Advanced Methods and Statistics I

Fall 2020

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Class Locations: Section 001: Tue/Thurs 9-10:15am [ONLINE](#)
Class Website: [ONLINE](#)
TAs: Michael Waltrip (Email: mwaltrip at gmu dot edu)
TA Office Hours: Thurs 11:00a - 12:00p DKH 2064
Labs: 201: Friday 8:30-10:20am ONLINE
202: Friday 10:30am-12:20pm ONLINE

Course Overview

Psychology 611 is the first course of a two-course sequence that serves to introduce psychology graduate students to statistics, research methodology, research design, and measurement. Traditional graduate psychology statistics courses emphasize statistical techniques as a matter of declarative knowledge. Students are expected to know each procedure and its "appropriate" application. An alternative approach tends toward technical discourse (e.g., matrix algebra, formula memorization, and hand calculations) and requires greater attention to minute detail and mathematical vernacular. A less used but equally suitable approach treats statistics as a method of principled argument. The method I use for this course is a hybrid of the three approaches. You will be expected to know the statistical terminology, apply your knowledge in both carrying out the procedures as well as interpreting the results, and then you will be expected to use the results in a manner consistent with scientific discourse.

For the most updated version of the syllabus, please refer to this page.

Course Objectives

The purpose of this course is to further your introduction to data analysis, research design, and measurement. Your course work to date ought to have prepared you well by covering measures of central tendency, measures of dispersion, measures of association, and measures of difference. Due to time constraints, I do not intend to review these terms or their purposes so I urge every student to review that material prior to this course. What I do intend to cover is a comprehensive view of univariate, bivariate and multivariate statistics - why we use statistics, why you should learn these tools, and what are the most important features to learn and understand. You will gain practical skills in interpreting, applying and explaining statistical procedures. The combination of an interactive lecture and a weekly laboratory will offer each student the opportunity to see the procedures, conduct the procedures yourselves, and then teach one another what you learned. This approach is the common medical model of education - see one, do one, and teach one - that results in better retention and deeper understanding.

Course Prerequisites

Students ought to recognize and understand the following concepts and terms: measures of central tendency (e.g., mean, median, mode), measures of dispersion (e.g., variance, standard deviation, range), tests of difference (e.g., t-tests, ANOVA), measures of association (e.g., correlation, covariance), tests of association (e.g., multiple regression,

chi-square), and research design. Students who recognize that they are not prepared to take the course will be strongly encouraged to take a more introductory course.

Reading Materials

Required Textbooks

✳ Iversen, G.R. and Norporth, H. Analysis of Variance (Sage University Paper Series on Quantitative Applications in the Social Sciences, No. 07-001). Newbury Park, CA: Sage. (ISBN: 978-0803930018)

✳ Carmines, E.G. and Zeller, R.A. (1979). Reliability and Validity Assessment. (Sage University Paper Series on Quantitative Applications in the Social Sciences, No. 07-017). Newbury Park, CA: Sage. (ISBN: 978-0803913714)

✳ Lewis-Beck, M.S. (1976). Applied Regression: An Introduction. (Sage University Paper Series on Quantitative Applications in the Social Sciences, No. 07-022). Newbury Park, CA: Sage. (ISBN: 978-1483381473)

✳ Fox, J. (1991). Regression diagnostics. (Sage University Paper Series on Quantitative Applications in the Social Sciences, No. 07-079). Newbury Park, CA: Sage. (ISBN: 978-0803939714)

Optional Textbooks

✳ Bruning, J.L. and Kintz, B.L. (1997). Computational handbook of statistics (4th Edition). Allyn & Bacon. (ISBN: 978-0673990853).

✳ StatSoft, Inc. (2010). Electronic Statistics Textbook. Tulsa, OK: StatSoft. WEB: http://www.statsoft.com/textbook/. - referred to as SS

✳ Vickers, A.J. (2009). What is a p-value anyway? 34 stories to help you understand statistics. Addison Wesley. (ISBN: 978-0321629302)

Students who are interested in more than just the general "nuts and bolts" of the standard statistical procedures ought to consult the following books. Many of the points I make in class come from these books but it is always best to read them from a more original source.

✳ Abelson, R.P. (1995). Statistics as principled argument. Lawrence Erlbaum Associates, Hillsdale, NJ. (ISBN: 0-8058-0528-1).

