Sumit Paudel

S. No.	Date	Title	Page No.	Teacher's Sign / Remarks

Engineering Economics (3-2-0)

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→ Course Objective

After completing this course, students will be able to

a) Understand & describe the basic concepts of economics, engineering economics, cost accounting & time value of money
b) Assist in the valuation of engineering projects in the public & private sector to take investment decisions.
c) Analyze the project risk & understand the concept of ecological limit- & economic development
d) Calculate depreciation, taxation & its application in analysis &
e) Identify different financing options & general accounting procedures.

→ Course Contents:-

1) Basics of engineering economics
2) Cost Concepts & fundamentals of Cost Accounting
3) Time value of Money
4) Basic Methods of Engineering Economics
5) Comparative Analysis of Alternatives
6) Risk Analysis
7) Ecological limits & Economic Development
8) Depreciation & Corporate Income Taxes
9) Interprise Financing & Capital Investment
10) Basic Accounting procedure

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Chapter 1 :- Basics of Engineering Economics

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Content:-

→ Definition of Economics, Demand, Law of Demand, law of Diminishing Utility, Marginal utility, supply, Law of supply
→ Engineering Economics, principles of Engineering Economy & its application.

* Definition of Economics:

→ According to Adam Smith (Father of Economics), "Economics is the science of wealth".
→ According to Alfred Marshall, "Economics is on the one side, a study of wealth & on the other more important side is a part of study of man".
→ Engineering Economics is concerned with systematic evaluation of the costs & benefits of proposed technical & business projects & ventures.

* Essential Business & Accounting Terminologies:-

(a) Annuity: (वार्षिकी) → Series of equal payments occuring at equal period of time. (Annually, Month, weekly)
(b) Asset:- (सम्पत्ति) → Capital owned by company, economic resource of entity. (Real Asset & Financial Asset)
(c) Break Even point (BEP) → A point on graph bet^n total revenue & total cost for that level of production & sales at which revenue is just sufficient to cover all expenses.
(d) Capital (पुंजी) → Wealth which may be utilized to economic advantage
(e) Cashflow → Statement showing actual rupees passing into & out of a treasury of a financial venture.
(f) Capital Recovery → Uniform annual cost of Capital investment.

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(g) Compound Interest:- That type of interest which is periodically added to the amount of principal investment so that subsequent interest is based on cumulative amount.
(h) Simple Interest:- Interest is charged only on the basis of initial principal amount for all over the time period.
(i) Depriciation:- Decline in value of capital assets due to wear & tear, passage of time, obsolescence etc.
(j) Economic life:- Time of capital asset that will be economically useful
(k) Time value of money:- Cumulative effect of elapsed time on the value of money/invested funds.
(l) Salvage value:- The value of capital asset at the end of economic life / scrap or residual value of machine
m) Inflation:- Situation of rise in general price level & fall in value of money.
(मुद्रास्फीति)
n) Deflation:- Situation of falling price level or rising value of money
o) Utility:- Power of ~~satisfaction~~ satisfaction to a consumer by consuming goods or services
p) Payback period:- Required time period to recover the initial investment of the project.
q) Demand:- Desire with ability to pay & willingness to pay
r) Supply:- Desire to sell with ability to sell & willingness to sell
s) Monopoly:- Market situation with only one seller & many buyers
t) Oligopoly:- Market situation with few sellers but each are anticipating others- reaction.
u) Price:- The amount of money paid per unit for a good or service
v) Marginal revenue → change in revenue due to one extra unit of quantity sold
w) Marginal Cost → Change in total cost due to one extra unit of output produced
x) Marginal Utility → change in total utility due to one more/additional unit of consumption.

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* Demand:-

→ Demand is the various quantities of an item that a buyer is willing to buy at various prices during a given period of time.

→ Desire with ability to pay & willingness to pay

→ Types of demand

1) Price Demand (Price ↑, Demand ↓)
2) Income Demand (Income ↑, Demand ↑)
3) Cross Demand (Effect on demand of one item due to another)
(Eg: Increase in price of tea will affect the demand of coffee)

* Law of Demand:

→ The quantity demanded increases with fall in price & diminishes with rise in price.

↓ Price ↑ Demand ⇔ ↑ price ↓ Demand

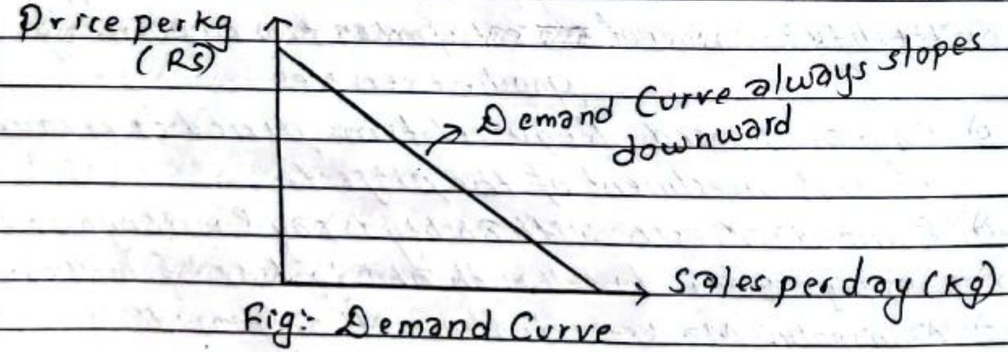


Fig:- Demand Curve

* Factors affecting demand:

- Technology
- Weather
- Price of related goods
- Price of goods
- Income of consumers
- Government policy
- Fashion
- Taste
- Availability of markets
- Size of population

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* Elasticity of Demand: (E_d)

→ The change in quantity demanded due to change in price, income etc. is called elasticity of demand.

E_d = proportionate change in quantity demanded / proportionate change in any one quantitative determinant of demand

→ Types

1) price elasticity of demand
2) Income elasticity of demand
3) Cross elasticity of demand.

→ Elastic demand → A small change in price leads to great change in quantity demand.

→ Inelastic demand → large chage in price leads to small change in quantity demand.

* Supply:-

→ The various quantities of an item that a seller is willing to sell at alternative prices, other things being equal

→ Desire to sell with ability to sell & willingness to sell.

* Law of Supply:-

→ Other factor remaining constant, supply varies positively with price.

→ Suppliers are always profit motivated, therefore they expect prices will goup & they will be able to make more profit

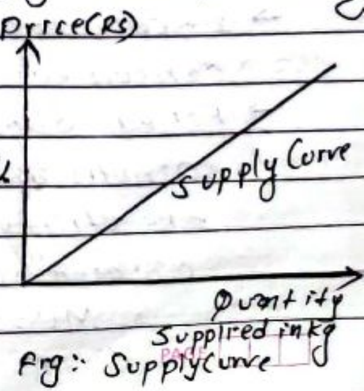


Fig:- Supply Curve

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* Factors influencing to Supply:-
→ Price of commodity
→ Price of factors of production
→ Price of related goods
→ production Technology
→ Change in money income
→ New inventions
→ Taxes & Subsidies
→ Development of Infrastructures
→ State of natural resource

* Utility:-
→ The power of satisfaction to a consumer by consuming goods or services.
→ For eg: a consumer can purchase a sandwich so they are no longer hungry, thus the sandwich provides some utility.

* Marginal Utility
→ The change in total utility due to one more/additional unit of consumption.
→ It calculates the utility beyond the first product consumed.
→ For eg: Suppose you drunk a bottle of water just few minutes again. Again, if you buy second bottle of water the utility gained from second bottle of water is marginal utility.

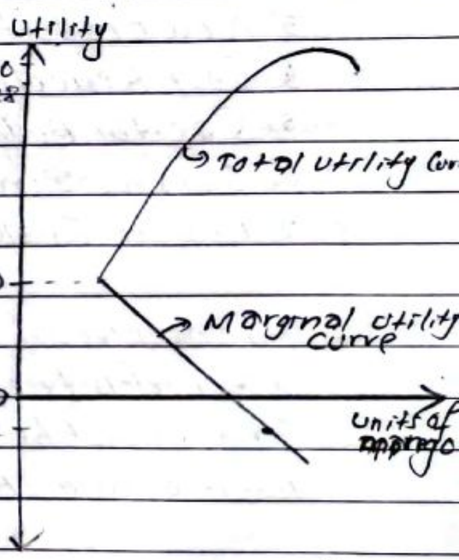
$$MU = \frac{\text{change in total utility}}{\text{change in total consumption by one unit}}$$

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* Law of Diminishing Marginal Utility:-
→ It states that, in the process of fulfilling human wants, when a consumer consumes more & more units of a commodity, the utility derived from each successive unit of the commodity goes on decreasing.
→ For eg:

Units of mango	Total utility	Marginal utility
1	10	10
2	18	8
3	24	6
4	28	4
5	30	2
6	30	0
7	28	-2

→ Suppose a consumer is consuming units of mango. He/she started eating mango one after another. The first ~~apple~~ mango gives him/her great pleasure/satisfaction/utility. Right that time, he starts second one & he compares it with first. Second mango gives him less satisfaction than first mango & satisfaction of third mango will be lesser & so on. In this way, consumer goes on consuming till it drops down to zero. In further force on consumption, the satisfaction will be negative which leads to decrease in total utility.



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* Role of Engineer's in Decision Making:-

→ Understand the problem
→ Define objective
→ colled relevant information/data
→ Develop feasible alternatives
→ Identify the criteria for decision making
→ Select the best alternative
→ Evaluate each alternative
→ Effective implementation & so on.

In decision making process, the role of engineers may also be different situations like
1) Equipment & process selection
2) Equipment replacement
3) New product & production expansion
4) Cost Reduction
5) Capital Budget Allocation
6) Service Improvement
7) Project Evaluation etc.

* Principles of Engineering Economics:

(a) Develop the Alternatives:-
There must be more than one alternatives the choice is made among these after subsequent analysis.

(b) Focus on Difference:-
Only the differences in expected outcomes among the alternatives are relevant to their comparison & should be considered in decision.

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(c) Use a consistent Viewpoint:-
The likely outcomes of the various alternatives, initial cost, future saving etc. should be consistently developed from a defined viewpoint.

(d) Use a common unit of measure:-
Using a common unit of measurement to specify as many of the prospective outcomes as possible will make easier the analysis & comparison of alternatives.

(e) Consider all relevant data:-
Selection of best alternative required consideration of almost all relevant criteria. This includes both the outcomes specified in the monetary unit & those expressed in some other unit of measurement

(f) Make uncertainty Explicit:-
Uncertainty is inbuilt in projecting the future outcomes of the alternatives & it should be honored in their analysis & comparison.

(g) Revisit the decision:-
The initial projected outcomes of the selected alternative should be subsequently compared with the actual results achieved. Revisiting of decision ensure the good result of the final decision.

✻ Uses & Application of Engineering Economics:-

1) Selecting between alternatives designs for a component, machine, structure, system, product or service during the engineering design process.
2) Estimating & analyzing the economics consequences of improvements in a factory operation.
3) Selecting among proposed projects within the annual capital budget limit.
4) Analyzing whether the equipment in the service should replace or not.
5) Choosing betn asset lease or purchase options to a product.

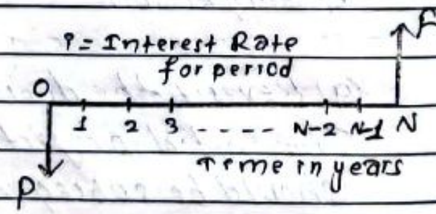
→ Hence, the use of engineering economics study involves technical & economic analysis with a decision making objective.

✻ Cash Flow:-

→ Cash flow is the statement which shows inflows & outflows of cash & cash equivalents during life of project.
→ Cash flow means the actual rupees coming into or goes out during different time.

* Cash flow diagram:-

→ The graphical representation of cash flows streams i.e both cash outflows & inflows with respect to time scale is referred as cash flow diagram.
→ Inflows & outflows are expressed by upward & downward arrows respectively.



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Chapter-2
Cost Concept & Fundamentals of Cost Accounting

Contents:-

→ Cost Terminology: Manufacturing cost & non-manufacturing cost
→ Cost for Business Decision: Differential cost & Revenue, Opportunity cost, Sunk cost & Marginal Cost

✻ Cost Terminologies:-

1) Cost: Amount of money paid for a thing.
2) Total cost: Sum of fixed costs & variable costs
3) Sunk cost: All the past costs which cannot be recovered when a firm leaves from an industry. Eg: Design, wages cost etc.
4) Opportunity cost: Cost of best rejected opportunity to earn return.
5) Fixed Cost: Cost remains constant in production (land, plant, building, equipment etc.)
6) Variable Cost: Cost of labour, rawmaterial, fuel etc.
7) Incremental Cost (Marginal cost) → change in total cost due to change in one unit of extra output.
8) Recurring cost: All the variable as well as fixed costs which is paid as a repeatable basis is recurring cost. Eg: Rent, wages, salaries, price of raw materials, fuel cost etc.
9) Non recurring cost: Cost of land, plant, equipment etc.
10) Direct Cost: (prime cost) → can be reasonably measured & allocated with specific output or work activity.
11) Indirect or Overhead Cost → All costs other than direct material & direct labour.
12) Standard cost: Representative or planned cost per unit of output that are established in advance of actual production or service delivery. Also called estimating cost.
13) Cash cost: Cost that involves payment of cash form.
14) Book cost: Cost that does not involve a cash transaction but is reflected in accounting system.

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* Manufacturing & Non-manufacturing Cost:-

→ **Manufacturing Cost**

- In the process of converting raw materials into finished goods a manufacturer needs various nature of costs that refers manufacturing cost.
- It is divided into three headings
  1) Direct raw material cost
  2) Direct labour cost
  3) Manufacturing overheads

→ **Non-Manufacturing Cost:-**

- It refers
  i) Marketing & selling costs/expenses
  → Order, supply, advertising, commission, travel etc.
  ii) Administrative costs/expenses
  → Compensation, secretarial support, general accounting, public relations etc.

15) Differential Cost & Revenue:
Cost between any two alternatives is known as differential cost
Diff in revenue betn any two alternatives is differential revenue

16) ~~Sunk cost~~: Life Cycle Cost:- Sum of all expenditures associated with the item/project during its entire service life.
- First cost (Initial investment, capital cost)
- Operating & maintenance cost
- Disposal cost

* Elements of cost:-

- Material cost
- Labour cost
- Overhead expenses.

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* Cost Accounting:-

→ Cost accounting is mainly concerned with the classifying, recording & appropriate allocation of expenditure. It also concern to the determination of cost of products & services & presentation of cost data.

→ Objective of Cost Accounting
① Ascertainment of cost
② Fixation of selling price
③ Cost Control
④ Matching cost with revenue
⑤ Special cost studies & investigation.
⑥ Preparation of financial statements, profit & loss account, balancesheet.

* Method of Cost Accounting

(a) Specific order costing / Job Costing
(b) Operation Costing / Process Costing.

Job Costing	Process Costing.
① Production is made by Specific order.	① Production is in continuous flow.
② Different jobs may be independent to each other.	② Identical production
③ Cost is computed when jobs is complete.	③ Costs are calculated at the end of each cost period.
④ No transfer of cost from one job to another.	④ Cost are transferred from one process to another until the goods are completely manufactured.

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Q Following are the cost data for the production of 150 badminton racquets. Find out prime cost & indirect cost from following cost data & also find out the cost of one badminton racquets

Labour Rate = Rs 50 per hour
Leather 80m @ Rs 200 per 'm'
Gut 400m @ Rs 70 per 'm'
Labour hours needed 300 hrs
Graphite 150kg @ Rs 300 per kg
Total annual factory overhead = Rs 80,00,000
Total annual direct labour hours 3,50,000 hrs

→ Here,

⇒ Prime cost:-

Direct cost (materials)
Leather = 80 × 200 = Rs 16,000
Gut = 400 × 70 = Rs 28,000
Graphite = 150 × 300 = Rs 45,000
Rs 89,000

Labor needed
Labor cost = 300 hrs × Rs 50/hr = Rs 15,000
Total prime cost = Rs 1,04,000

⇒ Indirect Cost:-

Indirect cost per hour = 80,00,000 / 3,50,000 = Rs 22.85 per hr

Total indirect cost = 300 hrs × Rs 22.85 per hr = Rs 6,855
Total cost of 150 badminton reqd = 104000 + 6855
= 1,10,855
Cost of one badminton = 110855 / 150 = Rs 739.03 per one racquet.

