STATA Features

Spatial autoregressive (SAR) models

- **Linear models for spatial data**
  - Spatially autoregressive and heteroskedastic errors
  - Spatial lags of dependent variables
  - Spatial lags of independent variables
  - Spatial lags given by one or more spatial weighting matrices
  - Different types of spatial weighting matrices
  - Maximum likelihood and generalized method of moments (GS2SLS) estimators

- **Estimate direct and indirect (spillover) effects**

- **Moran's test of spatial error correlation**

- **SAR models for longitudinal or panel data**

- **Instrumental-variables SAR models**

- **Create and manage spatial weighting matrices**

- **Import shapefiles**

```
Viewer - view sp1.smcl                                            —    □    ×
view sp1.smcl  ×
+                                            Dialog ▾  Also see ▾  Jump to ▾

. spregress y x, ml dvarlag(W) errorlag(W)

Spatial autoregressive model                    Number of obs  =    1,412
Maximum likelihood estimates                    Wald chi2(2)   =    25.76
                                                Prob > chi2    =   0.0000
Log likelihood = -4656.3167                     Pseudo R2      =   0.0020

          y │ Coefficient  Std. err.      z    P>|z|    [95% conf. interval]
────────────┼──────────────────────────────────────────────────────────────
y           │
      xtset │    .762087   .1667529     4.57   0.000    .4352573   1.088917
      _cons │   3.331143   1.748412     1.91   0.057   -.0956816   6.757968
────────────┼──────────────────────────────────────────────────────────────
W           │
          y │  -.5038401   .2096501    -2.40   0.016   -.9147468  -.0929335
        e.y │   .8295794   .1026362     8.08   0.000    .6284162   1.030743
────────────┼──────────────────────────────────────────────────────────────
     var(e.y)│  36.56831   2.830766                     31.42049   42.55952
────────────┼──────────────────────────────────────────────────────────────
Wald test of spatial terms:          chi2(2) = 589.63    Prob > chi2 = 0.0000
                                                              CAP  NUM  INS
```

Stata's Sp suite of commands fits simultaneous autoregressive (SAR) models to spatial lattice data.

Declare or import spatial lattice data

Use **spset** to declare your spatial data-recording coordinates

`. spset spid, coord(longitude latitude) coordsys(latlong)`

Or import your spatial data from a shapefile

`. spshape2dta` *shapefilename*

Create spatial weighting matrices

Create a contiguity matrix based on nearest neighbors

`. spmatrix create contiguity W`

Check for spatial dependence

Fit linear regression

`. regress y x`

Perform Moran's spatial test

`. estat moran, errorlag(W)`

Fit your model

Spatial error model

`. spregress y x, ml errorlag(W)`

Spatial lag model

`. spregress y x, ml dvarlag(W)`

Simultaneous autoregressive model

`. spregress y x, ml dvarlag(W) errorlag(W)`

(See output at top of page.)

Perform postestimation analysis

Estimate direct and indirect effects after fitting your model

`. estat impact`

And more.

SAR models for cross-sectional data

SAR model using inverse-distance weighting matrix **M** for errors and contiguity matrix **W** for spatial lags of dependent and independent variables:

```
. spregress hrate ln_population ln_pdensity gini,
        gs2sls dvarlag(W) errorlag(M)
        ivarlag(W: ln_population ln_pdensity gini)
```

Viewer - view sp2.smcl

Spatial autoregressive model
GS2SLS estimates

				Number of obs =	1,412
				Wald chi2(7) =	357.06
				Prob > chi2 =	0.0000
				Pseudo R2 =	0.1241

hrate	Coefficient	Std. err.	z	P>|z|	[95% conf. interval]	
hrate						
ln_populat~n	-.0475582	.3295548	-0.14	0.885	-.6934737	.5983573
ln_pdensity	.8989538	.3211524	2.80	0.005	.2695066	1.528401
gini	89.91969	6.409286	14.03	0.000	77.35772	102.4817
_cons	-32.21599	3.590014	-8.97	0.000	-39.25229	-25.17969
W						
ln_populat~n	2.679931	.5218152	5.14	0.000	1.657192	3.702669
ln_pdensity	-2.468953	.6209688	-3.98	0.000	-3.686029	-1.251876
gini	-57.38302	9.418108	-6.09	0.000	-75.84217	-38.92387
hrate	.6818566	.1141573	5.97	0.000	.4581125	.9056007
M						
e.hrate	.9533048	.1324392	7.20	0.000	.6937289	1.212881

Wald test of spatial terms: chi2(5) = 169.23   Prob > chi2 = 0.0000

Spatial data

- Data with shapefiles
- Data with spatial coordinates
- Nongeographic data such as networks
- Automatic translation of shapefiles
- Planar coordinates or longitude and latitude
- Calculate distances

SAR models for longitudinal or panel data

Random-effects SAR model with inverse-distance weighting matrix **M** for errors and spatial lags:

```
. spxtregress hrate ln_population ln_pdensity gini, re
        dvarlag(M) errorlag(M)
```

Viewer - view sp3.smcl

Random-effects spatial regression
Group variable: _ID

		Number of obs =	5,648
		Number of groups =	1,412
		Obs per group =	4

| | | Wald chi2(4) = | 714.85 |
| | | Prob > chi2 = | 0.0000 |
Log likelihood = -1.832e+04   Pseudo R2 = 0.0913

hrate	Coefficient	Std. err.	z	P>|z|	[95% conf. interval]	
hrate						
ln_populat~n	.6136447	.1777656	3.45	0.001	.2652305	.9620588
ln_pdensity	-.0951383	.1693845	-0.56	0.574	-.4271257	.2368492
gini	28.49245	2.571106	11.08	0.000	23.45317	33.53172
_cons	-13.04204	1.594928	-8.18	0.000	-16.16804	-9.916039
M						
hrate	.6354142	.041818	15.19	0.000	.5534524	.7173761
e.hrate	2.241958	.0486863	46.05	0.000	2.146535	2.337382
/sigma_u	2.778349	.1146385			2.562507	3.012372
/sigma_e	5.668232	.062084			5.547846	5.79123

Wald test of spatial terms: chi2(2) = 2385.86   Prob > chi2 = 0.0000

spxtregress also supports a fixed-effects estimator.

Spatial weighting matrices

- Nearest-neighbor, inverse-distance, and custom
- Normalization: spectral, min–max, or row
- Manage matrices: list, summarize, copy, save, and more
- Import and export matrices from text files
- Use and save matrices in Stata format

Use commands or point and click