

Operations Research Chapter 8

Problem 1

1. The following payoff table shows profit for a decision analysis problem with two decision alternatives and three states of nature:

<i>Decision Alternative</i>	<i>State of Nature</i>		
	S1	S2	S3
D1	250	100	25
D2	100	100	75

- a. Construct a decision tree for this problem.
 - b. If the decision maker knows nothing about the probabilities of the three states of nature, what is the recommended decision using the optimistic, conservative and minimax regret approaches?
2. The probabilities for the states of nature are $P(s_1) = 0.65$, $P(s_2) = 0.15$, and $P(s_3) = 0.20$.
- a. What is the optimal decision strategy if perfect information were available?
 - b. What is the expected value for the decision strategy developed in part (a)?
 - c. Using the expected value approach, what is the recommended decision without perfect information? What is its expected value?
 - d. What is the expected value of perfect information?

Problem 2

The following payoff table shows the profit for a decision problem with two states of nature and two decision alternatives:

Decision Alternative	State of Nature	
	s_1	s_2
d_1	10	1
d_2	4	3

- Use graphical sensitivity analysis to determine the range of probabilities of state of nature s_1 for which each of the decision alternatives has the largest expected value.
- Suppose $P(s_1) = 0.2$ and $P(s_2) = 0.8$. What is the best decision using the expected value approach?
- Perform sensitivity analysis on the payoffs for decision alternative d_1 . Assume the probabilities are as given in part (b) and find the range of payoffs under states of nature s_1 and s_2 that will keep the solution found in part (b) optimal. Is the solution more sensitive to the payoff under state of nature s_1 or s_2 ?

Problem 3

Hudson Corporation is considering three options for managing its data processing operation: continuing with its own staff, hiring an outside vendor to do the managing (referred to as outsourcing), or using a combination of its own staff and an outside vendor. The cost of the operation depends on future demand. The annual cost of each option (in thousands of dollars) depends on demand as follows:

Staffing Options	Demand		
	High	Medium	Low
Own staff	650	650	600
Outside vendor	900	600	300
Combination	800	650	500

- If the demand probabilities are 0.2, 0.5, and 0.3, which decision alternative will minimize the expected cost of the data processing operation? What is the expected annual cost associated with that recommendation?
- Construct a risk profile for the optimal decision in part (a). What is the probability of the cost exceeding \$700,000?

Problem 4

Hale's TV Productions is considering producing a pilot for a comedy series in the hope of selling it to a major television network. The network may decide to reject the series, but it may also decide to purchase the rights to the series for either one or two years. At this point in time, Hale may either produce the pilot and wait for the network's decision or transfer the rights for the pilot and series to a competitor for \$100,000. Hale's decision alternatives and profits (in thousands of dollars) are as follows:

<i>Decision Alternative</i>	<i>State of Nature</i>		
	Reject (s_1)	1 year (s_2)	2 years (s_3)
Produce pilot (d_1)	-100	50	150
Sell to competitor (d_2)	100	100	100

The probabilities for the states of nature are $P(s_1) = 0.20$, $P(s_2) = 0.30$, and $P(s_3) = 0.50$.

For a consulting fee of \$5000, an agency will review the plans for the comedy series and indicate the overall chances of a favorable network reaction to the series. Assume that the agency review will result in a favorable (F) or an unfavorable (U) review and that the following probabilities are relevant:

$$P(F) = 0.69 \text{ and } P(U) = 0.31$$

$$P(s_1 | F) = 0.09, P(s_2 | F) = 0.26 \text{ and } P(s_3 | F) = 0.65$$

$$P(s_1 | U) = 0.45, P(s_2 | U) = 0.39 \text{ and } P(s_3 | U) = 0.16$$

- Construct a decision tree for this problem.
- What is the recommended decision if the agency opinion is not used? What is the expected value?
- What is the expected value of perfect information?
- What is Hale's optimal decision strategy assuming the agency's information is used?
- What is the expected value of the agency's information?
- Is the agency's information worth the \$5000 fee? What is the maximum that Hale should be willing to pay for the information?

g. What is the recommended decision?

Problem 5

The Gorman Manufacturing Company must decide whether to manufacture a component part at its Milan, Michigan, plant or purchase the component part from a supplier. The resulting profit is dependent upon the demand for the product. The following payoff table shows the projected profit (in thousands of dollars):

Decision Alternative	State of Nature		
	Low Demand	Medium Demand	High Demand
	s_1	s_2	s_3
Manufacture, d_1	-20	40	100
Purchase, d_2	10	45	70

The state-of-nature probabilities are $P(s_1) = 0.35$, $P(s_2) = 0.35$, and $P(s_3) = 0.30$.

- Use a decision tree to recommend a decision.
- Use EVPI to determine whether Gorman should attempt to obtain a better estimate of demand.
- A test market study of the potential demand for the product is expected to report either a favorable (F) or unfavorable (U) condition. The relevant conditional probabilities are as follows:

$$P(F | s_1) = 0.10, P(F | s_2) = 0.40, P(F | s_3) = 0.60$$

What is the probability that the market research report will be favorable?

- What is Gorman's optimal decision strategy?
- What is the expected value of the market research information?
- What is the efficiency of the information?