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University of British Columbia, Department of Statistics
STAT 404, Design and Analysis of Experiments, 2017/18 Term 1
Instructor: William J. Welch
Course website: `http://ugrad.stat.ubc.ca/~stat404`

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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 Assistant	TBA, TBA
Teaching Assistant	TBA, TBA

Office hours for all the teaching team will be at the course website.

Time and place

Lectures	Mon, Wed, 3:00–4:30 pm, ESB 1012
Labs	Tue, 2:00–3:00 pm, ESB 1046 OR Wed, 5:00–6:00 pm, ESB 1042

Text books

Course text (required)	"STAT 404, Design and Analysis of Experiments" by Welch, W.J. (2017 edition), available at the bookstore
Clicker (required)	
Other books (optional)	Please see "Supplementary Reading" at the course website

Prerequisites

Prerequisite STAT 305; corequisite 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 clicker participation 5%

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: TBA. 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, 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 a 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, 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.

The formula sheet is one double-sided $8\frac{1}{2} \times 11$ sheet of paper *with formulas only*, i.e., no numbers unless they are part of the formula, no explanation of the formulas or other words, and no algorithms for carrying out tasks. Please put your name on the formula sheet as it will be handed in (and returned).

Mathematical operators like "Var" in $\mathrm{Var}(Y) = \sigma^2$ are not words, and this is a valid formula. But a statement like "the Var of Y is σ^2" is not a formula; it is an explanation and cannot be on the formula sheet. "Formulas" include R computer code, e.g., `mean(x)`.

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 the team may be called upon to answer questions from time to time.

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

Assignments

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

Traditional questions will also be given approximately weekly. They will NOT be collected or marked. Brief answers are provided in the course text, and some answers will be taken up in the lab or in class. No other solutions will be provided.

If you cannot get started with a 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 is encouraged.

The purpose of WeBWorK and other assignments is to prepare you for the quizzes and final, where similar questions will appear. The traditional questions 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. The course web site has information about how you may also download 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.

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
- PART IV OTHER TOPICS (TIME PERMITTING)
  - Computer-aided methods for designing experiments
  - Design and analysis of computer experiments