Lecture 01
Introduction to Course, Review & Basic Accounting

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Outline

General Reference: [Zim11] [SSS11] [KR11] [Dru17]

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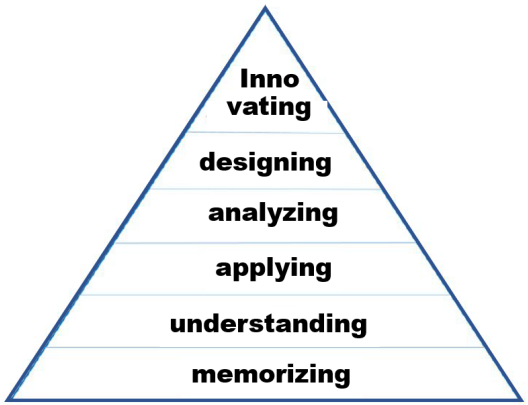
Syllabus: Before we start

Course Description

Fundamentals of financial reports; cost analysis for planning process; capital expenditure; cost control and opportunity loss management; capital rationing; profitability analysis and decision making for investment in challenging projects under uncertainty and risk.

Learning Objectives



- Analyze cost components and profitability
- Analyze financial reports and explain limited resources and sustainability
- Apply budgeting as control and explain their limitations
- Understand financial impacts of decision and risk management to company, project, and society

Grading Policy

Work & Score Distribution

- Mid Term Exam (40%)
- Homework & Quiz (20%) $\rightarrow$ myCourseVille
- Final Exam (40%)

Grading Policy

85 & above: final grade is definitely 'A'

between 50 & 85: A, B^+, B, C^+, ... , D

50 & below: final grade may be 'F'

OKC Class rules & expectations

- Don't interrupt others, but welcome for sharing
- Expect class attendance, no attendance but $\exists$ Quiz
- Each class has 10 minutes grace period for review
- Expect participation and volunteer during class
- Participate points will be awarded in group or whole class
- No assignment due date (Quiz $\ll$ Exam $<$ HW)
- Be responsible, especially meeting time & assignment
- If 25+% students has conflict $\rightarrow$ Zoom clip + online

- Because of AI, Exams are designed to classify student, but Quiz is for basic knowledge.

Code of honors

ChatGPT Policy: AI = tools + emerging skill

warning: do not trust AI (inherently bias); user must be **responsible**; any use must be clarified

- Education must do with ethic standards and social responsibilities
- Trust is integral and essential parts of learning process
- Self-discipline is necessity for development
- Dishonesty hurts the entire community (student, employer, TA)

adapted from: Georgia Institute of Technology –The Honor Code

Any violation to code of honors will severely punished, especially cheating and plagiarism

Textbook & references

Textbook

[?] Kinny, M.R. and Raiborn, C.A. (2020), *Cost Accounting: Foundations and Evolutions*, 10th ed., South-Western Cengage Learning, OH.

References

[?] Horngren, C. *et at.* (2014) *Cost Accounting: A Managerial Emphasis*, 15th ed., Pearson,

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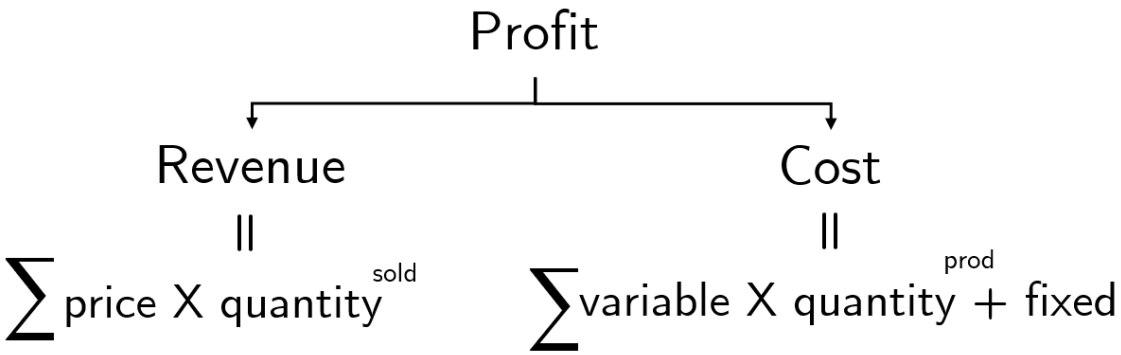
Supplement Materials are available in LMS (CourseVille)

Why engineer must care about costing?

