

## Individual and Moving Range Charts

The simplest and most popular type of variables control chart is the individual and moving range, or I and MR, chart. An I and MR chart is actually two charts.

The top chart, the individual (or individuals) chart, is a plot of each data point in time order. The center line on the chart is the average of all the values.

The bottom chart is the moving range chart. The moving range chart is for plotting the variability between observations.

For each pair of consecutive observations plotted on the individuals chart, we calculate the moving range. The moving range is plotted on the moving range chart.

The center line on the moving range chart is the average moving range for all pairs of consecutive points.

Control charts are used to separate inherent, common cause variation from special cause variation.

For an individuals chart, the control limits are placed at plus or minus 3 standard deviations. If the process is stable, and the data are normally distributed, approximately 99.73% of the observations will fall within these control limits. We don't know the standard deviation, so we estimate it using the data.

There are two ways that we can estimate the standard deviation.

We could use all of the data to produce a long-term, overall estimate, or we could use subsets of the data to produce a short-term estimate. Let's consider these two scenarios.

If we use the overall estimate of the standard deviation, it is likely that the data will contain a special cause of variation.

This would cause the control limits to be wider, resulting in a control chart that is less sensitive to detecting special causes.

The alternative, used for all variables control charts, is to estimate the standard deviation using subsets of the data. The question is, how do we create subsets when we have individual values?

We form subsets, or subgroups, by using pairs of consecutive points. When we do this, we are assuming that these subgroups include only common cause variation. That is, we assume that if a special cause has occurred, observations that are close together in time are more alike than those that are far apart.

Then, we calculate the moving range for each subgroup, and use the average moving range to estimate the standard deviation.

The upper and lower control limits on the individuals chart are based on this short-term, within-subgroup estimate of the standard deviation, rather than using the overall, long-term estimate. This makes the chart more sensitive to detecting special causes.

So why do we calculate moving ranges? Why not just calculate the standard deviations between pairs of points instead of approximating the standard deviation using the average moving range?

This goes back to the origins of control charts. They were created in the 1920s by Walter Shewhart to monitor the quality of a manufacturing process.

Simple arithmetic made sense because there were no computers or calculators. Control charts were created by hand, with pencil and paper.

Of course, now we have powerful computing capabilities and don't need to do the work by hand.

But if you're interested in seeing the computations used to construct control charts, see the Read About It for this lesson.

In this video, you learned about I and MR charts. You also learned how to create subgroups using pairs of consecutive points. Note that subgroups can also be formed using more than two consecutive points, but the typical subgroup size for I and MR charts is two.

Because these subgroups are selected in a rational manner, we refer to them as rational subgroups. In future videos, you learn more about the importance of constructing rational subgroups for variables control charts.

In the next video, you see how to construct an individual and moving range chart in JMP using the Control Chart Builder.

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