PROJECT SELECTION

Lecture in the
CS6022 – Software Project Management

Dr.R.BASKARAN
Professor
baaski@annauniv.edu

Department of Computer Science and Engineering,
Anna University, Chennai – 600 025.

01

NUMERIC MODELS

- The numeric selection models presented here may be sub-divided into financial models and scoring models.
- The financial models are:
  - **Pay back period**
  - **Return on investment** (IOR)
  - **Net Present Value** (NPV)
  - **Internal rate of return (IRR)**

PAY BACK PERIOD

- The payback period is the time taken to gain a financial return equal to the original investment. The time period is usually expressed in years and months.
- Consider this example, where a company wishes to buy a new machine for a four year project.
  - The manager has to choose between **MACHINE A** or **MACHINE B**, so it is a mutually exclusive situation.
  - Although both machines have the same initial cost ($35,000) their cash-flows perform differently over the four year period.

Year	Cash-Flow Machine A	Cash-Flow Machine B
0	($35,000)	($35,000)
1	$20,000	$10,000
2	**$15,000**	$10,000
3	$10,000	**$15,000**
4	$10,000	$20,000
Payback period	**2 years**	**3 years**

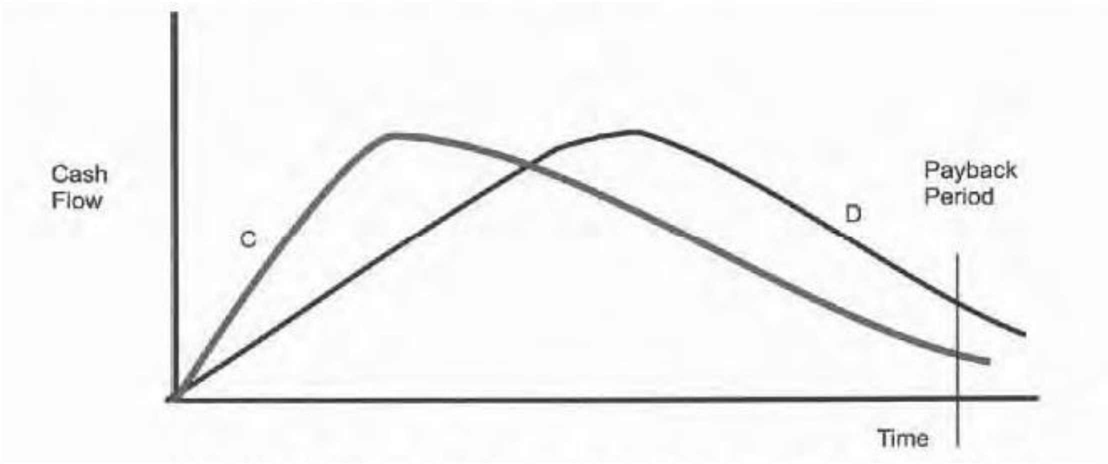
Payback Period (Machine **A** ***2*** years, Machine B **3** years)

PAY BACK PERIOD

- Machine **A** will recover its outlay one year sooner than machine B.
- Where project's are ranked by the shortest payback period, machine A is selected in preference to machine B.
- advantages of the payback method are:
  - It is simple and easy to use.
  - It uses readily available accounting data to determine cash-flows.
  - It reduces the project's exposure to risk and uncertainty by selecting the project that has the shortest payback period.
  - The uncertainty of future cash-flow is reduced.
  - It is an appropriate technique to evaluate high technology projects where the technology is changing quickly and the project could run the risk of being left holding out of date stock.
  - It is an appropriate technique for fashion projects where the market demand tends to change seasonally.
  - Faster payback has a favorable short-term effect on earnings per share.
  - The payback period quantifies the selection criteria in terms the decision-makers are familiar with.

PAY BACK PERIOD

- **Disadvantages** of the payback period calculation are:-
  - It does not consider the time value of money.
  - The payback period is indifferent to the timing of the cash-flow.
  - The project with a high, early income (cash in flow) would be ranked equally with a project which had late income if their payback periods were the same.

