STAT 468 (MAST 679/MAST 881), Sec. K
Design of Experiments
Winter 2021

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Preface: **Due to exceptional circumstances, this course will be taught, and all assessments will be done completely ONLINE. Given the subject matter and nature of this course, at least one of the exams, including the midterm and/or the final exam will be given online through the Concordia Online Exams (COLE) platform with online proctoring. For more details see the ADDENDUM at the end of this course outline.**

Office Hours: Fridays, 16:00-17:30.

Prerequisite: STAT 360 previously or concurrently.

Text: *Design and Analysis of Experiments*, 10th Edition, by Douglas C. Montgomery (John Wiley, 2020).
The textbook will be available at:
https://www.bkstr.com/concordiastore/home
Note: Students should order textbooks as early as possible, especially for printed versions in case books are backordered or there are any shipping delays.

Reference: *Linear Models* by S.R. Searle (John Wiley, 1971).

Assignments: There will be 5 or 6 assignments.   Assignments are compulsory and contribute 10% to your final grade. Working regularly on the assignments is essential for success in this course.   Students are expected to submit electronic assignments as a single PDF file through **Moodle**.   **Late assignments will not be accepted.**

Calculators:	Only calculators approved by the Department, such as **Sharp EL 531** or the **Casio FX 300MS**, are permitted for the class test and final examination. See https://www.concordia.ca/content/dam/artsci/math-stats/docs/AppCalculatorList.pdf for details.

Midterm Test: There will be one midterm test, based on the material of weeks 1-7, which will contribute up to 30% to your final grade (see the Grading Scheme below). This test/quiz will be held on **Friday, 12 March 2021** online and proctored on COLE platform (See Addendum). The test will be held for 75 minutes during online lecture time. This test will be a closed book exam.

NOTE: It is the Department's policy that tests missed for any reason, including illness, cannot be made up. If you miss the midterm test because of illness (medical note required) the final exam will count for 80% of your final grade, and the assignments will count for the remaining 20%

Final Exam: **The final examination will be 2 hours long. To obtain a good grade, the student MUST show that she/he has a THOROUGH understanding of the subject and is good at problem solving. The exam, on the date specified by the exam office, will be a closed book online exam proctored by COLE and/or Moodle platform (See Addendum).**

NOTE: Students are responsible for finding out the date and time of the final exams once the schedule is posted by the Examinations Office. Conflicts or problems with the scheduling of the final exam must be reported directly to **the Examinations Office**, **not to your instructor**. It is the Department's policy and the Examinations Office's policy that **students are to be available until the end of the final exam period. Conflicts due to travel plans will not be accommodated.**

Final Grade:
a) Assignments (5 approx.) 20%
b) Mid-term test (8th Week) 30%
c) Final examination 50%

If the grading scheme for this course includes graded assignments, a reasonable and representative subset of each assignment may be graded. Students will not be told in advance which subset of the assigned problems will be marked and should therefore attempt all assigned problems.

IMPORTANT: **PLEASE NOTE THAT THERE IS NO "100% FINAL EXAM" OPTION IN THIS COURSE.**

Week	Topics
1	**1. Introduction to Designed Experiments:** Strategy of Experimentation, Some Typical Applications of Experimental Design, Basic Principles, Guidelines for Designing Experiments
	2. Simple Comparative Experiments: Basic Statistical Concepts, Sampling and Sampling Distributions, Inferences About the Differences in Means- Randomized Designs; Hypothesis Testing, Confidence Intervals, Choice of Sample Size, Inferences About the Differences in Means, Paired Comparison Designs, Inferences About the Variances of Normal Distributions.
2	**3. Experiments with a single factor: Analysis of Variance.** An Example, The Analysis of Variance, Analysis of the Fixed Effects Model
	Analysis of the Fixed Effects Model (continued)
3	Model Adequacy Checking. Practical Interpretation of Results.
	Determining Sample Size; Other Examples of Single-Factor Experiments.
	The Random Effects Model: A Single Random Factor, Analysis of Variance for the Random Model, Estimating the Model Parameters.
4	The Regression Approach to the Analysis of Variance, Least Squares Estimation of the Model Parameters, The General Regression Significance Test.
	4. Experiments with Blocking Factors: The Randomized Complete Block Design, Statistical Analysis of the RCBD
	Estimating Model Parameters and the General Regression Significance Test
5	The Latin Square Design, The Graeco-Latin Square Design
	Balanced Incomplete Block Designs, Statistical Analysis of the BIBD; Least Squares Estimation of the Parameters, incidence matrix and constructions (selected)
6	**5. Factorial Experiments:** Basic Definitions and Principles, The Two-Factor Factorial Design

