



**DEPARTMENT OF MATHEMATICS
EAST STROUDSBURG UNIVERSITY**

MATH 318: Exploratory Data Analysis with R – Fall 2022

Instructor: Xuemao Zhang	Email: xzhang2@esu.edu	Telephone: 570-422-3441
Office Location: SciTech Building room 128		
Office Hours Monday 1:00PM – 3:00PM Wednesday 1:00PM – 3:00PM Thursday 9:00AM – 10:00AM		
Secretary: Christine Getz		Email: cgetz@esu.edu
Office Location: SciTech Building room 118		Telephone: 570-422-3447

Course Prerequisites: MATH 110 with a grade of B or higher.

Course Description: Exploratory data analysis is an approach to analyzing data sets with statistical graphics, interactive data visualization and numerical techniques. It makes complex data more accessible and understandable. Students will learn how to display, communicate, and analyze data using R, one of the top programming languages for data science.

Required:

- 1. Laptop/Desktop and Internet:** Technology needs of a Laptop/Desktop computer and 24/7 reliable Internet Access are required for our class. Eligible new customers will receive 60 days of Internet Essentials service: read <https://corporate.comcast.com/covid-19> for more information.
- 2. Desire2Learn(D2L):** <https://esu.desire2learn.com/> D2L is the application we use to help manage classes. Relevant course material and grades will be made available on the course website D2L. Important dates or sudden announcements will also be made via the course main page and news section. It is important to visit the course page regularly.
- 3. Lecture Notes:** Typed lecture notes will be available on D2L. It is recommended to bring a printed copy of the lecture notes to each class. Then you can simply add your own solutions/thoughts/comments/reminders as needed and have more time to digest the lecture.
- 4. Slack:** Slack (<https://slack.com/>) is used for informal communication of the class. Please click the invitation link in your ESU email inbox to join the Math318_Fall2022 workspace.

Some R References:

- (1) *An Introduction to R* by Venables and Smith <https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf>
- (2) *Quick-R: accessing the power of R* by Robert Kabacoff (<http://www.statmethods.net/>).
- (3) Learn R in R: [swirl: Learn R, in R. \(swirlstats.com\)](http://swirlstats.com)
- (4) *R for Data Science*. O'Reilly Media. <https://r4ds.had.co.nz/> by Wickham, H. and Golemund, G.

- (5) Wickham, H. (2016). ggplot2: Elegant Graphics for Data Analysis (2nd). Springer.
<http://had.co.nz/ggplot2/>
- (6) Xie, Y. (2018). R Markdown: The Definitive Guide.
<https://bookdown.org/yihui/rmarkdown/>
- (7) Xie, Y., Dervieux, C. and Riederer, E. (2022). R Markdown Cookbook.
<https://bookdown.org/yihui/rmarkdown-cookbook/>
- (8) RStudio Cheat Sheets. <https://www.rstudio.com/resources/cheatsheets/>
- (9) The UCLA Academic Technology Services site: <https://stats.oarc.ucla.edu/r/>

Course Format: Four weekly lecture hours will be used for the presentation of course material, recitations, and exams.

Lecture Hours		Location
Monday	12:00 – 12:50Pm	Science & Technology Center 145
Wednesday	12:00 – 12:50Pm	Science & Technology Center 145
Friday	12:00 – 12:50Pm	Science & Technology Center 145

Week-by-week tentative schedule

Week	Topics	Lecture notes
1	Introduction to R and R Markdown	Lecture 1 and 2
2	Introduction to EDA (Exploratory Data Analysis), R data types, R data structures, R data operators, Data import and export	Lecture 3, 4, and 5
3	R Base Plotting and Plotting with package ggplot2	Lecture 6 and 7
4	Univariate plots and multivariate plots with ggplot2, Git and GitHub	Lecture 8 and 9
5	Data manipulation with Base R and package Dplyr	Lecture 10 and 11
6	Data cleaning with Base R, package Dplyr and TidyR	Lecture 12 and 13
7	Displaying Distributions and Statistical Hypothesis Testing, and Sampling and estimation with R	Lecture 14 and 15
8	Visualizing Experimental Designs, Regression models and time series data	Lecture 16 and 17
9	Multivariate Data Visualization and Cluster Analysis	Lecture 18 and 19
10	Creating Animated Graphics and Interactive Data Visualization	Lecture 20 and 21
11	Visualizing Geospatial Data, Flexdashboard and Building R Shiny web apps	Lecture 22, 23, and 24
12	Introduction to Power BI, relational database and SQL	Lecture 25 and 26
13	Database creation and basic SQL commands	Lecture 27 and 28
14	Retrieving data from multiple tables with SQL and an example database	Lecture 29 and 30
15	Two Power BI dashboard examples	Lecture 31 and 32

The above is the tentative week-by-week schedule and the topics to be covered are listed. The schedule will be followed as closely as possible. Students are expected to have read the sections in the lecture notes for that day prior to coming to class.

