

## On the Use of Generalized $p$ -values to Test Variance Components

Diane K. Michelson

International Sematech Manufacturing Initiative

### Abstract

In this paper, we examine the problem of testing variance components of two similar models. The working example we will use is that of testing the variance components in a gauge study model before and after a process intervention. Specifically, the gauge study model is

$$y_{ijk} = \mu + Day_i + Load_j(Day_i) + Repeat_k(Day_i, Load_j),$$

where  $Day_i$  is the effect of the  $i$ th day,  $Load_j$  is the effect of the  $j$ th load within day, and  $Repeat_k$  is the effect of the  $k$ th repeat within day and load.  $Day$ ,  $Load$ , and  $Repeat$  are all random effects, and are assumed to be normally distributed with zero mean and differing variances. The problem is of testing  $H_0: \sigma^2_{Day,1} = \sigma^2_{Day,2}$  or  $H_0: \sigma^2_{Load,1} = \sigma^2_{Load,2}$  where the two variance components are calculated before and after intervention. We will explain the deficiencies in popular methods of testing these hypotheses, as well as give the generalized  $p$ -value methodology. Examples using gauge study and other nested models will be provided.