UNIT-1

Q.1. The best use of linear programming is to find optimal use of

(1) Money (2) Manpower

(3) Machine (4) All of the above

Ans. (4) All of the above.

Q.2. Which of the following is a limitation associated with an LP model

(1) The relationship among decision variables in linear

(2) No guarantee to get integer valued solutions

(3) No consideration of effect of time & uncertainty on lp model

(4) All of the above

Ans. (4) All of the above

Q.3. Write the system of inequalities Car los works at a movie theater selling tickets. The theater has 300 seats and charges \$7.50 for adults and \$5.50 for children. The theater expects to make at least \$2000 for each showing.

(1) $x+y \leq 3007.5x+5.5y \geq 2000$

(2) $x+y < 3007.5x+5.5y \geq 2000$

(3) $x+y \leq 3007.5x+5.5y \leq 2000$

(4) $x+y > 20007.5x+5.5y \leq 300$

Ans. (1) $x+y \leq 3007.5x+5.5y \geq 2000$

Q.4. The graph of $y \geq x - 3$ is shaded ???

(1) Over / Above (2) Under / Below

Ans. (1) Over / Above

Q.5. Rachel owns a car and a moped. She has at most 12 gallons of gas to be used between the car and the moped. The car's tank holds at most 10 gallons and the moped's 3 gallons. The mileage for the car is 20 mpg and for the moped is 100 mpg. What are the variables you need to define?

(1) x is gas, y is mileage (2) x is car, y is moped

(3) x is gas, y is moped (4) x is car, y is mileage

Ans. (2) x is car, y is moped

Q.6. The graph of $y \geq x - 3$ uses a ___?___ line
(1) Dashed (2) Solid
(3) Horizontal (4) Vertical
Ans. (2) Solid

Q.7. Cullin needs to save at least \$100 for homecoming. He works 2 jobs earning \$8/hour at Culvers and \$25/hour mowing lawns. He only has time to work 14 hours before homecoming.
(1) $x + y \geq 25x + y \leq 8$
(2) $100x + 25y \leq 1002x + 8y \leq 14$
(3) $x + y \geq 1008x + 25y \leq 14$
(4) $8x + 25y \geq 100x + y \leq 14$
Ans. (4) $8x + 25y \geq 100x + y \leq 14$

Q.8. Decision Tables can be used to specify complex decision logic in a high level software specification?
(1) True (2) False
Ans. (1) True

Q.9. Programming Methods- the use for programming methodology it depends upon the size and the complexity of the program. When a program beyond a particular size and complexity, a traditional methodology may fail to give efficient results and in the case one has to either use a new method which will satisfy the need.
(1) True (2) False
Ans. (1) True

Q.10. While plotting constraints on a graph paper, terminal points on both the axes are connected by a straight line because
(1) The resources are limited in supply
(2) The objective function as a linear function
(3) The constraints are linear equations or inequalities
(4) All of the above
Ans (4) All of the above.

Q.11. Which of the following is not a characteristic of the LP model
(1) Alternative courses of action
(2) An objective function of maximization type
(3) Limited amount of resources

(4) Non-negativity condition on the value of decision variables.
Ans. (~~1~~) (2) Alternative courses of action.

Q.12. Which of the following statements is true with respect to the optimal solution of an LP problem.
(1) Every LP problem has an optimal solution
(2) Optimal solution of an LP problem always occurs at an extreme point
(3) At optimal solution all resources are completely used
(4) If an optimal solution exists, there will always be at least one at a corner
Ans. (~~1~~) Every LP problem has an optimal solution

Q.13. If the number of available constraints is 3 and the number of parameters to be optimized is 4, then
(1) The objective function can be optimized
(2) The constraints are short in number
(3) The solution is problem oriented
(4) None of these
Ans. (2) The constraints are short in number

Q.14. Non-negativity condition is an important component of LP model because
(1) Variables value should remain under the control of the decision-maker
(2) Value of variables make sense & correspond to real-world problems
(3) Variables are interrelated in terms of limited resources
(4) None of the above
Ans. (2) Value of variables make sense & correspond to real-world problems

Q.15. Maximization of objective function in an LP model means
(1) Value occurs at allowable set of decisions
(2) Highest value is chosen among allowable decisions
(3) Neither of above
(4) Both 1 & 2
Ans. (~~4~~) (1) Both 1 & 2.

Q.16. In graphical method of linear programming problem if the iOS-cost line coincide with a side of region of basic feasible solutions we get

(1) Unique optimum solution
(2) unbounded optimum solution
(3) no feasible solution
(4) Infinite number of optimum solutions

Ans. (4) Infinite number of optimum solutions.

Q.17.For the constraint of a linear optimizing functi $z=x1+x2$ given by $x1+x2 \leq 1$, $3x1+x2 \geq 3$ and $x1, x2 \geq 0$

(1) There are two feasible regions
(2) There are infinite feasible regions
(3) There is no feasible region
(4) None of these

Ans. (3) There is no feasible region

Q.18.If the value of the objective function z can increased or decreased indefinitely, such solution called

(1) Bounded solution (2) Unbounded solution
(3) Solution (4) None of the above

Ans.(2) Unbounded solution

Q.19.Mathematical model of Linear Programming important because

(1) It helps in converting the verbal description a numerical data into mathematical expression
(2) decision makers prefer to work with formal models.
(3) it captures the relevant relationship among decisi factors.
(4) it enables the use of algebraic techniques.

Ans. (1) It helps in converting the verbal description a numerical data into mathematical expression

Q.20.Constraints in LP problem are called active if they

(1) Represent optimal solution
(2) At optimality do not consume all the availal resources
(3) Both a & b
(4) None of the above

Ans. (1) Represent optimal solution

Q.21.A constraint in an LP model becomes redunda because

(1) Two iso-profit line may be parallel to each other
(2) The solution is unbounded

(3) This constraint is not satisfied by the solution values
(4) None of the above

Ans. (1) Two iso-profit line may be parallel to each other

Q.22.If an iso-profit line yielding the optimal solution coincides with a constaint line, then

(1) The solution is unbounded
(2) The solution is infeasible
(3) The constraint which coincides is redundant
(4) None of the above

Ans. (1) The solution is unbounded sol^n is bounded & feasible

(4)

Q.23.An iso-profit line represents

(1) An infinite number of solutions all of which yield the same profit
(2) An infinite number of solution all of which yield the same cost
(3) An infinite number of optimal solutions
(4) A boundary of the feasible region

Ans. (4) A boundary of the feasible region

(1)

Q.24.A feasible solution to an LP problem

(1) Must satisfy all of the problem's constraints simultaneously
(2) Need not satisfy all of the constraints, only some of them
(3) Must be a corner point of the feasible region
(4) Must optimize the value of the objective function

Ans. (4) Must optimize the value of the objective function

(1)

Q.25.The graphical method of LP problem uses

(1) Objective function equation
(2) Constraint equations
(3) Linear equations
(4) All of the above

Ans. (4) All of the above

Q.26.Which of the following is an assumption of an LP model

(1) Divisibility (2) Proportionality
(3) Additivity (4) All of the above

Ans. (4) All of the above

Q.27.Which of the following is not a characteristic of the LP

(1) Resources must be limited
(2) Only one objective function
(3) Parameters value remains constant during planning period
(4) The problem must be of minimization type

Ans. (4) The problem must be of minimization type

Q.28.The best use of linear programming technique is find an optimal use of

Same = Ans 1

(1) Money (2) Manpower
(3) Machine (4) All of the above

Ans. ~~(2)~~ (4) Manpower

Q.29.The distinguishing feature of an LP model is

(1) Relationship among all variables is linear
(2) It has single objective function & constraints
(3) Value of decision variables is non-negative
(4) All of the above

Ans. (1) Relationship among all variables is linear

Q.30.Linear programming is a

(1) Constrained optimization technique
(2) Technique for economic allocation of limited resour
(3) Mathematical technique
(4) All of the above

Ans. (4) All of the above

Q.31.If the constraints in a linear programming proble are changed

(1) The problem is to be re-evaluated
(2) Solution is not defined
(3) The objective function has to be modified
(4) The change in constraints is ignore

Ans. (1) The problem is to be re-evaluated

Q.32.In. L.P.P ________

(1) Objective function is linear
(2) Constraints are linear
(3) Both objective function and constraints are linear
(4) None of the above

Ans. (3) Both objective function and constraints are linear

Q.33.A solution which optimizes the objective function called as ________.

(1) Solution (2) Basic solution
(3) Feasible solution (4) Optimal solution

Ans. (4) Optimal Solution

Q.34.A solution which satisfies non-negative conditions also is called as ________.

(1) Solution (2) Basic solution
(3) Feasible solution (4) None of the above

Ans. (3) Feasible Solution

Q.35.The graph of $x \leq 2$ and $y \geq 2$ will be situated in the

(1) First and second quadrant
(2) Second and third quadrant
(3) First and third quadrant
(4) Third and fourth quadrant

Ans. ~~(2)~~ (1) Second and third quadrant

Q.36.A basic solution is called non-degenerate, if

(1) All the basic variables are zero
(2) None of the basic variables is zero
(3) At least one of the basic variables is zero
(4) None of these

Ans. (2) None of the basic variables is zero

Q.37.The intermediate solutions of constraints must be checked by substituting them back into

(1) Objective function (2) Constraint equations
(3) Not required (4) None of the above

Ans. (2) Constraint Equations

Q.38.The set of decision variable which satisfies all the constraints of the LPP is called as ________.

(1) Solution (2) Basic solution
(3) Feasible solution (4) None of the above

Ans. ~~(1)~~ (3) Solution

Q.39.Non-negative condition in an LP model implies

(1) A positive coefficient of variables in objective function
(2) A positive coefficient of variables in any constraint
(3) Non-negative value of resourse
(4) None of the above

Ans. ~~(3)~~ (4) Non-negative value of resourse

Q.40.Before formulating a formal LP model, it is better to

(1) Express each constraints in words

(2) Express the objective function in words
(3) Verbally identify decision variables
(4) All of the above

Ans. (4) All of the above

Q.41.Which of the following is assumption of an LP mod

(1) Divisibility (2) Proportionality
(3) Additivity (4) All of the above

Ans. (4) All of the above

Q.42.Constraints in an LP model represents

(1) Limitations
(2) Requirements
(3) Balancing, limitations and requirements
(4) All of the above

Ans. (4) All of the above.

Q.43.The true statement for the graph of inequatio $3x+2y \leq 6$ and $6x+4y \geq 20$, is

(1) Both graphs are disjoint
(2) Both do not contain origin
(3) Both contain point (1, 1)
(4) None of these

Ans. (1) Both graphs are disjoint

Q.44.A model is

(1) An essence of reality (2) An approximation
(3) An idealization (4) All of the above

Ans. (4) All of the above

Q.45.The first step in formulating a linear programmin problem is

(1) Identify any upper or lower bound on the decisic variables
(2) State the constraints as linear combinations of tl decision variables
(3) Understand the problem
(4) Identify the decision variables

Ans. (4) Identify the decision variables

Q.46.The value of objective function is maximum unde linear constraints

(1) At the center of feasible region
(2) At (0,0)
(3) At any vertex of feasible region

(4) The vertex which is at maximum distance from (0, 0)

Ans. (3) At any vertex of feasible region

Q.47.Maximization of objective function in LPP means

(1) Value occurs at allowable set decision
(2) Highest value is chosen among allowable decision
(3) None of the above
(4) All of the above

Ans. ~~(2)~~ (1) Highest value is chosen among allowable decision.

Q.48.The linear function of the variables which is to be maximize or minimize is called

(1) Constraints (2) Objective function
(3) Decision variable (4) None of the above

Ans. (2) Objective Function

Q.49.Alternative solution exist in a linear programming problem when

(2)
(1) One of the constraint is redundant
(2) Objective function is parallel to one of the constraints
(3) Two constraints are parallel
(4) All of the above

Ans. ~~(4)~~ (2) All of the above

Q.50.Operation research analysis does not

(1) Predict future operation
(2) Build more than one model
(3) Collect the relevant data
(4) Recommended decision and accept

Ans. (2) Predict future operation

Q.51.Operation research approach is

(1) Multi-disciplinary (2) Artificial
(3) Intuitive (4) All of the above

Ans. (4) All of the above

Q.52.Operation research analysis does not

Same Ans S.D
(1) Predict future operation
(2) Build more than one model
(3) Collect the relevant data
(4) Recommended decision and accept

Ans. (1) Predict future operation

Q.53.A constraint in an LP model restricts

(1) Value of the objective function

(2) Value of the decision variable
(3) Use of the available resourses
(4) All of the above

Ans. (4) All of the above

Q.54.A feasible solution of LPP

(1) Must satisfy all the constraints simultaneously
(2) Need not satisfy all the constraints, only some them
(3) Must be a corner point of the feasible region
(4) All of the above

Ans. (1) Must satisfy all the constraints simultaneously

Q.55.Maximization of objective function in LPP means

Same Q no. 47

(1) Value occurs at allowable set decision
(2) Highest value is chosen among allowable decision
(3) None of the above
(4) All of the above

Ans. (2) Highest value is chosen among allowable decision

Q.56.Alternative solution exist in a linear programming problem when

Same Q no. 49

(1) One of the constraint is redundant
(2) Objective function is parallel to one of the constraint
(3) Two constraints are parallel
(4) All of the above

Ans. ~~(4)~~ (2) All of the above

Q.57.The linear function of the variables which is to be maximize or minimize is called

Same Q no. 48

(1) Constraints (2) Objective function
(3) Decision variable (4) None of the above

Ans. (2) Objective function

Q.58.The true statement for the graph of in equation $3x+2y\leq 6$ and $6x+4y\geq 20$, is

Same Q no 43

(1) Both graphs are disjoint
(2) Both do not contain origin
(3) Both contain point (1, 1)
(4) None of these

Ans. (1) Both graphs are disjoint

Q.59.The value of objective function is maximum under linear constraints

Same Q no. 46

(1) At the center of feasible region
(2) At (0,0)
(3) At any vertex of feasible region
(4) The vertex which is at maximum distance from (0, 0)

Ans. (3) At any vertex of feasible region

Q.60.A model is

(1) An essence of reality (2) An approximation
(3) An idealization (4) All of the above

Same Q no. 41

Ans. (4) All of the above

Q.61.The first step in formulating a linear programming problem is

(1) Identify any upper or lower bound on the decision variables
(2) State the constraints as linear combinations of the decision variables
(3) Understand the problem
(4) Identify the decision variables

Same Q no. 45

Ans. (4) Identify the decision variables

Q.62.Constraints in an LP model represents

Same Q no. 42

(1) Limititations
(2) Requirements
(3) Balancing, limitations and requirements
(4) All of above

Ans. (4) All of above

Q.63.The best use of linear programming is to find optimal use of

(1) Money (2) Manpower
(3) Machine (4) All the above

Same Q no. 1

Ans. (4) All the above

Q.64.Which of the following is assumption of an LP model

(1) Divisibility (2) Proportionality
(3) Additivity (4) All of the above

Same Q no. 26

Ans. (4) All of the above

Q.65.Before formulating a formal LP model, it is better to

(1) Express each constraints in words
(2) Express the objective function in words
(3) Verbally identify decision variables
(4) All of the above

Same Q no. 40

Ans. (4) All of the above

Q.66.Non-negative condition in an LP model implies

(1) A positive coefficient of variables in objective function

(2) A positive coefficient of variables in any constraint

(3) Non-negative value of resourse

(4) None of the above

Ans. ~~(3)~~ (4) Non-negative value of resourse

Same Q no. 39

Q.67.The set of decision variable which satisfies all the constraints of the LPP is called as ______.

(1) Solution (2) Basic solution

(3) Feasible solution (4) None of the above

Ans. ~~(2)~~ (3) Solution

Same Q no. 38

Q.68.The intermediate solutions of constraints must be checked by substituting them back into

(1) Objective function (2) Constraint equations

(3) Not required (4) None of the above

Ans. (2) Constraint equations

Same Q no 37.

Q.69.A basic solution is called non-degenerate, if

(1) All the basic variables are zero

(2) None of the basic variables is zero

(3) At least one of the basic variables is zero

(4) None of these

Ans. (2) None of the basic variables is zero

Same Q no. 36

Q.70.The graph of $x \leq 2$ and $y \geq 2$ will be situated in the

(1) First and second quadrant

(2) Second and third quadrant

(3) First and third quadrant

(4) Third and fourth quadrant

Ans. ~~(3)~~ (2) Second and third quadrant

Same Q no 35

Q.71.A solution which satisfies non-negative conditions also is called as______.

(1) Solution (2) Basic solution

(3) Feasible solution (4) None of the above

Ans. (3) Feasible solution

Same Q no. 34

Q.72.A solution which optimizes the objective function is called as ______.

(1) Solution (2) Basic solution

(3) Feasible solution (4) Optimal solution

Ans. (4) Optimal solution

Same Q no. 33

Q.73.In.L.P.P ______.

Same Q. no 32

(1) Objective function is linear

(2) Constraints are linear

(3) Both objective function and constraints are linear

(4) None of the above

Ans. (3) Both objective function and constraints are linear

Q.74.If the constraints in a linear programming problem are changed

(1) The problem is to be re-evaluated

(2) Solution is not defined

(3) The objective function has to be modified

(4) The change in constraints is ignored.

Ans. (1) The problem is to be re-evaluated

Q.75.Linear programming is a

(1) Constrained optimization technique

(2) Technique for economic allocation of limited resources

(3) Mathematical technique

(4) All of the above

Ans. (4) All of the above

Q.76.In a transportation problem with 4 supply points and 5 demand points, how many number of constra nts are required in its formulation?

(1) 20 (2) 1 (3) 0 (4) 9

Ans. (4) 9

Concept : In a transportation problem with m supply points and n demand points

Number of constraints = m + n

Number of variables = m × n

Number of equations = m + n - 1

Calculation:

Given:

m = 4, n = 5

Number of constraints = m + n = 4 + 5 = 9 Download Solution PDF

Q.77.Region represented by $x \geq 0, y \geq 0$ is:

(1) First quadrant (2) Second quadrant

(3) Third quadrant (4) Fourth quadrant

Ans. (1) First quadrant

Q.78.The objective function of a linear programming problem is:

(1) A constraint
(2) Function to be optimised
(3) A relation between the variables
(4) None of these

Ans. (2) Function to be optimised

Q.79. The linear inequalities or equations or restrictions on the variables of a linear programming problem are called:

(1) A constraint (2) Decision variables
(3) Objective function (4) None of the above

Ans. (1) A constraint

Q.80. A set of values of decision variables that satisfies the linear constraints and non-negativity conditions of an L.P.P. is called its:

(1) Unbounded solution (2) Optimum solution
(3) Feasible solution (4) None of these

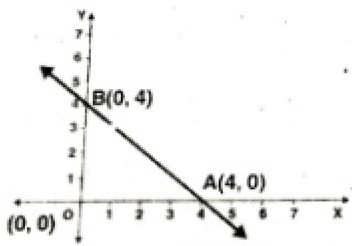
Ans. (3) Feasible solution

Q.81. The maximum value of $Z = 3x + 4y$ subjected to constraints $x + y \leq 4$, $x \geq 0$ and $y \geq 0$ is:

(1) 12 (2) 14
(3) 16 (4) None of the above

Ans. (3) 16

Explanation: The feasible region determined by the constraints, $x + y \leq 4$, $x \geq 0$, $y \geq 0$, is given below



O (0, 0), A (4, 0), and B (0, 4) are the corner points of the feasible region. The values of Z at these points are given below:

Corner point $Z = 3x + 4y$
O (0, 0) 0
A (4, 0) 12

B (0, 4) 16

Hence, the maximum value of Z is 16 at point B (0, 4)

Q.82. The minimum value of $Z = 3x + 5y$ subjected to constraints $x + 3y \geq 3$, $x + y \geq 2$, $x, y \geq 0$ is:

(1) 5 (2) 7 (3) 10 (4) 11

Ans. (2) 7

Explanation: The feasible region determined by the system of constraints, $x + 3y \geq 3$, $x + y \geq 2$, and $x, y \geq 0$ is given below

It can be seen that the feasible region is unbounded.

