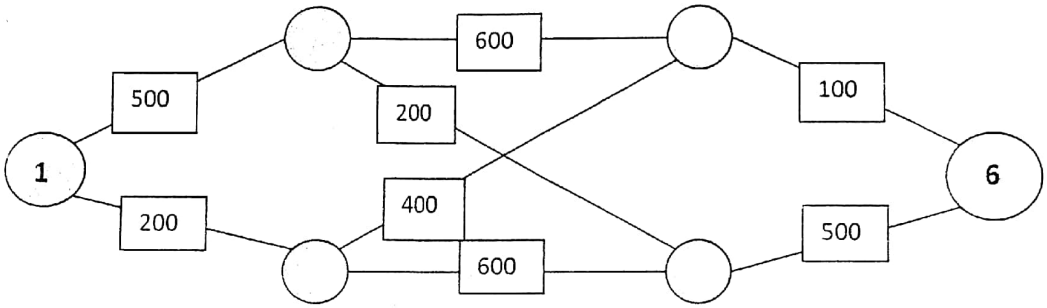
FACULTY OF MANAGEMENT STUDIES
UNIVERSITY OF DELHI
MBA Iyr 2nd Semester Examination, March 2017
MBAFT 6202: Management Science

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

Answer any **FOUR** questions.

1.(a) The following network describes the hourly volume of traffic (in standardized units) that can flow between various Districts (nodes in the network) in a Metropolitan city. Assume traffic can flow in both directions between each pair of districts at the same rate. What is the maximum flow of traffic 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 cash counters that take and process orders. Upon arrival, customers form a single line and place their food order at the next available cash counter. Assume that customers arrive at the rate of 36 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. What is the probability that a customer has to wait to place order? What is the average number of customers waiting in the queue?

To determine the efficiency of operations, the restaurant 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?

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

2. A real estate investor has the opportunity to purchase land currently zoned residential. If the county board approves a request to rezone the property as commercial within the next year, the investor will be able to lease the land to a large discount firm that wants to open a new store on the property. However, if the zoning change is not approved, the investor will have to sell the property at a loss. Profits (in thousands of dollars) are shown in the following payoff table:

Decision Alternative	**State of Nature**	
	Rezoning Approved, s1	**Rezoning Not Approved, s2**
Purchase, d1	600	-200
Do not purchase, d2	10	45

(a) If the probability that the rezoning will be approved is 0.5, what decision is recommended? What is the expected profit?

(b) The investor can purchase an option to buy the land. Under the option, the investor maintains the rights to purchase the land anytime during the next three months while learning more about possible resistance to the rezoning proposal from area residents. Probabilities are as follows:

Let H = High resistance to rezoning, and L = Low resistance to rezoning

P(H) = 0.55, P(s1 | H) = 0.18, P(s2 | H) = 0.82
P(L) = 0.45, P(s1 | L) = 0.89, P(s2 | L) = 0.11

What is the optimal decision strategy if the investor uses the option period to learn more about the resistance from area residents before making the purchase decision?

(c) If the option will cost the investor an additional $10,000, should the investor purchase the option? Why or why not? What is the maximum that the investor should be willing to pay for the option?

3.(a) A software development company has got five projects from new clients. Within the company there are seven teams, out of which five teams need to be selected for these projects. Based on past records, and analysis of technical skills, a team of experts have given scores to these teams (in a scale of 1 to 10) on their ability to successfully complete a project. A score closer to 10 indicates that the team is better suited to undertake that project. The scores are in the following table.

	Team 1	Team 2	Team 3	Team 4	Team 5	Team 6	Team 7
Project A	7	9	2	1	3	3	8
Project B	6	1	7	9	5	4	9
Project C	8	4	6	8	7	8	7
Project D	9	5	8	2	6	9	3
Project E	6	8	2	1	6	8	2

Find the five teams that should do these projects.

(b) At a small but growing airport, the local airline company is purchasing a new tractor for a tractor-trailer train to bring luggage to and from the airplanes. A new mechanised luggage system will be installed in three years, so the tractor will not be needed after that. However, because it will receive heavy use, so that the running and maintenance costs will increase rapidly as it ages, it may still be more economical to replace the tractor after one or two years. The following table gives the total net discounted cost associated with purchasing a tractor (purchase price minus trade-in allowance, plus running and maintenance costs) at the end of year i and trading it in at the end of year j (where end of year 0 is now).

	j		
i	**1**	**2**	**3**
0	Rs. 8,000	Rs. 18,000	Rs. 31,000
1		Rs. 10,000	Rs. 21,000
2			Rs. 12,000

Management wishes to determine at what times (if any) the tractor should be replaced to minimize the total cost for the tractor(s) over three years. Formulate a network model for this problem as a shortest path problem.

4.(a) Industrial Chemicals produces two adhesives used in the manufacturing process for airplanes. The two adhesives, which have different bonding strengths, require different amounts of production time: the IC-100 adhesive requires 20 minutes of production time per gallon of finished product, and the IC-200 adhesive uses 30 minutes of production time per gallon. Both products use 1 pound of a highly perishable resin for each gallon of finished product. Inventory currently holds 300 pounds of the resin, and more can be obtained if necessary. However, because of the limited shelf life of the material, any amount not used in the next two weeks will be discarded.

The firm has existing orders for 100 gallons of IC-100 and 120 gallons of IC-200. Under normal conditions, the production process operates eight hours per day, five days per week. Management wants to schedule production for the next two weeks to achieve the following goals:

Priority Level 1 Goals
Goal 1: Avoid underutilization of the production process.

Goal 2: Avoid overtime in excess of 20 hours for the two weeks.

Priority Level 2 Goals
Goal 3: Satisfy existing orders for the IC-100 adhesive; that is, produce at least 100 gallons of IC-100.
Goal 4: Satisfy existing orders for the IC-200 adhesive; that is, produce at least 120 gallons of IC-200.

Priority Level 3 Goal
Goal 5: Use all the available resin.

(a) Formulate a goal programming model for the Industrial Chemicals problem. Assume that both priority level 1 goals and both priority level 2 goals are equally important.

(b) Describe one of the methods (do not solve to optimality) that you can use to solve model developed for (a) above.

(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 linear optimization model (do not need to solve) for this problem.

5. *Office Automation, Ltd.*, developed a proposal for introducing a new computerized office system that will improve word processing and interoffice communications for a particular company. Contained in the proposal is a list of activities that must be accomplished to complete the new office system project. Use the following relevant information about the activities:

Activity	Description	Immediate Predecessor	Time (weeks)		Cost (Rs. 000s)	
			Normal	Crash	Normal	Crash
A	Plan needs	-	10	8	30	70
B	Order equipment	A	8	6	120	150
C	Install equipment	B	10	7	100	160
D	Set up training lab	A	7	6	40	50
E	Conduct training course	D	10	8	50	75
F	Test system	C, E	3	3	60	-

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.

6.(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) Two television stations compete for viewing audience. Local programming options for the 8:00 P.M. weekday time slot include a sitcom rerun, an early news program, or a home improvement show. Each station has the same programming options and must make its preseason program selection before knowing what the other television station will do. The viewing audience gains in thousands of viewers for Station A are shown in the payoff table.

		Station B		
		Sitcom Rerun	News Program	Moderate
Station A	Sitcom Rerun	10	-5	3
	News Program	8	7	6
	Home Improvement	4	8	7

Develop a model (finding equilibrium solution is not needed) to find answer to the following:
(a) What is the optimal strategy for each station?
(b) What is the value of the game?