**Course Outline**

**537 – Multivariate Statistics**

**Summer Term 2024 (Session B)**

Instructor: Dr. Kevin Nichols

Email: [knichols@fullerton.edu](mailto:knichols@fullerton.edu)

Classroom TWTh 5:30 – 8:15: MH-480 or via zoom <https://fullerton.zoom.us/j/5471011918>

Office Hours TWTh 8:20 – 9:10 MH-480 or via zoom (same room as lecture)

**COURSE DESCRIPTION FROM THE CATALOG**

In this course, we will be providing some of the fundamental tools needed to analyze data recorded in multi-dimensional spaces. This typically consists of data sets with many subjects, and a large number of attributes (or variables) recorded, per subject. As such, we shall review exploratory data analytical tools for summarizing data, as well as studying inferential approaches for comparing populations and samples, for gauging the effects of various predictors on multivariate responses, for efficiently and informatively reducing the dimensionality of the parameter spaces, and for applying supervised and unsupervised learning techniques on data having complex structures.

**SPECIFIC TOPICS/COURSE OBJECTIVES**

* Review of matrix algebra
* Introduction to multivariate summaries (mean vector, covariance matrix)
* Asymptotic properties of mean and covariance matrix estimators
* Tests for multivariate normality, estimation in multivariate frameworks
* Inference for mean vectors
* Principal components and factor analysis (dimension reduction)
* Parameter Shrinkage: Lasso, Ridge and Elastic-Net Regression
* Discrimination and Classification

**STUDENT LEARNING GOALS**

* The ability to analyze data using data summarizing tools such as graphs and numerical summaries.
* Expertise in statistical inference and classical statistical theory associated with the topic, including modeling of data and interpretations of technical aspects that lead to solving scientific questions.
* Programming competence as indicated by the students' capability to implement statistical theory to applied data.
* Comprehension of contemporary results and challenges associated with the advanced topic.

**REQUIRED TEXTS**

Johnson, R. Wichern, D. *Applied Multivariate Statistical Analysis sixth edition*, *ISBN*

-13-187715-1

**PLANNED ASSIGNMENTS**

REQUIRED TECHNOLOGY MATERIALS AND EQUIPMENT

This course will be streamed live online via the Internet. Zoom, a system for live stream delivery of online courses, will be used. Students can participate in class discussions, using a web-conferencing technology. Virtual office hours, accessible to both local and remote students, will be held. Zoom will be used to hold the virtual office hours. The course will involve running computer programs and presenting graphics as part of the instruction. These will be communicated to remote students in a live fashion through the Zoom system. Students who are present in class will simultaneously watch the computer presentation on an over-head projector. Short in-class projects may be assigned and discussed by both students present in class and present in remote sites.

Students must have all of the following:

* A computer equipped with a webcam, and a microphone.
* Cable or DSL access to the Internet with minimum download speed of 3MB/Sec is required.
* Scanner will be required to scan handwritten material, which will be e-mailed to the instructor. (Cell phone scan tech is fine)
* Zoom
* R

Students are encouraged to have the following:

* Python (with recommended IDE Pycharm)

ON-CAMPUS MEETING REQIREMENTS

There are no on-campus meeting requirements for those who opt to join the class remotely. However, a student may attend a class session in its entirety in person or remotely. Attendance in either form is required.

Late Work Policy

Late homework are not accepted and make‐up exams will be given only in extreme instances and only with advance permission of the instructor. Any student who does not take an exam at the scheduled time without prior consent of the instructor will receive a grade of zero on that exam. If any student feels that a sudden illness is sufficiently extreme to warrant a make‐up exam, the instructor must be provided with documentation prepared by an appropriate authority.

COURSE WEBSITE

Online course information is available on the course website, which is located on Titanium. Go to www.fullerton.edu, log onto your portal and access the course website from the Titanium link found in your portal. Students are expected to read the announcements on the website each week during the duration of the course.

COMMUNICATION

All course announcements and personal email are sent through your CSUF email accounts. You MUST check your CSUF email daily for the duration of the course.

COMMUNITY STANDARDS AND “NETIQUETTE”

Your posts are not formal essays, but neither are they private conversations. You will not be held accountable for the formal standards of academic writing (grammar, usage, mechanics), but you will be expected to write as clearly as you can. You are also required to adhere to the norms of online courtesy and collegiality, summed up generally as “netiquette” [(www.albion.com/netiquette/corerules.html](http://(www.albion.com/netiquette/corerules.html)). Consistently inappropriate posting by any student will be treated similarly to consistently inappropriate classroom behavior, and may result in that student’s being barred from further online discussion in the class, with a resulting loss of the participation grade for the course.

#### GRADING POLICY AND CRITERIA

Outside classroom online activities such as chatting and email exchanges will not be tracked or graded. However, participation in class both for students present and connected via Zoom is required, and will be graded. There will be occasional one-on-one oral/online chats between the instructor and individual students to assess student understanding of any graded material. These one-on-one communications will be scheduled outside of the class at a mutually convenient time to both students and the instructor.

