

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

Midterm Exam
Maximum marks: 40

Date: February 19, 2024
Duration: 2 hours

1. Suggest suitable process control method for the given process condition (with justification). [5 x 2 = 10]

- a) Producing natural rubber compound product.
- b) Quality of the product depends on operator skill.
- c) Machine parameter setting/condition is critical for quality.
- d) At a time 4 components are produced by the mould in an injection moulding process.
- e) The product quality depends on cutting tool condition.

2. A machine producing 3 components under similar setting. The data collected for the critical dimension is given below:- [8 + 2 = 10]

Sample No.	Part No.	Dimension	Sample No.	Part No.	Dimension	Sample No.	Part No.	Dimension
1	A	75	6	B	57	11	C	21
2	A	71	7	B	61	12	C	23
3	A	73	8	B	60	13	C	20
4	A	71	9	B	64	14	C	25
5	A	76	10	B	65	15	C	21

Assume the nominal dimension of the parts as $T_A = 70$, $T_B = 50$, $T_C = 20$ and the variances are not equal.

- a) Is the process under statistical control?
- b) What will be the control limit for future production?

3. A machine has 4 heads and 100% of the samples is checked for defects. Devise a suitable control chart method for the below data and state whether the process is in control. [10]

Subgroup no.	Head 1	Head 2	Head 3	Head 4
1	2	1	2	3
2	1	2	4	4
3	2	5	3	2
4	3	3	1	5
5	1	2	2	2
6	2	1	2	2
7	1	2	5	1
8	1	2	5	2
9	2	3	1	3

4. A product has two critical quality characteristics which has to be controlled jointly. The nominal values and the covariance matrix of these quality characteristics has been estimated from a subgroup of 25 with a sample size 10. [2 + 8 = 10]

$$\bar{x} = \begin{bmatrix} 4.2 \\ 3.5 \end{bmatrix}, S = \begin{bmatrix} 1.86 & 1.03 \\ 1.03 & 1.71 \end{bmatrix}$$

- a) Construct phase I limit. Data follows Bi-variant Normal.
b) Compare whether the following sample mean vector are under control.

i) (3.2, 2.7) ii) (4.9, 4) [Assume $\alpha = 0.05$]

5. Write short notes on [5 + 5 = 10]

- a) Explain where (in which process) and how to implement control chart for process control.
b) Defecting shift of mean for a highly capable process (Define a method).