SOLUTIONS TO SELECTED PROBLEMS

Student: You should work the problem completely before referring to the solution.

CHAPTER 9

Solutions included for problems: 1, 4, 7, 10, 13, 16, 19, 22, 25, 28, 32, 34, 37, 40, and 43

9.1 (a) Public sector projects usually require large initial investments while many private sector investments may be medium to small.

(b) Public sector projects usually have long lives (30-50 years) while private sector projects are usually in the 2-25 year range.

(c) Public sector projects are usually funded from taxes, government bonds, or user fees. Private sector projects are usually funded via stocks, corporate bonds, or bank loans.

9.4 Some different dimensions are:

1. Contractor is involved in design of highway; contractor is not provided with the final plans before building the highway.
2. Obtaining project financing may be a partial responsibility in conjunction with the government unit.
3. Corporation will probably operate the highway (tolls, maintenance, management) for some years after construction.
4. Corporation will legally own the highway right of way and improvements until contracted time is over and title transfer occurs.
5. Profit (return on investment) will be stated in the contract.
(b) Change cell D6 to $200,000 to get \( B/C = 1.023 \).
9.10 All parts are solved on the spreadsheet once it is formatted using cell references.

9.13 (a) By-hand solution: First, set up AW value relation of the initial cost, P capitalized a 7%. Then determine P for B/C = 1.3.

\[
1.3 = \frac{600,000}{P(0.07) + 300,000}
\]

\[
P = \frac{[600,000/1.3] - 300,000}{0.07} = 2,307,692
\]

9.16 Convert all estimates to PW values.

PW disbenefits = 45,000(P/A,6%,15) = $437,049

PW M&O Cost = 300,000(P/A,6%,15) = $2,913,660

\[
\frac{3,800,000 - 437,049}{2,200,000 + 2,913,660} = 0.66
\]
9.19 Calculate the AW of initial cost, then the 3 B/C measures of worth. The roadway should not be built.

9.22 Alternative B has a larger total annual cost; it must be incrementally justified.

\[
\text{Incr cost} = (800,000 - 600,000) + (70,000 - 50,000)(P/A,8\%,20)
= 396,362
\]

\[
\text{Incr benefit} = (950,000 - 250,000)(P/F,8\%,6)
= 441,140
\]

\[
\text{Incr B/C} = \frac{441,140}{396,362} = 1.11
\]

Select alternative B
9.25 East coast site has the larger total cost. Select east coast site.

9.28 (b) Location E

B = $500,000 – $30,000 – $50,000 = $420,000  
C = $3,000,000 * 0.12 = $360,000  
Modified B/C = $420,000 / $360,000 = 1.17

Location E is justified.

Location W

Incr B = $200,000
Incr D = $10,000
Incr C = ($7 million – $3 million) * 0.12 = $480,000
Incr M&O = ($65,000 – $25,000) – $50,000 = $-10,000

Note that M&O is now an incremental cost advantage for W.
Modified incr B/C = \[ \frac{200,000 - 10,000 + 10,000}{480,000} = 0.42 \]

W is not justified; select location E

9.32 Combine the investment and installation costs, difference in usage fees define benefits. Use the procedure in Section 9.3 to solve. Benefits are the incremental amounts for lowered costs of annual usage for each larger size pipe.

1. Order of incremental analysis: Size 130 150 200 230

<table>
<thead>
<tr>
<th>Total first cost, $</th>
<th>9,780</th>
<th>11,310</th>
<th>14,580</th>
<th>17,350</th>
</tr>
</thead>
</table>

2. Annual benefits, $  200 600 300

3. Not used since the benefits are defined by usage costs.

5-7. Determine incremental B and C and select at each pairwise comparison of defender vs challenger.

150 vs 130 mm
\[ \Delta C = (11,310 - 9,780)(A/P,8\%,15) \]
\[ = 1,530(0.11683) \]
\[ = $178.75 \]
\[ \Delta B = 6,000 - 5,800 \]
\[ = $200 \]
\[ \Delta B/C = 200/178.75 \]
\[ = 1.12 > 1.0 \quad \text{Eliminate 130 mm size.} \]

200 vs 150 mm
\[ \Delta C = (14,580 - 11,310)(A/P,8\%,15) \]
\[ = 3270(0.11683) \]
\[ = $382.03 \]
\[ \Delta B = 5800 - 5200 \]
\[ = $600 \]
\[ \Delta B/C = 600/382.03 \]
\[ = 1.57 > 1.0 \quad \text{Eliminate 150 mm size.} \]

230 vs 200 mm
\[ \Delta C = (17,350 - 14,580)(A/P,8\%,15) \]
\[ = 2770(0.11683) \]
\[ = $323.62 \]
\[ \Delta B = 5200 - 4900 \]
\[ = $300 \]
\[ \Delta B/C = 0.93 < 1.0 \quad \text{Eliminate 230 mm size.} \]

Select 200 mm size.
9.34 (a) Site D is the one selected.

(b) For independent projects, select the largest three of the four with B/C > 1.0. Those selected are: D, F, and E.

9.37 (a) Find benefits for each alternative and then calculate incremental B/C ratios.

Benefits for P: \( \frac{1.1}{10} = B_P \) \( B_P = 11 \)

Benefits for Q: \( \frac{2.4}{40} = B_Q \) \( B_Q = 96 \)

Benefits for R: \( \frac{1.4}{50} = B_R \) \( B_R = 70 \)

Benefits for S: \( \frac{1.5}{80} = B_S \) \( B_S = 120 \)

Incremental B/C for Q vs P
\[ \frac{B/C = 96 - 11}{40 - 10} = 2.83 \]

Incremental B/C for R vs P
\[ B/C = 1.48 \]
9.37 (cont) Incremental B/C for S vs P
   B/C = 1.56

   Incremental B/C for R vs Q
   B/C = -2.60
   Disregard due to less B for more C.

   Incremental B/C for S vs Q
   B/C = 0.60

   Incremental B/C for S vs R
   B/C = 1.67

(b) Select Q

9.40 Answer is (a)

9.43 Answer is (c)