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Chapter-3, Time Value of Money

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Contents:-

→ Interest, simple interest, compound interest, Nominal rate of interest, Effective Rate of Interest
→ Economic Equivalence: PW, FW & AW
→ Development of formulas for equivalence calculation

✻ Time value of Money:-

→ The idea that a rupees today worth more than a rupees in the future because rupees today can earn interest.
→ Time value of money is the time dependent value of money stemming both from changes in purchasing power of money & from the real earning potential of alternative investment over time. Since money has ability to earn interest.

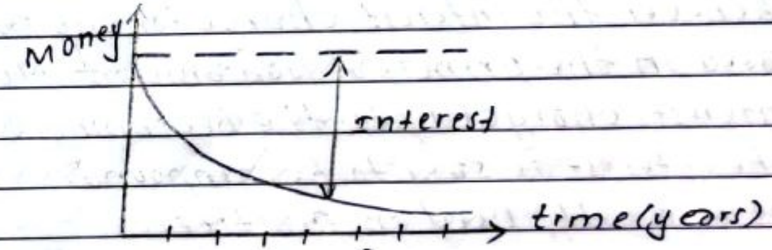


Fig: Time value of money.

✻✻ Interest:-

→ Fee that is charged for the use of money.
→ Depends upon total amount of money & length of time over which it is borrowed.
→ There are two methods on interest calculation
(i) Simple Interest
(ii) Compound Interest

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* Simple Interest:-

→ When the total amount of interest earned is directly proportional to the initial principal amount, then the interest is said to be simple.

→ Not used in commercial practice in modern time.

→ For deposit (P) at interest rate (r) for 'N' periods, total interest earned (I) would be,

$$I = PNr$$

The total future amount, (F) would be

$$F = P + I$$

* Compound Interest:-

→ Whenever the interest charge for any interest period is based on the principal loan amount plus any accumulated interest charges upto the beginning of that period, the interest is said to be compound.

→ It is mostly used in practice.

* Nominal Interest Rate:- (r)

→ The basic annual rate of interest is known as nominal interest rate. It is denoted by 'r'.

→ Nominal Interest rate may be stated for any time less than one year, such as semi-annual, quarter, month, week, day etc.

→ For eg:- If the interest rate is 12% per year & compound semi-annually, in this situation, nominal interest is 12%. But the actual rate of interest would be greater than 12% because of the compounding twice during a year.

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[Effective interest rate is the annual interest rate with considering the effect of compounding during a year]

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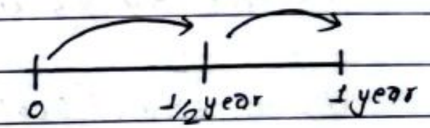
* Effective Interest Rate (i)

→ The actual rate of interest earned during one year is known as effective rate & it is also expressed on annual basis unless specifically stated.

→ Denoted by 'i'.

* Relation bet^n Effective (i) & Nominal (r) Interest Rates.

Let us suppose that, the interest rate is compounded semiannually.



We know, $F = P(1+i)^N$ ---(1)

Let,

i = Effective interest rate

r = Nominal Interest Rate per year

m = No. of compounding periods in year.

The interest rate per single compounding period would be,

$$i = r/m$$

Also, From (1)

$$P(1 + r/m)^m = P(1+i)^1$$

$$(1 + r/m)^m = 1 + i$$

$$i = \left(1 + \frac{r}{m}\right)^m - 1 \quad ---(11)$$

Suppose, the monthly interest rate is given, then effective interest rate will be,

$$i_{eff} = (1 + i_{monthly})^m - 1$$

$$i_{eff,monthly} = (1 + i_{eff,yearly})^{1/m} - 1$$

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* Derivation of Compound Interest Formulas of Single Cash Flows:-
* Finding 'F' when 'P' is given

If an amount of 'P' is deposited now to earn an interest of i% per period (year), then amount will grow as follows:

By the end of year 1, Amount $= P + Pi = P(1+i)$

By the end of year 2, Amount $= P(1+i) + P(1+i) \times i$

$= P(1+i)^2$

By the end of year 3, Amount $= P(1+i)^2 + P(1+i)^2 \times i$

$= P(1+i)^3$ & so on.

By the end of year N, Amount $= P(1+i)^N$

→ The accumulated amount after 'N' periods is the future sum & it is denoted by 'F':

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

$(1+i)^N$ → Single payment compound amount factor

$= (F/P, i\%, N)$

→ The process of determining future amount of sum of a single payment cash flow is known as compounding process.

* Finding 'P' when 'F' is given,

From above eqn,

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

$$P = F(1+i)^{-N}$$

$(1+i)^{-N}$ → Single payment present worth factor

$= (P/F, i\%, N)$

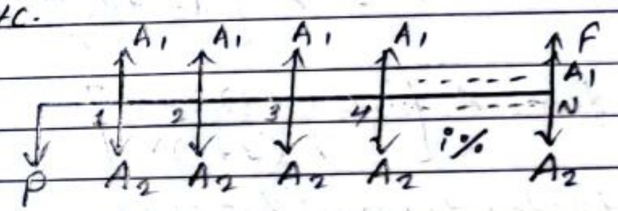
→ The process of determining present worth of a future sum is known as discounting process.

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** Interest Formulas relating a uniform series to its present & future sum.

* Uniform Series:- Uniform series shows equal cash flow amount (payments or receipts) occuring at the end of each equal periods. Such uniform series is often called an annuity & denoted by A:

Eg: Commercial installments, rental payments, insurance payments etc.

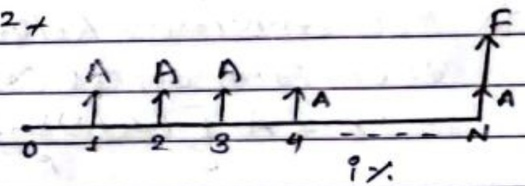


* Relation bet^n F & A,

The future sum of uniform series can be written as,

$F = A(1+i)^{N-1} + A(1+i)^{N-2} +$

$\cdots + A(1+i) + A$



This eqn can be written as,

$F = A + A(1+i) + A(1+i)^2$

$+ \cdots + A(1+i)^{N-1}$ --- (I)

Multiplying eqn (I) by $(1+i)$

$F(1+i) = A(1+i) + A(1+i)^2 + \cdots + A(1+i)^N$ --- (II)

Subtracting eqn (I) from (II)

$F(1+i) - F = A(1+i)^N - A$

$F \times i = A[(1+i)^N - 1]$

$$F = A\left[\frac{(1+i)^N - 1}{i}\right] \quad \text{---} \quad \text{(III)}$$

The factor term of bracket is called uniform series compound amount factor. Symbolically, it is written as $(F/A, i\%, N)$

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* Relation betⁿ P & A

We know, $F = P(1+i)^N$ ----(iv)

Also, from eqⁿ (iii) of previous relation betⁿ F & A,

$$F = A\left[\frac{(1+i)^N - 1}{i}\right] \text{ ---(v)}$$

Substituting value of F in (iv) into eqⁿ (v), we get

$$P(1+i)^N = A\left[\frac{(1+i)^N - 1}{i}\right]$$

$$P = A\left[\frac{(1+i)^N - 1}{i(1+i)^N}\right]$$

→ The factor term of bracket is called uniform series present worth factor & denoted by $(P/A, i\%, N)$.

※ Few Important Relations

(a) Uniform series Compound Amount

$$F = A\left[\frac{(1+i)^N - 1}{i}\right] = A*\left[F/A, i\%, N\right]$$

(b) Uniform Series present worth

$$P = A\left[\frac{(1+i)^N - 1}{i\times(1+i)^N}\right] = A\left[P/A, i\%, N\right]$$

(c) Sinking fund:

$$A = F\left[\frac{i}{(1+i)^N - 1}\right] = F\left(A/F, i\%, N\right)$$

(d) Capital Recovery Fund

$$A = P\left[\frac{i(1+i)^N}{(1+i)^N - 1}\right] = P\left(A/P, i\%, N\right)$$

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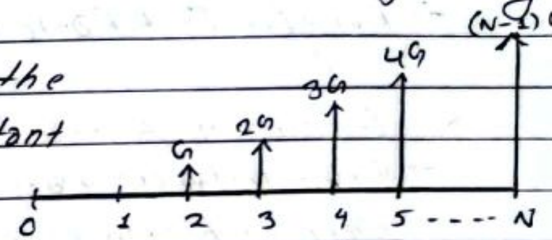
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※ Interest Calculation for Uniform Gradient:

→ An arithmetical progression of cash flow service which begins to increase or decrease from the end of second period onwards is called linear gradient series & it is generally known as gradient (G).

→ In figure/cash flow diagram, the cash flows increasing by constant amount (G) for each period. In this case, 'G' is known as uniform gradient amount. Increasing Gradient Series.



→ Finding 'F' when 'G' is given,

$$F = \frac{G}{i}\left[\frac{(1+i)^N - 1}{i}\right] - \frac{NG}{i}$$

$$F = \frac{G}{i}\left(F/A, i\%, N\right) - \frac{NG}{i}$$

→ Finding 'A' when 'G' is given,

$$A = \frac{G}{i} - \frac{NG}{i}\left[\frac{i}{(1+i)^N - 1}\right] = G\left[\frac{1}{i} - \frac{N}{(1+i)^N - 1}\right]$$

$$A = G\left(A/G, i\%, N\right)$$

→ Finding 'P' when 'G' is given,

$$P = G\left[\frac{(1+i)^N - 1 - Ni}{i^2(1+i)^N}\right]$$

$$P = G\left(P/G, i\%, N\right)$$

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Chapter-4, Basic Methods of Engineering Economic Studies

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Contents

→ Minimum attractive rate of return (MARR)
→ Payback period Method - Simple & Discounted
→ Equivalent worth methods: pw method, FW Method & AW method
→ Rate of Return Methods (IRR & ERR)
→ Benefit Cost Ratio Method.

✱ Minimum Attractive Rate of Return (MARR)

→ That interest rate at which an investor can accept to earn or borrow money easily.
→ It is regarded as a minimum rate of return that is required to invest the money.
→ It depends upon
i) Amount of fund available for investment
ii) No. of good projects available for investment
iii) Risks associated with investment
iv) Purpose of investment alternatives & their financial attractiveness
v) Type of Organization (Goverment / Private)

✱ Payback Period Method:-

→ This method calculates the number of years required for positive cashflows to just equal the total initial investment (I). But it doesnot account for savings after payback period generated by the project.

(a) Simple payback period:

→ It indicates the required time period to break even on an investment without considering time value of money

$$\text{Simple payback period (SPBP)} = \frac{\text{Initial investment}}{\text{Expected savings or Net cash inflows per period}}$$

(b) Discounted Payback Period:-

→ This method considers time value of money for determining payback period.
→ It is defined as the number of years required to recover the investment from discounting cash flow.

Q Calculate Simple & discounted payback periods from the given cash flows of a project when MARR is 20%.

End of period	Net Cash Flows (RS)
0	-25,000
1	+8,000
2	+8,000
3	+8,000
4	+8,000
5	+13,000

→ Solution,

For Simple payback period.

End of period	Net cash flow (RS)	Cumulative cash flow (RS)
0	-25,000	-25,000
1	+8,000	-17,000
2	+8,000	-9,000
3	+8,000	-1,000
4	+8,000	+7,000
5	+13,000	+20,000

$$\text{SPBP} = 3 + \frac{4-3}{7000+1000} \times (0+1000)$$

$$= 3.125 \text{ yrs} < 5 \text{ yrs (Accepted)}$$

3 -1000
SPBP 0
4 7000

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For discounted payback period,

End of period	Net cash Flow (RS)	Discounted c.f. into present (RS)	Cumulative cash Flow (RS)
0	-25,000	-25,000	-25000
1	+8,000	6667	-18,333
2	+8,000	5556	-12,777
3	+8,000	4630	-8,147
4	+8000	3858	-4,289
5	+13,000	5224	+935

$$DPBP = 4 + \frac{5-4}{935+4289} \times (0+4289)$$

$= 4.821$ years $\simeq$ 5 yrs (Rejected)

4	-4289
DPBP	0
5	935

Equivalent Worth Methods:

→ Equivalent worth method convert all cash flows into equivalent worth at some point of time (present / Annual future) by using interest rate equal to MARR.

(a) Present Worth Method

→ present worth (PW) is the equivalent worth of given series of cashflow at the present.

→ Decision Rule:

If PW (i%) > 0, Accept the project
If PW (i%) = 0, Remain indifferent
If PW (i%) < 0, Reject the project

(b) Annual Worth Method

→ Annual worth of a project is a uniform series of amount for a stated study period. It provides the basis for measuring investment worth into a series of equal payments at the end of each period.

→ Decision Rule,

AW (i%) > 0, Accept the project
AW (i%) = 0, Remain indifferent
AW (i%) < 0, Reject the project

(c) Future Worth Method:

→ Future worth of a project is the equivalent worth of all cash flows at the end of study period.

→ Decision Rule,

FW (i%) > 0, Accept the project
FW (i%) = 0, Remain indifferent
FW (i%) < 0, Reject the project

* Capital Recovery:-

→ There are two types of costs in business operation. They are operating cost & Capital cost. Operating cost (labour, raw materials, fuel etc.) are estimated on the annual production basis but capital costs (land, building equipments etc.) are fixed in initial period. Therefore, for purpose of annual equivalent cost analysis, capital costs must be converted into annual basis over the study periods & such annual equivalent capital cost is called Capital Recovery (CR)

$$CR(i\%) = AW(I) - AW(F)$$
$$= I(A/P, i\%, N) - S(A/F, i\%, N)$$

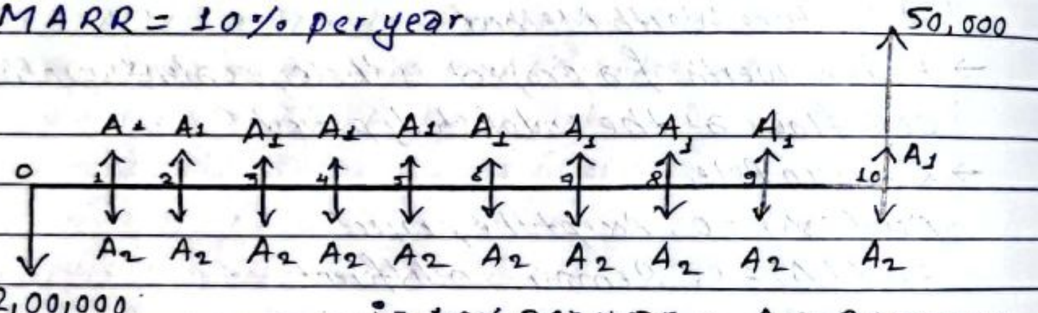
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Q. Check the feasibility of the following investment by using pw, FW & AW methods. What is the capital recovery amount of this project?

First Investment = RS 2,00,000
Salvage value = RS 50,000
Project period = 10 years
Annual Revenue = RS 50,000
Annual Cost = RS 15,000
MARR = 10% per year

→



i = 10% per year
A_1 = RS 50,000
A_2 = RS 15,000

Here,
$A = A_1 - A_2 = 50,000 - 15000 = 35,000$

→ By pw Method,

$pw(10\%) = -2,00,000 + 35,000 \times (P/A, 10\%, 10) + 50,000 \times (P/F, 10\%, 10)$
$= -2,00,000 + 35,000 \times 6.145 + 50,000 \times 0.3855$
$= RS\ 34350 > 0$ (feasible)

→ By FW method,

$FW(10\%) = 50,000 - 2,00,000 (F/P, 10\%, 10) + 35000 (F/A, 10\%, 10)$
$= 50,000 - 2,00,000 \times 2.594 + 35000 \times 15.937$
$= RS\ 88995 > 0$ (feasible)

→ By AW Method,

$AW(10\%) = 35000 - 200000 (A/P, 10\%, 10) + 50,000 (A/F, 10\%, 10)$
$= 35000 - 200000 \times 0.1627 + 50,000 \times 0.0627$
$= 5595 > 0$ (feasible)

→ Capital Recovery Amount

$C.R = AW(I) - AW(F)$
$= 2,00,000 \times (A/P, 10\%, 10) - 50,000 (A/F, 10\%, 10)$
$= 2,00,000 \times 0.1627 - 50,000 \times 0.0627$
$= RS\ 29405$

Rate of Return Methods:

→ Rate of return is defined as annual rate of profit resulting from an investment. It is especially relevant to evaluate mutually exclusive alternatives.

