



# MACHAKOS UNIVERSITY

University Examinations for 2020/2021 Academic Year

SCHOOL OF BUSINESS AND ECONOMICS

DEPARTMENT OF ECONOMICS

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF ECONOMICS AND STATISTICS

BACHELOR OF ECONOMICS AND FINANCE

BACHELOR OF ECONOMICS

EES 302: OPERATIONS RESEARCH I

DATE: 13/8/2021

TIME: 8.30-10.30 AM

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## INSTRUCTIONS:

- (i) Answer Question **ONE** and any other **TWO** questions
- (ii) Show all your workings clearly

## QUESTION ONE (COMPULSORY) (30 MARKS)

- a) Marx Motors Ltd advertised four different models of cars for sale. Four potential customers gave various offers for each model in thousands of Kenya shillings as shown in the table below

Customer/ Model	Harrier KBS 345T	Lexus KCA 450D	Vitz KDB 287K	Fielder KBL 635N
Becky	480	600	450	600
Annah	720	900	500	600
Jerald	288	360	300	400
Eli	480	600	450	360

If each customer was to buy only one car determine the optimal sale assignment for the company in order to maximize revenue. Find the total revenue. (10 marks)

- b) 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.
- i. Formulate a linear program (3 marks)
  - ii. Find the optimal mixture that minimizes the cost using graphical method (7 marks)

- c) A real estate firm has been contracted to build a maisonette. The firm's planning department came up with the following project work plan.

Activity	Activity Description	Duration in Weeks	Preceding Activities
A	Resource mobilization	5	-
B	Land purchase	10	-
C	Architectural designs	3	A&B
D	Building approvals	8	B
E	Purchase of materials and equipment	2	B
F	Construction	20	A&B
G	Power installation	3	D&F
H	Furnishing	10	D&F
I	Sale	8	C&G

- (a) Set up the project network diagram showing the various activities and durations (4 marks)
- (b) Explain briefly three benefits of such a network diagram (3 marks)
- (c) Determine the critical activities and duration of the project (3 marks)

### QUESTION TWO (20 MARKS)

- a) Briefly explain five benefits of using quantitative techniques in decision making. (5 marks)
- b) A Company has three depots, P, Q and R for its produce with capacity of 24, 72 and 84 units respectively. The depots supply the produce to four towns, A, B, C and D whose demands are 36, 36, 48 and 60 units respectively. The per unit transport costs in US Dollars from one depot to a given town are given in the table below.

Depots/towns	A	B	C	D
A	26	22	30	40
B	34	28	24	26
C	36	36	30	24

- i. Find the initial feasible solution for the transportation problem using the least cost method and the associated transport cost. (5 marks)
- ii. Find the optimum transportation schedule and the minimum total cost of transportation. (10 marks)

**QUESTION THREE (20 MARKS)**

A trader buys fresh vegetables from the farmers in the upcountry and sell them at her grocery store in town. She buys the vegetables at KShs 100 and sells at KShs 600 per kilogram. From the past experience the daily demands for the vegetables at her store range from 10, 20, 30 and 40 kilograms. She supplies the vegetables in the same range of the demands and sells any vegetables that remain after every day at a nearby school at KShs 400 per kilogram.

- a) Generate a conditional pay-off table using the above information (10 marks)
- b) Determine her optimal strategy based on the following criteria:
  - i. Maximax criterion (4 marks)
  - ii. Maximin criterion (4 marks)
  - iii. Laplace criterion (2 marks)

**QUESTION FOUR (20 MARKS)**

- a) Explain five ways you can apply quantitative techniques to improve your daily productivity (5 marks)
- b) A toy manufacturing company makes three types of products labelled A, B and C. The production process requires three main inputs namely iron, plastics and labour. The following table gives the availability of the resources, their usage by the three products and selling price per unit in Kenya Shillings.

	Resource requirement per unit			
Resources/product	A	B	C	Daily Supply
Iron (Kgs)	4	2	2	30 Kgs
Labour (hours)	6	6	24	60 Hours
Plastics (Kgs)	2	3	1	32 Kgs
Price per unit(\$)	1200	800	400	

- i) Formulate a linear program using the above information. (3 marks)
- ii) Solve the linear program formulated in part a above to find the number of units for each type of product that the company should make in order to maximize its revenue. (12 marks)

**QUESTION FIVE (20 MARKS)**

a) Two economics students, Ben and Joseph, are playing the game of matching fair coins. If the coins match Ben gets KShs 800 from Joseph but if the coins do not match Joseph gets KShs 800 from Ben.

i) Generate a payoff matrix for the game (2 marks)

a) Determine the optimum strategies for the players and the value of the game. (6 marks)

b) A project has the following characteristics

Activity	Pre-requisite	Time		Cost	
		Normal	Crash	Normal	Crash
A	-	10	8	1000	1200
B	-	7	4	600	840
C	B	15	11	1200	1600
D	A&B	6	4	800	900
E	B	8	4	1300	1500
F	C & D	9	4	1500	2000
G	E&F	12	6	1800	3000
H	C&D	13	10	800	1100

i. Draw the network diagram and identify the critical path (5 marks)

ii. Find the normal project duration and the associated cost (3 marks)

iii. Crash the relevant activities systematically and determine the optimal Project time and cost. (4 marks)