✳ van Belle, G. (2002). Statistical rules of thumb. Wiley-Interscience: New York. (ISBN: 0-4714-0227-3)

Additional Reading
Below are additional readings that are optional (and free) for all students. Many of these readings provide excellent examples of the topics we discuss in class. These additional and optional readings are required reading for students seeking to get an "A" in the course. Please select the links below for each module. Read all articles associated with each module. **NOTE: Do not summarize the articles during your module. My TA and I have read the articles. We demand that you integrate these optional readings into the module seamlessly. Summarizing the article does not constitute "A" level graduate work.**

Module 1: [Reading 1](); [ReadiTng 2]()

Module 2: [Reading 1](); [Reading 2](); [Reading 3]()

Module 3: [Reading 1](); [Reading 2]()

Grading Criteria

Grades will be determined by each student's observed performance on **three** statistics modules. Want to know why? [Read this piece](). Each student must demonstrate proficiency with the statistical procedures in the presence of the instructor or TA OR via recorded video (more on that later). **Every student must complete at least one module with me - Patrick - to receive a passing grade in the class.** All module performances are **limited to 15 minutes**; speed and fluency of your performance will be indicative of your proficiency. Students may complete a module (i.e., demonstrate proficiency) at any time after the last module lecture but no later than 2 weeks following that last lecture. Each student may retake one and only one module after failure. Due to limited resources, we must limit the number of retakes to one and the retake must be completed within the time frame specified above. Special consideration to individual cases may be provided but do not expect more than one retake or more than a week grace period. Performance on the modules will be graded on ternary scale (3-levels) where level 0 represents a failure to complete the module, level 1 represents a passing grade for the module, and level 2 represents a passing grade with the optional reading well-integrated into your responses. We will not prompt you to integrate the reading. Instead, you must come prepared to discuss how the reading pertains to the task you perform. Please note the following plea: there are approximately 35 students in each section (PSYC 611 - sections 001 & 002) and three modules for each of you to complete. If you each require 15 minutes per module and nobody needs to retake a module my TAs and I each need to devote 23 hours to the process. Spread out over the semester, the time commitment can easily be accomplished during our office hours - if and only if (iff) everyone works with us by 1) preparing in advance for the module, 2) scheduling your module completion early, and 3) helping us by being flexible with your schedule. I prefer to use these modular presentations of ability rather than multiple choice tests because I find the latter force you to memorize but not learn how to preform under realistic situations.

Modules

The following three modules and their associated performance criteria constitute the curriculum and primary grading criteria for PSYC 611. As mentioned previously, the modules must be completed on an individual basis in the presence of either the TA or the course instructor OR submitted via youtube as a screenshare. You may choose to complete any of the modules at any time within the window of opportunity noted above subject to TA or instructor availability. There will be more details provided about these modules and how to demonstrate your proficiency throughout the course and lab. The core competencies listed below with an "SW" require the use of a computer software statistics package. You may use any software you desire to perform the module, however, I recommend you use SPSS unless you have a compelling reason to use another package. In some cases, the module requires you to demonstrate you can do a procedure by hand ("H"). In those cases, please prepare a hand written document showing that you have performed the operations on a dataset of your choice (i.e., made up numbers or collected numbers of some sort). All hand operations must be done in advance of the module performance; there is no time to compute anything by hand during your module.

MODULE 1: Introductory Data Analysis
1. ***Notation, Levels of Measurement, Distributions***
   - ✳ *define terms*
   - ✳ *differentiate scales (H)*
   - ✳ *identify and produce univariate and sampling distributions (SW)*
   - ✳ *produce univariate plots (SW)*
   - ✳ *produce bivariate plots (SW)*
2. ***Measures of Central Tendency and Dispersion***
   - ✳ *define terms*
   - ✳ *compute measures of central tendency (H)*

✱ *compute measures of dispersion (H)*
✱ *identify and produce measures of central tendency and dispersion (SW)*
✱ *produce plot annotated with measures of central tendency and dispersion (SW)*
✱ *discuss implications of the plot*

