Manual: 7.1.6. Uncertainty

It is very important to note that all empirical measurements are uncertain. When you step on your bathroom scales in the morning and conclude that you weigh 80kg, ask yourself what this means.

First, the scales have some inherent uncertainty due to the springs being used internally to gauge your weight and turn the readout disc. This measurement uncertainty is usually specified by the manufacturer in the manual.

Second, there is an uncertainty in your reading of the measurement. Since you are looking down at a small disc on the floor, the difference between 80kg and 81kg is barely visible.

Thirdly, there is a change in your condition. Due to the amount of food and drink you consumed in the last hours, your total body weight will change even if you have not gained or lost any fat.

These three sources of error add up to make this measurement uncertain by perhaps about 2kg. So your measurement of 80kg is actually 80 +/- 2kg, i.e. your body weight is somewhere in the range of 78kg to 82kg.

All three of these error sources apply in industrial datasets as well. The sensor has an inherent uncertainty, the measurement chain from sensor to data historian adds a readout uncertainty, and the locally changing conditions at the precise location of the sensor will add variability that is not characteristic of the average situation that one is usually concerned about.

The importance of this lies in the fact that if we use uncertain data in a computation, then the computed result inherits uncertainty from each of its data sources. We can determine the uncertainty in the computed value if we know the measurement uncertainty in the original data. In mathematical modeling, it is as important to have a good model as it is to know how accurate that model is.