A**   4   1
1   4   sub-critical path   5

-1
6   **F**   13
6   5   7   12

super-critical path

-1
0   **B**   6
-1   6   5

$TF=-1$
Dummy 6
0
6
5

0
0   **C**   5
-1   0   5   5
critical path   LF

6   **E**   12
6   6   12

0
12   l 13
12   **12**

0   **D**   10   2
2   10   sub-critical path   12

2
10
12

Backward Pass

$TF=2$

Arrow-diagram Critical-path Network

Start Float = LS - ES = Total Float = Slack
Finish Float = LF - EF

Dr. Simon R Mouer, PE, PhD   *Jul-02*

Diagramming Hints

1 Show **time flow is left to right** (don't allow backward flowing arrows)   **Prevents loops**

2 Number Nodes sequentially from left to right in the order in which a forward pass could be executed.
   (This is a requirement for Arrow Diagramming methodology)

3 Other names for *Critical Path Method* (CPM): Network Analysis System (NAS)

4 Start-Float and Finish-Float for an Activity may be different because of the use of Start-start
   and/or Finish-finish relationships

Arrow Diagramming Method

Advantages	**Disadvantages**
Simpler technique for most people	Prone to create unnecessary bottlenecks
Fairly intuitive	Leads or lags require activity breakup
Simple tabular analysis	Limited to *Finish-start* relations

(Note: all four of the precedence relations can be simulated in Arrow Diagramming by)
(breaking the arrow activity into a start-activity, continue-activity, and end-activity.   )

Precedence Diagramming Technique
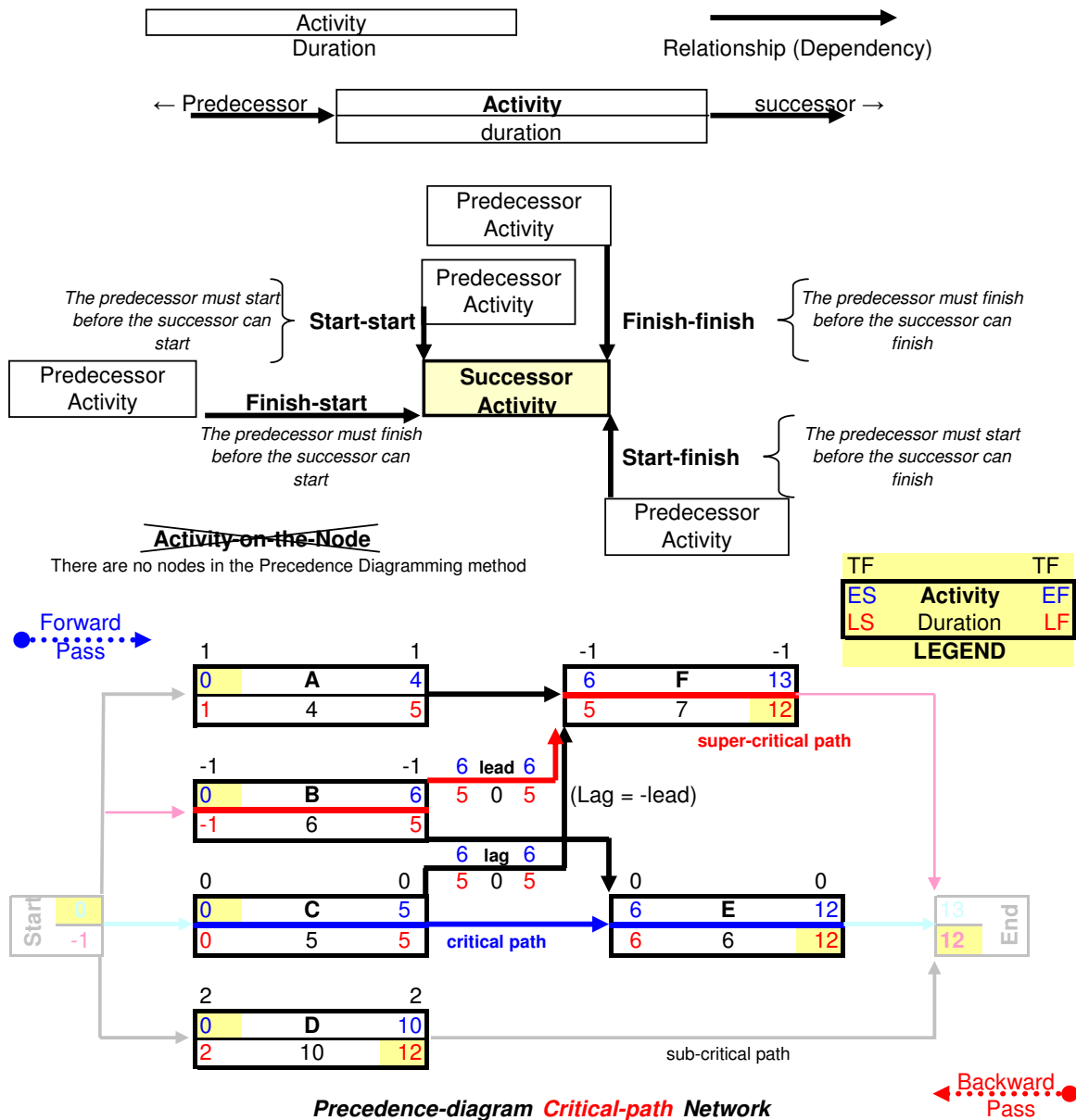
Activity
Duration

Relationship (Dependency)

← Predecessor → **Activity** successor →
duration

Predecessor
Activity

Predecessor
Activity

Start-start

Finish-finish

The predecessor must start before the successor can start

The predecessor must finish before the successor can finish

Predecessor
Activity

Finish-start

Successor Activity

The predecessor must finish before the successor can start

Start-finish

The predecessor must start before the successor can finish

Predecessor
Activity

~~Activity-on-the-Node~~
There are no nodes in the Precedence Diagramming method

TF		TF
ES	**Activity**	EF
LS	Duration	LF
	LEGEND	

Forward Pass

1		1
0	**A**	4
1	4	5

-1		-1
6	**F**	13
5	7	12

super-critical path

6 **lead** 6
-1		-1
0	**B**	6
-1	6	5

5 0 5

(Lag = -lead)

6 **lag** 6
5 0 5

0		0
0	**C**	5
0	5	5

critical path

0		0
6	**E**	12
6	6	12

Start	0			End	13	
	-1				12	

2		2
0	**D**	10
2	10	12

sub-critical path

Backward Pass

*Precedence-diagram **Critical-path** Network*

Start Float = LS - ES = Total Float = Slack
Finish Float = LF - EF

Dr. Simon R Mouer, PE, PhD   Jul-02

Diagramming Hints

1 Show **time flow is left to right** (don't allow backward flowing arrows)   **Prevents loops**

2 Number Nodes sequentially from left to right in the order in which a forward pass could be executed.
   (This is a requirement for Arrow Diagramming methodology)

3 Other names for *Critical Path Method* (CPM): Network Analysis System (NAS)

4 Start-Float and Finish-Float for an Activity may be different because of the use of Start-start
   and/or Finish-finish relationships

Precedence Diagramming Method

Advantages	Disadvantages
More realistic scheduling	More complicated forward or backward pass
Full complement of relationships	More difficult to understand
	Easy to misuse

(Note: nodes can be simulated in Precedent Diagramming by use of a zero duration activity)

Precedent relationships / dependencies

F-S Finish-start
S-S Start-start
F-F Finish-finish
        &
S-F Start-finish
        Relationships

C
0   0
4   10
4   6   10

A
0   0
0   4
0   4   4

D
2   3   3
4   7
6   7   3   **10**

F-S
4
4

F-S
4

F-F Use with caution - Ask yourself :
Is it a realistic constraint?

10   10

S-S Use with caution

B
0   2   2
0   4
0   2   4   6

0
0

4
6

S-S Use with caution

E
2   2   0
4   8   10
6   4   10   **10**

F-S
4
6

S-F

Use with caution
Like negative numbers, the S-F
relationship may have few counter-
parts in reality.

0
10

F
4   4   4
0   4
6   6   4   **10**

Bottleneck: A bottleneck is a logical constraint on the network forcing all actions through a single node or a single activity.
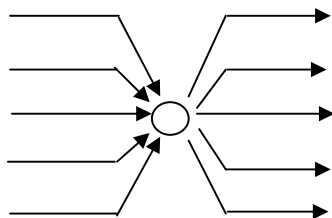
Node
Bottleneck
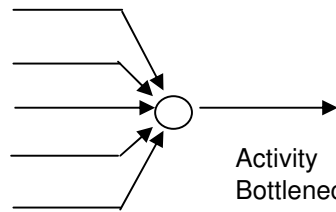
Activity
Bottleneck

A   B   C

E   F   G

H

M   N   P
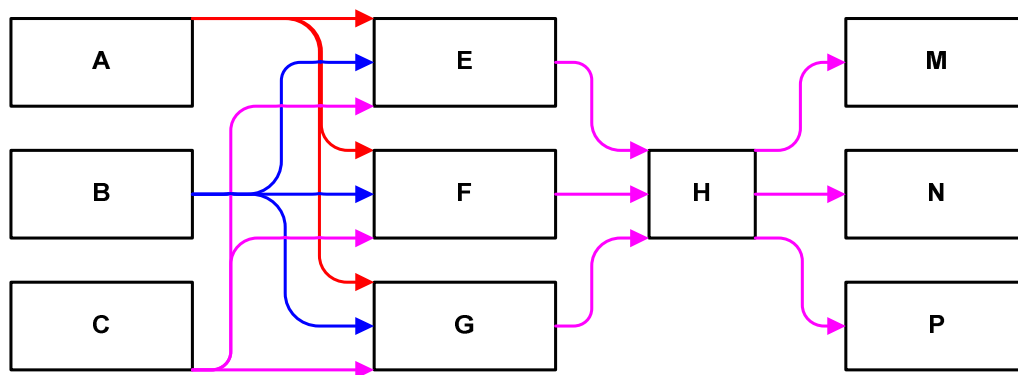
Bottleneck

Alternate
bottleneck

ACTIVITY DURATIONS

Determining an activity's duration can be by **expert opinion**, **specification**, **critical resource consumption**, or **probabilistic** methods.

Expert opinion duration estimates are very common. Such "expert guess" estimates of duration can contain considerable flexibility to be compressed, or, conversely, may be unrealistically short. When unsupported by any rationale, such durations can be subject to considerable argument between owner and contractor, which if not resolved can lead to claims and litigation.

Specification. An example of specification requirement is the curing of concrete before significant loading can be applied (typically a minimum of 7 days, or even longer).

Critical resource consumption. For activities dominated by material consumption, equipment productivity, or crew or worker productivity, a logical methodology can be employed which may be used to advantage in intense negotiations, or litigation. For such activities, the most critical resource should be identified. Duration is determined by the following relationship:

$$\textbf{Q}\text{uantity} = \textbf{R}\text{ate x }\textbf{T}\text{ime} \qquad (Q = R \times T)$$

$$\textbf{D}\text{uration} = \textbf{T}\text{ime} + \textbf{C}\text{ontingency} \qquad (D = T + C)$$

In the Q = RT equation, two variables must be known, and the third calculated. Thus, one may set **T**ime and **Q**uantity, and calculate **R**ate; or **R**ate and **Q**uantity may be set, and **T**ime calculated; or **R**ate and **T**ime set, and **Q**uantity calculated.

Rate as the calculated (dependent) variable is used when the **D**uration (**T**ime) is fixed, the **Q**uantity known, and you want to know what is/are the required equipment capacity, crew size, or number of persons.

Time as the calculated (dependent) variable is used when the **R**ate is fixed, the **Q**uantity known, and **T**ime is flexible. This situation occurs when equipment capacity or manpower is limited, such as when resource availability is constrained. Resource leveling is a persistent phenomena in most projects, and a major cause of activity duration creep.

Quantity as the calculated (dependent) variable is used when the both the **R**ate and **D**uration (**T**ime) are fixed, the **Q**uantity required is flexible. This situation might occur for stockpile production. Example: on remote jobs, the production of aggregates for concrete can be a major delay, and require early deployment, before the total **Q**uantity is known. Aggregates and cement used for concrete can be stockpiled in advance, but concrete itself has a very short shelf-life, and thus cannot be stockpiled.

Probabilistic durations are used on complex, fast-tracked projects such as essential military hardware or weaponry that is considered critical to maintaining readiness or superiority. In such case, the activity duration is very often an educated guess, with perhaps some preliminary Q=RT calculations. The owner in this case is interested in a probable delivery date, with an assessment of risk of acceleration or delay. PERT is a CPM technique that can yield such assessment.

For probability durations, a worst case, best case, and expected value case are estimated. Each of these cases may have a probability density function associated with the probability of occurrence. For most non-military applications, probability durations are a gross overkill.

Calendar day   **CALENDAR**

Calendar days	September						October																	
	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Workday	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri
	-4	-3	-2			-1	1	2	3	4			H	5	6	7	8			9	10	11	12	13

Activity A — Forward pass → : -5 / 1 … -2 / 4 … -8 / 10 … -7 / 18. Row A: 1 2 3 4 H F 1 2 3 4 5 6 7. Backward pass ← : A 1 2 3 4 1 2 3 H 4 5 6 7 F (−4 … 1 2 … 11 … 12)

Activity B — Forward pass → : -7 / 1 … -8 / 9. Row B: 1 2 3 4 H 5 6. Backward pass ← : 1 2 3 4 5 6 B H (−6 … 1)

Activity C — Forward pass → : -5 / 1 … -6 / 8 … -7 / 10 … -6 / 17. Row C: 1 2 3 4 H 5 E 1 2 3 4 5 6. Backward pass ← : C 1 2 3 4 5 1 2 H 3 4 5 6 E (−4 … 2 3 … 11 … 12)

Activity D — Forward pass → : -5 / -4 … -4 / 15. Row D: 1 2 3 4 H 5 6 7 8 9 10. Backward pass ← : 1 2 3 4 5 6 H 7 8 9 10 D (−3 … 11 … 12)

Obligated Performance Window

The *Calendar* defines non-work days, including holidays and weekends, and provides the means to convert *workdays* to *calendar-days* in a forward or backward pass.

Calendar-days are sequential, without regard to holidays or weekends

Starts begin on the morning of the first workday.

Finishes end on the evening of the last workday.

Activity *duration* may be in calendar days or workdays

Total Float is in calendar days

Starts and Finishes are in calendar days or dates.

Start-Float and Finish-Float for an Activity may be different by the change in the number of non-work days embedded in the path for the Forward Pass and the Backward Pass.

In many countries, overtime is paid at 150% of regular time rate, and work on a Sunday or Holiday is paid at 200% of regular time rate. In such situations, it is not always desirable to recover the schedule by working non-work days.

Hourly labor usually is awarded premium rates for overtime work, but salaried employees, such as professional and managerial staff, often receive no extra pay, or only straight time. Thus hourly workers and salaried employees may have different calendars.

Schedule Constraints

Most Scheduling software will allow the user to constrain the forward or backward passes in some manner by the use of schedule constraints. Such constraints may be *advisory*, in which case the software will advise the user that a specified date has been exceeded, but the advisory date is not actually applied to the schedule. In addition to just advisory, *absolute* and *conditional* constraints may be applied, which override any dates calculated in a forward or backward pass. The most common constraints are listed in the table below.

Constraint Type	Scheduling Impact	Description
Advisory		
(all the conditional)	None	Most software activate by using a warning-only tag on the conditional constraint
Conditional		
As Soon As Possible (ASAP)	Resource consumption begins on start date	Start the activity/task as soon as predecessors have completed (ES)
As Late As Possible (ALAP)	Consumes Total-float and Free-float	Delay the activity/task start to the late-start date (LS)
Finish No Later Than (FNLT)	Constraint applied on backward pass	This is the latest possible date that you will allow this activity/task to be completed. It can be finished on or before the specified date. It overrides backward pass calculations.
Start No Later Than (SNLT))	Constraint applied on forward pass	This is the latest possible date that you will allow this activity/task to begin. It can start on or before the specified date. It overrides backward pass calculations.
Finish No Earlier Than (FNET)	Constraint applied on backward pass	This is the earliest possible date that you will allow this activity/task to be completed. It can finish any time after the specified date. It overrides forward pass calculations.
Start No Earlier Than (SNET)	Constraint applied on forward pass	This is the earliest possible date that you will allow this activity/task to begin. It can start any time before the specified date. It overrides forward pass calculations.
Absolute Constraint		
Must Start On (MSO)	absolute	Absolute start date for this activity. It overrides both the by forward and backward pass.
Must Finish On (MFO)	absolute	Absolute finish date for this activity. It overrides both the by forward and backward pass.

Avoid the indiscriminate and unnecessary use of schedule constraints!! (When in doubt – don't)

It is usually desirable to apply the contract award date (or project initiation date) to the starting activity of a network for the *forward pass*, and the contract completion date (or project finish date) as the date to commence a *backward pass* at the ending activity of a network. Any ensuing positive float means that you are scheduled to finish ahead of the contract (or promised) completion date. Any negative float means that you are scheduled to finish later than the contract (or promised) completion date – unless you do something to regain the schedule commitments.

NOTE: You must know precisely how the scheduling software will implement constraints (i.e., only on the forward pass, or only on the backward pass, or both). Usually you want the starting activity of a network fixed on the forward pass, but free to float on the backward pass. Conversely, you usually want the ending activity fixed to the contract completion date on the backward pass, but free to float on the forward pass. Such constraints are *conditional*, and not *absolute*.

When additional constraints are interposed between the network start and ending dates, they muddle the picture so that pseudo-critical paths appear in the schedule that obfuscate your ability to identify which activity paths are really critical and require intensive management or alternate solutions.

It would be much better in most cases to assign *warning* dates to interim deliverables, rather than schedule constraint dates, so that real critical paths will be displayed.

RESOURCE LEVELING

Most projects are resource constrained to some degree -- some more than others. Even in areas with near-unlimited infrastructure, the specific availability of resources depends on the intensity of other economic activity vying for those resources. In times of economic prosperity resources may be limited and/or costly, while in times of economic depression the same resources may be plentiful and cheap.

Remote locations may require the costly importation of labor, equipment and materials. Where support infra-structure does not exist, the creation of life and construction support is usually expensive, and the workforce size necessarily limited.

Contractors have some inherent elasticity in the size of their workforce, but have limits on the number trustworthy executives and managers they have at their disposal. Each manager has a finite limit to his or her span of control and the number of workers or processes they can command at any one time.

For these reasons, whether planned or unplanned, projects tend to automatically level the utilization of resources, and the ability to peak resources is in reality quite limited. It would benefit the project manager in the long run to realize this, and plan for it so that he or she can influence the process.

CPM networks are initially constructed as if unlimited resources are available. The project manager or scheduler must be prepared to revise the logic of the network to accomodate multiple crews or multiple equipment if necessary, and to have a process for leveling the peak resource demand.

The typical resource-leveling process is to reduce the rate of consumption by lengthening the activity durations that utilize that resource. In addition activity start and finish may be adjusted so that the demand across activities is spread out. The initial leveling process attempts to utilize activity free-float and then any total float available. In many cases, resource leveling causes the total project time to increase.

Example: Demand on resource 'a'

1	2	3	4	5	6	7	8	9
		a	a	a	a	(10)		
a	a	a	a	a	a→			
		6						
		a	a	a	a	(10)		
	a	a	a	a	a→			
		6				a	a	
				a	a	a	(10)	
			a	a	a	a	a→	
				5				

Σ | 1 | 2 | 3 | 4 | 5 | 6 | 5 | 3 | 1 | 30

Σ	1	2	3	4	5	6	5	3	1
6						a			
5					a	a	a		
4				a	a	a	a	(30)	
3			a	a	a	a	a	a	
2		a	a	a	a	a	a	a	
1	a	a	a	a	a	a	a	a	a

Demand Histogram
Inintial Peaked Resource Demand

Priority

1	2	3	4	5	6	7	8	9	10	11	12
		a	a	a	a	(10)					
a	a	a	a	a	a→							(1)
			6								
					a	a	a	(10)			
		a	a	a	a	a	a	a→				(2)
				7							
									(10)		
							a	a	a	a	a
						a	a	a	a	a	a→	(3)
						6					

Σ | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 30

Σ	1	2	2	3	3	3	3	3	3	3	2	2
usage limit												
3				a	a	a	a	a	a	a	(30)	
2		a	a	a	a	a	a	a	a	a	a	a
1	a	a	a	a	a	a	a	a	a	a	a	a

Demand Histogram
Supportable Leveled Resource Demand

NETWORK STATUSing   Arrow Diagram Logic

Baseline Schedule
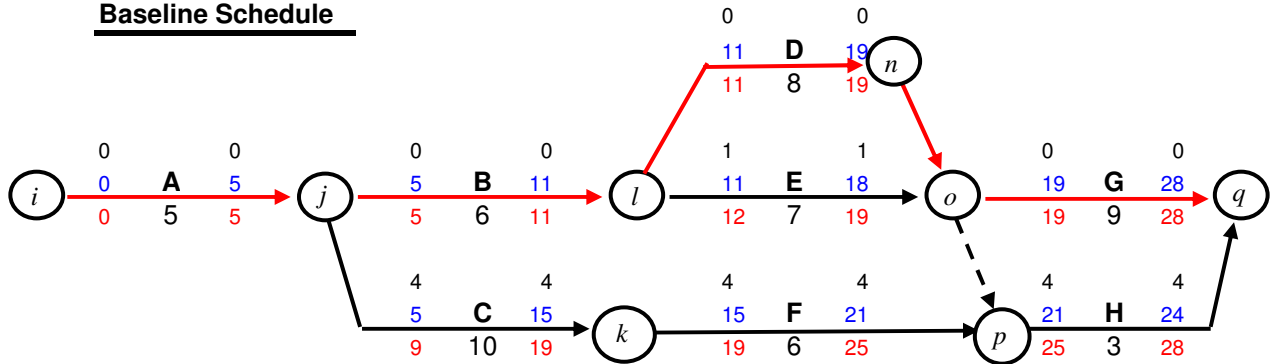
1st Status Attempt

2nd Status Attempt

NETWORK STATUSing   Precedent Diagram   Logic

Baseline Schedule

	0		0					
	11		**D**	19		19		
	11	11	8	19		19		

0		0	0		0	1		1	0		0
0	**A**	5	5	**B**	11	11	**E**	18	19	**G**	28
0	5	5	5	6	11	12	7	19	19	9	**28**

	4		4			18	4		4
5	5	**C**	15	15		25	21	**H**	24
9	9	10	19	19		25	25	3	28

		4		4	
		15	**F**	21	21
		19	6	25	25

1st Status Attempt

Time Now'   Negative Float

	-1		-1			
12	12	**D**	20		20	
11	11	8	19		19	

0	**A**	5		5	**B**	12	-1	12	**E**	19	0	19	20	**G**	29	-1
0	5	5		5	7	11		13	12	7	19	19	19	9	**28**	

6	**C**	14	5	14		19	20	**H**	23	5	5
6	8	19		19		25	25	3	28		

	5		5	
14	**F**	20	20	
19	6	25	25	

D D
<< Actual   Data Date   Forcast >>

2nd Status Attempt

Time Now'   2 critical paths

	0		0			
12	12	**D**	19		19	
12	12	7	19		19	

0	**A**	5		5	**B**	12	0	12	**E**	19	0	19	19	**G**	28	0
0	5	5		5	7	12		13	12	7	19	19	19	9	**28**	

6	**C**	14	5	14		19	20	**H**	23	5	5
6	8	19		19		25	25	3	28		

	5		5	
14	**F**	20	20	
19	6	25	25	

D D
<< Actual   Data Date   Forcast >>

PROJECT STATUSing

Time Now

Time-scaled Precedent Diagram

2 critical paths

Due Date

	0		0
12		D	19
12		7	19

	0		0		0		0
5	8	B	12		19	G	28
5	8	7-3=4	12		19	9	28

	0		0
12		E	19
12		7	19

0	A	5
0	5	5

	5		5		5	5		5
6	8	C	14			20	H	23
6		8-2=6	13		19		25	3	28

Legend
- Completed path
- Critical path
- Forward pass
- Backward pass

Data Date
<< Actual | Forcast >>

	5		5
14	F	20
19	6	25
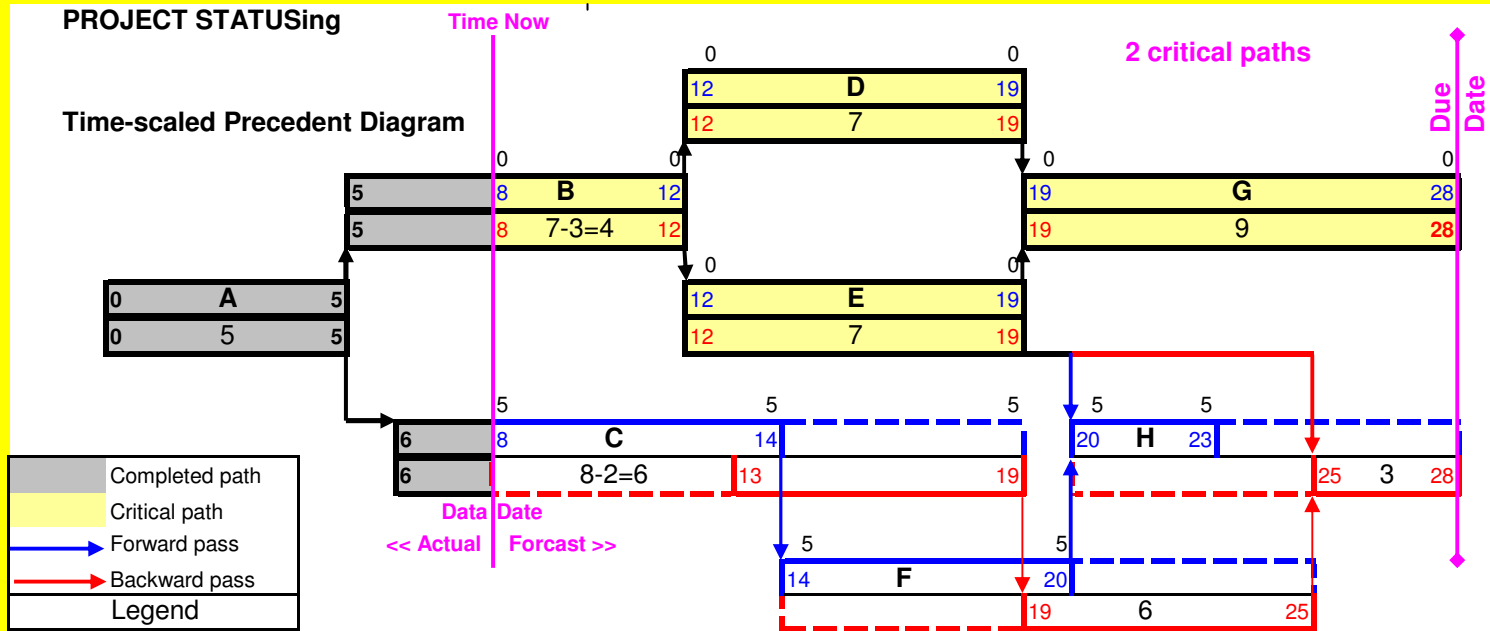
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | cal days |

Time-scaled Arrow Diagram

Time Now

Due Date
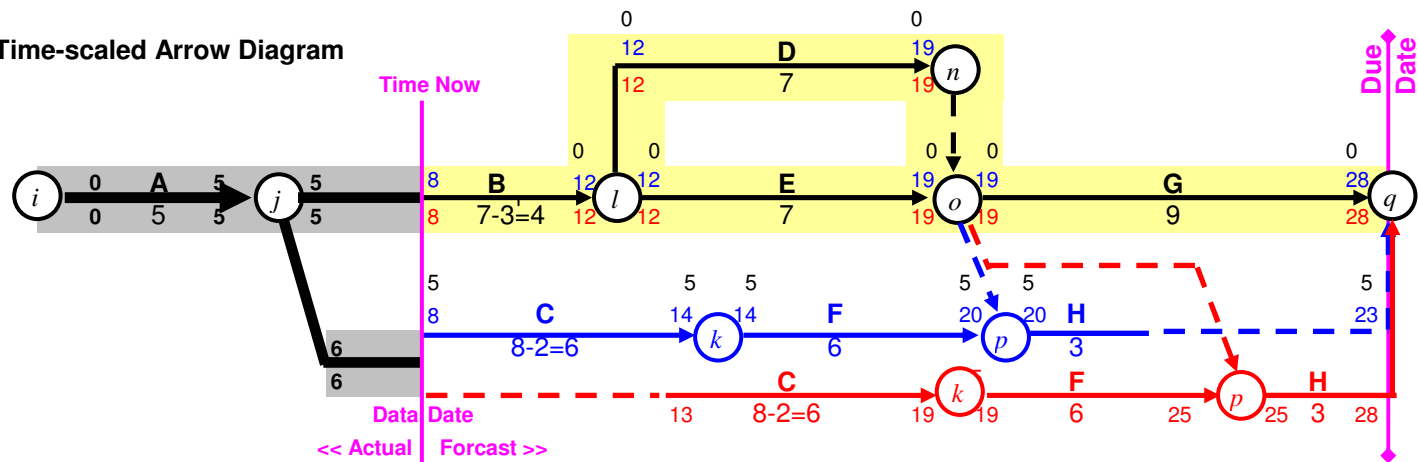
Project Cost Management
Budgeting, Cost Performance & Cost Control

Expected Value
Earned Value

D D   **Σ**

| Expected cost | 5 | 10 | 15 | | 30 | **B**udget **C**ost of **W**ork **P**erformed (BCWP) | **EV** |

Schedule (B/L) Variance   -15   = BCWS - BCWP = B/L - EV

B/L cost	5	10	15	15		45	**B**udget **C**ost of **W**ork **S**cheduled (BCWS)	**B/L**
Baseline (B/L) tasks	A	B	C	D
Actual tasks		**A**	**B**	**C**	D		-8 Net Variance
Actual cost		7	12	18		37	**A**ctual **C**ost of **W**ork **P**erformed (ACWP)

Cost Variance   +7   = ACWP - BCWP = Act - EV

| Expected cost | 5 | 10 | 15 | | 30 | **B**udget **C**ost of **W**ork **P**erformed (BCWP) | **EV** |

delay

Earned Value
Expected Value

Actual work

Scheduled work

D D

Time	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Σ $	0	5	15	30	45	60	75	90	105	120	135	150	160	165	
$	0	5	10	15	15	15	15	15	15	15	15	15	10	5	
B/L Tasks	A	B	C	D	E	F	G	H	I	J	K	L	M	
Σ EV		0	5	15	30	45	60	75	90	105	120	135	150	160	165
Budget (EV)		0	5	10	15	15	15	15	15	15	15	15	15	10	5
Actual Tasks		A	B	C	D	E	F	G	H	I	J	K	L	M
$	0	0	7	12	18	15	15	15	15	15	15	15	15	10	5
Σ $	0	0	7	19	37	52	67	82	97	112	127	142	157	167	172

Actual Forcast

Cummulative Cost Performance & Forecast

Legend:
- B/L
- Actual
- EV

Cost variance (+) *overrun*

Delay

B/L completion ▶

Forecast completion ▶

Schedule **E**fficiency = E_S = EV/BL = 30/45 = **67%**

Cost **E**fficiency = E_C = EV/Act = 30/37 = **80%**

D D

B/L or Schedule Variance
(–) underrun

Cost variance (+) *overrun*

Actual | Forecast

Y-axis: Cost (175, 150, 125, 100, 75, 50, 25, 0)
X-axis: Time (0 to 14)

HOMEWORK: (Due next week)

Given: tasks A - M , each task has a duration of 1 week, and a cost as shown below the task

Time(weeks)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
B/L Task times		A	B	C	D	E	F	G	H	I	J	K	L	M	
B/L Task cost, $		5	10	10	5	15	5	5	5	5	10	5	5	5	
Actual Costs, $		7	10	10	8	15	10								

Given: The time-scaled critical path network is as below:

Post the B/L task cost below each task in the time-scaled critical-path network below.

| Σ weekly B/L costs | | | | | | | | | | | | | | |
| Cumulative B/L costs | | | | | | | | | | | | | | |
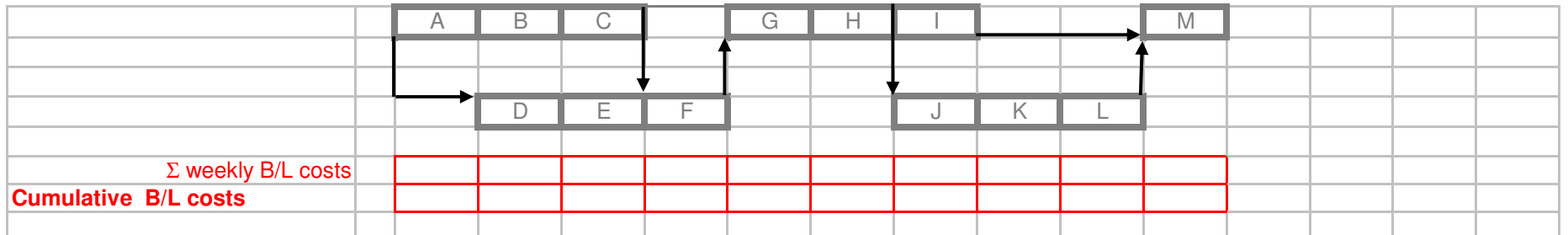
Given: The *Actual* performance of Tasks A - F is posted on the time-scaled critical-path network below.

Post the *Actual* task cost below each task in the time-scaled critical-path network below. Post the B/L cost below the forecast tasks.

Post the *expected* cost for each task below the actual/forecast cost

D|D

| Σ weekly actual costs | | | | | | | | | | | | | | |
| Cumulative Actual costs | | | | | | | | | | | | | | |

<< Actuals   Forecast >>

| Σ weekly *earned value* costs | | | | | | | | | | | | | | |
| Cumulative *earned value* costs | | | | | | | | | | | | | | |
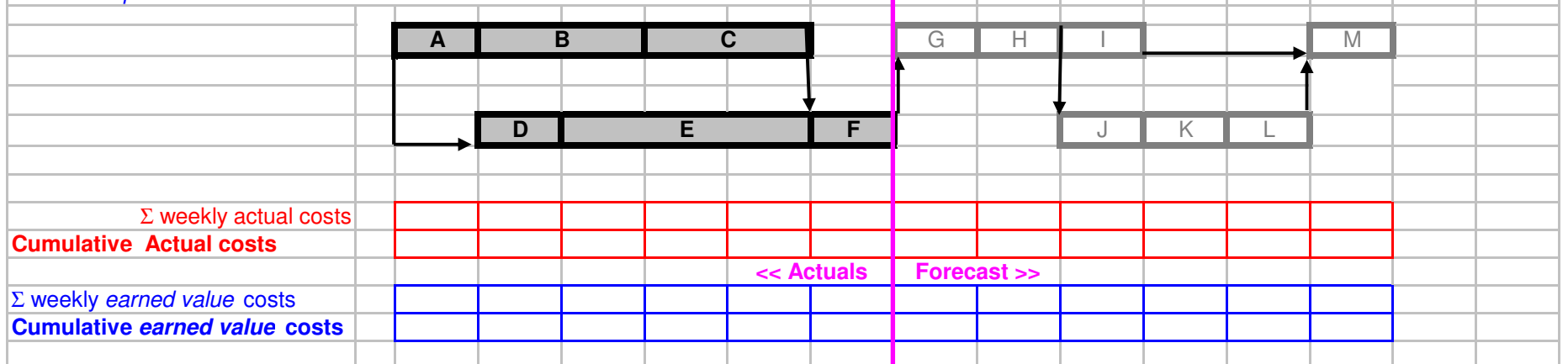
Plot the cumulative curves for the baseline, actual/forecast, and earned value.

HOW TO PERFORM EARNED-VALUE ANALYSIS

1. **Establish the Baseline (Budgeted Cost of Work Scheduled, or BCWS)**

   Prepare a critical-path network of the project activities.

   Run forward and backward passes to establish the critical path and project duration.

   Load each activity with critical resources.

   > Level the critical resources to a realistically achievable level. Resource leveling usually causes the project activity durations to increase, and the overall project duration to increase. Adjust the activity duration to be consistent with resource leveling. *(Note: Failure to perform resource leveling is a major reason that schedules are overly-optimistic and seldom achieved.)*

   Load the activities with the best estimate for the *cost* of each activity.

   Spread the cost for each activity to be consistent with resource usage.

   > If doing this by hand, run a time-scaled network diagram (usually in weeks) of all the activities. This will allow the manual summing of cost by time unit.

   For each week, sum all the costs for that week from every activity occurring in that week.

   > Below each week sum the cumulative cost by week.

   > Plot this *cumulative* data on a graph with *time* as 'x' axis, and *cumulative cost* in some currency as the 'y' axis. This is the **baseline cumulative cost estimate curve**.

   > If the work is performed under contract, the total estimated cost should equal the contract price. This cumulative estimate of the cost is known as the *budget cost of scheduled,* or *BCWS*. Also, better known simply as the **baseline**.

2. **Do not change the baseline during the project execution, except for an *owner-directed* change-of-scope.**

   > It is important that the baseline not be changed, except for owner-directed changes in scope. Otherwise the baseline tends to become a rubber baseline, always stretching to exactly matching the actual performance, and never correctly able to reveal schedule slippages and identify schedule impacts.

3. **Collect *actual cost* and time performance data.**

   > For each activity completed or in-progress, post the *actual cost*. This data is also known as the *actual cost of work performed (ACWP),* but more commonly, just *actual costs*. This action is performed each reporting period (normally monthly), and added to the last reporting period's accumulated costs. The accumulated cost is plotted on the same graph as the baseline.

4. **Post the *earned value* performance data.**

   For the same activities completed or in-progress in 3, above, post the *budgeted*, or *estimated*, cost. The budgeted cost for each activity is the same as that estimated for the baseline. This data is also known as the *budgeted cost of work performed (BCWP),* or more commonly, just *earned value*. This posting action is performed each reporting period (normally monthly), and added to the last reporting period's accumulated earned value. The accumulated *earned value* is plotted on the same graph as the baseline and the actual costs.

5. **Compare *Baseline* versus *Actual* versus the *Earned Value* for progress-to-date.**

   This comparison can be performed activity by activity, but is more commonly performed as a *cumulative* performance indicator, especially for upper management. When comparison is made activity by activity, the earned value is the same as the baseline estimate. However, when the comparison is made on a cumulative basis one cannot tell by observing the plotted lines which activities are affected. The *earned value* cumulative plot solves this problem by representing what the actual progress *should have cost*, based on the original estimated cost for each activity.

   Baseline versus Actual. This was the standard analysis before the *earned value* concept became popularized. If the *actual*s plotted below the baseline curve, then the project was behind schedule. If the *actual*s plotted above the baseline curve, then the project was ahead of schedule. No determination could be made through this analysis as to whether the project costs were over-running or under-running the budget or baseline estimate.

   Actual versus Earned Value. This comparison reveals whether the project is over-running or under-running costs. If the earned value plots below the actual costs, the project is over-running costs, i.e., the actual costs are greater than planned. If the earned value plots above the actual costs, the project costs are under-running costs, i.e., the actual costs are less than planned.

6. **Project the cumulative costs to the end of the project.**

   A final step to complete the analysis is to project time and cost curves to the end of the project for *actuals* (projected) and for *earned value* (projected). This projection is a very good depiction of what will happen to project completion if remedies to poor performance are not addressed and solved.

HOMEWORK ASSIGNMENT 6

READING ASSIGNMENT:
Read ahead all the material in the next Lesson Plan 7

HOMEWORK ASSIGNMENT:
Credit: due date - full, + 1 week - ¾, + 2 weeks - ½, + 3 weeks - ¼, + 4 weeks – $^1/_8$

INDIVIDUAL HOMEWORK (Due in 1 week)

Scheduling techniques, such as the critical path methods presented, originated as a time management tool for project managers. But such schedule techniques early-on served another purpose – projecting the time-flow of funds.

Besides inputing the time duration of each activity in the schedule, the cost associated with executing the activity is also input. The projected cash-flow required to execute the project then can be accumulated and projected on a daily, weekly or monthly basis.

Cash flow is normally projected on a cumulative basis. There will be a cash-flow curve associated with the early-start schedule, and a cash flow associated late-start schedule. Such cumulative cost curves usually have a slight s-shape to them – typically indicating a slow expenditure rate at the start of the project, a fast expenditure rate in the middle, and a slow expenditure rate at the end of the project. Because of the typical s-shape of the cumulate cost-projection curves, they are often called s-curves.

At the beginning of the project, the cash-flow is a *projection*, often frozen as the *baseline* expenditure from which progress will be measured. All actual performances are then compared to the baseline (usually the early-start cash –flow projection.) As the project progresses through time, each activity will experience actual costs. These actual costs are then compared to the baseline (earned-value) costs. Comparisons are usually made on a cumulative basis, rather than incremental so that true trends can be visualized versus just a localized variance.

The baseline projected expenditure is also called the *earned value* of the activity. It is what the costs should have been versus what they actually were after execution. Earned value (should have cost, or baseline projection) can be compared to actual costs on an activity by activity basis, but is normally done on an overall cumulative basis in order to filter out the effects of localized variances.

Earned-value versus actual cost, when done on a cumulative basis, provide project management very valuable and timely information on whether the project is over-running or under-running the project budget (assuming the project budget is based on the baseline.) If earned value is determined at frequent intervals during the project, along with forecasts of expenditures through the end of the project, cost over-runs and under-runs can be identified in time to take corrective measures.

Work the earned value problem in the lesson plan (the blank worksheet). Be sure to plot your results for full credit.

Lesson Plan 7 – Deleted

(Material relocated)

Lesson Plan 8– Deleted

(Material relocated)

MECC 125 - Accounting for Engineers

Lesson Plan 9 – 2+ Hours

LECTURE SUBJECTS:

Interest	
Definitions	**Uniform series (normal)**
Simple interest	**Derivation**
Derivation	**A useful identity**
Example	**Example**
Homework	**Homework**
Compound interest	**Uniform series (full)**
Derivation	**Derivation**
Examples	**An alternate solution**
Homework	**Uniform series (offset)**
Effective interest rate	**Arithmetic gradient series**
Derivation	**Derivation**
Example	**Example**
Homework	**Geometric gradient series**
Effective vs. Nominal	**Derivation**
Graphs	**Example**
Tables	**Homework** (extra credit)
	Continuous compounding
	Infinite Series

Spreadsheet solutions to interest problems
Introduction
Compound interest
Cascading solutions
Equal-principal series
Uniform series

Time Value of Money = (commercial use of money)   (Revised 12 jan 2003)

Simple Interest

| Simple interest |
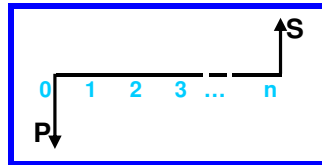
Compound Interest

| Present value of a future sum |
| Future value of a present sum |

| Sub-annual compounding periods |
| **Effective interest rate** |
| Effective vs nominal interest rates |

| Present value of a normal series |
| Normal series of a present value |

| Future value of a normal series |
| Normal series of a future value |

| Present value of a full series |
| Full series of a present value |

| Future value of a full series |
| Full series of a future value |

| Present value of an offset series |
| Offset series of a present value |

| Future value of a offset series |
| Offset series of a future value |

| Present value of an arithmetic series |
| Arithmetic series of a present value |

| Future value of an arithmetic series |
| Arithmetic series of a future value |

| Present value of an geometric series |

| Continuous compounding periods |
| **Continuous compounding interest** |
| Effective vs nominal interest rates |

| Present value of an infinite series |
| Infinite series of a present value |
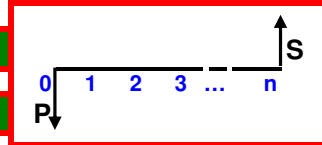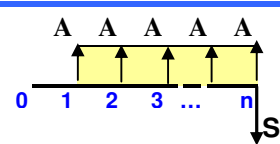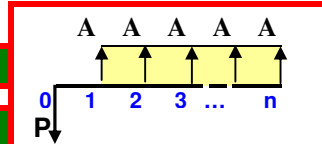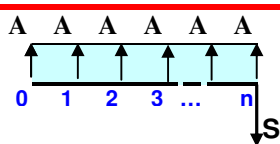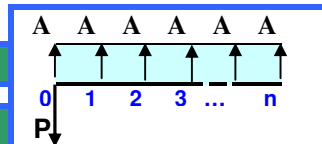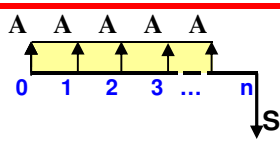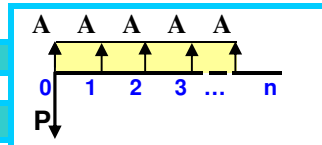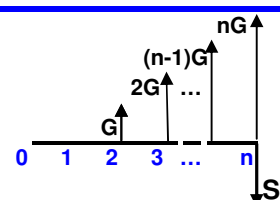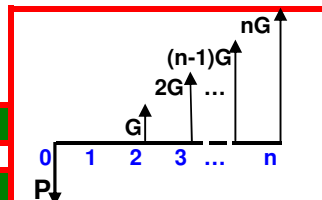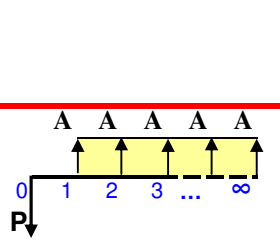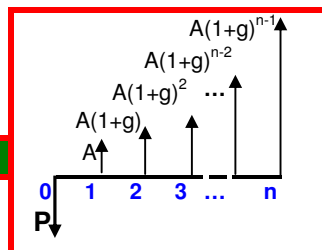
DEFINITIONS: SYMBOLS

P	Principal - Original amount borrowed	**Present Value**
i	Rate of interest (formulaic or contract rate)	
i_n	Annual rate of interest (nominal)	
i_a	effective annual rate of interest (nominal)	
$i*$	simple rate of interest	
I	Interest paid on Principal	Increase in Present Value
S	Sum of re-payments of Principal and Interest	**Future Value**
A	Annuity, Series amount	
n	number of annual payments	$= m / 12$
m	number of monthly payments	$= n \times 12$
q	number of compounding periods within a year	

Simple Interest (Not compounded) (Revised 12 Jan 2003) S

interest period = 1

$$S = P + I$$

$$I = i^* \times P$$

where i^* = interest rate over the entire loan duration

$$S = P + i^* \times P$$

$$S = P (1 + i^*)$$
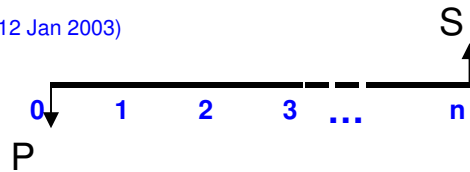
The interest rate is more commonly expressed as an annual rate, i.
The relation between i^* and i is expressed as follows:

$$i^* = n\, i_n \qquad \text{when the interest period covers multiple years.}$$

Or,

$$i^* = \frac{1}{q} i_n \qquad \text{when the interest period is a fraction of a year.}$$

where q = the number of periods in the year

i_n = nominal annual rate

EXAMPLE of Simple Interest:

Loan of P = 100 to be repaid in 12 years

i^* = 12% for the entire loan period

P = 100

$I = i^* \times P = 12\% \times 100 = 12$

$S = P + I = 100 + 12 = 112$

HOMEWORK: Calculate the simple interest components of the problems below.

1. John borrows 100,000 pesos from Juan, with a promise to repay him 120,000 pesos in two years. Assuming Juan actually repays on schedule, what is the simple interest rate?

2. Sally loans Jill 10,000 dollars at an agreed simple interest rate of 10%, to be repaid in 1 year. How much must Jill pay Sally at the end of the year to settle the loan?