$$\text{Profit} = \text{Revenue - Cost}$$

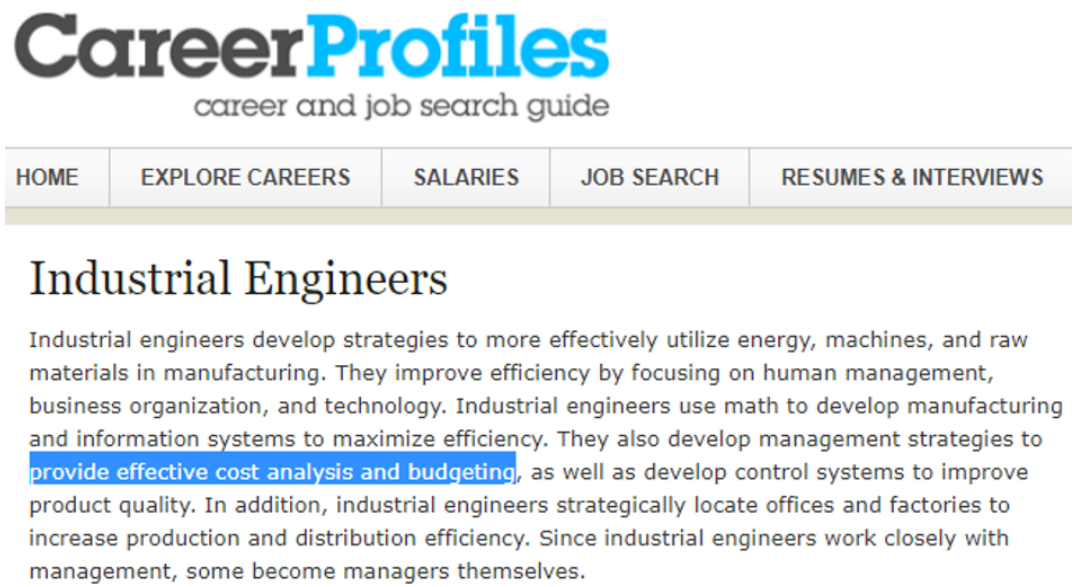


Concern

- **What are 'Fix'?:** various sources, i.e., sale, mkt, executive → mostly difficult
- **Uncertain Revenue:** quality^{sold} $\propto$ mkt, price taker → mostly external
- **Controllable Cost:** decide quality^{prod}, manage fixed cost → mostly internal

Why IE must know [industrial] cost & budgeting?

- **Opportunity for more profit:** setup good plan and control cost → profit
- **Costing insight:** reveals structure and underlying problems
- **Budgeting as grand plan:** resource, time, project scope, communication
- **Accounting = Data Source:** actual activity, performance, recorded expenditure → Data Mining, ML


CareerProfiles
career and job search guide

HOME | EXPLORE CAREERS | SALARIES | JOB SEARCH | RESUMES & INTERVIEWS

Industrial Engineers

Industrial engineers develop strategies to more effectively utilize energy, machines, and raw materials in manufacturing. They improve efficiency by focusing on human management, business organization, and technology. Industrial engineers use math to develop manufacturing and information systems to maximize efficiency. They also develop management strategies to provide effective cost analysis and budgeting, as well as develop control systems to improve product quality. In addition, industrial engineers strategically locate offices and factories to increase production and distribution efficiency. Since industrial engineers work closely with management, some become managers themselves.

Examples of Cost Management in Industry

Southwest Airline:

- **How:** analyzing fuel consumption as fixed and variable costs and do hedging
- **Benefit:** saving 1,300.0 M USD in 2008

Concrete Cafe:

- **How:** implementing job cost analysis to trace profitability and switch priority
- **Benefit:** better service near-HQ client and reducing traveling cost

SCG:

- **How:** implementing ABC and flexible budgeting across divisions
- **Benefit:** allocating FOH and identifying inefficiencies plants/activities

Basic Terminology

Debit Financial debts recorded in accounting (*to owe*, LHS of Acct)

Credit Financial benefits received in accounting (*to trust*, RHS of Acct)

Asset Any financial resources controlled by business

Liability Any financial resources borrowed by business

Equity Any financial resources staked by a business

Income Money that earns from sales of products or services, interests, or dividends

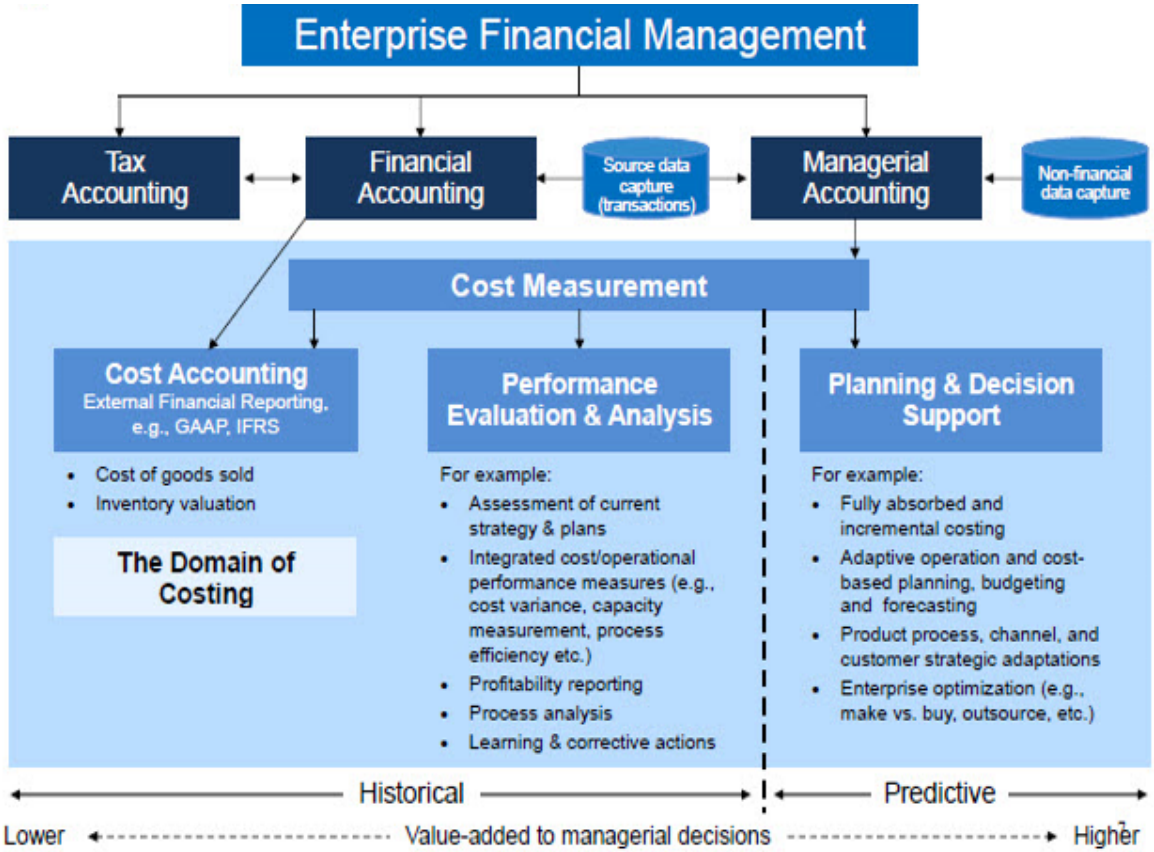
Expense Money that spends to produce products or services