The corner points of the feasible region are A (3, 0), B (3 / 2, 1 / 2) and C (0, 2)

The values of Z at these corner points are given below

Corner point $Z = 3x + 5y$
A (3, 0) 9
B (3 / 2, 1 / 2) 7 Smallest
C (0, 2) 10

7 may or may not be the minimum value of Z because the feasible region is unbounded

For this purpose, we draw the graph of the inequality, $3x + 5y < 7$ and check the resulting half-plane have common points with the feasible region or not. Hence, it can be seen that the feasible region has no common point with $3x + 5y < 7$.

Thus, the minimum value of Z is 7 at point B (3/2, 1/2).

Q.83. Maximize $Z = 3x + 5y$, subject to constraints: $x + 4y \leq 24$, $3x + y \leq 21$, $x + y \leq 9$, $x \geq 0$, $y \geq 0$

(1) 20 at (1, 0) (2) 30 at (0, 6)
(3) 37 at (4, 5) (4) 33 at (6, 3)

Ans. (3) 37 at (4, 5)

Q.84.The point which does not lie in the half-p... $2x + 3y - 12 < 0$ is:

(1) (2,1) (2) (1,2) (3) (-2,3) (4) (2,3)

Ans. (4) (2,3)

Explanation: By putting the value of point (2,3) in 2x ... – 12, we get:

$2(2) + 3(3) - 12$

$= 4 + 9 - 12$

$= 13 - 12$

$= 1$ which is greater than 0.

Q.85.The optimal value of the objective functio... attained at the points:

(1) On X-axis
(2) On Y-axis
(3) Corner points of the feasible region
(4) None of these

Ans. (3) Corner points of the feasible region

Explanation: Any point in the feasible region that g... the optimal value (maximum or minimum) of the obje... function is called an optimal solution.

Q.86.Which of the following is a type of Lin... programming problem?

(1) Manufacturing problem (2) Diet problem
(3) Transportation problems (4) All of the above

Ans. (4) All of the above

Simplex Methods

Q.87.One unit of product P1 requires 3 kg of resource ... and 1 kg of resource R2. One unit of product ... requires 2 kg of resource R1 and 2 kg of resource ... The profits per unit by selling product P1and P2 ... Rs. 2000 and Rs. 3000respectively. The manufactu... has 90 kg of resource R1 and 100 kg of resou... R2.The unit worth of resource R2 i.e., dual price ... resource R2 in Rs. Per kg is

(1) 0 (2) 1350 (3) 1500 (4) 20...

From the given data, the table below can ... extracted.

Resources	P1	P2	Availability
R1	3	2	90
R2	1	2	100
Profit per unit	2000	3000	
Number of units	x	y	

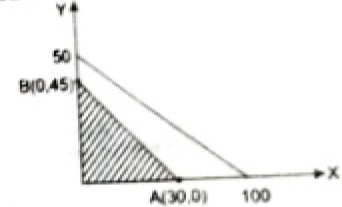
Zmax = 2000x + 3000y

Subjected to

$3x + 2y \le 90 \Rightarrow x30+y45 \le 1$ ...(1)

$x + 2y \le 100 \Rightarrow x100+y50 \le 1$...(2)

For the above contraints, Graphical method can be employed to maximize the profit



Calulation :

The feasible region cosists of corner points where the optimal solution lies.

The optimal solution is one of the best feasible solution where the objective function value is maximum in case of maximization problem and minimum in minimization problem.

Corner points of the feasible reason are

A(30 , 0) B(0 , 45)

$Z_A = 2000 \times 30 + 3000 \times 0 = 60,000$

$Z_B = 2000 \times 0 + 3000 \times 45 = 1,35,000$

Solution is optimal at B, x = 0 , y = 45

Zmax = 1,35,000 for B(0, 45)

To calulate the unit worth of resource R_2:

$3x + 2y + S_1 = 90$, $3 \times 0 + 2 \times 45 + S_1 = 90$

$S_1 = 0$ i.e R_1 resource is fully utilised .

$x + 2y + S_2 = 100$, $0 + 2 \times 45 + S_2 = 100$, $S_2 = 10$

i.e R_2 resource is unutilized at optimality. Hence dual price of R_2 is zero.

Q.88.One unit of product P_1 requires 3 kg of resource R_1 and 1 kg resource R_2. One unit of product P_2 requires 2 kg of resource R_1 and 2 kg of resource R_2. The

profits per unit by selling product P_1 and P_2
₹ 12000 and ₹ 3000 respectively. The manufac
has 90 kg of resource R_1, and 100 kg of resource
The manufacturer can make a maximum profit o

(1) 60000 (2) 135000 (3) 150000 (4) 20000

Ans. (2) 135000

Explanation

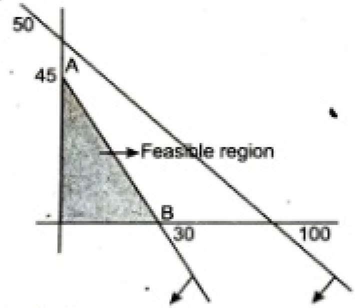
$z = 2000\ P_1 + 3000\ P_2$

Subjected to

$3P_1 + 2P_2 \le 90$

$P_1 + 2P_2 \le 100$

$P_1, P_2 \ge 0$



At point A (30, 0)

$Z = 30 \times 2000 \times 3000 \times 0 = 6000$

At point B (0, 45)

$Z = 2000 \times 0 + 3000 \times 45 = 135000$

Hence Maximum Profit

$[Z_{max} = 135000]$

Q.89. A company manufactures products P and Q quantities x_1 and x_2, respectively, using t resources. The following Linear Programmi Problem (LPP) is formulated to maximize the pro Z.

Maximize $Z = 3x_1 + 2x_2$

subject to $x_1 + 2x_2 \le 2$ (for Resource 1)

$2x1 + x2 \le 2$ (for Resource 2)

and $x_1, x_2 \ge 0$

The shadow price for Resource 2 is

(1) 0 (2) 2/3 (3) 1 (4) 4/3

Ans. (4) 4/3

Explanation

$Z = 3x1 + 2x2$

subject to

$x1 + 2x2 \le 2$ (for Resource 1)

$2x1 + x2 \le 2$ (for Resource 2)

$x1, x2 \ge 0$

Let, the unit worth of resource 1 and 2 are respectively y_1 and y_2

Forming Dual LPP,

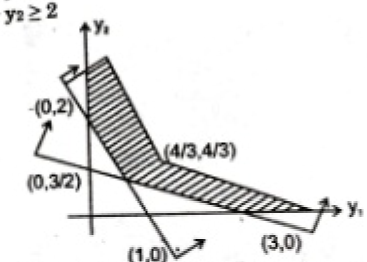
let, W be the unit worth function which is to be minimized

$W = 2\,y1 + 2\,y2$

and constraints become

$y_1 + 2y_2 \ge 3$

$2y_1 + y_2 \ge 2$



A feasible solution can be found at points (3,0) or (0,2) or (1/3,4/3)and corresponding W will be 6, 4 and 3.33 in which the minimum is 3.33 ∴ $y_1 = 1/3$ and $y_2 = 4/3$

Hence, the unit worth of resource 2 is 4/3.

90. A firm is required to procure three items (P, Q and R). The prices quoted for these items (in ₹) by suppliers S_1, S_2 and S_3 are given in table. The management policy requires that each item has to be supplied by only one supplier and one supplier supply only one item. The minimum total cost (in ₹) of procurement to the firm is:

Item	Suppliers		
	S_1	S_2	S_3
P	110	120	130
Q	115	140	140
R	125	145	165

(1) 350 (2) 360 (3) 385 (4) 395

Ans. (3) 385

Assignment MCQ Question 1 Detailed Solution

	S_1	S_2	S_3	
P	110	120	130	
Q	115	140	140	⇒
R	125	145	165	

Row reduction: Subtract minimum entry in each r
form all the entries on that column.

	S_1	S_2	S_3
P	0	10	20
Q	0	25	25
R	0	20	40

Column reduction: Subtract minimum entry
each row of job-opportunity cost matrix form all the entr
of that column.

0	0	0
0	15	5
0	10	20

Now we have opportunity cost matrix. Ma
assignment in the opportunity cost matrix.
For assigning, initially, check single zero row and then c
the zero in the column then check column with single ze
and repeat the process.

~~0~~	$\boxed{0}$	~~0~~
$\boxed{0}$	15	5
~~0~~	10	20

Here the total number of allocations = 2 which is le
than the size of the matrix (n = 3), so the current soluti
is not optimum.

Now, proceed to find the minimum no. of lin
required to cover all zeros at least once. The steps involv
are,

(i) Mark all rows for which assignment have not be
made (row 3)

(ii) Now mark all columns which have unassigned zero i
the marked row (column 1)

(iii) Now mark all rows which have assignment in th
marked column (row 2)

~~0~~	$\boxed{0}$	~~0~~	
$\boxed{0}$	15	5	✓
~~0~~	10	20	✓
✓			

Now, draw the minimum no. of lines through unmarked row and through the marked column to cover all zeros at least once.

~~0~~	$\boxed{0}$	~~0~~	
$\boxed{0}$	15	5	✓
~~0~~	10	20	✓
✓			

Now, select the smallest element that does not have lines through them, subtract it from all the elements that do not have a line through them and add it to every element that lies at the intersection of two lines and leave the remaining element of matrix unchanged, so here 5 is smallest. So following these steps we get new opportunity cost matrix.

5	0	0
0	10	0
0	5	15

Now again assigning

5	$\boxed{0}$	~~0~~
~~0~~	10	$\boxed{0}$
$\boxed{0}$	5	15

Thus the final assignment cost is

Item	Supplier	Cost
P	S_2	120
Q	S_3	140
R	S_1	125

The minimum cost = 120 + 140 + 125 = ₹ 385.

Q.91. Which of the following methods is commonly used, solve assignment problems?

(1) Stepping stone method
(2) Hungarian method
(3) North - west corner method
(4) Vogel's approximation method

Ans. (2) Hungarian method

Explanation : There are mainly four methods to sol assignment problems:

- ✓ Hungarian method
- ✓ Enumeration Method
- ✓ Simplex method
- ✓ Transportation method

The most common method used for solvi assignment is: Hungarian Method

Q.92. Five jobs (J1, J2, J3, J4 and J5) need to be processe in a factory. Each job can be assigned to any of tl five different machines (M1, M2, M3, M4 and M5 The time durations taken (in minutes) by tl machines for each of the jobs, are given in the tabl However, each job is assigned to a specific machir in such a way that the total processing time minimum. The total processing time is _____ minutes.

	M1	M2	M3	M4	M5
J1	40	30	50	50	58
J2	26	38	60	26	38
J3	40	34	28	24	30
J4	28	40	40	32	48
J5	28	32	38	22	44

(1) 176M (2) 146M (3) 158M (4) 205M

Ans. (2) 146 M

Concept:

For solving this problem, Hungarian method is used.

Calculation:

Step I:

Write reduced cost-matrix

10	0	20	20	28
0	12	34	0	12
16	10	4	0	6
0	12	12	4	20
6	10	16	0	22

10	$\boxed{0}$	16	20	22
$\cancel{0}$	12	30	$\cancel{0}$	6
16	10	$\boxed{0}$	$\cancel{0}$	$\cancel{0}$
$\boxed{0}$	12	8	4	14
6	10	12	$\boxed{0}$	16

Minimum number of lines crossing all zeroes = 4

Order of matrix = 5

⇒ Solution is not optimal.

Step II:

	M_1	M_2	M_3	M_4	M_5
J_1	16	$\boxed{0}$	16	26	22
J_2	$\cancel{0}$	6	24	$\cancel{0}$	$\boxed{0}$
J_3	22	10	$\boxed{0}$	6	$\cancel{0}$
J_4	$\boxed{0}$	6	2	4	8
J_5	6	4	6	$\boxed{0}$	10

Hence, total processing time (T) will be,

T = 30 + 38 + 28 + 28 + 22 = 146 minutes

Q.93. Vogel's approximation method is connected with

(1) Assignment problem (2) Inventory problem
(3) Transportation problem (4) PERT

Ans. (3) Transportation problem

Q.94. Transportation costs (in INR/unit) from factories to respective markets are given in the table below. The market requirements and factory capacities are also given. Using the North-West Corner method, the quantity (in units) to be transported from factory R to market II is

		Factory				Requirements (in units)
		P	Q	R	S	
Market	I	3	3	2	1	50
	II	4	2	5	9	20
	II	1	2	1	4	30
	Factory Capacity (in units)	20	40	30	10	

(1) 30 (2) 20 (3) 10 (4) 0

Ans. (3) 10

Concept : The North-West Corner Rule is a metho adopted to compute the initial feasible solution of th transportation problem .The prerequisite condition fo solving the transportation problem is that demand shoul be equal to the supply.

Steps:

Step 1 : Balance the problem.

Step 2 : Start allocating from North-West corner cell.

Step 3 : Remove the row or column whose supply o demand is fulfilled and prepare a new matrix.

Step 4 : Repeat the procedure until all the allocations ar over.

Calculation:

Given:

Total supply = 20 + 40 + 30 + 10 = 100 units

Total Demand = 50 + 20 + 30 = 100 units

	Factory				
	P	Q	R	S	REQ
I	20 [3]	30 [3]	x [2]	x [1]	50
II	x [4]	10 [2]	10 [5]	x [9]	20
III	x [1]	x [2]	20 [1]	10 [4]	30
	20	40	30	10	

∴ **from above it is clear that factory R to market II is 10 units**

Q.95. The initial state and the legal moves for each side define the _______ for the game.

(1) Search Tree (2) Game Tree

(3) State Space Search (4) Forest

Ans. (2) Game Tree

Clarification: An example of game tree for Tic-Tac-Toe game

OOO

Q- 87, 88, 89, 90, 92, 94

UNIT - 2

Q.96._____ deals with making sound decisions under conditions of certainty, risk and uncertainty.
(1) Game theory (2) Network analysis
(3) Decision theory (4) None of these
Ans. (3) Decision theory

Q.97._____ deals with the concepts such as critical path, float, events, etc.
(1) Game theory (2) Decision theory
(3) Queuing theory (4) Network analysis
Ans. (4) Network analysis

Q.98.________ is used to imitate an operation prior to actual performance.
(1) Inventory control (2) Simulation
(3) Game theory (4) Integrated Production Model
Ans. (2) Simulation

Q.99. ________ is concerned with determination of the most economic replacement policy.
(1) Probabilistic programming
(2) Linear programming
(3) Search theory
(4) Replacement theory
Ans. (4) Replacement theory

Q.100.The O R technique which helps in minimising total waiting and service cost is:
(1) Game theory (2) Queuing theory
(3) Both 1 and 2 (4) Decision theory
Ans. (2) Queuing theory

Q.101.Linear Programming technique is a:
(1) Constrained optimisation technique
(2) Technique for economic allocation of resources
(3) Mathematical technique
(4) All of the above
Ans. (4) All of the above

Q.102.A constraint in a Linear Programming Model restricts:

(1) Value of objective function
(2) Value of decision variable
(3) Use of available resources
(4) All of the above
Ans. (4) All of the above

Q.103.Before formulating a formal L P model, it is better to:
(1) Verbally identify decision variables
(2) Express the objective function in words
(3) Express each constraint in words
(4) All of the above
Ans. (4) All of the above

Q.104.Linear Programming Technique helps to find an optimal use of:
(1) Machine (2) Money
(3) Manpower (4) All of the above
Ans. (4) All of the above

Q.105.Which of the followings is an assumption of Linear Programming Technique?
(1) Divisibility (2) Additivity
(3) Proportionality (4) All of the above
Ans. (4) All of the above

Q.106.Which of the following is true with regard to a Linear Programming Model? Ans-1
(1) No guarantee to get integer valued solution
(2) The relationship among decision variables is liner
(3) Both 1 and 2
(4) None of the these
Ans. (4) None of the these

Q.107.The graphical method if LPP uses:
(1) Linear equations (2) Constraint equations
(3) Objective function (4) All of the above
Ans. (4) All of the above

Q.108.Constraints in an LPP are treated as active, if they:
(1) Do not consume all the available resources at optimality
(2) Represent optimal solution
(3) Both 1 and 2

(4) None of these

Ans. (2) Represent optimal solution

Q.109.While solving a LPP graphically, the area bound by constraints is called _______ .

(1) Feasible region (2) Infeasible region

(3) Unbounded region (4) None of these

Ans. (1) Feasible region

Q.110.While solving an LPP, infeasibility may be removed by:

(1) Removing a variable (2) Removing a constraint

(3) Adding a variable (4) Adding a constraint

Ans. (2) Removing a constraint

Q.111. ____ variables are fictitious and cannot have physical meaning.

(1) Slack variables (2) Surplus variables

(3) Artificial variables (4) Decision variables

Ans. (3) Artificial variables

Q.112.An optimal solution is considered as the ____ among the feasible solutions.

(1) Worst (2) Best

(3) Ineffective (4) None of these

Ans. (2) Best

Q.113._______ method is used to solve an assignment problem.

(1) American method (2) Hungarian method

(3) German method (4) British method

Ans. (2) Hungarian method

Q.114.The allocated cells in the transportation table called _______ .

(1) Occupied cells (2) Empty cells

(3) Unoccupied cells (4) None of these

Ans. (1) Occupied cells

Q.115.In transportation Problems, VAM stands _______ .

(1) Value Addition Method

(2) Vogel's Approximation Method

(3) Virgenean Approximation Method

(4) None of these

Ans. (2) Vogel's Approximation Method

Q.116.Initial feasible solution to a transportation Problem can be found out by _______ .

(1) VAM (2) MODI Method

(3) Both 1 & 2 (4) None of these

Ans. (1) VAM

Q.117._______ is applied to determine optimal solution.

(1) NWCR (2) VAM

(3) MODI Method (4) None of these

Ans. (3) MODI Method

Q.118.A Transportation Problem is said to be unbalanced when total supply is not equal to _______ .

(1) Total cost (2) Total demand

(3) Both a and b (4) None of these

Ans. (2) Total demand

Q.119.For a minimisation Transportation Problem, the objective is to minimise:

(1) Profit (2) Cost

(3) Solution (4) None of these

Ans. (2) Cost

Q.120. _______ is an important Operations Research Technique to analyse the queuing behaviour.

(1) Game theory (2) Waiting line theory

(3) Decision theory (4) Simulation

Ans. (2) Waiting line theory

Q.121.At a production machine, parts arrive according to a Poisson process at the rate of 0.35 parts per minute. Processing time for parts has an exponential distribution with a mean of 2 minutes. What is the probability that a random part arrival finds that there are already 8 parts in the system (in machine + in the queue)

(1) 0.0247 (2) 0.0576

(3) 0.0173 (4) 0.082

Ans. (3) 0.0173

<u>Concept</u>:

The probability that there is 'n' number of parts are in the system is:

$P_n = \rho^n P_o$

where ρ = traffic intensity, P_o represents that the system is idle i.e. $(1 - \rho)$ and ρλμρ=λμ

where λ = arrival rate and μ = service rate.

