LOM 5312 Advanced Statistical Methods for Management Decisions  
BA4312 Business Forecasting  
Winter/Spring 2010 - Professor L. Douglas Smith

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I am generally in my office and available by appointment during the day M-F. You may drop in at any time. Do not hesitate to call me at home, even late in the evening. I am happy to discuss concepts and to offer help over the telephone. You may also contact me via e-mail. Even when traveling, I check e-mail daily where practicable.

Prerequisite: LOM 5300 (or two-semester basic business statistics course at the undergraduate level).

Text: Mendenhall, William and Terry Sincich, A Second Course in Statistics: Regression Analysis (6th ed.), Prentice Hall, 2003 (M&S) (may use 5th edition if you have it)


Overview of Course

A study of the applications of statistical methods to managerial problems, forecasting and business research. Topics include the blending of multiple regression and analysis of variance into a general linear model, techniques for projecting seasonal time series with complementary variables, and forecasting techniques which deal with serially correlated data. The course will be constructed around a series of analytical exercises that illustrate applications of the statistical methods. Through class presentations, assigned exercises and a major project, students may gain experience in merging geodemographic data with proprietary data; constructing explanatory and predictive models for problems in marketing, finance, etc.; and extracting legitimate inferences from statistical analysis. Students will use commercial software (SAS, the Statistical Analysis System) for analyzing data, constructing models, and producing reports (with related maps, if desired) for communicating information.

Approximate Grading Scheme:

Exams (2) 60-65% ;  Major project and report 40-35%

Approximate grade breaks for the final weighted scores usually occur about 80 percent for B+/A-, 70 percent for C+/B-, and 60% for D+/C-. Appropriate consideration is given to differential expectations of graduate and undergraduate student performance, especially on the major project and report.

Topical Outline for Methodological Material

1. Multiple regression models for business analysis and forecasting  
   o overview of regression analysis and review of simple regression (M&S, Ch 2, 3)  
   o review of the multiple regression model (M&S, Ch 4)  
   o partitioning variability of dependent variable into explained and unexplained components (M&S Ch 4)  
   o least squares criterion for estimation of parameters (M&S Ch 4)
1. Matrix representation and calculation of parameters (M&S, App A)
   o F-test for over-all significance of regression relationship (M&S Ch 4)
   o t-test and corresponding F-test for marginal effects of adding individual variables or groups of
     variables (M&S Ch 4)
   o use of indicator (dummy) variables for qualitative factors (M&S Ch 4, Ch 5)
   o accommodating interactions between qualitative and quantitative factors (M&S CH 5)
   o stepwise processes for selecting variables and groups of variables (M&S Ch 6)
   o issues of relevant range and problems posed by correlated independent variables
     (multicollinearity) (M&S Ch 7)
   o analysis of residuals for model validation and identification of unusual observations (M&S Ch 8)
   o influence measures for data points (M&S Ch 9)
   o detecting serial correlation in successive observations (Ch 8)

2. Modeling nonlinear growth rates and other nonlinear relationships
   o polynomial models (M&S Ch 5)
   o Logarithmic models (M&S Ch 7, Ch 8, handout)
   o Inverse transformations (handout)
   o Piecewise linear models (M&S Ch 9, handout)
   o Robust regression procedures for automatic weighting of data points (Ch 9)

********* Midterm Exam *********

3. Models for predicting alternative discrete outcomes in marketing and finance
   o Logistic models for estimating probabilities of bivariate outcomes (M&S Ch 9)
   o Multinomial logistic models for estimating probabilities of several alternative outcomes (handout)

4. Models for extrapolating time series and dealing with autocorrelation
   o Exponential smoothing models with additive and multiplicative seasonality (M&S Ch 10, handout)
   o Regression models to accommodate step increases, changes in trend and seasonality (M&S Ch 10)
   o Autoregressive models (M&S Ch 10)
   o ARIMA models and Box-Jenkins approaches (handout)
   o Seasonal ARIMA models (optional: as individual student interests dictate)

5. ANOVA models and their corresponding regression representation
   o Basics of experimental design
     o treatment definitions (M&S Ch 11)
     o power of a test for differences in means (Ch 11, handout)
   o Classical one-way ANOVA model (M&S Ch 12.1-12.3)
     o regression representation with indicator (dummy) variables (M&S Ch 12.1-12.3)
   o Classical two-way ANOVA model with and without interactions (M&S Ch 12.5)
     o regression representation with indicator (dummy) variables (M&S Ch 12.5)

6. Practical Applications of the General Linear Model
   o M&S Case Studies CH 13-16

7. Introduction to Multivariate Analysis (optional - as individual student interests dictate and time
   allows)
   o Factor analysis – C&S Chapter 10
Instructions for Term Project

The purpose of the term project is to give students experience in statistical model-building for an actual business application. The student may use a combination of analytical techniques is appropriate for the task (e.g., presentation of summary statistics in tables and maps, development of statistical models to test relationships and generate contingency forecasts, or construction of smoothing and ARIMA models for time series extrapolations). On forecasting projects, comparing the results of using different techniques (e.g., regression, smoothing techniques and ARIMA) is highly desirable. Teams of up to three students may be formed for work on projects that require substantial data manipulation and analysis. A common report for the team may be submitted, but in the case of team projects, a separate memo is required to describe the contributions of each team member to the final product. You should try to limit the scope of the project to ensure that the work can be completed in about 50 or 60 hours of concentrated effort for each member of the project team.

1. Describe the analytical problem, indicating the question to be answered, statistical measures to be used, and the analytical techniques to be employed. Examples of questions that one might choose to address are:
   - What will be the future sales or deliveries of a product?
   - What will be the market share for a product or facility? To what is factors is market share sensitive?
   - What factors explain and help in the prediction of medical expenses for a company?
   - What are the drivers of risk and performance for financial assets?

2. Present alternative models that will be tested and employed to address the question.

3. Collect the data.

4. Perform statistical analyses, develop and validate the models, and apply them for forecasting or contingency analysis.

5. Draw conclusions.

6. Write a concise report (with maximum of ten typewritten pages in length) describing your results in a form that would be meaningful to managers with limited statistical background, yet with sufficient rigor to satisfy a statistician.

7. Submit the report on the scheduled day for the final exam or before.

Ideally, a project would address a substantive problem in connection with the work of a member of the team. Alternatively, we can negotiate projects with St. Louis area organizations or use data from past projects of the Center for Business and Industrial Studies or the Transportation Research Center (with appropriate clearances from the sponsoring organizations).