



KENYATTA UNIVERSITY
UNIVERSITY EXAMINATIONS 2009/2010
INSTITUTIONAL BASED PROGRAMME (AUGUST SESSION)
EXAMINATION FOR THE DEGREE OF MASTER OF SCIENCE IN
AGRIBUSINESS MANAGEMENT
KBT 523: OPERATIONS RESEARCH AND MANAGEMENT

DATE: THURSDAY 30TH DECEMBER 2010 TIME: 9.00 A.M. - 12.00 NOON

INSTRUCTIONS

Use of calculators is allowed.

Answer Question 1 and any other Three questions.

Question 1 (25 marks)

A certain feed manufacturer is considering buying two different commercial brands of broiler feed and blending them to provide a more effective, low-cost diet. The costs per kilogram of the commercial feed are Ksh20 for Brand 1 and Ksh25 for Brand 2. Each brand contains, in varying proportions, the four nutritional ingredients A, B, C, and D needed for proper growth of broilers. One kilogram of Brand 1 feed contains 14 gm of ingredient A and 60 gm of ingredient B. One kilogram of Brand 2 feed contains 28 gm of ingredient A and 30 gm of ingredient B. Ingredient C is only found in Brand 1 feed at 10gm per kg. Ingredient D is only found in Brand 2 feed at 30gm per kg. The minimum monthly ingredient requirements by broilers are: 140gm for A, 240gm for B, 10gm for C, and 60gm for D. The manager wants to know how much of each brand of commercial feed to buy in order to meet the minimum monthly requirements of the four ingredients while MINIMIZING THE COST of the homemade feed.

Let X_1 = number of kilograms of Brand 1 feed and X_2 = number of kilograms of Brand 2 feed.

Write all the answers to the following questions **STRICTLY ON THE GRAPH PAPER.**

- a) Formulate the linear programming problem (write down the equations that constitute the Linear Programming Model).
- b) Draw one **legible** graph to show the constraints stated in the problem. **Label clearly all the lines drawn and legibly write the appropriate value where any line drawn touches or crosses the axes.**

- c) Show the boundary of the feasible area in the graph you have drawn by writing "S S S S S S" a long its length.
- d) Given the prices stated above, draw an ISOCOST line on the graph you have drawn (label it DD) and use it to determine the least-cost combination of the Brand 1 and Brand 2 feeds. Calculate the resulting minimum cost.
- e) Assume that conditions change such that the price for Brand 1 feed is Ksh35 per kg but Brand 2 could be obtained for free from the neighbouring firm. Determine the least cost combination of Brand 1 and Brand 2 feed needed to minimize cost and the resulting minimum cost
- f) Assume that prices have changed to Ksh30 per kg for Brand 1 feed cost and Ksh15 per kg for Brand 2 feed. Draw another ISOCOST line (label it GG) and use it to determine the least-cost combination of the Brand 1 and Brand 2 feeds. State the unique characteristic of the resulting cost minimizing combination and give a reason

Question 2 (15 marks)

A tractor rental firm has accumulated excess tractors at three of tractor-leasing outlets 1, 2, and 3 and it has four outlets A, B, C, and D that have a shortage of tractors. The firm desires to transfer tractors from those with excess to those with shortage at minimum cost. The excess number of tractors, the shortages and unit transportation cost (\$) of a tractor from outlets with excess to those with shortage are shown as follows (Table 1):

Table 1					
To From	A	B	C	D	Excess tractors
1	70	80	45	90	70
2	120	40	30	75	115
3	110	60	70	80	60
Tractor shortage	80	50	90	25	245

Let X_{ij} be the number of tractors transported from outlet "i" with excess to outlet "j" with shortage.

- a) Find the initial solution using the NORTHWEST CORNER METHOD. Show the allocations in a table and compute the total cost for the solution.
- b) Find the initial solution using the LEAST COST METHOD. Show the allocations in a table and compute the total cost for the solution.

