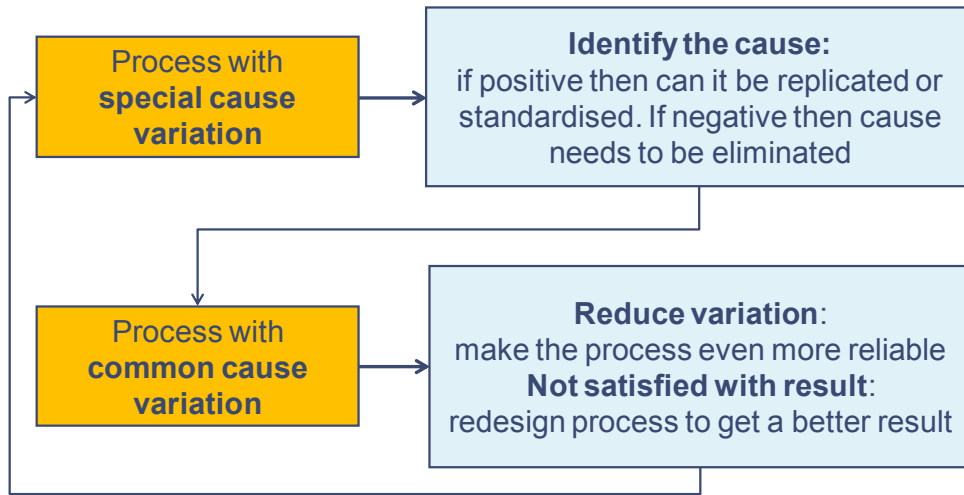
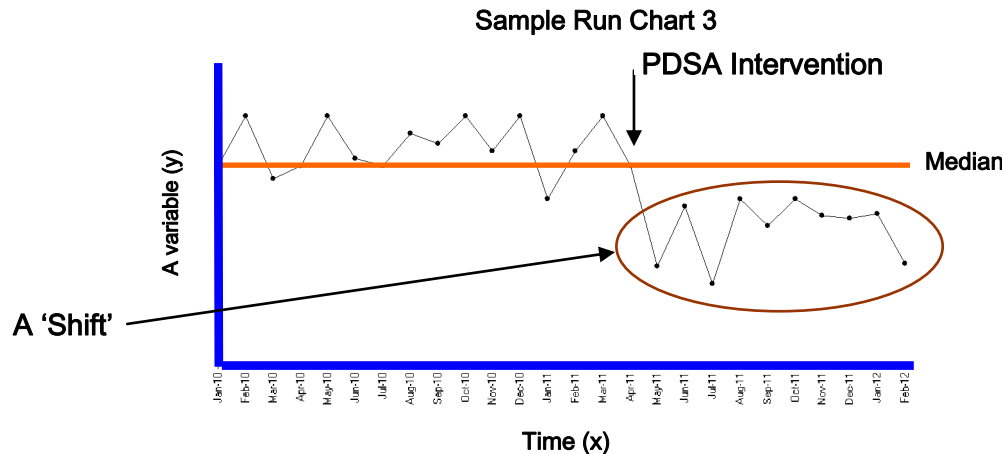


Application - Responding to Variation

The diagram below describes the appropriate action to take when interpreting your run chart following the application of the 3 tests.



Run charts are also useful in understanding if improvement work is having a statistically significant impact on the measure you are trying to improve. The example below shows how a test of change can trigger a special cause signal on a run chart showing the change has been effective. In this case the special cause signal is a shift.



