Statistics and Research Methods in Psychology

PSYC 3101-400, Fall 2013

Lectures: TR 9:30-10:45, Muen E0046 Labs: Muen D346, times shown below. *No labs the first week of class.* Final exam: Mon 12/16, 1:30-4pm, Muen E0046 Course website: http://matt.colorado.edu/teaching/stats

Instructor

Prof. Matt Jones mcj@colorado.edu Muen D260C Office hours: W 12:30-1:30, F 9-10

Teaching Assistants

Name	Email	Office	Hours	Lab Sections
Emma Johnson	Emma.C.Johnson@Colorado.edu	Muen D347A	M 2:30-4:30	T 1-2:50, W 9-10:50
Leif Oines	Leif.Oines@Colorado.edu	Muen D0040D	R 11-1	T 11-12:50, F 1-2:50

Course Objectives

Statistics constitute our best set of tools for formally analyzing scientific data, for separating what the data tell us from what they do not. They form the foundation of scientific understanding in every field of psychology. Although statistics are mathematical and somewhat abstract, a firm understanding of statistics allows us to see the beauty of nature with far more clarity than is otherwise possible.

This course is designed as an introduction to statistics as they are used in psychology and other sciences. We will approach this subject from three directions: conceptual understanding, mathematical foundations, and practical (computer-based) implementation. No previous experience with statistics is required, but you will need some basic familiarity with probability, as well as proficiency in mathematics up through algebra, matrix algebra, and basic calculus (derivatives).

By the end of the semester, you will be able to understand and use descriptive statistics for characterizing data, including measures of central tendency, variability, and frequency. You will be able to calculate inferential statistics for drawing scientific conclusions from data, including t-tests, analyses of variance (ANOVA), correlation, linear regression, and non-parametric tests. You will also learn to design scientific studies and to use statistical software to analyze data.

Required Text

Gravetter, F.J., & Wallnau, L.B. (2009). Statistics for the Behavioral Sciences (8th ed.). Belmont: Thomson Wadsworth.

R Statistics Programming Language

Lab sessions will involve training in computer-based statistical analyses, using the open-source software package, R. We have chosen R because it is free for you to install on your own computer and fairly quick to learn. There are many other languages available that you may decide to use as you continue your studies and career. The purpose of the lab sessions is not to learn R per se, but to have hands-on experience doing statistics. You can download R for your own computer by going to <u>http://www.r-project.org</u>, or bring it to the first week of lab to get help from your TA.

Calculators

You will need a basic calculator for the exams. <u>Graphing calculators and calculators with statistical functions (e.g., ΣX , ΣX^2) are not allowed.</u>

Requirements

Lecture participation. It is important to attend every lecture and every lab session. A full class makes a big difference to the quality of discussion and benefits everyone, and you will learn a lot more from this class by staying involved. I will present clicker questions during lectures, and your final grade will depend on your answering these questions (but <u>not</u> on whether your answers are correct). When assigning grades I will also round students up who are particularly engaged in asking questions during lecture.

Weekly homework. These will be fairly short problem sets, in the same style as the exam questions. If you can answer these questions then you can be confident you'll do well on the exams. Homework assignments will be due in lecture each Tuesday and must be

handed in <u>before class begins</u>. Be sure to fill in your name and section at the top of the page. Each student's lowest homework score will be dropped when calculating final grades.

Reading and practice problems. The textbook is an important complement to the lectures, and it covers several topics that will not be included in lecture. Likewise, the lectures are not a substitute for hands-on practice with the type of problems you will be tested on. You will not turn in your work on the problems from the book, but most students will not be able to do well on the exams without doing all of the readings and practice problems.

Lab work. Each lab session will include a set of practice problems on the concepts and techniques covered that week. At the end of the lab meeting, you will turn in your answers together with the computer commands you used to do your analyses. Your TA will explain this in more detail during the first lab meeting. If you miss a lab <u>and you notify your TA in advance</u>, you may turn in the assignment for half credit before the next meeting of your section. Each student's lowest lab score will be dropped when calculating final grades.

Exams. There will be three midterm exams, each covering the material from 3-4 weeks of the course. There will also be a cumulative final exam.

Grading

Homework	15%
Lab assignments	15%
Clicker participation	10%
Midterms (each)	10%
Final exam	30%

Grade cutoffs: A | 93% | A- | 90% | B+ | 87% | B | 83% | B- | 80% | C+ | 77% | C | 73% | C- | 70% | D+ | 67% | D | 63% | D- | 60% | F

Schedule

Date	Topic	Reading	Practice Problems	Lecture Topics
Aug 27	Overview	_	—	overview, procedures, example
Aug 29	Research Design	Ch 1, <i>except</i> Section 1.4 Appendix A Syllabus	Ch 1: 5-12, 18-23	variables, hypotheses, & data; experimental and non-experimental studies; correlation and causation; independent and dependent variables; random assignment
Sep 3	Goals of Statistics		Ch 1: 1-4	populations and samples; sampling error; random selection; parameters vs. statistics; descriptive statistics, estimators, and inferential statistics
Sep 5	Distributions	Ch 2	Ch 2: 1-26	frequency; quantiles; cumulative distribution; histograms; shape of distributions; continuous variables
Sep 10	Central Tendency & Scale Types	Ch 3 Section 1.4	Ch 1: 13-17 Ch 3: 1-28	mean, median, and mode; nominal, ordinal, interval, and ratio scales; choosing the right statistic
Sep 17	Variability	Ch 4, <i>except</i> Section 4.4 and first 1 ³ / ₄ pages of 4.5	Ch 4: 1-5, 7, 9, 12-13, 15-22	range; interquartile range; standard deviation and variance; outliers
Sep 19	z-scores	Ch 5	Ch 5: 1-28	standardized distributions and z- scores
Sep 24	Probability & Estimation	Ch 6 Section 4.4 First 1¾ pages of 4.5	Ch 4: 6, 8, 10-11, 14, 23-29 Ch 5: 29 Ch 6: 1-21; Optional: 22-28	probability; random sampling; expectation; bias; sample variance
Sep 26	Exam 1	Chs 1-6		
Oct 1	Binomial Test	Ch 19	Ch 19: 1-24 (binomial formula and normal approximation won't be on exams)	binomial distribution; null hypothesis; alternative hypothesis; Types I & II errors; critical value; alpha level; exact binomial test

