



Inference for Clustered Count Data based on Zero-Inflated Conway-Maxwell-Poisson Distribution with Application to the Iowa Fluoride Study

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Community water fluoridation is an important public health measure to prevent dental caries, but it continues to be somewhat controversial. The Iowa Fluoride Study is a longitudinal study on a cohort of Iowa children that began in 1991. The main purpose of this study (<http://www.dentistry.uiowa.edu/preventive-fluoride-study>) was to quantify fluoride exposures from both dietary and non-dietary sources and to associate longitudinal fluoride exposures with dental fluorosis (spots on teeth) and dental caries (cavities). We propose a regression model for count data exhibiting excessive zeros and a wide range of dispersion patterns. In addition, the data are clustered. A zero-inflated version of the Conway-Maxwell-Poisson distribution is used to describe the marginal distribution of a cluster member given its covariate vector. Two estimation methods are introduced. Finite sample behaviours of the estimators and the resulting confidence intervals are studied using an extensive simulation study. The methodology is illustrated using a data set on dental caries extracted from the Iowa Fluoride Study. Among other things, our novel modelling incorporating zero inflation, clustering and under-dispersion shades some new light on the effect of community water fluoridation.

Keywords: bootstrap; caries data; dental caries; expectation-solution algorithm.