→ Types,
i) Internal Rate of Return (IRR)
ii) External Rate of Return (ERR)

Internal Rate of Return (IRR)

→ IRR is that interest rate which equates the equivalent worth of an alternative's cash inflows to the equivalent worth of cash outflows.

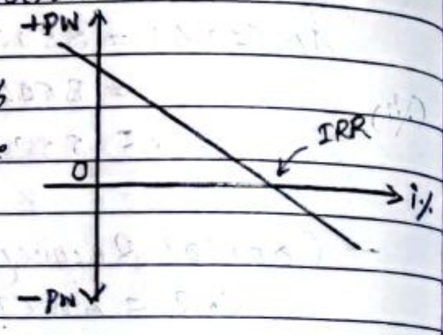
→ IRR is the break-even interest rate at which equivalent worth of a project's cash flow is zero.

→ If we plot a curve of pw for different values of i%, the IRR can be computed by spotting where the pw is zero.

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It is represented graphically as below.

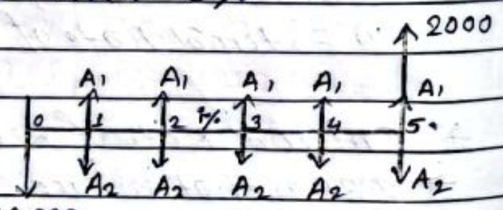


→ Although IRR can be computed by equating any equivalent worth to zero. It is advisable to use the PW method as it is found excessively used.

→ Decision Rule:
IRR > MARR → Accept the project
IRR = MARR → Remain Indifferent
IRR < MARR → Reject the project

Q. Determine IRR of the project with following information
Initial Investment = RS 10,000
Project life = 5 years
Annual revenue = RS 5,310
Annual expenses = RS 3,000
Salvage value = RS 2000 & MARR = 8%

→ Here,
$A = A_1 - A_2 = 2310$



$A_1 = 5310$ & $A_2 = 3,000$

By PW method,

$PW(i\%) = 2310(P/A, i\%, 5) + 2000(P/F, i\%, 5) - 10,000$

Assume $i = 10\%$

$PW(10\%) = 2310 \times 3.791 + 2000 \times 0.6209 - 10,000$
$= -0.99$

Assume, $i = 9\%$

$PW(9\%) = 2310 \times 3.8897 + 2,000 \times 0.6499 - 10,000$
$= 285.007$

Now, for IRR,

10%	RS	-0.99
IRR = ?		0
9%	RS	285.007

$$IRR = 10 + \frac{9 - 10}{285.007 + 0.99} \times (0 + 0.99)$$

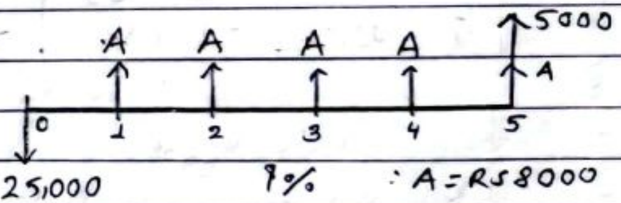
$= 9.996\% > MARR\ (8\%)$, Accepted.

Q. Compute the IRR for the following project. Also show the unrecovered investment balance in the graphical & Tabular form.

→ Initial Investment = RS 25000
Net Annual Revenue = RS 8000
Salvage value = RS 5,000
Useful life = 5 years & MARR = 20%

→ Solution,
By PW method,

$PW(i\%) = -25000 + 8000(P/A, i\%, 5) + 5000(P/F, i\%, 5)$



Assume, $i = 10\%$

$PW(10\%) = -25,000 + 8000 \times 3.7908 + 5000 \times 0.6209$
$= 8430.9$

Assume, $i = 20\%$

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$PW(20\%) = -25000 + 8000 \times 2.9906 + 5000 \times 0.4019$

$= 934.3$

Assume $i = 25\%$,

$PW(25\%) = -25000 + 8000 \times 2.6893 + 5000 \times 0.3277$

$= -1847.1$

Now, to calculate IRR,

20%		RS 934.3
IRR = ?		0
25%		RS -1847.1

$IRR = 20 + \frac{(25-20) \times (0-934.3)}{-1847.1-934.3}$

$= 21.67\%$

$\therefore$ IRR (21.67%) > MARR (20%), Accepted.

* Unrecovered investment Calculation (in tabular form)

EOY	Cash Flow (RS)	Unrecoved Investment: Beginning of year	Unrecoved Investment: End of year @ 21.6%	Net Unrecovered Investment
0	-25000	-	-25000	-25000
1	8000	-25000	-30,393	-22,393
2	8000	-22,393	-27,223	-19,223
3	8000	-19223	-23,369	-15,369
4	8000	-15369	-18,684	-10,684
5	13,000	-10684	-12,988	12

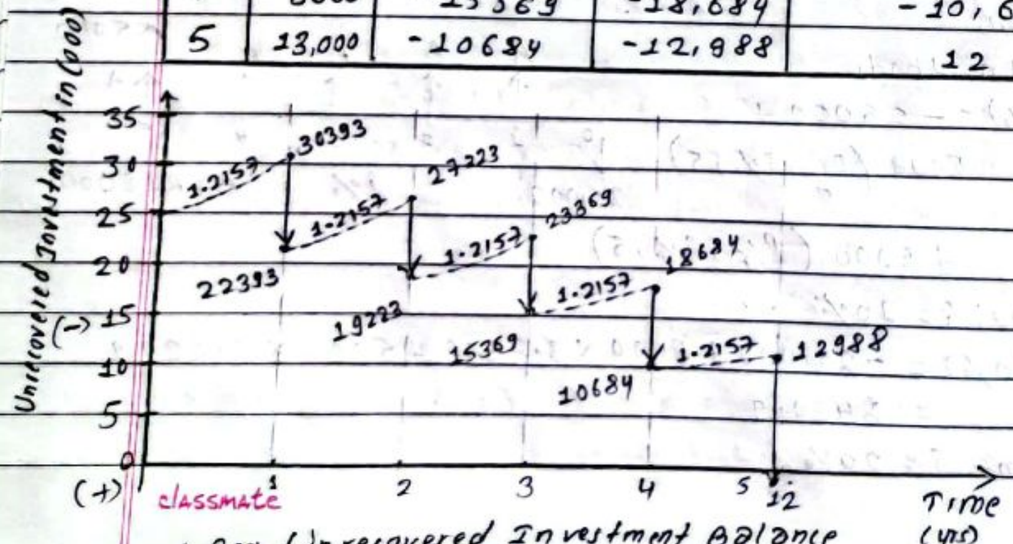


Fig: Unrecovered Investment Balance Diagram.

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* External Rate of Return:

→ Before starting ERR method, we should know about the drawbacks of IRR Method

1) The recovered funds if not consumed in each time period, recovered funds are reinvested at i% rather than at MARR. This is not always practical.
2) When algebric sign of cash flow changes more than one in the series, it is possible to obtain multiple rates of return.
3) Doesnot consider scale of investment
4) Involves linear interpolation of non-linear function.

→ ERR method eliminates the drawback of reinvestment assumption to some extent. ERR method takes into account the external reinvestment rate ~~thatbegins~~ (ε) at which net cash flows generated by a project over its life can be reinvested outside the firm.

→ Advantages of ERR over IRR

1) It does not need trial & error processes to solve for i%
2) There is no possibility of multiple rates of return.

→ Decision Rule:

ERR > MARR → Accept the project
ERR = MARR → Remain indifferent
ERR < MARR → Reject the project

Q. Calculate the ERR of the following project whose cash flows are as follows:

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Initial Cost = RS 5,00,000

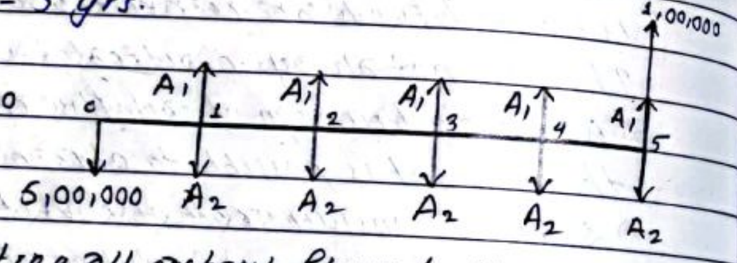
A·R = RS 2,00,000

A·C = RS 50,000 S·V = RS 1,00,000

MARR = @ = 12% per year

Project period = 5 yrs.

→ Solution



A_1 = RS 2,00,000

A_2 = 50,000

Step I :- Discounting all cashout flows to the pw

$PW(12\%) = 5,00,000 + A_2 (P/A, i\%, N)$

$= 500,000 + 50,000 \times (P/A, 12\%, 5)$

$= 680240$

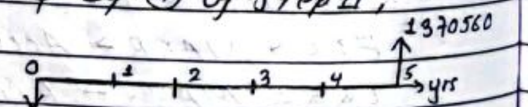
Step II :- Compounding all cashinflows to the end of project

$FW(12\%) = A_1 (F/A, i\%, N) + F$

$= 2,00,000 \times (F/A, 12\%, 5) + 1,00,000$

$= RS\ 1370560.00$

Step III :- Equate eqn ① of step I & eqn ② of step II,



Here,

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

$1370560 = 680240\ (1+i')^5$

$i' = 0.1503$

$i' = 15.03\%$ ∴ ERR = 15.03%

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✱ Cost-Benefit Analysis :-

→ Cost-Benefit Analysis involves the calculation of B/c ratio.

→ Benefit-cost (B/c) ratio can be defined as the ratio of the equivalent worth of benfits to the equivalent worth of costs.

→ B/c ratio is used to check the feasibility of project in both private & public Sectors.

→ While evaluating a project, time value of money must be considered. So, B/c ratio is actually a ratio of discounted benefits to discounted costs. It is also known as the saving investment ratio.

→ Two commonly used formulation of B/c ratio

1) Conventional B/C ratio
2) Modified B/C ratio

1) Conventional B/C ratio :-

a) PW Formulation, $B/c\ ratio = \frac{PW(B)}{PW(I) - PW(S) + PW(O\&M)}$

b) FW Formulation, $B/c\ ratio = \frac{FW(B)}{FW(I) - FW(S) + PW(O\&M)}$

c) AW Formulation, $B/c\ ratio = \frac{AW(B)}{AW(I) - AW(S) + AW(O\&M)}$

2) Modified B/C ratio

a) PW Formulation, $B/c\ ratio = \frac{PW(B) - PW(O\&M)}{PW(I) - PW(S)}$

b) FW Formulation, $B/c\ ratio = \frac{FW(B) - FW(O\&M)}{FW(I) - FW(S)}$

c) AW Formulation, $B/c\ ratio = \frac{AW(B) - AW(O\&M)}{AW(I) - AW(S)}$

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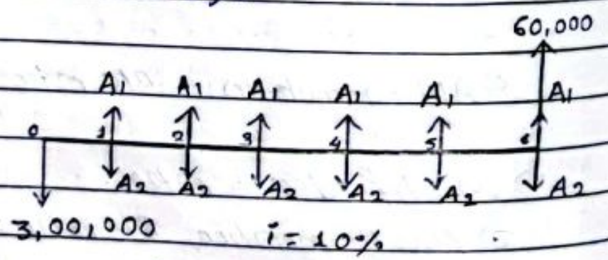
Where,
B = Benefits of the proposed project
I = Initial Investment in the proposed project
S = Salvage value of proposed project
O&M = Operation & Maintenance cost of proposed project
CR = Capital Recovery Fund

→ Decision:-
B/c ratio > 1, Accept the project
B/c ratio = 1, Remain indifferent
B/c ratio < 1, Reject the project.

Q Determine the both type of B/c ratio from following cash flow.
Initial Investment = Rs 3,00,000
Annual Revenue = Rs 85,000
Annual Cost = Rs 15,000
Salvage value = 20% of Initial Investment
Useful life = 6 yrs & MARR = 10%

→

PW Formulation
PW(I) = 3,00,000
PW(B) = 85000 (P/A, 10%, 6)
= 3,70,197
PW(S) = 60,000 (P/F, 10%, 6)
= 33,868
PW(O&M) = 15000 (P/A, 10%, 6)
= 65,329



Conventional B/c ratio = $\frac{370197}{300000 - 33868 + 65329} = 1.11 > 1$

Modified B/c ratio = $\frac{370197 - 65329}{300000 - 33868} = 1.14 > 1$

AW Formulation
AW(I) = 3,00,000 (A/P, 10%, 6) = 68860
AW(S) = 60,000 (A/F, 10%, 6) = 7776
AW(O&M) = 15,000 & AW(B) = 85,000
Conventional B/c ratio = $\frac{85000}{68860 - 7776 + 15000} = 1.11 > 1$

Modified B/c ratio = $\frac{85000 - 15000}{68860 - 7776} = 1.14 > 1$

FW Formulation
FW(I) = 3,00,000 × (F/P, 10%, 6) = 5,31,468
FW(B) = 85,000 × (F/A, 10%, 6) = 6,55,827
FW(S) = 60,000
FW(O&M) = 15,000 (F/A, 10%, 6) = 1,15,734
Conventional B/c ratio = $\frac{655827}{531468 - 60,000 + 115734} = 1.11 >$

Modified B/c ratio = $\frac{655827 - 115734}{531468 - 60,000} = 1.14 > 1$

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Chapter-5, Comparative Analysis of Alternatives

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Contents:-

→ Comparing mutually exclusive alternatives having same useful life by PBP Method, EW Method, Rate of Return method & BIC ratio Method

→ Comparing mutually Exclusive Alternatives having different useful lifes by Repeatability Assumption, Co-terminated assumption, Capitalized Worth Method.

→ Comparing Mutually exclusive, contingent & Independent Projects in Combination.

※ Independent Projects:

→ The project is said to be independent if its selection is free from the acceptance or rejection of any other projects in the group.

→ Eg: The purchase of generator, furniture & vehicle constitute three independent projects, so that we can evaluate separately & select them accordingly.

※ Dependent projects:-

→ The projects related to one another in such a way that the acceptance or rejection of one project influences the acceptance of others are called dependent projects.

→ Types
- Mutually exclusive projects
- Contingent projects

* Mutually Exclusive Projects:-

→ when one project is selected, all others are excluded in the group.

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* Contingent Projects:-

→ Two or more projects are said to be contingent if the acceptance of one project requires the acceptance of other.

→ For eg: The decision to connect internet is dependent upon the purchase of a computer however, the computer can be purchased without internet connection.

* Comparing Mutually Exclusive ~~projects~~ Alternatives having same useful life.

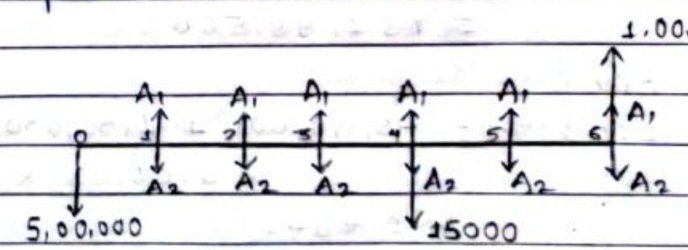
Q. Select which project is feasible to invest among other different projects whose cash flows are as follows.

