Psychology 359: Advanced Research Methods in Behavioural Sciences
Tentative Syllabus: Fall 2016

Course Information and Objective
Class   T/Th   2-3:30 in Swing 105
        T   3:45-5:00 in Swing 307

This course is an advanced introduction to statistical methods in psychology with 6 main goals.

1. 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.

2. A gentle introduction to ANOVA. Here we will cover the one-way ANOVA, mean comparisons, and the two-way ANOVA (main effects, interactions, contrasts). We will only cover between-group designs given our limited time.

3. An introduction to the general linear model (multiple regression) focusing on one predictor and two predictor regression equations, interactions, and categorical independent variables (i.e., ANOVA in the general linear model and ANCOVA).

4. Reporting and conveying results. Each problem set after the first one will ask you to write a brief summary of the results in APA format. Generally these will only be 1-4 sentences long. We will provide templates as guides. Remember to communicate what you learned/discovered/concluded. Statistics are simply the appendages to sentences that provide the rationale or basis for your conclusion.

5. An understanding of the current issues facing Psychology and other scientific disciplines with respect to replicability and reproducibility. We will cover recent developments including open data, open materials, and preregistration. 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.

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.

By the end of this course you will be able to (1) identify relevant statistical approaches to analyzing data, (2) appropriately conduct those appropriate analyses, (3) report your results, and (4) explain and defend your conclusions. For each of the sections and modules outlined in the syllabus schedule I will provide a general review guide so that you know what topics I expect you to know.

Office and Appointments

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Please make an appointment with one of us if you cannot make the scheduled office hours. Office hours and locations will be posted on the class website (see below).

Class Website & Discussion Board.
The class discussion board will be available through my website, http://www.appliedregression.com. This will provide an updated class schedule as well as the class discussion board. I encourage you to use the

discussion board to ask me and or Jordan questions, as well as solicit advice from your fellow students. **This forum is available for posting only for students currently enrolled in the class.**

Text
Navarro, D. (2014). *Learning Statistics with R: A Tutorial for Psychology Students and Other Beginners (Version 0.4).* Freely available textbook shared by the author online at http://health.adelaide.edu.au/psychology/ccs/teaching/lsr/. I have placed a pdf of the book on the Dropbox folder as well.

Software
The primary major statistical package that we will teach this semester is *R* (http://cran.r-project.org/). You will need to download and install this on a computer for several parts of several assignments. R is free and works for Windows or Mac (or Linux). You will also want to download and install R Studio for your desktop/laptop. Again, freely available at http://www.rstudio.com/products/rstudio/.
You will need to bring a laptop to lab with R and R Studio installed on it. If you do not have a laptop, please see me.

Grading
Course grades will be based on three major components. First, there will be 9 problem sets during the semester that will be worth 50% of your grade. Second, there will be a midterm and a final paper/project, each worth 25% of your grade.

Problem sets are to be turned in the date they are due in lecture. Failure to turn in a problem set by the due date will result in the loss of 5% of the assignment's value for each day beyond the deadline. Keep a copy of all assignments in case of loss. *Although I strongly encourage you to work in groups to discuss your assignments, I require that every person turn in their own programming, output, and assignment; Group projects are not acceptable.*

Handouts, Additional Materials, and Additional Readings
These will be made available through a shared Dropbox folder (read only). I will provide read access to the class folder to each person in the class. The shared folder will have the problem sets, lab notes, lab assignments, readings, as well as lecture notes.

Strategy for the Course
It is critical to keep up with the course and the readings on a *weekly (daily, hourly?)* basis. As soon as you can, identify several classmates from whom you can get notes (or clarifications of the lecture notes) should you miss class. It has been my experience that students tend to have extreme difficulty studying on their own without attending this class. Coming to lecture and completing the problem sets will help you keep up and will help to check your understanding of the material.

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**. 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.

Tentative Topics and Class Schedule

Welcome and Introduction   **Sept 8**

Broad overview of the course and why we are learning R.

Readings: Navarro chapters 3 and 4. This provides a good introduction to R and R Studio which we will go over in lab the following week. Feel free to skim chapters 1 and 2, but that should be extremely basic review.

No lab this first week.

Introduction to R   **Sept 13**

Bring your laptop to class and have installed R and R Studio on it before arriving.

