Statistics 501: Multivariate Statistical Methods

Instructor: Ranjan Maitra (pronounced Ron-jone Moi-tro, if you care)
Office: Snedecor Hall 2220 e-mail: `maitra`
Course website: This course uses Canvas. See `http://bb.its.iastate.edu`
Instructor Office hours: Snedecor Hall 2220. tbd
Lecture times:

- Section A: TR 9:30-10:45 am, https://iastate.zoom.us/j/99485605623?pwd=Zk9QMWhuWG5QQ1o1Qm8vaFdGWEY1Zz09

Textbook: None, but note that past semesters have used *Applied Multivariate Statistical Analysis* by Richard A. Johnson and Dean W. Wichern (*Prentice-Hall, 2007, Sixth Edition*).

Prerequisites: (1) STAT 500; (2) STAT 542; (3) STAT 579 or equivalent; (4) knowledge of matrix algebra. Solid grounding in linear algebra, calculus and introductory but graduate-level statistics.
Note: Each of (1), (2), (3) and (4) have to be satisfied as requirements. No Exceptions.
If you do not have the prerequisite, as per the Registrar, you are entitled to an automatic F.

Important Dates:

- Midterm Exams: two, tbd.
- Final: tbd, as per Registrar.

Course description:

Statistical methods for analyzing and displaying multivariate data; the multivariate normal distribution; inference in multivariate populations, simultaneous analysis of multiple responses, multivariate analysis of variance; summarizing high dimensional data with principal components, factor analysis, canonical correlations, classification methods, clustering, multidimensional scaling; introduction to basic nonparametric multivariate methods. Statistical software: R.

Course information and Policies:

Free Expression: Iowa State University supports and upholds the First Amendment protection of freedom of speech and the principle of academic freedom in order to foster a learning environment where open inquiry and the vigorous debate of a diversity of ideas are encouraged. Students will not be penalized for the content or viewpoints of their speech as long as student expression in a class context is germane to the subject matter of the class and conveyed in an appropriate manner.

Academic Dishonesty: The class will follow Iowa State University's policy on academic dishonesty. Anyone suspected of academic dishonesty will be reported to the Dean of Students Office.

Disability Accommodation: Iowa State University is committed to assuring that all educational activities are free from discrimination and harassment based on disability status. Students requesting accommodations for a documented disability are required to work directly with staff in Student Accessibility Services (SAS) to establish eligibility and learn about related processes before accommodations will be identified. After eligibility is established, SAS staff will create and issue a Notification Letter for each course listing approved reasonable accommodations. This document will be made available to the student and instructor either electronically or in hard-copy every semester. Students and instructors are encouraged to review contents of the Notification Letters as early in the semester as possible to identify a specific, timely plan to deliver/receive the indicated accommodations. Reasonable accommodations are not retroactive in nature and are not intended to be an unfair advantage. Additional information or assistance is available online at www.sas.dso.iastate.edu, by contacting SAS staff by email at accessibility@iastate.edu, or by calling 515-294-7220. Student Accessibility Services is a unit in the Dean of Students Office located at 1076 Student Services Building.

Discrimination and Harassment: Iowa State University does not discriminate on the basis of race, color, age, ethnicity, religion, national origin, pregnancy, sexual orientation, gender identity, genetic information, sex, marital status, disability, or status as a U.S. Veteran. Inquiries regarding non-discrimination policies may be directed to Office of Equal Opportunity, 3410 Beardshear Hall, 515 Morrill Road, Ames, Iowa 50011, Tel. 515-294-7612, Hotline 515-294-1222, email eooffice@iastate.edu.

Prep Week: This class follows the Iowa State University Prep Week policy as noted in section 10.6.4 of the Faculty Handbook.

Religious Accommodation: Iowa State University welcomes diversity of religious beliefs and practices, recognizing the contributions differing experiences and viewpoints can bring to the community. There may be times when an academic requirement conflicts with religious observances and practices. If that happens, students may request the reasonable accommodation for religious practices. In all cases, you must put your request in writing. The instructor will review the situation in an effort to provide a reasonable accommodation when possible to do so without fundamentally altering a course. For students, you should first discuss the conflict and your requested accommodation with your professor at the earliest possible time. You or your instructor may also seek assistance from the Dean of Students Office at 515-294-1020 or the Office of Equal Opportunity at 515-294-7612.

