Data in Quality

FAQ #5 in a series committed to assisting the HOPA membership along the quality improvement journey

“That which cannot be measured cannot be proven.”
- Anthony W. Richardson

In quality management, understanding and improving processes is key.

Two data visualization tools that can help identify trends in data, observe the impact of any implemented changes, and inform decision-makers on next steps are **run charts** and **control charts.**

Run Chart

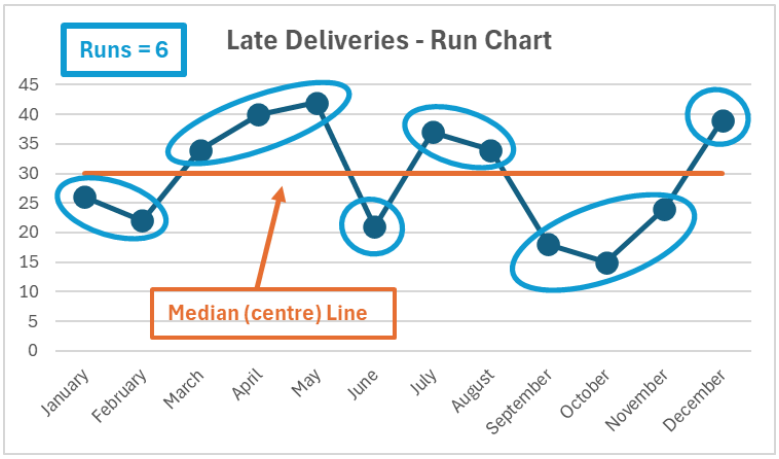
A run chart is a line graph used to **display how observed data changes over time,** helping identify trends, shifts, or cycles in data.

Run charts are particularly helpful to monitor process improvement efforts and detecting changes in process performance.

What is a “Run” on a Run Chart?

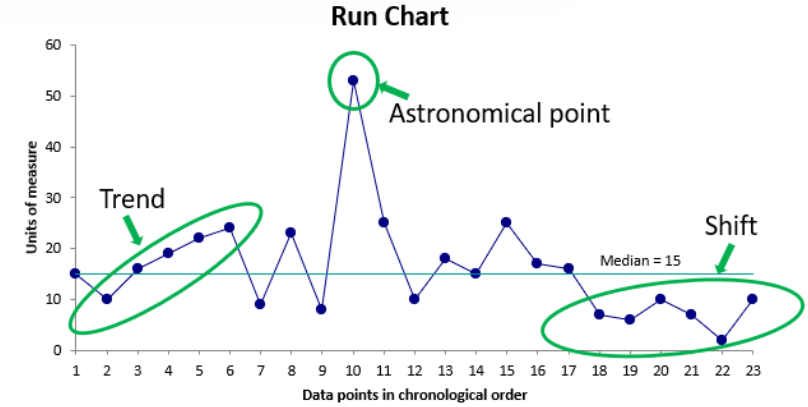
A run is defined as one or more consecutive data points on the same side of the median.

Data points that fall on the median are not included.



Steps to Create a Run Chart

1. Obtain a set of data points in their natural time sequence and plot the values in the sequence in which they occurred.
2. Draw the horizontal (X) axis and label with the unit of time. Draw the vertical (Y) axis and label with the name of the value being measured.
3. Draw lines to connect the data points on the graph.
4. If there are 10 or more data points, calculate the median of the plotted numbers and draw the median line on the graph. The median line is also called the “center line.”
5. Title and annotate the chart, noting when any tests of change were initiated. Also indicate any external events that may have affected the performance of the process.



Run Chart Rules to uncover signals of *real change*

Shift: Are there 6 or more consecutive data points above or below the median?

Trend: Are there 5 or more sequential data points all going up or down?

Number of Runs: Are there too few or too many runs?

Astronomical Data Point: Are there any data points that are unusually far away from the others?

