Chapter 3
Decision Analysis

TRUE/FALSE. Write ‘T’ if the statement is true and ‘F’ if the statement is false.

1) Expected monetary value (EMV) is the average or expected monetary outcome of a decision if it can be repeated a large number of times.  

2) Expected monetary value (EMV) is the payoff you should expect to occur when you choose a particular alternative.  

3) The decision maker can control states of nature.  

4) All decisions that result in a favorable outcome are considered to be good decisions.  

5) The difference in decision making under risk and decision making under uncertainty is that under risk, we think we know the probabilities of the states of nature, while under uncertainty we do not know the probabilities of the states of nature.  

6) EVPI (expected value of perfect information) is a measure of the maximum EMV as a result of additional information.  

7) The maximin decision criterion is used by pessimistic decision makers and minimizes the maximum outcome for every alternative.  

8) Optimistic decision makers tend to discount favorable outcomes.  

9) The decision theory processes of maximizing expected monetary value (EMV) and minimizing expected opportunity loss (EOL) should lead us to choose the same alternatives.  

10) The several criteria (maximax, maximin, equally likely, criterion of realism, minimax regret) used for decision making under uncertainty may lead to the choice of different alternatives.  

11) A decision table is sometimes called a payout table.  

12) The EMV approach and Utility theory always result in the same choice of alternatives.  

13) The criterion of realism is also called the Laplace criterion.  

14) The equally likely decision criterion is also called the Laplace criterion.  

15) A second table (an opportunity loss table) must be computed when applying the maximin decision criterion.
MULTIPLE CHOICE Choose the one alternative that best completes the statement or answers the question.

16) What makes the difference between good decisions and bad decisions?
A) A good decision considers all available data.
B) A good decision is based on logic.
C) A good decision considers all alternatives.
D) A good decision applies quantitative approaches.
E) All the above

17) Expected monetary value (EMV) is
A) the average or expected value of the decision, if you know what would happen ahead of time.
B) a decision criterion that places an equal weight on all states of nature.
C) the average or expected monetary outcome of a decision if it can be repeated a large number of times.
D) the average or expected value of information if it were completely accurate.
E) the amount you would lose by not picking the best alternative.

18) Which of the following is not considered a criteria for decision making under uncertainty?
A) pessimistic
B) optimistic
C) minimax regret
D) random selection
E) equally likely

19) A pessimistic decision making criterion is
A) maximax.
B) maximin.
C) equally likely.
D) decision making under certainty.
E) minimax regret.

20) Which of the following is true about the expected value of perfect information?
A) It is calculated as EMV minus tO.
B) It is calculated as expected value with perfect information minus maximum EMV.
C) It is the amount you would pay for any sample study.
D) It is the amount charged for marketing research.
E) None of the above.

21) Which of the following is NOT a characteristic of a good decision?
A) considers all available data
B) based on logic
C) considers all possible alternatives
D) always results in a favorable outcome
E) employs appropriate quantitative techniques
22) The following is a payoff table giving profits for various situations.

<table>
<thead>
<tr>
<th>States of Nature</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 1</td>
<td>120</td>
<td>140</td>
<td>120</td>
</tr>
<tr>
<td>Alternative 2</td>
<td>200</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>Alternative 3</td>
<td>100</td>
<td>120</td>
<td>180</td>
</tr>
<tr>
<td>Do Nothing</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

What decision would an optimist make?
- A) Alternative 1
- B) Alternative 2
- C) Alternative 3
- D) Do Nothing
- E) State of Nature A

23) The following is an opportunity loss table.

<table>
<thead>
<tr>
<th>States of Nature</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 1</td>
<td>0</td>
<td>90</td>
<td>85</td>
</tr>
<tr>
<td>Alternative 2</td>
<td>50</td>
<td>0</td>
<td>110</td>
</tr>
<tr>
<td>Alternative 3</td>
<td>75</td>
<td>80</td>
<td>0</td>
</tr>
</tbody>
</table>

What decision should be made based on the minimax regret criterion?
- A) Alternative 1
- B) Alternative 2
- C) Alternative 3
- D) State of Nature A
- E) Does not matter

24) The following is an opportunity loss table.

<table>
<thead>
<tr>
<th>States of Nature</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 1</td>
<td>50</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Alternative 2</td>
<td>5</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Alternative 3</td>
<td>0</td>
<td>20</td>
<td>25</td>
</tr>
</tbody>
</table>

What decision should be made based on the minimax regret criterion?
- A) Alternative 1
- B) Alternative 2
- C) Alternative 3
- D) State of Nature C
- E) Does not matter
25) The following is a payoff table.

