RUTGERS
Edward J. Bloustein School
of Planning and Public Policy

APPLIED MULTIVARIATE METHODS
833:525 / 970:527

Instructor
Dr. Ruth Winecoff (she/her)
Email: ruth.winecoff@rutgers.edu

Course Sessions
This course meets in-person.
Thursdays 6-9 pm
Bloustein School at the Civic Square Building, 251

Teaching Assistant
Triparnee Kusshari
Email: tk630@scarletmail.rutgers.edu

TA Office Hours
BY APPOINTMENT
Friday 11 am – 12 pm
Monday 4 pm – 5 pm

Class Cancellations: Please check the Rutgers University, New Brunswick Campus website for any announcements regarding cancellation of classes. I will email the class via Canvas Announcements as soon as I become aware of any cancellations or if I decide to cancel class. Please turn your notifications on so you don't miss any important information.

EMAIL POLICY. Please copy the instructor on **all** emails to the TA. Please allow 24-48 weekday hours for a response. If you haven't received a response within 48 hours, feel free to send a reminder as we may miss your email. If the matter is highly sensitive, please email the instructor directly.

COURSE DESCRIPTION. This course will introduce statistical methods for analyzing continuous, discrete (binary, nominal, ordinal, count), and repeated measures outcomes, as well as latent variable methods for analyzing data that are commonly encountered in policy analysis and research. The primary objective is to train students to be competent and thoughtful users of statistical methods. Topics include simple regression, multivariable regression, binary logistic regression, generalized linear models, repeated measures data analysis, introduction to multivariate analysis, exploratory factor analysis, and cluster analysis. Examples are drawn from the social sciences.

PREREQUISITES. This course is designed for students who have successfully completed Basic Quantitative Methods and have programming experience in a statistical package, such as R, SAS, Stata, or SPSS. Please review topics covered in your basic statistics class prior to the start of the semester. Topics to review include:

- Univariate statistics (computing and interpreting measures of center and spread)
- Probability and the standard normal distribution
- Inferential statistics (Central Limit Theorem, standard error, p-values, alpha, confidence intervals)
- Bivariate hypothesis tests (t test, ANOVA, chi-squared test of association, correlation)
- Research methods (study designs, sampling, principles of hypothesis testing)

COURSE LEARNING OBJECTIVES.
Students who successfully complete this course will be able to:

- Think critically and make decisions regarding the use of data.
- Use logistic regression models to analyze binary, nominal, or ordinal response data, and use Poisson regression models to analyze count response data.
- Use generalized estimating equations and mixed models to analyze repeated measures data.
- Use of factor analysis to investigate latent constructs.
- Use of cluster analysis as a tool to classify individuals into groups based on specified factors.
- Conduct data analysis and read outputs from R.

- Write statistical analysis section, create tables and figures, and interpret statistical analysis results.

CLASS MATERIALS. There is no required textbook for this class. A scientific calculator is necessary. Your calculator should have exponential, log, and square root capabilities.

We will be using R and RStudio for our statistical computing and graphics. Both are open source which means they are free to use. Instructions to download and use the software can be found here (please read *Chapter 1 "Getting Started with Data in R"* and complete the download instructions).

Course notes will be available for each lecture. All course notes will be posted on the Canvas course site. You are responsible for having or printing all relevant materials for class. Hard copies will not be provided in class (but are useful for notetaking). All students are required to arrive on time to live sessions. Cell phones must be turned off, set to vibrate or silent. No phone calls are allowed in the class.

USEFUL REFERENCES

1. Venables, W.N., Smith, D.M., & the R Core Team. (2022, Jun. 23). An Introduction to R. (Version 4.2.1). Available at: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf
2. Woolridge, J.M. Introductory Econometrics: A Modern Approach (7th ed). Available on the course site/Canvas
3. IDRE Statistical Consulting Group. Introduction to R. Available at: https://stats.oarc.ucla.edu/stat/data/intro_r/intro_r_interactive_flat.html

ASSESSMENT AND GRADING POLICY

The course uses a combination of attendance and engagement during in-person sessions, completing homework assignments, as well as a midterm and final project to assess mastery of the course learning objectives. Grading will be based on:

Pooled homework points ……..... 35%
Attendance and engagement ……..…… 15%
Exam I ……..……..……..……..……..…… 25%
Exam II ……..……..……..……..…….. 25%

All course requirements must be completed by April 24, 2024. Incomplete grades will not be given except for a serious documented condition.