Financial Acct: standardizing statements, required for auditing and taxing

Managerial Acct: internal and unofficial reports within a company

Cost Acct: A form of Mgt Acct focusing on costs of production **

Financial Vs Managerial Accounting



Basic concept in financial accounting

- **Conservative:** business activities with conservative → money, no qty
- **Dual Aspect:** every transaction → gain & lose of benefit
- **Full Disclosure:** all relevant information must be noted → footnote

$$\text{Asset} = \text{Equity} + \text{Liability}\ (\text{Income - Expense})$$

- **Asset:** What you control, e.g., cash, IOU, RM, FG, land, machine, building
- **Equity:** What you stake, e.g., profit/lost, share,
- **Liability:** What you borrow, e.g., bank loan, bond, credit card

T-accounting:

- **What:** analysis changes for a relevant financial classification
- **Structure:** debit side and credit side with a column division
- **Balance:** total debits = total credit

Example of T-accounting:

A project manager needs to track a new 3D printer for the project. On January 1, 19X1, he purchases the printer for $15,000 in cash with its depreciation $1,500 each year.

Purchasing using cash

Fixed Asset	**Debit**	**Credit**
Jan 1: Cash Purchase	$15,000	
Balance	**$15,000**	

Cash	**Debit**	**Credit**
Jan 1: 3D Purchase		$15,000
Balance		**($15,000)**

Recording depreciation expense

Depreciation Expense	**Debit**	**Credit**
Dec 31: 3D Printer	$1,500	
Balance	**$1,500**	

Accumulated Depreciation	**Debit**	**Credit**
Dec 31: Depre. Expense		$1,500
Balance		**($1,500)**

Basic account entries

Mr.Smith decided to open a semi-automatic car washing company in Atlanta with two groups of customers: retailer customers who pay cash and corporate ones who have 2 month credit. After put aside $50,000 of his own money for initial investment, he kept transactions as follows:

- 03/01 purchase land for $40,0000
- 03/01 purchase business supply in credit for $3,750
- 31/01 total retail monthly earing for $2,500
- 31/01 total cooperate monthly earing for $1,000
- 31/01 pay monthly operation expense $1,100
- 28/02 total retail monthly earing for $2,000
- 28/02 total cooperate monthly earing for $1,000
- 28/02 pay monthly operation expense $900
- 28/02 partial pay supplier for $1,000
- 01/03 sold half of land for $22,000
- 05/03 remodel his home $30,000
- 30/03 total retail monthly earing for $2,500
- 30/03 total cooperate monthly earing for $1,000
- 31/03 collect money from cooperate for $1,000 (Jan)
- 31/03 pay operation expense $1,000
- 31/03 give dividend $2,100 to shareholder

How Mr.Smith records these transactions and do financial accouting ?

Basic account entries

Asset

• cash	11,500
retail rev.	+2,500
expense	-1,000
cooperate	+1,000
land	22,000
	36,000
• acct receivable	2,000
	-1,000
	+1,000
	2,000
• business supply	3,750
• land	40,000
	-20,000
	20,000

