
Welcome to this session on Variation and Statistical Process Control (SPC), part of the Silver measurement module with GSQIA.

You are encouraged to watch the Run Chart session before this one.

NHS
Gloucestershire Hospitals
NHS Foundation Trust

## Session Contents

Variation – common cause and special cause

Statistical Process Control Charts
- What are they?
- What do they do?
- How are they helpful?

SPC Rules

SPC Templates



During this session we will look at the different types of variation that can be present within any systems or processes and understand what response should be undertaken.

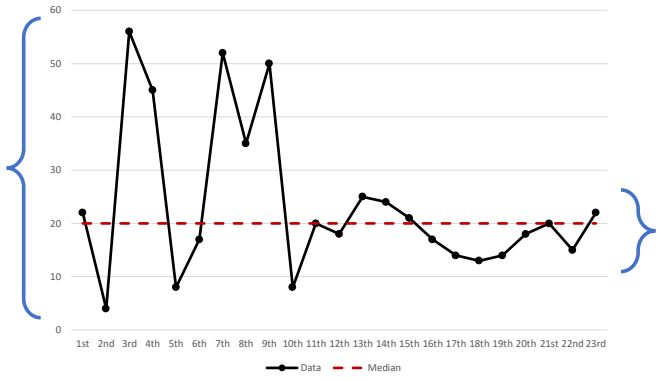
We will look in detail at SPC charts to be able to understand what an SPC chart is, what they do and why they can be helpful.

We will look at the SPC chart rules that can be applied in the same way as a run chart, to understand whether a pattern of data is likely to have resulted from the QI project itself or whether it is likely to have just happened by chance,

And finally, creation of an SPC is done using a template. Various templates exist online that can be used, the GSQIA website provides two versions on their resources page.

# Understanding Variation

Variation can be **Large** or **Small** or a mixture of the two



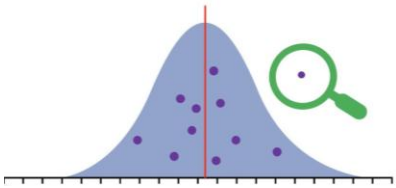



Variation is present in all systems and processes. Nothing will ever occur in exactly the same way every single time. Variation can be large or small, or a mixture of the two and will depend on all the different internal and external factors that impact the system

## Understanding Variation

Natural Variation - inherent to the system. If only natural variation is present it is known as being 'in control' or 'stable', it is predictable and consistent over time. Not necessarily working well!

Special Cause Variation – Not normal to the process and due to specific, identifiable factors. It is unpredictable and indicates that something unusual has occurred.
Could be good or bad…

