

**ST 755: Advanced Analysis of Variance**  
**(Mixed Models and Variance Components)**  
**(Fall 2011)**

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Class Hours MW 8:30-9:45AM

Location Room 5270, SAS Hall

Office Hours 3:00-4:00pm MW or by appointment

TA NA

Office Hours NA

Evaluation Based on 4 ~ 5 **independent** projects.

Textbook None

- References
1. Diggle, P.J., Heagerty, P., Liang, K.-Y., and Zeger, S.L. (2002), *Analysis of Longitudinal Data*, 2nd edition, Oxford University Press.
  2. Davidian, M. and Giltinan, D.M. (1995), *Nonlinear Models for Repeated Measurement Data*, Chapman & Hall, London.
  3. Mardia, K.V., Kent, J.T. and Bibby, J.M. (1979), *Multivariate Analysis*, Academic Press, London.
  4. Morrison, D.F. (1990), *Multivariate Statistical Methods, Third Edition*, McGraw-Hill, New York.
  5. Searle, S.R., Casella, G. and McCulloch, C.E. (1992), *Variance Components*, Wiley, New York.
  6. Tanner, M. (1996), *Tools for Statistical Inference, Third Edition*, Springer-Verlag, Berlin.

## Topics to be covered

1. Linear mixed models
  - (a) Model specification
  - (b) Estimation: Maximum likelihood estimation and restricted Maximum likelihood estimation (REML), BLUP
  - (c) Mixed models and missing data: EM algorithm
2. Generalized linear mixed models
  - (a) Model specification
  - (b) Approximate inference: PQL, bias correction
  - (c) Exact inference: Monte Carlo EM algorithm, adaptive quadrature.
  - (d) Non-linear mixed models
3. Variance components testing in mixed models
  - (a) Why the traditional likelihood ratio test and Wald test fail
  - (b) Likelihood ratio tests under nonstandard conditions
  - (c) Score test for variance components
  - (d) Application in genetic studies
4. Mixed models and nonparametric smoothing
  - (a) Smoothing spline estimation, choice of smoothing parameters
  - (b) Mixed model representation of smoothing spline
  - (c) Generalized additive mixed models
  - (d) Testing polynomial covariate effects
5. Relaxing distributional assumption of random effects
  - (a) Non-parametric approach
  - (b) Semi-nonparametric (SNP) approach
  - (c) Mixture of normal approach
  - (d) Conditional approach