PSYC 209 MEASUREMENT AND STATISTICS

Harker ISE Lab, Room 307
Section 014: Tues Thurs 8:00-9:15

PROFESSOR

Leigh Andrews, BA,
Email: landrews@psych.udel.edu
Office: 317 Wolf Hall
Office Hours: Tues 9:30-11, or by appointment

For assistance outside of class, please stop by my drop-in office hours (no appointment necessary). Do not hesitate to come by to revisit the concepts covered in class or get help with an assignment that is giving you trouble!

My goal as a professor is to assist you in learning to think and approach real-world problems with critical thinking and in a scientific manner. The skills you learn in this class can be applied in business or academia, in non-profit and corporate work, in a political campaign or an advertising campaign. It is important to me that you feel safe asking questions and looking for clarification, that you let me know when I'm being unclear, and that you feel that this course is clearly organized and fair.

My teaching philosophy is simple: making mistakes is the best way to learn! When I code, I make a lot of mistakes. I expect that this will happen to you, too, in this course. I designed the course to create a safe space for making mistakes in the class exercises. They will serve as your building blocks for the final exam. I look forward to getting to know you all!

COURSE DESCRIPTION

This course is an introduction to statistical analysis and measurement in psychology. The goal of our time together is to introduce you to different techniques for measuring psychological concepts, and then to develop the statistical skills and knowledge necessary for hypothesis testing and understanding the data gathered.

The purpose of Measurement and Statistics is to a) introduce you to several measurement types and techniques; b) explain how to analyze and test hypotheses about what we have measured; and c) understand and explain the statistical techniques (basic descriptive statistics, sampling and probability, hypothesis testing, t-tests, and ANOVAs) we have used to explore psychological data. You will also learn to use Excel and R to visualize and analyze data.

WHY STATISTICS?

There are two reasons that you may consider taking this course:

1. Knowledge of statistics helps to make better decisions. Examining data can save lives and improve our society. For example, in the past, people did not know that smoking leads to cancer and early deaths. In addition, the tobacco industry claimed that smoking is good for health and even prevents cancer. But, based on statistical data about smoking and premature deaths, CDC now thinks that smoking is a leading cause of death and discourage people from

smoking. Scientists made these discoveries using statistical techniques. By learning statistics, you too will be able to help yourself and others make better decisions.

2. Knowledge of statistical analysis is marketable and transferable. Government agencies and companies make decisions based on statistical results. They are also actively analyzing data. Learning how to interpret and run statistical analyses makes you marketable, as job projections of statisticians and data scientists are growing rapidly. Also, the R statistical language that you learn in this course is ranked 8th among all the programming language in the 2018 ranking by IEEE, adding a marketable skill to your career toolbox.

PREREQUISITES

Grade of C- or better in PSYC100. Open to majors and minors in Psychology.

COURSE OBJECTIVES AND GOALS

Our purpose is to build a foundation of knowledge in the measurement of variables that are of interest to psychologists, neuroscientists, and other researchers, and to introduce you to the use of inferential statistics to test hypotheses and draw conclusions.

By the end of this course, you:

- should be able to visualize data when provided with it, recognize types of data (categorical, numerical, ordinal), and explain what type of measurement was used when presented with a measure or data, so that you can design your own research questions.
- should be able to compare and contrast what t-tests, ANOVAs, regression, and chi-square tests are, and have an idea of when the use of each is appropriate to inform your own use of them in the future.
- should be able to interpret statistical data from a t-test, ANOVA, chi-square test, or regression, when reviewing a case study or research article.
- should be able to summarize statistical findings from these techniques in a scientific framework, using scientific language, so that you are able to make use of these tests yourself in looking at real world problems.

