Demo: Visualizing Measurement System Variation

For this video, we use the file Micrometer.jmp to demonstrate how to visualize the results of a measurement system analysis in JMP.

We use the Gauge R&R MSA method in the Measurement Systems Analysis platform to create variability charts, and use the EMP method to create average and range charts and parallelism plots.

In this MSA, the measurement system of interest is a hand micrometer, and the quality characteristic is the diameter of metal bearings. The study involves three inspectors measuring 10 parts, with each inspector measuring each part twice.

First, we create a variability chart.

We use the Measurement Systems Analysis platform from the Analyze menu under Quality and Process, and change the MSA Method to Gauge R&R.

Diameter is the Y, Response, Inspector is the X, Grouping variable, and Part is the Part, Sample ID.

The Variability chart for Diameter shows the repeated measurements for each part measured by each inspector.

The lines connecting the repeated measurements show repeatability variation. The lines are relatively long compared to the magnitude of our measurements. This tells us that there is a lot of repeatability variation.

The bottom chart, the standard deviation chart, shows the standard deviation for each part by operator combination.

To visualize reproducibility variation, we select Show Group Means from the top red triangle. The means for the different inspectors are similar to one another. On average, the inspectors are getting the same measurements.

To see if there is an interaction, we select Connect Cell Means from the top red triangle.

The patterns for the parts are different from one inspector to another, indicating that the different inspectors measure the same part differently.

Many other options for visualizing the results of the MSA are provided under the top red triangle.

To create an average and range chart, we again use the Measurement Systems Analysis platform from the Analyze menu under Quality and Process. This time we select EMP as the MSA Method. EMP is short for Evaluate Measurement Process.

We select Diameter as Y, Response, Part as Part, Sample ID and Inspector as X, Grouping.

The Averages chart shows the averages of the repeated measurements for the parts by the three operators. The control limits on the Averages chart are based on an estimate of the standard deviation from the repeated measurements.

If the measurement system is capable, most of the points will fall outside the control limits. This tells you that the measurement system can detect the differences between the parts.

In our example, most of the points fall within the control limits. This tells us that the measurement system is not capable. There is too much repeatability variation relative to the average measurements for the different parts.

Next, we select Parallelism Plots from the top red triangle. The lines for the three inspectors are not parallel, indicating that there is an interaction between inspectors and parts. The inspectors aren't getting the same average measurements on the same parts.

From these graphs, we see that the measurement system isn't capable. There is a lot of repeatability variation, and there is also an interaction between inspectors and parts.

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