MODULE 2: Scale Development and Hypothesis Testing
    1. Scale Development
✱ *explain relevant terms*
✱ *discuss the underlying assumptions of classical test theory*
✱ *conduct CTT on at least 5 items and 10 observations (H)*
✱ *conduct CTT on at least 10 items (SW)*
✱ *conduct validity analysis (SW)*
✱ *explain SW results*
✱ *discuss implications of the SW results*
    2. Hypothesis Testing
✱ *explain what hypothesis testing entails*
✱ *discuss inferential errors*
✱ *conduct simple bivariate test (SW)*
✱ *estimate effect size (H)*
✱ *estimate power (H)*

MODULE 3: GLM
    1. Multiple Regression and Correlation (MRC)
✱ *explain the purpose of MRC*
✱ *discuss the underlying MRC assumptions*
✱ *conduct a bivariate MRC with at least 10 observations (H)*
✱ *conduct an MRC with at least 3 predictors (SW)*
✱ *conduct diagnostics (SW)*
✱ *explain SW results including parameter estimates, hypothesis tests, and diagnostics*
✱ *discuss implications of the SW results*
    2. Analysis of Variance (ANOVA)
✱ *explain the purpose of ANOVA*
✱ *discuss the similarity between ANOVA and MRC*
✱ *discuss the underlying ANOVA assumptions*
✱ *conduct an ANOVA with at least 2 factors and 10 observations (H)*
✱ *conduct an ANOVA with at least 2 factors (SW)*
✱ *conduct diagnostics (SW)*
✱ *explain results including parameter estimates, hypothesis tests and diagnostics*
✱ *discuss implications of the results*

Literature Review

Doctoral students and interested masters level students (i.e., optional) must complete a literature review that will be graded by your advisor. The literature review serves as a basis for a second year project - submitted at the completion of your second year in the program. The specific guidelines for the literature review come from your advisor. I suggest you start right away discussing your ideas with your advisor. Proposals are due to your advisors no later than December 1st and grades from your advisors are due no later than December 12th. Please note that your advisor must

oversee your work on the literature review. I am happy to assist where statistics and methodology are concerned but first consult your advisor and the course TA's before asking me for specific help.

Human Subjects Training

One final requirement for PSYC 611 is the successful completion of the Collaborative Institutional Training Initiative (CITI) program. The program consists of an online exam that ensures that all persons who engage in work with human subjects understands the inherent risks you may expose those subjects to and how to avoid those risks. Additional information is available here. All students must show documentation that CITI course was completed to fulfill the PSYC 611 requirements. Please email me your completion date no later than the last week of class. Please submit your CITI training information to the following Google Form: http://goo.gl/forms/Ok7yY7yzuB.

Grading

Grades will be assigned based upon a simple formula. Students who successfully complete the three modules and attend lecture and attend lab receive a "B" for a grade. Failure to successfully complete these requirements results in a "C" grade or rather a failing grade for graduate school. Students who successfully complete the "B" grade requirements and integrate the optional readings into **every successful module** receive an "A" grade. These are the only grades assigned in the class. I reserve the right to offer "benefit of the doubt" points to those on the cusp of any letter grade.

Lecture Format

Each lecture consists of three 40 minute segments. The first segment covers the assigned readings, the second segment highlights the material necessary to fully understand the assigned reading, and the final segment offers more advanced concepts for those students interested in learning advanced topics. During the first 40-minute segment, I intend to cover the reading in a cursory fashion. My cursory coverage will not help you if you have not read the assigned readings prior to class. I strongly encourage you to read the material before lecture so this time can be maximally productive for your educational experience. The second 40-minute segment focuses only on the aspects that are not explicitly covered in the readings but are essential for your full understanding. I strongly encourage you to read my notes prior to lecture, print them out before class, and bring them to class so you may take notes on my notes. **Research on learning shows that students who write (by hand) during lecture are more able to encode and retrieve the material compared to those who type on their computers. I suggest you follow the research and write down your thoughts during lecture.** During the final 40-minute segment, I will address mathematical, conceptual, and philosophical aspects of the topic. You may excuse yourself for the last segment if you so desire, however, if you with to integrate the optional readings into your modules you may find it helpful to remain.

Lab Format

The statistics lab content strictly parallels the course content. Please consult the course web site for changes in topics covered each week. Attendance at the lab is essential and required for you to master the skills discussed in the lecture and it serves as an excellent opportunity to test yourselves on the modules.

