Chapter four

Investment Decisions/Investment appraisal method

Introduction

- *Investment* -is decision making process by which firms evaluate the purchase of fixed assets
- *Investment policy-* is the firm's formal planning process
- *investment*:
  - ❖ substantial expenditure
  - ❖ long time period
  - ❖ sales forecasts
  - ❖ investment appraisal
  - ❖ planning horizon

what makes economic decision differ from other decision ?

- Economic decision differ in fundamental way from the types of decisions typically encountered in engineering design.
- In engineering design ,the engineer uses known physical properties, the principles of chemistry and physics ,engineering design correlations, and engineering judgment to arrive at a workable and optimal design.
- If the engineering design to meet a particular need is done today, next year ,or five years time, the final design not change significantly

cont

- In economic decisions, the measurement of investment attractiveness ,information required in such evaluations always involves predicting or forecasting product sales, product selling price, and various costs over some future time frame 5year ,10year ,15year …
- All such forecasts have two thing in common ,
  - never completely accurate when compared with the actual value realized in future times.
  - A prediction or forecast made today is likely to be different than one made at some point in the future

Economic decision

- Economic decisions have to be based on best information available at the time of the decision
- The term decision refers to all investment decisions relating to engineering project
- The five main types of economic decisions are
    i. Service or quality improvement
    ii. New production or product expansion
    iii. Equipment and process selection
    iv. Cost reduction
    v. Equipment selection
- The factor of time and uncertainty are the defining aspect of any investment

Typical decision situations encountered

- Selection of one design out of several competing designs
- Selection of one construction methodology out of several construction methodologies
- Replacement decisions
- Investment decisions ? Risky investment with high returns vs safe investment with low return

Continued

- Allocation of funds for few public projects out of several competing projects

- Selection of a project out of several competing projects
- Number of units to be sold for break even

Common Things In Above Situations

- Each one of them involve some monetary considerations
- Generating different sets of alternatives and
- Evaluating the best out of them in a given situation

Alternative

- Economic decision can be viewed as the selection of one or more alternatives from a pool of alternatives.
- The pool of alternatives may include
  - Independent alternatives
  - Mutually exclusive alternatives
  - Contingent alternatives
  - And the do noting alternatives

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Independent alternatives

- Are alternatives where the acceptance of one alternative does not ,in and of itself ,preclude the selection of the other alternatives
  - Example . Investing part of your surplus capital in heavy equipment does not preclude investing the remaining portion of your surplus capital in real estate development.
- Provided there is sufficient capital, you can invest in both of these alternatives

cont

Mutually Exclusive Alternatives

- Are alternatives where the acceptance of one of the alternative precludes investing in the other alternatives
- Example if your company needs to purchase a single backhoe and has narrowed the selection down to three backhoes. when your company purchase one of the backhoes, and the purchase of the second backhoe is no longer the an options

cont

Contingent Alternative

- Are alternatives that may be selected only after alternative has been selected .
  - Example if your company is looking purchase of a dump truck and as a second alternative purchasing a dumping trailer to be pulled the dup truck

The do noting alternative is simply another way of saying that all of the alternative have been rejected.

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- Decision are limited not only by the type of alternatives in the pool but also by external constraints
  - A common external constraint is the limited supply of capital
  - Another common external constraint is contractual obligation

Investment evaluation criteria

- The essential property of sound investment evaluation criteria is that it should maximize the shareholders wealth
- Evaluation criteria for choice:
  - All cash flows over the life of the project are to be considered
  - Criteria should be clear and the objective to separate a good project from bad one
  - Help in ranking the projects, according to their profitability
  - Should recognize the fact that bigger cash flows are preferable to smaller ones and the early cash flows are better than later ones

Investment Appraisal

- Investment proposals are evaluated from different dimensions:
  - ***Economic evaluation***
  - Social benefit
  - Environmental impact
  - Consistent with local and nation development plan
  - Others….
- Topic focus: ***Economic evaluation for investment appraisal***

Investment Appraisal (cont…)

- Important investment evaluation methods:
  1. *Payback period*
  2. *Present worth/ Net Present Value (NPV)*
  3. *INPV*
  4. *Future Worth*
  5. *Internal Rate of Return (IRR)*
  6. *Cost-Benefit Analysis*
  7. Cost-effective Analysis
  8. Multi-criteria Analysis
  9. Liner programming
  10. Dynamic Programming

1 The Payback Period

- Payback period is the expected number of years required to recover the original investment.
- It measures risk, not return.
- The shorter the payback period, the more desirable will be the project
- First the maximum acceptable payback period (n_{max}) is specified against which the calculated payback period (n) is compared.

Payback period without interest /Conventional – payback Method

- The payback period without interest compares alternatives based on how long it takes to pay back the initial cost.
- The payback period is determined by finding the first period when the sum of the net cash flows, both receipts and disbursements, to date is non-negative (Zero or positive)
- The pay back period without interest ignores the interest on the initial costs.

