

[This question paper contains 6 printed pages.]

Sr. No. of Question Paper : 2553

Roll No.....

Unique Paper Code : 101304

Name of the Course : B.F.I.A. 2013

Name of the Paper : Quantitative Techniques

Semester : III

Duration : 3 Hours

Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **Seven** Questions in all.
3. Question No. **1** is compulsory.
4. Marks of each question are mentioned along with the questions.
5. Answer parts of a question together. Show your workings clearly.
6. Use of non-programmable scientific calculator is allowed.

1. (a) What is goal programming ? How is it different from linear programming problem ? (3)
- (b) A person wishes to invest Rs. 5,00,000 in a mix of investments. The investment choices and expected rates of return on each one of them are :

Investment	Mutual Fund A	Mutual Fund B	Money Market Fund	Government Bonds	Share Y	Share X
Projected Rate of Return	0.12	0.09	0.08	0.085	0.16	0.18

P.T.O.

The investor wants at least 35 percent of his investment in government bonds. Because of the higher perceived risk of the two shares, he has specified that the combined investment in these should not exceed Rs. 80,000. The investor also specified that at least 20 percent of the investment should be in the money market fund and the amount of money invested in shares should not exceed the amount invested in mutual funds. The final condition he kept is that the amount invested in mutual fund A should be no more than the amount invested in mutual fund B. As finance advisor formulate the investment mix problem as a linear programming problem that yield the highest annual total revenue to the person. (4)

- (c) A manufacturer produces three products daily X, Y and Z. The three products are each processed through three production operations with time constraints and then stored. The problem has been formulated as –

$$\text{Maximize } z = 32x_1 + 35x_2 + 45x_3$$

Subject to :

$$2x_1 + 3x_2 + 2x_3 \leq 120$$

$$4x_1 + 3x_2 + x_3 \leq 160$$

$$3x_1 + 2x_2 + 4x_3 \leq 100$$

$$x_1 + x_2 + x_3 \leq 40$$

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

Using simplex method solve the above problem. And on the basis of final simplex table obtained, answer the following questions –

- (i) Is the solution unbounded or not and why?
- (ii) Is the solution degenerate or not and why?
- (iii) Does the problem have multiple solutions? (8)

2. (a) Solve the following transportation problem for maximizing profit

Warehouse		Per Unit Profit (Rs)			
		Market			
		A	B	C	D
X		12	18	6	25
Y		8	7	10	18
Z		14	3	11	20

Availability at warehouse :		Demand in the market	
X	200 units	A	180 units
Y	500 units	B	320 units
Z	300 units	C	100 units
		D	400 units

(8)

- (b) What is balanced transportation problem? At max how many basic cells can be there in a transportation problem with m -sources and n -destinations? (2)

3. (a) Lexicographically Min $\{(\rho_1 + \rho_2 + \rho_3), \eta_4, \eta_5\}$

Subject to

$$2x_1 + 4x_2 + \eta_1 - \rho_1 = 600$$

$$4x_1 + 5x_2 + \eta_2 - \rho_2 = 1000$$

$$5x_1 + 4x_2 + \eta_3 - \rho_3 = 1200$$

$$20x_1 + 32x_2 + \eta_4 - \rho_4 = 5400$$

$$0.3x_1 + 0.75x_2 + \eta_5 - \rho_5 = 108$$

Where ρ_i is positive deviation of i^{th} goal and η_i is negative deviation of i^{th} goal. Derive the solution by simplex method for goal programming problem. (8)

- (b) Detail out the various customer behaviors that can occur in the arrival patterns of the queues. (2)

4. (a) A project consists of activities A, B, C...H, I. The notion $X < Y$ means that the activity X must be completed before Y can start and $X, Y < W$ means that W will start only after the completion of activities X and Y. With this notion construct the 'network diagram for the following constraints :

P.T.O.

