Advanced Psychological Statistics I

PSYX 520 – Autumn 2015

Course Location and Time

Skaggs Building 246
Friday 12:10 – 3:00 PM

Instructor Information

Instructor: Daniel J. Denis, Ph.D.
Office: Skaggs Building 369
Phone: 406-243-4539
Email: daniel.denis@umontana.edu
Office hours: TBA.

Course Overview & Expectations

This course is designed for graduate students in psychology. Although the course is self-contained, it is assumed that you have taken *at least one undergraduate statistics course*. The scope of the course is generally applied, however select theoretical details and results will be emphasized insomuch as they facilitate the understanding of statistical concepts. It is imperative to gain an *understanding* of statistics, and a sense of its logical **foundation**, before knowing **how** and **when** to apply them (and in some cases, whether they should be applied at all).

Credits

3.0

Learning Outcomes

1. By completion, you should have a reasonable understanding of the nature of statistics, its common applications and its benefits and limitations within scientific practice. You should be able to critically evaluate some statistical analyses and design issues in the field, and be in a position to independently expand and generalize your knowledge of the subject. More generally, by the end of the course, you should feel somewhat confident about your grasp of the nature of statistics and their applications in psychological and related sciences.

2. Understanding the wealth of statistical procedures used in psychology begins with an understanding of the **key fundamental foundations** that are a component of virtually every statistical method or procedure, and that lie at the very heart of statistical science. Unifying concepts and principles will be emphasized in this course as to encourage a general understanding and appreciation of statistical thinking. **The goal is to strike a balance between showing you HOW to do statistics and providing an appreciation for WHAT you are doing, so that you may generalize your skills to new domains.** Though it is understood that you will likely be working in applied research and will be a producer and/or consumer of research, it is quite

meaningless and hollow to conduct a statistical analysis based on probability concepts (for instance) if you are not at least somewhat familiar with the concepts or meaning of probability. In addition to providing the skills of data analysis, which will allow you to conduct the most common analyses used in modern social science, the goal is to provide you with the skills required to permit independent study of statistical topics in psychological research and beyond. Psychology and related sciences have literally seen an explosion of statistical methods in the past couple of decades, and unless you have a foundation for understanding them, you will quickly get lost in the "cookbook" approach, and in no time be making serious (and potentially egregious) errors of application and interpretation. To avoid this, you need some understanding of what unites virtually all statistical methods. Even the most "complex" of statistical methods are nothing more than elaborations of basic foundational statistical elements. For instance, if you truly understand the essentials of correlation and regression, structural equation modeling can be interpreted as an **extension** of these core concepts rather than as an entirely "new" procedure.

3. More specifically, this course will cover topics which include: functions, essentials of set theory and elementary mathematics, probability, conditional probability and distributions, independence, association, random sampling and randomization, measurement scales, probability and sampling distributions, discrete and continuous random variables, expectation, the binomial distribution, measures of central tendency, measures of variability, confidence intervals, normal distribution, hypothesis testing, the nature of the null vs. alternative hypotheses, power, inferences about population means, chi-square distribution, *F* distribution, linear contrasts and post-hoc comparison procedures, general linear model, experimental design, simple analysis of variance, factorial analysis of variance, correlation, linear regression, linear multiple regression.

Required Texts

Class notes will be provided. There is no required textbook, though the optional sources below are recommended.

Optional Texts & Resources

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

Dowdy, S., Wearden, S. & Chilko, D. (2004). *Statistics for research*. Wiley: New Jersey.

Morgan, G.A., Leech, N. L., Gloeckner, G. W. & Barrett, K. C. (2011). IBM SPSS for Introductory Statistics: Use and Interpretation, 4th ed. Routledge: New York.

Leech, N. L., Barrett, K. C. & Morgan, G. A. (2011). IBM SPSS for Intermediate Statistics: Use and Interpretation, 4th ed. Routledge: New York.

Barnett, R.A., Ziegler, M. R., & Byleen, K. E. (2011). College Mathematics for Business, Economics, Life Sciences, and Social Sciences. Prentice Hall: MA.

Denis, D. (2007). *Study guide for Kirk, R. E. (2008)*. *Statistics: An introduction*. Thomson/Wadsworth: Belmont, CA.

Field, A. (2009). *Discovering statistics using SPSS*. Sage Publications: California.

