

**Second Semester M.B.A Degree Examination,
December 2005/January 2006****Master of Business Administration
Quantitative Techniques for Management**

Time: 3 hrs.)

(Max.Marks : 100)

- Note:** 1. Answer any FIVE full questions.
2. All questions carry equal marks

1. (a) Model building is an essence of operations research. Discuss briefly. (3 Marks)
- (b) Explain the scope and applications of operations research. (7 Marks)
- (c) A firm can produce 3 types of cloth, A, B and C. 3 kinds of wool are required Red, Green and Blue. 1 unit of length of type A cloth needs 2 meters of red wool and 3 meters of blue wool. 1 unit of length of type B cloth needs 3 meters of Red wool, 2 meters of green wool, and 2 meters of blue wool. 1 unit type of C cloth needs 5 meters of green wool and 4 meters of blue wool. The firm has a stock of 8 meters of red, 10 meters of green and 15 meters of blue. It is assumed that the income, obtained from 1 unit of type A is Rs.3, from B, Rs.5 and from C Rs.4. Formulate this as an LPP . (10 Marks)

2. (a) What do you understand by the terms basic feasible solution, optimum basic feasible solution, and unbounded solution. (3 Marks)
- (b) Briefly explain the concept of duality in LPP . Also write the dual of the following L_P problem.

$$\text{Minimise } Z_x = 3x_1 - 2x_2 + 4x_3$$

Stc

$$3x_1 + 5x_2 + 4x_3 \geq 7$$

$$6x_1 + x_2 + 2x_3 \geq 4$$

$$7x_1 - 2x_2 - x_3 \leq 10$$

$$x_1 - 2x_2 + 5x_3 \geq 3$$

$$4x_1 + 7x_2 - 2x_3 \geq 2$$

$$x_1, x_2, x_3 \geq 0$$

(7 Marks)

- (c) Use the graphical method to solve the following L_P problem.

$$\text{Minimise } Z = -x_1 + 2x_2$$

Stc

$$-x_1 + 3x_2 \leq 10$$

$$x_1 + x_2 \leq 6$$

$$x_1 - x_2 \leq 2$$

$$\text{and } x_1, x_2 \geq 0$$

(10 Marks)

Contd.... 2

3. (a) Write the general structure of a transportation problem. (3 Marks)

(b) Solve the following transportation problem and obtain the solution for maximum profit. Solve the above problem for initial feasible solution.

	A	B	C	D	Supply
x	12	18	06	25	200
y	08	07	10	18	500
z	14	03	11	20	300
Demand	180	320	100	400	

(7 Marks)

(c) The following table shows all the necessary information on the availability of supply to each warehouse, the requirement of each market and unit transportation cost (in Rs.) from each house to each market.

		Market				
		P	Q	R	S	Supply
Warehouse	A	6	3	5	4	22
	B	5	9	2	7	15
	C	5	7	8	6	8
	Demand	7	12	17	9	45

The shipping clerk has worked out the following schedule from experience. 12 units from A to Q, 1 unit from A to R, 8 units from A to S, 15 units from B to R, 7 units from C to P and 1 unit from C to R.

- Check and see if the clerk has the optimal schedule.
- Find the optimal schedule and minimum total transport cost.
- If the clerk is approached by a carrier of route C to Q, who offers to reduce his rate in the hope of getting some business, by how much the rate should be reduced before the clerk will offer him the business. (10 Marks)

4. (a) How is transportation different from an assignment problem? (3 Marks)

(b) A department has Four subordinates and four jobs have to be assigned to them. Find the best assignment using the following data. The time in hours each men will take to perform the job is given

		Subordinates			
		I	II	III	IV
Tasks	A	8	26	17	11
	B	13	28	4	26
	C	38	19	18	15
	D	19	26	24	10

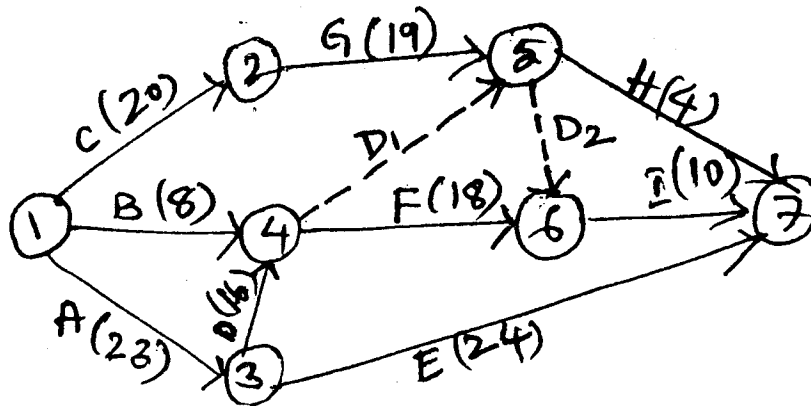
(7 Marks)

- (c) An airline company has drawn up a new flight involving five flights. To assist in allocating five pilots to the flights, it has asked them to state their preference scores by giving each flight a number out of 10. The higher the number, the greater is the preference. Certain of these flights are unsuitable to some pilots owing to domestic reasons. These have been marked with a X mark

	1	2	3	4	5
A	8	2	X	5	4
B	10	9	2	8	4
C	5	4	9	6	X
D	3	6	2	8	7
E	5	6	10	4	3

What should be the allocation of the pilots to flights in order to meet as many preferences as possible? (10 Marks)

5. (a) What do you understand by the term critical path in a network. (3 Marks)
 (b) What are the basic differences between PERT and CPM? (7 Marks)
 (c) A project consists of a series of tasks as given in the network. Find the critical path for the project. Find the total float for each activity in the network. Time is in weeks. (10 Marks)



6. (a) What do you understand by the terms pure and mixed strategies. (3 Marks)
 (b) Solve the game whose pay off matrix is given below. (use principle of dominance rule)

	Player B			
Player A	B_1	B_2	B_3	B_4
A_1	3	2	4	0
A_2	3	4	2	4
A_3	4	2	4	0
A_4	0	4	0	8

(7 Marks)

(c) Solve the following (2 x 3) game graphically

		Player B		
		I	II	III
Player A	I	1	3	11
	II	8	5	2

(10 Marks)

7. (a) What is a Poisson distribution? What are its parameters? (3 Marks)

(b) Explain the characteristics of normal distribution. (7 Marks)

(c) Customers arrive at the first class ticket counter of a railway station at the rate of 12/hour. There is one clerk serving the customers @ 30/hour.

- i) What is the probability that the system is idle?
- ii) What is the probability that there are more than 2 customers in the counter?
- iii) What is the probability that there are no customers to be served?
- iv) What is the probability that customer is being served and nobody is waiting?

(10 Marks)

8. (a) What do you understand by the term simulation? (3 Marks)

(b) Briefly explain the Monte Carlo technique of simulation. (7 Marks)

(c) A Bakery keeps stock of a popular brand of cakes. Previous experience shows the daily demand pattern for the item with the associated probabilities as given below.

Daily demand	Probability
0	0.01
10	0.20
20	0.15
30	0.50
40	0.12
50	0.02

Use the following sequence of random numbers to simulate the demand for next 10 days

Random numbers → 25, 39, 65, 76, 12, 05, 73, 89, 19, 49

(10 Marks)

* * * * *

2

USN

3									
---	--	--	--	--	--	--	--	--	--

NEW SCHEME

Second Semester MBA Degree Examination, July 2006
Master of Business Administration
Quantitative Techniques for Management

Time: 3 hrs.]

[Max. Marks: 100

Note: 1. Answer any FIVE full questions.

- 1 a. What are the situations where OR techniques will be applicable? (03 Marks)
 b. Write briefly about the following terms. (07 Marks)
 i) Iconic model ii) Analogue model iii) Mathematical model
 c. List and explain the limitations of operations Research (10 Marks)
- 2 a. Differentiate (03 Marks)
 i) feasible solution and optimum solution
 ii) unique and multiple solution
 iii) slack and surplus variable
 b. Write the dual of the following LPP (07 Marks)
 Min $Z = 3x_1 + 2x_2$
 Subject to,
 $x_1 - x_2 \leq 1$
 $x_1 + x_2 \geq 3$
 $x_1, x_2 \geq 0$ (07 Marks)
- c. Solve the following LP problem (10 Marks)
 Max $Z = 10x_1 + 15x_2$
 $2x_1 + x_2 \leq 26$
 $2x_1 + 4x_2 \leq 56$
 $x_1 - x_2 \geq -5$
 $x_1, x_2 \geq 0$ (10 Marks)
- 3 a. What are the characteristics of a transportation techniques? (03 Marks)
 b. A project work consists of four major jobs for which an equal number of contractors have submitted tenders. The tender amount quoted (in lakhs of rupees) is given in the matrix.

		Job			
		a	b	c	d
Contractor	1	10	24	30	15
	2	16	22	28	12
	3	9	26	32	10
	4	9	26	34	16

Find the optimal assignment (07 Marks)

- c. A steel company has three open hearth furnaces and five rolling mills. Transportation costs (rupees per quintal) for shipping steel from furnaces to rolling mills are shown in the following table:

	M ₁	M ₂	M ₃	M ₄	M ₅	Supply
F ₁	4	2	3	2	6	8
F ₂	5	4	5	2	1	12
F ₃	6	5	4	7	7	14
Demand	5	4	6	9	10	

What is the optimal shipping schedule? (10 Marks)

Contd....2

- 4 a. Compare CPM and PERT (03 Marks)
 b. Explain the following terms in PERT
 i) Three time estimates
 ii) Expected time of an activity
 iii) Normal distribution for project completion time (07 Marks)
 c. A small project consists of seven activities, the details of which are given below:

Activity	Immediate Predecessor	Duration (days)		
		Most likely	Optimistic (O)	Pessimistic
A	-	3	1	7
B	A	6	2	14
C	A	3	3	3
D	B, C	10	4	22
E	B	7	3	15
F	D, E	5	2	14
G	D	4	4	4

Draw the network and determine the critical path (10 Marks)

- 5 a. Define the following terms.
 i. Zero-sum game ii. Maxmin and Minmax policy (03 Marks)
 b. Solve the following game

		Player B			
		B ₁	B ₂	B ₃	
Player A	A ₁	(	4	2	4
	A ₂		2	4	0
	A ₃		4	0	3
)			

(07 Marks)

- c. Use the graphical method to solve the following game:
 Player B

Player A	(	2	2	3	-2
		4	3	2	6
)				

(10 Marks)

- 6 a. What is the standard notation for queuing model? (03 Marks)
 b. Explain the arrival process and service process of a queuing model (07 Marks)
 c. A repair shop attended by a single mechanic has an average of four customers an hour who bring small appliances for repair. The mechanic inspects them for defects and renders a diagnosis. This takes him six minutes on an average. Arrivals are poisson and service time has the exponential distribution. You are required to
 i. Find the proportion of time during which the shop is empty
 ii. Find the probability of finding atleast one customer in the shop
 iii. Find the average number of customers in the system
 iv. Find the average time spent, including service by a customer. (10 Marks)

- 7 a. What are the characteristics of Binomial distribution? (03 Marks)
 b. Output of a production process is known to be thirty percent defective. What is the probability that a sample of 5 items would contain 0, 1, 2, 3 and 4 defectives? (07 Marks)
 b. A bag contains 4 red and 3 blue balls. Two drawings of two balls each are made. Find the chance that the first drawing gives two red balls and second drawing two blue balls
 i) if the balls are returned to the bag after the first draw.
 ii) if the balls are not returned. (10 Marks)

- 8 a. What is random number? (03 Marks)
b. Define Monte Carlo simulation. Describe various steps in Monte Carlo simulation (07 Marks)
c. Bright Bakery Keeps stock of a popular brand of cake. Previous experience indicates the daily demand as given here.

