SOLUTIONS TO SELECTED PROBLEMS

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

CHAPTER 18

Solutions included for problems: 1, 4, 7, 10, 13, 16, 19, 22, 25, 29, 31, and 34

18.1 10 tons/day: \( PW = -62,000 + \frac{1500}{P/F,10\%,8} - 0.50(10)(200)(P/A,10\%,8) \)
\( -4(8)(200)(P/A,10\%,8) \)
\( = -100,779 \)

20 tons/day: \( PW = -140,257 \)

30 tons/day: \( PW = -213,878 \)

18.4 \( PW_{\text{Build}} = -80,000 - 70(1000) + 120,000(P/F,20\%,3) \)
\( = -80,556 \)

\( PW_{\text{Lease}} = -(2.5)(12)(1000) - (2.50)(12)(1000)(P/A,20\%,2) \)
\( = -75,834 \)

Lease the space.

New construction cost = 70(0.90) = $63 and lease at $2.75

\( PW_{\text{Build}} = -73,556 \)

\( PW_{\text{Lease}} = -83,417 \)

Select build. The decision is sensitive.

18.7 (a) Breakeven number of vacation days per year is \( x \).

\( AW_{\text{cabin}} = -130,000(A/P,10\%,10) + 145,000(A/F,10\%,10) - 1500 \)
\( + 150x - (50/30)(1.20)x \)

\( AW_{\text{trailer}} = -75,000(A/P,10\%,10) + 20,000(A/F,10\%,10) - 1,750 \)
\( + 125x - [300/30(0.6)](1.20)x \)

\( AW_{\text{cabin}} = AW_{\text{trailer}} \)

\( x = 19.94 \) days  
(Use \( x = 20 \) days per year)

(b) Determine \( AW \) for 12, 16, 20, 24, and 28 days.

\( AW_{\text{cabin}} = -13,558.75 + 148x \quad AW_{\text{trailer}} = -12,701.25 + 105x \)
Each pair of AW values are close to each other, especially for \( x = 20 \).

18.10 For spreadsheet analysis, use the PMT functions to obtain the AW for each \( n \) value for each G amount.

<table>
<thead>
<tr>
<th>Days, ( x )</th>
<th>AW(_{\text{cabin}})</th>
<th>AW(_{\text{trailer}})</th>
<th>Selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>-11,783</td>
<td>-11,441</td>
<td>Trailer</td>
</tr>
<tr>
<td>16</td>
<td>-11,191</td>
<td>-11,021</td>
<td>Trailer</td>
</tr>
<tr>
<td>20</td>
<td>-10,599</td>
<td>-10,601</td>
<td>Cabin</td>
</tr>
<tr>
<td>24</td>
<td>-10,007</td>
<td>-10,181</td>
<td>Cabin</td>
</tr>
<tr>
<td>28</td>
<td>-9415</td>
<td>-9761</td>
<td>Cabin</td>
</tr>
</tbody>
</table>

The AW curves are quite flat; there are only a few dollars difference for the various \( n \) values around the \( n^* \) value for each gradient value.
18.13 (a) First cost sensitivity: \( AW = -P(0.22251) + 24,425 \)
(b) AOC sensitivity: \( AW = -AOC + 21,624 \)
(c) Revenue sensitivity: \( AW = -32,376 + \text{Revenue} \)

18.16 Water/wastewater cost = (0.12 + 0.04) per 1000 liters = 0.16 per 1000 liters

**Spray Method**

**Pessimistic - 100 liters**
Water required = 10,000,000(100) = 1.0 billion
\( AW = -\frac{0.16}{1000}(1.0 \times 10^9) = -160,000 \)

**Most Likely - 80 liters**
Water required = 10,000,000(80) = 800 million
\( AW = -\frac{0.16}{1000}(800,000,000) = -128,000 \)

**Optimistic - 40 liters**
Water required = 10,000,000(40) = 400 million
\( AW = -\frac{0.16}{1000}(400,000,000) = -64,000 \)

**Immersion Method**
\( AW = -10,000,000(40)(0.16/1000) - 2000(A/P,15\%,10) - 100 = -64,499 \)

Immersion method is cheaper, unless optimistic estimate of 40 L is the actual.
18.19  (a) \( E(\text{time}) = \frac{1}{4}(10 + 20 + 30 + 70) = 32.5 \) seconds

(b) \( E(\text{time}) = 20 \) seconds
   The 70 second estimate does increase the mean significantly.

18.22  \( E(i) = \frac{103}{20} = 5.15\% \)

18.25  \( E(\text{revenue}) = 222,000 \)

\[
E(\text{AW}) = -375,000(A/P, 12\%, 10) - 25,000[(P/F, 12\%, 4) + (P/F, 12\%, 8)]
               \quad (A/P, 12\%, 10) - 56,000 + 222,000
\]
\[= 95,034 \]

Construct mock mountain.

18.29  \( \text{AW} = \text{annual loan payment} + \text{damage} \times \text{P(rainfall amount or greater)} \)
Subscript on \( \text{AW} \) indicates the rainfall amount.

\( \text{AW}_{2.00} = -42,174 \)
\( \text{AW}_{2.25} = -35,571 \)
\( \text{AW}_{2.50} = -43,261 \)
\( \text{AW}_{3.00} = -54,848 \)
\( \text{AW}_{3.25} = -61,392 \)

Build a wall to protect against a rainfall of 2.25 inches with an expected \( \text{AW} \) of
\( -35,571 \).

18.31  \( D3: \) Top: \( E(\text{value}) = 30 \)
       Bottom: \( E(\text{value}) = 10 \)
       Select top at \( D3 \) for \( 30 \)

   \( D1: \) Top: Value at \( D1 = 77-50 = 27 \)
       Bottom: \( 90 - 80 = 10 \)
       Select top at \( D1 \) for \( 27 \)

   \( D2: \) Top: \( E(\text{value}) = 66 \)
       Middle: \( E(\text{value}) = 0.5(200 - 100) = 50 \)
       Bottom: \( E(\text{value}) = 50 \)
18.31 (cont) At D2, value = E(value) – investment
Top:  66 – 25 = $41
Middle: 50 – 30 = $20
Bottom: 50 – 20 = $30
Select top at D2 for $41

Conclusion: Select D2 path and choose top branch ($25 investment)

18.34 (a) Construct the decision tree.

(b) Expansion option
(PW for D2, $120,000) = $4352
(PW for D2, $140,000) = $21,744
(PW for D2, $175,000) = $52,180
E(PW) = $28,700
18.34 (cont)  

**No expansion option**

(PW for D2, $100,000 = $86,960)

E(PW) = $86,960

Conclusion at D2: Select no expansion option

(c) Complete foldback to D1.

**Produce option, D1**

E(PW of cash flows) = $202,063

E(PW for produce) = $–47,937

**Buy option, D1**

At D2, E(PW) = $86,960

E(PW for buy) = cost + E(PW of sales cash flows)

= –450,000 + 0.55(PW sales up) + 0.45(PW sales down)

= –450,000 + 0.55(228,320) + 0.45(195,660)

= $–236,377

Conclusion: Both returns are less than 15%, but the expected return is larger for produce option than buy.

(d) The return would increase on the initial investment, but would increase faster for the produce option.