

SYST/OR 468/568 Applied Predictive Analytics

Fall 2015

George Mason University
Department of Systems Engineering and Operations Research

Instructor: KC Chang

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Class hour: Thursday 7:20-10:00 PM, Music/Theater Building 1005

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Course Description: Introduces predictive analytics with applications in engineering, business, finance, and econometrics. Topics include time series and cross-sectional data processing, data visualization, correlation, linear and multiple regressions, classification and clustering, time series decomposition, factor models and causal models, predictive modeling performance analysis and case study. Provides a foundation of basic theory and methodology with applied examples to analyze large engineering and econometric data for predictive decision making. Hand-on experiments with *R* will be emphasized.

Prerequisites: Graduate standing (Undergraduate engineering math: Calculus, probability theory, statistics, and some basic computer programming skills.)

For OR468, prerequisite: SYST330 and STAT344, co-requisite: STAT 354

Textbooks:

Required:

1. Max Kuhn and Kjell Johnson, “*Applied Predictive Modeling*,” Springer, 2013.
2. David Ruppert, “*Statistics and Data Analysis for Financial Engineering*,” Springer, 2011.

Recommended References:

1. W. N. Venables, D. M. Smith, and the R Core Team, “*An Introduction to R*,” <http://cran.r-project.org/doc/manuals/R-intro.pdf>, CRAN, 2014.
1. Rob Hyndman and George Athanasopoulos, “*Forecasting: Principles and Practice*,” OTexts, 2013.
2. Dean Abbott, “*Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst*,” Wiley, 2014.
3. Thomas Miller, “*Modeling Techniques in Predictive Analytics: Business Problems and Solutions with R*,” Pearson FT Press, 2013.
4. Chris Brooks, “*Introductory Econometrics for Finance*,” 3rd edition, Cambridge, 2014.

5. Ruey Tsay, “*Introduction to Analysis of Financial Data with R*,” Wiley, 2013.
6. Rene Carmona, “*Statistical Analysis of Financial Data in R*,” Springer, 2014.
7. Jeffrey M. Wooldridge, “*Introductory Econometrics: A Modern Approach*,” South-Western College Pub, 2012.

Optional Readings:

1. Foster Provost and Tom Fawcett, “*Data Science for Business*,” O’Reilly, 2013.
2. Eric Siegel, “*Predictive Analytics*,” Wiley, 2013.

Assignments and Exams:

There will be five hand-in assignments during the semester, a mini term project, as well as a mid-term exam and a final exam, both in-class. The exams will not be open book. However, you will be permitted a two-sided “cheat sheet” with notes and/or formulae.

Grading:

The assignments, mini project, mid-term, and final exams constitute 25%, 20%, 25% and 30% of the grades respectively.

Schedule:

- Unit #1: Introduction; review of predictive modeling, inferential statistics, and *R* lab
- Unit #2: Predictive modeling and data pre-processing
- Unit #3: Exploratory data analysis; visualization, transformation and kernel density
- Unit #4: Descriptive modeling: univariate and multivariate statistical models
- Unit #5: Regression models: linear prediction in finance and econometrics
- Unit #6: Nonlinear regression models and its applications in predictive analytics
- Unit #7: Mid-term exam
- Unit #8: Linear classification models and discriminant analysis
- Unit #9: Nonlinear classification model, clustering, and classification tree
- Unit #10: Multivariate time series models
- Unit #11: Factor models and principal components
- Unit #12: Bayesian inference and causal models
- Unit #13: Performance analysis and case study
- Unit #14: Course review
- Unit #15: Term project presentation
- Unit #16: Final exam