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Finding market structure by sales count dynamics —Multivariate structural time series models with hierarchical structure for count data—

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Abstract In this paper, we propose a multivariate time series model for sales count data. Based on the fact that setting an independent Poisson distribution to each brand's sales produces the Poisson distribution for their total number, characterized as market sales, and then, conditional on market sales, the brand sales follow a multinomial distribution, we first extend this Poisson–multinomial modeling to a dynamic model in terms of a generalized linear model. We further extend the model to contain nesting hierarchical structures in order to apply it to find the market structure in the field of marketing. As an application using point of sales time series in a store, we compare several possible hypotheses on market structure and choose the most plausible structure by using several model selection criteria, including in-sample fit, out-of-sample forecasting errors, and information criterion.

Keywords Count data · Generalized linear model · Hierarchical market structure · MCMC · Poisson–multinomial distribution · Predictive density · POS time series