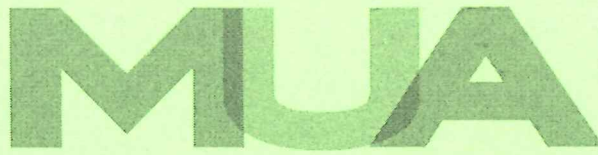


The  
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**UNDERGRADUATE UNIVERSITY EXAMINATIONS**

**SCHOOL OF MANAGEMENT AND LEADERSHIP**

**BACHELOR OF MANAGEMENT AND LEADERSHIP**

**BML 303 : OPERATIONS RESEARCH**

**DATE: 9<sup>TH</sup> APRIL 2024**

**DURATION: 2 HOURS**

**MAXIMUM MARKS: 70**

**INSTRUCTIONS:**

1. Write your registration number on the answer booklet.
2. **DO NOT** write on this question paper.
3. This paper contains **SIX (6)** questions.
4. Question **ONE** is compulsory.
5. Answer any other **THREE** questions.
6. Question **ONE** carries **25 MARKS** and the rest carry **15 MARKS** each.
7. **Write all your answers in the Examination answer booklet provided.**

**QUESTION ONE**

- a. Explain briefly the three techniques in transportation models used to determine the initial feasible solution. (6 marks)
- b. State any four assumptions used in game theory (4 marks)
- c. State any two assumptions underlying assignment models (2 marks)
- d. Consider the following payoff table indicating the results obtained when player Y applies strategies  $y_1, y_2, y_3, y_4$  and  $y_5$  indicated in columns and player X applies strategies  $x_1$  and  $x_2$  indicated in rows. Required to obtain the value of the game and optimal strategies for each player (7 Marks)

$$\begin{array}{c}
 \text{Y} \\
 \text{X} \begin{bmatrix} 6 & 3 & -1 & 0 & -3 \\ 3 & 2 & -4 & 2 & -1 \end{bmatrix}
 \end{array}$$

- e. Customers arrive at a service counter of a commercial bank at a mean arrival rate of 35 per minute. The mean service rate is 40 per minute. Calculate
- i. Average number of customers in the commercial bank hall (2 marks)
  - ii. The queue length (2 marks)
  - iii. Probability that the customer will have to wait (2 marks)

**QUESTION TWO**

- a) Define the following terms as used in decision making
- i. Saddle point (2 Mark)
  - ii. Game (1 Mark)
  - iii. Dominance (2 Mark)
- b) A team of 15 men is employed to unload Lorries at a terminal. The team works a 6-hour day during which 36 Lorries arrive and it takes  $7\frac{1}{2}$  minutes to unload one lorry with the team acting as a single unit. Lorries are served on a FIFO basis. It has been estimated that the cost of keeping Lorries waiting is Sh. 100 per hour. Members of the team are each paid Sh. 200 per hour. It is also estimated that if the size of the team increased to 20 men, the average service time would fall to 5 minutes.

**Required:** Determine whether it is worth to increase the size of the team (10 Marks)

**QUESTION THREE**

Consider the following transportation table for a minimization problem

		Destinations					Total Supply
		S1	S2	S3	S4	S5	
Sources	A1	10	4	8	6	6	50
	A2	6	2	2	1	7	45
	A3	2	11	6	7	5	35
	A4	8	15	5	9	1	50
Total Demand		45	25	40	32	38	180

**Required:**

Determine the initial basic feasible solution using:

- i. Least Cost Method (LCM) (4 marks)
- ii. North West Corner Rule (4 marks)
- iii. Vogel's Approximation Method (VAM) (7 marks)

**QUESTION FOUR**

- a) Outline the six phases of Operation research (3 Marks)
- b) A chain store manager has selected four employees in the marketing department and there are four products to be marketed in different locality. The employees differ in their efficiency and the products to be marketed differ in their intrinsic difficulty. This estimate of the times (in hours) each employee would take to market each product is given in the effectiveness matrix below:

EMPLOYEES	PRODUCTS			
	P1	P2	P3	P4
A	23	15	10	11
B	21	14	20	45
C	32	17	22	22
D	11	29	41	14

How should the products be allocated to an employee to as to minimize the total man hours (12 marks)

**QUESTION FIVE**

A producer of cooking oil produces two types of cooking oil Amimza and Lumo, requiring the same inputs. Inputs into the production processes are Man-hours, Machine-hours and Raw material. Each unit of the Lumo cooking oil uses 4 units, 12 units and 8 units of Man-hours, Machine-hours and raw-materials respectively while each unit of the Amimza cooking oil requires 8 units, 4 units and 8 units of Man-hours, Machine-hours and raw-materials respectively. During each workweek, there are 320 units, 480 units and 400 units of Man-hours, Machine-hours and raw materials respectively. Given that each unit of Lumo and Amimza contribute Ksh. 18 and Ksh. 12 towards total profit respectively.

**Required**

- a) Formulate a linear programming problem (3 Marks)  
 b) Obtain the optimal product mix using Simplex method (12 Marks)

**QUESTION SIX**

- a. Given the primal program as follows

$$\text{Max } Z = 2000X_1 + 1600 X_2$$

s.t

$$12X_1 + 4X_2 \leq 24 \dots\dots\dots R_1$$

$$20X_1 + 8X_2 \leq 48 \dots\dots\dots R_2$$

$$X_1, X_2 \geq 0$$

Suppose optimal solution is  $X_1 = 2$ ,  $X_2 = 4$  and maximum profit is 10,400. Also, suppose  $R_1$  increases by 20% and  $R_2$  decreases by 10%. Illustrate whether the new product mixes are feasible. (8 marks)

- b. Explain the following terms as used in operations research
- i. Duality (2 mark)
  - ii. Sensitivity analysis (2 mark)
  - iii. Transportation model (1 mark)
  - iv. Surplus variables (1 mark)
  - v. Unbound solution (1 mark)

**FORMULAS:**

$$g = \frac{\lambda}{\mu} \quad N_s = \frac{\lambda}{(\mu - \lambda)} \quad N_q = \frac{\lambda^2}{\mu(\mu - \lambda)} \quad T_s = \frac{1}{\mu - \lambda} \quad T_q = \frac{\lambda}{\mu(\mu - \lambda)}$$

