Q.2 a. What do you mean by 'degeneracy' and 'cycling' while solving linear programming problems? Explain. (4)

Answer:

The method of obtaining a degenerate basic feasible solution in a LPP is known as 'degeneracy'. It may arise

(i) at the initial stage. In this case at least one basic variable is zero in the initial basic feasible solution

(ii) at any subsequent iteration. In this case more than one basic variable is eligible to leave the basis and hence in the next iteration one or more basic variable becomes zero. The subsequent iteration may not produce any improvements in the objective function and thus produces degenerate solution. As a result, the simplex iteration are done repeatedly without improving the solutions. This concept is known as 'cycling'.

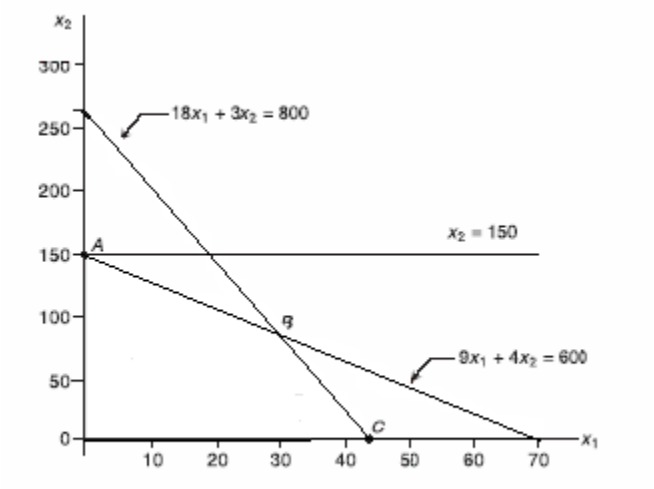
b. Using Graphical Method, solve the following linear programming problem:

Maximize $Z = 400X_1 + 200X_2$
Subject to constraints:
$18X_1 + 3X_2 \leq 800$
$9X_1 + 4X_2 \leq 600$
$X_2 \leq 150$
$X_1, X_2 \geq 0$ **(12)**

Answer:

The first constraint $18X1 + 3X2 \leq 800$ can be represented as follows.
We set $18X1 + 3X2 = 800$
When $X1 = 0$ in the above constraint, we get,
$18 \times 0 + 3X2 = 800$
$X2 = 800/3 = 266.67$
Similarly when $X2 = 0$ in the above constraint, we get,
$18X1 + 3 \times 0 = 800$
$X1 = 800/18 = 44.44$

The second constraint $9X1 + 4X2 \leq 600$ can be represented as follows,
We set $9X1 + 4X2 = 600$
When $X1 = 0$ in the above constraint, we get,
$9 \times 0 + 4X2 = 600$
$X2 = 600/4 = 150$
Similarly when $X2 = 0$ in the above constraint, we get,
$9X1 + 4 \times 0 = 600$
$X1 = 600/9 = 66.67$
The third constraint $X2 \leq 150$ can be represented as follows,
We set $X2 = 150$



Point	X1	X2	Z = 400X1 + 200X2
0	0	0	0
A	0	150	Z = 400 x 0+ 200 x 150 = 30,000* Maximum
B	31.11	80	Z = 400 x 31.1 + 200 x 80 = 28,444.4
C	44.44	0	Z = 400 x 44.44 + 200 x 0 = 17,777.8

The Maximum profit is at point A
When X1 = 150 and X2 = 0
Z = 30,000

Q.3 a. In a linear program problem what are the properties of basic solution, explain. (4)

Answer:

A **basic solution** has the following properties:

1. Each variable is designated as either a non basic variable or a basic variable.

2. The *number of basic variables* equals the number of functional constraints (now equations). Therefore, the *number of non basic variables* equals the total number of variables *minus* the number of functional constraints.

