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THE INSTITUTE OF CHARTERED ACCOUNTANTS OF SRI LANKA

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

YEAR II SEMESTER II (INTAKE III/IV – GROUP A)

END SEMESTER EXAMINATION – JULY 2016

QMT 20330 Operational Research

Date	:	18th July 2016
Time	:	9.00 a.m. – 12.00 p.m.
Duration	:	Three (03) hours

Instructions to Candidates:

- Answer **ONLY FIVE (05)** questions.
- The total marks for the paper is 100.
- All questions carry equal marks.
- Use of scientific calculator is allowed.
- Standard Normal Table and Formula Sheets are provided.
- Graph sheets will be provided on request
- Answers should be written neatly and legibly.

Question No. 01

Discuss the role played by the Management Science approaches in managerial decision making. Why is it important for a manager or decision maker to have a good understanding in this approach of decision making?

Question No. 02

A cargo plane has three compartments for storing cargo: front, centre and rear. These compartments have the following limits on both weight and space:

Compartment	Weight capacity (tonnes)	Space capacity (cubic metres)
Front	10	6800
Centre	16	8700
Rear	08	5300

Furthermore, the weight of the cargo in the respective compartments must be the same proportion of that compartment's weight capacity to maintain the balance of the plane.

The following four cargoes are available for shipment on the next flight:

Cargo	Weight (tonnes)	Volume (cubic metres/tonne)	Profit (£/tonne)
C_1	18	480	310
C_2	15	650	380
C_3	23	580	350
C_4	12	390	285

Any proportion of these cargoes can be accepted. The objective is to determine how much (if any) of each cargo C_1, C_2, C_3 and C_4 should be accepted and how to distribute each among the compartments so that the total profit for the flight is maximized.

i. Formulate the above problem as a linear program
ii. Briefly describe the advantages of using a software package to solve the above linear program, over a judgmental approach to this problem.

Question No. 03

The owner of a chain of fast-food restaurants is considering a new computer system for accounting and inventory control. A computer company sent the following information about the system installation:

Activity	Description	Immediate predecessor	Time (days)		
			Most optimistic	Most likely	Most pessimistic
A	Select the computer model	-	4	9	16
B	Design input/output system	A	6	11	20
C	Design monitoring system	A	5	12	19
D	Assemble computer hardware	B	15	26	37
E	Develop the main programs	B	10	21	32
F	Develop input/output routines	C	10	15	28
G	Create data base	E	6	12	18
H	Install the system	D, F	1	8	14
I	Test and implement	G, H	7	10	18

i. Calculate the expected duration and the standard deviation of the duration of each activity
ii. Draw the network diagram which represents the above activities incorporating all the required information
iii. Find the Early Start and Early Finish times of each activity using the Forward pass technique
iv. Find the Late Start and Late Finish times of each activity using the Backward pass technique
v. Find the Slack Time of each activity
vi. Identify the Critical Activities
vii. What is the minimum duration of installing the computer system?
viii. Determine the probability of completing the project in 50 days.

Question No. 04

A firm manufactures 3 products A, B and C. for which the profits are Rs. 300, Rs. 200 and Rs. 400 respectively. The firm has 2 machines X and Y. Product A requires 4 minutes of processing in machine X and 2 minutes of processing in machine Y. Similarly Products B and C require 3 and 5 minutes of processing in machine X and 2 and 4 minutes of processing in machine Y respectively.

Machine X and Y are available for 2000 and 2500 minutes respectively. The firm must manufacture at least 100 units of product A, at least 200 units of product B and at least 50 units of product C, but should not produce more than 150 units of product A.

i. Construct the linear programme corresponds to the above practical problem
ii. Find the initial basic feasible solution using an appropriate technique
iii. Get the next two iteration tableau using an appropriate technique.

Hint: Clearly show all your workings

Question No. 05

"PowerCo" has three electric power plants that supply the needs of four cities. Each power plant can supply the following numbers of kwh of electricity: plant I, 35 million; plant II, 50 million; and plant III, 40 million. The peak power demands in these cities as follows (in kwh): city I, 45 million; city II, 20 million; city III, 30 million; city IV, 30 million. The costs of sending 1 million kwh of electricity from plant to city is given in the table below. The Management of PowerCo is planning to minimize the cost of meeting each city's peak power demand.

	TO			
From	**City I**	**City II**	**City III**	**City IV**
Plant I	8	6	10	9
Plant II	9	12	13	7
Plant III	14	9	16	5

i. Find the Initial Basic Feasible Solution using the Vogals' Approximation method.
ii. Find the minimum possible cost schedule of sending electricity from the plants to the four cities using the Modified Distribution Method.
iii. What will be the cost if the "PowerCo" follows this transportation strategy?
iv. Does "PowerCo" have any alternative solution with the same transportation cost? Explain?

<u>Question No. 06</u>

i. Why the study of queuing theory is important for the operations manager, Discuss showing examples

ii. A tugboat serves ships arriving in a harbor. The average time between ship arrivals is 3 hours. The average time required to tow a ship to its berth is 2 hours. Studies have shown that ship arrivals are nearly Poisson and service time is exponentially distributed.
    a. Explain Kendal – lee notation for M/M/1 Model
    b. Calculate all the queuing performance statistics for this problem and interpret.
    c. If ships call another tugboat service whenever there are more than two ships in the harbor, what percentage of the ship arrivals are lost?
    d. A faster tugboat is being considered which will tow a ship to its berth in 1 hour. What effect will this have on waiting time and total times?

Formula Sheet

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

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

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

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

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

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

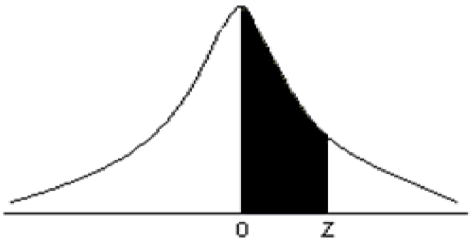
$$W_s = \frac{1}{\mu - \lambda}$$

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

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

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

Standard Normal Table



	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.49865	0.49869	0.49874	0.49878	0.49882	0.49886	0.49889	0.49893	0.49896	0.49900
3.1	0.49903	0.49906	0.49910	0.49913	0.49916	0.49918	0.49921	0.49924	0.49926	0.49929
3.2	0.49931	0.49934	0.49936	0.49938	0.49940	0.49942	0.49944	0.49946	0.49948	0.49950
3.3	0.49952	0.49953	0.49955	0.49957	0.49958	0.49960	0.49961	0.49962	0.49964	0.49965
3.4	0.49966	0.49968	0.49969	0.49970	0.49971	0.49972	0.49973	0.49974	0.49975	0.49976
3.5	0.49977	0.49978	0.49978	0.49979	0.49980	0.49981	0.49981	0.49982	0.49983	0.49983