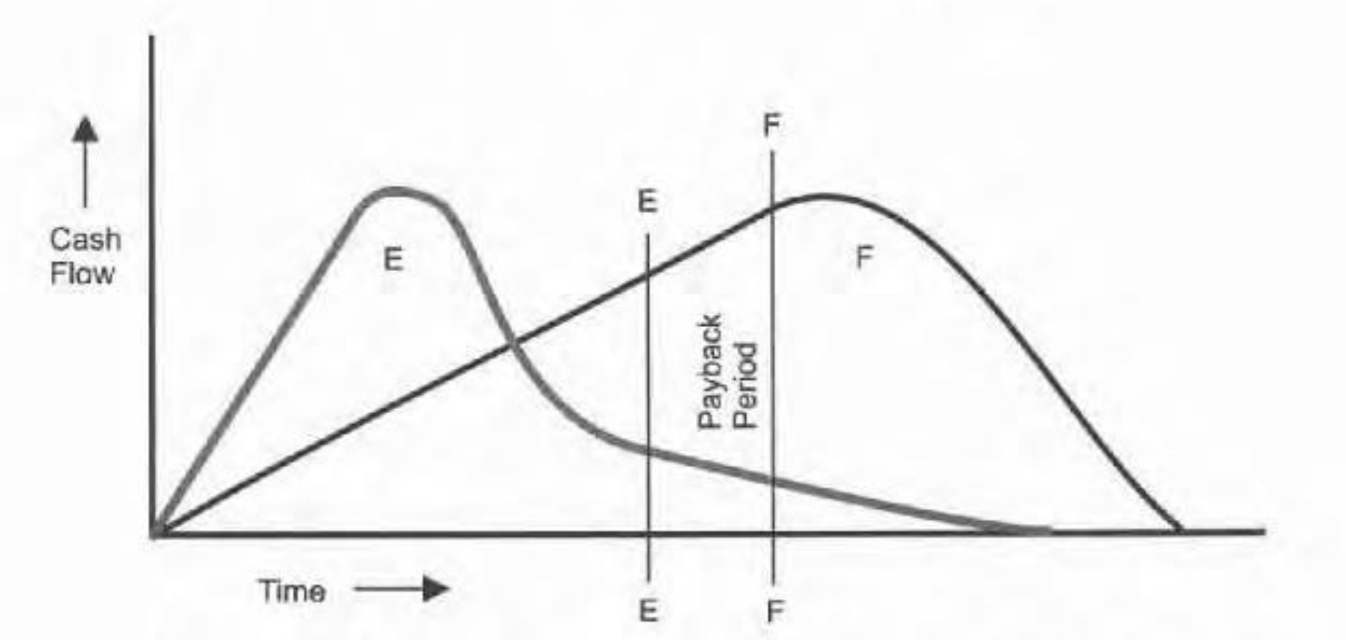


Payback Period (project **C** and project D have the same payback period even though their cash-flows are different)

OBSERVATION: The payback period calculation does not look at the total project.

PAY BACK PERIOD

- Project that built up slowly to give excellent returns (project F) would be rejected in favor of project E with lower early returns if the payback period was shorter.



Payback Period (does not consider the cash-flow after payback period. In this case project F may be a better option even though project E has a shorter payback period)

- It is not a suitable technique to evaluate long term projects where the effects of differential inflation and interest rates could significantly change the results.
- The figures are based on project cash-flow only. All other financial data are ignored.
- Although payback period would reduce the duration of risk, it does not quantify the risk exposure.

RETURN ON INVESTMENT (ROI)

$$\text{Average Annual Profit} = \frac{\text{(Total gains) - (Total outlay)}}{\text{Number of years}}$$

$$\text{Return on investment} = \frac{\text{Average Annual Profit}}{\text{Original investment}} \times \frac{100}{}$$

Year	Cash-flow Machine A	Cash-Flow Machine B
0	($35,000)	($35,000)
1	$20,000	$10,000
2	$15,000	$10,000
3	$10,000	$15,000
4	$10,000	$20,000
Total gains	$55,000	$55,000

Profit (A & B) = $55,000 - $35,000

Annual Profit $= \frac{\$20{,}000}{4\text{ yrs}} = \$5{,}000$ per year (same for both machines)

Return on investment $= \frac{\$5{,}000}{\$35{,}000} \times \frac{100}{1} = 14\%$

DISCOUNTED CASH-FLOW (DCF)

- The discounted cash-flow (DCF) technique takes into consideration the time value of money, for example, a \$100 today will not have the same worth or buying power as a \$100 this time next year.
- There are two basic DCF techniques which can model this effect, Net present value (NPV) and Internal rate of return (IRR).

