Re: Understanding subgroup sizes for Six Sigma

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- *From*: "Old Mac User" <chendrixstats@xxxxxxxx>

- *Date*: 22 Jun 2006 07:24:25 −0700

Shawn:

The whole "statistical quality control" situations is a mess. Most (if not all) of the "rule and regulations" are rooted in work done in the 1920s and some additional work done in the 1950s ("Rules for Runs", etc.) The truth is that a lot of it... more than you might imagine... is pure statistical B.S. The "sub−group thing" is among the worst. "Charts for Averages and Ranges"... X−bar, R charts) are often not relevant and can be misleading. The worst of the collection for "charting" is "attribute data", followed by "R&R" which is just awesomely terrible. I am a chemical engineer and a statistician, and was in charge of an applied statistics group for about 34 years at a major corporation. I left there in early 1998 (retired with 40 years service) just as Six−Sigma was coming in the door. I've taught SS "my way" for some companies, both large and small. While there is some merit in SS, most of the "statistics" taught under that practice is hogwash. So your B.S. detector is working just fine. I assure you that the more you dig into this the more it will stink.

I wish I could suggest some books on statistical quality control that at least have the "statistical part" done correctly. Sorry, but so far as I can tell there are none. The reasons for this are simple. All books and other writings are simply copied from work done in the 1920s, much of which was driven around the need to keep calculations simple. The problems lie not in the approximations and simplification of the methods, but moreso in gross failures to mention the important assumptions. Those assumptions are not trivial, and it's the failure to recognize and appreciate them that cause the problems. I'm not talking samll stuff here. I'm talking gross errors. So gross as to make much of the "SPC" work pointless, confusing, and misleading. By paying attentiokn we can do a lot better. The other problem is rotted in an organization (American Society of Quality) that is driven by money and politics. The people who run that are not interested in changes or improvements. Anyone who criticizes "SPC" as it now stands... rooted and flawed in the 1920s... or who points out the nonsense in such things as "C−charts" and "R&R" is immediately a "bad guy". Reason: Too many people in that old−boy network have made big−bucks "teaching and consulting" and they are not about to admit that the emporer is as naked as a jaybird. The book you have is indeed vague

Now to your direct question.

First of all, the sub−group thing is a total mess. There's seldom no good rationale for setting the groupings. The book you have is indeed vague on this point, but so are all the others. Frankly, I think there are better things to do with data. But let me try anyhow.

You wrote "but then he says that the subgroup size will dramatically lower this
probability and allow the operator to detect changes more quickly."
OK, increasing the sub−group size should in principle NOT CHANGE the frequency of false alarms. If the process is correctly centered on targer, then (using the classic 3−sigma chart, with no "rules for runs") then the frequency of false alarms should be near 1 in 370 charted data points. But, increasing the sub−group size MAY reduce the amount of time that passes by before we detect a change in the underlying process average. The reason I say MAY is this. If we arbitrarily increase the sub−group size then getting the "more data" may take "more time". Viz., if we are collecting data are the rate of one data per hour and we use a sub−group size of "4"... and if we increase the sub−group size to "8"... twice as much time will pass by before we get a sub−group and chart a point and make a decision.

All rules for charts should go back to an "Average Run Length" curve (ARL curve) first in terms of the average amount of data that will pass by us before we "detect" a change and also in terms of the amount of TIME that will pass by us befrore we "detect" a change.
So simply increasing the sub−group size to reduce the variation by averaging data may actually make matters worse in terms of our ability to detect meaningful changes in a process average. This is one of the many "potentially fatal errors" that are never mentioned in SPC literature. Moreover, almost nobody in the "old−boy network" mentions ARL curves. Yet the performance of control charts (performance = ability to detect changes in a process) hinges on those curves... getting access to them... and from them learning to make wise choices of charting methods. ARL curves are not obscure... they are well−known... but they are hardly even mentioned in SPC courses, books, etc.

So how good is the performance of control charts, in general? Well, the classic 3−sigma charts have very poor performance. This means their ability to detect changes is terrible. This has been known for decades, but it is never mentioned. At some point along the way "rules for runs" were added to improve performance. Good idea... but with unintended consequences. Adding "rules for runs" increases the frequency of false alarms... and can increase that frequency to as much as 1 in 15 charted data points. That's never mentioned.
Textbooks and "training programs" casually suggest including some "rules for runs" without mentioning the consequences... and those consequences can be extreme.

You wrote: My intuition, which is obviously
wrong, tells me that each of the 5, 10, 20, or 50 subgroup averages is
equally likely to plot outside the control limits.

Your intuition is not wrong. If you "follow the rules" for calculating the control limits, then the frequency of false alarms (an "out of control point" when in fact the average is still on target) will still be 1 on 370. Your intuition is correct. However, if the process average has shifted off−target then in principle you should be able to detect that "sooner". This last statement may or may not be true in practice... "depending". There are no "silver bullet" recipes for that one... some actual data is required in order to estimate the consequences of changing the sub−group size. It's easy, but not just a simple equation or some canned software. It takes some investigation and thinking.

As you probably noticed, I march to a different drummer. Most of what I known has come from hard experience. Much comes from standing in front of classes and teaching... and realizing that the questions students are asking (just like yours) don't fit into the "canned 1920s pattern". Also, realizing that the very words coming out of my mouth really don't make any sense... that something in inherently wrong about nearly all of the SPC training materials, etc. The fact is that it's easier to "do it right" than to struggle with SPC as it is taught even now, in 2006. Many people, including people I teach and consult with, have asked the hard questions that signify they also smell a rat. But the "good old−boy network" is so overwhelming and overbearing that is it difficult to penetrate it with hard questions.

This is a long note. I can send you some printed materials that explain some of the deficiencies I've mentioned... and some I have not mentioned. Some materials are digitized and other have to travel by snail−mail. Some are immediately obvious, once you see them. Some are a bit obscure, and require more thought.

To get to me send an e−mail to hedging77 followed by the usual "at" symbol and then yahoo.com That's an address I check about once a day.

From there I can give you my "real" e−mail address which is checked

almost continually.

Take care, and be of good cheer. Your intuition is sound. OMU

Shawn wrote:

> My company is making plans to tranistion to Six Sigma processes, so I purchased Pyzdek's book from Amazon to try and get a grip of it. My statistics education is a couple decades old at this point, but I think Pyzdek's wording is quite vague and is causing some of my confusion.
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> On the topic of subgroups and control charts, an example is presented with the typical Six Sigma "out of control" probability of .0027. He then goes on to suggest that the probability of an "out of control indication is 1/.0027 = every 370 units which I completely understand, but then he says that the subgroup size will dramatically lower this probability and allow the operator to detect changes more quickly.
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> What I don't understand, and he doesn't explain, is how can I quantify how "dramatically" it will change? If I'm using standard SS control limits of .0027, how/why would changing my subgroup size from say, 5, to 10, 20, or even 50 make a difference in the probability that one of the averages is "out of control"? My intuition, which is obviously wrong, tells me that each of the 5, 10, 20, or 50 subgroup averages is equally likely to plot outside the control limits.
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> Any help, equations, or pointers to material I could review would be greatly appreciated. Suggestions for a better beginner book would also be appreciated. (More examples!)

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