

Geog 560
Advanced Quantitative Analysis
Spring 2015
MW 9:30-10:45
Office Hours: M 4-5, R 1-2

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Description: This is a second course in statistical methods covering techniques widely used in quantitative geography. The primary emphasis is on data-driven predictive modeling, including multiple regression and extensions, nonlinear least squares, and categorical prediction. We also cover principal components, clustering and related methods, and computer-intensive methods. The course concludes with an introduction to times series if time permits. The formal prerequisite is a course in univariate methods, similar to Geography 360 or Statistics 301.

Readings: The primary texts are Kutner et al., *Applied Linear Regression Models* (Irwin, 2004 or 2003) and S. Sharma, *Applied Multivariate Techniques* (Wiley, 1996). We will also use J.E. Burt, G.M. Barber, and D.L. Rigby, *Elementary Statistics for Geographers, 3rd Ed.* (Guilford, 2009). Depending on your background, other texts may be helpful. For multiple regression, I recommend W. Mendenhall and T. Sincich, *A Second Course in Statistics* (Pearson, 2011), or T.P. Ryan, *Modern Regression Methods, 2nd Ed.* (Wiley, 2009), or Hill et al., *Undergraduate Econometrics* (Wiley, 2000). For other multivariate techniques, consider or R. A. Johnson and D. W. Wichern, *Applied Multivariate Statistical Analysis* (Pearson, 2007) or J. Tacq, *Multivariate Analysis: Techniques in Social Science Research* (Sage, 1997). Additional readings are on reserve in the Geography Library, and a variety of animations and resources are posted on learn@uw.

Grading: Course grades will be based on two exams (33% each) and a set of short exercises (33%). The exercises will use PC software and data available in Geography computing facilities. Beyond general familiarity with Windows, no specific computer knowledge is presumed.

Topic Outline

I. Review

- A. Basic Statistical Concepts
- B. Hypothesis Testing and Confidence Intervals
- B. Bivariate Regression and Correlation

II. Multiple Regression

- A. Estimation and Hypothesis Testing
- B. Problems and Diagnostics (multicollinearity, variable selection)

III. Extensions of Multivariate Regression

- A. Polynomials, Trend Surfaces, Transformations
- B. General Linear Adaptive Models
- C. Mixed Spatial/Aspatial Models (GWR, etc.)

IV. Intrinsically Nonlinear Models

- A. Problem Statement
- B. Methods for Nonlinear Least Squares

V. Nominal Dependent Variables

- A. Logit and Related Models
- B. Discriminant Analysis

- C. Other Categorical Prediction Methods
 - 1. Bayes Estimators (naïve and non-naïve)
 - 2. Nearest Neighbor
 - 3. Categorical Regression Trees

- VI. Density Estimation
 - A. Probability Density Functions
 - B. Spatial Data

- VII. Computer-Intensive Methods
 - A. Jackknifing
 - B. Bootstrapping

- VIII. Other Multivariate Methods
 - A. Principal Components Analysis
 - B. Cluster Analysis

- IX. Methods for Temporal Data
 - A. Sampling Theorem in Time and Space
 - B. Time Series Models

Other books:

F. P. Agterberg, *Geomathematics: Mathematical Background and Geo-science Applications*, Elsevier, 1974.

J-P. Chiles and P. Delfiner, *Geostatistics: Modeling Spatial Uncertainty*, Wiley, 2012.

R. D. Cook and S. Weisberg, *Applied Regression Including Computing and Graphics*, Wiley, 2009.

J.C. Davis, *Statistics and Data Analysis in Geology*, Wiley, 2003.

P. Goovaerts, *Geostatistics for Natural Resources Evaluation*, Oxford University Press, 1997.

J.M. Hilbe, *Logistic Regression Models*, Chapman and Hall/CRC Press, 2009.

D.W. Hosmer, S. Lemeshow, R.X. Sturdivant, *Applied Logistic Regression*, Wiley, 2013.

E. H. Isaaks and R. M. Srivastava, *Applied Geostatistics*, Oxford University Press, 1990.

D. B. Percival and A. T. Walden, *Spectral Analysis for Physical Applications*, Cambridge Univ. Press, 1993.

D. S. Wilks, *Statistical Methods in Atmospheric Sciences*, Academic Press, 2011.