Shewhart control chart

Improvement takes place over time. Determining if improvement has really happened and if it is lasting requires observing patterns over time.

Control charts, also known as Shewhart charts (after Walter A. Shewhart) are tools used to determine if a process is in a state of statistical control.

Using control charts has a variety of benefits. We can:

- learn how much variation exists in a process.
- assess stability and determine improvement strategy (common or special cause strategy).
- monitor performance and correct as needed.
- find and evaluate causes of variation.
- tell if our changes yielded improvements.
- see if improvements are “sticking”.

Elements:

A control chart consists of:

a. Points representing a statistic (e.g., a mean, range, proportion) of measurements of a quality characteristic in samples taken from the process at different times (i.e., the data).

b. The mean of this statistic using all the samples is calculated (e.g., the mean of the means, mean of the ranges, mean of the proportions).

c. A centre line is drawn at the value of the mean of the statistic.

d. Upper and lower control limits (sometimes called "natural process limits") that indicate the threshold at which the process output is considered statistically 'unlikely' .

e. Annotation with events of interest

Directions:

There are many different types of control charts, and you are encouraged to seek training/advice to create the right chart.

a. With less than 12 data points, a run chart should be used instead.

b. Trial limits can be established with 12 or more data points, and frozen and extended until 20-30 points are reached.

c. Trial limits can be revised to initial limits when 20-30 points are available.

d. Limits can be frozen and extend into the future to enable earlier detection of special cause.

Adapted from material sourced from the Institute for Healthcare Improvement

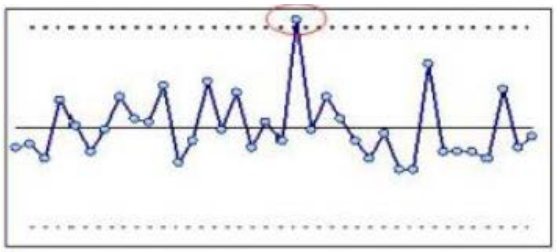
Limits are revised as follows:

- **a.** Trial limits should be revised once there are 20-30 data points.
- **b.** Limits may be recalculated with the exclusion of special cause points to establish the stability without these causes.
- **c.** If improvement has resulted in special cause representing a new system – 12 points, or 20 points in an I chart.
- **d.** Instability: where there are over 20 or more points and you cannot identify/remove special cause.

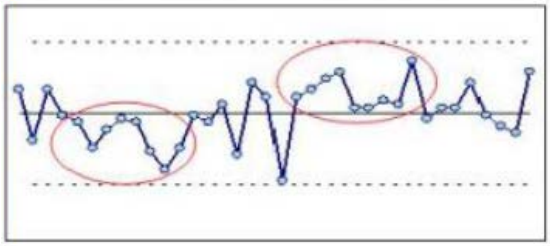
Analysis:

There are 5 Shewhart chart rules for identifying special cause:

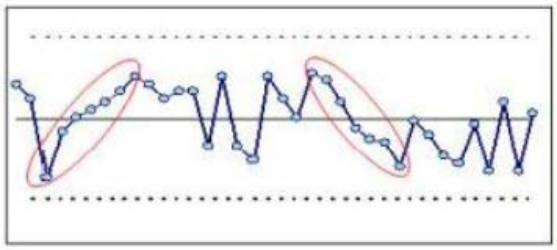
A single point outside the control limits



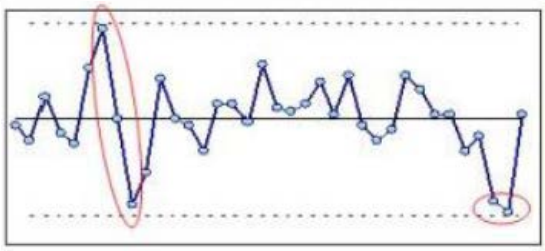
8 or more consecutive points above or below the centre line



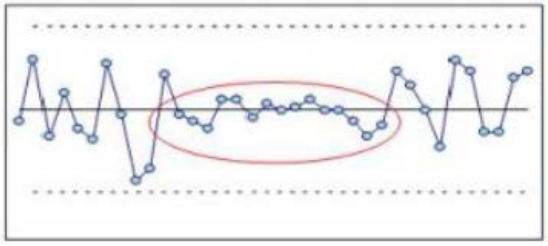
6 consecutive points increasing (trend up) or decreasing (trend down)



2 out of 3 consecutive points near a control limit (outer one-third)



15 consecutive points close to the centre line (inner one-third)



Common causes of variation:

- are inherent in system over time, affect everyone working in system, affect all outcomes of system.
- are “chance” causes.
- A process with only common cause is stable, or “in statistical control”.

Special causes:

- are not part of the system all the time, or do not affect everyone.
- arise because of specific circumstances.
- are “assignable” causes.
- A process with special cause is unstable, not in statistical control.

Improvement approach:

The improvement approach differs depending on whether you have found common or special cause in the system.

For common cause, the process is performing as well as possible, and requires process redesign to improve. The improvement approach will involve identifying aspects to change, testing and implementing these through Plan-Do-Study-Act (PDSA) cycles.

Special cause means that something that is not part of the process design is affecting the process. The improvement approach is to identify when the special cause occurred and why (frontline staff are the experts here), learn, and take action.

Where the special cause is undesirable, we should remove it and make it difficult to recur. Where the special cause is desirable, we should try and make it a permanent part of the process.