D 70363 (Pages : 4) Name...

Reg. No...

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2019

(CUCBCSS—UG)

Statistics

STS 5B 08—OPERATIONS RESEARCH AND STATISTICAL QUALITY CONTROL

Time : Three Hours Maximum : 80 Marks

Section A

Answer all **ten** *questions.*

Each question carries 1 *mark.*

1. ———— is a basic solution in which the values of the basic variables are non-negative.
2. When there exists no finite optimum the linear programme is said to have ———— solution.
3. ———— is an algebraic method of solving a linear programming problem.
4. Every linear programming problem has an associated linear program called ————.
5. Hungarian method is an optimization technique for solving.
6. The variations in a particular scheme of production which are beyond the control of human hand is known as ————.
7. ———— is the control chart for number of defective.
8. Decision to accept or reject a lot is taken on the basis of a sample only, it is called ———— plan.
9. The control limit delimited by consumer are called ————.
10. A curve showing the probability of accepting a lot of quality p is known as ————.

(10 × 1 = 10 marks)

Section B

Answer all **seven** *questions.*

Each question carries 2 *marks.*

11. Define slack variables. Optimum feasible solution.
12. What is producers risk and consumers risk ?
13. What are the applications of C chart ?

Turn over

... of variations ... po are ... chart can be used
in production process. They are powerful statistical tool of diagnosi
As an alternative to means chart and Range chart. They are chart for variables
Chart for attributes which can be used for controlling quality characte... we have control
15. characteristics
2 marks.
16. Contro...

14. Compare control chart for variables and control chart for attributes.

15. Using the following primal problem prove that dual of the dual in primal

$$\text{Minimize } Z = 3X_1 + X_2$$
$$\text{subject to } 10X_1 + 2X_2 \geq 84$$
$$8X_1 + 4X_2 \geq 120$$
$$X_1, X_2 \geq 0.$$

16. What are the assumptions used in linear programming.

17. Give the procedure for finding the initial feasible solution of a transportation problem.

(7 × 2 = 14 marks)

Section C

Answer any **three** *questions.*
Each question carries 4 marks.

18. What are the limitations of linear programming ?

19. Use the graphical method to solve the following LPP :

$$\text{Maximize } Z = 7X_1 + 5X_2$$
$$\text{subject to the conditions } 4X_1 + 3X_2 \leq 240;$$
$$2X_1 + X_2 \leq 100$$
$$X_1, X_2 \geq 0.$$

20. Obtain initial basic solution to the following transportation problem by North West Corner rule :

Market	W_1	W_2	W_3	W_4	Availabilily
Plant					
F_1	50	150	70	60	50
F_2	80	70	90	10	60
F_3	15	87	79	81	40
Requirement	20	70	50	10	

21. Pieces of cloth, out of different rolls, were inspected and following defects found. Draw control chart for number of defects and comment on the quality.

Defects : 1, 3, 5, 0, 6, 0, 9, 4, 4 and 3.

22. Discuss single sampling plan.

(3 × 4 = 12 marks)

Section D

Answer any **four** *questions.*
Each question carries 6 *marks.*

23. Write the general form of a Linear Programming Problem.

24. What is degeneracy in transportation problem ? Define assignment problem.

25. Show that transportation problem is a special case of linear programming.

26. Define : AQL, LTPD, AOQL.

27. Explain the construction of p and np charts.

28. Explain the role of statistics in controlling the quality of the product.

(4 × 6 = 24 marks)

Section E

Answer any **two** *questions.*
Each question carries 10 *marks.*

29. (a) Solve the following LP problem using the Simplex Method :

Maximise $Z = 70X_1 + 50X_2$
subject to $4X_1 + 3X_2 \leq 240$;
$2X_1 + X_2 \leq 100$
$X_1, X_2 \geq 0$.

(b) What are the characteristics of LPP ?

30. Solve the following assignment problem :

OPERATOR → JOB	J_1	J_2	J_3	J_4
M_1	5	3	2	8
M_2	7	9	2	6
M_3	6	4	5	7
M_4	5	7	7	8

31. Explain the relationship between control limits and natural tolerance limits.

32. Explain the terms :

(a) ASN.

(b) OC.

(c) Modified control limits.

(d) Single sampling plan and double sampling plan.

(2 × 10 = 20 marks)

Set (1)

S-70363

V Sem B.Sc Degree Examination Nov 2017

CUCBCSS-UG.

STS 5B 08 - Operations Research and Statistical Quality Control.

Section A

1. Basic feasible solution
2. Unbounded solution
3. Simplex Method
4. Dual.
5. Assignment Problem
6. chance variation
7. C. chart
8. Single sampling plan
9. Specification limit
10. OC curve,

(1 mark each)

Section B

11. Slack - Unused variables and the contribution associated with them is zero
Surplus - Shortage in available resources and their contribution are also taken as zero.

12. 1) risk of rejecting a lot - Rejecting a hypothesis when it is true
2) Accepting a hypothesis which is false

13. It is used for the control of number of defects
unlike p or np chart, the c chart applies to the no of defects per unit.
In many manufacturing or inspection situations, the sample size is large, and the prob of occurrence of defect is very small, the C-chart can be used

14. Mean chart and range chart are powerful statistical tool of diagnosis of sources of variation in production process. They are chart for variables
As an alternative to mean chart and Range chart, we have control chart for attributes which can be used for controlling quality character

15. characteristics
2 marks.