Daily demand	0	10	20	30	40	50
Probability	0.01	0.2	0.15	0.50	0.12	0.02

Simulate the demand for the next 10 days using following sequence of random number 48, 78, 19, 51, 56, 77, 15, 14, 68, 09.

Find out the stock situation if the owner decides to make 30 cakes every day.

(10 Marks)

USN

--	--	--	--	--	--	--	--	--	--	--	--

NEW SCHEME

Second Semester M. B. A. Degree Examination, Dec.06/Jan. 07
Business Administration
Quantitative Techniques for Management
 [Max. Marks:100]

Time: 3 hrs.]

- Note: 1. Answer any FIVE full questions.**
2. Use of statistical tables permitted.

- 1 a. Define Operations Research. (03 Marks)
 b. Explain the characteristics of Operation Research. (07 Marks)
 c. Consider the following problem faced by a production planner in a soft drink plant. He has two bottling machines A and B. A is designed for 8 – ounce bottles and B for 16 – ounce bottles. However, each can be used on both types with some loss of efficiency. The manufacturing data is as follows.

Machine	8 – ounce bottles	16 – ounce bottles
A	100/minutes	40/min
B	60/minutes	75/min

The machines can run 8 – hours per day, 5 days per week. Profit on an 8 – ounce bottle is 15 paise and on a 16 – ounce bottle 25 paise. Weekly production of the drink cannot exceed 3,00,000 ounce and the market can absorb 25,000, 8 – ounce bottles and 7000, 16 – ounce bottles per week. Formulate this problem as LPP. (10 Marks)

- 2 a. It has been said that each LP problem that has a feasible region has an infinite number of solutions. Explain. (03 Marks)
 b. Explain Infeasible and unbounded solution using the graphical solution approaches of LP. (07 Marks)
 c. Solve the following LP problem using the corner point graphical method : (10 Marks)

Maximize profit = $4x + 4y$
 Subject to : $3x + 5y \leq 150$
 $x - 2y \leq 10$
 $5x + 3y \leq 150$
 $x, y \geq 0.$

- 3 a. Is the transportation model an example of decision making under certainty or decision making under uncertainty? Why? (03 Marks)
 b. A Company has four districts I, II, III and IV to sell its production, and four salesmen A, B, C and D for it. The district wise sales – record of each salesman is as given in the table. Determine the area allocation so as to make the sales maximum. (use Hungarian method). (07 Marks)

Salesmen	Districts			
	I	II	III	IV
A	420	350	280	210
B	300	250	200	150
C	300	250	200	150
D	240	200	160	120

(07 Marks)

Contd... 2

- c. A particular product is manufactured in factories A, B, C, and D; and is sold at centres 1, 2 and 3. The cost in rupees of product per unit and capacity of each plant is given below :

Factory	Cost (Rs) Per unit	Capacity
A	12	100
B	15	20
C	11	60
D	13	80

The sale price in Rs per unit and the demand are as follows :

Sales Centre	Sales Price (Rs) per unit	Demand
1	15	120
2	14	90
3	16	50

Find the optimal sales distribution.

- 4 a. What are some of the questions that can be answered with PERT and CPM? (03 Marks)
 b. A project was planned using PERT with three time estimates. The expected completion time of the project was determined to be 40 weeks. The variance of the critical path is 9. (07 Marks)
 i) What is the probability that the project will be finished in 40 weeks or less?
 ii) What is the probability that the project takes longer than 46 weeks?
 iii) The project manager wishes to set the due date for the completion of the project so that there is a 90% chance of finishing on schedule. What should this due date be?
 c. For the following project, i) Draw the network ii) Determine the total float and free float. iii) Find the critical path. (10 Marks)

Activity :	A	B	C	D	E	F	G	H	I	J
Predecessor :	-	-	A,B	B	A	C	E,F	D,F	G,H	I
Duration (Week) :	2	3	4	1	5	3	2	7	6	3

- 5 a. How is Saddle point found in a game? (03 Marks)
 b. The Squadron of Sqdn. Leader Kumar is equipped with six Big – 27 fighters. The enemy is using $x - 16$ fighters. In combat the two types of planes are matching and they fight to draw if they are in equal number. However, if either side uses a larger number of planes, the other side will be destroyed. In the early hours of a day, Kumar is informed that five enemy planes are approaching the side. Kumar knows that the enemy planes would split up at the last minute and attack two installations. He wants to destroy the maximum number of enemy planes at the least cost of his own. Construct the pay off matrix taking the pay offs to be the number of enemy planes minus the number of planes Kumar loses. (07 Marks)
 c. Solve the following game by graphical method :

		Player B				
		B ₁	B ₂	B ₃	B ₄	B ₅
Player A	A ₁	2	-4	6	-3	5
	A ₂	-3	4	-4	1	0

- 6 a. What is a replacement problem? (03 Marks)
 b. The data on the operating costs per year and resale prices of equipment A whose purchase price is Rs 10,000 are given below :

Year	1	2	3	4	5	6	7
Operating Cost (Rs)	1500	1900	2300	2900	3600	4500	5500
Resale Value (Rs)	5000	2500	1250	600	400	400	400

- What is the optimum period for replacement? (07 Marks)
 c. A Computer contains 1000 resistors. When any resistor fails, its individual replacement costs Rs 4. However, if all the resistors are replaced at the same time, the cost for resistor would be reduced to Re. 1. The percentage of surviving resistors, $S(t)$ at the end of month 't' is given below :

t :	0	1	2	3	4
S(t) :	100	90	60	20	0

What is the optimum replacement plan? (10 Marks)

- 7 a. Define the following : i) Zero Sum game ii) Fair game. (03 Marks)
 b. Give general structure of the queuing system and explain. (07 Marks)
 c. The manager of a bank observes that on an average the Cashier can serve to customers in 5 minutes, and nine customers arrive every 5 minutes. Assuming Poisson arrivals and exponential service time, find i) the average number of customers waiting for service ii) The probability of having more than 10 customers in the system. (10 Marks)
- 8 a. What is random number? (03 Marks)
 b. Solve the following game :

	B ₁	B ₂	B ₃	B ₄
A ₁	3	2	4	0
A ₂	3	4	2	4
A ₃	4	2	4	0
A ₄	0	4	0	8

- c. A small retailer has studied the weekly receipts and payments over the past 200 weeks and has developed the following set of information. (07 Marks)

Weekly Receipts (Rs)	Probability	Weekly Payment (Rs)	Probability
3000	0.20	4000	0.3
5000	0.30	6000	0.4
7000	0.40	8000	0.2
12000	0.10	10000	0.1

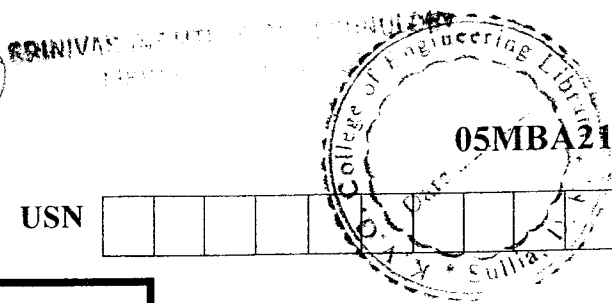
Using the following sequence of random numbers, simulate the weekly pattern of receipts and payments for 12 weeks of the next quarter, assuming further that the beginning bank balance is Rs 8000/-. What is the estimated balance at the end of the 12 weekly periods? What is the highest weekly balance during the quarter? What is average weekly balance for the quarter?

Random Numbers :

For Receipts : 03, 91, 38, 55, 17, 46, 32, 43, 69, 72, 24, 22

For Payments : 61, 96, 30, 32, 03, 88, 48, 28, 88, 18, 71, 99

(10 Marks)



NEW SCHEME

Second Semester MBA Degree Examination, June 2007
Business Administration
Quantitative Techniques for Management

Time: 3 hrs.]

[Max. Marks:100

Note : 1. Answer any FIVE full questions.

2. Area under standard normal curve shall be provided

(Ref.: N.D. Vohra – Appendix B).

3. Random number table shall be provided

(Ref.: N.D. Vohra Table B7 – Random Numbers).

