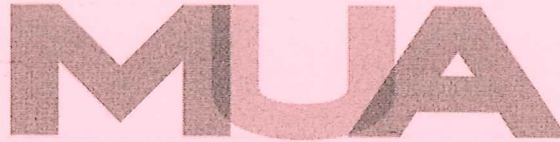


The
Management
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UNDERGRADUATE UNIVERSITY EXAMINATIONS
SCHOOL OF MANAGEMENT AND LEADERSHIP
BACHELOR OF MANAGEMENT AND LEADERSHIP

BML 303: OPERATIONS RESEARCH

DATE: 26TH MARCH 2025

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) Differentiate between the following terms as used in game theory (4 Marks)
- i. Dominance principle and Saddle point
 - ii. Pure strategy and Mixed strategy
- b) Examine any two models in Operation Research (4 Marks)
- c) A firm is engaged in both shipping and receiving activities. The management is always interested in improving the efficiency of new innovation in loading and unloading procedures. The arrival distribution of trucks is found to be poisson with arrival rate of 3 trucks per hour. The service time distribution is exponential and it takes 15 minutes to unload each truck.

Required:

Determine:

- i. Expected numbers of trucks in the queue (3 Marks)
- ii. Expected waiting time of the truck in the queue (2 Marks)
- iii. Expected waiting time of trucks in the systems (2 Marks)
- iv. Probability that the loading and unloading dock will be idle (2 Marks)

d) Given the following primal program

Objective Function, $Z = 9X_1 + 8X_2$ (Maximization)

Subject to;

$$6X_1 + 2X_2 \leq 12 \dots\dots\dots R_1$$

$$10X_1 + 4X_2 \leq 24 \dots\dots\dots R_2$$

$$X_1, X_2 \geq 0 \text{ (Non - Negativity conditions)}$$

Suppose optimal solution is $X_1 = 1$, $X_2 = 2$ and maximum profit is 8,000. Also, suppose R_1 increased by 10% and R_2 decreased by 20%.

Required:

- i. Find if the new product mix are feasible solution. (4 Marks)
- ii. Obtain the dual programme (4 Marks)

QUESTION TWO

- a) In a warehouse, customers draw materials from the store which currently has one staff. The owner of the warehouse is concerned about the time spent by customers in getting materials and has recommended the employment of labourer to assist the staff. On investigation it was found that: A simple queue exists; customer cost is Sh. 250 per hour; the staff cost Sh. 200 per hour and can deal with on average 10 customers per hour. A labourer could be employed at Sh. 175 per hour and the capacity of the warehouse would be 12 per hour in terms of service. On average 8 customers visit the store each hour.

Required:

- i. Find the percentage of time the staff is idle before the labourer is employed (2 Marks)
 - ii. How much time does the customers spend in the store after the labourer is employed? (2 Marks)
 - iii. Determine if it is worthwhile employing a labourer (4 Marks)
- b) A Furniture manufacturing firm has recorded the sales of tables over the last five weeks as shown in the table below:

Week	1	2	3	4	5	6
Sales of Tables (Ksh. '000')	8	10	11	15	23	?

Use the regression equation to predict the sales on the 6th week (7 Marks)

QUESTION THREE

- a) Consider the following pay off matrix for two competing firms in the market including: Firm A and Firm B.

	FIRM B				
FIRM A	b ₁	b ₂	b ₃	b ₄	b ₅
a ₁	3	-1	4	6	7
a ₂	-1	8	2	4	12
a ₃	16	8	6	14	12
a ₄	1	11	-4	2	1

Obtain the optimal strategies for each firm and the value of the game (7 Marks)

- b) Define the following terms as used in linear programming
- i. Infeasibility (2 Marks)
 - ii. Redundancy (2 Marks)

- iii. Multiple optimal solutions (2 Marks)
- iv. Shadow price (2 Marks)

QUESTION FOUR

- a) Explain three assumptions of the transportation model (3 Marks)
- b) Tea processing factory obtain their raw materials from farmers located in different places and after processing the final product is distributed through different centers. The information is as summarized below:

SOURCES	DESTINATIONS			
	A	B	C	TOTAL SUPPLY
1	6	8	10	150
2	7	11	11	175
3	4	5	12	275
TOTAL DEMAND	200	100	300	

Required:

Compute the initial basic feasible solution using:

- i. Least Cost Method (LCM) (3 Marks)
- ii. North West Corner Rule (NWC) (4 Marks)
- iii. Vogel's Approximation Method (VAM) (5 Marks)

QUESTION FIVE

- a) A computer centre has got four expert programmers and the center need a total of four application programmes which needs to be developed. The head of the computer centre, after studying carefully the programmes to be developed, estimates the computer time in minutes required by the respective experts to develop the application programmes as follows.

PROGRAMMERS	PROGRAMMES			
	APP ₁	APP ₂	APP ₃	APP ₄
Ann	120	100	80	90
Brendah	80	90	110	70
Caren	100	140	120	110
Dolphine	90	70	80	130

Required:

Assign the identified programmes to each respective programmer so as to minimize the processing time (10 Marks)

b) Describe the phases of operation research (5 Marks)

QUESTION SIX

a) Queuing is necessary evil. Discuss (5 Marks)

b) Some managers enrolled for two professional courses (Big Data and Accounting) which will require them to undergo through two processes including tuition and assessment. To master the contents adequately an average manager requires 80 minutes tuition and 30 minutes for assessment for Big Data course; and for Accounting course the manager requires 70 minutes for tuition and 40 minutes for assessment. However, the institution offering the courses has 100 hours for tuition and 120 hours for assessment available incase some managers need extra time. Its estimated that it would cost the managers \$25 to take a course in Big Data and \$30 to take a course in Accounting for all the credit hours.

Required:

Determine the optimal credit hours should the manager take for each of the course in order to minimize on the cost involved. Hint. Use simplex Method

(10 Marks)

FORMULAS:

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

.....

$$\hat{b} = \frac{n \sum XY - \sum X \sum Y}{n \sum X^2 - (\sum X)^2} \quad \hat{a} = \frac{1}{n} (\sum Y - \hat{b} \sum X) = \bar{Y} - \hat{b} \bar{X}$$