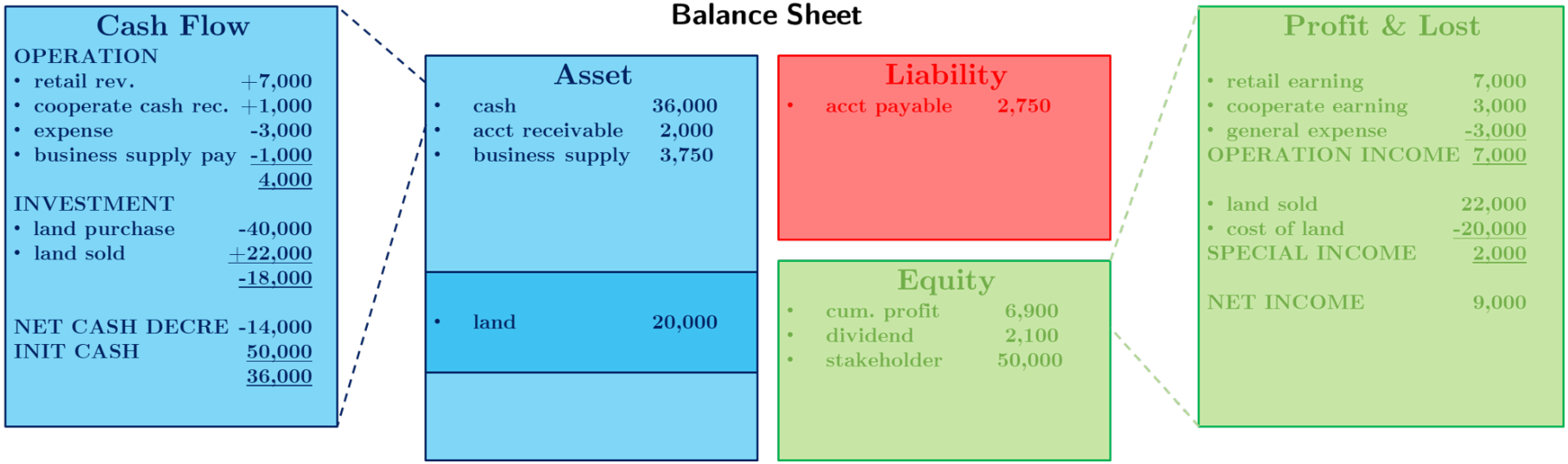
Liability

• acct payable	2,750

Equity

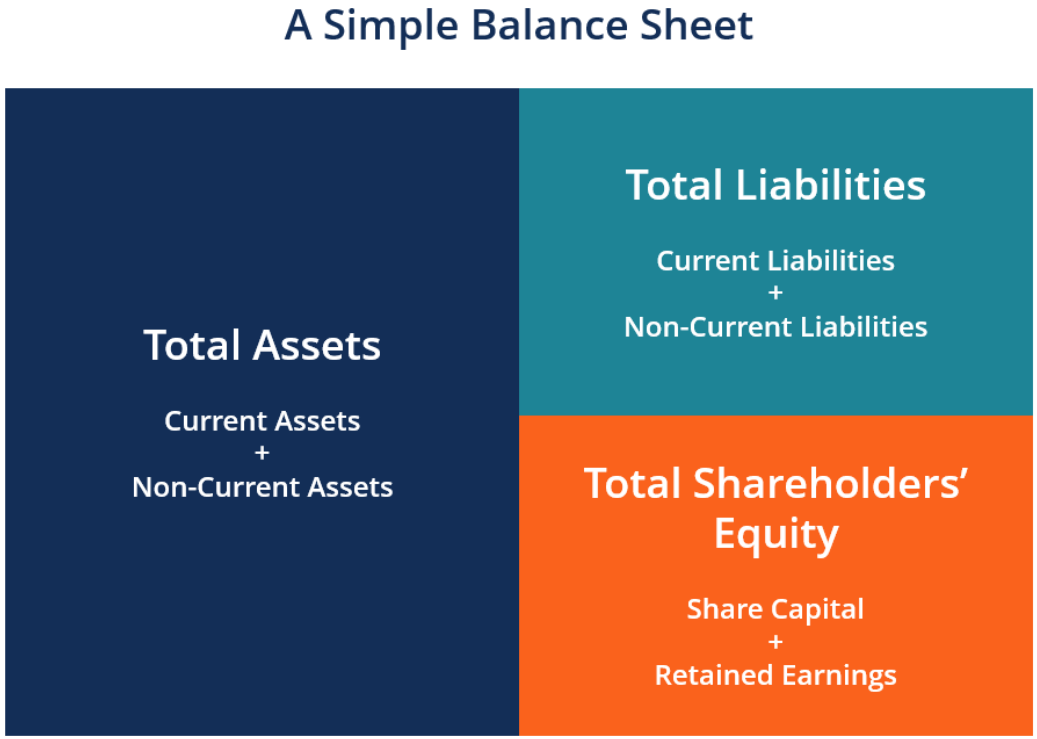
• cum. profit	6,900
• dividend	2,100
• stakeholder	50,000

Three Financial reports



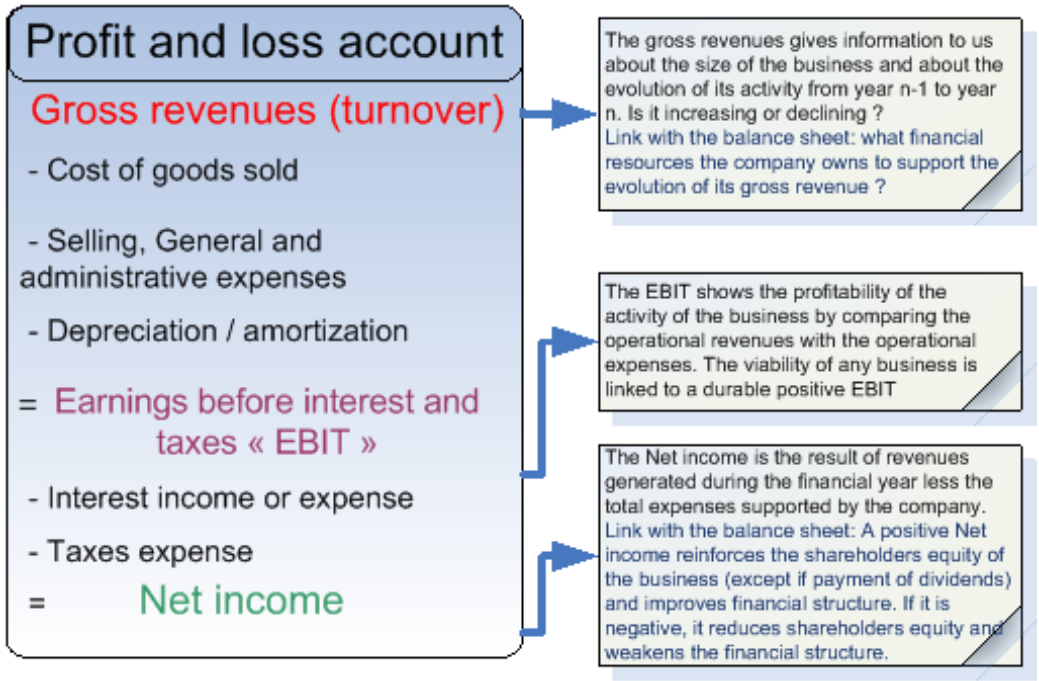
- **Balance Sheet (BS):** snap short of assets → form & quantity
- **Profit & Loss (P&L):** revenue in core business + depreciation → margin
- **Cash Flow (SC):** activities of cash and taxes → liquidity of business