Kirk, R. E. (2008). *Statistics: An introduction*. Thomson/Wadsworth: Belmont, CA.

Upton, G., & Cook, I. (2006). *Oxford Dictionary of Statistics*. Oxford University Press. New York.

Office Hours

Office hours are held weekly. You are also strongly encouraged to e-mail questions to the TA or instructor, as they arise. Writing your question out in an e-mail, as clearly as you can (even if very long) is an **excellent** way to clarify what you do not understand, and often, you achieve a deeper understanding of the topic itself. Replies will **usually** be given 24 to 48 hours after the e-mail is received. Please be as detailed and specific as you can in your e-mail so I know how to frame my response to best suit your needs. There will be a class e-mail listserv with which I will use to communicate with the class. Be sure you are on this list.

Evaluation

There are 4 components that will make up your final grade (see table below):

1. Assignments/Homework (8 @ 2% EACH = 16%)
2. Test 1 (10%)
3. Mid-Term Exam (30%)
4. Final Exam (50%) **

   ** **Final Exam = Final Grade** IF Final Exam is higher than cumulative total of Test 1 and Mid-term Exam.

Percentage	Grade	Percentage	Grade	Percentage	Grade
100	A	79	B +	59	D +
99	A	78	B +	58	D +
98	A	77	B +	57	D +
97	A	76	B	56	D
96	A	75	B	55	D
95	A	74	B	54	D
94	A	73	B	53	D
93	A	72	B -	52	D -
92	A	71	B -	51	D -
91	A	70	B -	50	D -
90	A	69	C +	< 50	F
89	A -	68	C +		
88	A -	67	C +		
87	A -	66	C		
86	A -	65	C		
85	A -	64	C		
84	A -	63	C		
83	A -	62	C -		
82	A -	61	C -		
81	A -	60	C -		

Percentage	Grade	Percentage	Grade	Percentage	Grade
80	A -				

Policies regarding Tests & Exams

All tests and exams will be written in-class, room 246 Skaggs. Be on time for all evaluations, as you will not have additional time if you arrive late.

Because of the nature of the short-answer and multiple-choice testing, tests and exams will require the class seating to be as sparse as possible (i.e., every second or third position). Please adopt "test-taking" seating on test days.

All material in lecture. However, usually, tests (and the final exam) will consist of a subset of material from each chapter. By attending lectures and keeping up with the class, you should get a good idea of what this subset will consist of.

Assignments

Unless otherwise noted, *homework assigned in a given class period is due in class the following week*. *Late homework will not be accepted*. In all assignments, you must show sufficient detail that you have understood the problem and have addressed it successfully. **Work turned in that does not show sufficient detail or thought process will receive a grade of zero**. **If you are unsure of how much explanation or work to include in your solutions, include more than not.**

Course Guidelines & Policies

Disability Modifications

The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors, and Disability Services for Students. If you think you may have a disability adversely affecting your academic performance, and you have not already registered with Disability Services, please contact Disability Services in Lommasson Center 154 or call 406-243-2243. I will work with you and Disability Services to provide an appropriate modification.

Attendance

If you absolutely must miss a class, please note that it is your responsibility to catch up on missed work. *Instructor notes will **not** be made available on an individual basis at any time.* Attending class lectures usually helps a great deal in understanding material, and consequently doing well on tests and exams.

Academic Misconduct

You are expected to adhere to the university's Student Conduct Code with regard to academic integrity. Academic misconduct in this course will not be tolerated and will result in an academic penalty. **If you are suspected of cheating on a test or exam, you will receive zero on that test or exam and be asked to leave the class permanently**. In short, even if you do not know the answer to a question, you're much better off guessing than risking the chance of getting caught cheating.

Policy on Class Disruptions

The expectations for this course are such that you remain respectfully silent while either the instructor is speaking or a colleague in the class is asking or responding to a question. In accordance with policies set by the University, **disruptions in class will not be tolerated**. This policy is set very strict so that **every student has the opportunity to learn in a quiet and constructive environment**. A failure to meet this expectation ($p < .05$) will result in you being dismissed permanently from the class. This policy is extremely strict as to protect the rights of students who have invested time, money and energy into this course and deserve nothing less than an optimal learning environment. The instructor will make every effort to make sure you, the student, has an ideal learning environment. Please speak to the instructor privately if you are being disturbed in class.