3. Robby paid Sam 125,000 pesos to settle a loan made three years earlier at a simple interest rate of 25%. How much was the original loan?

4. Sean agrees to loan Marlo 100,000 pesos at an annual rate of 12%, to be re-paid in 6 months. What is the simple interest rate?

   What is the total interest to be paid?

   What is the total payment to be made?

Formulaic Derivation: Compound interest, single payment

S

Compounding

0   1   2   3   ...   n

P

Period

Period					
0	S_0	$=$	P		
1	S_1	$=$	$P + iP$	$= P(1+i)$	
2	S_2	$=$	$P + iS_1$	$= P + iP(1+i) = P(1+i)^2$	
3	S_3	$=$	$P + iS_2$	$= P + iP(1+i)^2 = P(1+i)^3$	
...					
n	S_n	$=$	$P + iS_{n-1}$	$= P + iP(1+i)^{n-1} = P(1+i)^n$	

$$S = P(1+i)^n$$

'S' is the _future value_ of the _present amount_, **'P'**.

and **'P'** is the _present value_ of the _future sum_ **'S'**.

$$P = S/(1+i)^n$$
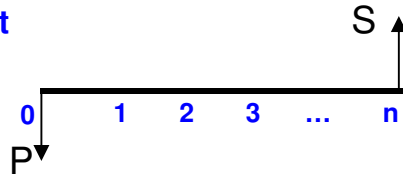
Note: the compounding period may be any period, such as week, month, quarter, trimester, or year, or even multi-year. The rate of interest must be stated in terms of the period. Examples: If the compounding period is monthly, the rate of interest is also monthly; if the compounding period is quarterly, the interest rate must also be quarterly; if the compounding period is yearly, the interest rate must also be yearly.

Solution for i

$$(1+i)^n = S/P$$
$$[(1+i)^n]^{1/n} = [S/P]^{1/n}$$
$$(1+i)^{n/n} = (S/P)^{1/n}$$
$$1+i = (S/P)^{1/n}$$
$$i = (S/P)^{1/n} - 1$$

Solution for n

$$(1+i)^n = S/P$$
$$n \log(1+i) = \log(S/P)$$
$$n = \frac{\log(S/P)}{\log(1+i)}$$

Note : n is normally an integer, but the above equation may not yield an integer

EXAMPLES: Single Payment compound interest

1. Juan loans Samy ₱10,000 on 1 January 2003, with a promise to repay on 1 January 2004 interest compounded monthly at 5%/ month. Calculate the repayment amount S

$S = P(1+i)^n$

$S = 10,000 (1+.05)^{12} = \underline{17,958.56}$

0   1   2   3   4   5   6   ...   12

P
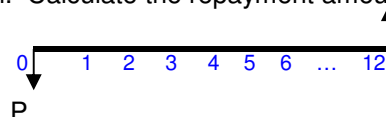
2. Jim loans Dan ₱10,000 on 1 January 2003, with a promise to repay on 1 January 2004 at an interest rate of 60% per year. Calculate the repayment amount.   S

$S = P(1+i)^n$

$S = 10,000 (1+.60)^1 = \underline{16,000.00}$

0   1

P
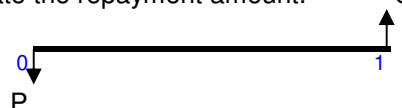
3. After 6 months Juan decides to sell Samy's promissory note (See Example 1 for details).
   How much is the promissory note worth at 6 month's maturity?
   Note: Future value approach

   $S = P (1 + i)^n$

   $S = 10,000 (1+.05)^6 = $ <u>13,400.96</u>
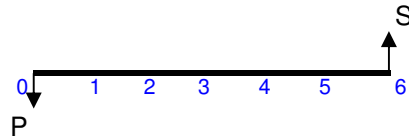
4. Josi offers to buy a promissory note that promises to pay the sum of P17,958.56 pesos in
   6 months. Josi calculated her offer based on 5% compounded month. How much is the offer?
   Note: Present value approach

   $P = S / (1 + i)^n$

   $P = 17,958.56/(1+.05)^6 = $ <u>13,400.95</u>
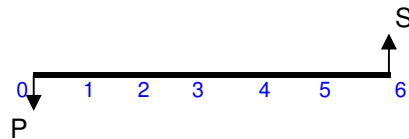
5. Given monthly compounding for 12 months, a present value of 100 and a future value of
   150, calculate the interest rate.

   $i = (S/P)^{1/n} - 1$

   $i = (150/100)^{1/12} - 1 = $ <u>3.44%</u>
   per month
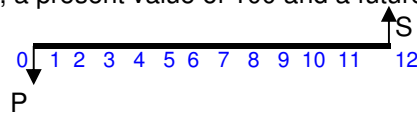
6. How long does it take to double P10,000 componded monthly at 1% per month?

   $$n = \frac{\log(S/P)}{\log(1+i)}$$

   $$n = \frac{\log(2)}{\log(1.01)}$$

   $$n = \frac{0.301029996}{0.004321374} = \underline{69.7 \quad \text{months}}$$
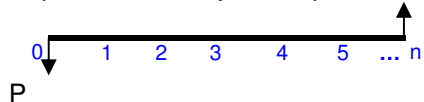
Homework: (Note: Draw the cash flow diagram for each problem - it's worth 50% of the score.

1. Jan loans Sam ₱100,000 on 1 January 2003, with a promise to repay on 1 January 2004
   with interest compounded monthly at 2% per month. Calculate the repayment amount.
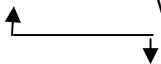
2. You have an opportunity to buy a promissory note paying the sum of P100,000 pesos in
   8 months. You estimate a fair rate of return is 2% per month. How much should you pay?
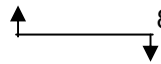
3. Given monthly compounding for 36 months, a present value of ₱150,000 and a future value
   of ₱300,000, what is the interest rate?
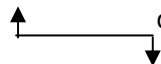
4. How long does it take to double P100,000 compounded monthly at 20% per month?
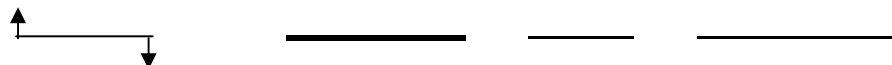
Effective versus nominal interest rate (Revised 12 Jan 2003)

The standard practice in quoting an interest rate is to state it in terms of an annual rate. If the actual compounding period is also one year, then there is no further discussion needed. However, in times of high economic activity, lending agencies and organizations, in their zeal to induce investors to deposit money into their organizations, often advertise more frequent compounding periods, such as semi-annually, quarterly, monthly, weekly, daily, or even continuously. Moreover, most loan and mortgage repayment schedules are monthly.

A question arises as to how to process these annual quotes in sub-annual compounding periods. The true relation between the true annual rate, also called the effective rate, and the sub-annual rate is as follows:

1) $(1 + i_a) = (1 + i_q)^q$

or for multiple compounding periods:

$(1 + i_a)^n = (1 + i_q)^{nq}$

where **q** = the number of compounding periods in the year

i_q = the interest rate for the compounding period

i_a = the *equivalent* annual interest rate at only one compounding period in the year

n = number of years

Solving the above for i_a yields:

2) $i_a = (1 + i_q)^q - 1$ **annual rate in terms of actual per-period rate**

Some governing jurisdictions require the equivalent annual rate to be disclosed to the borrower by the lender. However, most jurisdictions allow loan companies to use a simpler relationship, legally designated as the *nominal rate*, or apr (annual percentage rate), and defined as follows:

3) $i_n = q\, i_q$ **per-period rate in terms of nominal annual rate**

where i_n = the nominal annual interest rate for disclosure purposes

Solving the above for i_q yields:

4) $i_q = i_n / q$

When the nominal rate is quoted, which is most of the time, i_q is the true interest rate, since it is the actual rate which corresponds to the compounding period, but i_n is not the true mathematically equivalent annual interest rate. The relationship between i_n and i_a is as follows:

Substituting Eq. 4) into 2) yields:

5) $i_a = (1 + i_n/q)^q - 1$ **effective annual rate in terms of nominal annual rate**

or for multiple compounding periods:

$(1 + i_a)^n = (1 + i_n/q)^{nq}$

Whenever a cash-flow problem is stated using a nominal interest rate, i_n, it is necessary to convert that to a compounding period rate, i_q, and keep the entire analysis in terms of the compounding period to avoid any confusion. That is the criteria in which the formulas were developed. While we study i_a mathematically, it is universally ignored in the loan industry in favor of the simpler i_n. The question of which to disclose to the consumer is a legal one, and not a mathematical one.

A fractional **q** is used for a compounding period in excess of one year. When **n** =1, for a fractional q, a simple interest problem exists, and the effective annual rate for it can be calculated. The table to the right relates the meaning of fractional and integer multiples of **q** to the compounding period.

	compounding period	
q	months	years
1/8	96	8
1/7	84	7
1/6	72	6
1/5	60	5
1/4	48	4
1/3	36	3
3/8	32	2 2/3
3/7	28	2 1/3
1/2	24	2
3/5	20	1 2/3
2/3	18	1 1/2
3/4	16	1 1/3
6/7	14	1 1/6
1	**12**	**1**
2	**6**	1/2
3	**4**	1/3
4	**3**	1/4
6	**2**	1/6
12	**1**	1/12

(Simple interest / Compound interest axis indicator on left)

Examples:

q > 1   sub-annual compounding

1. Sue loans Ted $100 compounded monthly at 1% per month, payable in 12 months. What is the nominal interest rate? What is the effective annual rate? What is the future payment?

$i_n = q\ i_q$ =   12   1%   =   **12%**

$i_a = (1+i_q)^q -1 =$ $(1+.01)^{12} -1$ =   **12.68%**

$S = P(1+i)^n =$ $100(1+.01)^{12}$ =   **112.68**

Note: neither i_n nor i_a is required to solve the Future sum.

2. Sue loans Ted $100 compounded monthly at 1% per month, payable in 6 months. What is the nominal interest rate? What is the effective annual rate? What is the payoff?

$i_n = q\ i_q$ =   12   1%   =   **12%**

$i_a = (1+i_q)^q -1 =$ $(1+.01)^{12} -1$ =   **12.68%**

$S = P(1+i)^n =$ $100(1+.01)^{6}$ =   **106.15**

Note: neither i_n nor i_a is required to solve the Future sum.

q = 1   annual compounding

3. Sue loans Ted $100 compounded annually at 12% per year, payable in 1 year. What is the nominal interest rate? What is the effective annual rate? What is the payoff at the end of the year?

$i_n = q\ i_q$ =   1   12%   =   **12%**

$i_a = (1+i_q)^q -1 =$ $(1+.12)^{1} -1$ =   **12.00%**

$S = P(1+i)^n =$ $100(1+.12)^{1}$ =   **112.00**

Note: neither i_n nor i_a is required to solve the Future sum.

Example 3, with **q** = 1 (a compounding period of one year), and with **n** = 1, is the crossover point where the equivalent annual rate, i_a, is equal to the nominal rate i_n..

q < 1   supra-annual compounding

4. Sue loans Ted $100 compounded biennially at 12% over a two year perid, payable in two years. What is the nominal interest rate? What is the effective annual rate? What is the payoff at the end of the two years?

$i_n = q\ i_q$ =   1/2   12%   =   **6%**

$i_a = (1+i_q)^q -1 =$ $(1+.12)^{1/2} -1$ =   **5.83%**

$S = P(1+i)^n =$ $100(1+.12)^{1}$ =   **112.00**

Note: neither i_n nor i_a is required to solve the Future sum.

Example 4, with **q** = 1/2 (2- yr compounding period), and with **n** = 1, is in effect a simple interest problem (**n** will always be 1 for simple interest). For the nominal or equivalent annual rate, i_n or i_a, for simple interest, state **q** in terms of a fraction.

HOMEWORK:

1. Consider a loan of ₱100,000, compounded monthly at 5% per month, to be repaid at the end of 18 months.

What is the nominal interest rate? What is the effective annual rate? What is the future sum to be paid?

2. Consider a loan of ₱100,000, simple interest at 90%, to be repaid at the end of 18 months (1-1/2 yrs).

What is the nominal interest rate? What is the effective annual rate? What is the future sum to be paid?

1/2	2/3	3/4	5/6	7/8	9/10	10/11	...	100/103	100/102	100/101	Loan scheme
100%	50%	33%	20%	14%	11%	10%	...	3%	2%	1%	interest rate / month
1200%	600%	396%	240%	171%	133%	120%	...	36%	24%	12%	interest rate / year

Effective vs. Nominal Rates

US high interest rates

Effective vs Nominal Interest Rate

- q=12
- q=6
- q=4
- q=3
- q=2
- q=1

5/6

USA

Effective interest rate, annual

Nominal interest rate, annual

Nominal interest rate

USA

- q=1
- q=2
- q=3
- q=4
- q=6
- q=12

5/6

% Error

% Error vs Nominal Interest Rate

Effective vs Nominal Interest Rate

Effective interest rate, annual vs Nominal interest rate, annual

Legend: q=12, q=6, q=4, q=3, q=2, q=1

USA

% Error vs Nominal Interest Rate

Nominal interest rate vs % Error

Legend: q=1, q=2, q=3, q=4, q=6, q=12

USA

error $= (i_n - i)/i_n$

i	i_n	i_q	q	error	i	i_n	i_q	q	error	i	i_n	i_q	q	error
1%	1%	1%	1	0.0%	1.0%	1%	0.50%	2	-0.2%	1.0%	1%	0.33%	3	-0.3%
5.0%	5%	5%	1	0.0%	5.1%	5%	2.50%	2	-1.2%	5.1%	5%	1.67%	3	-1.7%
10.0%	10%	10%	1	0.0%	10.3%	10%	5.00%	2	-2.5%	10.3%	10%	3.33%	3	-3.4%
15.0%	15%	15%	1	0.0%	15.6%	15%	7.50%	2	-3.8%	15.8%	15%	5.00%	3	-5.1%
20.0%	20%	20%	1	0.0%	21.0%	20%	10.00%	2	-5.0%	21.4%	20%	6.67%	3	-6.8%
25.0%	25%	25%	1	0.0%	26.6%	25%	12.50%	2	-6.3%	27.1%	25%	8.33%	3	-8.6%
30.0%	30%	30%	1	0.0%	32.3%	30%	15.00%	2	-7.5%	33.1%	30%	10.00%	3	-10.3%
35.0%	35%	35%	1	0.0%	38.1%	35%	17.50%	2	-8.8%	39.2%	35%	11.67%	3	-12.1%
40.0%	40%	40%	1	0.0%	44.0%	40%	20.00%	2	-10.0%	45.6%	40%	13.33%	3	-13.9%
45.0%	45%	45%	1	0.0%	50.1%	45%	22.50%	2	-11.3%	52.1%	45%	15.00%	3	-15.7%
50.0%	50%	50%	1	0.0%	56.3%	50%	25.00%	2	-12.5%	58.8%	50%	16.67%	3	-17.6%
60.0%	60%	60%	1	0.0%	69.0%	60%	30.00%	2	-15.0%	72.8%	60%	20.00%	3	-21.3%
70.0%	70%	70%	1	0.0%	82.3%	70%	35.00%	2	-17.5%	87.6%	70%	23.33%	3	-25.1%
80.0%	80%	80%	1	0.0%	96.0%	80%	40.00%	2	-20.0%	103.2%	80%	26.67%	3	-29.0%
90.0%	90%	90%	1	0.0%	110.3%	90%	45.00%	2	-22.5%	119.7%	90%	30.00%	3	-33.0%
100.0%	100%	100%	1	0.0%	125.0%	100%	50.00%	2	-25.0%	137.0%	100%	33.33%	3	-37.0%
125.0%	125%	125%	1	0.0%	164.1%	125%	62.50%	2	-31.3%	184.3%	125%	41.67%	3	-47.5%
150.0%	150%	150%	1	0.0%	206.3%	150%	75.00%	2	-37.5%	237.5%	150%	50.00%	3	-58.3%
175.0%	175%	175%	1	0.0%	251.6%	175%	87.50%	2	-43.8%	296.9%	175%	58.33%	3	-69.7%
200.0%	200%	200%	1	0.0%	300.0%	200%	100.0%	2	-50.0%	363.0%	200%	66.67%	3	-81.5%
225.0%	225%	225%	1	0.0%	351.6%	225%	112.5%	2	-56.3%	435.9%	225%	75.00%	3	-93.8%
240%	240%	240%	1	0.0%	384%	240%	120.0%	2	-60.0%	483%	240%	80.00%	3	-101.3%
250.0%	250%	250%	1	0.0%	406.3%	250%	125.0%	2	-62.5%	516.2%	250%	83.33%	3	-106.5%
275.0%	275%	275%	1	0.0%	464.1%	275%	137.5%	2	-68.8%	604.1%	275%	91.67%	3	-119.7%
300.0%	300%	300%	1	0.0%	525.0%	300%	150.0%	2	-75.0%	700%	300%	100%	3	-133.3%
400.0%	400%	400%	1	0.0%	800.0%	400%	200.0%	2	-100.0%	1170%	400%	133%	3	-192.6%
500.0%	500%	500%	1	0.0%	1125%	500%	250.0%	2	-125.0%	1796%	500%	167%	3	-259.3%

i	i_n	i_q	q	error	i	i_n	i_q	q	error	i	i_n	i_q	q	error	
1.0%	1%	0.25%	4	-0.4%	1.0%	1%	0.17%	6	-0.4%	1.0%	1%	0.08%	12	-0.5%	
5.1%	5%	1.25%	4	-1.9%	5.1%	5%	0.83%	6	-2.1%	5.1%	5%	0.42%	12	-2.3%	
10.4%	10%	2.50%	4	-3.8%	10.4%	10%	1.67%	6	-4.3%	10.5%	10%	0.83%	12	-4.7%	
15.9%	15%	3.75%	4	-5.8%	16.0%	15%	2.50%	6	-6.5%	16.1%	15%	1.25%	12	-7.2%	
21.6%	20%	5.00%	4	-7.8%	21.7%	20%	3.33%	6	-8.7%	21.9%	20%	1.67%	12	-9.7%	
27.4%	25%	6.25%	4	-9.8%	27.8%	25%	4.17%	6	-11.0%	28.1%	25%	2.08%	12	-12.3%	
33.5%	30%	7.50%	4	-11.8%	34.0%	30%	5.00%	6	-13.4%	34.5%	30%	2.50%	12	-15.0%	
39.9%	35%	8.75%	4	-13.9%	40.5%	35%	5.83%	6	-15.8%	41.2%	35%	2.92%	12	-17.7%	
46.4%	40%	10.0%	4	-16.0%	47.3%	40%	6.67%	6	-18.2%	48.2%	40%	3.33%	12	-20.5%	
53.2%	45%	11.3%	4	-18.2%	54.3%	45%	7.50%	6	-20.7%	55.5%	45%	3.75%	12	-23.4%	
60.2%	50%	12.5%	4	-20.4%	61.6%	50%	8.33%	6	-23.3%	63.2%	50%	4.17%	12	-26.4%	
74.9%	60%	15.0%	4	-24.8%	77.2%	60%	10.00%	6	-28.6%	79.6%	60%	5.00%	12	-32.6%	
90.6%	70%	17.5%	4	-29.4%	93.9%	70%	11.67%	6	-34.1%	97.5%	70%	5.83%	12	-39.2%	
107.4%	80%	20.0%	4	-34.2%	111.9%	80%	13.33%	6	-39.9%	116.9%	80%	6.67%	12	-46.2%	
125.2%	90%	22.5%	4	-39.1%	131.3%	90%	15.00%	6	-45.9%	138.2%	90%	7.50%	12	-53.5%	
144.1%	100%	25.0%	4	-44.1%	152.2%	100%	16.67%	6	-52.2%	161.3%	100%	8.33%	12	-61.3%	
196.8%	125%	31.3%	4	-57.4%	211.3%	125%	20.83%	6	-69.0%	228.4%	125%	10.42%	12	-82.7%	0/1
257.4%	150%	37.5%	4	-71.6%	281.5%	150%	25.00%	6	-87.6%	311.0%	150%	12.50%	12	-107.3%	/1
327.0%	175%	43.8%	4	-86.9%	364.4%	175%	29.17%	6	-108.2%	412.2%	175%	14.58%	12	-135.6%	7/8
406.3%	200%	50.0%	4	-103.1%	461.9%	200%	33.33%	6	-130.9%	535.9%	200%	16.67%	12	-167.9%	
496.0%	225%	56.3%	4	-120.5%	575.8%	225%	37.50%	6	-155.9%	686.3%	225%	18.75%	12	-205.0%	
555%	240%	60.0%	4	-131.4%	653%	240%	40.00%	6	-172.1%	792%	240%	20.00%	12	-229.8%	5/6
597.3%	250%	62.5%	4	-138.9%	708.4%	250%	41.67%	6	-183.3%	868.8%	250%	20.83%	12	-247.5%	
710.9%	275%	68.8%	4	-158.5%	861.9%	275%	45.83%	6	-213.4%	1089%	275%	22.92%	12	-296.1%	
837.9%	300%	75.0%	4	-179.3%	1039%	300%	50.00%	6	-246.4%	1355%	300%	25.00%	12	-351.7%	
1500%	400%	100%	4	-275.0%	2043%	400%	66.67%	6	-410.8%	3057%	400%	33.33%	12	-664.2%	3/4
2463%	500%	125%	4	-392.6%	3697%	500%	83.33%	6	-639.4%	6434%	500%	41.67%	12	-1187%	

Uniform series normal (Revised 12 Jan 2003)

Part 1: Future value

This complex problem is solved by breaking the problem into a sum of single payment compound interest problems, as follows:

$S_1 = A(1+i)^{n-1}$

$+$

$S_2 = A(1+i)^{n-2}$

$+$

$S_3 = A(1+i)^{n-3}$

$+$
...
$+$

$S_4 = A(1+i)^{n-n}$
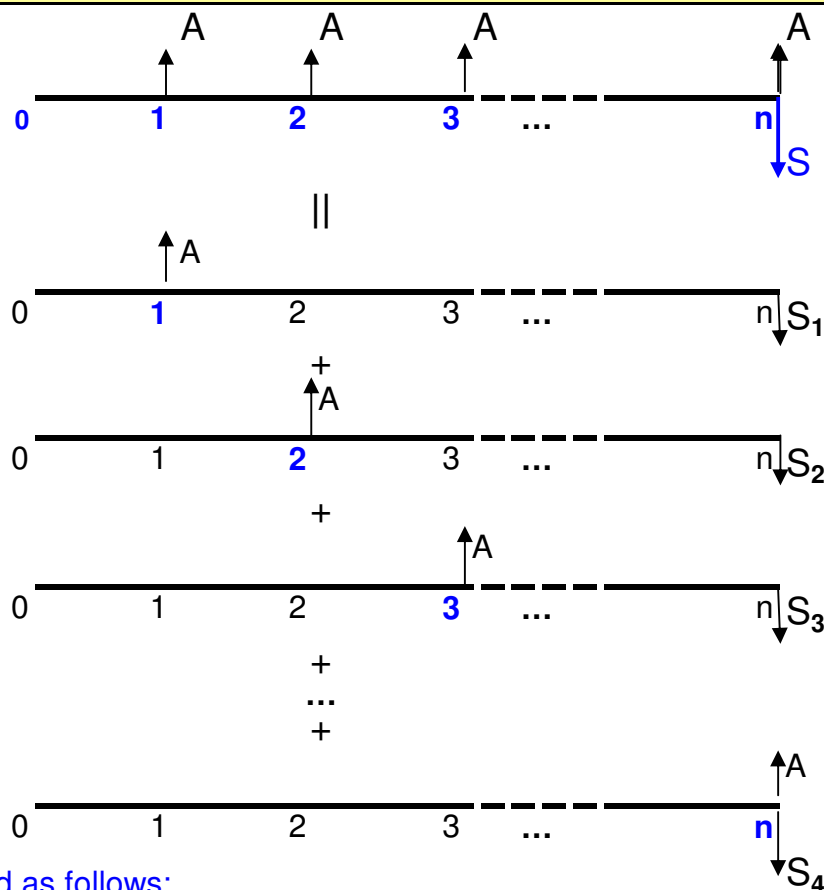
The individual parts are summed as follows:

$\Sigma \quad S = A[(1+i)^{n-1} + (1+i)^{n-2} + (1+i)^{n-3} + (1+i)^{n-n}]$

Multiply both sides of the above equation by (1+ i) to get the following equation:

$(1+i) S = A[(1+i)^{n} + (1+i)^{n-1} + (1+i)^{n-2} + (1+i)^{1}]$

Subtract the former equation, above, from the latter to get the following equation:

$(1+i) S = A[(1+i)^{n} + (1+i)^{n-1} + (1+i)^{n-2} + (1+i)^{1}]$

$S = A[\qquad (1+i)^{n-1} + (1+i)^{n-2} + (1+i)^{n-3} + (1+i)^{n-n}]$

$i\,S = A[(1+i)^{n} - 1]$

Solving the above for S yields the following:

This is the future value of a uniform series (normal)

$$S = \frac{(1+i)^{n} - 1}{i} A$$

Solving the above for A yields

$$A = \frac{i}{(1+i)^{n} - 1} S$$
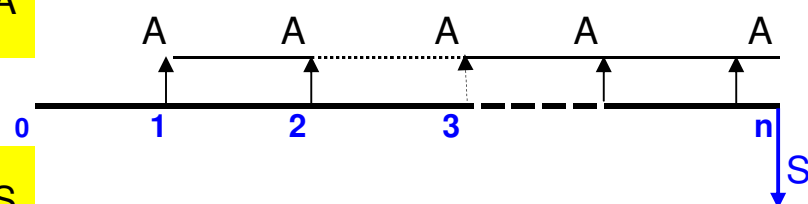
This is the uniform series (normal) of a future value
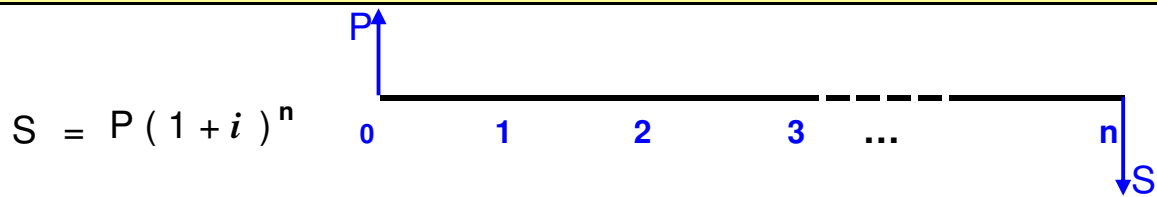
$$S = P(1+i)^n$$

$$0 = \frac{(1+i)^n - 1}{i} A - P(1+i)^n$$

Solving the above for P yields:

This is the present value of a uniform series (normal)

This is one of the more useful series in financial analysis

$$P = \frac{(1+i)^n - 1}{i(1+i)^n} A$$
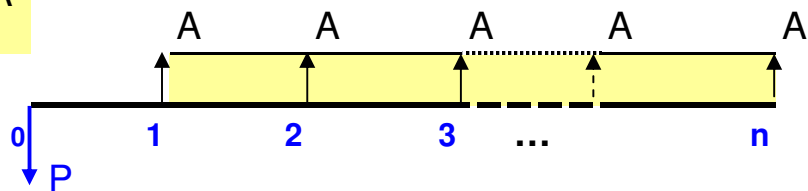
Solving the above for A yields

$$A = \frac{i(1+i)^n}{(1+i)^n - 1} P$$

Most widely used loan and uniform repayment series

This is the uniform series (normal) of a present value

A useful Identity for future derivations

$$S = A[(1+i)^{n-1} + (1+i)^{n-2} + (1+i)^{n-3} + (1+i)^{n-n}]$$
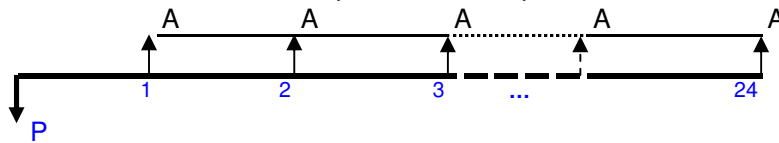
$$S = \frac{(1+i)^n - 1}{i} A$$

Our derivation of the future value of a uniform series resulted in the above equations, which, if set equal to each other, yield the following useful identity:

$$\frac{(1+i)^n - 1}{i} = A[(1+i)^{n-1} + (1+i)^{n-2} + (1+i)^{n-3} + (1+i)^{n-n}]$$
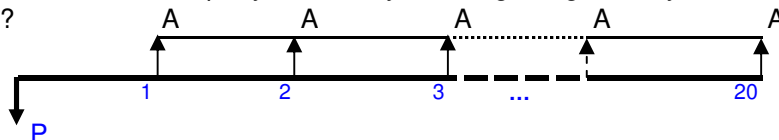
EXAMPLE: (Uniform series - normal)

1. Jim borrows ₱1 million to buy a new car, at an interest rate compounded at 2% per month for 24 months. What are the monthly payments?

$$A = \frac{i\,(1+i)^n}{(1+i)^n - 1}\,P$$

$$A = \frac{.02\,(1+.02)^{24}}{(1+.02)^{24} - 1}\,1m \quad = \quad \frac{0.032169}{0.608437}\,1{,}000{,}000 \quad = \quad \underline{52{,}871.10}$$

2. A project predicts a positive cash flow of ₱25 million per year for 20 years, beginning in one year. What is its present value at $i = 10\%$/year?
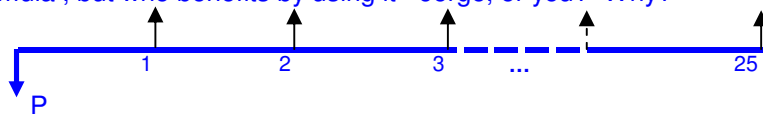
$$P = \frac{(1+i)^n - 1}{i\,(1+i)^n}\,A$$

$$P = \frac{(1+.10)^{20} - 1}{.10\,(1+.10)^{20}}\,25m \quad = \quad \frac{5.7275}{0.67275}\,25{,}000{,}000 \quad = \quad \underline{212{,}839{,}093}$$

3. Jorge offers to loan you P1,000,000 at a compounded monthly rate of 2%, to be repaid with interest in equal installments for 25 months. Jorge calculates your payments as follows:

$$\frac{1{,}000{,}000 + (2\%/month \times 25\ months \times 1{,}000{,}000)}{25\ months} \quad = \quad 60{,}000$$

You know this is not the correct formula , but who benefits by using it - Jorge, or you? Why?

$$A = \frac{i\,(1+i)^n}{(1+i)^n - 1}\,P$$

$$A = \frac{.02\,(1+.02)^{25}}{(1+.02)^{25} - 1}\,1m \quad = \quad \frac{0.032812}{0.640606}\,1{,}000{,}000 \quad = \quad \underline{51{,}220.44} \quad \text{correct payment}$$

Jorge benefits, because he is not accounting for the diminishing balance and early payments.

Homework:

1. You want to buy a house for ₱5 million. The bank asks you to pay a down payment of ₱500,000, and it will loan to you ₱4.5 million at a monthly rate of 1.5% for 120 months. What are your monthly payments?

2. Paula wins ₱10 million in the lotto. She is 55 years old and expects to live to be 80. She decides she will buy a car for ₱1 million, spend another ₱1 million, and buy an annuity with the ₱8 million balance. A bank offers her an annuity of ₱50,000 per month for 300 months. The going interest rate is 1% / month. Should she take the offer?

Uniform Series Full

Note that unlike the present value of a *normal* uniform series, which starts at time = 1, the *full* uniform series starts at time = 0, and continues until time = n.

Part 1: future value

This complex problem is solved by breaking the problem into a sum of single payment compound interest problems, as follows:

$S_0 = A(1+i)^4$

$+$
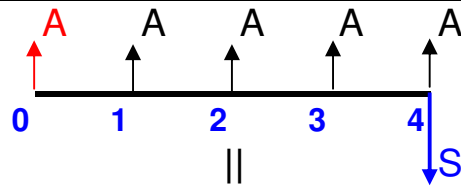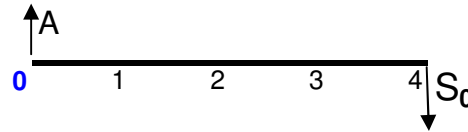
$S_1 = A(1+i)^3$

$+$
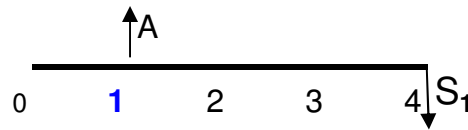
$S_2 = A(1+i)^2$

$+$
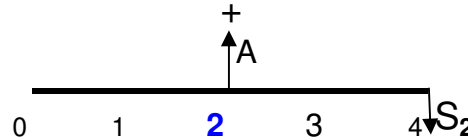
$S_3 = A(1+i)^1$

$+$
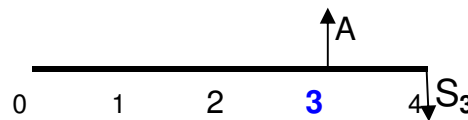
$S_4 = A$
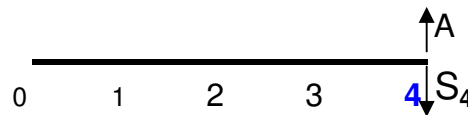
Now we can sum the individual parts

$$S = A[(1+i)^4 + (1+i)^3 + (1+i)^2 + (1+i) + 1]$$

Multiplying both sides of the above equation by (1+ i), yields the following equation:

$$(1+i)S = A[(1+i)^5 + (1+i)^4 + (1+i)^3 + (1+i)^2 + (1+i)]$$

Subtracting the former equation, above, from the latter, yields the following equation:

$$(1+i)S = A[(1+i)^5 + (1+i)^4 + (1+i)^3 + (1+i)^2 + (1+i) \qquad]$$

$$S = A[\qquad (1+i)^4 + (1+i)^3 + (1+i)^2 + (1+i) + 1]$$

$$iS = A[(1+i)^5 - 1]$$

Solving the above for S yields the following:

$$S = A[(1+i)^5 - 1]/i$$

The above series can be generalized to n periods as follows:

$$S = \frac{(1+i)^{n+1} - 1}{i}\ A$$

This is the future value of a full uniform series

It is typical of a savings or retirement plan

A A A A A

0 1 2 3 ... n

S
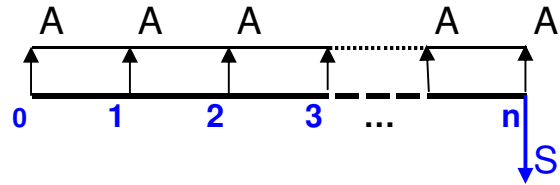
Solving the above for A yields:

$$A = \frac{i}{(1+i)^{n+1} - 1}\ S$$

This is the full uniform series of a future sum

Part 2: From the compound development is the present value of a future sum.

P

$$S = P(1+i)^n$$

0 1 2 3 ... n

S

Part 3: Subtracting Part 2 from Part 1 yields

$$0 = \frac{(1+i)^{n+1} - 1}{i}\ A\ - P(1+i)^n$$

Solving the above for P yields:

This is the present value of a full uniform series

$$P = \frac{(1+i)^{n+1} - 1}{i\ (1+i)^n}\ A$$

A A A A A A

0 1 2 3 ... n

P

Solving the above for A yields:

$$A = \frac{i\ (1+i)^n}{(1+i)^{n+1} - 1}\ P$$
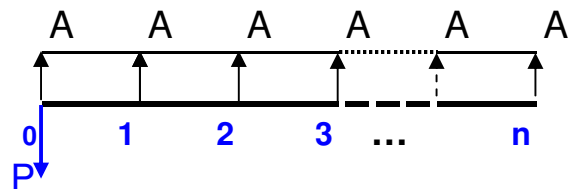
This is the full uniform series of a present value

An alternate solution takes advantage of the formula already derived for a normal uniform series, as follows:

A A A A A

0 1 2 3 4

P

||

$$P_1 = \frac{(1+i)^n - 1}{i\ (1+i)^n}\ A$$

A A A A A

0 1 2 3 ... n

P_1

+
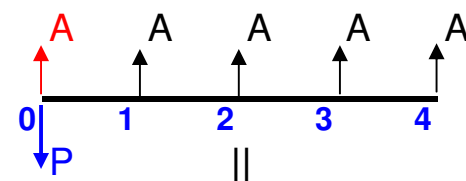
A

$$P_2 = A$$
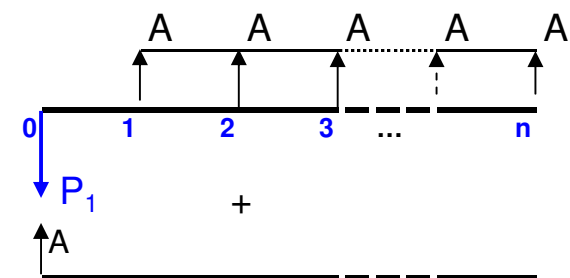
Summing the above

P_2
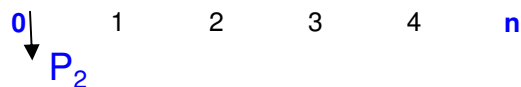
$$P = \frac{(1+i)^n - 1}{i\,(1+i)^n}\,A \;+\; A \qquad\qquad P = \left[\frac{(1+i)^n - 1}{i\,(1+i)^n} + 1\right]A$$

$$P = \frac{(1+i)^n - 1 + (1+i)^n}{i\,(1+i)^n}\,A \qquad = \frac{(1+i)^n(1+i) - 1}{i\,(1+i)^n}\,A$$

$$P = \frac{(1+i)^{n+1} - 1}{i\,(1+i)^n}\,A$$

From the compound development is the present value of a future sum.

P

$$S = P(1+i)^n$$

0   1   2   3   ...   n

S
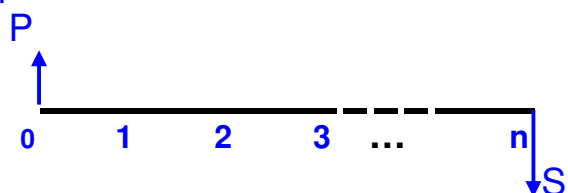
Substituting the formula for P into the above yields:

$$S = \frac{(1+i)^{n+1} - 1}{i}\,A$$

Uniform Series Offset

Note that unlike the present value of a *normal* uniform series, which starts at time = 1,
the *offset* uniform series starts at time = 0, and continues until time = n-1.

Part 1: future value

This complex problem is solved by breaking the problem into a sum of single payment compound interest problems, as follows:

$$S_0 = A(1+i)^4$$

$$+ \qquad +$$
$$S_1 = A(1+i)^3$$

$$+ \qquad +$$
$$S_2 = A(1+i)^2$$

$$+ \qquad +$$
$$S_3 = A(1+i)^1$$
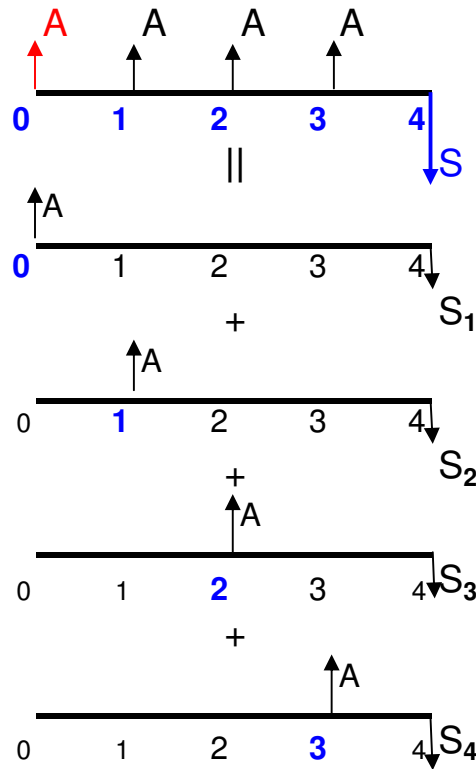
Now we can sum the individual parts

$$S = A[(1+i)^4 + (1+i)^3 + (1+i)^2 + (1+i)]$$

If we divide both sides of the above equation by (1+ i), we get the following equation:

$$S/(1+i) = A[(1+i)^3 + (1+i)^2 + (1+i)^2 + (1+i)^1 +$$

If we subtract the former equation, above, from the latter, we get the following equation:

$$S = A[(1+i)^4 + (1+i)^3 + (1+i)^2 + (1+i) \qquad]$$

$$S/(1+i) = A[\qquad (1+i)^3 + (1+i)^2 + (1+i) + 1]$$

$$iS/(1+i) = A[(1+i)^4 - 1]$$

Solving the above for S yields the following:

$$S = \frac{A[(1+i)^4 - 1](1+i)}{i}$$
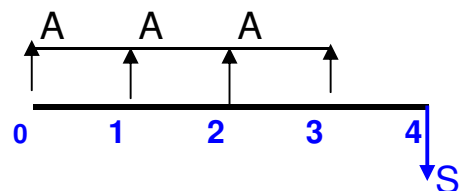
The above series can be generalized to n periods as follows:

This is the future value of an offset uniform series

It is typical of some savings or retirement plan

$$S = \frac{[(1+i)^n - 1](1+i)}{i} A$$
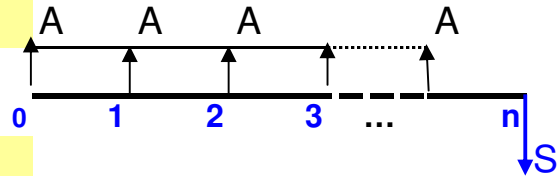
Solving the above for A yields:

$$A = \frac{i}{[(1+i)^n - 1](1+i)} S$$

This is the offset uniform series of a future value

Part 2: From the compound development is the present value of a future sum.

$$S = P(1+i)^n$$
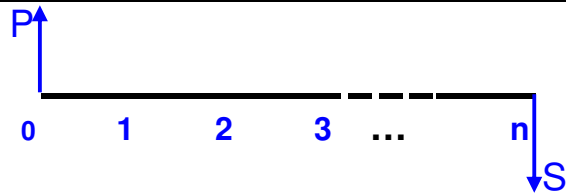
Part 3: Subtracting Part 2 from Part 1 yields

$$0 = \frac{[(1+i)^n - 1](1+i)}{i} A - P(1+i)$$

Solving the above for P yields: This is the present value of an offset uniform sum

$$P = \frac{(1+i)^n - 1}{i(1+i)^{n-1}} A$$
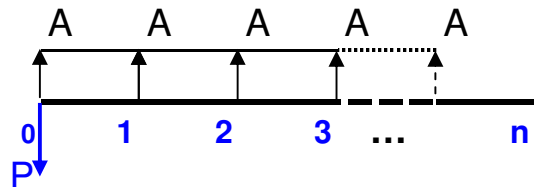
Solving the above for A yields:

$$A = \frac{i(1+i)^{n-1}}{(1+i)^{n+1} - 1} P$$

This is the offset uniform series of a present value

Arithmetic Gradient Series (Revised 12 Jan 2003)

Part 1: Breakout into uniform series and arithmetic gradient series

Arithmetic gradients are usually combined with uniform series. Usually, the first step is to separate the arithmetic gradient from the uniform series, as follows:

A   A+G   A+2G   A+3G   A+(n-1)G

0   1   2   3   4 ...   n

$\Vert$ S

Uniform series

$$S_U = \frac{(1+i)^n - 1}{i} A$$

A   A   A   A   A

0   1   2   3   4 ...   n S_U

\+

Arithmetic gradient

$$S_G = \quad ?$$

G   2G   3G   (n-1)G

0   1   2   3   4 ...   n S_G
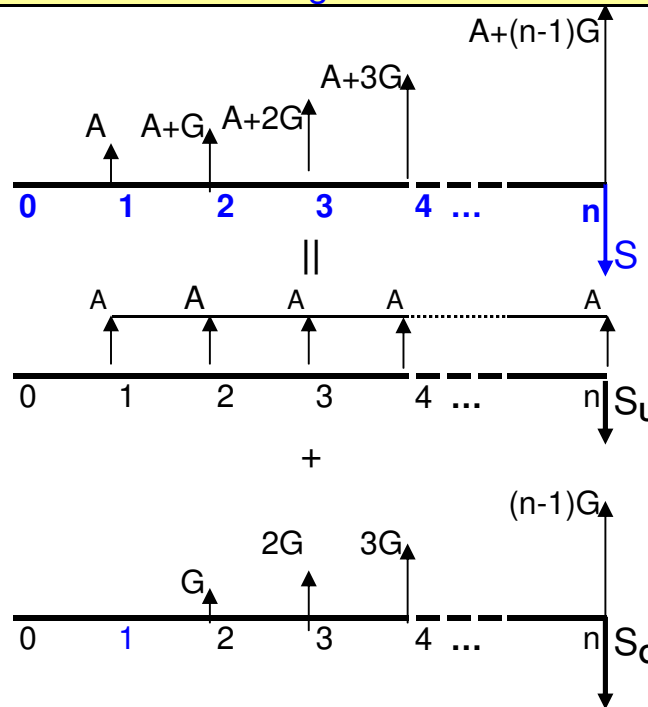
Part 2: Solution for the future value of the arithmetic gradient

This complex problem is solved by breaking the problem into a individual single-payment future sum problems, as follows:

G   2G   3G   (n-1)G

0   1   2   3   4 ...   n S_G

$\Vert$

$$S_2 = G(1+i)^{n-2}$$

G

0   1   2   3   4 ...   n S_2

\+

$$S_3 = 2G(1+i)^{n-3}$$

2G

0   1   2   3   4 ...   n S_3

\+

$$S_4 = 3G(1+i)^{n-4}$$

3G

0   1   2   3   4 ...   n S_4

\+
...
\+

$$S_n = (n-1)G(1+i)^{n-n}$$

nG

0   1   2   3   4 ...   n S_n
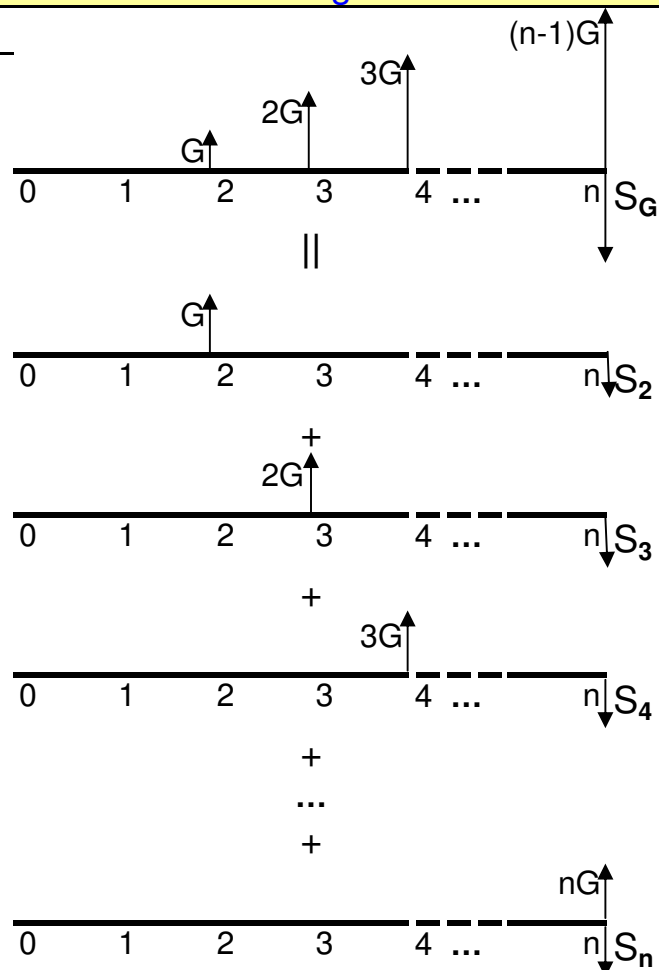
Now we can sum the individual parts

$$S_G = G[(1+i)^{n-2} + 2(1+i)^{n-3} + 3(1+i)^{n-4} + \ldots + (n-2)(1+i)^1 + (n-1)(1+i)^{n-n}]$$