Project A	Project 'B' MAR = 12 %.
Initial Investment = RS 5,00,000	
Annual Revenue = RS 2,00,000	
Annual Cost = RS 50,000	
Salvage value = RS 1,00,000	
Project period = 6 years	
MARR = 12%	
Repair & Maintenance cost at 4th year = RS 15,000	

End of year	Net C.F (RS)
0	-7,50,000
1	3,00,000
2	3,00,000
3	3,00,000
4	3,00,000
5	3,00,000
6	4,00,000

Use PW, PBP, IRR & BIC ratio method.

→ For project A,



A_1 = RS 2,00,000

A_2 = RS 50,000

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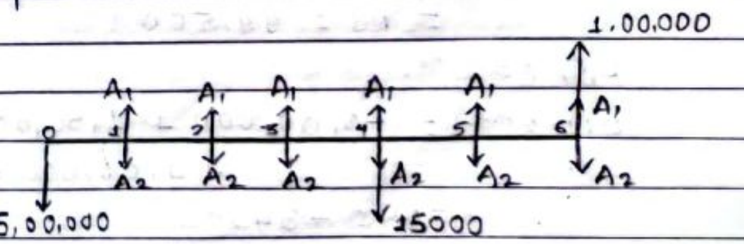
* Comparing Mutually Exclusive ~~projects~~ Alternatives having same useful life.

Q// Select which project is feasible to invest among other different projects whose cash flows are as follows.

Project A	Project 'B' MAR = 12 %.
Initial Investment = RS 5,00,000	End of year / Net C.F (RS)
Annual Revenue = RS 2,00,000	0 / -7,50,000
Annual Cost = RS 50,000	1 / 3,00,000
Salvage value = RS 1,00,000	2 / 3,00,000
Project period = 6 years	3 / 3,00,000
MARR = 12%	4 / 3,00,000
Repair & Maintenance cost at 4th year = RS 15,000	5 / 3,00,000
	6 / 4,00,000

Use PW, PBP, IRR & B/C ratio method.

→ For project A,



A_1 = RS 2,00,000

A_2 = RS 50,000

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(a) By pw method,

$pw(12\%) = -5,00,000 + 1,50,000\,(P/A, 12\%, 6) - 1500\,(P/F, 12\%, 1) + 1,00,000\,(P/F, 12\%, 6)$

$= -5,00,000 + 1,50,000 \times 4.1114 - 1500 \times 0.6355 + 1,00,000 \times 0.5066$

$= Rs\ 1,57,837.5$

(b) By Simple payback period (SPBP) Method,

EOY	Net C.F. (Rs)	Cumulative CF
0	-5,00,000	-5,00,000
1	1,50,000	-3,50,000
2	1,50,000	-2,00,000
3	1,50,000	-50,000
4	1,35,000	85,000
5	1,50,000	2,35,000
6	2,50,000	4,85,000

$SPBP = 3 + \frac{50,000}{1,35,000} = 3.37$ years.

(c) By IRR Method,

$pw(i\%) = -5,00,000 + 1,50,000\,(P/A, i\%, 6) - 15000\,(P/F, i\%, 1) + 1,00,000\,(P/F, i\%, 6)$

For $i = 10\%$

$pw(10\%) = -5,00,000 + 1,50,000 \times 4.3553 - 15000 \times 0.6830 + 1,00,000 \times 0.5645$

$= Rs\ 1,88,500$

For $i = 25\%$,

$pw(25\%) = -5,00,000 + 1,50,000 \times 2.9514 - 15000 \times 0.4096 + 1,00,000 \times 0.2621$

$= Rs\ -37224$

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For IRR,

10	199500
IRR = ?	0
25	-37224

$IRR = 10 + \frac{25-10}{(-37224-199500)} \times (0-199500) = 22.64\%$

(d) By B/C ratio method,

Conventional formula for pw formulation,

$B/C\ ratio = \frac{pw(B)}{pw(I) - pw(S) + pw(O\&M)}$

$pw(B) = 2,00,000\,(P/A, 12\%, 6)$

$= 2,00,000 \times 4.1114 = Rs\ 822280$

$pw(I) = 5,00,000 + 15000 \times (P/F, i\%, 4)$

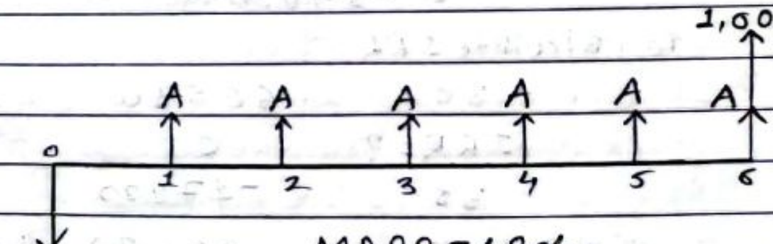
$= 5,00,000 + 15,000 \times 0.6355 = 509532.5$

$pw(S) = 1,00,000\,(P/F, 12\%, 6) = 50660$

$pw(O\&M) = 50,000 \times (P/A, 12\%, 6) = 50,000 \times 4.1114 = 205570$

$B/C\ Ratio = \frac{822280}{509532.5 - 50660 + 205570} = 1.237$

⇒ For project B,



MARR = 12%

A = 3,00,000

a) By pw method,

$pw(12\%) = -7,50,000 + 1,00,000\,(P/F, 12\%, 6) + 3,00,000\,(P/A, 12\%, 6)$

$= -7,50,000 + 1,00,000 \times 0.5066 + 3,00,000 \times 4.1114$

$= Rs\ 584084$

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b) By Simple payback period method

EOY	Net Cashflow(Rs)	Cum. Cashflow(Rs)
0	-7,50,000	-7,50,000
1	3,00,000	-4,50,000
2	3,00,000	-1,50,000
3	3,00,000	1,50,000
4	3,00,000	4,50,000
5	3,00,000	7,50,000
6	4,00,000	11,50,000

$$SPBP = 2 + \frac{1,50,000}{3,00,000} = 2.5 \text{ years}$$

c) By IRR Method,

$PW(i\%) = -7,50,000 + 3,00,000(P/A, i\%, 6) + 1,00,000(P/F, i\%, 6)$

For $i = 10\%$.

$PW(10\%) = -7,50,000 + 3,00,000 \times 4.3553 + 1,00,000 \times 0.5625$

$= 6,12840$

$PW(30\%) = -7,50,000 + 3,00,000 \times 2.6427 + 1,00,000 \times 0.2072$

$= 63,530$

$PW(35\%) = -7,50,000 + 3,00,000 \times 2.3852 + 1,00,000 \times 0.1652$

$= -17920$

To calculate IRR

30	63530
IRR = ?	0
35	-17920

$$IRR = 30 + \frac{35 - 30}{-17920 - 63530} \times (0 - 63530)$$

$= 33.89\%$

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Since, both projects have IRR greater than MARR. So, proceed incremental analysis.

Selecting project A as base alternative,

EOY	Net CF, project A	Net CF, Project B	Project B - project A
0	-5,00,000	-7,50,000	-2,50,000
1	1,50,000	3,00,000	1,50,000
2	1,50,000	3,00,000	1,50,000
3	1,50,000	3,00,000	1,50,000
4	1,35,000	3,00,000	1,65,000
5	1,50,000	3,00,000	1,50,000
6	2,50,000	4,00,000	1,50,000

Now, to calculate the IRR

$PW(i\%) = 0$

$$\Rightarrow -2,50,000 + 1,50,000 \times \left[\frac{(1+i)^6 - 1}{(1+i)^6 \times i^6}\right] + 15,000 \times (1+i)^{-4} =$$

$\Rightarrow$ IRR = 56.47% > MARR.

So, select project 'B' as feasible project

d) By B/C ratio method:

Using modified B/C ratio formula,

$$B/C \text{ ratio} = \frac{PW(B) - PW(O\&M)}{PW(I) - PW(S)}$$

$PW(B) - PW(O\&M) = 3,00,000(P/A, 12\%, 6)$

$= 3,00,000 \times 4.1114 = 1233420$

$PW(I) = 7,50,000$

$PW(S) = 1,00,000(P/F, 12\%, 6) = 50660$

Then,

$$\text{modified B/C Ratio} = \frac{1233420}{7,50,000 - 50660} = 1.763$$

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Since, both projects have B/C ratio > 1, so, proceed Incremental Analysis.

$pw(B) - pw(O\&M) = 1,50,000\ (P/A, 12\%, 6)$
$= 1,50,000 \times 4.1114$
$= 616710$

$pw(I) = 2,50,000 - 15,000 \times (P/F, 12\%, 4)$
$= 2,50,000 - 15,000 \times 0.6830$
$= 239755$

$\text{Modified B/C Ratio} = \frac{pw(B) - pw(O\&M)}{pw(I) - pw(S)_0}$
$= \frac{616710}{239755 - 0} = 2.572 > 1$

So, select project 'B' as feasible project.

※ Incremental Analysis:-

→ The projects having highest value of IRR, ERR & BCR maynot be preferred alternative, they are just relative measure & cannot be in the way as (PW, AW & FW) method for this purpose we adopt incremental Analysis.

→ Procedure for incremental analysis

1) Arrange the feasible alternative, based on increasing capital investment.
2) Establish a base alternative
   a) Cost Alternative: the first alternative (least capital investment) is base.
   b) Investment alternatives: If the first alternative is acceptable (IRR > MARR), select it as base. If the first

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alternative is not acceptable, choose the next alternative in order of increasing capital investment & check the profitability criteria (pw etc) values. Continue until an acceptable alternative is obtained. If none is obtained then do nothing alternative is selected.

Q An engineering firm is considering following exclusive alternatives. Assume MARR = 15%

EOY	Alternatives		
	A_1	A_2	A_3
0	-4000	-2,000	-6,000
1	5000	1600	3000
2	2000	1000	4,000
3	1600	1000	2,000

Determine the best alternatives by using IRR incremental Analysis.

→ First calculate IRR of all alternatives.

For A_1, $pw(i\%) = 0$
$-4,000 + 3000(1+i)^{-1} + 2000(1+i)^{-2} + 1600(1+i)^{-3} = 0$
$i = 34.34\% > MARR$ (accepted)

For A_2, $pw(i\%) = 0$
$-2,000 + 1600(1+i)^{-1} + 1000(1+i)^{-2} + 1000(1+i)^{-3} = 0$
$i = 40.76\% > MARR$ (accepted)

For A_3, $pw(i\%) = 0$
$-6,000 + 3000(1+i)^{-1} + 4000(1+i)^{-2} + 2000(1+i)^{-3} = 0$
$i = 24.81\% > MARR$ (Accepted)

Taking A_2 as base alternative & order for incremental analysis is A_2, A_1 & A_3.

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Now, the first incremental analysis is between A_1 & A_2.

EOY	$A_1 - A_2$	$A_3 - A_1$
0	-2,000	-2000
1	1400	0
2	1000	2000
3	600	400
IRR	27.61%	8.8%

→ Calculate IRR of incremental cash flow of $A_1 - A_2$

$PW(i\%) = 0$

$-2,000 + 1400(1+i)^{-1} + 1000(1+i)^{-2} + 600(1+i)^{-3} = 0$

$\therefore i = 27.61\% > MARR\ (15\%)$, accept A_1 & reject A_2

→ Again, incremental analysis bet^n A_1 & A_3 $(A_3 - A_1)$

$PW(i\%) = 0$

$\Rightarrow -2000 + 2000(1+i)^{-2} + 400(1+i)^{-3} = 0$

$i = 8.8\% < (MARR)\ (15\%)$, accept A_1 & reject A_3

So, best alternative is A_1.

* Different projects having different useful lifes:

→ Two methods of analysis of projects having different useful life

(a) Repeatability Assumption

(b) Co-terminated Assumption.

* Repeatability Assumption:

→ Two or more alternatives having different useful lifes are changed into projects having same useful life by expanding their life upto at least common year.

→ Procedure

a) Take LCM of two alternative projects life

b) Find out the repeatation number of each period.

$$\text{Repeatation Number} = \frac{LCM}{\text{Useful life}}$$

c) Find out pw by pw method & Compare it.

Q By using pw (or FW) & repeatability method, select the best project.

Project	A	B
Initial Investment (RS)	4,00,000	6,00,000
Annual Revenue (RS)	30,000	35,000
Annual O&M (RS)	3,000	4,000
Useful life (years)	6	8
Salvage value (RS)	4,000	7,000
MARR	12%	12%

→ Here,

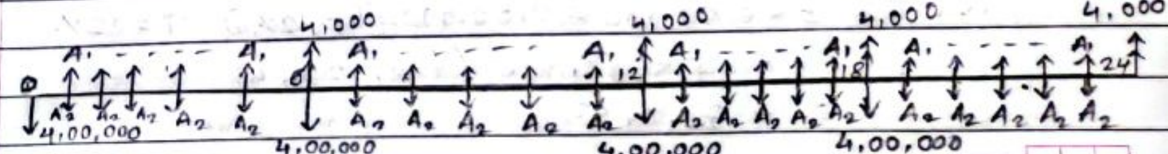
Study period = LCM of 6 & 8 = 24 years.

→ Project A, it requires 4 times repetition

Using pw formulation,

$pw(12\%) = -4,00,000 - 4,00,000(P/F, 12\%, 6) - 4,00,000(P/F, 12\%, 12) - 4,00,000(P/F, 12\%, 18) + 27000(P/A, 12\%, 24) + 4000(P/F, 12\%, 6) + 4000(P/F, 12\%, 12) + 4000(P/F, 12\%, 18) + 4000(P/F, 12\%, 24)$

$= RS\ -5,43,325$



MARR = 12% CFD for project A, $A_1 = 30,000$

$A_2 = 3,000$

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→ For project B, It requires three time repetition

$PW(12\%) = -6,00,000 - 6,00,000(P/F,12\%,8) - 6,00,000(P/F,12\%,16) + 31,000(P/A,12\%,24) + 7000(P/F,12\%,8) + 7000(P/F,12\%,16) + 7,000(P/F,12\%,24)$

$= -6,94,460$

→ Decision:

Both projects have negative value. i.e. both are not preferable but if decision is to be made we should go for lesser negative value. i.e project 'A' is best.

* Co-terminated Assumption:

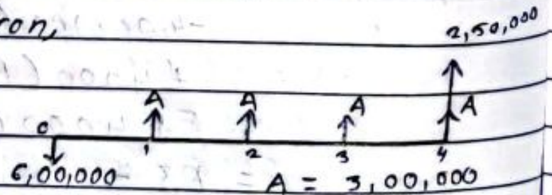
Q. Select which project is feasible to invest among two alternative projects whose cash flows areas follows. Use Repeatability & co-terminated assumption.

project A	project B (MARR = 12%)	
Initial cost = 5,00,000	EOY	Net CF
Net A.R. = 2,00,000	0	-6,00,000
Project life = 6 yrs	1	3,00,000
S.V = Rs 1,50,000	2	3,00,000
MARR = 12%	3	3,00,000
	4	5,50,000

→ By Co-terminated assumption,

→ For project B,

By pw method,



$PW(12\%) = -6,00,000 + 2,50,000(P/F,12\%,4) + 3,00,000(P/A,12\%,4)$ $i = 12\%$

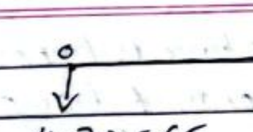
$= 4,70,065$

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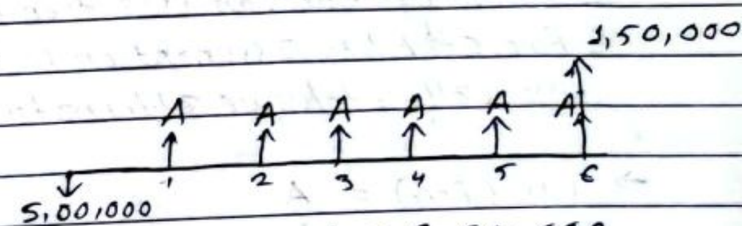
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$F = 4,70,065(F/P,12\%,6)$



$= 9,27,881.95$

→ For project A,



$A = 2,00,000$

$i = 12\%$

$FW(12\%) = -5,00,000(F/P,12\%,6) + 3,50,000 + 2,00,000(F/A,12\%,6)$

$= 7,80,068.03$

FW of project (B) > FW of project (A). So, project 'B' is highly preferable.