Payback period with interest/discounted –payback method

- The payback period with interest is the same as the payback period without interest, except it takes the time value of money into account when making the calculations.
- Compares alternatives based on how long it takes to pay back the initial costs including interest on the initial costs at the MARR.
- Determine at what point in time the present value of the nest cash flows (both cash receipts and disbursements) are equal to or greater than zero.

cont

- The formula for calculation of payback period ,when the cash inflows are constant

  Payback period = (initial investment/Annual cash inflow)

- In case of unequal cash inflows, the payback period can be found out by adding up the cash inflows until the total is equal to the initial cash outlay.

The Payback Period acceptance rule

If…	**It means…**	**Then…**
$n < n_{max}$	the investment would return the cost earlier than the expected time	The project may be accepted
$n > n_{max}$	the investment would return the cost later than expected time	The project should be rejected
$n = n_{max}$	The investment would return the cost exactly at the expected time	The project may be accepted but other evaluation method can also be used

Example 1

Q. For a Dozer purchased at a cost of $3.0*10^6$ birr determine the pay back period of the hourly rental rate is 900 birr/hr and the cost for fuel ,operation and maintenance is 158 birr/hr.

2 .Present Worth /The Net Present Value (NPV) Method

- Until the 1950s,the payback method was widely used as a means of making investment decisions.
- Then development of discounted cash flow techniques (DCFs),which take into account the time value of money .
- One of the DCFs is Net –Present –Worth (or net-present value) (NPV or PV)
- Standard method for the financial appraisal of long-term projects
- Used for capital budgeting, and widely throughout economics it measures the excess or shortfall of cash flows, in present value (PV) terms, once financing charges are meet.
- Indicator of how much value an investment or project adds to the value of the firm.
- These method recognize the cash flows, arising at different time periods, differs in value and comparable only when their present values are found out

Continued

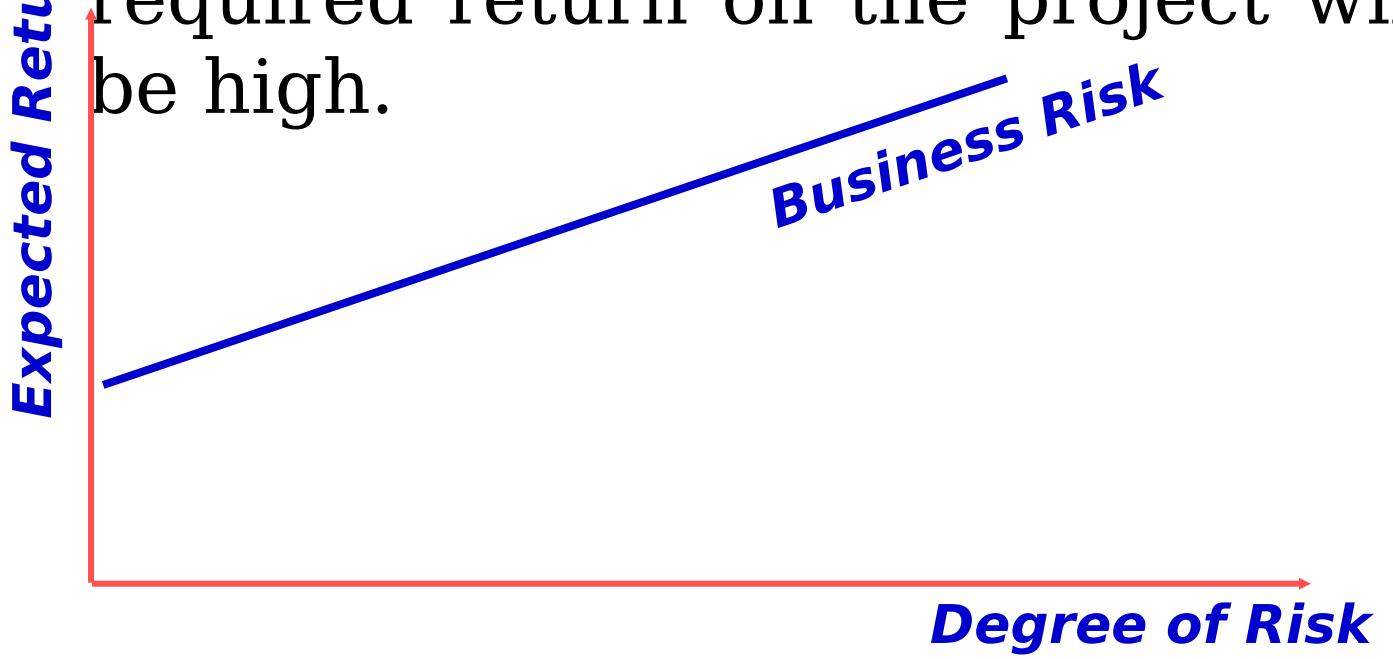
- Under PW criterion ,the present worth of all cash inflows associated with an investment project is compared with the present worth of all cash outflow associated with that project.
- The difference b/n the present worth of these cash flows referred to as the Net Present Worth (PW),determine whether the project is or is not an acceptable investment.