Multiplying both sides of the above equation by $(1+i)$, yields the following:

$$(1+i)\,S_G = G[(1+i)^{n-1} + 2(1+i)^{n-2} + 3(1+i)^{n-3} + \ldots + (n-2)(1+i)^2 + (n-1)(1+i)^1]$$

Subtracting the former equation, above, from the latter, yields the following equation:

$$(1+i)\,S_G = G[(1+i)^{n-1} + 2(1+i)^{n-2} + 3(1+i)^{n-3} + \ldots + (n-2)(1+i)^2 + (n-1)(1+i) \qquad]$$

$$S_G = G[\qquad 1(1+i)^{n-2} + 2(1+i)^{n-3} + \ldots + (n-3)(1+i)^2 + (n-2)(1+i) + (n-1)\,]$$

$$\overline{i\,S_G = G[(1+i)^{n-1} + (1+i)^{n-2} + (1+i)^{n-3} + \ldots + (1+i)^2 + (1+i) + 1 - n}$$

Substituting the following identity developed at the end of the normal uniform series:

$$\frac{(1+i)^n - 1}{i} = [(1+i)^{n-1} + (1+i)^{n-2} + (1+i)^{n-3} + \ldots + (1+i)^2 + (1+i) + 1]$$

which is the same as the preceding cofactor series, yields the following:

$$i\,S_G = \frac{(1+i)^n - 1}{i}\,G - nG$$

Solving the above for S yields:

$$S_G = \left(\frac{(1+i)^n - 1}{i} - n\right)\frac{G}{i}$$

or

Future sum of an arithmetic gradient

$$S_G = \frac{(1+i)^n - 1 - i\,n)}{i^2}\,G$$
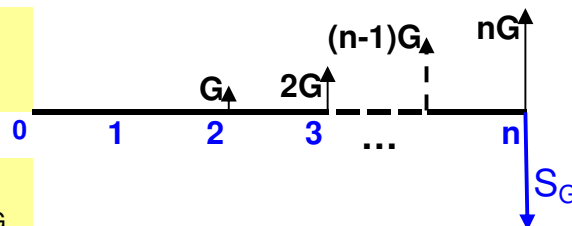
Solving for G

$$G = \frac{i^2}{(1+i)^n - 1 - i\,n)}\,S_G$$

Arithmetic gradient of a future sum

Part 3: From the compound development is the present value of a future sum.

$$P_G = S_G / (1+i)^n$$
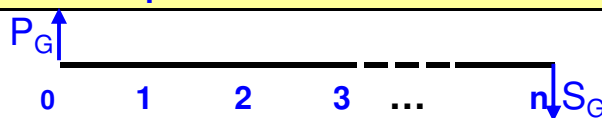
Part 4: Substituting S_G in terms of G into the above yields

Present value of an arithmetic gradient

$$P_G = \frac{(1+i)^n - 1 - i\,n)}{i^2\,(1+i)^n}\,G$$
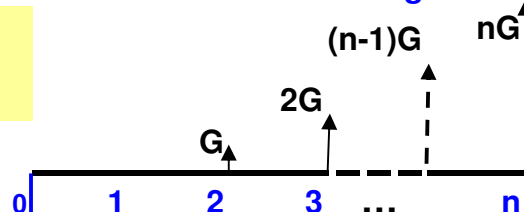
Solving for G

$$G = \frac{i^2\,(1+i)^n}{(1+i)^n - 1 - i\,n)}\,P_G$$

Arithmetic gradient of a Present value

EXAMPLE: (arithmetic gradient)

1. Assume you buy a new car, and the dealer will shoulder all the maintenance cost the first year. The dealer offers to sell you maintenance service plan as below. What should you pay for it? Assume the commercial rate of interest is 8% per year.

n	P
0	0
1	10,000
2	11,000
3	12,000
4	13,000
5	14,000

Solution:
It is critical to recognize that the composite series consists of a uniform series and an arithmetic gradient. Once that step is accomplished, the solution is simple:

Cash flow diagram:

$\parallel$

uniform series
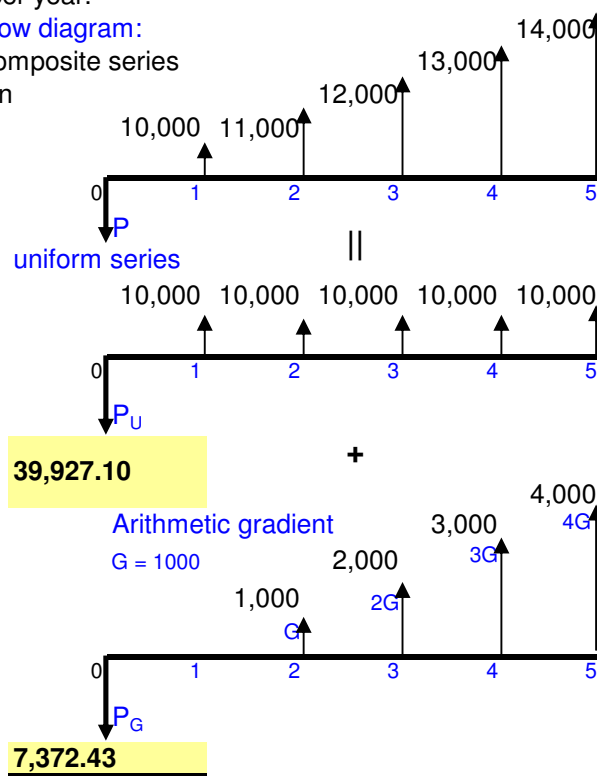
$$P_U = \frac{(1+i)^n - 1}{i\,(1+i)^n}\ A$$

$$P_U = \frac{(1+.08)^5 - 1}{0.08\,(1+.08)^5}\ 10{,}000$$

$$P_U = \frac{0.469328077}{0.117546246}\ 10{,}000\ =\ \boxed{39{,}927.10}$$

$$P_G = \frac{(1+i)^n - 1 - i\,n)}{i^2\,(1+i)^n}\ G$$

$$P_G = \frac{(1+.08)^5 - 1 - .08(\,5)}{0.08^2\,(1+.08)^5}\ 1{,}000$$

$$P_G = \frac{0.069328077}{0.0094037}\ 1{,}000\ =\ \underline{7{,}372.43}$$

$$P\ =\ P_U + P_G\ =\ \boxed{47{,}299.53}$$

Geometric Gradient Series (Revised 12 Jan 2003)

Part 1: Solution for the present value of the geometric gradient

Geometric gradient series are series in which the value of the nth term in the series is similar to compounding single-payment equation. We derive the formula by taking the present value of each term as follows:

$$P_1 = A \frac{1}{(1+i)}$$

$+$

$$P_2 = A \frac{(1+g)}{(1+i)^2}$$

$+$

$$P_3 = A \frac{(1+g)^2}{(1+i)^3}$$

$+$

$$P_4 = A \frac{(1+g)^3}{(1+i)^4}$$

$+$

$\ldots$

$+$

$$P_n = A \frac{(1+g)^{n-1}}{(1+i)^n}$$
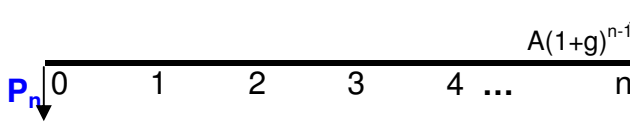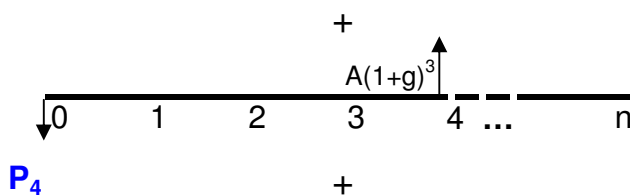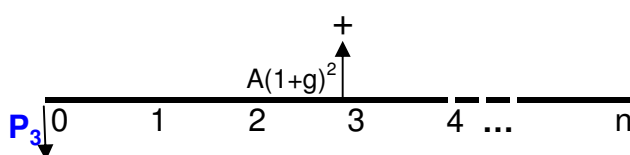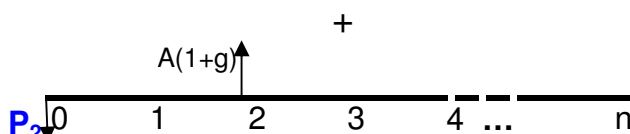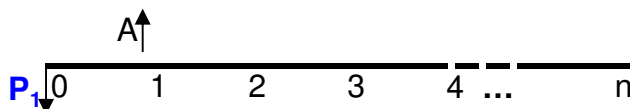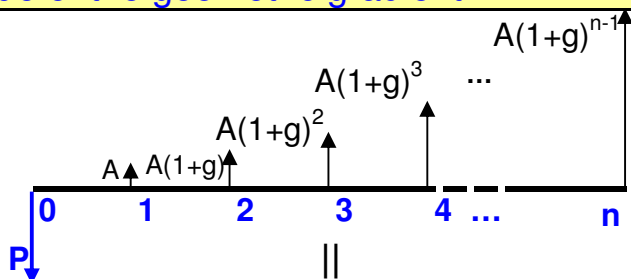
Summing the individual parts, and at the same time extracting the common term $(1+i)^{-1}$:

$$P = A(1+i)^{-1}(1 + a + a^2 + a^3 + \ldots + a^{n-1})$$

where

$$a = \frac{(1+g)}{(1+i)}$$

Multiplying both sides of the above equation by **a**, yields the following:

$$aP = A(1+i)^{-1}(a + a^2 + a^3 + \ldots + a^{n-1} + a^n)$$

Subtracting the latter equation, above, from the former, yields the following:

$$P = A(1+i)^{-1}(1 + a + a^2 + a^3 + \ldots + a^{n-1} \quad)$$
$$aP = A(1+i)^{-1}(\quad a + a^2 + a^3 + \ldots + a^{n-1} + a^n)$$
$$P - aP = A(1+i)^{-1}(1 - a^n)$$

Solving the above for P yields:

$$P = A \frac{(1 - a^n)}{(1 + i)(1 - a)}$$

Reconstituting **a** in terms of **g** and i yields:

$$P = A \frac{1 - \left[\frac{(1+g)}{(1+i)}\right]^n}{(1+i)\left[1 - \frac{(1+g)}{(1+i)}\right]}$$

Simplifying the above yields:

$$P = A \frac{1 - \frac{(1+g)^n}{(1+i)^n}}{(i - g)}$$

Present value of a geometric gradient series

The above equation becomes indeterminate as $g \rightarrow i$
For the case where $g = i$, use the following equation:

$$P = A \, n / (1+i)$$

EXAMPLE: (Geometric gradient series)
  1. Assume you buy a new truck, and the dealer will shoulder all the maintenance cost the first year. The purchase includes a 5-year maintenance service plan that is increases 10% each year. Assume the first year maintenance cost is P15,000. What is the present value of the plan? Assume that $i = 10\%$

Solution:

Cash flow diagram:

The critical step in this solution is to recognize it as a geometric gradient, with A = 15,000, and g = .05
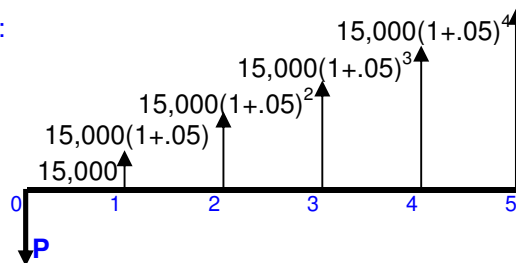
$$P = A \frac{1 - \frac{(1+g)^n}{(1+i)^n}}{(i - g)}$$

$$P = 15{,}000 \frac{1 - \frac{(1+.05)^5}{(1+.10)^5}}{(.10 - .05)}$$

$$P = 15{,}000 \frac{0.207529564}{0.05} = \underline{62{,}258.87}$$

2. Your new project has a cost estimate of ₱100 million in present year pesos (no inflation), with an estimated expenditure rate of 20 million / year, with the first disbursement at the end of year 1.

a. What actual amount of pesos will be expended at the end of the project? For each year?

Caution: several different assumptions can be made as to how to apply the rate of inflation, such as to the whole year, or to the mid-point. We assume to the whole year, as below:

Without inflation in millions

20 20 20 20 20

| | 1 | 2 | 3 | 4 | 5 | S |

$A_1 = 20\,(1.05)^1 =$ 21.000 million

With inflation in millions

21 22+ 23+ 24+ 25+

| | 1 | 2 | 3 | 4 | 5 | S |

$A_2 = 20\,(1.05)^2 =$ 22.050 million

$A_3 = 20\,(1.05)^3 =$ 23.153 million

$A_4 = 20\,(1.05)^4 =$ 24.310 million

$A_5 = 20\,(1.05)^5 =$ 25.526 million

S = **116.038** million **Actual, or historic pesos.**
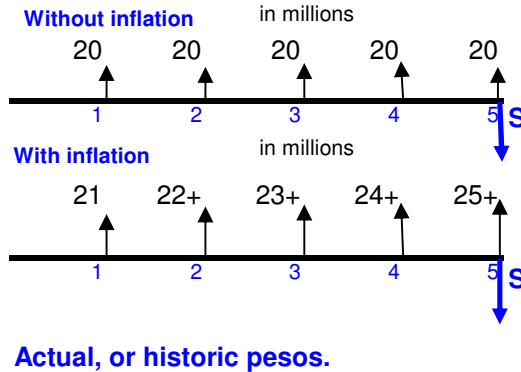
b. Use the geometric gradient series equation from the extra-credit Homework to solve for S

$$S = \frac{1 - \dfrac{(1+g)^n}{(1+i)^n}}{(i-g)\,(1+i)^n}\,A$$

NOTE: $i = 0$, and
A = 21 million

$A(1+.05)^4$
$A(1+.05)^3$
$A(1+.05)^2$
$A(1+.05)$
A

| 0 | 1 | 2 | 3 | 4 | 5 |

S

$$S = \frac{1 - \dfrac{(1+.05)^5}{1}}{(-.05)}\;21\text{million}$$
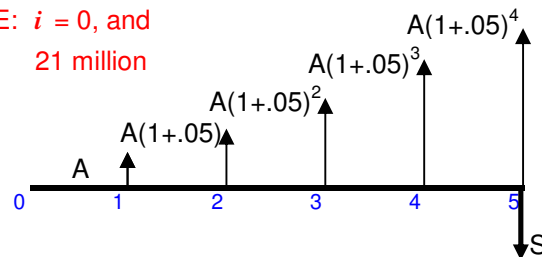
$$A = \frac{1 - 1.28}{-0.05}\;21{,}000{,}000 = \mathbf{116{,}038{,}256.25}\quad\textbf{Actual, or historic pesos.}$$

Note: A = 21, and not 20. Also, i =0 because we are isolating the effect of inflation from other financial considerations.

c. How to state multi-year project cost is a major concern to both public and private owners. Future inflation is a guess, and the public is uneducated about the effects of inflation on future costs. While **inflation is not a real cost growth**, it is perceived to be so by the general public, and many otherwise educated owners. Therefore, project engineers should develop a projected expenditure estimate based on expected rates of inflation. Always caveat the publication of such estimates as "subject to revision due to unexpected variations in the assumed inflation rates."

HOMEWORK: (Geometric gradient series)

1. (Extra credit). Derive the equation for the future sum of a geometric gradient series.

Continuous Compounding and Infinite Series (Revised 12 Jan 2003)

Continuous compounding

In times of high economic activity, lending agencies and organizations, in their zeal to induce investors to deposit money into their organizations, often advertise more frequent compounding periods, such as semi-annually, quarterly, monthly, weekly, daily, or even continuously. Derived below are the continuous compounding relationships:

From the discussion on effective interest rate comes the following equation:

1) $(1 + i)^n = (1 + i_n/q)^{nq}$

    where

    q = the number of compounding periods in the year

2) Let $x = i_n/q$

    Solving for q

    n = number of years

3) $q = i_n/x$

    i_q = the nominal annual interest rate

    Substituting 2) & 3) into 1)

    i_q = the interest rate for the compounding period

4) $(1 + i)^n = [(1 + x)^{1/x}]^{i_n n}$

    i = the *equivalent* interest rate (one compounding period / year)

    Consider the following limit:

5) $\underset{x \to 0}{\text{Limit}} (1 + x)^{1/x} = e$ where $e = 2.71828\ldots$

Consider from 2) that $x \to 0$ only as $q \to \infty$, which is the condition of continuous compounding. Thus for continuous compounding the relation is

$$\underset{q \to \infty}{\text{Limit}} (1 + i_n/q)^{nq} \quad = \quad \underset{x \to 0}{\text{Limit}} [(1 + x)^{1/x}]^{i_n n} \quad = \quad e^{i_n n}$$

Substituting the above limits into 4) yields:

6) $[1+i]^n = e^{i_n n}$

    or, taking the nth root of both sides

7) $[1+i] = e^{i_n}$

    and solving for i

8) $i = e^{i_n} - 1$

Substitute equations 6), 7) and/or 8) into any of the previously derived interest formulas to convert them to continuous compounding.   Note that the interest is expuresed as a nominal rate, i_n, because the rate for an infintesimal period would be meanngless.

Compound, single payment:

$$S = P \, e^{i_n n} \qquad\qquad P = S / \, e^{i_n n}$$
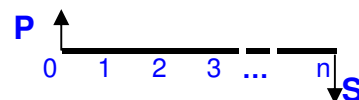
Future value of a uniform series (normal)

$$S = \frac{e^{i_n n} - 1}{e^{i_n} - 1} A \qquad\qquad A = \frac{e^{i_n} - 1}{e^{i_n n} - 1} S$$
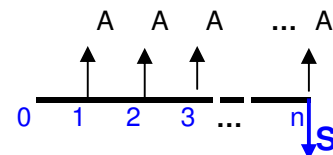
Present value of a uniform series (normal)

$$P = \frac{e^{i_n n} - 1}{(e^{i_n} - 1) \, e^{i_n n}} A \qquad\qquad A = \frac{(e^{i_n} - 1) \, e^{i_n n}}{e^{i_n n} - 1} P$$
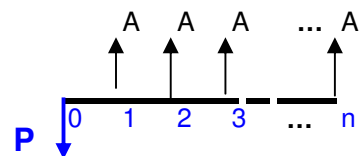
Infinite Series

An infinite series only has meaning to present worth. Consider the equation below for a uniform series (normal):

$$A = \frac{i\,(1+i)^n}{(1+i)^n - 1}\,P$$

Dividing the numerator and demonitor by $(1+i)^n$ yields:

$$\frac{(1+i)^n}{(1+i)^n} = 1$$

$$A = \frac{i}{1 - 1/(1+i)^n}\,P$$

$$\lim_{n \to \infty} \frac{i}{1 - 1/(1+i)^n} = i$$

$$A = i\,P \qquad \text{for an infinite series}$$

solving for P

$$P = A / i$$

EXAMPLE:

You borrow 1 million pesos from me at 10% per month. You can't pay back the principal, so I say: "Just pay the interest each month." You pay interest for one year, and then ask about your balance. What is your unpaid balance? If you continue to pay just interest, when will your payments end?

It is fundamental to realize that for any payment series, the loan's principal must be eventually repaid if the loan payments are to end. In this example, paying only the interest means the principal is never reduced. So the payments will continue indefinitely under such conditions.

This is an example of the second-most enviable position of the ultimate capitalist -- to live entirely off the interest payments without ever diminishing his capital (the first-most enviable position is to actually increase his capital while living entirely off the interest payments.)

Spreadsheet solutions

The spreadsheet was the initial '*killer application*' that, together with the personal computer, revolutionized personal computer sales and usage. Spreadsheets were available on main-frame computers before the advent of personal computers, but it was the PC that brought the power and ease of the spreadsheet to the common person, sparking the Personal Computer revolution.

 For very regular cash-flow streams, the complex interest formulas can be applied. But for the more frequent occurrence of irregular cash-flow streams occurring in feasibility studies, the use of spreadsheet greatly facilitates analysis and parametric studies.

Several spreadsheet example solutions, with cell formulas, are presented herein. These can be accessed by either clicking on the tabs at the bottom of this page, or clicking on the hyperlink button or description below.

Compound interest	Equal-principal series	Uniform series
Cascading solutions		Present value of a uniform series
Present value of a future sum		Uniform series of a single value
Future value of a present sum		

Cascading spreadsheet solutions

Most of the spreadsheet solutions presenting herein utilize a cascading solution technique. Simply put, the cascading solution employs the results of the previous row to compute values in the successor row. This type of solution is very easy to set up in a spreadsheet, and greatly simplifies the formulaic requirements. In fact, it is possible to set up complex solutions knowing only the very basic formulas.

	A	B	C	D	E	F	D	D	F	F
1	Loan of	P	=	100		to be repaid at the end of 12 years				
2		i	=	1%		per year				
3		I_n	=	i	x	S_n (*annual unpaid balance*)				
4										
5	Cascading Solution Examples						formula		formula	
6							$I_n =$	$I_n =$	$S_n =$	$S_n =$
7	n	P		I_n		S_n	$i\,S_{n-1}$	cell formula	$S_n = S_{n-1} + I_n$	cell formula
8	0	100		0		100.00	0	0	$S_0 = P$	= B1
9	1			1.00		101.00	$I_1 = i\,S_0$	=D$2*F8	$S_1 = S_0 + I_1$	=F8+D9
10	2			1.01		102.01	$I_2 = i\,S_1$	=D$2*F9	$S_2 = S_1 + I_2$	=F9+D10
11	3			1.02		103.03	$I_3 = i\,S_2$	=D$2*F10	$S_3 = S_2 + I_3$	=F10+D11
12	4			1.03		104.06	$I_4 = i\,S_3$	=D$2*F11	$S_4 = S_3 + I_4$	=F11+D12
13	5			1.04		105.10	$I_5 = i\,S_4$	=D$2*F12	$S_5 = S_4 + I_5$	=F12+D13
14	6			1.05		106.15	$I_6 = i\,S_5$	=D$2*F13	$S_6 = S_5 + I_6$	=F13+D14
15	7			1.06		107.21	$I_7 = i\,S_6$	=D$2*F14	$S_7 = S_6 + I_7$	=F14+D15
16	8			1.07		108.29	$I_8 = i\,S_7$	=D$2*F15	$S_8 = S_7 + I_8$	=F15+D16
17	9			1.08		109.37	$I_9 = i\,S_8$	=D$2*F16	$S_9 = S_8 + I_9$	=F16+D17
18	10			1.09		110.46	$I_{10} = i\,S_9$	=D$2*F17	$S_{10} = S_9 + I_{10}$	=F17+D18
19	11			1.10		111.57	$I_{10} = i\,S_9$	=D$2*F18	$S_{11} = S_{10} + I_{11}$	=F18+D19
20	12			1.12		112.68	$I_{10} = i\,S_9$	=D$2*F19	$S_{12} = S_{11} + I_{12}$	=F19+D20

Compound interest

There are four spreadsheet examples on this page:

Button	Description	Value type	Formula
Loan	**cascading solution**	**Future value of a present amount**	$S = P(1+i)^n$
Loan	**formulaic solution**	**Future value of a present amount**	$S = P(1+i)^n$
Note	**Promissory note** (cascading)	**Present value of a future amount**	$P = S/(1+i)^n$
Note	**Promissory note** (formulaic)	**Present value of a future amount**	$P = S/(1+i)^n$

Example: Loan to be repaid at end of year 10

	A	B	C	D	E	F	G	H
1								
2		Loan of P	=	100				
3		i	=	1%		per year		
4		I_n	=	i		x	**prior balance**	
5		A	=	*annual payment*				
6		n	=	10				
7								
8				**Spreadsheet Solution (cascading)**				
9		**A**				I_n		
10	**n**	**Payment**	**=**	**Principal**	**+**	**Interest**		**Balance**
11	0							100.00
12	1					1.00		101.00
13	2					1.01		102.01
14	3					1.02		103.03
15	4					1.03		104.06
16	5					1.04		105.10
17	6					1.05		106.15
18	7					1.06		107.21
19	8					1.07		108.29
20	9					1.08		109.37
21	10			100.00		1.09		110.46
22								
23	**S =**	110.46	**=**	100.00	**+**	10.46		

Cell Formulas

	A	B	C	D	E	F	G	H
14	3					=D$5*H13		=H13+D14
15	4					=D$5*H14		=H14+D15
16	5					=D$5*H15		=H15+D16

	A	B	C	D	E	F	G	H
9				**Spreadsheet Solution (formulaic)**				
10				$S_n =$				
11	n			$P(1+i)^n$				
12	0			100.00				
13	1			101.00				
14	2			102.01				
15	3			103.03				
16	4			104.06				
17	5			105.10				
18	6			106.15				
19	7			107.21				
20	8			108.29				
21	9			109.37				
22	10			110.46				

	A	B	C	D	E
				$100(1+.01)^3$	**formula**
15	3			=D$3*(1+D$4)^A15	**cell formula**
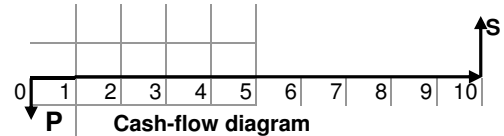
Cash-flow diagram

Note the cash-flow diagram, above. It represents graphically what the spread-sheet (or formula) is calculating. It is usually wise to draw the cash-flow diagram first, then pick the appropriate formula or spreadsheet solution to match it.

This example illustrates the time-value of money. In this case, it is the future value of a present amount. Note that the un-paid interest becomes part of the unpaid balance, and thus subject to interest at the next compounding period.

This particular example can be as easily solved by the formula, and thus is un-common to be applied to a spreadsheet. The value in utilizing a spreadsheet, however, lies in the presentation of all annual early payoffs that the borrower could avail of to liquidate the debt.

An alternate solution is to simply use the formula directly in the cell. While such a solution is trivial for a single value, it becomes very useful for a series of values, especially a non-uniform series.

Example: Note with a future value 112.68, redeemable in year 10

Cash-flow diagram (0 1 2 3 4 5 6 7 8 9 10), with P at origin and S axis.
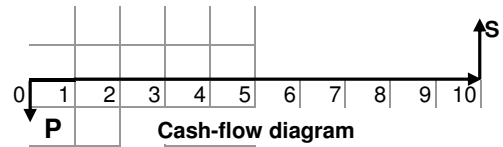
	A	B	C	D	E	F	G	H
2		Note of S	=	112.68				
3		**Discount rate of i**	=	1%		per year		
4			I_n =	i		x	**prior balance**	
5			A =	*annual payment*				
6			n =	10				
7								
8				**Spreadsheet Solution (cascading)**				
9		**A**				I_n		
10	**n**	**Payment**	=	**Principal**	+	**Interest**		**Balance**
11	1							100.00
12	9					1.00		101.00
13	2					1.01		102.01
14	3					1.02		103.03
15	4					1.03		104.06
16	5					1.04		105.10
17	6					1.05		106.15
18	7					1.06		107.21
19	8					1.07		108.29
20	9					1.08		109.37
21	10			100.00		1.09		110.46
22								
23	**S =**	110.46	=	100.00	+	10.46		

Cell Formulas

	A			D		F		H
14	3					=D$5*H13		=H13+D14
15	4					=D$5*H14		=H14+D15
16	5					=D$5*H15		=H15+D16

	A	B	C	D	E	F
9				**Spreadsheet Solution (formulaic)**		
10	**S =**	**110.46**		**P_n =**		
11	n			**$S/(1 + i)^n$**		
12	0			110.46		
13	1			109.37		
14	2			108.28		
15	3			107.21		
16	4			106.15		
17	5			105.10		
18	6			104.06		
19	7			103.03		
20	8			102.01		
21	9			101.00		
22	10			100.00		**Present value of 110.46 redeembale in 10 years at a discount rate of 1%/yr**

	A			D		F
				$110.46 / (1 + .01)^3$		formula
15	3			=D$2/(1+D$4)^A15		cell formula

Note: It is common in the loan industry to resell a promissory note, especially those that have collateral, to a third party. The primary reason is that the borrower is then estopped to claim any latent defects (not apparent on the face of the note.)

This example illustrates the time-value of money. In this case, it is the present value of a future amount. The spreadsheet solution is exactly the same as future value, just read backwards.

This particular example can be as easily solved by the formula, and thus is un-common to be applied to a spreadsheet. The value in utilizing a spreadsheet, however, lies in the presentation of the rising value of the note as the maturity time decreases

An alternate solution is to simply use the formula directly in the cell. While such a solution is trivial for a single value, it becomes very useful for a series of values, especially a non-uniform series.

Equal-principal series
to be repaid each year at P/10 + interest

Cash-flow diagram

	A	B	C	D	E	F	G	H
1								
2		Loan of P	=		100			
3			i	=	1%		per year	
4			I_n	=	i	x	prior balance	
5			A	=	*annual payment*			
6			n	=	10			
7								

This particular series was once very popular in paying off loans because it is so easy to calculate. It has been largely superceded by the uniform series.

This example illustrates the time-value of money. In this case, it is the present value of a future amount. The spreadsheet solution is exactly the same as future value, just read backwards.

	A	B	C	D	E	F	G	H
8				Spreadsheet Solution				
9		A		P/10		I_n		
10	n	Payment	=	Principal	+	Interest		Balance
11	0							100.00
12	1	11.00		10.00		1.00		90.00
13	2	10.90		10.00		0.90		80.00
14	3	10.80		10.00		0.80		70.00
15	4	10.70		10.00		0.70		60.00
16	5	10.60		10.00		0.60		50.00
17	6	10.50		10.00		0.50		40.00
18	7	10.40		10.00		0.40		30.00
19	8	10.30		10.00		0.30		20.00
20	9	10.20		10.00		0.20		10.00
21	10	10.10		10.00		0.10		0.00
22								
23	SUM	105.50	=	100.00	+	5.50		

		Cell Formulas					
14	3	=D14+F14	=D$4/10	=D$5*H13		=H13-D14
15	4	=D15+F15	=D$4/10	=D$5*H14		=H14-D15
16	5	=D16+F16	=D$4/10	=D$5*H15		=H15-D16

Uniform Series

There are two spreadsheet examples on this page:

Loan — uniform series of a present amount — cascading solution

PV — present value of a uniform series | formulaic solution

Loan to be repaid in uniform (equal) payments

P | Cash-flow diagram

	A	B	C	D	E	F	G	H
1								
2	Consider the following example:							
3	Loan of	P	=	100				
4		i	=	1%		per year		
5		I_n	=	i	x	prior balance		
6		A	=	10.56		*annual payment*		
7		n	=	10				
8			Spreadsheet Solution (cascading)					
9		**A**		I_n		P_n		
10	**n**	**Payment**	**−**	**Interest**	**=**	**Principal**		**Balance**
11	0							100.00
12	1	10.56		1.00		9.56		90.44
13	2	10.56		0.90		9.66		80.78
14	3	10.56		0.81		9.75		71.03
15	4	10.56		0.71		9.85		61.18
16	5	10.56		0.61		9.95		51.23
17	6	10.56		0.51		10.05		41.19
18	7	10.56		0.41		10.15		31.04
19	8	10.56		0.31		10.25		20.79
20	9	10.56		0.21		10.35		10.44
21	10	10.54		0.10		10.44		0.00
22								
23	SUM	105.58	−	5.58	=	100.00		

Cell Formulas

14	3	=D14+F14	=D$4/10	=D$5*H13	=H13-D14
15	4	=D15+F15	=D$4/10	=D$5*H14	=H14-D15
16	5	=D16+F16	=D$4/10	=D$5*H15	=H15-D16
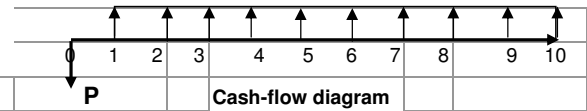
The uniform series of a present value must be calculated from the formula below.

$$A = \frac{i(1+i)^n}{(1+i)^n - 1} P$$

A	=	0.105582077 100
A	=	10.55820766

This particular series is now the most popular in paying off loans because it's uniform (equal) payments are easy to apply to automatic payments from payroll deductions and bank accounts. It is the standard form for a real estate mortgage. This spreadsheet form provides information on early payoff.

The drawback to this series is that it initially requires the calculation of A from a rather complex formula, above, and that result usually entails fractional cents, which can't be applied to payments. The solution to the fractional cents is to apply them all to the final payment.

Present Value of a uniform series

Suppose we want to calculate the present value of the time series to the right. In this case, the series is significantly different from our formulaic representation. One solution, presented here, is to break the problem into two parts: 1) being the formulaic solution, and 2) resolving the formulaic solution to the problem at hand.

A = 100

P | Cash-flow diagram

||

P_1	=	$\dfrac{(1+i)^n - 1}{i(1+i)^n} A_1$	n	=	8
			i	=	5%
			A_1	=	100

fx = PV
P_1= $646.32
646.32
formula

$A_1 = 100$

P_1 diagram 1

$S_2 = P_1$

+

P_2	=	$S_2/(1+i)^n$	n	=	2
			i	=	5%
			S_2	=	P_1

P_2=   586.23

S_2
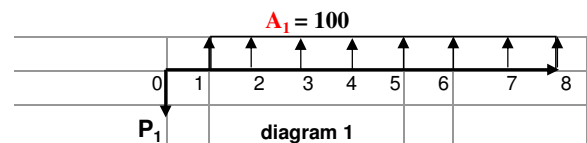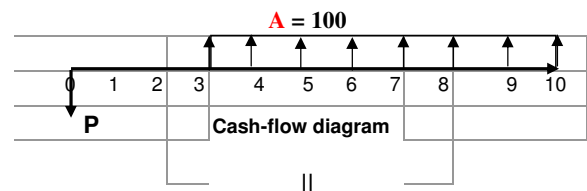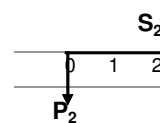
P_2 diagram 2

Lesson Plan 10 – Deleted

(Material relocated)

Lesson Plan 11

Introduction to Financial Justification of Projects - 1 hour

INTRODUCTION TO FINANCIAL JUSTIFICATION OF PROJECTS

MARKETABLE PRODUCT LIFECYCLE
>   Complex cash flow
>   Multiple year execution

METHODS OF FINANCIAL ANALYSIS

The Project Estimate
>   The first essential task on a project, after developing the scope, is to develop the cost estimate

Net Present Value (NPV)

$$\text{NPV} = \Sigma\ S_k / (1+i)^k \quad , k=1,n$$

What i to use?
>   Commercial projects
>>   Money market rates
>>   Commercial loan rates
>>   Bond market
>>   Company Policy (internal financing)
>   Government projects
>>   Treasury Notes
>>   Government bonds
>>   Legislative fiat
>>   Policy

Internal Rate of Return (IRR)
Solve i for NPV=0
>   Trial & error
>   Graphical
>   Interpolation
>   May be multiple solutions

What to compare IRR to?

Minimum Acceptable Rate of Return (MARR)
>   MARR set by risk assessment, and profit policies
>   Risk vs. Interest rate
>>   Risk of inflation
>>   Risk of catastrophe (or cost of insurance, insurance rate)
>>   Risk of security and theft
>>   Risk of competition and obsolescence
>>   Risk of product liability and litigation (or cost of insurance, insurance rate)
>>   Risk of marketing failure
>>>   Finding the optimum price vs. demand
>>>   the cost-price conundrum: *the lower the demand, the higher the cost*
>>>   Finding the right advertising approach
>>>   Creating market demand where none exists
>   Other feasible projects competing for funding

Benefit/Cost Ratio (B/C ratio) Government

A *benefit/cost ratio* is equivalent to an ROI calculation. Costs are determined the same way. The difference is in how *benefits* are calculated. For commercial projects, benefits are forecasts as profit streams. But in the government projects, generally there are no profits. Instead, there are *tangible and intangible benefits* for which a monetary value is *imputed*.

The imputation of the monetary value of a benefit in most cases is quite logical, sometimes based on actuary tables, experienced occurrences which can be converted to a probability, and sometimes on government policy. However, sometimes the imputation is quite arbitrary, and subject to criticism.

Effects of Inflation

Generally, inflation should not be taken into account for the financial justification of a project. Furthermore, all costs and benefits should be determined in the same base year (e.g., 2003 pesos). Any costs or benefits stated in other base years should be converted to the common base year. Unfortunately, some government agencies erroneously, or deliberately, add in the anticipated effects of inflation on imputed benefits, which distorts the true benefit-cost relationship, particularly if a high rate of inflation is assumed, and a low discount rate is used to determine net present value. Such practice is sometimes employed to justify projects which otherwise would not yield a benefit cost ration ≥ 1.

Exceptions. An exception exists for determining future project budgets, and estimating project costs in historic currency. For these projections, it is often desirable to add in the estimated effects of inflation.

Price erosion due to inflation. Many products reaching the stage where the product becomes a commodity (i.e., there is little brand loyalty among consumers, prices cannot be raised without losing market share, and, in fact, the product suffers an invisible price erosion as the price remains unchanged, in effect lowered in value due to inflation (lower purchasing power of the currency.) If the projected profits cover such a period, the apparent profits should be reduced to reflect the 'real' profit.

Feasibility · Planning · Design · Contracting · Plant or Facility Construction

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

negative cash flow

MARKETABLE PRODUCT LIFECYCLE

(revenue-expenditures)

IS THIS PROJECT PROFITABLE ??

Positive cash flow

30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60

Shakedown · Ramp-up · Market ownership · Competition enters product market · Mature

Arithmetically declining

60 · 120

PV_{costs}

$i = 0.5\%$ $\quad S_k / (1+i)^k$

k	$S_{0.k}$	PV
0	0	0.0
1	-5	-5.0
2	-5	-5.0
3	-10	-9.9
4	-15	-14.7
5	-10	-9.8
6	-15	-14.6
7	-25	-24.1
8	-25	-24.0
9	-40	-38.2
10	-25	-23.8
11	-5	-4.7
12	0	0.0
13	-50	-46.9
14	-20	-18.7
15	-25	-23.2
16	-35	-32.3
17	-40	-36.7
18	-60	-54.8
19	-60	-54.6
20	-60	-54.3
21	-60	-54.0
22	-60	-53.8
23	-60	-53.5
24	-60	-53.2
25	-60	-53.0
26	-60	-52.7
27	-45	-39.3
28	-30	-26.1
29	-15	-13.0
30	0	0.0
31	-5	-4.3
32	-10	-8.5
33	-5	-4.2
Σ	-1000	910.9 PV_{costs}

ignore sign

PV_{cost}

$PV_{benefits}$ (government project) — $PV_{profits}$ (commercial project)

k	S_k	PV	k	S_k	PV	k	S_k	PV
34	10	8.44	61	60	44.26	91	30	19.1
35	30	25.2	62	59	43.31	92	29	18.3
36	70	58.5	63	58	42.36	93	28	17.6
37	90	74.8	64	57	41.42	94	27	16.9
38	95	78.6	65	56	40.49	95	26	16.2
39	100	82.3	66	55	39.57	96	25	15.5
40	100	81.9	67	54	38.66	97	24	14.8
41	100	81.5	68	53	37.76	98	23	14.1
42	100	81.1	69	52	36.86	99	22	13.4
43	100	80.7	70	51	35.97	100	21	12.8
44	100	80.3	71	50	35.09	101	20	12.1
45	100	79.9	72	49	34.22	102	19	11.4
46	100	79.5	73	48	33.35	103	18	10.8
47	100	79.1	74	47	32.49	104	17	10.1
48	100	78.7	75	46	31.64	105	16	9.48
49	95	74.4	76	45	30.8	106	15	8.84
50	90	70.1	77	44	29.97	107	14	8.21
51	85	65.9	78	43	29.14	108	13	7.59
52	80	61.7	79	42	28.32	109	12	6.97
53	75	57.6	80	41	27.51	110	11	6.36
54	70	53.5	81	40	26.71	111	10	5.75
55	65	49.4	82	39	25.91	112	9	5.15
56	63	47.6	83	38	25.12	113	8	4.55
57	62	46.7	84	37	24.34	114	7	3.96
58	61	45.7	85	36	23.56	115	6	3.38
59	60	44.7	86	35	22.79	116	5	2.8
60	60	44.5	87	34	22.03	117	4	2.23
			88	33	21.28	118	3	1.67
			89	32	20.53	119	2	1.1
			90	31	19.79	120	1	0.55

(imputed) $PV_{benefits}$ $PV_{profits}$

Σ 2161 **1712** + Σ 1365 **945.3** + Σ 465 **282** = 3991 **2939**

Net Present Value

NPV = $PV_{profits}$ − PV_{costs} = 2939.3 − -910.9 = **2028.4**

Benefit-Cost Ratio

$$B/C_{ratio} = \frac{PV_{benefits}}{PV_{costs}} = \frac{2939}{910.9} = 3.2$$

IRR - Trial & Error Solution

IRR = The discount rate at which NPV = 0 = 3.678% compounded month

$i_n = q\, i_q = 12 \times 3.68\% = $ **44.1%** nominal annual rate

$i_a = (1 + i_q)^q - (1+.03678)^{12} - 1 = $ **54.3%** effective annual rate

Interpolation for IRR

	a	3%	150.9	b
0.01		x	0	200.8
		4%	-49.9	

$$\frac{a}{0.01} = \frac{b}{200.8} = \frac{150.9}{200.8}$$

$$a = 0.01 \frac{150.9}{200.8} = 0.0075$$

x = 3% + **a** = 3% + 0.75% = **3.751%**

Graphical Solution for IRR

Graphical Solution for Discount Rate @ NPV=0
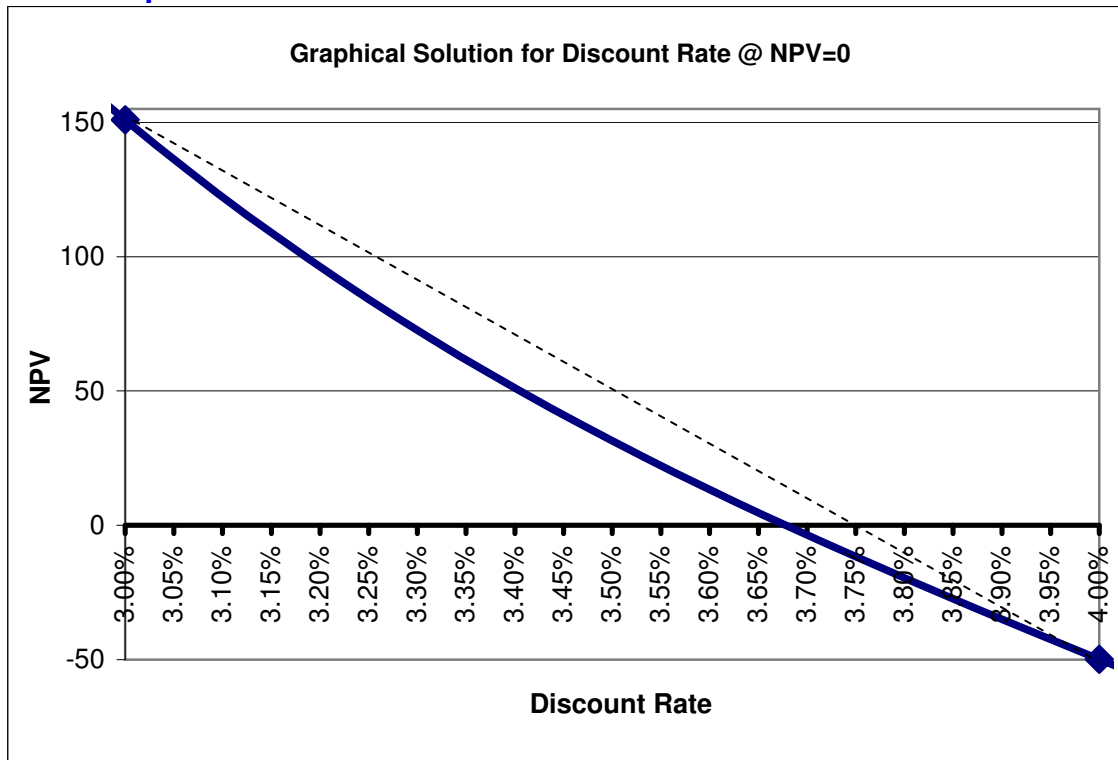
0.5%	2028
1%	1357
2%	553.2
3%	150.9
4%	-49.9
5%	-146.6

(y-axis: NPV, values 150, 100, 50, 0, -50)
(x-axis: Discount Rate, values 3.00% through 4.00% in 0.05% increments)

Which Solution to use ?

Most commercial projects will use IRR
Most government projects will use B/C ratio
For comparing alternatives

Test

IRR $\geq$ MARR
B/C $\geq$ 1.0

Rank according to NPV, select highest NPV
Incremental Analysis

Condition of Analysis

**Alternatives must have equal useful lives, or
equivalent (least common multiple)**

HOMEWORK   **NPV, B/C, & IRR**
Given the cashflow diagram to the right, the
values for A_k below, and a discount rate = 5%
Calculate the **NPV**, **B/C ratio**, and **IRR.**
currency values in year 0, time given in years
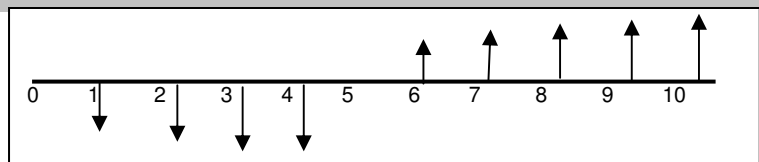
$A_1 =$ -15
$A_2 =$ -20
$A_3 =$ -25
$A_4 =$ -30
$A_5 =$ 0
$A_6 =$ 10
$A_7 =$ 20
$A_8 =$ 30
$A_9 =$ 40
$A_{10} =$ 60

Adjusting a cost estimate for Inflation
(For periodic budgeting purposes)

$\rho = 5\%/yr$

$\rho_q : 0.4\%$ $P_{0,k}(1+\rho_q)^k$

k	$P_{0,k}$	$S_{inflation}$
0	0	0.0
1	-5	-5.0
2	-5	-5.0
3	-10	-10.1
4	-15	-15.2
5	-10	-10.2
6	-15	-15.4
7	-25	-25.7
8	-25	-25.8
9	-40	-41.5
10	-25	-26.0
11	-5	-5.2
12	0	0.0
13	-50	-52.7
14	-20	-21.2
15	-25	-26.6
16	-35	-37.4
17	-40	-42.9
18	-60	-64.6
19	-60	-64.8
20	-60	-65.1
21	-60	-65.3
22	-60	-65.6
23	-60	-65.9
24	-60	-66.2
25	-60	-66.4
26	-60	-66.7
27	-45	-50.2
28	-30	-33.6
29	-15	-16.9
30	0	0.0
31	-5	-5.7
32	-10	-11.4
33	-5	-5.7
Σ	-1000	1080.0

ignore sign

Project cost in constant currency (year 0) — **Project cost estimate in historic (deflated) currency**

k	P_k	$S_{inflation}$	k	P_k	$S_{inflation}$	k	P_k	$S_{inflation}$
34	10	11.5	61	60	76.89	91	30	43.4
35	30	34.6	62	59	75.92	92	29	42.2
36	70	81	63	58	74.93	93	28	40.9
37	90	105	64	57	73.94	94	27	39.6
38	95	111	65	56	72.94	95	26	38.3
39	100	117	66	55	71.93	96	25	36.9
40	100	118	67	54	70.91	97	24	35.6
41	100	118	68	53	69.88	98	23	34.3
42	100	119	69	52	68.84	99	22	32.9
43	100	119	70	51	67.79	100	21	31.5
44	100	120	71	50	66.73	101	20	30.2
45	100	120	72	49	65.66	102	19	28.8
46	100	121	73	48	64.59	103	18	27.4
47	100	121	74	47	63.5	104	17	25.9
48	100	122	75	46	62.4	105	16	24.5
49	95	116	76	45	61.29	106	15	23.1
50	90	110	77	44	60.18	107	14	21.6
51	85	105	78	43	59.05	108	13	20.2
52	80	98.8	79	42	57.91	109	12	18.7
53	75	93	80	41	56.76	110	11	17.2
54	70	87.2	81	40	55.6	111	10	15.7
55	65	81.3	82	39	54.43	112	9	14.2
56	63	79.1	83	38	53.25	113	8	12.7
57	62	78.2	84	37	52.06	114	7	11.1
58	61	77.2	85	36	50.86	115	6	9.58
59	60	76.3	86	35	49.65	116	5	8.01
60	60	76.6	87	34	48.43	117	4	6.44
			88	33	47.2	118	3	4.85
			89	32	45.95	119	2	3.24
			90	31	44.7	120	1	1.63

Σ 2161 **2615** + Σ 1365 **1844** + Σ 465 **700** = 3991 **5159**

In this particular example, we will receive inflation forecasts as an annual rate that must be converted to a monthly rate using the equivalent annual rate formula for interest rates.

$$i_a = (1 + i_q)^q - 1$$

which in terms of inflation is

$$\rho_a = (1 + \rho_a)^q - 1$$

Solving for ρ_q.

$$\rho_q = (1 + \rho_a)^{1/q} - 1$$

Assuming an annual rate of inflation of 5%, the monthly equivalent is

$$\rho_q \;=\; (1+.05)^{1/12} - 1 \;=\; \mathbf{0.4074\%} \quad \text{effective monthly rate}$$

Note that in the Present Value problem, the monthly cost estimate is treated as S_k, while in the inflation problem, the monthly cost estimate is treated as P_k. That is because for inflation, the cost is expressed in year 0 currency, and we want to express it in terms of the value of the currency at the time it is expended.

