



LOYOLA COLLEGE (AUTONOMOUS) CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – STATISTICS

FIRST SEMESTER – NOVEMBER 2024

PST1MC05 – STATISTICAL QUALITY CONTROL



Date: 18-11-2024

Dept. No.

Max. : 100 Marks

Time: 01:00 pm-04:00 pm

SECTION A – K1 (CO1)

Answer ALL the questions

(5 x 1 = 5)

1 Fill in the blanks

- The parts per million defectives in a 6-sigma process is _____.
- _____ control chart is used for fraction non-conforming.
- _____ refers to the average number of points that must be plotted before a point indicates an out-of-control condition.
- The principal advantage of a double-sampling plan with respect to single sampling is that it may reduce _____.
- _____ distribution is used in acceptance sampling by variables when σ is unknown.

SECTION A – K2 (CO1)

Answer ALL the questions

(5 x 1 = 5)

2 True or False

- Specification limits are decided by Statisticians.
- EWMA control chart is also called as Geometric Moving Average control chart.
- C_p measures the potential capability of the process.
- Sequential sampling plan is an extension of double-sampling and multiple-sampling.
- The basic idea of variables sampling for proportion nonconforming is assure the acceptability of the lot with reasonable probability.

SECTION B – K3 (CO2)

Answer any THREE of the following

(3 x 10 = 30)

- Explain the various dimensions of quality in detail
- Illustrate the need for Multivariate Control chart and explain the construction of multivariate control chart using Hotelling T^2 Statistic.
- Explain the following (i) Specification Limits (ii) Natural Tolerance Limits (iii) Warning Limits (iv) Control Limits (v) ARL.
- Discuss OC-Curve, ASN, AOQ, AOQL and ATI in Acceptance Sampling for attributes.
- Explain Sequential sampling Plans for Process Parameter for the cases where (i) sigma known and (ii) sigma unknown.

SECTION C – K4 (CO3)

Answer any TWO of the following

(2 x 12.5 = 25)

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| 8 | (i) Obtain the control limits for (X-bar,R) and (X-bar, S) charts.
(ii) Discuss the role of Central Limit Theorem in variable control charts.
(iii) Explain the concept of Rational Subgroup.
(iv) Discuss Phase I and Phase II control charts. |
| 9 | The inner diameter measurement (quality characteristics) are given below.
Construct a CUSUM control chart based on the given data with Target=10, $\sigma=1$, Decision Interval=5 and interpret your results.
9.45,7.99,9.29,11.66,12.16,10.18,8.04,11.46,9.2,10.34,9.03,11.47,10.51,9.4,10.08,9.37,10.62,
10.31,8.52,10.84,10.9,9.33,12.29,11.5,10.6,11.08,10.38,11.62,11.31,10.52. |
| 10 | (i) Discuss Single Sampling Plan and Double Sampling Plan for attributes with an example.
(ii) Explain Sequential sampling plan with an example. |
| 11 | Discuss Single sampling plan and Double Sampling plan for Variables. |

SECTION D – K5 (CO4)

Answer any ONE of the following

(1 x 15 = 15)

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|----|--|
| 12 | Construct OC Curve for a Control Chart of Fraction Nonconforming with $n = 50$, $LCL = 0.0303$, and $UCL = 0.3697$ (3sigma control limits) and hence find ARL_0 and ARL_1 for process shifts. |
| 13 | (i) What is Total Quality Management (TQM)? (3 Marks)
(ii) Explain any 12 points from Deming's 14 Points for Total Quality Management. (12 Marks) |

SECTION E – K6 (CO5)

Answer any ONE of the following

(1 x 20 = 20)

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|----------|---|------|-------|-------|-------|-------|------|-------|------|------|---|----|----------|------|------|-------|-------|-------|-------|------|-------|------|------|
| 14 | Construct a EWMA control chart based on the data given below and interpret your results with $\text{Lambda}=0.1$, $L=2.7$, $\sigma=1$, Target=10
<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: left;">S.No</td> <td style="text-align: center;">1</td> <td style="text-align: center;">2</td> <td style="text-align: center;">3</td> <td style="text-align: center;">4</td> <td style="text-align: center;">5</td> <td style="text-align: center;">6</td> <td style="text-align: center;">7</td> <td style="text-align: center;">8</td> <td style="text-align: center;">9</td> <td style="text-align: center;">10</td> </tr> <tr> <td style="text-align: left;">Diameter</td> <td style="text-align: center;">9.45</td> <td style="text-align: center;">7.99</td> <td style="text-align: center;">10.29</td> <td style="text-align: center;">10.66</td> <td style="text-align: center;">12.16</td> <td style="text-align: center;">12.18</td> <td style="text-align: center;">9.04</td> <td style="text-align: center;">11.46</td> <td style="text-align: center;">11.3</td> <td style="text-align: center;">13.4</td> </tr> </table> | S.No | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | Diameter | 9.45 | 7.99 | 10.29 | 10.66 | 12.16 | 12.18 | 9.04 | 11.46 | 11.3 | 13.4 |
| S.No | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | | | | | | | | | | | |
| Diameter | 9.45 | 7.99 | 10.29 | 10.66 | 12.16 | 12.18 | 9.04 | 11.46 | 11.3 | 13.4 | | | | | | | | | | | | | |
| 15 | (i) Explain in detail the following process capability measures C_p , C_{pk} , C_{pm} . (12 Marks)
(ii) Process A: Mean=100 S.D=3
Process B: Mean=105 S.D=1
Specification limits are $LSL=90$, $USL=110$
Calculate C_p , C_{pk} , C_{pm} and interpret these ratios. (8 Marks)
Which process would you prefer? Justify. | | | | | | | | | | | | | | | | | | | | | | |

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