Our goals, in more specific concrete detail, are as follows:

At the end of this course, a student will be able to:

1. Visualize data using R Studio
    a. Create a scatterplot
    b. Create a histogram
    c. Create a boxplot
2. Format a visualization (a figure) according to the APA style
3. Recognize and describe types of data
    a. Numerical data
    b. Categorical data
4. Compute descriptive statistics (mean, mode, standard deviation) using R and interpret them
5. Describe key concepts in hypothesis testing apply them to guide a conclusion

   a. p-value
   b. Type I and Type II errors (decision errors)
   c. Confidence interval
6. Recognize, describe, and perform the following statistical analysis using R
   a. z-test
   b. t-tests: one-sample (paired), two-sample
   c. ANOVA (F-test)
   d. Correlation & Regression
7. Select an appropriate statistical technique given a data type and a research question
8. Interpret the analysis output from R
9. Write the results section based on the output in the APA style

COURSE MATERIALS

REQUIRED TEXTS

The OpenIntro Statistics Textbook –4th edition only!!!

> Diez, D., Barr C., & Çetinkaya-Rundel, M. 2014. OpenIntro Statistics, 4rd Edition. OpenIntro Inc. ISBN-10: 1943450048• ISBN-13: 9781943450046

I'm committed to making my class affordable and accessible. This textbook is freely available in a PDF format (https://www.openintro.org/stat/textbook.php?stat_book=isrs). If you prefer a paper copy, you can order it from Amazon.com for about $9.

SOFTWARE

R STUDIO (CLOUD OR STANDALONE)

Price: Free
We will use R Studio to visualize, manipulate, and analyze data. There are currently two ways to get access to R Studio. We will go over the installation process on the first day of the class

> RStudio Cloud (recommended)
> Create an account on https://rstudio.cloud/
> I recommend that you use your UD Google Account to sign-in.
> You will receive an invitation email to join the project to your @udel.edu account.
>
> Standalone RStudio on your computer (optional)
> You will need to first install R (base R) and then install RStudio Desktop (Open Source Edition). For additional instructions, see this video tutorial. I'm also happy to help you install RStudio on your computer.

RESOURCES

APA PUBLICATION MANUAL

American Psychological Association. (2010). *Publication manual of the American Psychological Association* (6th ed). Washington, DC: American Psychological Association.
We'll refer to the content of the APA manual to write results in an APA format.

Cheat Sheets for R
RStudio IDE Cheat Sheet - for navigating RStudio
https://github.com/rstudio/cheatsheets/raw/master/rstudio-ide.pdf
Data Visualization Cheat Sheet - for making visualizations
https://github.com/rstudio/cheatsheets/raw/master/data-visualization-2.1.pdf

R for Data Science
https://r4ds.had.co.nz/
This online book is a great source for learning about R programming language. If you are interested more about learning about R, I recommend this book.

LAPTOP

We will do in-class exercises using R Studio statistical software. Please bring your laptop computer to classes. A tablet device such as iPad may work by accessing the R Studio Cloud. Yet, I highly recommend bringing a laptop to class. If you do not have a laptop computer, you can borrow one from the library.

CLASS STRUCTURE

Your learning in this class will come from a combination of what we do in the classroom and what you do on your own outside of class.

Class sessions will consist of instructor-presented material and classroom activities. You are expected to attend all class meetings and to arrive on time; being present in class will be critical to your understanding of the course material.

Outside of class you will be practicing and expanding upon your knowledge via reading and homework.

GRADING

Percent of Final Grade		
Reading Check	18%	4pts each, 18 total assignments
In-Class Exercise	24 %	4pts each, 24 total assignments
Homework	10 %	10 pts each, 4 total assignments
Prelim and Midterm Quizzes	21 %	38pts and 45 pts respectively
Final Exam	27 %	1 Final exam, worth 108 pts

READING CHECKS (20%)

To activate your knowledge before each class, you will complete a reading check. They are due before the beginning of the classes. One of the questions in the reading check asks you to come up with one question about the reading material. In the following class, your group will decide one question to ask at the beginning of the class. (4 points x 18 = 72 points in total)

IN-CLASS EXERCISES (27%)

In each class, you will complete an exercise as participation. At the beginning of the semester, you will be randomly paired with two or three students. You will work with them throughout the semester for the in-class exercises. The purpose of having a group is to have others to discuss ideas during the exercises. You will submit your individual work. These exercises are due at the end of the class. (4 points each x 24 = 96 points in total)

HOMEWORK (9%)