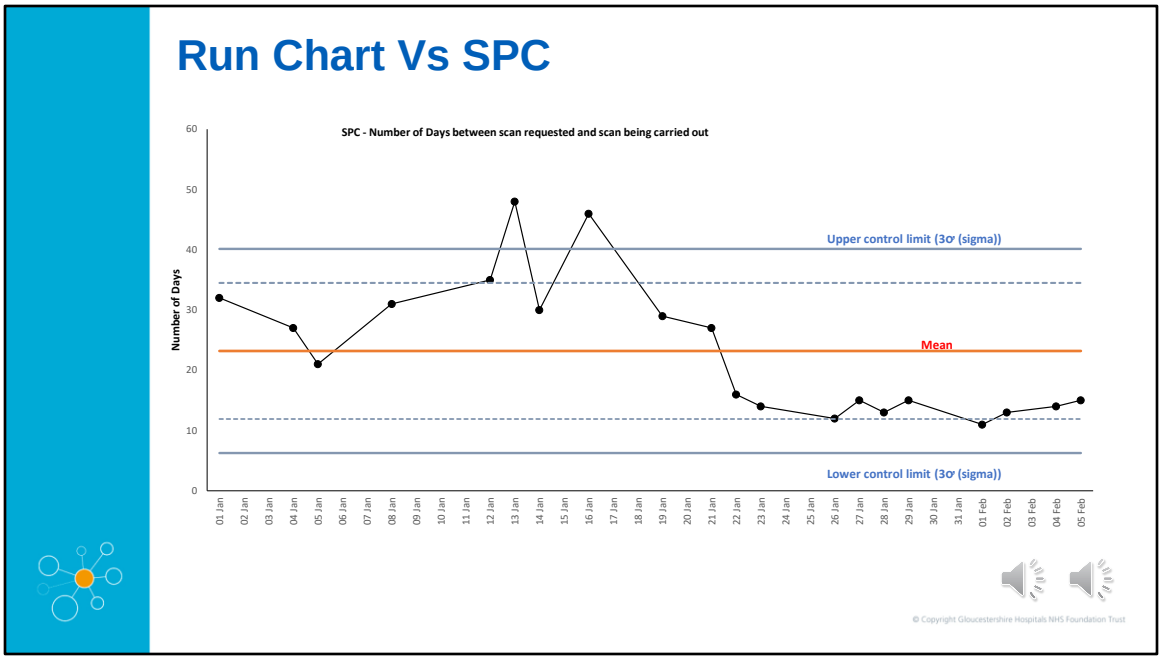




Common cause variation (also known as natural variation) is a type variation that is inherent to the system. It is always present and affects everyone and all outcomes. It is known as being a stable system or 'in control' as this variation is predictable and within established limits. Although a system with natural variation is considered stable, this doesn't necessarily mean that the system is working well.

In contrast special cause variation isn't inherent to the system, it doesn't necessarily affect everyone in the same way and is something that occurs due to a special circumstance. A system which show special cause variation is said to be unstable or out of control, it is unpredictable. Special cause variation can be good or bad and could be the result of a change that has been tested during a QI project.

Ideally the first step of a QI project should be to stabilise any special cause variation that is found within baseline data. This is done by completing an analysis of why that particular special cause occurred and if the outcome of the special cause was bad, put things in place to stop it from happening again. With stable baseline data you will be better able to attribute any changes in data to the changes that are being tested with PDSA cycles.



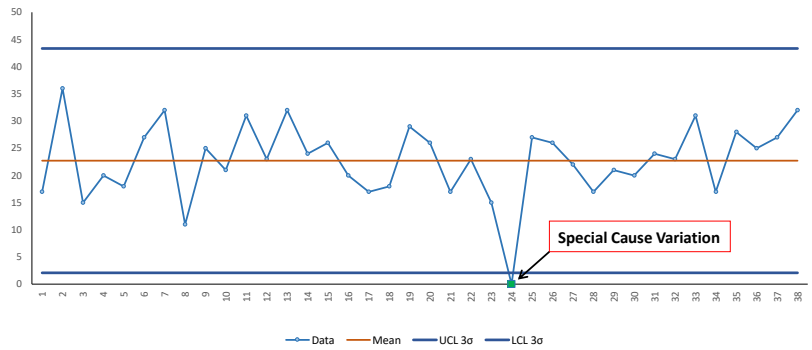

An SPC chart plots data in a similar way to a Run Chart, with a couple of notable exceptions.

Data is still plotted in a consecutive time ordered way, always from an earlier point in time to a later point in time. However, instead of using a median line an SPC *CLICK* has a mean line (the average of the data set) and provides additional lines known as upper and lower control limits, you may also see them referred to as sigma limits. These lines are calculated from the mean of the data set and the calculation is based on the lines being 3 standard deviations away from the mean, but while also taking into account the moving average of the data set.

Although the additional lines add to the complexity of the graph, plotting of the data itself remains the same, and the additional lines provide valuable information on the variation within the data set (which is between the upper and lower control limit), and also gives a better foundation for the rules that can be applied to SPCs to further analyse the data.