3. The **nonbasic variables** are set equal to zero.

4. The values of the **basic variables** are obtained as the simultaneous solution of the system of equations (functional constraints in augmented form). (The set of basic variables is often referred to as **the basis.**)

5. If the basic variables satisfy the *non negativity constraints,* the basic solution is a **BF solution.**

b. Use Big-M method to solve the following: (12)

Minimize $Z = 4X_1 + 3X_2$
Subject to: $2X_1 + X_2 \geq 10$
$-3X_1 + 2X_2 \leq 6$
$X_1 + X_2 \geq 6$
$X_1, X_2 \geq 0$

Answer:

Text Book – I, Example 3.4.1, Page No. 100

Q.4 a. Explain "North West Corner Method" to obtain basic feasible solution. (4)

Answer:

We have to begin with the upper left corner of the transportation tableau and set x_{11} as large as possible (clearly, x_{11} can be no larger than the smaller of s_1 and d_1).

• If $x_{11}=s_1$, cross out the first 1 or column 1 (but not both!).

o If we cross out row, change row of the tableau. Also change d_1 to d_1-s_1.

• If $x_{11}=d_1$, cross out the first column of the tableau. Change s_1 to s_1-d_1.

• If $x_{11}=s_1=d_1$, cross out either row d_1 to 0.

o If we cross out column, change s_1 to 0.

Continue applying this procedure to the most northwest cell in the tableau that does not lie in a crossed out row or column.

Eventually, we will come to a point where there is only one cell that can be assigned a value. Assign this cell a value equal to its row or column demand, and cross out both the cell's row and column. A basic feasible solution has now been obtained.

b. In a manufacturing unit there are four machines W, X, Y and Z and four jobs A, B, C and D are to be performed. The time taken by each machine to perform job is given. Solve this as an assignment problem. (12)

	A	B	C	D
W	120	100	80	90
X	80	90	110	70

Y	**110**	**140**	**120**	**100**
Z	**90**	**90**	**80**	**90**

Answer:

	A	B	C	D
W	120	100	80	90
X	80	90	110	70
Y	110	140	120	100
Z	90	90	80	90

Row conversion matrix

	A	B	C	D
W	120-80=40	20	0	10
X	80-70=10	20	40	0
Y	110-100=10	40	20	0
Z	90-80=10	10	0	10

COLUMN CONVERSION MATRIX

	A	B	C	D
W	40-10=30	20-10=10	0	10
X	0	10	40	0
Y	0	30	20	0
Z	0	0	0	10

ALLOCATION ACCORDING TO THE METHOD

	A	B	C	D
W	40-10=30	20-10=10	**0**	10

X	**0**	10	40	0 x
Y	0 x	30	20	**0**
Z	0 x	**0**	0 x	10

Allocation W- C, X-A, Y-D, Z –B 80 + 80 + 100 + 90 = 350

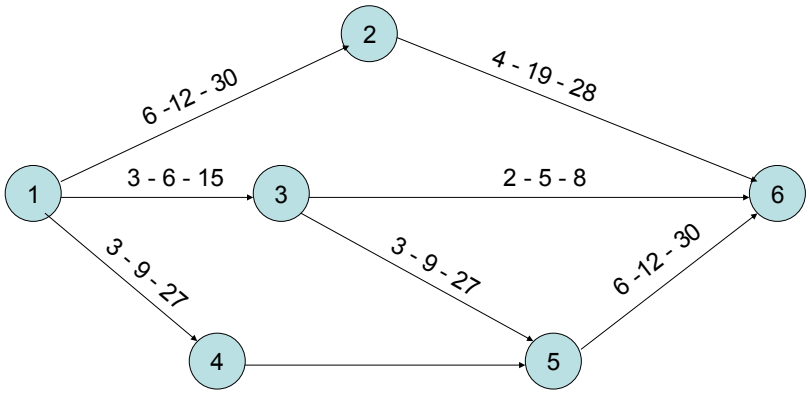
Q.5 The following table lists the jobs of a network along with their time estimates. (16)