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 1</td>
<td>30</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Alternative 2</td>
<td>5</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Alternative 3</td>
<td>0</td>
<td>20</td>
<td>25</td>
</tr>
</tbody>
</table>

What decision should be made based on the minimax regret criterion?
A) Alternative 1
B) Alternative 2
C) Alternative 3
D) State of Nature C
E) Does not matter

26) The following is a payoff table.

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>A</th>
<th>D</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 1</td>
<td>0</td>
<td>90</td>
<td>85</td>
</tr>
<tr>
<td>Alternative 2</td>
<td>50</td>
<td>0</td>
<td>110</td>
</tr>
<tr>
<td>Alternative 3</td>
<td>75</td>
<td>80</td>
<td>0</td>
</tr>
</tbody>
</table>

What decision should be made based on the minimax regret criterion?
A) Alternative 1
B) Alternative 2
C) Alternative 3
D) State of Nature C
E) Does not matter

27) The following is an opportunity-loss table.

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 1</td>
<td>70</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Alternative 2</td>
<td>100</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>Alternative 3</td>
<td>0</td>
<td>40</td>
<td>50</td>
</tr>
</tbody>
</table>

The probabilities for the states of nature A, B, and C are 0.3, 0.5, and 0.2, respectively. If a person were to use the expected opportunity loss criterion, what decision would be made?
A) Alternative 1
B) Alternative 2
C) Alternative 3
D) State of Nature C
E) State of Nature B
28) The following is a payoff table giving profits for various situations.

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>States of Nature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 1</td>
<td>A 100</td>
</tr>
<tr>
<td>Alternative 2</td>
<td>B 120</td>
</tr>
<tr>
<td>Alternative 3</td>
<td>C 180</td>
</tr>
<tr>
<td>Do Nothing</td>
<td></td>
</tr>
</tbody>
</table>

The probabilities for states of nature A, B, and C are 0.3, 0.5, and 0.2, respectively. If a person selected Alternative 1, what would the expected profit be?
A) 126
B) 120
C) 180
D) 133.33
E) None of the above

29) Dr. Mac, a surgeon, must decide what mode of treatment to use on Mr. Samuels. There are three modes of treatment: Mode A, B, and C, and three possible states of nature: 1. Treatment succeeds and patient leads a normal life. 2. Patient survives treatment but is permanently disabled, and 3. Patient fails to survive treatment. Dr. Mac has prepared the decision table below. What mode of treatment maximizes the expected value?

<table>
<thead>
<tr>
<th>Treatment Mode</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal Life</td>
</tr>
<tr>
<td>A</td>
<td>$1,000,000</td>
</tr>
<tr>
<td>P(outcome)</td>
<td>0.3</td>
</tr>
<tr>
<td>B</td>
<td>$3,000,000</td>
</tr>
<tr>
<td>P(outcome)</td>
<td>0.5</td>
</tr>
<tr>
<td>C</td>
<td>$10,000,000</td>
</tr>
<tr>
<td>P(outcome)</td>
<td>0.4</td>
</tr>
</tbody>
</table>

|                | Disability       |
| A              | -$2,000,000      |
| B              | -$2,500,000      |
| C              | -$5,000,000      |

|                | Non-Survival     |
| A              | -$600,000        |
| B              | -$500,000        |
| C              | -$500,000        |

A) Mode A
B) Mode B
C) Mode C
D) All three treatments are equally desirable.
E) Normal Life

30) Optimistic decision makers tend to _______
A) magnify favorable outcomes
B) ignore bad outcomes
C) discount favorable outcomes
D) A and B
E) B and C
31) Pessimistic decision makers tend to _______.  
A) ignore bad outcomes  
B) discount favorable outcomes  
C) magnify favorable outcomes  
D) A and B  
E) B and C

32) The optimistic decision criterion is the criterion of _______.  
A) realism  
B) maximax  
C) minimax regret  
D) maximin  
E) equally likely

33) The Hurwicz criterion is also called the criterion of _______.  
A) optimism  
B) regret  
C) pessimism  
D) equality  
E) realism

34) The equally likely criterion is also called the _______ criterion.  
A) LaFiore  
B) Laplace  
C) Hurwicz  
D) Huchenmetzer  
E) uncertainty

35) The expected value of sample information (EVSI) can be used to  
A) establish a maximum amount to spend on additional information.  
B) provide points on a utility curve.  
C) calculate conditional probabilities.  
D) establish risk avoidance.  
E) None of the above

36) A market research survey is available for $10,000. Using a decision tree analysis, it is found that the expected monetary value with no survey is $62,000. If the expected value of sample information is $7,000, what is the expected monetary value with the survey?  
A) $62,000  
B) $55,000  
C) $45,000  
D) $7,000  
E) None of the above

37) A market research survey is available for $10,000. Using a decision tree analysis, it is found that the expected monetary value with the survey is $75,000. The expected monetary value with no survey is $62,000. What is the expected value of sample information?  
A) $7,000  
B) $15,000  
C) $7,000  
D) $3,000  
E) None of the above
ESSAY. Write your answer in the space provided or on a separate sheet of paper.