- 1 a. Describe the Monte-Carlo simulation process with a flow diagram. (03 Marks)
- b. How simulation helps business decisions? State atleast four reasons. (07 Marks)
- c. Featherbyke Inc. manufactures 3 types of bicycles viz. Sporty 200 (S200), Endura 300 (E300) and Handy 500 (H500). The plant has a machine shop and an assembly shop. Each S200 requires 15 hours in machine shop and 5 hours in assembly shop, while E300 and H500 require 13 hours and 20 hours in machine shop and 4 hours and 8 hours in assembly shop respectively. The total machine shop capacity is 4000 hour per month and that of assembly shop is 1500 hours per month. The working capital requirements for S200, E300 and H500 are Rs.2400, Rs.4000 and Rs.6000 per month respectively and the total available fund per month shall not exceed Rs.1,20,000. The combined production of S200 and E300 shall atleast be 240 units per month for Featherbyke Inc. to break even. Also, the company was given the license to manufacture bicycles subject to producing 100 Nos. of H500 handicap cycles per month although manufacturing H500 results in a loss of Rs.200/- per unit. The profit margin earned by the company in producing S200 and E300 are Rs.500 and Rs.300 per unit respectively.
- Formulate the above as a linear programming model stating the objective function and the constraints, for maximizing the profit. (10 Marks)

- 2 a. Define the rules for drawing a PERT/CPM network (Activity on arrow model). (03 Marks)
- b. Describe how will you find out the project's standard deviation in a PERT project, assuming that you have identified the "Critical Activities", whose three time estimates t_o , t_m and t_p are known. (07 Marks)
- c. Although A, B, C, D are capable of doing all the jobs 1, 2, 3, 4 and 5, they cost differently to the company as shown below in the table. Please find an optimum allocation policy using HAM method. Is there an alternate optimum exists? If so, show the alternate optimum solution and the cost to the company (10 Marks)

Worker	Job (Cost in '00 Rs.)				
	1	2	3	4	5
A	25	18	32	20	21
B	34	25	21	12	17
C	20	17	20	32	16
D	20	28	20	16	27

Contd.... 2

- 3 a. State atleast 3 aspects/factors considered for “Slowly deteriorating item” model and “suddenly failing item” model for replacement strategy. (03 Marks)
- b. What is “Mixed strategy” and “Combined strategy” in game theory? When will you use these strategies? (07 Marks)
- c. The following table provides airphones marketing strategies M_1 M_2 M_3 and M_4 and Speed cells counter strategies C_1 C_2 C_3 C_4 and the pay-offs. Airphone and speed cell compute in the same market of phone service providers.

		Speed cell			
		C_1	C_2	C_3	C_4
Airplane	M_1	3	2	4	0
	M_2	3	4	2	4
	M_3	4	2	4	0
	M_4	0	4	0	8

Obtain optimal strategies for airphone and speed cell and find the value of the game. (10 Marks)

- 4 a. Define “optimal solution” in LP model. (03 Marks)
- b. Show by simple diagrams, “Infeasible solution” and “unbounded solution” and qualify them by indicating the objective function and constraints. (07 Marks)
- c. The profits, the availability in the warehouse and the demand in the markets are shown in the table below. Arrive at an optimum policy for moving the items from the warehouses to the market and determine the maximum profit yield. Use VAM for arriving at the initial solution and then use “MODI method” and “Stepping stone” method to arrive at the optimal solution. (10 Marks)

Warehouse	Per unit profit (Rs.)				Stock availability ↓
	Market				
	A	B	C	D	
X	12	18	6	25	200
Y	8	7	10	18	500
Z	14	3	11	20	300
Demand →	180	320	100	400	

- 5 a. Briefly discuss the steps involved in the “methodology” of operation research application in a business scenario with the help of a “flow diagram”. (03 Marks)
- b. Solve graphically:

Minimize: $Z = 3x_1 + 5x_2$

Subject to

$$-3x_1 + 4x_2 \leq 12$$

$$2x_1 + 3x_2 \geq 12$$

$$2x_1 - x_2 \geq -2$$

$$x_1 \leq 4$$

$$x_2 = 2$$

and $x_1, x_2 \geq 0$

(07 Marks)

- c. Write the dual of the above problem and identify the variable whose sign is “unrestricted”. (10 Marks)

- 6 a. How will you check for “optimality” in assignment problem and transportation problem? (03 Marks)
- b. Explain with the help of graph, how will you determine the “Optimum Service Level” if you are able to arrive at “Cost of waiting” and “Cost of servicing” in a customer service center. (07 Marks)

Contd.... 3

2.752

- c. A machine shop seeks for a contract service for repairing their "Gear hobbing machines". The service provider has 2 repairman, one is experienced and fast and the other one is little less experienced and slow in his work. The first repairman is provided at the rate of Rs.70/- per hour, while the second is provided at the rate of 50/- per hour. The former can repair 7 machines per hour while the later can repair 6 machines per hour. The gear Hibbing machine breakdown at the rate of 4 per hour and found to follow Poisson distribution pattern. The cost of non-productive machine time is Rs.90/- per hour. If you are the CEO of this company on whom (out of the two) you will decide to hire? (10 Marks)

- 7 a. Define "Clearance Ratio". If clearing ratio is <1 and >1 , what do they signify in a queuing system. (04 Marks)
- b. The Vice-President procurement of a company wishes to determine expected mean demand for a particular model of TV, during the 're-order' and lead time, in order to take care of, how far in advance to 're-order', before the stock level hits zero. The probability distributions of "Lead Time" and "Demand per day" are shown below:

1)

Lead time probability	0.45	0.30	0.25
Lead time (in days)	1	2	3

2)

Demand probability	0.15	0.25	0.40	0.2
Demand per day (No. of Ns)	1	2	3	4

- i) Using Monte-Carlo simulation method simulate the scenario for 20 reorders.
ii) Estimate the demand during the "Lead Time". (16 Marks)

- 8 a. Quantitative technique – an assertive advantage for decision making in business. Briefly discuss. (03 Marks)
- b. Crashing of project – discuss with respect to:
i) Crashing cost and opportunity cost in a project
ii) Sharing the resources of activities which have "total float" to crash the project duration. (07 Marks)
- c. A seminar on "Applications of quantitative techniques in today's business environment" is conceived as a project. the various activities and their precedence relationships and the three time estimates (t_o , t_m , t_p) are given below:

In Weeks

Activity	Precedence relationship	t_o	t_m	t_p
A	None	2	4	6
B	None	6	6	6
C	None	6	12	24
D	A	2	5	8
E	A	11	14	23
F	C	8	10	12
G	B, D	3	6	9
H	C	9	15	27
I	G, H, F	4	10	16

- i) Draw the PERT network
ii) Identify the "Critical path" and "Critical activities"
iii) What is the expected project completion time and projects standard deviation?
iv) What is the probability that the project will be completed in 38 weeks? (10 Marks)

USN

--	--	--	--	--	--	--	--	--	--

05MBA21

Second Semester M.B.A. Degree Examination, June / July 08
Quantitative Techniques

Time: 3 hrs.

Max. Marks:100

Note : 1. Answer any FIVE full questions.
2. Provide standard normal curve table.

- 1 a. A city hospital has the following minimal daily requirements for nurses.

Period	Clock Time (24 hour day)	Minimal No. of nurses required
1	6 am to 10 am	2
2	10 am to 2 pm	7
3	2 pm to 6 pm	15
4	6 pm to 10 pm	8
5	10 pm to 2 am	20
6	2 am to 6 am	6

Nurses report at the hospital at the beginning of each period and work for 8 consecutive hours. The hospital wants to determine the minimal no. of nurses to be employed so that there will be sufficient number of nurses available for each period. Give the solution in the form of LPP.

(03 Marks)

- b. Explain with suitable example i) Redundant constraints ii) Infeasibility iii) Unboundedness. (07 Marks)
- c. Assume that you have won a lottery of Rs 100000.00 and would invest in a combination of two stock portfolios with maximum investment allowed in either portfolio set at Rs 75000.00. The first portfolio has an average return of 10% whereas the second has 20%. In terms of risk factor associated with these portfolios, the first has a risk rating of 4 (on a scale from 0 to 10) and the second has 9. Since you want to maximize your return you will not accept an average rate of return below 12% or a risk factor above 6. How much should you invest in each portfolio? Formulate this as a LPP and solve by graphical method. (10 Marks)

- 2 a. How can the transportation method be applied to a transportation problem, where the objective function is called to be maximized? (03 Marks)
- b. A company has three plants and four warehouses. The supply and demand in units and the corresponding transportation costs are given. The table below gives this solution.

Plants	WH1	WH2	WH3	WH4	Supply
A	5	10	4	5	10
B	6	8	7	2	25
C	4	2	5	7	20
Demand	25	10	15	5	

- i) Is this solution feasible? ii) Is this solution degenerate? iii) Is this solution optimal? iv) Does this problem have more than one solution? Justify and show all. (07 Marks)
- c. A cement company has three factories which manufacture cement which is then transported to four distribution centers. The quantity of monthly production of each factory, the demand of each distribution centre and associated transportation cost per quintal are as below :

	Distribution Centers				Monthly production (quintals)
	W	X	Y	Z	
Factories A	10	8	5	4	7000
B	7	9	15	8	8000
C	6	10	14	8	10000

- i) Suggest optimal transportation schedule. (Use VAM method for initial solution)
- ii) Is there any other transportation schedule which is equally attractive?
- iii) If the company wants atleast 5000 quintals of cement transported from factory C to distribution centre Y, will this transportation schedule be any different? If so what will be the new optimal solution and effect on cost? (10 Marks)

- 3 a. How would you deal with the assignment problems where i) some assignments are prohibited? ii) the objective function is of maximization type? (03 Marks)
- b. A firm produces four products. There are four operators who are capable of producing any of these four products. The firm records 8 hours a day and allows 30 minutes for lunch. The processing time in minutes and the profit for each of this products are given below.