Calculation:

Given:

λ = 0.35 parts/min, μ = 1 parts in 2 min ⇒ 0.5 parts/min

ρ=λμ⇒0.350.5=0.7

The probability that there is '8' number of parts in the system is

$P_8 = \rho^8(1 - \rho)$

∴ $P_8 = (0.7)^8(1 - 0.7) \Rightarrow 0.0173$

Q.122.Cars arrive at a service station according Poisson's distribution with a mean rate of 5 hour. The service time per car is exponential wi mean of 10 minutes. At steady state, the ave waiting time in the queue is

(1) 10 minutes (2) 20 minutes

(3) 25 minutes (4) 50 minutes

Ans. (4) 50 minutes

Q.123.Jobs arrive at a facility at an average rate of an 8 hour shift. The arrival of the jobs foll Poisson distribution. The average service time job on the facility is 40 minutes. The service t follows exponential distribution. Idle time (in ho at the facility per shift will be

(1) 57 (2) 143 (3) 75 (4) 103

Ans. (2) 143 14/3

Concept:

Job arrival rate follows Poisson distribution

Arrival rate (λ) = 58 Jobs Hour

Service time for one job is 40 min

Therefore, Service rate (μ) =32JobsHour

Utilization factor, ρ=λμ

Idle time = 1 – ρ

Calculation:

λ=58 Jobs Hour, μ = 32 Jobs Hour ρ = λμ = 5832 =

Idle time = 1 – ρ = 1 - 512=712hour

Therefore, Idle time for 8-hour shift:

712×8=143hours

Q.124.At a work station, 5 jobs arrive every minute. The mean time spent on each job in the work station is 1/8 minute. The mean steady state number of jobs in the system is ________.

(1) 1.67 (2) 1.68 (3) 1.6 (4) 2.3

Ans. (1) 1.67

Explanation:

The number of jobs in the system is given by:

Ns=λμ−λ

where, λ = arrival rate, μ = service rate

Calculation:

Given:

λ (arrival rate) = 5 jobs/minute

μ (service rate) = 8 jobs/minute

Number of jobs in the system

Ls=λμ−λ=58−5=1.67

Q.125.The arrival of customers over fixed time intervals in a bank follow a Poisson distribution with an average of 30 customers/hour. The probability that the time between successive customer arrival is between 1 and 3 minutes is ________ (correct to two decimal places).

(1) 0.32-4.0 (2) 0.33-4.5

(3) 0.36-0.40 (4) 0.33-0.39

Ans. (3) 0.36 - 0.40

Calculation:

Average customers per hour, λ = 30 per hour = 1/2 per minute

P (1 ≤ x ≤ 3) = P (x = 1) + P (x = 2) + P (x = 3)

P(x)=e−λλxx!

P(1≤x≤3)=e−λλ11!+e−λλ22!+e−λλ33!=e−λ[λ1+λ22+λ36]

P(x)=e−0.5[0.51+0.522+0.536]=0.392

Q.126.Customers arrive at a ticket counter at a rate of 50 per hour and tickets are issued in the order of their arrival. The average time taken for issuing a ticket is 1 min. Assuming that customer arrivals form a Poisson process and service times are exponentially distributed, the average waiting time in queue in minutes is:

(1) 3 (2) 4 (3) 5 (4) 6

Ans. (3) 5

Concept:

Utilization factor (ρ) is given by:

ρ =λμ

where λ = Arrival rate, μ = service rate

Waiting time in queue is given by:

W_q = Lqλ where L_q = number of customers in queue

Number of customer (Lq) in queue isgiven by:

Lq=ρ21−ρ

Calculation:

Given:

Arrival rate (λ) = 50 cust/hour,service rate (μ) = cust/min = 60 cust/hour

Utilization factor (ρ) is

ρ=λμ=5060=56=0.8333

Number of customer (Lq) in queue is

Lq=ρ21−ρ=0.833321−0.8333=256customers

Waiting time in queue is

Wq=Lqλ=25650=112 hours

The average waiting time in the queue in minutes : 112×60=5 min

The number of customers in the system is given by:

L_s = ρ1−ρ

Waiting time in the system is given by:

W_s = Lsλ

Q.127.A queuing system using Kendall's notation is expressed in the symbolic form as (M/M/3); (FCFS/6). How many number of servers in the system?

(1) 6 (2) 3 (3) 2 (4) 1

Ans. (2) *3*

Explanation:-

Queuing models are represented by Kendell and Le notation whose general form is (a/b/c) : (d/e/f)

where,

a = Probability distribution for arrival pattern, b = Probability distribution for service pattern, c = No of **servers in the system,** d = Service rule or service order, e = *Size or capacity of the system,* f = *Size or capacity of calling population*

Therefore, No of server in the system (M/M/3) (FCFS/6) is = 3

128.In the notation (a/b/c) : (d/e/f) for summarizing the characteristics of queueing situation, the letters 'b' and 'd' stand respectively for

(1) Service time distribution and queue discipline

(2) Number of servers and size of calling source

(3) Number of servers and queue discipline

(4) Service time distribution and maximum number allowed in system

Ans. (1) service time distribution and queue discipline

129.For a M/M/1/∞/∞/FCFS queue model, the mean arrival rate is equal to 10 per hour and the mean service rate is 15 per hour. The expected queue length is

(1) 1.33 (2) 1.53 (3) 2.75 (4) 3.20

Ans. (1) 1.33

Concept:

Queuing Theory

Given:

Mean arrival rate (λ) = 10/hr, Mean service rate (μ) = 15/hr

∴ Traffic intensity, ρ=λμ=23

Queue length = ρ21−ρ

Calculation:

Queue length = 4/91/3 = 4/3

∴ **Queue length = 1.33**

130.Consider the following statements:

In a single-server queuing model

(1) The arrivals is a memory less process

(2) The arrivals is described as a Poisson distribution

(3) Uncertainty concerning the demand for service exists

Which of the above statements are correct?

(1) 1 and 2 only (2) 1 and 3 only

(3) 1, 2 and 3 (4) 2 and 3 only

Ans. (3) 1, 2 and 3

Explanation:

✓ We know that in a single-server queuing model, customer arrival is random or memory less process.

- ✓ Generally, arrivals do not occur at fixed reg intervals of times but tend to be clustered scattered in some fashion.
- ✓ A Poisson distribution is a discrete probab distribution which predicts the number of arrival a given time. It assumes that arrivals are ran and independent of all other operating conditions.
- ✓ Uncertainty exists concerning the demand for ser In a single server model, the type of distribution for service times is exponential distribution.
- ✓ It involves the probability of completion of a ser It should be noted that Poisson distribution canno applied to servicing because of the possibility of service facility remaining idle for some time. U the condition of continuous service, the follo characteristics of exponential distribution written, without proof:

Q.131.A company has a store which is manned b attendant who can attend to 8 technicians in hour. The technicians want in the queue and t are attended on first-come-first-served basis. technicians arrive at the store on an average 6 hour. Assuming the arrivals to follow Poisson servicing to follow exponential distribution, wha the expected time spent by a technician in system, what is the expected time spent by technician in the queue and what is the expec number of technicians in the queue?

(1) 22.5 minutes, 30 minutes and 2.75 technicians
(2) 30 minutes, 22.5 minutes and 2.25 technicians
(3) 22.5 minutes, 22.5 minutes and 2.75 technicians
(4) 30 minutes, 30 minutes and 2.25 technicians

Ans. (2) 30 minutes, 22.5 minutes and 2.25 technicians

Calculation:

Arrival Rate, λλ=6/hr

Service Rate, μμ=8/hr

λμρ=λμ=68=0.75

Expected(avg) number of customers in queue system or Average number of customers in the system:

Ls=ρ1−ρ=0.751−0.75=3 persons

Expected waiting time in system (includes service time) for each individual customer or time a customer spends in the system:

μλλ⇒Ws=1μ−λ=Lsλ=36=12 hr = 30 min

Expected (avg) queue length (excludes customers being served) or Average number of customers in the queue:

Lq=ρ21−ρ=0.7521−0.75=2.25

Waiting time in queue (excludes service time) for each individual customer or Expected time a customer spends in a queue:

λWq=Lqλ=2.256hr = 22.5 minutes

Q.132.Arrival of machines for repair in a maintenance shop follows a Poisson distribution at a rate of one per 18 hours. The time to repair follows an exponential distribution with Mean time to repair (MTTR) of 14 hours. If the productivity loss is ₹ 22,500 per hour, then the total expected loss of productivity due to machine breakdowns, (in thousand ₹) is

(1) 1403-1423 (2) 1416-1419
(3) 1420-1422 (4) 1432-1435

Ans. (2) 1416 - 1419

Explanation :

λ=118hr,

μ=114hrWs=1μ−λ=1114−118=10.071428−0.05555=63hrs

Total loss = W_s × loss/hr

= 63 × 22500 = 1417500 = 1417.5 thousand Rupee

Time spent in system = loss of production time

Q.133.Consider a single server queuing model with Poisson arrivals (λ = 4/hour) and exponential service (μ = 4/hour). The number in the system is restricted to a maximum of 10. The probability that a person who comes in leaves without joining the queue is

(1) 1/11 (2) 1/10
(3) 1/9 (4) 1/2

Ans. (1) 1/11

Concept:

Traffic intensity ρρ=λμ

∑n=0n▭Pn=1

The probability that there are n customer[s in]
system $P_n = P_0 \times \rho^n$

where, P_0 = probability of zero customer in que[ue]

Calculation:

Given:

$\lambda = 4$ per hour

$\mu = 4$ per hour

Traffic intensity ρρ=λμ=44=1

We know that,

∑n=010⬚Pn=1

$\therefore P_0 + P_1 + P_2 + \ldots + P_{10} = 1$

$P_0 + \rho P_0 + \rho^2 P_0 + \rho^3 P_0 + \ldots + \rho^{10} P_0 = 1$

$P_0(1 + \rho + \rho^2 + \ldots + \rho^{10}) = 1$

$P_0(1 + 1 + \ldots + 1) = 1$

P0=111

Probability that a person who comes in
without joining the queue i.e.

ρP11=ρ11P0=(1)11×111=111

Q.134.The number of customers arriving at a r[ailway] reservation counter is Poisson distributed wi[th] arrival rate of eight customers per hour. reservation clerk at this counter takes six mi[nutes] per customer on an average with an expone[ntially] distributed service time. The average number [of] customers in the queue will be

(1) 3 (2) 3.2

(3) 4 (4) 4.2

Ans. (2) 3.2

Arrival rate, $\lambda = 8$ per hour

Service rate, μ=606=10 per hour .

Average number of customers in the
⇒Lq=λ2μ(μ−λ)=8210(10−8)=3.2

Q.135.In an M/M/1 queuing system, the numb[er of] arrivals in an interval of length T is a Po[isson] random variable (i.e the probability of there be[ing n] arrivals in an interval of length T is e−λT(λT)nn! [The] probability density function f(t) of the inter-a[rrival] time is given by

(1) λ2(e−λ2t) (2) e−λ2tλ2

(3) $\lambda e^{-\lambda t}$ (4) e−λtλ

Ans. (3) $\lambda e^{-\lambda t}$

Probability of n arrivals in time 'T' = e−λT(λT)nn!

So, probability density function of inter arrival time = $\lambda e^{-\lambda t}$

Q.136.The term 'jockeying' in queuing theory refers to

(1) Not entering the long queue

(2) Leaving the queue

(3) Shifting from one queue to another parallel queue

(4) None of the above

Ans. (3) Shifting from one queue to another parallel queue

Concept:

There are four types of customer behaviours.

(1) **Jockeying-** When a customer keeps changing the queue just in hope to get fast service.

(2) **Balking-**Customer does not join the queue and leaves the system as the queue is very long

(3) **Reneging-** Customer joins the queue for a short period then leave the system as the queue is moving very slowly.

(4) **Cheaters-** Customer takes illegal means like bribing, fighting etc just in hope to get service faster.

Q.137.Cars arrive at a service station according to Poisson's distribution with a mean rate of 5 per hour. The service time per car is exponential with a mean of 10 minutes. At steady state, the average waiting time in the queue is

(1) 10 minutes (2) 20 minutes

(3) 25 minutes (4) 50 minutes

Same Q no. 122

Ans. (4) 50 minutes

Concept:

Waiting time in the queue λWq=Lqλ and ρρLq=ρ21−ρ
μρ=λμ

where, L_q = length of queue, λ = arrival rate, μ = service rate

Calculation:

Given:

$\lambda = 5$ cars per hour,

$\mu = 1$ car per 10 minute = 6 cars per hour

⇒ρ=56

Lq=(5/6)21−(5/6)=256

Wq=25/65=56 hours = 56×60=50 min

Q.138. Customers arrive at a shop according to Poisson distribution with a mean of customers/hour. The manager notes that customer arrives for the first 3 minutes after shop opens. The probability that a customer arr within the next 3 minutes is

(1) 0.86 (2) 0.39
(3) 0.61 (4) 0.50

Ans. (2) 0.39

Concept:

For the Poisson process of rate λ, and for any t, the Probability mass function for N(t) (i.e., the numb arrivals in (0,t]) is given by the Poisson PMF

PN(t)(n)=(λt)nexp(−λt)n!

If the arrivals of a Poisson process are split int new arrival processes, each new process is independen

Calculation:

Given:

Customers arrive at a shop according to the Poi distribution with a mean of 10 customers/hour.

⇒ λ = 10 customers/60 min = 1 customer/6 min = customers per minute;

The manager notes that no customer arrives for first 3 minutes after the shop opens,

⇒ t = 3 min and n = 0;

From the Poisson's PMF,

The probability of zero customers in 3 minutes wi

PN(3)(0)=(16·3)0exp(−16·3)0!=e−0.5=0.606

Now,

The probability that the customer arrives in the 3 minutes = 1 - P(0)

∴ The probability that the customer arrives in next 3 minutes = 1 - 0.606

∴ The probability that the customer arrives in next 3 minutes ≐ 0.39

Q.139. Jobs arrive at a facility at an average rate of an 8 hour shift. The arrival of the jobs foll Poisson distribution. The average service time job on the facility is 40 minutes. The service t follows exponential distribution. Idle time (in hou at the facility per shift will be

(1) 57 (2) 143 (3) 75 (4) 103

Ans. (2) 143

Concept:

Job arrival rate follows Poisson distribution

Arrival rate (λ) = 58JobsHour

Service time for one job is 40 min

Therefore, Service rate (μ) =32JobsHour

Utilization factor, ρ=λμ

Idle time = 1 − ρ

Same Q no. 123

Calculation:

λ=58JobsHour,μ=32JobsHourρ=λμ=5832=512

Idle time = 1 − ρ = 1 - 512=712hour

Therefore, Idle time for 8-hour shift:

712×8=143hours

Q.140. At a work station, 5 jobs arrive every minute. The mean time spent on each job in the work station is 1/8 minute. The mean steady state number of jobs in the system is ________.

(1) 1.56 (2) 1.35 (3) 1.45 (4) 1.67

Ans. (4) 1.67

Explanation:

Same Q no. 124

Given:

λ (arrival rate) = 5 jobs/minute

μ (service rate) = 8 jobs/minute

Number of jobs in the system

Ls=λμ−λ=58−5=1.67

The number of jobs in the queue is given by:

Nq=(λμ)(λμ−λ)

Q.141. In waiting line problems if the arrivals are completely random, then the probability distribution of number of arrivals in a given time follows a/an

(1) Poisson distribution
(2) Normal distribution
(3) Exponential distribution
(4) Binomial distribution

Ans. (1) Poisson distribution

Explanation:

In queuing theory, the arrival rate or arrival pattern follows the Poisson distribution service rate or service pattern follows Exponential distribution.

Poisson Probability Distribution for Arrival Pattern:

The number of customer arrivals in a specific time period follows the Poisson Probability Distribution pattern and is expressed as follows:

P(X)=λxe−λX!

X = the number of arrivals in the time period

λ = the average or mean number of customer arrivals per unit of the time period or mean arrival rate

Exponential Probability Distribution for Service Times

The service time for a unit or customer is variable and random. An exponential distribution function expresses the service time as follows:

f(t) = μ e-μt

μ is the rate that units or customers are served.

Q.142. The arrival of customers over fixed time intervals in a bank follow a Poisson distribution with an average of 30 customers/hour. The probability that the time between successive customer arrival is between 1 and 3 minutes is ________ (correct to two decimal places).

(1) 0.382 (2) 0.392 (3) 0.452 (4) 0.982

Ans. (2) 0.392

Calculation:

Average customers per hour, λ = 30 per hour = 1/2 per minute

P (1 ≤ x ≤ 3) = P (x = 1) + P (x = 2) + P (x = 3)

P(x)=e−λλxx!

P(1≤x≤3)=e−λλ11!+e−λλ22!+e−λλ33!=e−λ[λ1+λ22+λ36]

P(x)=e−0.5[0.51+0.522+0.536]=0.392

Q.143. Shopkeeper handles only 1 person in 6 minutes while customer is arriving in every 8 minutes. Average queue length will be

(1) 3 Customer (2) 4 Customer

(3) 5 Customer (4) 6 Customer

Ans. (1) 3 Customer

Concept:

No. of customers in the system, λμλLS=λμ−λ

No. of customers in the queue, λμμλLq=λ2μ(μ−λ)

λ = arrival rate, μ = service rate

Calculation:

Given:

λ = 1/8 per minute, μ = 1/6 per minute

Number of customers in the queue,

λμμλLq=λ2μ(μ−λ)

Lq=(18)216(16−18)

Lq=16416×124

Lq=24×664=2.25 (rounding off to next integer we get L_q = 3)

Q.144. If for a single server poisson arrival and exponential service time, the arrival rate is 12 per hour. Which one of the following service rates will provide a steady state finite queue length?

(1) 6 per hour (2) 10 per hour

(3) 12 per hour (4) 24 per hour

Ans. (4) 24 per hour

Explanation:

For steady-state μ > λ i.e. service rate should be greater than arrival rate.

Where μ = service rate and λ = arrival rate.

As λ = 12.

So for finite queue length μ = 24 is the best option.

Q.145. Customers arrive at a ticket counter at a rate of 50 per hour and tickets are issued in the order of their arrival. The average time taken for issuing a ticket is 1 min. Assuming that customer arrivals form a Poisson process and service times are exponentially distributed, the average waiting time in queue in minutes is:

(1) 3 (2) 4 (3) 5 (4) 6

Ans. (3) 5

Concept:

Utilization factor (ρ) is given by:

ρ = λμ

where λ = Arrival rate, μ = service rate

Waiting time in queue is given by:

W_q = Lqλ where L_q = number of customers in queue

Number of customer (Lq) in queue is given by:

Lq=ρ21−ρ

Calculation:

Given:

Arrival rate (λ) = 50 cust/hour,

service rate (μ) = 1 cust/min = 60 cust/hour

Utilization factor (ρ) is

$\rho=\lambda\mu=5060=56=0.8333$

Number of customer (Lq) in queue is

$Lq=\rho21-\rho=0.833321-0.8333=256$customers

Waiting time in queue is

$Wq=Lq\lambda=25650=112$ hours

The average waiting time in the queue in minutes = $112\times60=5$ min

The number of customers in the system is given by:

$L_s=\rho1-\rho$

Waiting time in the system is given by:

$W_s=Ls\lambda$

Q.146.Monte Carlo simulation of queues is used when

(1) Arrival time distributions are standard
(2) Service time distributions are standard
(3) Mathematical analysis cannot be adopted
(4) None of the above

Ans. (3) Mathematical analysis cannot be adopted

Explanation:

Monte Carlo Simulation for Queueing

- ✓ The Monte Carlo technique is quite useful for analyzing waiting line problems which are difficult or impossible to be analyzed mathematically.
- ✓ Simulated Sampling Method (SSM), helpful when first come, first served assumption is not valid for a particular queue.
- ✓ In many cases, the observed distribution of arrival times and service time cannot be fitted to a certain mathematical distribution (Poisson and exponential distribution) and the Monte Carlo SSM is the only hope.
- ✓ Multiple queues condition of arrival in one queue and departure from different queues is also well handled by the Monte Carlo SSM.
- ✓ SSM consist of replacing the actual universe of the item with its theoretical counterpart, which is the universe described by some assumed probability distribution.