38) A concessionaire for the local ballpark has developed a table of conditional values for the various alternatives (stocking decision) and states of nature (size of crowd).

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>States of Nature (size of crowd)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Large</td>
</tr>
<tr>
<td>Large Inventory</td>
<td>$22,000</td>
</tr>
<tr>
<td>Average Inventory</td>
<td>$15,000</td>
</tr>
<tr>
<td>Small Inventory</td>
<td>$9,000</td>
</tr>
</tbody>
</table>

If the probabilities associated with the states of nature are 0.30 for a large crowd, 0.50 for an average crowd, and 0.20 for a small crowd, determine:
(a) the alternative that provides the greatest expected monetary value (EMV)
(b) the expected value of perfect information (EVPI)

39) A concessionaire for the local ballpark has developed a table of conditional values for the various alternatives (stocking decision) and states of nature (size of crowd).

<table>
<thead>
<tr>
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<th>States of Nature (size of crowd)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Large</td>
</tr>
<tr>
<td>Large Inventory</td>
<td>$22,000</td>
</tr>
<tr>
<td>Average Inventory</td>
<td>$15,000</td>
</tr>
<tr>
<td>Small Inventory</td>
<td>$9,000</td>
</tr>
</tbody>
</table>

If the probabilities associated with the states of nature are 0.30 for a large crowd, 0.50 for an average crowd, and 0.20 for a small crowd, determine:
(a) the opportunity loss table.
(b) minimum expected opportunity loss (EOL).

40) The ABC Co. is considering a new consumer product. They believe there is a probability of 0.4 that the XYZ Co. will come out with a competitive product. If ABC adds an assembly line for the product and XYZ does not follow with a competitive product, their expected profit is $40,000; if they add an assembly line and XYZ does follow, they still expect a $10,000 profit. If ABC adds a new plant addition and XYZ does not produce a competitive product, they expect a profit of $600,000; if XYZ does compete for this market, ABC expects a loss of $100,000.
(a) Determine the EMV of each decision.
(b) Determine the EOL of each decision.
(c) Compare the results of (a) and (b).
(d) Calculate the EVPI.

41) The ABC Co. is considering a new consumer product. They have no idea whether or not the XYZ Co. will come out with a competitive product. If ABC adds an assembly line for the product and XYZ does not follow with a competitive product, their expected profit is $40,000; if they add an assembly line and XYZ does follow, they still expect a $10,000 profit. If ABC adds a new plant addition and XYZ does not produce a competitive product, they expect a profit of $600,000; if XYZ does compete for this market, ABC expects a loss of $100,000.

Calculate Hurwicz’s criterion of realism using α’s of 0.7, 0.3, and 0.1.
42) Barbour Electric is considering the introduction of a new product. This product can be produced in one of several ways: (a) using the present assembly line at a cost of $25 per unit, (b) using the current assembly line after it has been overhauled (at a cost of $10,000) with a cost of $22 per unit; and (c) on an entirely new assembly line (costing $30,000) designed especially for the new product with a per unit cost of $20. Barbour is worried, however, about the impact of competition. If no competition occurs, they expect to sell 15,000 units the first year. With competition, the number of units sold is expected to drop to 9,000. At the moment, their best estimate is that there is a 40% chance of competition. They have decided to make their decision based on the first year sales.

(a) Develop the decision table (EMV).
(b) Develop a decision table (EOL).
(c) What should they do?

43) The following payoff table provides profits based on various possible decision alternatives and various levels of demand.

<table>
<thead>
<tr>
<th>Alternatives</th>
<th>Demand</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>Med</td>
<td>High</td>
</tr>
<tr>
<td>Alternative 1</td>
<td>80</td>
<td>120</td>
<td>140</td>
</tr>
<tr>
<td>Alternative 2</td>
<td>90</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Alternative 3</td>
<td>50</td>
<td>70</td>
<td>150</td>
</tr>
</tbody>
</table>

The probability of a low demand is 0.4, while the probability of a medium and high demand is each 0.3.

(a) What decision would an optimist make?
(b) What decision would a pessimist make?
(c) What is the highest possible expected monetary value?
(d) Calculate the expected value of perfect information for this situation.