



UNIV*6020 Experimental Design and Applied Data Analysis for the Agricultural Sciences F-W

1 INSTRUCTOR

Instructor: Dr. Michelle Edwards and OAC faculty as needed for specialized topics

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2 AIMS & OBJECTIVES

2.1 Calendar Description

This course focuses on statistical principles, experimental designs, and communication of findings to research peers within the agricultural field. Students apply statistical techniques and perform data analyses. SAS or R will be used to perform data analyses.

2.2 Course Description

This course will be offered as a set of modules, with each module lasting 1-2 weeks. The course will be offered in the F and W semesters, with mandatory modules offered in the Fall semester, and optional modules at the end of the Fall and into the Winter semesters. The goal of this modular course is to offer flexibility to students and to provide a base knowledge of applied data analyses so that departments and faculty members can teach more advanced and specialized courses.

Students, with their advisors, must select the required number of modules, to provide 12 weeks of instruction in total, to obtain credit for the course. There are 4 modules that are

MANDATORY – these will cover a review of the classical statistical inference tests, including t-test, F-test, type I and II errors, confidence intervals, a discussion on p-values; the basics of experimental designs, and regression analyses. Optional topics will include an introduction to Meta-Analysis, an introduction to Exploratory Statistics, additional experimental designs, and other topics. Additional modules may be added to meet specific needs as they arise, with faculty collaboration.

Please note that examples used throughout the course will be from the agricultural and natural science fields, to cover topic areas studied in OAC.

2.3 Learning Outcomes

Upon successful completion of this course, students will have demonstrated the ability to:

1. Select and differentiate among classical inference statistical tests
2. Choose an appropriate experimental design to match research goals and available resources
3. Identify and analyze statistical models that match experimental designs and/or research goals
4. Critique, evaluate, and defend data analyses and research outputs to their peers
5. Apply research data management skills to their own research.

2.4 Instructor's Role and Responsibility to Students

The role of the instructor is to facilitate discussion and provide feedback to students through assessed assignments and meaningful conversations around agricultural statistics. The instructor will maintain a database to ensure that all students satisfy the required number of modules and complete the accompanying assignments. The instructor will engage with students' advisor on an as need basis to ensure the student and advisor expectations of both content and learning outcomes are being met.

3 TEACHING AND LEARNING ACTIVITIES

3.1 Timetable

Lectures: 3 hours per week

Tutorials: 2 hours per week as needed

Below is a listing of the MANDATORY and OPTIONAL modules currently available for the course. As noted, if there is a specific topic of interest, please contact the instructor to discuss.

The modules at the end of the WINTER semester labelled Research Project are set aside for presentation of the students' final project.

3.2 Course Topics and Schedule

Week	Topic	
F Week 1	Base Module	MANDATORY
F Week 2	Base Module Cont'd	"
F Week 3	Experimental Designs #1	MANDATORY
F Week 4	Experimental Designs #1 Cont'd	"
F Week 5	Experimental Designs #2	MANDATORY
F Week 6	Experimental Designs #2 Cont'd	"
F Week 7	Regression Analysis	MANDATORY
F Week 8	Regression Analysis Cont'd	"
F Week 9	Experimental Designs #3	OPTIONAL
F Week 10	Meta-Analysis	OPTIONAL
F Week 11	Introduction to Animal Models	
F Week 12	My model won't converge – Troubleshooting analyses	OPTIONAL
W Week 1	Data Visualization Introduction	OPTIONAL
W Week 2	Exploratory Statistics	OPTIONAL
W Week 3	GxE in Plants	OPTIONAL
W Week 4	Observational Studies	OPTIONAL
W Week 5	Surveys	OPTIONAL
W Week 6		
W Week 7	Research Project presentations*	
W Week 8	Research Project presentations*	
W Week 9	Research Project presentations*	
W Week 10	Research Project presentations*	
W Week 11	Research Project presentations*	
W Week 12	Research Project presentations*	

* Students will book 1 day to present their research project and 1 separate day to review peer presentations.

4 LEARNING RESOURCES

4.1 Course Website

Course material, news, announcements, and grades will be regularly posted to the UNIV*6020 Courselink site. You are responsible for checking the site regularly.

4.2 Required Resources

4.2.1 Recommended Texts:

- Bowley, S.R. 2015. A hitchhiker's guide to statistics in biology. Generalized Linear Mixed Model Edition. Plants et al., Kincardine ON. ISBN 978-0-9685500-4-5
A limited number of copies will be available in the bookstore.
- Kuehl, R.O. 2000. Design of Experiments: Statistical Principles of Research Design and Analysis. 2nd edition. Duxbury Press. CA, USA.

4.2.2 Software:

You have the option to choose to work with SAS or R for all data analyses in this course. Please ensure you have the software installed on your laptop or workstations prior to the start of the course.

SAS

If you select to perform the statistical analyses in this course with SAS, either the Licensed SAS version 9.4, or the free version called SAS University Edition will be suitable for the analyses required. Both contain the SAS/STAT 14.2 release. Note that it is your responsibility to acquire access to the SAS software.

Many of the research labs have the Licensed SAS version installed in the computer pools for their research teams. The software is also on all computers in the Learning Commons computer lab (Library). We have also placed it on the open-access computers located on the third floor CRSC outside the elevators. The computers in CRSC 121-A will also be available for use by the course Thursday afternoons. Students in the Dept. Animal Biosciences also have access to the licensed version on their Departmental server.

