

# Stat 441/541: EXPERIMENTAL DESIGN Spring 2015

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Text: *Design and Analysis of Experiments*, Douglas Montgomery, 8th Edition

- Introduction to Experimental Design Principles
- Experiments with a Single Factor (Chapter 3)
  - The Statistical Model and Parameter Estimation
  - Residual Diagnostics for Checking Model Adequacy
  - Decomposition of Total Sum of Squares, Expected Mean Squares
  - Matrix Forms
  - Contrasts and Multiple Comparison Tests
  - The Random Effects Model
- Further Topics On Single Factor Experiments (Chapter 3)
  - Tests for Homogeneity of Variance and Tests of Normality
  - Transformations (Chapter 15 Section 1)
  - Sample Size Determination
- Designs Involving Blocking (Chapter 4)
  - Randomized Complete Block Designs
  - Simple Repeated Measures Design
  - Matrix Forms
  - Latin Square Designs and Balanced Incomplete Block Designs
  - Sample Size Determination
- Factorial Designs with Fixed Effects Only (Chapter 5)
  - Dealing with Significant Interactions Among Factors
  - Residual Diagnostics for Checking Model Adequacy
  - Matrix Forms
  - Sample Size Determination
  - Unreplicated Factorial Designs
  - Unbalanced Designs
- Factorial Experiments with Random Effects (Chapter 13)
  - Random and Mixed Effects Models
  - Expected Means Squares
  - Exact and Approximate  $F$ -tests
  - Estimation of Variance Components

- Nested and Split-Plot Designs (Chapter 14)
  - $m$ -stage Nested Designs
  - Designs with Nested and Crossed Factors
  - Designs with Split-plotting.
  - Replicated Latin Square Designs (Chapter 4 Section 2)
- Introduction to the Analysis of Covariance (ANCOVA) (Chapter 15 Section 3)
- Introduction to Response Surface Designs (as time allows)

Note: The two-level full and fractional-factorial designs in Chapters 6 to 8 and a thorough review response surface designs in Chapter 11 are covered in STAT 578.

**Grading:** Many questions on assignments and exams will be the same for those students taking Stat 441 or Stat 541. There will, however, be variations, especially additional components involving derivations, for those students taking Stat 541.

Exam I	75 pts
Exam II	75 pts
Final Project	50 pts
Homework Assignments	$\approx$ 150-200 pts

The *SAS* (and occasionally *R*) statistical package will be used extensively. Unless explicitly stated, you may use any package you choose when completing assignments. If, however, you choose to use *R*, you may have to do some independent work for some problems because I will not give examples of *R* code for all designs covered in the course.

The Course Notes contain computer output with the *SAS* and, occasionally, *R* code. The code can be downloaded from my course webpage ([www.math.montana.edu/~jobo/st541](http://www.math.montana.edu/~jobo/st541)). *SAS* is available online using SAS OnDemand or in the computing labs in Reid Hall. The *R* software is a free download.

### DOE Project

- You will propose and run an experiment. This proposal will include a description of the experimental factors and response(s) of interest and the objectives of the experiment. This will be submitted no later than two weeks before the final exam date. I will be available for discussion and/or consultation regarding the problem you choose.

This project can be collaborative with one partner. However, if two people collaborate, the project must involve a more complex design.

- I will review the proposal. At this point, I may or may not have comments and suggestions with a resubmission of the proposal. Once I inform you that your proposal is acceptable, you will do the following
  - Run the experiment and then analyze the data.
  - Interpret the results. Prepare a short report on your findings. Results will also be shared with the entire class in short presentations. Presentations will be scheduled during the final exam period and/or during the last week of class.
- Complete details for the project will be posted after the first exam.