Overview

An introduction to the most commonly used statistical methods for planning (designing) and analyzing experiments.

Calendar description

Theory and application of analysis of variance for standard experimental designs, including blocked, nested, factorial and split plot designs. Fixed and random effects, multiple comparisons, analysis of covariance.

Teaching team

Instructor	Will Welch, ESB 3132, Ext 2-3339, will [at] stat [dot] ubc [dot] ca
Teaching Assistants	Please see canvas for your lab TA's contact information

Office hours for all the teaching team will also be at canvas.

Text books

Course text (required)	"STAT 404, Design and Analysis of Experiments" by Welch, W.J. (2025 EDITION) from the bookstore. There are important updates relative to earlier editions.
Other books (optional)	Please see "Supplementary Reading" at canvas

Prerequisites

Prerequisite STAT 305 and one of MATH 152, MATH 221, or MATH 223; corequisite ECON 326 or STAT 306; please consult the credit exclusion list within the Faculty of Science section in the calendar.

Assessment

3 quizzes 30%, final exam 45%, labs 5%, project 10%, WeBWorK 5%, in-class iClicker participation 5%

There will be 11 (possibly 10) graded labs with equal weights; the best 8 will be averaged.

The group project will include a proposal counting for 2%, with the remaining 8% for a presentation of the finished experiment.

There will be 6 WeBWorK assignments with equal weights; the best 5 will be averaged.

iClicker marks in each class will be approximately half for participation and half for correct answers. The total score to obtain 5% for the course will be adjusted to allow for late addition of the course and about 3 missed classes.

To pass the course it is normally necessary to obtain 50% of the available points on the quiz and final examinations, i.e., 37.5 or more out of the maximum 75 points. Otherwise the examination grade is normally reported as a percentage. If the 50% examination threshold is satisfied, the grade reported is weighted based on all assessment components above.

Quizzes

Quizzes are scheduled in class on the following dates: Tuesday, October 7; Tuesday, October 28; Tuesday, November 18. They will start at the beginning of class, so please make sure you are on time. Quizzes

will be based on material from WeBWorK assignments, other suggested exercises, lab problems, and the lectures, including activities held in the lectures.

If you would like a quiz question remarked, write a note specifying the question/part and the reason for requesting a review of the grading. Attach this to your paper and give it to me or your lab Teaching Assistant *no later than one week after the papers were returned to students.*

There will be no make-up quizzes. If you miss a quiz for a documented valid reason, please use the form at canvas in the module "COURSE INTRODUCTION" and follow the instructions for communicating with the teaching team also in that module. The weights for the other quizzes and the final will be readjusted to maintain their total weight of 75%. Valid reasons for missing a quiz are typically medical conditions, other emergencies, or an important UBC event. Please take note that, as the quiz dates are known well in advance and are in class time, normally there will be no accommodation for exams in other classes, vacations, social events, business transactions, or similar activities.

Examination aids

You may take a formula sheet to the quizzes and final examination. Sometimes a calculator will be needed—please bring a *non-programmable* one in case. No other aids are permitted. Details are at canvas. Please bring your student ID to the quizzes and the final exam.

Labs

You will work in a team; its membership will be determined by the lab Teaching Assistant. Your team should sit together in lectures too, as team work is encouraged in class.

For most labs, a joint report for the team will be handed in at the end. It will be marked.

Project

In brief, one lab will be devoted to giving your team time to start a project proposal, due one week later. The project presentation will be made at a date approximately at the end of classes. Your lab Teaching Assistant will give more details.

Assignments

There will be online WeBWorK assignments for credit approximately every two weeks.

Tasks that are more open-ended include the weekly labs and suggested exercises in the course text posted at canvas approximately weekly. Lab solutions will be available after the labs. Answers to suggested exercises in the course text will *not* be collected or marked; brief or more complete answers are often provided in the course text. No other solutions will be provided.

If you cannot get started with a suggested question or are stuck at some point in the solution, please see one of the teaching team during office hours. We are here to help *you* successfully complete the problem; it does not help you if we do the problem for you. See us as often as you need to keep making progress. Working together in groups on the ungraded exercises is encouraged.

The purpose of WeBWorK and other assignments is to prepare you for the quizzes and final, where similar questions will appear. The suggested exercises are not part of assessment but are also an (essential!) aid to learning by doing.

Computing

Computing is an integral part of this course, e.g., to carry out tedious analysis of variance calculations. We will use the R data-analysis environment. At canvas you will find how to download RStudio and R to you own computer, data sets and examples, and several online R tutorials, including a "getting started guide". Some of the assigned questions and some labs will involve computing. Familiarity with R will be tested on the quizzes and final examination.

Academic concession (From UBC and Faculty of Science Policy)

You may need to request an academic concession for medical reasons, on compassionate grounds, or in certain cases of conflicting responsibilities. Please refer to UBC's policy on Academic Concession for details. To apply for an academic concession, please use the form at canvas in the module "COURSE INTRODUCTION" and follow the instructions for communicating with the teaching team also in that module.

If you are ill (From UBC and Faculty of Science Policy)

Please do not come to class if you have an illness that could be transmitted to your classmates (e.g., a respiratory infection). In this class, grading is intended to provide flexibility so that you can prioritize your health and still succeed. If you are ill and will miss a small number of classes due to illness it is sufficient to let us know via the above academic concession form. If you are ill for a longer period of time, please contact Will to discuss, and apply for an academic concession. More information about UBC's framework for preventing communicable disease is at `https://srs.ubc.ca/health-safety/safety-programs/communicable-disease-prevention-framework/`

Academic Integrity (From UBC and Faculty of Science Policy)

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences.

Outline of topics

The course will proceed roughly in the same order as the course notes.

- Introduction
- PART I ANALYSIS
  - Review of linear models and least squares
  - Completely randomized t-treatment experiments (treatment contrasts)
  - Randomized-block designs and two-way factorials
  - Factorial experiments
  - Two-level factorial designs
- PART II PLANNING OF EXPERIMENTS
  - Blocking and fractionating two-level factorial designs
  - Latin-square designs
  - Dealing with other variables (via randomization, blocking, replication, analysis of covariance)
  - Analysis of covariance
- PART III COMPLEX STOCHASTIC STRUCTURE
  - Fixed versus random effects
  - Split-plot and repeated-measures designs