Resources Further information about using Run Charts —

- Harrison (2012) Using Run Charts for Healthcare Improvement (MCA Website)
- Nelson, Batalden, Godfrey (2007) Quality by Design Chapter 22.
- Carey (2003) - Improving Healthcare with Control Charts



Run Charts

'A one page book'

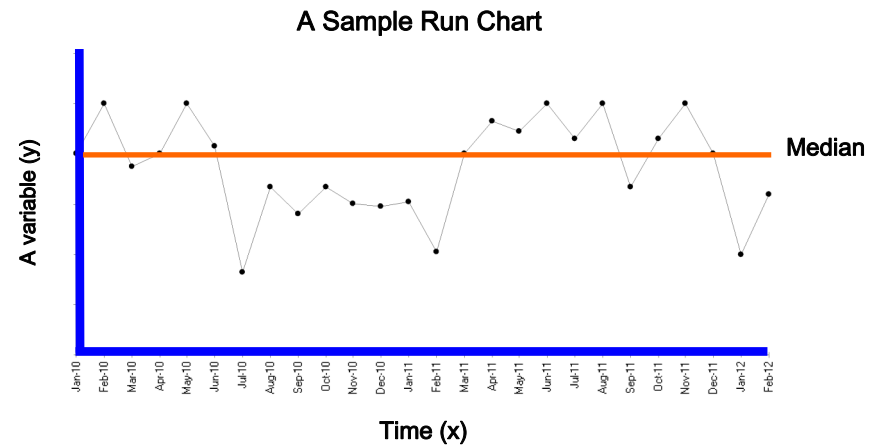
'All improvement involves change, not all changes are improvements'

Batalden & Davidoff Qual Saf Health Care. (2007)

You need to measure to differentiate.

The focus of this one page book is measurement, specific to PDSA (Plan Do Study Act) cycles to determine whether the changes you are testing are really improvements. It covers the use of simple measurement to determine whether you have reached your specific aim and determine if the change you implement trigger a 'special cause signal'.

The anatomy of a Run Chart



Run charts are very simple to construct and interpret. A run chart shows data points in time order. It also shows the 'median' value of the data set plotted as a centre line.

Variation

To interpret run charts we need to distinguish between two types of variation—

Common Cause variation

Variation caused by chance causes, by random variation in the system, resulting from many small factors
Example: Variation in work commute due to traffic lights, pedestrian traffic, parking issues

Special Cause variation

Variation caused by special circumstances or assignable cause not inherent to the system
Example: Variation in work commute impacted by flat tyre, road closure, heavy frost/ice

Neither type is good or bad. However if you want to change a process a special cause signal can indicate that the change work has been effective. A process may exhibit common cause variation but be totally unacceptable.

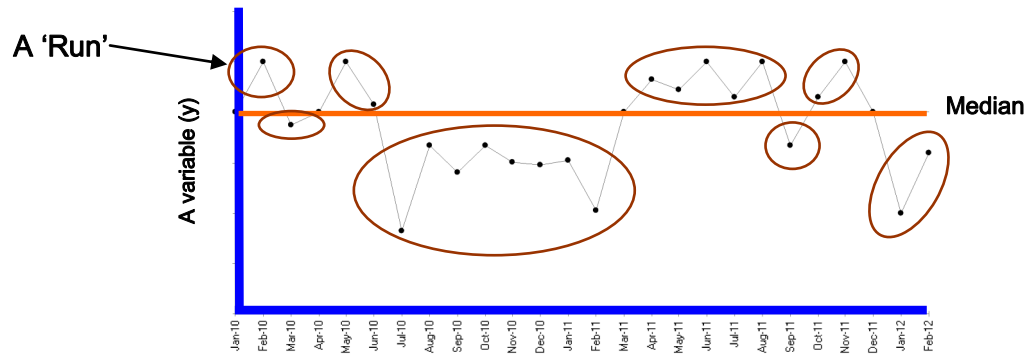
Detecting Special Cause signals on your Run Chart

There are three types of special cause signals to look out for on a run chart

1. The presence of too much or too little variability

This is detected by firstly counting the number of 'runs' on your chart. A run defined as one or more consecutive data points on the same side of the median. Runs exclude any points that are on the median line. So in the example below there are 8 runs circled.

