

A Look Back at Variation

This month's publication takes us back to a topic that started it all for our monthly publications back in January 2004 – variation. That article started out with my spilling milk when I was young. Back in those days, we didn't have those fancy plastic cups with lids on them. We just had glasses for children that were actually made of glass. No sippy cups. And whose fault was it when my milk spilled? My fault? Certainly not my mother's fault. Well, understanding variation may change how you look at whose "fault" it is.



In addition, this month we introduce how we have made it easier for you to navigate around our 13 years of publications in our SPC Knowledge Base. There are now over 150 articles on a variety of statistical topics – all free for you to access.

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Variation: Spilling The Milk

This is from our first publication back in January 2004 (with a few edits).



I used to, now and then, spill a glass of milk when I was young. Our table slanted toward where my mother sat. So, the milk always headed in her direction. And she usually had some choice words when this happened. Of course, I was at fault. I needed to be more careful. Or was that really true? If you understand variation, you will realize that most of the problems you face are not due to individual people, but to the process -- the way it was designed and the way it is managed on a day-to-day basis.

Variation comes from two sources, common and special causes. Think about how long it takes you to get to work in the morning. Maybe it takes you 30 minutes on average. Some days it may take a little longer, some days a little shorter. But as long as you are within a certain range, you are not concerned. The range may be from 25 to 35 minutes. This variation represents common cause variation --- it is the variation that is always present in the process. And this type of variation is consistent and predictable. You don't know how long it will take to get to work tomorrow, but you know that it will be between 25 and 35 minutes as long as the process remains the same.

Now, suppose you have a flat tire when driving to work. How long will it take you to get to work? Definitely longer than the 25 to 35 minutes in your "normal" variation. Maybe it takes you an hour

longer. This is a special cause of variation. Something happened that was not supposed to happen. It is not part of the normal process. Special causes are not predictable and are sporadic in nature.

Why is it important to know the type of variation present in your process? Because the action you take to improve your process depends on the type of variation present. If special causes are present, you must find the cause of the problem and then eliminate it from ever coming back, if possible. This is usually the responsibility of the person closest to the process.



If only common causes are present, you must **FUNDAMENTALLY** change the process. The key word is fundamentally -- a major change in the process is required to reduce common causes of variation. And management is responsible for changing the process.

It has been estimated that 94% of the problems a company faces are due to common causes. Only 6% are due to special causes (that may or may not be people related). So, if you always blame problems on people, you will be wrong at least 94% of the time. It is the process most of the time that needs to be changed. Management must set up the system to allow the processes to be changed.

So, Mom, sorry. But most of the time, spilling the milk was not my fault. It was usually yours (management). The glasses were too big for my small hands (no spill-proof cups in those days). When I wanted to put it by the edge of the table to make it easier to reach, you said move it back - I might spill it. And with the meal-time conversation, how could I concentrate on my milk!

The first thing to do in process improvement efforts is to teach the concept of variation. You need to know what is due to common causes of variation and what is due to special causes of variation.

A Case Study in Variation

That first publication back in 2004 also contained the following story. To really understand variation, many people have to change their paradigm. The following is a true story. A plant produced a number of different powdered products. Each of these products was run through the same production equipment at different conditions and put into unique silos (one or more for each product type).

To ensure that the product went to the correct silo, an operator had to set up the lines from the process to the correct silo. If product was introduced into the wrong silo, the entire silo had to be sold as off-grade, at a tremendous reduction in price. The cost was typically \$30,000 per incident.



The plant leadership had a policy that anyone who cross-contaminated a silo received three days off with no pay. What type of variation did leadership assume was present? Special cause. They assumed that the operators were at fault. One manager said that he was not going to "idiot proof" the plant.

Was leadership correct? The only way to find out is to collect data.

It turns out that anyone who had worked in the unit for more than 3 months had time off for cross-contaminating a silo. If everyone is doing it, what type of variation is it? Common cause. And the only way to reduce common cause of variation is to change the process.

Leadership put together a team that worked on the problem. The team came up with two simple solutions: label the lines and put better lights out at night. Easy solutions but beyond the authority of the operators to get done by themselves. With the solutions implemented, the problem, which had been occurring almost monthly, went away entirely. So simple if you understand variation.

