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Semiparametric Bivariate Zero-Inflated Poisson Models with Application to Studies of Abundance for Multiple Species

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Ecological studies involving counts of abundance, presence-absence or occupancy rates often produce data having a substantial proportion of zeros. Furthermore, these types of processes are typically multivariate and only adequately described by complex nonlinear relationships involving externally measured covariates. Ignoring these aspects of the data and implementing standard approaches can lead to models that fail to provide adequate scientific understanding of the underlying ecological processes, possibly resulting in a loss of inferential power. One method of dealing with data having excess zeros is to consider the class of univariate zero-inflated generalized linear models. However, this class of models fails to address the multivariate and nonlinear aspects associated with the data usually encountered in practice. Therefore, we propose a semiparametric bivariate zero-inflated Poisson model that takes into account both of these data attributes. The general modeling framework is hierarchical Bayes and is suitable for a broad range of applications. We demonstrate the effectiveness of our model through a motivating example on modeling catch per unit area for multiple species using data from the Missouri River benthic fish study, implemented by the United States Geological Survey.

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