**PGDM, 2014-16**

**Management Science**

**DM-207A**

**Trimester – II, End-Term Examination: December 2014**

Time allowed: 2 hrs 30 min | Max Marks: 50

Roll No: _____

**Instruction:** Students are required to write Roll No on every page of the question paper, writing anything except the Roll No will be treated as **Unfair Means.** In case of rough work please use answer sheet.

## Section – A

**Attempt any 3 out of 5 questions from this section. Each question carries 5 marks .**

Question 1 Evening shift resident doctors in a government hospital work five consecutive days and have two consecutive days off. Their five days of work can on any day of the week and their schedule rotates indefinitely. The hospital requires the following minimum number of doctors to work on the given days:

| Sun | Mon | Tues | Wed | Thus | Fri | Sat |
|---|---|---|---|---|---|---|
| 35 | 55 | 60 | 50 | 60 | 50 | 45 |

No more than 40 doctors can start their five working days on the same day. Formulate this problem as an LP model to minimize the number of doctors employed by the hospital.

Question 2 Consider the following simplex tableau:

| $C_j$ | | | 3 | 5 | 4 | 0 | 0 | 0 |
|---|---|---|---|---|---|---|---|---|
| $C_B$ | B | b (= $X_B$) | $X_1$ | $X_2$ | $X_3$ | $S_1$ | $S_2$ | $S_3$ |
| 0 | $s_1$ | $b_1 = 8$ | 2 | 3 | 0 | 1 | 0 | 0 |
| 0 | $s_2$ | $b_2 = 10$ | 0 | 2 | 5 | 0 | 1 | 0 |
| 0 | $s_3$ | $b_3 = 15$ | 3 | 2 | 4 | 0 | 0 | 1 |
| | | $Z_j$ | 0 | 0 | 0 | 0 | 0 | 0 |
| | | $Z_j - C_j$ | -3 | - 5 | -4 | 0 | 0 | 0 |

a) Is this the initial tableau? How do you know?
b) What variables are in solution? What are their values?
c) What is the value of the objective function?
d) Is this solution optimal? How do you know?
e) Which variable will enter the solution and which variable will leave the solution?

Question 3 Will the northwest-corner solution rule always result in a higher total cost than the Vogel's approximation rule? Why, or why not?

Question 4 'Linear programming is one of the most frequently and successfully applied operations research technique to managerial decisions.' Elucidate this statement with some examples.

Question 5 Consider the assignment problem as shown in Table. In this problem, 5 different jobs are to be assigned to 5 different operators such that the total processing time is minimized. The matrix entries represent processing times in hours.

| | | Operator | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| Job | 1 | 10 | 12 | 15 | 12 | 8 |
| | 2 | 7 | 16 | 14 | 14 | 11 |
| | 3 | 13 | 14 | 7 | 9 | 9 |
| | 4 | 12 | 10 | 11 | 13 | 10 |
| | 5 | 8 | 13 | 15 | 11 | 15 |

## Section – B

**Attempt any 2 out of 3 questions from this section. Each question carries 10 marks.**

Question 1 A producer of pleasure boats wants to maximize revenue during the next month. Two types of boats sold, are $x1$ and $x2$. Type $x1$ sells for \$40,000 and type $x2$ sells for \$30,000. The $x1$ boats require 10 weeks of labor and 600 board feet of lumber each. The $x2$ boats need 3 weeks of labor and 1,000 board feet of lumber. There are 30 weeks of labor and 3,000 board feet of lumber available this season. Because of the desire to avoid ending up with uncompleted boats, the manager has specified that only integer solutions will be accepted. Use the branch and bound method to obtain the optimal solution. Illustrate the LP relaxation solution and the subproblems in a node diagram.

Question 2 Test the consistency of the following pairwise comparison matrix.

$$\begin{pmatrix} 1 & 5 & 7 \\ 1/5 & 1 & 6 \\ 1/7 & 1/6 & 1 \end{pmatrix}$$

Question 3 Consider the data of a project summarized in Table

| | | Duration (weeks) | | |
|---|---|---|---|---|
| Activity | predecessor(s) | To | Tm | Tp |
| A | -- | 4 | 4 | 10 |
| B | -- | 1 | 2 | 9 |
| C | -- | 2 | 5 | 14 |
| D | A | 1 | 4 | 7 |
| E | A | 1 | 2 | 3 |
| F | A | 1 | 5 | 9 |
| G | B, C | 1 | 2 | 9 |
| H | C | 4 | 4 | 4 |
| I | D | 2 | 2 | 8 |
| J | E, G | 6 | 7 | 8 |

a. Construct the project network.
b. Find the expected duration and the variance of each activity.
c. Find the critical path and the expected project completion time.
d. What is the probability of completing the project on or before 35 weeks?

## Section – C

**Compulsory Case Study (15 Marks)**

Harley's Sand and Gravel Pit has contracted to provide topsoil for three residential housing developments. Topsoil can be supplied from three different "farms" as follows:

| Weekly Capacity | Farm (cubic yards) |
|---|---|
| A | 100 |
| B | 200 |
| C | 200 |

Demand for the topsoil generated by the construction projects is

| Weekly Demand | Project (cubic yards) |
|---|---|
| 1 | 50 |
| 2 | 150 |
| 3 | 300 |

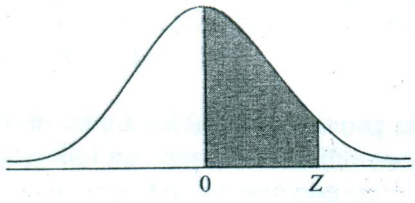
The manager of the sand and gravel pit has estimated the cost per cubic yard to ship over each of the possible routes:

**Cost per Cubic Yard to**

| From | Project #1 | Project #2 | Project #3 |
|---|---|---|---|
| Farm A | $4 | $2 | $8 |
| Farm B | $5 | $1 | $9 |
| Farm C | $7 | $6 | $3 |

This constitutes the information needed to solve the problem. Arrange the above information and find the optimum solution.

**Table A.4:**
Areas of the Standard Normal Distribution




The entries in this table are the probabilities that a standard normal random variable is between 0 and $Z$ (the shaded area).

| $Z$ | 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 | 0.4987 | 0.4987 | 0.4987 | 0.4988 | 0.4988 | 0.4989 | 0.4989 | 0.4989 | 0.4990 | 0.4990 |
| 3.1 | 0.4990 | 0.4991 | 0.4991 | 0.4991 | 0.4992 | 0.4992 | 0.4992 | 0.4992 | 0.4993 | 0.4993 |
| 3.2 | 0.4993 | 0.4993 | 0.4994 | 0.4994 | 0.4994 | 0.4994 | 0.4994 | 0.4995 | 0.4995 | 0.4995 |
| 3.3 | 0.4995 | 0.4995 | 0.4995 | 0.4996 | 0.4996 | 0.4996 | 0.4996 | 0.4996 | 0.4996 | 0.4997 |
| 3.4 | 0.4997 | 0.4997 | 0.4997 | 0.4997 | 0.4997 | 0.4997 | 0.4997 | 0.4997 | 0.4997 | 0.4998 |
| 3.5 | 0.4998 | | | | | | | | | |
| 4.0 | 0.49997 | | | | | | | | | |
| 4.5 | 0.499997 | | | | | | | | | |
| 5.0 | 0.4999997 | | | | | | | | | |
| 6.0 | 0.499999999 | | | | | | | | | |