One-way ANOVA   **Sept 15, 20, 22**

Introduction to the one-way analysis of variance. We will cover the ANOVA summary table and how to calculate all aspects by hand as well as contrasts, pairwise comparisons, and writing a results section.

Readings: Navarro chapter 14 and Faraway, J. J. (2005). Linear Models with R. Chapman & Hall, chapter 14. Seaman, Levin, & Serline (1991). Note that you can ignore (skip) section 14.10 in Navarro on the Kruskal-Wallis test. Yes, these ANOVA two chapters cover the same material, but it is often helpful to have another exposure from a slightly different perspective. For Seaman, Levin & Serlin, read the abstract, focus on Tables 3 – 6, and read the Specific Recommendations for the Substantive Researcher section on pages 584-5. Yes, ignore all of the technical material in the middle.

Lab: Introduction to R and R Studio and the ANOVA example in Navarro, chapter 14. Topics covered include contrasts, Fisher-Hayter and Tukey pairwise comparisons, and additional material on how to do ANOVA in R

Problem Set 1 due Tuesday Sept 20 at the beginning of lecture.

Two-way ANOVA   **Sept 27, 29**

Introduction to the two-way ANOVA. ANOVA summary table, main effects and interactions. Contrasts, pairwise tests on marginal means, how to decompose interactions, and how to write a results summary.

Readings: Navarro Chapter 16 (skip sections 16.6 to 16.11), Faraway (2005) Chapter 15, and

Faraway (2002) Chapter 16. This last chapter reviews one-way ANOVA as well.

Lab (Sept 22): Reanalysis of the ANOVA example in Navarro, chapter 16. Topics covered include contrasts, Fisher-Hayter and Tukey pairwise comparisons on marginal means, and simple main effects.

Problem Set 2 due Tuesday, Sept 27 at the beginning of lecture.

Study Design and Reporting Results   Oct 4, 6, 11

What should we present and how to obtain it? (Confidence intervals and effect sizes; resampling). How do we plan and justify sample sizes for future studies? (Statistical power)

Confidence Interval Readings: Howell Confidence Intervals on Effect Size.pdf; Biesanz (2014); Cumming and Finch (2005).

Resampling (Bootstrapping) Readings: Singh & Xie.pdf (International Encyclopedia for Education); Fox (2016) Chapter 21.

Statistical Power Readings: Biesanz & Schrager (2014). Both of my manuscripts are technical so do your best with them. I will explain these in lecture. Focus on the big picture, not the technical details.

Stability of Confidence Intervals Reading: Schönbrodt and Perugini (2013). See also Schönbrodt's blog posting on this article at

> http://www.nicebread.de/at-what-sample-size-do-correlations-stabilize/
> https://www.r-bloggers.com/at-what-sample-size-do-correlations-stabilize/
> **Bonus video!** https://vimeo.com/57127001

Labs: (1) Computing effect sizes and confidence intervals for Cohen's *d*, the correlation, and r-squared. (2) Statistical power analysis using G*Power and Biesanz & Schrager (2014). Download and install G*Power from http://www.gpower.hhu.de/en.html.

Problem Set 3 due at the beginning of class, Oct 4.

Problem Set 4 due at the beginning of class, Oct 11.

Integration and Review   Oct 13

Applied empirical example that integrates all we have covered thus far. We will examine a two-way ANOVA, decompose the results, determine effect sizes and confidence intervals, and provide a written summary. This will also provide a review session for the midterm.

No new readings this week.

Lab: We will verify our calculations in R and determine confidence intervals for effect sizes since that cannot be done by hand in class.

In-class midterm.   **Oct 18**

We will use both class periods for the midterm.

Current Issues and the Crisis in Psychology. What is the problem?   **Oct 20**

Discussion of current issues in the statistical analysis of psychological data.

Readings for Oct 20 (note that these are short, readable, and entertaining):

False Positive Rates: Ioannidis (2005) and the summary of this perspective in an [Economist Article.](#)

Researcher degrees of freedom: Simmons et al (2011)

Simine Vazire's blog post: [Life After Bem](#)

Laura King's letter in Dialogue vol 26 (pages 6-9).

OSF. (2015). Estimating the reproducibility of psychological science. Science.