Operator	Products			
	A	B	C	D
1	15	9	10	6
2	10	6	9	6
3	25	15	15	9
4	15	9	10	10
Profit/Unit (Rs)	8	6	5	4

Find the optimal assignment of products to operators. (07 Marks)

- c. Given the following information : i) Draw the network ii) Determine Total float, Free float. iii) Find the critical path. (10 Marks)

Activity	A	B	C	D	E	F	G	H	I	J
Predecessor activities	-	-	A,B	B	A	C	E,F	D,F	G,H	I
Duration	2	3	4	1	5	3	2	7	6	3

- 4 a. What is a logic dummy? Give any two applications of using logic dummies. (03 Marks)
- b. Bring out the dependency relationships from the network given below. (07 Marks)

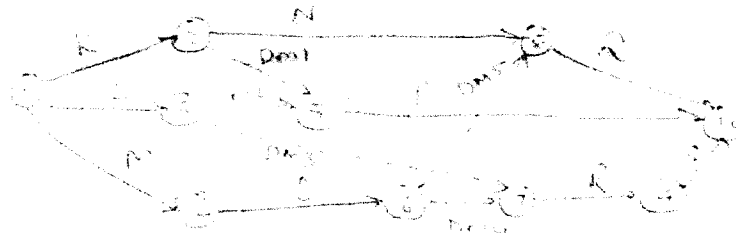


Fig. 4(b)

- c. A small project is comprised of seven activities whose time estimates are listed in the table below :

Activity (i - j)	TIME		
	Optimistic	Most likely	Pessimistic
1 - 2	1	1	7
1 - 3	1	4	7
1 - 4	2	2	8
2 - 5	1	1	1
3 - 5	2	5	14
4 - 6	2	5	8
5 - 6	3	6	15

- i) Draw the project network. ii) Determine the critical path and compute expected project completion time iii) What is the probability that project will be completed in no more than four weeks later than expected time. (10 Marks)

- 5 a. Explain briefly i) saddle point ii) pure strategy iii) mixed strategy in game theory. (03 Marks)
b. Reduce the following two person zero sum game to 2×2 order using dominance rule and obtain the optimal strategies for each player and value of the game. (07 Marks)

		Player B			
		B1	B2	B3	B4
Player A	A1	3	2	4	0
	A2	3	4	2	4
	A3	4	2	4	0
	A4	0	4	0	8

- c. The maintenance costs and resale price of machine A whose purchase price is Rs 10000.00 are given below :

Year	1	2	3	4	5	6	7
Maintenance cost (Rs)	1500	1900	2300	2900	3600	4500	5500
Resale Price (Rs)	5000	2500	1250	600	400	400	400

- i) Suggest optimal period for replacement of machine.
ii) When the machine is 2 years old another machine B which is new model of A is available. The optimal period of this machine B is 4 years, with an average cost Rs 3600. Should we change A with B? If so when? (10 Marks)
- 6 a. Explain briefly the difference in replacement policies of items which deteriorate gradually and items which fail completely. (03 Marks)
b. Goodlite Company has installed 2000 electric bulbs of certain brand. The company follows the policy of replacing the bulbs as and when they fail. Each replacement costs Rs 2. The probability distribution of the life of the bulbs is as below : (07 Marks)

Life of bulbs (weeks)	1	2	3	4	5
% of bulbs	0.10	0.30	0.45	0.10	0.05

Determine cost/week of the replacement policy in the long run .

- c. A company manufactures 30 units per day. The sale of these items depends upon demand, which has the following distribution.

Sales	Probability
27	0.10
28	0.15
29	0.20
30	0.35
31	0.15
32	0.05

The production cost and sales price of each unit are Rs 40/- and Rs 50/- respectively. Any unused product is to be disposed off at a loss of Rs 15/- per unit. There is a penalty of Rs 5/- per unit if the demand is not met. Using the following random numbers, estimate the total profit (loss) for the company for the next ten days 10, 99, 65, 99, 95, 01, 79, 11, 16, 20. If the company decides to produce 29 units per day, what is the advantage or disadvantage to the company? (10 Marks)

- 7 a. Give a general structure of the queuing system and explain. (03 Marks)
b. What do you understand by queuing structure? Explain i) First come – First served ii) Last come – First served iii) Service in random order basis of customer handling. (07 Marks)

- c. At Dr. Prachi's clinic, on an average 6 patients arrive per hour. The clinic is attended by Dr Prachi herself. Some patients require only the repeat prescription, others come for minor check up, while some others require a thorough inspection for the diagnosis. This takes the doctor six minutes per patient on an average. It can be assumed that arrivals follow a Poisson distribution and the doctor's inspection time follows an exponential distribution. Determine : i) percent of times a patient can walk right inside doctor's cabin without having to wait. ii) the average number of patients in Dr. Prachis clinic. iii) the average number of patients waiting for their turn. iv) the average time a patient spends in the clinic. (10 Marks)

- 8 a. Write the dual: Maximise $Z = 10y_1 + 8y_2 - 6y_3$.
 Subject to $3y_1 + y_2 - 2y_3 \leq 10$
 $- 2y_1 + 3y_2 - y_3 \geq 12$
 $y_1, y_2, y_3 \geq 0$. (03 Marks)
- b. Consider the production planning of the Super Fast Manufacturing Co. which makes item P and V. The steel requirements for P is 400gm per piece and that for V is 350gm per price. Both P and V are machined on lathe which takes 85 and 50 minutes respectively and are processed on grinder which requires 55 and 30 minutes respectively. Each unit of P consumes 20 minutes of polishing time. The resource availability is Total machine hours : 1450 hours ; Total steel : 250 kg. 30% of total machine time is that of lathe, 50% of grinder and remaining of polishing unit. Contribution to profits for P and V is Rs 40/- and Rs 30/- respectively. Formulate this as a LPP for determining the number of units of P and V to be produced which would maximize profit. Given also is the constraint that the company cannot sell more units of item P then of item V. (07 Marks)
- c. Inter arrival and service durations studied over past few years for a single channel queuing system revealed the following patterns.

Inter Arrival Time		Service Time	
Minutes	Probability	Minutes	Probability
2	0.19	1	0.15
4	0.22	3	0.26
6	0.32	5	0.30
8	0.17	7	0.18
10	0.10	9	0.11

Using the random number table given, simulates queue behavior for a period of 60 minutes.

1908	3227	5974	8196	2748	4507
2665	5278	7792	4649	8512	8363
3410	4206	4397	0753	1748	2375

(10 Marks)

USN

--	--	--	--	--	--	--	--	--	--

Second Semester MBA Degree Examination, Dec 08 / Jan 09
Quantitative Techniques for Management

Time: 3 hrs.

Max. Marks:100

Note : 1. Answer any FOUR full questions from Q.No. 1 to Q.No. 7. Q.No. 8 is compulsory.
2. Use of statistical tables is permitted.

- 1 a. Explain the Maximin and Minimax principles used in Game theory. (03 Marks)
b. Obtain the dual of the following Linear Programming problem.

$$\begin{aligned} \text{Minimize } Z &\rightarrow x_1 + x_2 + x_3 \\ \text{Subject to } &x_1 - 3x_2 + 4x_3 = 5 \\ &x_1 - 2x_2 \leq 3 \\ &2x_2 - x_3 \geq 4 \\ &x_1, x_2 \geq 0 \text{ and } x_3 \text{ is unrestricted.} \end{aligned}$$

(07 Marks)

- c. The rate of arrival of customers at a public telephone booth follows Poisson distribution with an average time of 10 minutes between one customer and the next. The duration of a phone call is assumed to follow exponential distribution with mean time of 3 minutes.
i) What is probability that a person arriving at the booth will have to wait?
ii) What is the average length of the non-empty queues that form from time to time?
iii) What is the average time a customer has to wait before getting service? (10 Marks)

- 2 a. What is a critical path? Why is it so important in scheduling and controlling projects? (03 Marks)

- b. Explain the methodology of Operations Research. (07 Marks)

- c. Let us assume that you have inherited Rs 1,00,000 from your father that can be invested in a combination of only two stock portfolios, with the maximum investment allowed in either portfolio set at Rs 75,000. The first portfolio has an average rate of return of 10%. Whereas the second has 20%. In terms of risk factors associated with these portfolios, the first has a risk rating of 4 (on a scale from 0 to 10) and the second has 9. Since, you have to maximize your return, you will not accept an average rate of return below 12% or a risk factor above six. Hence, how you should invest in each portfolio? Formulate problem as LPP. (10 Marks)

- 3 a. Explain the terms Objectives function, Basic variable and Decision variable. (03 Marks)
b. For the following game with pay of matrix, determine the optional strategies and the value of the game. (07 Marks)

$$P_1 \begin{bmatrix} 5 & 1 \\ 3 & 4 \end{bmatrix} P_2$$

- c. A small project consists of eight activities, the details of which are given below :

Activity	Immediate Predecessor	Optimistic Time	Most Likely Time	Pessimistic Time
A	-	1	1	7
B	-	1	4	7
C	-	2	2	8
D	A	1	1	1
E	B	2	5	14
F	C	2	5	8
G	D, E	3	6	15
H	F, G	1	2	3

- i) Draw the PERT network and find the expected project completion time.
 - ii) What duration will have 95% confidence for the project completion? (10 Marks)
- Note : $2 \rightarrow 1.645$ for 95% confidence level.

- 4 a. What is replacement problem? When does it arise? (03 Marks)
- b. A company has 3 operational departments (weaving, processing, packing) with capacity to produce 3 different types of clothes namely A, B and C yielding a profit of Rs 2, Rs 4 and Rs 3 per meter respectively. One meter of A requires 3 minutes in weaving, 2 minutes in processing and 1 minutes to packing. Similarly one meter of B requires 4 minutes in weaving, 3 minutes in other two departments. In a week, total run time of each department is 60, 40 and 80 hrs for weaving, processing and packing departments respectively. Formulate the LPP to find product mix to maximize the profit. (07 Marks)
- c. With the following CPM network, find i) Crucial path ii) Duration of the project iii) Total float, Free float and Independent float for the activities. (10 Marks)

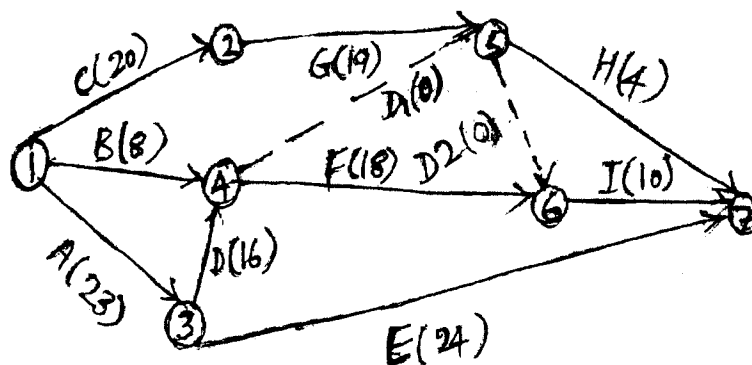


Fig.4(c)

- 5 a. Explain the term 'strategy', 'pay off matrix' and 'Two Person Zero – Sum Game', with reference to Game theory. (03 Marks)
- b. Explain the basic elements of a Queuing System. (07 Marks)
- c. Find the IBFS for the following transportation problem by i) North West Corner Rule. ii) Vogel's Approximation Method. (10 Marks)

	D	E	F	G	Available
A	11	13	17	14	250
B	16	18	14	10	300
C	21	24	13	10	400
Demand	200	225	275	250	

- 6 a. State three applications of Queuing theory in business enterprises. (03 Marks)
- b. Solve the following Assignment problem for its minimization. (07 Marks)

Men \ Task	E	F	G	H
A	18	26	17	11
B	13	28	14	26
C	38	19	18	15
D	19	26	24	10

- c. A firm is considering replacement of a machinery whose cost price is Rs 12,200 and the scrap value Rs 200. The running costs in Rs are as follows

Yr	1	2	3	4	5	6	7	8
Running cost	200	500	800	1200	1800	2500	3200	4000

When is the machine to be replaced?