HOMEWORK **Inflation**

Given the cashflow diagram to the right, and the A_k values below, Calculate the series in historic currency for ρ = 5%

currency values in year 0, time given in years
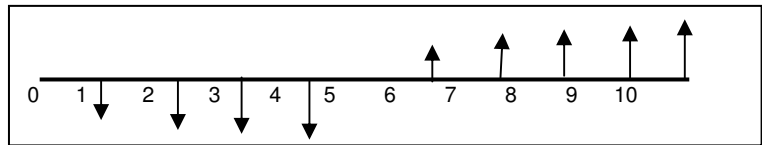
A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_{10}
-15	-20	-25	-30	0	10	20	30	40	60

Minimum Acceptable (or Attractive) Rate of Return (MARR)

MARR is the threshhold for IRR below which a commercial entity is reluctant to proceed. There are many components that can be factored into a MARR. The major factors include the real interest rate, the rate of inflation, and some interest rate increment that compensates for the risks to be incurred. In addition to those discussed below, company policy and governemt edict may dictate additional factors.

r The real interest rate

ρ rate of inflation

f_{risk} interest rate increment sufficient to overcome the perceived risks

f_{other} interest rate increment sufficient to satisfy company policy or government edict

While the Fisher equation gives the exact relationship between r, ρ, and i, for most applications it is sufficienlty accurate in calculating a MARR to treat the factors as simple sums, as follows:

$$\textbf{MARR} = r + \rho + f_{risk} + f_{other}$$

The desirable range of r varies considerably, but may be targeted between 3%/year and 10% per year. It is highly related to how much a firm receives in interest for idle funds.

Any forecast for the rate of inflation carries an inherrent risk of error, and the only guide is to look at historical inflation rates and hazard a trend forecast. The longer the projection is into the future, the more error is likely to compound itself. .

Quantifying risk

Any risk that can be insured against should reflected in the cost estimate as insurance costs, and need not be re-factored into the MARR. All the other myriad risks may be dealt with in either a *risk-aversion* assessment, a probability tree, or simulation models (e.g., monte carlo simulation, or a combination of these techniques.

Risk-aversion assessment

Most of us require a much higher reward for taking on a risk with a high probability of occurring, but require much less reward as the probability of occurrence of the risk diminishes. Risk aversion assessment is a subjective technique that measures the decision-maker's risk aversion preferences and sets the MARR accordingly. The method shifts the burden to the decision maker in a non-threatening manner.

Basic question: Given 100,000 of your money, what minimum ROI would you require to risk all of it if the probility of loss was: (The risked amount should be comparable to the project)

ROI(%)	prob$_{loss}$	Possible scenarios (should be related to decision maker's interest and experience)
1%	0%	bank deposit(with deposit insurance guarantee)
2%	5%	bank deposit(with out deposit insurance guarantee)
5%	10%	stock market (blue chip firms)
10%	15%	stock market (top 100 - 500 firms)
20%	20%	production of an existing product - in a still competitive market
35%	25%	production of a new product - some market analysis
75%	40%	production of a new product - no market analysis
125%	60%	oil well exploration in proven field
200%	99%	oil well exploration in uncharted areas

Assess project probability of failure: **15%**

Sources for estimate on the probability of project failure:

Project team history
Company history
Industry history
Dept. Of Commerce statistics
University studies

Estimate the real rate of return by what the company might get for idle funds.

Estimate the rate of future inflation by observing the past rates of inflation and projecting a trendline.

MARR Related to Risk

Decision Maker's Risk-Reward curve

f_{risk}

Project probability of project failure

Probability of investment failure
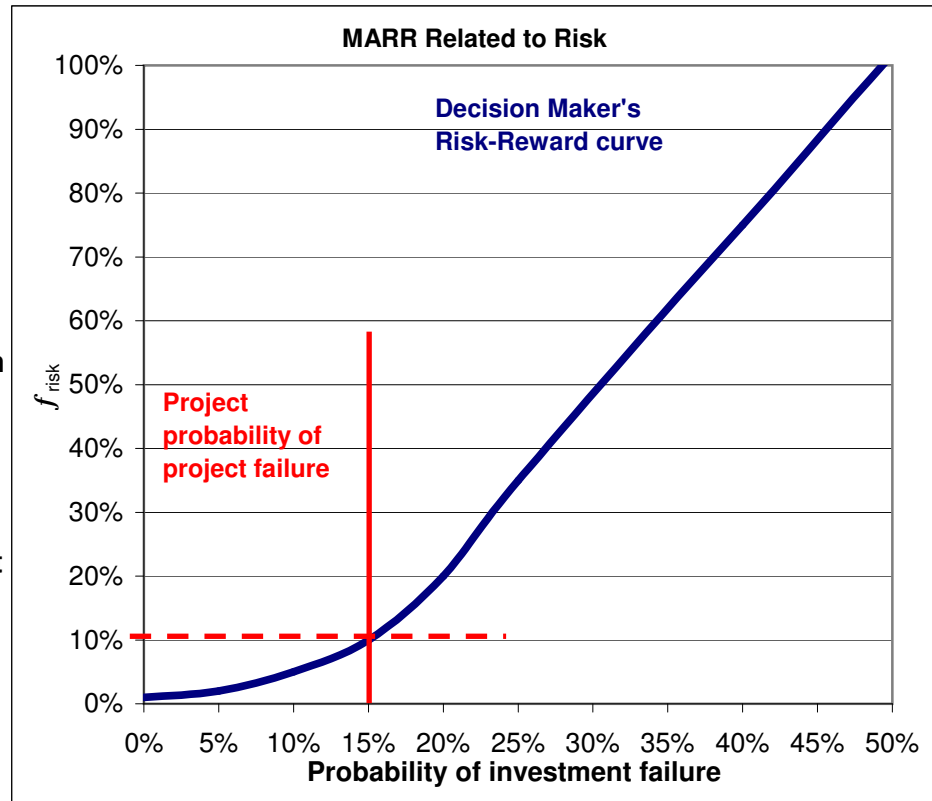
EXAMPLE

Your estimate the company's basic real rate of return is 5% per year, the rate of inflation is projected at 6% per year, and the rate of return associated with risk is estimated at 15%. What is the MARR for your project?

r	=	**5%**	usually based on current yield for idle money
ρ	=	**6%**	trendline forcast based on historical records
f_{risk}	=	**15%**	very subjective and particular to the decision maker(s)
		26%	MARR

GROUP HOMEWORK

Using a technique similar to the Risk Aversion Assessment, above, determine for your group a risk-reward curve. Estimate a probability of project failure for your project (assume it is a commercial project, even if it's a government project). Determine a MARR related to risk for your projct. Estimate the rate of infaltion for the design life of your project. Estimate the the real rate of return for idle funds for your project. Determine the MARR for your project.

Estimating Benefits

The benefit-cost algorithm is utilized primarily in government and not-for-profit organizations as a means of justifying a proposed project that has no profit stream.   For those government projects which have a revenue stream from taxes or user fees which more than cover the costs, the IRR and MARR can be employed, or combined with benefit-cost analysis.

Types of benefits

Suppose a government agency or not-for-profit agency contemplates constructing a bridge or other access improvements in a rural area.
What types of benefits might accrue because of such project?
One answer is to look at the benefits that affect human populations in three major areas:
  1) Benefits in the immediate area of **project** construction
  2) Benefits to the **target** community served
  3) Benefits to secondary communities **connected** to the target area
Another answer is to look at the benefits occurring over time:
  1) Immedite, or **short** term benefits from project execution
  2) **Medium** term benefits after completion of the project, primarily associated with community growth enabled by the project.
  3) **Long**-term benefits from inreasesd security, stability, and sustained commercial activity, and associated sustainable increased tax revenues

We can summarize the potential benefits by time and area in the Table to the left.

Area	Time frame		
	short	medium	long
project	X	x	x
target	x	**X**	**x**
connected	x	x	**X**

The **project** area is the construction area of the project. The bulk of the benefits generated during the construction period will be within this area. As the project moves into the *medium* and *long*-term phases, substantially less benefits are realized in the project area.

The **target** area is the intended primary beneficiary of the project. Relatively little, if any, benefits are obtained during the short construction period. Most of the project benefits occur in the target area after construction, during the middle phase. As the project moves into the long phase, fewer benefits are generated.

The **connected** areas are those that do commerce, trade, and communications with the target area. The connected areas should began to enjoy increased commerce and trade with the target area as the target area improves its position due to the project.

Short Term Benefits (project construction)

The **short** term is the time required to construct the project. In severe economically depressed areas, much of the construction cost might be recaptured as a benefits.

Area	Time frame		
	short	medium	long
project	X	x	x
target	X	**X**	x
connected	x	x	**X**

Project area (project construction area)

1) **Labor**: Employment of the unemployed, if any, in the immediate project area.
   Generally, this benefit is claimed only to the extent that the unemployment rate is reduced.

2) **Equipment**: Purchase or rental of construction equipment.
   Generally, this benefit is claimed only to the extent that equipment utilization is improved.

3) **Materials:** Purchase of construction materials
   Generally, this benefit is claimed only to the extent that material consumption is increased

4) **Commercial Dissruption:** Dissruption of other economic activity
   Disruptions, such as farm lands removed from production, are a negative benefit.

5) **Safety, Health and Well-being:** Accidents mitigated and lives saved
   The reduction of accidental injuries and deaths are counted as a benefit. However, during construction, there are likely to be more, not less injuries and death.

Target area (project primary beneficiary)

1) **Labor**: Employment of the unemployed, if any, in the construction effort
   Generally, this benefit is claimed only to the extent that the unemployment rate is reduced.

2) **Equipment**: Purchase or rental of construction equipment.
   Generally, this benefit is claimed only to the extent that equipment utilization is improved.

3) **Materials:** Purchase of construction materials
   Generally, this benefit is claimed only to the extent that material consumption is increased

4) **Commercial Enhancement:** Enhancement of target area economic activity
   If the target area has construction-related resources, it may benefit during the construction period.

5) **Safety, Health and Well-being:** Accidents mitigated amd lives saved
   More likely negative during the construction period, depending on participation in construction.

Connected areas (project secondary beneficiary)

1) **Labor**: Employment of the unemployed, if any, in the project target area.
   Generally, this benefit is claimed only to the extent that the unemployment rate is reduced.

2) **Equipment**: Purchase or rental of construction equipment.
   Generally, this benefit is claimed only to the extent that equipment utilization is improved.

3) **Materials:** Purchase of construction materials
   Generally, this benefit is claimed only to the extent that material consumption is increased

4) **Commercial Enhancement:** Enhancement of connected area economic activity
   If the seconsary area has construction-related resources, it may benefit during construction.

5) **Safety, Health and Well-being:** Accidents mitigated amd lives saved
   More likely negative during the construction period, depending on participation in construction.

Medium-Term Benefits

The **medium** term is the time period after construction of the project is completed, and during which the target area realizes the econmic benefits of the project.

Area	Time frame		
	short	medium	long
project	**X**	X	x
target	x	**X**	x
connected	x	x	**X**

Project area (project construction area)

1) *Labor*: Employment enhancement, if any, in the immediate project area.

   Might inure if marketable skills learned during construction.

2) *Equipment*: Purchase or rental of construction equipment.

   Construction equipment abandoned or left behind might be useful.

3) *Materials:* Purchase of construction materials

   Construction materials abandoned or left behind might be useful.

4) *Commercial Enhancement:* Some commercial activity may remain

   Commercial support that tends to grow aroound a construction site may continue to some degree.

5) *Safety, Health and Well-being:* Accidents mitigated and lives saved

   Ususaly, some aspect of the project focuces on the enhancemnt of safety, health and well being. This may inure to the immediate construction area, as well as the target area.

Target area (project primary beneficiary)

1) *Labor*: Employment should rise as economic acivity increases due to the project.

   Generally, this benefit is claimed only to the extent that the unemployment rate is reduced.

2) *Equipment*: Equipment sales/rental may rise due to increased economic activity.

   Generally, this benefit is claimed only to the extent that equipment utilization is improved.

3) *Materials:* Sales of materials may rise due to increased economic activity.

   Generally, this benefit is claimed only to the extent that material consumption is increased

4) *Commercial Enhancement:* Enhancement of target area economic activity

   This may also include the increase in tax revenues for governemnt as incomes rise.

5) *Safety, Health and Well-being:* Accidents mitigated amd lives saved

   The saving of lives and reduction in accident is generally claimed as a benefit.

Connected areas (project secondary beneficiary)

1) *Labor*: Employment of the unemployed, if any, in the project target area.

   Generally, this benefit is claimed only to the extent that the unemployment rate is reduced.

2) *Equipment*: Purchase or rental of construction equipment.

   Generally, this benefit is claimed only to the extent that equipment utilization is improved.

3) *Materials:* Purchase of construction materials

   Generally, this benefit is claimed only to the extent that material consumption is increased

4) *Commercial Enhancement:* Enhancement of connected area economic activity

   If the seconsary area has construction-related resources, it may benefit during construction.

5) *Safety, Health and Well-being:* Accidents mitigated amd lives saved

   The saving of lives and reduction in accident is generally claimed as a benefit.

Long-Term Benefits

The **long** term is the time period after the target area benefits have been realized, and the increased economic activity of the target area spills over into connected areas

Time frame			
Area	**short**	**medium**	**long**
project	**X**	x	x
target	x	**X**	x
connected	x	x	**X**

Project area (project construction area)

1) *Labor*: Employment enhancement, if any, in the immediate project area.
Little, if any benefits continue in the construction area

2) *Equipment*: Purchase or rental of construction equipment.
Little, if any benefits continue in the construction area

3) *Materials:* Purchase of construction materials
Little, if any benefits continue in the construction area

4) *Commercial Enhancement:* Some commercial activity may remain
Little, if any benefits continue in the construction area

5) *Safety, Health and Well-being:* Accidents mitigated and lives saved
Ususally, some aspect of the project focuces on the enhancemnt of safety, health and well being. This may inure to the immediate construction area, as well as the target area.

Target area (project primary beneficiary)

1) *Labor*: Employment should stabilize as economic acivity stabilizes
Additional benefit gain will be slow

2) *Equipment*: Equipment sales/rental should stabilize.
Additional benefit gain will be slow

3) *Materials:* Sales of materials should stabilize.
Additional benefit gain will be slow

4) *Commercial Enhancement:* Economic activity should stabilize.
Additional benefit gain will be slow

5) *Safety, Health and Well-being:* Accidents mitigated amd lives saved
The benefit from the project may continue over the design-life of the project.

Connected areas (project secondary beneficiary)

1) *Labor*: Employment should rise due to spill over of target area economic activity.
Additional benefit gain will be moderate.

2) *Equipment*: Equipment sales/rental should rise with spill-over from target area.
Additional benefit gain will be moderate.

3) *Materials:* Sales of materials should rise with pill-over from target area.
Additional benefit gain will be moderate.

4) *Commercial Enhancement:* Economic activity should rise in the connected area due to spill-over economic activity in the target area.

5) *Safety, Health and Well-being:* Accidents mitigated amd lives saved
Possible spill-over due to enhanced facilities in the construction area.

General Procedures

Assume You have been selected as a consultant to develop a benefit-cost ratio for a project under consideration to improve access to a village of indigenous people that is isolated during the rainy periods. Except for intermittant access, the village and surrounding area are suitable for agricultural development.

Step 1 : *Define the target area in terms of its present arial extent, population, economic activity, public services, and access.*

Resources:	*Site visits, arial maps, geodesic/military quadrangles, satelite images, surveys, census*				
Name	Santa María village (Christian lumads), Noor Al Din village (Maranao Moslems)				
Location	Lanao del Sur		occupations		
Population	families	sanitation	industries	water supply	roads
men	age categories		land in cultivation	housing types	trails
women	birth rate	health	crops	communications	schools

Step 2: Develop at least three alternative solutions:

Alternatives   Comment/Example

Basic alternative *Do nothing* is always an alternative, and can be thought of as the basic alternative.

Requested solution Usually, the requesting agency has a favored solution, which may not be the best one.

Example: Build a bridge across a 30 meter ravine seperating the area from a nearby highway.

Alternative(s): The consulting engineer should inpendently look at the problem for alternative remedies

Example :Build a new 15 kilometer road through swampy lowlands subject to frequent inundation.

Step 3: Estimate the useful life of each project alternative. If the alternatives have different useful lives, then the analysis period is the least common multiple of all the alternative lives.

Alternative 1:   -

Alternative 2: 5 years   Least common mutiple is 10 years

Alternative 3: 10 yerars   Analysis period is 10 years

Step 4: For each alternative, project the target area growth in terms of areal extent, population, economic activity, and quality of life.

Note: Even the 'do nothing' alternative will experience some population growth, economic growth, adaptation, and a partial solution to the target area's perceived project problem. It is also possible that 'quality of life' benefits may be negative.

Step 5: For each alternative, impute a monetary value for increase in economic activity, and the quality of life improvemnts over the analysis period.

Imputing costs for economic activity is relatively straight forward, but usually requires expertise be tapped outside of engineering, such as agricultural, commerce, and industry. Also. Health care expertise is useful imputing a benefit for improvements in sanitation and water potability.

Step 6: Compare the alternatives. The real benefit of an alternative is how much more it produces than the do nothing alternative, or a competing alternative.

The easiest task in comparing alternatives is when they all have the same design life, and cost the same. Then it is only necessary to compare benefits. However, this is seldom the case. The unequal life issue is solved by using the **least common multiple** as the analysis period. The unequal cost issue is resolved by using **incremental analysis**.

Lesson Plan 12

CONTINUATION OF FINANCIAL JUSTIFICATION OF PROJECTS - 2 HOUR

MARKETABLE PRODUCT LIFECYCLE   (Lesson 11 handout)
Complex cash flow   /   Multiple year execution

The Project Estimate
The first essential task on a project, after developing the scope, is to develop the cost estimate
COST ESTIMATE

Feasibility Phase	*Planning Phase*	*Design Phase*	*Performed*
$/ft^2 ₱/m^2	$/ft^2 ₱/m^2	LABOR / CREWS	**by**
ROM	Refined ROM	MATERIALS	*Engineers*
		EQUIPMENT	

PROFIT/BENEFITS ESTIMATE
Revenues – production costs   *Performed by Marketing*

METHODS OF FINANCIAL ANALYSIS

Net Present Value (NPV) $NPV = \Sigma\, S_k / (1+i)^k$, k=1,n

What *i* to use?   Commercial projects   Government projects

Money market rates   Treasury Notes
Commercial loan rates   Government bonds
Bond market   Legislative fiat
Company Policy (internal financing)   Government Policy

HOMEWORK

Internal Rate of Return (IRR)   **Solve *i* for NPV=0   Compare IRR to MARR**
Trial & error / Graphical / Interpolation
HOMEWORK

Benefit/Cost Ratio (B/C ratio) Government
HOMEWORK

Inflation   (Handout)
Year 0 currency ($_0$, $_{03}$, $_{2003}$, ₱_0, ₱_{03}, ₱_{2003}$) / Common base currency projections
Cost and benefit projections given in year 0 S_k for PV / P_k for inflation
Example
HOMEWORK

MARR
Components   *r* ρ f_{risk}   f_{other}
Real rate of return for idle funds
Estimating the future rate of inflation
Quantifying risk
Risk aversion assessment
Project probability of failure
GROUP HOMEWORK

		Time Frame	
Area	**short**	**medium**	**long**
project	**X**	X	X
target	X	**X**	**X**
connected	X	X	**X**

Estimating Benefits
Time frame vs Area of consideration
General procedures

Lesson Plan 13

Inflation and Financial Analysis- 2^+ hours

Homework due:

    Discussion   NPV, P/C, IRR

                        Inflation 1

    Turn in

Consumer Price Index (CPI)   Definition

Cost of Living   Article

Inflation and Deflation   Article

Inflation measurement

    Consumer Price Index – US

        The Basket of Consumer Goods

        CPI Tables

        Month to month annual percentages

    Inflation Indexed to specific base years

        Table

        Graph

        Comparing product costs over time

        Comparing projects over time

    Calculating an inflation index

    Consumer Price Index – Philippines

Inflation-deflation & Financial Analysis

    Safe-harbor strategy

    Seeking equilibrium

Homework

    Filipino inflation rates

    Inflation & financial analysis

CPI
==Consumer Price Index==. An **==inflation==**ary **==indicator==** that measures the change in the cost of a fixed basket of products and services, including **==housing, electricity, food, and transportation==**. The CPI is published monthly. also called **==cost-of-living index==**.

   The Consumer Price Index (CPI) is a measure of the average change in prices over time of basic consumer goods and services. From Jan. 1978, the Bureau of Labor Statistics began publishing CPI's for 2 population groups: (1) a CPI for all urban consumers (CPI-U), which covers about 80% of the total population; and (2) a CPI for urban wage earners and clerical workers (CPI-W), which covers about 32% of the total population. The CPI-U includes, in addition to wage earners and clerical workers, groups such as professional, managerial, and technical workers, the self-employed, short-term workers, the unemployed, retirees, and others not in the labor force.
   The CPI is based on prices of food, clothing, shelter, fuels, transportation fares, charges for doctors' and dentists' services, drugs, and prices of the other goods and services bought for day-to-day living. The index measures price changes from a designated reference period, 1982-84, which equals 100.0.
   Use of this reference period began in Jan. 1988. [1]

Cost of Living

I   INTRODUCTION   ==Cost of Living, amount of money needed to purchase the goods and services required to maintain a certain standard of living==. Since World War I, when the knowledge of price movements was thought to be helpful in order to maintain a stable economy, ==cost-of-living statistics have become important barometers of national economies==.

II   BUREAU OF LABOR STATISTICS

In the U.S., the principal source of price statistics is the Bureau of Labor Statistics of the Department of Labor. The Consumer Price Index (CPI), often used to determine the cost of living and formerly called the cost-of-living index, measures the change in prices for a mixed market basket of goods and services. It does not measure the

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cost of achieving, at a given month's prices, the standard of living actually attained in the base period. Thus, while the cost-of-living concept provides a framework for dealing with practical questions that arise in the construction of the CPI, no "true" cost-of-living index has been compiled.

The CPI was initiated during World War I when rapid increases in prices, particularly in shipbuilding centers, made such an index essential for calculating cost-of-living adjustments in wages. To be sure that the index would reflect the relative importance of goods and services purchased by consumers, studies of family expenditures were conducted in 92 industrial areas in 1917-19. Periodic collection of price data was started, and in 1919 the Bureau of Labor Statistics began publishing separate indexes for 32 cities. Regular publication of a national index, the U.S. city average, began in 1921.

Index numbers based on a norm of 100 for a particular base period are used to express the CPI. As of 1992, the reference base, or norm, for most items is the average of the three-year period from 1982 to 1984 (thus, 1982-84 = 100). Deviations from this norm reflect the rise or fall in the cost of living for one year. The CPI is based on a sample of prices of all goods and services that people buy for day-to-day living. The present market basket, introduced in early 1987, was derived from a survey of expenditures collected during 1982-84. Categories of expenses are food, shelter, fuels and utilities, household furnishings and operations, clothing, transportation, medical care, entertainment, and personal care.

The CPI is used as an indicator of inflation by the federal government and the Federal Reserve Board to formulate economic policy. Another use of the CPI is to escalate income payments; more than 3 million workers are covered by collective bargaining agreements that provide for increases in wage rates based on increases in the CPI. The index also affects the income of about 60 million persons through adjustments in federal expenditures for social programs.

III EFFECTS

Since the end of World War II, the cost of living has increased fairly steadily at an average annual rate of approximately 4 percent. Changes have varied widely, ranging from a decrease of 1.8 percent in 1949 to an increase of 13.3 percent in 1979. Between 1970 and 1985 worldwide energy prices surged; in the U.S. oil prices rose by almost 300 percent, providing most of the impetus for a 180-percent increase in the CPI. Since 1985 the rate of inflation has moderated. The CPI was up only 3.0 percent in 1992. Even so, rising costs affect everyone, especially people on fixed incomes, such as pensions. *See* Inflation and Deflation.[2]

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[2]"Cost of Living."*Microsoft® Encarta® Encyclopedia 2001*. © 1993-2000 Microsoft Corporation. All rights reserved.

Inflation and Deflation

I INTRODUCTION

Inflation and Deflation, in economics, terms used to describe, respectively, **a decline** or an increase **in the value of money, in relation to the goods and services it will buy.**

Inflation is the **pervasive and sustained rise** in the aggregate level of prices measured by an index of the cost of various goods and services. Repetitive price increases erode the purchasing power of money and other financial assets with fixed values, creating serious economic distortions and uncertainty. Inflation results when actual economic pressures and anticipation of future developments cause the demand for goods and services to exceed the supply available at existing prices or when available output is restricted by faltering productivity and marketplace constraints. Sustained price increases were historically directly linked to wars, poor harvests, political upheavals, or other unique events.

Deflation involves a sustained decline in the aggregate level of prices, such as occurred during the Great Depression of the 1930s; it is usually associated with a prolonged erosion of economic activity and high unemployment. Widespread price declines have become rare, however, and inflation is now the dominant variable affecting public and private economic planning.

II KINDS OF INFLATION

When the ***upward trend of prices*** is gradual and irregular, averaging only a few percentage points each year, such creeping inflation is not considered a serious threat to economic and social progress. It ***may*** even ***stimulate*** **economic activity**: The **illusion of personal income growth** beyond actual productivity **may encourage consumption**; **housing investment may increase in anticipation of future price appreciation**; **business investment in plants and equipment may accelerate as prices rise more rapidly than costs**; **and personal, business, and government borrowers realize that loans will be repaid with money that has potentially less purchasing power**.

A greater concern is the growing pattern of chronic inflation characterized by much higher price increases, at annual rates of 10 to 30 percent in some industrial nations and even 100 percent or more in a few developing countries. Chronic inflation tends to become permanent and ratchets upward to even higher levels as economic distortions and negative expectations accumulate. To accommodate chronic inflation, normal economic activities are disrupted: Consumers buy goods and services to avoid even higher prices; real estate speculation increases; businesses concentrate on short-term investments; incentives to acquire savings, insurance policies, pensions, and long-term bonds are reduced because inflation erodes their future purchasing power; governments rapidly expand spending in anticipation of inflated revenues; and exporting nations suffer competitive trade disadvantages forcing them to turn to protectionism and arbitrary currency controls.

In the most extreme form, chronic price increases become hyperinflation, causing the entire economic system to break down. The hyperinflation that occurred in Germany following World War I, for example, caused the volume of currency in circulation to expand more than 7 billion times and prices to jump 10 billion times during a 16-month period before November 1923. Other hyperinflations occurred in the United States and France in the late 1700s; in the USSR and Austria after World War I; in Hungary, China, and Greece after World War II; and in a few developing nations in recent years. During a hyperinflation the growth of money and credit becomes explosive, destroying any links to real assets and forcing a reliance on complex barter arrangements. As governments try to pay for increased spending programs by rapidly expanding the money supply, the inflationary financing of budget deficits disrupts economic, social, and political stability.

III HISTORY

Examples of inflation and deflation have occurred throughout history, but detailed records are not available to measure trends before the Middle Ages. Economic historians have identified the 16th to early 17th centuries in Europe as a period of

long-term inflation, although the average annual rate of 1 to 2 percent was modest by modern standards. Major changes occurred during the American Revolution, when prices in the U.S. rose an average of 8.5 percent per month, and during the French Revolution, when prices in France rose at a rate of 10 percent per month. These relatively brief flurries were followed by long periods of alternating international inflations and deflations linked to specific political and economic events.

The U.S. reported average annual price changes as follows: 1790 to 1815, up 3.3 percent; 1815 to 1850, down 2.3 percent; 1850 to 1873, up 5.3 percent; 1873 to 1896, down 1.8 percent; 1896 to 1920, up 4.2 percent; and 1920 to 1934, down 3.9 percent. This extended history indicates a recurring sequence of inflations, linked to wartime periods, followed by long periods of price stability or deflation. Consumer prices accelerated during the World War II era, rising at an annual average rate of 7.0 percent from 1940 to 1948, and then stabilized from 1948 to 1965, when the annual increases averaged only 1.6 percent, including a peak of 5.9 percent in 1951 during the Korean War.

In the mid-1960s a chronic inflationary trend began in most industrial nations. From 1965 to 1978 American consumer prices increased at an average annual rate of 5.7 percent, including a peak of 12.2 percent in 1974. This ominous shift was followed by consumer price gains of 13.3 percent in 1979 and 12.4 percent in 1980. Several other industrial nations suffered a similar acceleration of price increases, but some countries, such as West Germany (now part of the united Federal Republic of Germany), avoided chronic inflation. Given the integrated status of most nations in the world economy, these disparate results reflected the relative effectiveness of national economic policies.

This **unfavorable inflationary trend was reversed in most industrial nations during the mid-1980s**. **Austere government fiscal and monetary policies** begun in the early part of the decade **combined with sharp declines in world oil and commodity prices** to return the average inflation rate to about 4 percent.

IV CAUSES

Demand-pull inflation occurs when **aggregate demand exceeds existing supplies**, forcing price increases and pulling up wages, materials, and operating and financing costs. **Cost-push inflation** occurs when **prices rise to cover total expenses and preserve profit margins**. A pervasive **cost-price spiral** eventually **develops** as groups and institutions respond to each new round of increases. Deflation occurs when the spiral effects are reversed.

To explain why the basic supply and demand elements change, economists have suggested **three substantive theories**: the **available quantity of money**; the **aggregate level of incomes**; and **supply-side productivity** and cost variables.

Monetarists believe that changes in price levels reflect fluctuating volumes of money available, usually defined as currency and demand deposits. They argue that, to create stable prices, the *money supply should increase at a stable rate commensurate with the economy's real output capacity*. Critics of this theory claim that changes in the money supply are a response to, rather than the cause of, price-level adjustments.

The aggregate level of income theory is based on the work of the British economist **John Maynard Keynes**, published during the 1930s. According to this approach, **changes in the national income determine consumption and investment rates**; thus, **government fiscal spending and tax policies should be used to maintain full output and employment levels**. The money supply, then, should be adjusted to finance the desired level of economic growth while avoiding financial crises and high interest rates that discourage consumption and investment. Government spending and tax policies can be used to offset inflation and deflation by adjusting supply and demand according to this theory. In the U.S., however, the growth of government spending plus "off-budget" outlays (expenditures for a variety of programs not included in the federal budget) and government credit programs have been more rapid than the potential real growth rate since the mid-1960s.

The third theory concentrates on **supply-side elements** that are related to the significant **erosion of productivity**. These elements include the **long-term pace of capital investment** and **technological development**; changes in the **composition and age of the labor force**; the **shift away from manufacturing activities**; the rapid **proliferation of government regulations**; the **diversion of capital investment** into nonproductive uses; the growing **scarcity of certain raw materials**; social and political developments that have **reduced work incentives**; and various economic shocks such as **international monetary and trade problems**, **large oil price increases**, and **sporadic worldwide crop disasters**. These supply-side issues may be important in developing monetary and fiscal policies.

V   EFFECTS

The specific effects of inflation and deflation are mixed and fluctuate over time. **Deflation is typically caused by depressed economic output and unemployment**. Lower prices may eventually encourage improvements in consumption, investment, and foreign trade, but only if the fundamental causes of the original deterioration are corrected.

Inflation initially increases business profits, as wages and other costs lag behind price increases, leading to more capital investment and payments of dividends and interest. **Personal spending may increase** because of "buy now, it will cost more later" attitudes; potential **real estate price appreciation** may attract buyers. Domestic inflation may **temporarily** **improve the balance of trade** if the same volume of exports can be sold at higher prices. **Government spending rises** because many programs are explicitly, or informally, indexed to inflation rates to preserve the real value of government services and transfers of income. Officials may also anticipate paying larger budgets with **tax revenues** from **inflated** incomes.

Despite these ==temporary gains==, however, ==inflation eventually disrupts normal economic activities==, particularly if the pace fluctuates. **Interest rates typically include the anticipated pace of inflation** that **increases business costs, discourages consumer spending**, and **depresses the value of stocks and bonds**. **Higher mortgage interest rates and rapidly escalating prices for homes discourage housing construction**. Inflation **erodes the real purchasing power of current incomes and accumulated financial assets**, resulting in reduced consumption, particularly if consumers are unable, or unwilling, to draw on their savings and increase personal debts. Business investment suffers as overall economic activity declines, and profits are restricted as employees demand immediate relief from chronic inflation through automatic cost-of-living escalator clauses. Most raw materials and operating costs respond quickly to inflationary signals. Higher export prices eventually restrict foreign sales, creating deficits in trade and services and international currency-exchange problems. Inflation is a major element in the prevailing pattern of booms and recessions that cause unwanted price and employment distortions and widespread economic uncertainty.

The **impact** of inflation on individuals depends on many variables. People with relatively **fixed incomes**, particularly those in low-income groups, suffer during accelerating inflation, while those with flexible bargaining power may keep pace with or even benefit from inflation. Those dependent on assets with fixed nominal values, such as **savings accounts, pensions, insurance policies, and long-term debt instruments, suffer erosion of real wealth**; other assets with flexible values, such as real estate, art, raw materials, and durable goods, may keep pace with or exceed the average inflation rate. Workers in the private sector strive for cost-of-living adjustments in wage contracts. **Borrowers usually benefit** while **lenders suffer**, because mortgage, personal, business, and government **loans are paid with money that loses purchasing power over time** and interest rates tend to lag behind the average rate of price increases. A pervasive "inflationary psychology" eventually dominates private and public economic decisions.

VI STABILIZATION MEASURES

Any **serious anti-inflation effort will be difficult, risky, and prolonged** because **restraint tends to reduce real output and employment before benefits become apparent**, whereas fiscal and monetary stimulus typically increases economic activity before prices accelerate. This pattern of economic and political risks and incentives explains the dominance of expansion policies.

Stabilization efforts try to offset the distorting effects of inflation and deflation by restoring normal economic activity. To be effective, such initiatives must be sustained rather than merely occasional fine-tuning actions that often exaggerate existing cyclical changes. **The fundamental requirement is stable expansion of money and credit commensurate with real growth and financial market needs**. Over extended periods the Federal Reserve System can influence the availability and cost of money and credit by controlling the financial reserves that are required and by other regulatory procedures. Monetary restraint during cyclical expansions reduces inflation pressures; an accommodative policy during cyclical recessions helps finance recovery. Monetary officials, however, cannot unilaterally create economic stability if private consumption and investment cause inflation or deflation pressures or if other public policies are contradictory. Government spending and tax policies must be consistent with monetary actions so as to achieve stability and prevent exaggerated swings in economic policies.

Since the mid-1960s the rapid growth of federal budget spending plus even greater percentage increases in off-budget outlays and a multitude of federal lending programs have exceeded the tax revenues almost every year, creating large government deficit borrowing requirements. Pressures to provide money and credit required for private consumption and investment and for financing the chronic budget deficits and government loan programs have led to a rapid expansion of the money supply with resulting inflation problems. Effective stabilization efforts will require a better balance and a more sustained application of both monetary and fiscal policies.

Important supply-side actions are also required to fight inflation and avoid the economic stagnation effects of deflation. Among the initiatives that have been recommended are the reversal of the serious deterioration of national productivity by increasing incentives for savings and investment; enlarged spending for the development and application of technology; improvement of management techniques and labor efficiency through education and training; expanded efforts to conserve valuable raw materials and develop new sources; and reduction of unnecessary government regulation.

Some analysts have recommended the use of various income policies to fight inflation. Such policies range from mandatory government guidelines for wages, prices, rents, and interest rates, through tax incentives and disincentives, to simple voluntary standards suggested by the government. Advocates claim that government intervention would supplement basic monetary and fiscal actions, but critics point to the ineffectiveness of past control programs in the United States and other industrial nations and also question the desirability of increasing government control over private economic decisions. Future stabilization policy initiatives will likely concentrate on coordinating monetary and fiscal policies and increasing supply-side efforts to restore productivity and develop new technology. *See also* Business Cycle; Finance; Money.

Contributed By:
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Inflation

Invisible	*To the eye, the physical appearance of the currency is unchanged*
Indirectly measured	*Price, not currency, changes are measured, not all of which are inflationary*
Measured after the fact	*We cannot measure price changes until after they have occurred*
Monetary phenomena	*It is the value of the currency that changes, not the value of basket of goods*

CPI

Consumer Price Index. An **inflation**ary **indicator** that measures the change in the cost of a **fixed basket of products** and services, including housing, electricity, food, and transportation. The CPI is also called *cost-of-living index*.

The Basket of Products

Expenditure Category	Examples
All Items	
Food and beverages	breakfast cereal, milk, coffee, chicken, wine, full service meals and snacks
Housing	rent of primary residence, owners' equivalent rent, fuel oil, bedroom furniture
Apparel	men's shirts and sweaters, women's dresses, jewelry
Transportation	new vehicles, airline fares, gasoline, motor vehicle insurance
Medical care	prescriptions, medical supplies, physicians, eyeglasses & eye care, hospital care
Recreation	televisions, cable television, pets and pet products, sports equipment, admissions
Education & communications	college tuition, postage, telephone services, computer software and accessories
Other goods & services	tobacco and smoking products, haircuts and other personal services, funeral expenses
Special Indexes	
Energy	
Food	
All items less food and energy	

CPI-U unadjusted, referenced to 1982-1984 base year Index =100

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average Annual	Average HALF1	Average HALF2
1992	138.1	138.6	139.3	139.5	139.7	140.2	140.5	140.9	141.3	141.8	142.0	141.9	140.3	139.2	141.4
1993	142.6	143.1	143.6	144.0	144.2	144.4	144.4	144.8	145.1	145.7	145.8	145.8	144.5	143.7	145.3
1994	146.2	146.7	147.2	147.4	147.5	148.0	148.4	149.0	149.4	149.5	149.7	149.7	148.2	147.2	149.3
1995	150.3	150.9	151.4	151.9	152.2	152.5	152.5	152.9	153.2	153.7	153.6	153.5	152.4	151.5	153.2
1996	154.4	154.9	155.7	156.3	156.6	156.7	157.0	157.3	157.8	158.3	158.6	158.6	156.9	155.8	157.9
1997	159.1	159.6	160.0	160.2	160.1	160.3	160.5	160.8	161.2	161.6	161.5	161.3	160.5	159.9	161.2
1998	161.6	161.9	162.2	162.5	162.8	163.0	163.2	163.4	163.6	164.0	164.0	163.9	163.0	162.3	163.7
1999	164.3	164.5	165.0	166.2	166.2	166.2	166.7	167.1	167.9	168.2	168.3	168.3	166.6	165.4	167.8
2000	168.8	169.8	171.2	171.3	171.5	172.4	172.8	172.8	173.7	174.0	174.1	174.0	172.2	170.8	173.6
2001	175.1	175.8	176.2	176.9	177.7	178.0	177.5	177.5	178.3	177.7	177.4	176.7	177.1	176.6	177.5
2002	177.1	177.8	178.8	179.8	179.8	179.9	180.1	180.7	181.0	181.3	181.3	180.9	179.9	178.9	180.9
	1.1%	1.1%	1.5%	1.6%	1.2%	1.1%	1.5%	1.8%	1.5%	2.0%	2.2%	**2.4%**	1.6%	1.3%	1.9%

month-month % change
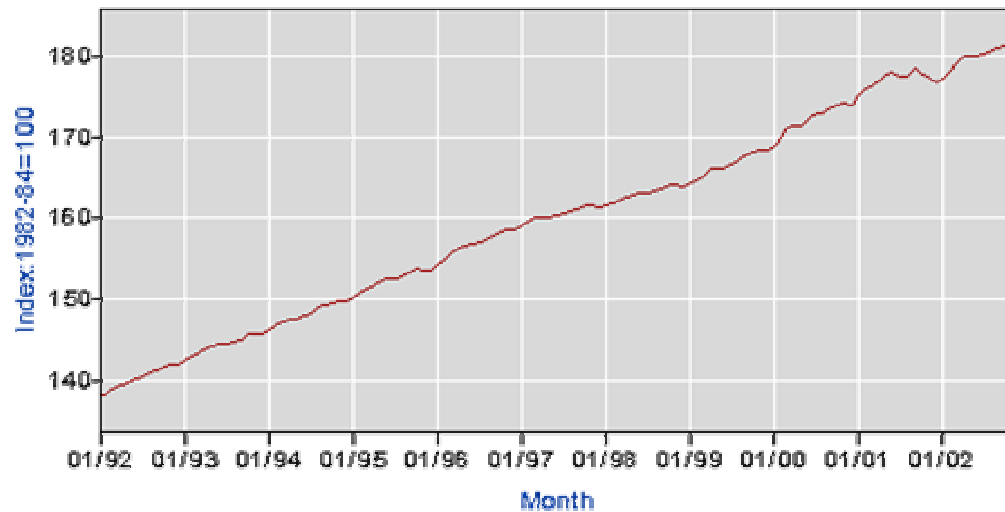
$$\frac{180.9 - 176.7}{176.7} = 2.4\%$$

The CPI represents all goods and services purchased for consumption by the reference population (Consumer Price Index for All Urban Consumers or Consumer Price Index for Urban Wage Earners and Clerical Workers). The Bureau of Labor Statistics (BLS) has classified all expenditure items into more than 200 categories, arranged into eight major groups. Major groups and examples of categories in each are as follows:

Also included within these major groups are various government-charged user fees, such as water and sewerage charges, auto registration fees, and vehicle tolls. The CPI also includes taxes, such as sales and excise taxes, that are directly associated with the prices of specific goods and services. However, the CPI excludes taxes, such as income and Social Security taxes, not directly associated with the purchase of consumer goods and services.

CPI-U unadjusted, month-to-month percent change

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average Annual	Average HALF1	Average HALF2
1992	2.60	2.80	3.20	3.20	3.00	3.10	3.20	3.10	3.00	3.20	3.00	2.90	3.00	3.00	3.10
1993	3.30	3.20	3.10	3.20	3.20	3.00	2.80	2.80	2.70	2.80	2.70	2.70	3.00	3.20	2.80
1994	2.50	2.50	2.50	2.40	2.30	2.50	2.80	2.90	3.00	2.60	2.70	2.70	2.60	2.40	2.80
1995	2.80	2.90	2.90	3.10	3.20	3.00	2.80	2.60	2.50	2.80	2.60	2.50	2.80	2.90	2.60
1996	2.70	2.70	2.80	2.90	2.90	2.80	3.00	2.90	3.00	3.00	3.30	3.30	3.00	2.80	3.10
1997	3.00	3.00	2.80	2.50	2.20	2.30	2.20	2.20	2.20	2.10	1.80	1.70	2.30	2.60	2.10
1998	1.60	1.40	1.40	1.40	1.70	1.70	1.70	1.60	1.50	1.50	1.50	1.60	1.60	1.50	1.60
1999	1.70	1.60	1.70	2.30	2.10	2.00	2.10	2.30	2.60	2.60	2.60	2.70	2.20	1.90	2.50
2000	2.70	3.20	3.80	3.10	3.20	3.70	3.70	3.40	3.50	3.40	3.40	3.40	3.40	3.30	3.50
2001	3.70	3.50	2.90	3.30	3.60	3.20	2.70	2.70	2.60	2.10	1.90	1.60	2.80	3.40	2.20
2002	1.10	1.10	1.50	1.60	1.20	1.10	1.50	1.80	1.50	2.00	2.20	**2.40**	1.60	1.30	1.90
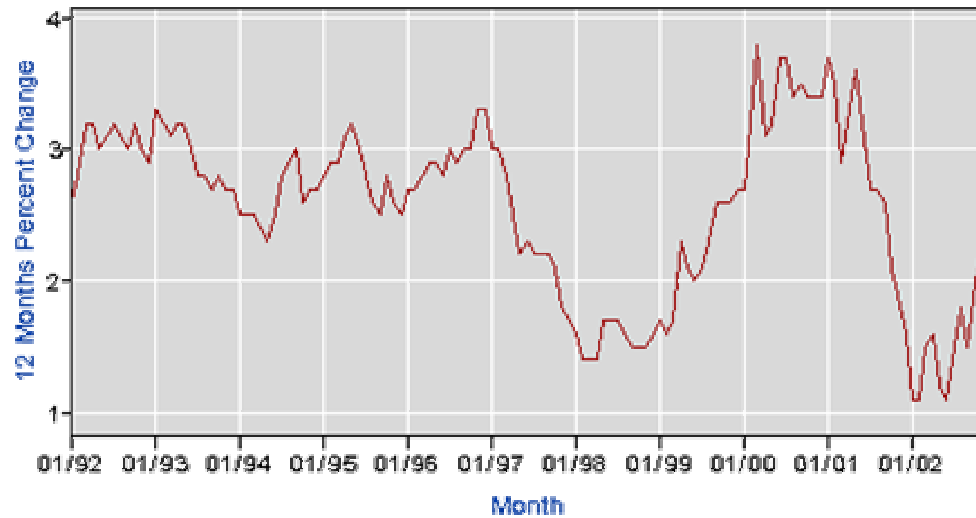
The CPI does not include investment items, such as stocks, bonds, real estate, and life insurance. (These items relate to savings and not to day-to-day consumption expenses.)

Seasonal adjustment is a statistical technique which eliminates the influences of weather, holidays, the opening and closing of schools, and other recurring seasonal events from economic time series. This permits easier observation and analysis of cyclical, trend, and other nonseasonal movements in the data. By eliminating seasonal fluctuations, the series becomes smoother and it is easier to compare data from month to month.

