

**SCHOOL OF MATHEMATICS AND STATISTICS
CARLETON UNIVERSITY**

**STAT 3504 A – ANALYSIS OF VARIANCE AND EXPERIMENTAL
DESIGN**

2020 LATE SUMMER

CLASS SCHEDULE	<u>Lectures:</u> Mondays and Wednesdays (6:05 to 8:55 p.m.) (Online at Zoom) <u>Tutorials:</u> Mondays (5:05 to 5:55 p.m.) (Online at Zoom)
INSTRUCTOR	Tanvir Quadir E-mail: tanvir.quadir@carleton.ca cuLearn at www.carleton.ca/cuLearn
VIRTUAL OFFICE HOURS	Before weekly class on Wednesdays (Online at Zoom)
TEACHING ASSISTANT	TBA

COURSE DESCRIPTION:

Analysis of variance and experimental design discusses the statistical design of different scientific studies and specialized linear models called analysis of variance models and inferences based on those models. Topics covered include single and multifactor analysis of variance, orthogonal contrasts and multiple comparisons, analysis of covariance; nested, crossed and repeated measures design; completely randomized design, randomized block design, Latin squares design, and factorial experiments.

Prerequisites: STAT 3503. Students who believe they have taken a similar background course or courses from another university must provide School with appropriate documentation to obtain permission.

The course consists of lectures 6 hours a week (synchronous live session at Zoom which will be recorded and available at cuLearn), and tutorials 1 hour a week. *Tutorials will start from the second class and students should attend weekly tutorials.* During the tutorials the T.A. will briefly summarize the main points explained in the lectures, provide further examples or go through problem sets in the course textbook, and implement ANOVA models using *SAS* or *R*. The detailed schedule of the tutorial classes to be held at Zoom and the topics to be covered in each tutorial will be available at cuLearn.

DATA ANALYSIS USING SAS/R: Students are required to use *SAS/R* for their assignments. Data used for assignment/examples will be available at cuLearn.

EVALUATION DATES:

Midterm Examination (Online at cuLearn)	<u>Midterm</u> : Aug. 3, 2020, 6 p.m.- 8 p.m.	25%
Assignments (Three) (To be submitted at cuLearn)	<u>Assignment 1</u> : Due on Jul. 20, 2020 <u>Assignment 2</u> : Due on Jul. 29, 2020 <u>Assignment 3</u> : Due on Aug. 12, 2020	10%× 3 = 30%
Final Examination (Online at cuLearn)	Between August 17 - 23, 2020 (TBA by the Registrar's Office)	45%

TEXTBOOK:

Applied Linear Statistical Models by Kutner, Nachtsheim, Neter and Li, 5th edition 2013, McGraw-Hill.

TENTATIVE COURSE SCHEDULE (MAY BE ADJUSTED AS COURSE UNFOLDS):

<i>Week</i>	<i>Date</i>	<i>Description</i>	<i>Week</i>	<i>Date</i>	<i>Description</i>
1	Jul. 6	Introduction, Overview, and Terminology: Chapters 15.1 – 15.3, 16.1:	4	Jul. 29	Randomized Complete Block Design (cont'd): Chapters 21.6 – 21.9 (Assignment 2 due)
1	Jul. 8	Single Factor Analysis of Variance and ANOVA Diagnostics: Chapters 16.1 – 16.6, 18.1 – 18.2	5	Aug. 3	Midterm Exam: Weeks 1 – 3
2	Jul. 13	Remedial Measures and Analysis of Factor Level Means: Chapters 18.3 – 18.6, 17.1 – 17.4	5	Aug. 5	Analysis of Covariance: Chapter 22
2	Jul. 15	Multiple Comparisons and Alternative Formulation of Single Factor ANOVA: Chapters 17.5 – 17.9, 16.7 – 16.8	6	Aug. 10	Two-factor Studies with Unequal Sample Sizes: Chapter 23.1 – 23.3
3	Jul. 20	Two-factor Studies with Equal Sample Sizes: Chapters 19.1 – 19.6 (Assignment 1 due)	6	Aug. 12	Topic TBA: Chapters 25 - 28 (Assignment 3 due)
3	Jul. 22	Strategies for Two-factor ANOVA with Interaction and Three-factor Studies: Chapters 19.7 – 19.9, 24.1 – 24.5	6	Aug. 14	Review
4	Jul. 27	Randomized Complete Block Design: Chapters 21.1 – 21.5		Aug. 17–23	Final Exam (TBA by Registrar Office)

EVALUATION CRITERIA:

