Syllabus for DATA_SCI 7020 Statistical and Mathematical Foundations for Data Analytics

Spring 2022

Description

This course is an intermediate statistics class designed to build the mathematical foundation for students dealing with Big Data phenomena. Topics include discussions of probability, data sampling, data summarization, sampling distributions, statistical inference, statistical pattern analysis, hypothesis testing, regression, and nonparametric inference over multidimensional data collections. Students will engage in Big Data projects using various publicly available data sets and leveraging modern Data Science tools, techniques, and cyberinfrastructure.

Prerequisites

Graduate standing, admission to the program, or instructor's consent for non-DSA students. Students are expected to have basic working knowledge of programming in R.

Objectives

Students will

1. have a firm understanding of the nature and challenges of multidimensional data, the foundational mathematical operations from linear algebra, and the extensions of basic probability and statistics into multidimensional spaces.
2. understand the theoretical underpinnings of multivariate statistical analysis, such as mean vectors, covariances.
3. be able to apply statistical analysis to a variety of multivariate data sets, understanding how to choose the appropriate techniques for a variety of challenges.
4. be able to construct computational solutions using appropriate tools and techniques as they tackle big data.

Instructor

Dr. Ilker Ersoy, ersoyi@health.missouri.edu   Office: 22H, Heinkel Building

Textbook

There is no required textbook. Reading Assignments will be given from published papers and online resources.

Course Format

A module is released each week with lectures covering theory provided as videos in Canvas and as lab notebooks in JupyterHub environment. Weekly programming practices and exercises will be given as Jupyter notebooks. All online material except videos will be distributed by git server at git.dsa.missouri.edu. Weekly discussion topics will be on Canvas board where students will contribute to the discussion. Students will use course's Slack channel for communication and course help.

Grading

Final grade will be based on individual assignments, discussion participation, and a final project. For the final project, students are expected to find a data set from a domain of their choice and to create a compelling data story applying all the statistical and mathematical principles and techniques they have learned in the course.

Weekly assignments: 70%
Final project: 20%
Discussion participation: 10%

Standard grading scales applies:

A+: >= 98%	C+: 77% - 79%
A : 93% - 97%	C : 73% - 76%
A-: 90% - 92%	C-: 70% - 72%
B+: 87% - 89%	F : < 70%
B : 83% - 86%	
B-: 80% - 82%	

Schedule

Table of weeks/modules and topics covered:

Modules	Topics
1 Jan.18-22	Introduction and Review of Statistics: descriptive, inferential stats, distributions, graphing distributions.
2 Jan.22-29	Multivariate Statistics, Linear Algebra: vectors, covariances, matrices, correlations.
3 Jan.29- Feb 5	Multivariate Exploration: dimensionality reduction, factor analysis, PCA, LDA.
4 Feb.5-12	Probabilities, Bayesian Statistics.
5 Feb.12-19	Regression: Linear, multiple, logistic, multivariate regression.
6 Feb.19-26	Statistical Testing: sampling methods, significance testing, P-values, T-test, chi-square test.
7 Feb.26- Mar.5	Analysis of Variance: one-way ANOVA, Factorial ANOVA.
8 Mar.5-12	MANOVA, Final Projects.

Course Policies

Late submissions will not be permitted unless there are extenuating circumstances in which case late submissions will be penalized 10% for each day up to four days. Students are expected to do their own assignments individually. While they are encouraged to discuss problems and ideas with their classmates, any act of cheating will not be tolerated. Any evidence of plagiarism, in part or in full, is considered cheating. Any excerpts taken from published material in any form (ideas, code, data, written text, etc.) must be cited by a full reference to the original work.

Changes to Syllabus

The instructor reserves the right to make adjustments or changes to the contents of the syllabus throughout the semester with advanced notice.

Academic Honesty

Academic integrity is fundamental to the activities and principles of a university. All members of the academic community must be confident that each person's work has been responsibly and honorably acquired, developed, and presented. Any effort to gain an advantage not given to all students is dishonest whether or not the effort is successful. The academic community regards breaches of the academic integrity rules as extremely serious matters. Sanctions for such a breach may include academic sanctions from the instructor, including failing the course for any violation, to disciplinary sanctions ranging from probation to expulsion. When in doubt about plagiarism, paraphrasing, quoting, collaboration, or any other form of cheating, consult the course instructor.

All exercises and projects are designed and intended to be an individual effort, *collaborative implementation or copying* will result in a zero (0) on the exercise for all students involved.

