**27:202:542**
**INTRODUCTORY STATISTICS**
Fall 2022 Syllabus


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| Professor: | Robert (Bob) Apel, Ph.D. |
| Office: | Center for Law and Justice, Room 579H |
| E-mail: | robert.apel@rutgers.edu |


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| Class Location: | Center for Law and Justice, Room 567 |
| Class Time: | Tuesday, 1:00 to 3:40 |
| Office Hours: | By appointment |

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| Teaching Assistant: | TBD |
| Office: | TBD |
| E-mail: | TBD |
| Lab Location: | TBD |
| Lab Time: | TBD |

## COURSE DESCRIPTION

This course is required for partial fulfillment of the support sequence for the Ph.D. program in criminal justice. The purpose is to introduce the basic principles of data visualization and statistical inference in order to provide a foundation for quantitative analysis. The methods considered will be rooted in the linear regression model, despite the fact that many approaches will not actually be called regression (e.g., the difference-in-means estimator).

### Course Objectives

- Expertise in the calculation and interpretation of descriptive statistics, and in the many forms of visualization of quantitative information.
- Familiarity with probability theory, the root of statistical inference, as well as specific probability distributions for discrete data and continuous data.
- Familiarity with the terminology, logic, and procedures of hypothesis testing.
- Comfort with R and RStudio for performing basic programming and analysis functions.

### Course Prerequisite

It will be assumed that students have little prior exposure to statistics, and have only rudimentary knowledge of computer-based statistical programs. Comfort with algebra is assumed, although in-class reviews will be conducted where necessary.

## COURSE MATERIALS

In this course, we will use R and RStudio. Students are strongly encouraged to bring a laptop with them to class each week. Before the start of the course, they should download and install R (https://cran.r-project.org) and RStudio Desktop (https://www.rstudio.com) compatible with their operating system. Because these are open-source programs, there will be no need to purchase any software licenses.

Powerpoint slides covering weekly material will be made available by the instructor. They will be posted in advance in the course folder on Canvas (http://canvas.rutgers.edu), along with the data files and R scripts used for in-class exercises. Students should print up the slides before each class and use them for notetaking purposes, and have the data files and R scripts loaded onto their laptops and ready for analysis.

**Required Books**

- Healy, Kieran. (2019). *Data Visualization: A Practical Introduction*. Princeton, NJ: Princeton University Press.
- Imai, Kosuke. (2017). *Quantitative Social Science: An Introduction*. Princeton, NJ: Princeton University Press.

**COURSE GRADING**

The grading scale that will be used for the final semester grades is as follows:

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| A | 90.0% or higher | (Outstanding) |
| B | 80.0% to 89.9% | (Good) |
| C | 70.0% or 79.9% | (Satisfactory) |
| F | 69.9% or lower | (Unsatisfactory) |

Grading will be based on the following four criteria:

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| Class Preparation | 10% |
| Problem Sets | 50% |
| Empirical Project | 40% |
| | 100% |

**Class Preparation (10%)**

Students are expected to have read and to be conversant (to the extent possible) with all of the required reading material for each class meeting. Some of this material will be of a technical nature, so the goal of the class meetings will be to help students understand what they have read (both conceptually and algebraically), and to work through empirical applications of key concepts. In fact, it might be good practice to read the assigned material on two occasions—once before the class meeting (for initial familiarity), and again after the class meeting (for improved comprehension).

**Problem Sets (50%)**

There will be five (5) problem sets assigned throughout the semester, using data made available by the instructor. They are to be e-mailed to the instructor by the beginning of the class periods during which they are due. The objective of the problem sets is to give students hands-on experience using software (R and RStudio) to manipulate data, produce visualizations, and estimate a variety of statistical tests.

Problem sets and data files are provided in the course folder on Canvas (http://canvas.rutgers.edu). The teaching assistant will lead a weekly lab session to answer questions and provide assistance with the problem sets. Students are also encouraged to work in pairs or in small groups, and a course Slack page will be set up to facilitate communication outside of class (https://slack.com).

While joint results may be reported, each student must provide his or her own interpretations of the findings. Late problem sets will not be accepted, unless the student has given prior notification and approval has been granted by the instructor.

**Empirical Project (40%)**

Instead of a final exam, the semester will culminate in an independent research project on a topic of the student's choosing. A written report will be submitted one week after the conclusion of the course. Because this course is devoted to data visualization and quantitative analysis, students will be expected to demonstrate proficiency with application to their research problem. It is expected that the written project will be 10-15 pages in length.