Important elements of present worth analysis.

- **Interest rate (i):** **This interest rate is often is referred to as either a required rate of return or a minimum attractive rate of return (MARR). Usually this selection is a policy decision made by top management. (it should not be less than Banks interest rate)**
- **Analysis Period:** **is the time span over which the economic effect of an investment will be evaluated**

interest

- It is appropriate to use higher discount rates to adjust for risk for riskier projects
- If a project offers a high risk, the required return on the project will also be high.



Analysis period

Case 1 **(analysis period equal with projects life)**

It is a simple analysis.

Case 2 **(Analysis period differs from projects life)**

- **projects life longer than Analysis period**

  we analyse each alternatives for the analysis period and are left with unused considered as salvage value.

- **Projects life shorter than Analysis period**

  Additional project to be replaced when the initial project has reached the limit of its useful life.

- **Analysis period coincide with longest projects life**

  Revenue projects with different lives can be compared if they require only one time investment.

Analysis period…

Case 3 **(When the analysis period is not provided)**

- **when the useful lives of the projects are equal.**

The analysis period is the useful life of the projects.

- **When the useful lives of the projects are different.**

The LCM of the useful lives of the alternative is considered as analysis period.

Net-Present –Worth Criterion For Evaluation of single project

- Step 1:Determine the interest rate that the firm wishes to earn on its investment. this interest rate is often referred to as either a required rate of return or a minimum attractive rate of return (MARR)
- Step 2: Estimate the service life of the project
- Step 3:Estimate the cash inflow for each period over the service life
- Step 4: Estimate the cash outflow for each period over the service life
- Step 5:determine the net cash flows for each period (Net cash flow= cash inflow-cash outflow)

Continued

- Step 6: Find the present worth of each net cash flow at the MARR. add up these present – worth .their sum is defined as the project's PW

$$PW(i) = \frac{A_0}{(1+i)^0} + \frac{A_1}{(1+i)^1} + \frac{A_2}{(1+i)^2} + \cdots + \frac{A_N}{(1+i)^N}$$

