

## Estimating Process Capability Index $C_p$ After Testing Equality of Variances

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### Abstract

Process capability indices are used widely in manufacturing industries to measure the performance of a system and evaluate the ability of the system meeting specification requirements. We consider the estimation of the basic process capability index  $C_p$ . When a random sample is taken from a normal distribution, the sample standard deviation is an estimator of the population standard deviation. It is used to replace the population standard deviation in  $C_p$  and obtain an estimator of  $C_p$ . If a second random sample is available from a population with the same variance, it is advantageous to pool the two samples and use the pooled sample variance. The pooled sample standard deviation can be used for estimating  $C_p$ . In some situations, the experimenter is uncertain whether the two populations have the same variance. This uncertainty can be resolved by testing the equality of the two variances; then a preliminary test estimator can be constructed. We study the bias and mean square error of the preliminary test estimator and compare it with the usual estimator using the first sample only. The maximum and minimum relative efficiencies of the preliminary test estimator are given for various significance levels. The maxmin criterion is used to determine the level of the preliminary test.

**Keywords:** Process capability indices, preliminary test estimator, selection of significance level, maxmin criterion.

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