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Comment

Edward J. Bedrick and Joe R. Hill

We congratulate Professor Agresti for his comprehensive review of exact inference with categorical data. We share his enthusiasm for exact conditional methods and believe that the coming years will produce many important computational breakthroughs in this area.

The mechanics of conditioning on sufficient statistics to generate reference distributions for estimation, testing and model checking with loglinear models for Poisson data and logistic regression models for binomial data are well-known, but the utility of conditioning in these settings is not universally agreed upon. Furthermore, the role of conditioning in the analysis of discrete generalized linear models with noncanonical link functions has received little attention from most of the statistical community. As a result, scientists and statisticians are familiar with conditional methods, but many are unsure how such methods should be incorporated into an overall strategy for analyzing categorical data. We feel that the use and abuse of conditional methods will not be fully understood or appreciated without such a strategy. We hope that Professor Agresti's survey and the ensuing discussions stimulate further work in this direction.

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CHECKING LOGISTIC REGRESSION MODELS

We would like to convey some of our recent work on model checking for logistic regression and some of our thoughts regarding conditional inference. For the sake of simplicity, we assume that a single model is under consideration. A little notation is required. The usual logistic regression model has two distinct parts: a sampling component and a structural component. The sampling component specifies that $Y = (Y_1, \ldots, Y_n)'$ is a vector of independent binomial random variables with $Y_i \sim \text{Bin}(m_i, \pi_i)$. The structural or regression component of the model is given by

$$\text{logit}(\pi) = X\beta, \tag{1}$$

where $\text{logit}(\pi)$ is an $n \times 1$ vector of log-odds with elements $\log\{\pi_i/(1 - \pi_i)\}$, X is an $n \times p$ full-column rank design matrix with ith row x_i', and β is a $p \times 1$ vector of unknown regression parameters. Under model (1), $S = X'Y$ is sufficient for β. Let $\hat{\pi}$ be the MLE of π under this model.

The distribution of the data $\text{pr}(Y; \beta)$, indexed by β, can be factored into the marginal distribution of the sufficient statistic S, and the conditional distribution of the data given the sufficient statistic:

$$\text{pr}(Y; \beta) = \text{pr}(Y \mid S)\text{pr}(S; \beta).$$

Taking a Fisherian point of view (Fisher, 1950), inferences about β are based on $\text{pr}(S; \beta)$, whereas model checks use the conditional distribution $\text{pr}(Y \mid S)$. Letting $s_{obs} = X' y_{obs}$ be the observed value of the sufficient statistic for the logistic model,