Inflation - Index table

Year	ρ_k	$\$_{2002}$	$\$_{1927}$	Year	ρ_k	$\$_{2002}$	$\$_{1927}$
1920				**1960**	1.4%	6.129	0.579
1921				1961	0.7%	6.086	0.575
1922				1962	1.3%	6.008	0.568
1923				1963	1.6%	5.913	0.559
1924				1964	1.0%	5.855	0.553
1925				1965	1.9%	5.746	0.543
1926				1966	3.5%	5.551	0.524
1927		10.59	**1.000**	1967	3.0%	5.390	0.509
1928	-0.96%	10.69	1.010	1968	4.7%	5.148	0.486
1929	0.21%	10.67	1.008	1969	6.2%	4.847	0.458
1930	-6.03%	11.35	1.072	**1970**	5.6%	4.590	0.434
1931	-9.52%	12.54	1.185	1971	3.3%	4.444	0.420
1932	-10.3%	13.98	1.321	1972	3.4%	4.297	0.406
1933	0.51%	13.91	1.314	1973	8.7%	3.953	0.373
1934	2.03%	13.64	1.288	1974	12.3%	3.520	0.333
1935	3.00%	13.24	1.251	1975	6.9%	3.293	0.311
1936	1.21%	13.08	1.236	1976	4.9%	3.139	0.297
1937	3.10%	12.69	1.199	1977	6.7%	2.942	0.278
1938	-2.78%	13.05	1.233	1978	9.0%	2.699	0.255
1939	-0.48%	13.11	1.239	1979	13.3%	2.382	0.225
1940	0.96%	12.99	1.227	**1980**	12.5%	2.118	0.200
1941	9.72%	11.84	1.118	1981	8.9%	1.945	0.184
1942	9.30%	10.83	1.023	1982	3.8%	1.873	0.177
1943	3.18%	10.50	0.992	1983	3.8%	1.805	0.171
1944	2.12%	10.28	0.971	1984	3.9%	1.737	0.164
1945	2.25%	10.05	0.950	1985	3.8%	1.674	0.158
1946	18.16%	8.51	0.804	1986	1.1%	1.655	0.156
1947	9.01%	7.81	0.737	1987	4.4%	1.586	0.150
1948	2.71%	7.60	0.718	1988	4.4%	1.519	0.143
1949	-1.81%	7.74	0.731	1989	4.6%	1.452	0.137
1950	5.8%	7.31	0.691	**1990**	6.1%	1.368	0.129
1951	6.0%	6.90	0.652	1991	3.1%	1.327	0.125
1952	0.8%	6.85	0.647	1992	2.9%	1.290	0.122
1953	0.7%	6.80	0.642	1993	2.7%	1.256	0.119
1954	-0.7%	6.85	0.647	1994	2.7%	1.223	0.116
1955	0.4%	**6.82**	**0.644**	1995	2.5%	1.193	0.113
1956	3.0%	6.62	0.625	1996	3.3%	1.155	0.109
1957	2.9%	6.43	0.608	1997	1.7%	1.136	0.107
1958	1.8%	6.32	0.597	1998	1.6%	1.118	0.106
1959	1.7%	6.21	0.587	1999	2.7%	1.088	0.103
				2000	3.4%	1.053	0.099
				2001	2.8%	1.024	0.097
				2002	**2.4%**	**1.000**	0.094

Converting historic $ to a base year.

Example: $\$_{2002}$ or $\$_{1927}$

Inflation Index, to convert historic $ to a base year $

Legend: base yr 2002, base yr 1927

Left axis: Multiplier to convert historic $ to 2002 $ (0–15)
Right axis: Multiplier to convert historic $ to 1927 $ (0–1.5)
X axis: year (1925–2005)
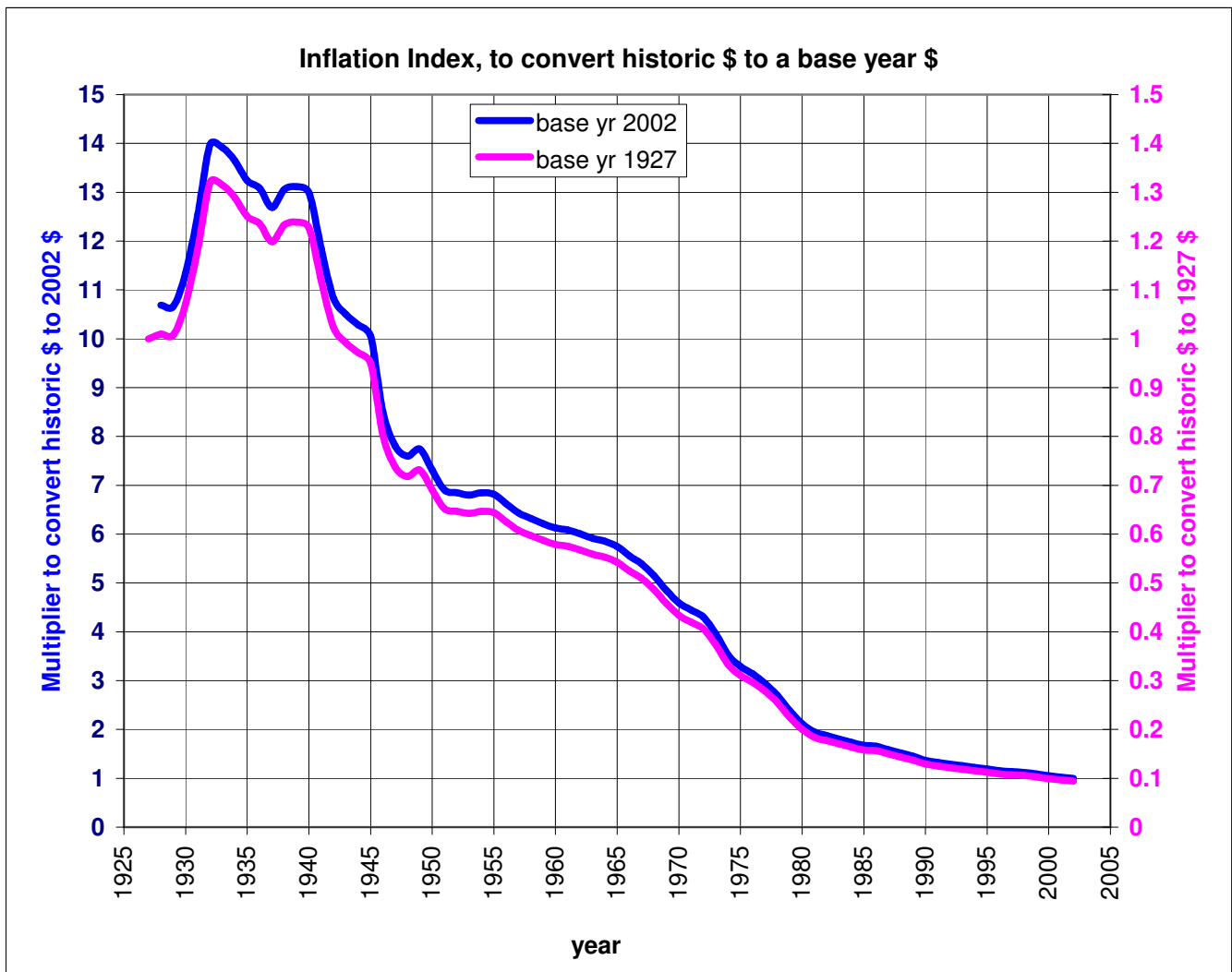
MULTIPLIER

Year	ρ_k	$\$_{2002}$		$\$_{1927}$
1954	-0.70%	6.85		0.647
1955	0.40%	**6.82**		**0.644**
1956	3.00%	6.62		0.625

Compare projects over time

COMMODITY	$\$_{2002}$	Historic $\$_{1955}$	$\$_{1927}$	Project	Year	Historic $/ft^2$	Index$_{2002}$	$\$_{2002}/ft^2$
Gasoline	1.91	0.28	0.18	A	1989	345	1.452	501
House	68,191	10,000	6,442	B	1991	380	1.327	504
Bread	1.70	0.25	0.16	C	1993	400	1.256	502
Car	10,229	1,500	966	D	1995	420	1.193	501
Coca cola	0.68	0.10	0.06	E	1997	440	1.136	500
Salary	26,336	3,862	2,488	F	1999	460	1.088	501
Min. wage	6.82	1.00	0.64	G	2000	480	1.053	505
					average	418		502
				H	2002	?		

Compare products over time

Calculating an inflation index

Going forward in time

Year	ρ_k		$\$_{1927}$		k
1927	-	•	**1.000**	P_{1927}	0
1928	-0.010		1.010	= 1.0000 /(1 - .010) = 1.000 / (1 - .010)	1
1929	0.002		1.008	= 1.0097 /(1+ .002) = 1.000 / (1 - .010)/(1+.002)	2
1930	-0.060		1.072	= 1.0076 /(1 - .060) = 1.000 / (1 - .010)/(1+.002)/(1-.060)	3

$$P_k = P_{k-1} / (1+\rho_k) \qquad P_k = \prod_{j=1,k}[1/(1 + \rho_j)] \qquad \ldots$$

Similar to compound interest formula

~~$P_k = S_{k=0} / (1 + \rho_k)^k$~~

But - you must understand what you are doing !
The standard formula cannot be used, because …
ρ_k **is not a constant or smooth variable from time**
increment to time increment.

$$P_k = \prod_{j=0,k-1}[(1 + \rho_j)] \qquad k=0_{2002} \qquad \ldots$$

		P_{k-1}		$= P_k (1+\rho_k)$		k
1999	2.70%	1.088	↑	= 1.053 (1+.034) = 1.000 (1+.024)(1+.028) (1+.034)	3
2000	3.40%	1.053		= 1.024 (1+.028) = 1.000 (1+.024)(1+.028)	2
2001	2.80%	1.024		= 1.000 (1+.024) = 1.000 (1+.024)	1
2002	**2.40%**	**1.000**	•	P_{2002}	0
Year	ρ_k	$\$_{2002}$			k

Going backward in time

Monthly Consumer Price Index for All Income Households in the Philippines by Commodity Group

All Items	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
1997	121.5	122.0	122.6	122.8	123.0	124.5	124.8	125.5	126.6	127.2	128.0	128.7	124.8
1998	130.0	131.9	133.0	133.8	135.4	137.8	138.1	138.8	139.3	140.2	142.3	142.1	136.9
1999	145.0	144.9	144.6	144.4	144.4	145.7	146.0	146.4	147.2	147.7	147.9	148.1	146.0
2000	148.7	149.3	149.4	149.6	150.3	151.4	152.1	153.1	153.8	154.9	156.7	157.9	152.3
2001	159.0	159.3	159.4	159.7	160.1	161.6	162.4	162.8	163.2	163.3	163.6	164.1	161.5
2002	165.1	164.8	165.2	165.5	165.9	166.3	166.7	167.6	167.9	167.8	167.9	168.6	166.6

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COMMODITY GROUP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
All Items	121.5	122	122.6	122.8	123	124.5	124.8	125.5	126.6	127.2	128	128.7	124.8
Food, Beverages and Tobacco	122.4	122.3	123	123.1	123.3	124.3	124.4	125.2	126	126.3	126.7	127.2	124.5
Clothing	116.9	117.1	117.4	117.5	117.8	118.5	119	119.7	120.6r	121.7r	122.6	123	119.3
Housing and Repairs	129.2	131.1	132.4	132.7	132.9	134.8	136.0r	136.7r	138.9r	140.1r	141.3r	142.0r	135.7
Fuel, Light and Water	116.5	117.7	118.7	119.6	118.9	118.8	118.5	119.8r	119.2r	120.7r	122.0r	122.6r	119.4
Services	123.5	124	124.2	124.4	124.8	130.5	131.4r	131.8	133.0r	134.3	136.2r	137.6r	129.6
Miscellaneous	105.2	105.7	105.4	105.4	105.5	105.8	106.1	106.4	107.1	107.4r	108	108.5	106.4

1998

COMMODITY GROUP	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Avg
All Items	130	131.9	133	133.8	135.4	137.8	138.1	138.8	139.3	140.2	142.3	142.1	136.9
Food, Beverages and Tobacco	128.3	129.8	130.8	131.9	134.3r	136.9	136.8r	137.3	137.8r	138.8	142.1	141.5	135.5
Clothing	123.7	125.3	126.4	126.8	127.6	128.8	129.4	129.9	130.8r	131.3	131.7	131.8	128.6
Housing and Repairs	144.1	146.5	148	149	150.2	151.6	152.9	153.9	154.3	155.1	155.4	155.9	151.4
Fuel, Light and Water	123.2	125.6	125.2	124.9	124.9	125.3	125.9	126.8	127.1	128.3	129.9	130.3	126.5
Services	140.8	142.5	144	143.8	144.7	149.4	150.1	151.2r	151.8r	152.5	153.2	153.4	148.1
Miscellaneous	109.4	111.6	113.2	114	114.8	115.7	116	116.6r	117.0r	117.4	118.1	118.2	115.2

1999

COMMODITY GROUP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
All Items	145	144.9	144.6	144.4	144.4	145.7	146	146.4	147.2	147.7	147.9	148.1	146
Food, Beverages and Tobacco	145.0 r	144.3	142.8	142.2	141.9	141.7	141.6	142	142.7	142.6	142.3	142.3	142.6
Clothing	134.9 r	135.4	135.9	136.1	136.2 r	136.5	136.8	137.1	137.4	137.7	138	138.3	136.7
Housing and Repairs	159.3	160.7	162.4	163	163.5	166.2 r	167.1	167.8	168.2	168.7	169.1	169.6	165.5
Fuel, Light and Water	130.1 r	130.2 r	130.8 r	131.1	131.7	132.3	133.1	133.8	137	139	140.2	140.5	134.2
Services	155.2 r	156.0 r	156.6 r	157.1 r	157.6 r	165.4 r	166.1 r	166.6 r	167.3 r	170.0 r	172.0 r	172.8	163.6
Miscellaneous	119.6	120	120.8	120.9	120.9	121.2	121.2	121.5	121.8 r	122	122.4	122.7	121.3

2 0 0 0

COMMODITY GROUP	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Avg
All Items	148.7	149.3	149.4	149.6	150.3	151.4	152.1	153.1	153.8	154.9	156.7	157.9	152.3
Food, Beverages and Tobacco	143.6	144	143.8	143.7	144.7	144.2	144.8 r	145.9	146.4	146.8	148.8	149.7 r	145.5
Clothing	138.5	138.7	139	139.3	139.6	139.8	140	140.3	140.7	141.4	142.1	143	140.2
Housing and Repairs	170.7 r	171.6 r	172.1 r	172.9 r	173.4 r	173.9	174.2 r	174.3 r	175.3	176.5	177.7	178.9	174.3
Fuel, Light and Water	139.7 r	140.6 r	141.5 r	143.0 r	142.8 r	143.7	145.3 r	148.2 r	149.8	151.8	153.8	156.6	146.4
Services	173.2 r	174.0 r	174.6 r	175.4 r	175.5 r	182.5	184.4	186	186.7	190.8 r	194.0 r	195.9 r	182.8
Miscellaneous	119.2	119.5	119.6	119.7	120	124.1	124.2	124.6	124.9	125.7	126.3	126.8	122.9

2 0 0 1

COMMODITY GROUP	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Avg
All Items	159	159.3	159.4	159.7	160.1	161.6	162.4	162.8	163.2	163.3	163.6	164.1	161.5
Food, Beverages and Tobacco	151	150.2	149.5 r	149.6 r	150.2	151.1	152.1	152.4 r	152.6	152.5	152.7	153.2	151.4
Clothing	143.6	144	144.3	144.6	145.1	145.4	145.7	146	146.2	146.4	146.9	147.1	145.4
Housing and Repairs	180.3 r	182.5 r	184.0 r	184.6 r	185	185.7	186.8	187.2	188.2	188.6	189.7	190.6	186.1
Fuel, Light and Water	157.2	159.9	161.7	162.8	160.2	162.7	164.1	164.7	165.3	165.9	166.7	167.2	163.2
Services	196.7	198.4 r	198.9	199.7	200.3	205.8	206.7	207.2	207.8	208.1	208.1	207.9	203.8
Miscellaneous	127.3	128	128.4	128.8	129	129.4	129.5	129.9	130	130.1	130.4	130.6	129.3

2002

COMMODITY GROUP	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Avg
All Items	165.1	164.8	165.2	165.5	165.9	166.3	166.7	167.6	167.9	167.8	167.9	168.6	166.6
Food, Beverages and Tobacco	153.7	152.8	153.2	153.3	153.6	153.8	154.5	155.8	156	155.3	154.9	155.6	154.4
Clothing	147.6	148.1	148.4	148.6	149	149.2	149.5	149.6	149.9	150.1	150.2	150.6	149.2
Housing and Repairs	192.7r	193.4r	193.8	194.1	194.4	195	195.8	196	196.6	196.8	197.2	197.5	195.3
Fuel, Light and Water	174.9	174.8	175.6	176.7	177.2	169.5	166.5	167.6	167.4	169.6	172.7	175.4	172.3
Services	208	208.5	208.8	209.5	210.4	215.8r	216	216.6	217.2	217.9	218.7	219.3	213.9
Miscellaneous	130.7	130.9	131.2	131.3	131.5	131.7	131.8	132.1	132.3	132.4	132.5	132.7	131.8

Source: Economic Indices and Indicators Division, Prices and Indicators Section
(1994 = 100)
Industry and Trade Statistics Department
National Statistics Office
Republic of the Philippines

htpp://www.census.gov.ph
Related press release | CPI/Inflation Rates statistics index

PHILIPPINES: PRICES, MONEY AND INTEREST RATES

Item	1995	1996	1997	1998	1999	2000	2001	2001	2002
I. PRICES (1994 = 100)									
A. CPI, Philippines								January - December	
(all items, ave. % change)	8.0	9.1	5.9	9.7	6.7	4.4	6.1	6.1	3.1
of which: Food, Beverages and	9.0	10.5	3.4	8.8	5.2	2.0	4.1	4.1	2.0
Non-Food	6.8	7.2	9.1	10.9	8.4	6.9	8.5	8.5	4.3
B. CPI, NCR (all items, ave % cha	8.2	8.4	6.6	10.0	5.5	4.6	7.2	7.2	3.7
C. CPI, AONCR (all items, ave. %	8.0	9.2	5.6	9.6	7.2	4.2	5.7	5.7	2.9
D. Purchasing Power of the Peso	0.93	0.85	0.80	0.73	0.69	0.66	0.62	0.62	0.60
								January - September	
E. GDP Deflator (% Change)	7.6	7.7	6.3	11.0	8.0	6.7	6.6	7.0	4.3
II. MONEY AND INTEREST RATES									
A. Money (End-of-Period)									
								November	
1. Money Supply (M1, P B) [1]	184.9	222.0	258.3	281.5	394.1	387.0	388.0	353.1	434.8 [p]
(% Change)	21.7	20.0	16.4	9.0	40.0	-1.8	0.3	-1.6	23.1
2. Domestic Liquidity (M3, P B)	761.4	881.4	1066.0	1144.6	1365.1	1427.4	1525.0	1465.9	1602.9 [p]
(% Change)	25.3	15.8	20.9	7.4	19.3	4.6	6.8	6.7	9.4
								October	
3. Base Money (P B) [2]	229.4	262.1	304.3	316.2	357.4	391.7	431.0	426.2	406.1
(% Change)	17.0	14.3	16.1	3.9	13.0	9.6	10.0	25.5	-4.7
								December	
4. Reserve Money (P B)	212.7	243.3	266.5	239.8	321.7	308.2	312.9	312.9	356.1 [p]
(% Change)	16.6	14.3	9.5	-10.0	34.1	-4.2	1.5	1.5	13.8
5. Net Credits from the Moneta								November	
(P B) [4]	1,084.4	1,507.7	1,922.9	1,870.4	1,923.3	2,087.8	2,109.6	2,135.9	2,140.7 [p]
(% Change)	32.0	39.0	27.5	-2.7	2.8	8.6	1.0	2.8	0.2
of which: Private Sector Cre									
(Nominal, P B)	748.7	1,130.5	1,454.7	1,410.7	1,394.4	1,506.8	1,462.2	1,475.5	1,450.8 [p]
(% Change)	43.5	51.0	28.7	-3.0	-1.2	8.1	-3.0	-1.9	-1.7
(Real, P B) [3]	666.3	938.3	1,134.7	987.5	948.2	949.3	906.6	900.8	870.5
(% Change)	29.0	40.8	20.9	-13.0	-4.0	0.1	-4.5	-6.5	-3.4
6. Foreign Curr. Deposits (P B									
Res. Non-Banks)	206.7	317.6	433.4	477.9	521.7	586.0	586.1	570.8	617.5 [p]
(% Change)	30.2	53.6	36.5	10.3	9.1	12.3	0.0	-3.2	8.2
7. Total Loans Outstanding- KE	737.3	1120.3	1416.8	1348.2	1354.2	1451.5	1399.2	1409.0	1428.1
(% Change)	35.8	51.9	26.5	-4.8	0.4	7.2	-3.6	-2.1	1.4
								October	
8. Non-Performing Loans - KB!	28.0	34.2	73.6	160.0	195.4	245.8	281.9	291.4	265.6
As % of total loans	3.8	3.1	5.2	10.4	12.3	15.1	17.4	18.8	16.4
9. Total Resources of the Fin'l	2551.3	3256.2	4072.6	4179.7	4711.4	5195.2	5235.5	5135.2	5429.9 [p]
B. Interest Rates (% p.a., average) - (Nominal)								January - December	
1. Manila Ref. Rates (90 days	9.6	10.9	11.1	13.8	10.1	8.81	10.13	10.13	6.38
2. T-bills 91 days [6]	11.3	12.4	13.1	15.3	10.2	9.86	9.86	9.86	5.43
3. Time Deposits (all maturitie	9.3	11.5	11.2	12.7	9.5	8.51	9.53	9.53	5.32 [p]
4. Lending Rates (all maturitie	14.6	14.8	16.2	18.4	11.8	10.86	18.60	18.60	8.90
(Real) [7]								January - December	
1. Manila Ref. Rates (90 days	1.6	1.8	5.2	4.1	3.4	4.41	4.03	4.03	3.28
2. T-bills 91 days [6]	3.3	3.3	7.2	5.6	3.5	5.46	3.76	3.76	2.33
3. Time Deposits (all maturitie	1.3	2.4	5.3	3.0	2.8	3.71	3.03	3.03	2.22
4. Lending Rates (all maturitie	6.6	5.7	10.3	8.7	5.1	6.46	12.50	12.50	5.80

[1] Includes Land Bank of the Philippines (LBP) from 1983.

[2] Data from 1986 include LBP. Includes DBP from February 7, 1996 when it started operations as an expanded commercial bank.

[3] Derived by multiplying the nominal value by the purchasing power of the peso; revised using CPI 1994=100.

[4] Peso and Foreign accounts excluding transactions of local banks' foreign office and interbank loans.

[5] Data for 1985 - 1989 are based on average rates on promissory notes issued by sample commercial banks, while data for 1990 to present are based on average rates on promissory notes and time deposits charged by sample commercial banks.

[6] Averages on date of issue.

[7] Derived by deducting CPI inflation rate from the nominal rate, 1994=100

[a] Starting Feb. 1998, data does not include one non-operational commercial bank..

[p] Preliminary

Note: Annual percent changes were computed based on values in millions.

Sources of Basic Data: National Statistical Coordination Board (NSCB), National Statistics Office (NSO), National Wages and Productivity Commission (NWPC), Department of Labor and Employment (DOLE), Department of Finance (DOF), Bureau of Treasury (BTr), Bangko Sentral ng Pilipinas (BSP) and Philippine Stock Exchange (PSE).

Date last updated: Jan 06 2004

Inflation - Deflation & Financial Analysis   Safe-harbor strategy

(Put the money in a box, or hide it under the mattress)

P_{2001}	Loan	100,000	100,000	100,000	100,000	100,000	100,000	100,000
$S=P(1+i)$	i	0%	0%	0%	0%	0%	0%	0%
P_{2002}	Repayment	100,000	100,000	100,000	100,000	100,000	100,000	100,000
	Interest$_{historic}$	0	0	0	0	0	0	0
	ROI$_{historic}$	0%	0%	0%	0%	0%	0%	0%
		Inflation			**Nuetral**	**Deflation**		
$P=S/(1+\rho)$	ρ	15%	10%	5%	0%	-5%	-10%	-15%

Analysis should be made in constant currency

P_{2001}	Analysis	86,957	90,909	95,238	100,000	105,263	111,111	117,647
Cost$_{2001}$	in constant	-13,043	-9,091	-4,762	0	5,263	11,111	17,647
%$_{2001}$	currency	-13.0%	-9.1%	-4.8%	0.0%	5.3%	11.1%	17.6%

← **Inflation reduces wealth**   **Deflation creates wealth** →
Prices rise   **Prices Fall**

Inflation creates pressure on capital owners to take risks and invest in order to avoid wealth reduction

Borrowing becomes more attractive, because as disposable income rises, the payoff burden becomes a smaller portion of disposable income.

Inflation pressures the economy to expand, creating an illusion of higher wages, higer profits and higher tax revenues

Deflation removes pressure on capital owners to take risks and invest, as wealth is created without risk

Borrowing is less attractive because as disposable income falls, the payoff burden becomes a larger portion of disposable income.

Deflation pressures the economy to contract, destroying the illusion of higher wages, higer profits and higher tax revenues.

Inflation - Deflation & Financial Analysis   Seeking Equilibrium

P_{2001}	Loan	100,000	100,000	100,000	100,000	100,000	100,000	100,000
$S=P(1+i)$	i	20%	15%	10%	5%	1%	0.5%	0%
P_{2002}	Repayment	120,000	115,000	110,000	105,000	101,000	100,500	100,000
	Interest$_{historic}$	20,000	15,000	10,000	5,000	1,000	500	0
	ROI$_{historic}$	20%	15%	10%	5%	1%	0.5%	0%
		Inflation			**Nuetral**		**Deflation**	
$P=S/(1+\rho)$	ρ	15%	10%	5%	0%	-5%	-10%	-15%

Analysis should be made in constant currency

P_{2001}	Analysis	104,348	104,545	104,762	105,000	106,316	111,667	117,647
Cost$_{2001}$	in constant	4,348	4,545	4,762	5,000	6,316	11,667	17,647
%$_{2001}$	currency	4.3%	4.5%	4.8%	5.0%	6.3%	11.7%	17.6%

Inflation rises slowly and accelarates

Government revenues tend rise

Capital owners increase lending at a positive real rate of return

Mild to moderate infation periods tend to be gradual and prolonged

High business and consumer confidence as business and investment expand

A speculation bubble may form from high-risk investments

Expansion slows as lender and borrower nervousness to risk exposure rises

Deflation reduces slowly

Government revenues tend to fall

Capital owners are less inclined to risk capital as the deflation worsens

Deflation periods tend to be sudden and of relatively short duration

Low business and consumer confidence as business and commerce contract

Speculation bubble collapses as high-risk investments fail

Contraction accelarates as market confidence evaporates

The Inflation - Deflation Cycle

Economic collapses is sudden and catastrophic

Homework - inflation index

1 Use the Filipino CPI summary table for *all years, all items-* Convert the CPI table to an annual % increase, for each month, from 1998-2002.

All Items — CPI Index

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
1997	121.5	122.0	122.6	122.8	123.0	124.5	124.8	125.5	126.6	127.2	128.0	128.7	124.8
1998	130.0	131.9	133.0	133.8	135.4	137.8	138.1	138.8	139.3	140.2	142.3	142.1	136.9
1999	145.0	144.9	144.6	144.4	144.4	145.7	146.0	146.4	147.2	147.7	147.9	148.1	146.0
2000	148.7	149.3	149.4	149.6	150.3	151.4	152.1	153.1	153.8	154.9	156.7	157.9	152.3
2001	159.0	159.3	159.4	159.7	160.1	161.6	162.4	162.8	163.2	163.3	163.6	164.1	161.5
2002	165.1	164.8	165.2	165.5	165.9	166.3	166.7	167.6	167.9	167.8	167.9	168.6	166.6

All Items — Month-to-month price increase, % change from year before

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
1997													
1998													
1999													
2000													
2001													
2002													

2 Use the December column for each year (1997-2002), from the % table you constructed in problem 1, above, to extract the annual rate of infation for each year (1998-2002).

Year-on year inflation rate, %, end of year

Year	ρ
1997	
1998	
1999	
2000	
2001	
2002	

3 Use the annual rate of infaltion table you extracted in problem 2, above, to:

(a) Construct an inflation index to convert historic pesos to 2002 pesos,

(b) Convert projects A, B, C, D & E from historic P/m^2 to P_{2002}/m^2,

(c) Estimate the cost of project F in P_{2000}/m^2, based on Projects A, B. C, D, & E.

(a) Year	ρ	P_{2002} index		(b) Year	Project	historic P/m^2	P_{2002}/m^2
1997				1997	A	6,875	
1998				1998	B	7,545	
1999				1999	C	7,900	
2000				2000	D	8,495	
2001				2001	E	8,740	
2002				(c) 2002	F	?	

4 Suppose you pay ₱1 million for a one year money market note. The rate of return, discounting inflation, is 10%. The annual rate of Inflation is 5%. At the end of the year, what is the return on investment in real terms, i.e., constant pesos at the time of purchase?

Lesson Plan 14

14A – Economic Cyclics 1$^+$ hour
14B - Comparative Analysis 1$^+$ hour

HOMEWORK DUE

Discussion/answers: Turn in after discussion

Filipino inflation rates
Inflation & financial analysis

BSP website

LECTURE

ECONOMIC CYCLES

Examples of cycles in real life (class exercise)

Weekly	Monthly	Quarterly	Trimester	semi-annual	Annual
Paychecks	Paychecks	Loan payments	Loan payments	Loan payments	Loan payments
Groceries	Rent/mortgage	Rent/mortgage	school tuition	Rent/mortgage	Rent/mortgage
Gasoline	Utility payments	School tuition		Vacations	Income taxes
	Gas bill				Vacations
	Water bill				Harvest
	Electric bill				
	Telephone bill				
	TV cable bill				

Production-Inventory-Consumption	**Types**	**Multiple cycles**
Ideal	Steady	Additive effect
Real	Divergent	Cumulative effect
Labor effects	Convergent	Stair-cliff

Dampening effects

Safety nets: unemployment insurance, job training/re-training, public education,
Multiple skilled individuals

Over-dampening

Excess government regulation	No-fire labor regulations
Excessive taxation	Socialistic economic systems
Corrupt and inefficient government	Communistic economic systems

COMPARATIVE ANALYSIS

Conventional Analysis

Common currency base
Equal analysis period (Least common multiple)
NPV, IRR, B/C ratio, MARR
Ranking

Incremental Analysis

Common currency base
Equal analysis period (Least common multiple)
Δ_{NPV}, Δ_{IRR}, $\Delta_{B/C}$, MARR
Unequal net, equal net, equal costs

HOMEWORK ASSIGNMENT - none

Long & short business/economic cycles

LABOR	PRODUCERS	CONSUMERS			

IDEAL - manage variable consuption via inventory

LABOR	PRODUCERS	CONSUMERS	produce	consume	inventory
labor					
	production	consumption	100	100	
labor	Inventory				0
	production	consumption +	100	120	
labor	inventory–				-20
	production	consumption	100	100	
labor	Inventory				0
	production	consumption –	100	80	
labor	inventory +				20
	production	consumption	100	100	
labor	Inventory				0
	production	consumption +	100	120	
labor	inventory–				-20
	production	consumption	100	100	
labor	Inventory				0
	production	consumption –	100	80	
labor	inventory +				20
	production	consumption	100	100	
labor	Inventory				0
	production	consumption +	100	120	
labor	inventory–				-20
	production	consumption	100	100	
labor	Inventory				0
	production	consumption –	100	80	
					20

REALITY - manage variable consuption by chasing inventory

LABOR	PRODUCERS	CONSUMERS	produce	consume	inventory
labor					
	production	consumption	100	100	
labor	Inventory				0
	production	consumption +	100	120	
labor+	inventory–				-20
	production+	consumption –	120	80	
labor–	inventory ++				40
	production–	consumption	80	100	
labor+	inventory–				-20
	production+	consumption –	120	80	
labor–	inventory ++				40
	production–	consumption –	80	80	
labor–	Inventory				0
	production–	consumption	80	100	
labor	inventory–				-20
	production	consumption +	100	120	
labor+	inventory–				-20
	production+	consumption –	120	80	
labor–	inventory ++				40
	production–	consumption	80	100	
labor	inventory–				-20
	production	consumption +	100	120	

Muti-cyclical Effects

Legend:
- y(c1)
- y(c2)
- y(c3)
- y(c4)
- y(c5)
- y(c6)
- Sum

Cummulative Multi-Cyclical Effects

Divergent systems	Failure	Prevention
Aero-elastic structures (flutter)	Structural destruction in seconds	Never-exceed flutter airspeed
Mechanical engines (resonance)	Severe engine damage and failure	red-line rpm
Economic systems	*catastrophic collapse*	*limit gov borrowing*
	runaway inflation	*limit deficit spending*
		limit monetary expansion

Stable systems	Responsive	Prevention
Aircraft operated within design	Safe, comfortable flight	Education, warnings
Engine operation within design	Reliable transportation	govenors
Economic systems	*repeatable, predictable*	*education, competence*
		avoid extreme behavior

Convergent systems	Inutil, ineffective	Prevention
Overloaded, nose-heavy aircraft	Sluggish response, inability to climb	operate within design
dirty air-filters, blocked exhaust	sluggish, inefficient, no power	regular maintenance
Economic systems	*stagflation, unemployment*	*minimize gov regulatiom*
	low productivity	*reduce union-mgt conflict*
	high investment risk	*limit monetary expansion*
	unattractive ROI	*small, efficient government*
		pro-growth gov policy
		eliminate gov corruption
		minimize gov taxes

New Project -conventional analysis

Constant currency

k	a	b	c	d
0	-40	-25	-35	-15
1	-10	0	-5	0
2	0	5	1	5
3	10	5	8	15
4	10	5	8	10
5	10	5	8	-15
6	10	5	8	0
7	10	5	8	5
8	10	5	8	10
9	10	5	8	10
10	10	5	8	10
Σ	**30**	**20**	**25**	**35**
	2	4	3	1

UnEqual Net

Rule: for i = MARR

If NPV ≥ 0, IRR ≥ MARR, B/C ≥ 1

If NPV < 0, IRR < MARR, B/C < 1

MARR = 8%

NPV

k	a	b	c	d
i_{MARR} =		**8%**		
0	-40	-25	-35	-15
1	-9.3	0.0	-5	0
2	0.0	4.3	0.9	4.3
3	7.9	4.0	6.4	12
4	7.4	3.7	5.9	7.4
5	6.8	3.4	5.4	-10
6	6.3	3.2	5.0	0
7	5.8	2.9	4.7	2.9
8	5.4	2.7	4.3	5.4
9	5.0	2.5	4.0	5.0
10	4.6	2.3	3.7	4.6
NPV	**0.0**	**3.9**	**0.6**	**16**
Rank	*4*	*2*	*3*	*1*

	a	b	c	d
B/C=	49.27 / 49.26	29 / 25	40.3 / 39.6	41 / 25
B/C	**1.00**	**1.16**	**1.02**	**1.65**
Rank	*4*	*2*	*3*	*1*

IRR

k	a	b	c	d
irr	**8.00%**	**10.95%**	**8.30%**	**25.4%**
0	-40	-25.0	-35	-15
1	-9.26	0.00	-4.6	0
2	0	4.06	0.85	3.18
3	7.94	3.66	6.30	7.607
4	7.35	3.30	5.82	4.044
5	6.81	2.97	5.37	-4.84
6	6.3	2.68	4.96	0
7	5.83	2.42	4.58	1.025
8	5.4	2.18	4.23	1.635
9	5	1.96	3.90	1.304
10	4.63	1.77	3.60	1.04
Σ	**0.0**	**0.0**	**0.0**	**0.0**
	4	*2*	*3*	*1*

NPV

Rank

Ranking results are identical

Incremental analysis

Constant currency

k	a	b	c	d
0	-40	-25	-35	-15
1	-10	0	-5	0
2	0	5	1	5
3	10	5	8	15
4	10	5	8	10
5	10	5	8	-15
6	10	5	8	0
7	10	5	8	5
8	10	5	8	10
9	10	5	8	10
10	10	5	8	10
Σ	30	20	25	35
Net	4	2	3	1
Σ_{cost}	-50	-25	-40	-30
Rank	4	1	3	2

Rank in order of increasing cost

Δ Increment

	2-1	3-2	4-2
k	d-b	c-d	a-d
0	10	-20	-25
1	0	-5	-10
2	0	-4	-5
3	10	-7	-5
4	5	-2	0
5	-20	23	25
6	-5	8	10
7	0	3	5
8	5	-2	0
9	5	-2	0
10	5	-2	0
Σ	15	-10	-5

Δ_{NPV}

	2-1	3-2	4-2
k	d-b	c-d	a-d
$i =$ MARR =			8%
0	10	-20	-25
1	0	-4.6	-9.3
2	0	-3.4	-4.3
3	7.94	-5.6	-4
4	3.68	-1.5	0
5	-14	15.7	17
6	-3.2	5.04	6.3
7	0	1.75	2.92
8	2.7	-1.1	0
9	2.5	-1	0
10	2.32	-0.9	0
Σ	12.4	-15.6	-16

$\Delta_{NPV} \geq 0$, retain 2 (d)

$\Delta_{NPV} < 0$, retain 2 (d)

$\Delta_{NPV} < 0$, retain 2 (d)

If $\Delta_{NPV} \geq 0$, retain 2
If $\Delta_{NPV} < 0$, retain 1

Δ_{IRR}

	2-1	3-2	4-2
k	d-b	c-d	a-d
irr	99.0%	-8.9%	-2.5%
0	10	-20	-25
1	0	-5.49	-10.3
2	0	-4.82	-5.25
3	1.27	-9.26	-5.39
4	0.32	-2.9	0
5	-0.64	36.66	28.3
6	-0.08	14	11.6
7	0	5.761	5.95
8	0.02	-4.22	0
9	0.01	-4.63	0
10	0.01	-5.08	0
Σ	11	0.0	0.0

$\Delta_{IRR} >$ MARR=8%, retain 2 (d)

$\Delta_{IRR} <$ MARR=8%, retain 2 (d)

$\Delta_{IRR} <$ MARR=8%, retain 2 (d)

If $\Delta_{IRR} \geq$ MARR, retain 2
If $\Delta_{IRR} <$ MARR, retain 1

Rule: $\Delta_{2-1}=$Flow$_2$-Flow$_1$, Cost$_2 >$Cost$_1$

NPV

k	a	b	c	d
$i =$ MARR =	8%			
0	-40	-25	-35	-15
1	-9.3	0	-4.6	0
2	0	4.3	0.9	4.3
3	7.9	4	6.4	12
4	7.4	3.7	5.9	7.4
5	6.8	3.4	5.4	-10
6	6.3	3.2	5	0
7	5.8	2.9	4.7	2.9
8	5.4	2.7	4.3	5.4
9	5	2.5	4	5
10	4.6	2.3	3.7	4.6
NPV	0.0	3.9	0.6	16

IRR — MARR=8%

k	a	b	c	d
irr	8.00%	11.0%	8.29%	25.4%
0	-40.0	-25	-35	-15
1	-9.3	0.0	-5	0
2	0.0	4.1	0.9	3.2
3	7.9	3.7	6.3	8
4	7.3	3.3	5.8	4.0
5	6.8	3.0	5.4	-5
6	6.3	2.7	5.0	0
7	5.8	2.4	4.6	1.0
8	5.4	2.2	4.2	1.6
9	5.0	2.0	3.9	1.3
10	4.6	1.8	3.6	1.0
NPV	0.00	0.00	0.00	0.00

B/C

B/C	$\frac{25}{17}$	$\frac{22}{35}$	$\frac{26}{43}$
$\Delta_{B/C}$	1.52	0.64	0.62

$\Delta_{B/C} \geq 1$, retain 2 (d)

$\Delta_{B/C} < 1$, retain 2 (d)

$\Delta_{B/C} < 1$, retain 2 (d)

CONCLUSION on incremental analysis

Advantages:
- Hard to find any

Disadvantages:
- Extra calculations
- No ranking of alternatives

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New Project -conventional analysis

MARR = **8%**

Equal Net

Rule: for _i_ = MARR

If NPV ≥ 0, IRR ≥ MARR, B/C ≥ 1

If NPV < 0, IRR < MARR, B/C < 1

Constant currency

k	a	b	c	d
0	-50	-30	-40	-15
1	-10	5	-5	5
2	0	5	1	5
3	10	5	8	5
4	10	5	8	5
5	10	5	8	-10
6	10	5	8	5
7	10	5	8	5
8	10	5	8	5
9	10	5	8	5
10	10	5	8	5
Σ	20	20	20	20

NPV

k	a	b	c	d
i_{MARR} =		8%		
0	-50	-30	-40	-15
1	-9.3	4.6	-5	5
2	0.0	4.3	0.9	4.3
3	7.9	4.0	6.4	4
4	7.4	3.7	5.9	3.7
5	6.8	3.4	5.4	-7
6	6.3	3.2	5.0	3
7	5.8	2.9	4.7	2.9
8	5.4	2.7	4.3	2.7
9	5.0	2.5	4.0	2.5
10	4.6	2.3	3.7	2.3
NPV	**-10**	**3.6**	**-4.4**	**8**
Rank	*4*	*2*	*3*	*1*

B/C=	49/59	34/30	40/45	30/22
B/C	**0.83**	**1.12**	**0.90**	**1.38**
Rank	*4*	*2*	*3*	*1*

IRR

k	a	b	c	d
irr	**4.75%**	**10.55%**	**6.15%**	**19.8%**
0	-50	-30.0	-40	-15
1	-9.55	4.52	-4.7	4.174
2	0	4.09	0.89	3.484
3	8.7	3.70	6.69	2.908
4	8.31	3.35	6.30	2.427
5	7.93	3.03	5.94	-4.05
6	7.57	2.74	5.59	1.691
7	7.23	2.48	5.27	1.412
8	6.9	2.24	4.96	1.178
9	6.59	2.03	4.68	0.984
10	6.29	1.83	4.40	0.821
Σ	0.0	0.0	0.0	0.0	NPV
	4	*2*	*3*	*1*	Rank

Ranking results are identical

Incremental analysis

Constant currency

k	a	b	c	d
0	-50	-30	-40	-15
1	-10	5	-5	5
2	0	5	1	5
3	10	5	8	5
4	10	5	8	5
5	10	5	8	-10
6	10	5	8	5
7	10	5	8	5
8	10	5	8	5
9	10	5	8	5
10	10	5	8	5
Σ	20	20	20	20
Benefit	70	45	60	50
Σ_{cost}	-50	-25	-40	-30
Rank	4	1	3	2

Rank in order of increasing cost

Δ Increment

	2-1	3-2	4-2
k	d-b	c-d	a-d
0	15	-25	-35
1	0	-10	-15
2	0	-4	-5
3	0	3	5
4	0	3	5
5	-15	18	20
6	0	3	5
7	0	3	5
8	0	3	5
9	0	3	5
10	0	3	5
Σ	0	0	0

Δ_{NPV}

	2-1	3-2	4-2
k	d-b	c-d	a-d
i = MARR =			8%
0	15	-25	-35
1	0	-9.3	-14
2	0	-3.4	-4.3
3	0	2.38	3.97
4	0	2.21	3.68
5	-10	12.3	13.6
6	0	1.89	3.15
7	0	1.75	2.92
8	0	1.62	2.7
9	0	1.5	2.5
10	0	1.39	2.32
Σ	4.8	-12.7	-18

$\Delta_{NPV} \geq 0$, retain 2 (d)

$\Delta_{NPV} < 0$, retain 2 (d)

$\Delta_{NPV} < 0$, retain 2 (d)

Δ_{IRR}

	2-1	3-2	4-2
k	d-b	c-d	a-d
irr	0.0%	0.0%	0.0%
0	15	-25	-35
1	0	-10	-15
2	0	-4	-5
3	0	3	5
4	0	3	5
5	-15	18	20
6	0	3	5
7	0	3	5
8	0	3	5
9	0	3	5
10	0	3	5
Σ	0.0	0.0	0.0

No comparison can be done

No comparison can be done

No comparison can be done

Rule: Δ_{2-1}=Flow$_2$-Flow$_1$, Cost$_2$ >Cost$_1$

If $\Delta_{NPV} \geq 0$, retain 2   If $\Delta_{IRR} \geq$ MARR, retain 2
If $\Delta_{NPV} < 0$, retain 1   If $\Delta_{IRR} <$ MARR, retain 1

NPV (MARR=8%)

k	a	b	c	d
i = MARR = 8%				
0	-50	-30	-40	-15
1	-9.3	4.6	-4.6	4.6
2	0	4.3	0.9	4.3
3	7.9	4	6.4	4
4	7.4	3.7	5.9	3.7
5	6.8	3.4	5.4	-7
6	6.3	3.2	5	3.2
7	5.8	2.9	4.7	2.9
8	5.4	2.7	4.3	2.7
9	5	2.5	4	2.5
10	4.6	2.3	3.7	2.3
NPV	-10	3.6	-4.4	8.3

IRR

k	a	b	c	d
irr	4.75%	10.6%	6.15%	19.8%
0	-50.0	-30	-40	-15
1	-9.5	4.5	-5	4
2	0.0	4.1	0.9	3.5
3	8.7	3.7	6.7	3
4	8.3	3.3	6.3	2.4
5	7.9	3.0	5.9	-4
6	7.6	2.7	5.6	2
7	7.2	2.5	5.3	1.4
8	6.9	2.2	5.0	1.2
9	6.6	2.0	4.7	1.0
10	6.3	1.8	4.4	0.8
NPV	0.0	0.0	0.0	0.0

B/C

B/C	$\frac{15}{10}$	$\frac{25}{38}$	$\frac{28}{46}$
$\Delta_{B/C}$	1.47	0.66	0.60

$\Delta_{B/C} \geq 1$, retain 2 (d)

$\Delta_{B/C} < 1$, retain 2 (d)

$\Delta_{B/C} < 1$, retain 2 (d)

CONCLUSION on incremental analysis

Advantages:
   Hard to find any
Disadvantages:
   Extra calculations
   No ranking of alternatives

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New Project -conventional analysis

MARR =   8%

Constant currency

k	a	b	c	d
0	-30	-20	-30	-15
1	0	5	5	5
2	5	5	5	5
3	5	5	5	5
4	5	5	5	5
5	5	-10	5	-15
6	5	5	5	5
7	5	5	5	5
8	5	5	5	5
9	5	5	5	5
10	5	5	0	5
Σ	15	15	15	15

Net

Equal costs, equal net

Rule: for i = MARR

If NPV ≥ 0, IRR ≥ MARR, B/C ≥ 1

If NPV < 0, IRR < MARR, B/C < 1

NPV

k	a	b	c	d
i_{MARR} = 8%				
0	-30	-20	-30	-15
1	0	4.6	5	5
2	4.3	4.3	4.3	4.3
3	4.0	4.0	4.0	4
4	3.7	3.7	3.7	3.7
5	3.4	-6.8	3.4	-10
6	3.2	3.2	3.2	3
7	2.9	2.9	2.9	2.9
8	2.7	2.7	2.7	2.7
9	2.5	2.5	2.5	2.5
10	2.3	2.3	0.0	2.3
NPV	**-1.1**	**3.3**	**1.2**	**4.9**
Rank	*4*	*2*	*3*	*1*

B/C=	$\frac{29}{30}$	$\frac{30}{26.8}$	$\frac{31}{30}$	$\frac{30}{25}$
B/C	**0.96**	**1.12**	**1.04**	**1.20**
Rank	*4*	*2*	*3*	*1*

IRR

k	a	b	c	d
irr	**7.30%**	**11.70%**	**9.00%**	**15.3%**
0	-30	-20.0	-30	-15
1	0	4.48	4.6	4.337
2	4.34	4.01	4.21	3.761
3	4.05	3.59	3.86	3.262
4	3.77	3.21	3.54	2.829
5	3.52	-5.75	3.25	-7.36
6	3.28	2.57	2.98	2.128
7	3.05	2.30	2.74	1.846
8	2.85	2.06	2.51	1.601
9	2.65	1.85	2.30	1.388
10	2.47	1.65	0.00	1.204
Σ	0.0	0.0	0.0	0.0	NPV
	4	*2*	*3*	*1*	Rank

Ranking results are identical

Incremental analysis

Constant currency

k	a	b	c	d
0	-30	-20	-30	-15
1	0	5	5	5
2	5	5	5	5
3	5	5	5	5
4	5	5	5	5
5	5	-10	5	-15
6	5	5	5	5
7	5	5	5	5
8	5	5	5	5
9	5	5	5	5
10	5	5	0	5
Σ	15	15	15	15
Benefit	45	45	45	45
Σ$_{cost}$	-30	-30	-30	-30
Rank	4	1	3	2

Rank in order of preference

Δ Increment

	2-1	3-2	4-2
k	d-b	c-d	a-d
0	5	-15	-15
1	0	0	-5
2	0	0	0
3	0	0	0
4	0	0	0
5	-5	20	20
6	0	0	0
7	0	0	0
8	0	0	0
9	0	0	0
10	0	-5	0
Σ	0	0	0

Δ$_{NPV}$

	2-1	3-2	4-2
k	d-b	c-d	a-d
i = MARR =			8%
0	5	-15.0	-15.0
1	0	0	-4.6
2	0	0	0
3	0	0	0
4	0	0	0
5	-3.4	13.6	13.6
6	0	0	0
7	0	0	0
8	0	0	0
9	0	0	0
10	0	-2.3	0
Σ	1.6	-3.7	-6

Δ$_{IRR}$

	2-1	3-2	4-2
k	d-b	c-d	a-d
irr	0.0%	0.0%	0.0%
0	5	-15	-15
1	0	0	-5
2	0	0	0
3	0	0	0
4	0	0	0
5	-5	20	20
6	0	0	0
7	0	0	0
8	0	0	0
9	0	0	0
10	0	-5	0
Σ	0.0	0.0	0.0

Δ$_{NPV}$ ≥ 0, retain 2 (d) — No comparison can be done

Δ$_{NPV}$ < 0, retain 2 (d) — No comparison can be done

Δ$_{NPV}$ < 0, retain 2 (d) — No comparison can be done

Rule: Δ$_{2-1}$=Flow$_2$-Flow$_1$, Cost$_2$ >Cost$_1$

If Δ$_{NPV}$ ≥ 0, retain 2	If Δ$_{IRR}$ ≥ MARR, retain 2
If Δ$_{NPV}$ < 0, retain 1	If Δ$_{IRR}$ < MARR, retain 1

MARR=8%

NPV

k	a	b	c	d
i = MARR = 8%				
0	-30	-20	-30	-15
1	0	4.6	4.6	4.6
2	4.3	4.3	4.3	4.3
3	4	4	4	4
4	3.7	3.7	3.7	3.7
5	3.4	-7	3.4	-10
6	3.2	3.2	3.2	3.2
7	2.9	2.9	2.9	2.9
8	2.7	2.7	2.7	2.7
9	2.5	2.5	2.5	2.5
10	2.3	2.3	0	2.3
NPV	-1.1	3.3	1.2	4.9

IRR

k	a	b	c	d
irr	7.30%	11.7%	9.00%	15.3%
0	-30.0	-20	-30	-15
1	0.0	4.5	5	4
2	4.3	4.0	4.2	3.8
3	4.0	3.6	3.9	3
4	3.8	3.2	3.5	2.8
5	3.5	-5.8	3.2	-7
6	3.3	2.6	3.0	2
7	3.1	2.3	2.7	1.8
8	2.8	2.1	2.5	1.6
9	2.7	1.8	2.3	1.4
10	2.5	1.7	0.0	1.2
NPV	0.0	0.0	0.0	0.0

Δ$_{NPV}$ ≥ 0, retain 2 (d)

Δ$_{NPV}$ < 0, retain 2 (d)

Δ$_{NPV}$ < 0, retain 2 (d)

B/C	5.0 / 3.4	13.6 / 17.3	13.6 / 19.6
Δ$_{B/C}$	1.47	0.79	0.69

Δ$_{B/C}$ ≥ 1, retain 2 (d)

Δ$_{B/C}$ < 1, retain 2 (d)

Δ$_{B/C}$ < 1, retain 2 (d)

No comparison can be done

No comparison can be done

No comparison can be done

CONCLUSION on incremental analysis

Advantages:
Hard to find any

Disadvantages:
Extra calculations
No ranking of alternatives

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SUMMARY   Comparison of Alternatives

Common procedures for all solutions

Set all cash flow in constant currency   (remove effects of inflation)

Most Estimates will be prepared in a constant currency

Each estimate must be in the same constant currency   Example $\$_{2002}$, P_{2002}

Estimates made on historical costs must be converted to the common currency

Equal analysis period

Each solution must be analyzed using the *least-common multiple* (**LCM**) of the design lives of all the solutions.