So how do you separate common from special causes of variation? The only effective way to do this is by using control charts.

Variation and Control Charts

The follow is an excerpt from our December 2010 publication on teaching variation to leadership. Consider sales for the two months shown below:

Jan-15: \$11,229

Feb-15: \$10,016

Are these sales numbers the same? The measurements we take reflect the variation in the process. The problem with measurement systems that compare one-time frame to another is that the actual performance (variation) of the process is hidden - we don't know what the underlying process is doing.

The monthly sales report is a good example. It compares this month's sales to last month's sales. Or maybe to the same month for the previous year. What nonsense. What does this tell you? Well – it tells me if things are better or worse. Does it? Well, I feel better when the sales number is higher. Really? What usually happens after a record sales month? The next month is often lower. You have to understand variation. The assumption that there is one reason why sales are higher this month than last month's is not valid.



The only tool to effectively examine the behavior of a process is a control chart. The data in Table 1 is our sales data. What does this table of data show you?

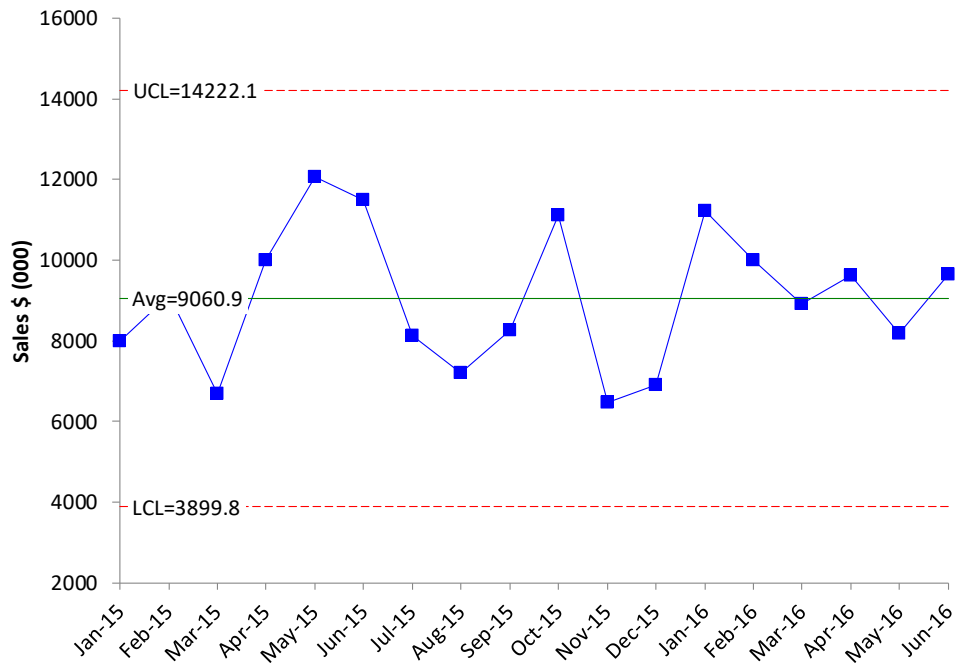
Table 1: Sales Data

Month	Sales (000)	Month	Sales (000)
Jan-15	7997	Oct-15	11117
Feb-15	9132	Nov-15	6481
Mar-15	6694	Dec-15	6897
Apr-15	10005	Jan-16	11229
May-15	12055	Feb-16	10016
Jun-15	11485	Mar-16	8903
Jul-15	8133	Apr-16	9617
Aug-15	7215	May-16	8190
Sep-15	8278	Jun-16	9653

The table does begin to show some of the variation in the underlying process. It is an improvement over the limited comparison of two numbers. But it is still difficult to see the underlying process behavior.

To really understand what is happening, you need to construct a control chart. The individuals control chart for the data in Table 1 is shown in the figure below. We will not show the moving range chart here.

Figure 1: Sales Data – X Control Chart



The upper control limit (UCL) is the largest value you would expect from a process with just common causes of variation present. The lower control limit (LCL) is the smallest value you would expect. As long as all the points are within the limits and there are no patterns, only common cause of variation are present. The process is said to be "in control" To improve it, you must fundamentally change the process.

