The University of Manitoba
STAT 4530 – Design of Experiments 1
Fall Term 2017

Course Outline

Course Number & Title: STAT 4530, Design of Experiments 1.

Time, Location & CRN: Tuesdays & Thursdays 1:00 p.m. – 2:15 p.m., 316 Machray Hall.
CRN: 16179.

Instructor: Dr. Saumen Mandal

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Office Hours: Tuesdays & Thursdays 11:30 a.m. – 1:00 p.m., or by appointment.

If the above times are not convenient for you, please phone, email or speak to me to arrange an alternate time to meet.

Web Pages: UM Learn: http://umanitoba.ca/umlearn
Statistics: http://umanitoba.ca/statistics
Gradebook: http://www.stats.umanitoba.ca/gradebook

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.

Textbook

Design and Analysis of Experiments by Douglas C. Montgomery. 9th Edition,
ISBN: 978-1-119-11347-8, John Wiley & Sons.

This book is available in our bookstore. I requested the bookstore for both hardcopy and eBook option. The price for the electronic version is only $64 (plus applicable taxes). The bookstore has got some cards printed up for you for purchasing it online. They also made it available as a direct download access code which can be purchased through the website: http://umanitoba.ca/campus/bookstore/textbooks/index.html

Lecture notes and other materials (e.g. assignments, data sets, SAS code) will be posted in UM Learn.

Statistical Software

SAS statistical software will be used to perform the analysis of experiments. Instructions will be given in the class. Data sets and SAS code will be posted in UM Learn. There are many computers on campus that can be used for running SAS. In particular, you can practice this software in the Stats Lab at 311 Machray Hall. You can also install a copy of the SAS University Edition in your computer for free:

http://www.sas.com/en_us/software/university-edition.html#for-students-learners
Documentation, including installation guides:
http://support.sas.com/software/products/university-edition/#s1=3

Assignments

There will be two assignments, each counting equally (5%) toward your final grade. Assignments will include some theoretical problems and analysis of different experiments. The computing problems will involve some data analysis using SAS software.

Assignments are due in the beginning of class on the day assigned. No late assignments will be accepted. All assignments will be done on 8.5×11 paper, using one side only. Make a cover-page for each assignment with your name, student number, instructor's name, course number and assignment number. Write your name and student# on top right corner on each page. Any computer output should be cut out and placed in your assignments at the appropriate place (with paste or staples). Whenever you answer a question using SAS, you must attach the output (highlight the appropriate sections and answer the questions using the output).

Midterm Tests and Final Exam

There will be two in-class midterm tests. The tentative dates are October 24 and November 21. If there is a change on these dates, I will notify you well in advance. The syllabus for the first midterm test will be the materials covered until October 17. The syllabus for the second midterm test will be the materials covered until November 14. There will be no make-up midterm tests. Students who miss a test with legitimate reasons and notify me within 48 hours will have the midterm weight added to the final exam.

The final exam will be two hours in duration and will be scheduled by the Student Records Office. The final exam will cover the whole syllabus.

For the midterm tests and the final examination: (i) nonprogrammable handheld calculators are permitted (graphing calculators are not permitted), (ii) electronic devices, such as cell phones or headphones, are prohibited, (iii) statistical tables will be provided, if required, and (iv) a formula-sheet with selected formulas will be provided. The midterm tests and final exam are closed book.

Course Evaluation and Grading Scheme

The final mark for the course will be obtained from the following rule:

Assignments: 10%
Midterm Test 1: 20%
Midterm Test 2: 20%
Final Exam: 50%

Work should normally be graded and returned promptly. It is expected to return the graded materials within two weeks of submission. Marks for the assignments and midterm tests will be posted on Statistics Gradebook: http://www.stats.umanitoba.ca/gradebook

The following are the minimum percentage grades required to receive the final grades:
A+ (90%), A (80%), B+ (75%), B (70%), C+ (65%), C (60%), D (50%), F (below 50%).

General Goals and Course Contents

In the beginning, we will revisit some topics that you have encountered before. 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. We will also make use of the computer software SAS throughout the course.

The following is a non-exhaustive list of topics to be covered in the course.