- ✓ A random number table is then used for sampling from this theoretical population. Such SSM is called the Monte Carlo Method.

Monte Carlo Method Advantages :

- ✓ Monte Carlo simulation is a computerized mathematical technique that allows people to account for risk in quantitative analysis and decision making.
- ✓ Computerization use makes easy storage and retrieval of a large amount of data for months and years.
- ✓ Manipulation of those factors which can be controlled. (i.e. simulating)
- ✓ Monte Carlo simulation performs risk analysis by building models of possible results by uncertainty.
- ✓ It then calculates results over and over, each time using a different set of random values from the probability functions.
- ✓ Monte Carlo simulation helps the decision-maker with a range of possible outcomes and the probabilities they will occur for any choice of action.

Queuing Theory :

- ✓ Queuing theory is the mathematical study of waiting for a queue.
- ✓ A queueing model is constructed so that queue lengths and waiting times can be predicted.
- ✓ Queueing theory is generally considered a branch of operations research because the results are often used when making business decisions about the resources needed to provide a service.

Q.147.A queuing system using Kendall's notation is expressed in the symbolic form as (M/M/3); (FCFS/6). How many number of servers in the system?

(1) 6 (2) 3 (3) 2 (4) 1

Same Q.no 127

Ans. (2) 3

Explanation:-

Queuing models are represented by Kendell and Lee notation whose general form is (a/b/c) : (d/e/f)

where,

a = Probability distribution for arrival pattern,

b = Probability distribution for service pattern,

c = No of servers in the system,

d = Service rule or service order,
e = Size or capacity of the system,
f = Size or capacity of calling population
Therefore, No of server in the system (M/M/3) : (FCFS/6) is = 3

Q.148.The reasons which are basically responsible for the formation of a queue should be that

(1) The average service rate is less than the average arrival rate
(2) Output rate is linearly proportional to input
(3) Output rate is constant and the input varies in a random manner
(4) All of the above

Ans. (4) All of the above

✓ Queuing theory or waiting line theory is primarily concerned with processes characterized by random arrivals (i.e., arrivals at random time intervals); the servicing of the customer is also a random process, the average service rate is less than the average arrival rate.

✓ If we assume there are costs associated with waiting in line, and if there are costs of adding more channels (i.e., adding more service facilities), we want to minimize the sum of the costs of waiting and the costs of providing service facilities. The computations will lead to such measures as the expected number of people in line, the expected waiting time of the arrivals, and the expected percentage utilization of the service facilities.

✓ These measures can then be used in the cost computations to determine the number and capacity of service facilities that are desirable.

Q.149.In the notation (a/b/c) : (d/e/f) for summarizing the characteristics of queueing situation, the letters 'b' and 'd' stand respectively for

(1) Service time distribution and queue discipline
(2) Number of servers and size of calling source
(3) Number of servers and queue discipline
(4) Service time distribution and maximum number allowed in system

Ans. (1) Service time distribution and queue discipline

Kendall's notation for queues:

(a/b/c) : (d/e/f)

a = Inter-arrival rate of distribution
b = Service time distribution
c = Number of servers
d = System capacity (queue discipline)
e = Populationn size,
f = Service discipline

Arriving and service distributions can of the following type:

M: Exponential,
D: Deterministic,
E_k: Erlang with parameter k,
H_k: Hyperexponential with parameter k,
G: General

Q.150.Little's law is relationship between

(1) Stock level and lead time in an inventory system
(2) Waiting time and length of the queue in a queuing system
(3) Number of machines and job due dates in a scheduling problem
(4) Uncertainty in the activity time and project completion time

Ans. (2) Waiting time and length of the queue in a queuing system

Explanation:

Little's Law:

Little's law says - The long-term average number of customers in a stable L is equal to the long-term average arrival rate l, multiplied by the long-term average time a customer spends in the system W.

or $L = l \times W$

Hence, the correct option is (b) waiting-time and length of the queue in a queuing system.

Q.151.In a single-channel queuing model, the customer arrival rate is 12 per hour and the serving rate is 24 per hour. The expected time that a customer is in queue is ______ minutes.

(1) 2.0 m (2) 2.5 m (3) 3.0 m (4) 3.5 m

Ans. (2) 2.5

Explanation:

$\lambda = 12$ customer/hr

$\mu = 24$ customer/hr

Wq=λμ(μ−λ)=1224(24−12)

=124hrs=124×60=2.5minutes

Q.152.For a M/M/1/∞/∞/FCFS queue model, the mean arrival rate is equal to 10 per hour and the mean service rate is 15 per hour. The expected queue length is

(1) 1.33 (2) 1.53 (3) 2.75 (4) 3.20

Ans. (1) 1.33

Concept:

Queuing Theory

Given:

Mean arrival rate (λ) = 10/hr, Mean service rate (μ) = 15/hr

∴ Traffic intensity,

ρ=λμ=23

Queue length = ρ21−ρ

Calculation:

Queue length = 4/91/3 = 4/3

∴ Queue length = 1.33

Q.153.Consider a single machine workstation to which jobs arrive according to a Poisson distribution with a mean arrival rate of 12 jobs/hour. The process time of the workstation is exponentially distributed with a mean of 4 minutes. The expected number of jobs at the workstation at any given point of time is ______(round off to the nearest integer).

(1) 2 (2) 3 (3) 4 (4) 5

Ans. (3) 4

Explanation:

Given:

arrived rate follows Poisson distribution,

$\lambda = 12$ Jobs / hours

Service rate follows exponential distribution,

t = 4 minutes

μt=460hours=115hours,

μ=1t=15Jobs/hours

Now, Expected number of Jobs i.e. length of system.

λμλLs=λμ−λ

Ls=1215−12

Ls=123

∴ $L_s = 4$ Jobs

Q.154.At a production machine, parts arrive according to a Poisson process at the rate of 0.35 parts per minute. Processing time for parts has an exponential distribution with a mean of 2 minutes. What is the probability that a random part arrival finds that there are already 8 parts in the system (in machine + in the queue)

(1) 0.0247 (2) 0.0576

(3) 0.0173 (4) 0.082

Ans. (3) 0.0173

Concept:

The probability that there is 'n' number of parts are in the system is:

$P_n = \rho^n P_0$

where ρ = traffic intensity, P_0 represents that the system is idle i.e. (1 - ρ) and

ρλμρ=λμ

where λ = arrival rate and μ = service rate.

Calculation:

Given:

λ = 0.35 parts/min, μ = 1 parts in 2 min ⇒ 0.5 parts/min

ρ=λμ⇒0.350.5=0.7

The probability that there is '8' number of parts are in the system is

$P_8 = \rho^8(1 - \rho)$

∴ $P_8 = (0.7)^8(1 - 0.7) \Rightarrow 0.0173$

Q.155.A three-step repair service with one server at each step would be an example of a:

(1) Multiple-phase, Multiple-server.

(2) Single-phase, Single-server.

(3) Single-phase, Multiple-server.

(4) Multiple-phase, Single-server.

Ans. (4) Multiple-phase, Single-server.

Q.156.Which of the following statements is true?

(1) For a multiple-server system, the mean arrival rate must be less than the mean service rate.

(2) If the average time between customer arrivals is five minutes, the average arrival rate is twenty per hour.
(3) 100% utilization in a queuing model is a realistic goal.
(4) One of the assumptions of a queuing model is FIFO (first in, first out).

Ans. (4) One of the assumptions of a queuing model is FIFO (first in, first out)

Q.157.The utilization factor for a system is defined as:

(1) The average time a customer spends in the system.
(2) The average time a customer spends waiting in the queue.
(3) The percent idle time.
(4) The mean number of arrivals per period divided by the mean number of customers served per period.

Ans. (3) The Mean Number Of Arrivals Per Period Divided By The Mean Number Of Customers Served Per Period.

Q.158.If everything else remains constant, but the service time become constant instead of exponential, then:

(1) The average waiting time in the queue will double.
(2) The average queue length will be halved.
(3) The average waiting time in the queue will decrease by 33%.
(4) The average queue length will triple.

Ans. (2) The average queue length will be halved.

Q.159.Customers enter a waiting line on a first-come, first-served basis. The arrival rate follows a Poisson distribution, while service times follow an exponential distribution. If the average number of arrivals is six per minute and the average service rate of a single-server is ten per minute, what is the average number of customers in the system?

(1) 0.6 (2) 1.25 (3) 0.9 (4) 1.50

Ans. (4) 1.50

Q.160.Refer to Question #56. What is the average time a customer spends waiting in line for service?

(1) 1.11 minutes (2) 0.90 minutes
(3) 0.15 minutes (4) 6.67 minutes

Ans. (3) 0.15 minutes

Q.161.Refer to Question #56. What is the utilization factor for this queuing system?

(1) 80% (2) 70% (3) 60% (4) 50%

Ans. (3) 60%

Q.162.Using Kendall's notation to classify a queue configuration, the term M indicates which probability distribution?

(1) Exponential (2) Constant
(3) Normal (4) General

Ans. (1) Exponential

Q.163.The M/M/s queue configuration allows for:

(1) Multiple servers (2) Constant service time
(3) General service time (4) A single server

Ans. (1) Multiple servers

Q.164.The average arrival rate of 2 customers per hour to a single server, single phase queuing model is the same as (on average):

(1) There is 30 minutes between arrivals.
(2) There is 40 minutes between arrivals.
(3) There is 20 minutes between arrivals.
(4) There is 10 minutes between arrivals.

Ans. (1) There is 30 minutes between arrivals

Q.165.Given that arrivals are random over a one hour period and follow the Poisson probability distribution then the (arrival) calculation of P(3) is:

(1) Probability of an arrival within 3 hours
(2) Probability of 3 arrivals each hour.
(3) Probability of an arrival in more than 3 hours.
(4) Probability of 3 or more arrivals each hour.

Ans. (2) Probability of 3 arrivals each hour

Q.166.The M/M/s queue configuration assumes:

(1) $s\mu > \lambda$ (server × rate per server > arrival rate).
(2) $\mu < \lambda$ (rate per server < arrival rate)
(3) $s\mu < \lambda$ (server × rate per server < arrival rate).
(4) $\mu > \lambda$ (rate per server > arrival rate)

Ans. (1) $s\mu > \lambda$ (server × rate per server > arrival rate).

Q.167.In queuing system, ______ refers to those waiting in a queue or receiving service

(1) Service provider (2) Client
(3) Customer (4) Patron
Ans. (3) Customer

Q.168.A queue is formed when the demand for a service
(1) Exceeds the capacity to provide that service
(2) Is less than the capacity to provide that service
(3) Is equal to the capacity to provide that service
(4) There is no relation of service capacity and queue
Ans. (1) Exceeds the capacity to provide that service

Q.169.Commonly assumed probability distribution of arrival pattern is ________.
P
(1) Poisson distribution (2) Binomial distribution
(3) Normal distribution (4) Beta distribution
Ans. (1) Poisson distribution

Q.170.Commonly assumed probability distribution of service pattern
(1) Poisson distribution (2) Exponential distribution
(3) Normal distribution (4) Beta distribution
Ans. (2) Exponential distribution

Q.171.A customer's behavior of jumping from one queue to another is called ______.
(1) Jockeying (2) Reneging
(3) Collusion (4) Balking
Ans. (1) Jockeying

Q.172.The _______ indicates the order in which members of the queue are selected for service.
(1) Queue discipline (2) Arrival pattern
(3) Service Pattern (4) Customer behavior
Ans. (1) Queue discipline

Q.173.Traffic intensity in Queuing Theory is also called ________.
(1) Service factor (2) Arrival factor
(3) Utilization factor (4) Consumption factor
Ans. (3) Utilization factor

Q.174.In a transportation problem, we must make the number of ______ and______ equal.
(1) destinations; sources
(2) Units supplied; units demanded

(3) Columns; rows
(4) Positive cost coefficients; negative cost coefficients
Ans. (2) Units supplied; units demanded

Q.175.______ or ______ are used to "balance" an assignment or transportation problem.
(1) Destinations; sources
(2) Units supplied; units demanded
(3) Dummy rows; dummy columns
(4) Large cost coefficients; small cost coefficients
Ans. (3) Dummy rows; dummy columns

Q.176.The net cost of shipping one unit on a route not used in the current transportation problem solution is called the________.
(1) Change index (2) New index
(3) Modi index (4) Improvement index
Ans. (4) Improvement index

Q.177.The procedure used to solve assignment problems where in one reduces the original assignment costs to a table of opportunity costs is called ________.
(1) Stepping-stone method (2) Matrix reduction
(3) Modi method (4) Northwest reduction
Ans. (2) Matrix reduction

Q.178.The method of finding an initial solution based upon opportunity costs is called ________.
(1) The northwest corner rule
(2) Vogel's approximation
(3) Johanson's theorem
(4) Flood's technique
Ans. (2) Vogel's approximation

Q.179.An assignment problem can be viewed as a special case of transportation problem in which the capacity from each source is______ and the demand at each destination is______.
(1) 1; 1 (2) Infinity; infinity
(3) 0; 0 (4) 1000; 1000
Ans. (1) 1; 1

Q.180.________ occurs when the number of occupied squares is less than the number of rows plus

(1) Degeneracy (2) Infeasibility
(3) Unboundedness (4) Unbalance
Ans. (1) Degeneracy

Q.181.Both transportation and assignment problems are members of a category of LP problems called ______
(1) Shipping problems
(2) Logistics problems
(3) Generalized flow problems
(4) Network flow problem
Ans. (4) Network flow problem

Q.182.The equation Ri + Kj = Cij is used to calculate ______.
(1) An improvement index for the stepping-stone method
(2) The opportunity costs for using a particular route
(3) The modi cost values (ri, kj)
(4) The degeneracy index
Ans. (3) The MODI cost values (Ri, Kj)

Q.183.In case of an unbalanced problem, shipping cost coefficients of _____ are assigned to each created dummy factory or warehouse.
(1) very high positive costs (2) very high negative costs
(3) 10 (4) zero
Ans. (4) Zero

Q.184.The initial solution of a transportation problem can be obtained by applying any known method. However, the only condition is that
(1) The solution be optimal
(2) The rim conditions are satisfied
(3) The solution not be degenerate
(4) All of the above
Ans. (2) The rim conditions are satisfied.

Q.185.The dummy source or destination in a transportation problem is added to
(1) Satisfy rim conditions
(2) Prevent solution from becoming degenerate
(3) Ensure that total cost does not exceed a limit
(4) None of the above
Ans. (1) Satisfy rim conditions

Q.186.The occurrence of degeneracy while solving a transportation problem means that
(1) Total supply equals total demand
(2) The solution so obtained is not feasible
(3) The few allocations become negative
(4) None of the above
Ans. (2) The solution so obtained is not feasible

Q.187.An alternative optimal solution to a minimization transportation problem exists whenever opportunity cost corresponding to unused route of transportation is:
(1) Positive & greater than zero
(2) Positive with at least one equal to zero
(3) Negative with at least one equal to zero
(4) None of the above
Ans. (2) Positive with at least one equal to zero

Q.188.One disadvantage of using North-West Corner rule to find initial solution to the transportation problem is that
(1) It is complicated to use
(2) It does not take into account cost of transportation
(3) It leads to a degenerate initial solution
(4) All of the above
Ans. (2) It does not take into account cost of transportation

Q.189.The solution to a transportation problem with 'm' rows(supplies) & 'n' columns (destination) is feasible if number of positive allocations are
(1) m+n (2) m*n
(3) m+n-1 (4) m+n+1
Ans. (3) m+n-1

Q.190.If an opportunity cost value is used for an unused cell to test optimality, it should be
(1) Equal to zero
(2) Most negative number
(3) Most positive number
(4) Any value
Ans. (2) Most negative number

Q.191.During an iteration while moving from one solution to the next, degeneracy may occur when

(1) The closed path indicates a diagonal move
(2) Two or more occupied cells are on the closed path but neither of them represents a corner of the path.
(3) Two or more occupied cells on the closed path with minussign are tied for lowest circled value
(4) Either of the above

Ans. (3) Two or more occupied cells on the closed path with minussign are tied for lowest circled value

Q.192.The large negative opportunity cost value in an unused cell ina transportation table is chosen to improve the current solution because

(1) It represents per unit cost reduction
(2) It represents per unit cost improvement
(3) It ensure no rim requirement violation
(4) None of the above

Ans. (1) It represents per unit cost reduction

Q.193.The smallest quantity is chosen at the corners of the closed path with negative sign to be assigned at unused cell because

(1) It improve the total cost
(2) It does not disturb rim conditions
(3) It ensure feasible solution
(4) All of the above

Ans. (3) It ensure feasible solution

Q.194.When total supply is equal to total demand in a transportation problem, the problem is said to be

(1) Balanced (2) Unbalanced
(3) Degenerate (4) None of the above

Ans. (1) Balanced

Q.195.Which of the following methods is used to verify the optimality of the current solution of the transportation problem

(1) Least cost method
(2) Vogel's approximation method
(3) Modified distribution method
(4) All of the above

Ans. (3) Modified distribution method

Q.196.The degeneracy in the transportation problem indicates that

(1) Dummy allocation(s) needs to be added
(2) The problem has no feasible solution
(3) The multiple optimal solution exist
(4) 1 & 2 but not 3

Ans. (3) The multiple optimal solution exist

Q.197.In a transportation problem, when the number of occupied routes is less than the number of rows plus the number of columns-1, we say that the solution is:

(1) Unbalanced (2) Infeasible
(3) Optimal (4) Degenerate

Ans. (4) Degenerate.

Q.198.The only restriction we place on the initial solution of a transportation problem is that: we must have nonzero quantities in a majority of the boxes.

(1) All constraints must be satisfied.
(2) Demand must equal supply.
(3) We must have a number (equal to the number of rows plus the number of columns minus one) of boxes which contain nonzero quantities.
(4) None of the above

Ans. (1) All constraints must be satisfied

Q.199.The initial solution of a transportation problem can be obtained by applying any known method. However, the only condition is that

(1) The solution be optimal
(2) The rim condition are satisfied
(3) The solution not be degenerate
(4) All of the above

Ans. (2) The rim condition are satisfied

Q.200.The dummy source or destination in a transportation problem is added to

(1) Satisfy rim condition
(2) Prevent solution from becoming degenerate
(3) Ensure that total cost does not exceed a limit
(4) All of the above

Ans. (1) Satisfy rim condition

Q.201.The occurrence of degeneracy while solving a transportation problem means that

(1) Total supply equals total demand

(2) The solution so obtained is not feasible
(3) The few allocations become negative
(4) None of the above

Ans. (2) The solution so obtained is not feasible

Q.202.An alternative optimal solution to a minimization transportation problem exists whenever opportunity cost corresponding to unused routes of transportation is:

(1) Positive and greater than zero
(2) Positive with at least one equal to zero
(3) Negative with at least one equal to zero
(4) All of the above

Ans. (2) Positive with at least one equal to zero

Q.203.One disadvantage of using North-West Corner Rule to find initial solution to the transportation problem is that

(1) It is complicated to use
(2) It does not take into account cost of transportation
(3) It leads to degenerate initial solution
(4) All of the above

Ans. (2) It does not take into account cost of transportation

OOO

UNIT-3

Q.204.What is concerned with the prediction of replacement costs and determination of the most economic replacement policy ?

(1) Search Theory
(2) Theory of replacement
(3) Probabilistic Programming
(4) None of the above

Ans. (2) Theory of replacement

Solution: Theory of replacement is concerned with the prediction of replacement costs and determination of the most economic replacement policy. The Replacement Theory in Operations Research is used in the decision making process of replacing a used equipment with a substitute; mostly a new equipment of better usage. The replacement might be necessary due to the deteriorating property or failure or breakdown of particular equipment.

Q.205.What refers to Linear Programming that includes an evaluation of relative risks and uncertainties in various alternatives of choice for management decisions ?

