The Management University of Africa

MUA

Sponsored by the Kenya Institute of Management

UNDERGRADUATE UNIVERSITY EXAMINATIONS

SCHOOL OF MANAGEMENT AND LEADERSHIP

DEGREE OF BACHELOR OF MANAGEMENT AND LEADERSHIP

BML 303: OPERATIONS RESEARCH

DATE: 2ND DECEMBER 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 following qualitative methods of forecasting that can be used in business management **(4 Marks)**

i. Nominal group

ii. Customer survey

iii. Executive opinion

iv. Delphi method

b) Suppose you are given the following linear programming problem:

Objective Function, $Z = 10x_1 + 30x_2$ (Minimization)

Subject to: $x_1 + 3x_2 \geq 21$ R1

$2x_1 + 4x_2 \geq 13$ R2

And $x_1, x_2 \geq 0$ (Non-Negativity Condition)

i. Obtain the dual programme from the optimal programme **(3 Marks)**

ii. Suppose R_1 decreases by 20% and R_2 increases by 10%, perform sensitivity analysis for new optimal solution **(4 Marks)**

c) Explain Vogels approximation method can be applied to determine the feasible solution for transportation model where total supply is not equal to total demand **(3 Marks)**

d) Two competitors Alex and Vincent applied different strategies to run their businesses. Alex's strategies best strategies are w, x and y whereas Vincent's strategies are p and q. Repeated application of their strategies led to the following results presented in a payoff table:

Vincent's Strategies	Alex's Strategies		
	w	x	y
P	-1	0	-3
q	-4	2	-1

Required: Obtain the value of the game and optimal strategies for each player **(6 Marks)**

e) Customers arrive at a fast-food hotel managed by a single cashier according to poison distribution with and one customer arrive every 10 minutes. The cashier attends the customers on first come first served basis at 10 customers per hour. Find the queue length and the traffic intensity **(5 Marks)**

QUESTION TWO

a) Define the term Simulation **(1 Mark)**

b) Explain the six phases of operation research **(6 Marks)**

c) Liberty tours and travel company has been using a bill board to advertise for their products for six months. The data related to the total sales and the cost of advertisement is as summarized below:

Period (Months)	Jan	Feb	March	April	May	June	July	Aug
Sales ($)	145	180	130	110	110	210	150	160
Cost of Advertisement ($)	137	110	70	80	87	91	102	90

Required:

i. By identifying appropriate dependent and independent variables, find the least square regression line. **(7 Marks)**

ii. Use the line to determine the cost of advertisement for a sale of $500 **(1 Mark)**

QUESTION THREE

Products from two sources A and B with resource quantities 27 and 24 units respectively are to be transported to four destinations W_1, W_2, W_3 and W_4 with demand quantities 10,11, 17 and 19 respectively. Unit transportation costs between locations are as follows:

	DESTINATIONS			
SOURCES	W_1	W_2	W_3	W_4
A	23	16	21	28
B	15	17	29	18

Find the minimum cost schedule using:

a) Least Cost Method **(5 Marks)**

b) North West Corner Method **(4 Marks)**

c) Vogel's Approximation Method **(6 Marks)**

QUESTION FOUR

a) Differentiate between:

i. Jockeying and Reneging **(2 Marks)**

ii. Balking and channels of queue **(2 Marks)**

b) Vehicles weighing machines at Mlolongo breaks down at the rate of 6 per hour. The cost of machine in the system is Sh. 800 per hour. The government is contemplating of engaging either of the two contractors to repair the machines. Contractor A charges Sh. 200 per hour and services the machine at the rate of 8 per hour whereas contractor B chargers Sh. 230 per hour and services the machines at the rate of 10 per hour. Assuming a work shift of 10 hours, which contractor should be engaged and why? **(11 Marks)**

QUESTION FIVE

a) A company has four jobs to be performed and has hired three labourers to perform the jobs. The estimates of the time, each labourer would have taken for the jobs to be performed is given below in the matrix.

	LABOURERS		
JOBS	**L_1**	**L_2**	**L_3**
J_1	9	26	15
J_2	13	27	6
J_3	35	20	15
J_4	18	30	20

Required:

Determine the allocation of the jobs is to be done so as to the labourer so as to minimize the time taken. What is the minimum time **(10 Marks)**

b) Giving examples to illustrate each case, differentiate between saddle point and dominance principal as applied in game theory **(5 Marks)**

QUESTION SIX

An Enterprise deals with production of smart watches, iPhones and iPads. The production of a smart watch requires a capital of Shs. 4000 and 400 hours of labour. The production of iPhone requires a capital expenditure of Shs. 2500 and 300 hours of labour. The production of iPad requires a capital expenditure of Shs. 3000 and 250 hours of labour. The firm has a Shs. 200,000 capital and 21,600 hours available for production of smart watches, iPhones and iPads. The firm makes a profit of Shs. 320 on each Smart watch, Shs. 220 on each iPhone and Shs. 280 on each iPad.

Required:

a) Formulate the mathematical model for this problem and solve the same using simplex method **(11 Marks)**

b) Obtain the dual programme and deduce its optimal product mix from the optimal tableau for question (a) above **(4 Marks)**

FORMULAS:

$\varrho = \frac{\lambda}{\mu}$ $\quad Ns = \frac{\lambda}{(\mu - \lambda)}$ $\quad Nq = \frac{\lambda^2}{\mu(\mu-\lambda)}$ $\quad Ts = \frac{1}{\mu-\lambda}$ $\quad Tq = \frac{\lambda}{\mu(\mu-\lambda)}$

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