



MACHAKOS UNIVERSITY

University Examinations for 2018/2019 Academic Year

SCHOOL OF BUSINESS AND ECONOMICS

DEPARTMENT OF ECONOMICS

FOURTH YEAR SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF ECONOMICS AND STATISTICS

BACHELOR OF ECONOMICS

EES 402: OPERATIONS RESEARCH II

DATE: 23/9/2019

TIME: 2.00-4.00 PM

INSTRUCTIONS TO CANDIDATES

Answer Question **ONE** and any other **TWO** questions

QUESTION ONE (30 MARKS)

- a) At a certain Huduma Centre nine customers arrived every one hour to buy paints. The attendants took five minutes to serve each customer on average. Assuming that the arrivals follow a Poisson distribution and the serving time follows an exponential distribution, determine the following;

- i) The arrival and service rates (2 marks)
- ii) The percentage of time that there is no customer being served at the centre (2 marks)
- iii) The average number of customers in the station (2 marks)
- iv) The average number of customers waiting for their turn (2 marks)
- v) The average time a customer spends at the centre (2 marks)

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

- b) A construction project is composed of twelve activities whose description, relationships and durations in days indicated in brackets are described as follows:

- i) Draw the network diagram for this project.

(5 marks)

- ii) Determine the earliest and latest start times and finish times and hence the critical path and project duration,

(5 marks)

Activity	Pre-requisite Activity	Expected Time (days)
A	None	30
B	None	11
C	None	6
D	C	14
E	B	22
F	C	54
G	E & F	30
H	E & F	12
I	A	18
J	A	34
K	D, G, H & J	32
L	D & H	15

- c) A linear program is expressed as follows:

Minimize

$$W = 3y_1 + 2y_2$$

Subject to

$$y_1 + 3y_2 \geq 6$$

$$2y_1 + y_2 \geq 3$$

$$y_1 \geq 0, y_2 \geq 0$$

- i) State the corresponding dual maximization problem

(2 marks)

- ii) Solve the dual maximization problem to determine the solutions for the original minimization problem

(8 marks)

QUESTION TWO (20 MARKS)

The annual demand per item is 6400 units. The unit cost is £ 12 and the inventory carrying charges 25% per annum. If the cost of procurement is £ 300 determine the following

:

- i) Economic order quantity (EOQ) (5 marks)

- ii) No. of orders per year (5 marks)

- iii) Time between two consecutive orders (5 marks)

- iv) Optimal cost (5 marks)

QUESTION THREE (20 MARKS)

A farmer prepares a mixture of 2 animal feeds A and B for his cattle. Each unit of feed A contains 10gm. of protein and 20 gm. of carbohydrate and costs Kshs.180. Each unit of B contains 20gm. of protein and 25gm. of carbohydrate and costs Kshs.360. The mixture must contain at least 500gm. of protein and 800gm. of carbohydrate.

- a) Formulate a linear program (5 marks)
- b) Find the optimal mixture that minimizes the cost using graphical method (15 marks)

QUESTION FOUR (20 MARKS)

A Company has three depots, P, Q and R for its produce with capacity of 80, 240 and 280 units respectively. The depots supply the produce to four towns, A, B, C and D whose demands are 120, 120, 160 and 200 units respectively. The per unit transport costs in US Dollars from one depot to a given town are given in the table below.

		Towns			
		A	B	C	D
Depots	P	28	24	32	42
	Q	36	30	26	28
	R	38	38	32	26

Find the initial feasible solution for the transportation problem using the Vogel's Approximation Method and calculate the associated cost.

QUESTION FIVE (20 MARKS)

A steel manufacturing company makes three types of steel products labelled P, Q and R each of which requires three main inputs that comprise of certain amount of iron in kilogrammes, units of capital and labour-hours. Everyday the company has 150 Kgs of iron, 200 units of capital and 320 labour hours available for making these products. A unit of each of these products have the following requirements for the inputs as shown in the table below:

	P	Q	R
Iron	2	1	1
Capital	2	2	8
Labour	2	3	1

The price per unit of P, Q and R is \$ 30, 20 and 10 respectively.

- i) Formulate a linear program using the above information. (3 marks)
- ii) Solve the LP to determine the number of units for each product that the company should make to maximize its revenue. (15 marks)
- iii) Determine and interpret the dual price for capital. (2 marks)