Students must obtain approval for the topic of the term paper in advance from the instructor. Some possible ideas for the term paper include the following:

- *Perform an original analysis of a research question.* This requires students to obtain a data file with an outcome and at least one independent variable. The term paper must be written in the form (although not necessarily the length) of a journal manuscript, with sections for an introduction, literature review, methods, results, and discussion/conclusion, as well as references, tables, and figures. This is the recommended topic for doctoral students in the course.
- *Reproduce the key finding from a published study.* This requires students to either obtain a data file from the author of the original study, or else collect data from the same sources cited in the study. The term paper must provide relevant background information about the original study, describe the attempt to reproduce one key finding, and discuss the implications of the successful or unsuccessful effort to do so. It must include tables and figures from the original study, as well as tables and figures from the reproduction.
- *Produce a map to visualize some kind of spatial data.* This requires students to first read Chapter 5.3 in Imai (2017) and Chapter 7 in Healy (2019). The term paper must provide relevant background information about the subject of study, a description of data sources, and a discussion of the observed spatial pattern. It must also include tables and figures.
- *Any other idea proposed by the student.* Advance approval must be obtained from the instructor.

Details about this project will be left intentionally vague, so that students have maximum flexibility in identifying the question they intend to study. Students are urged to start thinking right away about potential topics for their project. Done strategically, this project can serve as the start of a comprehensive exam or other empirical paper. Students are welcome (and are in fact encouraged) to use this project as an opportunity to consult with their faculty advisor or mentor, and to make substantial progress on analyses that can lead to an empirical paper or journal manuscript.

**COURSE POLICIES**

**Class Announcements**

As needed, e-mail will be utilized to post course announcements (e.g., class cancellation due to inclement weather) as well as to occasionally provide links to items that are relevant for the topics covered in this course (e.g., newspaper articles, journal articles).

**Classroom Climate**

Disruptive behavior in the classroom cheats other students of the opportunity to learn. Examples include arriving late to class, leaving and re-entering the classroom during the seminar, talking excessively, using cell phones, eating, reading outside material, and persisting in speaking without being recognized. The instructor reserves the right to ask disruptive students to leave the classroom.

**Academic Integrity**

The instructor will uphold Rutgers University policies concerning ethical behavior and academic integrity, and students are expected to familiarize themselves with these policies. The relevant principles, policies, and disciplinary procedures can be accessed from the university's website at http://academicintegrity.rutgers.edu.

**ACCOMMODATION AND SUPPORT STATEMENT**

Rutgers University Newark (RU-N) is committed to the creation of an inclusive and safe learning environment for all students and the University as a whole. RU-N has identified the following resources to further the mission of access and support:

**For Individuals Experiencing Disability:** The Office of Disability Services (ODS) works with students with medical, physical, and/or mental conditions who encounter disabling barriers in order to determine reasonable and appropriate accommodations for access. Students who have completed the process with ODS and have approved accommodations are provided a Letter of Accommodation (LOA) specific to each course. To initiate accommodations for their course students must both provide the LOA to and have a conversation with the course instructor about the accommodations. This should occur as early in the semester as possible. More information can be found at the RU-N ODS website (ods.newark.rutgers.edu). Contact ODS at (973) 353-5375 or via email at ods@newark.rutgers.edu.

**For Individuals Who Are Pregnant:** The Office of Title IX and ADA Compliance is available to assist with any concerns or potential accommodations related to pregnancy. Students may contact the Office of Title IX and ADA Compliance at (973) 353-1906 or via email at TitleIX@newark.rutgers.edu.

**For Short-Term Absence Verification:** The Office of the Dean of Students can provide assistance for absences related to religious observance, emergency or unavoidable conflict (illness, personal or family emergency, etc.). Students should refer to University Policy 10.2.7 for information about expectations and responsibilities. The Office of the Dean of Students can be contacted by calling (973) 353-5063 or emailing deanofstudents@newark.rutgers.edu.

**For Individuals with Temporary Conditions/Injuries:** The Office of the Dean of Students can assist students who are experiencing a temporary condition or injury (broken or sprained limbs, concussions, or recovery from surgery). Students experiencing a temporary condition or injury should submit a request using the following link: https://temporaryconditions.rutgers.edu.

