学位論文内容の要旨

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学位論文題名

Bayesian analysis on spatial econometric models
空間計量経済モデルのベイズ分析

For discrete dependent variables, the most commonly used models are logit models and probit models. Due to the widespread existence of spatial effects, researchers have applied spatial econometric models to discrete response variables. When spatial dimension is considered as an independent factor, a logistic structured additive regression (STAR) model may be used to explore the spatial effects. When the discrete dependent variables are ordinal and correlated, a multivariate ordered probit model can be applied to capture the interactions of ordinal responses. Currently, there are few researchers considering the spatial effects on multivariate ordinal responses, and the spatial dependencies have been confirmed to exist in many ordinal dependent variables. Therefore, a new multivariate probit model is needed to capture the interactions and the spatial dependencies of ordinal responses. Besides spatial dependencies, temporal dependencies also widely exist in ordinal dependent variables. Therefore, a more comprehensive model needs to be proposed to capture temporal and spatial dependencies simultaneously for the multivariate ordinal responses.

The traditional estimation method of discrete dependent variable models is the maximum likelihood (ML) method, but Beron and Vijverberg (2004) found it difficult to estimate. Albert and Chib (1993) introduced latent continuous variables into probit models and proposed the Bayesian inference for the estimation. Following Albert and Chib (1993), Bayesian inference have been widely applied to discrete response variable models (Chen and Dey, 2000; Hasegawa, 2010; Jeliazkov et al., 2008; LeSage, 1999). LeSage (1999) introduced Albert and Chib (1993)'s method in spatial econometrics and proposed the Markov Chain Monte Carlo (MCMC) method to estimate the spatial models. Because the Bayesian method can be applied to complex models that cannot or is difficult be estimated by traditional methods, it is gradually recognized and used in spatial econometrics.

In Chapter 2, the STAR models are applied to the chronic disease data in elderly Chinese people. Chronic diseases have become important factors affecting the health of elderly

Chinese people. Because the prevalence of chronic disease varies among the provinces, it is necessary to understand the spatial effects on these diseases, as well as their relationships with potential risk factors. Because the structured additive regression (STAR) model can combine spatial effects, nonlinear effects of continuous factors, and the linear or fixed effects into a single model, it is applied to the data obtained from the 2000, 2006, and 2010 Chinese Urban and Rural Elderly Population Surveys. R2BayesX package is used to conduct the Bayesian analysis. The empirical results show that the province is a critical influencing factor, and the highest spatial effect usually appeared in two types of provinces: economically developed provinces, and economically backward provinces with complex terrain.

Spatial influences, besides being treated as an independent factor, have also been confirmed to exist in many dependent variables. Since many ordinal discrete responses are correlated and spatially dependent, it is better to study them together, rather than separately. Thus, a model that captures the interactions and the spatial relationships of multivariate ordinal outcomes in needed. Following. Smith and LeSage (2004) and Jeliazkov et al. (2008), a multivariate spatial ordered probit (MSOP) model is proposed to address this need in Chapter 3. In applying this model, the parameters are calculated using the Bayesian inference based on the MCMC sampling. The validity and accuracy of the MSOP model is verified by simulated datasets, and the model performs very well with the simulated data. In addition, this study illustrates the model by applying it to two response variables, self-rated health and life satisfaction of elderly people in six provinces in East China. The empirical results show that the spatial dependencies are indispensable on the response variables.

Besides spatial dependencies, temporal dependencies also widely exist. In Chapter 4, the MSOP model is extended to the dynamic multivariate spatial ordered probit (DMSOP) model, wherein the spatial dependencies are explained using an additive error specification, as in Smith and LeSage (2004). The DMSOP model is the first attempt to capture temporal and spatial dependencies simultaneously for the multivariate ordinal responses. The parameters are still calculated using the Bayesian inference based on the MCMC sampling. A simulation study is implemented to demonstrate the validity and accuracy of the model. The DMSOP model performs effectively with the simulated data. It successfully explains the temporal and spatial dependencies, and the interaction of multivariate ordinal response variables as well as the effects of the explanatory variables. Additionally, the study applied the DMSOP model to the survey data from China Family Panel Studies (CFPS). The spatial coefficient and the temporal coefficient are considerable, and thus the spatial and temporal dependencies in the empirical study are critical.

Key Words: Bayesian inference, dynamic, Markov chain Monte Carlo (MCMC), multivariate response variables, ordered probit model, spatial dependency.

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