MACHAKOS UNIVERSITY

University Examinations for 2024/2025 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

FIRST YEAR FIRST SEMESTER EXAMINATION FOR DEGREE IN BACHELOR OF ARTS IN PUBLIC ADMINISTRATION

APA 102: QUANTITAVE TECHNIQUES FOR POLICY MAKERS

DATE: 23RD JANUARY, 2025 **TIME: 8.30 AM – 10.30 AM**

INSTRUCTIONS:

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

QUESTION ONE (30 MARKS)

(a) Explain the following terms as used in quantitative techniques

(i) Square matrix

(ii) Pivot column (4 Marks)

(b) Differentiate between the terms definite and indefinite integrals. (4 Marks)

(c) State FOUR requirements of a linear programming problem. (4 Marks)

(d) State and explain THREE assumption of input-output model. (6 Marks)

(e) If the total cost are given by $c(x) = 360 + 10x = 0.2x^2$and the total revenue are given by $R(x) = 50x - 0.2x^2$

(i) Form the profit function (2 Marks)

(ii) Determine the maximum profit point (4 Marks)

(f) Given that $y = 2e^{3x}cos4x$, determine $\frac{dy}{dx}$

(6Marks)

QUESTION TWO (20 MARKS)

a) Explain the meaning of the following terms as applied in decision making

i) States of nature

ii) Pay-offs (4 Marks)

iii) State and explain the two types of nodes used in construction of Decision tree analysis. (4 Marks)

b) A manufacturer makes two products *m* and *n*, the cost of making 8 units of *m* and 5 units of *n* is sh 1400.The cost of making 3 units of *m* and 7 units of product *n* is sh 730.The manufacturer makes a profit of 30% and 40% on each unit of product *m* and product *n* respectively.

(i) Calculate the cost of making one unit of product *m* and product *n*. (8 Marks)

(ii) Calculate the selling price of one unit of product *m* and product *n*. (4 Marks)

QUESTION THREE (20 MARKS)

a) Solve the quadratic equation $6x^2 - 5x + 1 = 0$ (6 Marks)

b) State and explain the three parts (characterization) of formulation of a linear programming model. (6 Marks)

c) A businessman has three alternatives open to him each of which can be followed by any of the four possible events. The conditional payoff (in sh) 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

i) Laplace (Equally likely)) criterion. (4 Marks)

ii) Minimax regret criterion. (4 Marks)

QUESTION FOUR (20 MARKS)

a) A firm engaged in producing two models of machine X and Y performs only three operations-assembly, wiring and testing. The relevant data is as follows

	Hours required for each unit		
Unit sale price (Sh)	**Assembly**	**Wiring**	**Testing**
Model X:50	1.0	0.2	0.0
Model Y:80	1.5	0.2	0.1

The total number of hours available each week are as follows: Assembly=600, wiring=100, Testing=30.The firm wishes to determine its weekly product mix so as to maximize revenue

i) Formulate a linear programing model. (5 Marks)

ii) Solve using Simplex Method for the optimal solution. (5 Marks)

b) Given that $A = \begin{bmatrix} 2 & 2 \\ 3 & 1 \end{bmatrix}, B = \begin{bmatrix} 1 & 1 \\ 3 & 4 \end{bmatrix}, C = \begin{bmatrix} 3 & 1 \\ 2 & 2 \end{bmatrix}$ Show that

i) $(A+B)^T = A^T + B^T$ (3 Marks)

ii) $(AB)^T = B^T A^T$ (3 Marks)

iii) $(ABC)^T = C^T B^T A^T$ (4 Marks)

QUESTION FIVE (20 MARKS)

a) A company has its total cost function given by *TC = 600-5x* and the total revenue function given by *TR = 20 – x*; where x is the quantity of goods produced. Determine the firm's break even quantity. (8 Marks)

b) In a certain town, there are two supermarkets P and Q. During the month of April 2010, the market share of were 60% and 40% respectively. The table below shows a stable transition matrix.

	P	Q
P	0.7	0.3
Q	0.2	0.8

i) Interpret the values of 0.2 along the P column and 0.3 along the Q row of the transition matrix. (2 Marks)

ii) Determine the market shares in the month of June 2010. (3 Marks)

iii) Determine the long run equilibrium market share. (7 Marks)