Understanding Statistical Process Control (SPC) Charts
Introduction

This guide is intended to provide an introduction to Statistic Process Control (SPC) charts. It can be used with the ‘AQuA SPC tool’ to produce, understand and interpret your own data. For guidance on using the tool see the ‘How to use the AQuA SPC Tool’ document.

This introduction to SPC will cover:

• Why SPC charts are useful
• Understanding variation
• The different types of SPC charts and when to use them
• How to interpret SPC charts and what action should be subsequently taken
Why SPC charts are useful

When used to visualise data, SPC techniques can be used to understand variation in a process and highlight areas that would benefit from further investigation.

SPC techniques indicate areas of the process that could merit further investigation. However, it does not indicate that the process is right or wrong.

SPC can help:
- Recognise variation
- Evaluate and improve the underlying process
- Prove/disprove assumptions and (mis)conceptions
- Help drive improvement
- Use data to make predictions and help planning
- Reduce data overload
Understanding variation

In any process or system you will see variation (for example differences in output, outcome or quality)

Variation in a process can occur from many difference sources, such as:

- People - every person is different
- Materials - each piece of material/item/tool is unique
- Methods – doing things differently
- Measurement - samples from certain areas etc can bias results
- Environment - the effect of seasonality on admissions

There are two types of variation that we are interested in when interpreting SPC charts - ‘common cause’ and ‘special cause’ variation.
**Common cause**

If the process is stable and predicable any variation is known as ‘common cause variation’. A process is ‘in control’ if it only displays common cause variation.

**Special cause**

If the process is unstable or ‘out of control’ any variation is known as ‘special cause variation’. This means that it is not an inherent part of the process. Special cause variation highlights that something unusual has occurred within the process and is attributable to factors that were not within the original process design.
The different types of SPC charts and when to use them

Statistical Process Control (SPC) charts are simple graphical tools that enable process performance monitoring. They are used to identify which type of variation exists within the process. They highlight areas that may require further investigation.

Two of the most popular SPC tools are the run chart and the control chart. Both can be produced with the ‘AQuA SPC tool’ to analyse data that is observed over a period of time. These are called ‘dynamic processes’. Charts showing this type of data are often referred to as a ‘time-series’ or a ‘longitudinal’ SPC chart.

A process that is not observed over a period of time is called a ‘static processes’ A Funnel chart is commonly used in these cases. These charts are useful for understanding variation for a process at multiple organisations, such as hospitals or GP practices. This can be done using the ‘AQuA Funnel Chart Tool’.
The run chart

This shows data collected over a period of time. The time series plotted on the horizontal or x axis. The centreline of a run chart consists of the median (the middle value when all values are ranged in ascending order).
Control chart

A control chart is similar to a run chart but with the addition of control limits (an Upper Control Limit (UCL) and a Lower Control Limit (LCL)). The centreline is calculated by the mean.

This chart enables the monitoring of the process level and identification of the type of variation in the process over time with additional rules associated with the control limits.

To produce a control chart you need an absolute minimum of 10 data points to create a valid chart, however there is increased reliability when using 20 or more data points. If one of the initial data points is out of process limits you may like to consider excluding that point from the calculations.

Ideally, control limits will remain fixed unless you have made a process improvement – i.e. you made a fundamental change to the process and it improved the process (this would be evident through ‘special cause’ variation). Following this, you may wish to recalculate the control limits.
Interpreting charts to identify special cause variation

If you can see any of the following it means that there is special cause variation. The first four rules can be applied to both run charts and control charts:

1. **Shift** - seven or more successive data points falling on the same side of the centreline
2. **Trend** - seven or more successive data points heading in the same direction (either increasing or decreasing)
3. **Zig-Zag** - fourteen or more successive data points decrease and increase alternatively (creating a zig-zag pattern)
4. **Cyclical Pattern** - a regular pattern occurring over time – for example a seasonality effect

There are additional rules for control charts:

6. **Control limits** - one or more data points fall outside the control limits
7. **Middle third** - the number of points within the middle third of the region between the control limits differs markedly from two-thirds of the total number of points

The following pages illustrate these rules.
Identifying special cause variation - shift

This rule applies to run charts and control charts.
Identifying special cause variation - trend

This rule applies to run charts and control charts.
Identifying special cause variation - zig zag

This rule applies to run charts and control charts

14 or more decreasing and increasing alternately
Identifying special cause variation - cyclical pattern

This rule applies to run charts and control charts
Identifying special cause variation - control Limits

This rule applies to control charts
Identifying special cause variation - middle thirds

This rule applies to control charts.

Considerably less than 2/3 of all the points fall in this zone.

Considerably more than 2/3 of all the points fall in this zone.

Centreline

LCL

UCL
Appropriate action

All process have variation. How you deal with this variation will depend on your findings. Here are some general rules:

1. If the system is under control (no special-cause variation) and operating at an appropriate level, no action is necessary. However, you may still seek to further improve performance.
2. If the system is operating at an appropriate level but there is special-cause variation, then investigating the cause may be appropriate.
3. If the system is under control but operating at an inappropriate level (for example, targets not met or performance is poor when compared to peers), it may be necessary to change the system.
4. In some situations, a system may be neither in-control nor operating at an appropriate level, in which case tackling special-cause variation before altering the process may be necessary.
References


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http://www.isdscotland.org/Health-Topics/Quality-Improvement/Statistical-Process-Control/

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