$A < D$; $A < E$; $B < F$; $C < G$; $D < H$; $E, F < I$

The project has the following time schedules for the above activities :

Activity	A	B	C	D	E	F	G	H	I
Optimistic Time	5	18	26	16	15	6	7	7	3
Pessimistic Time	10	22	40	20	25	12	12	9	5
Most Likely Time	8	20	33	18	20	9	10	8	4

Determine the critical activities for the network and compute the expected task time and the variance of the critical path. (5)

- (b) Find the optimum order quantity for a product for which the price breaks are as follows :-

Quantity	Unit Cost (Rs)
$0 \leq Q_1 < 800$	Re. 1.00
$800 \leq Q_2$	Re. 0.98

The yearly demand for the product is 1600 units, cost of placing an order is Rs. 5 and cost of shortage is 10% per year. (5)

5. (a) A small project consists of seven activities for which the relevant data are given below

Activity	Preceding Activity	Activity Duration (in Days)
A	-	4
B	-	7
C	-	6
D	A,B	5
E	A,B	7
F	C,D,E	6
G	C,D,E	5

(i) Draw the project network and obtain the critical path.

(ii) Calculate total float for each activities.

(6)

- (b) There are 5 jobs A,B,C,D,E and these are to be performed on five machines I,II,III,IV,V. One job is to be allocated to a machine centre, though each machine is capable of doing any job, at different costs given by the matrix below :

	I	II	III	IV	V
A	2	9	2	7	1
B	6	8	7	6	1
C	4	6	5	3	1
D	4	2	7	3	1
E	5	3	9	5	1

Suggest an optimal assignment schedule.

(4)

6. A company is planning to launch a new product, which can be introduced initially in Western India or in the entire country. If the product is introduced only in Western India the investment outlay will be Rs. 12 million. After two years the company can evaluate the project to determine whether it should launch it in the entire country or continue in Western India only. If expansion process is done the company will have to incur an additional investment of Rs. 10 million. To introduce the product in the entire country right in the beginning would involve an outlay of Rs. 20 million. The product in any case, will have a life of 5 years, after which its value will become zero.

If the product is introduced only in western India, demand would be high or low with the probabilities of 0.8 and 0.2 respectively and annual cash inflow of Rs. 4 and 2.5 million respectively.

If the product is introduced in the entire country right in the beginning, demand would be high or low with the probabilities of 0.6 and 0.4 respectively and annual cash inflow of Rs. 8 and 5 million respectively.

Based on the observed demand in Western India, if the product is introduced in the entire country the following probabilities would exist for high and low demand on an All-India basis-

P.T.O.

Western India	Whole Country	
	High Demand	Low Demand
High Demand	0.90	0.10
Low Demand	0.40	0.60

Use decision tree analysis to locate the optimal strategy for the company. Also name the criteria and technique used for locating the optimal strategy. (10)

7. (a) A road transportation company has one reservation clerk on duty at a time. He handles information of bus schedules and makes reservations. Customers arrive at a rate of 8 per hour and the clerk can service 12 customers on an average per hour. Assuming Poisson distribution for arrival rate and exponential distribution for service rate, find –

- (i) Average number of customers waiting for the service in system and in queue.
- (ii) Average time a customer has to wait before getting service.
- (iii) The management is contemplating installing a computer system to handle the information and reservations. This is expected to reduce the service time from 5 to 3 minutes. The additional cost of having the new system works out to be Rs. 50 per day. The cost of goodwill of having to wait is estimated to be 12 paise per minute spent before being served. Should the company install the computer system? Assume 8 hours working day. (6)

- (b) Explain classical EOQ Model. (4)

8. The matrix below show the pay off in a 4*2 game between A and B

		Player B	
		I	II
Player A	1	-7	6
	2	7	-4
	3	-4	-2
	4	8	-6

- (i) Formulate a linear programming problem for player A. Using the formulated LPP obtain the Linear Programming problem for player B. What principle is used in doing so? (4)
- (ii) Solve the above 4*2 game using graphical method. (6)

(100)

[This question paper contains 6 printed pages.]

Sr. No. of Question Paper : 1225

Roll No.....