**For Gender or Sex-Based Discrimination or Harassment:** The Office of Title IX and ADA Compliance can assist students who are experiencing any form of gender or sex-based discrimination or harassment, including sexual assault, sexual harassment, relationship violence, or

stalking. Students can report an incident to the Office of Title IX and ADA Compliance by calling (973) 353-1906 or emailing TitleIX@newark.rutgers.edu. Incidents may also be reported by using the following link: tinyurl.com/RUNReportingForm. For more information, students should refer to the University's Title IX Policy and Grievance Procedures located at https://uec.rutgers.edu/wp-content/uploads/60-1-33-current-1.pdf.

**For Support Related to Interpersonal Violence:** The Office for Violence Prevention and Victim Assistance (VPVA) can provide any student with confidential support. The office does not have a reporting obligation to Title IX. Students can contact the office by calling (973) 353-1918 or emailing run.vpva@rutgers.edu. There is also a confidential text-based helpline available to students; students can text (973) 339-0734 for support. Students do not need to be a victim/survivor of violence; any student can receive services, information and support.

**For Crisis and Concerns:** The Campus Awareness Response and Education (CARE) Team works with students in crisis to develop a plan of support plan and address personal situations that might impact their academic performance. Connect with the CARE Team by using the following link: tinyurl.com/RUNCARE or emailing careteam@rutgers.edu.

**For Stress, Worry, or Concerns about Well-Being:** The Counseling Center has confidential therapists available to support students. Students should reach out to the Counseling Center to schedule an appointment: counseling@newark.rutgers.edu or (973) 353-5805. If students are not quite ready to make an appointment with a therapist but are interested in self-help, check out Sanvello for an easy, web-based approach to self-care and support. Visit https://my.rutgers.edu/, click on Sanvello: Wellness @ RUN, and log in with your netid to begin your journey toward wellness.

For emergencies, call 911 or contact Rutgers University Police Department (RUPD) by calling (973) 353-5111.

**HEALTH AND SAFETY PROTOCOL**

Use of face coverings in offices, conference rooms, research labs, housing, and public spaces in buildings is optional. Face coverings are required in all teaching spaces (classrooms, lecture halls, seminar rooms, etc.), teaching labs, computer labs, buses, libraries, and clinical facilities. Additionally, face coverings will continue to be required in student-staff and student-faculty meeting spaces.

**COURSE SCHEDULE**

Readings refer to chapters in Kosuke Imai's *Quantitative Social Science: An Introduction* (QSS) and Kieran Healy's *Data Visualization: A Practical Introduction* (DV), and are to be completed by the class date listed. Problem sets are listed on the dates they are due, and they will be distributed the week prior to the due date. This schedule is subject to change depending on time demands.

| Class Date | Class Topic | Reading |
|---|---|---|
| Tue, Sep 6 | *1 Introduction:* R Tutorial | QSS 1 |
| Tue, Sep 13 | *2 Causality:* Randomized Experiments | QSS 2.1-2.4 |
| Tue, Sep 20 | *3 Causality:* Observational Studies<br>*** Problem Set #1 Due *** | QSS 2.5-2.7 |
| Tue, Sep 27 | *4 Measurement:* Visualization Using Base R | QSS 3 |
| Tue, Oct 4 | *5 Measurement:* Visualization Using ggplot2<br>*** Problem Set #2 Due *** | DV 3, 4, 5 |
| Tue, Oct 11 | *6 Prediction:* Prediction Error | QSS 4.1 |
| Tue, Oct 18 | *7 Prediction:* Two-Variable Regression | QSS 4.2 |
| Tue, Oct 25 | *8 Prediction:* Multi-Variable Regression<br>*** Problem Set #3 Due *** | QSS 4.3-4.4 |
| Tue, Nov 1 | *9 Probability:* Probability Concepts | QSS 6.1 |
| Tue, Nov 8 | *10 Probability:* Conditional Probability | QSS 6.2 |
| Tue, Nov 15 | *11 Probability:* Probability Distributions<br>*** Problem Set #4 Due *** | QSS 6.3-6.5 |
| Tue, Nov 22 | NO CLASS – THURSDAY SCHEDULE | NA |
| Tue, Nov 29 | *12 Uncertainty:* Statistical Inference | QSS 7.1 |
| Tue, Dec 6 | *13 Uncertainty:* Hypothesis Testing | QSS 7.2 |
| Tue, Dec 13 | *14 Uncertainty:* General Linear Model<br>*** Problem Set #5 Due *** | QSS 7.3-7.4 |
| Tue, Dec 20 | *Final Project Due via E-mail, 5:00 pm* | NA |