The homework assignments are to help you practice the problems at home. You will grade your homework via a process that will be posted later in the class. (10 points x 4 = 40 points)

PRELIM AND MIDTERM QUIZZES (21%)

The prelim and midterm quizzes are to help to reinforce your knowledge about inference and hypothesis testing before moving onto specific tests. These quizzes will be given in class. You will have an opportunity to earn revision credits. You can earn a maximum of 50% of missed points by submitting a revision. Your revision should include typewritten reason/s for both (a) why your original answers were incorrect and (b) why the revised answers are correct. Revision is due within one week of returning the quiz. (38 points for the prelim and 45 points for the midterm)

Your attendance *is required* on the days in which there is an in-class exam. In the event of an emergency or unavoidable conflict, prior to the start of the regularly scheduled exam, you must let your professor know that you will be missing the exam. If you are eligible to take a make up exam (see below) the TA will schedule and proctor your make up exam ***within one week.*** At the time of your scheduled make-up exam, you must provide written documentation of the reason for your absence.

ELIGIBILITY

You are eligible to take a make-up exam within one week of the originally scheduled exam only under the following two circumstances:

- You know ahead of time that you must miss an exam because of a previously scheduled conflict that you are not able to change (e.g., a university-sponsored sports competition that are you participating in, surgery, a religious event), or
- In the case of serious illness or emergency.

FINAL EXAM (23%)

Our final exam will be completed individually. The format will be take-home. You will be given a set of data and questions. You will select a statistical approach to answer a question. The dataset and statistical analysis should mirror those covered in in-class exercises. The final exam will include a research question and a dataset. Your task is to identify an appropriate statistical test for the

research question, run the analysis, and visualize graphs for the results. The exam question will be released on a date specified in the course schedule. (108 points)

LATE SUBMISSIONS

Late submissions are accepted with a 10% deduction from the total score for each day late from the due date.

ATTENDANCE (0%)

Although we will take attendance every day, attending class does not contribute to your final grade, although the reading checks and in class exercises do.

Attending class is to *your* benefit – it gives you the opportunity to hear the course material explained more fully and with new examples, as compared to the textbook alone. Most importantly, attending class means that you will have the opportunity to try out new course material for yourself on the spot, talk with other students about how to do it, and get help and feedback from the professor.

Each day, I will take attendance – either by passing a sign in sheet around the classroom, or by visually scanning the room and taking note of who is present. To view your attendance record on Canvas, click on the Attendance link and then view the Roll Call Attendance submission details page. You will need see Attendance via the Grades link because attendance in this class is not being graded and does not contribute to your final grade.

Your attendance *is required* on the days in which there is an in-class exam. See the section above re exams for procedures if you are unable to attend an exam.

GRADE SCALE

		B+	87-89.99	C+	77-79.99	D+	67-69.99
A	93-100	B	83-86.99	C	73-76.99	D	63-66.99
A-	90-92.99	B-	80-82.99	C-	70-72.99	D-	60-62.99
						F	<60

The letter grade you receive is determined by the numerical range that your grade falls into, without additional rounding.

To assist you in calculating your grade, a Grade Calculator is available on Canvas.

UD CAPTURE

The class will be recorded via UD Capture. Please note that the materials presented via the projector and the audio will be recorded and be available on the Canvas website. This service is provided via IT Academic Technology Services (http://ats.udel.edu/)

SCHEDULE, READINGS, AND ASSIGNMENTS

The dates on the syllabus are *tentative* and will be changed as the semester proceeds, depending on how quickly or slowly we get through the course material.