	Statistical Analysis of the Fixed Effects Model
7	One Observation per Cell, The General Factorial Design, Blocking in a Factorial Design
	6. Two-Level Factorial Designs: The 2^2 Design, The 2^3 Design
8	**Mid-term exam, (8th Week) (Covering Chapters 2-5)**
	2^k design ANOVA skeleton, A Single Replicate of the 2^k Design; Normal-plots, overview if Lenth's method, Examples
9	**7. Blocking and Confounding Systems for Two-Level Factorials:** Blocking a Replicated 2^k Factorial Design, confounding in the 2^k Factorial Design Confounding the 2^k Factorial Design in Two Blocks; Partial Confounding
	8. Two-Level Fractional Factorial Designs: The One-Half Fraction of the 2^k Design, The One-Quarter Fraction of the 2^k Design,
10	The General 2^{k-p} Fractional Factorial Design
	9. Other Topics on Factorial and Fractional Factorial Designs: The 3^k Factorial Design: The 3^2 Design, The 3^3 Design Confounding in the 3^k Factorial Design in Three Blocks
	Fractional Replication of the 3^k Factorial Design
11	**11. Response Surface Methodology:** Introduction to Response Surface Methodology, The Method of Steepest Ascent Analysis of a Second-Order Response Surface,
	Experimental Designs for Fitting Response Surfaces; Designs for Fitting the First-Order Model, Designs for Fitting the Second-Order Model,
12	Designs for Fitting the Second-Order Model (continued), Mixture Experiments
	13. Random Effects Models: Random Effects Models, The Two-Factor Factorial with Random Factors; The Two-Factor Mixed Model, Approximate F Tests
13	**14. Experiments with Nested Factors and Hard-to-Change Factors:** The Split-Plot Design, The Split-Split-Plot Design (concept)
	15. Other Design and Analysis Topics: 15.3 The Analysis of covariance
	Review

Academic Integrity and the Academic Code of Conduct
This course is governed by Concordia University's policies on Academic Integrity and the Academic Code of Conduct as set forth in the Undergraduate Calendar and the Graduate Calendar. Students are expected to familiarize themselves with these policies and conduct themselves accordingly. "Concordia University has several resources available to students to better understand and uphold academic integrity. Concordia's website on academic integrity can be found at the following address, which also includes links to each Faculty and the School of Graduate Studies: concordia.ca/students/academic-integrity." *[Undergraduate Calendar, Sec 17.10.2]*

Behaviour
All individuals participating in courses are expected to be professional and constructive throughout the course, including in their communications.

Concordia students are subject to the Code of Rights and Responsibilities which applies both when students are physically and virtually engaged in any University activity, including classes, seminars, meetings, etc. Students engaged in University activities must respect this Code when engaging with any members of the Concordia community, including faculty, staff, and students, whether such interactions are verbal or in writing, face to face or online/virtual. Failing to comply with the Code may result in charges and sanctions, as outlined in the Code.

Intellectual Property
Content belonging to instructors shared in online courses, including, but not limited to, online lectures, course notes, and video recordings of classes remain the intellectual property of the faculty member. It may not be distributed, published or broadcast, in whole or in part, without the express permission of the faculty member. Students are also forbidden to use their own means of recording any elements of an online class or lecture without express permission of the instructor. Any unauthorized sharing of course content may constitute a breach of the Academic Code of Conduct and/or the Code of Rights and Responsibilities. As specified in the Policy on Intellectual Property, the University does not claim any ownership of or interest in any student IP. All university members retain copyright over their work.

Extraordinary circumstances
In the event of extraordinary circumstances and pursuant to the Academic Regulations the University may modify the delivery, content, structure, forum, location and/or evaluation scheme. In the event of such extraordinary circumstances, students will be informed of the change.

Addendum: This course will be taught and all assessments will be completely online. A midterm and/or a final online exam will be provided through the Concordia Online Exams (COLE) platform with online proctoring (also known as auto-proctoring). More information about the COLE system may be found at the COLE website. Additionally, an **online proctoring tool called Proctorio** will be used to provide proctoring during the exam.

Please note the following with respect to online proctored exams:

- That the exam will take place during the exam period at the designated date and time set by the professor (midterm) or the Exams office (final). All exam times will be set to Eastern Standard/Daylight Time.
- That your image, voice and screen activity will be recorded throughout the duration of the exam.
- That you must show your Concordia University Identification card to validate your identity. Alternative government-issued photo identification will be accepted, though it is not recommended. Only identification in English or French will be accepted.

- That any recording made will only be viewed by authorized university personnel (no external entity has authorization to review the recording).
- That you will be responsible for ensuring appropriate, properly functioning technology (webcam, a microphone, appropriate browser and an ability to download any necessary software, as well as a reliable internet connection with a minimum of a 3G connection).
- That you are very **strongly recommended** to enter the virtual test site found at the COLE website and become familiar with the software that will be used for your exam before starting the exam.
- That you will need a quiet place within which to take the exam. Earplugs or noise-cancelling headphones that are not connected to a device may also be used to allow you to focus for the duration of the exam.

Students who are unable to write an exam because they are unable to meet the above conditions and requirements are advised that they will need to drop the course. More information can be provided on the next offering of this course by consulting the Department. Students are advised that the drop deadline (DNE) for this course is **January 26, 2021**.

Students who require additional accommodations for their exams due to a documented disability should contact the Access Centre for Students with Disabilities as soon as possible (acsdinfo@concordia.ca).

If you face issues during the exam, you should inform your professor of those issues immediately. Please note that there are in-exam supports you should spend time getting to know. Visit the COLE website for more information.