MA 542

Regression Analysis

Regression analysis is a statistical tool that utilizes the relation between a response variable and one or more predictor variables for the purposes of description, prediction and/or control. Successful use of regression analysis requires an appreciation of both the theory and the practical problems that often arise when the technique is employed with real-world data. Topics covered include the theory and application of the general linear regression model, model fitting, estimation and prediction, hypothesis testing, the analysis of variance and related distribution theory, model diagnostics and remedial measures, model building and validation, and generalizations such as logistic response models and Poisson regression. Additional topics may be covered as time permits. Application of theory to real-world problems will be emphasized using statistical computer packages. (Prerequisite: knowledge of probability and statistics at the level of MA 511 and of matrix algebra is assumed.)

Where and When

Stratton Hall 106
Mondays from 5:30pm-8:20pm

Instructor information

Prof. Randy Paffenroth
Office location: 105C Stratton Hall
Office hours: 11-12pm on Wednesdays, 11-12pm on Thursdays, and 9-11am on Fridays. Other times are available by appointment, and walk-ins are always welcome if I am around and not otherwise indisposed.
Best ways to contact me:

- WPI email: rcpaffenroth@wpi.edu
- Gmail and Google hangouts: randy.paffenroth@gmail.com
- Office phone: (508) 831-6562

I should be able to turn around email questions relatively quickly 9am-5pm, Monday-Friday. My availability at night and on weekends is more limited and I certainly check my email far more infrequently, but you may feel free to try and contact me.

Teaching Assistant/Grader

TBD

High level course goals and learning objectives

By the end of the class you should be able to:

- *Use tools* regression to make predictions of response variables given one or more predictor variables.
- *Assess* the quality of predictions based upon the statistics of the predictor variables.
- *Apply* regression techniques to data sets from real world problems.
- *Diagnose* any issues that arise from statistical anomalies in the training data.
- Have a deep appreciation for some of the *important mathematical subtleties* of regression analysis.

Recommended background for course

Prerequisite: knowledge of probability and statistics at the level of MA 511 and of matrix algebra is assumed.

In particular, you will need to know some linear algebra:

- Vectors (that they can represent points in space, column vs. row, etc.)
- Matrices (transposes, that they don't commute, etc.)
- Inner products
- How to solve linear systems
- etc.

You will also need to know some probability and statistics

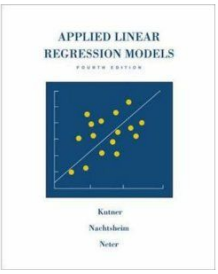
- Random variables (what they represent, etc.)
- Descriptive statistics (mean, variance, etc.)
- Hypothesis testing
- Estimation and prediction
- etc.

You will need to be able get your hands dirty playing with, processing, and plotting data using your favorite computer language! The textbook does not assume any particular computer language, and you are free to do the homework assignments using any computer language you like. **However, I will only be able to provide assistance for R and Python!** If you choose any other language you will be on your own for the class and I will not be able to provide assistance. If you intend to use another language then please let me know beforehand.

Now, with that being said, this is not intended to be a programming course (i.e., your code will not be graded, or even collected), but actually working with data will be extremely important (i.e., the results of the code will be graded)!

Textbook

Applied Linear Regression Models



Kutner, Nachtsheim, and Neter

Recommended texts

Other texts that would be useful for the course are:

- Linear Algebra and Its Applications, by David Lay. This has been used as the textbook for MA2071 (one of the requirements for the course).
- Applied Statistics for Engineers and Scientists, by Joseph Petruccelli, Balgobin Nandram, and Minghui Chen. This has been the textbook for MA2611 and MA2612 (the other requirement for the course).
- Learning R: A Step-by-Step Function Guide to Data Analysis By Richard Cotton O'Reilly Media, September 2013

Evaluation/Grades

Final grades will be determined based upon the following breakdown:

Homeworks (5 assignments)	40%
Midterm exam	30%
Final exam	30%

The midterm exam and final exam will be in class, non-cumulative, and open note, but **no collaboration will be allowed** and the exams be graded based upon demonstrated understanding of key concepts. For each exam, you are allowed to bring in up to ten 8 ½ by 11 sheets of paper (either printed or handwritten) with whatever notes you want for the exam. The homework problems will be performed **individually** and will be graded for demonstrated understanding of key concepts and quality of presentation.

Make-up Exam Policy

Make-up exams will only be allowed in the event of a documented emergency or religious observance. The exam dates are listed on the syllabus and you are responsible for avoiding conflicts with the exams.

Late Assignment Policy

In general, late assignments will either not be accepted or, at best, be heavily penalized. If an emergency arises or you know in advance about a conflict please let Prof. Paffenroth know as soon as possible.

Collaboration and Academic Honesty Policy

Collaboration is prohibited on the exams and homeworks. All violations of the collaboration policy will be handled in accordance with the WPI Academic Honesty Policy.

Schedule

On this schedule the homework and exam dates are fixed. On the other hand, because this is the first time I am teaching the course, I reserve the right to change the order and content of lectures to improve the learning experience for the course. I will ensure that the homeworks and exams match the material actually covered.

	Monday	
Class 1	January 15 (Thursday with Monday schedule)	Course introduction Statistics Chapter 1 Linear Regression with One Predictor Variable
Class 2	January 26	Chapter 1 Linear Regression with One Predictor Variable (cont.) Chapter 2 Inference in Regression and Correlation HW 1 assigned
Class 3	February 2	Chapter 3 Diagnostics and Remedial Measures
Class 4	February 9	HW 1 due Chapter 4 Simultaneous Inferences and Other Topics in Regression Analysis HW 2 assigned
Class 5	February 16	Linear Algebra Chapter 5 Matrix Approach to Simple Linear Regression Analysis
Class 6	February 23	HW 2 due Chapter 6 Multiple Regression Review for the midterm HW 3 assigned

Class 7	March 2	Midterm exam
	March 9	Term break
Class 8	March 16	HW 3 duel Chapter 7 Multiple Regression II HW 4 assigned
Class 9	March 23	Chapter 8 Regression Models for Quantitative and Qualitative Predictors
Class 10	March 30	HW 4 due Chapter 9 Building the Regression Model I: Model Selection and Validation HW 5 assigned
Class 11	April 6	Chapter 10 Building the Regression Model II: Diagnostics Measures
Class 12	April 13	HW 5 due Chapter 11 Building the Regression Model III: Remedial Measures
Class 12	April 20	Patriot's day
Class 13	April 27	Chapter 14 Logistic Regression, Poisson Regression, and Generalized Linear Models Review for the final exam
Class 14	May 4	Final exam

Accommodation for Special Needs or Disabilities

If you need course adaptations or accommodations because of a disability, or if you have medical information to share with me, please make an appointment with me as soon as possible. If you have not already done so, students with disabilities who believe that they may need accommodations in this class are encouraged to contact the Office of Disability Services as soon as possible to ensure that such accommodations are implemented in a timely fashion. This office is located in the West St. House (157 West St), (508) 831-4908.

Accommodation for Religious Observance

Students requiring accommodation for religious observance must make alternate arrangements with Prof. Paffenroth at least one week before the date in question.

Personal Emergencies

In the event of a medical or family emergency, please contact Prof. Paffenroth to work out appropriate accommodations.