Geog 560 Jim Burt
Advanced Quantitative Analysis 425 Science Hall
Spring 2015 263-4460
MW 9:30-10:45 jeburt@wisc.edu
Office Hours: M 4-5, R 1-2

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.