Dates to remember:

- The final date for withdrawal from the course without academic record is Tuesday September 6, 2022. The last day to withdraw the course is **Thursday, November 3, 2022**. After this date students remain registered will receive final grades.

Student Learning Outcomes: After completing the course students will demonstrate the ability to conduct exploratory data analysis using R, share reproducible research with R Markdown and GitHub, and construct a Power BI reports with different tools in Power BI:

- To be able to import/export data, tidy data and write functions and control structures.
- To be able to use the R add-on package SAMPLING to simulate data by simple random sampling, stratified sampling and cluster sampling and estimate population parameters.
- To be able to use base R to create basic graphs such as bar plots, Pie charts, histograms and density plots, dot plots, line charts, box plots, and scatterplots.
- To be able to use R packages such as ggplot2 to construct aesthetic mappings and customize plots.
- To be able to visualize geographical data using map visualization packages in R.
- To be able to construct 3D plots and animated graphics.
- To be able to create interactive data visualizations.
- To be able to visualize statistical inference using the R add-on package INFER or other packages.
- To be able to build interactive web apps using the R package Shiny.
- To be able to use the web-based hosting service GitHub (<https://github.com/>) to post and share any open-source computing project.
- To be able to use the mark-up language Markdown to conduct reproducible research and produce elegantly formatted reports of data analyses.
- To be able to manage data held in a relational database with SQL (Structured Query Language).
- To be able to analyse data from different data sources, and work with the different tools of the Power BI universe to construct a Power BI report.

Course Evaluation:

Homework Assignments (6)	30%
Four In-class quizzes (September 28, October 12, October 26, and November 9)	20%
Two Projects	30%
Final Project (11:00-1:00 PM Wednesday)	20%

- There will be 6 homework assignments. Each homework requires you to conduct data analysis or data visualization using R and RStudio.
- The 4 Quizzes will take place in classes. Each quiz will be about 20 minutes. All quizzes require you to conduct data analysis or data visualization using R.
- There will be 2 projects. Each project requires you to conduct data analysis or visualization using R, RStudio and Power BI.
- The evaluation of the final project contains two parts: oral presentation (5%), and written report (15%).

Grading Scheme

A = [94, 100] A ⁻ = [90, 93]	B ⁺ = [87, 89] B = [83, 86] B ⁻ = [80, 82]	C ⁺ = [75, 79] C = [70, 74]	D=[60, 69]	E = [0, 59]
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IMPORTANT DISCLAIMER: All information in this syllabus is provided as a guide for the course. It is possible that specific items and dates may change based on learning needs, emergencies, illness, school closings, other conditions that may arise, etc. These possible changes are at the discretion of the instructor.

Course Policies:

- **Attendance:** If you miss a class, you are **responsible** for getting any missed information from the recorded lecture or another student.
- Students are required to be available for all examinations during the periods for which they are scheduled. A makeup Exam will not be given unless arrangements have been made with the instructor prior to the Exam, and arrangements are granted only in extreme **documented** circumstances.
- Extension of due dates for completion of Homework/Exam or Final Exam may be granted to students on the basis of illness, accident or other extreme and unanticipated legitimate circumstances beyond the student's control, with supporting documentation. Supporting documentation will be required and must be submitted before deferrals are approved.
- For illness or accident, supporting documentation will take the form of:
 - A certificate or letter from the attending physician clearly indicating the start and end dates of the illness and the student's inability to write an examination.

For other circumstances, students should consult the instructor about acceptable forms of documentation.

Communication Policy: I expect to be able to contact you via the email address listed in your MyESU account, which is your **ESU email** by default. Always include the course name "**Math318**" in the email subject. If you haven't maintained this address lately, log on and fix it. Empty your deleted messages folder and your sent messages folder then clean up your inbox messages. No excuses. Trouble with email? Call the help desk @3789 or 570-422-3789 from an outside phone.

University Policies

Masking Protocol: Face masks are optional when attending face-to-face classes.

Covid-19 Protocol for Fall 2022: There may be instances throughout the semester that students may not be able to attend in-person class due to exposure to Covid-19 or due to testing positive for Covid-19. In those situations, please be aware of the following:

- Students need to officially report their quarantine status or positive results on the official ESU Covid-19 reporting dashboard. Please fill out the form here:
<https://www.esu.edu/health-and-wellness/covid19-reporting-form.cfm>
- Students who are too ill to attend class synchronously will need to keep up to date with the course material through reading the assigned chapters being covered in the class lectures.
- If a class is cancelled, you will be notified in two ways — email and through D2L "news".
- If a class is moved online synchronous, students can join the online meeting at the zoom link specified.