Mac Users: The SAS University Edition works fine on this platform and the price is right (\$0) but you will require a program such as VMware Player, which is part of the installation of the SAS University edition.

It is not necessary for this course, but if you want to have a copy of the full edition on your own laptop (Windows OS) you will have to make arrangements with CCS and purchase a license code for the year. Note that only the Windows 64 bit version has been licensed by the University. Before doing so, check with your advisor in case he/she has purchased a renewal for a lab license for their research group.

R

R is a system that is used for statistical computation and graphics. It has a number of aspects to it that include a programming language, graphics, interfaces or connection opportunities with

other languages, and debugging capabilities. For the purposes of this course, I recommend that you use RStudio rather than the R Console.

R is available for both Windows and Mac users. Note that it is your responsibility to acquire and install the R and RStudio software prior to the start of the course. There is NO cost for these.

5 ASSESSMENT

5.1 Dates and Distribution

Assignment	Due Date	Weighting	Learning Outcome(s) Assessed
Online Quiz #1	F - Wk2	10	1
Online Quiz #2	F - Wk4	5	1,2
Online Quiz #3	F - Wk8	5	1,3
Online Quiz #4	W - Wk6*	5	1,2,3,4,5
Data Analysis #1	F - Wk4	10	1,2
Data Analysis #2	F - Wk6	10	1,2,3
Data Analysis #3	F - Wk8	10	1,2,3
Data Analysis #4 – Opt Mod#1	W	5	3,4
Data Analysis #5 – Opt Mod#2	W	5	3,4
Data Analysis #6 – Opt Mod#3	W	5	3,4
Final Project	Last day of W Classes	30	1,2,3,4,5

*This last quiz will be a check-in quiz of the common materials covered by the students. Even though they may be taking different OPTIONAL modules, they should be well versed and reminded of materials covered in the REQUIRED modules

5.2 Assessment Descriptions

- 5.2.1 Online quizzes. These will be conducted in CourseLink. You will be allowed up to two attempts to write each quiz. Your recorded grade will be the average of all attempts. Quizzes will cover the materials in the mandatory modules.
- 5.2.2 Data Analyses. There will be an experiment or a dataset to analyze at the end of each module. The submitted report will include answers to questions provided for each module, along with R or SAS syntax and outputs.
- 5.2.3 Final Project. Each student participating in the course will be responsible for a final project and presentation. The final assignment is a maximum 5 page typed (double spaced) report detailing an experiment you are proposing to conduct, or are in the process of conducting, as part of your thesis research. The purpose of the project is to provide you an opportunity to apply the three major principles that the late Gertrude Cox (North Carolina State) emphasized for conducting experiments:
 - 1. The experimenter should clearly set forth his or her objectives before proceeding with the experiment.
 - 2. The experiment should be described in detail.
 - 3. An outline of the analysis should be drawn up before the experiment is started.

The report must be written in scientific format and must:

- 1) Introduce the problem and the background information motivating the experiment under consideration;
- 2) Define the hypothesis and objectives of the experiment;
- 3) Detail the experimental design and the layout of the experiment;
- 4) Outline the statistical analysis and list the SAS or R statements needed to obtain the analyses; and
- 5) Indicate the assumptions required to make the analysis valid.

It is acceptable, and you are encouraged, to include one or two figures and one or two tables as part of the report. Tables, figures, references, the SAS or R statements, and cover pages will not be included as part of the "page-count."

The final presentation will be a 5-minute presentation in front of a group of peers, describing your experimental design and proposed statistical analysis. Presentations will be the last 6 weeks of the WINTER semester.

5.3 Course Grading Policies

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements. See the graduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations:

https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/sec_d0e2228.shtml

Passing grade: In order to pass the course, students must obtain a grade of 65% or higher on the total mark of all assessments.

6 UNIVERSITY STATEMENTS

6.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly; e-mail is the official route of communication between the University and its students.

6.2 When You Cannot Meet a Course Requirement

If, due to medical, psychological, or compassionate circumstances you find yourself unable to complete an in-course requirement, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals

[\[https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml\]](https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml)

Graduate Calendar - Grounds for Academic Consideration

[\[https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/sec_d0e2182.shtml\]](https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/sec_d0e2182.shtml)

6.3 Drop Date

Courses that are one semester long must be dropped by the end of the last class day; two-semester courses must be dropped by the last day of class in the second semester. The regulations and procedures for changing graduate course registration are available in the Undergraduate and Graduate Calendars.

Undergraduate Calendar – Dropping Courses

[\[https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml\]](https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml)

Graduate Calendar – Registration Changes

[\[https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml\]](https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml)

6.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments; you may be asked to resubmit work at any time.

6.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least seven days in advance and not later than the 40th class day.

More information can be found on the SAS website [<https://www.uoguelph.ca/sas>]

6.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community—faculty, staff, and students—to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar – Academic Misconduct

[<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>]

Graduate Calendar – Academic Misconduct

[https://www.uoguelph.ca/registrar/calendars/graduate/2018-2019/genreg/sec_d0e2632.shtml]

6.7 Recording of Materials

Presentations that are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

6.8 Resources

The Academic Calendars [<https://www.uoguelph.ca/academics/calendars>] are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.