Syllabus for PSYC209: Measurement and Statistics (2019 Winter)

Course Information

Course Name: Measurement and Statistics
Course Number: PSYC209
Course Schedule: Mondays, Tuesdays, Wednesdays, Thursdays, Fridays, 2–3:45 p.m.
Location: Alison Hall 133

Instructor Information

Naoyuki (Nami) Sunami
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🐦 @n_sunami

Office Hours: 4–5 p.m. on Mondays and Thursdays, or by appointment
(McKinly 326B)

Welcome to PSYC209 "Measurement and Statistics"! This is an introductory statistics course that covers a wide range of concepts. My teaching philosophy is: making mistakes is the best way to learn. When I code, I make a lot of errors. I expect that this happens to you, too, in learning materials 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 use a special email address for this course: nsunami+psyc209@udel.edu. Please send any questions to this email address. You can expect me to reply to emails from 9 a.m. to 5 p.m., Monday to Friday. Feel free to drop by during the office hours. If the times do not work for you, we can make an appointment, or have a meeting online via zoom.

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

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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.

Learning Goals

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
2. Select an appropriate statistical technique given a data type and a research question
3. Interpret the analysis output from R
4. Write the results section based on the output in the APA style

Required Materials

The OpenIntro Textbook
Price: Free
Diez, D. M., Barr, C. D., & Çetinkaya-Rundel, M. (2014). *Introductory statistics with randomization and simulation*. CreateSpace Independent Publishing Platform.

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 at about $9.

R Studio (cloud or standalone)
Price: Free

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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.

1. 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.

2. 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.

Laptop computer
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.

Supplementary Materials

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.

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Course Requirements

Reading Checks

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

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

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 3 = 30 points)

Prelim and Midterm Quizzes

The prelim and midterm quizzes are to help to reinforce your knowledge about inference and hypothesis testing before moving onto specific tests. This 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. (28 points for the prelim and 45 points for the midterm)

Final Exam

Our final exam will be a paper 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. (81 points)

Late Submissions

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

Grade

I use the following letter grades to compute your grade. Points will not be rounded.
90.00% or more   : A
80.00%–89.99%   : B
70.00%–79.99%   : C

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60.00%–69.00%   : D
Less than 60%   : F

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/)

Course Schedule

Each class will consist of (a) a lecture based on the assigned reading, and (b) an in-class exercise using R Studio.

Class	Date	Day	Topic	Due Before the Class
1	1/7/19	Monday	Syllabus Review Introduction to R How to submit your work	Bring your laptop to the class
2	1/8/19	Tuesday	Types of Variables	Reading Check Due 1.2.1 Observations, variables, and data matrices (p.3) 1.2.2 Types of variables (p.6) 1.2.3 Association (p.7)
3	1/9/19	Wednesday	Visualizing Data: Central tendencies (Mean, Mode)	Reading Check Due: 1.6.1 Scatterplot (p.20) 1.6.2 Dot plot and the mean (p.21) 1.6.3 Histograms (p.23)
4	1/10/19	Thursday	Visualizing Data: Variability (Standard deviation, box plots) Homework 1 Distributed	Reading Check Due: 1.6.4 Variance and Standard deviation (p.25) 1.6.5 Boxplots (p.28) 1.6.6 Robust Estimates (p.30)

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5	1/11/19	Friday	Review Homework Putting it all together: Visualization, central tendency, variability	Homework 1 Due
6	1/14/19	Monday	**Preliminary Quiz on R, Variable Types and Visualization** Introduction to Inference & Hypothesis Testing 1: Case Studies	Reading Check Due: 2.1 Randomization case study: gender discrimination 2.2 Randomization case study: opportunity cost
7	1/15/19	Tuesday	Introduction to Inference & Hypothesis Testing 2: Concepts	Reading Check Due: 2.3 Hypothesis testing 2.3.1 Hypothesis testing in the US court system 2.3.2 p-value
8	1/16/19	Wednesday	Decisions for Hypothesis Testing: Type I and Type II errors and how to control them *Course evaluation out: You will receive a link to evaluate the course and the instructor.	Reading check: 2.3.3 Decision errors 2.3.4 Choosing a significance level 2.3.5 Introducing two-sided hypothesis 2.3.6 Controlling for the Type I Error Rate 2.3.7 How to use a hypothesis test
9	1/17/19	Thursday	Case Studies using Hypothesis Testing	Reading Check Due: 2.4 Simulation Case Studies 2.4.1 Medical Consultant 2.4.2 Tappers and listeners
10	1/18/19	Friday	Using Normal Distribution for Hypothesis Testing *Course evaluation due Homework 2 Distributed	Reading Check Due: 2.5 Central Limit Theorem 2.5.1 Null distribution from the case studies 2.6 Normal distribution 2.6.1 Normal distribution model

