FACULTY OF MANAGEMENT STUDIES
## UNIVERSITY OF DELHI
MBA Iyr 2ndSemester Examination,March-April 2014
MBAFT 6202: Management Science

Time: 3 hours   **Maximum marks:** 50

Answer any **FIVE** questions.

1.(a) The following network describes the hourly volume of traffic that can flow between
       various Districts in a Metropolitan city. Assume traffic can flow in both directions between
       each district at the same rate. What is the maximum flow of cars between Communities 1
       and 6 in one hour? Formulate a linear programming model (Do not solve) to find the
       solution.
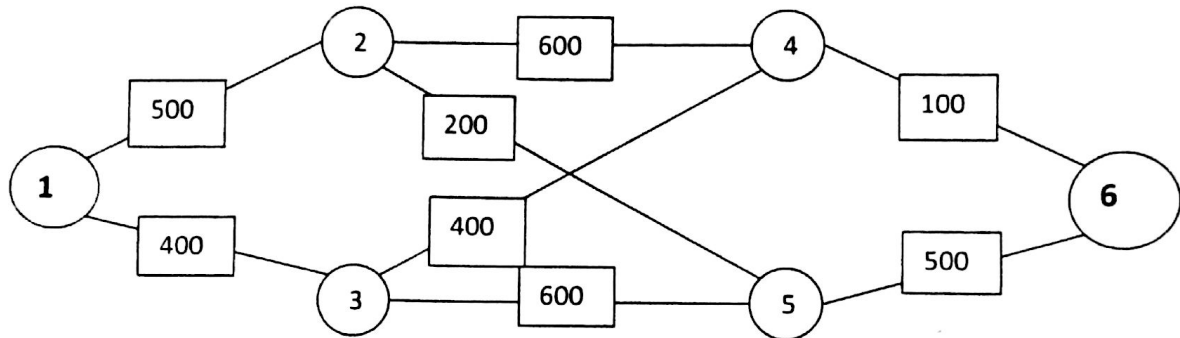
(b) A fast food restaurant currently has 2 cashiers. Upon arrival, customers form a single line
     and place their food order at the next available register. Assume that customers arrive at the
     rate of 35 per hour. It takes an average of 3 minutes to place and process each customer's
     order. Assume that arrival rate follows a Poisson distribution and service time follows an
     exponential distribution. To determine the efficiency of operations, the cafeteria manager
     wishes to examine several queue operating characteristics. Based upon the analysis, the
     manager believes that if the average waiting time per customer in the system is greater than
     5 minutes, then a request for an additional employee should be made. Should the manager
     make a request to hire an additional employee?

$$p_0 = \cfrac{1}{\displaystyle\sum_{n=0}^{k-1} \frac{1}{n!}\left(\frac{\lambda}{\mu}\right)^{n} + \frac{1}{k!}\left(\frac{\lambda}{\mu}\right)^{k}\left(\frac{k\mu}{k\mu - \lambda}\right)}, \quad L = \frac{\left(\lambda/\mu\right)^{k}\lambda\mu}{(k-1)!(k\mu-\lambda)^{2}}\, p_0 + \left(\frac{\lambda}{\mu}\right)$$

2. The *XYZ* Manufacturing company must decide whether to manufacture a component part at its Pune plant or purchase the component part from a supplier. The resulting profit is dependent upon the demand for the product. The following payoff table shows the projected profit in millions of Rupees.

Decision Alternative	State of Nature		
	Low demand	Medium demand	High demand
Manufacture	-20	40	100
Purchase	10	45	70

The current estimates for probabilities of state of nature are: P(Low demand) = 0.35, P(Medium demand) = 0.35 and P(High demand) = 0.30.

(i) Use decision tree to recommend a decision

(ii) Use EVPI to determine whether *XYZ* should attempt to obtain a better estimate of demand

(iii) A test market study of the potential demand for the product is expected to report either a favourable(F) or Unfavourable(U) condition. The relevant conditional probabilities are as follows;

P(F | Low demand) = 0.10,
P(F | Medium demand) = 0.40 and
P(F | High demand) = 0.70

What is the probability that the market research report would be favourable?

(iv) What is *XYZ*'s optimal decision strategy?

3. *PQR* is an accounting firm that has three new clients. Project leaders will be assigned to the three clients. Based on the different backgrounds and experiences of the leaders, the various leader-client assignments differ in terms of projected completion times. The possible assignments and the estimated completion times in days are:

Project Leader	Clients		
	1	2	3
Gita	10	16	32
Vijay	14	22	40
Sita	22	24	34
Ajay	14	18	36

(i) Formulate the problem as a linear program.

