Course: BIOEN 498/599: Biostatistics

Credits: 3

Instructor: Herbert Sauro Office: William Foege: N410A
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Course Summary: The topic of this course is the application of statistics in bioengineering, medicine and biology. The course will cover basic statistical techniques together with an introduction to more advanced topics related to model selection, non-linear fitting and data analysis using techniques such as principle component analysis.

UW General Catalog Course Description: Application of statistics in bioengineering, medicine and biology. Descriptive statistics; elementary probability; discrete and continuous random variables and their distributions; hypothesis testing involving continuous and categorical (nominal and ordinal) variables, regression and nonlinear fitting as well as advanced techniques such as PCA, ANOVA and model selection.

Prerequisites: MATH 124 or 134 or equivalent. Basic programming skills in either Matlab, Octave, Scilab, Python, R, Basic (eg FreeBasic, SmallBasic), or C#. A basic working knowledge of Excel.

Prerequisites: The key requirement in the prerequisites is an ability to handle basic algebra and calculus and how to use at a basic level at least one computer language to do computations and graphing.

Instructor's detailed course description: BIOEN 498/599 is a 3 credit lecture class. Graduate students in 599 will learn more advanced topics related to data analysis and be expected to submit a data analysis project.

Textbooks: Required readings instructors' lecture notes and videos, all posted electronically on class web site. Textbook: See web site.

Learning Objectives: By the end of the course, students should be able to:

1. Use Python to display data and carry out basis analyses
2. Explain the basic principles of probability and be able to solve simple to mid-level probability problems in bioengineering.
3. Understand estimation, confidence limits and hypothesis testing and how they are applied
4. Explain the basic conceptual approach used in many statistical tests (frequenists approach) and how they are applied to bioengineering problems.
5. Learn basic statistical tests commonly used in a typical bioengineering laboratory
6. (For 599 only) Implement linear regression.

Topics Covered:

Lecture: TTh **9.30:10.50 – GLD 435**

Week	Description
1	**Using Python, plotting data**
2	**Probability and probability distributions (Navidi: Chap 2; Diez: 2)**
3	**Random variables and commonly use distributions (Navidi: Chap 4; Diez: 3)**
4	**Estimation and confidence intervals (Navidi: Chap 5; Diez: 4,5)**
5	**Statistical hypothesis testing (Navidi: Chap 6; Diez: 4)**
6	**Midterm, frequenists and Bayesian approaches.**
7	**Statistical hypothesis testing (Navidi: Chap 6; Diez: 6)**
8	**Error Propagation (Navidi: Chap 3; Diez: 2)**
9	**Analysis of Variance (Navidi: Chap 9; Diez: 5)**
10	**Correlation and Linear regression (Navidi: Chap 7; Diez: Chap 7)**

Assignments and Grading

Weekly Class Assignments (35%) A weekly take-home assignment will be given.

There will be no weekly quizzes.

Midterm Open Book Exam (30%) will assess students' basic knowledge of the tools and principles taught in this course. Application and integration of this material is assessed in the final project for 599

498: Final Open Book Exam (35%) A final comprehensive exam will be given at the end of term.

599: Final Project (35%) Students in 599 will be expected to do an end of term project related to data analysis.

Course Policy

(Deadlines, Cooperation vs. Plagiarism, Class Attendance, Disability)

Deadlines. All assignments (reading analysis, labs, and projects) must be turned via the course web site by the time and date specified. ***Because solutions will be posted on the due date, no late reports can be accepted without prior permission,*** so turn in everything you were able to accomplish in the allocated time.

Health, family, and other emergencies. We will be fairly understanding of one or two health, family, or even academic emergencies during the quarter, if you contact the instructors prior to the time the assignment is due, so we can delay posting the solution for a few days to accommodate your emergency. If you need to do this, please remind the TA that you were given permission by copying the email onto the first page of the assignment. You are not expected to come to class if you are sick; if you must miss more than 2 class discussions or the midterm quiz for health reasons, please arrange make up assignments with the instructors.

Helping vs Cheating: The goal of labs and discussion is to provide a learning tool, not to assess, so these are graded leniently. Nevertheless, it is considered cheating to consult or copy worked assignments or solutions from any previous year. You are encouraged to discuss projects and homework with your fellow students, but you may not copy or take credit for another person's work and you must write your assignments independently. When you help each other, follow these guidelines:

- you cannot give an answer
- you cannot provide code or debug someone else's code.
- you can teach coding tools, debugging tricks, or point out correct syntax for functions.
- you can point out the relevant parts of the lecture notes or text.
- you can discuss the pluses and minuses of different approaches
- you can discuss and argue interpretation
- Use the type of help given by your instructors as a guideline.
- If you receive help or collaborate, you must acknowledge the person(s) on your written assignment. You will not be graded down for this.

Plagiarism. Please place in quotes any material that you copy directly, and reference the source of material when you rewrite ideas in your own words.

Feedback and suggestions about the class will be highly appreciated. Please feel free to email me or talk to me in person.

To request academic accommodations due to a disability, please contact Disabled Student Services, 448 Schmitz, (206) 543-8925 (V/TTY). If you have a letter from Disabled Student Services (DSS) documenting that you have a disability that requires academic accommodations, please present the letter to the instructor so we can discuss the accommodations you might need for the class.

Course Outcomes of High Relevance:

(a) An ability to apply knowledge of mathematics, science and engineering

- Evaluate how to apply model fitting and model evaluation.

(e) An ability to identify, formulate, and solve engineering problems.

- Ability to apply appropriate statistical tests to a range of problems.

Relationship of Course to Program Objectives:

Obtain employment in bioengineering related fields, such as medicine, device development, or biotechnology.

- This course should contribute to the ability of students to obtain employment in related fields by providing hard skills of computational knowledge.

Contribute to responsible development of new technical knowledge.

- This course should contribute to the ability of students to responsibly develop new technical knowledge by teaching them critical skills of verification and validation needed to ensure quantitative models they design are accurate and appropriate for the problem.