Division of Biostatistics

Department of Epidemiology and Public Health
University of Miami Miller School of Medicine

BST 575 - An Introduction to Generalized Linear Models

Winter Term 2013

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CRB 1056

Course Description:

The standard linear model is one of the most commonly used of statistical techniques. A powerful extension of this model which allows a large variety of outcomes not easily handled by the standard linear model, are the so-called generalized linear models (GLMs). In this class, we wills study these models in detail. In multiple places in the course, we will examine some modern day extensions of GLMs including shrinkage estimation, mixed models and GEE. We will provide a unifying framework for formulation, estimation and inference. Throughout the course, real data applications from medicine will be used and extensive use of the R programming language will be made to implement ideas discussed. A previous upper level undergraduate type course in regression analysis is assumed. In addition, it would be useful for students to have had an introductory course in statistical theory.

Course Learning Objectives:

Students are expected to learn the underlying statistical concepts being taught as well as being able to apply the concepts in case-study type applications.

Course Requirements:

Participation in class discussions, completion of homework assignments (which will include problem solving and analyzing real data), midterm and final exams.

Course Material (Reference Textbooks)

McCullagh, P. and Nelder, J.A. (1999). *Generalized Linear Models*, Second Edition, Chapman and Hall, CRC Press, ISBN 0412317605
Dobson, A.J. and Barnett, A.G.(2008). *An Introduction to Generalized Linear Models,* CRC Press, ISBN 1584889500

Grading/Evaluation:

Homework (3-4 assignments) (40%); Midterm Exam (25%); Final Exam (35%)

Course Schedule:

Topics:

1. Introduction (2 – 3 lectures)
   Some background material
   - Standard (normal) linear regression model
   - Estimators other than least squares – e.g. robust estimators, shrinkage estimation
   - Generalized linear regression model
2. Theory of Generalized Linear Models (4 - 5 lectures)
   - Model components
     - exponential family and its properties
     - link functions
   - Maximum likelihood estimation
     - Newton-Raphson method
     - iteratively reweighted least squares
   - Goodness-of-fit
     - analysis of deviance
     - Pearson statistic
     - analysis of residuals
   - Model selection – AIC, BIC, Fence Methods
3. Particular Models (2-3 lectures)
   - Binary data
   - Binomial data
   - Multinomial data
   - Poisson data
4. Overdispersion & Quasi-Likelihood Models (2 lectures)
   Linear Mixed Models, Generalized Estimating Equations
   Best Predictive Estimation (applications to Small Area Estimation)
5. Smoothing and Generalized Additive Models (GAMs) (2 lectures)