STATISTICAL QUALITY CONTROL

- **Chance Causes**

Some “stable pattern of variation” or “a constant cause system” is inherent in any particular scheme of production and inspection. This pattern results from many minor causes that behave in random manner. The variation due to these causes is beyond the control of human hand and can not be prevented or eliminated under any circumstances. One has got to allow for variation within this stable pattern, usually termed as allowable variation. The range of such variation is known as natural tolerance of the process.

- **Assignable Causes**

The 2nd type of variation attributed to any production process is due to non random or the so called assignable causes and is termed as preventable variation. The assignable causes may creep in any stage of the process, right from the arrival of the raw material to the final delivery of goods. Some of the important factors of assignable causes of variation are defective raw material, negligence of operators, improper handling of machines, faulty equipment, unskilled staff and so on. These causes can be identified and eliminated and are to be discovered in a production process before it goes wrong, i.e. before the production process becomes defective.

- **Rational subgroups**

In SQC rational subgroup has a greater role due to its applicability specially in product control and process control. In general sense, subgroup is a collection of items from continuous flow of production from certain population. Here the subgroups are rational in the sense that they are so called that the variation in quality characteristics within the subgroup may be attributed entirely due to chance causes while systematic variation if at all exits can occur only from one subgroup to another. In statistical language the products within a subgroup may be supposed to belong to a single homogeneous population and difference in any among the population corresponding to the different subgroups will indicate the presence of systematic variation.

The most obvious basis for the selection of subgroups is the order of production. The rational subgroups must be constructed in such a fashion that the included items are more or less homogeneous in nature w.r.t. Time, machine etc. for example, items produced in one busy hour are to be placed in one subgroup and items produced in the remaining hours are to be placed in another subgroup and so on. However, there may be assignable causes that are not revealed merely by taking subgroup in order of production, e.g., two or more machines in a factory may have different subgroups for different machines or different operators or for different shifts.

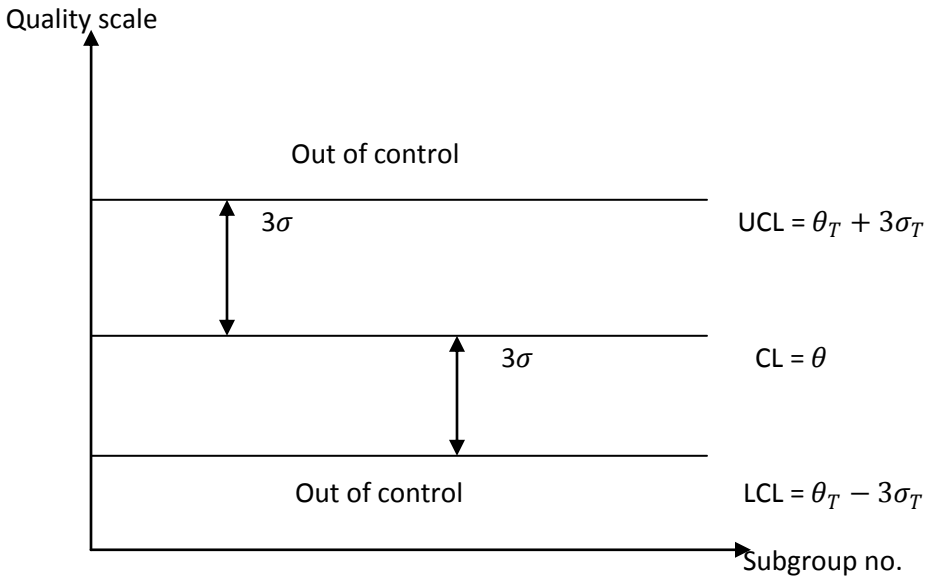
Process Control & Control Charts (Shewhart's control chart technique)

The main objective in any production process is to control and maintain the quality of the manufactured product so that it confirms to specified quality standards. In other words, we want to ensure that the proportion of defective items in the manufactured products not to large. This is called process control and is achieved through the technique of control charts pioneered by a physicist Dr. Walter A. Shewhart. Based on the theory of probability and sampling, Shewhart control chart provides a powerful tool of discovery and correcting the assignable causes of variation. These enable us to stabilize our control the process at desire performance and thus bring the process under statistical control. It is generally represented graphically for better understanding. A control chats consists three horizontal lines-----

1) Central line (CL)

2) Upper Control Limit (UCL)

3) Lower Control Limit (LCL)



In control chart technique, probabilistic consideration is the main thing besides others. We know that he process will be under control if the distribution of the quality characteristic under consideration (i.e., the distribution of X, the item quality measure) be identical for different samples. Here we shall focus our attention on some parameter of the distribution of quality characteristic sayθ. Let T be the corresponding statistic (termed as subgroup quality measure). If the process is under control, then θ must be same from subgroup to subgroup and consequently the fluctuation in the value of T from sample to sample should be due to random variation alone. We assume that

E (T) = θ_T and Var(T) = σ_T^2.

We may take any value of T lying outside the limit of $\theta_T - 3\sigma_T$ & $\theta_T + 3\sigma_T$ is an indication of the presence of preventable variation, i.e., we take

UCL = E(T) + 3 ×SE(T) = $\theta_T + 3\sigma_T$

CL = E(T) = θ_T

LCL = E(T) - 3 ×SE(T) = $\theta_T - 3\sigma_T$

The reason behind this argument lies in the fact that if T is normally distributed, then

P $[\theta_T - 3\sigma_T < T < \theta_T + 3\sigma_T] = 0.9973$

If T is not normally distributed then also by Chebyshev's inequality,

P $[\theta_T - 3\sigma_T < T < \theta_T + 3\sigma_T] > \frac{8}{9}$ =0.8889 i.e., if the process is in control, then T∈ $[\theta_T - 3\sigma_T, \theta_T + 3\sigma_T]$ with high probability.

If the observed T_i, i th subgroup quality measure lies between the limits of $\theta_T - 3\sigma_T$ & $\theta_T + 3\sigma_T$, it is taken to be a fairly good indication of the no existence of the assignable causes of the variation at the time when ith sample is drawn. If the observed T_i lies outside the limit one suspect the existence of the assignable causes of the variation and the process is supposed to be out of control. In this case, the obvious action is to stop the process and haunt for and remove the assignable causes.

Advantage

1) These limits are easily obtained.
2) Tables are available.
3) Two limits are symmetrically placed about the CL.

- Even though all the points are inside the control limits indication of trouble or presence of assignable causes and variation of the process are sometimes evident from unusual pattern or arrangements of points
    1) A series of points all falling close to one of the control limits.
    2) A long series predominantly on one side of the central line.
    3) A series of points exhibiting the trend.