AMS 274: Generalized Linear Models
Spring 2010

Instructor: Athanasios Kottas
Office: 153A Baskin Engineering Building
Phone: 459-5536, E-mail: thanos@ams.ucsc.edu

Course web page: http://www.soe.ucsc.edu/classes/ams274/Spring10/

Lectures: Tuesday, Thursday 10-11:45am (Baskin Engineering 169)
Office hours: Monday 12:30-2pm, Wednesday 11am-12:30pm (or by appointment)

Course description and background: This is a graduate-level course on the theory, methods and applications of Generalized Linear Models (GLMs). Emphasis will be placed on statistical modeling, building from standard normal linear models, extending to GLMs, and going beyond GLMs. With regard to inference and prediction, we will cover both likelihood and Bayesian methods. In particular, within the Bayesian modeling framework, we will discuss practically important hierarchical extensions of the standard GLM setting.
Please note that this is a course on methods for GLMs, rather than a course on using software for data analysis with GLMs. Students will be expected to be familiar with *statistical software R*, which will be used to illustrate the methods with data examples as part of the homework assignments. For homework problems based on Bayesian GLMs, you will be expected to write your own programs (R will suffice for this) to fit various types of Bayesian models using Markov chain Monte Carlo methods.
Knowledge of distribution theory, likelihood inference, **and** Bayesian modeling and computing will be assumed. AMS 205, 206 and 207 provide this background.

Grading: The course grade will be based on:
* Homework assignments
* Midterm exam
The midterm will be assigned between the 5th to 7th week of classes, and may be in-class, take-home, or include both in-class and take-home components. Details will be provided at a later time.

Tentative syllabus: We will cover topics from the following.
1. Introduction to GLMs
* Statistical modeling in the context of GLMs
* Exponential dispersion family of distributions (definitions, properties, and examples)
* Components of a GLM, examples of GLMs
2. Likelihood inference for GLMs
* Likelihood estimation (iterative weighted least squares) and inference (asymptotic interval estimates)
* Model diagnostics (residuals for GLMs, model comparison criteria)

3. Regression models for categorical responses and count data

∗ Models for binary responses (dose-response modeling, probit and logit models)

∗ Poisson regression and log-linear models

∗ Basic ideas for modeling of contingency tables

∗ Multinomial response models for nominal or ordinal responses

4. Bayesian GLMs

∗ General setting, examples, priors for GLMs

∗ Markov chain Monte Carlo posterior simulation methods for GLMs

∗ Bayesian residual analysis and model choice

∗ Hierarchical GLMs, overdispersed GLMs, generalized linear mixed models

In addition, and as time permits, we will cover topics from: Analysis of longitudinal and clustered data; Generalized additive models; Accelerated failure time and proportional hazards regression models for survival analysis data.

Reading/References: The lectures will be based on material taken from books and articles from the related literature. There is no required textbook. The course webpage will include relevant references as needed. Some handouts and notes will be provided.

Books that will be used for the lectures include:

• Agresti, A. (2002). *Categorical Data Analysis (Second Edition)*. Wiley.

• Johnson, V.E. and Albert, J.H. (1999). *Ordinal Data Modeling*. Springer.

• McCullagh, P. and Nelder, J.A. (1989). *Generalized Linear Models (Second Edition)*. London: Chapman & Hall.

Further references include:

• D. Dey, S.K. Ghosh, B.K. Mallick (editors) (2000). *Generalized Linear Models: A Bayesian Perspective*. (Biostatistics (New York, N.Y.), 5.) Marcel Dekker.

• Dobson, A.J. (2002). *An Introduction to Generalized Linear Models (Second Edition)*. Chapman & Hall.

• Fahrmeir, L. and Tutz, G. (1994). *Multivariate Statistical Modelling Based on Generalized Linear Models*. New York: Springer-Verlag.

• Gill, J. (2001). *Generalized Linear Models: A Unified Approach*. Series: Quantitative Applications in the Social Sciences, Sage University Papers, Thousand Oaks.

• Hastie, T.J. and Tibshirani, R.J. (1990). *Generalized Additive Models*. London: Chapman and Hall.

• Hoffmann, J.P. (2003). *Generalized Linear Models, An Applied Approach*. Pearson Allyn & Bacon.

• Jorgensen, B. (1997). *The Theory of Dispersion Models*. Chapman and Hall.

• Lindsey, J.K. (1997). *Applying Generalized Linear Models*. New York: Springer.

• Myers, R.H., Montgomery, D.C. and Vining, G.G. (2001). *Generalized Linear Models: With Applications in Engineering and the Sciences*. Wiley.