Transcripts for Time between Control Charts

FARROKH ALEMI: This set of slides was organized by Dr. Alemi. With demonstrated the time between control charts using time between exercise patterns of one single patient. You need to distinguish between random days of missed exercise from real changes in the underlying exercise patterns. We are doing this for one patient, keep in mind. So we have only one observation per time period. There are a number of steps to construct the time between control charts. It starts with verifying assumptions and goes still interpreting and distributing the control chart.

Let's start with verifying assumption this should be one observation per time period. If the analysis is done per day, that means one observation per day. The second assumption is that every day is a new day and not dependent on prior days. Exercise on one day does not affect exercise on the other days. So we are assuming you do not hurt yourself today and are unable to exercise next day.

The last assumption needs a little bit of more explanation. It has to do with the distribution of the rare event. If success is more frequent then failures, then longer stretches of failures-- that's the event that's rare-- should be increasingly rare. In other words, if occasionally a person fails to exercise, then to three or longer consequences of missed exercise should be increasingly less and less frequent.

Time between control charts focus on consecutive days of certain events occurring. This slide shows how consecutive days are scored. Suppose missed days are rare, and we want to count consecutive missed days. If this is the first day of data collection, then a missed day counts as one consecutive day, otherwise 0 days. Any day that the patient has no mistakes resets the consecutive days to 0. Otherwise, we keep adding 1 to whatever yesterday's counts was.

If it was a day in which habit was kept, so it was 0, then adding 1 will make today's count of consecutive mistakes 1. If yesterday we had three consecutive missed days and today's another mistake, then we add 1, 2, 3, to get 4 consecutive mistakes.

R is the ratio of failure days to success days. It must be a value less than 1. If it is greater than 1, we flip the ratio. And instead of missed consecutive days, we plot consecutive days the habit was kept. The upper control limit is calculated as R plus 3 times the square root of R times 1 plus R. The lower control limit is always 0 in these charts and never plotted.

In these control charts, x-axis is time, usually measured in days. But the y-axis is number of consecutive days of rare event. Let us look at some data. A 35-year-old female kept daily record of keep keeping to exercise plans for 18 days. First week was pre-intervention. Failures occurred on second, fourth, sixth, seventh day and also on the 16th day. Is she improving?

Let's count the number of consecutive missed exercise days, set to 0 every time she exercised, set to 1 the first day of missed exercise. Increase the number of consecutive missed days by 1 more than the prior day every time there is a missed day. So we see that on day four, this person has had three missed exercise days. Then she exercises and a number of consecutive missed days drops to 0 on day five. On day seven, it's back to two missed days.

Keep in mind that you have to calculate the R statistic for the rare event. In our data in the first seven days, the person rarely exercised. In contrast, in the remaining 11 days, the person rarely missed exercise. The control limits can be derived from pre- and post-intervention. We choose to do it from post-intervention since there are a statistic would be smaller and the control limits will be tighter.

The post-intervention period there are 11 days. In one of them, she missed exercise, and in 10, she did not. So the R statistic is 0.1, or 10%. Since R is 0.1, we can calculate the upper control to be 1.09. This is the control limit three standard deviations apart. So it should contain 99% of the consecutive days.

We can now plot to control chart the x-axis r shows the days since start of data collection. The y-axis shows the number of consecutive missed days. The blue line with markers shows the observed rate of consecutive missed days. The red line shows the control limit. It's solid for post-intervention period and dashed for the period prior to the intervention. It was calculated from the post-intervention data and extended to the pre-intervention period.

To interpret the time between control chart, note that any point that is above the control limit cannot be due to chance. For this patient, lots of consecutive mistakes are above the control limit prior to the intervention. No significant failures occurred after the intervention. So we can reasonably conclude that the intervention was helpful.

Now tell the story of the patient visually and distribute your control chart to the patient. Include in the report how you check the assumptions of the control chart. Include a summary of key findings and hypothesize the likely factors that contributed to increase consecutive missed days. Time between chart tell if changes are random or real.