HOMEWORK

- Each assignment should be neatly completed and submitted **as one PDF** document via Canvas (allowed multiple submissions before the deadline).
- Homework is always due on **Fridays at 11:59 pm ET** on Canvas. Plan ahead for eventualities re: technology, travel plans, work etc. You can submit assignments early. *If you must*, I allow students to submit assignments up to 24 hours after the due date for a 10% deduction. After that, no assignments will be accepted.
- Typing of homework is required, unless otherwise stated on the assignment.
- You are encouraged to *generally* work together in the spirit of learning but you must turn in your own original homework. Solutions should be your own, based on your own work, and **not** copies of classmates with whom you have collaborated.
- The homework with the lowest score will not be counted toward the final grade. This is your "freebie" – if you get sick, have an emergency, etc. Use it wisely!

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ATTENDANCE AND ENGAGEMENT. Students are expected to attend all class sessions and participate actively during class and lab exercises. Attendance and completion of in-class activities/lab exercises will count as attendance and engagement. Requests for excused absences must be made in writing to the course instructor. **Notification must take place before the absence.**

EXAMS

- Exams will focus on concepts and interpretation – i.e., NOT your skills in R
- Exams will be a mix of multiple choice, short answer, and essay
- Exams will be held in class

FINAL THOUGHTS

- The course will be given in consecutive lectures.
- In order to prepare, students should plan to fully engage in all course content.
- Please print or download materials in advance of class.
- Material will build on previous lectures, so act quickly if you don't understand something or have questions.

Students often state that these topics are challenging, but also very useful. Try to be as engaged as possible with the material (attend lectures and labs, seek help if needed, do the homework, etc.) and work hard, because it would be worth it. We are here to help and want to see you succeed!

COURSE GUIDE

Week & Date	Topics
Week 1: Jan 18	Course introduction & statistical inference review
Week 2: Jan 25	Simple regression - Introduction to regression - Construct and interpret simple regression models with various predictors - Construct and interpret confidence intervals for parameters in a simple regression - Use R to fit simple regression models and interpret output
Week 3: Feb 1	Multiple regression - Construct and interpret multiple regression models with various predictors - Construct and interpret confidence intervals for parameters in a multiple regression - Use R to fit multiple regression models and interpret output
Week 4: Feb 8	Multiple regression - Confounding and effect modification - Model fit and model selection - Use R to assess confounding, interaction, obtain model diagnostics
Week 5: Feb 15	Logistic regression - Construct and interpret logistic regression models with various predictors - Construct and interpret confidence intervals for parameters in a logistic regression - Use R to fit logistic regression models and interpret output
Week 6: Feb 22	Logistic regression - Confounding and effect modification - Use R to assess confounding, interaction
Week 7: Feb 28	Logistic regression - Logistic regression review - Model fit and model selection - Use R to obtain model diagnostics
Week 8: Mar 7	Exam I
Week 9: Spring Break!	

Week 10: Mar 20	Generalized linear models: Logit models - Introduction to GLM - Model specification and interpretation - Overview of nominal and ordinal logit models with R code
Week 11: Mar 27	Generalized linear models: Poisson models - Introduction to GLM - Model specification and interpretation - Overview of Poisson models with R code
Week 12: Apr 3	Repeated measures analysis: GEE - Introduction to repeated measures data - Generalized estimating equations - Use R to fit GEE models and interpret output
Week 13: Apr 10	Repeated measures analysis: GLMM - Introduction to GLMM - Random intercept model - Use R to fit random intercept models and interpret output
Week 14: Apr 17	Multivariate data analysis - Multivariate methods - Introduction to factor analysis - Introduction to cluster analysis
Week 15: Apr 24	Exam II

**Disclaimer: This syllabus should be taken as a reasonable guide for the course content. However, you cannot claim any rights from it; the instructor reserves the right to change dates, topics, or methods of assessment in line with class progress. Any changes will be communicated via official announcements in class and on Canvas (via the announcement mechanism).

