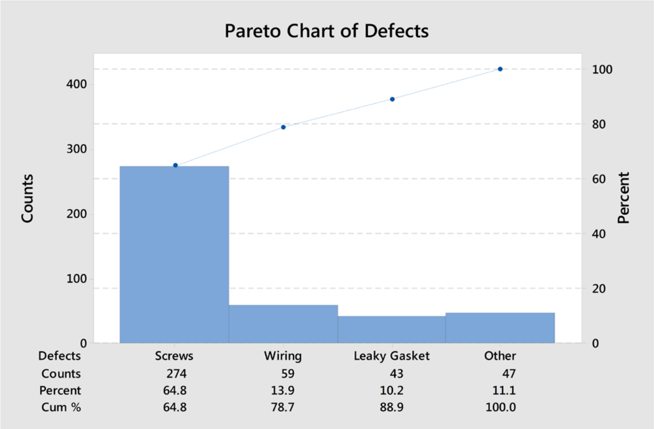
Minitab

The Quick Guide to Six Sigma Statistics: 10 Tools Explained

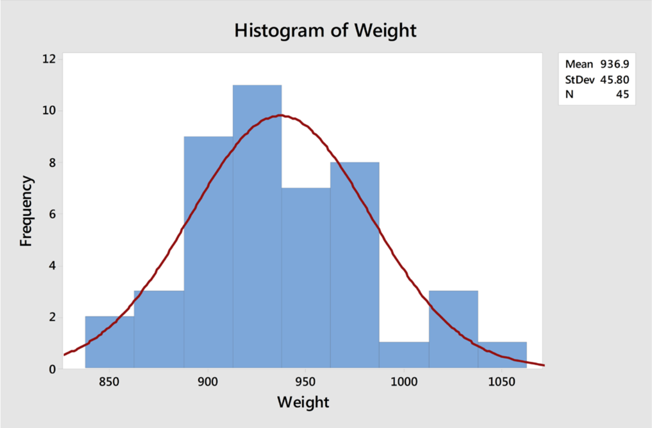
Six Sigma is a proven quality improvement method that gets results. By following a logical series of steps, organizations of all sizes have solved remarkable problems and saved billions of dollars. Many practitioners feel intimidated by the statistics vital to Six Sigma, but you don't need to be. While data plays a critical role in improving quality, most of the analyses used are not difficult to understand, even if you're not statistics-savvy. Getting familiar with these tools is a good place to start. This guide provides an overview of 10 statistical tools commonly used in Six Sigma, and explains what they do and why they're important.

1. Pareto Chart



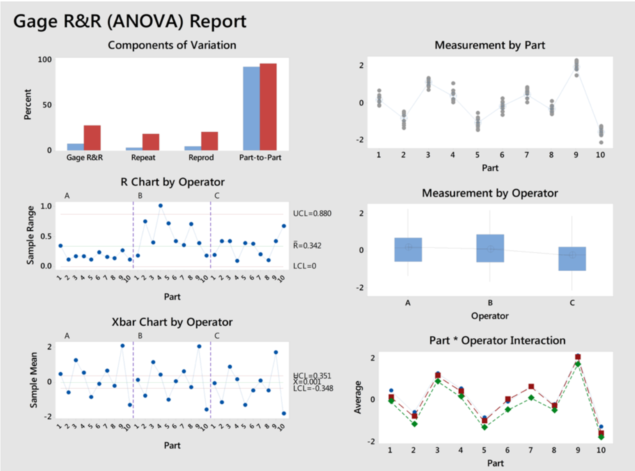
The Pareto Principle says that about 80% of outcomes result from 20% of the causes. This likely even applies to your wardrobe—perhaps you wear 20% of your clothes 80% of the time. The Pareto chart is a specialized type of bar chart that distinguishes the "critical few" causes from the "trivial many" so you can focus on what's most important. For example, if you record defect types every time one occurs, a Pareto chart pinpoints the most frequent defects so you can direct improvement efforts at the most prevalent problems.

