

PART A



**Control Charts
for
Variables**

CONTROL CHARTS FOR VARIABLES

The first part of this lab course comprises Sessions 1 to 5 which will enable you to develop practical skills for constructing control charts for variables in MS Excel 2007. In Unit 1 of the course MSTE-001 (Industrial Statistics-I), you have learnt about the importance of control charts. You know that these are used in manufacturing processes to distinguish between the variation in a process resulting from chance causes and the variation resulting from assignable causes. These variations may arise due to low raw material quality, unskilled labour, machines, faulty equipment, etc. For example, when we purchase any product, we like to ensure that the product we buy is as per the specifications mentioned on it. The specifications may be in terms of length, diameter, thickness, strength, weight, etc., of the product:

- Weight of bottled juice and packet of chips,
- Wattage of bulbs, CFLs, etc.,
- Diameter and material of water pipes used in homes,
- Thickness of slabs or other metal parts used in construction,
- Diameter of fuse pins and ball bearing of fans,
- Length of aluminium foils, and so on.

Control charts help in detecting variations resulting from assignable causes. These can be eliminated and controlled through various ways. There are two types of control charts: (i) control charts for variables and (ii) control charts for attributes (see Fig. A.1).

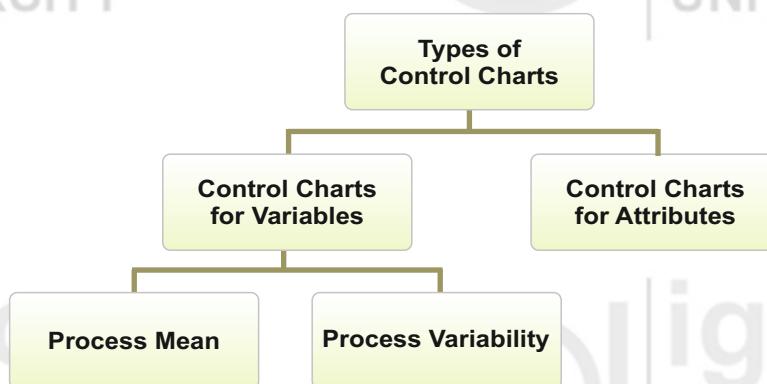


Fig. A.1

You have learnt in Unit 2 of MSTE-001 that the term “**variable**” means the quality characteristic which can be measured numerically, e.g., diameter of water pipes, length of aluminium foils, weight of cricket balls, etc. You know that the control charts based on numerical measurements of quality characteristics are called **control charts for variables**.

When we deal with a numerically measurable quality characteristic, it is necessary to control the central tendency as well as the dispersion (variability) of the quality characteristic for the process. For central tendency, we usually apply mean and for variability, we calculate range or standard deviation.

Therefore, there are different control charts for variables for controlling the mean and variability of the process. The following control charts for variables are used most frequently:

1. Control chart for process mean (\bar{X} -chart, read as X-bar chart)
2. Control chart for process variability (R-chart and S-chart)

To control the mean quality level or process average, we generally use the control chart for mean, i.e., \bar{X} -chart and to control the variability of the process, we use either control chart for range, i.e., R-chart or control chart for standard deviation, i.e., S-chart. You will learn how to construct each of these charts in Lab Sessions 1 to 5.

In Session 1, you will learn how to prepare the control chart for mean used to control variation in the average values of the quality characteristic when **process variability is known**. Sessions 2 and 3 deal with construction of control chart for mean when **process variability is unknown**. We shall consider the sample range or sample standard deviation, respectively, as estimators of process standard deviation (σ) to demonstrate control chart for mean using a specific problem.

In Session 4, we demonstrate the construction of R-chart to monitor the variation in the process variability using **sample range**. In Session 5, you will learn how to construct the S-chart to control the process variation using **sample standard deviation**.

All sessions of this part have been designed in such a way that after successfully completing them, you will be able to construct different variable control charts using MS Excel 2007 and interpret them. You will also be able to decide which control chart to use for any given data.