# Solutions to Cost-Benefit Analysis and Economic Feasibility Studies

1. **Problem 1:** A project has an initial investment cost of $500,000 and is expected to generate annual benefits of $120,000 for 6 years. Compute the benefit-cost ratio if the discount rate is 8%.

   **Solution:** The Benefit-Cost Ratio (BCR) is calculated by dividing the present value of benefits by the present value of costs. The present value of an annuity (benefits) is given by:

   $$PV_{benefits} = B \times \frac{1 - (1 + r)^{-n}}{r}$$

   where:

   - $B$ = annual benefits = $120,000
   - $r$ = discount rate = 0.08
   - $n$ = number of years = 6

   Substituting the values:

   $$PV_{benefits} = 120,000 \times \frac{1 - (1 + 0.08)^{-6}}{0.08} \approx \$552,324$$

   The present value of costs is the initial investment:

   $$PV_{costs} = \$500,000$$

   Thus, the BCR is:

   $$BCR = \frac{PV_{benefits}}{PV_{costs}} = \frac{552,324}{500,000} \approx 1.10$$

   Since the BCR is greater than 1, the project is considered economically feasible.

   **Video Solution:** `https://www.youtube.com/watch?v=ISsw9EYN-wY`

2. **Problem 2:** A company invests $1,000,000 in a highway improvement project. The total economic benefits over 10 years are estimated at $1,500,000. Determine the benefit-cost ratio and assess the feasibility of the project.

   **Solution:** The Benefit-Cost Ratio (BCR) is calculated as:

   $$BCR = \frac{TotalBenefits}{TotalCosts} = \frac{1,500,000}{1,000,000} = 1.5$$

   Since the BCR is greater than 1, the project is considered economically feasible.

   **Video Solution:** `https://www.youtube.com/watch?v=N3BzlvIEYpE`

3. **Problem 3:** A hydropower plant has an initial cost of $4,000,000 and is expected to generate annual savings of $500,000. Determine the payback period.

   **Solution:** The payback period is the time required to recover the initial investment. It is calculated as:

$$PaybackPeriod = \frac{InitialInvestment}{AnnualSavings} = \frac{4,000,000}{500,000} = 8years$$

   **Video Solution:** `https://www.youtube.com/watch?v=9lL7COBqyZY`

4. **Problem 4:** A bridge construction project has a total cost of $2,000,000, and its expected annual benefits are $300,000. If the discount rate is 6%, determine the present value of benefits over 10 years.

   **Solution:** The present value of an annuity (benefits) is calculated using the formula:

$$PV = B \times \frac{1 - (1 + r)^{-n}}{r}$$

   where:

   - $B$ = annual benefits = $300,000
   - $r$ = discount rate = 0.06
   - $n$ = number of years = 10

   Substituting the values:

$$PV = 300,000 \times \frac{1 - (1 + 0.06)^{-10}}{0.06} \approx \$2,208,030$$

   **Video Solution:** `https://www.youtube.com/watch?v=ISsw9EYN-wY`

5. **Problem 5:** A firm conducts sensitivity analysis on a road construction project with an estimated cost of $800,000. If the maintenance cost increases by 15% from an initial estimate of $50,000 per year, determine the new total cost over 10 years.

   **Solution:** First, calculate the increased annual maintenance cost:

$$IncreasedMaintenanceCost = 50,000 \times (1+0.15) = 50,000 \times 1.15 = \$57,500$$

   Over 10 years, the total maintenance cost is:

$$TotalMaintenanceCost = 57,500 \times 10 = \$575,000$$

   Adding the initial construction cost:

$$TotalProjectCost = 800,000 + 575,000 = \$1,375,000$$

   **Video Solution:** `https://www.youtube.com/watch?v=ISsw9EYN-wY`