

ST650 – Design and Linear Modeling II – Fall, 2009

Instructor: Phil Chapman

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Class: MWF 11:00-11:50, Scheduled in E106 Eng, but moved to 006 Stat.

Prerequisites: ST640 or consent of instructor

Objectives: The topic of the course is applied linear models. Key features are:

1. The topics of design and analysis will be studied together. The idea behind this approach is that to choose an appropriate design it is necessary to understand the properties of the anticipated data analysis.
2. The emphasis will be on applications, rather than theory. Theory developed in ST640 will be used extensively; there will be explanations and demonstrations using that theory, but few formal proofs. I think of this course as training statistical consultants.
3. Applications in the agricultural, biological, ecological, and medical sciences will be emphasized, rather than applications in manufacturing or business.
4. Most statistical computations in this course will be done in SAS. Some analyses will be done using R, primarily to contrast the two programs. SAS is the primary computing platform for government, industry, and academia (outside Stat departments). R is gaining momentum, but SAS continues to be important. Having some experience with SAS will make you more employable as a statistician, or statistical consultant.

Software:

1. SAS 9.2 for Windows (the current version).
2. R 2.9.1. (the current version)

Texts: There is no required text. It is a good idea to purchase a design text as a reference.

Primary References:

1. *Dr. Mary Meyer's Course Notes for ST640: Spring 2009.*
2. *Statistical Design* by George Cassella (Springer).
3. *Planning, Construction, and Statistical Analysis of Comparative Experiments* by Geisbrecht and Gumpertz (Wiley).
4. *SAS for Mixed Models, Second Ed.* By Littell, Milliken, Stroup, Wolfinger, and Schabenberger (SAS Institute)
5. My handouts (mostly SAS examples)

Additional references:

1. *A First Course in Experimental Design and Analysis of Experiments* by Oehlert (Freeman Press)
2. *Design and Analysis of Experiments, Fifth Ed.*, by Montgomery, (Wiley)
3. *Design of Experiments Statistical Principles of Research Design and Analysis, Second Ed.* By Kuehl (Duxbury)
4. *Analysis of Messy Data, Volume 1: Designed Experiments* by Milliken and Johnson (Lifetime Learning) (A second edition was published in the spring.)
5. *Methods and Applications of Linear Models* by Hocking (Wiley)
6. *Theory and Application of the Linear Model* by Graybill (Duxbury)
7. *Empirical Model-Building and Response Surfaces* by Box and Draper (Wiley)
8. *Design of Experiments* by Fisher (MacMillan)
9. *Experimental Design* by Cochran and G. Cox (Wiley)
10. *Linear Mixed Models for Longitudinal Data* by Verbeke and Molenberghs (Springer)
11. *Design and Analysis of Gauge R&R Studies* by Burdick, Borror, and Montgomery (SIAM)
12. *Confidence Intervals on Variance Components* by Burdick and Graybill (Marcel Dekker)
13. *Linear Models with R* by Julian Faraway (Chapman-Hall/CRC)
14. *Extending the Linear Model with R: Generalized Linear, Mixed Effects and Nonparametric Regression Models* by Julian Faraway (Chapman-Hall/CRC)
15. *Linear Mixed Models: A Practical Approach Using Statistical Software* by West, Welch and Gatechi (Chapman-Hall/CRC)
16. *Mixed-Effects Models in S and S-PLUS* by Pinheiro and Bates (Springer)
17. *The R Book* by Michel Crawley (Wiley)

Grading:

Homework (nearly weekly)	30%
Midterm	35%
Final	35%

Approximate Course Outline:

1. Intro to some principles of experimental design
2. Randomization
3. Designs for controlling variation (blocking)
4. Factorial designs with fixed effects
5. Factorial models with random effects
6. Mixed models
7. Repeated measures and spatial covariance structures
8. Factorial designs at two and three levels (2^k and 3^k designs)
9. Brief introduction to response surface methods