A Sample Run Chart



Time (x)

# observations (not on median)	Lower limit	Upper limit
14	4	11
15	4	12
16	5	12
17	5	13
18	6	13
19	6	14
20	6	15
21	7	15
22	7	16
23	8	16
24	8	17
25	9	17
26	9	18
27	9	19
28	10	19
29	10	20
30	11	21

This table displays a section of a probability chart developed by statisticians to interpret run charts. Use it as a look up table. Ordinarily it is best to have at least 16 points on a run chart to identify a special cause.

Our chart has 26 data points but 4 are on the median. So we need to use the line for 22 observations. In our chart we have 22 observations and 8 runs.

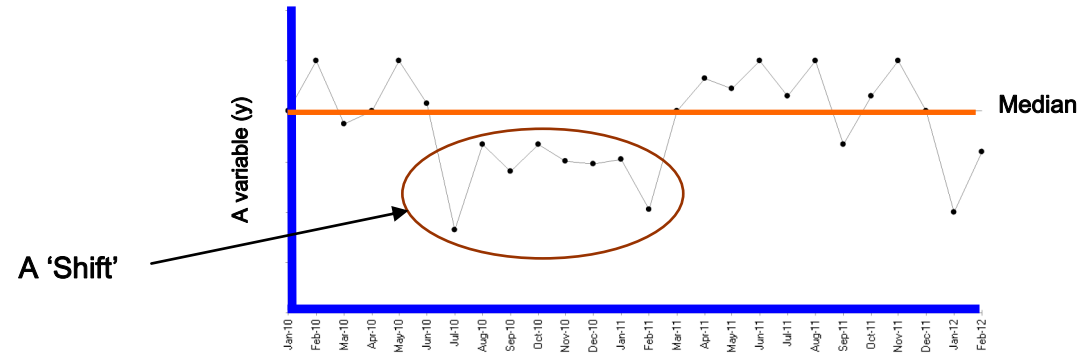
The table shows if there are less than 7 runs or more than 16 runs it is a signal that one or more special causes are present.

In this case the number of runs falls within the lower and upper limits and therefore a special cause is not indicated by this test.

2. The presence of a shift in the process

A special cause signal exists if a run contains 8 or more data points. Points on the median are excluded. Our example has 1 shift circled signalling the presence of a special cause.

A Sample Run Chart

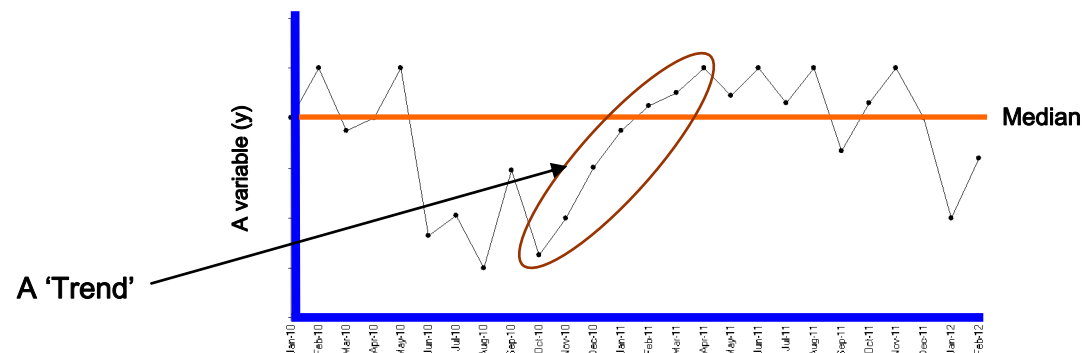


Time (x)

3. The presence of a trend

A trend is defined as a unusually long series of **consecutive** increases or decreases in the data. Experts disagree on the exact number, but usually require that the number should be at least six or seven. Our example above has no trend special cause signal as the longest series of consecutive increasing or decreasing points is 3, which is not a trend.

Sample Run Chart 2



Time (x)

For a trend can count any points that are on the median but ignore points that repeat the preceding value. The run chart above shows a trend between October 10 and April 11 with a start point plus 6 consecutively increasing values inside the oval.

A run chart displaying too much or too little variation (1), a shift (2) or a trend (3) is defined as not being in statistical control and exhibits special cause variation.