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NA	1/21/19	Monday	NO CLASS	NO CLASS
11	1/22/19	Tuesday	Review Homework Inference & Hypothesis Testing 6 Z-scores and proportion under the curve	Homework 2 Due Reading Check Due: 2.6.2 Standardizing with Z scores 2.6.3 Normal probability table 2.6.4 Normal probability examples
12	1/23/19	Wednesday	Inference & Hypothesis Testing 7 Standard Error	Reading Check Due: 2.7.1 Standard Error 2.7.2 Normal model application: opportunity cost 2.7.3 Normal model application: medical consultant 2.7.4 Conditions for Applying the normal model
13	1/24/19	Thursday	Confidence Interval	Reading Check Due: 2.8.1 Confidence Intervals – Capturing the population parameter 2.8.2 Constructing a 95% confidence interval 2.8.3 Changing the confidence level
14	1/25/19	Friday	Putting it all together: Inference and Hypothesis Testing	
15	1/28/19	Monday	**Midterm Quiz on Inference and Hypothesis Testing**	Reading Check Due: 4.1. One-sample means with the t-distribution

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			t-test – one-sample	4.1.1. two examples using the normal distribution 4.1.2 Introducing the t-distribution
16	1/29/19	Tuesday	t-test – two means	Reading Check Due: 4.3 Difference of two means 4.3.1 Confidence interval for a difference of means 4.3.2 Hypothesis tests based on a difference in means 4.3.3 Case study: two versions of a course exam
17	1/30/19	Wednesday	ANOVA Basics	Reading Check Due: 4.4 Comparing many means 4.4.1 Is batting performance related to player position in MLB 4.4.2 ANOVA and the F test 4.4.3 Reading an ANOVA table from R
18	1/31/19	Thursday	ANOVA Application	Reading Check Due: 4.4.4 Graphical diagnostics for an ANOVA analysis 4.4.5 Multiple comparisons and controlling Type I Error rate
19	2/1/19	Friday	Putting it all together: one-sample t-test, two-means t-test, ANOVA	
20	2/4/19	Monday	Correlation & Regression 1 - Introduction to Correlation and Regression Homework 3 Distributed	Reading Check Due: Chapter 5 – Introduction to linear regression 5.1 Line fitting, residuals, and correlation 5.1.1 Beginning with straight lines 5.1.2 Fitting a line by eye 5.1.3 Residuals 5.1.4 Describing linear relationships with correlation

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21	2/5/19	Tuesday	Correlation & Regression 2 — Interpreting Regression Output	Reading Check Due: 5.2 Fitting a line by least squares regression 5.2.1 An objective measure of finding the best line 5.2.2 Finding the least squares line 5.2.3 Interpreting regression line parameter estimates
22	2/6/19	Wednesday	Correlation & Regression 3 — Application of Regression	Reading Check Due: 5.4 Inference for Linear regression 5.4.1 Conditions for the least squares line 5.4.2 Midterm elections and unemployment 5.4.3 Understanding regression output from software
23	2/7/19	Thursday	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 **Final Examination Distributed After the Class**	Homework 3 Due
24	2/8/19	Friday	Cancelled - Please work on your exam	
NA	2/9/19	Saturday	Final examination due by 5 p.m.	Homework 3 Revision Due

*The content of the syllabus can be changed with the discretion of the instructor.

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Policy

Inclusion of Diverse Learning Needs

This course is open to all students who meet the academic requirements for participation. Any student who has documented a need for accommodation should contact Disability Support Services (http://www.udel.edu/DSS/) and the instructor privately to discuss the specific situation as soon as possible. Disability Support Services can be reached at 302-831-4643, or dssoffice@udel.edu. DSS staff will coordinate accommodations for students.

Academic Honesty

Please familiarize yourself with the UD policies regarding academic dishonesty (http://www1.udel.edu/stuguide/18-19/code.html). 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 hinder the educational process.

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 by federal law to inform the university's Title IX Coordinator. The university needs to know information about such incidents to, not only offer resources, but to ensure a safe campus environment. 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 reporting information please refer to www.udel.edu/sexualmisconduct.

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/