Week	Date	Class Topic and Activity	Due in Class
Week 1	Tues, Aug 27	Syllabus Review Introduction to R How to submit your work	Bring your laptop to the class
	Thurs, Aug 29	Types of Variables	Reading Check Due 1.2.1 Observations, variables, and data matrices 1.2.2 Types of variables 1.2.3 Relationships between variables
Week 2	Tues, Sep 3	Visualizing Data: Central tendencies (Mean, Mode)	Reading Check Due: 2.1.1 Scatterplots for paired data 2.1.2 Dot plot and the mean 2.1.3 Histograms and shape
	Thurs, Sep 5	Visualizing Data: Variability (Standard deviation, box plots) Homework 1 Distributed	Reading Check Due: 2.1.4 Variance and standard deviation 2.1.5 Boxplots, quartiles, and the median 2.1.6 Robust statistics
Week 3	Tues, Sep 10	Review Homework Putting it all together: Visualization, central tendency, variability	Homework 1 Due
	Thurs, Sep 12	**Preliminary Quiz on R, Variable Types and Visualization**	
Week 4	Tues, Sep 17	Introduction to Inference & Hypothesis Testing 1: Case Studies	Reading Check Due: 2.3 Malaria vaccine
	Thurs, Sep 19	Introduction to Probability	Reading Check Due: 3.1 Defining probability
Week 5	Tues, Sep 24	Probability part II	Reading check: 3.2 Conditional probability

	Thurs, Sep 26	Probability and randomness	Reading Check Due: 3.4 Random variables 3.5 Continuous distributions
Week 6	Tues, Oct 1	No Class (Rosh Hashanah)	No Class (Rosh Hashanah)
	Thurs, Oct 3	Normal Distributions	Reading Check Due: 4.1 Normal Distributions
Week 7	Tues, Oct 8	Review Homework Inference!	Homework 2 Due Reading Check Due: 5.1 Point estimates and sampling variability
	Thurs, Oct 10	Confidence Intervals	Reading Check Due: 5.2 Confidence Intervals for a sample proportion
Week 8	Tues, Oct 15	Testing a Proportion Homework 3 Distributed	Reading Check Due: 5.3 Hypothesis Testing for a proportion
	Thurs, Oct 17	Putting it all together: Inference and Hypothesis Testing	Homework 3 Due
Week 9	Tues, Oct 22	**Midterm Quiz on Inference and Hypothesis Testing**	
	Thurs, Oct 24	t-test – one-sample	Reading Check Due: 7.1. One-sample means with the t-distribution
Week 10	Tues, Oct 29	t-test – two means	Reading Check Due: 7.3 Difference of two means
	Thurs, Oct 31	ANOVA Basics	Reading Check Due: 7.5 Comparing many means with ANOVA 7.5.1 Core ideas of ANOVA 7.5.2 Is batting performance related to player position in MLB 7.5.3 ANOVA and the F test

			7.5.4 Reading an ANOVA table from software
Week 11	Tues, Nov 5	ANOVA Application	Reading Check Due: 7.5.6 Graphical diagnostics for an ANOVA analysis 7.5.7 Multiple comparisons and controlling Type I Error rate
	Thurs, Nov 7	Putting it all together: one-sample t-test, two-means t-test, ANOVA	
Week 12	Tues, Nov 12	Correlation & Regression 1 - Introduction to Correlation and Regression Homework 3 Distributed	Reading Check Due: Chapter 8 – Introduction to linear regression 8.1 Fitting a line, residuals, and correlation
	Thurs, Nov 14	Correlation & Regression 2 — Interpreting Regression Output	Reading Check Due: 8.2 Fitting a line by least squares regression
Week 13	Tues, Nov 19	Correlation & Regression 3 — Application of Regression	Reading Check Due: 5.4 Inference for Linear regression
	Thurs, Nov 21	Putting it all together: When to use which tests: ● One-sample t-test ● Two-sample t-test ● ANOVA ● Correlation ● Regression Communicating results: APA Style and Reporting Advanced Visualization in R	Homework 4 Due
Week 14	Tues, Dec 3	Spillover – Outliers?	
	Thurs, Dec 5	**Final Examination Distributed After the Class**	
FINALS WEEK			

COMMUNICATION

For all class announcements (course cancellations, changes in assignments, etc.), I will send out an Announcement via Canvas. If you have a question about content or an assignment, please email me through the Inbox in Canvas as well. I generally require 24 hours to respond to an email, and although I may sometimes respond more quickly, time sensitive emails sent without enough time may not be responded to.