Net Present Value (NPV) :

- If we invest \$100 at 20% interest, after one year it will be worth \$120 and after two years compounded it will be worth \$144. Now NPV is the reverse of compound interest.
- If you were offered \$120 one year from now and the inflation and interest rate was 20%, working backwards its value in todays terms would be \$100. This is called the PRESENT VALUE and when the cash-flow over a number of years is combined in this manner the total figure is called the Net Present Value (NPV).

Years	Project Cash-Flow	Discount Factor	Present Value
0			
1			
2			
3			
Total			NPV

Project cash-flow = income - expenditure
Present value = discount factor x cash-flow

Department of Computer Science and Engineering,
Anna University, Chennai – 600 025.

NET PRESENT VALUE (NPV)

The discount factor is derived from the reciprocal of the compound interest formula.

Discount factor = $1 / (1 + i)^n$

where i = the forecast interest rate

n = the number of years from start date

Years	10%	11%	12%	13%	14%	15%	16%	17%
1	0.9091	0.9009	0.8929	0.885	0.8772	0.8696	0.8621	0.8547
2	0.8264	0.8116	0.7972	0.7831	0.7695	0.7561	0.7432	0.7305
3	0.7513	0.7312	0.7118	0.693	0.675	0.6575	0.6407	0.6244
4	0.683	0.6587	0.6355	0.6133	0.5921	0.5718	0.5523	0.5337
5	0.6209	0.5935	0.5674	0.5428	0.5194	0.4972	0.4761	0.4561

Years	18%	19%	20%	21%	22%	23%	24%	25%
1	0.8475	0.8403	0.8333	0.8264	0.8197	0.813	0.8065	0.80
2	0.7182	0.7062	0.6944	0.683	0.6719	0.661	0.6504	0.64
3	0.6086	0.5934	0.5787	0.5645	0.5507	0.5374	0.5245	0.512
4	0.5158	0.4987	0.4823	0.4665	0.4514	0.4369	0.423	0.4096
5	0.4371	0.419	0.4019	0.3855	0.37	0.3552	0.3411	0.3277

NET PRESENT VALUE (NPV)

- insert the cash-flow
- transfer the discounting factors from the table
- calculate present value - multiplying cash-flow by discount factor
- aggregate the present values to give the NPV (see tables 5 and 6).

Machine A – NPV for Discount factor of 20%

Column (1)	Column (2)	Column (3)	= (2) x (3)
Years	Project Cash-Flow	Discount Factor 20%	Present Value
0	($35,000)	1	($35,000)
1	$20,000	0.8333	$16,666
2	$15,000	0.6944	$10,416
3	$10,000	0.5787	$5,787
4	$10,000	0.4823	$4,823
Total NPV			$2,692

Machine B – NPV for Discount factor of 20%

Column (1)	Column (2)	Column (3)	= (2) x (3)
Years	Project Cash-Flow	Discount Factor 20%	Present Value
0	($35,000)	1	($35,000)
1	$10,000	0.8333	$8,333
2	$10,000	0.6944	$6,944
3	$15,000	0.5787	$8,681
4	$20,000	0.4823	$9,646
Total NPV			($1,396)

NET PRESENT VALUE (NPV)

- The advantages of using **NPV** are:

  It introduces the time value of money.

  It expresses all future cash-flows in today's values, which enables direct comparisons.

  It allows for inflation and escalation.

  It looks at the whole project from start to finish.

  It can simulate project what-if analysis using different values.

  It gives a more accurate profit and loss forecast than non DCF calculations.

- The disadvantages are:-

  Its accuracy is limited by the accuracy of the predicted future cash-flows and interest rates.

  It is biased towards short run projects.

  It excludes non financial data e.g. market potential.

  It uses a fixed interest rate over the duration of the project. The technique can, however, accommodate a varying interest rate.

  OBSERVATIONS: Although NPV quantifies the profit this is expressed in absolute terms. Managers tend to prefer profitability expressed as a percentage.

Department of Computer Science and Engineering,
Anna University, Chennai – 600 025.

INTERNAL RATE OF RETURN (IRR)

- The internal rate of return is also called DCF **yield** or DCF return **on** investment.
- The IRR is the value of the discount factor when the NPV is zero.
- The IRR is calculated by either a trial and error method or plotting NPV against IRR.

