Psychology 359: Advanced Research Methods in the Behavioural Sciences
Tentative Syllabus: Fall 2021

Lectures: Tuesdays and Thursdays, 2:00–3:30 in LIFE 2302. Lectures will be live streamed on Zoom and recorded as well and available later that day or the next on Canvas. Students who are unwell, sick, or otherwise unable to attend (e.g., in self-isolation) can use these recordings to keep up with the class.

Instructor: Jeremy Biesanz, Associate Professor, 4351 CIRS.

Online office hours Mondays 1-2pm. Office Hours Zoom Link with passcode 227494.

Teaching Assistant: Irein Thomas. Office hours by appt.

Course Information and Objective

Psychology 359 is an introductory course dealing with the basics of behavioral statistics, experimental design, and computer applications. Students should have had at least the equivalent of a one-semester undergraduate course in behavioral statistics—this means that no instruction in elementary descriptive statistics is included in Psychology 359.

We will examine in depth the theoretical underpinnings of inferential statistics and selected inferential procedures (e.g., correlation and t-test and introduction to the general linear model). In addition to the statistical content covered in the lecture part of the course, some topics in experimental design, current research techniques, and issues in behavioral research, along with use of available open-source statistical software will be covered in both the lab and lecture components of the course.

This course is an advanced introduction to statistical methods in psychology with the following goals.

1. An understanding of the current issues facing Psychology and other scientific disciplines with respect to replicability and reproducibility. How has science and inference often been practiced and how should it be conducted instead?
2. Detailed understanding of best practices in data science with respect to laboratory research. We will focus on sustainable research workflows from idea conception through manuscript submission. The primary focus will be on best methods and practices for planning studies before collecting data and how to preserve and document data and analyses in a manner that would be compatible with open science.
3. Understanding and familiarity with open science. We will briefly cover pre-registration, open data, open materials, and reproducibility. By the end of the course you will be fully familiar with all of these and be able to implement these in your own research if and when needed.
4. A general introduction to statistical inference. Some of this should be review, but many of you will have covered this at different levels in previous courses. Here we will cover parameter estimation, sampling theory, hypothesis testing, confidence intervals, effect sizes, causal inference, statistical power, and understanding p-values. These are the basic inferential tools for all statistical analyses and for understanding your data. We will generally use the simple two-group experimental design (i.e., t-tests) while covering these topics.
5. Understanding and experience with implementing best practices with respect to visualizing and presenting data.

6. An introduction to the open-source statistical computing language R. Many of the techniques and methods that we will cover are easily implemented in R but would require specialized (and expensive) software otherwise.

Class Discussion Board

The class discussion board will be on Piazza. I encourage you to use the discussion board to ask questions and solicit advice from your fellow students as well as your instructors. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. Find our class signup link at: Piazza Signup Link. Note that the link says Summer 2021, but that is the correct course!

Text

Navarro, D. (2016). *Learning Statistics with R: A Tutorial for Psychology Students and Other Beginners (Version 0.6)*. A pdf is available at LSR.

Evaluation

Course student evaluation will consist of the following:

1. Problem sets (60%). A number of problem sets will be assigned during the course. These will be separate from the work done in lab. Problem sets will be submitted online as pdf files through Canvass. Problem sets *will not* be equally weighted — problems sets with more points will carry more weight. The first several problem sets will have fewer points and thus count less.
2. Final project (40%) in December exam period.

The overall class average is likely to be curved in a manner that reflects that this is a selective course. Consistent with previous years, I anticipate that the class average will be ~80% with a standard deviation of ~7.

Software

You will need a laptop or computer. The following software will be used extensively this term:

> R will be the primary major statistical package that we will use. R Studio is an interface (and more) for R. TeX. Download site for Mac and for Windows. General information here. This is used to generate pdf files in R Studio.

Handouts, Additional Materials and Readings, and Datacamp

Class materials will be made available through Canvas including readings, lecture notes, problem sets, and other class materials. I will also make extensive use of the Piazza discussion board on Canvas and encourage you to post questions there as well.