Monkeypox Protocol for Fall 2022: Monkeypox [symptoms](#) may include fever, headache, muscle aches and backache, swollen lymph nodes, chills, exhaustion, sore throat, cough, nasal congestion, and a rash that can look like pimples or blisters. The rash can be located near genitals, hands, feet, chest, face, or mouth. If you develop symptoms consistent with Monkeypox, please contact ESU's Health Center at LVHN-Pocono. Please make an appointment ahead of time by calling (272) 762-4378. For additional information, please visit the [PA Department of Health's Monkeypox Fact Sheet](#) and the [CDC Monkeypox page](#).

Title IX: East Stroudsburg University and its faculty are committed to assuring a safe and productive educational environment for all students. In order to meet this commitment and to comply with Title IX of the Education Amendments of 1972 and guidance from the Office for Civil Rights, the University requires faculty members to report incidents of sexual violence shared by students to the University's Title IX Coordinator. The only exceptions to the faculty member's reporting obligation are when incidents of sexual violence are communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University--approved research project. Faculty members are obligated to report to the person designated in the University protection of minors policy any sexual violence or any other abuse of a student who was, or is, a child (a person under 18 years of age) when the abuse allegedly occurred. Information regarding the reporting of sexual violence and the resources that are available to victims of sexual violence is set forth at: Title IX: Sexual Harassment and Sexual Violence See. <http://www4.esu.edu/titleix/>

ESU Diversity, Equity and Inclusion Statement (DEI): East Stroudsburg University recognizes that achieving academic and inclusive excellence requires challenging bias with a focus on equity. ESU is committed to creating a supportive campus climate where all members of the ESU community feel a sense of responsibility to grow and contribute positively to a just, global and diverse society. See https://www.esu.edu/about/history_beliefs/diversity-equity-inclusion.cfm

ESU's DEI Statement was created to be a foundational recognition of the institutional commitment to diversity, equity, inclusion, and social justice. This statement sets a campus-wide purposeful tone for how ESU will navigate issues related DEI and continue its growth and development in this area.

ESU has a variety of resources available for our students who need support or want to engage in activities to promote diversity, equity, and inclusion on campus. We encourage students to utilize the resources available through departments such as the Center of Multicultural Affairs and Inclusive Education, the Gender and Sexuality Center, OASIS, and the Veterans Center. For more information, contact the Office of Campus Life and Inclusive Excellence via Phone: 570-422-3463 or Email: DEI@esu.edu

East Stroudsburg University of Pennsylvania does not discriminate on the basis of race, color, national origin, religion, sex, disability, age, sexual orientation, gender identity or veteran's status in its programs and activities in accordance with applicable federal (Titles VI, VII and IX of Civil Rights Act) and state laws (43 P.S. §. 953) and regulations. For more information, visit <https://www.esu.edu/about/notices.cfm>

It is everyone's responsibility to create an environment where we all feel safe and welcome at ESU. If you experience or witness a bias incident, discrimination or harassment, you are encouraged to complete an incident report. For more information or submit a report visit <https://www.esu.edu/diversity/community-restoration-team.cfm>

Accommodations: Accessibility and Accommodations "It is the University's goal that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on a disability, please let me know immediately so that we can discuss options. You are also welcome to contact the Office of Accessible Services Individualized for Students, or OASIS, on campus (Sycamore Suites, Lower Level, 17, 304 Normal Street) at 570-422-3954 (**Fax:** 570-422-3268; **Email:** oasis@esu.edu; **Webpage:** <https://www.esu.edu/oasis/index.cfm>) for information concerning the process to request reasonable accommodations." Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

Academic Integrity: It is expected that students will embrace and practice the principles of academic honesty and integrity (see p. 49 in the ESU Student Handbook, 2020-2021 for academic misconduct violations). Appropriate collaboration is encouraged, but cheating and plagiarism will result in an E (failing grade) for the test or assignment and the possibility of more severe penalties based upon proceedings facilitated by the ESU Office of Student Conduct and Community Standards. For additional information about the requirements and consequences involved, contact the Office of Student Conduct and Community Standards at https://www.esu.edu/student_conduct or at 570-422-3461.

Student Procedure for Extended Absence Notification: The Dean of Students provides assistance and support for students who miss a minimum of three class days due to illness, personal or family emergencies. A note will be circulated to professors advising of the absence. Students are still required to contact their professors for guidance related to any missed work during the absence.

To utilize this service, the student or family member completes the Request Instructor Notification for Extended Absences Form including supporting documentation related to the absence. In some cases, if a student is unable to return to one or more of their classes, the Dean of Students can discuss enrollment options. Students or family members should contact the office at 570-422-3461 to discuss options. For form, please go to https://www.esu.edu/registrar/extended_absence.cfm

Writing Three or More Exams on the Same Day

A student scheduled to write three invigilated final examinations in one calendar day may apply to have one examination rescheduled on an alternate examination day. When an alternative testing schedule cannot be agreed upon by the student and faculty, the determination shall be made by Provost. You should email the form (available on the Academic Calendar webpage https://www.esu.edu/academics/calendar/documents/18-19/final_exam_policy.pdf) to the Assistant to the Provost at least three weeks (21 calendar days) prior to the start of final exams.