Example   Least common multiple: 60

Alternatives:	**A**	**B**	**C**	**D**	**LCM**
Useful life (months)	15	30	12	20	**60**
Analysis period:	**60**	**60**	**60**	**60**	
Cycles	**4**	**2**	**5**	**3**	

Conventional Analysis   (equivalent solutions)

NPV   Set discount rate = MARR

NPV $\geq$ 0, IRR $\geq$ MARR, accept alternative

NPV < 0, IRR < MARR, reject alternative

Rank acceptable alternatives   (the higher the NPV, the better the alternative)

IRR   Select IRR so that NPV = 0   (requires trial & error to converge on solution)

IRR $\geq$ MARR, accept alternative

IRR < MARR, reject alternative

Rank acceptable alternatives   (the higher the IRR, the better the alternative.)

B/C   Sum costs and benefits based on NPV with discount rate = MARR

Benefits = sum of all positive present values

Cost = absolute value of the sum of all negative present values

B/C $\geq$ 1, accept alternative

B/C < 1, reject alternative

Rank acceptable alternatives   (the higher the B/C, the better the alternative.)

Common procedures for all solutions

Set all cash flow in constant currency   (remove effects of inflation)
Most Estimates will be prepared in a constant currency
Each estimate must be in the same constant currency
Estimates made on historical costs must be converted to the common currency

Equal analysis period
Each solution must be analyzed using the *least-common multiple* (**LCM**) of the design lives of all the solutions.
Example   Least common multiple: 60

Alternatives:	A	B	C	D	LCM
Useful life (months)	15	30	12	20	**60**
Analysis period:	**60**	**60**	**60**	**60**	
Cycles	**4**	**2**	**5**	**3**	

Incremental Analysis   (equivalent solutions)

Rank alternatives in order of increasing costs
If costs are equal, rank in order of increasing net in constant currency
If nets are equal, rank in order of increasing benefits
If benefits are equal, rank in any convenient order

Example	Rank	**R$_1$**	**R$_2$**	**R$_3$**	**R$_4$**	**…**
	Alternative	**C**	**A**	**B**	**D**	
	Cost	**22**	**24**	**26**	**30**	

LOWEST ⟶ HIGHEST

Subtract the *cash flows* of the first two alternatives, (lower cost from the higher)

R$_2$ − **R$_1$** = **Δ$_{2-1}$**
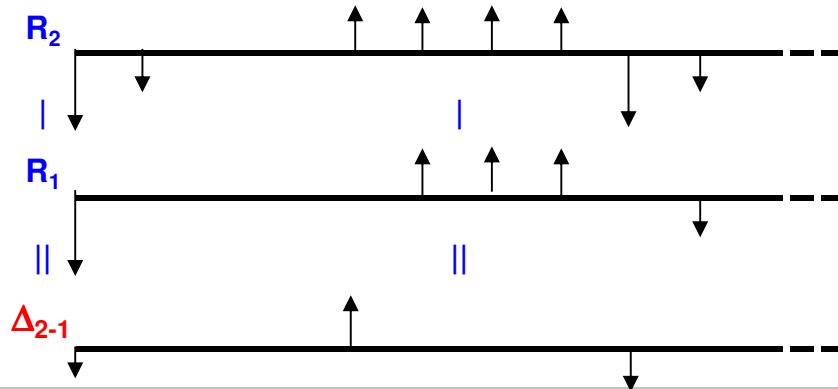
Perform economic analysis on Δ$_{2-1}$ (Same procedures as if it were a conventional analysis)

NPV, IRR, B/C ratio   (*i* for NPV = MARR)

If $\Delta_{NPV} \geq 0$ or $\Delta_{IRR} \geq$ MARR   or $\Delta_{B/C} \geq 1$ Retain R$_2$, reject R$_1$

If $\Delta_{NPV} < 0$ or $\Delta_{IRR} <$ MARR   or $\Delta_{B/C} < 1$ Retain R$_1$, reject R$_2$

Repeat economic analysis
Winner from prior analysis is R1, and next challenger is R2
Repeat until all challengers have been evaluated

Lesson Plan 15

SCHEDULE
    Individual Projects   **due in by 22 Mar 2003**
    Group Presentation Schedule   Please target a date for your group project presentation.

LECTURE
    PAYBACK PERIOD
        Historical Currency
        Constant Currency
        NPV
        Equivalent Uniform Sum

    EQUIVALENT UNIFORM SUM
        Example
        Homework w answers
        Summary

    REPLACEMENT ANALYSIS
        Introduction
        Policy
        General considerations
        Operating costs
        Sunk Cost
        Salvage value
        Economic useful life
        Decision Process
        Example
            Defender EUAC Table
            Contender EUAC Table
            Graph

HOMEWORK ASSIGNMENT – none

This is the **next to the last** of the lecture series.

Payback Period

Payback perios: the time it takes for the benefits to offset the costs. The shorter the payback period, the better the solution.

Constant currency

k	a	b	c	d
0	-40	-25	-35	-15
1	-10	0	-5	0
2	0	5	1	5
3	10	5	8	10
4	10	5	8	10
5	10	5	8	-15
6	10	5	8	0
7	10	5	8	5
8	10	5	8	10
9	10	5	8	10
10	10	5	8	0
Σ	30	20	25	20	Net
	2	4	3	1	

Running Σ Constant currency

k	a	b	c	d
0	-40	-25	-35	-15
1	-50	-25	-40	-15
2	-50	-20	-39	-10
3	-40	-15	-31	0
4	-30	-10	-23	10
5	-20	-5	-15	-5
6	-10	0	-7	-5
7	0	5	1	0
8	10	10	9	10
9	20	15	17	20
10	30	20	25	20
	4	2	3	1?

NPV

i_{MARR} = 8%

k	a	b	c	d
0	-40	-25	-35	-15
1	-9.3	0.0	-5	0
2	0.0	4.3	0.9	4.3
3	7.9	4.0	6.4	8
4	7.4	3.7	5.9	7.4
5	6.8	3.4	5.4	-10
6	6.3	3.2	5.0	0
7	5.8	2.9	4.7	2.9
8	5.4	2.7	4.3	5.4
9	5.0	2.5	4.0	5.0
10	4.6	2.3	3.7	0.0
NPV	0.0	3.9	0.6	8
Rank	4	2	3	1

Running Σ PV

k	a	b	c	d
0	-40.0	-25.0	-35.0	-15.0
1	-49.3	-25.0	-39.6	-15.0
2	-49.3	-20.7	-38.8	-10.7
3	-41.3	-16.7	-32.4	-2.8
4	-34.0	-13.1	-26.5	4.6
5	-27.2	-9.7	-21.1	-5.6
6	-20.9	-6.5	-16.1	-5.6
7	-15.0	-3.6	-11.4	-2.7
8	-9.6	-0.9	-7.1	2.7
9	-4.6	1.6	-3.1	7.7
10	0.0	3.9	0.6	7.7
Rank	4	2	3	1?

Historical currency

ρ = 5%

k	a	b	c	d
0	-40.0	-25	-35.0	-15
1	-10.5	0.0	-5.3	0.0
2	0.0	5.5	1.1	5.5
3	11.6	5.8	9.3	11.6
4	12.2	6.1	9.7	12.2
5	12.8	6.4	10.2	-19
6	13.4	6.7	10.7	0.0
7	14.1	7.0	11.3	7.0
8	14.8	7.4	11.8	14.8
9	15.5	7.8	12.4	15.5
10	16.3	8.1	13.0	0.0
	60	36	49	32	Net
Rank	1	4	3	2	

Running Σ Hist. cur.

k	a	b	c	d
0	-40.0	-25.0	-35.0	-15.0
1	-50.5	-25.0	-40.3	-15.0
2	-50.5	-19.5	-39.1	-9.5
3	-38.9	-13.7	-29.9	2.1
4	-26.8	-7.6	-20.2	14.2
5	-14.0	-1.2	-10.0	-4.9
6	-0.6	5.5	0.8	-4.9
7	13.5	12.5	12.0	2.1
8	28.2	19.9	23.8	16.9
9	43.8	27.6	36.3	32.4
10	60.0	35.8	49.3	32.4
Rank	4	2	3	1

Constant currency

k	a	b	c	d
0	-40	-25	-35	-15
1	-10	0	-5	0
2	0	5	1	5
3	10	5	8	10
4	10	5	8	10
5	10	5	8	-15
6	10	5	8	0
7	10	5	8	5
8	10	5	8	10
9	10	5	8	10
10	10	5	8	0
Σ	30	20	25	20
Rank	2	4	3	1

Equivalent uniform sum

	a	b	c	d
Total Cost	50	25	40	30
Uniform sum	10	5	8	6.5
Total Cost / Uniform sum	5	5	5	4.615
+	1	1	1	1
=	6	6	6	4

Payback period

Equivalent uniform sum
Constant currency

k	a			d	
0	-40			-15	
1	-10			0	
2	0			5	
3	10			10	
4	10			10	
5	10			-15	
6	10			0	
7	10			5	
8	10			10	
9	10			10	
10	10			0	
Σ	**30**			**20**	Net
	80			25	Net benefit
	50			15	Net cost
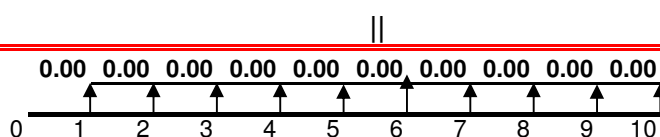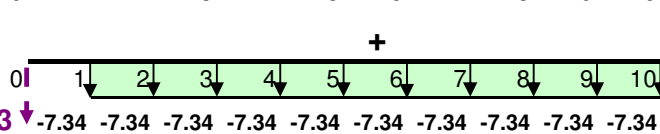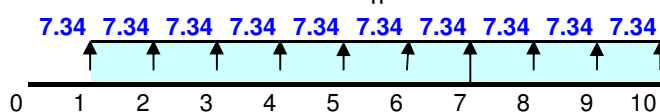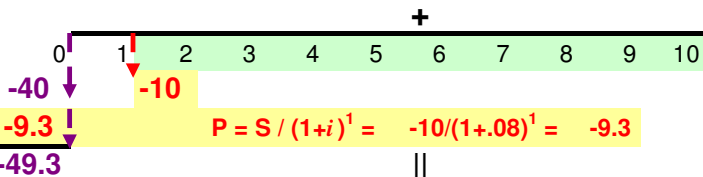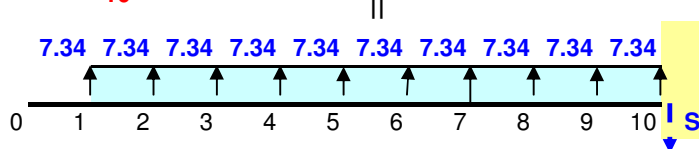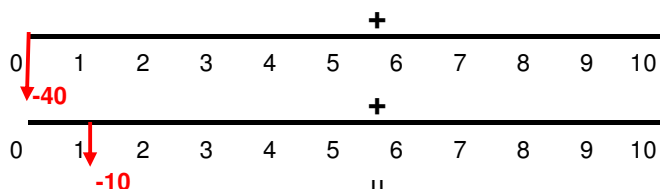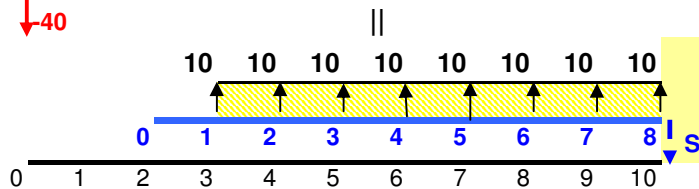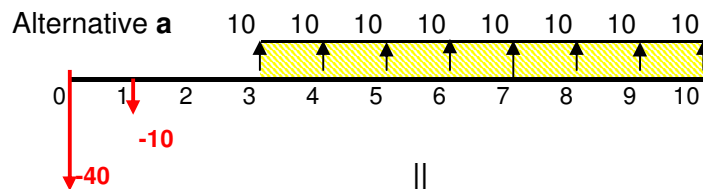
Alternative a

$$S = \frac{(1+i)^8 - 1}{i} \cdot 10$$

$$\frac{(1+i)^{10} - 1}{i} \cdot A = \frac{(1+i)^8 - 1}{i} \cdot 10$$

$$A = \frac{(1+i)^8 - 1}{(1+i)^{10} - 1} \cdot 10$$

$i =$ MARR = 8.0%

$$A = \frac{(1+.08)^8 - 1}{(1+.08)^{10} - 1} \cdot 10 = 7.34$$

$$S = \frac{(1+i)^{10} - 1}{i} \cdot A$$

$P = S / (1+i)^1 = -10/(1+.08)^1 = -9.3$ $i =$ MARR $= 8\%$

$i =$ MARR = 8.0%

$$A = \frac{i(1+i)^n}{(1+i)^n - 1} \cdot P = \frac{.08(1+.08)^{10}}{(1+.08)^{10} - 1} \cdot -49.3$$

$A = -7.34$

Equivalent uniform sum
Alternative 'a'

Equivalent uniform sum

Constant currency

k	a			d

k	a	d
0	-40	-15
1	-10	0
2	0	5
3	10	10
4	10	10
5	10	-15
6	10	0
7	10	5
8	10	10
9	10	10
10	10	0
Σ	30	50	Net
	80	25	Net benefit
	50	15	Net cost

Homework answers
NPV

k	a	d

$i_{MARR} = 8\%$

k	a	d
0	-40.0	-15
1	-9.3	0.0
2	0.0	4.3
3	7.9	7.9
4	7.4	7.4
5	6.8	-10.21
6	6.3	0.0
7	5.8	2.9
8	5.4	5.4
9	5.0	5.0
10	4.6	0.0
NPV	0.0	7.7
	49.3	32.9	Net present benefit
	49.3	25.2	Net present cost
B/C	1.0	1.3

Alternative 'a'
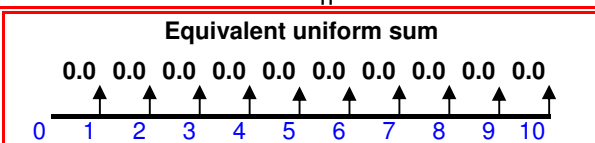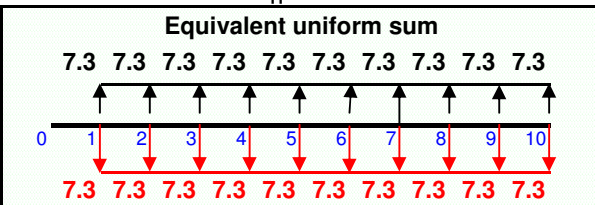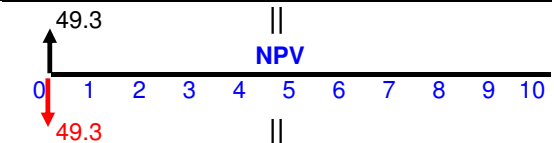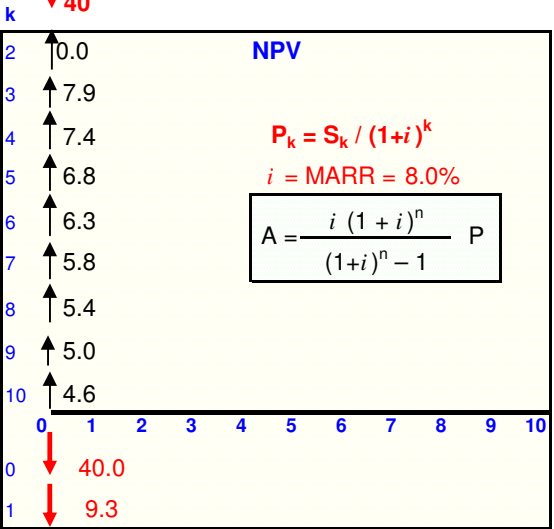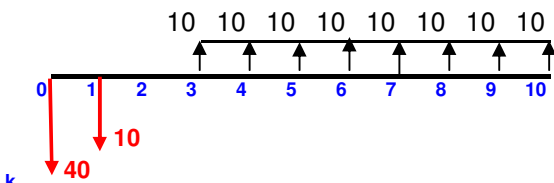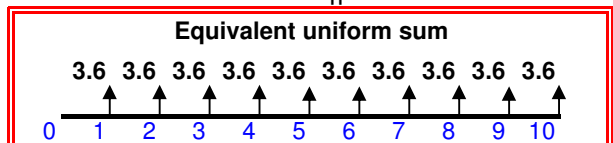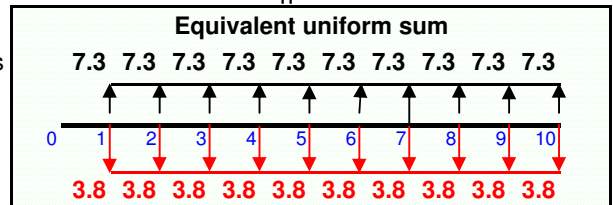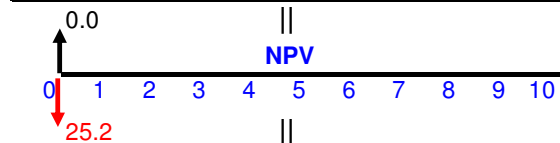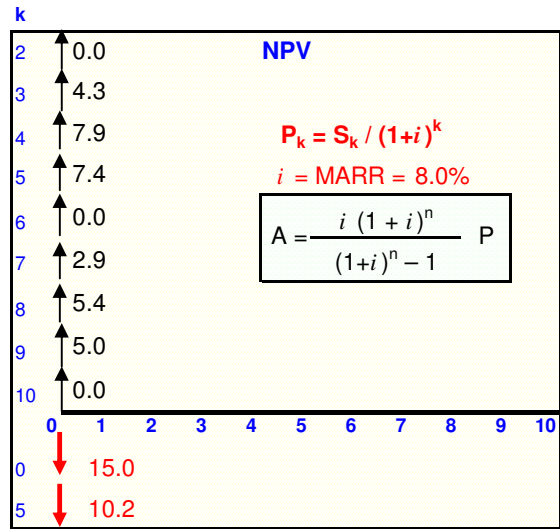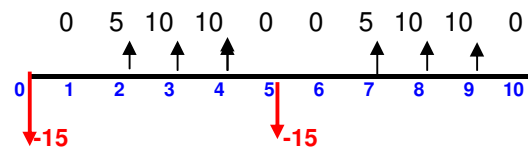
$$P_k = S_k / (1+i)^k$$
$$i = MARR = 8.0\%$$
$$A = \frac{i\,(1+i)^n}{(1+i)^n - 1}\,P$$

Alternative 'd'

$$P_k = S_k / (1+i)^k$$
$$i = MARR = 8.0\%$$
$$A = \frac{i\,(1+i)^n}{(1+i)^n - 1}\,P$$

Equivalent uniform sum (a)

benefits: 7.3 7.3 7.3 7.3 7.3 7.3 7.3 7.3 7.3 7.3

costs: 7.3 7.3 7.3 7.3 7.3 7.3 7.3 7.3 7.3 7.3

net: 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

Equivalent uniform sum (d)

benefits: 7.3 7.3 7.3 7.3 7.3 7.3 7.3 7.3 7.3 7.3

costs: 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8 3.8

net: 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6 3.6

SUMMARY   **Comparison of Alternatives**

Common procedures for all solutions

Set all cash flow in constant currency   **(remove effects of inflation)**

Most Estimates will be prepared in a constant currency

Each estimate must be in the same constant currency   Example $_{2002}$, ₱_{2002}

Estimates made on historical costs must be converted to the common currency

Equal analysis period

Each solution must be analyzed using the *least-common multiple* (**LCM**) of the design lives of all the solutions.

Example   Least common multiple: 60

Alternatives:	A	B	C	D	LCM
Useful life (months)	15	30	12	20	**60**
Analysis period:	**60**	**60**	**60**	**60**	
Cycles	**4**	**2**	**5**	**3**	

Conventional Analysis   (equivalent solutions)

NPV   Set discount rate = MARR

NPV $\geq$ 0, IRR $\geq$ MARR, accept alternative

NPV < 0, IRR < MARR, reject alternative

Rank acceptable alternatives   (the higher the NPV, the better the alternative)

IRR   Select IRR so that NPV = 0   (requires trial & error to converge on solution)

IRR $\geq$ MARR, accept alternative

IRR < MARR, reject alternative

Rank acceptable alternatives   (the higher the IRR, the better the alternative.)

B/C   Sum costs and benefits based on NPV with discount rate = MARR

Benefits = sum of all positive present values

Cost = absolute value of the sum of all negative present values

B/C $\geq$ 1, accept alternative

B/C < 1, reject alternative

Rank acceptable alternatives   (the higher the B/C, the better the alternative.)

NEUS   Set discount rate = MARR   **Net Equivalent Uniform Sum**

a.k.a   Convert constant currency cash flow to Present Values (PV)

EUAS   Sum PV costs and benefits separately   **E**quivalent **U**niform **A**nnual **S**um

Σ PV_{Benefits} = sum of all positive present values

Σ PV_{Cost} = absolute value of the sum of all negative present values

Convert ΣPV_{benefits} and ΣPV_{costs} to Equivalent Uniform Sums (EUS)

Net EUS $\geq$ 0, accept alternative   **NEUS = Net EUS = EUS_{benefits}– EUS_{costs}**

Net EUS < 0, reject alternative

Rank acceptable alternatives   (the higher the NEUC, the better the alternative)

Replacement Analysis

Replacement analysis is largely a matter of comparing the, NPV, IRR, B/C ratio, or **net equivalent uniform sum** (**NEUS**) of two alternatives, one in-place, called the **defender**, and another alternative as a possible replacement, called the **contender** (or *challenger*.) If the **MARR** is used in all evaluations of the *Time Value of Money*, **NPV, IRR, B/C ratio, and NEUS all yield the same results**. Equivalent uniform sums (EUS) are often preferred in replacement analysis because decision makers more easily relate it to recurring operation and maintenance (O&M) costs they normally encounter.

Different replacement policy and procedures might be set for perhaps three classes of equipment or systems: low-value, low-risk; medium-value, medium-risk; and high-value, high-risk. Each class might have different cost thresholds, analysis requirements, and approval criteria, such as follows:

	class	Cost Range	Procedure	Approval/Review
1)	**low-value, low-risk, essential for operations**	$0 < \$ < 1,000$ $(0 < ₱ < 5,000)$	Replace item if repair $ > Replacement $	Section head
2)	**medium-value, medium-risk, essential for operations**	$1,000 < \$ < 5,000$ $(5,000 < ₱ < 25,000)$	NEUS analysis @ MARR=5%	Dept./Division Head
3)	**high-value, high-risk, new technology, or new capability**	$5,000 < \$$ and up $(25,000 < ₱$ and up$)$	Full replacement analysis (full MARR)	Operating budget committee & VP

Low-value, low risk. The decision as to whether to replace or repair low-value components of an essential operating system should rest with the Line Manager. The time wasted in replacement analysis and review is likely to result in lost production and extra costs far outweighing any possible savings in formal processes.

Medium-value, medium risk. An abbreviated analysis that covers the typical concerns might be performed, sans elaborate formal justifications. A reduced MARR should be employed for installed essential equipment. The decision as to whether to replace medium-value, medium risk components of an essential operating system should rest with a decision authority at least one level above the line manager. An independent review by a recognized expert is probably sufficient review.

High-value, high risk. Full Replacement Analysis should be performed, with justifications, assumptions, and backup calculations. The MARR should be commensurate with the risk. The decision to replace high-value, high-risk systems should be at the Vice President level. An independent review by a recognized expert and Operating Budget Committee approval is wise. There are several types of full replacement analysis, with sub-types, that require similar, but somewhat modified, procedures, some of which are discussed below. Particular industries and companies may set additional or other criteria.

1   The replacement item is an **essential fixed-capacity** cog in a machine or system, and separate **benefits cannot reasonably be assigned** to it. In this case, the **benefits are assumed as zero**, and the comparison becomes one of the **least cost,** normally the **MEUAC**.

2   The replacement candidate is an **essential variable-capacity** item which can effect the productivity of a machine or system, and separate **benefits related to the variable capacity can reasonably be assigned** to it. In this case, the **benefits are determined**, and the comparison becomes one of the **highest net benefit,** usually **Net EUAB**. There are at least two sub-cases to this case:

a   The present economic climate promotes reasonable **expectation that increased capacity** of the machine or system will be **needed to meet projected demand**. In this sub-case, both the **defender and contender's differing abilities to increase productivity are accounted for in the estimated benefits.**

b   The present economic climate is such that **no reasonable expectation exists that increased capacity of the machine or system will be needed to meet projected demand**. In this sub-case, **neither the defender nor the contender's abilities to increase productivity should be accounted for** in the estimated benefits. This situation is often present in mature industries or product lines, and where defender capacity already exceeds demand.

3   The replacement **Contender embodies new technologies and/or capabilities** which could substantially increase the utilization and/or productivity of a machine or system, and **separate benefits related to the increased utilization or capacity can reasonably be assigned** to it. In this case, the net benefits are determined, and the comparison becomes one of the **highest net benefit**. There are at least two sub-cases to this case:

   a   The present economic climate promotes **reasonable expectation that increased utilization** or capacity of the machine or system will be needed to meet projected demand. In this sub-case, **both the defender and contender's abilities, if any, to increase productivity are accounted for in the estimated benefits**.

   b   The present economic climate is such that **no reasonable expectation exists that increased utilization or capacity of the machine or system will be needed** to meet projected demand. In this sub-case, **neither the defender nor the contender's abilities to increase productivity should be accounted for in the estimated benefits**. This situation is often present in mature industries or product lines.

4   The replacement contender is a **major machine or system overhaul**, either of the defender, or a "**re-manufactured**" item **swap**. In either case, downtime impact on productivity must be addressed. Major overhaul or remanufactured swaps are often a much more economical solution than new equipment. An example of this is light aircraft piston engines which hit their recommended *time between overhaul* (TBO). FAA regulations require owners to open the engine for inspection at this point, so replacing out-of-tolerance parts, or even bringing the engine to like-new specifications, is viable. Such "remanufactured" engine may cost $5,000, while a new engine may be $20,000 or more.

Operating costs. Both the Defender and the Contender will normally have operating costs that may be different. Aged defenders are often less efficient, and thus may require higher energy and labor costs to operate than a new contender, which may have markedly higher efficiency. Defenders normally have operating cost records in historical currency, which must be converted to constant currency, before projecting future costs.

Sunk cost: The acquisition cost of the Defender, and all past maintenance expenses are sunk costs - that is, they cannot be recovered (except salvage value), and thus are usually **no longer a consideration in economic analysis** - with **two exceptions**: 1) the aforementioned **salvage value** of the defender, and 2) past maintenance costs are useful f**or projecting future maintenance costs**, providing that all **historical costs** are **converted to a constant currency**. This factor works as a **disadvantage for the contender i**n that the **contender's acquisition costs** must be **included** in the analysis, while the d**efender's acquisition costs** are generally sunk costs, and **excluded** from the analysis.

Defender's salvage value. There usually exist an overabundance of competing ways to determine a defender's salvage value, which for replacement analysis purposes would be the **fair market value** of the defender as of the time it is to be disposed of. Sometimes it may be worth doing a little maintenance to enhance that salvage value, providing that the salvage value enhancement will be greater than the cost of the final maintenance. **Trade-in value** on new equipment is typically overstated by salesmen in order to make the contender's acquisition cost appear to be less, and should not be used. **Book value** (the difference between the defender's original acquisition cost and its subsequent depreciation for tax purposes) is a fictional cost used for tax purposes, and seldom has any relation to fair market value.

Economic Useful Life. Most machines or systems can operate in near perpetuity, requiring only regular preventative maintenance, and the occasional replacement of failed parts. This fact generally **works in favor of the defender**. However, over time, there are **two major adversarial developments suffered by the defender:** *obsolescence* **and** *increasing maintenance costs* **,** explained below, which are in reality a **problem created by the Contender**. Thus, **economic useful life is set by the contender, and it is that cross-over point where** net **benefits of the Contender begins to equal and exceed the** net **benefits of the Defender.**

1 **Obsolescence**, wherein the **output of the defender** machine or system is **no longer a useful product**, or **cheaper or better substitutes have become available**. In this light, the **contender often has a decided advantage** if it embodies more powerful processing capability. and even more so if it does so at a lower cost. If, in fact, the defender can no longer produce the required product, it must be replaced, and economic analysis becomes one of alternate contenders.

2 **Increasing cost of maintenance** for defender in labor, parts and support service may over time eventually exceed the acquisition cost of the contender. Or, the repair parts for the defender are no longer available, or the cost to make them extremely high. In this light, the **defender is often at a disadvantage as it ages**, as the **frequency of repairs and maintenance** may **increase**, increasing the cost for labor and parts repair/replacement. **Historical maintenance costs must be converted to the current year currency, when making future projections**.

   a In the US and **Western countries**, the **cost of replacement is very often much lower than the cost of repairing** the machine or system, due to the relatively high cost of labor compared to the cost of the materials. The **prevalent practice is to junk old equipment and acquire new ones**.

   b Just the opposite is often true in the **developing countries**, where l**abor costs tend to be much lower in comparison to material and equipment costs**, which are often bloated by the imposition of custom duties and taxes. Thus, many parts and systems that are discarded in the West are **economically repaired in most developing countries**.

3 **Depreciation** as an indicator for economic life**.** Either straight-line or accelerated depreciation methods popular for reducing tax burdens are often looked to as indicators of economic useful life. According to this approach, the economic life of a piece of capital equipment ends when it is fully depreciated. Such **equipment depreciation calculations are approximate** (although legal by IRS rules), **and have only a remote stastical connection to actual useful life, economic or otherwise.** While the concept of decreasing useful life is valid, the Internal Revenue depreciation schedules are not necessarily a useful or accurate predictor of actual economic useful life.

4 **Maximum net equivalent uniform annual benefit (MaxEUAB, or MEUAB); or Minimium equivalemt uniform annual cost (MinEUAC, or MEUAC),** for cases with no assignable benefits**.** This technique makes an **annual re-assessment based on the equivalent uniform annual net benefit (EUAB), or equivalent uniform annual cost** (**EUAC**) for cases with no assignable benefits. Included for analysis are initial capital outlay, salvage value (if any), operating costs, maintenace costs, and periodic equipment overhaul. This technique assumes that **for each year, a decision could be made to replace the Defender**. Two economic phenomena usually present in equipment analysis are as follows:

   a As the equipment ages, its initial capital outlay is spread over more years, so the equivalent uniform annual cost associated with capital outlay tends to **decrease** each year as the decision to replace is deferred;

   b The operations and maintenance cost (O&M) tend to **increase** with age for each year the decision to replace is deferred, even with rehular maintenace.

The **net effect** of these two trends is that **total cost initially *decrease* with age**, but at some point **then total costs begin to *increase* as the Defender continues to age**. The point in time where the total net benefits are at a maximum (on an annualized basis) is called the MEUAB, or total costs are a minimum MEUAC (for cases with no assigned benefits), It is important to realize that tabular or graphic depictions of the net EUAB, or total EUAC (for cases with no assigned benefits), **the equivalent uniform sum for that year extends from year 1 to year k** (the year for which the equivalent uniform sum is calculated. Thus the **EUAB or EUAC does not represent a continuim of cost through time**, **but rather a continuim of decision through time** (the decision to replace the Defender).

The year in which the net EUAB is maximum (**MEUAB**), or the EUAC is minimum (**MEUAC**, for cases with no assigned benefits), **is considered the end of the useful *economic* life** of the system, as it **represents the most efficient retention time**. Any time shorter or longer period is less efficient. But the the MEUAB, or MEUAC, is not necessarily a sharply defined point, often having a range extending over a few or several years. **No decision to retire the Defender can be rationalized until a Contender is found with a net MEUAB greater** than the Defender's (**or a MEUAC less** than the Defender's for cases with no assignable benefits).

Decision Process. The actual point at which a decision is rendered is for the current year only. The entire analysis and decision process is repeated each year. Normally, the Defender's MEUAB, or MEUAC is yet to be realized, and may not occur for years into the future. So the comparison is of the Defender's current year net EUAB (or total EUAC, for cases with no assignable beneits), to the Contender's MEUAB (or MEUAC, for cases with no assignable benefits).

1) Determine the type of case and appropriate replacement strategy.
2) Convert all historic cost and benefit data to be used in the analysis to current year currency.
3) Calculate the net EUAB (or total EUAC for each year for the Defender and the Contender.
4) Establish a MARR for the economic comparison that is comensurate with the risks involved.
5) If economic lives are not the same, which is the usual case, then the MEUAC is the only method that can be applied.
6) The Contender's MEUAC must be less than the Defender's in order for the challenge to suceed.

Tax consequences. Depending on how depreciation was performed in actual tax filing, the sale of the Defender at an actual salvage value greater than in the Tax Return may be considered a gain, which might be taxable in the year realized. If significant, the tax associated with the gain should be a cost to be annualized in the replacement analysis.

Defender

k	Depr	Mkt val	S₀-Sₖ	i Sₖ	Annualized (S₀-Sₖ)	EUACₖ i = 10%	Oper.	Maint.	Major OH 25%	Total annual O&M	PV total O&M	Σₖ PV	EUACₖ i =MARR 10%	Total EUAC cost
		S=Salvage					**increase/yr**							**Total EUAC cost**
		Depr. Rate 5%			Annualized		1.0%	6.0%						
0		75,000												
1	0.95	71,250	3,750	7,125	4,125	11,250	0	4000		4,000	3636	3636	4,000	15,250
2	0.90	67,500	7,500	6,750	4,321	11,071	0	4,240		4,240	3504	7140	4,114	15,186
3	0.85	63,750	11,250	6,375	4,524	10,899	0	4,494		4,494	3377	10517	4,229	15,128
4	0.80	60,000	15,000	6,000	4,732	10,732	0	4,764		4,764	3254	13771	4,344	15,076
5	0.75	56,250	18,750	5,625	4,946	10,571	0	5,050		5,050	3136	16907	4,460	15,031
6	0.70	52,500	22,500	5,250	5,166	10,416	0	5,353		5,353	3022	19928	4,576	14,992
7	0.65	48,750	26,250	4,875	5,392	10,267	0	5,674		5,674	2912	22840	4,691	14,958
8	0.60	45,000	30,000	4,500	5,623	10,123	0	6,015		6,015	2806	25646	4,807	14,930
9	0.55	41,250	33,750	4,125	5,860	9,985	0	6,375		6,375	2704	28350	4,923	14,908
10	0.50	37,500	37,500	3,750	6,103	9,853	0	6,758		6,758	2605	30955	5,038	14,891
11	0.45	33,750	41,250	3,375	6,351	9,726	0	7,163		7,163	2511	33466	5,152	14,878
12	0.40	30,000	45,000	3,000	6,604	9,604	0	7,593		7,593	2419	35885	5,267	14,871
13	0.35	26,250	48,750	2,625	6,863	9,488	0	8,049		8,049	2331	38217	5,380	**14,868**
14	0.30	22,500	52,500	2,250	7,127	9,377	0	8,532		8,532	2247	40463	5,493	14,869
15	0.25	18,750	56,250	1,875	7,395	9,270	0	9,044		9,044	2165	42628	5,605	14,875
16	0.20	15,000	60,000	1,500	7,669	9,169	0	9,586		9,586	2086	44715	5,715	14,884
17	0.15	11,250	63,750	1,125	7,947	9,072	0	10,161		10,161	2010	46725	5,825	14,897
18	0.10	7,500	67,500	750	8,230	8,980	0	10,771		10,771	1937	48662	5,933	14,914
19	0.05	3,750	71,250	375	8,518	8,893	0	11,417		11,417	1867	50529	6,041	14,933
20	0.00	0	75,000	0	8,809	8,809	0	12,102		12,102	1799	52328	6,146	14,956
21	0.00	0	75,000	0	8,672	8,672	0	12,829		12,829	1734	54062	6,251	14,923
22	0.00	0	75,000	0	8,550	8,550	0	13,598		13,598	1670	55732	6,354	14,904
23	0.00	0	75,000	0	8,443	8,443	0	14,414		14,414	1610	57342	6,455	14,898
24	0.00	0	75,000	0	8,347	8,347	0	15,279		15,279	1551	58893	6,555	14,902
25	0.00	0	75,000	0	8,263	8,263	0	16,196		16,196	1495	60388	6,653	14,915

Contender

k	Cost t Aquire	S=Salvage Mkt val	Depr. Rate 5% S_0-S_k	$i S_k$	Annualized (S_0-S_k)	$EUAC_k$ $i=$ 10%	increase/yr 1.0% Oper.	6.0% Maint.	Major OH 25%	Total annual O&M	PV total O&M	Σ_k PV	$EUAC_k$ $i=$MARR 10%	Total EUAC cost
0	CY	125,000												
1	0.95	118,750	6,250	11,875	6,875	18,750	0	0		0	0	0	0	18,750
2	0.90	112,500	12,500	11,250	7,202	18,452	0	1,000		1,000	826	826	476	18,929
3	0.85	106,250	18,750	10,625	7,540	18,165	0	2,000		2,000	1503	2329	937	19,101
4	0.80	100,000	25,000	10,000	7,887	17,887	0	3,000		3,000	2049	4378	1,381	19,268
5	0.75	93,750	31,250	9,375	8,244	17,619	0	4,000		4,000	2484	6862	1,810	19,429
6	0.70	87,500	37,500	8,750	8,610	17,360	0	4,240		4,240	2393	9255	2,125	19,485
7	0.65	81,250	43,750	8,125	8,986	17,111	0	4,494		4,494	2306	11562	2,375	19,486
8	0.60	75,000	50,000	7,500	9,372	16,872	0	4,764		4,764	2222	13784	2,584	19,456
9	0.55	68,750	56,250	6,875	9,767	16,642	0	5,050		5,050	2142	15926	2,765	19,408
10	0.50	62,500	62,500	6,250	10,172	16,422	0	5,353		5,353	2064	17989	2,928	19,349
11	0.45	56,250	68,750	5,625	10,585	16,210	0	5,674		5,674	1989	19978	3,076	19,286
12	0.40	50,000	75,000	5,000	11,007	16,007	0	6,015		6,015	1916	21895	3,213	19,221
13	0.35	43,750	81,250	4,375	11,438	15,813	0	6,375		6,375	1847	23741	3,342	19,156
14	0.30	37,500	87,500	3,750	11,878	15,628	0	6,758		6,758	1780	25521	3,464	19,092
15	0.25	31,250	93,750	3,125	12,326	15,451	0	7,163		7,163	1715	27236	3,581	19,031
16	0.20	25,000	100,000	2,500	12,782	15,282	0	7,593		7,593	1653	28888	3,692	18,974
17	0.15	18,750	106,250	1,875	13,246	15,121	0	8,049		8,049	1592	30481	3,800	18,920
18	0.10	12,500	112,500	1,250	13,717	14,967	0	8,532		8,532	1535	32015	3,904	18,871
19	0.05	6,250	118,750	625	14,196	14,821	0	9,044		9,044	1479	33494	4,004	18,825
20	0.00	0	125,000	0	14,682	14,682	0	9,586		9,586	1425	34919	4,102	18,784
21	0.00	0	125,000	0	14,453	14,453	0	10,161		10,161	1373	36292	4,196	18,649
22	0.00	0	125,000	0	14,251	14,251	0	10,771		10,771	1323	37615	4,288	18,539
23	0.00	0	125,000	0	14,071	14,071	0	11,417		11,417	1275	38890	4,378	18,449
24	0.00	0	125,000	0	13,912	13,912	0	12,102		12,102	1229	40119	4,465	18,378
25	0.00	0	125,000	0	13,771	13,771	0	12,829		12,829	1184	41303	4,550	18,321
26	0.00	0	125,000	0	13,645	13,645	0	13,598		13,598	1141	42444	4,633	18,278
27	0.00	0	125,000	0	13,532	13,532	0	14,414		14,414	1099	43543	4,714	18,246
28	0.00	0	125,000	0	13,431	13,431	0	15,279		15,279	1059	44603	4,793	18,224
29	0.00	0	125,000	0	13,341	13,341	0	16,196		16,196	1021	45624	4,869	18,210
30	0.00	0	125,000	0	13,260	13,260	0	17,167		17,167	984	46608	4,944	18,204
31	0.00	0	125,000	0	13,187	13,187	0	18,198		18,198	948	47556	5,017	18,204
32	0.00	0	125,000	0	13,121	13,121	0	19,289		19,289	914	48469	5,088	18,209
33	0.00	0	125,000	0	13,062	13,062	0	20,447		20,447	880	49350	5,157	18,219
34	0.00	0	125,000	0	13,009	13,009	0	21,674		21,674	848	50198	5,224	18,234

Total EUAC at year k

Total EUAC (y-axis): 5,000 to 21,000

Year k (x-axis): 0 to 35

- Defender-Economic useful life
- MEUAC-Contender
- MEUAC-Defender

Legend:
- Defender
- Contender
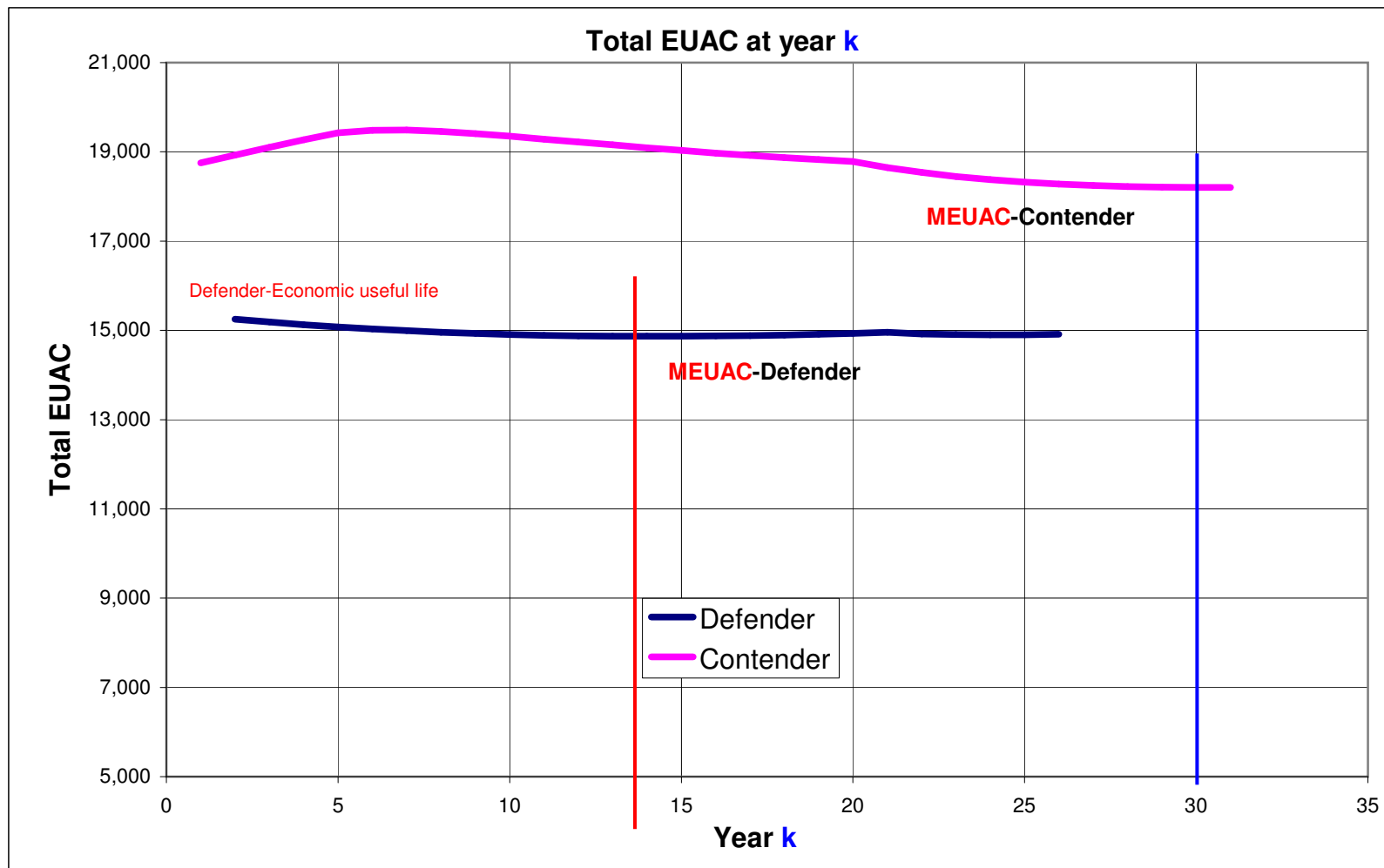
| If EUAC$_{Contender}$ < EAUC$_{Defender}$ **Replace** by end of current year | If EUAC$_{Contender}$ ≥ EAUC$_{Defender}$ **Do not Replace** |

Lesson Plan 16

Depreciation & Taxes

SCHEDULE
Individual Projects   due in by 22 Mar 2003
Group Presentation Schedule   Please target a date for your group project presentation.

