

Advanced Statistical Methods for Psychology 830:400 Fall 2022

Instructor: [Dr. Melchi M. Michel](#)

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Email:

Please make sure to include the course number (i.e., "[PSY 400]") in the subject line of your emails. You should expect a response from me within 48 h

Phone: (848) 445-8919

Office Hours: Mon. 2pm-3pm via Zoom (or by appointment; schedule via email)

Lecture

| Sections | Days | Time | First Meeting | Location |
|----------|-------------|-----------------|---------------|-------------------------|
| 01 | Mon. & Wed. | 3:50pm – 5:10pm | 9/07/2022 | SEC 216 |

Course Materials

Readings:

- Required Textbook: *OpenIntro Statistics. 4th Ed.* (Diez, Barr, & Cetinkaya-Rundel, 2019) ISBN: 978-1943450039

This book can be downloaded as a [free PDF](#) (just set the price to zero) or purchased as a paperback from amazon.com for around \$20.

- Optional Text: *Naked Statistics: Stripping the Dread from the Data* (Whelan, 2014) ISBN: 978-0393347777

Additional readings will be posted on the course Sakai site.

Laptop PC (Windows, Mac, or Linux):

This course will require you to have (in class) a laptop running Windows, MacOS, or Linux (a Chromebook *may* also work, but the installation process will be a bit more involved). These are needed to use the R and RStudio software required for lab exercises and to allow you access to other course resources (e.g., lecture slides, supplemental readings, etc.).

Please visit the Rutgers Student Tech Guide page for resources available to all students. If you do not have the appropriate technology for financial reasons, please email Dean of Students deanofstudents@echo.rutgers.edu for assistance. If you are facing other financial hardships, please visit the Office of Financial Aid at <https://financialaid.rutgers.edu/>.

Software:

This course makes extensive use of the [R](#) and [RStudio](#) software packages. In addition, I recommend that you get access to a basic spreadsheet program (e.g., Excel in MS Office, Numbers in iWork, Calc in OpenOffice). If you don't have one installed, Google Sheets should be accessible through any major web browser.

Course Goals

The main objective of this course is to teach you how to take raw behavioral science data, explore it, and present the results in a useful way. I will present a broad introduction to some of the fundamental tools and concepts of statistics for representing, visualizing, modeling, and interpreting data.

In comparison to Quantitative Methods (a prerequisite), this course will cover some more advanced techniques including exploratory data analysis, nonparametric methods, multiple regression, model fitting, and modern Monte Carlo and bootstrap resampling techniques. The main difference, however, is that this course will focus on cultivating an intuitive understanding for these techniques and how to apply them to practical problems and discouraging rote "plug and chug" computation and uncritical application of traditional NHST methods.

To that end, we will deal almost exclusively with real datasets gathered to answer scientific questions, and you will learn to use the popular, free (open source), and powerful software package 'R' to explore, visualize and analyze these data.

Above all, I intend the course is designed to be useful, and I hope that you find it to be one of the most useful courses of your undergraduate career. It is intended to be useful for students who want to go on to do graduate-level academic research as well as for students who want to go directly into public or private sector jobs involving data science or the collection, analysis, and presentation of data.

Course Requirements

Attendance & Participation:

Students are expected to attend all classes. The class lectures will cover many new concepts, some of which are not covered in the textbook. You are

unlikely to learn the material without attending lectures.

However, if you have been told to quarantine, or are experiencing symptoms of COVID-19 (or any transmittable disease) you should remain at home and not attend in-person class meetings. Should you expect to miss one or two classes, please use the University absence reporting website <https://sims.rutgers.edu/ssra/> to indicate the date and reason for your absence. An email is automatically sent to me.

If you expect to be absent for a longer period of time (e.g., more than one week), you should instead contact the dean of students (<http://deanofstudents.rutgers.edu/>).

Students are expected to pay attention in class, and to participate actively (e.g., answer questions that I pose in class, ask your own questions to clarify or flesh out lecture topics, etc.)

