Lesson 04 Decision Making Solutions

Solved Problem #1: see textbook

Solved Problem #2: see textbook

Solved Problem #3: see textbook

Solved Problem #6: (costs) see textbook

#1: A small building contractor has recently experienced two successive years in which work opportunities exceeded the firm’s capacity. The contractor must now make a decision on capacity for the next year. Estimated profits under each of the two possible states of nature are shown in the table below. The units are in $ thousands.

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do nothing</td>
<td>50</td>
<td>60</td>
</tr>
<tr>
<td>Expand</td>
<td>20</td>
<td>80</td>
</tr>
<tr>
<td>Subcontract</td>
<td>40</td>
<td>70</td>
</tr>
</tbody>
</table>

a. Calculate the regret table.

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do nothing</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>Expand</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Subcontract</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

Determine the alternative and payoff/regret which should be selected for the decision criteria in each of the following questions.

b. Maximax (best of all possible alternatives)?

Expand – payoff $80 thousand

c. Maximin (best of all the worst alternatives)?

Do nothing – payoff $50 thousand

d. Laplace (best of the expected payoffs for all alternatives)?

Tie between Do nothing and Subcontract – Payoff $55 thousand

e. Minimax regret (least of all the maximum regrets for each alternative)?

Subcontract – Regret $10 thousand

#2: Refer to problem 1. Suppose after a certain amount of discussion, the contractor is able to subjectively assess the probabilities of low and high demand: P(Low) = .3, P(High) = .7.

a. Determine the expected profit fore each alternative?

Do nothing - $57 thousand
Expand - $62 thousand
Subcontract - $61 thousand
b. What is the alternative the contractor would select under the Expected Value under Risk (EMV - greatest expected payoff for all alternatives) decision criteria?

Expand with a payoff of $62 thousand

c. Compute the Expected Profit Under Certainty, Expected Profit Under Risk, and the Expected Value of Perfect Information?

Expected Profit under Certainty - $71 thousand  
Expected Profit under Risk - $62 thousand  
Expected Value of Perfect Information – $9 thousand

#3: Refer to problem 1.

a. Construct a graph that will enable you to perform how sensitive the problem is to the probabilities for each state of nature using P(High)?

b. Over what range of P(High) would each alternative be best?
Do nothing best when \( 0 \leq P(\text{High}) < 0.50 \)
Subcontract best when \( 0.50 < P(\text{High}) < 0.6667 \)
Expand best when \( 0.6667 < P(\text{High}) \leq 1 \)

c. Over what range of \( P(\text{Low}) \) would each alternative be best?
Expand best when \( 0 \leq P(\text{Low}) < 0.3333 \)
Subcontract best when \( 0.3333 < P(\text{Low}) < 0.5 \)
Do nothing best when \( 0.5 < P(\text{Low}) \leq 1 \)

#4: The lease of Theme Park, Inc., is about to expire. Management must decide whether to renew the lease for another 10 years or to relocate near the site of a proposed motel. The town planning board is currently debating the merits of granting approval to the motel. A consultant has estimated the net present value in dollars of Theme Park’s two alternatives under each state of nature as shown below.

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>Motel Approved</th>
<th>Motel Rejected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renew</td>
<td>500,000</td>
<td>4,000,000</td>
</tr>
<tr>
<td>Relocate</td>
<td>5,000,000</td>
<td>100,000</td>
</tr>
</tbody>
</table>

a. Calculate the regret table.

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>Motel Approved</th>
<th>Motel Rejected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renew</td>
<td>4,500,000</td>
<td>0</td>
</tr>
<tr>
<td>Relocate</td>
<td>0</td>
<td>3,900,000</td>
</tr>
</tbody>
</table>

Determine the alternative and payoff/regret which should be selected for the decision criteria in each of the following questions.

b. Maximax (best of all possible alternatives)?
   - Relocate – net present value (payoff) of $5,000,000

c. Maximin (best of all the worst alternatives)?
   - Renew – net present value (payoff) of $500,000

d. Laplace (best of the expected payoffs for all alternatives)?
   - Relocate – net present value (payoff) $2,550,000

e. Minimax regret (least of all the maximum regrets for each alternative)?
   - Relocate – net present value (regret) $3,900,000

#5: Refer to problem 4. Suppose that the management of Theme Park, Inc., has decided that there is a 35% probability that the motel’s application will be approved. Answer the following questions.

