Project Cost Management

Guide to Mathematical Questions

Payback Period and Life Cycle Cost

- Payback Period
  - Number of years required for an organization to recapture an initial investment
  - Discount rate is not taken into account in payback period calculations
  - Project selection criterion: Select a project with a shorter payback period

  Example: There are 2 projects. Project A has an investment of $ 500,000 and payback period of 3 years. Project B has an investment of $ 300,000 and payback period of 5 years. Using the payback period criterion, which project will you select?

  Answer: Project A will be selected. (The fact that project B has a lower investment than project A will not impact the selection.)

- Life Cycle Cost
  - The overall estimated cost of a particular project alternative over the time period corresponding to the life of the project. Includes
    - Direct and Indirect Costs
    - Periodical or continuing costs of operation and maintenance
  - Project selection criterion: For 2 projects having the same investment, select a project with lower Life Cycle Cost.

Return on investment (ROI)

- Represents profits in relation to the capital invested.
- Used to evaluate the efficiency of an investment by comparison with different investment options.
- **ROI** = (gain from investment / cost of investment-1)

  = Net profit / Investment
  - Project selection criterion: For 2 projects having the same investment, select a project with lower Life Cycle Cost.

Present Value, NPV and DCF

- *Present Value is the future value (FV) of a payment discounted at a discount rate (r) for the delay in payment.*

  Example of Present Value: Assume that $ 1,100 (FV) is going to be *invested* one year (n) from now. The discount rate (e.g. inflation) is 10% (r). What is the Present Value?

  Answer: Present Value = $\frac{FV}{(1 + r/100)^n} = \frac{\$\ 1{,}100}{(1 + 10/100)^1} = \frac{\$\ 1{,}100}{1.1} = \$\ 1{,}000$

What this means: *The future value of today's $1,000 is $1,100 after one year. Thus, there is a decrease in the value of money.*

- Net Present Value (NPV)
  - Net Present Value (NPV) = (Present Value of All Cash Inflows) - (Present Value of All Cash Outflows)
  - Project Selection Criteria: Select the project with the maximum Net Present Value. The time value of money is already taken into account while calculating NPV.

  Example: There are 2 projects. Project A has as NPV of $ 1,000 and will be completed in 5 years. Project B has a NPV of $ 800 and will be completed in 1 year. Which project will you select?

  Answer: Project A will be selected. The fact that project B has a lesser duration than project A does not matter because time is already taken into account in NPV calculations.
- This is also called as *Discounted cash flow (DCF)* analysis

Internal Rate of Return (IRR)

- Discount Rate on an investment which makes present value of cash inflows equal to present value of cash outflows.
- Project selection criterion: Select a project with higher IRR

Example: There are 2 projects. Project A has an IRR of 15% and will be completed in 5 years. Project B has an IRR of 10% and will be completed in 1 year. Which project will you select?

Answer : Project A will be selected. (The fact that project B has a lesser duration than Project A does not matter because time is already taken into account in IRR calculations.)

Benefit Cost Ratio (BCR)

- BCR = $\frac{\text{Benefits (or Payback or Revenue)}}{\text{Costs}}$

- Project selection criterion: Select project with a higher BCR

- BCR > 1 means that benefits (i.e. expected revenue) is greater than the cost. Hence it is beneficial to undertake the project.

- Project selection criterion: Select a project with a higher BCR

  Example: There are 2 projects. Project A has an investment of $ 500,000 and a BCR of 2.5. Project B has an investment of $ 300,000 and a BCR of 1.5. Using the Benefit Cost Ratio criterion, which project will you select?

  Answer : Project A will be selected. (The fact that project B has a lower investment than project A will not impact the selection.)

Benefit / Payback / Revenue = Cost + Profit earned or Cost – Loss incurred

Opportunity Cost and Sunk Cost

- Opportunity Cost:
  - This is the cost of passing up the next best choice while making a decision.
  - Once the best option is decided, the opportunity cost of not choosing the other option is determined.

  Example: There are 2 projects. Project A has as NPV of $ 1,000. Project B has a NPV of $ 800. What is the opportunity cost if Project A is selected?

  Answer : If project A is selected, NPV is $ 1,000. If Project A is selected and Project B is rejected, project with NPV of $ 800 will not be executed. Hence the opportunity cost of Project A = $ 800.

- Sunk Cost:
  - This is the cost that has already been incurred – therefore cannot be avoided.
  - Project selection criterion: When deciding on the best option, ignore the sunk cost, because it has already been incurred and cannot be avoided.

  Example: Project A had an initial budget of $ 1,000 out of which an amount of $ 800 has already been spent. To complete Project A, we still need an additional $ 500. Project B requires $ 1200 to complete. Which project do you select?