Consider **Machine A** first, to reduce the NPV increase the discounting factor in small steps until NPV becomes negative:

Column (1)	Column (2)	Column (3)	= (2) x (3)
Years	Project Cash Flow	Discount Factor 22%	Present Value
0	($35,000)	1	($35,000)
1	$20,000	0.8197	$16,394
2	$15,000	0.6719	$10,079
3	$10,000	0.5507	$5,507
4	$10,000	0.4514	$4,514
Total NPV			$1,494

Machine A - Discount Factor 22% (The NPV is still positive, therefore increase the DF by 2%)

Column (1)	Column (2)	Column (3)	= (2) x (3)
Years	Project Cash-Flow	Discount Factor 24%	Present Value
0	($35,000)	1	($35,000)
1	$20,000	0.8065	$16,130
2	$15,000	0.6504	$9,756
3	$10,000	0.5245	$5,245
4	$10,000	0.423	$4,230
Total NPV			$361

Machine A - Discount Factor 24% (The NPV is still positive, therefore increase the DF by 2%)

Machine A - Discount Factor 25% (NPV is now negative, therefore **IRR** must lie between 24% and 25%)

INTERNAL RATE OF RETURN (IRR)

Department of Computer Science and Engineering,
Anna University, Chennai – 600 025.

- Machine B the NPV is already negative at 20%, so decrease the discounting factor until NPV becomes positive - try 18%to start with.

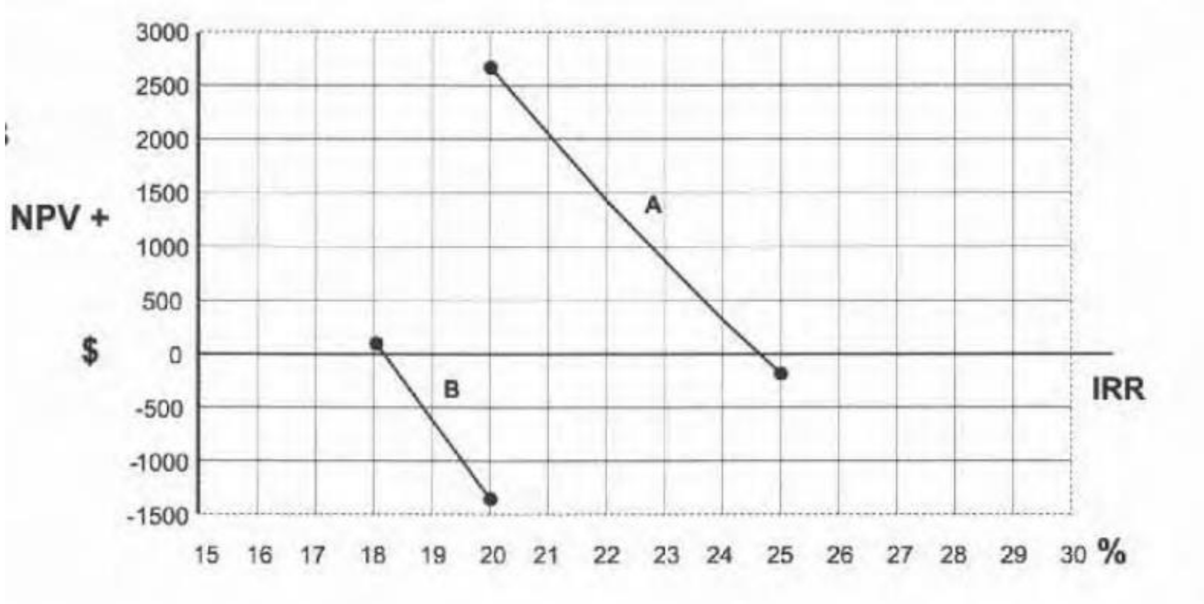
Column (1)	Column (2)	Column (3)	= (2) x (3)
Years	Project Cash-Flow	Discount Factor 18%	Present Value
0	($35,000)	1	($35,000)
1	$10,000	0.8475	$8,475
2	$10,000	0.7182	$7,182
3	$15,000	0.6086	$9,129
4	$20,000	0.5158	$10,316
Total NPV			$102

Column (1)	Column (2)	Column (3)	= (2) x (3)
Years	Project Cash-Flow	Discount Factor 19%	Present Value
0	($35,000)	1	($35,000)
1	$10,000	0.8403	$8,403
2	$10,000	0.7062	$7,062
3	$15,000	0.5934	$8,901
4	$20,000	0.4987	$9,974
Total NPV			($660)

- The IRR for machine B must lie between 18% and 19%.