$$= \sum_{n=0}^{N} \frac{A_n}{(1+i)^n}$$

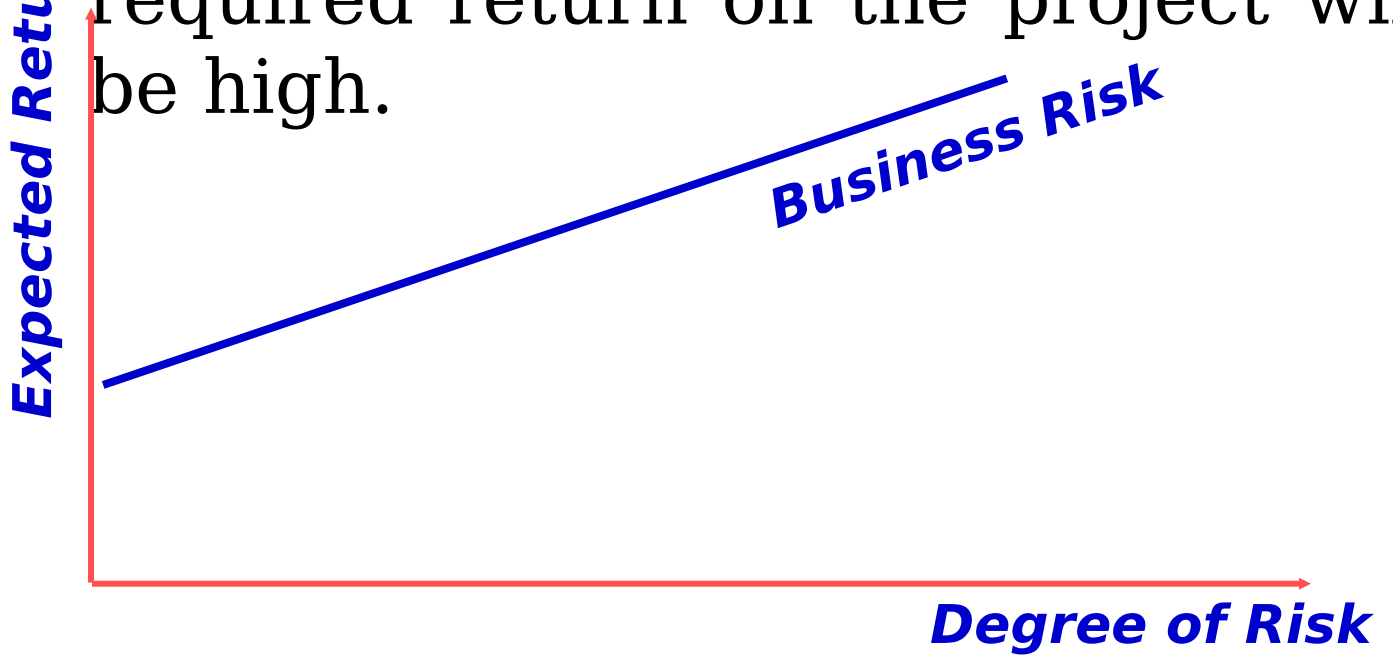
$$= \sum_{n=0}^{N} A_n(P/F, i, n),$$

Step 7:Acceptance rule

If…	**It means…**	**Then…**
NPV > 0	The investment would add value to the firm	The project may be accepted
NPV < 0	The investment would subtract value from the firm	The project should be rejected
	The	We should be indifferent in the decision whether to accept or reject the project. This project

NPV (cont…)

- It is appropriate to use higher discount rates to adjust for risk for riskier projects
- If a project offers a high risk, the required return on the project will also be high.



Example 1

A building contractor signed a lump sum contract agreement. The terms of payments were as follows

i. 2 *10^6 birr immediately
ii. 3*10^6 every year for five years (effective from the 1st year on wards)
iii. 2.5*10^6 every year there after for five years

If i = 10% ,how much is the contract value ?ANS =27.26*10^6 birr

Example 2

Q1_Two mutually exclusive alternative are being considered for the water supply of small town with a constant water demand of $2*10^6$ M^3 /yr for 20 yrs. both alternatives are equally attractive from the technical ,social and political point of view

Alternative A:

- The water can be supplied by a neighboring town at a price of 0.40 birr/M^3

Alternative B

- water can be supplied from wells and will be treated and transported to town. This requires a total investment of $5.5*10^6$ birr .The investment will have value of $1*10^6$ birr at the end of 20yr period .annual maintains and operation cost are 260,000 birr and remain constant during the 20yrs.

Which alternatives is more attractive ?

-10.87 & -9.5

Example 3.1

Q. Your company need to purchase a dump truck and has narrowed the selection down to two alternatives .

- The 1st alternative is to purchase anew dump truck for 65,000 birr. at the end of the seventh year the salvage value of the new dump truck is estimated to be 15,000birr.
- The second alternative is to purchase used dump truck is estimated to be 50,000birr.at the end of fourth year the major maintenance is estimated to be 20,000 birr. the annual profit ,revenues less operation cost are 17,000 per year for either truck using MARR of 18% and Seven –year study period

  Calculate the Net present Value for each of the dump trucks ,which truck should your company purchase ?

Example 3.2

Q. Your company need to purchase a dump truck and has narrowed the selection down to two alternatives .

- The 1st alternative is to purchase anew dump truck for 65,000 birr. at the end of the fourth year estimated book value of the new dump truck is 40,000 birr
- The second alternative is to purchase used dump truck is estimated to be 50,000birr.at the end of fourth year the salvage value of the used dump truck is estimated to be 5,000 birr. the annual profit ,revenues less operation cost are 17,000 per year for either truck using MARR of 18% and Four –year study period

  Calculate the Net present Value for each of the dump trucks ,which truck should your company purchase ?

Example 3.3

Q. Your company need to purchase a dump truck and has narrowed the selection down to two alternatives .

- The 1st alternative is to purchase anew dump truck for 65,000 birr. at the end of the seventh year the salvage value of the new dump truck is estimated to be 15,000birr.
- The second alternative is to purchase used dump truck is estimated to be 50,000birr.at the end of fourth year the salvage value of the used dump truck is estimated to be 5,000 birr. the annual profit ,revenues less operation cost are 17,000 per year for either truck using MARR of 18%

  Calculate the Net present Value for each of the dump trucks ,which truck should your company purchase ?

Example 4

- For the two equipment shown below in table ,the following cash flow is developed .the operating cost of equipment B is 168,000 birr Per annum through out its life .equipment A has an operating cost of 140,000for the first 5 yr and 224,000 for the remaining 4 years .w/h equipment would you economically acceptable ? Use i =8%

	Equipment A	Equipment B
Initial cost	840,000	630,000
Salvage value	63,000	105,00
Service life	9yrs	6yrs

Example:5

- It is required to excavate 400,000 tons of soil. A contractor is given the assignment to finish the job in two years. The contractor wanted to do the job with excavators. He found two models of excavator with different service life and cost. **Model A** costs 1,290,000birr and has a life of 6000 hrs before overhaul. Operation costs 344,000birr/yr for 2000hrs.at this rate it will serve for 3yr with a salvage value of 215000birr.Model B 2,064,000 birr and has a life of 12000 hrs before overhaul. It has an operation cost of 193500 birr for 2000hrs of operation per year. Its has total life of 6yr with a salvage value of 258,000birr.to finish in two years, both models requires two pieces of equipment. which option is the best for the two years operation if i=15%