Throughout this term we will also make extensive use of Datacamp. We will provide details on which courses (videos) to watch on the class Canvas discussion forum and in lecture/lab. Although completion of these courses on Datacamp will not explicitly be part of the course evaluation, they will provide the essential training and background to complete the problem sets and final project. In other words, they are necessary but not formally graded.

Strategy for the Course

It is critical to keep up with the course and the readings on a continuous basis.It is a good strategy to review your notes from the previous lecture before coming to class. In this way you will discover if parts of your notes are not clear can ask for clarification in class. I will look to you throughout the course for feedback about your level of understanding. *You should ask questions in class.* I highly encourage it! If you have a question, it is very likely that other students in the room have the same question. It helps to actively participate in class.

Topical Units

Best Data Science Practices (BDSP)

What is the ideal workflow? How can we achieve this? We will revew the entire workflow and discuss and practice best practices in version control, data cleaning, dataset organization (tidy data), codebooks and documentation, reference managers, and archiving.

Review of Statistical Inference (RSI)

Here we will cover stanard statistics distributions (e.g., normal, $t(df)$, $\chi^2(df)$, and $F(df_1, df_2)$), null hypothesis significance testing, and p-values.

Commonly used Statistical Tests (CST)

We will examine and focus on the t-test and correlation in depth. We will consider different versions of these tests (e.g., assuming that groups have different variances, correlations with categorical variables and rank-order associations). These statistical models will be used for the rest of the course for inference, effect size estimation, and study planning.

Best Reporting Practices (BRP)

How do we estimate effect sizes? How do we determine the uncertainty associated with effect sizes? We will cover standardized effect sizes and approaches to determining confidence intervals for effect size estimates.

Study Design and Planning (SDP).

What is statistical power? How can we estimate statistical power for a new study? Why is retrospective statistical power not a useful concept?

Open Science (OS)

How does open science relate to best data practices? We will cover preregistration, open data, and open materials and discuss each of these in depth.

Current Crisis in Science (CCS)

Although sometimes referred to as the crisis in Psychology (or more focused on specific areas), it is clear that science in general has a problem with how business as usual has been conducted. We will review the crisis, discuss problematic practices, and solutions to these problems.

General Linear Model (GLM)

We will examine how to analyze continuous as well as categorical independent variables in the multiple regression framework. This will be a basic introduction to the general linear model, focusing on the interpretation of regression coefficients, how to extract specific information from analytical models, as well as how to examine assumptions and diagnostics and understand and conduct robust analyses.

Date	Units: Specific Topics
Sept 9	Introduction and Overview Lecture Notes: Review.pdf Readings: LSR Chapters 3 and 4
Sept 14	CCS: Current crisis in Psychology and replication studies Readings: Ioannidis (2005); Open Science Collaboration (2015) Simmons, Nelson, and Simonsohn (2011)
Sept 16	CCS: Idealized template for workflow practices Lecture Notes: BestWorkflowPractices.pdf
Sept 21	BDSP: Data codebooks and tidy data Lecture Notes: Data_Codebooks.pdf and Raw_to_Tidy_and_Clean.pdf See also the Codebook Resources Folder Readings: LSR Chapter 7; Wickham (2014)
Sept 23	RSI: Inferences and hypothesis testing Lecture Notes: Hypothesis_Testing.pdf Readings: LSR Chapter 11; Cohen (1990); Pernet (2017)
Sept 28	RSI: Probability distributions, *p*-values, and quantiles Lecture Notes: Probability_Distributions.pdf Readings: LSR Chapters 9 and 11
Sept 30	No Class
Oct 5	CST : *t*-tests for independent groups and correlations Lecture Notes: IndependentGroups_t_test.pdf Readings: LSR Chapters 13; Erceg-Hurn and Mirosevich (2008)
Oct 7	CST : Measures of association Lecture Notes: Measures_of_Association.pdf Readings: LSR Chapter 12 **Problem Set 1 due Oct 7**
Oct 12	RSI and CCS: Inference, errors, and the fragility of *p*-values Lecture Notes: Inference_Estimation_Uncertainty.pdf Readings: Cohen (1994) Cohen (1995)
Oct 14	BRP: Effect size estimates and confidence intervals Lecture Notes: Inference_Estimation_Uncertainty.pdf Readings: Cumming and Finch (2005); Wicherts, Bakker, and Molenaar (2011); LSR chapter 10 **Problem Set 2 due Oct 14**
Oct 19	BRP: Effect size estimates and confidence intervals (continued) Lecture Notes: Inference_Estimation_Uncertainty.pdf

Table 1: Tentative Outline for the first half of the Fall 2021 Term.
LSR refers to the Learning Statistics with R textbook.

