KIRIRI WOMENS' UNIVERSITY OF SCIENCE AND TECHNOLOGY
UNIVERSITY EXAMINATION, 2023/2024 ACADEMIC YEAR
THIRD YEAR, FIRST SEMESTER EXAMINATION
FOR THE DEGREE OF BACHELOR OF BUSINESS AND INFORMATION TECHNOLOGY

Date: 7th December, 2023
Time: 8.30am –10.30am

KMA 2304 - MATHEMATICAL METHODS FOR MANAGERIAL DECISIONS

INSTRUCTIONS TO CANDIDATES

ANSWER **QUESTION ONE (COMPULSORY)** AND **ANY OTHER TWO** QUESTIONS

QUESTION ONE (30 MARKS)

a) In every managerial decision making, there are three fundamental elements to be considered. Elaborate on these elements.

(5 marks)

b) A business owner is trying to decide whether to buy, rent, or lease office space and has constructed the following payoff table based on whether business is brisk, medium or slow.

Alternatives	State of Business		
	Brisk	Medium	Slow.
Buy	90	70	-10
Rent	70	60	40
Lease	60	50	55

Determine the optimal decision based on the following criteria

i)   Optimistic criterion. (2 marks)

ii) Minimax Savage criterion. (3 marks)

iii) Laplace equal likelihood method. (3 marks)

iv) Hurwicz Approach with probability of optimism $\alpha = 0.6$. (3 marks)

c)   Consider the following pay-off table.

Actions	State of Nature			
	S1	S2	S3	S4
A	70	100	100	130
B	220	50	90	120
C	90	80	80	100
Prob	0.32	0.25	0.28	0.15

Use the following criterion for decision making under risk environment to determine the optimal decision.

i) Expected Monitory Value.   (3 marks)

ii) Expected Opportunity Loss.   (3 marks)

iii) Return-To-Risk-Ratio.   (3 marks)

d)   Consider a for played by companies A and B. Company A has 4 strategies while B has 5 strategies at hand. The payoff table for company A is as shown below

		Company B				
		1	2	3	4	5
	I	1	3	2	7	4
Company	II	3	4	1	5	6
A	III	6	5	7	6	5
	IV	2	0	6	3	1

Reduce the game by domination property and solve it.

                                                                               (5 marks)

QUESTION TWO (20 MARKS)

An oil company has some land that is reported to possibly contain oil. The company classifies such land into four categories by the total number of barrels that are expected to be obtained from the well, i.e., a 500,000 – barrel well, 200,000 – barrel well, 50,000 – barrel well, and a dry well. The company is faced with deciding whether to drill for oil, to unconditionally lease the land or to conditionally lease the land at a rate depending upon oil strike. The cost of drilling the well is KES 15,000,000; if it is a producing well and the cost of drilling is KES 11,250,000 if it is a dry well. For producing well, the profit per barrel of oil is KES 750, (after deduction of processing and all other costs except drilling costs). Under the unconditional lease agreement, the company receives KES 6, 750,000 for the land whereas for the conditional lease agreement the company receives KES 75 for each barrel of oil extracted if it is a 500,000- or 200,000-barrel oil strike and nothing if otherwise. The probability for striking a 500, 000 – barrel well is 0.1, probability for striking a 200,000 – barrel well is .15, probability for striking a 50,000 – barrel well is .25, and probability for a dry well is 0.5.

a)   Make a profit payoff table for the oil company.

                                                                               (7 marks)

b)   Based on the payoff table formulated above, determine the optimal solution using the following criterions.

   i) Expected monetary value.

                                                                            (5 marks)

   ii) Return-to Risk Ratio.

                                                                            (5 marks)

c)   Find the Expected Value of the Perfect Information.

                                                                             (3 marks)

QUESTION THREE (20 MARKS)

ABC Products Company is investigating the possibility of producing and marketing backyard storage sheds. Undertaking this project would require the construction of either a large, medium or a small manufacturing plant. If the company decide to undertake the project, it may or may not conduct a marked survey before deciding on the size of the plant. The market survey costs KES 1,000,000. The market survey results can either be positive(with probability of 0.6) or negative (with probability 0.4). Whether the survey results are positive or not, the company can still continue with construction process. The market for the product produced—storage sheds—could be either favorable or unfavorable. ABC, of course, has the option of not developing the new product line at all. With a favorable market, a large facility will give ABC Products a net profit of KES 30,000,000. If the market is unfavorable, a KES 27,000,000 net loss will occur. A medium plant will result in a net profit of KES 22,000,000 in a favorable market, but a net loss of KES 10,000,000 will be encountered if the market is unfavorable. A small plant will result in a net profit of KES 15,000,000 in a favorable market, but a net loss of KES 3,000,000 will be encountered if the market is unfavorable. The probability of a favorable market is 0.7 while that of unfavorable market is 0.30 when survey results are positive. But if the survey results are negative, the probability of a favorable market is 0.3 and that of unfavorable market is 0.7. If the survey is not conducted, the probability of having favorable or unfavorable market is assumed to be 0.5(both equal).

a) Construct a decision tree, indicating the events and alternative courses of action.

                                                                            (8 marks)

b)   Use the constructed decision tree to;
   i)   Expected value for each node.

                                                                            (7 marks)

   ii) Optimal course of action.

                                                                            (3 marks)

c)   Why is decision tree more preferred to payoff table?

                                                                            (2 marks)

QUESTION FOUR (20 MARKS)

Two companies are competing for the same product. To improve its market share, company A decides to launch the following strategies. The company B decides to use media advertising to promote its product as follows

   • A1 = give discount coupons
   • A2 = home delivery services
   • A3 = free gifts
   • B1 = internet
   • B2 = newspaper
   • B3 = magazine

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A game is to be played by company A and company B as shown in the table below

		Company B		
		B1	B2	B3
	A1	3	-2	4
Company A	A2	-1	4	2
	A3	2	2	6

Let V = value of the game p1, p2 & p3 = probabilities of selecting strategies A1, A2 & A3 respectively and q1, q2 & q3 = probabilities of selecting strategies B1, B2 & B3 respectively.

a) Construct a standard form LP representing the game in the table above.

(6 marks)

b) Solve the LP in (a) using simplex methods. (10 marks)

c) Determine from the solution in (b), the best strategies for A and B and the value of the game.

(4 marks)

QUESTION FIVE (20 MARKS)

a) Consider the following payoff table,

Actions	Event		
	S_1	S_2	S_3
A	50	100	500
B	10	300	200
$P(S_j)$	0.8	0.1	0.1

Determine:

i) the optimal action using the Expected Monetary Value (EMV) criterion. (3 marks)

ii) the Expected Value of the Perfect Information (EVPI). (3 marks)

b) Suppose that an event F relies on the occurrence of a particular state of nature. the conditional probabilities are $P(F|S_1) = 0.2$, $P(F|S_2) = 0.4$ and $P(F|S_3) = 0.4$.

i) Suppose that you are informed that event F occurs, revise the probabilities $P(S_1)$, $P(S_2)$ and $P(S_3)$. (6 marks)

ii) Based on these revised probabilities, compute the expected monetary value of action A and action B. (3 marks)

iii) Compute Expected Value of Sample information. (3 marks)

iv) Determine the Efficiency of the Sample information. (2 marks)