ADA Notice

Students with Disabilities

If you anticipate barriers related to the format or requirements of this course, if you have emergency medical information to share with me, or if you need to make arrangements in case the building must be evacuated, please let me know as soon as possible.

If disability related accommodations are necessary (for example, a note taker, extended time on exams, captioning), please establish an accommodation plan with the Disability Center (http://disabilitycenter.missouri.edu), S5 Memorial Union, 573- 882-4696, and then notify me of your eligibility for reasonable accommodations. For other MU resources for persons with disabilities, click on "Disability Resources" on the MU homepage.

Statement on Mental Health

The University of Missouri is committed to supporting student well-being through an integrated network of care, with a wide range of services to help students succeed. The MU Counseling Center offers professional mental health care and can help you find the best approach to treatment based on your needs. Call to make an appointment at 573-882-6601. Any student in crisis may call or go to the MU Counseling Center between 8:00 – 5:00 M-F. After hours phone support is available at 573-882-6601.

Visit our website at https://wellbeing.missouri.edu to take an online mental health screening, find out about workshops and resources that can help you thrive, or learn how to support a friend. Download Sanvello, a phone app that teaches skills and strategies to help you maintain good mental health. Log in with your Mizzou e-mail to unlock all the tools available through Sanvello at no cost to you.

Special Statement on Decreasing the Risk of COVID-19 in Classrooms and Labs

MU cares about the health and safety of its students, faculty, and staff. To provide safe, high-quality education amid COVID-19, we will follow several specific campus policies in accordance with the advice of the Center for Disease Control and Boone County health authorities. This statement will be updated as information changes.

• **If you are experiencing any COVID-related symptoms,** or are otherwise feeling unwell, do not attend in-person classes and contact your health care provider and/or student health immediately. COVID symptoms include: fever greater than 100.4 or chills; cough, shortness of breath or difficulty breathing; fatigue; unexplained muscle or body aches; headache; new loss of taste or smell; sore throat; congestion or runny nose; nausea or vomiting; diarrhea.
• We will all wear **face coverings while in the classroom**, unless you have a documented exemption due to a disability or medical condition.
• We will maintain a **6-foot distance from each other at all times** (except in specific lab/studio courses with other specific guidelines for social distancing).
• We will enter the classroom and **fill the room starting at the front, filing all the way across a row**. When class ends, we will exit the row nearest to the door first; the instructor or TA will give the signal for the next row to exit, in the same manner.
• In any small section or lab class that requires them, **additional measures will be listed in the syllabus and be mandatory for class participation**.
• Online office hours will be available for all students.

• This course may be recorded for the sole purpose of sharing the recording with students who cannot attend class. The instructor will take care not to disclose personally identifiable information from the student education records during the recorded lesson.

Compliance with these guidelines is required for all; anyone who fails to comply will be subject to the accountability process, as stated in the University's Collected Rules and Regulations, Chapter 200 Student Code of Conduct.

If an instructor has concerns about how a student is following COVID-19 policies and protocols, please report those concerns to the Office of the Dean of Students. You can fill out a COVID Safety Measures Reporting Form here: https://cm.maxient.com/reportingform.php?UnivofMissouriSystem&layout_id=38

By taking the above measures, we are supporting your health and that of the whole Mizzou community. Thank you in advance for joining me and your peers in adhering to these safety measures.

Intellectual Pluralism

The University community welcomes intellectual diversity and respects student rights. Students who have questions or concerns regarding the atmosphere in this class (including respect for diverse opinions) may contact the departmental chair or divisional director; the Office of Academic Integrity; the MU Equity Office, or equity@missouri.edu.

All students will have the opportunity to submit an anonymous evaluation of the instructor(s) at the end of the course.

Recording Course Activities

University of Missouri System Executive Order No. 38 lays out principles regarding the sanctity of classroom discussions at the university. The policy is described fully in section 200.015 of the Collected Rules and Regulations. In this class, students may not make audio or video recordings of course activity, except students permitted to record as an accommodation under section 240.040 of the Collected Rules. All other students who record and/or distribute audio or video recordings of class activity are subject to discipline in accordance with provisions of section 200.020 of the Collected Rules and Regulations of the University of Missouri pertaining to student conduct matters.

Those students who are permitted to record are not permitted to redistribute audio or video recordings of statements or comments from the course to individuals who are not students in the course without the express permission of the faculty member and of any students who are recorded. Students found to have violated this policy are subject to discipline in accordance with provisions of section 200.020 of the Collected Rules and Regulations of the University of Missouri pertaining to student conduct matters.