Balance Sheet



- **Current:** can liquidated within 1 year, i.e., cash, inventory, listed cooperate share
- **Non-Current:** cannot liquidated within 1 year, i.e. building, land, bond
- **Fixed Asset:** larger category of non-current asset, PPE

Profit and Loss/ Income Statement



- **Gross Profit:** profit before considering admin, market, general
- **Operating Profit:** profit after considering admin, market, general
- **EBITDA:** profits w/o investment, tax, depreciation, amortization
- **Net Profit:** after pay for everything $\rightarrow$ equality (BS)
- **Net Income:** $\approx$ 'Net Profit' by used by public company

Statement of Cash flow

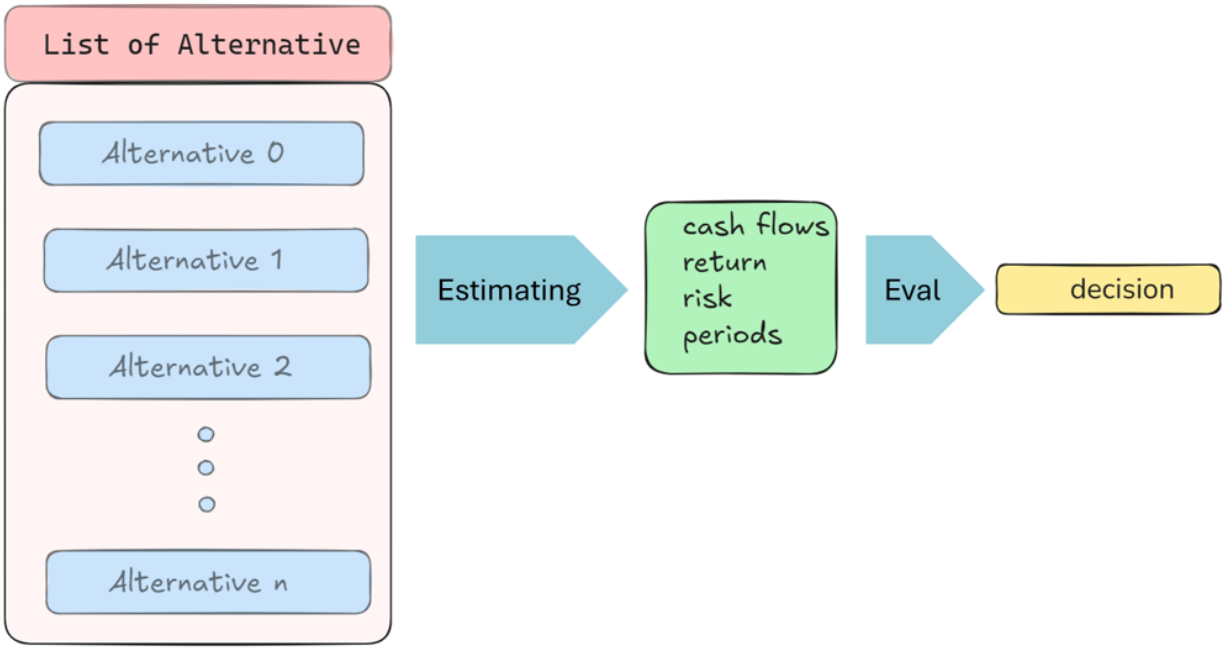
For the *Four Months* Ended April 30, 2017

Operating Activities	
Net income	$ 300
Increase in inventory	(200)
Increase in supplies	(150)
Increase in Accounts payable	150
Cash provided (used) in operating activities	100
Investing Activities	0
Financing Activities	
Investment by owner	2,000
Net increase in cash	2,100
Cash at the beginning of the month	0
Cash at April 30, 2017	$2,100

- **Operation:** cash in/out from main operation activity
- **Investment:** cash in/out from investment and special activity
- **Financial:** cash in/out from bank, including dividend