Academic Integrity Policy

Academic Integrity is vital to the mission of Rutgers, to education at Rutgers and membership in the Rutgers community. It is a core value that supports trust among students, and between students and teachers. It is also a shared value; administration, faculty, and students each play a vital part in promoting, securing, and nurturing it. Academic dishonesty is not an individual act that affects only the students involved. It violates communal trust, impacts other members of the community, and is an offense against scholarship. For this reason, any instance of cheating or plagiarism will be dealt with harshly. Honesty matters.

Principles of academic integrity require that every Rutgers University student:

- properly acknowledge and cite all use of the ideas, results, or words of others.
- properly acknowledge all contributors to a given piece of work.
- make sure that all work submitted as his or her own in a course or other academic activity is produced without the aid of unsanctioned materials or unsanctioned collaboration.
- obtain all data or results by ethical means and report them accurately without suppressing any results inconsistent with his or her interpretation or conclusions.
- treat all other students in an ethical manner, respecting their integrity and right to pursue their educational goals without interference. This requires that a student neither facilitate academic dishonesty by others nor obstruct their academic progress.
- uphold the canons of the ethical or professional code of the profession for which he or she is preparing.

Adherence to these principles is necessary in order to ensure that:

- everyone is given proper credit for his or her ideas, words, results, and other scholarly accomplishments.
- all student work is fairly evaluated, and no student has an inappropriate advantage over others
- the academic and ethical development of all students is fostered.
- the reputation of the University for integrity in its teaching, research, and scholarship is maintained and enhanced.

All students are required to familiarize themselves with the university's full policy on academic integrity. Please see the Rutgers Academic Code and Academic Oath at: http://academicintegrity.rutgers.edu/

Helpful Rutgers tutorials on the subjects of academic integrity and plagiarism are found at:
http://sccweb.sccnet.rutgers.edu/douglass/sal/plagiarism/Intro.html and
http://library.camden.rutgers.edu/EducationalModule/Plagiarism/ and
http://www.libraries.rutgers.edu/rul/lib_instruct/i nstruct_document.shtml

Please see the Rutgers Academic Code and Academic Oath at: http://academicintegrity.rutgers.edu/

Disability Accommodation
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 accommodation, your campus's disability services office will provide you with a Letter of Accommodations. Please share this letter with me and discuss the accommodations you need as early in the course as possible. To begin this process, please complete the Registration form on the ODS web site at: https://ods.rutgers.edu/students/registration-form.

LIBRARY AND OTHER RESOURCES
Rutgers University Libraries offer numerous resources to assist students. Librarians can help guide you through research and reference tools. A series of LibGuides are available to get you started. The librarian who specifically supports the Bloustein School is Julia Maxwell at Alexander Library:

Julia Maxwell, MSI, MA Ed (she/her)
Social Sciences Librarian
Rutgers - New Brunswick | Alexander Library
julia.maxwell@rutgers.edu | julia-maxwell.com

Rutgers has Learning Centers on each campus where any student can obtain tutoring and other help; for information, check http://lrc.rutgers.edu. Rutgers also has a Writing Program where students can obtain help with writing skills and assignments: http://plangere.rutgers.edu/index.html . Writing Tutoring: https://rlc.rutgers.edu/student-services/writing-tutoring.

Bloustein offers help with a variety of technology problems. For technology assistance at Bloustein, visit: http://policy.rutgers.edu/its/helpdesk/contact.php

Students are expected to take the initiative to become aware of Rutgers University and Bloustein policies regarding their academic work. See www.rutgers.edu/academics/catalogs for the overall Rutgers catalog and the Bloustein website, including course descriptions and details about all degree programs: http://ejb.rutgers.edu.

Disability Accommodation

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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 accommodation, your campus's disability services office will provide you with a Letter of Accommodations. Please share this letter with me and discuss the accommodations you need as early in the course as possible. To begin this process, please complete the Registration form on the ODS web site at: https://ods.rutgers.edu/students/registration-form.

Counseling, Alcohol and Other Drug Assistance Program & Psychiatric Services (CAPS)
(848) 932-7884 / 17 Senior Street, New Brunswick, NJ 08901/ http://health.rutgers.edu/medical-counseling-services/counseling/

Student Health & Wellbeing Report a Concern: http://health.rutgers.edu/do-something-to-help/