(1) Probabilistic Programming
(2) Stochastic Programming
(3) Both 1 and 2
(4) Linear Programming

Ans. (3) Both 1 and 2

Solution: Probabilistic Programming and Stochastic Programming refers to Linear Programming that includes an evaluation of relative risks and uncertainties in various alternatives of choice for management decisions. Probabilistic programming is a programming paradigm in which probabilistic models are specified and inference for these models is performed automatically. Stochastic Programming. Stochastic programs are mathematical programs where some of the data incorporated into the objective or constraints is uncertain.

Q.206.What enables us to determine the earliest and the latest times for each of the events and activities and thereby helps in the identification of the critical path?

(1) Programme Evaluation
(2) Review Technique (PERT)
(3) Both 1 and 2
(4) Deployment of resources

Ans. (3) Both 1 and 2

Solution: Programme Evaluation and Review Technique (PERT) enables us to determine the earliest and the latest times for each of the events and activities and thereby helps in the identification of the critical path. Program evaluation is a systematic method for collecting, analyzing and using information to answer questions about projects, policies and programs, particularly about their effectiveness and efficiency. Review Technique or PERT is used to identify the time it takes to finish a particular task or activity.

Q.207.Linear Programming technique is used to allocate scarce resources in an optimum manner in problems of______ ?

(1) Schedule (2) Product Mix
(3) Both 1 and 2 (4) Servicing Cost

Ans. (3) Both 1 and 2

Solution : Linear Programming technique is used to allocate scarce resources in an optimum manner in problems of Schedule and Product Mix. Linear programming is a mathematical technique for allocating limited resources is optimum manner. In the words of William M. Fox, "Linear programming is a planning technique that permits some objective function to be minimized or maximized within the framework of given situational restrictions."

Q.208.Operations Research techniques helps the directing authority in optimum allocation of various limited resources, such as ________.

(1) Men and Machine (2) Money
(3) Material and Time (4) All of the above

Ans. (4) All of the above

Solution : Operations Research techniques helps the directing authority in optimum allocation of various limited resources, such as Men and Machine, Money and Material and Time.

Q.209.Which of the following is correct?

(1) Re-order quantity in a fixed order-interval system equals EOQ
(2) Review period of the item is always kept higher than its lead time
(3) Re-order level of an item is always more than its minimum stock
(4) Buffer stock is the total stock kept to meet the demand during lead time

Ans. (3) Re-order level of an item is always more than its minimum stock

Re-order level of an item is always more than its minimum stock

Q.210.The group replacement policy is suitable for identical low cost items which are likely to ________.

(1) Fail suddenly
(2) Fail completely and suddenly
(3) Fail over a period of time
(4) Be progressive and retrogressive

Ans. (3) Fail over a period of time

Q.211.Identify the correct statement

(1) An assignment problem may require the introduction of both dummy row and dummy column
(2) An assignment problem with m rows and n columns will involves a total of m x n possible assignments
(3) An unbalanced assignment is one where the number of rows is more than, or less than the number of columns
(4) Balancing any unbalanced assignment problem involves adding one dummy row or column

Ans. (3) An unbalanced assignment is one where the number of rows is more than, or less than the number of columns

Q.212.A game is said to be fair if ________.

(1) Lower and upper values are zero
(2) Only lower value to be zero
(3) Only upper value to be zero
(4) Lower and upper values are not equal to zero

Ans. (1) Lower and upper values are zero

Q.213.Which of the following is not a part of holding (or carrying) costs?
(1) Rent for storage space
(2) Extra expenses for an overnight express mail.
(3) Spoilage costs
(4) Electricity and heat for the buildings
Ans. (2) Extra expenses for an overnight express mail.

Q.214.The area bounded by all the given constraints is called ________.
(1) Feasible region
(2) Basic solution
(3) Non feasible region
(4) Optimum basic feasible solution
Ans. (1) Feasible region

Q.215.When D=18000, holding cost=Rs.1.20, set-up cost=Rs.400 ,EOQ = ________.
(1) 3465 (2) 3750
(3) 3500 (4) 4000
Ans. (1) 3465

Q.216.Given arrival rate = 15/hr, service rate = 20/hr, the value of traffic intensity is ____. AR/SR
(1) 3/4 (2) 4/3 (3) 3/5 (4) 4/5
Ans. (1) 3/4

Q.217.An activity is critical if its ________ float is zero
(1) Total (2) Free
(3) Independent (4) Interference
Ans. (1) Total

Q.218.________ is employed in construction and business problems
(1) Queue (2) Replacement
(3) CPM (4) PERT
Ans. (4) PERT

Q.219.Which of the following characteristics apply to queuing system?
(1) Customer population (2) Arrival process
(3) Both 1 & 2 (4) Neither 1 nor 2
Ans. (3) Both 1 & 2
Solution: Customer population and Arrival process characteristics apply to queuing system. Queuing theory is

the mathematical study of the congestion and delays of waiting in line. Queuing theory (or "queueing theory") examines every component of waiting in line to be served, including the arrival process, service process, number of servers, number of system places, and the number of customers which might be people, data packets, cars, etc.

Q.220.Which of the following is not a key operating characteristics apply to queuing system?
(1) Utilization factor
(2) Percent idle time
(3) Average time spent waiting in the system & queue
(4) None of the above
Ans. (4) None of the above
Solution : In designing a good queuing system, it is necessary to have good information about the model. The characteristics listed below would provide sufficient information.
(1) The arrival pattern.
(2) The service mechanism.
(3) The queue discipline.
(4) The number of customers allowed in the system.
(5) The number of service channels.

Q.221.Priority queue discipline may be classified as.
(1) Finite or infinite
(2) Limited & unlimited
(3) Pre-emptive or non-pre-emptive
(4) All of the above
Ans. (3) Pre-emptive or non-pre-emptive
Solution: Priority queue discipline may be classified as Pre-emptive or non-pre-emptive. For priority queues, one must distinguish pre-emptive service from non-pre-emptive service. A service discipline is said to be non-pre-emptive if, once the service to a customer is started, it is not disrupted until the whole service requirement is completed.

Q.222.The calling population is assumed to be infinite when.
(1) Arrivals are independent of each other
(2) Capacity of the system is infinite
(3) Service rate is faster than arrival rate
(4) All of the above
Ans. (1) Arrivals are independent of each other

Solution : The calling population is assumed to be infinite when arrivals are independent of each other. The population of potential customers is refered to as the calling population. The calling population can be finite or infinite. In the systems with large population, we usually assume the population is infinite.

Q.223.Which of the cost estimates & performance measures are not used for economic analysis of a queuing system?

(1) Cost per server per unit of time
(2) Cost per unit of time for a customer waiting in the system
(3) Average number of customers in the system
(4) Average waiting time of customers in the system

Ans. (4) Average waiting time of customers in the system

Solution: Average waiting time of customers in the system of the cost estimates & performance measures are not used for economic analysis of a queuing system. Queuing theory (or "queueing theory") examines every component of waiting in line to be served, including the arrival process, service process, number of servers, number of system places, and the number of customers which might be people, data packets, cars, etc.

Q.224.The initial cost of a machine is ₹ 7100 and scrap value is ₹ 100. The maintenance costs found from experience are as follows:

Year	1	2	3	4	5	6	7	8
Maintenance	200	350	500	700	1000	1300	1700	2100

When should the machine be replaced?

(1) 6^{th} year
(2) 7^{th} year
(3) 8^{th} year
(4) 9^{th} year

Ans. (2) 7^{th} year

Solution.

Year	Running cost	Cumulative running cost	Scrap value	Difference	Average investment cost	Average running cost	Average annual total cost
A	B	C	D	E	F = E/A	G = C/A	H = F + G
1	200	200	100	7000	7000	200	7200
2	350	200 + 350 = 550	100	7000	3500	225	3775
3	500	550 + 500 = 1050	100	7000	2333.33	350	2683.33
4	700	1050 + 700 = 1750	100	7000	1750	437.5	2187.50
5	1000	1750 + 1000 = 2750	100	7000	1400	550	1950
6	1300	2750 + 1300 = 4050	100	7000	1166.67	675	1841.67
7	1700	4050 + 1700 = 5750	100	7000	1000	821.42	1821.42
8	2100	5750 + 2100 = 7850	100	7000	875	981.25	1856.25

This table shows that the average annual total cost during the seventh year is minimum. Hence, the machine should be replaced after the 7^{th} year.

Q.225.The initial cost of a machine is ₹ 6100 and resale value drops as the time passes. Cost data are given in the following table:

Year	1	2	3	4	5	6	7	8
Maintenance	100	250	400	600	900	1200	1600	20
Resale Value	800	700	600	500	400	300	200	10

Q.226.When should the machine be replaced?

(1) 5^{th} year (2) 6^{th} year

(3) 7^{th} year (4) 8^{th} year

Ans. (2) 6^{th} year

Explanation as previous Question

This table shows that the average annual total cost during the sixth year is minimum. Hence, the machine should be replaced after the 6^{th} year.

Q.227.A firm is considering the replacement of a machine, whose cost price is ₹ 12,200 and its scrap value is ₹ 200. From experience the running (maintenance and operating) costs are found to be as follows:

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

When should the machine be replaced?

(1) 5^{th} year

(2) 6^{th} year

(3) 7^{th} year

(4) 8^{th} year

Ans. (2) 6^{th} year

Q.228.A milk plant is offered an equipment A which is priced at ₹ 60,000 and the costs of operation and maintenance are estimated to be ₹ 10,000 for each of the first 5 years, increasing every year by ₹ 3000 per year in the sixth and subsequent years. If money carries the rate of interest 10% per annum what would the optimal replacement period?

(1) 5^{th} year (2) 6^{th} year

(3) 7^{th} year (4) 8^{th} year

Ans. (4) 8^{th} year

Q.229.The cost of a machine is ₹ 6100 and its scrap value is only ₹ 100. The maintenance costs are found to be

Year	1	2	3	4	5	6	7	8
Maintenance Cost (in ₹)	100	250	400	600	900	1250	1600	2000

When should the Machine be replaced?

(1) 6^{th} year (2) 7^{th} year

(3) 8^{th} year (4) 9^{th} year

Ans. (1) 6^{th} year

Q.230.In LPP the condition to be satisfied is

(1) Constraints have to be linear

(2) Objective function has to be linear

(3) none of the above

(4) both 1 and 2

Ans. (4) both 1 and 2

Q.231.Identify the type of the feasible region given by the set of inequalities

x - y <= 1

x - y >= 2

where both x and y are positive.

(1) A triangle (2) A rectangle

(3) An unbounded region (4) An empty region

Ans. (4) An empty region

Q.232.Consider the given vectors: a(2,0), b(0,2), c(1,1), and d(0,3).Which of the following vectors are linearly independent?

(1) b, and c are independent

(2) a, b, and d are independent

(3) a and c are independent

(4) b and d are independent

Ans. (3) a and c are independent

Q.233.Consider the linear equation

x1 + 3 x2 - 4 x3 + 5 x4 = 10

(1) How many basic and non-basic variables are defined by this equation?

(2) One variable is basic, three variables are non-basic

(3) Two variables are basic, two variables are non-basic

(4) Three variables are basic, one variable is non-basic

(5) All four variables are basic

Ans. (2) One variable is basic, three variables are non-basic

Q.234.The objective function for a minimization problem is given by

$z = 2x1 - 5x2 + 3x3$

The hyper plane for the objective function cuts a bounded feasible region in the space (x1,x2,x3). Find the direction vector d, where a finite optimal solution can be reached.

(1) d(2,-5,3) (2) d(-2,5,-3)

(3) d(2,5,3) (4) d(-2,-5,-3)

Ans. (2) d(-2,5,-3)

Q.235.In game theory, the outcome or consequence of a strategy is referred to as the

(1) Payoff (2) Penalty

(3) Reward (4) end-game strategy

Ans. (1) payoff

Q.236.Operations Research approach is?

(1) multi-disciplinary (2) Scientific

(3) Intuitive (4) collect essential data

Ans. (1) multi-disciplinary

Q.237.Operation research approach is typically based on the use of ______.

(1) physical model (2) mathematical model

(3) iconic model (4) descriptive model

Ans. (2) mathematical model

Q.238.Mathematical model of linear programming problem is important because ______ it helps in converting the verbal description and numerical data into mathematical expression

(1) decision makers prefer to work with formal models

(2) it captures the relevant relationship among decision factors

(3) it enables the use of algebraic technique

Ans. (1) decision makers prefer to work with formal models

Q.239.In Program Evaluation Review Technique for an activity, the optimistic time 2, the pessimistic time is 12 and most-likely time is4. What is the expected time?

(1) 0 (2) 1 (3) 5 (4) 6

Ans. (3) 5

$t_e = \frac{t_0 + 4t_m + t_p}{6}$

Q.240.Graphical method of linear programming is useful when the number of decision variable are ______.

(1) 2 (2) 6 (3) Finite (4) Infinite

Ans. (1) 2

Q.241.A feasible solution to a linear programming problem ______.

(1) must satisfy all the constraints of the problem simultaneously

(2) need not satisfy all of the constraints, only some of them

(3) must be a corner point of the feasible region.

(4) must optimize the value of the objective function

Ans. (1) must satisfy all the constraints of the problem simultaneously

Q.242.Utilization factor is also known as ______.

(1) Traffic intensity

(2) Kendals notation

(3) Row minima method

(4) Unbalanced assignment problem

Ans. (1) Traffic intensity

Q.243.While solving a linear programming problem in feasibility may be removed by ______.

(1) adding another constraint

(2) adding another variable

(3) removing a constraint

(4) removing a variable

Ans. (3) removing a constraint

Q.244.In the optimal simplex table, Zj-Cj=0 value indicates ______.

(1) alternative solution (2) bounded solution

(3) infeasible solution (4) unbounded solution

Ans. (1) alternative solution

Q.245.If all aij values in the entering variable column of the simplex table are negative, then ______.

(1) there are multiple solutions

(2) there exist no solution

(3) solution is degenerate

(4) solution is unbounded

Ans. (4) solution is unbounded

Q.246.If an artificial variable is present in the basic variable column of optimal simplex table, then the solution is ________.

(1) alternative (2) bounded
(3) no solution (4) infeasible

Ans. (4) infeasible

Q.247.For any primal problem and its dual ________.

(1) optimal value of objective function is same
(2) primal will have an optimal solution iff dual does too
(3) both primal and dual cannot be infeasible
(4) dual will have an optimal solution iff primal does too

Ans. (2) primal will have an optimal solution iff dual does too

Q.248.Principle of complementary slackness states that ________.

(1) primal slack*dual main=0
(2) primal main+dual slack=0
(3) primal main+dual surplus=0
(4) dual slack*primal main not equal to zero

Ans. (1) primal slack*dual main=0

Q.249.If primal linear programming problem has a finite solution, then dual linear programming problem should have ________.

(1) finite solution (2) infinite solution
(3) bounded solution (4) alternative solution

Ans. (1) finite solution

Q.250.The initial solution of a transportation problem can be obtained by applying any known method. How-ever, the only condition is that ________.

(1) the solution be optimal
(2) the rim conditions are satisfied
(3) the solution not be degenerate
(4) the few allocations become negative

Ans. (2) the rim conditions are satisfied

Q.251.The dummy source or destination in a transportation problem is added to ____.

(1) satisfy rim conditions
(2) prevent solution from becoming degenerate
(3) ensure that total cost does not exceed a limit
(4) the solution not be degenerate

Ans. (1) satisfy rim conditions

Q.252.Which of the following methods is used to verify the optimality of the current solution of the transportation problem ________.

(1) Modified Distribution Method
(2) Least Cost Method
(3) Vogels Approximation Method
(4) North West Corner Rule

Ans. (1) Modified Distribution Method

Q.253.An optimal assignment requires that the maximum number of lines which can be drawn through squares with zero opportunity cost be equal to the number of ________.

(1) rows or coloumns (2) rows and coloumns
(3) rows + columns – 1 (4) rows-columns

Ans. (1) rows or coloumns

Q.254.Maximization assignment problem is transformed into a minimization problem by ________.

(1) adding each entry in a column from the maximum value in that column
(2) subtracting each entry in a column from the maximum value in that column
(3) subtracting each entry in the table from the maximum value in that table
(4) adding each entry in the table from the maximum value in that table

Ans. (3) subtracting each entry in the table from the maximum value in that table

MCQ on Operations Research

Q.255.To proceed with the MODI algorithm for solving an assignment problem, the number of dummy allocations need to be added are ________.

(1) n (2) n-1 (3) 2n-1 (4) n-2

Ans. (2) n-1

Q.256.An artificial variable leaves the basis means, there is no chance for the ________ variable to enter once again.

(1) Slack (2) Surplus
(3) Artificial (4) Dual

Ans. (3) artificial

Q.257.Simplex method was designed by ________.
(1) Dantzig (2) Charnes
(3) Lemke (4) Hungarian
Ans. (1) Dantzig

Q.258.Dual Simplex Method was introduced by ________.
(1) Dantzig (2) Charnes
(3) Lemke (4) Hungarian
Ans. (3) Lemke

Q.259.The cell with allocation can be called ________.
(1) Cell (2) Empty cell
(3) Basic cell (4) Non-basic cell
Ans. (3) Basic cell

Q.260.The cell without allocation is called ________.
(1) Basic cell (2) Non-basic cell
(3) Empty cell (4) Basic solution
Ans. (2) Non-basic cell

Q.261.Service mechanism in a queuing system is characterized by ________.
(1) customers behavior (2) servers behavior
(3) customers in the system (4) server in the system
Ans. (2) servers behavior

Q.262.The problem of replacement is felt when job performing units fail ________.
(1) suddenly and gradually
(2) gradually
(3) suddenly
(4) neither gradually nor suddenly
Ans. (1) suddenly and gradually

Q.263.Least Cost Method is also known as ________.
(1) North West Corner Method
(2) Matrix Minima Method
(3) Row Minima method
(4) Coloumn Minima method
Ans. (2) Matrix Minima Method

Q.264.The objective of network analysis is to ________.
(1) minimize total project duration
(2) minimize total project cost

(3) minimize production delays, interruption and conflicts
(4) maximize total project duration
Ans. (1) minimize total project duration

Q.265.A activity in a network diagram is said to be ________ if the delay in its start will further delay the project completion time.
(1) forward pass (2) backward pass
(3) Critical (4) non critical
Ans. (3) critical

Q.266.A strategy that is best regardless of what rival players do is called
(1) first-mover advantage.
(2) a Nash equilibrium strategy.
(3) tit-for-tat.
(4) a dominant strategy.
Ans. (4) a dominant strategy.

Q.267.A game that involves interrelated decisions that are made overtime is a
(1) sequential game (2) repeated game
(3) zero-sum game (4) nonzero-sum game
Ans. (1) sequential game.

Q.268.A game that involves multiple moves in a series of identical situations is called a
(1) sequential game (2) repeated game
(3) zero-sum game (4) nonzero-sum game
Ans. (2) repeated game.

Q.269.Sequential games can be solved using
(1) tit-for-tat (2) dominated strategies
(3) backward induction (4) risk averaging
Ans. (3) backward induction

Q.270.A firm that is threatened by the potential entry of competitors into a market builds excess production capacity. This is an example of
(1) a prisoners' dilemma (2) collusion
(3) a credible threat (4) tit-for-tat
Ans. (3) a credible threat.