Unique Paper Code : 101304

Name of the Paper : Quantitative Techniques

Name of the Course : B.F.I.A.

Semester : III

Duration : 3 Hours

Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. All questions are compulsory.
3. Internal choice is given wherever needed.
4. Marks of each question are mentioned along with the questions.

1. (a) State the general assumptions of a linear programming problem. (2)
- (b) Establish the difference between (i) Feasible solution (ii) Basic feasible solution (iii) Degenerate basic feasible solution (iv) Optimum basic feasible solution. (2)

2. (a) Following is an optimal simplex table for linear programming problem :

Maximize $z = x_1 + 2x_2$; subject to the constraints

$$-x_1 + 2x_2 \leq 8$$

$$x_1 + 2x_2 \leq 12$$

$$x_1 - 2x_2 \leq 3$$

$$x_1, x_2 \geq 0$$

C_B	Basis	b	x_1	x_2	S_1	S_2	S_3
2	x_2	5	0	1	$\frac{1}{4}$	$\frac{1}{4}$	0
1	x_1	2	1	0	$-\frac{1}{2}$	$\frac{1}{2}$	0
0	S_3	11	0	0	1	0	1
	$Z_j - C_j$	12	0	0	0	1	0

P.T.O.

Where S_1, S_2, S_3 are the vectors corresponding to the slack variables

- (i) Obtain an alternative optimal basic feasible solution.
- (ii) Solve the above linear programming problem graphically.
- (iii) Write an optimal non basic solution of the problem.

OR

A retired person wants to invest up to an amount of Rs. 30,000 in fixed income securities. His broker recommends investing in two bonds: Bond A yielding 7% and Bond B yielding 10%. After some consideration, he decides to invest at most Rs. 12,000 in Bond B and at least Rs. 6000 in Bond A. He also wants the amount invested in Bond A to be at least equal to the amount invested in Bond B. What should the broker recommend if the investor wants to maximize his return on investment? Solve graphically. (7)

- (b) Solve the following LPP :

Maximize $z = 6x_1 + 4x_2$; subject to the constraints

$$-2x_1 - 3x_2 \geq -30$$

$$3x_1 + 2x_2 \leq 24$$

$$x_1 + x_2 \geq 3; x_1, x_2 \geq 0 \quad (8)$$

2. (a) State and formulate general transportation problem. State the necessary and sufficient condition for the existence of its feasible solution. Also write the dual of formulated general transportation problem. (5)
- (b) ABC company is spending Rs. 1,200 on transportation of its units from three plants to four destinations. The supply and demand of units with unit transportation cost are as given –

	D1	D2	D3	D4	Supply
P1	20	30	50	17	7
P2	70	35	40	60	10
P3	40	12	60	25	18
Demand	5	8	7	15	

What can be the maximum saving by optimal scheduling from plants to destinations ? (5)

3. A Production manager is interested in maximizing profit of his company which manufactures two products; Product A and Product B. The requirement of material and labor needed to make the products along with the unit profit for both products are as follows –

Product	Labor (in hrs.)	Material M ₁ (in kg.)	Material M ₂ (in kg.)	Unit Profit (Rs.)
A	2	4	5	20
B	4	5	4	32
Availability (per Week)	600	1000	1200	

The manager is also concerned with maintaining workforce of the division at nearly constant level of 108 persons per week in the interest of employee morale. Also it is known that the production of one unit of A would maintain 0.3 persons in the workforce and one unit of B would maintain 0.75 persons. Formulate and solve this as linear goal programming problem when given that the manager sets the target of profit to be at least Rs. 5400 per week. (8)

4. The following table lists the jobs of a project with their time estimates

Job (i-j)	Optimistic Time (in Days)	Most Likely Time (in Days)	Pessimistic Time (in Days)
1-2	3	6	15
1-6	2	5	14
2-3	6	12	30
2-4	2	5	8
3-5	5	11	17
4-5	3	6	15
5-8	1	4	7
6-7	3	9	27
7-8	4	19	28

P.T.O.

