

CEL 772 QUANTITATIVE METHODS IN CONSTRUCTION MANAGEMENT

Time allowed: 2 hour	MAJOR	Maximum Marks 40
WS 204	Time 1:00 to 3:00 PM	28.11.2006

Answer all questions. Assume any suitable data in case it is missing.

Q1	<p>Solve the following linear programming problem by dual simplex method</p> <p>Minimize $x_1 + 2x_2 + 3x_3$ Subject to: $x_1 + 3x_2 + 5x_3 \geq 7$ $2x_1 + 5x_2 + 7x_3 \geq 10$; $x_1, x_2 \text{ and } x_3 \geq 0$</p>	06																						
Q2	<p>A hardware company deals in drilling rod. The demand frequency of drilling rods and lead times for the same are given in the following two tables:</p> <p>Table: Demand frequency of drilling rod</p> <table> <tr> <th>Demand</th><th>frequency</th></tr> <tr> <td>0</td><td>15</td></tr> <tr> <td>1</td><td>30</td></tr> <tr> <td>2</td><td>60</td></tr> <tr> <td>3</td><td>120</td></tr> <tr> <td>4</td><td>45</td></tr> <tr> <td>5</td><td>30</td></tr> </table> <p>Table: Lead time frequency</p> <table> <tr> <th>Lead time</th><th>frequency</th></tr> <tr> <td>1</td><td>10</td></tr> <tr> <td>2</td><td>25</td></tr> <tr> <td>3</td><td>15</td></tr> </table> <p>Lead time of one day means, if the company orders today (28.11.2006 anytime), the drill rod would reach the company on 30.11.2006(morning). Assume the order quantity = 10, and reorder point =5 Simulate the process for a period of 10 days to get the following:</p> <ol style="list-style-type: none"> average ending inventory average lost sales average number of orders placed <p><i>Use random number table given with the question paper.</i></p>	Demand	frequency	0	15	1	30	2	60	3	120	4	45	5	30	Lead time	frequency	1	10	2	25	3	15	08
Demand	frequency																							
0	15																							
1	30																							
2	60																							
3	120																							
4	45																							
5	30																							
Lead time	frequency																							
1	10																							
2	25																							
3	15																							

Q 3	<p>A manufacturing firm produces two types of product A and B. According to the past experience, production of either product A or product B requires an average of one hour in the plant. The plant has a normal production capacity of 400 hours a month. The marketing department of the firm reports that because of limited market, the maximum number of product A and product B that can be sold in a month are 240 and 300 respectively. The net profit from the sale of product A and product B are Rs 800 and Rs 400 respectively. The manager of the firm has set the following goals (of equal importance).</p> <p>G1: He wants to avoid any underutilization of normal production capacity.</p> <p>G2: He wants to sell maximum possible units of product A and product B. Since the net profit from the sale of product A is twice the amount from that of product B, the manager has twice as much desire to achieve sales for product A as for product B.</p> <p>G3: He wants to minimize the overtime operation of the plant as much as possible.</p>	06
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Q4	<p>Five bids for five projects (1, 2, 3, 4, and 5) from five contractors A, B, C, D and E have been received by an owner. The details of the bid price (in million Rs.) of each contractor for each of the five projects are shown in the following table. The owner has decided to follow the policy of 'one contractor one project'. How should the owner allocate the projects to each of the contractors in order to have minimum total liability?</p>	06
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		Projects				
		(1)	(2)	(3)	(4)	(5)
Contractor	A	75	28	61	48	59
	B	78	71	51	35	19
	C	73	61	40	49	68
	D	55	50	52	48	63
	E	71	60	61	74	70

- Q 5 Company 'A' is trying to decide upon a strategy of winning contracts against company 'B' in a particular type of construction jobs. 'A' can adopt a mark-up of either 10% or 15%. 'B' on the other hand adopts a mark up of 10%, 12% and 15%. The pay offs for 'A' in Rs. are given below. Determine the best strategy for A and B and the corresponding probability values? 06

	B 10%	B 12%	B 15%
A 10%	200,000	300,000	-400,000
A 15 %	300,000	200,000	200,000

- Q 6 The marginal profit and marginal loss associated with a product A is Rs 2.75 and Rs. 4 respectively. The probability of selling 10 products is 10%. The chance of selling 15 products is 20%. There is a 30% chance that either 20 or 25 products will be sold. Finally, there is a 10% chance of selling 30 products. Based on these data what is your recommendation to the company as far as keeping stock of product A is concerned. 06

Table: Random Number

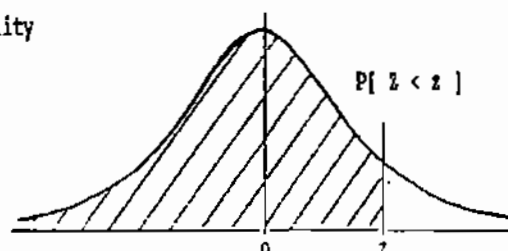
52 06 5088 53 30 10 47 99 37 66 91 35 32 00 84 57 07
 37 63 2802 74 35 24 03 29 60 74 85 90 73 59 55 17 60
 82 57 6828 05 94 03 11 27 79 90 87 92 41 09 25 36 77
 69 02 3649 71 99 32 10 75 21 95 90 94 38 97 71 72 49
 98 94 9036 06 78 23 67 89 85 29 21 25 73 69 34 85 76
 96 52 6287 49 56 59 23 78 71 72 90 57 01 98 57 31 95
 33 69 2721 11 60 95 89 68 48 17 89 34 09 93 50 44 51
 50 33 5095 13 44 34 62 64 39 55 29 30 64 49 44 30 16
 88 32 1850 62 57 34 56 62 31 15 40 90 34 51 95 26 14
 90 30 3624 69 82 51 74 30 35 36 85 01 55 92 64 09 85
 50 48 6118 85 23 08 54 17 12 80 69 24 84 92 16 49 59
 27 88 2162 69 64 48 31 12 73 02 68 00 16 16 46 13 85
 45 14 4632 13 49 66 62 74 41 86 98 92 98 84 54 33 40
 81 02 0178 82 74 97 37 45 31 94 99 42 49 27 64 89 42
 66 83 1474 27 76 03 33 11 97 59 81 72 00 64 61 13 52
 74 05 8282 93 09 96 33 52 78 13 06 28 30 94 23 37 39
 30 34 8701 74 11 46 82 59 94 25 34 32 23 17 01 58 73

STANDARD STATISTICAL TABLES

1. Areas under the Normal Distribution

The table gives the cumulative probability up to the standardised normal value z i.e.

$$P[Z < z] = \int_{-\infty}^z \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{1}{2}z^2\right) dz$$



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5159	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7854
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8804	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9773	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9865	0.9868	0.9871	0.9874	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9924	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9980	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
z	3.00	3.10	3.20	3.30	3.40	3.50	3.60	3.70	3.80	3.90
P	0.9986	0.9990	0.9993	0.9995	0.9997	0.9998	0.9998	0.9999	0.9999	1.0000