

**A NONPARAMETRIC REGRESSION-BASED TEST FOR POISSON
OVERDISPERSION**

A thesis by

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ABSTRACT

Overdispersion in the Poisson regression model (also known as extra-Poisson variation) occurs when the nominal response variance exceeds the mean, and often leads to underestimated standard errors and subsequent errors in inferences about the model. Extra-Poisson variation is usually detected by modeling the variance as a parametric function of the mean. However, this method is also prone to misspecification of the response variance model and, consequently, of inferences about the alternative overdispersed distribution. This study proposes a nonparametric approach to modeling the variance and making inferences about extra-Poisson variation. An overdispersed count distribution is developed to accommodate the possibility of a nonparametric form of the variance. A score test statistic is then used to test for overdispersion and compared with the t -distribution for the parametric test. Alternatively, a bootstrap test is proposed instead of assuming that the score test achieves the t -distribution asymptotically. The simulation study shows that the nonparametric variance models fare better than the parametric models, even when the latter correctly specifies the variance and when there is misspecification in the data. While the parametric t -test may seem to exhibit a higher statistical power, the bootstrap test is shown to have a dramatic decrease in Type-I error, warranting that it is a more properly sized test.

Keywords: Poisson regression, overdispersion, variance model, bootstrap test