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In control or out – How is your dairy?

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DID MY milk production go up? Did my milk production go down? How can I tell if the new ration helped? When did this or that problem begin? My cows aren't producing as well as they were. What happened to cause this change?

These are questions I hear constantly, yet seldom are dairies in a position to answer them. Why? The dairies don't keep accurate enough records or compile data in a way that allows them to answer the question. I would like to suggest that the use of statistical process control charts is a way to overcome these problems.

Statistical process control charts are a tool for organizing data collected on the dairy into context in order to interpret change (or lack of it). For example, I had one dairy producer boast that his bulk milk tank had gone up 3,000 pounds the day after he had made a ration change. Normally, that would be cause for celebration. However, I knew that his daily average variation, or change in bulk tank milk, was 5,000 pounds. In essence, nothing had changed except that the producer felt better.

This example is a good reason for using these charts and I would like to make some comments relative to getting set up and the possibilities.

How do I get started?

1. You need to determine what you want to monitor on your dairy that has economic or production value to you so you can determine if the changes you expected to see actually happened.

For example, I have done control charts of bulk tank milk, fat percent, fat pounds, protein percent, protein pounds, fat/protein ratio, OS percent, lactose percent, SNF percent, SCC, PI, SPC, temperature, and water. I have also monitored dry matter intakes, milk per pound of dry matter, income over feed costs, total feed cost per day, total income per day, and daily levels of health parameters such as DAs. Many of the parameters listed can be monitored on a per cow basis if you have daily inventories. The bottom line is that the sky is the limit, assuming you don't violate rule number two.

2. You need to collect data that are repeated on a short enough time interval that the computations are meaningful. For example, daily or bi-daily bulk tank pickups are great for this type of system, but monthly or bimonthly DHIA data may not be appropriate because of the large time lag between data points.

3. You must keep a daily diary of events that occurred on the farm such as feed, ration, weather, or management changes. **This is the most important part, yet it is the part most neglected by dairy producers.**

4. Once the data are collected, you need to have a way of computing and graphing the information that you collect. In my case, I use a program that automatically makes the computations of the mean and variation. If you don't have a program like that, use a spreadsheet so that you can compute the mean and standard deviations. Setting up the spreadsheet is fairly easy. The following description is actually easier than it sounds:

All parameters will be set up in columns. The oldest information will be in the first row and the newest data in the last row. Column A can contain the date; column B the production parameter of interest. Then pick the window of time that you want to

use as your baseline (see comment below) as long as you use at least 20 data points. Column C will then contain the mean. Use this same value for all of column C. Column D will contain the variation or standard deviation for the same time period used to compute the mean.

The true variance in a statistical process control chart is slightly different from the standard deviation, but the result will be close enough for our needs. This value will be used in the next six columns. Column E will be the mean **plus** the standard deviation, and column F will be the mean minus the standard deviation. Whatever those two numbers are, they should be pasted into the whole column for each of the respective columns. Columns G and H are the mean plus and minus **two** times the standard deviation (i.e. mean + (2*sd). Finally, columns I and J are the mean plus and minus **three** times the standard deviation.

You should end up with columns for the date, actual production values, mean, and plus and minus one, two and three standard deviations.

In picking the time frame for the calculations, some people compute the mean and standard variation for the whole data set, some pick a point in time that they want to compare the remainder of the information against, and some just pick the most recent 20+ data points as the reference. All three ways are valid and the use of each is dependent on what you are trying to determine. It is important to use at least 20 data points.

Now you can graph the data using the date column as the x-axis and all of the other columns as individual data lines. You should end up with something similar to Figure 1. The only difference is that you will have an extra pair of lines that I don't have on my graph.

I will also add a warning comment: a large percentage of the dairies I look at have seasonal variations in fat and protein percentage that sometimes make it difficult to interpret the results if you are using the most recent 20 data points as a reference (i.e., the percentages decrease in the spring and increase in the fall). Another area of concern is if you have irregular bulk tank pickup schedules, such as four pickups today and two pickups tomorrow, then back to four. I use something called exponential weighted moving average to "see" through the background noise. If you don't have a program like mine, you should consider using the moving average function in your spreadsheet.

I have included an example of irregular bulk tank milk pickups using the normal control chart (Figure 1) compared with the exact same data computed using the exponential weighted moving average (Figure 2). As you can see, the resulting chart can make the difference between seeing a problem and thinking everything is fine.

