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THE DUAL PROCESS CAPABILITY METRICS

by John J. Flaig, Ph.D.

If you read the article on process capability metrics in the January 2002 issue of the Journal of Quality Technology you will see that several of the discussants make critical comments about the use of the fraction nonconforming (i.e., p or NC) as a capability metric and they are basically correct, NC alone does not provide sufficient information. However, if net sensitivity is added [Flaig, 1999], the dual metric [NC, NS] provides a much better tool for assessing capability and making improvement decisions. For example, Dr. Bothe cites several cases where NC alone provides little or no guidance for improvement. However, if NS is added, the picture changes completely. Thus, if the process distribution is symmetric and the left and right NC are equal, then the improvement plan is to reduce σ. If the distribution is not symmetric and the fallout in the tails are the same, but NS > 0, then process improvement follows from σ reduction and perhaps from a shift in μ to the right (if the goal is to improve robustness). The problem now becomes one of multivariate optimization where the objective is NC $\rightarrow$ 0 and NS $\rightarrow$ 0, and the results depend on the weights assigned to each of the variables. The solution to this problem and the one, cited by Dr. Bothe, where the failure costs in the tails are different can be carried out using a non-linear optimal search program such as that used in the paper Process Capability Optimization [Flaig, 2002]

Another concern expressed by Dr. Ramberg is that the “goalpost” metric NC, though intuitively reasonable, is problematic because the NC metric reflects a binary view of process quality rather than the more modern and reasonable quadratic loss philosophy. This is certainly true, but if we define capability as making product that meets the specifications, then we have attribute data. I

don't disagree that a continuous function would be better and as Dr. Ramberg suggests Cpm or expected loss, EL, might be a good choice, if they mapped seamlessly into the underlying concept of capability. However, though Cpm and EL probably do reflect a part of the general concept of process "goodness", if used alone, they fail to reflect expected yield, which is one of the key concerns of operators and management. Further, I have concerns about the use of the expected loss as a capability metric because it is based only on the expected failure cost and does not include the effect on the revenue stream. In addition, the expected loss function is invariant to changes in specifications. These two issues seem, to me, to be fatal omissions for a proposed capability metric.

In any case, we need to remember that one of the issues in management's mind is what will be the effect of a change in the process parameters or specification limits on the nonconformance rate and profitability and as Dr. Hubele points out our capability metrics need to reflect these concerns.

Reference:

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