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.
- \[ \text{ROI} = \frac{\text{gain from investment}}{\text{cost of investment}} - 1 \]
  \[ = \frac{\text{Net profit}}{\text{Investment}} \]

  - 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: \[
\text{Present Value} = \frac{\text{FV}}{(1 + \frac{r}{100})^n} = \frac{1,100}{(1 + \frac{10}{100})} = 1,100 \cdot \frac{1}{1.1} = 1,000
\]

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 an 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 = \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

- Earned Value Management is a methodology to assess 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

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Term</th>
<th>Description</th>
<th>Formula</th>
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<tbody>
<tr>
<td>PV</td>
<td>Planned Value (BCWS)</td>
<td>The value of the work planned to be completed to a point in time, usually the data date, or project completion.</td>
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<tr>
<td>EV</td>
<td>Earned Value (BCWP)</td>
<td>The planned value of all the work completed (earned) to a point in time, usually the data date, without reference to actual costs.</td>
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<tr>
<td>AC</td>
<td>Actual Cost</td>
<td>Actual Cost of work completed that is incurred and recorded.</td>
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<td>SV</td>
<td>Schedule Variance</td>
<td>A measure of schedule performance on a project. Negative SV: Behind schedule Positive SV: Ahead of schedule</td>
<td>EV - PV</td>
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<tr>
<td>CV</td>
<td>Cost Variance</td>
<td>A measure of cost performance on a project. Negative CV: Over budget; Positive CV: Under budget</td>
<td>EV - AC</td>
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<tr>
<td>CPI</td>
<td>Cost Performance Index</td>
<td>A measure of cost efficiency on a project. Value got for 1$ of actual cost.</td>
<td>EV = (BAC) / (EAC)</td>
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<tr>
<td>SPI</td>
<td>Schedule Performance Index</td>
<td>A measure of schedule efficiency on a project. Progress as a % of planned progress</td>
<td>EV / PV</td>
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## Earned Value Management (continued)

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| EAC     | Estimate at Completion       | The expected total cost when the defined scope of work will be completed. | 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.                           | (BAC-EV) / (EAC-AC)  
(BAC-EV) / (BAC-AC) |