Activity	to	tm	Tp
1-4	**3**	**9**	**27**
1-3	**3**	**6**	**15**
1-2	**6**	**12**	**30**
4-5	**1**	**4**	**07**
3-5	**3**	**9**	**27**
3-6	**2**	**5**	**08**
5-6	**6**	**12**	**30**
2-6	**4**	**19**	**28**

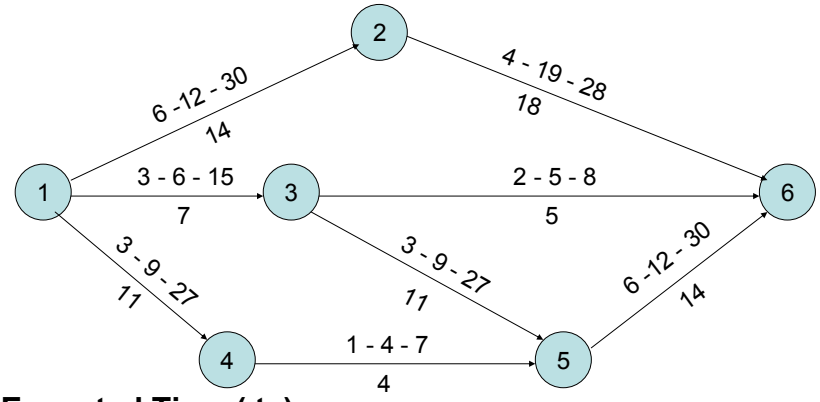
i) Draw the project network.
ii) What is the probability that the job will be completed in 35 days?
iii) What due date has 90% chance of being met?

Answer:

1.Construction of the Network

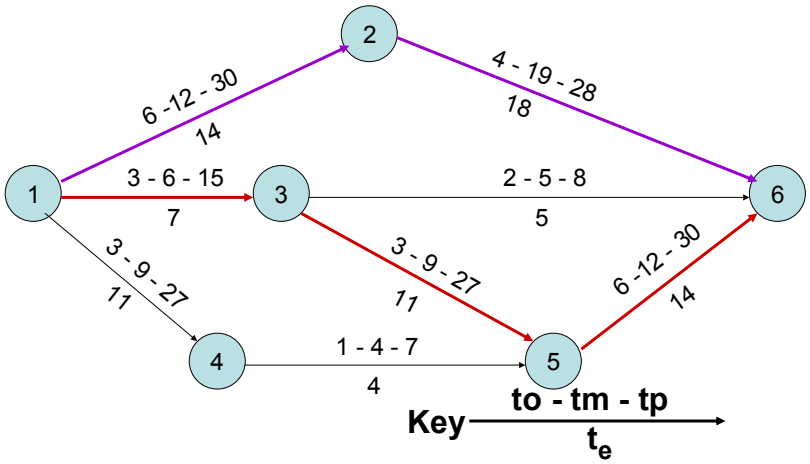


2. Calculation of Expected time for all the activities



Expected Time (te):
'te' can be calculated by the following formula
te = (to + 4tm + tp) / 6

3. Determination of Critical Path



Expected Duration of the project Te = 32 days

As there are two Critical Paths, the path which gives more variance(σ2) is taken as Critical Path

Path A

Activity	σ2 = ((t p – t o) / 6)2	σ2
1-2	((30 – 6)/6)2	16
2-6	((28 – 4)/6)2	16

Σ σ2 = 32.00

Path B

Activity	σ2 = ((t p – t o) / 6)2	σ2
1-3	((15 – 3)/6)2	4
3-5	((27 – 3)/6)2	16
5-6	((30 – 6)/6)2	16

Σ σ2= 36.00

$\sigma = \sqrt{\Sigma}\,\sigma 2 = \sqrt{36} = 6$

Therefore the Critical Path is 1 - 3 - 5 - 6

b)
Probability of completing the project within a given date
$Z = (TS – TE) / \sigma$
Where TS = Scheduled time for project completion
TE = Expected time for the project completion
σ = Standard deviation for the Network
$= (35 – 32) / 6$
$= + 0.5$