2. Histogram



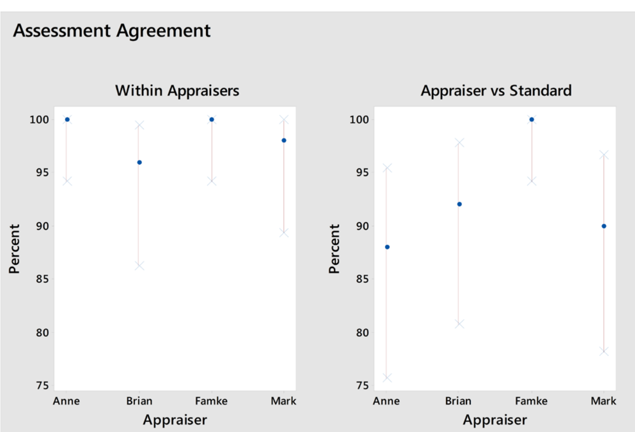
A histogram provides a snapshot of numeric, continuous data. With histograms, you can quickly identify the center and spread of your data. Where does most of the data fall? And where are the minimum and maximum values, approximately? A histogram also shows you if your data are bell-shaped or not, and can help you identify outliers, or highly unusual data points, which may require further investigation.

3. Gage R&R



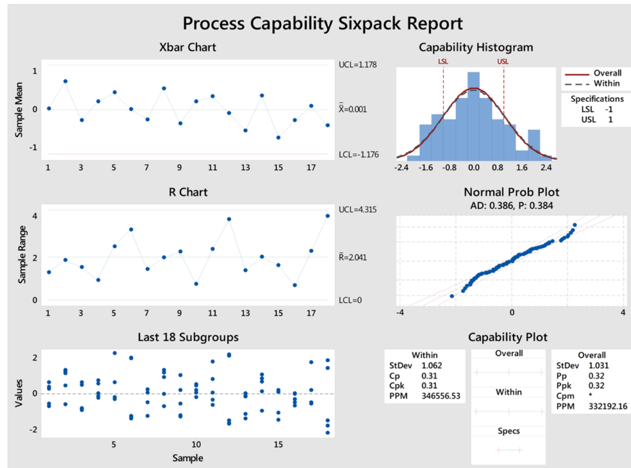
Would you weigh yourself using an unreliable scale? Would you wear a watch that didn't keep time? You can't improve a process that you can't adequately measure, which is why we need Gage R&R. This tool—for continuous numeric measurements, such as weight, diameter, and pressure—helps you determine if your measurements are both repeatable and reproducible, when the same person is repeatedly measuring the same part, and when different operators are measuring the same part.

4. Attribute Agreement Analysis



Attribute agreement analysis is another tool for making sure you can trust your data. Where Gage R&R is ideal for numeric measurements, attribute agreement analysis is ideal for categorical assessments, such as Pass or Fail. This tool will reveal whether or not people rating these categories agree with themselves, with other appraisers, and with a known standard.

5. Process Capability

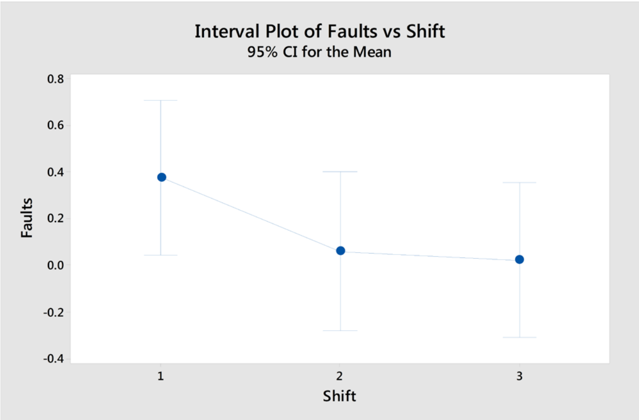


Nearly every process has an acceptable lower and/or upper bound. Manufactured parts can't be too large or too small, wait times can't extend beyond an acceptable threshold, fill weights need to exceed a specified minimum. Capability analysis quantifies how well your process meets specifications, and provides insight into how to improve a poor process. Frequently cited capability metrics include Cpk, Ppk, defects per million opportunities (DPMO), and Sigma level.