* Capitalized Worth Method:

→ Capitalized worth is the present worth of an alternative for overall study period.

→ CW method is introduced as a special case of PW criterion when revenue & expenses occur over an infinite length of time.

→ Many public projects like Hydropower, Road, Irrigation, bridge etc. have substantially longer service lives & benefits is also extended over this period. While evaluating or comparing such projects, we introduce a special case of pw in order to make effective analysis & this term is called capitalized worth (CW).

→ This method is convenient for evaluating & comparing

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alternatives where
a) The project has perpetual service life.
b) planning horizon is extremely long.
c) Repeatability assumption is applicable (incase of mutually exclusive alternatives).

→ $CW(i\%) = \frac{A}{i}$

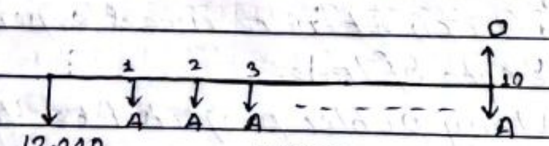
→ Steps for computing capitalized worth of any investment
- Find AW of project
- Divide the AW by MARR or interest rate.

Q Compare structures M & N given in below by CW method.

	Structure M	Structure N
Initial Investment(Rs)	12,000	40,000
Salvage value (Rs)	0	10,000
Annual Expenses (Rs)	2200	1000
Useful life (years)	10	25

MARR = 15%

→ For project M,



MARR = 15%
A = 2200

$AW_M(15\%) = -12000(A/P, 15\%, 10) - 2200$
$= -12,000 \times 0.1992 - 2200$
$= -4591.6$

$CW_M(15\%) = \frac{A}{i} = \frac{-4591.6}{0.15} = -Rs\ 30,610.6$

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→ For project N,



MARR = 15% A = 1,000

$AW_N(15\%) = -40,000(A/P, 15\%, 25) + 10,000(A/F, 15\%, 25) - 1,000$

$= -40,000 \times \frac{1}{6.4641} + 10,000 \times \frac{1}{212.793} - 1,000$

$= -7141.03$

$CW_N(15\%) = \frac{-7141.03}{0.15} = -47606.86$

Here, $CW_M(15\%) < CW_N(15\%)$
Hence, select structure 'M' so as to reduce the cost.

Formulation of mutually exclusive combination of projects.

(a) Independent projects case

Projects		Explanation
A	B	
0	0	Do nothing
1	0	Accept A
0	1	Accept B
1	1	Accept C

(b) Mutually Exclusive Projects Case

Projects			Explanation
A	B	C	
0	0	0	Do nothing
1	0	0	Accept A
0	1	0	Accept B
0	0	1	Accept C

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(c) Contingent projects case:

→ Suppose we have three projects A, B & C where 'A' is contingent on the acceptance of both 'B' & 'C' & 'C' is contingent on the acceptance of B.

project-			Explanation
A	B	C	
0	0	0	Do nothing
0	1	0	Accept B
0	1	1	Accept B & C
1	1	1	Accept A, B & C

Q Some engineering projects are being considered as following cash flows estimation over four years as shown in table below. Determine what combination of project is best if the capital to be invested is

a) Unlimited

b) Limited to Rs 50,000 by using pw method & MARR = 10% per year.

project	B_1	B_2	C_1	C_2	D
Initial Investment(Rs)	50,000	30,000	14,000	15,000	10,000
Annual Revenue(Rs)	20,000	12,000	4,000	5,000	6,000

B_1 & B_2 → Mutually Exclusive

C_1 & C_2 → Mutually Exclusive & contingent on the acceptance of B_2

D → Contingent on acceptance of C_1 & B_2

→ pw calculation for each project

$pw(B_1) = -50,000 + 20,000 (P/A, 10\%, 4) = 13,400$

$pw(B_2) = -30,000 + 12,000 (P/A, 10\%, 4) = 8,040$

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$pw(C_1) = -14000 + 4000 (P/A, 10\%, 4) = -1320$

$pw(C_2) = -15,000 + 5000 (P/A, 10\%, 4) = 850$

$pw(D) = -10,000 + 6,000 (P/A, 10\%, 4) = 9020$

→ Mutually Exclusive Project Combinations

Mutually Exclusive Combination	project				
	B_1	B_2	C_1	C_2	D
1	0	0	0	0	0
2	1	0	0	0	0
3	0	1	0	0	0
4	0	1	1	0	0
5	0	1	0	1	0
6	0	1	1	0	1

→ Combined project cash flows & present worths.

Mutually Exclusive Combination	Cash flows (R.S) for end of year					pw (R.S) at MARR = 10%
	0	1	2	3	4	
1	0	0	0	0	0	0
2	-50,000	20,000	20,000	20,000	20,000	13,400
3	-30,000	12,000	12,000	12,000	12,000	8,040
4	-44,000	16,000	16,000	16,000	16,000	6,720
5	-45,000	17,000	17,000	17,000	17,000	8,890
6	-54,000	22,000	22,000	22,000	22,000	15,740

→ Decision

1) When investment is unlimited, mutually exclusive comb'n '6' is the best comb'n (highest pw) of Rs 15,740.

2) When capital investment is limited to 50,000, mutually exclusive combination '2' is the best because it has highest present worth of Rs 13,400.

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Sumit Paudel

Chapter 6, Risk Analysis

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Contents

→ Origin/Sources of project Risks
→ Methods of describing project risks: Sensitivity Analysis, Breakeven Analysis, Scenario Analysis.

※ Risk:-

→ Risk is a condition where there is a possibility of deviation between desired & expected outcome but for which an array of alternative outcomes & their probabilities are known.
→ The term project risk is used to refer variability in a project's NPW.

※ Origin/Sources of Project Risk:-

Both risk & Uncertainty in decision making activities are caused by the lack of precise knowledge regarding future business condition, technological development, market demand & so on. There are four major sources of risk & uncertainty that affect project's NPW.

(a) Cash flow Estimate:
→ Inaccuracy of cash flow estimates used in study.
→ If they are based on past experience, a fair degree of reliance may be placed on estimates.

(b) Nature of Business
→ Different business have different nature.
→ Some business are less stable & more risky.
→ For eg: Mining projects are more risky than farming projects with expectation of stability & income generation.

(c) Rate of Interest / Rate of Inflation:-
→ Current health of economy & future expectations of economic conditions are responsible for determining market rate of interest & its stability.

(d) Study Period:
→ Long study period generally increases the uncertainty of a capital investment & economic return.

※ Methods of describing project Risks:-

→ There are three methods for describing project risk.
a) Breakeven analysis
b) Sensitivity analysis
c) Scenario analysis.

※ Breakeven Analysis:-

→ The point at which equivalent worth of cash outflows is equals to the equivalent worth of cash inflows is called Break Even Point & its analysis is called break even analysis.

※ Break-Even Analysis for Single Project:-

→ The costs of producing a good can be split into two main parts
Fixed costs (C_f) :- start up cost such as land, building, rent, insurance, equipments etc.
Variable cost (C_v) :- Cost of wages, raw materials, fuel, advertisee
Total cost is,

$$C_T = C_f + C_v$$

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The linear relationship assumed for variable costs.

$C_V = V_c(X)$

where, V_c = variable cost per unit output

X = Quantity of production.

Hence, $C_T = C_F + V_c(X)$

→ The total sales revenue (S_T) during same period would be,

$S_T = S_p(X)$, where S_p = Selling price per unit output

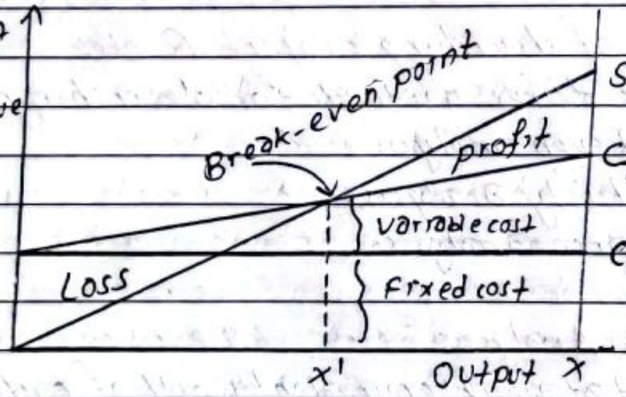


Fig:- Break-Even Analysis.

For breakeven point,

$S_T = C_T$

$\Rightarrow S_p(x') = C_F + V_c(x')$

$\Rightarrow C_F = (S_p - V_c)\,x'$

$\Rightarrow x' = \frac{C_F}{S_p - V_c}$

Hence, to determine break even point or output volume.

$x' = \frac{C_F}{S_p - V_c}$ (units)

- Obviously, to each a break-even position, the selling price has to be greater than variable cost per unit.

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Q. If sony company wants to produce branded laptop computers with increasing market demand. The company is estimated following figures.

Fixed cost: RS 20,00,000

Total Cost :- RS 40,00,000

Total sales = RS 30,00,000

Sales quantity = 50 units

a) Find break even point of production.

b) What should be the output if company desires profit of RS 5,00,000?

→ Given,

C_F = 20,00,000

C_T = 40,00,000

S_T = 30,00,000

Sales quantity = 50 units.

(a) Finding break even output ~~units~~ units.

Here, $C_V = C_T - C_F$ = 40,00,000 - 20,00,000 = 20,00,000

variable cost per unit output (V_c) = $\frac{20,00,000}{50}$ = 40,000

Selling price per unit output (S_p) = $\frac{30,00,000}{50}$ = 60,000

Break even output (x') = $\frac{C_F}{S_p - V_c}$ = $\frac{20,00,000}{60,000 - 40,000}$ = 100 units

(b) Finding sales output for net profit of RS 5,00,000

We know,

Net profit = Total sales amount − Total cost

$5,00,000 = S_p * x - (C_F + V_c * x)$

$5,00,000 = 60,000 \times x - (20,00,000 + 40,000 \times x)$

$x = 125$ units.

After selling 125 units, net profit of 5,00,000 can be obtained.

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※ Break Even Analysis for comparing two alternatives.

→ when there are two investment opportunities under consideration & heavily dependent on single & common factor, we can solve for the value of that factor by equating equivalent worth at which the conclusion is standoff. That value is known as breakeven point

→ In mathematical terms,

$$EW_A = f_1(y)$$
$$EW_B = f_2(y)$$

where,

EW_A = Equivalent worth calc^n for net cashflow of alternative A

EW_B = Eqvt. Worth calc^n for net cashflow of alternative B.

y = common factor affecting the eqvt. worth values of A & B.

→ Breakeven point is the value of 'y' for which

$$f_1(y) = f_2(y)$$

Q Consider the following two motors each of 100 Hp output capacity.

Item	Motor A	Motor B
purchase cost (RS)	1,25,000	1, 60,000
Efficrency (η)	74%	92%
Life (years)	10	10
Maintenance cost (RS)/yr	5,000	2,500
Annual tax & insurance	1.5% of	the investment
MARR	15%	15%

(a) How many hours per year would the motors have to be operated at full load for the annual costs to be equal? If electricity cost is RS 5/kwhr.

(b) If annual operation is more than 55 hours, which motor should be selected?

→ solution,

For motor A,

Calculating annual equivalent cost

1) Capital Recovery cost = $1,25,000 (A/p, 15\%, 10) = 24906.5$

2) Maintenance cost = RS 5,000

3) Tax & insurance = 1.5% of 1,25,000 = RS 1,875

4) Operating expenses for power,

Let 'x' be the number of hours of operation per year,

Operating expenses = Input x Rate x Hours of operation

$$= \frac{\text{output}}{\text{efficrency}} \times \text{Rate} \times \text{hours of operation}$$

$$= \frac{100 \times 0.746}{0.74} \times 5 \times x \quad (1hp = 746 watt)$$

$$= 504.05x$$

total annual cost for motor A = $31781.5 + 504.05x$ --(1)

For motor B

Calculating annual eqvt cost

1) Capital Recovery Cost = $1,60,000 (A/p, 15\%, 10) = 31,880.32$

2) Maintenance cost = RS 2500

3) Tax & insurance = 1.5% of 1,60,000 = RS 2,400

4) Operating expenses for power,

Let 'x' be the number of hours of operation per year,

Operating expenses = $\frac{100 \times 0.746}{0.92} \times 5 \times x = 405.43x$

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Total Annual cost of motor B = 36780.32 + 405.43x - (ii)

→ To get break even point,

AW of A = AW of B

31781.5 + 504.05x = 36780.32 + 405.43x

x = 51 hours per year (break even hour)

→ If annual operation > 55 hours,

total annual cost of A = 31781.5 + 504.05 × 55

= 59504.25

Total annual cost of B = 36780.32 + 405.43 × 55

= 59078.97

Since, total annual cost of 'B' is less than that of 'A'

so, select motor 'B'.

※ Scenario Analysis :-

→ Scenario analysis is a technique that considers that sensitivity of NPW due to change in key variables at a time & the range of likely values of those variables.

→ For example: the decision maker may examine two extreme case :- a 'worse-case' scenario (low sales/price/ high cost) & a 'best-case' scenario (high sales/price/ low cost).

→ The NPWs, under the worse & the best scenarios are then calculated & compared with expected NPW.

Q. From the following information, calculate NPW for each scenario by assuming x = 1,25,000, MARR = 15% & life of project is 5 years.

Variable Considered	Worse-case Scenario	Most-likely case	Best-case Scenario
Unit demand/yr	1600	2000	2400
Unit price (Rs)	48	50	53
Variable cost (Rs)/unit	17	15	12
Fixed cost (Rs)/yr	11,000	10,000	8,000
Salvage value (Rs)	30,000	40,000	50,000

→ solution,

(a) Worse Case Scenario,

NPW(15%) = -1,25,000 + (1600×48 - 1600×17 - 11,000)(P/A, 15%, 5) + 30,000(P/F, 15%, 5)

= 19,311 (profit)

(b) Most likely case Scenario,

NPW(15%) = -1,25,000 + (2000×50 - 15×2000 - 10000)(P/A, 15%, 5) + 40,000 (P/F, 15%, 5)

= 96,020 (profit)

(c) Best Case Scenario,

NPW(15%) = -1, 25,000 + (2400×53 - 12×2400 - 8000)(P/A, 15%, 5) + 50,000 (P/F, 15%, 5)

= 2,02,899 (profit)

→ Scenario Analysis indicates, there is no risk for investment.

※ Sensitivity Analysis :-

→ Sensitivity analysis reveals how much the NPW of a project will change in response to a given change in one input

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variable/parameter.

→ In calculating cash flows, some items may have greater influence on the final result than others i.e the most significant item may be easily identified. For example: the estimate of annual revenue is often a major factor in a problem in which the annual revenue varies alternatively.

→ Steps:-

→ change the specific variable by several specified percentages above & below the most likely value while holding all other variables constant.

→ Calculate a new NPW for each of the values we obtained.

→ Plot sensitivity graph.

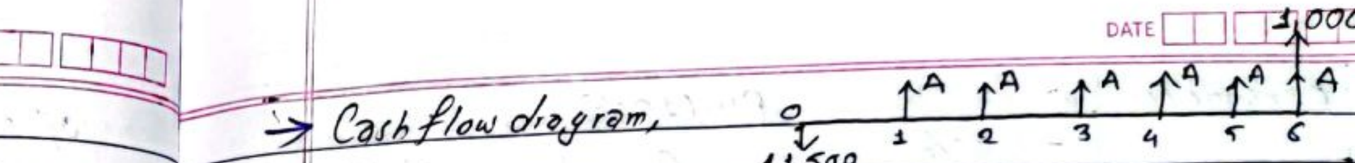
→ The slope of the lines show how sensitive the NPW is to changes in each of the inputs. The steeper the slope, the more sensitive the NPW is to a change in particular variable/parameter/input.

Q. Perform sensitivity Analysis of the following project over a range of ± 40% in (a) initial investment (b) annual net revenue (c) Salvage value (d) Useful life.

