Advanced Methods in Health Data Science Syllabus

DATA_SCI 8140

Introduction

This course covers advanced topics in health data analysis. Students will learn about research informatics and clinical trials, and advanced statistical methods used in health data analysis. Additionally, students will be exposed to new forms of health data processing such as free text data, image data, and longitudinal data. Students will explore the use of machine learning and AI in health care settings, and applied clinical informatics in the form of decision support. Project work involves accessing and analyzing real (de-identified) health care data.

Course Prerequisites

1. ***DATA_SCI 8130: Data Science for Health Care***

Topics

1. Health research informatics and randomized controlled trials
2. Survival analysis and repeated categorical analysis
3. Time series analysis and mixed models
4. Patient generated data and research registries
5. Health care image processing
6. Clinical decision support, explainable AI, and business intelligence
7. Applications of supervised and unsupervised methods to health data
8. Association rule mining for hypothesis generation

Instructor

Tim Green, PhD
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Grading Breakdown

1. 25% Quizzes
2. 75% Module Projects

Learning Resources

Selected online learning resources will be utilized, such as videos, class notes, APIs, tutorials, bootcamps, on-line articles and technical papers.

Course Learning Objectives

1. Describe research informatics and its role in health data analysis
2. Introduce the concepts of randomized controlled trials designs and analysis
3. Describe advanced statistical methods suitable for health data analysis
4. Explore other methods of health data acquisition such as patient generated data and clinical research registries
5. Discuss techniques and issues surrounding mining data from free text clinical notes and matching data across different ontologies
6. Explain the DICOM image format and how to access and process data from it
7. Explore artificial intelligence methods for health data processing such as deep learning, and the issues surrounding their use in a health care setting
8. Introduce clinical decision support concepts and relevant standards
9. Discuss health care business intelligence

Grading Scales (Letter Grade: %)

The standard grading scale applies, with no grade curving. Note that the minimum passing grade is 70%:

A+	100%	to 98%
A	< 98%	to 93%
A-	< 93%	to 90%
B+	< 90%	to 87%
B	< 87%	to 83%
B-	< 83%	to 80%
C+	< 80%	to 77%
C	< 77%	to 73%
C-	< 73%	to 70%
F	< 70%	to 0%

Course Schedule: Detailed Topics

Module	Topics	Detailed Topics
1	Health research informatics and randomized controlled trials	CDISC SDTM Format, REDCap data format, Electronic data capture, FDA and sponsor drug study submission requirements
2	Survival analysis and repeated categorical analysis	Kaplan Meier plots, Life tables, Log-rank test, Cox proportional hazards regression analysis, Cochran's Q test
3	Time series analysis and mixed models	Autocorrelation, seasonality, stationarity, ARIMA, mixed modeling
4	Patient generated data and research registries	Incorporating PGD, overview of research registries

5	Health Care image processing	Image data formats, processing and application of deep learning techniques to health image data
6	Clinical decision support, explainable AI, and business intelligence	SMART, FHIR standards, importance of explanations, role of BI in health care
7	Applications of supervised and unsupervised methods to health data	Applications of clustering, decision trees, and neural networks to health data
8	Association rule mining for hypothesis generation	Association rule mining, data mining and hypothesis generation using ARM

[The following sections are sourced from https://provost.missouri.edu/syllabus-information/ *]*

Academic Dishonesty

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 MU Disability Center, 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 can't 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.