DAY 1

Spatial Data and Spatial Analysis

Welcome and Organization

Introduction and Motivation

- Why spatial data analysis
- Outline of course
- A quick tour

What is special about spatial data

- GIS and spatial data
- Spatial sampling
- Spatial models

Lab

Overview and demonstration of course software

ArcView 3.2

SpaceStat 1.91

SpaceStat and DynESDA Extensions for ArcView

CrimeStat

Variowin

Optional: Basics of ArcView (for those not familiar with ArcView)

Exercises 1 through 6 in Workbook on CD (not in the attached set!)

Basics of SpaceStat (may be skimmed by those already familiar with SpaceStat)

Exercise 1: SpaceStat Basics

Exercise 2: Linking SpaceStat and ArcView

Readings

Anselin L. (1999). The future of spatial analysis in the social sciences. *Geographic Information Sciences* 5, 67-76.

Further Reading

Goodchild M. and Getis A (eds) (2000). Special Issue: Spatial Analysis and GIS. *Journal of Geographical Systems* 2, 1-110.

Goodchild M., Anselin L., Appelbaum R., Harthorn B. (2000). Toward spatially integrated social science. *International Regional Science Review* 23, 139-159.

Mitchell A. (2000). *The ESRI guide to GIS analysis*. Redlands: ESRI Press.

Fortheringham A.S., Brunsdon C., Charlton M. (2000). *Quantitative Geography, Perspectives on Spatial Data Analysis*. London: Sage Publications.

DAY 2

Visualization and ESDA

Visualization and Exploratory Spatial Data Analysis

- Geovisualization
- Exploratory spatial data analysis (ESDA)
- Smoothing rates

Exercises

ESDA

Exercise 3: Outlier Analysis

Exercise 4: Smoothing Rates

Exercise 5: DynESDA Extension Basics

Exercsie 6: Dynamic ESDA

Readings

Anselin L. (1999). Interactive techniques and exploratory spatial data analysis. In P. Longley, M. Goodchild, D. Maguire, D. Rhind (eds) *Geograpical Information Systems* (2nd ed). New York: Wiley.

Bailey, T and Gatrell A (1995). *Interactive spatial data analysis*. New York: Wiley. (pp. 299-308)

Further Reading

Lawson, A.B. and Williams, F. (2001). *An Introductory Guide to Disease Mapping*. Chichester: Wiley.

Point Pattern Analysis

Point Pattern Analysis

- Pattern
- First order statistics
- Nearest neighbor statistics
- Second order statistics

Exercises

Descriptive statistics and nearest neighbor analysis using CrimeStat

Exercise 7: Centrography

Exercise 8: Nearest neighbor statistics

Readings

Levine N. (2000). *CrimeStat 1.1, A spatial statistics program for the analysis of crime incident locations*. Washington: National Institute of Justice, Chapters 4 and 5.

Further Reading

Bailey and Gatrell, Chapters 3-4.

DAY 3

Spatial Autocorrelation

Spatial Arrangement and Spatial Weights

- Connectivity in space
- Spatial weights
- Spatial lag operator

Exercises:

Spatial weights manipulation in SpaceStat

Exercise 9: Constructing Spatial Weights from ArcView Shape Files

Exercise 10: Spatial Weights Based on Distance Metrics

Exercise 11: Spatial Weights and Spatial Lags

Readings

Anselin L. (1992) *SpaceStat Tutorial*. Chapters 10-17.

Anselin L. (1995) *SpaceStat V1.80 User's Guide*, pp. 19-30.

Further Reading

Cliff A. and Ord J.K. (1981). *Spatial Processes, Models and Applications*. London: Pion, pp. 17-19.

Anselin L. (1988). *Spatial econometrics, methods and models*. Boston: Kluwer Academic, Chapter 3.

Spatial Autocorrelation Indices

- Global spatial autocorrelation

Exercises:

Spatial autocorrelation statistics

Exercise 12: Join Count Statistics

Exercise 13: Spatial Correlogram for Moran's I and Geary's c

Readings

Cliff and Ord (1981), Chapter 2.

SpaceStat Tutorial, Ch. 21, 22 and 24, SpaceStat V1.80 User's Guide pp. 37-38.

Further Reading

Upton G. and Fingleton B. (1985). *Spatial data analysis by example*. New York: Wiley, pp. 151-176, 186-194.

DAY 4

Spatial Autocorrelation (continued)

Spatial Autocorrelation Indices

- Visualizing spatial autocorrelation
- Local indicators of spatial association (LISA)

Exercises:

Spatial autocorrelation statistics: computation and visualization

Exercise 14: Visualizing Spatial Dependence, Moran Scatterplot

Exercise 15: LISA Maps

Readings

Anselin L. (1995). Local indicators of spatial association - LISA. Geographical Analysis 27, 93-115.

Further Reading

Anselin L. (1996). The Moran scatterplot as an ESDA tool to assess local instability in spatial association. In Fischer M., Scholten H., Unwin D. (eds) *Spatial analytical perspectives on GIS*, pp. 111-125. New York: Pergamon.

Ord J.K. and Getis A. (1995). Local spatial autocorrelation statistics: distributional issues and applications. *Geographical Analysis* 27, 286-306.

Geostatistics

- Geostatistical perspective
- Variogram function
- Variogram models

Exercises:

Exploring and modeling variograms

Exercise 16: Variowin Basics

Exercise 17: Exploring Variograms

Exercise 18: Modeling Variograms

Readings

Bailey and Gatrell (1995). Chapter 5.

Further Reading

Cressie N. (1993) *Statistics for spatial data*. New York: Wiley, Chapter 2.

Pannatier, Y (1996). *Variowin, software for spatial data analysis in 2D*. Berlin: Springer-Verlag, Chapters 4, 5.

DAY 5

Geostatistics (continued)

- Kriging

Readings

Bailey and Gatrell (1995). Chapter 5.

Further Reading

Goovaerts P. (1997). *Geostatistics for natural resources evaluation*. New York: Oxford, Chapter 5.

Spatial Regression

Spatial Regression

- Spatial econometrics
- Spatial regression specifications
- Estimation
- Specification testing

Exercises:

Setting up spatial regressions in SpaceStat

Exercise 19: SpaceStat Regression Basics

Diagnostics for spatial dependence

Exercise 20: Diagnostics for Spatial Effects

Estimating models with spatial dependence

Exercise 21: ML Estimation of the Spatial Lag Model

Exercise 22: IV Estimation of the Spatial Lag Model

Exercise 23: ML Estimation of the Spatial Error Model

Readings

Anselin L. (2001). Spatial econometrics. In Baltagi B. (ed) *A companion to theoretical econometrics*., pp. 310-330. Oxford: Basil Blackwell.

Spatial Econometrics, Chapters 4-6.

Further Reading

Anselin L. and Bera A. (1998). Spatial dependence in linear regression models with an introduction to spatial econometrics. In Ullah A. and Giles D. (eds) *Handbook of applied economic statistics*, pp. 237-289. New York: Marcel Dekker.