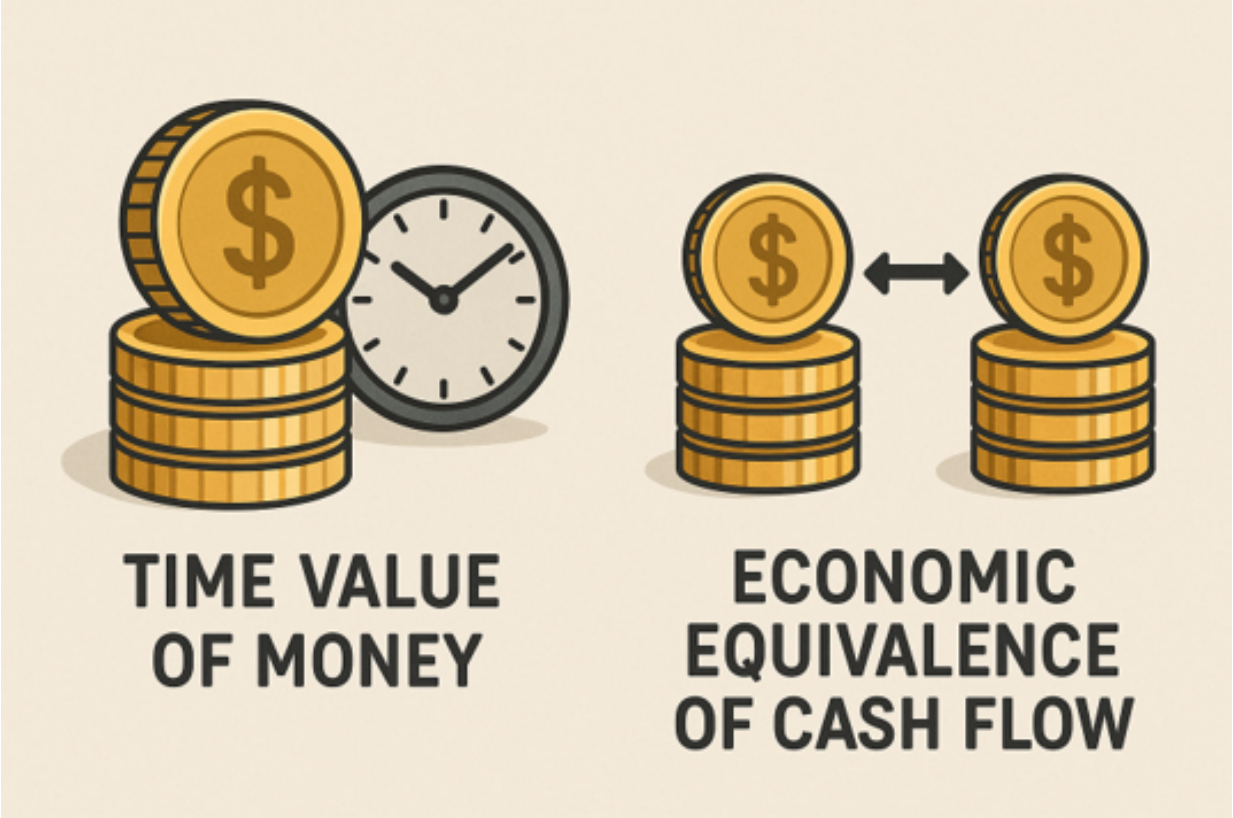
What is Engineering Economy?

- **What:** monetary ways to justify a project worth; math techniques that simplify economic comparison



- **Example:** project to invests, re-finance auto loan worth, MC replacement
- **Concept:** time value of money & equivalence of cash flow
- **Purpose:** measure of worth & decision rules

Engineering Economic Key Assumption



Time Value of Money

- **What:** money available at different time is worth differently
- **Example:** borrow money (family VS friends), bank loan
- **Formulation:** Equivalence depend on

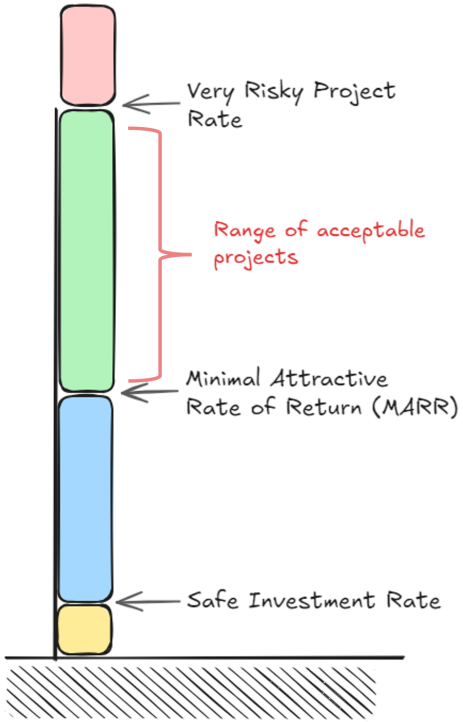
$$F = P(1+i)^t$$

- ***amount of money:*** present worth (P), future worth (F), annual worth (A)
- ***time:*** (t) Project length/horizen
- ***interest rate/ discount rate:*** conversation factor (i)

Question

What is the 'suitable' interest rate/ discount rate?

Minimum Attractive Rate of Return (MARR)



- **What:** expect return of capital with same risk (alternative)

  cost of capital of this project
- **Application:** threshold to accept project
- **How to compute:** average weight of each capital (personal + bank)
- **Note:** before tax, set by company

Interest Rate

- **Nominal Rate:** simple multiple interest into annual rate

  Example 1.0% per month $= (0.01)(12) =$12.0% per year

- **Efficient Rate:** compound principle+interest into annual rate,

  Example 1.0% per month compound $= (1 + 0.01)^{12} - 1 =$ 12.68% per year

what is efficient rate of annual normal rate r compounded infinitely?

$$\lim_{n \to \infty} (1 + \frac{r}{n})^n = \exp(r)$$

Example: Bank Interest

The nominal interest rate of saving account is vary depending on period as follows.