From the Normal distribution Table, we get the probability of completing the project in 35 days is 69.15%

c)
The due date for 90% chance of being met.
Probability of completing the project within a given date
$Z = (TS – TE) / \sigma$
The value of Z from the table for a 90% probability is +1.28
TS = ? (to be calculated) ,TE = 32, $\sigma = 6$
i.e. $1.28 = (TS– 32) / 6$
TS = 39.68 days

Q.6 a. State the Operating Characteristics of Poisson-exponential single Server model – infinite population. (4)

Answer:
Operating Characteristics

a) Queue length
   - average number of customers in queue waiting to get service

b) System length
   - average number of customers in the system

c) Waiting time in queue
   - average waiting time of a customer to get service

d) Total time in system
   - average time a customer spends in the system

e) Server idle time
   - relative frequency with which system is idle

b. At a service counter of fast-food joint, the customers arrive at the average interval of six minutes whereas the counter clerk takes on an average 5 minutes for preparation of bill and delivery of the item. Calculate the following:
(i) counter utilization level
(ii) average waiting time of the customers at the fast food joint
(iii) expected average waiting time in the line
(iv) average number of customers in the service counter area
(v) average number of customer in the line

(vi) probability that the counter clerk is idle
(vii) probability of finding the clerk busy
(viii) chances that customer is required to wait more than 30 minutes in the system
(ix) probability of having four customer in the system
(x) probability of finding more than 3 customer in the system (12)

Answer:

Given $\lambda = 60/10 = 10$ customer/hr
$\mu = 12$ customer/hr

a) $\rho = \lambda / \mu = 10/12 = 0.833$

b) $Ws = 1/ \mu - \lambda = 1/12-10 = 0.5$ hr

c) $Wq = \lambda/ \mu (\mu - \lambda) = 10/12(12-10) = 0.416$ hr

d) $Ls = \lambda/ (\mu - \lambda) = 10/12-10 = 5$ customers

e) $Lq = \lambda^2 / \mu (\mu - \lambda) = 10^2 /12(12-10) = 4.167$ customers

f) $1 - \rho = 1 - \lambda / \mu = 1 - 10/12 = 0.167$

g) $\rho = \lambda / \mu = 10/12 = 0.833$

h) chances of probability that customer wait more than 30min = 30/60 = 0.5 hrs

$P (T>t) = e^{-(\mu - \lambda) t}$
$P (T>0.5) = e^{-(12 - 10) 0.5} = 0.368$

i) $P (N) = \rho N (1-\rho)$
$P (4) = \rho 4 (1-\rho) = (0.833)^4(1-0.833) = 0.0806$

j) $P (n>k) = \rho (k+1)$
$P (n>3) = \rho (3+1) = (\lambda / \mu)^4 = (10/12)^4 = 0.474$

PART B
Answer any TWO questions. Each question carries 16 marks.

Q.7 a. How Taylor's Scientific Management system is useful for the management System? Briefly explain. (4)

Answer:

Taylor's Scientific Management:

Taylor's ideas, research and recommendations brought into focus technological, human and organizational issues in industrial management. Benefits of Taylor's scientific

management included wider scope for specialization, accurate planning, timely delivery, standardized methods, better quality, lesser costs, minimum wastage of materials, time and energy and cordial relations between management and workers. According to Gilbreths, the main benefits of scientific management are "conservation and savings, making an adequate use of every one's energy of any type that is expended".

b. What are the needs for organizational change? Also explain the barriers a manager faces in implementing the change in the organization. (6+6)

Answer:

Text Book – II, Page No. 75 – 78 (3.4.1 – 3.4.2)

Q.8 a. What are the (i) Hygiene Factors and (ii) Motivators according to the theory of Motivation? Explain. (6)

Answer:

(i) ***Hygiene Factors:*** Hygiene factors represent the need to avoid pain in the environment. They are not an intrinsic part of a job, but they are related to the conditions under which a job is performed. They are associated with negative feelings. They must be viewed as preventive measures that remove sources of dissatisfaction from environment. Hertzberg believed that hygiene factors created a zero level of motivation and if maintained at proper level prevents negative type of motivation from occurring. Thus, hygiene factors, when absent, increase dissatisfaction with the job. When present, help in preventing dissatisfaction but do not increase satisfaction or motivation.

