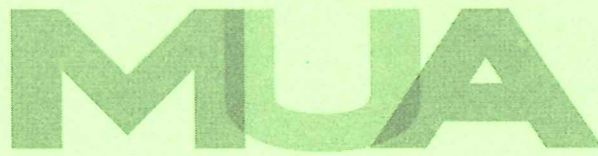


The
Management
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UNDERGRADUATE UNIVERSITY EXAMINATIONS

SCHOOL OF MANAGEMENT AND LEADERSHIP

DEGREE OF BACHELOR OF EDUCATION ARTS

BUS 307: QUANTITATIVE TECHNIQUES IN BUSINESS

DATE: 2ND AUGUST 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) Given that:

$$\text{Maximize, } Z = 2x_1 + 3x_2$$

$$\text{Subject to, } 2x_1 + x_2 \leq 4 \dots\dots\dots \text{resource 1 (R}_1\text{)}$$

$$x_1 + 3x_2 \leq 5 \dots\dots\dots \text{resource 2 (R}_2\text{)}$$

and $x_1, x_2 \geq 0$ (Non-Negativity condition)

Optimal solution: $x_1 = 1; x_2 = 2$ and $Z = 8$

Required:

Perform post-optimality analysis to obtain the new optimal solution and to check whether it is feasible assuming that resources R_1 increases by 20% and R_2 increases by 10% (6 Marks)

b) A team of 10 unloaders is employed by large warehouse to offload goods coming in. During an 8-hour day, 40 Lorries arrive and it takes the team 10 minutes to unload each lorry. Each team member is paid 300 shillings per hour and it costs 100 shillings per hour to keep a lorry in the systems. Studies show that increasing the team to 14 members would reduce the unloading time to 7 minutes. Would it be worthwhile increasing the team to 14? (5 Marks)

c) An economy has three main industries which are steel, motor vehicles and construction. The industries are interdependent. Each unit of steel output requires 0.2 units from steel, 0.3 units from motor vehicles and 0.4 units from construction. A unit of motor vehicles output requires 0.2 units from steel, 0.4 units from motor vehicles and 0.2 units from construction. A unit of construction output requires 0.3 units from steels, 0.4 units from motor vehicles and 0.1 units from construction. The final demand is 20 million units from steels, 50 million units from motor vehicles and 30 million units from construction.

Required:

i. Obtain the technical coefficient matrix (3 Marks)

ii. State three uses of input output analysis (3 Marks)

d) Find the optimum strategies and the value of the game from the following pay off matrix concerning two-person game

$$\begin{array}{c} \text{Player X} \\ \begin{bmatrix} 1 & 4 \\ 5 & 3 \end{bmatrix} \end{array}$$

Find the value of the game and the optimum strategies for each player (4 Marks)

e) A manufacturing project yields the following dependency table:

ACTIVITY	PRECEDING ACTIVITY
B, C, D	A
E, F	B
G	E
H	F
J	G, H, C, D
K	D
I	G, H
L	I, J, K

Draw a network for the project

(4 Marks)

QUESTION TWO

Suppose a situation where a farmer wants to plant one of the following crops (Maize, Beans, Rice or Wheat) and depend on the rainfall whose occurrence has been estimated to be low, medium, high or very high. The payoffs of each combination of alternative and rainfall conditions are given in the following table:

ALTERNATIVES	CONDITIONS			
	Low	Medium	High	Very high
Maize	27	12	14	26
Beans	45	17	34	20
Rice	52	36	27	15
Wheat	41	22	29	12

Required to advice on the optimal alternative the farmer should choose using:

- Optimistic Approach (2 Marks)
- Pessimistic Approach (2 Marks)
- Minimax criterion (3 Marks)
- Hurwitz criterion, $\alpha = 0.3$ (4 Marks)
- Laplace criterion (4 Marks)

QUESTION THREE

- a) A manufacturer of cooking fat produces two types of cooking fat Normal and Soft, requiring the same inputs. Inputs into the production processes are Man-hours, Machine-hours and Raw material. Each unit of the Soft cooking fat uses 4 units, 12 units and 8 units of Man-hours, Machine-hours and raw-materials respectively while each unit of the Normal cooking fat requires 8 units, 4 units and 8 units of Man-hours, Machine-hours and raw-materials respectively. During each work week, there are 320 units, 480 units and 400 units of Man-hours, Machine-hours and raw-materials respectively. Given that each unit of Soft and Normal contribute Ksh. 18 and Ksh. 12 towards total profit respectively.