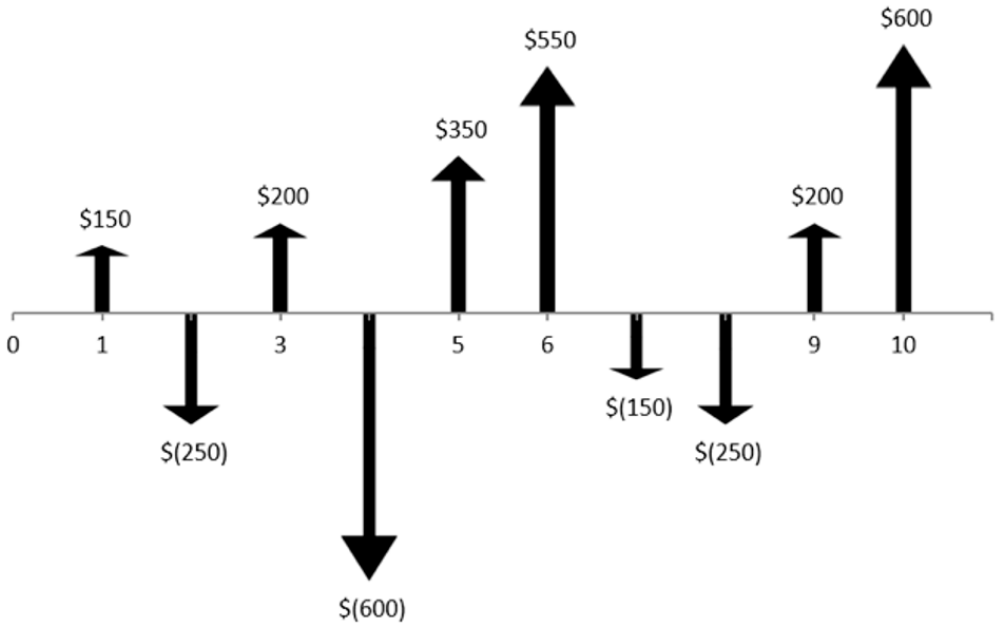
	annual nominal rate (mth)				
	0-3	3-6	6-12	12-24	24+
annual rate	0.90	1.15	1.35	1.50	1.70
interest$_{@100.0k}$	225.0	287.5	675.0	1,500.0	1,700.0

a) what is the total interest of 100,000 THB when it is deposited for 36 month?

b) what is the average nominal rate?

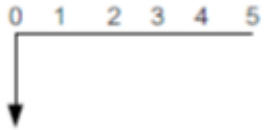
c) what is the average effective rate compounded monthly?

Cash Flow

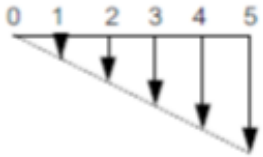


- **What:** cost & benefit of investing in a project
  - ***Inflow:*** incoming (+), e.g., income, savage, saving, revenue
  - ***outflow:*** outgoing (-), e.g., operation cost, investment, expense
- **Net Cash Flow:** sum of inflow and outflow of same period
- **Roles:** operation in the same period & transform to equivalent forms

Equivalent Form of Cash Flow



Single Cash Flow



Arithmatic Gradient Cash Flow Series

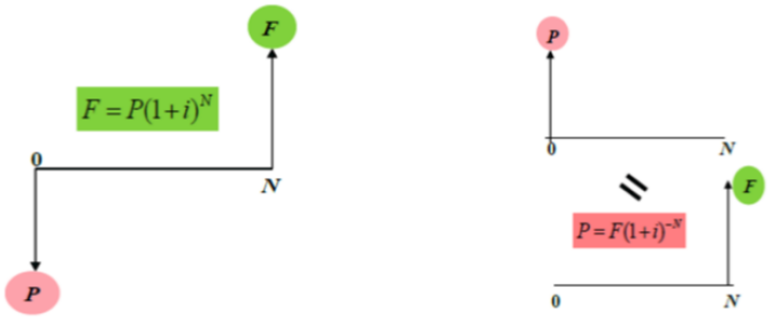
Uniform Cash Flow Series

Geomatic Gradient Cash Flow Series

- **Single:** single cashflow at a given period (F or P)
- **Uniform:** constant for all n periods (A)
- **Gradient:** linearly for all n periods ($A_1 + G \cdot (n-1)$)