- c) Starting with the initial solution from the LEAST COST METHOD and seeking an improvement towards optimal solution using the STEPPING STONE METHOD, determine the non basic cell (route) that will be used FIRST and the AMOUNT of commodity it will take. HOW MUCH will the transportation cost be reduced by this move?
- d) Find the initial solution using THE VOGEL'S APPROXIMATION METHOD (VAM). Show the allocations in a table and compute the total cost for the solution.
- e) Starting with the initial solution from the NORTHWEST CORNER METHOD, and seeking an improvement towards optimal solution using the MODIFIED DISTRIBUTION METHOD (MODI), determine the non basic cell (route) that will be used FIRST and the AMOUNT of commodity it will take. HOW MUCH will the transportation cost be reduced by this move?

Question 3 (15 marks)

In the context of applying Management Science in decision-making:

- a) State and explain any TWO advantages of using mathematical models and for each, give an example. **(4 marks)**
- b) A common problem is stated as "garbage in garbage out". Outline this problem and give ONE way of overcoming it. **(4 marks)**
- c) Distinguish between an "objective function" and a "decision variable" by giving an example from a Transportation model. **(4 marks)**
- d) Physical inventory in a business "stores labour". Explain briefly using an example **(3 marks)**.

Question 4 (15 marks)

Consider the LP model shown in Table 2 below and one tableau of the simplex method (Table 3) used towards obtaining the profit maximizing combination of products X_1 and X_2 .

Table 2 Linear programming model		
Maximize	$Z = 300X_1 + 200X_2$	(profit)
Subject to		
	$5X_1 + 2X_2 \leq 180$	(labour)
	$3X_1 + 3X_2 \leq 135$	(material)
	$X_1, X_2 \geq 0$	

Table 3 Simple Tableau						
C_j		b_i	300 X_1	200 X_2	0 S_1	0 S_2
300	X_1	36	1	2/5 (A)	1/5	0
0	S_2	27	0	9/5	-3/5 (B)	1
	Z_j	****	7	120	60	0
	$C_j - Z_j$		0	80	-60 (C)	0 (D)

In Table 3

- Compute the appropriate value for cell ****. What does it mean? BE SPECIFIC.
- What does the value in the cell labelled A mean? BE SPECIFIC.
- What does the value in the cell labelled B? BE SPECIFIC
- What does the value in the cell labelled C mean? BE SPECIFIC.
- What does the value in the cell labelled D mean? BE SPECIFIC.
- Use Table 3 to make the tableau, which should come next. **Show all the necessary calculations.**

Question 5 (15 marks)

Chujaa Manufacturers are considering making a new easy to use knapsack sprayer in-house and have determined that setup costs would be \$90 in machinist time and lost production time, and 10 units can be produced in a day once the machine has been set up. The cost (including labour time and materials) of producing one unit is estimated at \$14. The carrying cost per unit per year is \$5. The demand is constant at 810 units per year. There are 270 working days per year for this firm.

Calculate the:

- Optimal production quantity (to the nearest whole unit)
- Time taken to produce the optimal quantity
- Amount of inventory sold during production time
- Maximum inventory level
- Annual carrying cost
- Annual setup cost
- Total annual inventory cost (including material cost)

Question 6 (15 marks)**a) (7 marks)**

A certain manager has four workers to be assigned four machines

WORKER \ MACHINE	A	B	C	D
1	10	2	8	6
2	9	5	11	9
3	12	7	14	14
4	3	1	4	2

- Determine the optimal assignment and compute the total cost
- Identify all alternative solutions if multiple optimal solutions exist

b) (8 marks)

Four jobs can be processed on four different machines. The profit generated depends on the machine used to process the job as shown

JOB \ MACHINE	A	B	C	D
1	42	35	28	21
2	30	25	20	15
3	30	25	20	15
4	24	20	16	12

- Write a table converting the problem in to a minimization problem.
- Solve the problem as a minimization assignment problem to determine the optimal allocation of jobs to machine that maximizes profit. What is the total profit?

=====