Q.271.What is the fundamental purpose of game theory?
(1) To analyse decision-making

(2) To analyse strategic interactions
(3) To predict decision outcome
(4) To predict firm behaviour
Ans. (2) To analyse strategic interactions

Q.272.An assignment problem is considered as a particular case of a transportation problem because
(1) The number of rows equals columns
(2) All xij= 0 or 1
(3) All rim conditions are 1
(4) All of the above
Ans. (4) All of the above

Q.273.An optimal assignment requires that the maximum number of lines that can be drawn through squares with zero opportunity cost be equal to the number of
(1) Rows or columns (2) Rows & columns
(3) Rows + columns –1 d (4) None of the above
Ans. (4) None of the above (1)

Q.274.While solving an assignment problem, an activity is assigned to a resource through a square with zero opportunity cost because the objective is to
(1) Minimize total cost of assignment
(2) Reduce the cost of assignment to zero
(3) Reduce the cost of that particular assignment to zero
(4) All of the above
Ans. (1) Minimize total cost of assignment

Q.275.The method used for solving an assignment problem is called
(1) Reduced matrix method (2) MODI method
(3) Hungarian method (4) None of the above
Ans. (3) Hungarian method

Q.276.The purpose of a dummy row or column in an assignment problem is to
(1) Obtain balance between total activities &total resources
(2) Prevent a solution from becoming degenerate
(3) Provide a means of representing a dummy problem
(4) None of the above
Ans. (1) Obtain balance between total activities &total resources

Q.277.Maximization assignment problem is transformed into a minimization problem by
(1) Adding each entry in a column from the maximization value in that column
(2) Subtracting each entry in a column from the maximum value in that column
(3) Subtracting each entry in the table from the maximum value in that table
(4) Any one of the above
Ans. (3) Subtracting each entry in the table from the maximum value in that table

Q.278.If there were n workers & n jobs there would be
(1) n! solutions (2) (n-1)! Solutions
(3) (n!) nsolutions (4) n solutions
Ans. (1) n! solutions

Q.279.An assignment problem can be solved by
(1) Simplex method (2) Transportation method
(3) Both 1 & 2 (4) none of above
Ans. (3) Both 1 & 2

Q.280.The assignment problem
(1) Requires that only one activity be assigned to each resource
(2) Is a special case of transportation problem
(3) Can be used to maximize resources
(4) All of the above
Ans. (4) All of the above

Q.281.An assignment problem is a special case of transportation problem, where
(1) Number of rows equals number of columns
(2) All rim conditions are 1
(3) Values of each decision variable is either 0 or 1
(4) All of the above
Ans. (4) All of the above

Q.282.Every basic feasible solution of a general assignment problem, having a square pay-off matrix of order, n should have assignments equal to
(1) 2n+1 (2) 2n-1 (3) m+n-1 (4) m+n
Ans. (2) 2n-1

Q.283.To proceed with the MODI algorithm for solving an assignment problem, the number of dummy allocations need to be added are

(1) N (2) 2n (3) n-1 (4) 2n-1

Ans. (3) n-1

(P) **Q.284.The Hungarian method for solving an assignment problem can also be used to solve**

(1) A transportation problem
(2) A travelling salesman problem
(3) A LP problem
(4) Both 1 & 2

Ans. (2) A travelling salesman problem

Q.285.An optimal solution of an assignment problem can be obtained only if

(1) Each row & column has only one zero element
(2) Each row & column has at least one zero element
(3) The data is arrangement in a square matrix
(4) None of the above

Ans. (4) None of the above

(P) **Q.286.Which method usually gives a very good solution to the assignment problem?**

(1) northwest corner rule
(2) Vogel's approximation method
(3) MODI method
(4) stepping-stone method

Ans. ~~(3)~~ (2) MODI method

Q.287.The northwest corner rule requires that we start allocating units to shipping routes in the: middle cell.

(1) Lower right corner of the table.
(2) Upper right corner of the table.
(3) Highest costly cell of the table.
(4) Upper left-hand corner of the table.

Ans. (4) Upper left-hand corner of the table.

Q.288.The table represents a solution that is:

(1) an initial solution (2) Infeasible
(3) degenerate (4) all of the above

Ans. (3) degenerate

Q.289.Which of the following is used to come up with a solution to the assignment problem?

(1) MODI method
(2) northwest corner method
(3) stepping-stone method
(4) Hungarian method

Ans. (4) Hungarian method

Q.290.What is wrong with the following table?

(P)
(1) The solution is infeasible.
(2) The solution is degenerate.
(3) The solution is unbounded.
(4) The solution is inefficient in that it is possible to use fewer routes.

Ans. (1) The solution is infeasible

Q.291.The solution presented in the following table is

(1) Infeasible (2) Degenerate
(3) Unbounded (4) Optimal

Ans. (4) Optimal

Q.292.The solution shown was obtained by Vogel's approximation. The difference between the objective function for this solution and that for the optimal is

(1) 40 (2) 60 (3) 80 (4) 100

Ans. (3) 80

Q.293.Optimal solution of an assignment problem can be obtained only if

(1) Each row & column has only one zero element
(2) Each row & column has at least one zero element
(3) The data is arrangement in a square matrix
(4) None of the above

Ans. ~~(1)~~ (3) (4) Each row & column has only one zero element

Q.294.In assignment problem of maximization, the objective is to maximise

(1) Profit (2) Optimization
(3) Cost (4) None of the above

Ans. (1) Profit

Q.295.What is the difference between minimal cost network flows and transportation problems?

(1) The minimal cost network flows are special cases of transportation problems

(2) The transportation problems are special cases of the minimal cost network flows
(3) There is no difference
(4) The transportation problems are formulated in terms of tableaus, while the minimal cost network flows are formulated in terms of graphs

Ans. (2) The transportation problems are special cases of the minimal cost network flows

Q.296.With the transportation technique, the initial solution can be generated in any fashion one chooses. The only restriction is that

(1) the edge constraints for supply and demand are satisfied.
(2) the solution is not degenerate.
(3) the solution must be optimal.
(4) one must use the northwest-corner method

Ans. (1) the edge constraints for supply and demand are satisfied.

Q.297.The purpose of the stepping-stone method is to

(1) develop the initial solution to the transportation problem.
(2) assist one in moving from an initial feasible solution to the optimal solution.
(3) determine whether a given solution is feasible or not.
(4) identify the relevant costs in a transportation problem.

Ans. (2) assist one in moving from an initial feasible solution to the optimal solution.

Q.298.The purpose of a dummy source or dummy destination in a transportation problem is to

(1) prevent the solution from becoming degenerate.
(2) obtain a balance between total supply and total demand.
(3) make certain that the total cost does not exceed some specified figure.
(4) provide a means of representing a dummy problem.

Ans. (2) obtain a balance between total supply and total demand.

Q.299.Which of the following is NOT needed to use the transportation model?

(1) the cost of shipping one unit from each origin to each destination
(2) the destination points and the demand per period at each
(3) the origin points and the capacity or supply per period at each
(4) degeneracy

Ans. (4) degeneracy

Q.300.Which of the following is a method for improving an initial solution in a transportation problem?

(1) northwest-corner (2) intuitive lowest-cost
(3) southeast-corner rule (4) stepping-stone

Ans. (4) stepping-stone

Q.301.The transportation method assumes that

(1) there are no economies of scale if large quantities are shipped from one source to one destination
(2) the number of occupied squares in any solution must be equal to the number of rows in the table plus the number of columns in the table plus1.
(3) there is only one optimal solution for each problem.
(4) the number of dummy sources equals the number of dummy destinations.

Ans. (1) there are no economies of scale if large quantities are shipped from one source to one destination

Q.302.An initial transportation solution appears in the table.

(1) Yes, this solution can be improved by \$50.
(2) Yes, this solution can be improved by \$100.
(3) No, this solution is optimal.
(4) Yes, the initial solution can be improved by \$10.

Ans. (3) No, this solution is optimal.

Q.303.What is the cost of the transportation solution shown in the table?

(1) \$1350 (2) \$1070 (3) \$1150 (4) \$1230

Ans. (2) \$1070

Q.304.Which statement regarding this transportation table is best?

(1) The solution is degenerate.
(2) This solution can be improved by shipping from C to X.

(3) This solution would be improved by shipping from B to W.

(4) This solution was developed using the northwest corner rule.

Ans. (2) This solution can be improved by shipping from C to X

Q.305.Which of these statements about the stepping-stone method is best?

(1) A dummy source and destination must be added if the number of rows plus columns minus 1 is not equal to the number of filled squares.

(2) Only squares containing assigned shipments can be used to trace a path back to an empty square.

(3) An improvement index that is a net positive means that the initial solution can be improved.

(4) Only empty squares can be used to trace a path

Ans. (2) Only squares containing assigned shipments can be used to trace a path back to an empty square.

ooo

UNIT-4

Q.306.The costs associated with inventory is/are:

(1) Purchase price of the inventory

(2) Re-order costs

(3) Inventory holding costs, Shortage costs

(4) All of the above

Ans. (4) All of the above

Q.307.Re-order costs are the costs of making orders to purchase a quantity of a material item from a supplier. They include costs such as:

(1) The cost of delivery of the purchased items, if these are paid for by the buyer

(2) The costs associated with placing an order, such as the costs of telephone calls

(3) Costs associated with checking the inventory after delivery from the supplier

(4) Batch set up costs if the inventory is produced internally

(5) All of the above.

Ans. (5) All of the above

Q.308.Inventory holding costs include:

(1) Cost of capital tied up

(2) Insurance costs

(3) Cost of warehousing, obsolescence, deterioration and theft

(4) All of the above

Ans. (4) All of the above

Q.309.Shortage costs of inventory include:

(1) Lost profit on sale

(2) Future loss of profit due to loss of customer goodwill

(3) Costs due to production stoppage due to shortage of raw materials

(4) All of the above

Ans. (4) All of the above

Q.310.The Economic Order Quantity model (EOQ) is a mathematical model used to calculate the quantity of inventory to order from a supplier each time that

an order is made. The aim of the model is to identify the order quantity for any item of inventory that minimizes total annual inventory costs

(1) The above statement is correct

(2) The above statement is incorrect

Ans. (1) The above statement is correct

Q.311.Which of the following is/are the assumptions of Economic order quantity (EOQ)?

(1) There are no bulk purchase discounts for making orders in large sizes. All units purchased for each item of material cost the same unit price.

(2) The order lead time (the time between placing an order and receiving delivery from the supplier) is constant and known.

(3) Annual demand and consumption for the inventory item is constant throughout the year.

(4) All of the above

Ans. (4) All of the above

Q.312.For the purpose of Economic order quantity (EOQ) the relevant costs are:

(1) The annual holding cost per item per annum

(2) The annual ordering costs

(3) Both 1 & 2

(4) None

Ans. (3) Both 1 & 2

Q.313.The order quantity or purchase quantity that minimises the total annual cost of ordering the item plus holding it in store is called the economic order quantity or EOQ.

(1) True (2) False

Ans. (1) True

Q.314.In the economic order quantity or EOQ model the equation (Q/2) × CH calculates:

(1) The number of orders each year

(2) The total holding costs each year

(3) Total ordering costs each year

(4) None

Ans. (2) The total holding costs each year

Q.315.In the economic order quantity or EOQ model the equation D/Q calculates:

(1) The number of orders each year

(2) The total holding costs each year

(3) Total ordering costs each year

(4) None

Ans. (1) The number of orders each year

Q.316.In the economic order quantity or EOQ model the equation (D/Q) × CO calculates:

(1) The number of orders each year

(2) The total holding costs each year

(3) Total ordering costs each year

(4) None

Ans. (3) Total ordering costs each year

Q.317.The EOQ is the quantity that minimises the sum of the annual order costs and the annual holding costs. The annual holding costs equal the annual order costs at this level.

(1) True (2) False

Ans. (1) True

Q.318.To minimize the total cost of holding and ordering inventory using EOQ model. It is necessary to balance the relevant costs. These are:

(1) The variable costs of holding the inventory

(2) The fixed costs placing the order

(3) Both 1 & 2

(4) None

Ans. (3) Both 1 & 2

Q.319.The EOQ can be calculated using a:

(1) Table (2) Graph

(3) Formula (4) All of the above

Ans. (4) All of the above

Q.320.Economic order theory assumes that the average inventory held is equal to one half of the reorder quantity.

(1) True (2) False

Ans. (1) True

Q.321.Supply lead time. This is the period of time between placing a new order with a supplier and receiving the delivery of the purchased items. The length of this supply lead time might be uncertain and might be several days, weeks or even months.

(1) The above is statement is correct

(2) The above statement is incorrect

Ans. (1) The above is statement is correct

Q.322.Reorder level is the level of inventory at which a new order for the item should be placed with the supplier.

(1) True (2) False

Ans. (1) True

Q.323.In an inventory control system, if there is uncertainty about the length of the supply lead time and demand during the lead time there might be following warning levels for inventory, to warn management that:

(1) The item should now be reordered (the reorder level)

(2) The inventory level is too high (a maximum inventory level)

(3) The inventory level is getting dangerously low (a minimum inventory level)

(4) All of the above

Ans. (4) All of the above

Q.324.If the supply lead time is certain and demand during the lead time is constant, a company would be able to set a reorder level such that it used the last item just as a new order arrived thus reducing holding costs to a minimum. The reorder level to do this is found as:

(1) Maximum demand for the material item per day/week × Maximum supply lead time in days/weeks

(2) Demand for the material item per day/week × Lead time in days/weeks

(3) Both 1 & 2

(4) None

Ans. (2) Demand for the material item per day/week × Lead time in days/weeks

Q.325.If the supply lead time is uncertain, and demand during the lead time is also uncertain, there should be a safety level of inventory. A company may wish to ensure that they are never out of stock. The reorder level to achieve this is found as:

(1) Maximum demand for the material item per day/week × Maximum supply lead time in days/weeks

(2) Demand for the material item per day/week × Lead time in days/weeks

(3) Both 1 & 2

(4) None

Ans. (1) Maximum demand for the material item per day/week × Maximum supply lead time in days/weeks

Q.326.Safety inventory is the average amount of inventory held in excess of average requirements in order to remove the risk of a stock-out.

(1) False (2) True

Ans. ~~(1)~~ (2) False

Q.327.Safety inventory is also known as:

(1) Buffer stock (2) Safety stock

(3) Both 1 & 2 (4) None

Ans. (3) Both 1 & 2

Q.328.Buffer/safety inventory - the basic level of inventory kept for emergencies. A buffer is required because both demand and lead time will fluctuate and predictions can only be based on best estimates.

(1) The above statement is correct

(2) The above statement is incorrect

Ans. (1) The above statement is correct

Q.329.Practically the risks associated with a stock out are so great that the company always tries to avoid it even if it leads to extra holding cost.

(1) Incorrect (2) Correct

Ans. (2) Correct

Q.330.The objective of good inventory management is to determine:

(1) The optimum re-order level

(2) How many items are left in inventory when the next order is placed

(3) The optimum re-order quantity – how many items should be ordered when the order is placed for all material inventory items.
(4) All of the above
Ans. (4) All of the above

Q.331.Inventory costs include:
(1) Purchase costs
(2) Holding costs, ordering costs
(3) Costs of running out of inventory
(4) All of the above
Ans. (4) All of the above

Q.332.What would be the possible reasons for holding inventories?
(I) To ensure sufficient goods are available to meet expected demand
(II) To provide a buffer between processes
(III) To meet any future shortages
(IV) To take advantage of bulk purchasing discounts
(V) To absorb seasonal fluctuations and any variations in usage and demand
(VI) To allow production processes to flow smoothly and efficiently
(VII) As a necessary part of the production process
(VIII) As a deliberate investment policy, especially in times of inflation or possible shortages
(1) All of the above
(2) (I) (II) (III) only
(3) (III) and (VII) only
(4) None
Ans. (1) All of the above

Q.333.The cost which may arise if inventory is kept too low is the type associated with running out of inventory. There are a number of causes of stockout costs.
(I) Lost contribution from lost sales
(II) Loss of future sales due to disgruntled customers
(III) Loss of customer goodwill
(IV) Cost of production stoppages
(V) Labour frustration over stoppages
(VI) Extra costs of urgent, small quantity, replenishment orders

(I) and (IV) only
(1) (I) (IV) (V) only
(2) All of the above
(3) None
(4) All of the above
Ans. (3) All of the above

Q.334.The overall objective of inventory control is, therefore, to maintain inventory levels so that the total of the ________ costs is minimised.
(1) Holding costs (2) Ordering costs
(3) Stockout costs (4) Only 1 & 2
(5) All of the above
Ans. (5) All of the above

Q.335.Inventory control levels can be calculated in order to maintain inventories at the optimum level. The three critical control levels are:
(1) Reorder level, minimum level and maximum level
(2) Reorder level, Safety stock and Average inventory
(3) Buffer stock, minimum level and maximum level
(4) None
Ans. (1) Reorder level, minimum level and maximum level

Q.336.Minimum level is a warning level to draw management attention to the fact that inventories are approaching a dangerously low level and that stockouts are possible.
(1) True (2) False
Ans. (1) True

Q.337.This is the quantity of inventory which is to be ordered when inventory reaches the reorder level. If it is set so as to minimise the total costs associated with holding and ordering inventory, then it is known as the economic order quantity.
(1) The above statement is false
(2) The above statement is true
Ans. (2) The above statement is true

Q.338.The two-bin system of stores control (or visual method of control) is one whereby each stores item is kept in two storage bins.
(1) Correct (2) Incorrect
Ans. (1) Correct

Q.339.In the ABC method materials are classified A, B & C according to their expense – group A being the expensive, group B the medium-cost and group C the inexpensive materials.
(1) False (2) True
Ans. (2) True

Q.340.Which of the following is not an inventory?
(1) Machines (2) Raw material
(3) Finished products (4) Consumable tools
Ans. (1) Machines

Q.341.The following classes of costs are usually involved in inventory decisions except
(1) Cost of ordering (2) Carrying cost
(3) Cost of shortages (4) Machining cost
Ans. (4) Machining cost

Q.342.The cost of insurance and taxes are included in
(1) Cost of ordering
(2) Set up cost
(3) Inventory carrying cost
(4) Cost of shortages
Ans. (3) Inventory carrying cost

Q.343. 'Buffer stock' is the level of stock
(1) Half of the actual stock
(2) At which the ordering process should start
(3) Minimum stock level below which actual stock should not fall
(4) Maximum stock in inventory
Ans. (3) Minimum stock level below which actual stock should not fall

Q.344.The minimum stock level is calculated as
(1) Reorder level – (Normal consumption x Normal delivery time)
(2) Reorder level + (Normal consumption x Normal delivery time)
(3) (Reorder level + Normal consumption) x Normal delivery time
(4) (Reorder level + Normal consumption) / Normal delivery time
Ans. (1) Reorder level – (Normal consumption x Normal delivery time)

Q.345.Which of the following is true for Inventory control?
(1) Economic order quantity has minimum total cost per order
(2) Inventory carrying costs increases with quantity per order
(3) Ordering cost decreases with lo size
(4) All of the above
Ans. (4) All of the above

Q.346.The time period between placing an order its receipt in stock is known as
(1) Lead time (2) Carrying time
(3) Shortage time (4) Over time
Ans. (1) Lead time

Q.347.Re-ordering level is calculated as
(1) Maximum consumption rate x Maximum re-order period
(2) Minimum consumption rate x Minimum re-order period
(3) Maximum consumption rate x Minimum re-order period
(4) Minimum consumption rate x Maximum re-order period
Ans. (1) Maximum consumption rate x Maximum re-order period

Q.348.Average stock level can be calculated as
(1) Minimum stock level + ½ of Re-order level
(2) Maximum stock level + ½ of Re-order level
(3) Minimum stock level + 1/3 of Re-order level
(4) Maximum stock level + 1/3 of Re-order level
Ans. (1) Minimum stock level + ½ of Re-order level

Q.349.The Economic Order Quantity (EOQ) is calculated as
(1) (2D*S/h)^1/2 (2) (DS*/h)^1/2
(3) (D*S/2h)^1/2 (4) (D*S/3h)^1/2
Where, D=Annual demand (units), S=Cost per order, h=Annual carrying cost per unit
Ans. (1) (2D*S/h)^1/2

Q.350.The order cost per order of an inventory is Rs. 400 with an annual carrying cost of Rs. 10 per unit. The Economic Order Quantity (EOQ) for an annual demand of 2000 units is

(1) 400 (2) 440 (3) 480 (4) 500

Ans. (1) 400

Q.351.Which one of the following is NOT a technique of inventory control?