(ii) ***Motivators:*** Motivators are associated with positive feelings of employees about the job. They make people satisfied with their job. Motivators are necessary to keep job satisfaction and job performance high. On the other hand, if they are not present they do not prove highly satisfying. Motivational factors or satisfiers are directly related to job content itself, the individual's performance of it, its responsibilities and the growth and recognition obtained from it. Motivators are intrinsic to the job. Thus, when motivators are absent, prevent both satisfaction and motivation. When, motivators are present, they lead to satisfaction and motivation.

b. Explain the salient features of (i) Qualitative Forecasting (ii) Judgemental Forecasting (iii) Quantitative Forecasting. (3+3+4)

Answer:

Qualitative Forecasting: It is aimed primarily at predicting long-term trends in technology and other important aspects of the environment

The focus is upon longer-term issues that are less amenable to numerical analysis as quantitative approaches.

The **Delphi method and Scenario analysis can be used as techniques.**

Judgmental Forecasting : It relies mainly on individual judgments or committee agreements regarding future conditions.

1. Judgmental forecasting methods are highly susceptible to bias.

2. The **jury of executive opinion** is one of the two judgmental forecasting model. It is a means of forecasting in which organization executives hold a meeting and estimate, as a group, a forecast for a particular item.
3. The **Sales-force composite** is a means of forecasting that is used mainly to predict future sales and typically involves obtaining the views of various salespeople, sales managers, and/or distributors regarding the sales outlook.

Quantitative forecasting: It relies on numerical data and mathematical model to predict future conditions. There are two types of quantitative forecasting most frequently used.
1. **Time-series methods** used historical data to develop forecasts of the future.
a. The underlying assumption is that patterns exist and that the future will resemble the past.
b. Time-series methods do not in themselves predict the impact of present or future actions that managers might take to bring about change.
c. A trend reflects a long-range general movement is either an upward or a downward direction.
d. A seasonal pattern indicates upward or downward changes that coincide with particular points within a given year.
e. A cyclical pattern involves changes at particular points in time that span longer than a year.
f. Time-series are more valuable for predicting broad environmental factors than in predicting the impact of present or future actions.
g. Because time-series rely on past trends there can be a danger in their use if environmental changes are disregarded.
2. **Explanatory** or **causal models** attempt to identify the major variables that are related to or have caused particular past conditions and then use current measures of those variables (predictors) to predict future conditions.
a. Explanatory models allow managers to assess the probable impact of changes in the predictors.
b. Regression models are equations that express the fluctuations in the variable being forecasted in terms of fluctuations among one or more other variables.
c. Econometric models are systems of simultaneous multiple regression equations involving several predictor variables used to identify and measure relationships or interrelationships that exist in the economy.
d. Leading indicators are variables that tend to be correlate with the phenomenon of major interest but also tend to occur in advance of the phenomenon.

Q.9 a. Explain the following Objectives of Pricing:
(i) Profit Objectives
(ii) Volume Based Objectives
(iii) Competitive Objectives **(10)**

Answer:

Pricing Objectives

(a) Profit Objectives:

Pricing objectives need to be measured precisely. Performance can then be compared with objectives to assess results. In practice, the objective of profit maximization may be realized in multiple ways. In some markets, relatively low prices result in greater sales and higher profits. But in other markets, relatively high prices result in slightly decreased unit sales and also higher profits. Thus, the profits of some firms may be based on low prices and high sales volume, while for other firms high prices and low sales volume may be more profitable. Another common pricing objective is some form of target return on investment, that is, regaining a specified percentage of investment as income. Return on investment (ROI) is expressed as the ratio of profits to investments. For manufacturers, investments include capital, machinery, buildings, and land, as well as inventory. For wholesalers and retailers, inventory and buildings constitute the bulk of investments.

