University of Puerto Rico. Mayagüez Campus
College of Engineering.
Industrial Engineering Department

Course Syllabus

General Information

Course Number: InIn 6010
Course Title: **Multiple Regression Analysis**
Credit-Hours: Three

Course Description

Analysis of unplanned experimental data to develop models for predicting complex systems behavior. Topics include: matrix formulation and properties of least squares estimators in multiple linear regression; analysis of residuals; diagnostics for influential data; strategies for variable selection; diagnostics, effects, and corrective measures for problems with correlated predictor variables; biased regression and other estimation criteria; autocorrelated residuals; simultaneous inference, model validation; use of computer programs to analyze real data and to develop a model.

Prerequisites

Authorization of the Director of the Department

Textbook and References

- Montgomery, D.C., E.A. Peck, and G.G. Vining. 2012. **Introduction to Linear Regression Analysis**, Fifth Edition, John Wiley & Sons, New York, p 642.
- Wei, W.W.S. 2006. Time Series Analysis. Univariate and Multivariate Methods. 2nd Pearson education Inc., Boston, p 612.
- Hagan, M.T., H.B. Demuth, and M. Beal. 1976. Neural Network Design. PWS Publishing Co., Boston, p 400.
- Draper, N.R. and Smith, H., 1981, Applied Regression Analysis, 2nd Edition, John Wiley and Sons, New York.
- Montgomery, D.C., 1984, Design and Analysis of Experiments, 2nd Edition, John Wiley and Sons, New York.
- Daniel & Wood, 1982, Fitting Equations to Data: Computer Analysis of Multifactor Data, 2nd Edition, John Wiley and Sons.
- Belsley, Kuh, & Welsch, 1981, Regression Diagnostics: Identifying Influential Data and Sources of Colinearity, John Wiley and Sons.
- Chatterjee, and Price, 1982, Regression Analysis by Example, John Wiley and Sons.
- Chaterjee, S., and Hadi, A.S., 1988, Sensitivity Analysis in Linear Regression, John Wiley and Sons, New York.
- Neter, & Wasserman, 1974, Applied Linear Statistical Models, R.D. Irwin.
- Freund, and Minton, 1979, Regression Methods: a Tool For Data Analysis, Mercel Dekker.

Purpose

This course has been designed for Industrial Engineering graduate students who want to strengthen their background in model building strategies. This course provides a very good opportunity for students from other engineering disciplines that want to increase their empirical model building skills. The main purpose of this course is to develop student skill to identify linear and nonlinear models that best represent the natural relationship among the variables involved in a given data set. Special attention will be devoted to model building under the presence of outliners and multicollinearity problems.

Course Syllabus

Course Goals

At the completion of the course the students will be able to identify what are the major assumptions in any linear regression model; perform model identification, parameter estimation, and residuals analysis to a given real data set; identify when should be applied and how to implement ridge regression, component principal regression, nonlinear regression, weighted regression and develop a univariate time series model.

Requirements

All students are expected to come to class on time, and prepared; do all assigned readings and related homework; actively participate in class discussions; and satisfy all assessment criteria to receive credit for the course.

Department and Campus Policies

Class attendance: Class attendance is compulsory. The University of Puerto Rico, Mayagüez Campus, reserves the right to deal at any time with individual cases of non-attendance. Professors are expected to record the absences of their students. Frequent absences affect the final grade, and may even result in total loss of credits. Arranging to make up work missed because of legitimate class absence is the responsibility of the student. (Bulletin of Information Undergraduate Studies)

Absence from examinations: Students are required to attend all examinations. If a student is absent from an examination for a justifiable reason acceptable to the professor, he or she will be given a special examination. Otherwise, he or she will receive a grade of zero of "F" in the examination missed. (Bulletin of Information Undergraduate Studies)

Final examinations: Final written examinations must be given in all courses unless, in the judgment of the Dean, the nature of the subject makes it impracticable. Final examinations scheduled by arrangements must be given during the examination period prescribed in the Academic Calendar, including Saturdays. (see Bulletin of Information Undergraduate Studies).

Partial withdrawals: A student may withdraw from individual courses at any time during the term, but before the deadline established in the University Academic Calendar. (see Bulletin of Information Undergraduate Studies).

Complete withdrawals: A student may completely withdraw from the University of Puerto Rico, Mayagüez Campus, at any time up to the last day of classes. (see Bulletin of Information Undergraduate Studies).

Disabilities: All the reasonable accommodations according to the Americans with Disability Act (ADA) Law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.

Ethics: Any academic fraud is subject to the disciplinary sanctions described in article 14 and 16 of the revised General Student Bylaws of the University of Puerto Rico contained in Certification 018-1997-98 of the Board of Trustees. The professor will follow the norms established in articles 1-5 of the Bylaws.

Course Syllabus

General Topics

Lecture	Topic	Reading
	I. Simple Linear Regression	
1	Least square estimation	T: 2.1 - 2.2
2	Interface on a simple linear regression model	T: 2.3 - 2.5
3	Coefficient of determination and correlation.	T: 2.6
4	Regression trough origin	T: 2.10
	II. Multiple Linear Regression	
5-6	Parameter estimation Properties of least squares estimates	T: 3.1-3.2
7	Confidence intervals and hypothesis testing on regression coefficients	T: 3.3 – 3.4
8	Prediction of new observations	T: 3.5
	III. Variable Selection and Model Building	
9-10	Model building problems. All possible regressions	T: 10.1, 10.2
11-12	Direct search on t. Stepwise regression methods	T: 10.3
	IV. Measures of Model Adequacy	
13	Variance stabilization transformation	T: 5.2-5.3
14-15	Analytical methods for selecting a transformation	T: 5.4
16	Generalized and weighted least squares	T: 5.5
17	Autocorrelation on residuals	Notes
	V. Polynomial Regression Models	
18	Polynomial models in one variable	T: 7.2
19-23	Piecewise polynomial models. Polynomial an trigonometric terms	Notes
	VI. Multicollinearity	
24	Source of multicolinearity. Effects of multicollinearity	T: 9.2, 9.3
25	Multicollinearity diagnostics.	T: 9.4
26-27	Methods of dealing with multicollinearity. Ridge regression,	T: 9.5
28-29	Principal components regression	T: 9.5
	VII. Indicator Variables	
30-31	General concepts of indicator variables	T: 8.1
32-34	Regression models with indicator variables	T: 8.2, 8.3
	VIII. Time Series Analysis	
35	Stochastic processes, and the autocorrelation function	R1: 2.1-2.3
36	Estimation of the autocorrelation function	R1: 2.5
37	Autoregressive processes	R1: 3.1
	IX Artificial neural networks	
38	Introduction to artificial neural networks	R2: 1
39	Neuron model and network architecture	R2: 2
40	The backpropagation and the Levenberg-Marquardt backpropogation algorithm	R2:11-12

*Legend:
T= Montgomery, D.C., E.A. Peck, and G.G. Vining. 2012
R1= Wei, W.W.S. 2006
R2= Hagan, M.T., H.B. Demuth, and M. Beal. 1976