

ELEC 481

Assignment 4

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Problem 1 (8-1)

Potential costs:

Build cost of the plant, Maintenance cost, Operational cost, Cost of disposal of nuclear waste.

Potential benefits:

Electricity rate may drop for the local.

Local government/public sector benefits financially from the plant.

Stakeholder viewpoints:

Local citizens (safety concerns)

Regional public sector (cost and benefit)

Local government (regulations)

Problem 2 (8-11)

According to the equation given:

$$\frac{(PW \text{ of benefits})}{(PW \text{ of cost})} = 18 - \frac{54}{PW \text{ of cost}}$$

For the optimal project, the derivative of B/C ratio is 1 since marginal cost = marginal benefit:

$$\left(\frac{(PW \text{ of benefits})}{(PW \text{ of cost})} \right)' = \frac{54}{(PW \text{ of cost})^2} = 1$$

Thus,

$$PW \text{ of cost} = 3\sqrt{6} = 7.35$$

$$PW \text{ of benefit} = 8.85$$

Therefore, the present worth of cost is 7.35 million dollars and the B/C ratio is 1.2

Problem 3 (8-12)

40-year analysis:

Gravity:

$$\text{PW of cost} = \$2,800,000 + \$10,000 (P/A, 8\%, 40) = \$2,919,246.13$$

$$\text{PW of benefit} = \$200,000 (P/A, 8\%, 20) + \$400,000 (P/A, 8\%, 20) (P/F, 8\%, 20) = \$2,806,215.85$$

$$\text{B/C ratio} = 0.9613 < 1$$

Pumping:

$$\text{PW of cost} = \$1,400,000 + \$200,000 (P/F, 8\%, 10) + \$25,000 (P/A, 8\%, 40)$$

$$+ \$50,000 (P/A, 8\%, 10) + \$100,000 (P/A, 8\%, 30) (P/F, 8\%, 10) = \$2,647,711.29$$

$$\text{PW of benefit} = \$2,806,215.85$$

$$\text{B/C ratio} = 1.0599 > 1$$

Thus, pumping plan is better.

Problem 4 (8-15) (See attached spreadsheet for details.)

15-year analysis with 12% MARR:

Assume 12% is the current interest rate.

a) Conventional B/C ratio

A:

$$\text{PW of cost} = \$9,500 + \$1,000 (P/A, 12\%, 15) = \$16,310.86$$

$$\text{PW of benefit} = \$6,000 (P/F, 12\%, 15) + \$3,200 (P/A, 12\%, 15) = \$22,890.94$$

$$\text{B/C ratio} = 1.40$$

B:

$$\text{PW of cost} = \$18,500 + \$2,750 (P/A, 12\%, 15) = \$37,229.88$$

$$\text{PW of benefit} = \$4,200 (P/F, 12\%, 15) + \$5,000 (P/A, 12\%, 15) = \$34,821.65$$

$$\text{B/C ratio} = 0.94$$

C:

$$\text{PW of cost} = \$22,000 + \$6,400 (P/A, 12\%, 15) = \$65,589.53$$

$$\text{PW of benefit} = \$14,000 (P/F, 12\%, 15) + \$9,800 (P/A, 12\%, 15) = \$69,304.22$$

$$\text{B/C ratio} = 1.06$$

A is the best alternative.

b) Present worth analysis

Year	A	B	C
0	-9500.00	-18500.00	-22000.00
1-14	2200.00	2250.00	3400.00
15	8200.00	6450.00	17400.00
NPW	6580.08	-2408.23	3714.69

A is the best alternative.

c) Internal rate of return analysis (IRR)

A is the best alternative having the highest IRR (23%).

d) Payback period

A is the best alternative having the shortest payback period (less than 5 years).

Problem 5 (8-19)

Assume B is the first end-of-year benefit after the construction.

PW of costs = \$275,000

PW of benefits = $B (P/A, 6\%, 15) + \$2,000 (P/G, 6\%, 15) = 9.71 \cdot B + \$115,110$

If cost = benefit, we have $B = \$16467 > \16000 .

That suggests we want the construction done no sooner than 2024. (\$18,000 will be the first amount of benefit collected.)

However, if we want to maximize the profit, the reconstruction should be done in 2025.

Problem 6 (8-21)**a)**

PW of costs = capital expenditure + $\$15,000 (P/A, 5\%, 50)$

PW of benefits = $\$60,000 (P/A, 5\%, 10) + \$65,000 (P/A, 5\%, 10) (P/F, 5\%, 10)$
 $+ \$67,000 (P/A, 5\%, 10) (P/F, 5\%, 20) + \$69,000 (P/A, 5\%, 10) (P/F, 5\%, 30)$
 $+ \$74,000 (P/A, 5\%, 10) (P/F, 5\%, 40)$
 $= \$1,170,890$

Justified capital expenditure = $\$1,170,890 - \$15,000 (P/A, 5\%, 50) = \$897,050$

b)

Similarly,

$$\text{PW of costs} = \text{capital expenditure} + \$15,000 (P/A, 8\%, 50)$$

$$\begin{aligned} \text{PW of benefits} &= \$60,000 (P/A, 8\%, 10) + \$65,000 (P/A, 8\%, 10) (P/F, 8\%, 10) \\ &\quad + \$67,000 (P/A, 8\%, 10) (P/F, 8\%, 20) + \$69,000 (P/A, 8\%, 10) (P/F, 8\%, 30) \\ &\quad + \$74,000 (P/A, 8\%, 10) (P/F, 8\%, 40) \\ &= \$769,919 \end{aligned}$$

$$\text{Justified capital expenditure} = \$1,170,890 - \$15,000 (P/A, 8\%, 50) = \$586,424$$

It shows that justified capital expenditure decreases as interest rate goes up from 5% to 8%.

Problem 7

No. If NPW is greater than zero, it simply suggests that the plan is worth doing, or there is some profit to make. However, it doesn't guarantee that this is the best plan in comparison since other plans may have higher NPW or B/C ratio. Meanwhile, inflation could also occur in the future. In addition to all that, we also need to consider it from different stakeholder viewpoints because there could be some cases where a plan gets delivered with NPW close to 0.