MASENO UNIVERSITY

UNIVERSITY EXAMINATIONS 2016/2017

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR DEGREE OF BACHELOR OF BUSINESS ADMINISTRATION WITH INFORMATION TECHNOLOGY

CITY CAMPUS –EVENING

ABA 402: QUANTITATIVE METHODS II

Date: 23rd November, 2016 Time: 5.30 - 8.30pm

INSTRUCTIONS:

- Answer Question ONE (Compulsory) and any other THREE.

QUESTION ONE

(a) Define the following terms as used in Operations Research

i. Queue discipline.

ii. Assignment model.

iii. Simulation.

iv. Pay-off. [4 marks]

(b) Discuss the components of a queuing system. [4 marks]

(c) A company manufactures two types of boxes, corrugated and ordinary cartons. The boxes undergo two major processes: cutting and pinning operations. The profits per unit are Kshs. 6 and Kshs. 4 respectively. Each corrugated box requires 2 minutes for cutting and 3 minutes for pinning operation, whereas each carton box requires 2 minutes for cutting and 1 minute for pinning. The available operating time is 120 minutes and 60 minutes for cutting and pinning machines. Determine the optimum quantities of the two boxes to maximize the profits. Solve graphically. [5 marks]

(d) Find the optimal solution to the following TP.

		Warehouses					
		W1	W2	W3	W4	W5	Capacity
Factories	F1	4	1	3	4	4	60
	F2	2	3	2	2	3	35
	F3	3	5	2	4	4	40
	Demand	22	45	20	18	30	

[8 marks]

(e) A supermarket has two girls at the sales counter. People arrive according to a Poisson fashion at a rate of 10 per hour. If the service time is exponential with a mean of 4 minutes, find

i. Expected number of customers in the supermarket. [2 marks]

ii. Average waiting time for a customer for getting services. [2 marks]

iii. Probability for a customer has to wait for service. [2 marks]

iv. Percentage of idle time for the girls. [1 mark]

v. Mean queue-length. [2 marks]

QUESTION TWO

(a) Wheat is harvested in the Rift Valley and stored in grain elevators in the three towns Eldoret, Kericho and Nakuru. These grains elevators supply three mills that produce flour in Kisumu, Nairobi and Mombasa. Grain is shipped to the mills in railroads which are capable of holding one ton of wheat each. Each grain elevator is able to supply the following number of tons (i.e. railroad cars) of wheat to the mill on the monthly basis. Determine the transportation schedule and its cost.

Towns	Mills			
	Kisumu	Nairobi	Mombasa	Demand
Eldoret	6	8	10	200
Kericho	7	11	11	100
Nakuru	4	5	12	300
Supply	100	175	275	

[10 marks]

(b) What are the steps involved in a Monte Carlo simulation?. [5 marks]

(c) In linear programming, some assumptions are made on the contribution of each decision variables. Discuss briefly these assumptions. [5 marks]

QUESTION THREE

(a) Differentiate between assignment and transportation problem. [2 marks]

(b) Find the optimal assignment to the following AP

		Machine				
		A	B	C	D	E
Jobs	1	11	17	8	16	20
	2	9	7	12	6	15
	3	13	16	15	12	16
	4	21	24	17	28	26
	5	14	10	12	11	15

[5 marks]

(c) Construct the dual to the primal problem

$$\text{Maximize } Z = 6x_1 + 10x_2$$

Subject to constraints,

$$\begin{aligned} 2x_1 + 8x_2 &\leq 10 \\ 3x_1 + 5x_2 &\leq 45 \\ 5x_1 - 6x_2 &\leq 10 \\ x_2 &\leq 40 \end{aligned}$$

where $x_1, x_2 \geq 0$ [5 marks]

(d) Trucks at a single platform weigh-bridge arrive according to Poisson probability distribution. The time required to weigh the truck follows an exponential probability distribution. The mean arrival rate is 12 trucks per day, and the mean service rate is 18 trucks per day. Determine the following:

i. What is the probability that no trucks are in the system? [2 marks]

ii. What is the average number of trucks waiting for service? [2 marks]

iii. What is the average time a truck waits for weighing service to begin? [2 marks]

iv. What is the probability that an arriving truck will have to wait for service? [2 marks]

QUESTION FOUR

(a) Elucidate the main steps in simulation. [5 marks]

(b) At a man barber shop, customers arrive according to Poisson distribution with a mean arrival rate of 5 per hour and his hair cutting time was exponentially distributed with an average hair cut taking 10 minutes. It is assumed that because of his expertise customers were always willing to wait. Find

i. Average number of customers in the shop and the average number of customers waiting for a hair cut. [2 marks]

ii. The percent of time an arrival can walk right in without having to wait. [1 mark]

iii. The average time a customer spends in the shop. [2 marks]

(c) A company manufactures two types of models M_1 and M_2. Each M_1 model requires 4 hours of grinding and 2 hours of polishing while each M_2 model requires 2 hours of grinding and 5 hours of polishing. The company has two grinders and 3 polishers. Each grinder works for 40 hours a week and each polisher works for 60 hours a week. Profit on a M_1 model is Ksh 30 and that on M_2 model is Ksh 40. Formulate this as a LPP and solve it using simplex algorithm. [5 marks]

(d) A marketing manager has five salesmen and five sales districts. Considering the capabilities of the salesmen and the nature of districts, the marketing manager estimates that sales per month (in Kshs '000's) for each salesman in each district would be as follows. Find the assignment of salesmen to districts that will result in maximum sales.

		District				
		A	B	C	D	E
Salesman	1	32	38	40	28	40
	2	40	24	28	21	36
	3	41	27	33	30	37
	4	22	38	41	36	36
	5	29	33	40	35	39

[5 marks]

QUESTION FIVE

(a) Formulate the seven steps in methodology of Operations research. [7 marks]

(b) A farmer has a 320 acre farm on which she plants two crops corn and soya beans. For each acre of corn planted, her expenses are Ksh 50 and for soya beans Kshs 100. Each acre of corn requires 100 bushels of storage and yields a profit of Kshs 60,

each acre of soya beans requires 40 bushels of storage and yields a profit of Ksh 90. If the total amount of storage space available is 19200 bushels and and the farmer has only Ksh 20000 on hand, how many acres of each crop should she plant in order to maximize her returns. What will her profit be of she follows this strategy? Use simplex algorithm. [13 marks]