(10 Marks)

- 7 a. Differentiate between PERT and CPM network. (03 Marks)
b. Solve the following Game : (07 Marks)

		Player B					
Player A	A ₁	[	B ₁	B ₂	B ₃	B ₄]
	A ₂		2	1	0	-2	
			1	0	3	2	

- c. Given $X_{12} = 25$, $X_{14} = 45$, $X_{22} = 5$, $X_{23} = 50$, $X_{31} = 85$ and $X_{32} = 5$, is it the optimal solution in the transportation? If not, modify it to obtain a better feasible solution. (10 Marks)

		Available Units					
	[	6	1	9	3	]	70
		11	5	2	8		55
		10	12	4	7		90
Required Units		85	35	50	45		

8 CASE STUDY :

A washing powder manufacturing company wants to study an investment project based on 3 factors : Market Demand in Units ; Contribution per unit and Investment required. These factors are felt to be independent of each other. Company estimates the following probability distribution:

Actual Demand		Contribution / Unit		Required Investment	
Units	Probability	Rs	Probability	Rs	Probability
20,000	0.05	3.00	0.10	17,50,000	0.25
25,000	0.10	5.00	0.20	20,00,000	0.50
30,000	0.20	7.00	0.40	25,00,000	0.25
35,000	0.30	9.00	0.20		
40,000	0.20	10.00	0.10		
45,000	0.10				
50,000	0.05				

Using Monte Carlo simulation for 10 units, estimate the percentage of Return on Investment for each as defined by $ROI\% = \frac{\text{Cash Inflow}}{\text{Investment}} \times 100$.

Recommend on optimal investment strategy based on ROI%. Use following Random Numbers:

Demand : 28, 57, 60, 17, 64, 20, 27, 58, 61, 30

Contribution : 19, 07, 90, 02, 57, 28, 29, 83, 58, 41

Investment : 18, 67, 16, 71, 43, 68, 47, 24, 19, 97.

(20 Marks)

6-12-08

Second Semester MBA Degree Examination, June-July 2009**Quantitative Techniques for Management**

Time: 3 hrs.

Max. Marks:100

Note:1. Answer any FIVE full questions.**2. Normal distribution table is allowed.**

- 1 a. Explain the role of OR models in decision making. (03 Marks)
- b. The automobile company manufactures around 150 scooters. The daily production varies from 146 to 154 depending upon the availability of raw material and other working conditions:

Production (per day)	146	147	148	149	150	151	152	153	154
Probability	0.04	0.09	0.12	0.14	0.11	0.10	0.20	0.12	0.08

The finished scooters are transported in a specially arranged lorry accommodating 150 scooters. Using the following random numbers simulate the process to find out:

- i) What will be the average number of scooters waiting in the factory?
ii) What will be the average number of empty space on the lorry?

Random numbers are : 80, 81, 76, 75 and 64. (07 Marks)

- c. A company manufacturing air-coolers has two plants located at Bombay and Calcutta with a capacity of 200 units and 100 units per week respectively. The company supplies the air coolers to its four show rooms situated at Ranchi, Delhi, Lucknow and Kanpur which have a maximum demand of 75, 100, 100 and 30 units respectively. The profit per unit is shown in the table below.

	Ranchi	Delhi	Lucknow	Kanpur
Bombay	90	90	100	110
Calcutta	30	70	130	85

Plan the production programme so as to maximize the profit. (10 Marks)

- 2 a. What are objective functions, constraints and bounds with reference to LIP? (03 Marks)
- b. A branch of a bank has only one typist. Since the typing work varies in length, the typing rate is randomly distributed approximately a Poisson distribution with mean strike rate of 8 letters per hour. The letters arrive at a rate of 5 per hour during the entire 8 hour workday. If the type writer is valued at Rs 15- per hour. Determine i) Equipment utilization ii) Average idle time cost of the typewriter per day iii) Average system time. (07 Marks)
- c. The initial basic feasible solution for the transportation problem is given below. Find the optimal solution. Is the optimal solution is unique? If not find the alternative optimal solution.

	Godowns							Stock available
		1	2	3	4	5	6	
Factory	A	7	5 (20)	7	7	5	3 (40)	60
	B	9 (10)	11	6 (10)	11	X	5	20
	C	11	10	6 (30)	2 (20)	2 (40)	8	90
	D	9 (50)	10	9	6	2	2	50
Demand		60	20	40	20	40	40	

Note : It is not possible to transport any quantity from B to Godown 5. (10 Marks)

- 3 a. With respect to LPP show by graph:
 i) Degenerate optimal solution. (03 Marks)
 ii) Unbounded solution. (07 Marks)
- b. Explain the steps involved in sequencing while processing 2 jobs through 'n' machine with example. (10 Marks)
- c. A self service stores employes one cashier at its corner. Nine customers arrive on an average every 5 minutes while cashier can serve 10 customers in 5 minutes. Assuming Poisson distribution for arrival rate and exponential distribution for service rate, find
 i) Average number of customers in the system.
 ii) Average time a customer spends in the system.
 iii) Average queue length. (10 Marks)

- 4 a. Explain 'Queue Discipline' with reference to queuing system. (03 Marks)
 b. Solve the following game: (07 Marks)

		Player B		
		B ₁	B ₂	B ₃
Player A	A ₁	1	3	11
	A ₂	8	5	2

- c. There are five jobs, each of which is to be processed through three machines A, B and C in order CAB processing time in hours are:

Job	A	B	C
1	4	7	3
2	5	9	8
3	1	5	7
4	2	6	5
5	3	10	4

Determine the optimum sequence for the five jobs and the minimum elapsed time. (10 Marks)

- 5 a. What do you mean by 'crashing the activity'? Explain. (03 Marks)
 b. Two player A and B match coins. If the coin matches with Head A will gain 8 units and if it matches with Tail A will gain 1 unit. If wins does not 'A' will loses 3 units. Determine the optimum strategy for the players and the value of the game. (07 Marks)
 c. A company produces two types of leather belts; A and B. Profits on the two types of belts are 40 and 30 paise per belt respectively. Each belt of type A requires twice as much time as required by a belt B. If all belts were of type B, the company could produce 1000 belts per day. The supply of leather is sufficient only for 800 belts per day. Belt A requires a fancy buckle and only 400 fancy buckles are available for this per day. For Belt B only 700 buckles are available per day. How should the company manufacture the two types of belts in order to have maximum overall profit? (10 Marks)
- 6 a. Explain the following with respect to game theory:
 i) Two person zero sum game. ii) Min-Max criteria. (03 Marks)
 b. Determine the initial basic feasible solution to the following transportation problem by,
 i) North-west corner rule ii) VAM (Vogel's approximation method). (07 Marks)

		Destination				
		1	2	3	4	5	Supply
A	2	11	10	3	7	4
B	1	4	7	2	1	8
C	3	9	4	8	12	9
Demand	3	3	4	5	6	

- 6 c. The time estimates (in weeks) for the activities of a PERT network are given below:

Activity	Most likely time	Optimistic time	Pessimistic time
1-2	1	1	7
1-3	4	1	7
1-4	2	2	8
2-5	1	1	1
3-5	5	2	14
4-6	5	2	8
5-6	6	3	15

- i) Draw the project network and determine critical paths and its duration.
 ii) What is the probability that the project will be completed at least 4 week earlier than expected time?
 iii) If the project due date is 19 weeks, what is the probability of not meeting the due date.

Z	-0.67	-1.33
P	0.2514	0.0918

(10 Marks)

- 7 a. Explain i) value of game ii) Saddle point with respect to game theory.

(03 Marks)

- b. Solve the following LPP graphically:

$$\text{Minimize } z = -x_1 + 2x_2$$

$$\text{Subject to } -x_1 + 3x_2 \leq 10$$

$$x_1 + x_2 \leq 6$$

$$x_1 - x_2 \leq 2$$

$$x_1, x_2 \geq 0$$

(07 Marks)

- c. A project consists of a series of task with following relationships: A<D, E; B, D<F; C<G; B<H; F, G<I;

(A<D, E, means D, E cannot start until A is completed and soon) with the above notation construct a network diagram and find the critical path and the duration of the project, for which time of completion of each task is given below:

(10 Marks)

Task	A	B	C	D	E	F	G	H	I
Time	23	8	29	16	24	18	19	4	10

- 8 a. What are the elements of a queuing system?

(03 Marks)

- b. Explain the following in context to OR with example:

- i) Schematic model ii) Iconomic model iii) Mathematical model.

(07 Marks)

- c. The investment required for introducing a new product is Rs.10000/-. The profits estimate for variable cost, selling price and annual sales volume are given below. Simulate the situation to find out selling price, variable cost and annual sales volume by for 5 trails using given random number and determine average profit.

Variable cost		Selling price		Annual volume	
Value (Rs)	Probability	Value (Rs)	Probability	Value (Rs)	Probability
1	0.20	3	0.20	4000	0.20
2	0.50	4	0.60	6000	0.50
3	0.30	5	0.20	8000	0.30

Random numbers:

For variable cost: 9, 84, 41, 92, 65

For selling price: 24, 38, 73, 7, 4

For annual volume: 7, 48, 57, 64, 72

(10 Marks)

* * * * *

USN

--	--	--	--	--	--	--	--	--	--	--	--	--

05MBA21

Second Semester MBA Degree Examination, June-July 2009
Quantitative Techniques for management

Time: 3 hrs.

Max. Marks:100

Note: Answer any FIVE full questions.

