CONTROL CHART FOR VARIABLES

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Control chart for variables

The variable control charts may be applied to any measurable quality characteristic. In order to control a measurable characteristic, we have to exercise control on the measure of location ($\bar{x}$ chart) as well as measure of dispersion (range/ R chart) which are described below:

$\bar{x}$ and R charts:

No production process is perfect enough to produce all the items exactly alike. Some amount of variation in the produced items is inherent in any production skill. The control limits in the $\bar{x}$ and R charts are so placed that they reveal the presence or absence of assignable causes of variation in the

- Average - mostly relating to machine setting and
- Range - mostly related to negligence on the part of operator.

Calculation of $\bar{x}$ and R Charts

Let X_{ij} , $j=1, 2, \ldots, n$ be the measurement of the i^{th} sample ($i=1, 2, \ldots, k$). The means $\bar{X}_i$, range R_i and s.d. S_i for the i^{th} sample are given by,

$$\bar{X}_i = \frac{1}{n}\sum_{j=1}^{n} X_{ij}$$

$$R_i = {}^{max}{}_{j} X_{ij} - {}^{min}{}_{j} X_{ij}$$

$$S_i^2 = \frac{1}{n}\sum_{j=1}^{n}\left(X_{ij} - \bar{X}_i\right)^2$$

Next we have to find $\bar{x}, \bar{R}, \bar{S}$, the averages of sample mean, sample range and sample s.d. as follows:

$$\bar{\bar{X}} = \frac{1}{k}\sum_{i=1}^{k}\bar{X}_i$$

$$\bar{R} = \frac{1}{k}\sum_{i=1}^{k}R_i$$

$$\bar{S} = \frac{1}{k}\sum_{i=1}^{k}S_i$$

Standard error of the sample mean $\frac{\sigma}{\sqrt{n}}$ is , where *n* is the sample size, i.e.,

$$S.E.(\bar{X}_i) = \frac{\sigma}{\sqrt{n}}, \quad i = 1, 2, \ldots, n$$

From sampling distribution of range, we know that

$$E(R) = d_2.\sigma$$

where, d_2 is a constant depending on the sample size. Thus an estimate of σ can be obtained from $\bar{R}$ by the relation

$$\bar{R} = d_2 . \sigma$$

or,
$$\sigma = \frac{\bar{R}}{d_2}$$

$\bar{X}$ gives an unbiased estimate of population mean μ, since

$$E(\bar{X}) = \frac{1}{k}\sum_{i=1}^{k} E(X_i) = \mu$$