→ Initial investment (I) = 11,500
Net Annual Revenue (AR) = 3,000
Salvage Value (S) = 1,000
Useful life (N) = 6 yrs
MARR = 10%
Draw also the sensitivity diagram/graph.

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→ Cash flow diagram,



A = Rs 3,000 & i = 10%

Now,

$PW(10\%) = -11,500 + 1000\,(P/F, 10\%, 6) + 3000\,(P/A, 10\%, 6)$

$= -11,500 + 1000 \times 0.5645 + 3,000 \times 4.3553$

$= Rs\ 2130.4$ (564.4 + 13065.6)

→ When initial investment (I) varies ± 40%,

At +40%, PW = $-11,500 \times 1.4 + 13065.6 + 564.4 = -2470$

At -40%, PW = $-11,500 \times 0.6 + 13065.6 + 564.4 = 6730$

→ When net Annual Revenue (AR) varies ± 40%,

At +40%, PW = $-11,500 + 13065.6 \times 1.4 + 564.4 = 7,356$

At -40%, PW = $-11,500 + 13,065.6 \times 0.6 + 564.4 = -3096$

→ When salvage value (S) varies ± 40%,

At +40%, PW = $-11,500 + 13065.6 + 564.4 \times 1.4 = 2,356$

At -40%, PW = $-11,500 + 13065.6 + 564.4 \times 0.6 = 1,904$

→ When useful life (N) varies ± 40%,

At +4%, $PW = -11,500 + 3000 \times \left[\frac{(1+0.1)^{8.4}-1}{(1+0.1)^{8.4}\times 0.1}\right] + 1000\,(1+0.1)^{-8.4}$

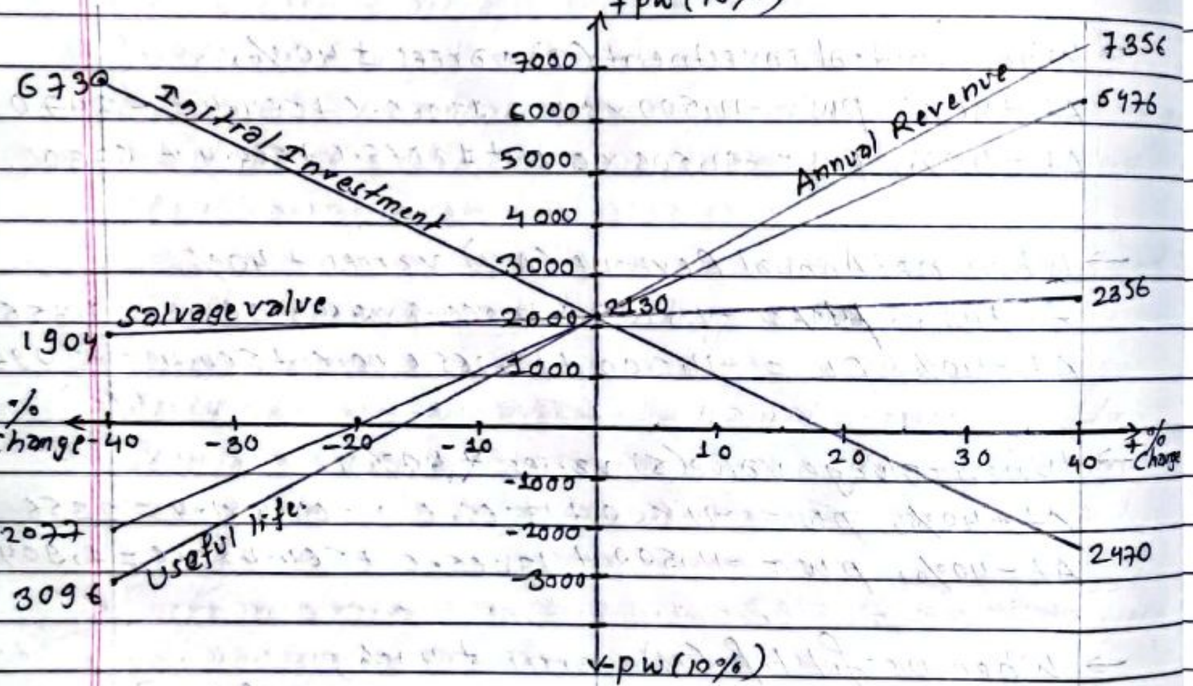
$= 5476$

At -40%, $PW = -11,500 + 3000 \left[\frac{(1+0.1)^{3.6}-1}{(1+0.1)^{3.6}\times 0.1}\right] + 1000\,(1+0.1)^{-3.6}$

$= -2077$

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parameter	PW(10%)		
	-40%	0	+40%
I	6,730	2,130	-2470
AR	-3,096	2,130	7,356
S	1,904	2,130	2,356
N	-2,077	2,130	5,476



→ Result: on the basis of calculation table & sensitivity diagram annual revenue (AR) parameter of the project is highly sensitive when compare to other parameters. i.e AR curve is more steeper than other in diagrams. It is followed by Investment (I) & useful life (N) parameter respectively. Salvag value(S) parameter is the least sensitive on this particular project.

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Chapter 8:- Depreciation & Corporate Income Taxes

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Outline:-

→ Depreciation & its causes, Asset Depreciation & Accounting Depreciation

→ Basic methods of depreciation:- Straightline method, Declining Balance Method, Sinking fund method, SOYD method, Unit of production method, MACRS

→ Introduction to corporate Income Tax. Taxation law, Depreciation Rates, personal Tax, Corporate Tax, VAT

→ After Tax Cashflow Estimate, General Procedure for Making After Tax economic analysis.

※ Depreciation:-

→ Depreciation is the gradual & permanent decrease in the value of an capital asset from any causes.

→ Depriciation is a measure of the exhaution of the effective life of a fixed asset owing to use or obsolescence during a given period.

※ Causes of Depreciation:-

(i) Wear & Tear
(ii) Effusion of time
(iii) Obsolescence
(iv) Exhaustion or depletion:- (fashion out)
(v) Accident (natural or man-made desasters)
(vi) Fall in marked value

※ Advantages of providing Depreciation fund:-

1) Ascertainment of cost of production
2) Correct ascertainment of net profit or loss

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3) Replacement of assets
4) To keep capital safe
5) For correct ascertainment of income tax
6) Fair financial position.

※ Factors affecting the amount of depreciation
1) Total cost of asset
2) Estimated useful service life
3) Estimated Salvage value
4) Estimated Expenditure for repair
5) Legal provision

※ Asset Depreciation & Accounting Depreciation:-
* Asset Depreciation:-
→ Asset depreciation refers the gradual decrease in the economic value/utility of fixed assets like; equipments, real estate, vehicles, with passing the time & wear & tear. so, it is called economic depreciation.

Types ⇒ physical Depreciation:-
It can occur in any fixed asset due to
i) wear & tear
ii) Deterioration

⇒ Functional Depreciation
It occurs as a result of change in technology. It decreases or eliminate need for an asset due to inability to meet increased quantity & quality demands of market.

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* Accounting Depreciation:-
→ Accounting depreciation provides information to make financial statement of any organization.
→ Accounting depreciated is a systematic allocation of asset's value into book value in proportion of its total depreciable life.
→ It is mostly used in engineering economic analysis because it provides a basis for determining the income taxes associated with any project undertaken.

※ Depreciation Methods:
→ Straight line method
→ Declining balance method
→ Double Rate Declining balance Method
→ Straight line plus average interest method
→ Sinking fund method
→ Sum of year digit method
→ Service output method
→ Modified accelerated Cost Recovery System (MACRS)

* Straight Line Method:-
→ Also called fixed installment method.
→ In this method, the same or equal or fixed amount of depreciation is charged every year throughout the life of the asset so that book value of asset may be reduced to zero.
→ Annual depreciation in year k, $d_k = \frac{B - S}{N}$

where, B = Original Cost / Initial Cost
N = Life of the asset.
S = Salvage value

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→ Cumulative depreciation through year k,

$$D_K = k\,(B-S)$$

→ Book value at the end of year k,

$$BV_K = B - D_K$$

→ If rate is given,

$$\text{annual depreciation} = \text{Total depriciable value} * \frac{\text{Rate}(\%)}{100}$$

$$\text{Rate of depriciation} = \frac{\text{Amount of annual depriciation}}{\text{Total depriciable value}} \times 100$$

Q) A machine costing of RS 11,000 is estimated to have a life of 10 years & the salvage value is estimated as Rs 1,000 at the end of life. Determine annual depreciation & rate of depreciation by using straight line method.

→ Given,

Original Cost = RS 11,000

Estimated life = 10 years

Salvage value = RS 1,000

$$\text{Annual Depreciation} = \frac{11,000 - 1,000}{10} = 1000 \text{ per year}$$

$$\text{Rate of depreciation} = \frac{1000}{10,000} \times 100 = 10\% \text{ per year.}$$

Q) A machine costing of Rs 4,000 is estimated to have life 10 years & salvage value is zero. Find
(a) Depreciation amount for the 6th year.
(b) Accumulated depreciation throughout the 6th year.
(c) Book value at the end of 6th year.

→ Given,

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original cost (B) = RS 4,000

useful life (N) = 10 yrs

Salvage value (S) = 0

→ In straight line method, depreciation amount for every year is same or equal. so,

depreciation amount for 6th year $= \frac{4000 - 0}{10} =$ RS 400

→ Accumulated depreciation throughout 6th year = 6 x 400
= RS 2400

→ Book value at the end of 6th year = 4000 - 2400
= RS 1,600

✱ Disadvantages of straight line method:

1) It is not proper to provide equal depreciation when asset is getting old.
2) It ignores interest on capital invested in fixed assets.
3) This method is not recognized by income tax authorities

✱ Declining Balance Method:

→ Constant/Uniform/Average percentage Method / Matheson Method.
→ This method is assumed that the annual cost of depreciation is a fixed or constant percentage of the book value at the beginning of the year.
→ Also called diminishing balance method.
→ It is based on assumption that a large amount of depreciation should be provided in the earlier year of use than later years.
→ We cannot reduced the book value of asset to zero under this method.

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→ The rate of deprecration can be calculated as.

$$R = 1 - \sqrt[N]{\frac{S}{B}}$$

Where, R = Rate of depreciation
N = Estimated life of asset
S = Salvage value & B = Original cost
(This formula cannot be applied if asset has no salvage value)

→ $d_k = B(1-R)^{k-1} \times (R)$
$D_k = B[1-(1-R)^k]$
$BV_k = B(1-R)^k$

Q A machine costing of Rs. 4,000 is estimated to have life of 10 years. Find d_6, D_6 & BV_6 if R = 20% & there is no salvage value by using Matheson Method.

→ Given,
B = RS 4,000
N = 10 years
R = 0.2 & S = 0
Then,
$d_6 = 4000(1-0.2)^{6-1} \times 0.2 = RS\ 262.144$
$D_6 = 4000[1-(1-0.2)^6] = RS\ 2951.424$
$BV_6 = 4000[1-0.2]^6 = RS\ 1,048.576$

* Disadvantage of Declining balance method.
→ It is difficult to decide rate of depreciation if SV is not given.
→ Book value of asset cannot be reduced to nil with this method
→ It is applicable only for long life assets.
→ It ignores interest on capital invested in fixed assets.

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* Double Rate Declining Balance Method:-
→ According to this method, depreciation rate will be calculated under straight line method & multiply it by 2. Then, the amount of depreciation is calculated by adopting declining balance method, so as to bring down the book value of the asset to its salvage value.

Rate of depreciation (R) = $1/N * 100 * 2$

Q Consider the following accounting information for a computer system.
Initial cost of asset = RS 10,000
Useful life = 5 years.
Compute the annual depreciation amount & resulting book value by using double rate declining method.

→ Given,
B = RS 10,000
N = 5 years.
Declining balance rate (R) = $1/N \times 100 \times 2 = 1/5 \times 100 \times 2$
= 40%

We can compute required annual depreciation amount & resulting book values with the given information as follows.

Year	Book value (RS)	Annual depreciation at 40%
1	10,000	4,000
2	6,000	2,400
3	3,600	1,440
4	2,160	864
5	1,296	518.4

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* Sinking fund method:-

→ This method ensures that the full capital invested in a project is recovered at the end of project's life.

→ This method provides fixed periodic charges at the end of each period that earns compound interest over the life of asset & would be equal to original cost of asset.

→ Annual equt amount $(A) = (I-S) \times (A/F, i\%, N)$

→ Net depreciation charge in year (k)

$d_k = (I-S) \times (A/F, i\%, N) \times (F/P, i\%, k-1)$

$BV_k = I - (I-S) \times (A/F, i\%, N) \times (F/A, i\%, k)$

Q. Compute the depreciation charge & book value of each year by using sinking fund method with following information.

Initial Cost of Asset = RS 1,00,000

Salvage Value = RS 20,000

Life of the asset = 8 years, $i = 12\%$

→ Fixed annual depreciation $(A) = (I-S) \times (A/F, i\%, N)$

$= (1,00,000 - 20,000) \times \left\{\frac{i}{(1+i)^N - 1}\right\}$

$= 80,000 \times 0.0813 = RS\ 6504.22$

Net depreciation for year 1,

$d_1 = (I-S) \times (A/F, i\%, N) \times (F/P, i\%, K-1)$

$= A \times (F/P, i\%, K-1)$

$= 6504.22 \times (F/P, 12\%, 1-1)$

$= 6504.22 \times 1$

$= 6504.22$

Net depreciation for year 2,

$d_2 = 6504.22 \times (F/P, 12\%, 1)$

$= 6504.22 \times 1.12$

$= RS\ 7,284.48$

Book value at the end of year 1,

$BV_1 = I - d_1 = 1,00,000 - 6504.22 = 93495.78$

Book value at the end of year 2

$BV_2 = I - (d_1 + d_2)$ or $BV_1 - d_2$

$= 93495.78 - 7284.48$

$= 86211.52$ & so on.

On continuing this process, we obtain the depreciation value & book value shown in following table.

$6504.22 (F/P, 12\%, K-1)$

Year(k)	Fixed depreciation(A)	Net depreciation	Book value at the end (BV) at year:
0	—	—	1,00,000
1	6504.22	6504.22	93,496
2	6504.22	7284.48	86,211.52
3	6504.22	8158.62	78,052.90
4	6504.22	9137.65	68,915.25
5	6504.22	10234.17	58,681.08
6	6504.22	11462.27	47,218.81
7	6504.22	12837.74	34,381.07
8	6504.22	14378.27	20,002.80

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* Sum of Year Digit (SOYD) Method:

→ Depreciation per annum is calculated on the basis of proportion of total number of estimated life years of an asset.

→ This method results larger depreciation charges during the beginning years of asset & smaller depreciation charges as asset getting old.

→ According to this method, per year depreciation charge can be calculated as,

$$\text{SOYD Depreciation} = \frac{\text{Remaining useful at beginning of particular year}}{\text{SOYD for the total useful life}} \times (I-S)$$

Where, I = Initial Investment

S = Salvage Value.

Q A machine having a cost of RS 36,000 & estimated Salvage value at the end of 5th year is RS 6,000. Calculate depreciation charges per annum under sum of year digit method.

→ Given,

I = RS 36,000

S = RS 6,000

N = 5 years

Sum of year digit = 5+4+3+2+1 = 15

or $\frac{N(N+1)}{2} = \frac{5(5+1)}{2} = 15$

Proportion of year ⇒ 5:4:3:2:1

Depreciation charges for particular year will be as follows,

Year	SOYD Depreciation
1	$5/15 \times (36000-6000) = 10,000$
2	$4/15 \times 30000 = 8,000$
3	$3/15 \times 30,000 = 6,000$
4	$2/15 \times 30,000 = 4,000$
5	$1/15 \times 30,000 = 2,000$

* Service Output Method (Unit of Production Method)

→ If the decreased in value of any asset is based on total working hour or production unit, then this method is useful for calculation of depreciation.

→ Depreciation rate per unit of output / working hour,

$$R = \frac{(I-S)}{\text{Total working hour or production unit}}$$

where, I = Initial Investment

S = Salvage Value.