All the points are within the control limits and there are no patterns. The sales process is "in control." Sales might be as low as 3,899 or as high as 14,222 each month. The variation is simply the random variation in the process. We can predict what will happen in the future. As long as the process remains the same, sales will average 9060 per month with the monthly variation being between the control limits.

Quite often, people will say that the control limits are too wide - and don't really help them. They miss the point. It is not the control limits, but the story that the control chart tells. It provides feedback on the state of the process - improving or declining or in control. And this process is in statistical control, it tells leadership that the process must be fundamentally changed if sales are to increase. The key word here is fundamentally. This means new products, new sales approaches, etc. And the control chart can be used to judge the impact of those fundamental changes.

Navigating the SPC Knowledge Base

Earlier this year, we made it easier to navigate the over 150 publications in the SPC Knowledge Base. For years, we simply had the publications listed by the month they were published. The link below takes you to that page:

[List of publications by month published](#)

As our number of publications grew, we needed a better method of allowing users to find the publications of interest to them. So, we divided the articles into categories to make it easier to find the publications. The link below takes you to that page:

[List of publications by category](#)

The categories we use are given below:

- Variation
- Dr. W. Edwards Deming
- Control Charts
 - Basics
 - Variable Control Charts
 - Rational Subgrouping
 - Attribute Control Charts
 - Control Chart Examples
- Bar Charts: Pareto and Histograms
- Measurement Systems Analysis
- Process Capability
- Root Cause Analysis
- Comparing Processes
- Experimental Design Techniques
- Basic Statistics
- Process Improvement
- Miscellaneous



Clicking on a category takes you to a list of publications under that category. For example, if you select “Variation” in the list of categories, all our publications under that category are displayed. This is shown to the right. There have been 11 articles (not including this one) on the topic of variation. You can see our first publication listed as “Variation (January 2004).”

VARIATION

- Variation (January 2004)
- Leadership and Variation (February 2004)
- Revisiting Variation (March 2006)
- Overcontrolling a Process: The Funnel Experiment (July 2006)
- Another Look at Variation (January 2008)
- The Red Beads: Understanding Variation (February 2009)
- Teaching Variation to Leadership (December 2010)
- Returning to the Basics: Variation (January 2012)
- Variation, People and Pay for Performance (March 2012)
- It is the Operator's Fault! (November 2014)
- Horse Racing and Listening to Control Charts (August 2015)

Suppose you click on the first article listed. This takes you to the article on variation from January 2004. When you are on the publication page, look at the right-hand column. You will see a list of all the publications in that category. The one you are viewing is listed in black; the others are in blue. This allows you to move to other publications within the category.

Variation

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January 2004

In this issue:

- Variation: Spilling the Milk
- A Case Study in Variation
- Separating Common from Special Causes of Variation
- Quick Links

Greetings,

Welcome to the inaugural edition of the SPC for Excel e-zine. Each month you will receive information on a featured SPC topic and other items. We hope you enjoy this issue. Please let us know your ideas for topics to cover as well as any ideas you might have for improving the e-zine.

We will begin this issue where everyone needs to begin whenever you are implementing SPC - with variation. To effectively use SPC, you must understand the concept of variation - and in particular, the difference between common and special causes of variation.

VARIATION: SPILLING THE MILK

Variation

- << Return to Categories
- Variation
- Leadership and Variation
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- Another Look at Variation
- The Red Beads: Understanding Variation
- Teaching Variation to Leadership
- Returning to the Basics: Variation
- Variation, People, and Pay for Performance
- It is the Operator's Fault!
- Horse Racing and Listening to Control Charts

Hopefully, this makes it easier to navigate through all the publications to find the ones that interest you!

Best Wishes for the New Year

We appreciate you taking time to read our publications. It has been a joy to provide them to you over the years – our gift for those seeking to understand. Best wishes to you and yours in the New Year!

Quick Links

- [Visit our home page](#)
- [SPC for Excel Software](#)
- [SPC Training](#)
- [SPC Consulting](#)
- [SPC Knowledge Base](#)
- [Ordering Information](#)

Thanks so much for reading our publication. We hope you find it informative and useful. Happy charting and may the data always support your position.

Sincerely,

Dr. Bill McNeese
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