Conversion between equivalent Form

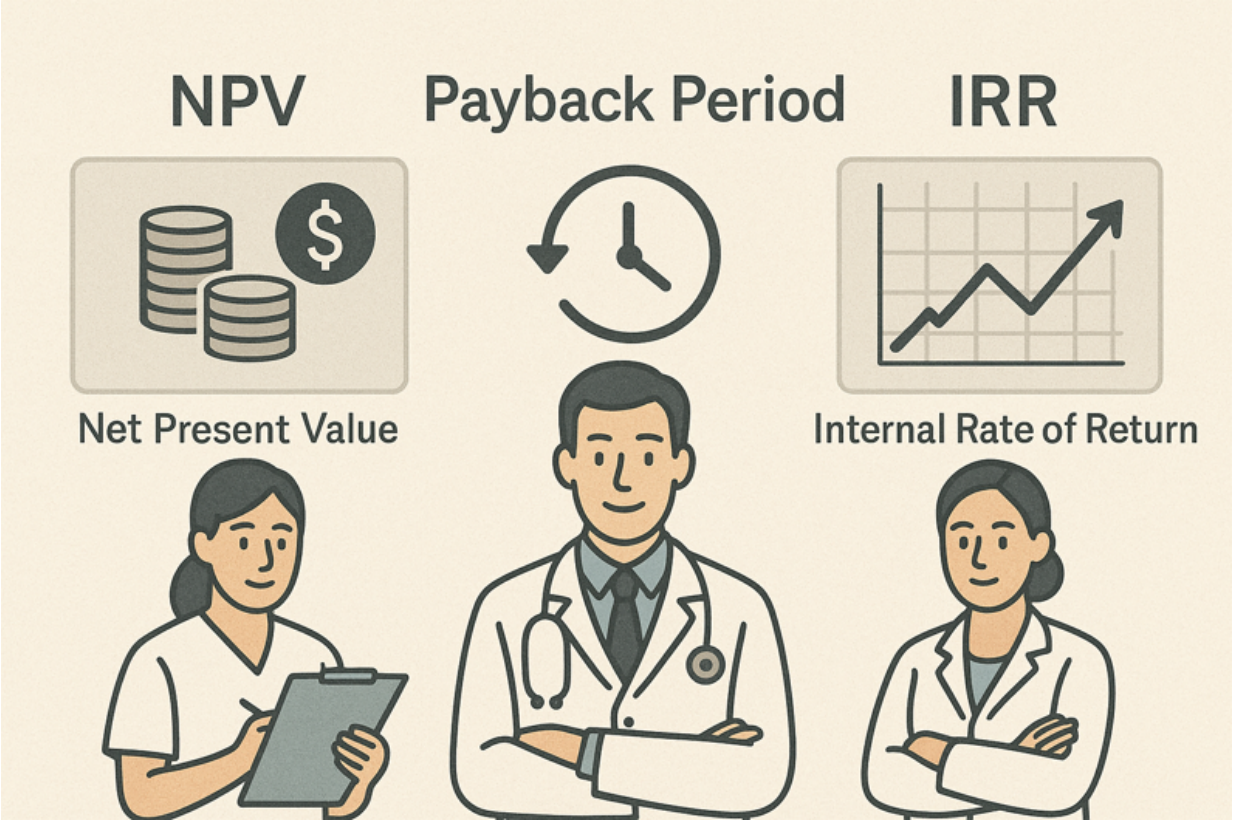
$$F = P(1+i)^t$$



- **to Present Worth:** (P), `-1*PV(rate,nper,pmt ,fv,type)`
- **to Future Worth:** (F), `-1*FV(rate, nper,pmt ,pv,type)`
- **to Annual Worth:** (A), `-1*PMT(rate,nper,pv,fv ,type)`

where `RATE`= interest rate
`NPER`= number of periods
`FV`= future value at time $\texttt{nper}^{th}$
`PV`= present value at time 0^{th}
`PMT`= annual payment

Engineering Economy Index



Net Present Value (NPV)

- **What:** cumulative discounted cash flow to year 0^{th}
- **Application:** private + grunt work
- **Rules:** ok, if positive
- **Advantage:** absolute, completed
- **Disadvantage:** number of parameters
- **EXCEL CODE:** $\sum$ `-PV (i,n,A,F,0)`

$$NPV(i, \mathbf{cash}) = \sum_{j=0}^{T} \frac{cash_j}{(1+i)^j}$$

Example: NPV

Determine Net Present Value of the following cash flow of project if an annual investment interest rate is 8%.

Year (j)	0	1	2	3	4	5	6
cash flow ($cash_j$)	-1350	363	551	681	761	821	1467
$PV = \frac{cash_j}{(1.08)^j}$	-1350	336.1	472.4	540.6	559.4	558.8	924.5

- $NPV = \sum PV = 2041.7$

Payback Period

- **What:** period that makes positive of cumulative cash flow
- **Application:** private + business
- **Rules:** ok, if shorter than x^{th}
- **Advantage:** provide sensitive/risk
- **Disadvantage:** ignore future cash flow

EXAMPLE: Find payback period of the previous example

Year (j)	0	1	2	3	4	5	6
Cash flow ($cash_j$)	-1350	363	551	681	761	821	1467
PV	-1350.0	336.1	472.4	540.6	559.4	558.8	924.5
Cum.PV	-1350.0	-1013.9	-541.5	-0.9	558.5	1117.2	2041.7

Internal Rate of Return (IRR)

- **What:** discount rate that make NPV = 0 at year n^{th}
- **Application:** private + business
- **Rules:** ok if higher than MARR
- **Advantage:** easy to understand
- **Disadvantage:** relative to scale

EXAMPLE: Find payback period of the previous example

Year (j)	0	1	2	3	4	5	6	total
Cash flow ($cash_j$)	-1350	363	551	681	761	821	1467	-
$PV_{@8.0\%}$	-1350.0	336.1	472.4	540.6	559.4	558.8	924.5	2041.7
$PV_{@20\%}$	-1350.0	302.5	382.6	394.1	367.0	329.9	491.3	917.5
$PV_{@30\%}$	-1350.0	279.2	326.0	310.0	266.4	221.1	303.9	356.7
$PV_{@40\%}$	-1350.0	259.3	281.1	248.2	198.1	152.7	194.8	-15.8

Benefit per Cost ratio (b/c)

- **What:** ratio between cost and benefit of project
- **Application:** public/ high intangible benefit/ must pick one
- **Rules:** highest or greater than 1.0 ($\frac{\$}{\$}$)
- **Advantage:** apply for other non-monetary benefits
- **Disadvantage:** no popular in private + business

Summary on Engineering Economy

- **What:** monetary ways to justify a project
- **Concept:** time value of money & equivalence of cash flow
- **Cash flow:** cost & benefit of investing in a project
- **Project length:** (e.g., typical IT/IS 5-7 years)
- **Discounted rate:** % interest + MARR

Net present value: converting all cash flows to Year 0
Payback period: year/period in which NPV = 0
Internal rate of return (IRR): discounted rate that make NPV = 0
B/C ratio: $\frac{\text{benefit}}{\text{cost}}$

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