(1) ABC analysis (2) FSN analysis
(3) GOLF analysis (4) FTMN analysis

Ans. (4) FTMN analysis

Q.352.ABC inventory control focuses on those

(1) Items not readily available
(2) Items which consume less money
(3) Items which have more demand
(4) Items which consume more money

Ans. (4) Items which consume more money

Q.353.Break-even analysis chart is drawn between

(1) overhead cost and fixed cost
(2) volume of production and income
(3) material cost and labour cost
(4) none of these

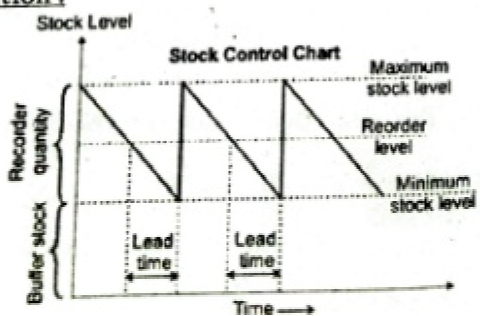
Ans. (2) volume of production and income

Q.354.A company uses 2555 units of an item annually. Delivery lead time is 8 days. The reorder point (in number of units) to achieve optimum inventory is

(1) 7 (2) 8 (3) 56 (4) 60

Ans. (3) 56

Solution :



Calculation:

Given:

$D = 2555$ units/year, $T_L = 8$ days $\Rightarrow$ 8/365 year.

ROL = Lead Time × Demand

ROL=2555×8/365⇒56units

When lead time T_L is greater than cycle time T, then:

$ROL = (T_L - T) \times D$

Q.355.An item can be purchased for ₹ 100. The ordering cost is ₹ 200 and the inventory carrying cost is 10% of the item cost per annum. If the annual demand is 4000 units, the economic ordering quantity is

(1) 50 (2) 100 (3) 200 (4) 400

Ans. (4) 400

Calculation:

Given:

$D = 4000$ units/year, C_u = Rs. 100 per unit, C_c = 10%

of $C_c = 0.1 \times 100$ = Rs. 10 per unit per year,

C_0 = Rs. 200 per order, Q = ?

Now, we know that

∴EOQ=2DCoCc

=2×4000×20010=400units

Q.356.For an assembly line, the production rate was 4 pieces per hour and the average processing time was 60 minutes. The WIP inventory was calculated. Now, the production rate is kept the same, and the average processing time is brought down by 30 percent. As a result of this change in the processing time, the WIP inventory.

(1) decreases by 25% (2) increase by 25%
(3) decreases by 30% (4) increase by 30%

Ans. (3) decreases by 30%

Given,

Processing time, $P.T_1 = 60$ min = 1 hour

Production rate = 4/hr = 4 units per hour

Second case:

Production rate = 4/hour

But processing time reduced by 30%

∴ New processing time, $P.T_2 = (0.7 \times 1)$ hour

New Production per hour = 4 × 0.7 = 2.8 units.

Thus, Work in progress has been reduced and decrease in

WIP=4−2.84×100=30%

Q.357. At breakeven point slope of sales line is equal to

(1) Variable Expenses + Constant Expenses Total Sales
(2) Total Sales Total Expenses
(3) Total Sales–Profit Variable Expenses + Profit
(4) Variable Expenses–Constant Expenses Total Sales

Ans. (1) Variable Expenses + Constant Expenses Total Sales

Explanation:

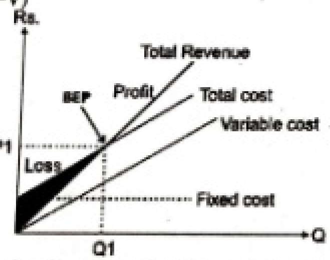
Breakeven analysis is used to find the minimum level of production required. It evaluates both fixed and variable costs.

A breakeven analysis is used to determine how much sales volume your business needs to start making a profit, based on your fixed costs, variable costs, and selling price.

Break-even analysis consists of:

(1) Fixed cost (F)
(2) Variable cost (V)
(3) Sales revenue (S)

BEP=(FS–V)



From the diagram, the slope of the sales line at BEP will be given by,

Slope of sales line=Total Cost Total Sales at BEP

At BEP, Total cost = Fixed cost + Variable cost

Slope of sales line = Variable Cost + Fixed Cost Total Sales at BEP = Variable Expenses + Constant Expenses Total Sales

Q.358. The difference between actual sales and breakeven point is known as

(1) Margin of safety (2) Price-cost margin
(3) Contribution (4) Profit

Ans. (1) Margin of safety

Explanation:

Margin of safety:

- ✓ The Margin of safety is the difference between the break-even point and output is produced.
- ✓ A large margin of safety indicates that the business can earn profit even if there is a great reduction in output.
- ✓ A small margin of safety indicates that the profit will be small even if there is a small drop in output.

Margin of safety (M/S) ratio is given by,

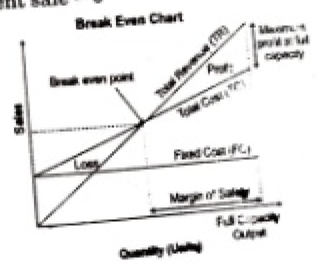
Margin of safety ratio (MS) = Margin of safety Present sale = Sales – Breakeven point sales Present sale

Break-even point:

- ✓ It is the point of intersection of the total cost line and total revenue line.
- ✓ There is neither profit nor loss at the break-even point.
- ✓ At the break-even point, the margin of safety ratio is 0.

At the break-even point, Sales = break-even point sales

Margin of safety ratio (MS) = Sales – Breakeven point sales Present sale = 0



Break-even chart:

- ✓ The break-even analysis is the study of cost-volume-profit (CVP) relationship.
- ✓ It refers to a system of determining that level of operations where the organisation neither earns profit nor suffer any loss i.e where the total cost is equal to total sales i.e the point of zero profit (break-even point).

- ✓ In a broader sense, it refers to a system of analysis that can be used to determine probable profit at any level of activity.
- ✓ The figure below shows the break-even chart.

Q.359. For a single item inventory system, the demand is continuous, which is 10000 per year. The replenishment is instantaneous and backorders (S units) per cycle are allowed as shown in the figure.

As soon as the quantity (Q units) ordered from the supplier is received, the backordered quantity is issued to the customers. The ordering cost is Rs. 300 per order. The carrying cost is Rs. 4 per unit per year. The cost of backordering is Rs. 25 per unit per year. Based on the total cost minimization criteria, the maximum inventory reached in the system is _____ *(round off to nearest integer).*

Ans. 1130 - 1140

__Calculation:__

Given, D = 10000/year, C_h = 4 /unit/year, C_o = 300/order, C_b = 25 /unit/year

Qmax=2×10,000×3004×2525+4

Q_{max} = 1137.147 units

Q.360. A manufactures can produce 12000 bearing per day. The manufactures received an order of 8000 bearing per day from a customer. The cost of holding a bearing in stock Rs. 0.20 per month. Set up cost per production run is Rs. 500. Assuming 300 working days in a year, the frequency of production run should be

(1) 4.5 Days (2) 4.5 Months
(3) 6.8 Days (4) 6.8 Months

Ans. (3) 6.8 Days

__Calculation:__

Given:

Annual demand in units, r = 8000 × 300 units/year

Production rate of bearings, K = 12000 × 300 unit/years

Set up cost per production run, C_o = Rs. 500/-

The holding cost of a bearing, C_c = Rs. 0.2 × 12 per years

EOQ=2C0rCc[1−rk]=54,772

Frequency = EOQ/r

∴ Frequency of production run = 54,7728,000 = 6.84 days

Q.361. Demand during lead time with associated probabilities is shown below :

Demand	50	70	75	80	85
Probability	0.15	0.14	0.21	0.20	0.30

Expected demand during lead time -

Answer 74 - 75 .

__Concept:__

The expected time during lead time can be calculated by:

te=∑DP(x)

where D = Demand, P(x) = Probability

__Calculation:__

D	P(x)	DP(x)
50	0.15	7.50
70	0.14	9.80
75	0.21	15.75
80	0.2	16.00
85	0.3	25.50
		74.55

The expected demand during lead time is:

te=∑DP(x) = 74.55

Q.362. In the classical economic order quantity (EOQ) model, let Q and C denote the optimal order quantity and the corresponding minimum total annual cost (the sum of the inventory holding and ordering costs). If the order quantity is estimated incorrectly as $Q' = 2Q$, then the corresponding total annual cost C' is

(1) $C' = 1.25C$ (2) $C' = 1.5C$
(3) $C' = 1.75C$ (4) $C' = 2C$

Ans. (1) $C' = 1.25C$

Concept:

The **total annual cost** for the inventory system is given as:

C = DQCo + Q2Ch

where C is the total annual cost, D is the annual demand, Q is the order quantity, C_o is the ordering cost and C_h is the holding cost per unit per year.

In economic order quantity (EOQ), DQCo = Q2Ch

Calculation:

Given:

In economic order quantity,

DQCo=Q2Ch or C = Q2Ch + Q2Ch

$\Rightarrow$ **C = QC$_h$**

Now, the new order quantity is Q' = 2Q, so the new total cost is

C' = DQ'Co + Q'2Ch = C' = D2QCo + 2Q2Ch

$\Rightarrow$ 12(Q2Ch)+QCh = Q4Ch + QCh = 54QCh

$\therefore$ **C' = 1.25C**

Q.363.A manufacturing company purchases 9000 parts of a machine for its annual requirements ordering for month usage at a time, each part costing Rs. 20. The ordering cost per order is Rs. 15 and carrying charges are 15% of the average inventory per year. What should be the optimum order quantity?

(1) 200 (2) 300 (3) 400 (4) 500

Ans. (2) 300

Concept:

Economic order quantity is given by:

EOQ=2DCoCh

where D = demand (unit/time), C_o = ordering cost (Rs/order), C_h = cost of carrying inventory (Rs/unit/time) .

Calculation:

Given:

D = 9000 Units year, Cost of one part (C) = Rs. 20, Co = Rs. 15/order

Ch = 15% of unit cost

= 15100 × 20

= Rs.3/unit/year

Economic order quantity is:

(EOQ) = 2DCoCh = 2 × 9000 × 153 = 300 units

Q.364.Which of the following inventory costs represents the cost of loss of demand due to shortage in supplies?

(1) Stockout cost (2) Unit cost

(3) Procurement cost (4) Carrying cost

Ans. (1) Stockout cost

Explanation:

Shortage or Stockout cost

✓ Shortage simply means the absence of inventory and the loss associated with not serving the customer is known as Shortage or stockout cost. It includes potential profit delay loss, fast transportation cost

Important Points

Carrying cost	It is the cost associated with storing keeping inventory items in the production system.
Procurement cost	It is the cost of purchasing inventory for sale
Unit cost	A unit cost is a total expenditure incurred by a company to produce, store, and sell one unit of a particular product.

Q.365.A firm's inventory turnover of ₹ 8,00,000 is 5 times the cost of goods sold. If the inventory turnover is improved to 8 with the cost of goods sold remaining the same, a substantial amount of fund is either released from, or gets additionally invested in, inventory. Which one of the following statements is correct?

(1) ₹ 1,60,000 is released

(2) ₹ 1,60,000 is additionally invested

(3) ₹ 60,000 is released

(4) ₹. 60,000 is additionally invested

Ans. (3) ₹ 60,000 is released

Concept:

Inventory turnover ratio is given by

Inventory turnover

= Cost of goods sold Inventory cost

1st Case:

Cost of goods sold = Rs. 800,000

Inventory turnover = 5

Let inventory cost in 1st case be 'x'

$\therefore$ 5 = 8,00,000x

x = 160,000

2nd Case:

Cost of goods sold = 800,000.
Inventory turnover = 8
Let inventory cost in 2nd case by 'y'
∴8=800,000y
y = 100,000
∴ x − y = 160000 − 100,000
Rs. 60,000 released.

Q.366. Annual demand for window frames is 10000. Each frame costs ₹ 200 and ordering cost is ₹ 300 per order. Inventory holding cost is ₹.40 per frame per year. The supplier is willing to offer 2% discount if the order quantity is 1000 or more, and 4% if order quantity is 2000 or more. If the total cost is to be minimized, the retailer should

(1) order 200 frames every time
(2) accept 2% discount
(3) accept 4% discount
(4) order Economic Order Quantity

Ans. (3) accept 4% discount

Concept:

For discount model at different price break, find total cost at each price break and EOQ.

Calculation:

Given:
D = 10000 units; C_u = Rs. 200
C_o = Rs. 300/order ; C_h = 40 per frame/year.
EOQ = 2DCoCh = 387.298
Total cost, TC = DC + Q2Ch + DQCo
At EOQ,
TC = (10000)(200) + 387.2982(40) + 10000387.298(300) = Rs.2015492
At Q = 1000, discount of 2%
= (10000)(200)(0.98) + 10002(40) + 100001000(300) = Rs.1983000
At Q = 2000, discount of 4%
TC = (10000)(200)(0.96) + 20002(40) + 100002000(300) = Rs.1961500

So, the minimum total cost is with a discount of 4%. Hence, select the 4% discount.

Q.367. Classifying items in A, B and C categories for selective control in inventory management is done by arranging items in the decreasing order of:

(1) Total inventory costs (2) Item value
(3) Annual usage value (4) Item demand

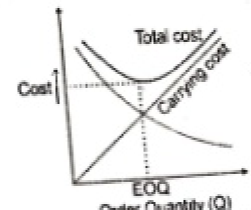
Ans. (3) Annual usage value

Q.368. A particular item has a demand of 9000 units/year. The cost of one procurement is ₹ 108 and the holding cost per unit is ₹ 2.40/year. The replacement is instantaneous and no shortages are allowed. What is the optimum number of orders/years?

(1) 7 orders/year (2) 8 orders/year
(3) 9 orders/year (4) 10 orders/year

Ans. (4) 10 orders/year

Concept:



From the inventory curve, total cost decreases with increases in an ordering quantity and starts increasing thereafter. The ordering quantity (Q), for which total cost is minimum, is called as Economic Order Quantity (EOQ).

EOQ=2DC0Ch
Optimum number of order = Demand EOQ

Concept:

Given:
D = 9000 units/year
C_0 = 108
C_h = 2.40/year
EOQ = 2DC0Ch
EOQ = 2×9000×1082.4 = 900
∴ EOQ = 900 units/order

Now,

Optimum number of order = DemandEOQ
Optimum number order = 9000900
∴ Optimum no. of order = 10 orders/year

Q.369.ABC analysis deals with

(1) Analysis of process chart
(2) Flow of metals
(3) Ordering schedule of job
(4) Controlling inventory costs money

Ans. (4) Controlling inventory costs money

<u>Explanation:</u>

The inventory comprises of large number of items. All items are not of equal importance. The firm, therefore should pay more attention and care to those items whose usage value is high and less attention to those whose usage value is low.

There are different types of selective inventory control:

ABC analysis(Always Better Control)	Inventory items are **classified based on their annual usage value** in monetary terms.	**Class A** - item: 10 % of the item accounts 75% costs. **Class B** - item: 20% of the item accounts 15% costs. **Class C** - item: 70% of the item accounts 10% costs.
VED Analysis (Vital, Essential, Desirable)	Inventory items are classified on the basis of their criticality i.e. according to the cost of incurring a stock out	**V-Vital:** Without which the production process would come to standstill **E-Essential:** Their non-availability will adversely affect the efficiency of the production system. It should be given second priority. **D-Desirable:** Without which the process is unaffected but is good if they are available for better efficiency.
SDE Analysis (Scarce, Difficult, Easily Available)	This type of analysis is useful in the study of those items which are scarce in availability	**S-Scarce:** Imported items which are generally in short supply **D-Difficult:** These are available in market but not always traceable or immediately supplied **E-Easily:** Easily available in the market
HML Analysis (High, Medium, Low Cost)	This type of analysis is similar to ABC analysis, except that cost per item is taken.	**H-Highest:** Items whose unit cost is very high, or maximum are given top priority **M-Medium:** Items whose unit cost is of medium value **L-Low:** Items whose unit cost is low
FSND Analysis (Fast, Slow, Non-moving, Dead Items)	Inventory items are classified in the descending order of their usage (Consumption rate/ movement value).	**F-Fast moving items:** That are consumed in short span of time **N-Normal moving items:** That are consumed over a period of one year **S-Slow moving items:** These items are not frequently issued and consumed over a period of two years or more. **D-Dead items:** Consumption of such items are almost nil. It can also be taken as obsolete items

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UNIT-5

Q.370. **Consider the below table for Jobs given with profit and deadline:**

Job	J1	J2	J3	J4	J5	J6	J7	J8	J9
Profit	15	20	30	18	18	10	23	16	25
Deadline	7	2	5	3	4	5	2	7	3

Find the maximum profit earned?

(1) 147 (2) 150 (3) 135 (4) None

Ans. (1) 147

Sort the jobs in descending order of the profit value :

Job	J3	J9	J7	J2	J4	J5	J8	J1	J6
Profit	30	25	23	20	18	18	16	15	10
Deadline	5	3	2	2	3	4	7	7	5

Now the following jobs can be performed :

Day	Job No.	Profit Earned
1	J2	20
2	J7	23
3	J9	25
4	J5	18
5	J3	30
6	J8	16
7	J1	15

Total profit = 147.

NOTE that all the jobs were available at the beginning, so we take a array of size equal to the maximum deadline and fill it backwards.

Student should try to analyse the time complexity of algorithm used.

Q.371. **Consider the 10 Jobs for A to J. The execution of each job takes 1 unit of time. One job can be executed at a time. Each job is related with a profit and a deadline. If job is completed before deadline then the corresponding profit is earned. The maximum profit earned is ______.**

Job	A	B	C	D	E	F	G	H	I	J
Profit	25	35	40	30	18	25	33	43	19	25
Deadline	4	7	4	7	1	4	6	5	3	6

(1) 200
(2) 230
(3) 231
(4) 321

Ans. (3) 231

(1) Array size = min(max(deadline)), number of jobs) = (7, 10) = 7

(2) Sort the Jobs in descending order based on profit

(3) Fill the array in reverse order of deadline

Array

Job .	A	J	D	C	H	G	B
Profit	25	25	30	40	43	33	35

0 1 2 3 4 5 6 7

Maximum profit = 25 + 25 + 30 + 40 + 43 + 33 + 35
= 231

Q.372. **We are given 9 – tasks T1, T2, T3, T4,...... T9 . The execution of each task requires one unit of time. Each task Ti has a profit P_i and a deadline D_i. You will get profit P_i if the task T_i is completed before the end of the deadline D_i.**

Task	T1	T2	T3	T4	T5	T6	T7	T8	T9
Profit	15	20	30	18	18	10	23	16	25
Deadline	7	2	5	3	4	5	2	7	3

If maximum profit is earned then

(1) All tasks are completed
(2) T1 & T6 are left out
(3) T1 & T8 are left out
(4) T4 & T6 are left out

Ans. (4) T4 & T6 are left out

The Greedy algorithm for Job sequencing problem with deadline is as follows :

(1) Sort all jobs in decreasing order of profit.

(2) Initialize the result sequence as first job in sorted jobs.

(3) Do following for remaining n – 1 jobs

(a) If the current job can fit in the current result sequence without missing the deadline, add current job to the result. Else ignore the current job.

Following the above algorithm :

Task	T3	T9	T7	T2	T4	T5	T8	T1	T6
Profit	30	25	23	20	18	18	16	15	10
Deadline	5	3	2	2	3	4	7	7	5

Now we can add the task in the following order :

{T3}
{T9, T3}
{T7, T9, T3}
{T2, T7, T9, T3}
{T2, T7, T9, T5, T3}
{T2, T7, T9, T5, T3, T8}
{T2, T7, T9, T5, T3, T8, T1}

So task T4 and T6 are left out.