Mask Policy:

In order to protect the health and well-being of all members of the University community, masks must be worn by all persons on campus when in the presence of others (within six feet) in indoor teaching spaces, libraries, and clinical settings. You can find complete information on the university's COVID-19 protocols for the Fall 2022 semester here: <https://coronavirus.rutgers.edu/fall-semester-2022-health-and-well-being-protocols/>

Masks must be worn during class meetings; any student not wearing a mask will be asked to leave.

Masks should conform to CDC guidelines and should completely cover the nose and mouth: <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/about-face-coverings.html>

Exams:

A closed-book midterm exam will be administered in class during the eighth week of the semester. It will consist of conceptual questions posed in a mixture of brief essay and short-answer formats. The (comprehensive) final exam will be structured similarly to the midterm exams, but will be somewhat longer, and will be scheduled during the official Rutgers final examination period.

Students must take both exams, and will be expected to take the exams at their scheduled dates and times. If you are so ill that you cannot physically take the exam on the scheduled day, you must let me know *before* the start of the exam, and you will need to provide a valid and documented excuse. In these (rare) cases, a make-up exam will be offered during the reading period at the end of the semester. This exam will be different than the corresponding midterm exam offered during the semester, and may vary considerably in both content and format.

Weekly Lab Exercises:

A primary aim of this course is to give you practical experience exploring and analyzing data using statistical software. Toward this end, each new unit introduced during the lecture portion of the class will be further explored during a lab portion, in which you will learn to use the R statistical software package to answer questions about data. Lab exercises will be typically be assigned in class on Wednesday (and posted on the course Canvas site) and will be due by the end of class on the following Wednesday. You will be responsible for finishing and submitting each exercise by the appropriate due date. No late homework assignments will be accepted.

Research Project & Presentation:

The research project will provide you with the opportunity to apply the concepts and techniques that you learned in the course to a topic of interest to you. You should have a brief proposal ready by the first class following the midterm indicating the question(s) that you are interested in and your plan for investigating this question. At the end of the semester, you will have to prepare a project report detailing:

- Brief background on and motivation for your topic of interest (i.e., why are you interested in this topic, what is the current state of scientific knowledge regarding it?)
- A description of your dataset (i.e., where it came from, how it was collected, etc.)
- A description of your analysis and results (include an explanation of why you chose the analysis you did, what your assumptions were, a description of the results of each analysis, and a copy of the code you used)

You will also prepare a brief (~10 min.) presentation to explain your research project to the class. [Detailed information](#) regarding the requirements of the proposal and project is available under the "Pages" tab on Canvas.

Grade Breakdown

| Component | Weight |
|----------------------------|--------|
| Midterm Exam | 20% |
| Final Exam | 20% |
| Weekly Lab Exercises | 25% |
| Project & Presentation | 25% |
| Attendance & Participation | 10% |
| Total | 100% |

Academic Integrity

Collusion (getting any form of assistance from other students or outside sources) on exams is prohibited. Students suspected of doing so will be brought up on charges before university's Office of Student Conduct, and penalties, up to and including expulsion, will be imposed for those found guilty. (See <http://academicintegrity.rutgers.edu/academic-integrity-policy> for specifics).

Honor pledge

All students will need to sign the Rutgers Honor Pledge on every major exam, assignment, or other assessment as follows:

On my honor, I have neither received nor given any unauthorized assistance on this examination (assignment, paper, quiz, etc.).

Student Services

Academic Accommodations

Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: <https://ods.rutgers.edu/students/documentation-guidelines>. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with a Letter of Accommodations. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. To begin this process, please complete the Registration form on the ODS web site at: <https://ods.rutgers.edu/students/registration-form>.