Control Chart

A control chart, or statistical process control chart, is **used to determine the type of variation that may be present in data that is plotted over time.**

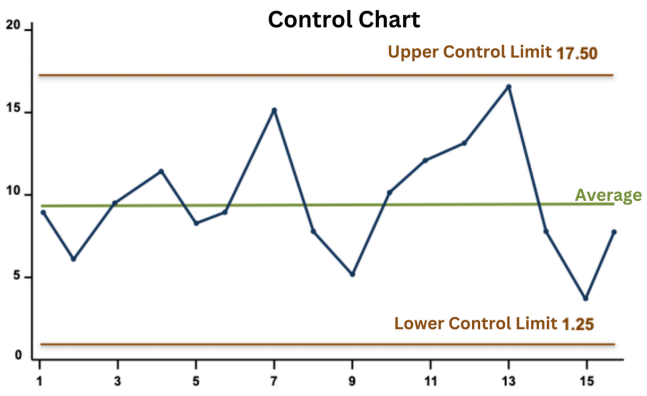
Types of Variation

Common cause variation (random or nonassignable variation) is due to regular, natural, or ordinary causes and is inherent in the design of the process. It results in a “stable” and predictable process.

Special cause variation (nonrandom or assignable variation) is due to irregular or unnatural causes which are not inherent in the design of the process. It results in an “unstable” and unpredictable process.

Steps to Create a Control Chart

- Obtain a set of data points in their natural time sequence and plot the values in the sequence in which they occurred.
- Draw the horizontal (X) axis and label with the unit of time. Draw the vertical (Y) axis and label with the name of the value being measured.
- Draw lines to connect the data points on the graph. If there are 10 or more data points, calculate the mean and draw the mean line on the graph.
- Calculate the standard deviation (σ) of the data.
- Draw an upper control limit line three standard deviations above the mean.
- Draw a lower control limit line three standard deviations below the mean.



Rules to Identify Special Cause Patterns on Control Charts

- A single data point is outside the control limits.
- A run of eight or more points in a row occurs above or below the center line.
- Six consecutive points are increasing (trend up) or decreasing (trend down).
- Two of three consecutive points are near a control limit (beyond two sigma limits).15 consecutive points occur within one sigma above or below the center line (“hugging the center line”).

Compare & Contrast

	Run Chart	SPC Chart
Tools Needed	Pencil and paper or Excel	Special software
Ease of Creation	Easy - Anyone can make this	Complex - Created by statisticians
Centerline	Median	Mean
Ideal Use	All quality improvement activities	System dashboards
Data Needed	≤ 10 data points (more is better)	≤ 15 data points (more is better)
Sensitivity	Less sensitive	More sensitive and detailed
Tests	Four rules - Easy to learn	Dozens of sets - Harder to learn

SPC Chart = Statistical Process Control Chart

References:

1. *Quality Improvement Essentials Toolkit. Boston: Institute for Healthcare Improvement; 2017. (Available at ihi.org)*
2. Six Sigma Daily. (2019, February 12). *What is a Six Sigma Control Chart and How Do I Create One?* Six Sigma Daily. What is a Six Sigma Control Chart and How Do I Create One?
3. Mohammed MA, Worthington P, Woodall WH. Plotting basic control charts: tutorial notes for healthcare practitioners. Qual Saf Health Care. 2008 Apr;17(2):137-45.
4. Koetsier A, van der Veer SN, Jager KJ, Peek N, de Keizer NF. Control charts in healthcare quality improvement. A systematic review on adherence to methodological criteria. Methods Inf Med. 2012;51(3):189-98.

Stay tuned for future topics:

QI tools ~ Developing QI projects: data in quality, defining measures and countermeasures, assessing results ~ Quality indicators and metrics ~ How to teach residents about quality ~ Designing a quality rotation vs longitudinal project ~ Sharing results

Interested in more information? Click here to see our HOPA Quality website.

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