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PSYX 521.01: Advanced Psychological Statistics II

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PSYX 521 - Advanced Psychological Statistics II

Spring 2015

Instructor Information

Instructor: Daniel J. Denis, Ph.D.
Office: 369 Skaggs Building
Office Hours: Monday 12:00–1:00; Wednesday 1:00–3:00
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Course Information

Meeting Times: Fridays, 12:40 – 3:30pm
Location: 246 Skaggs Building

Course Overview

This course is a continuation of Psyx 520 (Stat I). The course will be slightly more applied than Stat I, but will rely heavily on the principles of statistics covered in Stat I. The goal is to learn and understand statistics, so that you can think about them **creatively** and **critically** when doing your own research, as well as when interpreting research in your field. The course is designed for graduate students in psychology. Because statistics is at its core a humanistic philosophical discipline (as one could argue is true of mathematics as well), we will also occasionally discuss some of its history, as to allow us a better (and richer) understanding of how statistical methods evolved, and why they were deemed necessary in the evolution of science. Issues in measurement will also arise over the course, and we will discuss how to deal with these issues. For instance, performing statistical analyses on a measurement of one's anxiety is only as good as how well the given measure "taps" into the construct of anxiety. Similarly, issues of measurement also rear their head when contemplating how to best parameterize the statistical model of linear regression, which sometimes requires the use of special coding schemes to accommodate various types of data. With the advance of specialized statistical tools such as structural equation models (SEM), we will also try to critically evaluate the use of regression methods, and their failure to take measurement error in predictors into account. We will also discuss such elements as the intraclass correlation and coefficient alpha from the vantage point of classical test theory.

Course Objectives

By the end of the course, you should have a good to excellent grasp of the following topics:

1. A more solid understanding of the principles of Stat I
2. Random Effects Models
3. Mixed Models, including Repeated Measures and Longitudinal Designs
4. Randomized Block Designs
5. A more broad understanding of Experimental Method (and alternatives)
6. Simple Linear Regression, Correlation, and Bivariate Distributions

7. Multiple Regression and the Nature of Multivariate Distributions
8. Model Building with ANOVA or Regression
9. Analysis of Covariance

You will also be exposed to some or all of the following:

1. Bayesian Statistical Analysis (as an alternative to NHST)
2. Classical Measurement Theory in Test Construction.
3. Experimental vs. Non-Experimental Designs.
4. The Matrix Algebra of Multiple Regression Analysis.
5. Data Management Using SPSS.
6. Missing Data in Statistical Analyses.
7. Putting Statistics into Context: The Role of Statistics in Science.
8. Mediation Analysis.
9. Moderation Analysis.
10. An Introduction to R Statistical Software.
11. Path Analysis and Structural Equation Models
12. Advanced Repeated Measures & Longitudinal Designs
13. The Analysis of Categorical and Qualitative Data
14. Non-parametric Statistical Methods.

Credits: 4.0

Required Text

Hays, W. L. (1994). *Statistics*, 5th ed. Wadsworth Publishing Company, Belmont CA.

Optional Texts

Field, A. (2009). *Discovering Statistics Using SPSS*. Sage Publications.
Howell, D. (2009). *Statistical methods for psychology*. Wadsworth Publishing.
Kirk, Roger E. (2007). Statistics: An Introduction. 5th ed. Thomson/Wadsworth.
Denis, D. (2007). Study Guide for Kirk, R. E. (2007). Statistics: An Introduction. Wadsworth

Office Hours

Office hours are held weekly. You are also strongly encouraged to e-mail questions to the instructor and/or TA, when they arise. Writing your question out in an e-mail, as clearly as you can, is an excellent way to clarify what you do not understand, and often, you achieve a deeper understanding of the topic itself while writing out your e-mail. Please be as detailed and specific as you can in your e-mail, so we know how to frame our response to best suit your needs.

Final Grade Assignment

There are 3 components that will make up your final grade*:

1. Mid-term Test (20%)
2. Assignments (20%)
3. Seminar (30%)
4. *Final Exam (30%)

* If your final exam grade is better than your mid-term test grade, your final exam will be scored out of 50% instead of 30%.