Example 6

- An investor wants to establish a construction company. In order to do that he purchased land at n=o, for $1.5*10^6$ birr. The building and garage requires $3*10^6$ million birr, which is completed in one year. As soon as this is ready, end of first year, equipments worth of $4*10^6$ are purchased to start up.
- During the 1^{st} operating year a revenue of $3.5 *10^6$ birr is obtained. This revenue increases at 5% per year from the previous year for the next 9 yrs.
- After 10 yrs the revenue remained constant for 3 yrs and the company phased out.
- The salvage value at the end its 13 years service life is
  - $2 * 10^6$ for land
  - $1.4 * 10^6$ for building
  - $0.5 * 10^6$ for equipment
- Annual operating and maintenance costs are about 40% of revenue each year. If the investor's MARR= 15%, is this a good investment?

Capitalized –Equivalent Method

- A special case of the PW criterion is when useful life of a proposed project is Perpetual or the planning horizon is extremely long .
- Many public projects such as bridges ,waterway construction ,irrigation systems, and hydroelectric dams are expected to generate benefit over an extended period of time (or forever)
- We use capitalized –equivalent (CE(i)) method for evaluating such project

Equation

- CE(i) = A(P/A,i, ∞)
  = A/i

Present –worth factor as N approaches infinity

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

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

$$PW(i) = A(P/A.i.N \to \infty) = \frac{A}{i}.$$

Example

- Maintenance money for new building is to be deposited now. the expected cost estimated is as follows:
  a) 40,000 per year for the first 5yr
  b) 50,000 per year from year 6-10
  c) 60,000 per year perpetually there after

1. If i=13%,how large shall be deposited
2. What is the perpetual equivalent annual cost?

3.Incremental Net Present Value

- This method is another way to select between mutually exclusive alternatives with different initial costs.
- The initial cost is the cash disbursements in year 0.
- The incremental net present value compares two alternative at a time .
- The alternative with the higher initial cost is compared to the alternatives with the lower initial cost based on the net present value of the difference in the cash receipts and disbursements for the two alternatives.

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- If the INPV is Positive ,purchase the more expensive alternative
- If INPV Zero ,both investment is equally attractive
- If INPV is negative ,is financially attractive to purchase the leases expensive piece of equipment

Step -INPV

- Rank all of the alternatives in order of initial cost from lowest to highest
- Identify the alternatives with the lowest initial cost as the current best alternative.
- Compare the current best alternatives with the alternatives with the next higher initial cost based on the incremental net present value of the difference in the cash receipts and disbursements for the two alternatives
- If the INPV is zero or negative ,the current best alternative remains the current best alternative and the competing alternative is eliminated from consideration .
- If the INPV is positive ,the competing alternative becomes the current best alternative and the former current best alternative is eliminated from consideration .
- The process is repeated until all alternatives have been compared .
- The current best alternative at the end of the comparison becomes the selected alternative

Example -

- Your company is looking at purchasing anew front – end loader and has narrowed the choice down to four loaders. the purchase price ,annual profit, and salvage value at the end of five years for each of the loaders is found in table .which front-end loader should your company purchase based on the incremental net present values using MARR of 20% and a useful life of five years?

Cash flow	Loader A	Loader B	Loader C	Loader D
Purchase Price	110,000	127,000	120,000	130,000
Annual profit	37,000	43,000	40,000	44,000
Salvage value	10,000	13,000	12,000	13,000

4.Future worth

- The future worth method compares alternatives based on their future values at the end of the study period
- FW is calculated by determining the equivalent value of the cash receipts and disbursements at the end of the study period
- If the FW is positive ,the alternative produces a return greater than the MARR
- If the FW is Zero ,the alternative produces a return equal to the MARR
- If the FW is negative ,the alternative produces a return less than the MARR

Example:1

- Your company is looking at purchasing the front –end loader at cost of 120,000 birr. the loader would have a useful life of five years a salvage value of 12,000 at the end of the fifth year. the loader can be billed out at 95.00 birr per hour. it cost 30.00 per hour to operate the front –end loader and 25.00 per hour for the operator. using 1,200 billable hours per year determine the future worth for the purchase of the loader using a MARR of 20% .should your company purchase the loader

Example:2

- A construction company is considering the purchase of one of the two new front end loaders whose data are listed below.