Oct 3	Distribution of the Sample Mean	Ch 7	Ch 7: 1-23	distribution of sample means; Law of Large Numbers; standard error; Central Limit Theorem; Normal distribution; distribution of sample variance; chi-square distribution
Oct 8	Single-sample t-test	Ch 9, <i>except</i> Section 9.3 through p. 295 Section 8.4	Ch 9: 1-25 Save questions about effect size for Oct 17	hypothesis tests for population mean; the problem of unknown variance; t statistic; degrees of freedom; t-test; directional tests
Oct 10	Hypothesis Testing	Ch 8, <i>except</i> Sections 8.4 & 8.6	Ch 8: 1-25 Save effect size Qs for Oct 17	test statistic; critical region; types I & II errors; power; p-value
Oct 15	Two-sample t-tests	Ch 10, <i>except</i> pp. 320-323 Ch 11, <i>except</i> pp. 348-349	Ch 10: 1-25 Ch 11: 1-24 Save effect size Qs for Oct 17	between-subjects design; independent-sample t-test; within-subjects design; paired- samples t-test
Oct 17	Effect Size	Ch 12, Sections 8.6 & 9.3, pp. 320-323, 348-349	Ch 12: 1-25 Qs on Cohen's <i>d</i> from Chs 8-11	statistical reliability vs. size of an effect; point vs. interval estimates; confidence intervals
Oct 22	Three Views of Inferential Statistics	—	_	relationship between confidence interval, critical value, and alpha
Oct 24	Review	Chs 7-12, 19		
Oct 29	Exam 2	Chs 7-12, 19		
Oct 31	Correlation	Ch 16, <i>except</i> Sections 16.4-16.5	Ch 16: 1-18	relationships between continuous variables; Pearson correlation
Nov 5	Regression	Ch 17	Ch 17: 1-14, 18-21	linear relationships; least-squares prediction; residual variance and R- squared; multiple predictors
Nov 7	Analysis of Variance (ANOVA)	Ch 13	Ch 13: 1-27 $(\eta^2 \text{ won't be on exams})$	comparing means of several groups; partitioning sum-of- squares; degrees of freedom; F distributions
Nov 12	Repeated Measures	Ch 14	Ch 14: 1-25	comparing several related measurements; within-subjects factors; subject-level variance
Nov 14	Factorial ANOVA	Ch 15	Ch 15: 1-11, 16-18	tests for multiple independent variables; factorial design; main effects and interactions
Nov 19	Review	Chs 13-17		
Nov 21	Exam 3	Chs 13-17		
Dec 3	Goodness of Fit	Ch 18	Ch 18: 1-24 (phi won't be on exams)	Normal approximation of binomial distribution; generalizing the binomial test; frequency tables; testing independence
Dec 5	Non-parametric tests	Ch 20	Ch 16: 19-22 Ch 20: 1-3	assumption violations and non- parametric tests; Mann-Whitney; Wilcoxon; Kruskal-Wallis; Friedman
Dec 10	Review	Chs 1-20		
Dec 12	Review	Chs 1-20		
Dec 16	Final Exam	1:30-4, Muen E0046		All reading, lectures, and labs from the semester

Standard CU Classroom Policies

CU Policy for Students with Disabilities

If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services *at least two weeks before any exam* so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact Disability Services at 303-492-8671 or by e-mail at dsinfo@colorado.edu.

If you have a temporary medical condition or injury, see Temporary Injuries under Quick Links at Disability Services website (http://disabilityservices.colorado.edu/) and discuss your needs with your professor.

CU Sexual Harrassment Policy

The University of Colorado Boulder (CU-Boulder) is committed to maintaining a positive learning, working, and living environment. The University of Colorado does not discriminate on the basis of race, color, national origin, sex, age, disability, creed, religion, sexual orientation, or veteran status in admission and access to, and treatment and employment in, its educational programs and activities. (Regent Law, Article 10, amended 11/8/2001). CU-Boulder will not tolerate acts of discrimination or harassment based upon Protected Classes or related retaliation against or by any employee or student. For purposes of this CU-Boulder policy, "Protected Classes" refers to race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, or veteran status. Individuals who believe they have been discriminated against should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Student Conduct (OSC) at 303-492-5550. Information about the ODH, the above referenced policies, and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at http://hr.colorado.edu/dh/

http://m.colorado.cdu/dh/

CU Religious Observance Policy

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. See full details at http://www.colorado.edu/policies/fac_relig.html. If you have a conflict with an exam or another assignment in this class, *please notify me two weeks in advance* so that we can accommodate your needs.

CU Classroom Behavior Policy

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, color, culture, religion, creed, politics, veteran's status, sexual orientation, gender, gender identity and gender expression, age, disability, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. See policies at http://www.colorado.edu/policies/classbehavior.html

http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student code

CU Honor Code

All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Other information on the Honor Code can be found at

http://www.colorado.edu/policies/honor.html

http://www.colorado.edu/academics/honorcode/