

**PGDM (RM), 2017-19**  
**Management Science**  
**RM-206**

**Trimester – II, End-Term Examination: December 2017**

Time allowed: 2 hrs 30 min

Max Marks: 50

Roll No: _____
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**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 (3\*5=15 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** It has been said that each LP problem that has a feasible region has an infinite number of solution. Explain.

**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** Briefly explain Analytic hierarchy Process. 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 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 (2\*10=20 Marks)**

**Question 1** Innis Investments manages funds for a number of companies and wealthy clients. The investment strategy is tailored to each client's needs. For a new client, Innis has been authorized to invest up to \$1.2 million in two investment funds: a stock fund and a money market fund. Each unit of the stock fund costs \$50 and provides an annual rate of



return of 10%; each unit of the money market fund costs \$100 and provides an annual rate of return of 4%.

The client wants to minimize risk subject to the requirement that the annual income from the investment be at least \$60,000. According to Innis's risk measurement system, each unit invested in the stock fund has a risk index of 8, and each unit invested in the money market fund has a risk index of 3; the higher risk index associated with the stock fund simply indicates that it is the riskier investment. Innis's client also specified that at least \$300,000 be invested in the money market fund. Innis needs to determine how many units of each fund to purchase for the client to minimize the total risk index for the portfolio.

Find the dual of the above problem.

**Question 2** General Description- A firm that assembles computers and computer equipment is about to start production of two new Web server models. Each type of model will require assembly time, inspection time and storage space. The amount of each of these resources that can be devoted to the production of the server is limited. The manager of the firm would like to determine the quantity of each model to produce in order to maximize the profit generated by sales of these servers. Additional Information- In order to develop a suitable model of the problem, the manager has met with design and manufacturing personnel. As a result of those meeting, the manager has obtained the following information:

	Type 1	Type 2
<b>Profit per unit</b>	\$60	\$50
<b>Assembly time per unit</b>	4 hours	10 hours
<b>Inspection time per unit</b>	2 hours	1 hours
<b>Storage space per unit</b>	3 cubic feet	cubic feet

The manager also has acquired information on the availability of company resources. These amounts are:

Resources	Amount available
Assembly time	100 hours
Inspection time	22 hours
Storage space	39 cubic feet

The manager also met with the firm's marketing manager and learned that demand for the server was such that whatever combination of these two models of servers is produced, all of the output can be sold.

### Sensitivity Report

#### Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
\$C\$3 X1		9	0	60	40	10
\$D\$3 X2		4	0	50	10	20

#### Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
\$E\$6 LHS	Assembly time	76	0	100	1E+30	24
\$E\$7 LHS	Inspection time	22	10	22	4	4
\$E\$8 LHS	Storage space	39	13.33333333	39	4.5	6

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Based on the sensitivity report answer the followings:

- Reduced cost of X1 and X2 are zero. How it has been calculated?
- Explain shadow price in the sensitivity Report?
- What if would get an additional 4 hours of Inspection time by paying \$1 per hour more than usual? Would this be profitable?

Question 3 Consider the data of a project summarized in Table

Activity	predecessor(s)	Duration (weeks)		
		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

- Construct the project network.
- Find the expected duration and the variance of each activity.
- Find the critical path and the expected project completion time.
- 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 have 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	Project #1	Project #2	Project #3
From 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 optimal solution.