

# **Flexible marginalized models for bivariate longitudinal ordinal data with application to causal inference for quality of life data**

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## **Abstract:**

Random effects models are commonly used to analyze longitudinal categorical data. Marginalized random effects models (MREMs) are a class of models that permit direct estimation of marginal mean parameters and characterize serial dependence for longitudinal categorical data via random effects (Heagerty, 1999; Lee and Daniels, 2008). In this paper, we produce a Kronecker product (KP) covariance structure to capture both dependence between processes at a given time and dependence within a process over time (serial dependence). For the latter, we consider a more general class of models than standard (first order) autoregressive correlation models, by re-parameterizing the correlation matrix using partial autocorrelations (Daniels and Pourahmadi, 2009). We assess the reasonableness of the KP structure with a score test. A maximum marginal likelihood estimation method is proposed utilizing a Quasi-Newton algorithm with Quasi-Monte Carlo integration of the random effects. We analyze quality of life data from a colorectal cancer clinical trial using our methods.

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