GRADING CRITERIA

The midterms will be due at the beginning of each session. There will be a final culminating project that counts as the final exam for the course. Letter grades will be assigned according to the distribution of the overall grades. Plus-minus grading will be used. The grade breakdown is as follows:

HW 10%

Exam 1 30%

Exam 2 30%

Final Exam 30%

Plus-minus grading will be used based on the following point breakdowns:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Percent** |  | *93-100* | *90-92* | *87-89* | *83-86* | *80-82* | *77-80* | *70-76* | *60-69* | *00-59* |
| **Grade** |  | *A* | *A-* | *B+* | *B* | *B-* | *C+* | *C* | *D* | *F* |

Penalty for Academic Dishonesty

Students are expected to do their course-work individually. A grade of “F” will be assigned in the event of any academic dishonesty. (See below for Academy Dishonesty)

**Special Needs:**

If you have a disability or special need for which you are or may be requesting an accommodation, please inform me and contact the Office of Disability Support Services, located in University Hall 101, as early as possible. For more information, the Office of Disability Support Services can be reached by calling (657) 278-3117 or visit their website at www.fullerton.edu/DSS. Confidentiality will be protected.

**Academic Integrity**

*"Students who violate university standards of academic integrity are subject to disciplinary sanctions, including failure in the course and suspension from the university. Since dishonesty in any form harms the individual, other students and the university, policies on academic integrity are strictly enforced. I expect that you will familiarize yourself with the academic integrity guidelines found in the current student handbook."* (UPS 300.021).

* Cheating- ''obtaining or attempting to obtain credit for work by the use of any dishonest, deceptive, fraudulent, or unauthorized means" and/or "helping someone commit an act of academic dishonesty".
* Unacceptable examination behavior- communicating with fellow students, copying material from another student's exam or allowing another student to copy from an exam, possessing or using unauthorized materials, or any behavior that defeats the intent of an exam.
* Plagiarism- taking the work of another and offering it as one's own without giving credit to that source, whether that material is paraphrased or copied in verbatim or near­ verbatim form
* Unauthorized collaboration on a project, homework or other assignment where an instructor expressly forbids such collaboration
* Documentary falsification including forgery, altering of campus documents or records, tampering with grading procedures, fabricating lab assignments, or altering medical excuses.

**Emergency Information**

Students should familiarize themselves with the actions they should take in an emergency at <http://prepare.fullerton.edu/>

**5-WEEK SUMMER SCHEDULE**

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| --- | --- | --- | --- |
| **WEEK** | **TOPIC(S)** | **ACTIVITIES** | **READING ASSIGNMENTS** |
| 1 | Review of Topics in Linear Algebra  Multivariate Normal Distributions  Conditional Distributions and Estimation |  | Chapter 2  **NO CLASS THURSDAY** |
| 2 | Hotteling’s T^2  Confidence Regions, Simultaneous Confidence Intervals  Paired Confidence Intervals | HW 1 Assigned Tuesday, Due Tuesday 7-16 | 4.2,4.3,4.4,4.6  5.2,5.3,5.4 |
| 3 | ANOVA, MANOVA, PCA, Factor Analysis, Multivariate Response Regression | Exam 1 Assigned Tuesday, Due Tuesday 7-23 | 6.3,6.4,7.7,8.2,8.3,8.4 |
| 4 | Discrimination and Classification  Ridge, Lasso and Elastic-Net | Exam 2 Assigned Tuesday,  Due Tuesday 7-29 | 9, 11, 12 (not sure on sections yet). |
| 5 | Catch up | Final exam assigned Tuesday, Due **FRIDAY 8-2 11:59pm** | TBD |

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| --- | --- |
| STUDENT LEARNING GOALS | METHODS OF ASSESSING STUDENT LEARNING |
| The ability to analyze data using data summarizing tools such as graphs and numerical summaries. | Homework and exams will test student knowledge of analytical methods.  Computer and data analysis projects will assess the ability of students to apply the methods learned to solving real-world and practical problems. |
| Expertise in statistical inference and classical statistical theory associated with the topic, including modeling of data and interpretations of technical aspects that lead to solving scientific questions. | Homework and exams will assess student understanding on statistical inference and classical statistical theory.  Reports on journal articles will assess the level of literacy in classical theory associated with the advanced topic. |
| Programming competence as indicated by the students' capability to implement statistical theory to applied data. | Computer and data analysis projects will assess the ability of students to apply the methods learned to solving practical and real world problems. |
| Comprehension of contemporary results and challenges associated with the advanced topic. | Reports on journal articles will assess the ability of students to use outside sources, as needed, as well as determine the degree of comprehension students have with regards to recent contributions in science to the advanced topic. |

I reserve the right to make changes to this syllabus.