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Studying Measurement System Accuracy

Until now, you've seen MSA's studying repeatability and reproducibility variation. A measurement system can be repeatable and reproducible, but this does not mean that the measurement system can accurately measure the parts.

Remember that bias is the difference between the measurement and the true value. A biased measurement system is, on average, not accurate. In order to estimate the bias, you must know the true value of each item being measured. For the Area Measurement MSA, we know the exact area of each object, although we didn't tell you this when you conducted the exercise.

Here are the true values. We call this true value the standard. Comparing the measured value to the standard enables you to study the bias in the area measurement system. To estimate bias, you simply calculate the difference between the measured value and the standard.

Here is the histogram for the Area Measurement data, not including your measurements. The average difference, or bias, is -0.373. This tells you that, on average, the measurements are 0.373 units below the true value.

You can also study bias across the standards, the different inspectors, and the different parts. When we compare the measured value to the standard, we use the term bias. When we study inspectors or parts, the term measurement error is generally used.

Here is a graph of the bias values plotted for each standard. We can see, for example, that the largest part, with an area of 4.4 units, has the largest error on average, and that the part with an area of 3 units is, on average, accurate (or unbiased). We can also see that some individual measurements fell far from the true value.

Here is a graph of the errors for each inspector. Hans M and Olivia L are very close to the standard on average, but the measurements for Ruth H and Yuki S are, on average, 0.7 units below the true value. This graph also show that most inspectors have one or two measurements that are far from the true value.

Before we move on, let's talk about the differences between the inspectors. In this example, we've used inspector names and have referred to inspectors by name when talking about bias. In measurement system studies, the goal is to identify sources of variation within the measurement system. Inspectors and operators are part of the system. If there is variation between operators, this is the result of causes of variation within the system. Blaming operators does not improve the system. It can even make things worse. It's generally recommended that you don't use names. Instead, you anonymize the results to eliminate the tendency to place blame.

To reduce measurement system variation repeatability, reproducibility, bias, or other problems you need to dig in and understand what's causing the variation and address these root causes. You see an example of this in an upcoming video.

In this video, you learned about the concepts of bias and accuracy and have seen how to explore bias for the Area Measurement MSA data. Analyzing the data is the first step in identifying issues in the measurement system. Understanding the reasons why there is bias for particular parts or inspectors is an important next step.

In the next video, you learn how to formally analyze measurement bias in JMP. Many of the statistical results reported in a bias analysis have not yet been introduced, so we omit the statistical details.

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