Points	Grade	Evaluation
100 – 90	A	EXCELLENT
89 – 80	A-	VERY GOOD
79 – 77	B+	GOOD
76 – 73	B	GOOD
72 – 70	B-	GOOD
69 – 67	C+	SATISFACTORY
66 – 63	C	SATISFACTORY
62 – 60	C-	SATISFACTORY
59 – 57	D+	POOR
56 – 53	D	POOR
52 – 50	D-	POOR
< 50	F	FAILURE

Student Seminars

The student seminar component of the course comprises 30% of your final grade, and is a major component of this course. Each seminar must be done individually. Details of the student seminar, and criteria on which it will be evaluated, will be discussed in class. **The primary criteria is that your seminar be a masterpiece presentation of a statistical topic.** It is expected that you will begin preparing for the seminar NOW, so that by the time you present, it represents something extremely well-prepared and advanced (and in depth).

You will be assigned one of the following topics:

1. Bayesian Statistical Analysis (as an alternative to NHST)
2. Classical Measurement Theory in Test Construction.
3. Experimental vs. Non-Experimental Designs.
4. The Matrix Algebra of Multiple Regression Analysis.
5. Data Management Using SPSS.
6. Missing Data in Statistical Analyses.
7. Putting Statistics into Context: The Role of Statistics in Science.
8. Mediation Analysis.
9. Moderation Analysis.
10. An Introduction to R Statistical Software.
11. Path Analysis and Structural Equation Models
12. Advanced Repeated Measures & Longitudinal Designs
13. The Analysis of Categorical and Qualitative Data
14. Non-parametric Statistical Methods

In your seminar, you are encouraged to provide handouts, notes, etc., to the class. The instructor may also provide additional handouts on the day of each seminar, though these will form no part of your independent presentation.

Accommodation of Students with Disabilities

In accordance with the University of Montana's mission to provide equal educational opportunities for all students, the instructor is willing to provide necessary accommodations for students with disabilities. If you require any accommodations, please make these known to the instructor, who will work with the office of Disability Services in adapting this course to meet your needs.

Attendance

Past experience in this course suggests that students who miss classes usually receive poor grades. This is a reflection of the difficulty of the subject, and the need to stay on pace with the class and course. Attending class lectures usually helps a great deal in understanding material.

Incompletes

Departmental and university policies regarding incompletes do not allow one to change "incomplete" grades after 1 year has passed since the "I" was granted.

Lectures

Most of the material presented in lectures will be drawn from Hays. You can also use Field (2009) as a menu-driven guide to using SPSS. Field's text will likely also be useful when conducting your MA or Ph.D. research. Hays' text is thorough, extremely well-written, and a complete "stand alone" source on the nature of statistics. Lectures will serve to highlight the most essential points in each chapter, that is, the big "chunks" or "themes" necessary for a good understanding of statistics. The smaller, yet still just as important details, can be absorbed through a careful reading (or two or three) of each chapter. Generally, ***_you should focus on what is highlighted in lectures and in my notes, and read Hays to understand and reinforce these concepts_***.

Also, for select areas within chapters, handouts will sometimes be provided. These handouts are meant to highlight the most crucial areas in Hays, and also to give you an alternative reading of the material.

Mathematical Arguments Used in Statistics

As was true of Stat I, Stat II will **not** be taught as if it were a mathematics course because <u>statistics is not equal to mathematics</u>. You will not be tested on whether you can prove or justify the equations that make up the discipline of statistics. Most test items, as was true of Stat I, will focus on your <u>understanding and grasp of the material</u>, both through applied questions and theoretical or conceptual questions. However, familiarity with the mathematics of statistics can sometimes (but not always) aid in your understanding of the fundamental concepts. For that reason, lectures, as well as handouts, will sometimes contain mathematical arguments to help in your understanding of statistics. However, as was the case in Stat I, knowing how to "work" a formula or follow a mathematical argument **may or may not** help you in understanding the underlying statistical concept. If you understand the concept however, the math often (but not always) makes much more sense, and may help to fill "gaps" in your conceptual knowledge. As well, learning the math might help you in understanding statistical concepts. It's generally a two-way street, but guard against knowing the math, without understanding the underlying conceptual meanings. Tests and exams will aim to evaluate your <u>understanding</u> of statistics –

the do you "get it" part. In this course, mathematics is simply seen as a way of expressing this understanding.

