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SCHOOL OF ACCOUNTING AND BUSINESS
BSc. (APPLIED ACCOUNTING) GENERAL / SPECIAL DEGREE PROGRAMME

INTAKE II/III/IV – GROUP B

END SEMESTER EXAMINATION – OCTOBER 2016

QMT 20330 Operational Research

Date	:	23rd October 2016
Time	:	1.00 p.m. - 4.00 p.m.
Duration	:	Three (03) hours

Instructions to Candidates:

- Answer **ALL** questions.
- The total marks for the paper is 100.
- All questions carry equal marks.
- Use of scientific calculator is allowed.
- The Standard Normal Distribution Table and Formula Sheet are provided.
- Graph sheets will be provided on request
- Answers should be written neatly and legibly.

Question No. 01

The ‘AzA’ furniture company manufactures tables, chairs, desks, and bookcases. A table requires 5 feet of softwood and 2 feet of hardwood, and takes 3 hours of labour to produce. A chair requires 1 foot of softwood, 3 feet of hardwood, and 2 hours of labour. A desk requires 9 feet of softwood, 4 feet of hardwood, and 5 hours of labor. Finally, a bookcase requires 12 feet of softwood, 1 foot of hardwood, and 10 hours of labor to be produced.

The company has only 1500 feet of softwood, and 1000 feet of hardwood in their stocks. The factory employs 10 people, each of them work 8 hours per day and overtime is not permitted by the company. The firm plans its production for a 10-day period, according to the estimated demand projected by the sales manager. The sales manager has asked for at least 40 tables, 130 chairs, and 30 desks, and says he can sell any amount in excess of these minimum requirements. There is a little demand for bookcases, so there is no minimum requirement, but the sales manager does not think he could accept more than 10 for sale.

Softwood costs SLR 500 per foot, hardwood SLR 1000 per foot, and labor SLR 400 per hour. These products can be sold for the following prices:

Table, SLR 24800/ unit;
Chair, SLR 8400/unit;
Desk, SLR 10300/unit;
Bookcase, SLR 13900/unit.

Formulate this problem as a linear programming problem and solve using an appropriate method clearly showing all the details.

<u>Question No. 02</u>

The ‘HRC Concrete’ Company has plants in three locations and is currently working on three major construction projects, each located at different sites. The transporting cost per truckload of concrete, daily plant capacities, and daily project requirements are provided in the accompanying table.

		To			
		Project A	Project B	Project C	Plant Capacities
From	Plant I	1000	400	1100	70
	Plant II	1200	500	800	50
	Plant III	900	700	600	30
Project Requirements		40	50	60	150

i. Formulate an initial feasible solution to HRC’s transportation problem using Vogel’s Approximation Method.

ii. Solve the transportation problem using the Modified Distribution Method.

iii. Is there any alternative schedule to this problem? If so what is/are the alternative/s?

iv. If the HRC Concrete’s owner has decided to increase the capacity at his smallest plant to 60 loads, what would be the new optimal schedule?

v. How does the changing the third plant’s capacity altered the optimal transportation assignment?

Question No. 03

A logger has timber rights to two stands. The logger has contracted to provide a mill with 12 units of jack pine, 8 units of birch, and 24 units of aspen. It costs SLR 30000 /day to operate in stand 1 and SLR 16000/day to operate in stand 2. In a day's operation in stand 1, 6 units of jack pine, 2 units of birch and 4 units of aspen can be harvested and delivered. Similar numbers for stand 2 are 2 units of jack pine, 2 units of birch and 12 units of aspen.

i. Describe the logger's objective in words.
ii. Define the decision variables you will use in formulating this problem as a linear program.
iii. Identify the constraints in the given problem and write down its mathematical form.
iv. Formulate the linear programming problem which corresponds to the above problem.
v. Find the initial basic feasible solution
vi. Use an appropriate method to solve the linear programming model developed in part (iv) above.

Question No. 04

i. Why the knowledge on queuing theory is important for the operations manager, Discuss with the aid of practical examples.

ii. At the annual family picnic, lemonade is available for self-service. People line up at the jug and help themselves to a cup of lemonade. It was observed that the relatives use different sizes of cups and take different times for service. One of the family members observed that service times were exponentially distributed, with an average of 30 seconds to fill a cup. The relatives were arriving at various times during the afternoon at a rate of one for every minute following a Poisson distribution.
   a. Explain Kendal –Lee notation for M/M/1: $/\propto/\propto$ Model
   b. What proportion of the time the lemonade jug will be idling?
   c. How many people would you expect to see on average at the lemonade jug?
   d. How long would it take on average to get a cup of lemonade?
   e. What is the probability that there will be more than two people at the jug?
   f. Find the other steady state characteristics of this queuing model and interpret.

Question No. 05

i. A publisher has just signed a contract for the publication of a book. The tasks, precedence order and the time estimates for each tasks in weeks are provided in the following table.

			Time		
Activity	**Task**	**Precedence**	**Most Likely**	**Optimistic**	**Pessimistic**
A	Appraisal of book by reviewers	-	8	4	10
B	Initial pricing of book	-	2	2	2
C	Assessment of market ability	A,B	2	1	3
D	Revisions by author	A	6	4	12
E	Editing of final draft	C, D	4	3	5
F	Typesetting of text	E	3	3	3
G	Plates for art work	E	4	3	5
H	Designing and printing of jacket	C, D	6	4	9
I	Printing and binding of book	F, G	8	6	16
J	Inspection and final assembly	I, H	1	1	1

a. For this PERT network, find the expected task durations and the variances of task durations for the above PERT network.
b. Draw a network and find the critical activities.
c. Calculate the expected duration of the project
d. Find the probability that the duration of the project does not exceed 37 weeks

ii. ‘APX solutions’ has just received an order for some specially designed software. The contract states that it will incur a penalty of SLR 20000 per day penalty for each day the software is not delivered after 12^{th} day. The indirect costs of APX solutions are SLR 40000 per day. Direct cost data and activity precedence relationships are given below.

Activity ID	Immediate Predecessor	Normal Time	Crash Time	Normal Cost (SLR 000’s)	Crash Cost (SLR 000’s)
A	None	4	3	200	260
B	None	7	4	280	400
C	None	5	4	400	540
D	A	6	5	240	280
E	B	3	2	180	220
F	C	11	6	500	750
G	D,E	4	3	160	290
H	F,G	3	1	60	100

Use these data to recommend a completion date that will minimize the costs of APX solutions.

Formula Sheet

$$\rho = \frac{\lambda}{\mu}$$

$$P_0 = 1 - \frac{\lambda}{\mu}$$

$$P_n = P_0 \left[\frac{\lambda}{\mu}\right]^n$$

$$L_q = \frac{\lambda^2}{\mu(\mu - \lambda)}$$

$$L_s = \frac{\lambda}{\mu - \lambda}$$

$$W_q = \frac{\lambda}{\mu(\mu - \lambda)}$$

$$W_s = \frac{1}{\mu - \lambda}$$

$$t = \frac{a + 4m + b}{6}$$

$$\sigma_i = \sqrt{\frac{(b-a)^2}{6}}$$

$$\sigma = \sqrt{\sum \sigma_i^2}$$