Specification of Spatial Models with Measurement Error: A Simulation Study

Anıl Eralp[1], Şahika Gökmen[2] and Rukiye Dağalp[3]

[1] *Bolu Abant İzzet Baysal University, Bolu, Turkey*
[2] *Ankara Hacı Bayram University, Ankara, Turkey*
[3] *Ankara University, Ankara, Turkey*

Abstract

In the literature, the response and explanatory variables examine over the observations and random errors that arise during the observation process. The variables that cannot exactly measure are called error-in-variables and are analyzed with measurement errors models. Besides some variables are not measurable directly with a measurement unit due to their nature and are measured indirectly and so-called latent variables, and in these kinds of variables, measurement error is also encountered [1]. Therefore, measurement errors could be encountered in both direct and indirect measurements of the relevant variable. When the measurement error is generally mentioned, it is that arises from the measurement in observing the true value of variables. In this context, the difference between the true value of observation and its observed values gives the measurement error. As a simple explanation, the random variable X^*, called error-prone, is observed with a measurement error U instead of the real variable X that is $X^* = X + U$ defined by the classical error model. The measurement error U is assumed a random variable with a distribution of $N(0; \sigma_U^2)$ and unrelated to X [2]. Therefore, the effects of measurement error cause inconsistent parameter estimation and so the inconsistent prediction in a regression model analyzing with error-prone covariates [3] [4]. The effect of the measurement error in the explanatory variables is much more important than the measurement error in the response variable on the parameter estimation. The results of statistical analysis are reliable, useful, and meaningful depending on the measurements of the data that is used, although there is an opinion that measurement errors are small enough to be neglected and can be ignored in the analysis in practice. In contrast, the view of measurement errors ignored by studies in this area has been decreasing in recent years. There are lots of studies for both indicate the effects of measurement error through the different models and improve new methodologies to estimate measurement error models.

Observations for a random variable are assumed to be independent of each other in conventional regression models using cross-section data sets. However, the observations obtained from points in regional locations, spatial dependence is often encountered between observations.

Spatial dependence is that observation values in a location tend to be similar to observation values in nearby locations; spatial regression methods are used to explain the cause of this dependence [5]. In parallel with the increase in the production of spatial data, the importance of measurement errors has raised with the increase in the use of spatial models. However, it is seen that error-in-variables are handled in relatively few studies investigating spatial models using spatial data have stressed (e.g., [6] [7] [8]. These studies investigate spatial regression models using spatial data with the classical measurement error models. In case, Anselin and Lozano-Gracia (2009) discuss the model estimation presence of measurement error that occurs actually the unobservable covariate but is measured by spatial interpolation [9]. This study can be taken as an example of the measurement error caused by a latent variable.

Keywords

Measurement error, spatial regression models, simulation.

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