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### **Title**

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### **Author**

Farrell, Rob

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**Patrick Doreian: Modeling Sociological Processes Using Spatially  
Distributed Data  
By Rob Farrell**

*Background* Patrick Doreian set out in the 1970s to foster a paradigmatic shift in sociological methodology. He correctly noticed the rudimentary fashion in which geographical autocorrelation was addressed in sociological research. Many of his contemporaries were attempting to estimate linear relationships with spatially distributed data. However, they failed to account for the interdependencies that existed between observations of these geographically based variables. Doreian was concerned that incorrect inferences could be drawn from simple linear relationships that failed to incorporate an underlying spatial process. He therefore produced a set of publications in the late 1970s and early 1980s that was meant to facilitate among his fellow sociological researchers the usage of known spatial interaction estimation methods.

*Innovation* The stage for Doreian's contribution was provided by a set of significant methodological developments in statistics and mathematical ecology. The seminal paper of Whittle (1954) helped begin a significant discussion about estimating autoregressive coefficients in space. Also, working primarily in mathematical ecology, Mead (1967) presented a small-sample derivation of the "competition coefficient" (autocorrelation coefficient) estimation for several multi-directional hexagonal arrays using Maximum Likelihood Estimation. Ord (1975) produced a succinct compilation of spatial interaction estimation methods to date, identified computation possibilities, and extended the concepts to mixed regressive-autoregressive models. Doreian set out to make the derivation of these methods accessible to those working in sociology.

Through his publications in the sociological literature, Doreian accomplished two primary objectives. First, he introduced his colleagues to advanced estimation methods of spatial interaction (Doreian 1976) currently in practice by statisticians, geographers, and mathematical ecologists. Second, Doreian (1980, 1981) showed empirically the importance of incorporating these methods in sociological research. Together, these two accomplishments brought an

increased capability for sociologists to perform analyses with spatial data.

To show the role these methods played in interpreting data, Doreian extended two well-known social science research projects, one on political insurgency (Mitchell 1969) and the other on electoral support in Louisiana (Inverarity 1976), and presented them in a new light. Doreian took the data used by Mitchell and compared the parameter estimates for the explanatory variables from Ordinary Least Squares (OLS) with those estimated from the Maximum Likelihood Estimation (MLE) procedures outlined by Ord (1975) and Mead (1967). Similarly, he indirectly extended the project from Inverarity by examining electoral support for Democrats in Louisiana with and without spatial effects included, using the same MLE procedures.

For both analyses, he identified the differences between the results obtained from Ordinary Least Squares (OLS) and those obtained from a mixed regressive-autoregressive model estimated using the autoregressive component. He found that parameter estimates for exogenous variables changed significantly when the spatial effect was included in the model. He also found that standard errors of the parameter estimates in the non-spatial models were larger than in the mixed model. His papers therefore highlighted the potential for inflated parameter estimates and standard errors under OLS, as well as the potential for varying inferential results from the two methods. His work in this area showed that spatial effects are important, and that they need to be treated with appropriate analytic methods when present.

These methods were developed in a time when computing costs were still substantial. However, today, computing opportunities allow for researchers to more easily calculate, visualize, and understand spatial autocorrelation in their data sets. GeoDa is an example of a software package that allows users to construct spatial weighting schemes and can produce on-the-fly spatial autocorrelation measures and maps. Luc Anselin at the University of Illinois developed this tool in conjunction with the Center for Spatially Integrated Social Science, an NSF-funded project. Advances such as this now provide social scientists with resources to quickly and easily understand spatial autocorrelation in their data sets. Contemporary quantitative texts, such as *Quantitative Geography* (Fotheringham, et. al. 2000), now consider knowledge of these techniques fundamental to social science research. Patrick Doreian called attention to the techniques for handling spatial effects in models; and, technology provided the decision support systems to enable researchers to assess when these techniques are appropriate.

Continuing to work as a mathematical sociologist at the University of Pittsburgh, Patrick Doreian holds a primary academic appointment in Sociology and secondary appointments in Statistics and Psychology. His research still has a

significant focus on modeling social networks and the mathematical concerns associated with spatial autocorrelation in these models. Patrick Doreian did not develop the methods for modeling spatial interaction, but he is credited for his significant role in making fellow social scientists aware of spatial processes and for illustrating the value of spatial methodologies in social science.

### *Publications*

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### *Related Works*

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*Links* [GeoDa](#)  
[Patrick Doreian homepage](#)

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Page Author: Rob Farrell