Date	Units: Specific Topics
Oct 21	SDP: Statistical power and study planning Lecture Notes: Expected Power Slides.pdf Readings: Cohen (1992); Button et al. (2013); O'Keefe (2007)
Oct 26	GLM: Introduction to the general linear model Lecture Notes: Univariate_Regression.pdf Readings: LSR Chapter 15 **Problem Set 3 due Oct 26**
Oct 28	GLM: Introduction to the general linear model (continued) Lecture Notes: Bivariate_and_General_Regression.pdf Readings: LSR Chapter 15
Nov 2	GLM: Introduction to the general linear model (continued)
Nov 4	GLM: Categorical independent variables (group codes) Lecture Notes: Group_codes.pdf Readings: Pages 6–13 from West, Aiken, and Krull (1996) **Problem Set 4 due Nov 4**
Nov 9	GLM: Categorical independent variables (group codes) continued
Nov 11	Remembrance Day
Nov 16	GLM: Analysis of covariance (ANCOVA) Lecture Notes: ANCOVA_in_Regression.pdf **Problem Set 5 due Nov 16**
Nov 18	GLM: Analysis of covariance (ANCOVA) continued
Nov 23	GLM: Assumptions and Diagnostics Lecture Notes: Assumptions_and_Diagnostics.pdf **Problem Set 6 due Nov 23**
Nov 25	GLM: Assumptions and Diagnostics (continued)
Nov 30	GLM: Worked example and writeup
Dec 2	GLM: Introduction to resampling (bootstrapping) and robust estimation Lecture Notes: Resampling_and_Robust_Methods.pdf Readings: Hesterberg (2015) **Problem Set 7 due Dec 2**
Dec 7	Final Project overview; Small worked example with writeup

Table 2: Tentative Outline for the second half of the Fall 2021 Term.
LSR refers to the Learning Statistics with R textbook.

UBC Statement regarding online learning for international students

During this pandemic, the shift to online learning has greatly altered teaching and studying at UBC, including changes to health and safety considerations. Keep in mind that some UBC courses might cover topics that are censored or considered illegal by non-Canadian governments. This may include, but is not limited to, human rights, representative government, defamation, obscenity, gender or sexuality, and historical or current geopolitical controversies. If you are a student living abroad, you will be subject to the laws of your local jurisdiction, and your local authorities might limit your access to course material or take punitive action against you. UBC is strongly committed to academic freedom, but has no control over foreign authorities (please visit UBC Calendar for an articulation of the values of the University conveyed in the Senate Statement on Academic Freedom). Thus, we recognize that students will have legitimate reason to exercise caution in studying certain subjects. If you have concerns regarding your personal situation, consider postponing taking a course with manifest risks, until you are back on campus or reach out to your academic advisor to find substitute courses. For further information and support, please visit Support Resources.

Class Mask Policy

Provincial Health Orders and UBC policy now mandate masks in all indoor public spaces on campus. These spaces include classrooms, residence halls, libraries, and common areas. Students who wish to request an exemption to the indoor mask mandate must do so based on one of the grounds for exemption detailed in the PHO Order on Face Coverings (COVID-19). Such requests must be made through the Center for Accessibility (Vancouver campus).

After review, students that are approved for this accommodation will be provided with a letter of accommodation to share with faculty members teaching courses in which they are registered. In the intervening time, these students are welcome in the class.

Mask wearing protects you as well as others in your environment. Let's do everything we can as a community to stop the spread of this virus.

References

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