Exercise – 2.2

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A. Theoretical Review Questions

1. Given the complete set of outcomes in a certain situation, how is the EMV determined for a specific course of action? Explain in your own words.
2. Explain the difference between decision making under condition of uncertainty and decision making under condition of risk.
4. What do you understand by "decision making under risk"? Explain how decisions are made under risk situations.
3. Write short notes on: (i) EMV criterion (ii) EOL criterion (iii) Maximax criterion rule
   (iv) Maximin criterion rule (v) Minimax regret criterion rule (vi) Hurwitz decision rule
   (vii) Laplace decision rule (viii) EVPI (ix)Marginal analysis technique

B. Practical Problems

1. A man has the choice of running either a hot -snack stall or an ice-cream stall at a sea side resort during the summer season. If it is a fairly cool summer, he should make Rs.5000 by running the hot-snack stall, but if the summer is quite hot, he can only expect to make Rs.1000. On the other hand, if he operates the ice-creams stall, his profit is estimated at Rs.6500 if the summer is hot, but only Rs.1000 if it is cool. There is a 40% chance of the summer being hot. What should be his decision to maximize expected profit by using EMV criterion?
2. A businessman wants to decide whether to stock commodity X or Commodity Y. He can stock either but not both. If he stocks X and if it is a success, he feels that he can make Rs.200 but if it is a failure, he will lose Rs.500. If he stocks Y and if it is a success, he feels that he can make Rs.400 but if it is a failure, he would lose Rs.300. He has the following probability distribution.

Probability of	With stock of Commodity (X)	With stock of commodity (Y)
Success	0.80	0.60
Failure	0.20	0.40

   (i) Calculate the EMV of stocking each commodity.

   (ii) Which commodity X or Y, should he stock based on the EMV criterion?

3. A trader has two investment opportunities, A and B available to him but does not have enough capital to invest in the both. The probability of success on A is 0.70 while that on B is 0.40. Both the investments require an initial capital of Rs.20000 and both return nothing if the venture is not successful. Investment A returns Rs.30000 over cost if it is successful, whereas the successful completions of B will return Rs.50000 over cost. Using EMV criterion decide the best strategies the trader should adopt.
4. A businessman has three alternative actions he can take, each of which can be followed by any of four possible events. The conditional payoffs for each action- event combination are as under.

Event	Action		
	1	2	3
A	4	-2	7
B	0	6	3
C	-5	9	2
D	3	1	4

   Assume that all events have equal probabilities of occurring. Which action should he take based on the EMV criterion?

5. A vendor sells cakes not less than 4 and not more than 8 every day. Based upon his past experience, he found that 10% of the days he sells only 4 cakes, 20% of the days he sells 5 cakes, 40% of the days, 6 cakes, 20% of the days, 7 cakes and 10% of the days, 8 cakes. The cake costs Rs.3 each and sells it for Rs.8 each. If any of the cakes is not sold at the end of the day, it has to be thrown out so that there is no salvage value.

   (i) How many cakes he should stock each day in order to maximize his total profit.

   (ii) What is the maximum expected profit?

6. A newsstand operator assigns probabilities to the demand for the five magazines as follows.

No. of copies sold	10	11	12	13	14
Probability	0.10	0.15	0.20	0.25	0.30

   An issue sells for Rs.50 and costs Rs.30. If the operator cannot return unsold copies, how many copies should be ordered?

7. A distribution of past sales of a commodity for ABC Enterprises is as follows:

Quantities buyer's bought	No. of days occurred	Probability
20 units	10	0.10
25 units	30	0.30
40 units	50	0.50
60 units	10	0.10

ABC Enterprises buys these for Rs.6 and sells them for Rs.10.

(i) What quantities should be bought to maximize expected profits?

(ii) What is the expected profit with perfect information (EPPI)?

(iii) What is the expected value with perfect information (EVPI)?

8. A physician purchases a particular vaccine on Monday each week. The vaccine must be used within the week following, otherwise it becomes worthless. The vaccine costs Rs.2 per dose and the physician charges Rs.4 per dose. In the past 50 weeks, the physician has administered the vaccine in the following quantities.

Doses per week	20	25	50	60
Number of weeks	5	15	25	5

(i) Determine how many doses the physician should buy every week.

