Selecting Statistical Software for Six Sigma

Anyone who has been exposed to the fundamental concepts of Six Sigma knows the importance that statistical methods play in quantifying improvements in process quality. Inherent in the name is the concept that quality is related to variability, since the Greek letter "sigma" is the standard statistical notation used to represent the standard deviation of a probability distribution. Whether the variable of interest is the strength of a manufactured item or the waiting time at an ATM, quantification of variability is fundamental to the assessment of system quality. That job is usually delegated to a statistical package, of which there are many.

This article examines some of the important criteria that should be considered when selecting a statistical package to use in Six Sigma programs. Choosing the right package has a lot to do with the eventual success or failure of the Six Sigma initiative. If the wrong choice is made, users will put the software aside after their training is finished and go back to business as usual.

Criterion #1: Background of targeted users

Statistical packages vary greatly in their assumptions about the user's background in mathematics and statistics. With some programs, users without several courses in basic and advanced statistical methods will find it difficult to: (a) select the proper procedures for their particular data, and (b) interpret the statistical results once they have been calculated. Other programs provide tools to guide users in selecting the proper methods, often through some type of wizard. Online statistical "advisors" then interpret the numerical results in simple language that does not assume the user remembers everything they may have learned in their statistics classes. In selecting the proper program, be sure to ask yourself:

- How strong a background in statistics does my typical user have?
- Do they apply statistical methods frequently, or is analyzing data just one of many tasks they are asked to perform?
- Do I have enough statisticians and Master Black Belts available to help users select the proper methods and interpret the results once the data have been analyzed? Or do I need a program that provides that help as part of the software?

Criterion #2: Type of data commonly analyzed

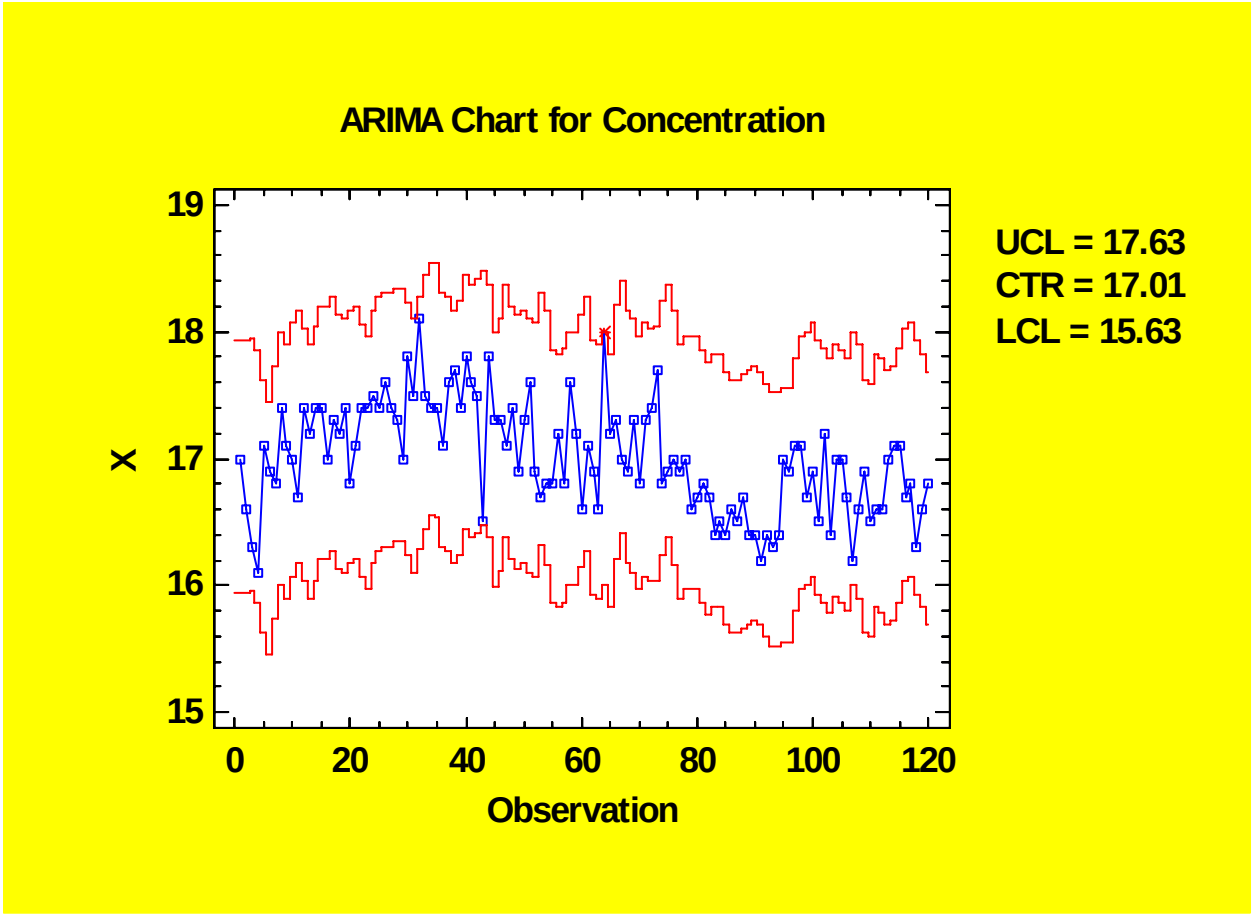
Each statistical package tends to have a specific emphasis. Some are oriented toward engineering and manufacturing applications. Others put a heavy emphasis on uses in basic R&D. Still others are geared toward applications in the service industries. Since the type of data collected varies from one area to another, packages tend to emphasize procedures for the type of data that their users most frequently encounter.