- (i) Draw the project network and obtain the critical path
- (ii) Calculate the expected completion time and variance of the critical path.
- (iii) What is the probability of completing the project 5 days before the expected time ? (8)

5. (a) What is ABC analysis ? (2)

(b) A manufacturing company is presently following this plan: It purchases 9000 parts of a machine for its annual requirement ordering one month usage at a time. Each part costs Rs. 20. The ordering cost per order is Rs. 15 and the carrying charges are 15% of the average inventory per year. Suggest a more economical purchasing policy for the company. How much would it save the company per year ? (5)

6. Convert the following LPP into an assignment problem and then solve it.

$$\text{Minimize } Z = 18x_{11} + 26x_{12} + 17x_{13} + 11x_{14} + 13x_{21} + 28x_{22} + 14x_{23} + 26x_{24} + 38x_{31} + 19x_{32} + 18x_{33} + 15x_{34} + 19x_{41} + 26x_{42} + 24x_{43} + 10x_{44}$$

Subject to :

$$x_{11} + x_{12} + x_{13} + x_{14} = 1; \quad x_{21} + x_{22} + x_{23} + x_{24} = 1; \quad x_{31} + x_{32} + x_{33} + x_{34} = 1;$$

$$x_{41} + x_{42} + x_{43} + x_{44} = 1; \quad x_{11} + x_{21} + x_{31} + x_{41} = 1; \quad x_{12} + x_{22} + x_{32} + x_{42} = 1;$$

$$x_{13} + x_{23} + x_{33} + x_{43} = 1; \quad x_{14} + x_{24} + x_{34} + x_{44} = 1$$

$$\text{all } x_{ij} = 0 \text{ or } 1$$

(5)

7. (a) Use the notion of dominance to simplify the rectangular game with the following pay off :

		Player B			
		I	II	III	IV
Player A	1	18	4	6	4
	2	6	2	13	7
	3	11	5	17	3
	4	7	6	12	2

Find its graphical solution.

(6)

- (b) A self-service store employs one cashier at its counter. An average of 9 customers arrive every 5 minutes while the 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 queue length
 - (iii) Average time a customer spends in the system
 - (iv) Average time a customer waits before being served. (4)

8. An oil company has recently acquired rights in a certain area to conduct surveys and test drillings to lead to lifting oil if it is found in commercially exploitable quantities.

The area is considered to have good potential for finding oil in commercial quantities. At the outset, the company has the choice to conduct further geological tests or to carry out drilling programme immediately. On the known conditions, the company estimates that there is a 70:30 chance of further tests showing a success.

Whether the tests show the possibility of ultimate success or not or even if no tests are undertaken at all, the company could still pursue its drilling programme or alternatively selling its rights to drill in the area. Thereafter, however, it carries out the drilling programme, the likelihood of final success or failure is considered dependent on the foregoing stages :

- (i) if 'successful' tests have been carried out, the expectation of success in drilling is given as 80:20
- (ii) if the test indicate 'failure', then the expectation of success in drilling is 20:80
- (iii) if no tests have been carried out at all the expectation of success in drilling is 55:45.

Costs and revenues have been estimated for all possible outcomes as follows :

Outcome		Net present value (Rs. Millions)
Success :	With prior tests	100
	Without prior tests	120
Failure :	With prior tests	-50
	Without prior tests	-40
Sale of exploitation rights	Prior tests show 'success'	65
	Prior tests show 'failure'	15
	Without prior tests	45

- (i) Draw decision tree for the above sequential decisions.
- (ii) Compute the best course of action to be taken by the management on the basis of Expected Monetary Value criterion. (8)

[This question paper contains 5 printed pages.]

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Your Roll No.

BFIA / III Sem. - 2011

BACHELOR OF FINANCIAL AND INVESTMENT
ANALYSIS - Paper 304

Quantitative Techniques

Time : 3 hours

Maximum Marks : 75

(Write your Roll No. on the top immediately
on receipt of this question paper.)

