



KENYATTA UNIVERSITY
UNIVERSITY EXAMINATIONS 2011/2012
SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR
OF SCIENCE

SMA 362/SST 201: OPERATION RESEARCH I

DATE: Tuesday, 3rd April, 2012

TIME: 11.00 a.m. – 1.00 p.m.

INSTRUCTIONS: Answer question ONE and any other TWO questions

QUESTION ONE (30 Marks)

(a) Differentiate between the following terms as used in Operation Research

- (i) Balanced and unbalanced transportation problems. (2 marks)
- (ii) Duality and sensitivity analysis (2 marks)
- (iii) State and transition matrix (2 marks)

(b) State and explain five application areas of Markov chains. (5 marks)

(c) Two manufacturers A and B are competing with each other in a restricted market. Over the years A's customers have exhibited a high degree of loyalty as measured by the fact that customers are using A's product 80% of the time. Also former customers purchasing the product from B have switched back to A's product 60% of the time.

- (i) Construct and interpret the state transition matrix (4 marks)
- (ii) If the current Market share for company A is 40% and that for company B is 60%, Determine the market shares of the two companies in the long run. (6 marks)

- (d) Tom and Jerry Ltd produces both interior and exterior paints from two raw materials, X and Y. The following table provides the basic data of the problem:

Raw materials	Tons of raw material per ton of		Maximum daily availability (tons)
	Exterior paint	interior paint	
X	6	4	24
Y	1	2	6
Profit per ton (in \$1000)	5	4	

A market survey indicates that the daily demand for interior paint cannot exceed that of exterior paint by more than 1 ton. Also, the maximum daily demand of interior paint is 2 tons. Formulate a linear model in order to determine the optimum product mix of interior and exterior paints that maximizes the total daily profit. (5 marks)

- (e) Giving an example, explain the objective of assignment problems. (4 marks)

QUESTION TWO (20 Marks)

- (a) Differentiate between a shortest route problem and a minimum span problem (2 marks)
- (b) Explain Five main steps involved in solving the shortest route problem (5 marks)
- (c) An individual who lives in Thika town Nairobi, Kenya and works in Westlands in Nairobi, Kenya seeks a cycling route that will minimize his morning cycling time (in minutes) along major highways connecting intermediate points/towns. This data is shown in the table below. A blank entry signifies that no major highway connects the two points.

Towns	Thika (T)	Juja (J)	Kiambu (K)	Forest road (F)	Town Center (T)	Westlands (W)
Thika (T)		18	-	32	-	-
Juja (J)	18	-	12	28	-	-
Kiambu (K)	-	12	-	17	-	32
Forest road (F)	32	28	17	-	4	17
Town Center (T)	-	-	-	4	-	11
Westlands (W)	-	-	32	17	11	-

(i) Develop a master list for the above problem. (3 marks)

(ii) Use the shortest route algorithm to find the shortest route from Thika to Westlands (10 marks)

QUESTION THREE (20 Marks)

The following is a Linear Programming, (LP) problem

$$\text{Maximize } Z = 10X_1 + 15X_2 + 20X_3$$

Subject to

$$2X_1 + 4X_2 + 6X_3 \leq 24$$

$$3X_1 + 9X_2 + 6X_3 \leq 30$$

$$X_1, X_2 \text{ and } X_3 \geq 0$$

(a) Develop the dual of the problem above. (5 marks)

(b) Write the standard form for the above LP problem (5 marks)

(c) Solve for the optimum values of solution, Z from the Linear Programming problem using the simplex method. (10 marks)

QUESTION FOUR (20 Marks)

- (a) Explain the objective of transportation problem (2 marks)
- (b) Give any two examples of transportation problems (2 marks)
- (c) Explain three steps in transportation algorithm (6 marks)
- (d) Karafu Transport Company ships truckloads of grain from three silos to four mills. The supply (in truckloads) and the demand (also in truckloads) together with the unit transportation costs per truckload (in USD) on different routes are summarised in the transportation model below.

		Mill				Supply
		1	2	3	4	
Silos	1	10	2	20	11	15
	2	12	7	9	20	25
	3	4	14	16	18	10
Demand		5	15	15	15	

Using the North West corner cell algorithm,

- (i) Determine the initial basic Feasible Solution (9 marks)
- (ii) Find the total least cost incurred by the company. (1 mark)

QUESTION FIVE (20 Marks)

- (a) Outline any three primary rules in constructing Activities On Arrows (AOA) diagram of a network. (3 marks)
- (b) Explain the meaning of the term *Critical path* of a network for a given project. (2 marks)

(c) The following table gives various activities that are scheduled to be undertaken by a business man before launching a new product in a market.

<u>PROJECT DETAILS</u>		
<u>Activity</u>	<u>Description</u>	<u>Immediate Precedence (Months)</u>
A	-	2
B	-	6
C	-	4
D	B	3
E	A	6
F	A	8
G	B	3
H	C,D	7
I	C,D	7
J	E	5
K	F,G,H	4
L	F,G,H	3
M	I	13
N	J,K	7

- (i) Construct the Critical path network (5 marks)
 - (ii) Determine the critical path (7 marks)
 - (iii) Find the project completion time (3 marks)
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END OF EXAMINATION