(ii) Find the optimal assignment, using Hungarian algorithm.

4.(a) A certified financial planner (CFP) has been asked by a client to invest Rs.25,000,000. This money may be placed in stocks or a mutual fund (MF) in real estate. The expected return on investment is 13% for stocks and 10% for real estate MF. While the client would like a very high expected return, she would be satisfied with a 11% expected return on her money.

Due to risk considerations, several goals have been established to keep the risk at an acceptable level. One goal is to put at least 30% of the money in real estate MF. Another goal is that the amount of money in real estate should not exceed 50% of the money invested in stocks. In addition to these goals, there is one absolute restriction. Under no circumstances should more than Rs.20,000,000 be invested in any one area.

Formulate this as a goal programming problem. Assume that return is more important to the investor than risk. Are there any alternate formulations?

(b) A company currently has two factories: F1 and F2, and three retail outlets: R1, R2, and R3. The shipping costs per unit along with the monthly capacity and demand requirements are summarized below:

	Shipping Cost (in Rs.) Per Unit			
	R1	R2	R3	Supply
F1	30	20	40	10000
F2	10	30	50	20000
Demand	10000	10000	20000	

The firm has decided to build a new factory to expand its productive capacity. The two sites being considered are FA and FB. The estimated shipping costs for the new factories along with their estimated fixed cost and production capacity are summarized below:

	R1	R2	R3	Supply	Fixed Cost
FA	20	40	30	10000	200,000
FB	30	50	20	10000	250,000

Which of the new locations will yield the lowest cost in combination with the existing factories and retail outlets? Formulate an linear optimization model (do not need to solve it for optimality).

5. A university needs to prepare a banquet for its graduating seniors. The following information describes the relationships between the activities that need to be completed for this banquet. The catering manager was able to estimate the number of hours needed to complete each activity (also shown on the table).

Prede	Activity	Optimistic time	Most Likely Time	Pessimistic Time
—	A	2	3	5
—	B	4	6	7
A	C	3	4	5
A	D	2	3	5
B	E	1	2	3
C,E	F	5	7	11
F	G	6	8	9
E,G	H	4	6	7

(i) Use PERT to identify the expected time and variance for each activity.

(ii) What is the critical path?

(iii) What is the expected time and variance of the critical path?

(iv) Determine the expected completion time of the project.

(v) What is the probability that the project will be completed in 24 hours?

6. The following table gives the list of activities and other details for a project.

Activity	Preceding Activity	Duration (In days)	Crashed duration and cost per day of crashing
A	--	9	6 days; Rs. 10,000
B	A	3	2 days; Rs. 12,000
C	A	6	4 days; Rs.9,000
D	B	11	7 days; Rs. 15,000
E	B	8	6 days; Rs. 11,000
F	C	12	8 days; Rs. 10,000
G	C	6	4 days; Rs. 12,000
H	D	7	4 days; Rs. 18,000
I	B, E, F	9	8 days; Rs. 22,000
J	C, G, H	10	6 days; Rs. 27,000
K	F, G, I, J	6	4 days; Rs. 19,000

The indirect cost is Rs. 50,000 per day.

(i) Draw a PERT network of the project.

(ii) Calculate the time-cost optimal tradeoff project duration and corresponding cost.

7.(a) Discuss with one example, how Transition Probability Matrix, help managers in modeling decision problems.

The still-camera industry is controlled by four companies Alpha, Beta, Gamma and Delta. If customers buy either Alpha or Beta they never buy another brand. If they buy Gamma the probabilities that they will buy Alpha, Beta, Gamma and Delta next month are 0.45, 0.4, 0.05 and 0.1. If they buy Delta the probabilities that they will buy Alpha, Beta, Gamma and Delta next month are 0.1, 0.2, 0.3 and 0.4 respectively. Represent this situation as a state-transition diagram and transition probability matrix.

(b) For the next festive season two competing firms (firm A and Firm B) are drawing their promotional plans. Both believe that their decision making is happening under a two-person constant sum game environment with both sides having perfect information. The corresponding zero-sum game has the following pay-off matrix.

	Firm B plans		
	Aggressive	Normal	Moderate
Firm A plans — Aggressive	300	200	200
Firm A plans — Normal	200	100	300
Firm A plans — Moderate	400	300	200

Find the optimal strategies for both the firms.