a. If management uses the Expected Monetary Value (EMV) as the decision criterion, which alternative should it choose? Why?
   - Renew
   - The expected payoff (net present value) for renew is $2,775,000 and the expected payoff (net present value) for relocate is $1,815,000 and the EMV criterion rule is to choose the alternative with the maximum expected payoff.

b. If management has been offered the option of a temporary lease which will cost $24,000 while the town planning board considers the motel’s application, would you advise management to sign the lease? Explain you answer.
   - Yes
   - The Expected Value of Perfect Information (EVPI) is higher than the lease cost; therefore, management should sign the lease.
#6: Refer to problem 4 and 5.
   a. Construct a graph which can be used to analyze how sensitive the decision is to the probability that a new motel is approved.

   ![Sensitivity Analysis for Probability of (Motel Approved)](image)

   b. What is the probability of the new motel’s approval at which point Theme Park, Inc.’s management is indifferent to which alternative they choose? In other words, what is the probability of the new motel’s approval at which point both alternatives will have the same payoff? Specify your answer as a percentage using 2 decimal points of accuracy.

   Probability .4643 or 46.43%

   c. Identify the probability range for the new motels approval where
      i. Renew is the best alternative
         
         \[ 0 (0\%) \leq \text{Probability (Motel Approved)} < .4643 (46.43\%) \]
      
      ii. Relocate is the best alternative
         
         \[ .4643 (46.43\%) \leq \text{Probability (Motel Approved)} \leq 1 (100\%) \]

#7: The research staff of a marketing agency has assembled the following payoff table (stated in thousands of dollars) for 4 different project proposals: #1, #2, #3, and #4. There are only 2 possible future conditions: either the proposal will be accepted or rejected.

<table>
<thead>
<tr>
<th>-Alternatives-</th>
<th>Accepted</th>
<th>Rejected</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>10</td>
<td>-2</td>
</tr>
<tr>
<td>#2</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>#3</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>#4</td>
<td>0</td>
<td>7</td>
</tr>
</tbody>
</table>
a. Construct a graph which can be used to analyze how sensitive the decision is to the probability that the proposal is rejected.

b. Identify the probability range for the proposal being rejected where
   i. Proposal #1 has the highest payoff
      
      $0 \ (0\%) \leq \text{Probability (rejected)} < 0.2857 \ (28.57\%)$
   
   ii. Proposal #2 has the highest payoff
      
      $0.2857 \ (28.57\%) < \text{Probability (rejected)} < 0.6000 \ (60.00\%)$
   
   iii. Proposal #3 has the highest payoff
      
      $0.6000 \ (60.00\%) < \text{Probability (rejected)} < 0.7143 \ (71.43\%)$
   
   iv. Proposal #4 has the highest payoff
      
      $0.7143 \ (71.43\%) < \text{Probability (rejected)} \leq 1 \ (100\%)$

#8: The following payoff table represents costs in thousands of dollars associated with 2 states of nature and 4 alternatives.

<table>
<thead>
<tr>
<th>States of Nature</th>
<th>Alternatives</th>
<th>#1</th>
<th>#2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>120</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>60</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>10</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>90</td>
<td>90</td>
<td></td>
</tr>
</tbody>
</table>
c. Construct a graph which can be used to analyze how sensitive the decision is to the probability that state of nature #1 occurs.

![Sensitivity Analysis for Probability of (#1)](image)

![Graph showing Sensitivity Analysis for Probability of (#1)](image)

**Legend:**
- A
- B
- C
- D
- E

**Alternative Payoff:**
- A
- B
- C
- D
- E

**Probability (#1):**
- 0 (0%)
- 0.2500 (25.00%)
- 0.5833 (58.33%)
- 1 (100%)

**Alternative:**
- A
- B
- C
- D
- E

**D. Identify the probability range for the proposal being rejected where**

i. Alternative A has the least cost

\[ 0 (0\%) \leq \text{Probability (#1)} < 0.2500 (25.00\%) \]

ii. Alternative B has the least cost

\[ 0.2500 (25.00\%) < \text{Probability (#1)} < 0.5833 (58.33\%) \]

iii. Alternative C has the least cost

\[ 0.5833 (58.33\%) < \text{Probability (#1)} \leq 1 (100\%) \]

iv. Alternative D has the least cost

D never has the least cost