25,886 &32,050

	Front End Loader A	Front end loader B
First cost (Birr)	-100,000	-40,000
Annual net income	+16,000	+13,00
Useful Life (yrs)	10	5
Replacement cost escalation	NA	10%/yr compounded
Salvage Value	+10,000	+10,000
Interest rate (%)	8	8

Annual Equivalent (reading assignment)

- The annual equivalent method compares alternatives based on their equivalent annual receipts less the equivalent annual disbursements.
- In this method we can calculate the unit profit/loss, that we incur in operating machine
- The annual equivalent is calculated by converting the cash receipts and disbursements into a uniform series of annual cash flow occurring over the study period using
- AE(i) = PW(i)(A/P, i, N)

Evaluating a single project

- The accept –reject decision rule for a single revenue project is
  - If AE (i)> 0,accept the investment
  - If AE (i) =0 ,remain indifferent to the investment
  - If AE (i) < ,reject the investment

Example 1

- If one purchase a vibrator and the NPV=4000birr.if the vibrator works for 2000hrs per year and has a life span of 3yr
  a) find the hourly equivalent worth of the vibrator
  b) If it operates for 1500,2500 & 2000hrs during the 1^{st},2^{nd}, &3^{rd} years ,calculate the equivalent hourly worth i=10%

Internal Rate of Return (IRR)

- Is the discount rate that equates the present value of the project's expected cash inflow's to the present value of the project's costs.
- Which takes into account the magnitude of and timing of cash flow

  PV inflows = PV investment costs

  IRR is a rate that brings NPV=0
- The time schedule of accuracy of the future cash flow is known ,but the discount rate is not known.
- The discount rate is ascertained by the trial and error method, where the present value of future inflow is equal to the present value of out flows, which is known as Internal Rate of Return

Return on investement

- Definition – rate of return is the interest earned on the unpaid balance of an amortized loan.
- example – suppose that a bank lends 10,000,which is repaid in installments of 4,021 at the end of each year for three years. How would you determine the interest rate that the bank charges on this transaction?

- Definition 2- Rate of return is the break –even interest rate i at which the present worth of proejct is Zero or
- PW(i) = PW cash inflow –PW cash outflows=0 Or

$$PW(i^*) = \frac{A_0}{(1+i^*)^0} + \frac{A_1}{(1+i^*)^1} + \cdots + \frac{A_N}{(1+i^*)^N} = 0.$$

Calculate rate of return

- To calculate rate of return on investment, we must convert the various consequence of the investment into a cash flow. Then we will solve the cash flow for the unknown value of the internal rate of return (IRR)
  - PW of benefit –PW of costs =0
  - PW of benefit/ PW of costs =1
  - Net present worth =0
  - PW of costs =PW of benefit
  - AE of benefit –AE of cost =0

Computational methiod

- Methods
  - Direct –solution method
  - Trial –and –error method
  - Excel Method

Acceptance rule for evaluating a single project

- In order to take a decision about the acceptance or rejection of the project ,the IRR is to be compared with required rate of return.(cut of rate)
- If IRR is lower than the cut-off rate ,the project would be **rejected**, and if IRR is grater than the cut –off rate ,the project would be **accepted**.

  IRR < MARR ,reject the project

  IRR>MARR, accept the project.
- In case IRR is equal to required rate of return ,the project may be accepted or rejected.

  IRR =MARR

Example :Direct –solution method

- Consider the f.f cash flow
-

N	A	B
0	-8000	-16,000
1	0	+10,400
2	0	+12,000
4	+12,000	

Trial and Error approach

- Assume (i) and compute PW (i)-

  if PWi > 0 –increase i

  if PW i < 0-decrease i

Evaluating Mutually Exclusive Projects

- When we have to compare mutually exclusive investment projects, we need to apply the incremental analysis approach.

Incremental analysis approaches

- Example- when alternative are two

Let MARR =10%

Yr	A	B	B-A
0	-3,000	-12,000	-9000
1	1350	4200	2800
2	1800	6225	4425
3	1500	6330	4830
IRR	25%	17.43%	15% -Alt B is selected

- Selection Criterion:-
  - ✓ IRR (B-A) >MARR –Select B
  - ✓IRR (B-A) < MARR-select A
  - ✓IRR (B-A) =MARR –select either

Example -When alternative are above two

Yr	A	B	C	B-A	C-B
0	-1000	-1000	-2000	0	-1000
1	900	600	900	-300	300
2	500	500	900	0	400
3	100	500	900	400	400
4	50	100	900	50	800
	MARR 10%			i=21%>10 % B is better	i=26.36%>10% C is the choice

EVALUATION OF PUBLIC PROJECTS – DISCUSSION ON BENEFIT COST RATIO

The Cost Benefit Ratio (CBR)

- It is similar to NPV in the way one compares the value added.
- Compares the value added per the cost incurred and used to evaluate projects of different sizes.

$$CBR = \frac{\sum_{t=1}^{n} B_t (1+r)^{-1}}{\sum_{t=1}^{n} C_t (1+r)^{-1}}$$

- In all the preceding discussions we focused our attention on private projects, where the objective was to maximize the profits while adhering to the contractual requirements of the projects
- The objective of public projects is to provide goods/services to the public at the minimum cost.