Attempt all questions.

1. Ozark Farms uses atleast 800 lb of special feed daily. The special feed is a mixture of Corn and Soyabean Meal with the following composition

Feed stuff	lb per lb of feed stuff		
	Protein	Fiber	Cost (\$/lb)
Corn	0.09	0.02	0.30
Soyabean Meal	0.60	0.06	0.90

The dietary requirement of the special feed are atleast 30% protein and atleast 5% fiber. Ozark Farms wishes to determine the daily minimum - cost feed mix. [Formulate the above as LPP & solve graphically]

(10)

P.T.O.

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2. Solve the following LPP by Two-phase method

$$\begin{aligned} \text{Min } Z &= 4x_1 + x_2 \\ \text{S.t. } \quad 3x_1 + x_2 &= 3 \\ &4x_1 + 3x_2 \geq 6 \\ &x_1 + 2x_2 \leq 4 \\ &x_1, x_2 \geq 0 \end{aligned} \quad (10)$$

3. Consider the LPP

$$\begin{aligned} \text{Max } Z &= -x_1 + 2x_2 - x_3 \\ \text{S.t. } \quad 3x_1 + x_2 - x_3 &\leq 10 \\ &-x_1 + 4x_2 + x_3 \geq 6 \\ &x_2 + x_3 \leq 4 \\ &x_j \geq 0, \text{ for } j = 1, 2, 3 \end{aligned}$$

Solve, the above using Simplex Method and determine the range of b_2 and b_3 of requirement vector so as to maintain the feasibility of current optimal solution. Also find the range of c_2 of cost vector so as to maintain the feasibility of current optimal solution. (10)

4. In a 3×3 transportation problem, let x_{ij} be the amount shipped from source i to destination j and c_{ij} be the corresponding transportation cost per unit. The

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amounts of supply at source 1, 2 and 3 are 15, 30 and 85 units respectively and the demands at destination 1, 2 and 3 are 20, 30 and 80 units, respectively. Assuming that starting north west-corner solution is optimal and that the associated values of the multipliers are given as $u_1 = -2$, $u_2 = 3$, $u_3 = 5$, $v_1 = 2$, $v_2 = 5$ and $v_3 = 10$.

- (a) Find the associated optimal cost.

- (b) Determine the smallest value of c_{ij} associated with each non-basic variable that will maintain the optimality of the north-west - corner solution. (10)

5. A firm produces two products say X and Y. Product X sells for a net profit of Rs. 80 per unit while product Y sells for a net profit of Rs. 40 per unit. The goal of the firm is to earn Rs. 900 in the next week. Also, the management wants to achieve sales volume for the two products close to 17 and 15 respectively. Formulate this problem as a goal programming model. (5)
6. A project consists of eight activities with the following relevant information.

P.T.O.

Activity	Immediate predecessor	Estimated duration		
		Optimistic	Most likely	Pessimistics
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 out the expected project completion time.
- (ii) What duration will have 95% confidence for project completion?
- (iii) If the average duration for activity F increases to 14 days, what will be its effect on the expected project completion time which will have 95% confidence?

[For standard normal $Z = 1.645$, area under the standard normal curve from 0 to Z is 0.45]

(10)

7. Write a short note on EOQ and derive the formula of economic lot size. (5)
8. Two firms are competing for business under the condition so that one firm's gain is another firm's loss. Firm A's payoff matrix is given below

		Firm B		
		No ad	Medium ad	Heavy ad
Firm A	No advertising	10	5	-2
	Medium advertising	13	12	15
	Heavy advertising	16	14	10

Suggest optimum strategies for the two firms and the net outcome thereof. (10)

9. In a railway marshalling yard, goods trains arrive at a rate of 30 trains per day. Assuming that the inter-arrival time follows an exponential distribution and the service time distribution is also exponential with an average 36 minutes. Calculate the following:

- (i) the mean queue size &
- (ii) the Probability that the queue size exceeds 10.

(5)