- 1 a. What are the assumptions underlying Linear Programming problem? (03 Marks)
 b. Briefly discuss the characteristics of operation research. (07 Marks)
 c. Briefly explain the methodology of operation research. (10 Marks)

- 2 a. What is a Model? Distinguish between Analogue and Iconic models. (05 Marks)
 b. A firm makes two products X and Y, and has a total production capacity of 9 tonnes per day, X and Y requiring the same production capacity. The firm has a permanent contract to supply at least 2 tonnes of X and at least 3 tonnes of Y per day to another company. Each tonne of X requires 20 machine hours of production time and each tonne of Y requires 50 machine hours of productions time. The daily maximum possible number of machine hours is 360. All the firms out put can be sold, and the profit made is Rs.80 per tonne of X and Rs.120 per tonne of Y. It is required to determine the production schedule for maximum profit and calculate profit. (15 Marks)

- 3 a. Explain the Primal-Dual relationships. (05 Marks)
 b. Given the following transportation problem.

Ware house	Market			Supply
	A	B	C	
1	10	12	7	180
2	14	11	6	100
3	9	5	13	160
4	11	7	9	120
Demand	240	200	220	

It is known that currently nothing can be sent from warehouse. 1 to market A and from ware house 3 to market C. Solve the problem and determine the initial basic feasible solution by Volel's Approximation method. (15 Marks)

- 4 a. How is Dangling avoided in the network? (03 Marks)
 b. Distinguish between PERT and CPM. (07 Marks)
 c. Solve the following assignment problem and obtain the minimum cost at which all the jobs can be performed. (10 Marks)

Worker	Job (Cost in 00's Rs)				
	1	2	3	4	5
A	25	18	32	20	21
B	34	25	21	12	17
C	20	17	20	32	16
D	20	28	20	16	27

- 5 a. What is a Game Theory? Give two examples. (03 Marks)
 b. Construction the network and determine the critical path for the following project. (07 Marks)

Activity	1-2	1-3	1-4	2-5	3-4	3-7	4-5	4-6	5-8	6-7	6-8	7-8
Duration (Days)	5	8	3	4	0	7	4	6	6	7	2	6

- c. The Taj service station has a central store where service mechanics arrive to take spare parts for the jobs they work upon. The mechanics wait in queue if necessary and are served on FIFO basis. The store is manned by one attendant who can attend 8 mechanics in an hour on an average. The arrival rate of mechanics averages 6 per hour. Assuming that the pattern of mechanics arrivals is Poisson distributed and service is exponentially distributed, determine W_s , W_q and L_q where the symbols carry their usual meaning. **(10 Marks)**

- 6 a. What is Simulation? **(03 Marks)**
 b. Discuss the operating characteristics or Queuing theory. **(07 Marks)**
 c. A firm is using a machine whose purchase price is Rs.13,000. The installation charges amount to Rs.3,600 and the machine has a scarp value of only Rs.1,600 because the firm has a monopoly of this type of work. The maintenance cost in various years is given in the following table.

Year :	1	2	3	4	5	6	7	8	9
Cost (Rs.) :	250	750	1000	1500	2100	2900	4000	4800	6000

The firm wants to determine after how many years should the machine be replaced. On economic considerations, assuming that the machine replacement can be done only at the year ends. **(10 Marks)**

- 7 a. What is Maxmin Minimax principle? **(03 Marks)**
 b. What are the advantages and limitations of simulation? **(07 Marks)**
 c. Solve the following game, determine the optimal strategies and the value of game.

$$A \begin{matrix} & \text{B} \\ \begin{bmatrix} 4 & -4 \\ -4 & 4 \end{bmatrix} \end{matrix}$$

(10 Marks)

- 8 a. What are the advantages of Duality? **(03 Marks)**
 b. Briefly explain the MONTE-CARLO simulation procedure. **(07 Marks)**
 c. A tourist car operator finds that during the past few months the cars use has varied so much that cost of maintaining the car varied considerably. During the past 200 days the demand for car fluctuated as below.

Trips per week	Frequency
0	16
1	24
2	30
3	60
4	40
5	30

Using the following sequence of Random numbers simulate the demand for next 10 weeks.
 Random Numbers : 82, 96, 18, 96, 20, 84, 56, 11, 52, 03. **(10 Marks)**

USN

--	--	--	--	--	--	--	--	--	--

Second Semester MBA Degree Examination, Dec.09/Jan.10
Quantitative Techniques for Management

Time: 3 hrs.

Max. Marks:100

Note: 1. Answer any FIVE full questions.
2. Statistical tables may be provided.

- 1 a. State the essential characteristic features of Operation Research. (03 Marks)
- b. Discuss briefly the benefits & limitations of Operation Research. (07 Marks)
- c. A manufacturer employs three inputs: Man hours, Machine hours & Cloth material to manufacture two types of dresses. Type 'A' dress fetches him a profit of Rs.160 per piece, while type 'B' that of Rs.180 per piece. The manufacturer has enough man hours to manufacture 50 pieces of Type A or 20 pieces of Type B dresses per day while machine hours he possesses suffice only 30 pieces of Type A or for 24 pieces of Type B dresses. Cloth material available per day is limited but sufficient enough for 30 pieces of either type of dress. Formulate the linear programming model and solve it graphically. (10 Marks)

- 2 a. What are the three components of LP Model? (03 Marks)
- b. Explain the major applications of LP in Business. (07 Marks)
- c. Obtain the dual of LPP given below.
 Maximize $Z = 8x_1 + 10x_2 + 5x_3$
 Subject to $x_1 - x_3 \leq 4$
 $2x_1 + 4x_2 \leq 12$
 $x_1 + x_2 + x_3 \geq 2$
 $3x_1 + 2x_2 - x_3 = 0$
 $x_1, x_2, x_3 \geq 0$ (10 Marks)

- 3 a. What is transportation problem? (03 Marks)
- b. Using North West corner method obtain an initial feasible solution to the problem given below. (07 Marks)

Source	Destination			Supply
	D ₁	D ₂	D ₃	
S ₁	8	6	10	300
S ₂	12	16	10	400
S ₃	14	10	12	300
Demand	450	350	200	1000

- c. The manager of a depot has four subordinates to perform three tasks. Since the efficiency of each subordinate is different, the estimated time taken by each subordinate to perform these four tasks would be different. These estimated times are given in the matrix below. Suggest the optimal assignment of the tasks to each person so as to minimize the total time to perform these three tasks. (10 Marks)

Workers	Tasks		
	T ₁	T ₂	T ₃
W ₁	19	36	25
W ₂	23	37	16
W ₃	45	30	25
W ₄	28	40	30

Important Note: 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and/or equations written on 42+8=50, will be treated as malpractice.

- 4 a. Differentiate between PERT & CPM. (03 Marks)
 b. Draw the network for the activities given in the table below and determine critical path, project duration, total float and free float. (07 Marks)

Activity	1 - 2	1 - 3	1 - 4	2 - 3	2 - 6	3 - 5	3 - 6	4 - 5	5 - 6
Duration (days)	3	4	14	10	5	4	6	1	1

- c. The following data are available pertaining to a construction project.

Activity	Immediate predecessor	Time estimates		
		Optimistic	Most likely	Pessimistic
A	-	1	2	3
B	-	2	3	4
C	A	1	2	3
D	B	2	4	6
E	C	1	4	7
F	C	1	2	9
G	D, E	3	4	11
H	F, G	1	2	3

- i) Draw PERT Network and find project completion time.
 ii) Determine the duration for project completion that has a probability of 90%. (10 Marks)

- 5 a. Explain the terms:
 i) Optimal strategy ii) Pure strategy iii) Mixed strategy. (03 Marks)
 b. A company plans to assign five salesmen to five districts in which it operates. Estimates of sales revenue in thousands of rupees for each salesman in different district are given in the following table. In your opinion, what should be the placement of the salesman if the objective is to maximize the expected sales revenue? (07 Marks)

Salesman \ District	D ₁	D ₂	D ₃	D ₄	D ₅
S ₁	40	46	48	36	48
S ₂	48	32	36	29	44
S ₃	49	35	41	38	45
S ₄	30	46	49	44	44
S ₅	37	41	48	43	47

- c. Solve the following transportation problem for maximum profit. (10 Marks)

Warehouse	Market				Supply
	A	B	C	D	
X	12	18	6	25	200
Y	8	7	10	18	500
Z	14	3	11	20	300
Demand	180	320	100	400	

- 6 a. What assumptions are generally made in solving sequencing problems? (03 Marks)
 b. In a factory there are six jobs to perform, each of which would go through two machines A & B, in the order AB. The processing times (in hours) for the jobs are given below. You are required to determine the optimal sequence for performing jobs & minimum total elapsed time. (07 Marks)

Job	1	2	3	4	5	6
Machine A	7	4	2	5	9	8
Machine B	3	8	6	6	4	1

- c. Solve the following game using graphical method. (10 Marks)

		B's strategy			
		b ₁	b ₂	b ₃	b ₄
A's strategy	a ₁	8	5	-7	9
	a ₂	-6	6	4	-2

- 7 a. State the three basic components of Queuing system. (03 Marks)
- b. The extension counter of the SBI in the premises of a University enrolls all new customers (Students) in the saving bank accounts. In the month of August, as the colleges in the university begin the classes, a lot of new accounts have to be opened for new students enrolled. The bank manager estimates that the arrival rate during this period will be Poisson distributed with an average of 3 customers per hour. The service is exponentially distributed with an average of 15 minutes per customer to set up a new account. The Bank Manager wants to determine the operating characteristics for this system to know whether current strength of one server is sufficient to handle the increased traffic. (07 Marks)
- c. Solve the following game using dominance rule. (10 Marks)

		Union strategies			
		U ₁	U ₂	U ₃	U ₄
Company Strategies	C ₁	0.25	0.27	0.35	-0.02
	C ₂	0.20	0.16	0.08	0.08
	C ₃	0.14	0.12	0.15	0.13
	C ₄	0.30	0.14	0.19	0

- 8 a. State the various areas of applications of simulation. (03 Marks)
- b. There are five jobs, each of which must go through machines X, Y & Z in the order XYZ. Processing time (in hours) are given below.

Job	1	2	3	4	5
Machine X	10	11	8	7	6
Machine Y	6	4	5	3	2
Machine Z	9	5	4	6	8

Determine optimal job sequence and minimum total elapsed time. (07 Marks)

- c. A Manufacturing Company keeps stock of a special product previous experience indicates the daily demand as follows.

Daily demand	5	10	15	20	25	30
Probability	0.1	0.2	0.15	0.5	0.12	0.02

Simulate the demand for the next 10 days using random nos. 82, 95, 18, 96, 20, 84, 56, 11, 52, 03. Also find the daily average demand for that product on the basis of simulated data.