Q A machine costing of RS 50,000 is estimated to have Rs. 10,000 salvage value when replaced after 30,000 hours of used. Find its depreciation rate per hour of use & book value after 10,000 hours of operation.

→ Given, I = 50,000 & S = 10,000

Total working hour = 30,000

Rate of depreciation = $\frac{50,000-10,000}{30,000}$ = RS 1.333 per hour

Book value after 10,000 hours of operation,

$BV_{10,000hr} = 50,000 - 1.333 \times 10,000$

= RS 36,666.66

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* Modified Accelerated Cost Recover System (MACRS)

→ MACRS is the principal method for determining depreciation in engineering projects.

→ Under MACRS, the ~~SV~~ is defined to be zero & useful life estimates are not used directly in calculating depreciation amount.

→ The MACRS scheme includes eight categories of assets with lives of 3, 5, 7, 10, 15, 20, 27.5 & 39 years.

→ A half year time convention is used in MACRS depreciation calculation that means all assets placed in service before the middle of the year.

→ Hence, a half year's depreciation being taken in the first year, ~~& that~~ a full year's depreciation is allowed in each of the remaining years & a half year's depreciation is taken in the year following the end of the recovery period.

Q A taxpayer wants to place in service of RS 10,000 asset that is assigned to the 5 year class. Compute the MACRS % & depreciation amount for the asset.

→ Given,

life of asset = 5 years

Cost of asset = 10,000

Salvage value = 0

Straight line rate = 1/N * Book value

Declining Balance Rate = $\frac{R}{N} = \frac{200\%}{5} = 40\%$

$= 0.4 * \text{book value}$.

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→ MACRS % & depreciation amount calculation may be as follows.

Year	MACRS % Calculation	Selected MACRS	Depreciation Basis	Depreciation Amount
1	1/2 Year DB = 1/2 × 0.4 × 100% = 20%			
	1/2 year SL = 1/2 × 1/5 × 100% = 10%	20%	10,000	2,000
2.	DB = 0.4 (100% - 20%) = 32%			
	SL = 1/4.5 (100% - 20%) = 17.78%	32%	10,000	3,200
3	DB = 0.4 × (100 - 20 - 32) = 19.2%			
	SL = 1/3.5 (100% - 52%) = 13.7%	19.2%	10,000	1,920
4.	DB = 0.4 (100 - 52 - 19.2) = 11.52%			
	SL = 1/2.5 (100 - 71.2) = 11.52%	11.52%	10,000	1,152
5.	DB = 0.4 × 17.28% = 6.9%			
	SL = 1/1.5 × 17.28% = 11.52%	11.52%	10,000	1,152
6.	1/2 year DB = 1/2 × 0.04 × 5.76% = 1.15%			
	1/2 year SL = 1/2 × 1/0.5 × 5.76% = 5.76%	5.76%	10,000	576
	Total	100%		10,000

* Straight line plus average interest method:-

→ Because the declining balance method never reaches a book value of asset to zero, it is permissible to switch from this method to straight line method so that an asset's book value will become to zero. Therefore, it is called declining balance with switchover to straight line method.

→ It is also called straightline plus average interest method

→ According to this method, switchover occurs in the year where a larger or equal depreciation amount is obtained from the straight line method in comparison to declining balance method.

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Q Consider the following information for a machine operating system.
Initial cost = RS 4,000
Useful life = 10 years
Salvage value = 0
Depreciation Rate = 20% per year
Compute the annual depreciation amount & book values by straight line plus average interest method.

→ Given,
B = RS 4,000
N = 10 years.
R = 20%.
S = 0
Switchover from 20% declining balance to straight line method

Year	Beginning of year Book value	20% declining balance method		Straight line method	Depreciation Amount selected
1	4000	800	>	400	800
2	3200	640	>	355.56	640
3	2560	512	>	320	512
4	2048	409.6	>	292.57	409.6
5	1638.4	327.68	>	273.07	327.68
6	1310.72	262.14	=	262.14	262.14 (switch)
7	1048.58	209.72	<	262.14	262.14
8	786.44	157.77	<	262.14	262.14
9	524.30	134.22	<	262.14	262.14
10	262.16	107.37	<	262.14	262.14
Total		3,570.5			4,000

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** Tax :-
→ Tax is a compulsary contribution/payment to government by the people & institution without any expectation of direct benefit.
→ Major part of government revenue sources.
→ The fund raised from tax is spent on public welfare.
→ classification of tax on the basis of nature & impact.
• Direct Tax
• Indirect Tax

* Direct Tax :-
→ The tax which cannot be shifted to other is called direct tax
→ Direct tax is levied on individual persons or corporation and the tax burden ultimately lies on tax payer.
→ Example: Income tax, property tax (vehicle, building etc.), house rent tax, land tax, corporate tax, interest tax etc.
→ These taxes are also known as personal tax.

* Indirect Tax :-
→ This tax is legally imposed on one person but is actually paid by another person
→ The burden of indirect tax fall to others.
→ Generally, levied on goods & services.
→ These taxes are also known as impersonal taxes.
→ In context of Nepal, VAT, Custom duties, excise duties etc. are the examples of indirect tax.

* Depreciation :
→ Depreciation means fall in value of fixed capital assets due to passage of time & physical wear & tear.

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→ For the purpose of calculating net income of a year from any business or investment, there must be deducted depreciation amount of depreciable assets owned & used during the year.
→ Depreciation is an accounting concept that establishes an annual deduction against before income tax such that the effect of time and use on asset's value can be reflected in a firm's financial statements.

* Recaptured Depreciation:-
→ When the depreciable asset used in business is sold for an amount and if that amount is greater than the estimated book value but less than the original cost then it is known as recaptured depreciation.
→ It is also called Ordinary gain
Recaptured depreciation = Selling price - Book Value
Book value = Cost price - Accumulated depreciation
Total gain = capital gain + Recaptured depreciation

* Normal Gain:-
→ The profit earned in the ordinary course of business is known as normal gain.
→ The gain from the sales of product or inventories of an enterprise by using circulating capitals are known as normal gains.

* Capital gain/loss:-
→ A business organization may have capital assets. When such capital assets are sold for more or less than the purchasing price, a capital gain or capital loss may be realized.
capital gain/loss = selling price - Original cost

* Personal Tax:-
→ From the functional point of view, the tax can be divided into personal tax & corporate tax.
→ Personal tax is a direct tax & it is generally imposed by the central authority & collected through the local authorities.
→ Personal tax is mostly levied on income & property in Nepal.

(a) Income Tax:-
→ If the tax is levied on various sources of individual income, then it is known as personal income tax or income tax.
→ Income refers as the economic gain by the person during the particular accounting period.
→ According to income tax act 2002,

Status	Income Limit Per Year	Tax Rate per Year
Single	Upto 2,50,000	1%
	2,50,000 - 3,50,000	15%
	3,50,000 - 25,00,000	25%
	above 25,00,000	35%
Married	upto 3,00,000	1%
	3,00,000 - 4,00,000	15%
	4,00,000 - 25,00,000	25%
	above 25,00,000	35%

If income is more than 25%, total tax will be,
25% + 0.4 × 25%
= 25 + 10
= 35%

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(b) Property Tax:-

→ Property means goods or land or building in someone's ownership.
→ property taxes are compulsary levied on the ownership of land, building, vehicles, weapons & so on.
→ The revenue generated from it is normally used to provide services of public goods.
→ In Nepal, there are two types of property tax
  i) House & land tax
  ii) Unified Property Tax

※ Corporate Tax:-

→ Individuals as well as corporations are subject to income tax.
→ Income tax on corporations is known as corporate income tax or corporate tax.
→ Corporation is a word used to cover a variety of business enterprises, all of which are entities having a legal personality & distinct from their owners.
→ Nepal government has followed book profit as the tax base for the purpose of corporate income tax.
→ According to income tax act 2002,

S.N	Corporation	Tax Rate
1.	Income from export & special industry	20%
2.	Income from petroleum industry, banks & financial institution	30%
3.	Income from industrial enterprises or related with infrastructure projects	20%
4.	Other general corporate bodies	25%

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※ Value Added Tax (VAT)

→ Nepal introduced this system on 1 Mangsir, 2054 B.S.
→ VAT is activated along with replacement of sales tax, hotel tax, contract tax & entertainment tax in Nepal.
→ VAT is a broad based indirect tax system, so that it is levied on sales of all goods & services excluding those that have been exempted by the law.
→ Value addition is the difference bet^n purchase & sell price of goods.
→ Every business firm having turnover greater than 20 lakh per year, traders who import or export goods & services having more than Rs 10,000 once at a time, should register into local VAT office & such registered firm comes in VAT net. (Value Added Tax Act, 2052)
→ VAT rate is 13% in Nepal.
→ At present, VAT has contributed about 30% of government tax revenue.

※ After Tax Cash Flow Estimate:-

→ It is measure of a company's ability to generate positive cash flow after deducting taxes.
→ The general formula for after tax ~~flow~~ cash flow is,
  ATCF = Net income + Depreciation + Amortization.
→ The amount remaining after expenses, mortgage payment & income taxes have been deducted from the gross income of an investment property is the after tax cash flow.

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* General Procedure for making after tax economic analysis:

Let,

R_k = Revenue from the project during period 'k'
E_k = Expenses during year 'k'
d_k = depreciation during year 'k'
t = Effective income tax rate
T_k = Income tax consequences during year 'k'
$ATCF_k$ = After Tax Cash Flow from project during year 'k'

Now,

Net Income Before Tax (NIBT) = $R_k - E_k - d_k$

The income tax consequences during year 'k' will be,

$$T_k = -t(R_k - E_k - d_k)$$

When $R_k > (E_k + d_k)$, a tax liability occurs
When $R_k < (E_k + d_k)$, a decrease in tax amount occurs.

Net Income after tax is,

$$NIAT_k = (R_k - E_k - d_k) - t(R_k - E_k - d_k)$$
$$NIAT_k = (R_k - E_k - d_k)(1 - t)$$

The ATCF associated with a project equals the NIAT plus non-cash items such as depreciation.

$$ATCF_k = NIAT_k + d_k$$
$$ATCF_k = (R_k - E_k - d_k)(1 - t) + d_k$$
$$ATCF_k = (1 - t)(R_k - E_k) + t d_k$$

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Chapter-9, Enterprise Financing & Capital Investment

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Outline:-

→ Method of financing: Equity financing, debt financing & capital structure.
→ Cost of Capital: Cost of Equity, cost of debt & calculating cost of capital
→ Project Funding Mechanism: Government budget, public private partnership & private investment.
→ FIRR, EIRR & Return on Equity.

* Method of financing:-

→ When project is selected by making investment decision, the next step is to decide method of financing.
→ There are two methods for financing in any project.
(a) Equity financing
(b) Debt financing.

* Equity Financing:-

→ It refers financing by share increment
→ It is the first type of financing.
→ It has two models
i) Use of retained earnings into company development
ii) Issuing share to outsiders / creating new owners
→ If a company hadnot reinvested earnings, it might have distributed to the company's owner i.e. shareholders in the form of dividend.
→ If a company doesnot have sufficient cash on hand to make investment & not wish to borrow (loan), the company can arrange money by selling common stock to raise the required funds.

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* Debt Financing:-

→ It is the second major type of financing for any company which includes both
  i) short term borrowing from financial institutions
  ii) Sale of long term bonds.
→ Debt financing uses money raised through loans from financial institutions or banks or by an insurance of bonds to finance a capital investment.
→ Debt financing is money borrowed from investers for a fixed period of time @ fixed interest

* Capital Structure:-

→ Ratio of total debt to total capital
→ Also called debt ratio.

$$\text{debt ratio} = \text{capital structure} = \frac{\text{Total debt}}{\text{Total Capital}}$$

→ For example, a debt ratio of 0.4 indicates that 40% of capital is borrowed & 60% funds are provided by equity (share). This type of financing is called mixed financing.

* Cost of Capital:-

→ Most of the business firms arrange their capital budget with stock (share) & long term debt (bonds) as a source of capital.
→ It includes
  i) Cost of equity
  ii) Cost of debt

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* Cost of Equity:-

→ Minimum rate of return which a company must generate in order to convince investors to invest in the company's common stock at its current market price.
→ Cost of equity can be calculated as,

(a) Based on sources of capital,

weighted average cost of equity, ie $= \left(\frac{C_r}{C_e}\right) k_r + \left(\frac{C_c}{C_e}\right) k_e + \left(\frac{C_p}{C_e}\right) k_p$

Where,
  C_r = amount of equity financed from retained earnings.
  C_c = amount of equity financed from issuing new common stock
  C_p = amount of equity financed from preferred stock.
  $C_e = C_r + C_p + C_c$

Also,

$k_r = \frac{D_1}{P_0} + g$, D_1 = first year dividend ($D_0(1+g)$)
  P_0 = Present cost of stock
  g = Grow rate of stock.

$k_e = \frac{D_1}{P_0(1-f_c)} + g$, f_c = flotation cost

$k_p = \frac{D^*}{P^*(1-f_c)}$, where D^* = Fixed annual dividend
  P^* = Issuing price

(b) Based on financial market.

$ie = r_f + \beta(r_m - r_f)$

Where,
  ie = Cost of equity in %
  r_f = risk free interest rate
  r_m = Market rate of return
  β = Market price volatility that quantifies risk.

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* Cost of debt:-

→ Calculation of cost of debt as in the form of weighted average cost of capital is relatively straight forward & simple.

→ Two types of debt financing are loans & bonds.

→ Because the interest payments on both on tax deductible, the effective cost of debt will be reduced.

→ To determine the after tax cost of debt (i_d) we use formula.

$$i_d = \left(\frac{C_s}{C_d}\right) K_s (1 - t_m) + \left(\frac{C_b}{C_d}\right) K_b (1 - t_m)$$

Where, i_d = cost of debt

C_s = Amount of short term loan

C_b = Amount of bond financing

C_d = $C_s + C_b$ = total amount of debt

K_s = before tax interest rate on short term loan

K_b = before tax interest rate on bond.

t_m = firm's marginal tax rate.

* Calculating cost of Capital:

→ A firm raises capital on the basis of target capital structure & the target capital structure remains unchanged in the future.

→ Cost of capital can be calculated as,

$$k = \frac{i_d C_d}{V} + \frac{i_e C_e}{V}$$

Where, k = cost of capital

$V = C_d + C_e$ [C_d = Total debt capital ($C_s + C_b$); C_e = total equity capital ($C_r + C_c + C_p$)]

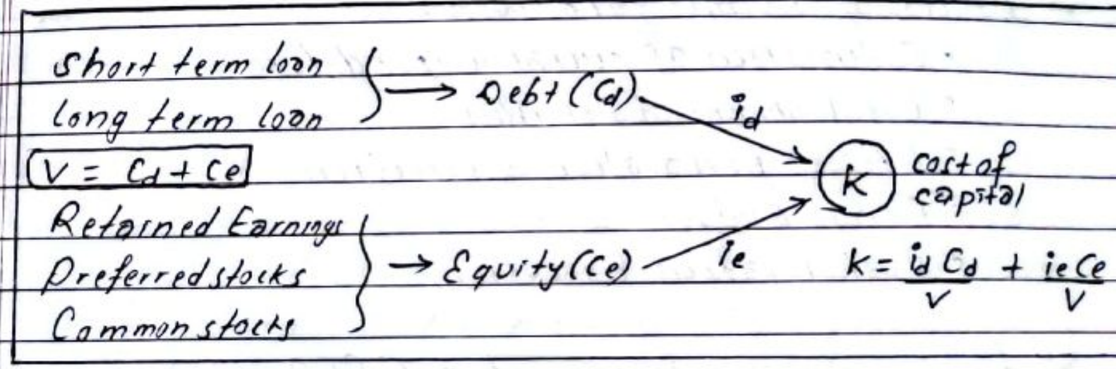
i_e = average equity interest rate per period

i_d = after tax average borrowing interest rate per period

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* Marginal Cost of Capital

→ The cost of obtaining another dollar of new capital & the marginal cost ~~of obtains~~ rises as more & more capital is raised during a given period.



