Shewhart control chart

Variation exists in every process. This can be common cause or special cause variation. Control charts are tools used to decide if a process is in a state of statistical control (common cause variation) or not (special cause variation).

Control charts can help us:

- See how much variation lies in a process.
- Decide what improvement approach to use.
- See process performance
- Find and test sources of variation.
- See effects of improvement.

Elements:

A control chart consists:

a. Points representing a statistic (e.g., a mean, range, ratio) of measures of a quality attribute in samples drawn from the process at different times (i.e., the data). Each point is a statistic (e.g., mean) of a subgroup. It is easier if subgroups are the same size.
b. The mean of this statistic using all the samples (e.g., the mean of the means, mean of the ranges, mean of the ratios). Other measures of centrality exist, but the mean is the most common.
c. Draw a centre line showing the mean.

d. Upper and lower control limits (sometimes called “natural process limits”) that show the threshold at which the process output is statistically 'unlikely'. Software can help in working this out. However, these limits are tend to be around three Standard deviations from the mean.
e. Annotation with things of interest

Requirements:

a. With less than 12 data points, use a run chart instead.
b. Set up trial limits with 12 or more data points. Freeze or extend this until you get 20-30 points.
c. Trial limits can change to initial limits when 20-30 points are available.

Revise trial limits:

a. Once you have 20-30 data points.
b. For the omission of special cause data to show the stability without these causes.

Steps:

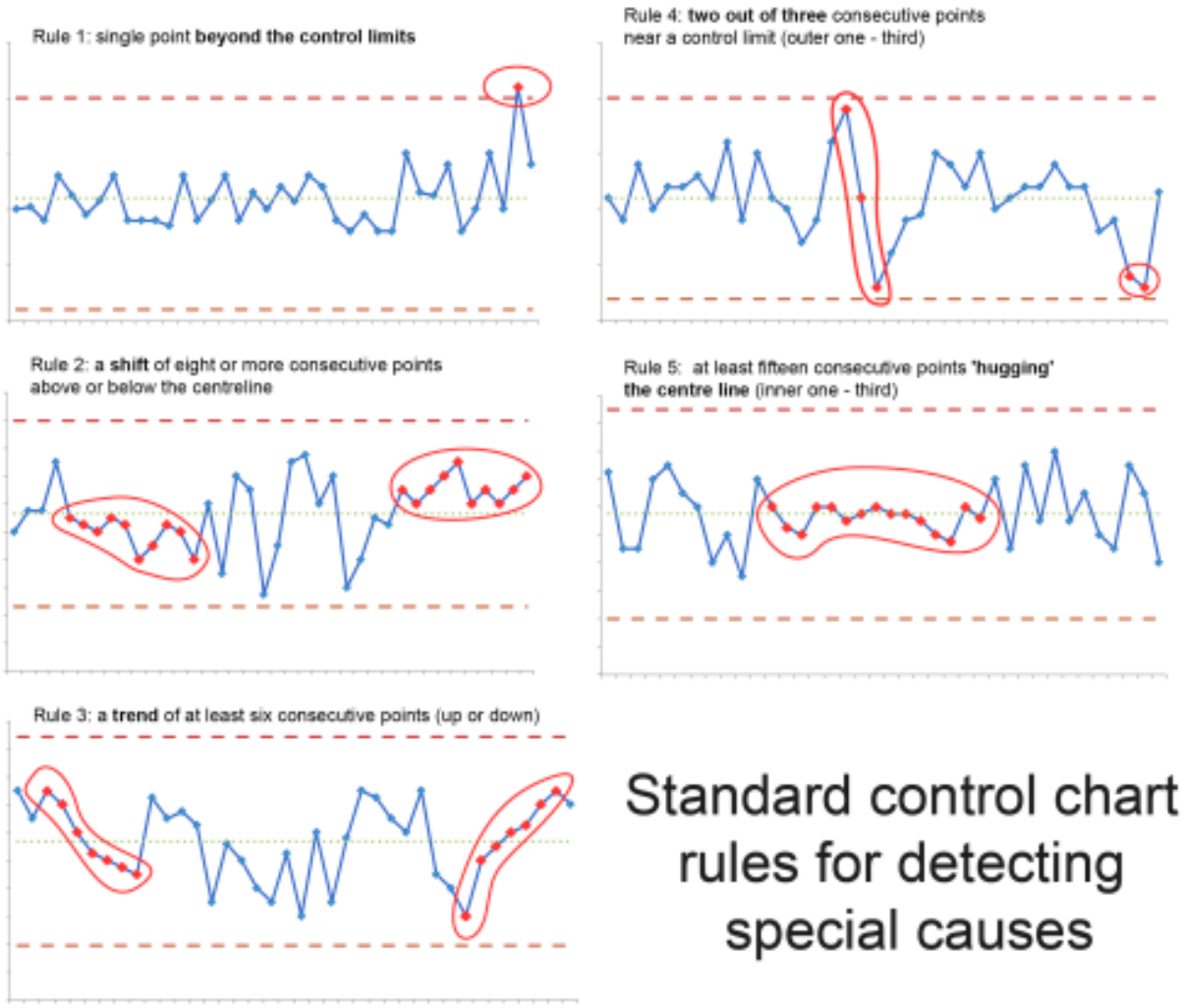
1. Choose the right control chart for your data.
2. Determine the proper period for collecting and plotting data.
3. Collect data, make your chart and analyse the data.
4. Look for “out-of-control signals” on the control chart. When this occurs, investigate the cause.

Analysis:

There are five Shewhart chart rules for finding special cause:

a. A single point outside the control limits
b. 8 or more successive points above or below the centre line
c. 6 consecutive points increasing (trend up) or decreasing (trend down)

d. 2 out of 3 consecutive points near a control limit (outer one-third)
e. 15 consecutive points close to the centre line (inner one-third)



Common causes of variation:

a. Are inherent in systems over time, affect everyone and all outcomes.
b. Are “chance” causes.

A process with only common cause is stable, or “in statistical control”.

Special causes:

a. Are not part of the system all the time, or do not affect everyone.
b. Arise because of specific cases.
c. Are “assignable” causes.

A process with special cause is unstable.

Improvement approach:

The improvement approach varies depending on whether you have found common or special cause variations. For common cause, the process is performing as well as possible (may not be very well), and requires process redesign to improve. The appropriate improvement approach here the Plan-Do-Study-Act (PDSA).

Special cause means that something that is not part of the process design is affecting the process. The improvement approach is to find when the special cause occurred and why (front-line staff are the experts here), learn, and act. Where the special cause is undesirable, we should get rid of it and prevent recurrence. Where the special cause is desirable, we should try to make it a permanent part of the process.

Bibliography

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