- The benefit accrued from such projects should at least recover the cost of the projects.
- Public projects here mean those funded by Government (State or Centre). The Government has a responsibility towards public welfare.

- Many Government projects cannot be evaluated strictly in commercial terms. Profit, taxes, payoff periods take a back seat in public projects unlike private projects.
- The resources of the Government however large are also limited and it has to choose between different alternative based on some criterion.

Objectives

- To check the viability of the project economically
- To select the most viable project from a set of economically viable projects
- To rank or order the economically viable alternatives for a given situation

- One of the most commonly used criteria to evaluate public projects is Benefit-Cost Ratio (B/C).
- B/C ratio is defined as the ratio of benefit to public and cost to the Government.
- . B-C ratio can be obtained using any one of the PW analysis, FW Method, AE method

- Due care is required to determine the numerator & denominator, since some confusion may arise in a problem
- However if the definition is clearly understood the ratio can be correctly obtained
- When comparisons of several alternatives are to be made, basis of incremental analysis should be made

- B/C ratio of more than one indicates that benefit outweighs cost and thus the investment is justifiable
- B/C of 1.5 means that each birr in costs yields 1.5 . in benefits over the life time of the project.
- B/C ratio of less than one indicated that benefit accrued from the project is less than the cost required to be invested and thus the investment is not justifiable.

- B/C analysis per se does not select an alternative however it is a useful tool to simply distinguish between an acceptable and unacceptable alternative.
- B/C criterion is designed to rank or order the project
- It sets only a minimum level of acceptability and does not pretend to identify the source of investment funds
- Basically it develops information useful for the purpose of decision making depending on the availability of investment funds, capital rationing and the special features of social merit and economic objectives.

Benefit/Cost Criteria

- Minimum investment
- Maximum benefit
- Aspiration level
- Maximum advantage of benefits over cost (B-C)
- Highest B/C Ratio
- Largest investment that has a benefit/cost ratio greater than 1
- Maximum incremental advantage of benefit over cost $\Delta B - \Delta C$
- Maximum incremental benefit/cost ratio $\Delta B/\Delta C$
- Largest investment that has an incremental B/C ratio greater than 1.0

- Analysis of several mutually exclusive road way alignments yield the following information. (i=7%)

	Alternative A	Alternative B	Alternative C
Annual benefit	375,000	460,000	500,000
Annual cost	150,000	200,000	250,000
B/C	2.5	2.3	2.0

- Solution
- Comparison of A&B
- > 1, Discard A(the defender) and accept B (the challenger) temporally

$$B/C = \frac{460{,}000 - 375{,}000}{250{,}000 - 200{,}000} = \frac{85{,}000}{50{,}000} = 1.7$$

- Comparison of C and B
- Discard the challenger C
- Therefore, B is the better alternative even though the benefit cost ratio is less than that of A. Alternative A offers a greater benefit for the total expenditure.

$$B/C = \frac{500{,}000 - 460{,}000}{250{,}000 - 200{,}000} = \frac{40{,}000}{50{,}000} = 0.8$$

Example

- A Government is planning for a hydro-electric project which will also provide flood control, irrigation & recreation benefits. The established benefits & cost of three alternatives are given in the following Table. The interest rate to be used for the analysis is 5% and the life of each of the alternatives X, Y, and Z is to be assumed as 50 years. Choose the best alternative

All values in million of Rs.

Alternatives	X	Y	Z	
Initial cost	250	350	500	
Annual Power sale	10	12	18	
Annual Flood control	2.5	3.5	5	
Annual Irrigation benefit	3.5	4.5	6	
Annual Recreation benefits	1	2	3.5	
Annual Operation & Maintenance	2	2.5	3.5	

Computation of B/C using Annual Cost/worth analysis

Annual cost C computation	X	Y	Z
Annual cost equivalent = P x (A/P, 5%, 50)	250 x 0.0548 = 13.7	350 x 0.0548 = 19.18	500 x 0.0548 = 27.4
Operation & Maintenance cost	2	2.5	3.5
Receipt on power sales	-10	-12	-18
Total annual cost equivalent	5.7	9.68	12.9
Annual Benefit B Computation			
Annual Flood control	2.5	3.5	5
Annual Irrigation benefit	3.5	4.5	6
Annual Recreation benefits	1	2	3.5
Total benefit	7	10	14.5
B/C Ratio	1.23	1.03	1.12

- B/C of the three alternatives is more than 1 and thus all the above alternatives are economically viable.

identify the best alternative

Annual cost C computation	Y-X	Z-X	
Annual cost equivalent = P x (A/P, 5%, 50)	100 x 0.0548 = 5.48	250 x 0.0548 = 13.7	
Operation & Maintenance cost	0.5	1.5	
Receipt on power sales	-2	-8	
Total annual cost equivalent	3.98	7.2	
Annual Benefit B Computations			
Annual Flood control	1	2.5	
Annual Irrigation benefit	1	2.5	
Annual Recreation benefits	1	2.5	
Total benefit	3	7.5	
B/C Ratio	3/3.98 = 0.75	7.5/7.2= 1.04	
Remarks	B/C <1 Reject Y	B/C>1 Accept Z	

Example

- Two machine are being considered for purchase .assume 10% interest, which machine should be bought ?