* Project Funding Mechanism:-

→ A project is a planned investment undertaken to deliver product/output, so it has a set of activities to achieve specific objectives

→ The costs required for project can be funded by mainly three mechanism

i) Government Budget

ii) Public Private partnership

iii) Private Investment

* Government Budget:-

→ Budget is a written document of government's income & expenditure for a particular finance year.

→ Most of the development & public utility projects like road, water supply, electricity, telephone, gas, hospital etc.

are established & run by government funding through government budget.
→ The funding made by local & national / central government agencies to produce & delivery various public utilities include in this ~~section~~ heading.
→ Process of budget formulation
- Estimation of overall expenditure
- Establishment of priorities
- Project preparation & selection
- Final Budget
- Authorization Execution

✱ Public Private Partnership (PPP or P3)
→ Public: Government institutions (Ministry, department, Province, Municipality, wards etc)
Private: local & international body, NGO, CBO etc
Partnership: Collaboration bet^n two or more institutions/ individuals to perform certain task
→ In PPP, goverment remains actively throughout the life of project & private sector is responsible for the more commercial functions like project design, construction, finance & operations.
→ Through P3, govt. can reduce cost & risk & private sector can generate business opportunities & general people can receive better & more accessible services.

✱ Private Investment:-
→ It includes domestic & foreign people or organization having financial & technical capabilities.
→ All of the private companies (Pvt. Ltd) & business projects one established & run by private investment.
→ Generally, private sector choose low risk with high return, low investment & short term lre of the projects.
→ At present, private sector has been the engine of growth in most of the countries.

✱ Financial Internal Rate of Return (FIRR)
→ It is an indicator to measure the financial return on investment of an income generation project & used to make investment decision.
→ FIRR is obtained by equating present value of investment costs (cash outflows) & present value of net incomes (cash inflows)

$$\sum_{n=0}^{m} \frac{I_n}{(1+r)^n} = \sum_{n=0}^{m} \frac{B_n}{(1+r)^n} \quad ---(1)$$

I_n = Investment expenditure for entire project life period from year 0 to 'm'.
B_n = Annual net incomes for the entire project life period from year zero to 'm'.
→ By solving eq^n(1), we can obtain the value of 'r' which is called FIRR.

✱ Economic Internal Rate of Return:-
→ Profits are essential for investment decision. However, financial profitability are important in investment decisions by the firms, they are not good signaling for

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the whole i.e. national ~~economy~~ economy. So, that there is essence of economic analysis of projects by using EIRR

→ EIRR can be calculated as,

$$EIRR = FIRR + a + b + c$$

where,

a = Profitability associated with users due to market price distoration

b = Profitability associate with externalities expressed in market price

c = Profitability associated with environmental distoration.

Return on Equity :- (ROE)

→ ROE is also measurement of profitability that calculates how many rupees of profit a company generates with each rupees of shareholders equity.

→ So, it is the amount of net income returned as a % of shareholders equity.

$$ROE = \frac{\text{Net income} - \text{preferred dividends}}{\text{shareholders equity or common equity}} \times 100$$

$$= \frac{\text{Net income}}{\text{shareholder equity}} * 100$$

→ ROE measures how efficiently a firm can use the money from shareholders to generate profit & grow the company. Hence, ROE is a profitability ratio from investors point of view not the company.

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Chapter-7, Ecological Limits & Economic Development

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Outline:-

→ Economic theory & Ecological limit
→ Concept of sustainable development
→ Ecological Footprint
→ Overcoming ecological limits.

* Economic Theory:-

→ Economic theory is a way to explanation of economic activities & its impacts on various grounds.
→ Traditional Concept :- Micro Economic theory (use of scarce resources for satisfying unlimited wants)
→ After 1930's :- Macro Economic Theory (focus to achieve high level of employment & income)
→ After 1980s :- Concern for limiting availability of natural resources for economic development & resulting environmental degradation.
→ Ecological economics point out that except sunlight all other resources like air, water, food, wood, fiber, minerals & energy sources are the foundation of the economy & come from the earth. Our lives & economy are completely dependent upon & bounded by the ecosystem & materials of this planet (earth) that means in reality our economy is a subsystem of the earth.
→ Modern economic theory has tended to overlook about the importance of ecosystem, the use of land & environment for balancing ecological constraints that refers ecological economics. It is a new academic field that attempts to correct critical environment, social & economic problems over times.

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Sumit Paudel

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* Ecological limit :-

→ The result of growing economic activity has been increasing costs in many areas of the economy like atmospheric environment minerals, use of land, forest water & so on. There are limits to the earth's capacity to act as a source of material inputs feeding for the economic system & sink for the wastage products. Hence, functioning ecological mechanism of the earth to keep economic development with sustainable manner there must be limiting (min^m) availability of natural resources that technically refers ecological limit.

→ Hence, ecological limit is to keep intact ecological services which is need to keep the sale of economy within the capacity of global ecosystem to sustain it.

* Concept of sustainable development:-

→ Deforestration, overfishing, toxic waste production, climate change, overgrazing air & water pollution etc. are the results given by economic decisions throughout the world.

→ The economic measurement & understanding about these issues have become more serious among the economists.

→ Since 1980s, the growing concern for environment has given birth to the concept of sustainable development. The term sustainable development was brought into common use by the report "Our Common Future" in 1987 A.D. This report defines, "Sustainable development is meeting the needs of present generation without compromising the needs of future generations.

→ The concept of sustainable development embraces the principle of resource management & carrying capacity of ecosystem.

* Ecological Footprint:-

→ Ecological footprint refers the total direct & indirect requirement of land use for the given units of crop production with global average i.e. primary productivity for resource regeneration & waste absorption for the agricultural & industrial production & infrastructure development of an economy.

→ It also describes how the trade flows of open economics would become adjustment by the land requirement for imports & exports.

→ Ecological footprint would be differ for the different regions of the world depending upon the dominance of carbon footprint i.e. require for recyling carbon-dioxide by the forests, ocean & soil.

* Overcoming Ecological Limits:-

→ It discusses how technology & human values can play a significant role in creating space for economic development by relaxing the ecological constraints. Hence, overcoming ecological limits point out the scope maintaining bet^n economic growth & environment through the development of renewable energy sources, decarbonization, recycling of wastes, taking organic view of technology & resource develop-

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→ An environmental limit is the boundary beyond which exploitation of a natural resource will have significant deterious effects.
→ If government donot monitor the use & degradation of natural resource systems effectively, the risks & probability of costs of such impacts on human wellbeing are not taken into account.
→ Hence, each & every development institutions should follow the implementation policy of sustainable development by realizing the relationship between economic growth & natural environment.

Chapter 10, Basic Accounting Procedure

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Outline:

→ Accounting Terminologies: Asset & liabilities, Fundamental equation of accounting
→ Financial statements: Balance sheet, Income statement & cashflow statements
→ Using ratios to make decisions: debt ratio, current ratio, quick ratio, acid test ratio, inventory turnover ratio, total asset turnover, profit margin on sales, return on total assets, PE ratio & book value per share.

✻ Accounting Terminologies:-

(a) Business Transaction:-
Those transcation & events which are financial nature & measured in terms of money- & establishing for profit motive purpose.

(b) Accounting:
→ Language of business because it provides information to managers, owners, customers, investors & other decision maker inside & outside the organization.
→ It is a system of collecting, summarizing, analyzing, classifying & interpreting business transactions in financial or monetary terms.

(c) Assets :-
→ The resources or properties owned by the business organizations to generate economic benefit is known as assets.

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- Fixed assets:-

→ permanent resources or properties

→ Eg: Land & buildings, vehicles, plant & machines etc.

- Current Assets:-

→ Current assets are also known as floating assets or liquid assets because these are converted into normal cash in normal course of business

→ Generally, current assets are not kept by the business firm for more than one year.

→ For eg:

1) Cash in hand and cash at bank
2) Bills receivable
3) Prepared expenses
4) Stock in trade
5) Sundry debtors
6) Short term investment
7) Accrued Incomes

- Fictitious Assets:-

→ Fictitious assets donot have any real value so that they are assets for namesake. They are taken as assets on legal & technical grounds.

→ For eg:- Preliminary expenses, advertisement expenses, discount on shares & debentures, underwriting commissions etc.

- Intangible Assets:-

→ These are assets which cannot be touched & donot have any physical form. Patent, Good will, Copyright & Trademarks are intangible assets.

(d) Capital:-

→ The amount invested by the trader in his trade is called capital.

Capital = Assets − Liabilities

(e) Liability:-

→ Liabilities are borrowed sums from the third parties to the business.

→ Liabilities are debts payable in the future by the firm to its creditors.

→ Generally liabilities are created by borrowing money or purchasing goods & services on credit.

- Current Liabilities:-

→ Current liabilities are repayable within one year.

→ Example

1) Sundry Creditors
2) Bills payable
3) Bank Overdraft
4) Outstanding Expences
5) Advance Income
6) Short Term loan
7) Provisions.

- Long Term Liabilities:-

→ Permanent liabilities which are raised for more than one year.

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→ For example
1) Debenture
2) Bank loan
3) Bond
4) Mortgage loan etc.

Fundamental Equation of Accounting

→ Assets, liabilities & capitals are the three basic elements of every business transaction. Assets denote resource & capital & liabilities are sources of finance. The value of resource & sources must be equal.
→ The fundamental eqn of accounting is,
Assets = Capital + liabilities
Capital = Assets − Liabilities
→ Accounting eqn is also known as balance sheet eqn.

Financial Statements:-

→ Financial statements are prepared for the purpose of presenting a periodical Review or Report on the Progress by the management.
→ They provide a systematic collection of financial data in a logical & consistent way.
→ Preparation of the financial statement is the responsibility of top management. As these statements are used by investors & financial analyst to examine the firm's performance in order to make investment decision, they should be prepared very carefully & contain as much information as possible.

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→ Financial statement are classified as,

(2) Income statement:
→ Statement of revenues & expenses
→ Unlike balance sheet, income statement is prepared for a certain period (weekly, Monthly or yearly)
→ In case of trading business, it is presented in two steps
i) Trading account
ii) Profit & loss Account
→ The objective of preparing trading account is to ascertain gross profit earned or gross loss suffered during the given accounting period.
→ Profit & loss account are prepared after the completion of trading account. Profit & loss account is prepared by considering indirect income & indirect expenses.

(6) Balance Sheet:-
→ It is a tabular sheet of balances of assets, liabilities & equity.
→ It mainly represents the basic accounting equation.
→ It is prepared at a given date to show financial position of a business concern.
→ Balance sheet is not an account but a statement of assets, liabilities & capital of business enterprises at a given date.
→ Balance sheet provides information not only total of assets but also composition of fixed assets, investments, current assets & fictitious assets. In liability side, it also shows owner's equity & burrowed from third parties.

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Q Prepare income statement of ABC Company of period 2011 from following data

1. Revenues	Rs	12000
2. Depreciation		500
3. Marketing Expenses		3000
4. General & administrative expenses		600
5. Other income		120
6. Interest Expense		220
7. Income Taxes		400
8. Cost of sales		6800

→ Income statement of ABC Company
End of 2011

		Rs.
1) Revenue		12000
2) Cost of goods sold	less	6800
Gross Income (GI)		5200
3) Marketing expenses	less	3000
4) General & Administrative Expenses	less	600
Earning before depreciation, interest & taxes (EBDIT)		1600
5) Depreciation	less	500
Net Operating Income (NOI)	less	1100
6) Other income, net		120
Earning before interest & taxes (EBIT)		1220
7) Interest Expenses	less	220
Earning before taxes		1000
8) Income taxes	less	400
Net Income (NI)		600

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Q Prepare a balance sheet of ABC company of 2011 from following data given below.

	Rs
1) Cash	400
2) Accounts Payable	600
3) Marketable Securities	100
4) Notes payable @ 10%	200
5) Accounts Receivable	1500
6) Accrued Wages	200
7) Inventories	1500
8) Other accruals	200
9) Deferred taxes	900
10) Gross plant & Equipment	900
11) Accumulated Depreciation	3500
12) Long Term Debt	2400
13) Preferred stock	0
14) Common Stock	1000
15) Paid in Capital	1000
16) Retained Earnings	2600
17) Treasury Stock	0

→

Balance sheet of ABC Company
(End of 2011)

Assets	Rs.	Capital & Liabilities	Rs.
1) Cash	400	1) Accounts payable	600
2) Marketable Securities	100	2) Notes payable @ 10%	200
3) Accounts Receivable	1500	3) Accrued Wages	200
4) Inventories	1500	4) Other accruals	100
Current Assets	3500	Current Liabilities	1100

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5) Gross plant & Eqp.	900	5) Deferred taxes	900
6) Acc. Depriciation (Less)	3500	6) Long Term Debt	2400
Net plant & Equipment	5500	7) Preferred Stock	0
Total Assets	9000	8) Common stock	1000
		9) Paid in Capital	1000
		10) Retained Earnings	2600
		11) Less Treasury stock	0
		Total liabilities & equity	9000

(c) Cashflow Statement:

→ A statement which explains the changes in cash position from one balance sheet date to next balance sheet date is known as cash flow statement.

→ A cashflow statement is the statement of cash inflow & outflow.

→ It is simply a statement of cash generation & its use by different activities categorized under three different broad activities

- Operating activities
- Investing activities
- Financing activities

* Using Ratios to make Decisions:-

(a) Debt Ratio :-

→ The present financial condition of the firm for paying long term loan is tested by debt ratio.

→ It helps to know about the ability of firm for paying the interest on loan & utilization of firm's fixed assets as well as resources on productive sector.

(i) Debt to equity ratio (DER)

$$\text{Debt to equity ratio} = \frac{\text{Total debt}}{\text{Shareholders Equity}}$$

Higher DER indicates large amount of debt in comparison to equity.

(ii) Debt to total capital ratio (DTCR)

$$\text{DTCR} = \frac{\text{Total debt}}{\text{Capital Employed}}$$

Lower DTCR indicates the more security to the creditors.

(b) Current Ratio :-

→ The ratio of current assets to current liabilities is called current ratio.

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

→ Higher the current ration, greater the ability of the firm's to pay its short term debt & vice-versa.

(c) Quick Ratio or Acid Test Ratio or Liquid Ratio :-

→ Ratio of quick assets to current liabilities

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

Quick Assets = Current Assets - Stock - Prepaid Expenses.

→ It measures the ability of firm to pay current liability immediately.

(d) Inventory Turnover Ratio (Stock Turnover Ratio)

→ Ratio of cost of goods sold to the average inventory.

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Inventory Turnover Ratio = $\frac{\text{Cost of Goods sold}}{\text{Average Inventory}}$

→ Low inventory turnover ratio indicates stocks are kept for long time in store.

→ High ITR indicates efficient inventory management.

(e) Total Asset Turnover (Investment Turnover Ratio)

→ Total Assets Turnover Ratio = $\frac{\text{Net sales}}{\text{Total Assets}}$

→ Total Assets = Fixed Assets + Investment + current assets, loan & advance - fictitious assets

Net Sales = Total Sales - Sales Return

(f) Profit Margin on sales:-

→ Profit margin ratio = $\frac{\text{Net Income/Net profit}}{\text{Net sales}}$

→ Higher ratio shows efficient use of resources & making profit.

(g) Return on Total Assets:-

→ It is the relationship betⁿ net profit & total assets.

Return on assets = $\frac{\text{Net profit}}{\text{Total Assets}}$

→ Higher ratio indicates available resources are employed efficiently.

(h) Price Earning Ratio (P/E Ratio)

P/E ratio = $\frac{\text{Initial market price per share}}{\text{current earning per share}}$

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→ It is the best indicator of ongoing performance of a company as well as future prospects.

→ It can also be used to compare a company against its own historical record or to compare aggregate markets against one another or over time.

(i) Book Value per share:-

→ Also called net worth per share

→ Ratio of common shareholder's equity to number of common shares outstanding.

Book value per share = $\frac{\text{Common Shareholder's equity}}{\text{Number of common shares outstanding}}$

→ It refers to the value of share which is calculated on the basis of data recorded on the balance sheet.