LECTURE

PAYBACK PERIOD
Equivalent Uniform Sum (revisited) $N = NPV_{Costs} / EUAS_{Benefits}$

INCOME TAX

US - FEDERAL
Corporate
Personal - single
Personal – married
Comparable rate – graph
US – State
Philippines

INCONSISTENT BUSINESS AND TAX MODELS

DEPRECIATION & TAX
Straight Line Depreciation
Depreciation Schedule
Tax
Analysis

Sum of Year / Digits Depreciation
Depreciation Schedule
Tax
Analysis

Declining & Double Declining
Depreciation Schedule
Tax
Analysis

Declining & Double Declining with Straight Line Conversion
Depreciation Schedule
Tax
Analysis

Modified Accelerated Cost Recovery System (MACRS)
Useful Tax Life
Depreciation Schedules

CAPITAL BUDGETING

HOMEWORK ASSIGNMENT – none

One more lecture on **Annual Operating Budget**

Federal Income Tax Rates

TAX BRACKETS   2002 US Corporate Income Tax Rates

Tax	Taxable Income, $				Running	Tax on $1,000,000	
Rate	From	To	Δ	Tax on Δ	Sum	Amount	Tax
			0		0		0
15%	$0	50,000	50,000	7,500	7,500	50,000	7,500
25%	50,001	75,000	25,000	6,250	13,750	25,000	6,250
34%	75,001	100,000	25,000	8,500	22,250	25,000	8,500
39%	100,001	335,000	235,000	91,650	113,900	235,000	91,650
34%	335,001	10,000,000	9,665,000	3,286,100	3,400,000	665,000	226,100
35%	10,000,001	15,000,000	5,000,000	1,750,000	5,150,000		
38%	15,000,001	18,333,333	3,333,333	1,266,667	6,416,667		
35%	18,333,333				Sum	1,000,000	340,000

Margin

Total Tax

*Personal service corporations pay a flat 35%

Taxable Income = Revenues - expenses - tax credits - non-taxable revenues

US Federal Income Tax - Corporate 2002
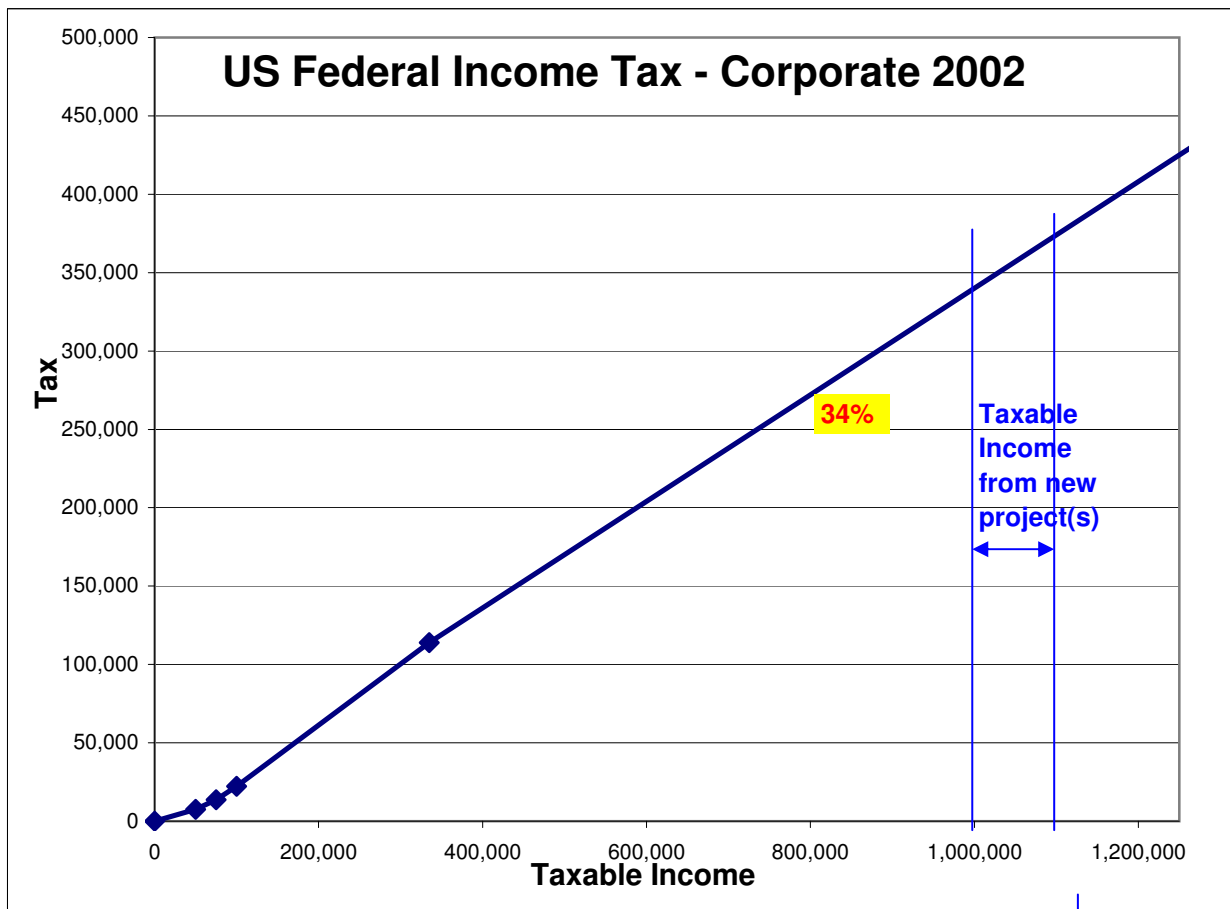
TAX BRACKETS   2002 US Personal Income Tax Rates - single status

Tax Rate	Taxable Income, $			Tax on Δ	Running Sum	Tax on $1,000,000	
	From	To	Δ			Amount	Tax
			0		0		0
10%	$0	6,000	6,000	600	600	6,000	600
15%	6,000	27,950	21,950	3,293	3,893	21,950	3,293
27%	27,950	67,700	39,750	10,733	14,625	39,750	10,733
30%	67,700	141,250	73,550	22,065	36,690	73,550	22,065
35%	141,250	307,050	165,800	58,030	94,720	165,800	58,030
38.6%	307,050	2,000,000	1,692,950	653,479	748,199	692,950	267,479
					Sum	1,000,000	362,199

Margin

Total Tax

*Personal service corporations pay a flat 35%

Taxable Income = Income - exemptions - deductions - business expenses - tax credits - non-taxable revenues

US Federal Income Tax - Personal 2002 - single status

Tax

Personal
Corporate

38.6

Taxable
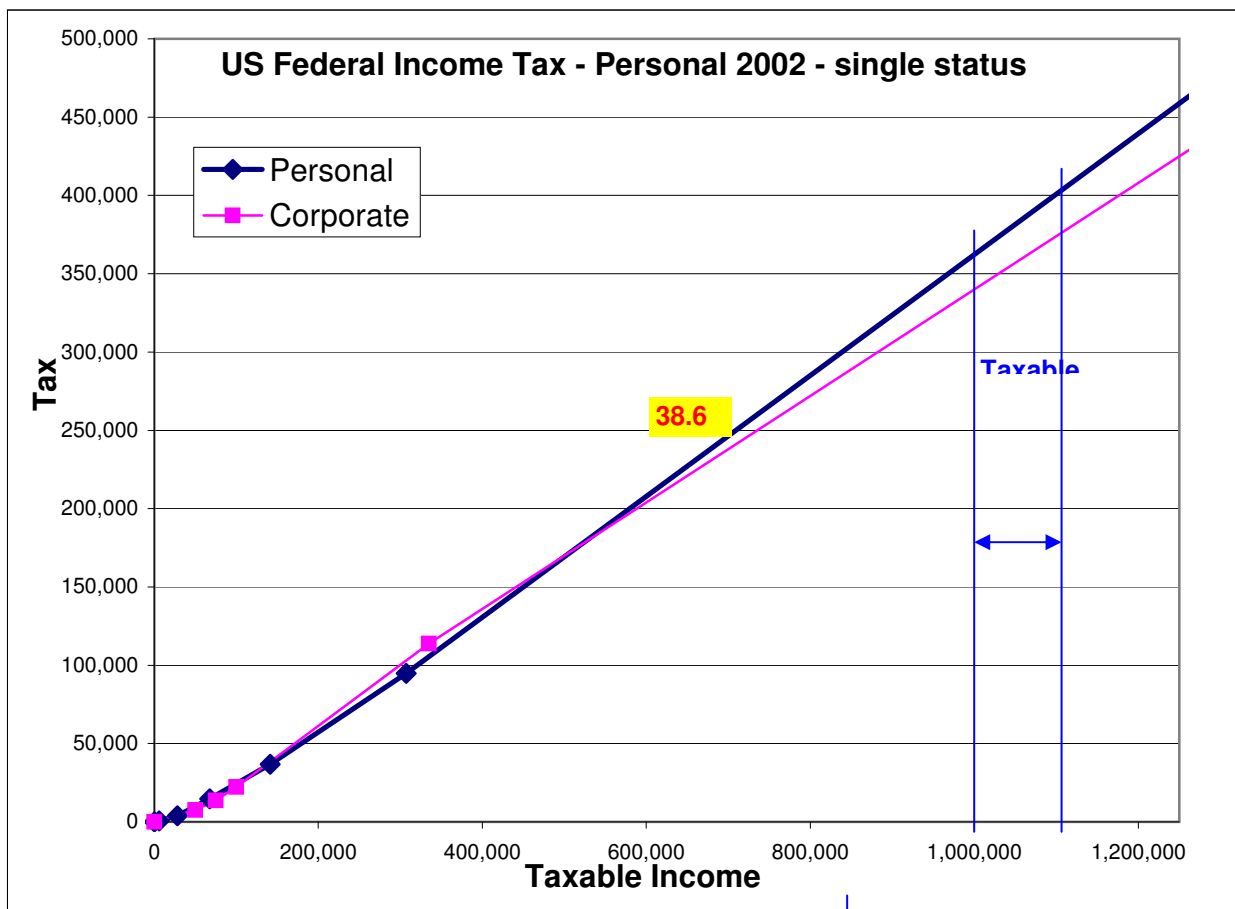
Taxable Income

TAX BRACKETS   **2002 US Personal Income Tax Rates - married status**

Tax Rate	Taxable Income, $			Tax on Δ	Running Sum	Tax on $1,000,000	
	From	To	Δ			Amount	Tax
			0		0		0
10%	$0	12,000	12,000	1,200	1,200	12,000	1,200
15%	12,000	46,700	34,700	5,205	6,405	34,700	5,205
27%	46,700	112,850	66,150	17,861	24,266	66,150	17,861
30%	112,850	171,950	59,100	17,730	41,996	59,100	17,730
35%	171,950	307,050	135,100	47,285	89,281	135,100	47,285
38.6%	307,050	2,000,000	1,692,950	653,479	742,759	692,950	267,479
					Sum	1,000,000	356,759

Margin   **Total Tax**

*Personal service corporations pay a flat 35%

Taxable Income = Income - exemptions - deductions - business expenses - tax credits - non-taxable revenues

US Federal Income Tax - Personal 2002 - married status
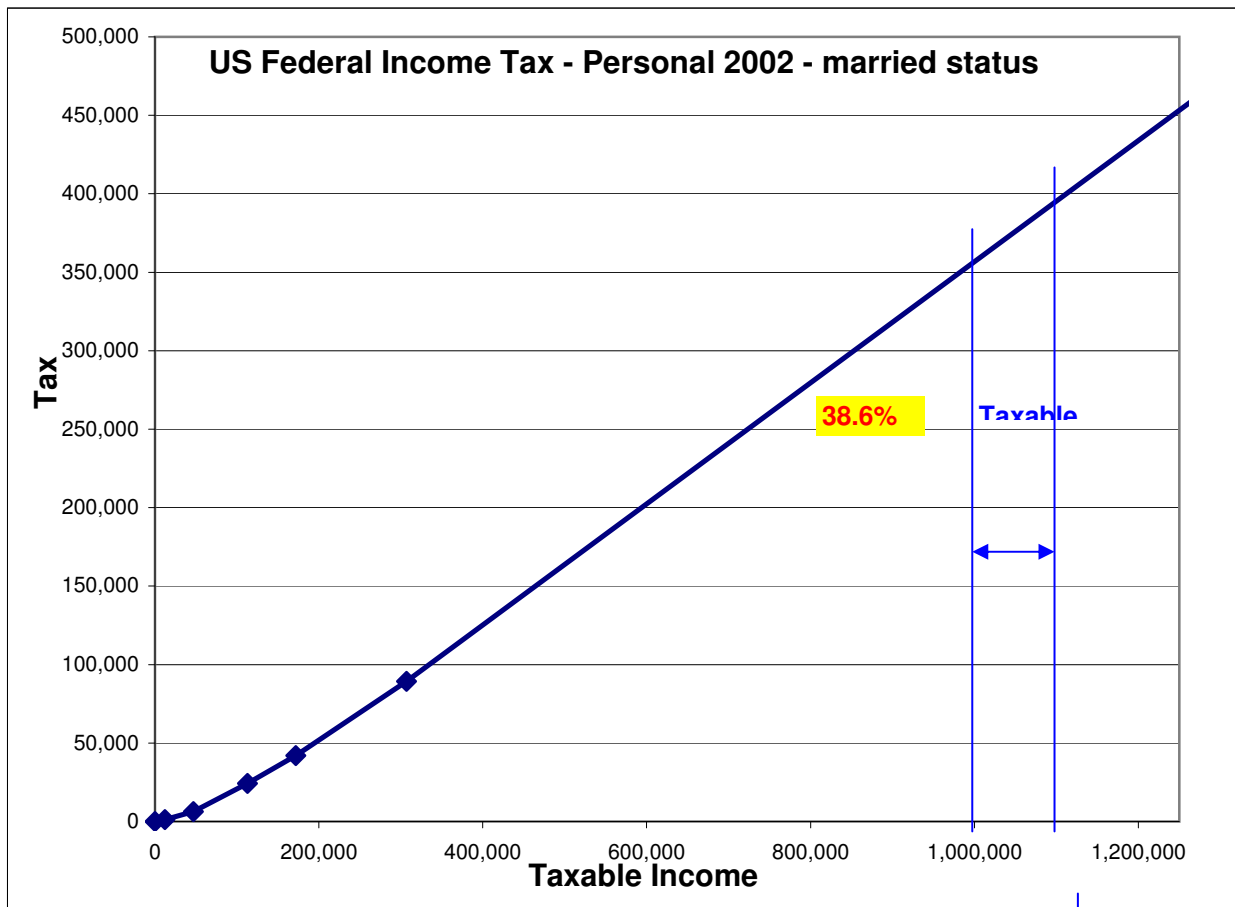
Comparable taxes - low range

US Federal Income Tax - 2002

Legend:
- Married
- Single
- Corporate

Y-axis: Tax (0 to 25,000)
X-axis: Taxable Income (0 to 100,000)
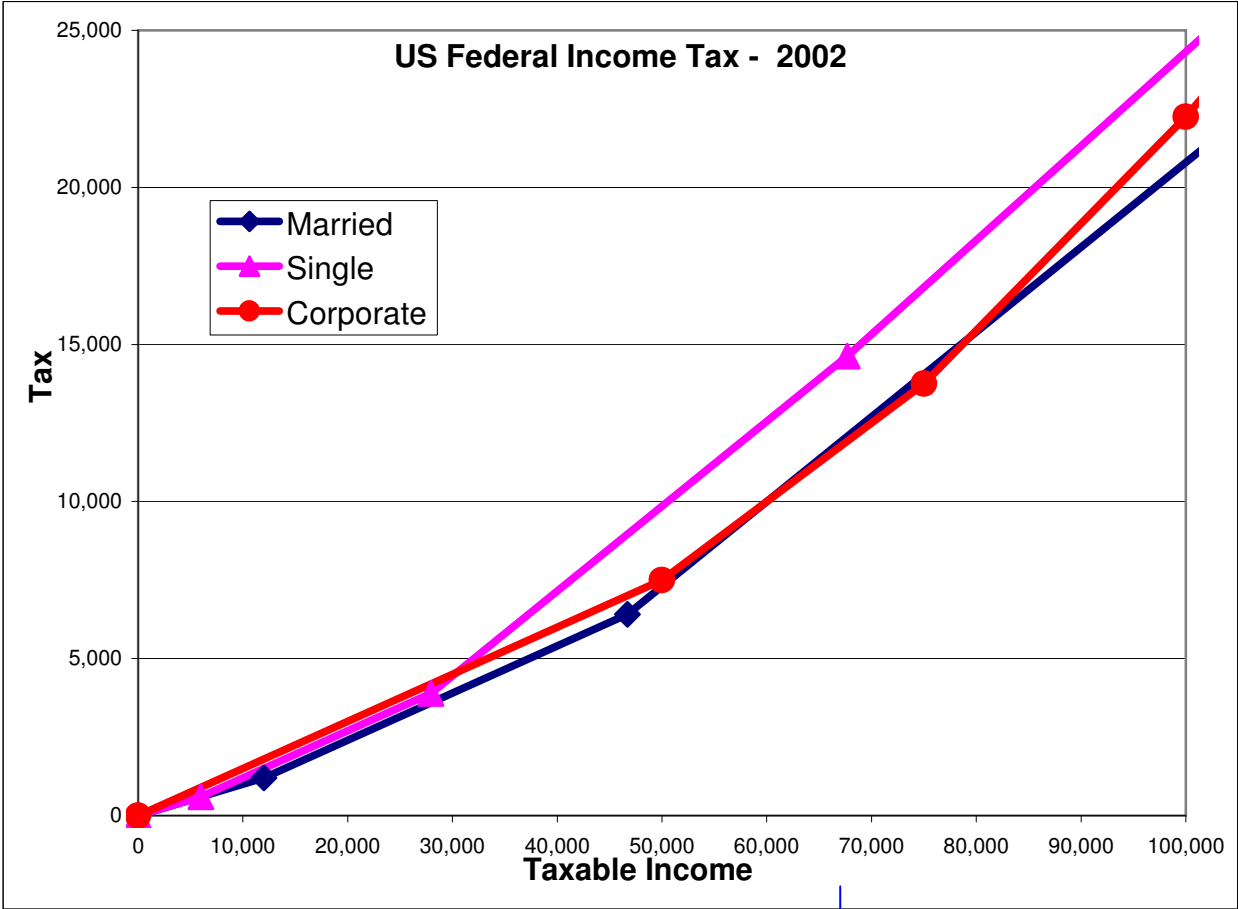
RANGE OF STATE CORPORATE INCOME TAX RATES in the USA

(For tax year 2002 -- as of January 1, 2002)

State	Tax Rates	Tax Brackets			Bank Tax Rates	Federal Tax Deductible
ALABAMA	6.5	----Flat Rate----		1	6.5	*
ALASKA	1.0 - 9.4	10,000	90,000	10	1.0 - 9.4	
ARIZONA	6.968	----Flat Rate----		1	6.968	
ARKANSAS	1.0 - 6.5	3,000	100,000	6	1.0 - 6.5	
CALIFORNIA	8.84 (c)	----Flat Rate----		1	10.84 (c)	
COLORADO	4.63	----Flat Rate----		1	4.63	
CONNECTICUT	7.5 (d)	----Flat Rate----		1	7.5 (d)	
DELAWARE	8.7	----Flat Rate----		1	8.7-1.7 (e)	
FLORIDA	5.5 (f)	----Flat Rate----		1	5.5 (f)	
GEORGIA	6.0	----Flat Rate----		1	6.0	
HAWAII	4.4 - 6.4 (g)	25,000	100,000	3	7.92 (g)	
IDAHO	7.6 (h)	----Flat Rate----		1	7.6 (h)	
ILLINOIS	7.3 (i)	----Flat Rate----		1	7.3 (i)	
INDIANA	7.9 (j)	----Flat Rate----		1	8.5	
IOWA	6.0 - 12.0	25,000	250,000	4	5.0	* (k)
KANSAS	4.0 (l)	----Flat Rate----		1	2.25 (l)	
KENTUCKY	4.0 - 8.25	25,000	250,000	5	--- (a)	
LOUISIANA	4.0 - 8.0	25,000	200,000	5	--- (a)	*
MAINE	3.5 - 8.93 (m)	25,000	250,000	4	1.0	
MARYLAND	7.0	----Flat Rate----		1	7.0	
MASSACHUSETTS	9.5 (n)	----Flat Rate----		1	10.5 (n)	
MINNESOTA	9.8 (o)	----Flat Rate----		1	9.8 (o)	
MISSISSIPPI	3.0 - 5.0	5,000	10,000	3	3.0 - 5.0	
MISSOURI	6.25	----Flat Rate----		1	7.0	* (k)
MONTANA	6.75 (p)	----Flat Rate----		1	6.75 (p)	
NEBRASKA	5.58 - 7.81	50,000		2	--- (a)	
NEW HAMPSHIRE	8.5 (q)	----Flat Rate----		1	8.5 (q)	
NEW JERSEY	9.0 (r)	----Flat Rate----		1	9 (r)	
NEW MEXICO	4.8 - 7.6	500,000	1 million	3	4.8 - 7.6	
NEW YORK	7.5 (s)	----Flat Rate----		1	7.5 (s)	
NORTH CAROLINA	6.9 (t)	----Flat Rate----		1	6.9 (t)	
NORTH DAKOTA	3.0 - 10.5	3,000	50,000	6	7 (b)	*
OHIO	5.1 - 8.5 (u)	50,000		2	--- (u)	
OKLAHOMA	6.0	----Flat Rate----		1	6.0	
OREGON	6.6 (b)	----Flat Rate----		1	6.6 (b)	
PENNSYLVANIA	9.99	----Flat Rate----		1	--- (a)	
RHODE ISLAND	9.0 (b)	----Flat Rate----		1	9.0 (v)	
SOUTH CAROLINA	5.0	----Flat Rate----		1	4.5 (w)	
SOUTH DAKOTA	---				6.0-1.0% (b)	
TENNESSEE	6	----Flat Rate----		1	6.0	
UTAH	5.0 (b)	----Flat Rate----			5.0 (b)	
VERMONT	7.0 - 9.75 (b)	10,000	250,000	4	7.0 - 9.75 (b)	
VIRGINIA	6.0	----Flat Rate----		1	6.0 (x)	
WEST VIRGINIA	9.0	----Flat Rate----		1	9.0	
WISCONSIN	7.9	----Flat Rate----		1	7.9	
DIST. OF COLUMBIA	9.975 (y)	----Flat Rate----			9.975 (y)	

Source: Compiled by FTA from various sources

Note: Michigan imposes a single business tax (sometimes described as a business activities tax or value added tax) of 1.9% on the sum of federal taxable income of the business, compensation paid to employees, dividends, interest, royalties paid and other items. Similarly, Texas imposes a franchise tax of 4.5% of earned surplus. Nevada, Washington, and Wyoming do not have state corporate income taxes.

(a) Rates listed include the corporate tax rate applied to financial institutions or excise taxes based on income. Some states have other taxes based upon the value of deposits or shares.

(b) Minimum tax is $50 in Arizona, $50 in North Dakota (banks), $10 in Oregon, $250 in Rhode Island, $500 per location in South Dakota (banks), $100 in Utah, $250 in Vermont.

(c) Minimum tax is $800. The tax rate on S-Corporations is 1.5% (3.5% for banks).

(d) Or 3.1 mills per dollar of capital stock and surplus (maximum tax $1 million) or $250.

(e) The marginal rate decreases over 4 brackets ranging from $20 to $650 million in taxable income. Building and loan associations are taxed at a flat 8.7%.

(f) Or 3.3% Alternative Minimum Tax. An exemption of $5,000 is allowed.

(g) Capital gains are taxed at 4%. There is also an alternative tax of 0.5% of gross annual sales.

(h) Minimum tax is $20. An additional tax of $10 is imposed on each return.

(i) Includes a 2.5% personal property replacement tax.

(j) Consists of 3.4% on income from sources within the state plus a 4.5% supplemental income tax.

(k) Fifty percent of the federal income tax is deductible.

(l) Plus a surtax of 3.35% (2.125% for banks) taxable income in excess of $50,000 ($25,000).

(m) Or a 27% tax on Federal Alternative Minimum Taxable Income.

(n) Rate includes a 14% surtax, as does the following: an additional tax of $2.60 per $1,000 on taxable tangible property (or net worth allocable to state, for intangible property corporations); minimum tax of $456.

(o) Plus a 5.8% tax on any Alternative Minimum Taxable Income over the base tax.

(p) A 7% tax on taxpayers using water's edge combination. Minimum tax is $50.

(q) Plus a 0.50 percent tax on the enterprise base (total compensation, interest and dividends paid). Business profits tax imposed on both corporations and unincorporated associations.
the franchise tax are subject to a 7.25% income tax. Banking and financial corporations other than savings institutions are subject to the franchise tax. Corporations with net income under $100,000 are taxed at 7.5%. Beginning in 2001, the tax on S corporations is being phased out over a 3-year period. The tax rate on a New Jersey S corporation that has entire net income not subject to federal corporate income tax in excess of $100,000 will remain at 2% for privilege periods ending on or before June 30, 2001. The rate will be 1.33% for privilege periods ending on or after July 1, 2001, but on or before June 30, 2002; the rate will be 0.67% for privilege periods ending on or after July 1, 2002, but on or before June 30, 2003; and there will be no tax imposed for privilege periods ending on or after July 1, 2003. The tax on S corporation with entire net income not subject to federal corporate income tax of $100,00 or less is eliminated for privilege periods ending on or after July 1, 2001. Regulated investment companies are subject to a flat tax of $250 annua
to $100 depending on payroll size ($250 for banks); if any of these is greater than the tax computed on net income. An addition tax of 0.9 mills per dollar of subsidiary capital is imposed on corporations. Small corporations with income under $290,000 pay a 7.5% tax on all income.

(t) Financial institutions are also subject to a tax equal to $30 per one million in assets.
additional litter tax is imposed equal to 0.11% on the first $50,000 of taxable income, 0.22% on income over $50,000; or 0.14 mills on net worth.

(v) For banks, the alternative tax is $2.50 per $10,000 of capital stock ($100 minimum).

(w) Savings and Loans are taxed at a 6% rate.

(x) State and national banks subject to the state's franchise tax on net capital is exempt from the income tax.

(y) Minimum tax is $100. Includes surtax. Effective 1/1/2003, tax rate decreases to 9.45%.

Philippine Tax Tables

For Individuals Earning Purely Compensation Income and Individuals Engaged in Business and Practice of Profession

Over	But Not Over	Rate
0	10,000	P 0 + 5%
10,000	30,000	P 500 + 10% of the excess over P 10,000
30,000	70,000	P 2,500 + 15% of the excess over P 30,000
70,000	140,000	P 8,500 + 20% of the excess over P 70,000
140,000	250,000	P 22,500 + 25% of the excess over P 140,000
250,000	500,000	P 50,000 + 30% of the excess over P 250,000
500,000		P125,000 + **34%** of the excess over P500,000

Provided, that effective January 1, 1999, the top marginal rate will be 33% and effective January 1, 2000, the said rate will be 32%.

NOTE: When the tax due exceeds P2,000.00, the taxpayer may elect to pay in two equal installments, the first installment to be paid at the time the return was filed and the second, on or before July 15 of the same year.

SOURCE: http://www.bir.gov.ph
http://www.bir.gov.ph/tax_income.html#Tabl

For Domestic Corporations

1	**32%** **Taxable income from all sources**
a. In General	2% Gross Income
b. Minimum Corporate Income Tax	10% Improperly Accumulated Taxable Income
c. Improperly Accumulated Earnings	
2. Proprietary Educational Institution	10% Taxable income from all sources
3. Non-stock, Non-profit Hospitals	10% Taxable income from all sources
4. GOCC, Agencies & Instrumentalities	
a. In General	32% Taxable income from all sources
b. Minimum Corporate Income Tax	2% Gross Income
c. Improperly Accumulated Earnings	10% Improperly Accumulated Taxable Income
5. National Gov't & LGUs	
a. In General	32% Taxable income from all sources
b. Minimum Corporate Income Tax	2% Gross Income
c. Improperly Accumulated Earnings	10% Improperly Accumulated Taxable Income
6. Taxable Partnerships	32% Taxable income from all sources
a. In General	2% Gross Income
b. Minimum Corporate Income Tax	Accumulated
c. Improperly Accumulated Earnings	
7. Exempt Corporation	0% Taxable Income
a. On Exempt Activities	Same as in 1a
b. On Taxable Activities	
8. General Professional Partnerships	0%
9. Corporation covered by Special Laws	Rate specified under the respective special laws
For Resident Foreign Corporations	**32% Taxable income from all sources**
	1 2% Gross Income
.a. In General	10% Improperly Accumulated Taxable Income
b. Minimum Corporate Income Tax	
c. Improperly Accumulated Earnings	
2. International Carriers	25% Gross Philippine Billings
3. Regional Operating Headquarters	10% Taxable Income
4. Corporation Covered by Special Laws	Rate specified under the respective special laws
5. Offshore Banking Units (OBUs)	10% Gross Taxable Income On Foreign Currency Transaction and 32% on Taxable Income other than Foreign Currency Transaction
6. Foreign Currency Deposit Units (FCDU)	10% Gross Taxable Income On Foreign Currency Transaction and 32% on Taxable Income other than Foreign Currency

Inconsistent Government & Business Decision Models

(Top table)

	Constant currency					NPV		IRR		
k	**Alternative 'a'**		**Taxable Income** Before Tax	**40% Tax Margin**	**Taxable Income** After Tax	i_{MARR} **8%**		**8.00%**	**8.00%** *irr*	
	Revenue	Expense				Before tax	After tax	Before tax	After tax	
0	0	40	-40	-16	-24	-40.0	-24.0	-40.0	-24.0	
1	0	10	-10	-4	-6	-9.3	-5.6	-9.3	-5.6	
2	6	6	0	0	0	0.0	0.0	0.0	0.0	
3	12	2	10	4	6	7.9	4.8	7.9	4.8	
4	12	2	10	4	6	7.4	4.4	7.4	4.4	
5	12	2	10	4	6	6.8	4.1	6.8	4.1	
6	12	2	10	4	6	6.3	3.8	6.3	3.8	
7	12	2	10	4	6	5.8	3.5	5.8	3.5	
8	12	2	10	4	6	5.4	3.2	5.4	3.2	
9	12	2	10	4	6	5.0	3.0	5.0	3.0	
10	12	2	10	4	6	4.6	2.8	4.6	2.8	
Σ	102	72	30	12	18	0.0	0.0	0.0	0.0	**NPV**
	Σ Benefits		80		48	49.27	29.56	49.27	29.56	
	Σ Costs		50		30	49.26	29.56	49.26	29.56	
	ROI=income/cost		60%		60%	0%	0%	0%	0%	
	B/C		1.60		1.60	1.00	1.00	1.00	1.00	
			No Time value of Money			**Time value of Money**				

Negative tax not allowed & Taxable Income ≠ Analysis cash flow

	Constant currency					NPV		IRR		
k	**Alternative 'a'**		**Analysis Income** Before Tax	**40% Tax Margin**	**Analysis Income** After Tax	i_{MARR} **8%**		**8.00%**	**-0.12%** *irr*	
	Revenue	Expense				Before tax	After tax	Before tax	After tax	
0	0	40	0	0	0.0	0.0	0.0	0.0	0.0	
1	0	10	0	0	0.0	0.0	0.0	0.0	0.0	
2	6	6	0	0	0.0	0.0	0.0	0.0	0.0	
3	12	2	10	4	6.0	7.9	4.8	7.9	6.0	
4	12	2	10	4	6.0	7.4	4.4	7.4	6.0	
5	12	2	10	4	6.0	6.8	4.1	6.8	6.0	
6	12	2	10	4	6.0	6.3	3.8	6.3	6.0	
7	12	2	10	4	6.0	5.8	3.5	5.8	6.1	
8	12	2	10	4	6.0	5.4	3.2	5.4	6.1	
9	12	2	10	4	6.0	5.0	3.0	5.0	6.1	
10	12	2	10	4	6.0	4.6	2.8	4.6	6.1	
Σ	102	72	80	32	48	49.3	29.6	49.3	48.4	**NPV**
	Σ Benefits		80		48	49.27	29.56	49.27	48.38	
	Σ Costs		0		0	0	0	0	0	
	ROI=income/cost		#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
	B/C		#DIV/0!		#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
			No Time value of Money			**Time value of Money**				

Rationale for not allowing negative taxes:

The government looks at business investments as a mere conversion of an asset from liquid to non-liquid, and does not consider it an expense.

DEPRECIATION & TAX

Governments do not allow *capital expenditures* to be deducted as expenses (creating negative tax). Bit they generally do allow *depreciation* of the *capital item or facility* , and the depreciation to be included in the expenses deducted from revenues. Land can not be depreciated.

Capital expenditure: **The expenditure of money (capital) for the acquisition of an item or facility that is an equivalent asset. The liquid asset (money) is transformed into a non-liquid asset.**

Capital item or facility: **The item or facility which is considered an equivalent asset to the liquid asset (money) by which it was acquired.**

Depreciation: **The decrease in value that occurs to capital item or facility as it ages or wears out.**

Depletion: **The decrease in value that occurs to land because of the extraction of minerals or natural resources, such as oil, gas, timber, sands and gravels, gold, silver, etc.**

Straight Line   The simplest depreciation schedule is the constant rate, or straight line.

Revenue — Total Depreciation: 7 7 7 7 7 5 5 5 | Σ 50

Expense
Depreciation
Depreciation: 2 2 2 2 2 | 10
+
Depreciation: 5 5 5 5 5 5 5 5 | 40

k	Rev	Exp	Deprec.	Taxable Income BeforeTax	Margin 40% Tax
0	0	0	0	0	0
1	0	0	0	0	0
2	6	6	0	0	0
3	12	2	7.00	3.00	1.20
4	12	2	7.00	3.00	1.20
5	12	2	7.00	3.00	1.20
6	12	2	7.00	3.00	1.20
7	12	2	7.00	3.00	1.20
8	12	2	5.00	5.00	2.00
9	12	2	5.00	5.00	2.00
10	12	2	5.00	5.00	2.00
Σ	102	22	50	30	12.00

-40 -10   0 1 2 3 4 5 6 7 8

40 Book value

0

0 1 2 3 4 5 6 7 8

40 Depreciation

k	Rev	Exp	Deprec.	Analysis CashFlow BeforeTax	Tax	Analysis CashFlow AfterTax
0	0	40		-40	0	-40
1	0	10		-10	0	-10
2	6	6		0	0	0
3	12	2		10	1.20	8.8
4	12	2		10	1.20	8.8
5	12	2		10	1.20	8.8
6	12	2		10	1.20	8.8
7	12	2		10	1.20	8.8
8	12	2		10	2.00	8.0
9	12	2		10	2.00	8.0
10	12	2		10	2.00	8.0
Σ	102	72		30	12.00	18.0

	NPV			IRR	
i_{MARR}	8%		**8.00%**	**5.20%** *irr*	
	Before tax	After tax		Before tax	After tax
	-40.0	-40.0		-40.0	-40.0
	-9.3	-9.3		-9.3	-9.5
	0.0	0.0		0.0	0.0
	7.9	7.0		7.9	7.6
	7.4	6.5		7.4	7.2
	6.8	6.0		6.8	6.8
	6.3	5.5		6.3	6.5
	5.8	5.1		5.8	6.2
	5.4	4.3		5.4	5.3
	5.0	4.0		5.0	5.1
	4.6	3.7		4.6	4.8
Σ	**0.0**	**-7.1** NPV		**0.0**	**0.0**

	Before tax	After tax
$\Sigma_{Benefits}$	49.27	42.15
Σ_{Costs}	49.26	49.26
B/C ratio	**1.00**	**0.86**

Sum of Years (sum of digits)

k	k	digit	fraction	Deprec.	Σ	Book
0						
1	**k**	digit	fraction	**Deprec.**	Σ	Book
2	0					40
3	1	8	2/9	**8.89**	8.89	31.1
4	2	7	7/36	**7.78**	16.67	23.3
5	3	6	1/6	**6.67**	23.33	16.7
6	4	5	5/36	**5.56**	28.89	11.1
7	5	4	1/9	**4.44**	33.33	6.7
8	6	3	1/12	**3.33**	36.67	3.3
9	7	2	1/18	**2.22**	38.89	1.1
10	8	1	1/36	**1.11**	40.00	0.0
	Σ	36	1.00	**40.00**		

k	k	digit	fraction	Deprec.	Σ	Book
0						
1	**k**	digit	fraction	**Deprec.**	Σ	Book
2	0					10
3	1	5	1/3	**3.33**	3.33	6.67
4	2	4	4/15	**2.67**	6.00	4.00
5	3	3	1/5	**2.00**	8.00	2.00
6	4	2	2/15	**1.33**	9.33	0.67
7	5	1	1/15	**0.67**	10.00	0.00
8						
9						
10						
	Σ	15	1.00	**10.00**		

Total Deprec.

	0
	0
	0
	12.22
	10.44
	8.67
	6.89
	5.11
	3.33
	2.22
	1.11
Σ	50

---

k	Rev	Exp	Deprec.	Taxable Income BeforeTax	Margin 40% Tax	Taxable Income AfterTax
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	6	6	0	0	0	0
3	12	2	**12.22**	-2.22	-0.89	-1.3
4	12	2	**10.44**	-0.44	-0.18	-0.3
5	12	2	**8.67**	1.33	0.53	0.8
6	12	2	**6.89**	3.11	1.24	1.9
7	12	2	**5.11**	4.89	1.96	2.9
8	12	2	**3.33**	6.67	2.67	4.0
9	12	2	**2.22**	7.78	3.11	4.7
10	12	2	**1.11**	8.89	3.56	5.3
Σ	102	22	50	30	**12.00**	18

Total Depreciation   12.2 10.4 8.7 6.9 5.1 3.3 2.2 1.1 | Σ 50

Depreciation   3.3 2.7 2.0 1.3 0.7 0.0 | 6.7

+

Depreciation   8.9 7.8 6.7 5.6 4.4 3.3 2.2 1.1 | 40
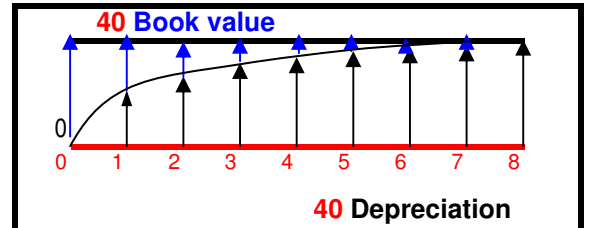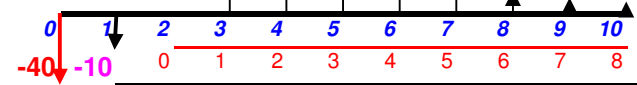
-40 -10

40 Book value

40 Depreciation

≠

k	Rev	Exp	Deprec.	Analysis CashFlow BeforeTax	Tax	Analysis CashFlow AfterTax
0	0	40		-40	0	-40
1	0	10		-10	0	-10
2	6	6		0	0	0
3	12	2		10	-0.89	10.9
4	12	2		10	-0.18	10.2
5	12	2		10	0.53	9.5
6	12	2		10	1.24	8.8
7	12	2		10	1.96	8.0
8	12	2		10	2.67	7.3
9	12	2		10	3.11	6.9
10	12	2		10	3.56	6.4
Σ	102	72		30	**12.00**	18.0

	NPV		IRR	
i_{MARR}	**8%**		**8.00%**	**5.46%**
Before tax	After tax		Before tax	After tax
-40.0	-40.0		-40.0	-40.0
-9.3	-9.3		-9.3	-9.5
0.0	0.0		0.0	0.0
7.9	8.6		7.9	9.3
7.4	7.5		7.4	8.2
6.8	6.4		6.8	7.3
6.3	5.5		6.3	6.4
5.8	4.7		5.8	5.5
5.4	4.0		5.4	4.8
5.0	3.4		5.0	4.3
4.6	3.0		4.6	3.8
0.0	**-6.1** NPV		**0.0**	**0.0**

	Before tax	After tax
ΣBenefits	49.27	43.17
ΣCosts	49.26	49.26
B/C ratio	**1.00**	**0.88**

Declining & Double-Declining Balance

k	d	1.5 declining	2 double declining		k	d	1.5 declining	2 double declining		Total Deprec.
0	n	8			0	n	5			0

k	d/n	Balance	Deprec.	Σ	Book	k	d/n	Balance	Deprec.	Σ	Book	Total Deprec.
0					40	0					10	0
1	2/8	40	10.0	10.00	30.00	1	2/5	10	4.00	4.00	6.00	14.00
2	2/8	30.0	7.50	17.50	22.50	2	2/5	6.0	2.40	6.40	3.60	9.90
3	2/8	22.5	5.63	23.13	16.88	3	2/5	3.6	1.44	7.84	2.16	7.07
4	2/8	16.9	4.22	27.34	12.66	4	2/5	2.2	0.86	8.70	1.30	5.08
5	2/8	12.7	3.16	30.51	9.49	5	2/5	1.3	0.52	9.22	0.78	3.68
6	2/8	9.5	2.37	32.88	7.12							2.37
7	2/8	7.1	1.78	34.66	5.34							1.78
8	2/8	5.3	1.33	36.00	4.00							1.33
Σ	2		36.00			Σ	2	23.06	9.22			45.22

Note: This method can not depreciate to zero

Total Depreciation 14.0 9.9 7.1 5.1 3.7 2.4 1.8 1.3 | Σ 45

|| ||

Depreciation 4 2.4 1.4 0.9 0.5   9.2

+ +

Depreciation 10 7.5 5.6 4.2 3.2 2.4 1.8 1.3   36

40 Book value

k	Rev	Exp	Deprec.	Taxable Income BeforeTax	Margin 40% Tax	Taxable Income AfterTax
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	6	6	0	0	0	0
3	12	2	14.00	-4.00	-1.60	-2.4
4	12	2	9.90	0.10	0.04	0.1
5	12	2	7.07	2.94	1.17	1.8
6	12	2	5.08	4.92	1.97	3.0
7	12	2	3.68	6.32	2.53	3.8
8	12	2	2.37	7.63	3.05	4.6
9	12	2	1.78	8.22	3.29	4.9
10	12	2	1.33	8.67	3.47	5.2
Σ	102	22	45	34.7821	13.91	20.8693

≠ →

k	Rev	Exp	Deprec.	Analysis CashFlow BeforeTax	Tax	Analysis CashFlow AfterTax
0	0	40		-40	0	-40
1	0	10		-10	0	-10
2	6	6		0	0	0
3	12	2		10	-1.60	11.6
4	12	2		10	0.04	10.0
5	12	2		10	1.17	8.8
6	12	2		10	1.97	8.0
7	12	2		10	2.53	7.5
8	12	2		10	3.05	6.9
9	12	2		10	3.29	6.7
10	12	2		10	3.47	6.5
Σ	102	72	30		13.91	16.1

	NPV		IRR	
i_{MARR}	8%		8.00%	5.00%
	Before tax	After tax	Before tax	After tax
	-40.0	-40.0	-40.0	-40.0
	-9.3	-9.3	-9.3	-9.5
	0.0	0.0	0.0	0.0
	7.9	9.2	7.9	10.0
	7.4	7.3	7.4	8.2
	6.8	6.0	6.8	6.9
	6.3	5.1	6.3	6.0
	5.8	4.4	5.8	5.3
	5.4	3.8	5.4	4.7
	5.0	3.4	5.0	4.3
	4.6	3.0	4.6	4.0
NPV	0.0	-7.2	0.0	0.0

	Before tax	After tax
Σ Benefits	49.27	42.1
Σ Costs	49.26	49.26
B/C ratio	1.00	0.85

Declining & Double-Declining Balance with Straight Line Conversion

	d	**1.5** declining	**2** double declining		**d**	**1.5** declining	**2** double declining	**Total Deprec.**
0	**n**	**8**		**0**	**n**	**5**		0

k		d/n	Balance	Deprec.	Σ	Book	k		d/n	Balance	Deprec.	Σ	Book	Total Deprec.
0							0							0
1	**k**	d/n	Balance	**Deprec.**	Σ	Book	1	**k**	d/n	Balance	**Deprec.**	Σ	Book	0
2	0					**40**	2	0					**10**	0
3	1	2/8	40	**10.0**	10.00	30.00	3	1	2/5	10	**4.00**	4.00	6.00	**14.00**
4	2	2/8	30.0	**7.50**	17.50	22.50	4	2	2/5	6.0	**2.40**	6.40	3.60	**9.90**
5	3	2/8	22.5	**5.63**	23.13	16.88	5	3	2/5	3.6	**1.44**	7.84	2.16	**7.07**
6	4	2/8	16.9	**4.22**	27.34	12.66	6	4	2/5	2.2	**1.08**	8.92	**1.08**	**5.30**
7	5	2/8	12.7	**3.16**	30.51	9.49	7	5	2/5	1.1	**1.08**	10.00	**0.00**	**4.24**
8	6	2/8	9.5	**3.16**	33.67	**6.33**	8							**3.16**
9	7	2/8	6.3	**3.16**	36.83	**3.17**	9							**3.16**
10	8	2/8	3.2	**3.16**	40.00	**0.00**	10							**3.16**
	Σ	2		**40.00**				Σ	2	22.84	**10.00**			50.00

Total Depreciation 14.0 9.9 7.1 5.3 4.2 3.2 3.2 3.2 **Σ 50**

Depreciation 4 2.4 1.4 1.1 1.1 **10**

+

Depreciation 10 7.5 5.6 4.2 3.2 3.2 3.2 3.2 **40**

				Taxable Income	**Margin 40%**	**Taxable Income**
				BeforeTax		AfterTax
k	Rev	Exp	Deprec.	BeforeTax	Tax	AfterTax
0	0	**0**	0	0	0	0
1	0	**0**	0	0	0	0
2	6	6	0	0	0	0
3	12	2	**14.00**	-4.00	-1.60	-2.4
4	12	2	**9.90**	0.10	0.04	0.1
5	12	2	**7.07**	2.94	1.17	1.8
6	12	2	**5.30**	4.70	1.88	2.8
7	12	2	**4.24**	5.76	2.30	3.5
8	12	2	**3.16**	6.84	2.73	4.1
9	12	2	**3.16**	6.84	2.73	4.1
10	12	2	**3.16**	6.84	2.73	4.1
Σ	102	22	50	30.0032	**12.00**	18.0019

40 Book value

40 Depreciation

			Analysis CashFlow		Analysis CashFlow
			BeforeTax	Tax	AfterTax
k	Rev	Exp	Deprec.	Tax	AfterTax
0	0	**40**		0	-40
1	0	**10**		0	-10
2	6	6		0	0
3	12	2		-1.60	11.6
4	12	2		0.04	10.0
5	12	2		1.17	8.8
6	12	2		1.88	8.1
7	12	2		2.30	7.7
8	12	2		2.73	7.3
9	12	2		2.73	7.3
10	12	2		2.73	7.3
Σ	102	72		**12.00**	18.0

	NPV		IRR	
i_{MARR}	**8%**		**8.00%** **5.00%**	
Before tax	**After tax**		**Before tax**	**After tax**
-40.0	-40.0		-40.0	-40.0
-9.3	-9.3		-9.3	-9.5
0.0	0.0		0.0	0.0
7.9	9.2		7.9	10.0
7.4	7.3		7.4	8.2
6.8	6.0		6.8	6.9
6.3	5.1		6.3	6.1
5.8	4.5		5.8	5.5
5.4	3.9		5.4	4.9
5.0	3.6		5.0	4.7
4.6	3.4		4.6	4.5
0.0	**-6.2**	NPV	**0.0**	**1.2**

	Before tax	After tax
Σ Benefits	49.27	43.07
Σ Costs	49.26	49.26
B/C ratio	**1.00**	**0.87**

Declining & Double-Declining Balance with Straight Line Conversion
Book Value vs k

Book Value

k

40
10

Old	New	New		Old	New	New
Book	**Book**	**Deprec.**		**Book**	**Book**	**Deprec.**
40	**40**	0		**10**	**10**	0
30.00	30.00	10.00		6.00	6.00	4.00
22.50	22.50	7.50		3.60	3.60	2.40
16.88	16.88	5.63		2.16	2.16	1.44
12.66	12.66	4.22		1.30	**1.08**	**1.08**
9.49	9.49	3.164		0.78	**0.00**	**1.08**
7.12	**6.33**	**3.164**				**10.00**
5.34	**3.16**	**3.164**				
4.00	**0.00**	**3.164**			**1.080**	
		40.00		2	2.16	

3.164
3 | 9.49

Comparison of Methods

		After Tax	
	Tax	**NPV**	**IRR**
Straight Line	12.00	-7.1	5.20%
Sum of Years/Digits	**12.00**	**-6.1**	**5.46%**
Double Declining Balance	13.91	-7.2	5.00%
DDB w St Line Conversion	12.00	-6.2	5.00% MACRS is a version of DDB

Modified Accelarated Cost Recovery System (MACRS)

Table 10-2. MACRS Recovery Periods for Property Used in Rental Activities

Type of Property	MACRS Recovery Period	
	General Depreciation System	**Alternative Depreciation System**
Computers and their peripheral equipment	5 years	5 years
Office machinery, such as: Typewrites, Calculators, Copiers	5 years	6 years
Automobiles	5 years	5 years
Light trucks	5 years	5 years
Appliances, such as: Stoves Refrigerators	5 years	9 years
Carpets	5 years	9 years
Furniture used in rental property	5 years	9 years
Office furniture and equipment, such as: Desks, Files	7 years	10 years
Any property that does not have a class life and that has not been designated by law as being in any other class	7 years	12 years
Roads	15 years	20 years
Shrubbery	15 years	20 years
Fences	15 years	20 years
Residential rental property (buildings or structures) and structural components such as furnaces, water pipes, venting,	27.5 years	40 years
Additions and improvements, such as a new roof	The recovery period of the property to which the addition or improvement is made, determined as if the property were placed in service at the same time as the addition or improvement.	

