



KENYATTA UNIVERSITY
UNIVERSITY EXAMINATIONS 2008/2009
1st SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF
SCIENCE

SCE 433: OPERATIONAL RESEARCH

DATE: Tuesday 2nd December, 2008

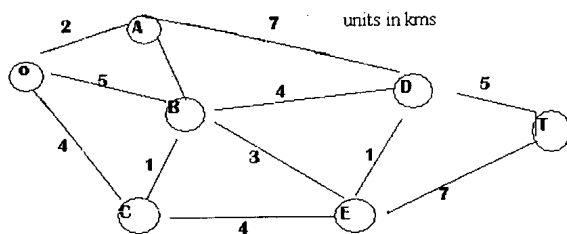
TIME: 2.00 p.m. – 4.00 p.m.

INSTRUCTIONS

Attempt question one and any other two questions.

Question One (30 marks)

- a) Define operations research stating two areas of its application (4 Marks)
- b) What are the basic requirements of transportation system for there to be a feasible solution (2 Marks)
- c) Briefly explain a dummy destination in a transportation system. (2 Marks)
- d) What is the relationship between a problem and its dual, using a specific example, give the economic interpretation of the dual of the problem. (5 Marks)
- e) The ministry of public works Kenya is to tarmac a road connecting two towns (from O to T) at the minimum cost possible through any of already established routes as shown in the figure below where the cost of tarmac is ksh. 275,000 per km regardless of the route. Find out the shortest route and the cost incurred.



(8 Marks)

Study the following scenario and answer question f, g and h

A firm produces two products X and Y with a contribution of Kshs 8 and Kshs 10 per unit respectively and wish to maximize profit. Production data per unit is as follows

Product	Labour Hrs	Material A	Material B
X	3	4	6
Y	5	2	8
Total available	500	350	800

- f) Formulate the linear programming made in the standardized manners. (3 Marks)
- g) Solve the model using the graphical method (3 Marks)

- h) Calculate the shadow prices of the binding constraints and interpret. (3 Marks)

Question Two

In an executive hotel, waiters collect food from the kitchen head cook. The hotel manager is concerned about the time waiters spend waiting their order to be served by the head cook and is contemplating on employing a cook to assist. The decision is based on the following

- Waiters cost ksh 20 per hr
 - The Head cook costs ksh18.50 per hour and can deal with 10 waiters per hour
 - A cook could be employed at ksh10 per hour and would increase the capacity of kitchen to handle 12 waiters per hour
 - On average 8 waiters visit the kitchen each hour
- a) Advise the hotel manager and prove your decision and the financial benefit the hotel will gain after implementing your proposal (10 Marks)

A manufacturer is to market a new fertilizer which is to be a mixture of two ingredients A and B. The properties of the two ingredients are.

	Bonus meal	Nitrogen	Lime	Phosphate	Cost kg
A	20%	30%	40%	10%	Kshs. 12
B	40%	10%	45%	5%	Kshs. 8

The ministry of Agriculture have decided that

- i) The fertilizer will be sold in bags containing 100kg
- ii) The bag must contain at least 15% nitrogen
- iii) It must contain at least 8% phosphate
- iv) It must contain at least 25% bone meal

The manufacturer wishes to meet the above requirement at the minimum.

- b) Develop the optimum equation and the constraints of the above situation (5 Marks)
- c) By use of the graphical method calculate the feasible solutions. (5 Marks)

Question Three

A car rental company is faced with an allocation problem resulting from rental agreements that allows cars to be returned to locations other than those at which they were originally rented. At the present time there are two locations with 15 and 13 surplus cars respectively, and four locations requiring 9, 6, 7 and 9 cars respectively. Unit transportation cost (in Ksh) between the locations are as follows.

	Destn	Destn	Destn	Destn
	1	2	3	4
Source 1	45	17	21	30
Source 2	14	18	19	31

- Setup the initial transportation tableau and calculate the initial cost. (6 Marks)
- Find the shadow costs (7 Marks)
- Improve the solution to obtain the optimal solution. (7 Marks)

Question Four

Global service Ltd (GSL) is in the process of introducing a new service. The technical manager has listed the following activities, their predecessors and associated costs.

Activity	predecessor	(week) expected time	cost (shs)
A	-	8	41,600
B	-	3	15,600
C	A	7	36,400
D	A	5	26,000
E	A	3	16,000
F	C	3	15,000
G	D	4	20,800
H	B,D,E	8	40,800
I	H	3	14,000
J	F,G,I	4	23,800

Workout the following

- The project network, critical path & expected project duration (6 Marks)
- If activity B is delayed by 3 wks, Activity E by 4 wks and activity F by 2 wks by how many weeks will the project time be delayed? (4 Marks)
- GSL has an expected revenue of Shs 5M projected if the project is completed within 30 wks, but if the deadline is not met, the expected revenue is only sh. 500,000 with a penalty of Shs. 750,000 being imposed. Compute the expected profit. (10 Marks)

Question Five

- Suppose that a fairly large Kitale farmer was producing wheat and maize. The profitability of these crops are Ksh. 400 and Kshs. 500 per unit of output of wheat & maize respectively.

During the coming plantation season, the farmer is faced with three primary constraints.

- i) Land (L) consists of 1500 acres with unit wheat requiring 5 acres and a unit of maize requiring 2 acres.
 - ii) Labour (N) consisting of 10 people with a unit of wheat requiring 0.03 men and a unit of maize requiring 0.02 men.
 - iii) Fertilizer (F) consisting of 1200 kg with a unit of wheat requiring 2 kg and unit of maize requiring 3 kg.
- a) Formulate a LP model in a standardized manner. (4 Marks)
 - b) Determine (using the simplex method) how much wheat & maize the farmer will produce if he wishes to maximize profits. (12 Marks)
 - c) What is the amount of profit earned at these output level and comment on your results. (4 Marks)