# Tests for Special Cause Variation

1. A single point outside the upper or lower control limits



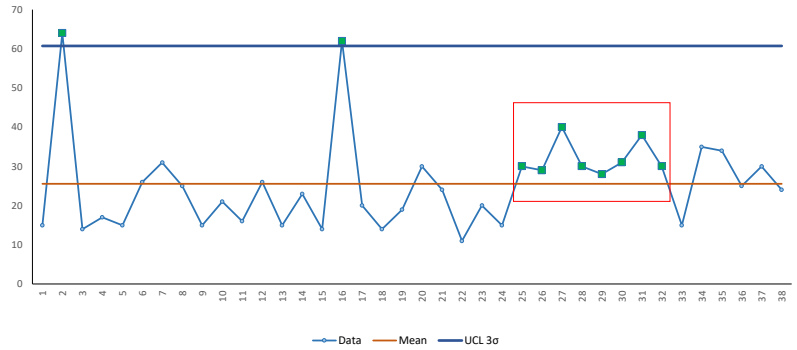



If none of the following tests for special cause variation can be seen within your data then it is a stable system with natural variation.

The first rule is the appearance of any point outside the upper or lower control limit. The likelihood of a point falling outside the control limits is 0.3%.

## Shift

2. 7 or more consecutive values on the same side of (above or below) the mean





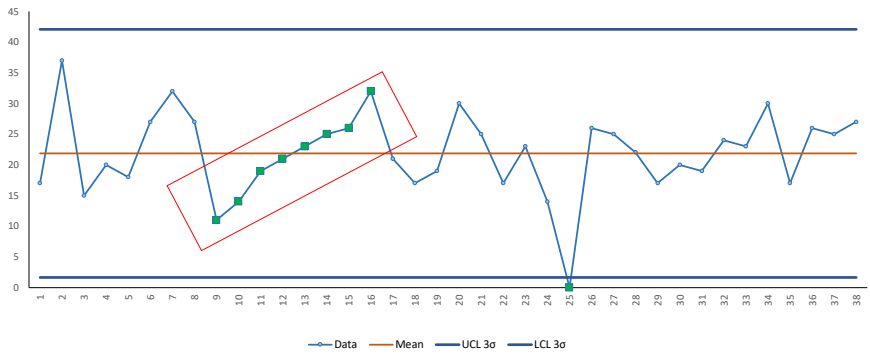

The second rule is called a Shift, and is similar to that of a run chart, however there is a difference in the number of consecutive data points required for the rule to apply.

You may find that other information sources which attribute a different number of consecutive values for each of the rules. This difference depends on the strength of the probability of the pattern occurring by chance. The GSQIA Way consistently applies the following number of points to the rules for SPC charts.

If there are 7 or more consecutive points on the same side of the mean line then a Shift has occurred.

# Trend

3. 7 or more consecutive points increasing or decreasing.

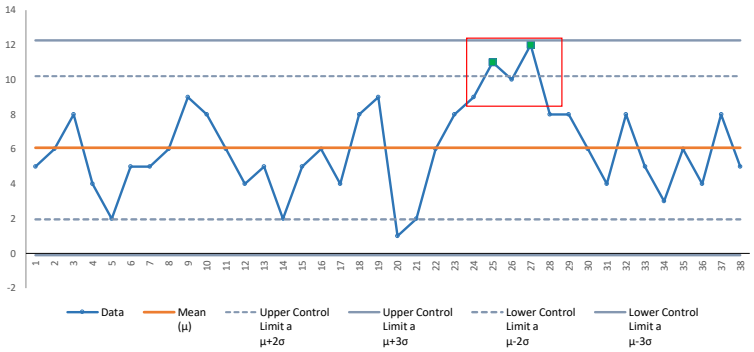





7 or more consecutive points that are all increasing, or all decreasing shows a Trend in the data.

## Two out of Three Rule

4. Two out of three consecutive points fall near (outer 3rd) a control limit

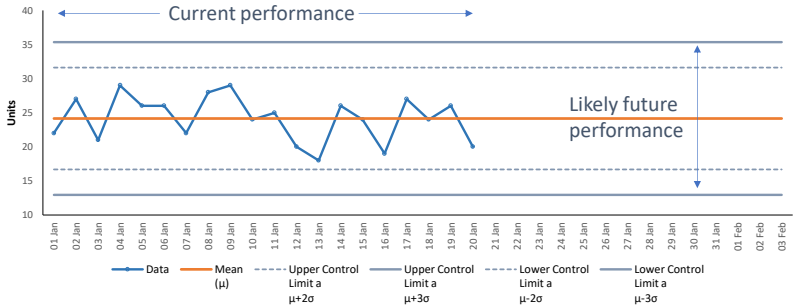





Finally, where two out of three (or three out of three) consecutive points all fall on the outer third this is the equivalent of seeing one data point outside the control limits. It is a very unusual occurrence.