Most business and investment property placed in service after 1986 is depreciated using MACRS.

MACRS consists of two systems that determine how you depreciate your property. The main system is called the **General Depreciation System (GDS).** The second system is called the **Alternative Depreciation System (ADS).** GDS is used to figure your depreciation deduction for property used in most rental activities, unless you elect ADS.

To figure your MACRS deduction, you need to know the following information about your property:
1. Its recovery period,
2. Its placed-in-service date, and
3. Its depreciable basis.

Personal home changed to rental use.   You must use MACRS to figure the depreciation on property you used as your home and changed to rental property in 2002.

Table 10-3. Optional MACRS Tables

Table 10-3-A. MACRS 5-Year property

Year	Half-year convention	Mid-quarter convention			
		First quarter	Second quarter	Third quarter	Fourth quarter
1	20.00%	35.00%	25.00%	15.00%	5.00%
2	32.00%	26	30	34	38
3	19.20%	15.6	18	20.4	22.8
4	11.52%	11.01	11.37	12.24	13.68
5	11.52%	11.01	11.37	11.3	10.94
6	5.76%	1.38	4.26	7.06	9.58
	100.00%				

Table 10-3-B. MACRS 7-Year property

Year	Half-year convention	Mid-quarter convention			
		First quarter	Second quarter	Third quarter	Fourth quarter
1	14.29%	25.00%	17.85%	10.71%	3.57%
2	24.49%	21.43	23.47	25.51	27.55
3	17.49%	15.31	16.76	18.22	19.68
4	12.49%	10.93	11.97	13.02	14.06
5	8.93%	8.75	8.87	9.3	10.04
6	8.92%	8.74	8.87	8.85	8.73
	86.61%				

Table 10-3-C. MACRS 15-Year property

Year	Half-year convention	Mid-quarter convention			
		Second quarter	First quarter	Third quarter	Forth quarter
1	5.00%	8.75%	6.25%	3.75%	1.25%
2	9.50%	9.13	9.38	9.63	9.88
3	8.55%	8.21	8.44	8.66	8.89
4	7.70%	7.39	7.59	7.8	8
5	6.93%	6.65	6.83	7.02	7.2
6	6.93%	5.99	6.15	6.31	6.48
	44.61%				

Table 10-3-D. Residential Rental Property (27.5-year)

Use the row for the month of the taxable year placed in service.					
Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Jan. 3.49%	3.64%	3.64%	3.64%	3.64%	3.64%
Feb. 3.18%	3.636	3.636	3.636	3.636	3.636
Mar 2.88%	3.636	3.636	3.636	3.636	3.636
Apr. 2.58%	3.636	3.636	3.636	3.636	3.636
May 2.27%	3.636	3.636	3.636	3.636	3.636
Jun 1.97%	3.636	3.636	3.636	3.636	3.636
July 1.67%	3.636	3.636	3.636	3.636	3.636
Aug. 1.36%	3.636	3.636	3.636	3.636	3.636
Sept. 1.06%	3.636	3.636	3.636	3.636	3.636
Oct. 0.76%	3.636	3.636	3.636	3.636	3.636
Nov. 0.46%	3.636	3.636	3.636	3.636	3.636
Dec. 0.15%	3.636	3.636	3.636	3.636	3.636

21.67%

Capital Budgeting

Problem: **Many candidate projects**, but **only 150 available** to fund them
Goal: **Maximize Benefits** (government), or **profits** (commercial) for the fixed sum avaiable
Solution: Rank by **B/C ratio**, sub-rank by **profit**

Example

Ranked by B/C ratio, subranked by profit

Project	B/C	Cost
a	1.0	10
b	1.2	20
c	1.0	15
d	1.0	40
e	0.9	30
f	1.4	40
g	1.3	40
h	1.7	50
Σ	9.5	245

Project	B/C	Profit	Benefit $\Sigma_{benefit}$ Σ_{profit}	Cost	Σ_{cost}		composite B/C ratio	
h	1.7	85	85	50	50		**1.70**	
f	1.4	56	141	40	90		**1.57**	
g	1.3	52	193	40	130		**1.48**	
b	1.2	24	**217**	20	**150**	**fund**	**1.45**	**highest composite**
d	1.0	40	257	40	190	**Defer**	**1.35**	
c	1.0	15	272	15	205		**1.33**	
a	1.0	10	282	10	215		**1.31**	
~~e~~	0.9	~~27~~	309	~~30~~	245		**1.26**	
Σ	9.5	309			245			

Ranked by profit, and then by B/C ratio   **composite**

Project	B/C	Profit	Benefit $\Sigma_{benefit}$ Σ_{profit}	Cost	Σ_{cost}		B/C ratio	
h	1.7	85	85	50	50		1.70	
f	1.4	56	141	40	90		1.57	
g	1.3	52	193	40	**130**	**fund**	1.48	**doesn't utilize all funds**
d	1.0	40	233	40	170	**Defer**	1.37	
~~e~~	0.9	~~27~~	260	~~30~~	200		1.30	**unprofitable**
b	1.2	24	284	20	220		1.29	
c	1.0	15	299	15	235		1.27	
a	1.0	10	309	10	~~245~~		1.26	
Σ		9.5	309		245			

Ranked by profit, and then by B/C ratio   **composite**

Project	B/C	Profit	Benefit $\Sigma_{benefit}$ Σ_{profit}	Cost	Σ_{cost}		B/C ratio
h	1.7	85	85	50	50		1.70
f	1.4	56	141	40	90		1.57
g	1.3	52	193	40	130		1.48
c	1.0	15	208	15	**145**	**fund**	**1.43**
d	1.0	40	248	40	185		1.34
~~e~~	0.9	~~27~~	275	~~30~~	215		1.28
b	1.2	24	299	20	235		1.27
a	1.0	10	309	10	245		1.26
Σ		9.5	309		245		

Lesson Plan 17

Operating Budget

Break-Even Analysis

SCHEDULE
Individual Projects   due in by 22 Mar 2003
Group Presentation Schedule Please target a date for your group project presentation.

LECTURE

OPERATING BUDGET
Summary
All Revenues
All Expenses
Income
Graph

REVENUES – All Projects
EXPENSES – All Directorates and Offices
EXPENSES – Engineering Directorate – All Divisions
EXPENSES – Engineering Directorate –
Director's Office Breakdown
Graph

Revenues – Project data subsets / graphs

BREAK-EVEN ANALYSIS
General considerations
Disadvantages
Advantages
Analysis

Two-stage construction example
Formulaic solution
Graphical solution

Three-stage construction example
Formulaic solution (optional extra-credit homework)
Graphical solution

HOMEWORK ASSIGNMENT – Extra credit (optional) 3-stage formulaic solution

Maybe one more short lecture on **Objectives Decision Matrix**

Next session – Review for Final Exam

FISCAL YEAR 2003 OPERATING BUDGET   Pesos, millions   End of Month Values

ITEM		1 Jan	2 Feb	3 Mar	4 Apr	5 May	6 Jun	7 Jul	8 Aug	9 Sep	10 Oct	11 Nov	12 Dec
All Revenues - All Projects													
Planned	month	100	100	100	100	100	100	100	100	100	100	100	100
	Cumulative	100	200	300	400	500	600	700	800	900	1000	1100	1200
Actual/Forecast	month	**95**	**95**	**95**	95	96	97	98	99	99	99	99	100
	Cumulative	**95**	**190**	**285**	380	476	573	671	770	869	968	1067	1167
All Expenses - All Departments, Directorates, and Offices													
Planned	month	86	86	86	86	86	86	86	86	86	86	86	86
	Cumulative	86	172	258	344	430	516	602	688	774	860	946	1032
Actual/Forecast	month	**87**	**88**	**89**	90	91	92	93	94	95	96	97	98
	Cumulative	**87**	**175**	**264**	354	445	537	630	724	819	915	1012	1110
Income = Revenues – Expenses													
Planned	month	14	14	14	14	14	14	14	14	14	14	14	14
	Cumulative	14	28	42	56	70	84	98	112	126	140	154	168
Actual/Forecast	month	**8**	**7**	**6**	5	5	5	5	5	4	3	2	2
	Cumulative	**8**	**15**	**21**	26	31	36	41	46	50	53	55	57

Actuals | **Forecast**
Data | Date

2003 Operating Budget
(Cumulative Pesos)

Legend:
- Planned Revenues
- Actual Revenue
- Forecast Revenues
- Planned Expenses
- Actual Expenses
- Forecast Expenses
- Planned Income
- Actual Income
- Forecast Income

Data Date

Y-axis: Pesos, millions
X-axis: 2003, month

FISCAL YEAR 2003 OPERATING BUDGET   Pesos, millions

ITEM		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Revenues - All Projects													
Planned	month	100	100	100	100	100	100	100	100	100	100	100	100
	Cumulative	100	200	300	400	500	600	700	800	900	1000	1100	1200
Actual/Forecast	month	95	95	95	95	96	97	98	99	99	99	99	100
	Cumulative	95	190	285	380	476	573	671	770	869	968	1067	1167
Miscelaneous Sources													
Planned	month	5	5	5	5	5	5	5	5	5	5	5	5
	Cumulative	5	10	15	20	25	30	35	40	45	50	55	60
Actual/Forecast	month	**5**	**5**	**5**	5	5	5	5	5	5	5	5	5
	Cumulative	**5**	**10**	**15**	20	25	30	35	40	45	50	55	60
Project A													
Planned	month	8	8	8	8	8	8	8	8	8	8	8	8
	Cumulative	8	16	24	32	40	48	56	64	72	80	88	96
Actual/Forecast	month	**8**	**8**	**8**	8	8	8	8	8	8	8	8	8
	Cumulative	**8**	**16**	**24**	32	40	48	56	64	72	80	88	96
Project B													
Planned	month	9	9	9	9	9	9	9	9	9	9	9	9
	Cumulative	9	18	27	36	45	54	63	72	81	90	99	108
Actual/Forecast	month	**9**	**9**	**9**	9	9	9	9	9	9	9	9	9
	Cumulative	**9**	**18**	**27**	36	45	54	63	72	81	90	99	108
Project C													
Planned	month	6	6	6	6	6	6	6	6	6	6	6	6
	Cumulative	6	12	18	24	30	36	42	48	54	60	66	72
Actual/Forecast	month	**6**	**6**	**6**	6	6	6	6	6	6	6	6	6
	Cumulative	**6**	**12**	**18**	24	30	36	42	48	54	60	66	72
Project D													
Planned	month	8	8	8	8	8	8	8	8	8	8	8	8
	Cumulative	8	16	24	32	40	48	56	64	72	80	88	96
Actual/Forecast	month	**7**	**7**	**7**	7	8	8	8	8	8	8	8	8
	Cumulative	**7**	**14**	**21**	28	36	44	52	60	68	76	84	92
Project E													
Planned	month	16	16	16	16	16	16	16	16	16	16	16	16
	Cumulative	16	32	48	64	80	96	112	128	144	160	176	192
Actual/Forecast	month	**15**	**15**	**15**	15	15	16	16	16	16	16	16	16
	Cumulative	**15**	**30**	**45**	60	75	91	107	123	139	155	171	187
Project F													
Planned	month	10	10	10	10	10	10	10	10	10	10	10	10
	Cumulative	10	20	30	40	50	60	70	80	90	100	110	120
Actual/Forecast	month	**9**	**9**	**9**	9	9	9	10	10	10	10	10	10
	Cumulative	**9**	**18**	**27**	36	45	54	64	74	84	94	104	114
Project G													
Planned	month	14	14	14	14	14	14	14	14	14	14	14	14
	Cumulative	14	28	42	56	70	84	98	112	126	140	154	168
Actual/Forecast	month	**13**	**13**	**13**	13	13	13	13	14	14	14	14	14
	Cumulative	**13**	**26**	**39**	52	65	78	91	105	119	133	147	161
Project H													
Planned	month	24	24	24	24	24	24	24	24	24	24	24	24
	Cumulative	24	48	72	96	120	144	168	192	216	240	264	288
Actual/Forecast	month	**23**	**23**	**23**	23	23	23	23	23	23	23	23	24
	Cumulative	**23**	**46**	**69**	92	115	138	161	184	207	230	253	277

Actuals   Forecast

Data Date

ANNUAL OPERATING BUDGET - Project Data Subsets

2 0 0 2
Past Year
Operating Budget

2 0 0 3
Current Year
Operating Budget

2 0 0 4
Next Year
Operating Budget
Also called the *budget year*

1 Operating Budget data requirements are a subset of Project Management data.
   a The operating budget only considers funds expended or received in the budgeted year.
   b Past year(s) project performance targets and criteria are not considered in the current year operating budget.
   c Next year(s) project performance targets and criteria are not considered in the current year operating budget.

2 Annual Operating Budgets are excellent tools for managing cost center expenses.

3 Government annual operating budgets may have annual appropriations in place of revenue, with a target of zero for income (revenue - expense). Most government projects may not have a negative income.

4   Do not attempt to manage **project** performance via the Operating Budget. There is insufficient project performance information in the operating budget to adequately manage a **project**.

FISCAL YEAR 2003 OPERATING BUDGET   Pesos, millions

ITEM		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Expenses - All Departments, Directorates, and Offices													
Planned	month	86	86	86	86	86	86	86	86	86	86	86	86
	Cumulative	86	172	258	344	430	516	602	688	774	860	946	1032
Actual/Forecast	month	**87**	**88**	**89**	90	91	92	93	94	95	96	97	98
	Cumulative	**87**	**175**	**264**	354	445	537	630	724	819	915	1012	1110
Executive office													
Planned	month	5	5	5	5	5	5	5	5	5	5	5	5
	Cumulative	5	10	15	20	25	30	35	40	45	50	55	60
Actual/Forecast	month	**6**	**6**	**6**	6	6	6	6	6	6	7	7	7
	Cumulative	**6**	**12**	**18**	24	30	36	42	48	54	61	68	75
Finance and Accounting Department													
Planned	month	4	4	4	4	4	4	4	4	4	4	4	4
	Cumulative	4	8	12	16	20	24	28	32	36	40	44	48
Actual/Forecast	month	**4**	**4**	**4**	4	4	4	4	4	4	4	5	5
	Cumulative	**4**	**8**	**12**	16	20	24	28	32	36	40	45	50
Personnel Office													
Planned	month	2	2	2	2	2	2	2	2	2	2	2	2
	Cumulative	2	4	6	8	10	12	14	16	18	20	22	24
Actual/Forecast	month	**2**	**2**	**2**	2	2	2	2	2	2	2	2	3
	Cumulative	**2**	**4**	**6**	8	10	12	14	16	18	20	22	25
Public Relations Office													
Planned	month	3	3	3	3	3	3	3	3	3	3	3	3
	Cumulative	3	6	9	12	15	18	21	24	27	30	33	36
Actual/Forecast	month	**3**	**3**	**3**	3	3	3	3	3	3	3	3	3
	Cumulative	**3**	**6**	**9**	12	15	18	21	24	27	30	33	36
Marketing Directorate													
Planned	month	4	4	4	4	4	4	4	4	4	4	4	4
	Cumulative	4	8	12	16	20	24	28	32	36	40	44	48
Actual/Forecast	month	**4**	**5**	**5**	5	5	5	5	5	5	5	5	5
	Cumulative	**4**	**9**	**14**	19	24	29	34	39	44	49	54	59
Project Management Directorate													
Planned	month	8	8	8	8	8	8	8	8	8	8	8	8
	Cumulative	8	16	24	32	40	48	56	64	72	80	88	96
Actual/Forecast	month	**8**	**8**	**9**	9	9	9	9	9	9	9	9	9
	Cumulative	**8**	**16**	**25**	34	43	52	61	70	79	88	97	106
Information Management Directorate													
Planned	month	5	5	5	5	5	5	5	5	5	5	5	5
	Cumulative	5	10	15	20	25	30	35	40	45	50	55	60
Actual/Forecast	month	**5**	**5**	**5**	6	6	6	6	6	6	6	6	6
	Cumulative	**5**	**10**	**15**	21	27	33	39	45	51	57	63	69
Operations Directorate													
Planned	month	7	7	7	7	7	7	7	7	7	7	7	7
	Cumulative	7	14	21	28	35	42	49	56	63	70	77	84
Actual/Forecast	month	**7**	**7**	**7**	7	8	8	8	8	8	8	8	8
	Cumulative	**7**	**14**	**21**	28	36	44	52	60	68	76	84	92
Engineering Directorate													
Planned	month	12	12	12	12	12	12	12	12	12	12	12	12
	Cumulative	12	24	36	48	60	72	84	96	108	120	132	144
Actual/Forecast	month	**12**	**12**	**12**	12	12	13	13	13	13	13	13	13
	Cumulative	**12**	**24**	**36**	48	60	73	86	99	112	125	138	151

General Santos Satellite Office

Planned	month	12	12	12	12	12	12	12	12	12	12	12	12
	Cumulative	12	24	36	48	60	72	84	96	108	120	132	144
Actual/Forecast	month	**12**	**12**	**12**	12	12	12	13	13	13	13	13	13
	Cumulative	**12**	**24**	**36**	48	60	72	85	98	111	124	137	150

Zamboanga Satellite Office

Planned	month	12	12	12	12	12	12	12	12	12	12	12	12
	Cumulative	12	24	36	48	60	72	84	96	108	120	132	144
Actual/Forecast	month	**12**	**12**	**12**	12	12	12	12	13	13	13	13	13
	Cumulative	**12**	**24**	**36**	48	60	72	84	97	110	123	136	149

Cagayan De Oro Satellite Office

Planned	month	12	12	12	12	12	12	12	12	12	12	12	12
	Cumulative	12	24	36	48	60	72	84	96	108	120	132	144
Actual/Forecast	month	**12**	**12**	**12**	12	12	12	12	12	13	13	13	13
	Cumulative	**12**	**24**	**36**	48	60	72	84	96	109	122	135	148

Actuals   Forecast

Data Date

FISCAL YEAR 2003 OPERATING BUDGET		Pesos, millions											
ITEM		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Expenses - Engineering Directorate by Division													
Planned	month	12	12	12	12	12	12	12	12	12	12	12	12
	Cumulative	12	24	36	48	60	72	84	96	108	120	132	144
Actual/Forecast	month	12	12	12	12	12	13	13	13	13	13	13	13
	Cumulative	12	24	36	48	60	73	86	99	112	125	138	151
Director's Office													
Planned	month	1	1	1	1	1	1	1	1	1	1	1	1
	Cumulative	1	2	3	4	5	6	7	8	9	10	11	12
Actual/Forecast	month	1	1	1	1	1	2	2	2	2	2	2	2
	Cumulative	1	2	3	4	5	7	9	11	13	15	17	19
Civil Engineering													
Planned	month	2	2	2	2	2	2	2	2	2	2	2	2
	Cumulative	2	4	6	8	10	12	14	16	18	20	22	24
Actual/Forecast	month	2	2	2	2	2	2	2	2	2	2	2	2
	Cumulative	2	4	6	8	10	12	14	16	18	20	22	24
Mechanical Engineering													
Planned	month	2	2	2	2	2	2	2	2	2	2	2	2
	Cumulative	2	4	6	8	10	12	14	16	18	20	22	24
Actual/Forecast	month	2	2	2	2	2	2	2	2	2	2	2	2
	Cumulative	2	4	6	8	10	12	14	16	18	20	22	24
Electrical Engineering													
Planned	month	1	1	1	1	1	1	1	1	1	1	1	1
	Cumulative	1	2	3	4	5	6	7	8	9	10	11	12
Actual/Forecast	month	1	1	1	1	1	1	1	1	1	1	1	1
	Cumulative	1	2	3	4	5	6	7	8	9	10	11	12
Structural Engineering													
Planned	month	1	1	1	1	1	1	1	1	1	1	1	1
	Cumulative	1	2	3	4	5	6	7	8	9	10	11	12
Actual/Forecast	month	1	1	1	1	1	1	1	1	1	1	1	1
	Cumulative	1	2	3	4	5	6	7	8	9	10	11	12
Architural & Landscaping													
Planned	month	2	2	2	2	2	2	2	2	2	2	2	2
	Cumulative	2	4	6	8	10	12	14	16	18	20	22	24
Actual/Forecast	month	2	2	2	2	2	2	2	2	2	2	2	2
	Cumulative	2	4	6	8	10	12	14	16	18	20	22	24
Survey & Geodetic													
Planned	month	1	1	1	1	1	1	1	1	1	1	1	1
	Cumulative	1	2	3	4	5	6	7	8	9	10	11	12
Actual/Forecast	month	1	1	1	1	1	1	1	1	1	1	1	1
	Cumulative	1	2	3	4	5	6	7	8	9	10	11	12
Foundations and Materials													
Planned	month	2	2	2	2	2	2	2	2	2	2	2	2
	Cumulative	2	4	6	8	10	12	14	16	18	20	22	24
Actual/Forecast	month	2	2	2	2	2	2	2	2	2	2	2	2
	Cumulative	2	4	6	8	10	12	14	16	18	20	22	24
			Actuals		**Forecast**									
				Data	Date									

FISCAL YEAR 2003 OPERATING BUDGET		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ITEM	Pesos, millions	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Expenses - Engineering Directorate - Item Breakdown

Director's Office		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Planned	month	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Cumulative	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00
Actual/Forecast	month	1.000	1.000	1.000	1.000	1.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
	Cumulative	1.00	2.00	3.00	4.00	5.00	7.00	9.00	11.00	13.00	15.00	17.00	19.00
Director	Plan	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024
	Actual/Forecast	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024
Salary	Plan	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
	Actual/Forecast	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Health Insurance	Plan	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	Actual/Forecast	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Life Insurance	Plan	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	Actual/Forecast	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Retirement fund	Plan	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
	Actual/Forecast	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Vacation	Plan	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	Actual/Forecast	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Ass't Director	Plan	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098
	Actual/Forecast	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098
Salary	Plan	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
	Actual/Forecast	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
Health Insurance	Plan	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	Actual/Forecast	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Life Insurance	Plan	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	Actual/Forecast	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Retirement fund	Plan	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080
	Actual/Forecast	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080
Vacation	Plan	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
	Actual/Forecast	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
Secretary	Plan	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
	Actual/Forecast	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
Salary	Plan	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	Actual/Forecast	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Health Insurance	Plan	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	Actual/Forecast	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Life Insurance	Plan	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	Actual/Forecast	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Retirement fund	Plan	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	Actual/Forecast	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Vacation	Plan	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Actual/Forecast	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Travel	Plan	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
	Actual/Forecast	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Per diem	Plan	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
	Actual/Forecast	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
Office supplies	Plan	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
	Actual/Forecast	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Office Equip.	Plan	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093
	Actual/Forecast	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093	0.093
Bonus pool	Plan	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
	Actual/Forecast	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
subcontracts	Plan	0.158	0.158	0.158	0.158	0.158	0.158	0.158	0.158	0.158	0.158	0.158	0.158
	Actual/Forecast	0.158	0.158	0.158	0.158	0.158	1.158	1.158	1.158	1.158	1.158	1.158	1.158

2003 Operating Budget
Engineering Directorate Expenses
(Cumulative Pesos)

Pesos, millions

2003, month

Data Date

Planned - Engr Directorate
Actual - Engr Directorate
Forecast - Engr Directorate
Planned - Director's Ofc
Actual - Director's ofc
Forecast - Director's Ofc
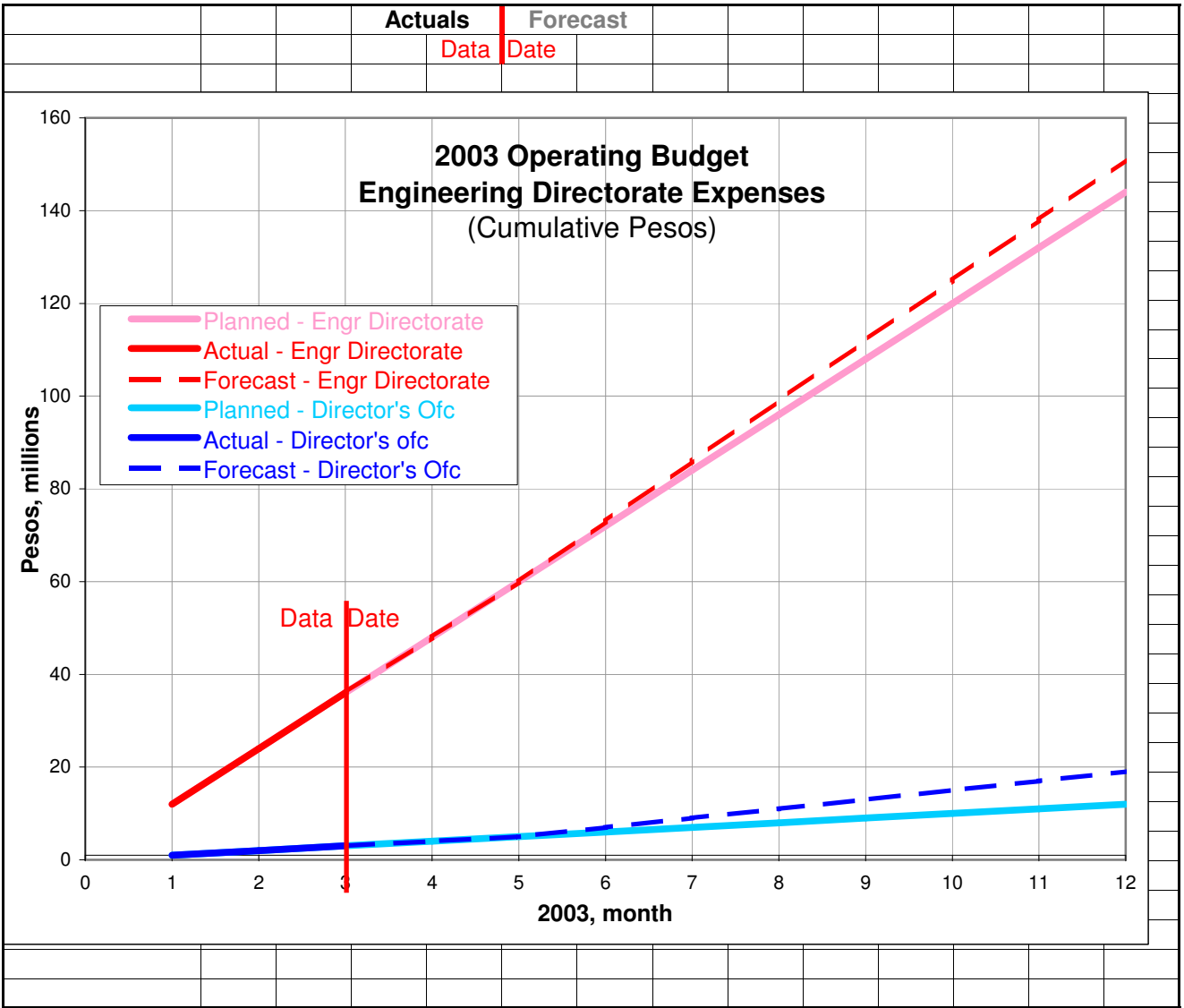
Break-Even Analysis

Almost any facility can be designed to be built in stages, with each stage being usable.
For example: the height of a dam for flood control or for a water resevoir, the size of a parking lot, the floor area of a modular building, the capacity of a waterline, and so forth.

Disadvantages to building in stages:
 1 Mutiple stages cost more than a single stage because equipment has to be re-mobilized for each stage,
 2 Some design parameters may have to be oversized to accommodate later stages,
 3 Noticable inefficiency in design may be required to accommodate staged construction.

Advantages to building in stages:
 1 Insufficient funds may be available to construct in a single stage.
 2 User demand or benefit may vary considerably over the design-life of the project .
 3 Considerable uncertainty over future demand estimates may exist.

Break-Even analysis uses the time value of money to help decide if and when mutiple stages are more economical than a single stage.

Two-stage construction versus single-stage (Example):

Single stage construt ion:	**80,000 P$_{2003}$**	
Two-stage construction:	**100,000 P$_{2003}$**	
1st stage:	**50,000 P$_{2003}$**	
2nd stage:	**50,000 P$_{2003}$**	
Time-value of money =	10% /yr	

Basic economic question: when does the present value of the 2-stage cost equal the single-stage cost? *(What is **k** ?)*
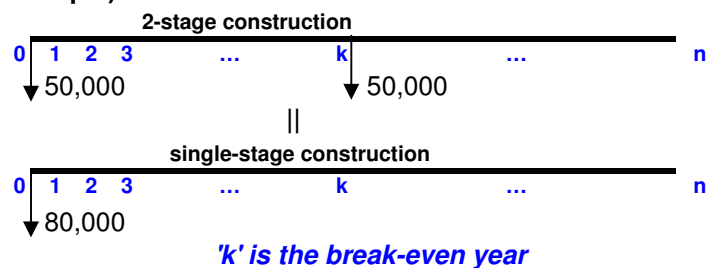
'k' is the break-even year

Solution 1: Formula - Subtract the single stage from the multiple stage, and solve for k.

The problem reduces to a compund interest problem of solving for the **k** that makes the present value of S$_k$ equal P at year **0**.
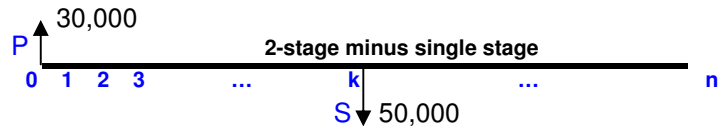
$$S = P(1+i)^k$$

$$k = \frac{\log(S/P)}{\log(1+i)} = \frac{\log(50,000/30,000)}{\log(1+10\%)} = 5.4 \ \text{yrs}$$

The interpretation of this is that it is economical to construct in two stages, provided that the stages are at least 5.4 years apart.

Solution 2: Graphical - Plot the PV of S for various k, until it intersects the PV of single-stage.

$i = 10\%$ $P = S / (1+i)^k$

k	PV$_0$	+	PV$_k$	=	PV$_{2\text{-stage}}$
0	50,000	+	50,000	=	100,000
1	50,000	+	45,455	=	95,455
2	50,000	+	41,322	=	91,322
3	50,000	+	37,566	=	87,566
4	50,000	+	34,151	=	84,151
5	50,000	+	31,046	=	81,046
6	50,000	+	28,224	=	78,224
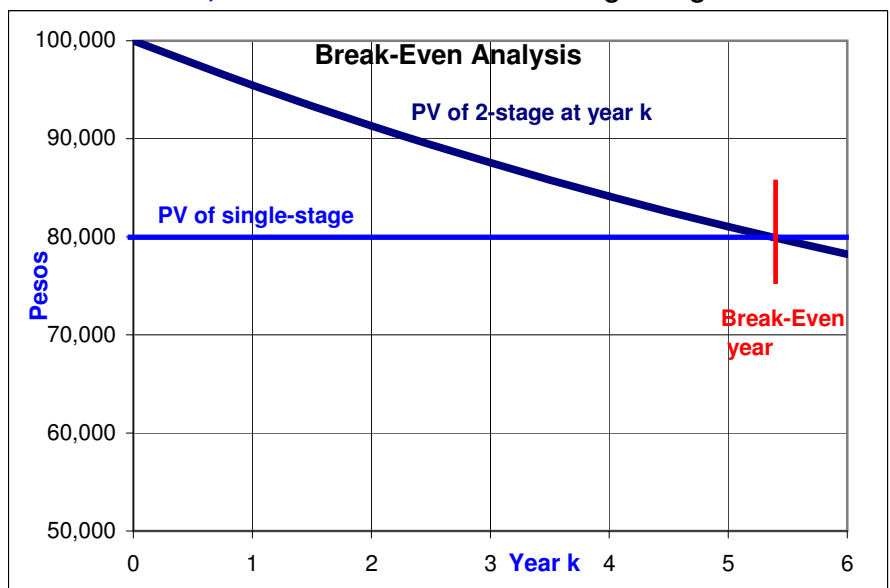
Three-stage construction versus single-stage (Example):

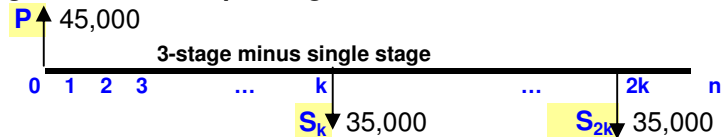|		
Single stage constrution:	80,000 P_{2003}	
3-stage construction:	105,000 P_{2003}	
1st stage:	35,000 P_{2003}	
2nd stage:	35,000 P_{2003}	
3rd stage:	35,000 P_{2003}	
Time-value of money =	10% /yr	

3-stage construction

```
0  1  2  3      ...      k           ...      2k      n
   ↓35,000              ↓35,000               ↓35,000
                         ||
```

*Basic economic question: when does the present value of the 3-stage cost equal the single-stage cost? (What is **k** ?)*
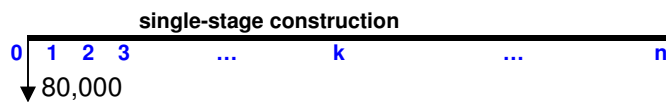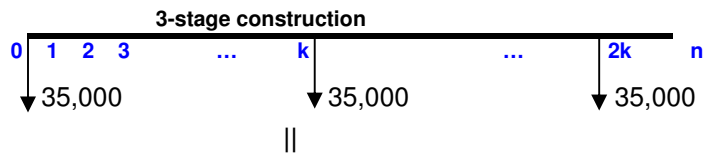
single-stage construction

```
0  1  2  3      ...      k           ...              n
   ↓80,000
```

'k' is the break-even year

Solution 1: Formula - Subtract the single stage from the multiple stage, and solve for k.

The problem reduces to a compund interest problem of solving for the k that makes Present Value of S_k at year k, and S_{2k} at year 2k, equal P at year 0.

P ↑ 45,000

3-stage minus single stage

```
0  1  2  3      ...      k           ...      2k      n
                     S_k ↓35,000          S_2k ↓35,000
```

$$P = S_k /(1+i)^k + S_{2k} /(1+i)^{2k} \qquad S_k = S_{2k}$$

$$P = P_k + P_{2k} = 45,000$$

Extra-credit Homework problem: Solve the above set of equations for **k** and **2k**.   (Optional)

Solution 2: Graphical - Plot the PV of S for various k, until it intersects the PV of single-stage.

$i = 10\%$ $P_k = S_k/(1+i)^k$ $P_{2k} = S_{2k}/(1+i)^{2k}$

k	PV_0	+	PV_k	+	PV_{2k}	=	$PV_{3\text{-stage}}$
0	35,000	+	35,000	+	35,000	=	105,000
1	35,000	+	31,818	+	28,926	=	95,744
2	35,000	+	28,926	+	23,905	=	87,831
3	35,000	+	26,296	+	19,757	=	81,053
4	35,000	+	23,905	+	16,328	=	75,233
5	35,000	+	21,732	+	13,494	=	70,226
6	35,000	+	19,757	+	11,152	=	65,909

The interpretation of this is that it is economical to construct in three stages, provided that the stages are at least 3.2 years apart.

Break-Even Analysis — PV of 3-stage at year k and 2k; PV of single-stage; Pesos vs Year k
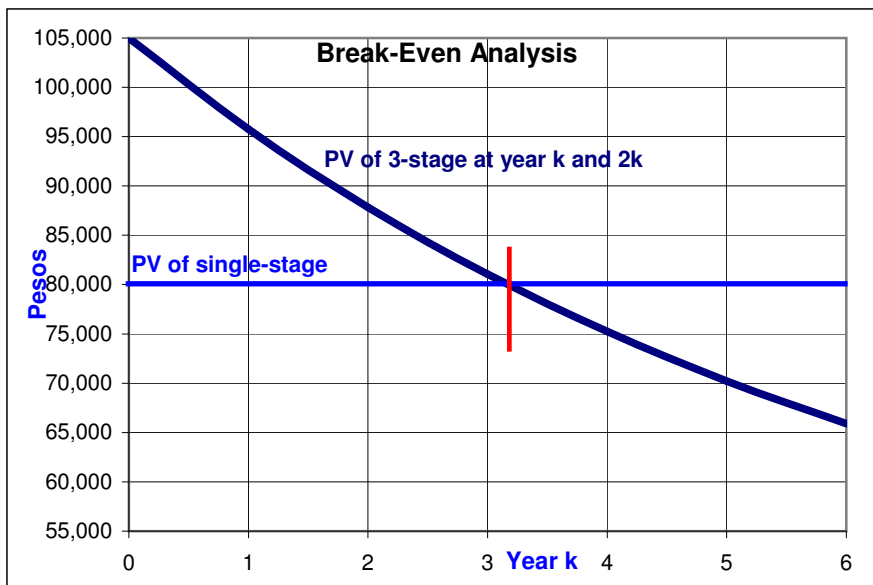
NOTE: We simplify the examples to better illustrate the solution by assuming that the useful life of the single-stage is equal to the combined useful life of the two-stage or three-stage, and that maintenance and operations costs are the same. If this is not true for a real problem, then those costs should be included in the analysis. If the useful life is not the same, then a least-common multiple analysis period should be used,

Lesson Plan 18

Objective Decision Analysis

Estimates

Review for Final

SCHEDULE
   3rd Individual Project now due
   Group Presentation Schedule   Please target a date for your group project presentation.

HOMEWORK
   Break-Even Analysis – 3-stage formulaic solution

LECTURE

   OBJECTIVE DECISION ANALYSIS

   ESTIMATES

REVIEW FOR FINAL EXAM

PRESENTATIONS

Objective Decision Matrix

Step 1: Alternative solutions.
1. Alternate 1 - Do nothing - status quo
2. Alternate 2 - Bridge over River Kwai
3. Alternate 3 - Low-water crossing
4. Alternate 4 - Circuitous highland detour
   …

   Note: Doing nothing is always an option.

Step 2: Objectives *(Financial & non-financial)*

Absolute *(Go or No Go)*
- **A1** IRR $\geq$ MARR, NPV $\geq$ 0, B/C $\geq$ 1
- **A2** Total cost < ₱1,000,000
- …

Scored *(0 - 100)*
- **S1** Maximize IRR, NPV, B/C, NEUB,
- **S2** Minimize travel time
- **S3** Maximize usage / utility

Step 3: Score Objectives

Set Objective scoring algorith — *scale of 0 to 100*

S1 Maximize B/C ratio — Algorithm: **score = B/C*100/(B/C)$_{max}$**

Score
0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100
B/C: 1 .... 1.5 2

S2 Minimize travel time — Algorithm: **score = (1-Km/Km$_{max}$)*100**

Score
0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100
Km: 50 .... 25 0

S3 Maximize usage/utility — Algorithm: **score = (% of time avail.)*100**

0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100
% available: 0 .... 50 100

Score alternatives

Alternative	B/C	Score
1	1	67
2	1.0	67
3	1.3	87
4	1.5	100

Alternative	Km	Score
1	1	96
2	5	80
3	1	96
4	25	0

Alternative	%	Score
1	25%	25
2	100%	100
3	50%	50
4	75%	75

Evaluate Absolute objectives

	Alternative	B/C$\geq$1	Go/No Go
A1	1	1	Go
	2	1.0	Go
	3	1.3	Go
	4	1.5	Go

	Alternative	P$\leq$1m	Go/No Go
A2	1	0	Go
	2	1.2	**No**
	3	0.4	Go
	4	0.35	Go

Step 4: Assign relative importance and weighting of *scored* objectives.

Objective	S1	S2	S3	Σ
Relative importance	3	1	2	6
Weight	0.50	0.17	0.33	1.00

$$W_{S1} = \frac{RI_{S1}}{\Sigma RI} = \frac{3}{6} = 0.50$$

$$W_{S2} = \frac{RI_{S2}}{\Sigma RI} = \frac{1}{6} = 0.167$$

$$W_{S3} = \frac{RI_{S3}}{\Sigma RI} = \frac{2}{6} = 0.33$$

Step 5: Assemble scoring results

	Alternative Solutions	A1	A2	S1	S2	S3	Weighted Score	Rank
1	Do nothing - status quo	Go	Go	67	96	25	58	4
2	Bridge over River Kwai	Go	**No**	67	80	100	80	1
3	Low-water crossing	Go	Go	87	96	50	76	2
4	Circuitous highland detour	Go	Go	100	0	75	75	3

higher score is better

Step 6: Calculate weighted scores and Rank

Wt Sc	=	Wt$_1$	S1	+	Wt$_2$	S2	+	Wt$_3$	S3
Wt Sc	=	0.50	67	+	0.17	96	+	0.33	25
Wt Sc	=	0.50	67	+	0.17	80	+	0.33	100
Wt Sc	=	0.50	87	+	0.17	96	+	0.33	50
Wt Sc	=	0.50	100	+	0.17	0	+	0.33	75

Estimates

1 Feasibility phase   Accuracy: Rough Order of magnitude (ROM): ±25%

Based on approximate footprints & historical costs for similar projects (cast in current $ or ₱, e.g., ₱2003)

Buildings - Approximate floor areas	$/ft^2	₱/m^2
Streets & Roads - typical road x-sections	$/mille	₱/km
Pipelines- typical flows, per linear length	$/ft	₱/m
Bridges - typical span	$/ft span	₱/m span

...

Note 1: All comparison of estimates from other alternatives must be made in the same year base, e.g., ₱2003, to remove the effect of inflation from historical costs.

Note 2: Feasibility phase estimates tend to be made on the high side, so as to preclude the necessity of increasing the estimate in later phases (which is considered as "bad news" to many owners). However, if overdone, this practice can also prematurely kill projects prematurely deemed as "too expensive."

Note 3: If a cash out-flow is required over a number of years (as for a multi-year construction program), it is best to assume some future rate of inflation, and present the cash flow requirements in terms of future year values (akin to historic $ or ₱ for past projects). Always state your assumptions.

2 Planning phase   Accuracy: Refined Order of magnitude (ROM): ±15%

The planning stage estimate is constructed very similar to the feasibility stage estimate, except that quantity estimates and extenuating or mitigating circumstances affecting cost are better known.

3 Design phase   Accuracy: Material, equipment & labor estimate: ±5% to ±10%

The design stage estimate is based on material take-offs from design drawings and specifications, and construction equipment and labor-crewing requirements. The accuracy of the estimate is dependent upon the level of detail in the design drawings. Typically, an estimate is started on about 30% design completion, refined at about 60% design completion, and finalized on final design completion. The final estimate is usually made in the form of an independent bid to perform the work, and is used to evaluate the reasonableness of construction bids. Most final owner-estimates take into account prevailing market conditions in the construction industry, and are kept confidential, i.e., not disclosed to potential bidders.

Project/construction activity and schedule. Most construction project durations are somewhat elastic on construction time. But very short construction periods tend to introduce crewing inefficiencies, resulting in higher costs.

Material takeoff. Quantity take-offs from design drawings is the key task that allows accurate cost estimates to be performed.

Equipment. The type of work often dictates certain classes of equipment. Most estimates assume the contractor will rent the standard equipment normally used.

Labor crews. Labor crews vary in efficiency and competency. Foreign estimates using Means US crew productivity rates should be adjusted for different national efficiency and productivity rates.

Indirects. Overheads, and profit. A contractor has to recover his overhead and indirect costs, and profit expectations in the bidding document, normally by spreading them into the bid items.

Bid items. All contractor costs must be apportioned to bid items, including indirects, overheads, and profit expectations. The bid schedule may be a lump sum for a facility, a bill-of-materials, or unit prices.

4 Soliciting construction bids

While the owner has a legitimate need to keep the final estimate confidential, at least until after bids have been received and evaluated, bidders need some idea of the project value. Many owners use a letter code or cost range system such as that depicted to the right, commonly used by both government and private owners to quantify the project value range in the solicitation-of-interest stage.

code	Range, $, millions	
	from	to
I	3	5$^-$
J	5	10$^-$
K	10	15$^-$
L	15	25$^-$
M	25	50$^-$