(10 Marks)

* * * * *

Second Semester MBA Degree Examination, Dec.09/Jan.10

Quantitative Techniques for Management

Time: 3 hrs.

Max. Marks:100

- Note: 1. Answer any FIVE full questions.
2. Use graph sheets wherever necessary.
3. Standard normal tables can be provided.**

- 1 a. Enumerate the two kinds of physical models. Give illustrations. (03 Marks)
b. How do you solve a maximal unbalanced assignment problem? Explain. (07 Marks)
c. A firm has a single channel service station with the following arrival and service time probability distributions.

Inter Arrival Time (min)	Probability
10	0.10
15	0.25
20	0.30
25	0.25
30	0.10

Service Time (min)	Probability
5	0.08
10	0.14
15	0.18
20	0.24
25	0.22
30	0.14

The customer's arrival at the service station is a random phenomenon and the time between the arrivals varies from 10 minutes to 30 minutes. The service time varies from 5 minutes to 30 minutes. The queuing process begins at 10.00 am and proceeds for about 6 hours. An arrival goes to the service facility immediately if it is free. Otherwise it will wait in queue. The queue discipline is first come first served. If the attendant's wages were Rs.10 per hour and the customer's waiting time costs Rs.15 per hour, then would it be an economical proposition to engage a second attendant? Answer using Monte Carlo simulation technique. Use the random number table given below for your simulation. Reading row-wise, the first two digits represent random arrivals and the last two digits represent random services.

1	2	3	4	5	6	7	8	9	10
2026	7343	3098	9987	6658	8390	3284	7560	0408	1550

11	12	13	14	15	16	17	18	19	20
2937	6242	3728	6884	9465	1001	9979	6511	9916	9520

(10 Marks)

- 2 a. What is the principle underlying the minimum cost method of solving a transportation problem? (03 Marks)
b. A refrigerator manufacturing company has production operations in 3 cities and distribution centres in 4 places. The production capacities and the demands are given below.

Plant	Capacity (in Units)
Agra	4,000
Bahadurgarh	8,000
Faridabad	7,000

Distribution Centre	Demand (in units)
New Delhi	5,000
Mumbai	3,500
Kolkata	6,000
Chennai	4,500

The problem is as to how many units should be shipped from each plant to each distribution centre so that the total cost of transportation is minimized. Given further that the cost (in rupees) for each unit shipped on each route is as follows. Start the solution with Vogel's Approximation method.

	New Delhi	Mumbai	Kolkata	Chennai
Agra	42	70	65	78
Bahadurgarh	35	64	69	84
Faridabad	27	38	70	80

(07 Marks)

- c. Google Turkey Products prepares two types of turkey cutlets for sale to fast food restaurants. Each type of cutlet consists of white meat and dark meat. Cutlet 1 sells for Rs.200 per kg and must consist of at least 70% white meat. Cutlet 2 sells for Rs.150 per kg and must consist of at least 60% white meat. At most 50 kgs of cutlet 1 and 30 kgs of cutlet 2 can be sold. The two types of turkeys used to manufacture the cutlets are purchased from the Gobble & Gobble Turkey farm. Each type 1 turkey costs Rs.700 and yields 5 kgs of white meat and 2 kgs of dark meat. Each type 2 turkey costs Rs.600 and yields 3 kgs of white and 3 kgs of dark meat. Formulate the problem with a suitable objective function. (10 Marks)

- 3 a. Define degeneracy in transportation problem. How do you resolve the situation? (03 Marks)

- b. Write the dual for the following:

$$\text{Minimize } Z = 9x_1 + 3x_2 - 5x_3 + 11x_5$$

$$\text{Subject to } 7x_1 - 5x_2 - 15x_3 + 13x_4 - 9x_5 \leq 50$$

$$2x_1 + 15x_2 - 5x_4 = 11$$

$$14x_2 - 17x_4 - 19x_5 \geq 37$$

$$11x_1 - 7x_2 + 18x_3 - 12x_5 \leq 12$$

$$5x_2 - 13x_4 + 9x_5 = 23$$

$$7x_1 - 2x_2 - 15x_3 + 19x_4 \geq 24$$

$$x_1, x_2, x_5 \geq 0; x_3, x_4 = \text{Free.}$$

(07 Marks)

- c. The town of Tundun is putting up bids for four used police vehicles. The town will allow individuals to make bids on all four vehicles but will be successful in getting only one vehicle depending on the bidding. The individuals have made the following bids. Which car should be awarded to whom in order to optimize the sales revenue to the town? (10 Marks)

Individual	Vehicle (Rs. in hundreds)			
	Ambassador	Bolero	Corolla	Icon
Arul	1,000	900	1,100	900
Balu	1,100	1,000	950	950
Chandru	1,050	950	900	1,050
David	1,150	1,000	920	1,000

- 4 a. Differentiate static, dynamic and discrete-event simulation models. (03 Marks)

- b. State the necessary and sufficient conditions of critical path. Can a project have multiple critical path? Why is the critical path of such importance in large project scheduling and control? (07 Marks)

- c. Explain the steps in operations research methodology. (10 Marks)

- 5 a. How does 'crashing' important and useful to a project manager? (03 Marks)

- b. Solve graphically,

$$\text{Minimize } Z = 15x_1 + 25x_2$$

$$\text{Subject to } 2x_1 + 5x_2 \geq 60$$

$$x_1 + x_2 \geq 14$$

$$x_2 \leq 8$$

$$x_1, x_2 \geq 0$$

(07 Marks)

- c. A company is considering the purchase of a new machine costing Rs.15,000. The economic life of the machine is expected to be 8 years. The salvage value of the machine at the end of the life will be Rs.3,000. The annual running costs are estimated to be Rs.7,000.

- i) Assuming an interest rate of 5%, determine the present worth of future costs of the proposed machine (Put at 5% interest, 8 years = 6.4632).

- ii) Compare the new machine with presently owned machine that has an annual operating cost of Rs.5,000 and cost of repair Rs.1,500 in the second year with an annual increase of Rs.500 in the subsequent years of life. (10 Marks)

- 6 a. Define the terms 'Jockeying', 'Balking' and 'Reneging' of queue behaviour. (03 Marks)
 b. Give the Kendall – Lee notation for describing a queuing system with an illustration. (07 Marks)
 c. Solve the following game graphically. (10 Marks)

	Players B				
Player A	2	2	3	-1	4
	4	3	2	6	4

- 7 a. State the reasons for replacement. (03 Marks)
 b. List down the steps involved in solving an inventory problem using simulation. (07 Marks)
 c. Peter's market is a local grocery store with only one check-out counter. Assume that the shoppers arrive at the check-out lane according to a Poisson probability distribution, with a mean arrival rate of 15 customers per hour. The check-out service times follows an exponential probability distribution, with mean service rate of 20 customers per hour.
- i) If the manager's service goal is to limit the waiting time prior to beginning the check-out process to no more than 5 minutes, what recommendation would you provide regarding the current check-out system? After reviewing the waiting line analysis of the problem, the manager of Peter's market wants to consider one of the following alternatives for improving service. Which alternative would you recommend? Justify your recommendation.
 - ii) Hire a second person to bag the groceries while the cash register operator is entering the cost data and collecting money from the customer. With this improved single channel operation, the mean service rate could be increased to 30 customers per hour.
 - iii) Hire a second person to operate a second check-out counter. The two operators can work in parallel with a mean service rate of 20 customers per hour for each counter.
- The cost of hiring an operator is Rs.40 per hour and the attendant is Rs.20 per hour and that of idle time of shopper is Rs.40 per hour. (10 Marks)
- 8 a. Given the probability of $A(\frac{1}{2}, \frac{1}{2})$ and the value of the game $5/2$, find the value of 'q' and the probability for the player B. (05 Marks)

	Players B	
Player A	3	q
	2	6

- b. A project has fourteen activities A through N. The relationship among the activities and the time required are given.
- i) Draw an event diagram and the expected time for activities.
 - ii) Find ET, LT, TS and FS and critical path.
 - iii) Find the project completion time and variance of the critical path.
 - iv) Find the probability of completing 4 weeks before and 3 weeks after the project completion time.

- A is the first operation.
- B and C can be performed in parallel and are immediate successors to A
- D, E and F follow B
- G follows E
- H follows D, but it cannot start until E is complete
- I and J succeed G
- F and J succeed K
- H and I succeed L
- M succeeds L and K
- The last operation N succeeds M and C

Activity	Time (in weeks)		
	Most likely	Optimistic	Pessimistic
A	5	4	6
B	12	10	14
C	8	7	9
D	20	13	21
E	12	9	15
F	13	13	13
G	6	5	7
H	9	7	11
I	9	6	12
J	11	9	13
K	12	8	16
L	7	7	13
M	14	11	17
N	15	12	18

(15 Marks)

* * * * *



Second Semester MBA Degree Examination, May/June 2010
Quantitative Techniques for Management

Time: 3 hrs.

Max. Marks:100

Note:1. Answer any FIVE full questions.**2. Area under standard normal curve shall be provided.**

- 1 a. What is meant by a saddle point in game theory? (03 Marks)
 b. What are the opportunities and short comings of operation research approach? (07 Marks)
 c. You are given the information about the cost of performing different jobs by different persons. The job person making ∞ mark indicates that the individual involved cannot perform the particular job. Using the information, find i) the optimal assignment of jobs and ii) The cost of such assignment. (10 Marks)

Person	Job				
	J ₁	J ₂	J ₃	J ₄	J ₅
P ₁	27	18	∞	20	21
P ₂	31	24	21	12	17
P ₃	20	17	20	∞	16
P ₄	22	28	20	16	27

- 2 a. What are the different steps involved in the solution algorithm of transportation method? (03 Marks)
 b. Distinguish between individual and group replacement methods. With a neat sketch discuss the optimal replacement interval of the items that fail suddenly. (07 Marks)
 c. Solve the following game using graphical method: (10 Marks)

		Player B	
		b ₁	b ₂
Player A	a ₁	-7	6
	a ₂	7	-4
	a ₃	-4	-2
	a ₄	8	-6

- 3 a. Write the general mathematical model of LPP. (03 Marks)
 b. How do you classify the queuing models? List the assumptions made in the Poisson – exponential single server model with infinite population. (07 Marks)
 c. Use the graphical method to solve the following LP problem:
 Maximize $z = 2x_1 + x_2$
 Subjected to $x_1 + 2x_2 \leq 10$; $x_1 + x_2 \leq 6$; $x_1 - x_2 \leq 2$; $x_1 - 2x_2 \leq 1$; $x_1, x_2 \geq 0$ (10 Marks)

- 4 a. What is meant by traffic intensity in queuing theory? What is the significance of it with respect to unity? (03 Marks)
 b. Explain Monte Carlo simulation, with a flow diagram. (07 Marks)
 c. A machine M₁, costing Rs.9000 has a maintenance cost of Rs.200 in the first year of its operation which rises by Rs.2000 in each of the successive years. Assuming that the machine replacement can be done at the end of the year, determine the best age at which the machine be replaced. There is an offer to replace the machine M₁, which is a year old, by another machine M₂, which costs Rs.8000. The machine M₂ needs Rs.2000 to be spent on installation, has no salvage value and requires Rs.400 on maintenance in the first year followed by an increase of Rs.800 per annum in the yearly expenditure on maintenance. Should the machine M₁, be replaced by machine M₂? Justify your answer. (10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
 2. Any revealing of identification, appeal to evaluator and/or equations written eg. 42+8 = 50, will be treated as malpractice.