(b) Volume Based Objectives:

Some organizations set pricing objectives in terms of sales volume. A common goal is sales growth, in which case the firm sets prices to increase demand. Other firms may seek sales maintenance, knowing that growth does not ensure higher profits and that they may not have the resources needed to pursue sales growth.

If capturing a high market share is a marketing objective, pricing objectives should reflect this goal. In general, a high market share is achieved by setting prices relatively low to increase sales. From a profitability perspective, the organization must be willing to accept lower initial profits in exchange for the profits that may be produced over time by increased volume and high market share. However, other companies achieve a strong position in selected markets by setting high prices and offering high-quality products and service.

(c) Competitive Objectives:

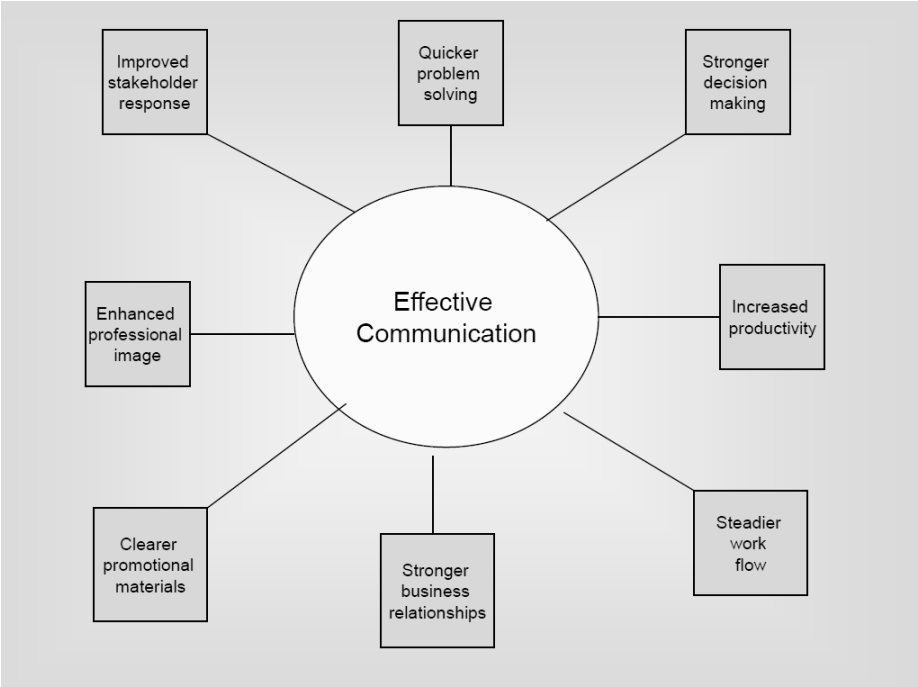
At times, firms base their pricing objectives on competitive strategies. Sometimes, the goal is to achieve price stability and engage in nonprice competition, while at other times, they price aggressively. When marketing a mature product and when the firm is the market leader, it may seek to stabilize prices. Price stability often leads to nonprice competition in which a firm's strategy is advanced by other components of the marketing mix: the product itself, the distribution system, or the promotional efforts.

In some markets, a firm may choose to price aggressively, that is, price below competition, to take advantage of market changes, for example, when products are in early stages of the life cycle, when markets are still growing, and when there are opportunities to establish or gain a large market share. As with a market share or volume objective, this aggressiveness must be considered within the context of a longer term perspective.

b. Draw block diagram depicting various elements of effective communication. (6)

Answer:

Block diagram of "effective Communication:



TEXT BOOK

I. Operations Research, An Introduction, Hamdy A. Taha, Eight Edition, PHI, 2007
II. Engineering Management, Fraidoon Mazda, Low Price Indian Edition, Addison-Wesley