Accepted Manuscript

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PII: S0304-4076(18)30058-7
DOI: https://doi.org/10.1016/j.jeconom.2018.01.008
Reference: ECONOM 4498

To appear in: *Journal of Econometrics*

Received date : 21 September 2014
Revised date : 23 July 2017
Accepted date : 17 January 2018

Please cite this article as: Hillier G., Martellosio F., Exact and higher-order properties of the MLE in spatial autoregressive models, with applications to inference. *Journal of Econometrics* (2018), https://doi.org/10.1016/j.jeconom.2018.01.008

Exact and higher-order properties of the MLE in spatial autoregressive models, with applications to inference.

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January 11, 2018

Abstract
The quasi-maximum likelihood estimator for the autoregressive parameter in a spatial autoregression usually cannot be written explicitly in terms of the data. A rigorous analysis of the first-order asymptotic properties of the estimator, under some assumptions on the evolution of the spatial design matrix, is available in Lee (2004), but very little is known about its exact or higher-order properties. In this paper we first show that the exact cumulative distribution function of the estimator can, under mild assumptions, be written in terms of that of a particular quadratic form. Simple examples are used to illustrate important exact properties of the estimator that follow from this representation. In general models a complete exact analysis is not possible, but a higher-order (saddlepoint) approximation is made available by the main result. We use this approximation to construct confidence intervals for the autoregressive parameter. Coverage properties of the proposed confidence intervals are studied by Monte Carlo simulation, and are found to be excellent in a variety of circumstances.

Keywords: spatial autoregression, maximum likelihood estimation, group interaction, social networks, complete bipartite graph, saddlepoint.
JEL Classification: C12, C21.

Acknowledgements: We would like to thank the Editor (Oliver Linton), the Associate Editor, the anonymous referees, and Benedikt Pötscher for very helpful comments and suggestions.

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