Contact Information: If you are experiencing, or have experienced, a problem with any of the above statements, email academicissues@iastate.edu.

E-mail: Checking your e-mail on a **daily** basis is necessary as course communication through Canvas uses your University e-mail account. Occasions may occur when the Instructor may need to disseminate important course updates via e-mail.

Assessments:

Final grade: Letter grades including plus/minus will be given based on performance on the assessment categories above. The percentage distribution is as follows:

Midterm Exams (two) 20% each Homeworks 25% Final Exam 35%

Homework: Unless otherwise announced, homework assignments are **due on Saturday by 12 am**. (*This means that homeworks are due within the sixty seconds that transpire after 11:59 pm of Fridays.*) These are to be turned in **as a pdf document, only** at the Canvas site by the date the homework is due. I recommend that you compare your answers with the solutions that I post and **ask** me if you have questions (or have better ideas at solving the problems). I encourage you to collaborate on the homework problems, but for purposes of learning, to work out your own answers independently. *Late homework submissions are not accepted.*

Exams: Midterm exam dates will be decided during the course of the class and may, at least partially, include a data analysis/reporting component. **Conflicts with exams:** Accommodations will only be made for students with appropriate university documentation (e.g. NCAA competition). Please provide at least **two (2) weeks notice** of potential conflicts. All other conflicts will count as a missed exam.

Final exam: The final exam is cumulative. I understand that this date is **Thursday May 6, 2021** between **9:45-11:45 a.m.** Note: This date and time is set by the University and is subject to change. Check Canvas for the date, time, and place of the final exam. Final exams may not be taken early or late under any circumstances. Also, project/data analysis portions of the exam are not subject to this time.

Additional Information:

Statistical Software: This course will use the free statistical software R, available for Windows, Mac, or Linux. We will use this software to assist with probability calculations, statistical inference, and regression topics.

As with any software, there is an initial frustrating learning curve. However, using this software is important, because R is heavily used in the statistics world. Moreover, the days of simple problems which could be done on calculators is over and does not illustrate the riches of multivariate statistics. Because it is freely available and versatile in every sense of the word, you can use it in the future for any projects that may arise. I am available as a resource to help you with this software should any difficulties arise. However, it is assumed that you have knowledge in R. Not using this software for homeworks when needed is not an option for this class, so please plan accordingly.

Course Outcomes/Objectives: The objective of the course is to have students learn statistical methods for analyzing and displaying multivariate data and to perform inference in multivariate populations. The class will also expose the students to do simultaneous analysis of multiple responses, multivariate analysis of variance; summarize high dimensional data with principal components, factor analysis, canonical correlations, classification methods, clustering and/or multidimensional scaling. Upon successful completion of this class, students, should, upon proper application of their faculties and knowledge, be able to analyze and display multivariate data and to perform inference in multivariate populations. They should also be able to do simultaneous analysis of multiple responses, multivariate analysis of variance; summarize high dimensional data with principal components, factor analysis, canonical correlations, classification methods, clustering and/or multidimensional scaling.

How to do well in the class: The lectures and homeworks contain examples, activities, and discussion to help you learn the material. Therefore, both attending lecture, understanding the material and doing the homework will provide you the most depth to reinforce your learning of multivariate statistics.

This is a three-credit-hour class. As per the department and the university catalog, each week students should spend three 50-minute periods in lecture and nine hours outside of class learning the material. Students should be prepared to put forth this kind of effort in order to master the large amount of covered material. Do not fall behind and expect to catch up later in the semester!

Important: This is a graduate class in multivariate statistical methods designed for graduate students majoring in statistics. As such, it is intended to be taught at 500-level for graduate statistics majors. Students majoring in disciplines outside statistics are very welcome, but those desiring a gentler introduction into multivariate statistics may, as an alternative, consider Stat 407 taught by the statistics department every fall semester. *This class is designed to be taught at the graduate level in statistics and will assume proficiency in the pre-requisites.*

Feedback: I am always open to feedback about the syllabus, the course, and its policies. I seriously consider any feedback. If a change to the syllabus is deemed necessary, I will discuss the change in lecture and post the updated syllabus on Canvas. Accordingly this syllabus is subject to change.