(ii) Compute EVPI.

(iii) A physician is thinking of spending on a small market survey to obtain additional information regarding the demand levels. How much should he be willing to spend on such a survey?

9. A newspaper boy estimates the probability of the demand for a new magazine as follows:

Demand	1	2	3	4
Probability	0.40	0.30	0.20	0.10

A copy of the magazine sells for Rs.5 that cost Rs.4.

(a) Find the optimal number of the newspaper that would maximize the profit.

(b) Find the expected profit with perfect information.

(c) Find the expected value of perfect information.

10. A distribution of past daily sales of a commodity is as follows:

Daily sales (units)	1000	1200	1400	1600	1800
Probability	0.05	0.15	0.35	0.30	0.15

If selling price per unit is Rs.40 and cost price per unit is Rs.25 and salvage price per unit is Rs.5, what is

(i) optimum quantity?

(ii) maximum expected profit?

(iii) expected values for perfect information?

11. An ice-cream retailer buys ice-cream at a cost of Rs.50 per cup and sells it for Rs.80 per cup. Any remaining unsold at the end of the day can be disposed of at a salvage price of Rs.20 per cup. Past sales have been ranged between 15 and 18 cups per day. There are no reasons to believe that sales volume will take on any other magnitude in future. If the sale history has the following probabilities, find how many cups the retailer should bought per day to maximize the profit.

Market size	15	16	17	18
Probability	0.10	0.20	0.40	0.30

(a) What quantity should be bought to maximize expected profit?

(b) What will be his maximum expected profit? If he has perfect information of the market, what would be the expected profit?

(c) What is the cost of uncertainty?

12. A retailer has to decide as to the optimum number of units to be stocked of a certain item under following conditions.

(a) Cost price in season is Rs.12. (b)Selling price in season is Rs.18.

(c) Bargain price after season is Rs.9. (d)Cost of holding the item beyond season is Re.1.

The probability distribution of demand based on past data is as follows.

Units demanded	7	8	9	10	11
Probability	0.20	0.20	0.25	0.20	0.15

Determine the optimum stock level on the EMV criterion and expected value for perfect information.

13. The following table shows three states of nature (events) and three actions. The amount that a person will gain in each combination of states of nature and action is shown in the table.

Events	**Actions**		
	A_1 (Rs.)	A_2(Rs.)	A_3(Rs.)
D_1	25000	-7000	-18000
D_2	30000	50000	-8000
D_3	40000	25000	60000

Probabilities for three states of nature (events) are also given below.

States of nature	D_1	D_2	D_3
Probability	0.3	0.5	0.2

(i) Find out EMV for each decision alternative.

(ii) Find out EPPI and EVPI.

(iii) A researcher first has agreed to conduct a survey to provide the management with additional information regarding the state of nature. It will charge Rs.12000 for undertaking this survey. Do you think that the survey should be conducted?

14. The captain's table is a mail-order distributor of fresh lobsters. The company buys these for Rs.40 per pound and sells them for Rs.75 per pound. The per week shipment distribution is as follows:

Shipments per week, pound	No. of weeks this occurred	Probability of occurrence
3000	5	0.05
5000	20	0.20
8000	20	0.20
12000	40	0.40
18000	15	0.15

The company has been approached by a consulting of firm specializing in sales forecasting. The firm has offered to provide the captain's table with a sales-forecasting model, which will increase the distributor's present profit by matching purchases with sales. The cost of buying and running this model will be Rs.75000 a week. Should the company buy it?

15. Given is the following payoff matrix.

States of nature	Prob.	Acts		
		X	Y	Z
A	0.30	-120	-80	100
B	0.50	200	400	-300
C	0.20	260	-260	600

Using the expected monetary value criterion and expected opportunity loss criterion methods, decide which act can be chosen as the best.

16. Management of XYZ Company is considering use of newly discovered chemical which, when added to detergents, will make the washing set, thus eliminating the necessity of adding softness. The management is considering at present time, hence alternatives S_1, S_2, and S_3. Select the optimal strategy using expected monetary value and expected loss criteria method from the following payoff matrix.