INTERNAL RATE OF RETURN (IRR)

Interest Rate	NPV Machine A	NPV Machine B
18%	-	$102
19%	-	($660)
20%	$2,692	($1,396)
21%	-	-
22%	$1,494	-
23%	-	-
24%	$361	-
25%	($184)	-



The IRR analysis is a measure of the *return on investment,* therefore, select the project with the highest IRR.

Drawback: One of the limitations with IRR is that it uses the same interest rate throughout the project, therefore as the project's duration extends this limitation will become more significant.

NET PRESENT VALUE (NPV) USING VARIABLE INTEREST RATES

Year	Cash Flow	Interest Rate	Compound Interest	Discount Factor Yearly	Total Discount Factor	Present Value
1	100	10%	110	0.9091	0.9091	100
2		20%	132	0.8333	0.7576	100
3		15%	152	0.8696	0.6588	100

SCORING MODELS

- In an attempt to broaden the selection criteria a scoring model called the factor model which uses multiple criteria to evaluate the project will be introduced.
- The factor model simply lists a number of desirable factors on a project selection proforma along with columns for Selected and Not Selected.

Factors	Select	Do not select	Weighting
Profit > 20%	x		
Enter new market		x	
Increase market share	x		
New equipment required		x	
Use equipment not being utilised	x		
No increase in energy requirements	x		
No new technical expertise required	x		
Use underutilised workforce	x		
Manage with existing personnel		x	
No outside consultants required		x	
No impact on workforce safety	x		
No impact on environmental issues		x	
Payback period < 2 years	x		
Consistent with current business	x		
Offer good customer service	x		
Total	10	5	

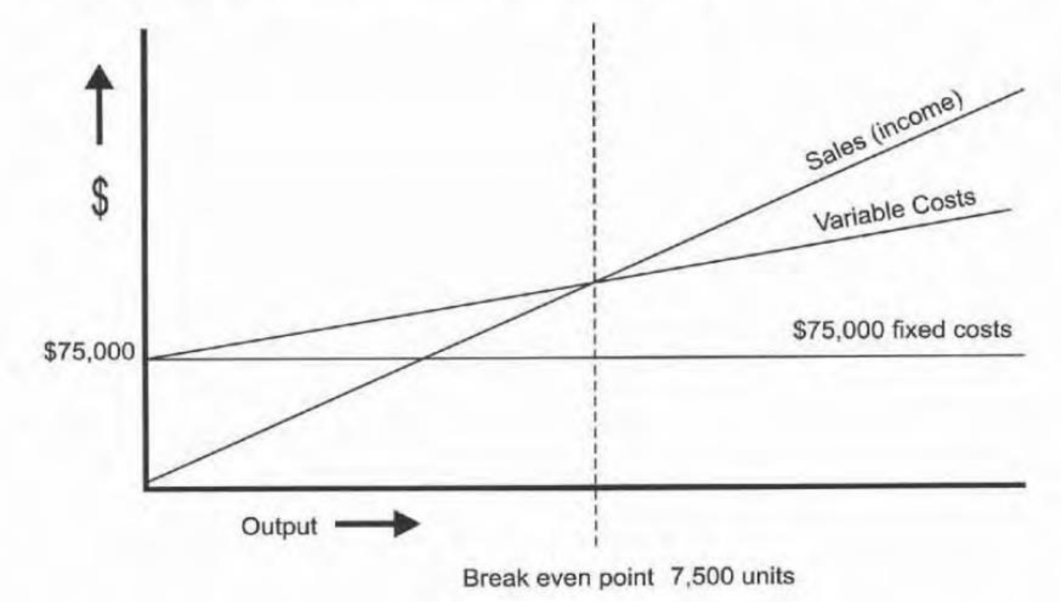
The factors can be weighted simply 1 to 5 to indicate; 1 "very poor", 2 "poor", 3 "fair", 4 "good" and 5 "very good".

Three, seven and ten point scales can also be used.

COST BREAK-EVEN ANALYSIS

- To model how the costs change with increasing production and determine the break-even point.
- Example: A company makes a product which sells for $15 each. The variable cost per unit is $5, this covers labor and material, leaving $10 per unit as a contribution towards fixed costs. The fixed costs total is $75,000 per annum, which covers all the overhead costs. The break-even point is reached when the contribution equals the fixed costs.

$$\text{Break-even point} = \frac{\text{Fixed costs}}{\text{Contribution per unit}} = \frac{\$75{,}000}{\$10} = 7{,}500 \text{ units.}$$



THANKS!

BASKARAN RAMACHANDRAN
baaski@annauniv.edu