Machine x

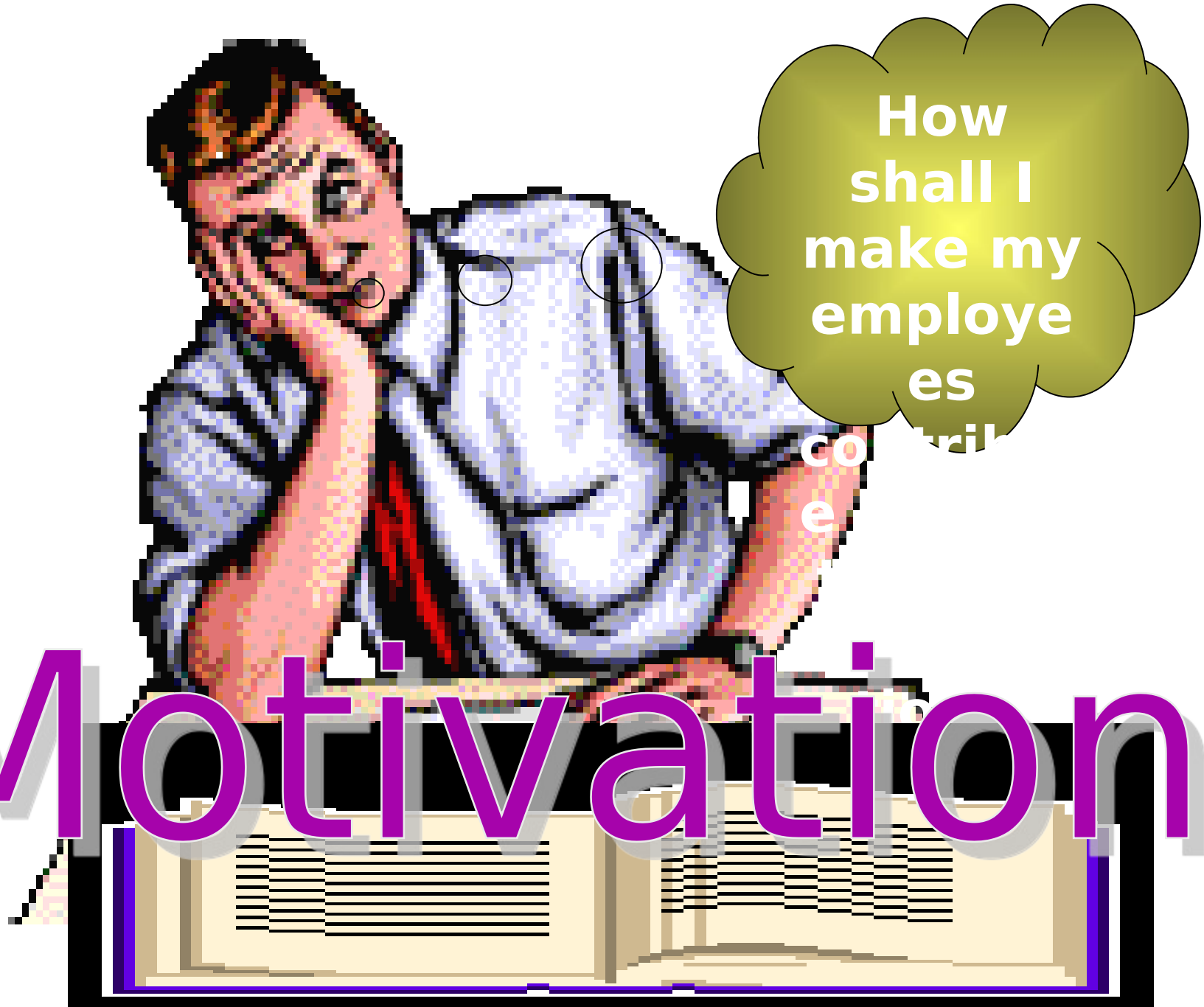
- initial cost =200
- Uniform annual benefit =95
- Salvage value =50
- Useful life, in year =6

Machine y

- initial cost = 700
- Uniform annual benefit =120
- Salvage value =150
- Useful life, in year =12



END



Motivation



Thank You Very Much!

The End