Applied Technology

www.e-AT-USA.com

Process Capability Measurement

by John J. Flaig, Ph.D.

Assessing process capability is one of the most important activities that the practitioner may ever undertake. Yet there is still a good deal on disagreement among experts about the proper methodology and metrics. Drs. Kotz and Johnson give an excellent presentation on the current status of process capability measurement in the January issue of the Journal of Quality Technology, Vol. 34, No. 1, which I encourage you to read. Not to be left out, here are my thoughts on the subject of process capability measurement.

First, we need to define capability. I think most people would say intuitively that this means that the process produces product that meets the customer specifications. A good metric should, therefore, map intuitively into this underlying concept. So ask yourself, do any of the common Process Capability Indices (Cp, Cpk, or Cpm) tell you what percentage of the product meets the specifications? No, they don't, unless some non-trivial assumptions are made about the process distribution. In fact, it is easy to construct two distributions that have the same Cpk and one has twice the number of nonconformances as the other. Conversely, two processes might have the same fraction nonconforming can have distinctly different distribution shapes.

The problem here is that capability is a function of the process distribution location, spread, shape, and specification limits with the result that all these variables cannot be mapped into a single unique number in a meaningful way. Many researchers in this field seem to be coming to the same conclusion – one metric is insufficient to accurately characterize process capability. Thus, using the estimated fraction conforming to characterize capability is in my view necessary, but not sufficient.

This problem can be addressed in several ways. The trend is to use several metrics. For example, one approach is to use Cp, Cpk, P_L and P_U (where the P's are the lower and upper estimated fraction nonconforming). Minitab uses this approach. The approach that I favor is to model the observed data distribution and estimate the fraction nonconforming (NC) and the rate of change in the fraction nonconforming or net sensitivity (NS). This dual metric has the form [NC, NS]. Where NC is a measure of the expected process capability and NS is a measure of the possible variation in process capability. Thus, this dual metric gives us a measure of location and a measure variation for the concept we are trying to characterize. In addition, it tells us in which direction to move the process to reduce the fraction nonconforming. Finally, and most importantly, this dual metric maps intuitively into the concept of process capability.

Flaig, J. J. (1999). Process Capability Sensitivity Analysis. Quality Engineering, Marcel Dekker, Vol. 11, No. 4, pp. 587-592.
Flaig, J. J. and Spencer, W. C. (2003). Process Qualification. Quality Engineering, Marcel Dekker, Vol. 16, No. 2.

John J. Flaig, Ph.D.
Managing Director
Applied Technology
Tel: 408-266-5174
E-mail: JohnFlaig@yahoo.com
Website: www.e-AT-USA.com

© 2004 Applied Technology. All rights reserved.