Each student's grade in the course will be calculated as a weighted average of scores for three take-home assignments (30%), a midterm examination (25%), a final examination (45%). Students must fulfil *all* of the course requirements as set out for mid-terms, assignment and final exam to achieve a passing grade (D- or higher). Important guidelines pertaining to the evaluation instruments are the following:

1. A total of **at least 30%** is required on the **final exam** in order to receive a passing grade in the course
2. **At least two of the assignments must be handed in**, otherwise an automatic grade of FAIL will be given

ONE MIDTERM EXAMINATION (25%): Midterm examination will be held at cuLearn at the specified time and will last 2 hours. There is no deferred midterm. If you miss a midterm exam and provide a valid medical certificate or a verifiable compassionate reason within one week of the missed exam, the assigned weight (of 25%) will be added to your final exam; otherwise a mark of zero is assigned.

THREE ASSIGNMENTS (30%) – DUE ON JUL. 20, JUL. 29 AND AUG. 12, 2020: The assignments need to be submitted at cuLearn on or before the stated deadline. In case you are unable to submit the assignment before the due date, please discuss and obtain written permission from the instructor, otherwise the assignment will be considered late, and late assignments will receive a grade of zero. Students may wish to work together on assignments, but each student must write up his/her assignment independently.

The assignments require you to use *SAS/R* to run projects. The graded assignments along with feedback will be published at the cuLearn. I do encourage you all to use *SAS/R* as it is one of the most popular software packages for statistical analysis, which is currently being used in many governmental institutions and the private sector.

You can use *SAS 9.4* or *R* by connecting to VDI (Virtual Desktop Interface) using VMWare Horizon Client or HTML and Carleton credential. Tutorials of using *SAS* and *R* for analyzing data of experimental design will be available at cuLearn.

<https://cudesktop.carleton.ca>

You can also download *R* for Windows/Linux/Mac from the link below.

<https://muug.ca/mirror/cran/>

FINAL EXAMINATION (45%): The 3-hour final examination will take place at cuLearn during the official final examination period of August 17 to 23, 2020, and is scheduled by the Registrar's Office. Please do not make travel plans prior to August 23, 2020. Failure to write the final examination when the student has achieved satisfactory performance during the term will result in a grade of DEF ('Deferred Final Examination'). Application to write a deferred final examination must be made at the Registrar's Office. See Academic Regulation 2.3 for the official meanings of these grades. If you miss the final examination, please contact the Registrar's Office as soon as possible after the missed exam in order to qualify to write a deferred exam next semester. Summer term deferred final examinations will be held between September 18 and 20, 2020.

ADDITIONAL INFORMATION:

COURSE STANDING: Standing in a course is determined by the course instructor subject to the approval of the Faculty Dean. This means that grades submitted by the instructor may be subject to revision. No grades are final until they have been approved by the Dean.

ACADEMIC INTEGRITY: Students should familiarize themselves with the Carleton University policy on Academic Integrity. This policy details those behaviours considered to be violations of academic integrity (e.g. cheating, plagiarism) and provides guidelines as to the imposition of various sanctions, including a reduction in grade, suspension, and expulsion. Also be aware of the document titled "Pammett on Plagiarism and Paraphrasing," which can be found on the page at www.carleton.ca/economics/courses/writing-preliminaries.

IMPORTANT DEADLINES: July 9, 2020 is the last day to register for the course; July 17, 2020 is the last day to withdraw with a full fee adjustment; and August 14, 2020 is the last day to withdraw without academic penalty.

STUDENTS REQUIRING SPECIAL ACCOMMODATION:

You may need special arrangements to meet your academic obligations during the term. For an accommodation request, the processes are as follows:

PREGNANCY OBLIGATION Write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website: <https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-AcademicAccommodation.pdf>

RELIGIOUS OBLIGATION Write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website: <https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-AcademicAccommodation.pdf>

ACADEMIC ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or pmc@carleton.ca for a formal evaluation or contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting

accommodation from PMC, meet with me to ensure accommodation arrangements are made.
<https://carleton.ca/pmc>

SURVIVORS OF SEXUAL VIOLENCE As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: <https://carleton.ca/sexual-violence-support/>

ACCOMMODATION FOR STUDENT ACTIVITIES Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. <https://carleton.ca/senate/wp-content/uploads/Accommodation-for-StudentActivities-1.pdf>

ADDITIONAL STUDENT SUPPORT INFORMATION:

Carleton University offers additional support at the Writing Tutorial Service (215PA), Student Life Services (501 Unicentre), and the Student Academic Success Centre (302 Tory).