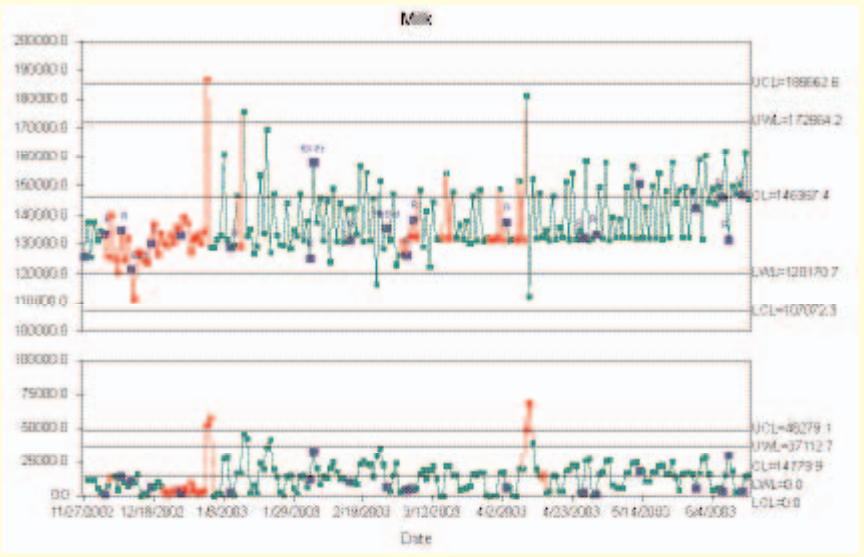

Figure 1:
An example of a statistical process control chart for bulk tank milk values. Only the mean and plus, and minus two and three times the variation are shown.

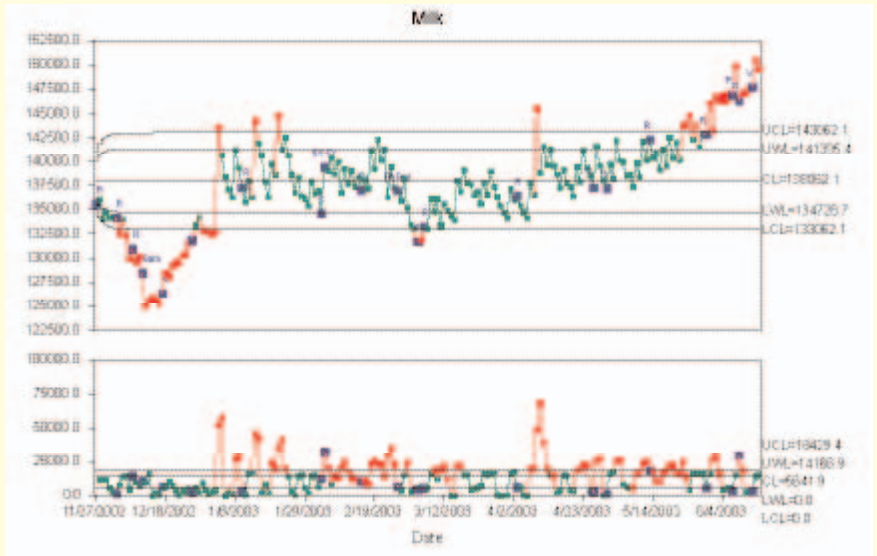

Figure 2:
The same values for bulk tank milk as shown in Figure 1, except the mean and variance values are computed using an exponentially weighted moving average. Again, only the mean and plus and minus two and three times the variation are shown.

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Once you have created the chart, the most important part of the exercise is to interpret it. This is where you can use your daily diary to mark on the chart when events took place that could change the status quo. For example, if you make a ration change, mark the chart when the ration change occurred (see the blue points marked "R" on the charts). Another example might be changing forage source or a weather change or new feeder or etc.

I find the best discussions occur if we can look at the data changes in the same context of when a management change occurred. One thing I have noticed is that most ration changes do not result in any measurable change in the usual production values, such as milk volume, fat percent or protein percent. That might be good or bad depending on what you were changing.

For this reason, I also like to look at pounds of fat and protein after a ration change because the milk volume and components percents sometimes change in opposite directions and the end result is the same amount of fat and protein pounds.

In general, I have noticed that there is a lot of variation on dairies. This means the background noise is so high it is hard to determine if a real change has occurred. If you are expecting a one or two pound change in milk production due to a ration change, then you need to tighten down on the variation to a level that allows you to pick up that change.

For example, rather than use the computed variation from your data, use the data mean plus a realistic variation that you think will allow you to pick up a change of this magnitude. I urge you to be careful when you do this and go into it with your eyes wide open.

I think statistical process control charts are absolutely necessary to really determine if a change is real or an artifact of the normal day-to-day variation on the dairy. Without this type of data analysis you might be making costly mistakes and not know it. If you can't afford to make costly mistakes, consider using these types of charts on your dairy. They are great to help focus discussions during management team meetings. Give them a chance to help you make better management decisions.