16. 1) Constraints and objective function are linear
2) Divisibility - explain
3) Certainity
4) Any two - 2 marks.

17. Any one method - 2 marks

Section C.

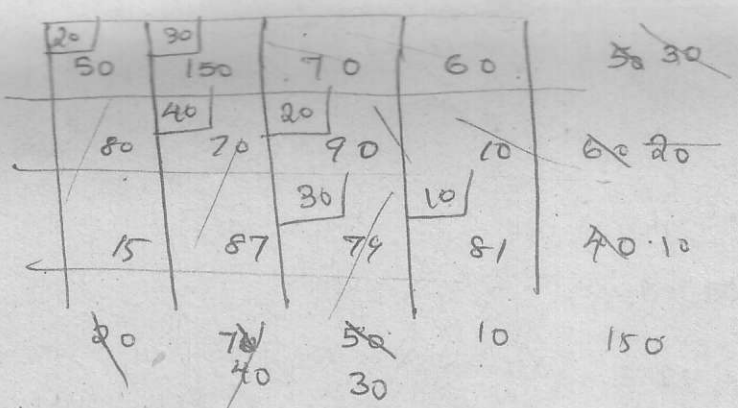
18. 1: There is no guarantee that linear programming will give solution in integral values
2. Unless linear programming approach, uncertainty is not allowed.
3. The assumption of linearity is a limitation
4. It fails to give solution, if have multiple goals

19.

Corner points	Profit
(0,0)	0
(50,0)	350
(30,40)	410
(0,80)	400.

Solution, $x_1 = 30$, $x_2 = 40$, Max $Z = 410$. (4 MARKS)

20.



(4 MARKS)

Cost = $50\times20 + 150\times30 + 70\times40 + 90\times20 + 79\times30 + 81\times10$

21. Mean of defects = $\frac{35}{10} = 3.5$,

UCL : $3.5 + \sqrt{3.5} = 9.11$

LCL : $3.5 - \sqrt{3.5} = -2.11$

The process is under control (4 MARKS)

22. If the decision about accepting or rejecting a lot is taken on the basis of one sample only, the acceptance plan is described as Single sampling plan.

steps 1. Select a random sample of size n from a lot of size N

2) Inspect all the articles in the sample. Let d be the no. of def.

3). If $d \leq c$ accept the lot, replacing the defective pieces by non defective

Section D

23. Choose the quantities

$$x_j \geq 0, \quad j = 1, 2 \cdots n$$

This is known as non-negativity restrictions

Maximise

$$Z = \sum_{j=1}^{m} c_j x_i$$

Subject to constraints $\sum_{j=1}^{m} a_{ij} x_i \leq b_i \quad (i = 1, 2 \cdots m)$

24. no. of used squares will not be equal to the no. of row requirements hence one (2+2) Assignment problem

25. Transportation is an optimisation problem with linear objective function and linear constraints

To solve

$$\text{Min} \sum_{i}^{} \sum_{j}^{} x_{ij} \cdot c_{ij}$$

Subject to $\sum_{j=1}^{m} x_{ij} = S_i \quad \forall i = 1, 2 \cdots m$

$$\sum_{i=1}^{m} x_{ij} = D_j \quad \text{for all } j = 1, 2 \cdots n.$$

other as LPP is

$$\text{Max or Min} \quad Z = c_1 x_1 + \cdots + c_n x_n$$

Subject to $a_{11} x_1 \cdots \leq \geq b_1 \quad i = 1, 2 \cdots m$

26. A.Q.L - A lot with relatively small fraction defective (2 marks)
usually PL Rejecting a lot of quality $P_1 J = 0.05$

LTPD: Lot Tolerence Proportion or Percent Defective
usually denoted by P_t, is the lot quality which is considered to be bad by the consumer.

AOQL: The expected fraction defective remaining in the lot after application of the sampling inspection plans is termed as AOQL.

27. P chart:

$$UCL = p' + A\sqrt{p'(1-p')}$$

$$LCL \quad p' - A\sqrt{p'(1-p')}$$

$$CL = p'$$

$p = d/m = \frac{\text{no. of defectives}}{\text{size}}$

$E(p) = p, \quad V(p) = \frac{pq}{n}$.

$\therefore E(p) \pm 3\,SE(p)$

$p \pm 3\sqrt{\frac{pq}{n}}$

np chart (d chart)

$E(d) \pm 3\,SE(d) = np \pm 3\sqrt{np(1-p)}$

10

28. Quality control is a powerful productivity technique for effective diagnosis of lack of quality in materials, process, machine or end product. SQC is an effective use of data for studying the cause of variation.

Statistical Control involves — 4 marks

Section E

29.

a) $Z = 4100$, $x_1 = 30$, $x_2 = 40$ — 6 marks

b) Five characteristics.

1) Objective function
2) Constraints
3) Non-Negativity
4) Linearity
5) Finiteness. (4 marks)

30.

5	3	2	8
7	9	2	6
6	4	5	7
5	7	7	8

I

3	1	0	7
5	7	0	4
2	0	1	3
0	2	2	5

II

3	1	[0]	4
5	7	0	1
2	[0]	1	0
[0]	2	2	0

III

	S_1	S_2	S_3	S_4
M_1	2	[0]	0	2
M_2	4	6	[0]	0
M_3	2	0	2	[0]
M_4	[0]	2	3	0

(3). Explanation — 10 marks

(32). Any — Each point one - 2-5 marks.