A Note on the Use of Statistical Software

SPSS (and sometimes R) will be used in this course. Although SPSS will be taught and used, it is of **extreme importance** that you do not equate "SPSS knowledge" with statistical knowledge. The emphasis in this course will be on <u>first understanding statistics</u>, then applying them on the computer. Learning how to use SPSS effectively and efficiently is relatively easy **IF YOU FIRST UNDERSTAND THE STATISTICAL PROCEDURES** which it offers. Using Field (2009) as a guide now and in the future will help you in using SPSS. However, Field's book, and most other software manuals, by themselves, will provide you with only a limited understanding of statistics (an exception to this are the SAS manuals, which usually provide good statistical material as well as computational routines). **It is much easier to know what a multiple regression is first, then learn how to do it on a computer, than to know how to do it on a computer, and be totally clueless as to what it is. Further, you will rarely be asked at a thesis or dissertation defense to demonstrate your knowledge of SPSS, no more than you would be asked to demonstrate your ability to use your pocket calculator. However, you will likely be asked to defend the statistics you've used in your research.**

Recommendations for Studying Statistics

In learning and/or expanding your knowledge of statistics, always try to see the "parts" within the "whole." In other words, take the elements that you learn, and try to situate them within the "bigger picture." You need a certain amount of small pieces before you can build the bigger picture, but always make the effort to see the larger frame. Once you do, the smaller pieces fall into place, and even new things that you learn can be more easily situated within the larger framework. For instance, if you are familiar with the general linear model (big picture), you can more easily situate and understand ANOVA and regression (smaller pieces). Similarly, if you understand what an F-distribution is (small piece), you can link this concept to better understanding ANOVA and regression (larger pieces).

In completing the assignments, <u>studying in groups is encouraged</u>. Discussing statistical concepts with others (including the instructor) is a powerful way to master the subject. <u>Always be critical of what you are learning</u>. There are countless debates over the proper use of statistics in research. Both statistics and psychology are still relatively young sciences. All scientific knowledge should be regularly subjected to reconstruction.

	TENTATIVE COURSE SCHEDULE		
DATE	**TOPIC**	**CHAPTERS - HAYS**	**ASSIGNMENT DUE**
30 Jan.	Course Syllabus, Course Policies Review of Stat I	Appendix E, 1 – 8, 10, 11, 12 & Handouts	
06 Feb.	**Factorial ANOVA** **Random Effects ANOVA**	**12, 13**	
13 Feb.	**Random Effects ANOVA** **Mixed Model ANOVA**	**13**	
20 Feb.	**Mixed Model ANOVA**	**13**	
27 Feb.	**Mixed Model ANOVA**	**13**	
06 Mar.	**Block Designs & Repeated Measures as Mixed Models** **(Longitudinal Analyses)**	**14**	
13 Mar.	**Regression and Correlation** **Regression and Correlation**	**14** **14**	
20 Mar.	**Partial and Multiple Regression** **Partial and Multiple Regression**	**15** **15**	
27 Mar.	**MID-TERM TEST (20%)**	**12, 13, 14 & Class Topics/Readings**	
03 Apr.	**Spring Break – NO CLASS**	**-**	
10 Apr.	**Regression (further topics)**	**14**	
17 Apr.	**Multilevel Models**	**Handouts**	
24 Apr.	**ANCOVA** **Student Seminars**	**17**	
01 May.	**Student Seminars**	**-**	
08 May.	**Student Seminars**	**-**	
15 May. **10:10AM – 12:10PM**	**Final Exam (30%) – Location TBA.**	**12, 13, 14, 15, 16, 17 & All Class Topics/Readings/Seminars, etc.,**	