

Psychological Science I: Statistics

PSYC 2111, Fall 2016

<http://matt.colorado.edu/teaching/stats>

Instructor

Prof. Matt Jones
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Muen D260C
Office hours: T 12:15-1:30, W 10:45-11:30, other times available by request

Teaching Assistants

Name	Email	Office	Hours	Lab Sections
Brooke Huibregtse	Brooke.Huibregtse@Colorado.edu	Muen D438	T 11-1	T 1-2:50, T 3-4:50
Chelsie Benca	Chelsie.Benca@Colorado.edu	Muen D438	M 12-2	W 8-9:50, W 10-11:50
Alex Kirk	Alex.Kirk@Colorado.edu	Muen D213D	M 4-6	W 1-2:50, F 1-2:50
Adam Young	Adam.P.Young@Colorado.edu	Muen E225	MW 9-10	R 1-2:50, R 3-4:50
Spencer Huggett	Spencer.Huggett@Colorado.edu	Muen D438	TR 12:30-1:30	F 9-10:50, F 11-12:50

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 <http://www.r-project.org>, 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. Graphing calculators and calculators with statistical functions (e.g., ΣX , ΣX^2) are not allowed.

Requirements

Reading. Textbook chapters are to be read before each lecture. The lecture will assume you've done the reading, and you'll often get lost if you haven't.

Clicker quizzes. Each lecture will begin with a brief quiz based on the assigned reading. If you've done the reading then these questions should be easy.

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 before class begins. Be sure to fill in your TA's name (as well as your own) at the top of the page. Each student's lowest homework score will be dropped when calculating final grades.

Practice problems. The lectures will be largely conceptual and are not a substitute for hands-on practice with the type of problems you will be tested on. Most students will not be able to do well on the exams without a lot of this practice, more than comes from the weekly homework assignments. You can decide whether to work on the selected problems before or after each lecture, and you do not need to turn in your work on these.

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 and you notify your TA in advance, 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

Quizzes	10%
Homework	15%
Lab assignments	15%
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 23	Overview	—	—	overview, procedures, example
Aug 25	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
Aug 30	Goals of Statistics		Ch 1: 1-4	populations and samples; sampling error; random selection; parameters vs. statistics; descriptive statistics, estimators, and inferential statistics
Sep 1	Distributions	Ch 2	Ch 2: 1-26	frequency; quantiles; cumulative distribution; histograms; shape of distributions; continuous variables
Sep 6	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 8	Variability	Ch 4, <i>except</i> Section 4.4 and first 1¾ pages of 4.5	Ch 4: 1-5, 7, 9, 12-13, 15-22	range; interquartile range; standard deviation and variance; outliers
Sep 13	z-scores	Ch 5	Ch 5: 1-28	standardized distributions and z- scores
Sep 15	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 20	Review	Chs 1-6		
Sep 22	Exam 1	Chs 1-6		
Sep 27	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
Sep 29	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

Oct 4	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 13	distribution; distribution of sample variance; chi-square distribution hypothesis tests for population mean; the problem of unknown variance; t statistic; degrees of freedom; t-test; directional tests
Oct 6	Hypothesis Testing	Ch 8, <i>except</i> Sections 8.4 & 8.6	Ch 8: 1-25 Save effect size Qs for Oct 13	test statistic; critical region; types I & II errors; power; p-value
Oct 11	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 13	between-subjects design; independent-sample t-test; within-subjects design; paired-samples t-test
Oct 13	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 18	Three Views of Inferential Statistics	—	—	relationship between confidence interval, critical value, and alpha
Oct 20	Review	Chs 7-12, 19		
Oct 25	Exam 2	Chs 7-12, 19		
Oct 27	Correlation	Ch 16, <i>except</i> Sections 16.4-16.5	Ch 16: 1-18	relationships between continuous variables; Pearson correlation
Nov 1	Regression	Ch 17	Ch 17: 1-14, 18-21	linear relationships; least-squares prediction; residual variance and R-squared; multiple predictors
Nov 3	Analysis of Variance (ANOVA)	Ch 13	Ch 13: 1-27 (η^2 won't be on exams)	comparing means of several groups; partitioning sum-of-squares; degrees of freedom; F distributions
Nov 8	Repeated Measures	Ch 14	Ch 14: 1-25	comparing several related measurements; within-subjects factors; subject-level variance
Nov 10	Factorial ANOVA	Ch 15	Ch 15: 1-11, 16-18	tests for multiple independent variables; factorial design; main effects and interactions
Nov 15	Review	Chs 13-17		
Nov 17	Exam 3	Chs 13-17		
Nov 29	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 1	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 6	Review	Chs 1-20		
Dec 8	Review	Chs 1-20		

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 me.

CU Sexual Harrassment Policy

The University of Colorado Boulder (CU Boulder) is committed to maintaining a positive learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct, discrimination, harassment or related retaliation against or by any employee or student. CU's Sexual Misconduct Policy prohibits sexual assault, sexual exploitation, sexual harassment, intimate partner abuse (dating or domestic violence), stalking or related retaliation. CU Boulder's Discrimination and Harassment Policy prohibits discrimination, harassment or related retaliation based on race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Individuals who believe they have been subject to misconduct under either policy should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127. Information about the OIEC, the above referenced policies, and the campus resources available to assist individuals regarding sexual misconduct, discrimination, harassment or related retaliation can be found at the OIEC website (<http://www.colorado.edu/institutionalequity/>).

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> and 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> and <http://www.colorado.edu/academics/honorcode/>.