ACADEMIC INTEGRITY

Please familiarize yourself with UD policies regarding academic dishonesty. To falsify the results of one's research, to steal the words or ideas of another, to cheat on an assignment, to re-submit the same assignment for different classes, or to allow or assist another to commit these acts corrupts the educational process. Students are expected to do their own work and neither give nor receive unauthorized assistance. Complete details of the university's academic integrity policies and procedures can be found at http://www1.udel.edu/studentconduct/policyref.html Office of Student Conduct, 218 Hullihen Hall, (302) 831-2117. E-mail: student-conduct@udel.edu

HARASSMENT AND DISCRIMINATION

The University of Delaware works to promote an academic and work environment that is free from all forms of discrimination, including harassment. As a member of the community, your rights, resource and responsibilities are reflected in the non-discrimination and sexual misconduct policies. Please familiarize yourself with these policies at www.udel.edu/oei . You can report any concerns to the University's Office of Equity & Inclusion, at 305 Hullihen Hall, (302) 831-8063 or you can report anonymously through UD Police (302) 831-2222 or the EthicsPoint Compliance Hotline at www1.udel.edu/compliance. You can also report any violation of UD policy on harassment, discrimination, or abuse of any person at this site: sites.udel.edu/sexualmisconduct/how-to-report/

FACULTY STATEMENT ON DISCLOSURES OF INSTANCES OF SEXUAL MISCONDUCT

If, at any time during this course, I happen to be made aware that a student may have been the victim of sexual misconduct (including sexual harassment, sexual violence, domestic/dating violence, or stalking), I am obligated to inform the university's Title IX Coordinator. The university needs to know information about such incidents in order to offer resources to victims and to ensure a safe campus environment for everyone. The Title IX Coordinator will decide if the incident should be examined further. If such a situation is disclosed to me in class, in a paper assignment, or in office hours, I promise to protect your privacy--I will not disclose the incident to anyone but the Title IX Coordinator. For more information on Sexual Misconduct policies, where to get help, and how to report information, please refer to www.udel.edu/sexualmisconduct. At UD, we provide 24-hour crisis assistance and victim advocacy and counseling. Contact 302-831-1001, UD Helpline 24/7/365, to get in touch with a sexual offense support advocate.

For information on various places you can turn for help, more information on Sexual Misconduct policies, where to get help, and reporting information please refer to www.udel.edu/sexualmisconduct

INCLUSION OF DIVERSE LEARNING NEEDS

Any student who thinks he/she may need an accommodation based on a disability should contact the Office of Disability Support Services (DSS) office as soon as possible. The DSS office is located at 240 Academy Street, Alison Hall Suite 130, Phone: 302-831-4643, fax: 302-831-3261, DSS website (www.udel.edu/DSS/). You may contact DSS at dssoffice@udel.edu

NON-DISCRIMINATION

The University of Delaware does not discriminate against any person on the basis of race, color, national origin, sex, gender identity or expression, sexual orientation, genetic information, marital status, disability, religion, age, veteran status or any other characteristic protected by applicable law in its employment, educational programs and activities, admissions policies, and scholarship and loan programs as required by Title IX of the Educational Amendments of 1972, the Americans with Disabilities Act of 1990, Section 504 of the Rehabilitation Act of 1973, Title VII of the Civil Rights Act of 1964, and other applicable statutes and University policies. The University of Delaware also prohibits unlawful harassment including sexual harassment and sexual violence.

For inquiries or complaints related to non-discrimination policies, please contact:
Interim Director, Institutional Equity & Title IX Coordinator - Fatimah Stone titleixcoordinator@udel.edu, 305 Hullihen Hall Newark, DE 19716 (302) 831-8063

For complaints related to Section 504 of the Rehabilitation Act of 1973 and/or the Americans with Disabilities Act, please contact: Director, Office of Disability Support Services, Anne L. Jannarone, M.Ed., Ed.S. - ajannaro@udel.edu
Alison Hall, Suite 130, Newark, DE 19716 (302) 831-4643 OR contact the U.S. Department of Education - Office for Civil Rights (wdcrobcolp01.ed.gov/CFAPPS/OCR/contactus.cfm)