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

YEAR II SEMESTER II END SEMESTER EXAMINATION – APRIL 2015

QMT 20330 Operational Research

Date	:	22nd April 2015
Time	:	9.00 a.m 12.00 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.
- Standard Normal Table and Formula Sheets are provided.
- Answers should be written neatly and legibly.

Question No. 01

- i. Discuss the different roles played by the qualitative and quantitative approaches of managerial decision making. Why it is important for a manager or decision maker to have a good understanding in both of these approaches of decision making?
- ii. A bank ATM machine can serve customers at an average rate of 20 customers per hour. Also, assume that the customers arrive at the teller's window at an average rate of 15 per hour. Arrivals are believed to follow the Poisson distribution and service time follows the exponential distribution. In the steady state,
 - a. When a customer arrives, what is the probability that the teller machine is idle?
 - b. What is the probability that the system has exactly 3 customers?
 - c. Calculate the other important performance characteristics of this queuing system and interpret each of the characteristics.

Question No. 02

The "ModernMen" manufacturer produces two types of men's T-shirt: with collar and without collar labeled style A and style B respectively. Each unit of style A needs one man-hour; while each unit of style B requires 2 man-hours. No more than 16 units of each style A and style B can be sold each day. Manpower capacity is limited to 24 hours a day. The contribution to profit of each unit of style A and style B is Rs. 400 and Rs. 550 respectively. Develop linear programming model that corresponds to this problem and solve.

Question No. 03

The Munchies Cereal Company makes a cereal from several ingredients. Two of the ingredients, oats and rice, provide vitamins A and B. The company wants to know how many grams of oats and rice it should include in each box of cereal to meet the minimum requirements of 48 milligrams of vitamin A and 12 milligrams of vitamin B while minimizing the cost. Thirty (30) grams of oats contributes 8 milligrams of vitamin A and 1 milligram of vitamin B, whereas Thirty (30) grams of rice contributes 6 milligrams of vitamin A and 2 milligrams of vitamin B. One kilogram of oats costs Rs. 1500, and one kilogram of rice costs Rs. 100. Formulate a linear programming model for this problem and solve using the simplex method.

Question No. 04

A manufacturer has distribution centers at P, Q and R. These centers have availability of 40, 20 and 40 units of his products respectively. His retail outlets A, B, C, D and E require 25, 10, 20, 30 and 15 units, respectively. The transport cost (in rupees per unit) between each center and outlet is given in the table below:

	Α	В	С	D	Ε	
Р	55	30	40	50	40	
Q	35	30	100	45	60	
R	40	60	95	35	30	

- i. Find the Initial Basic Feasible Solution using the Vogals' Approximation method.
- ii. Find the minimum possible transportation cost of shifting the product from the distribution centers to the five retail outlets using the Modified Distribution Method.
- iii. What will be the transportation cost if the manufacturer follows this transportation strategy?

iv. Does the manufacturer have any alternative solution with the same transportation cost? Explain?

Question No. 05

A construction company is preparing a PERT network for laying the foundation of a new cinema complex. Given below are the set of activities, their predecessor requirements and three estimates of the completion time.

		Time estimates (weeks)				
Activity	Predecessors	Optimistic	Pessimistic	Most likely		
А	None 02 04		04	03		
В	None	08	08	08		
С	А	07	11	09		
D	В	06	06	06		
Е	С	09	11	10		
F	С	10	18	14		
G	C, D	11	11	11		
Н	F, G	06	14	10		
Ι	E	04	06	05		
J	Ι	03	05	04		
K	Н	01	01	01		

i. Calculate the Mean duration for all the activities.

ii. Calculate the Standard deviation of duration for all the activities.

iii. Draw the PERT network clearly indicating all the necessary components.

- iv. Calculate the slack for each activity and determine the critical path.
- v. Find the Mean duration of the project and the standard deviation of the duration of the entire project.
- vi. The contract specifies a penalty of Rs. 25,000 for each week, if the completion of project extends beyond 37 weeks. What is the probability that this company will have to pay a maximum penalty of Rs.75, 000?

Formula Sheet

$$\rho = \frac{\lambda}{\mu}$$
 $P_0 = 1 - \frac{\lambda}{\mu}$
 $P_n = P_0 \left[\frac{\lambda}{\mu}\right]^n$

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

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

$$t = \frac{a+4m+b}{6} \qquad \sigma_i = \sqrt{\frac{(b-a)^2}{6}} \qquad \sigma = \sqrt{\sum \sigma_i^2}$$

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
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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	0.48/1	0.48/5	0.48/8	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
25	0.4029	0.4040	0.4041	0.4042	0.4045	0.4046	0 40 49	0.4040	0.4051	0 4052
2.5	0.4936	0.4940	0.4941	0.4943	0.4943	0.4940	0.4946	0.4949	0.4951	0.4952
2.0	0.4955	0.4955	0.4950	0.4957	0.4959	0.4900	0.4901	0.4902	0.4903	0.4904
2.7	0.4903	0.4900	0.4907	0.4908	0.4909	0.4970	0.4971	0.4972	0.4973	0.4974
2.0	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
2.9	0.4701	0.4702	0.4702	0.4705	0.4704	0.4704	0.4705	0.4705	0.4700	0.4200
3.0	0.49865	0.49869	0.49874	0.49878	0.49882	0.49886	0.49889	0.49893	0.49896	0.49900
3.0	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