Academic Honesty

I must state for the record that cheating of any kind will be dealt with by rules set forth in the University Honor Code. I prefer never to have any academic integrity problems arise during the semester. The aim of graduate education is to learn material that many others have not learned and master this material to ensure your future success. The degree you receive reflects the hard work you put into your courses. Please do not cheat yourself by misrepresenting your

effort. Do the work or accept the consequences. Spend your effort learning the material and avoid being overly grade conscious. With a concerted effort to learn, you will not be tempted to cheat.

Disability Accommodations

If you are a student with a disability and you need academic accommodations, please see me and contact the Disability Resource Center (DRC) at 703-993-2474. All academic accommodations must be arranged through that office.

Important Dates

8/31 (Last day to add classes), **9/8** (Final drop deadline with no tuition penalty), **9/16-9/28** (Web withdrawal period with 100% liability), **10/12** (Fall break - no Tues class), **11/25-11/29** (Thanksgiving recess), **12/5** (Last day of classes)

Tentative Schedule

Week	Date	Mod	Topic and Lecture Note Links	Readings	Video ([Playlist Here](#))	Quiz
1	8/26	1	Introductions ([Notes](#))	Syllabus (this page)	**Part 1 (Syllabus), Part 2 (Lecture)**	[Q1](#) [Results](#)
2	9/1	1	Introduction to Data Analysis ([Notes](#)) and a [little history of William S. Gosset](#) ; [Jeff's Slides](#); [my shiny app](#)	Bruning and Kintz (skim)*	**[Part 1](#); [Part 2](#); [Part 3](#)**	[Q2](#) [Results](#)
3	9/8	1	Introduction to Data Analysis ([Notes](#)) MODULE 1 DATA	[SS (basic concepts)](#)	**Part 1 (Module 1); [Part 2 (yep, again)](#); Part 3**	[Q3](#) [Results](#)
4	9/15	2	Scale Development ([Notes](#))	Carmines (entire book)	**[Part 1](#); [Part 2](#)**	[Q4](#) [Results](#)

5	9/22	2	Scale Development ([Notes](#))	[SS (reliability and item analysis)](#)	[**Part 1**](#); [**Part 2**](#)	[Q5 Results](#)
6	9/29	2	Hypothesis Testing ([Notes](#))	p-value*		[Q6 Results](#)
7	10/6	2	Statistical Power (Notes - see advanced material from prior notes) [MODULE 2 DATA](#)	[SS (power)](#)	[**Module 2 Demo**](#) [**Second Module 2 Demo**](#) [Module 2 Q&A Form](#)	
8	**10/13***	3	GLM intro and MRC ([Notes](#))	[SS (GLM)](#)		[Q7 Results](#)
9	10/20	3	MRC ([Notes](#))	Lewis-Beck (entire book)	[**Watch Videos 2-16**](#)	[Q8 Results](#)
10	10/27	3	MRC (Notes same as previous lecture notes)	[SS (MRC)](#)	[**SS Types**](#)	[Q9 Results](#)
11	**11/3***	3	MRC diagnostics ([Notes](#))	Fox	[**Watch Videos 21-26**](#)	[Q10 Results](#)
12	11/10	3	ANOVA ([Notes](#))	Iverson (1st half)	[**Part 1**](#); [**Part 2**](#)	[Q11 Results (soon)](#)
13	11/17	3	ANOVA ([Notes](#)) THE LAST LECTURE - Module 3 Demonstration **PROPOSALS DUE TODAY (TO YOUR ADVISORS)**	Iverson (2nd half) [SS (ANOVA)](#)	[**Part 1 (only part)**](#)	[Q12 Results](#)

1 4			No class - Thanksgiving break			
1 5	12/1	3	GLM MODULE 3 Time: MODULE 3 DATA		Submit Course Ratings Please Video recording instructions	
	12/8		**LAST DAY TO COMPLETE MODULES**		Module 3 Demo 1	
	12/8		**PROPOSAL GRADES DUE TODAY (FROM YOUR ADVISORS)**			

* indicates optional readings but ones that are highly recommended. These optional readings are IN ADDITION TO the optional readings for the "A" module readings.
* due to the holidays, we meet on Thursday ONLY this week.