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## HECKMAN TWO-STAGE SPATIAL MODELS FOR AGRICULTURAL LAND USE CHANGE

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### *Abstract*

Modelling agricultural land use and land use change is a remarkable challenge in terms of statistical analysis. Often, the scarcity of data hampers an exhaustive analysis of the subject, while, instead, its abundance complicates the estimation of a statistical model, since there exists no suitable technique than can cope with the complexity and the size of the problem, especially when spatial dependence and spatial autocorrelation are taken into account. This issue is strongly related to the spatial scale of the study region: large areas tend to have less refined scales, while smaller areas support finer ones. The Provence region in Southern France offers the unique opportunity to access fine scale data (around 5 millions parcels) for a NUTS2 region. For this study, we are forced to discard existing approaches, such as spatio-temporal multinomial (Sidharthan & Bhat, 2012) and multivariate a-spatial fractional models (Murteira & Ramalho, 2014), since they cannot handle big sample sizes and the large number of alternative agricultural land use. We propose a two-stage procedure, a.k.a. Heckman two-stage method, that allows for correcting non-randomly selected samples. In the first stage we formulate a model for the probability of presence/absence of the different crop choices. This model will be fit using the spatial probit technique (Martinetti & Geniaux, 2016), in order to account for spatial dependence between observations and a set of independent variables that describes the parcel characteristics. In the second stage we will analyse the shares of the different land use by means of a fractional model that will account for the presence/absence information provided by the first probit estimation (Heckman correction). The resulting model aims to explain the distribution of agricultural land use types as a function of socio-economic, pedo-climatic and historical characteristics of the territory at different spatial scales, also accounting for possible spatial autocorrelation between observations.

### *References*

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