As an example, engineers tend to deal with two types of data: measurement data such as tensile strength and count data such as numbers of defects. Users in the service industries often deal with survey data. In research and development, there is a heavy emphasis on designed experiments. Amongst users in the financial and business communities, time series analysis and forecasting are frequently used.

You also need to evaluate each package's ability to deal with unusual data features that you expect to encounter. While all statistical packages include routines to handle data that is normally and independently distributed, packages vary quite a bit in their capabilities to handle data that do not meet the standard assumptions. Ask whether there are procedures to fit regression models when the data are discrete counts rather than continuous measurements. Are there procedures to handle censored data, which might result from a measurement system with a lower limit of detection? Can the control charts handle data with a high sampling frequency, making the assumption of independence between successive data values invalid? You also need to be sure that the program has procedures for handling very small or very large datasets if you expect to encounter such cases.

When selecting a statistical package, be sure to consider:

- What types of data are my users most likely to encounter?
- Is the package I have selected geared toward the type of applications we see most often?
- What tools does the software have for dealing with data that do not follow the standard assumptions of normality and independence?
- Can the software deal with very small or very large samples?



ARIMA control chart: designed for monitoring data with a high sampling frequency. Such data violate the assumption of independence which is necessary when using a standard Shewhart chart.

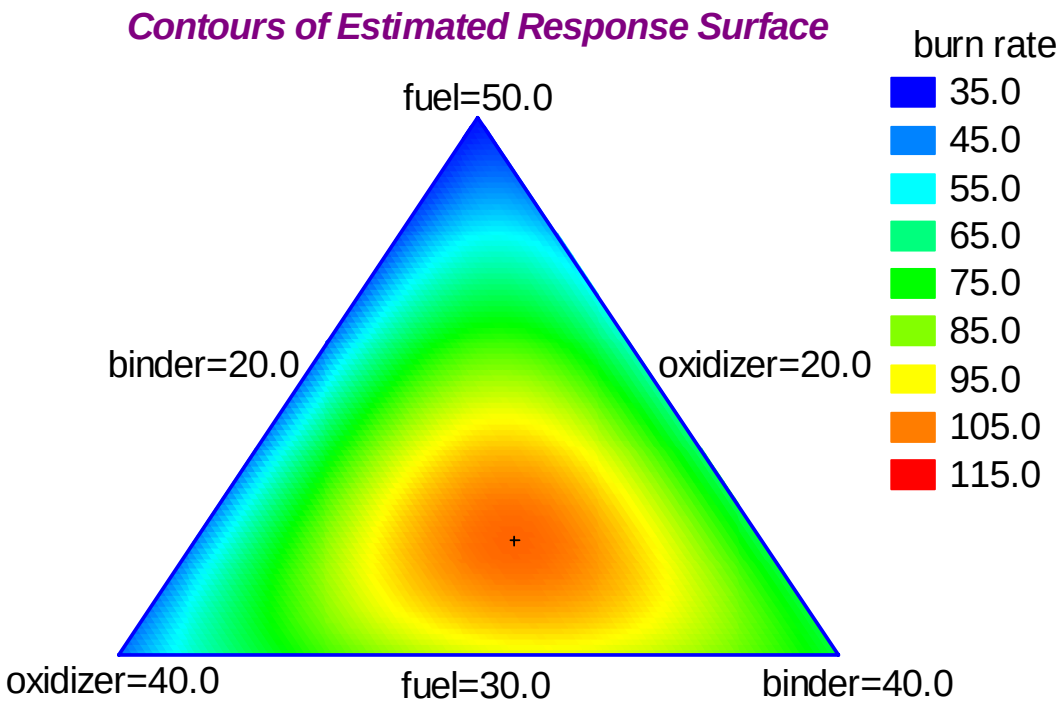
Criterion #3: Exploratory data analysis or repetitive data processing

John Tukey, a famous statistician, wrote a textbook many years ago titled Exploratory Data Analysis. In it, he presented many techniques he had developed which were designed to help users explore their data. With the advent of the PC, statistical packages were developed with similar goals of enabling an analyst sitting at a keyboard to try many different ways of examining his or her data in an effort to extract whatever information it held. This was in sharp contrast to traditional programs which assumed that users would develop a set of analyses that would later be repeated on many different datasets. Whereas programs developed for exploratory data analysis tend to function through dialog boxes and windows that are "hot-linked" to the data in other windows and instantly update if that data change, the more traditional packages rely on having a language in which programs can be developed, saved, and later executed.

