

Description

The `Sp` commands manage data and fit regressions accounting for spatial relationships. `Sp` fits SAR models that include spatial lags of dependent and independent variables with spatial autoregressive errors on **lattice** and **areal** data, which includes nongeographic data such as social network nodes.

Different fields use different jargon for spatial concepts. SAR stands for (take your pick) spatial autoregressive or simultaneous autoregressive.

Eight short introductions will turn you into an expert on the `Sp` software. In these introductions, you will learn about spatial weighting matrices and how to create them as you prepare your data for analysis. You will learn about three estimation commands—`spregress`, `spivregress`, and `spxtregress`—for fitting SAR models. You will also find a worked example that includes data preparation, model fitting, and interpretation. Read the introductions first and read them sequentially.

The introductions and the commands of interest with spatial data are listed below, and each command is described in detail in its respective manual entry.

Learning the system

[SP] Intro 1	A brief introduction to SAR models
[SP] Intro 2	The W matrix
[SP] Intro 3	Preparing data for analysis
[SP] Intro 4	Preparing data: Data with shapefiles
[SP] Intro 5	Preparing data: Data containing locations (no shapefiles)
[SP] Intro 6	Preparing data: Data without shapefiles or locations
[SP] Intro 7	Example from start to finish
[SP] Intro 8	The <code>Sp</code> estimation commands

Preparing data

[D] zipfile	Compress and uncompress files in zip archive format
[SP] spshape2dta	Translate shapefile to Stata format
[SP] spset	Declare data to be <code>Sp</code> spatial data
[SP] spbalance	Make panel data strongly balanced
[SP] spcompress	Compress Stata-format shapefile

Looking at data

[SP] grmap	Graph choropleth maps
[SP] spdistance	Calculator for distance between places

Setting the spatial weighting matrix

[SP] spmatrix	Create, manipulate, and import/export weighting matrices
[SP] spgenerate	Generate spatial lag ($\mathbf{W} \times \mathbf{x}$) variables

Fitting models

[SP] spregress	Fit cross-sectional SAR models
[SP] spivregress	Fit cross-sectional SAR models with endogenous covariates
[SP] spxtregress	Fit panel-data SAR models

Postestimation

[SP] estat moran	Moran's test after regress
[SP] spregress postestimation	Postestimation tools for spregress
[SP] spivregress postestimation	Postestimation tools for spivregress
[SP] spxtregress postestimation	Postestimation tools for spxtregress

Remarks and examples

The sections below provide more information about SAR models.

References for learning SAR models

Technical references on the development and fitting of SAR models

References for learning SAR models

Spatial models have been applied in a variety of disciplines, such as criminology, demography, economics, epidemiology, political science, and public health. [Cressie \(1993\)](#), [Darmofal \(2015\)](#), [LeSage and Pace \(2009\)](#), and [Waller and Gotway \(2004\)](#) provide textbook introductions.

[Darmofal \(2015, chap. 2\)](#) gives an introduction to spatial weighting matrices.

[LeSage and Pace \(2009, sec. 2.7\)](#) define total, direct, and indirect impacts.

[Anselin \(1988\)](#) gives a classic introduction to the subject.

Technical references on the development and fitting of SAR models

SAR models date back to the work of [Whittle \(1954\)](#) and [Cliff and Ord \(1973, 1981\)](#).

The GS2SLS estimator was derived by [Kelejian and Prucha \(1998, 1999, 2010\)](#) and extended by [Arraiz et al. \(2010\)](#) and [Drukker, Egger, and Prucha \(2013\)](#).

The formulas for the GS2SLS without higher-order spatial weighting matrices were published in [Drukker, Prucha, and Raciborski \(2013a\)](#). For the higher-order models, `spregress`, `gs2s1s` implements the estimator derived in [Badinger and Egger \(2011\)](#) and [Drukker, Egger, and Prucha \(2023\)](#).

The properties of the ML estimator were proven by [Lee \(2004\)](#), who also provides the formulas for the robust estimator of the VCE.

[Kelejian and Prucha \(2010\)](#) give a technical discussion of how normalizing spatial weighting matrices affects parameter definition.

[Lee and Yu \(2011\)](#) give formulas and theory for SAR panel models.

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StataCorp’s `Sp` commands are based on earlier versions published in Drukker, Prucha, and Raciborski (2013a, 2013b) and Drukker et al. (2013).

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