# Run chart vs SPC

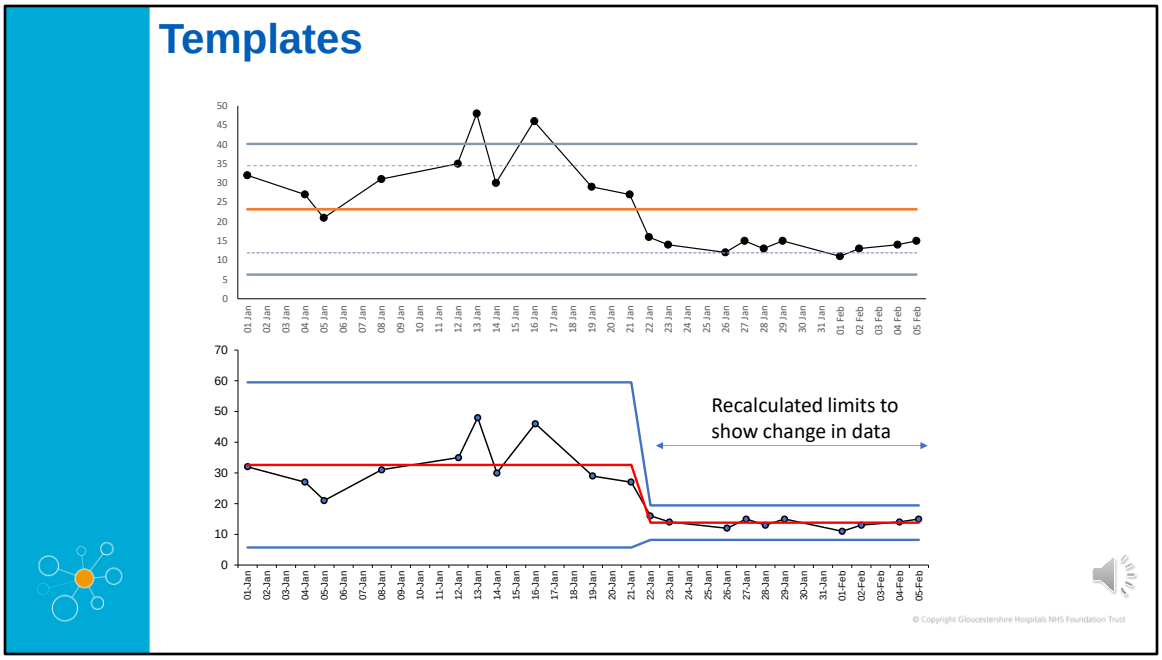
- 20+ data points ➡ SPC
  - Better distinction between types of variation
  - In a stable system and SPC can predict where future event will fall






While a run chart is helpful at the start of a project because you can start building a run chart with just one data point, if you have 20 or more it is worthwhile moving the data over to an SPC.

This is because if provides a better distinction between special and common cause variation, and with a stable system you are able to predict with some degree of certainty where future events will fall, due the presence of the upper and lower control limits




Two different SPC templates are available on the GSQIA resources webpage.

The first is a template which creates upper and lower control limits for the whole data set. The second allows a recalculation of the upper and lower control limits when a change has resulted in a new performance level or reduction in variation.

- Your facilitator / Gold coach and GSQIA are here to support – please get in touch ghn-tr.gsqia@nhs.net
- Additional resources that are available around data and measurement:
  - Step by step creation of a run chart in Excel
  - Run charts
  - Data and Data Collection
  - Measures – outcome, process and balancing