Q.373.If Jobs J = (J1, J2, J3, J4) are given their processing time Ti =(1,1,2,3) and deadlines are Di = (3,4,2,3) maximum how many jobs can be done ?

(1) 1
(2) 2
(3) 3
(4) all

Ans. (3) 3

From the given information

Job	Ti	Di
J1	1	3
J2	1	4
J3	2	2
J4	3	3

So, J1 has 3 days deadline and it requires 1 day to finish . So we can schedule it on 3rd day.

Similarly, J2 has 4 days of deadline and requires 1 day to finish. So schedule J2 on 4th day.

J3 has 2 days deadline and requires 2 days to finish. So schedule J2 on first 2 days.

So, Day 1 & 2 : J3
Day 3 : J1
Day 4 : J2

Now there is no slot for J4.

So , maximum 3 jobs can be completed.

Q.374.Give the sequence of Tasks completed.

(1) T2, T3, T4, T5, T6, T7, T9
(2) T2, T7, T9, T5, T3, T8, T4
(3) T2, T7, T5, T9, T3, T1, T8
(4) none

Ans. (4) none

we can add the task in the following order :

{T3}
{T9, T3}
{T7, T9, T3}
{T2, T7, T9, T3}
{T2, T7, T9, T5, T3}
{T2, T7, T9, T5, T3, T8}
{T2, T7, T9, T5, T3, T8, T1}

Q.375.We are given 10 tasks. The execution of task requires 1 unit of time. Each task Ti has profit Pi and deadline Di. Profit Pi is earned if task Ti is completed before Di th unit of time.

Task : T1 T2 T3 T4 T5 T6 T7 T8 T9 T10

Profit : 15 22 X 18 25 12 24 18 20 15

Deadline: 1 2 2 3 4 5 3 6 1 5

Suppose maximum total profit earned by scheduling above task is 129, then profit 'x' assigned to T3 is?

(1) 27 (2) 23 (3) 24 (4) 25

Ans. (4) 25

The maximum profit obtained without scheduling T3 is 124 by the following assignment .

1->20,2->22,3->24,4->25,5->15,6->18.

20+22+24+25+15+18=124.

But the maximum profit obtained is 129. So T3 must be schedule either during 1st slot (0-1) or 2nd slot (1-2). placing T3 neither of these slot give the maximum profit as X+104 .

So X+104=129

X = 25.

Q.376.Greedy job scheduling with deadlines algorithms' complexity is defined as

(1) O(N) (2) $\Omega(n \log n)$
(3) $O(n2 \log n)$ (4) $O(n \log n)$

Ans. (1) O(N)

Q.377.The method which return different solutions from a single point, which is ______.

(1) greedy method (2) branch and bound
(3) dynamic programming (4) divide and conquer

Ans. (1) greedy method

Q.378. Job sequencing with deadline is based on _______ method

(1) greedy method (2) branch and bound
(3) dynamic programming (4) divide and conquer

Ans. (1) greedy method

Q.379. fractional knapsack is based on _______ method

(1) greedy method (2) branch and bound
(3) dynamic programming (4) divide and conquer

Ans. (1) greedy method

Q.380. The files x1,x2,x3 are 3 files of length 30,20,10 records each. What is the optimal merge pattern value?

(1) 110 (2) 60 (3) 90 (4) 50

Ans. (3) 90

Q.381. The optimal merge pattern is based on _______ method

(1) Greedy method (2) Dynamic programming
(3) Knapsack method (4) Branch and bound

Ans. (1) Greedy method

Q.382. Which of the following standard algorithms is not a Greedy algorithm?

(1) Dijkstra's shortest path algorithm
(2) Prim's algorithm
(3) Kruskal algorithm
(4) Bellmen Ford Shortest path algorithm

Ans. (4) Bellmen Ford Shortest path algorithm

Q.383. What is the time complexity of Huffman Coding?

(1) O(N) (2) O(N log N)
(3) O(N(log n)^2) (4) O(N^2)

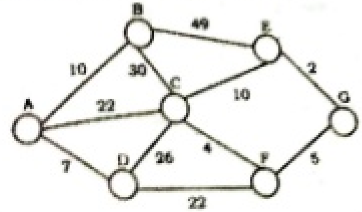
Ans. (2) O(N log N)

Q.384. Which of the following is true about Huffman Coding

(1) Huffman coding may become lossy in some cases
(2) Huffman codes may not be optimal lossless codes in some cases
(3) In Huffman coding, no code is prefix of any other code
(4) All of the above

Ans. (3) In Huffman coding, no code is prefix of any other code

Q.385. Consider the undirected graph below:



Using Prim's algorithm to construct a minimum spanning tree starting with node A, which one of the following sequences of edges represents a possible order in which the edges would be added to construct the minimum spanning tree?

(1) (E,G), (C,F), (F,G), (A,D), (A,B), (A,C)
(2) (A,D), (A,B), (A,C), (C,F), (G,E), (F,G)
(3) (A,B), (A,D), (D,F), (F,G), (F,E), (F,C)
(4) (A,D), (A,B), (D,F), (F,C), (F,G), (G,E)

Ans. (4) (A,D), (A,B), (D,F), (F,C), (F,G), (G,E)

Q.386. _______ models involves the allocation of resources to activities in such a manner that some measure of effectiveness is optimized.

(1) Sequencing (2) Allocation Models
(3) Queuing Theory (4) Decision Theory

Ans. (2) Allocation Models

Q.387. _______ are expressed is n the form of inequities or equations

(1) Constraints (2) Objective Functions
(3) Both 1 and 2 (4) None of the above

Ans. (1) Constraints

Q.388. _______ may be defined as a method of determining an optimum programme inter dependent activities in view of available resources

(1) Goal Programming
(2) Linear Programming
(3) Decision Making
(4) None of the above

Ans. (2) Linear Programming

Q.389. _______ refers to the combination of one or more inputs to produce a particular output.

(1) Solution (2) variable
(3) Process (4) None of the above

Ans. (3) Process

Q.390. _______ is one of the fundamental combinatorial optimization problems.

(1) Assignment problem
(2) Transportation problem
(3) Optimization Problem
(4) None of the above

Ans. (1) Assignment problem

Q.391. A basic solution which also satisfies the condition in which all basic variables are nonnegative is called

(1) Basic feasible solution
(2) Feasible solution
(3) Optimal solution
(4) None of the above

Ans. (1) Basic feasible solution

Q.392. A BFS of a LPP is said to be _______ if at least one of the basic variable is zero

(1) Degenerate (2) Nondegenerate
(3) Infeasible (4) Unbounded

Ans. (1) Degenerate

Q.393. A feasible solution is called a basic feasible solution if the number of nonnegative allocations is equal to

(1) m.n+1 (2) m.n.1
(3) m+n.1 (4) None of the above

Ans. (2) m+n.1

Q.394. A given TP is said to be unbalanced, if the total supply is not equal to the total

(1) Optimization (2) Demand
(3) Cost (4) None of the above

Ans. (2) Demand

Q.395. A minimization problem can be converted into a maximization problem by changing the sign of coefficients in the

(1) Constraints (2) Objective Functions
(3) Both 1 and 2 (4) None of the above

Ans. (2) Objective Functions

Q.396. PERT stands for

(1) Program Estimation and Reporting Technique
(2) Process Estimation and Review Technique
(3) Program Evaluation and Review Technique
(4) Planning Estimation and Resulting Technique

Ans. (3) Program Evaluation and Review Technique

Q.397. CPM is Critical Path Method

(1) Synthesizing in concepts
(2) Is built of activities oriented programmes
(3) Is used for repetitive works
(4) All of the above

Ans. (4) All of the above

Q.398. The performance of a specific task in CPM is known as

(1) Dummy (2) Event
(3) Activity (4) Contract

Ans. (3) Activity

Q.399. Positive slack on a PERT indicates that project is

(1) Ahead of schedule (2) Beyond schedule
(3) As per schedule (4) On critical path

Ans. (1) Ahead of schedule

Q.400. Which of the following statement is wrong?

(1) An activity consumes time and resources whereas an event does not consume time or resources
(2) The performance of a specific task is called an activity
(3) An event is an instantaneous point in time at which an activity begins or ends
(4) The turning of a job on lathe is an event whereas job turned is an activity

Ans. (4) The turning of a job on lathe is an event whereas job turned is an activity

Q.401. CPM is the

(1) Time oriented technique
(2) Event oriented technique
(3) Activity oriented technique

(4) Target oriented technique

Ans. (3) Activity oriented technique

Q.402.The probability distribution of activity times in PERT follows following distribution

(1) Normal (2) Binomial

(3) Beta (4) Exponential

Ans. (3) Beta

Q.403.Pick up the correct statement. Dummy activity on a PERT/CPM chart means, it

(1) Consumes time, but no resources

(2) Consumes resources but no time

(3) Consumes neither time nor resource

(4) Is a dangling event

Ans. (3) Consumes neither time nor resource

Q.404.The time of completing a project in network analysis is given by following time of the critical activity meeting at the final triode

(1) Early finish (2) Early start

(3) Late start (4) Late finish

Ans. (1) Early finish

Q.405.The time by which the activity completion time can be delayed without affecting the start of succeeding activities, is known as

(1) Duration (2) Total float

(3) Free float (4) Interfering float

Ans. (3) Free float

Q.406.An optimum project schedule implies

(1) Optimum utilization of men, machines and materials

(2) Lowest possible cost and shortest possible time for project

(3) Timely execution of project

(4) To produce best results under given constraints

Ans. (2) Lowest possible cost and shortest possible time for project

Q.407.Gantt chart gives information about

(1) Scheduling and routing

(2) Sales

(3) Production schedule

(4) Machine utilization

Ans. (3) Production schedule

Q.408.CPM has following time estimate

(1) One time estimate (2) Two time estimate

(3) Three time estimate (4) Four time estimate

Ans. (1) One time estimate

Q.409.Acceptance sampling is used in

(1) Job production (2) Batch production

(3) Mass production (4) Job evaluation

Ans. (3) Mass production

Q.410.A diagram showing the path followed by men and materials while performing a task is known as

(1) String diagram (2) Flow process chart

(3) Travel chart (4) Flow diagram

Ans. (4) Flow diagram

Q.411.The start or completion of task is called

(1) An event (2) An activity

(3) A duration (4) A second

Ans. (1) An event

Q.412.Slack of various events on the critical path in PERT/CPM chart

(1) Increases continuously

(2) Decreases continuously

(3) Remain constant

(4) May increase or decrease depending on various factors

Ans. (3) Remain constant

Q.413.Scheduling gives information about

(1) When work should start and how much work should be completed during a certain period

(2) When work should complete

(3) That how idle time can be minimized

(4) Proper utilization of machines

Ans. (1) When work should start and how much work should be completed during a certain period.

Q.414.Scheduling

(1) Prescribes the sequence of operations to be followe

(2) Determines the programme for the operations

(3) Is concerned with starting of processes
(4) Regulates the progress of job through various processes

Ans. (2) Determines the programme for the operations

Q.415. Pessimistic time is

(1) The maximum time which an activity might require
(2) The average time required for a job
(3) The most probable time considering all conditions
(4) The minimum time in which an activity can possibly be accomplished

Ans. (1) The maximum time which an activity might require

Q.416. Critical path moves along the activities having total float of

(1) Positive value (2) Negative value
(3) Zero value (4) Same value

Ans. (3) Zero value

Q.417. Dispatching

(1) Prescribes the sequence of operations to be followed
(2) Determines the programme for the operations
(3) Is concerned with the starting of processes
(4) Regulates the progress of job through various processes

Ans. (3) Is concerned with the starting of processes

Q.418. The probabilistic time is given by (where to = Optimistic time, tp = Pessimistic time, and tn = Most likely time)

(1) (to + tp + tn)/3 (2) (to + 2tp + tn)/4
(3) (to + 4tp + tn)/5 (4) (to + tp + 4tn)/6

Ans. (4) (to + tp + 4tn)/6

Q.419. In CPM, the cost slope is determined by

(1) Crash cost / Normal Cost
(2) (Crash Cost – Normal cost) / (Normal time – Crash time)
(3) Normal Cost/Crash cost
(4) (Normal cost – Crash cost) / (Normal time – Crash time)

Ans. (2) Crash Cost – Normal cost) / (Normal time – Crash time)

Q.420. PERT is the

(1) Time oriented technique
(2) Event oriented technique
(3) Activity oriented technique
(4) Target oriented technique

Ans. (2) Event oriented technique

Q.421. 'O' on a PERT/CPM chart represents

(1) An ordinary event
(2) A significant event representing some milestone
(3) An event to be transferred to other network chart
(4) Dangling event

Ans. (1) An ordinary event

Q.422. CPM stands for

(1) Combined Process Method
(2) Critical Path Method
(3) Common Planning Method
(4) Critical Process Method

Ans. (2) Critical Path Method

Q.423. Routing

(1) Prescribes the sequence of operations to be followed
(2) Determines the programme for the operations
(3) Is concerned with starting of processes
(4) Regulates the progress of job through various processes

Ans. (1) Prescribes the sequence of operations to be followed

Q.424. Critical path on PERT/CPM chart is obtained by joining the events having

(1) Maximum slack (2) Minimum slack
(3) Average slack (4) No slack

Ans. (2) Minimum slack

Q.425. Routing prescribes the

(1) Flow of material in the plant
(2) Proper utilization of man power
(3) Proper utilization of machines
(4) Inspection of final product

Ans. (1) Flow of material in the plant

Q.426. The time which results in the least possible direct cost of an activity is known as

(1) Normal time (2) Slow time
(3) Crash time (4) Standard time
Ans. (2) Slow time

Q.427.Routing assists engineers in deciding in advance
(1) The flow of material in the plant
(2) The methods of proper utilization of manpower
(3) The methods of proper utilization of machine
(4) The layout of factory facilities
Ans. (3) The methods of proper utilization of machine

Q.428.Pick up the correct statement about relationship between various floats
(1) Free float = total float
(2) Independent float = total float
(3) Independent float > free float
(4) Independent float < free float
Ans. (4) Independent float < free float

Q.429.An activity of the project is graphically represented by _______ on the network diagram.
(1) A circle (2) A straight line
(3) An arrow (4) A rectangle
Ans. (3) An arrow

Q.430.Master schedule is prepared for
(1) Single product continuous production
(2) Multi product batch production
(3) Assembly product continuous production
(4) Single product batch production
Ans. (3) Assembly product continuous production

Q.431.Centralized and decentralized are the types of
(1) Routing (2) Dispatching
(3) Scheduling (4) Follow up
Ans. (2) Dispatching

Q.432.A dummy activity used in PERT network to describe
(1) precedence relationship
(2) dangling
(3) resource idleness
(4) resource restriction
Ans. (1) precedence relationship

Q.433.In a small engineering project, the three time estimate of PERT activity are optimistic time = 10min, most likely time = 12min, pessimistic time = 16min find standard deviation ?
(1) 0.5 min (2) 1 min
(3) 1.5 min (4) 2 min
Ans. (2) 1 min

Q.434.Solve the following Job sequencing with deadlines problem n=7, Profits (p1, p2, p7) = {3, 5, 20, 18, 1, 6, 30} Deadlines (d1, d2, d7) = {1, 3, 4, 3, 2, 1, 2}
optical solution –
(1) 163 (2) 74 (3) 75 (4) 76
Ans. (2) 74
Let n=7, Profits(p1, p2. ....p7)={3, 5, 20, 18, 1, 6, 30} Deadlines(d1, d2,....d7)={1, 3, 4, 3, 2, 1, 2} The feasible solution and their values are given below.

Sr. No	Feasible Solution	Frequenting Sequence	Value
1	(1,2)	1,2 or 2,1	8
2	(1,3)	3,1	23
3	(1,4)	4,1	21
4	(1,5)	5,1	4
5	(1,6)	6,1	9
6	(1,7)	7,1	33
7	(2,3)	3,2	25
8	(3,4)	4,3	38
9	(4,5)	5,4	19
10	(5,6)	6,5	7
11	(6,7)	7,6	36
12	(1)	1	3
13	(2)	2	5
14	(3)	3	20
15	(4)	4	18
16	(5)	5	1
17	(6)	6	6
18	(7)	7	30

Consider the jobs in the non-increasing order of profits subject to the constraint that the resulting job sequence J is a feasible solution.
In the example considered before, the non-increasing profit vector is

p1	80
p2	70
p3	15
p4	6
p5	6
p6	3
p7	1
d1	2
d2	4
d3	3
d4	1
d5	3
d6	1

(i) Now we start adding the job with J = 0 and Σ i ∈ J Pi = 0

(ii) Job 7 is added to J as it has the largest profit and thus J = {7} is a feasible one.

(iii) Now job 3 is considered. The solution J = {3, 7} is a feasible one with processing sequence (7, 3).

(iv) The next job, Job 4 is considered. The solution J = {3, 4, 7} is a feasible one with processing sequence (3, 4, 7).

(v) Finally, the next job, Job 6 is considered. The solution J = {3, 4, 6, 7} is a feasible one with processing sequence (3, 4, 6, 7).

(vi) Thus we have J = {3, 4, 6, 7} is optimal solution with value 74.

Q.435.______ are entities whose value is determined from the solution of LPP

(1) objective function (2) decision variable
(3) constraints (4) opportunity cost

Ans. (1) objective function

Q.436.The region of feasible solution in LPP graphical method is called ______.

(1) infeasible region (2) unbounded region
(3) infinite region (4) feasible region

Ans. (4) feasible region

Q.437.The outgoing variable row in the simplex table is called ______.

(1) outgoing row (2) key row
(3) basic row (4) interchanging row

Ans. (3) basic row

Q.438.When the solution is degenerate in transportation problem, we add a ______

(1) dummy (2) epsilon
(3) penalty (4) regret

Ans. (2) epsilon

Q.439.______ method is used in Assignment Problem

(1) ncwr (2) lcm
(3) vam (4) hungarian

Ans. (4) hungarian

Q.440.The longest path in the network diagram is called ______.

(1) head path (2) sub path
(3) critical path (4) sub critical path

Ans. (3) critical path

Q.441.IF the Minimax are (10,18,16) and Maximin are (8,10,7). The saddle point is ______.

(1) 7 (2) 10 (3) 18 (4) 8

Ans. (2) 10

Q.442.Pick the wrong relationship:

(1) interfering float = total float – free float
(2) total float =free float + independent float
(3) total float ≥ free float ≥ independent float
(4) free float = total float – head event slack

Ans. (2) total float =free float + independent float

Q.443.The shortest time in the PERT is called ______ time

(1) expected (2) pessimitic
(3) optimistic (4) most likely

Ans. (3) optimistic

Q.444.The total time required to complete all the jobs in a job sequence problem is known as ______.

(1) processing order (2) idle time
(3) processing time (4) elapsed time

Ans. (4) elapsed time

Q.445.Operations Research Models in which values of all variables and all possible outcomes are known with certainty are called models.

(1) physical (2) symbolic
(3) deterministic (4) probabilistic

Ans. (3) deterministic

Q.446. Operations Research Models in which some or all variables are random in nature are called models.

(1) physical (2) symbolic
(3) deterministic (4) probabilistic

Ans. (4) probabilistic

Q.447.________ and are techniques applied in project management.

(1) cpm and pert
(2) assignment & transportation
(3) game theory
(4) decision theory& inventory models

Ans. (1) **cpm and pert**

Q.448.________ are the entities whose values are to be determined from the solution of the LPP.

(1) objective function (2) decision variables
(3) constraints (4) opportunity cost

Ans. (2) decision variables

Q.449.________ specifies the objective or goal of solving the LPP.

(1) objective function (2) decision variables
(3) constraints (4) opportunity cost

Ans. (1) objective function

OOO