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

Midterm Exam                                                Date: February 18, 2025
Maximum marks: 40                                           Duration: 2 hours


1. Explain the following in detail                                    [10 + 5 +5 = 20]

   a) Method of SPC implementation in a manufacturing process.

   b) Explain with examples the method of process control when the process is
      dominated by
      -   Initial setting
      -   Raw material
      -   Operator skill

   c) The tolerance of a continuous characteristic is 5 ± 0.1mm, with Cp= Cpk = 1.25.
      Establish the setup control limit for ensuring setting of process average,
      considering process variation is under control.

2. A product has 2 quality characterises, jointly follows Bivariate Normal distribution.
   The mean vector and covariance matrix is estimated by using 20 subgroup of size 10
   data from stable process as follows.  ($\propto$ = 0.05)                    [2 + 8 = 10]

$$\bar{\bar{x}} = \begin{bmatrix} 4.0 \\ 4.5 \end{bmatrix} \quad s = \begin{bmatrix} 1.3 & 1.1 \\ 1.1 & 1.4 \end{bmatrix}$$

   a) Calculate the Phase I limit.

   b) Check whether the following sample averages are under control?

      i)      [4.1, 4.7]              ii) [4.9, 5.2]

3. A printed circuit board is checked for 100% of the defects. The process of
   manufacturing remains same for different types of boards. The data of two board
   types are given below:                                                    [10]

| Part No. | No. of Defects | Part No. | No. of Defects |
|----------|----------------|----------|----------------|
| 1261 | 16 | 1055 | 16 |
| 1261 | 10 | 1055 | 15 |
| 1261 | 15 | 1055 | 10 |
| 1261 | 8  | 1055 | 12 |
| 1261 | 11 | 1055 | 11 |
| 1261 | 8  | 1055 | 8  |
| 1261 | 15 |      |    |

   Is the process under statistical control?

4. Define the method of setting up standardized control chart in a process; explain the
   method for                                                                [5]

   i) I, MR chart      ii) p-chart