

**STAT 4530**  
**DESIGN OF EXPERIMENTS 1**  
**Fall Term 2009**

- Instructor:** Dr. Saumen Mandal  
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- Office Hours:** Tuesdays, Thursdays: 9:30 a.m. – 11:00 a.m.  
and by appointment or whenever I am in.
- Text:** Design and Analysis of Experiments by Douglas C. Montgomery.  
7<sup>th</sup> Edition, ISBN: 978-0-470-12866-4, John Wiley & Sons.  
  
Some notes will be provided.
- Assignments and Tests:** There will be three assignments and two term tests. The dates of the term tests will be given later. You can check the information/announcements in the U of M JUMP: <http://jump.umanitoba.ca/>  
Also note the instructor's web page: <http://home.cc.umanitoba.ca/~mandals/> for any additional information.
- Marks Breakdown:**
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|--------------|-----|
| Assignments: | 20% |
| Term Test 1: | 15% |
| Term Test 2: | 15% |
| Final:       | 50% |
- Calendar Description:** (Formerly 005.453) Objectives in designing experiments; designs commonly used in research including analysis and an introduction to the construction of designs. Prerequisites: STAT 3800 or the former STAT 3600 (005.360) (C); and STAT 3480 (005.348) (C); or consent of department.
- Computer Packages:** Instructions will be given if the use of a software is required.
- Miscellaneous:** I have been asked to draw your attention to the sections in *The University of Manitoba Undergraduate Calendar* dealing with academic dishonesty, including plagiarism, cheating, and examination impersonation.
- 2009 Pandemic Advisory:** Should major disruptions to university activities occur as a result of a pandemic, the course content, marks breakdown, and other provisions of this document may be adjusted as the circumstances warrant.
- Course Contents:** The following is a non-exhaustive list of topics to be covered in the course. In the beginning, you will notice that we will be revisiting some topics that you have encountered in your previous courses. Then we will start advanced topics. Our primary goal will be to reinforce the fundamental concepts, and to have a solid understanding of Design of Experiments. In most instances we will also be extending the breadth and depth of the coverage.

## **1. PRELIMINARIES** (Chapters 1, 2, 3, 4, 13)

- Basic principles of design
- Point estimates, Confidence intervals, Tests, Power functions of tests
- Bivariate and Multivariate Normal distributions
- Linear Models and its applications in Design of Experiments
- Distributions and properties of least squares estimates
- Analysis of variance
- Fixed, Random and Mixed effects models
- Derivations of expected mean squares,  $F$  tests
- CRD, RBD, LSD
- Variance components

## **2. $2^k$ and $3^k$ FACTORIAL DESIGNS** (Chapters 6, 9)

- Factorial designs - Introduction
- Estimation and interpretation of main effects and interactions
- SS due to factorial effects and tests of factorial effects
- Formal tests of significance in  $2^k$  and  $3^k$  experiments

## **3. BLOCKING AND CONFOUNDING IN $2^k$ and $3^k$ FACTORIAL DESIGNS** (Chapters 7, 9)

- Orthogonality of a design
- $2^k$  designs in  $2^b$  blocks
- $3^k$  designs in  $3^b$  blocks
- Introduction of general notation:  $s^k$  designs in  $s^b$  blocks ( $s = 2, 3$ ):  $(s^k, s^b)$  designs
- Construction of  $(s^k, s^b)$  designs
- Complete and Partial confounding in  $(s^k, s^b)$  designs
- Formal tests of significance in  $(s^k, s^b)$  experiments

## **4. INCOMPLETE BLOCK DESIGNS (IBD)** (Chapter 4)

- General incomplete block designs
- Properties of incomplete block designs
- Balanced incomplete block designs (BIBD)
- Properties of BIBD
- Construction and analysis of BIBD
- Intra-block and inter-block estimates

## **5. ANALYSIS OF COVARIANCE (ANOCOVA)** (Chapter 15)

- Analysis of covariance with one or more concomitant variable(s)
- Analysis of covariance for one-way layout
- Analysis of covariance for an RBD
- Distribution of different sum of squares
- Comparison between ANOCOVA and ANOVA

If time permits, the following topics will be considered.

## **6. TWO-LEVEL FRACTIONAL FACTORIAL DESIGNS** (Chapter 8)

## **7. SPLIT-PLOT DESIGNS** (Chapter 14)

## **8. OPTIMAL DESIGNS** (Chapter 11)