With the advent of web services, more and more analyses are being dynamically linked to data sources. Time series forecasts, capability indices, Pareto charts and the like can be placed on a web page and made to change whenever new data become available.

When you evaluate a statistical package, ask yourself:

- If I tend to mine data for information, how easily can I try multiple approaches with multiple options? Is the software designed to help get answers while I sit there, or will I end up writing programs to submit for execution?
- If I have standard analyses that I run over and over again on different datasets, how easy is it to create and run a fixed set of procedures?
- Can the analyses be structured so that they update automatically whenever the data change?



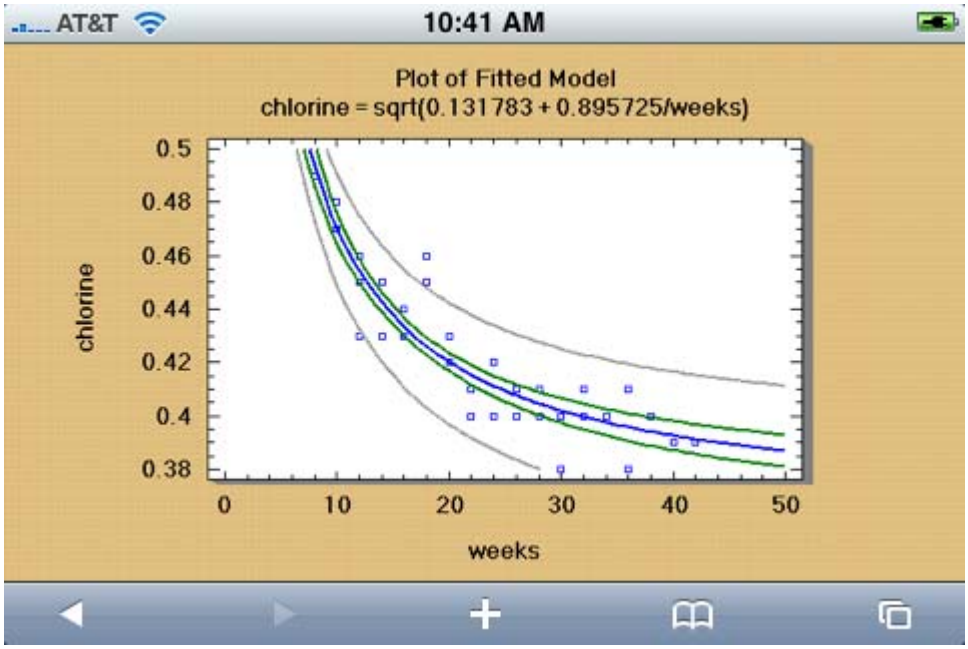
Contours of response surface for rocket propellant burn rate as a function of fuel, oxidizer, and binder. From mixture experiment described by Myers and Montgomery in Response Surface Methodology: Process and Product Optimization Using Designed Experiments 2nd edition, Wiley, 2002.

Criterion #4: Accessibility of statistical results

Once statistical analyses have been completed, the results need to be shared. Unless you intend to purchase licenses for everyone in your organization, this means that output needs to be transferred to other formats such as PDF files, PowerPoint slides, and web pages that can be accessed from any web browser. If you frequently deal with colleagues in other countries, you should also look for a package that makes it easy to translate the statistical results into other languages.

When selecting a statistical package, be sure to ask:

- How easy is it to create a report or presentation that I can share with other colleagues?
- Can the output be placed on a web page where anyone can view it using only a web browser? Or does everyone need to purchase a seat for the software?
- Can users access the results from anywhere using a mobile device?
- How easily can I create the same analyses in other languages to share with colleagues in other countries?



Stability regression curve viewed using a web browser on an Apple IPhone. Generated upon request using a web service.

Summary

There are a large number of programs that can be used to perform the statistical calculations required in Six Sigma. However, not all programs are designed to support users who do not do statistics every day. The type of guidance and advice built into packages that are designed for practitioners rather than statisticians and the ease of sharing those results can be the difference between a Six Sigma program that achieves real success and one that falls short or inspires apathy.

Before you select a statistical package, be sure to consider the four criteria outlined above. It may take some time, but it will be well worth the effort.

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