Uva Wellassa University
Faculty of Management
Degree of Bachelor of Business Management in Entrepreneurship and Management
THIRD YEAR SECOND SEMESTER EXAMINATION –AUGUST/ SEPTEMBER 2014
EMG 374-3- Scientific Decision Making

Instructions to candidates:
No. of pages : Six (06)
No. of questions : Seven (07)
Time allocation : Three (03) Hours
Marks allocation : Hundred (100) marks
Answer **only Six (06)** questions **including question No. 01.**

Index Number:

01. "Synergy Company Ltd;" produces two products on two machines. A unit of product 1 requires 2 hours on machine 1 and 1 hour on machine 2. For product 2, a unit requires 1 hour on machine 1 and 3 hours on machine 2. The revenues per unit of product 1 and 2 are Rs.30 and Rs.20, respectively. The total daily processing time available for each machine is 8 hours.

The newly appointed operations manager seeks your assistance in arriving at certain decisions. Thus, he has formulated the problem as a linear programming problem as arrived at the optimal solution also as follows.

X_1 – Number of Machine hours should be available at Machine 1

X_2 - Number of Machine hours should be available at Machine 2

$$\text{Max } Z = 30X_1 + 20X_2$$

St;

$$2X_1 + X_2 \leq 8 \text{ [Machine 1]}$$

$$X_1 + 3X_2 \leq 8 \text{ [Machine 2]}$$

$$X_1, X_2 \geq 0$$

The optimal production plan is as follows.

- Number of Machine hours should be available at Machine 1 – 3.2 hours
- Number of Machine hours should be available at Machine 2 – 1.6 hours
- Maximum profit = Rs.128

You are required to:

Advise the operations manager on the followings with justifications. Show you all workings related to the calculations.

i) If synergy can increase the capacity of both machines, which machine should receive a higher priority? (5 Marks)

ii) A suggestion is made to increase the capacity of machines 1 and 2 at the additional cost of Rs.10 per hour. Is this advisable? (5 Marks)

iii) If the capacity of machine 1 is increased from the present 8 hours to 13 hours, how will this increase impact the optimum revenue? (5 Marks)

iv) To which extent the coefficients of objective function will remain unchanged? (Hint: Post optimality analysis) (10 Marks)

(Total – 25 Marks)

02.

i) Paddy harvested in Anuradhapura District is stored in grain elevators in three different cities namely, Kakirawa (K), Padawiya (P) and Horowpathana (H). These grain elevators supply for three flour mills located in Madatugama (M), Tirappane (T) and Galnewa (G). Paddy is shipped to the mills in Lorries and each Lorry is capable of carrying one ton of Paddy. The area manager wants to determine the number of tons of paddy to be transported from each grain elevator to each mill on a monthly basis in order to minimize the total cost of transportation. Thus, he has formulated the problem as a mathematical model of a transportation problem and obtained the initial basic solution by using "Least Cost Method". He is seeking your assistance to find out the optimal solution as he doesn't know how to proceed. The initial basic solution is given below.

To / From	M	T	G	Supply
K	6	8 **25**	10 **125**	150
P	7	11	11 **175**	175
H	4 **200**	5 **75**	12	275
Demand	200	100	300	600

You are required to:

a) Determine whether the solution is a degenerate solution or not. (02 Marks)

b) Determine whether this solution is an optimal solution or not. (05 Marks)

c) Determine the tons of paddy to be transported from each grain elevator to each mill on a monthly basis in order to minimize the total cost of transportation. (08 Marks)

(Total – 15 Marks)

03. The Sri Lanka navy wishes to assign 4 ships (1, 2, 3 and 4) to patrol 4 areas (A, B, C and D) of the sea. Ships are being used to lookout for illegal fishing boats and to watch for enemy submarines. Therefore, the commander rates each ship in terms of its probable efficiency in each area and the relative efficiencies are given below.

Sea Area / Ship	A	B	C	D
1	20	60	50	55
2	60	30	80	75
3	80	100	90	80
4	65	80	75	70

If the commander wants to determine the patrols assignments producing the greatest over all efficiencies on the basis of the rating shown, what is the optimal assignment?

(Total – 15 Marks)

04. Consider the following project details of a manufacturing firm. The project management team has estimated the activity durations and related costs as follows.

Activity	Normal time (weeks)	Normal cost (Rs.)	Crash time (weeks)	Crash cost (Rs.)
1-2	3	1800	2	1900
1-3	8	60	6	100
2-4	4	1500	4	1500
2-5	13	300	10	900
3-5	6	1000	4	1200
3-6	5	400	2	1000
4-5	2	120	1	140
4-6	2	700	1	800
5-6	6	350	4	450

Further, it has been identified that the indirect cost of the project is Rs.90 per week.

i) Draw the network diagram and identify the critical path of completing this project. (07 Marks)

ii) If it is necessary to complete the project in 17 weeks, at what cost it could be achieved? (08 Marks)

(Total -15 Marks)

05. Assume that "The Nest Farm" is a recently established farm in your village. The farm owner is considering drilling a well. He has found that in the past only 85% of the wells had yielded water at a depth of 250 feet in the area. If no water found at a depth of 250feets, some persons drilled further down up to 300feets but there is only 25% possibility of finding water at the depth. The farm owner has estimated that the cost of drilling is Rs.35 per foot and also he will have to pay Rs.15000 over the next 10 years (In PV terms) to buy water from a neighbor if he does not have his own well. The farmer has the decision alternatives of "Do not drilling a well", "Drill up to 250feets" and "If no water is found at 250 feet drill up to 300feets".

The farmer is expecting your assistance in arriving at a decision scientifically.

You are required to:

i) Draw a decision tree to represent the situation. (07 Marks)

ii) Determine the strategy to be followed under the Expected Monetary Value approach. (08 Marks)

(Total – 15 Marks)

06. Consider a situation at a bank where the man arrival rate of customers is one customer every 4 minutes and the mean service time is 2.5 minutes.

i) How many customers are there in the queue in average? (02 Marks)

ii) What is the average length of the queue? (02 Marks)

iii) What is the average time a customer spends in the system? (03 Marks)

iv) What is the average time a customer waits before being served? (03 Marks)

v) The bank will open up a new counter when convinced that an arrival would expect to have to wait at least 2.5 minutes for the service. By how much must the flow of arrivals be increased in order to justify a second counter? (05 Marks)

(Total - 15 Marks)

07.

i) Chandler Distributors is an American water pumps distributor and has a demand for 1,000 water pumps each year. The cost of a pump is $50. It costs Chandler Distributors $40 to place an order, and the carrying cost is 25% of the unit cost. If pumps are ordered in quantities of 200, Chandler Distributors can get a 3% discount on the cost of the pumps. Should Chandler Distributors order 200 pumps at a time and take the 3% discount? (07 Marks)

ii) "Arms of Steel" is an organization that sells weight training sets. The new weight training set model that they sell is AS1 model. The carrying cost for the AS1 model is

Rs.500 per set per year. In order to meet the demand, Arms of Steel orders large quantities of AS1 seven times a year. The stock-out cost for AS1 is estimated to be Rs.5000 per set. Over the past several years, Arms of Steel has observed the following demand during the lead time for AS1:

Demand During Lead Time **(DDLT)**	Probability
40	0.1
50	0.2
60	0.2
70	0.2
80	0.2
90	0.1

The reorder point for AS1 model is 60 units. What level of safety stock should be maintained for the AS1 model? (08 Marks)

(Total - 15 Marks)