

Indian Statistical Institute, Bangalore
MS (QMS) First Year
Second Semester - Advanced Statistical Process Control

Midterm Exam
Maximum marks: 50

Date: February 20, 2023
Duration: 3 hours

1. [2 + 4 + 14 = 20]

a) State the conditions for implementation of DNOM control chart for short run production.

b) In a short run production, the machine produces similar parts with the dimension $8 \pm 0.5\text{mm}$; $17 \pm 0.6\text{mm}$ and $12 \pm 0.6\text{mm}$. If the process standard deviation of all parts are same; suggest how to compute control limit for the above dimensions?

c) In a short run production system, the machine producing parts with the nominal dimension $T_A = 80$, $T_B = 40$ and $T_C = 20$. The process standard deviations are not same. Check whether the process is under statistical control.

Sample No.	Part Name	Dimension	Sample No.	Part Name	Dimension	Sample No.	Part Name	Dimension
1	A	85	6	B	37	11	C	21
2	A	81	7	B	41	12	C	24
3	A	83	8	B	40	13	C	20
4	A	81	9	B	44	14	C	26
5	A	86	10	B	45	15	C	22

2. An injection moulding tool produces 4 parts at a time from each cavity. The parts are checked for defects. Suggest a suitable control chart and verify whether the process is under statistical control? [10]

Sample No.	Cavity 1	Cavity 2	Cavity 3	Cavity 4
1	4	7	4	6
2	3	4	1	5
3	6	8	0	4
4	2	2	2	3
5	1	5	3	8
6	0	3	0	2
7	5	2	2	1
8	2	1	1	0
9	3	0	0	2
10	1	7	2	6

3. Two quality characteristics follow Bivariate Normal Distribution. Let x_{ijk} be the i th observation on the i th quality characteristic in the k th subgroup. The mean vector and the variance covariance matrix is estimated by using 20 subgroups of 10 samples each;

$$\bar{\bar{x}} = \begin{bmatrix} 2.0 \\ 2.5 \end{bmatrix} \quad \bar{s} = \begin{bmatrix} 1.35 & 0.82 \\ 0.82 & 1.22 \end{bmatrix}$$

a) Construct Phase I and Phase II limit. [5 + 5 = 10]

b) Check whether the following sample mean vector are within control.

i) (2.0 2.7) ii) (1.9 2.3)

4.

[5 + 5 = 10]

a) Calculate the modified limit of \bar{X} chart for a process; where LSL = 10, USL = 30 and CPK of the process is 1.5. The process can tolerate 0.1% of non-conformity?

b) State the conditions under which SPC can be implemented in a process for the purpose of process control?