6. t-Tests

A t-test can be used to compare the average of one sample to a target, or to the average of another sample. For example, if your company sells beverages in 16 oz. containers, you can use a 1-sample t-test to determine if your production line's average fill is off target. If you buy flavor syrup from two suppliers and want to determine if there's a difference in the average volume of their respective shipments, then you can use a 2-sample t-test to compare the two suppliers.

7. ANOVA

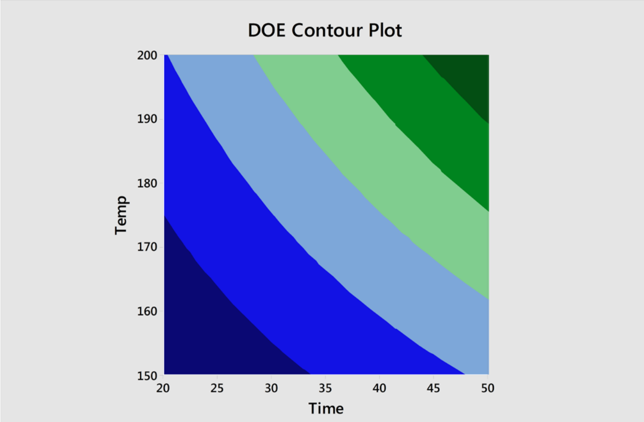


Where t-tests compare a mean to a target, or two means to each other, ANOVA lets you compare more than two means. For example, you can use ANOVA to test if the average production volumes across 3 shifts are equal. You can also use ANOVA to analyze means for more than 1 variable. For example, you can simultaneously compare the means for 3 shifts and the means for 2 manufacturing locations.

8. Regression

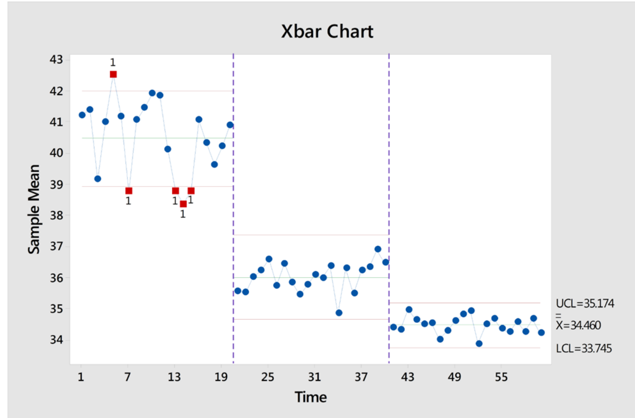
Regression is useful for determining if a relationship exists between an output and one or more input variables. For example, you can determine if there is a relationship between a company's marketing expenditures and its sales revenue. If a relationship between the variables does exist, then you can use the regression equation to describe that relationship and predict future output values for given input values.

9. DOE



While regression and ANOVA are typically used for data that's already available, Design of Experiments (DOE) provides an efficient data collection strategy, where inputs are simultaneously adjusted, to identify if relationships exist between inputs and outputs. Once you collect the data and identify the important inputs, you can then use DOE to determine optimal settings.

10. Control Charts



A stable, and therefore predictable, process is a hallmark of quality products and services. Yet every process has natural fluctuation. A control chart distinguishes "special-cause" variation from acceptable, natural variation. These charts graph data over time and flag out-of-control data points so you can detect unusual variability and take action only when necessary. Control charts also help you ensure that your process improvements are sustained into the future.

Conclusion

Six Sigma projects can provide significant benefits for your business, but you cannot reap those benefits without collecting and analyzing data so you can understand where opportunities exist and make significant and sustained improvements. The power to effect change and contribute to the success of Six Sigma projects often lies in the hands of practitioners who are highly skilled subject-matter experts in many fields, but not statistics. With a basic understanding of the most commonly used Six Sigma statistics, as seen here, and easy-to-use statistical software, you can overcome the statistical hurdles associated with improving quality, and analyze your data with confidence.

Michelle Paret, product marketing manager, Minitab Inc. michelle.paret@minitab.com

Minitab is the leading provider of statistical software for quality improvement and statistics education. More than 90% of Fortune 100 companies and more than 4,000 colleges and universities use Minitab 17, our flagship product. Visit www.minitab.com to learn more or contact us at sales@minitab.com.