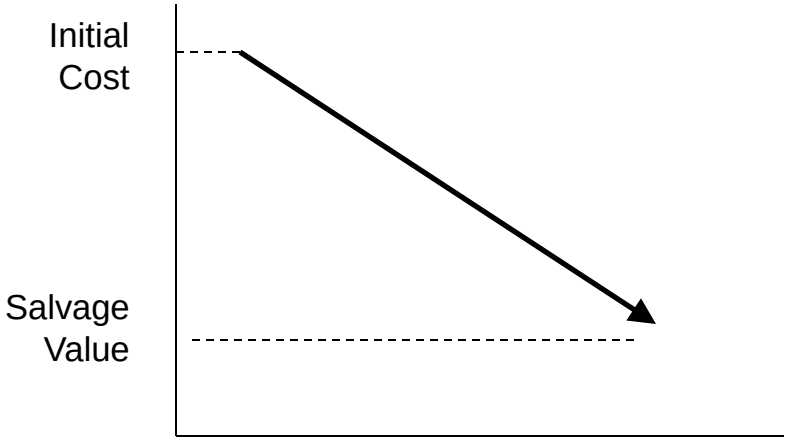
  Answer : $ 800 spent in Project A is sunk cost – hence should be ignored. So:
  - Cost of completing project A = $ 500
  - Cost of completing project B = $ 1200

  Hence, we should select project A.

Depreciation

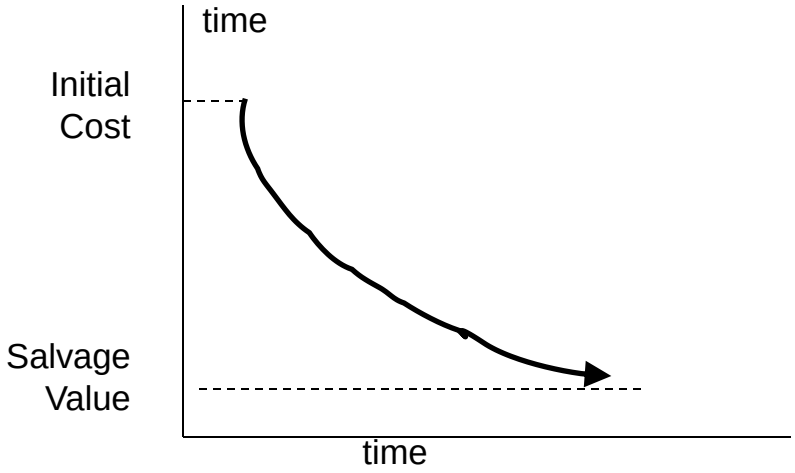
- Depreciation is the decrease in value of an asset over a period of time and is considered for accounting and tax purposes.

- Depreciation Methods:
  - Straight Line Depreciation:
  - The asset depreciates by the same amount every year



  - Accelerated Depreciation:
    The asset depreciates more rapidly in this method during the initial years as compared to the Straight Line method.

    Other methods of depreciation are:
    - Double Declining Balance
    - Sum of the Year's Digits



Earned Value Management

- **E**arned **V**alue **M**anagement is a methodology to asses Project performance and progress.
- It combines scope, schedule and resource measurements.

- Points to note:
  - Positive Variances (e.g., SV, CV) are desirable
  - All ratios greater than 1 (e.g., CPI, SPI) are desirable

Earned Value Management

Acronym	Term	Description	Formula
PV (BCWS)	Planned Value (Budgeted Cost of Work Scheduled)	The value of the work planned to be completed to a point in time, usually the data date, or project completion.	
EV (BCWP)	Earned Value (Budgeted Cost of Work Performed)	The planned value of all the work completed (earned) to a point in time, usually the data date, without reference to actual costs.	
AC	Actual Cost	Actual Cost of work completed that is incurred and recorded.	
SV	Schedule Variance	A measure of schedule performance on a project. Negative SV: Behind schedule Positive SV: Ahead of schedule	EV – PV
CV	Cost Variance	A measure of cost performance on a project. . Negative CV : Over budget; Positive CV : Under budget	EV – AC
CPI	Cost Performance Index	A measure of cost efficiency on a project. Value got for 1$ of actual cost.	$\frac{EV}{AC} = \frac{(BAC)}{(EAC)}$
SPI	Schedule Performance Index	A measure of schedule efficiency on a project. Progress as a % of planned progress	$\frac{EV}{PV}$

Project Management Institute, A Guide to the Project Management Body of Knowledge, (*PMBOK® Guide*) – Fifth Edition, Project Management Institute, Inc., 2013, Table 7-1, Page 224.

Earned Value Management (continued)

Acronym	Term	Description	Formula
EAC	Estimate at Completion	The expected total cost when the defined scope of work will be completed. 1. Original estimating assumptions no longer valid 2. Current variances are atypical; similar variances will not occur in the future 3. Current variances are typical; similar variances may occur in the future 4. EAC taking both CPI and SPI into account	1. AC + ETC 2. AC + BAC-EV 3. AC+ {(BAC-EV)/CPI} Or BAC/CPI 4. AC+{(BAC-EV)/(CPI*SPI)}
BAC	Budget at Completion	Budget for the whole project	EAC * CPI
ETC	Estimate to Complete	From a particular point in time, how much more time is required to complete the project	EAC – AC
VAC	Variance at Completion	Over or under budget	BAC – EAC
TCPI	To-Complete Performance Index	The work remaining divided by the funds remaining. Equation expressed in terms of EAC: Equation expressed in terms of BAC:	(BAC-EV) / (EAC-AC) (BAC-EV) / (BAC-AC)

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