- 5 a. What are the advantages of OR models? (03 Marks)
 b. Find the optimal strategies for A and B in the following game. Also obtain the value of game. (07 Marks)

		Player B		
		b ₁	b ₂	b ₃
Player A	a ₁	9	8	-7
	a ₂	3	-6	4
	a ₃	6	7	-7

- c. A tape recorder company manufacturers models A, B and C, which have profit contributions per unit of Rs.15, Rs.40 and Rs.60 respectively. The weekly minimum production requirements are 25 units for model A, 130 units for model B and 55 units for model C. Each type of recorder requires a certain amount of time for the manufacturing of component parts, for assembling and for packing. Specifically, a dozen units of model A require 4 hours for manufacturing, 3 hours for assembling and 1 hour for packaging. The corresponding figures for a dozen units of model B are 2.5, 4 and 2 and for a dozen units of model C are 6, 9, and 4. During the forthcoming week, the company has available 130 hours of manufacturing, 170 hours of assembly and 52 hours of packaging time. Formulate this problem as an LP model so as to maximize the total profit to the company. (10 Marks)

- 6 a. What are the phases of simulation? (03 Marks)
 b. List the applications of LP in management. (07 Marks)
 c. A small project is composed of 7 activities whose time estimates are listed in the below table. Activities are indicated by their beginning, (i) and ending (j) node numbers.

Activity (i j)		1-2	1-3	1-4	2-5	3-5	4-6	5-6
Estimated Duration (weeks)	Optimistic	1	1	2	1	2	2	3
	Most likely	1	4	2	1	5	5	6
	Pesimistic	7	7	8	1	14	8	15

- i) Draw the project network.
 ii) Find the expected duration and variance for each activity. What is the expected length of the project?
 iii) Calculate the variance and standard deviation of the project length.
 iv) What is the probability that the project will be completed.
 ➤ At least 4 weeks earlier than expected time?
 ➤ No more than 4 weeks later than expected time? (10 Marks)

- 7 a. What is the significance of using PERT/CPM? (03 Marks)
 b. PQR company owns facilities at 6 places. It has manufacturing plants at places A, B and C with daily productions of 50, 40 and 60 units respectively. At point D, E and F it has three warehouses with daily demands of 20, 95 and 35 units respectively. Per unit shipping costs are given in below table. Find the total transportation cost using VAM (Vogel's Approximation Method). (07 Marks)

		Warehouse		
		D	E	F
Plant	A	6	4	1
	B	3	8	7
	C	4	4	2

- c. The rate of arrival of customers at a public telephone follows Poisson distribution, with an average time of ten minutes between one customer and the next. The duration of a phone call is assumed to follow exponential distribution with a mean time of three minutes.
 i) What is the probability that a person arriving at the booth will have to wait?
 ii) What is the average length of the queue?
 iii) The Mahanagar telephone Ltd., will install another booth when it is convinced that the customers would have to wait for at least three minutes for their turn to make a call. How much should be the flow of customers in order to justify a second booth? (10 Marks)

- 8 a. State at least three factors considered for 'slowly deteriorating' and 'suddenly failing item' model for replacement strategy. (03 Marks)
- b. Explain with a neat sketch, the Beta distribution with three time estimates, with reference to PERT analysis. (07 Marks)
- c. ABC company has 2 different assembly lines to produce its product 'pressurex'. The processing time for each assembly line is a random variable and is described by following distribution:

Process Time (min)	Assembly (A ₁)	Assembly (A ₂)
10	0.10	0.20
11	0.15	0.40
12	0.40	0.20
13	0.25	0.15
14	0.10	0.05

Using following random numbers, generate data on the process time for 15 units and compute expected process time. Read the numbers vertically taking the first two digits for processing time on assembly A₁ and last two digits for processing line on assembly A₂.

(10 Marks)

4134 8343 3602 7505 7428
 7476 1183 9445 0089 3424
 4943 1915 5415 0880 9309

* * * * *

Second Semester MBA Degree Examination, May/June 2010

Quantitative Techniques for Management

Time: 3 hrs.

Max. Marks:100

Note: Answer any FIVE full questions.

- 1 a. Define operations research. (03 Marks)
 b. Discuss the characteristics and limitations of operations research. (07 Marks)
 c. Give the classification of models used in OR. Explain the mathematical modeling process. (10 Marks)
- 2 a. Explain the components involved in the formulation of an LPP, with a simple example. (03 Marks)
 b. Formulate the dual of the following primal problem.
 Minimize, $z = 2x_1 + 6x_2 - 4x_3$
 Subject to, $x_1 + x_2 + x_3 \leq 300$; $2x_1 - 2x_2 + 7x_3 \geq 10$; $x_1 - x_2 + 3x_3 = 50$; $x_1 + x_3 \geq 20$;
 $x_1, x_2, x_3 \geq 0$. (07 Marks)
 c. Sachin's woodcarving company, manufactures two types of wooden toys : soldiers and trains. A soldier toy is sold for Rs.27 and uses Rs.10 worth of raw materials. Each soldier toy that is manufactured increases Sachin's variable labour and overhead costs by Rs.14. A train toy is sold for Rs.21 and uses Rs.9 worth of raw materials. Each train toy that is manufactured increases Sachin's variable labour and overhead costs by Rs.10. To manufacture these toys it requires two types of skilled labour, that is, carpentry and finishing. A soldier toy requires 1 hour of carpentry labour and 2 hours of finishing labour. A train toy requires 1 hour of carpentry labour and 1 hour of finishing labour. Each week, Sachin can obtain all the needed raw material but has only 80 carpentry hours and 100 finishing3hours. Demand for train toys is unlimited, but at most 40 soldier toys are bought each week. Formulate this as on LPP in order to maximize Sachin's weekly profit. (10 Marks)
- 3 a. Explain the concept of degeneracy in transportation problem. (03 Marks)
 b. Jumbo company has four machines and four jobs to be completed. Each machine must be assigned to complete one job. The time required to et up each machine for completing each job is shown in the following table. Jumbo company wants to minimize the total set up time needed to complete the four jobs. Solve by Hungarian method. (07 Marks)

Machine \ Job	J ₁	J ₂	J ₃	J ₄
M ₁	14	5	8	7
M ₂	2	12	6	5
M ₃	7	8	3	9
M ₄	2	4	6	10

- c. Solve the following transportation problem using Vogel's approximation method and check for optimality using MODI method. (10 Marks)

Machine \ Destination	D ₁	D ₂	D ₃	D ₄	Supply
O ₁	21	16	25	13	11
O ₂	17	18	14	23	13
O ₃	32	17	18	41	19
Demand	6	10	12	15	43

- 4 a. Define the dummy activity. What is the purpose of introducing a dummy activity? (03 Marks)
 b. List out the differences between PERT and CPM. (07 Marks)
 c. Draw the network for the activities given below:

Activity	1-2	1-3	1-4	2-3	2-6	3-5	3-6	4-5	5-6
Duration (days)	3	4	14	10	5	4	6	1	1

Determine the critical path and project duration along with the earliest, latest start and finish time of activities. (10 Marks)

- 5 a. Differentiate between pure and mixed strategy of a game theory. (03 Marks)
 b. Solve the following game. Use Dominance rule. (07 Marks)

Player B

Player A	1	7	2
	6	2	7
	5	1	6

- c. Solve the following 2×3 game graphically. (10 Marks)

Player B

Player A	1	3	11
	8	5	2

- 6 a. Explain the rule (algorithm) used for sequencing n jobs through two machines. (03 Marks)
 b. List out the assumptions in sequencing. (07 Marks)
 c. A machine operator has to perform three operations of turning, threading and knurling on a number of different jobs. The time required to perform these operations (in minutes) for each job is known. Determine the order in which the jobs should be processed in order to minimize the total time required to turn out all the jobs. Also find the cycle time (elapsed time) and idle times on these three operations. (10 Marks)

	Jobs	1	2	3	4	5	6
Machines							
Turning		3	12	5	2	9	11
Threading		8	6	4	6	3	1
Knurling		13	14	9	12	8	13

- 7 a. Define the elements of queuing system. (03 Marks)
 b. Explain the different queuing models. (07 Marks)
 c. The arrivals at an ATM booth are assumed to be exponentially distributed. The arrival rate is 4 per hour and the service rate is 12 per hour. Determine :
 i) Average number of customers in the system ; ii) Average number of customers waiting to be served or average queue length ; iii) Average time a customer spends in the system ; iv) Average waiting time of a customer before being served. (10 Marks)
- 8 a. Explain simulation, with an example. (03 Marks)
 b. Discuss the steps involved in Monte Carlo simulation method. (07 Marks)
 c. A company manufactures 30 items per day. The sale of these items depends upon demand which has the following distribution:

Sales (units)	27	28	29	30	31	32
Probability	0.10	0.15	0.20	0.35	0.15	0.05

The production cost and sale price of each unit are Rs.40 and Rs.50 respectively. Any unsold product is to be disposed of at a loss of Rs.15 per unit. There is a penalty of Rs.5 per unit if the demand is not met. Using the following random numbers estimate the total profit/loss for the company for the next 10 days : 10, 99, 65, 99, 95, 01, 79, 11, 16, 20.

If the company decides to produce 29 items per day, what is the advantage or disadvantage to the company? (10 Marks)

* * * * *