MODELING ASYMMETRIC BIVARIATE ORDERED CATEGORICAL DATA USING A GENERALIZATION OF GUMBELS BIVARIATE LOGISTIC DISTRIBUTION

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In many areas of medical research, especially in studies that involve paired organs, a bivariate ordered categorical response is available. Using a bivariate continuous distribution as the latent variable is an interesting strategy for analyzing these data sets. In this context, the bivariate standard normal distribution, which leads to the bivariate cumulative probit regression model, is the most common choice. In this paper, we introduce another latent variable regression model for modeling bivariate ordered categorical responses. This model may be an appropriate alternative for the bivariate cumulative probit regression model, when postulating a symmetric form for marginal or joint distribution of response data does not appear to be a valid assumption. We also develop the necessary numerical procedure to obtain the maximum likelihood estimates of the model parameters. To illustrate the proposed model, we analyze data from an epidemiologic study to identify some of the most important risk indicators of periodontal disease among students 15-19 years in Tehran, Iran. For this data, the results showed that our proposed model gives a better fit compared to the commonly used bivariate cumulative probit regression model.