

Multivariate Biomedical Signal Processing

BME 6522

Class Periods: Tuesday Period 4 (10:40 am to 11:30 am) and Thursday Period 4-5 (10:40 am to 12:35 pm)

Location: To be determined

Academic Term: Spring 2025

Instructor

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Office Location: BMS J285

Office Hours: Tuesday and Thursday 9:30 am to 10:30 am

Teaching Assistants

N/A

Course Description

This 3-credit course deals with statistical analysis of biomedical signals from a multivariate time series analysis perspective. Starting from the theory of stochastic processes we introduce concepts and methods both in the time domain and in the spectral domain. Whenever possible actual recordings from biomedical applications will be used to demonstrate the methods.

Course Pre-Requisites / Co-Requisites

Multivariate calculus and basic knowledge of probability and statistics.

Course Objectives

This course will acquaint the student with all the major methods for analyzing multivariate biomedical signals from a time series analysis perspective. Upon completion the student will be able to (1) understand the concepts in multivariate time series analysis and (2) analyze multivariate biomedical signals independently.

Materials and Supply Fees

None.

Required Textbooks and Software

No textbooks. Course notes and handouts will be distributed. Matlab programming is required.

Recommended Reading

The Analysis of Time Series: An Introduction by Chatfield; *Spectral Analysis and Its Applications* by Jenkins and Watts

Course Schedule

1. *Gaussian Random Variables (7-8 lectures)*
 - i. Concept of random variables
 - ii. Review of univariate Gaussian distributions
 - iii. Multivariate Gaussian distributions
 - iv. Assessing the relations among random variables: correlation, multiple correlation and partial correlation
2. *Multivariate Time Series: Time Domain Approach (6-7 lectures)*
 - i. Concept of stochastic processes
 - ii. Stationarity and ergodicity
 - iii. Time series models: (a) AR Models and (b) ARMA Models
 - iv. Estimating time series models from data
 - v. Assessing the relations among time series
3. *Multivariate Time Series: Spectral Domain Approach (7-8 lectures)*

- i. Spectral representation of stationary time series
 - ii. Assessing the relations among time series in the spectral domain: coherence, multiple coherence and partial coherence
 - iii. Estimating spectra: data based estimation versus model based estimation
 - iv. Examples
4. *Evaluating Causal Relations Among Multiple Time Series (6-7 lectures)*
- i. Wiener-Granger causality
 - ii. Geweke's spectral decomposition
 - iii. Statistical assessment of significance
 - iv. Examples from neurophysiology

Attendance Policy, Class Expectations, and Make-Up Policy

Attendance is strongly encouraged. Students are expected to take careful class notes.

Evaluation of Grades

70% homework, 30% term project.

Grading Policy

Curved grading will be applied.

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://www.dso.ufl.edu/drc>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluation

Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at <https://evaluations.ufl.edu/evals>. Evaluations are typically open during the last two or three weeks of the semester, but students will be given specific times when they are open. Summary results of these assessments are available to students at <https://evaluations.ufl.edu/results/>.

University Honesty Policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (<https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Software Use

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <http://registrar.ufl.edu/catalog0910/policies/regulationferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

If you or a friend is in distress, please contact umatter@ufl.edu or 352 392-1575 so that a team member can reach out to the student.

Counseling and Wellness Center: <http://www.counseling.ufl.edu/cwc>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.