Current Issues and the Crisis in Psychology. What is the response?   **Oct 25**

Discussion of the response to the current crisis in psychology. Readings are for the most part short and entertaining.

Lucas & Donnellan (2013), Eich (2013), Cumming (2014), Funder et al (2013).

Brent Robert's blog posts: [Roberts1](#) and [Roberts2](#)

Brian Nosek has two articles on how to respond and how we should change scientific practice. These are on Dropbox as Nosek Scientific Utopia I.pdf and Nosek Scientific Utopia II.pdf.

There is a long lecture from him that goes through this as well at [Nosek's Lecture](#)

Introduction to Regression: One and Two Predictors   **Oct 27, Nov 1, 3**

An introduction to the general linear model, starting with simple one and two predictor models.

Reading: Navarro Chapter 15, sections 15.1 to 15.7

Lab: Examining Navarro's data in detail. Running one and two predictor regressions in R.

Problem Set 5 due Oct 27 at the beginning of lecture.

Assumptions and Diagnostics   Nov 8, 10

What are the assumptions underlying OLS regression? How can we examine those assumptions? How to think about outliers and potentially errant or influential datapoints. How do we examine those?

Readings: Navarro Chapter 15, sections 15.8 to 15.10. Skip sections 15.10.1 to 15.10.3 Cohen, Cohen, West, & Aiken (2003), chapter 10.

Lab: Examining assumptions and diagnostics in R. Computing confidence intervals for the standardized regression coefficient.

Problem Set 6 due Nov 8 at the beginning of lecture.

Interactions among continuous variables.   Nov 15, 17, 22

Reading: Aiken & West (1991) Chapters 1 to 3.

Lab: Examining the lecture example in detail (conscientiousness data from Biesanz, West, & Graziano, 1998). Plotting interactions. Simple relationships. Effect sizes for simple relationships.

Problem Set 7 due at the beginning of class on Nov 15.

Problem Set 8 due at the beginning of class on Nov 22.

Group Codes, ANOVA and ANCOVA, Categorical Interactions   Nov 24 - Dec 1

How do we analyze ordinal or nominal predictors in the regression framework?

How do covariates work in the ANOVA context (i.e., ANCOVA)?

How do we model and interpret categorical x continuous interactions?

Reading: West, Aiken, & Krull (1995). Excellent article and very thorough.

Lab: Illustration on how to conduct dummy and effect coding.

Problem Set 9 due at the beginning of class on Nov 29.

Psychology Department's Position on Academic Misconduct

Cheating, plagiarism, and other forms of academic misconduct are very serious concerns of the University, and the Department of Psychology has taken steps to alleviate them. In the first place, the Department has implemented software that, can reliably detect cheating on multiple-choice exams by analyzing the patterns of students' responses. In addition, the Department subscribes to *TurnItIn*--a service designed to detect and deter plagiarism. All materials (term papers, lab reports, etc.) that students submit for grading will be scanned and compared to over 5 billion pages of content located on the Internet or in TurnItIn's own proprietary databases. The results of these comparisons are compiled into customized "Originality Reports" containing several, sensitive measures of plagiarism; instructors receive copies of these reports for every student in their class.

In all cases of suspected academic misconduct, the parties involved will be pursued to the fullest extent dictated by the guidelines of the University. Strong evidence of cheating or plagiarism may result in a zero credit for the work in question. According to the University Act (section 61), the President of UBC has the right to impose harsher penalties including (but not limited to) a failing grade for the course, suspension from the University, cancellation of scholarships, or a notation added to a student's transcript.

All graded work in this course, unless otherwise specified, is to be original work done independently by individuals. Do **not** use Google/Yahoo/MSN Search/etc. to find articles for assignments in this course. **Do** use any of the indexes and databases listed under Indexes and Databases, Subject Resources, OneSearch or Metasearch on the Library's website at http://www.library.ubc.ca. (Not sure which index to use? Click HELP on the library homepage at www.library.ubc.ca or try Subject Resources.)

If you have any questions as to whether or not what you are doing is even a borderline case of academic misconduct, please consult your instructor. For details on pertinent University policies and procedures, please see Chapter 5 in the UBC Calendar (http://students.ubc.ca/calendar).