Required

Identifying the suitable variables, formulate a linear programming model and solve the problem to obtain optimal product mix (9 Marks)

- b) There are 2,500 newly recruited cadets into the police force. Their average height was found to be 168 cm with a standard deviation of 5 cm. If the height is assumed to follow a normal distribution, then determine the number of cadets whose heights was:

- i. Greater than 158 cm (3 Marks)
 ii. Between 154 cm and 173 cm (3 Marks)

QUESTION FOUR

Murugi's Consortium is a consultancy firm dealing with advising Salon's businesses on Beauty Products within Eldoret town. The table below shows the implementation program of the project:

Activity	Immediate Predecessor	Optimistic Time (Weeks)	Most Likely Time (Weeks)	Pessimistic Time (Weeks)
A	-	2	3	5
B	-	1	2	3
C	A	2	4	6
D	B	3	4	7
E	A	5	6	8
F	D, E	4	6	7
G	B	1	2	3
H	C, F	1	3	5
I	G, H	2	3	5

Required:

- a) Draw the network diagram (3 Marks)
- b) Identify the critical path and project duration (7 Marks)
- c) What is the probability that the project will be completed between 20th week and 23rd week? (5 Marks)

QUESTION FIVE

- a) A certain type of machine breaks down at the rate of 5 per hour. The cost of machine in the system is Sh. 200 per hour. Two repairment, Wafula and Kamau have been interviewed. Wafula charges Sh. 70 per hour and services the machine at the rate of 7 per hour. Whereas Kamau chargers Sh. 100 per hour and services the machines at the rate of 9 per hour. Assuming a work shift of 8 hours, which repairman should be engaged and why? (7 Marks)
- b) A personnel manager wants to find out if a test carried out during an employee's interview and a skills assessment at the end of basic training is a guide to performance after working for the company for one year. The table below shows the results of the interview test of 10 employees and their performance for one year:

Employee	A	B	C	D	E	F	G	H	I	J
Interview test, x%	65	71	79	77	85	78	85	90	81	62
Performance after one year, y%	65	74	82	64	87	78	61	65	79	69

Predict the performance of an employee after one year who had scored 60% in the interview text (8 Marks)

QUESTION SIX

- a) A company uses special product which it orders from outside suppliers. Demand per annum is 2000 units, ordering cost sh. 20 per order, the holding cost is 20% of the item price and basic price per unit sh. 10. The company is offering the following discount on basic price.

QUANTITY ORDERED	DISCOUNT
200 - 210	5%
211 - 220	10%
221 - above	15%

Required:

- i. Calculate the EOQ using the basic price **(2 Marks)**
 - ii. Advise the company on the most economical ordering quantity and whether to go for the discount. **(8 Marks)**
- b) State five steps involved in decision making **(5 Marks)**

FORMULAS

$$\text{Variance} = \frac{\sum F(X - \text{mean})^2}{\sum F} \quad \text{or} \quad \text{Variance, } S^2 = \frac{\sum fx^2}{\sum f} - \bar{x}^2$$

$$\text{Standard deviation} = \sqrt{\frac{\sum F(x - \text{mean})^2}{\sum F}} \quad \text{or}$$

$$\text{Standard deviation, } S = \sqrt{\frac{\sum fx^2}{\sum f} - \bar{x}^2} \quad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

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

$$\text{EOQ} = \sqrt{\frac{2 \times CO \times D}{Ch}} \quad Ch = Cc = i \times C / \text{Units}$$

$$\text{Number of orders} = \frac{\text{Demand}}{\text{EOQ}}$$

$$\text{Total Cost (TC)} = D \times C / \text{units} + \frac{\text{EOQ}}{2} \times Ch + \frac{\text{Demand}}{\text{EOQ}} \times Co$$

$$\text{BEP}_{(\text{units})} = \frac{\text{Fixed Cost}}{\text{Revenue}_{\text{unit}} - \text{Variable}_{\text{cost}}_{\text{unit}}}$$

$$\text{Activity variance} = \left[\frac{p - o}{6} \right]^2$$

$$Z = \frac{(x - \text{Mean})}{\text{project standard deviation}}$$

$$\text{Input-Output Model, } X = (I_n - M)^{-1} \times d$$