1. Basic Designs and Preliminaries (Chapters 1, 2, 3, 4, 13)
   Basic principles of design. Linear Models and its applications in Design of Experiments. Distributions and properties of least squares estimators. Fixed, Random and Mixed effects models. Completely Randomized Design (CRD). Randomized Complete Block Design (RCBD). Latin Square Design (LSD). Derivations of expected mean squares, F tests.

2. 2^k and 3^k Factorial Designs (Chapters 5, 6, 9)
   Introduction to factorial designs.
   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.

4. Fractional Factorial Designs (Chapters 8, 9)
   2^{k-p} and 3^{k-p} Fractional factorial designs.
   Generators, Defining Relation, Alias Structure, Resolution, Minimum Aberration Design.
   Sequential experimentation, Fold Over Designs.

5. Split-plot Designs (Chapter 14)
   Testing the whole plot and subplot treatments.
   Testing the interaction between whole plot and subplot treatments.
   Expected mean squares, Estimates of the standard errors for different types of comparisons.

If time permits, the following topics will be considered.

6. Analysis of Covariance (ANOCOVA) (Chapter 15)

7. Incomplete Block Designs (IBD) (Chapter 4)

Important Dates

The following dates are important to how the course will progress throughout the term.

Sept. 7: First lecture - course overview.
Sept. 20: Registration revision deadline.
Oct. 5 – 6: Fall Term break.
Oct. 17: End of material for midterm test 1.
Oct. 24: Midterm test 1.
Nov. 14: End of material for midterm test 2.
Nov. 17: Voluntary withdrawal (VW) deadline.
Nov. 21: Midterm test 2.
Dec. 7: Last lecture.
Dec. 11 – 21: Final exam period.

Academic Dishonesty

It is important that you understand what constitutes academic dishonesty and that you are familiar with the very serious consequences. Links to resources that describe academic dishonesty (including plagiarism, cheating, inappropriate collaboration, examination impersonation and typical penalties) can be found at: http://umanitoba.ca/science/undergrad/resources/webdisciplinedocuments.html.

Copyrighted Material

Please respect copyright. We may use copyrighted content in this course and ensure that the contents are appropriately acknowledged according to copyright laws and university guidelines. The course notes, assignments, tests and exams are the intellectual property of your instructor or the Department of Statistics. Reproduction or distribution of these materials is strictly forbidden without their consent. For more information, see the university's copyright office website at http://umanitoba.ca/copyright.

Recording of Class Lectures

Your instructor and the University of Manitoba hold copyright over the course materials, presentations and lectures which form part of this course. No audio or video recording of lectures or presentations is allowed in any format, openly or surreptitiously, in whole or in part without permission from your instructor.

Use of Electronics in the Classroom

It is the general University of Manitoba policy that all technology resources are to be used in a responsible, efficient, ethical and legal manner. A student may use technology in the classroom setting only for educational purposes approved by the instructor and/or the University of Manitoba Accessibility Services. Students should not engage in electronic messaging/posting activities (e-mail, texting, video or voice chat, social networking (e.g. Facebook) or electronic gaming during scheduled class time.

Class Communication

The University requires all students to activate an official University email account. Please note that all communication between your instructor and you as a student must comply with the Electronic Communication with Students Policy. For more information, please see:
http://umanitoba.ca/admin/governance/governing_documents/community/electronic_communication_with_students_policy.html

You are required to obtain and use your U of M email account for all communication between yourself and the university.

Student Accessibility Services

If you are a student with a disability, please contact Student Accessibility Services (SAS) for academic accommodation supports and services such as note-taking, interpreting, assistive technology and exam accommodations. Students who have, or think they may have, a disability (e.g. mental illness, learning, medical, hearing, injury-related, visual) are invited to contact SAS to arrange a confidential consultation.

ROASS Schedule A

Schedule A of the Responsibilities of Academic Staff with regards to Students (ROASS) policies of the University of Manitoba lists resources and policies for students. It is important that you familiarize yourself with these resources and policies.

Schedule A will be posted in UM Learn. This document is also available from the Department of Statistics web page: http://umanitoba.ca/statistics.