If you believe that you might require academic accommodations, you should register with disability services as soon as possible. It is your responsibility to self-identify with the Office of Disability Services and to provide me with the appropriate documentation from that office at least one week prior to any request for specific course accommodations. There are no retroactive accommodations. If you require accommodations for exams (e.g., extended time, reduced distractions) you will be responsible for setting up and scheduling your own accommodations for each exam. The request form can be found at <https://ods.rutgers.edu/exam-accommodations>.

Wellness Services

- **Counseling, ADAP & Psychiatric Services (CAPS)** CAPS is a University mental health support service that includes counseling, alcohol and other drug assistance, and psychiatric services staffed by a team of professionals within Rutgers Health services to support students' efforts to succeed at Rutgers University. CAPS offers a variety of services that include: individual therapy, group therapy and workshops, crisis intervention, referral to specialists in the community, and consultation and collaboration with campus partners.
 - Crisis Intervention : <http://health.rutgers.edu/medical-counseling-services/counseling/crisis-intervention/>
 - Report a Concern: <http://health.rutgers.edu/do-something-to-help/>
- **Violence Prevention & Victim Assistance (VPVA)** The Office for Violence Prevention and Victim Assistance provides confidential crisis intervention, counseling and advocacy for victims of sexual and relationship violence and stalking to students, staff and faculty. To reach staff during office hours when the university is open or to reach an advocate after hours, call 848-932-1181.

Anticipated Course Schedule

The schedule below is subject to change. Please check the Sakai site regularly for announcements, updates, and additional readings.

| Week | Dates | Topics | Assigned Readings |
|---------------------|--------------------------|---|---|
| 1 | Wed. 9/7 | Course Orientation & Intro to R/ RStudio | |
| 2 | Mon. 9/12 Wed. 9/14 | Research Design & Data Analysis (EDA) | Chapter 1 |
| 3 | Mon. 9/19 Wed. 9/21 | Probability | Chapter 2 |
| 4 | Mon. 9/26 Wed. 9/28 | Random Variables and Distributions | Chapter 3 (3.1, 3.2, & 3.4) |
| 5 | Mon. 10/3 Wed. 10/5 | Foundations of Inference I: Estimation, Hypothesis Testing, & Power | Chapter 4 |
| 6 | Mon. 10/10 Wed. 10/12 | Foundations of Inference II: Intro to the Bootstrap | Posted Reading (Part 1 only) or this reading (through section 5.3, if you're more ad |
| 7 | Mon. 10/17 Wed. 10/19 | Inference for Categorical Data (proportions) | Chapter 6 |
| 8 | Mon. 10/24 | Catch up & Midterm Review | |
| | Wed. 10/26 | Midterm Exam | |
| Spring Break | Mon. 3/15 Thu. 3/18 | Spring Break | |
| 9 | Mon. 10/31 Wed. 11/2 | Inference for Categorical Data (Chi Square) | Chapter 6 Project Proposals Due |

| Week | Dates | Topics | Assigned Readings |
|---------------------------|--------------------------|--|-----------------------------|
| 10 | Mon. 11/7 Wed. 11/9 | Correlation & Regression | Chapter 7 |
| 11 | Mon. 11/14 Wed. 11/16 | Multiple Linear Regression | Chapter 8 |
| 12 | Mon. 11/21 | The Classics: review of t-tests and one-way ANOVA | Chapter 5 |
| Thanksgiving Break | Wed. 11/24 | Thanksgiving Break note: change of designation Wed. -> Fri. | |
| 13 | Mon. 11/28 Wed. 11/30 | Review of t-tests and one-way ANOVA (cont.) Factorial & Repeated Measures ANOVAs | Chapter 5 Posted Reading |
| 14 | Mon. 12/5 Wed. 12/7 | Factorial & Repeated Measures ANOVAs (cont.) Advanced Visualization using GGPlot | Posted Reading |
| 15 | Mon. 12/12 Wed. 12/14 | Student Presentations | Project Reports Due |
| Final Exam | TBA | FINAL EXAM @ TBA Be sure to check http://finalexams.rutgers.edu/ for updates | |