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.

Questions during Class

Although you are welcome and often encouraged to ask questions during lecture, class questions to some extent will have to be limited if they become too numerous, as to allow us to make our way through all the material we need to wade through by the end of the course. Be sure to recognize that only once in a "blue moon" will you understand EVERYTHING from the beginning to end of a given lecture, which is why studying between lectures is necessary. This is normal. If you understand the main themes of lectures, and can more or less "stay with us" as we progress through the lecture, that's a good guidepost to evaluate your in-class progress. Many of the questions you have during class will be answered by post-class study (or sometimes while waiting at a red light on the way home). Such is the nature of learning - do your best to "get it now," but if you can't, then sit or sleep on it for a little bit and return to *experience* the concept again from scratch once more. It might just "take" this time! Even the best of the best learners are always learning. As soon as you declare a concept "mastered," you possibly close the door to new learning and deepening of that very concept. If you would like to discuss learning strategies further, feel free to contact myself or the TA.

Mathematical Arguments Used in Statistics

Stat I will not be taught as if it were a mathematics course because statistics (applied) is not equal to mathematics. You will not be tested on whether you can *prove* or *justify* the equations that make up the discipline of statistics. Most test items will focus on your understanding and grasp of the material rather than on your ability to manipulate equations (though it would be nice if both went hand-in-hand). Familiarity with the mathematics of statistics can sometimes (but not always) aid in your understanding of the fundamental concepts. For that reason, lectures will sometimes contain mathematical arguments to help in your understanding of statistics. However, be aware that 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, or at minimum, **provide you with a means to express your statistical knowledge**. The opposite is also true - 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, it will get you nowhere fast. Tests

and exams will aim to evaluate your understanding of statistics – the "Do you get it?" part, and not weather you were able to memorize a formula you don't truly understand yet. In this course, mathematics is simply seen as a vehicle or means to expressing statistical understanding. **Focus on the concepts** (even the most technical of mathematics are but expressions of underlying concepts).

A Note on the Use of Statistical Software

Although SPSS (and at times, R) will be used, it is of extreme importance that you do not equate "SPSS knowledge" with statistical knowledge. The emphasis in this course will be on first understanding statistics, then applying them on the computer. Learning how to use SPSS (or any other software) effectively and efficiently is relatively easy **IF YOU FIRST UNDERSTAND THE STATISTICAL PROCEDURES** which it offers. Using software texts as a guide now and in the future will help you in using SPSS or R or SAS, or STATA, etc. **It is much easier to know what an ANOVA 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. To do that, you must UNDERSTAND what you are doing, and not simply HOW to do it.**

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).

Studying in groups is encouraged. Discussing statistical concepts with others is a powerful way to master the subject. Always be critical of what you are learning. There are countless debates over the proper use of statistics in research, and both statistics and psychology are still relatively young sciences, and to some extent, grew up together (but are still in their teen years). All scientific knowledge should be regularly subjected to reconstruction.

Tentative Course Timetable

Date	Topic	Primary Readings	Assignments (Graded)
04 Sept.	Syllabus, Introductions	-	-
11 Sept.	Mathematics & Probability	Notes – Chapter 2	#1
18 Sept.	Mathematics & Probability	Notes – Chapter 2	#2
25 Sept.	Introduction to Statistics	Notes – Chapter 3	#3

Date	Topic	Primary Readings	Assignments (Graded)
02 Oct.	Introduction to Statistics	Notes – Chapter 3	#4
09 Oct.	Introduction to Statistics	Notes – Chapter 3	-
16 Oct.	**TEST 1 (10%)**	**-**	
23 Oct.	Analysis of Variance (Fixed Effects)	Chapter 4	#5
30 Oct.	Analysis of Variance (Fixed Effects)	Chapter 4	
06 Nov.	**MID-TERM EXAM (30%)**		
13 Nov.	Factorial ANOVA	Chapter 5	#6
20 Nov.	Linear Regression	Chapter 8	
27 Nov.	THANKSGIVING FRIDAY (NO CLASS)		
04 Dec.	Linear Regression	Chapter 8	#7
11 Dec.	Multiple Regression	Chapter 9	#8
18 Dec.	**FINAL EXAM (50%)** - 8:00am to 10:00am 246 Skaggs	*All material covered in the course is subject to examination*	-