Strategies	States of nature		
	N_1	N_2	N_3
S_1: New improvement detergent	15	12	18
S_2: Super soft	9	14	10
S_3: Extra wash	13	4	26

Probabilities for three states of nature (events) are also given below.

States of nature	N_1	N_2	N_3
Probability	0.35	0.45	0.20

17. A newspaper vendor buys a newly started local newspaper at the rate of Rs.5 and sells it at the rate of Rs.10. The unsold newspapers do not have any value. The newspaper vendor knows that he cannot sell more than 40 newspapers in a day and minimum sales could not be less than 20. According to some past experience the probabilities assigned are as follows:

Daily sales of newspaper	20	25	30	35	40
Probability of being sold	0.05	0.10	0.20	0.35	0.30

(i) How many papers should be bought in order to maximize the expected profit?

(ii) How many papers should be bought based on EOL criterion?

(iii) Comment on results obtained from (i) and (ii).

(iv) Also, calculate the expected value of perfect information (EVPI). Show that EVPI is equal to minimum EOL.

18. A vendor buys magazine at the rate of Rs.15 and sells them at the rate of Rs.25. The unsold magazines can be sold at the rate of Rs.5 per copy. The number of copies demanded and their corresponding probabilities are given below:

No. of copies demanded	400	410	420	430	440	450
Probability	0.08	0.16	0.25	0.27	0.13	0.11

Using EMV and EOL criteria, (a) how many copies should the vendor buy in order to maximize the profit and minimize the loss? Also (b) compute expected value for perfect information.

19. The demand pattern of the cakes made in a bakery is as follows:

No. of cakes demanded	0	1	2	3	4	5
Probability	0.05	0.10	0.25	0.30	0.20	0.10

If the preparation cost is Rs.30 per unit and selling price is Rs.40 per unit, how many cakes the baker make to maximize his profit using marginal analysis?

20. The captain's table is a mail-order distributor of fresh lobsters. The company buys these for Rs.40 per kg and sells them for Rs.75 per kg. The per week shipment distribution is as follows:

Shipments per week, kg	No. of weeks this occurred
300	5
500	20
800	20
1200	40
1800	15

Select the optimal shipment of lobster per week using marginal analysis technique. The company has been approached by a consulting of firm specializing in sales forecasting and offers a sales-forecasting model which costs Rs.9000 a week. What advice will you give to the company regarding the purchase and not purchasing the model?

Answers

B.

1. Max. EMV = Rs.3400, a hot-snack

2. (i) EMV for X = Rs.60, EMV for Y = Rs 120 (ii) Y

3. EMV for A = Rs.15000; EMV for B = Rs.8000; A **4**. Action 3.

5. (i) optimum stock = 6 (ii) EMV = Rs.26.80;

6. Optimum no. of copies = 12 **7**. (i) 25 or 40 units (ii) Rs. 142 (iii) Rs. 47

8. (i) 50 (ii) Rs.23 (iii) A physician should not spend more than Rs.23 for market survey to obtain additional information.

9. (a) 1 unit (b) Rs.2 (c) Re.1

10. (i) 1400 (ii) Rs.19250 (iii) Rs.2800

11. (a) 17 ice-creams each day (b) Maximum expected profit = Rs.486; EPPI= Rs.507 (c) EVPI= Rs.21

12. Optimum stock level is 9; EVPI = Rs.5.7

13. (i) EMV for A_1 = Rs.30500; EMV for A_2 = Rs.27900; EMV for A_3 = Rs.2600

(ii) EPPI = Rs.44500 and EVPI = Rs.14000

(iii) It is advisable to conduct the survey to get net gain of Rs. 2000.

14. Cost of uncertainty = Rs.137500; company should buy the forecasting model to get net Rs.62500.

15. Act Y

16. Maximum EMV = Rs.14.25, Minimum EOL = Rs. 2.5; The best alternative is S_1: New improvement detergent.

17. (i) Max. EMV = Rs.147.5; 35 (ii) Min EOL = Rs.21.25; 35 **(**iii) Same (iv) Rs.21.25

18. (a) 430 copies under both EMV and EOL criteria (b) EVPI = Rs.116 **19**. 2

20. 1200 kg; Cost of uncertainty = Rs.13750; Company should buy the forecasting model to get net gain Rs.4750.