



MACHAKOS UNIVERSITY

University Examinations for 2024/2025 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS, STATISTICS AND ACTUARIAL SCIENCES

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR DEGREE IN
BACHELOR OF SCIENCE (STATISTICS AND PROGRAMMING

SST 401 -DECISION THEORY

DATE: 13TH JANUARY, 2025

TIME: 2.00 PM – 4.00 PM

INSTRUCTIONS:

Answer question **ONE (Compulsory)** and **any other TWO** questions

QUESTION ONE (COMPULSORY) (30 MARKS)

1 (a) Explain the meaning of the following terms as applied in decision theory.

- i). Opportunity loss
- ii). Roll-back technique (4marks)

(b). Differentiate between each of the following terms as applied in decision theory

- i) Marginal profit and Marginal loss
- ii) Maximax and maximin decision rule (4marks)

(c) Prepare a decision tree for the information given in the following decision matrix relating to cost data:

State of nature Pr	Fire 0.01	No fire 0.99
Alternatives		
Insure	Ksh 1000	Ksh 1000
Do not insure	Ksh80000	Ksh 0

State what action should be taken to minimize cost (5 marks)

- (d) A businessman has three alternatives open to him each of which can be followed by any of the four possible events. The conditional payoff(insh) for each action-event is as shown below;

Alternatives	Payoff conditional on events			
	A	B	C	D
P	8	0	-10	6
Q	-4	12	18	-2
R	14	6	0	8

Determine which alternative should the business choose, if he adopts the

- Equally likely criterion. (4marks)
- Minimax regret criterion. (4marks)

- (f) Suppose 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 he can make ksh 200 and if it is a failure he will loose ksh 500. If he stocks Y and if it is a success, he feels that he can make ksh 400 and if it is a failure he will loose ksh 300. Which commodity X or Y should he stock if he has the following probability distribution in view: (4marks)

<i>Probability of</i>	<i>With stock of commodity X</i>	<i>With stock of commodity Y</i>
Success	0.80	0.60
Failure	0.20	0.40

- (g) The marginal loss on Washington Reds, a brand of apples from the state of Washington is \$35 per case and the marginal profit is \$15 per case. During the past one, the mean sales of Washington Reds in cases was 45000 cases and the standard deviation was 4450. Assuming that the sales follow a normal distribution, determine how many cases of Washington Reds should be brought to the market. (5marks)

QUESTION TWO (20 MARKS)

- a) Rick Miller has just opened a new bakery in Frisco, Colorado, called Morning Fresh. In performing an economic analysis, Rick has determined that the marginal cost or loss for each dozen doughnuts sold is \$4. The marginal profit is estimated to be \$2.75 per dozen doughnuts. At this time Rick is considering stocking 10, 15, 20, 25, or 30 dozen doughnuts. The probability of selling 10 dozen doughnuts is 10%, 15 dozen doughnuts is 20%, and 30% chance that the bakery can sell either 20 or 25 dozen doughnuts. There is also 10% chance of selling 30 dozen doughnuts, which is considered by Rick to be the most that Morning Fresh would accommodate. Use marginal analysis to advise Rick. (8marks)
- b) A company has three different security systems models namely: standard, deluxe, and super. An analysis of the probable acceptance of the models has been carried out and the pay-off table is shown below;

Model acceptance	Acceptance probability	Profit sh'000' (Model type)		
		Standard	Deluxe	Super
Excellent	0.2	60	100	20
Moderate	0.5	40	60	80
Poor	0.3	20	0	-40

- (i) Decide which model should be introduced to the market using:
- Expected pay off rule (4marks)
 - Minimin decision rule. (4marks)
- (ii) In the context of this question outline briefly the limitations of the two decision criteria used. (2marks)
- (iii) What would be the value of knowing the model acceptance level before making the decision on which model to produce? (2marks)

QUESTION THREE (20 MARKS)

- a) Consider the following pay-off matrix table

Event	Act			
	Probability	A1	A2	A3
D1	0.3	10	20	30
D2	0.5	40	-10	20
D3	0.2	20	50	50

- (i) Determine which act to choose using the maximum expected pay-off. (4marks)
- (ii) Determine the expected pay-off under certainty (with perfect information). (4marks)
- (iii) Using the answers in (i) and (ii) above calculate the expected value of perfect information. (2marks)

- (b) A businessman has to select two independent investments A and B available to him but he has the capital to undertake both of them simultaneously. He can choose to take A first and the stop, or if A is successful then take B, or vice versa. The probability of success on A is 0.7 while for B it is 0.4. Both investments require an initial capital outlay of ksh 2000 and both return nothing if venture is unsuccessful. Successful completion of A will return ksh 3000 (over cost), successful completion of B will return ksh 5000 (over cost). Draw a decision tree and determine the best strategy. (10marks)

QUESTION FOUR (20 MARKS)

- (a). The following payoff table provides the profits for each of four alternatives in each of the three states of nature;

Alternatives	States of nature		
	A	B	C
1	120	60	-20
2	90	80	100
3	81	81	81
4	-50	90	110

The probabilities for the states of nature are; $P(A)=0.8$, $P(B)=0.1$, and $P(C)=0.1$

- Develop the opportunity loss table. (4marks)
 - Hence use the Expected Opportunity Loss value to determine the best decision. (6marks)
- b). A manager expresses indifference between an investment that will yield a certain return of ksh 10000 and a risky venture with 50 per cent chance of ksh 30000 profit and a 50 per cent chance of loss of ksh 1000. The manager utility function is as follows:

Money ksh	-1000	0	5000	20000	30000
Utility	-2	0	10	20	30

A new risky venture is proposed. The possible payoffs are either ksh 0 or ksh 20000

- Determine what probability combination of ksh 0 and ksh 20000 would make the manager indifferent to the certain ksh 10000. (7marks)
- Explain the limitations of utility functions. (3marks)

QUESTION FIVE (20 MARKS)

(a) A manager has a choice between;

A risky contract promising sh 7 million with a probability 0.6 and sh 4 million with a probability 0.4 and a diversified portfolio consisting of two contracts with independent outcomes each promising sh 3.5 million with probability 0.6 and sh 2 million with probability 0.4.

- (i) Construct a decision tree. (7marks)
- (ii) Using the decision tree diagram in (i) above and the EMV criterion, help the manager to make a choice. (3marks)

(b) In the past few years, the traffic problem in Lynn McKell's hometown have gotten worse. Now, Broad Street is congested about half the time. The normal travel time for Lynn is only 15 minutes when Broad Street is used and there is no congestion. With congestion, however, it takes Lynn 40 minutes to get to work. If Lynn decides to take the expressway, it will take 30 minutes regardless of the traffic conditions.

Lynn's utility for travel time is (15minutes) = 0.9, U (30minutes) = 0.7, U (40 minutes) = 0.2

- i) Determine which route will minimize Lynn's travel time. (5marks)
- ii) Determine which route will maximize Lynn's utility. (4marks)
- iii) With a reason is Lynn a risk seeker or a risk avoider. (1mark)