



Department Computational and Data Sciences
College of Science

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CSI 678

Time Series Analysis and Forecasting

1. General Information

Instructor:	Dr. Olga Gkountouna
Where:	Blackboard Collaborate
When:	Wednesday, 4:20-7:10pm. Jan 24 - May 18, 2022
Course website:	Blackboard
Credits:	3
Prerequisites:	STAT 544 or equivalent, or permission of instructor.
Office Hours:	By appointment (<i>please email me at ogkounto@gmu.edu</i>).

2. Course Description

The main focus of this course is the study and analysis of *Time Series Data*. The topics to be covered include modeling stationary and nonstationary processes; autoregressive, moving average and mixed model processes; hidden periodicity models; properties of models; autocovariance and autocorrelation functions, and partial autocorrelation function; spectral density functions; identification of models; estimation of model parameters, and forecasting techniques. Students will develop class projects using time series data either suggested by the instructor, or time series data of their preference. The final deliverables of this class are: a final presentation in class, and a project report written in the format of a scientific article.

3. Learning Outcomes

By the end of the course each student will

- have a broad knowledge-base on fundamentals, theory and techniques of time series analysis;
- be able to articulate and effectively communicate concepts and ideas related to time series analysis and forecasting to experts, non-experts, and other professionals in a work environment;
- have the ability to appropriately apply the knowledge acquired in the course for various hypothetical and real-world time series storage, management and machine learning tasks;
- have experience with free and open-source programming packages of python/R, in order to apply data mining and analysis solutions to time series data sets,
- be able to properly interpret time series analysis results.

4. Format

The course will be taught as a combination of lectures and discussions. The students will do a class project instead of exams. They will present their project proposal in class, as well as give a presentation of the final project in the end.

5. Textbooks

No required textbook. Course slides and reading material will be provided via Blackboard.

Recommended textbooks: Forecasting: Principles and Practice, by Rob J Hyndman and George Athanasopoulos; *Practical Time Series Analysis*, O'Reilly.

6. Technology Requirements

Software. Students may choose the programming language they prefer to write their applications code. Python is recommended. For the final project report, the use of *Overleaf* online LaTeX editor is strongly recommended.

A basic understanding of computer programming principles and knowledge of any programming language or pseudo-code is desirable.

Hardware. You will need access to a Windows or Linux or Macintosh computer with at least 2 GB of RAM and to a fast, reliable broadband Internet connection (e.g., cable, DSL).

7. Grades

Each student will complete a course project that they will present in class. The final deliverable is a project report that is on the end of the semester (exact date to be announced). The final grade will be a numerical average of the following:

Final project report	50%
Presentation	40%
Class participation	10%

8. Project

Projects should include analysis and forecasting of real time series data, based on the methods and examples discussed in class.

Projects should be submitted **through the Blackboard course website**.

Please note: Deliverables should be submitted only through the Assignment submission section of the Blackboard system - DO NOT email deliverables directly to the instructor.
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9. General guidelines for project report preparation and submission

- a. Grades of project reports will be based on:
 - Academic merit.
 - Conciseness and completeness.
 - Organization and presentation.
- b. Please remember that your report is a professional document, and should therefore be formatted and constructed accordingly. All reports are to be typed. Hand-written assignments will not be accepted.
- c. Submission of your reports will be made exclusively through Blackboard.
- d. The electronic submission of your report has to be in **PDF format**, unless stated otherwise.
- e. Each submission should include a cover page with the following information: title, course number, student name, and submission date.
- f. Please make sure you have a backup of all the materials you submit.

10. Course outline (tentative)

In this course we will cover the following topics. Please note that the topics and their order are subjected to change at the discretion of the instructor. This class will not follow a rigid format, but will instead adjust to the talent levels and interests of the students.

Date	Lect. #	Topic
01/26	1	Introduction to Time Series Data
02/02	2	Exploratory Data Analysis for Time Series
02/09	3	Forecasting Methods; Data Transformations; Residual diagnostics; Prediction Intervals
02/16	4	Time Series Regression Models; Selecting Predictors; Non-Linear Regression
02/23	5	Time Series Decomposition
03/02	6	Exponential Smoothing Methods for Time Series; Forecasting with ETS models
03/09	7	Statistical Models for Time Series: Autoregressive model, Moving average model
03/16		Spring Break (No Classes)
03/23	8	Project Proposal presentations
03/30	9	Statistical Models for Time Series: ARIMA, Vector Auto-regression, other variations
04/06	10	Project progress discussions/presentations
04/13	11	Dynamic Regression Models for Time Series
04/20	12	Advanced Forecasting Methods; Complex Seasonality; Vector Autoregressions
04/27	13	Machine Learning for Time Series: Neural Networks
05/04	14	Project progress discussions/presentations
05/11	15	FINAL PROJECT PRESENTATIONS
05/15		PROJECT REPORTS DUE

11. Course website:

The course has a Blackboard website. This website will provide you a single portal through which you may obtain lecture notes, retrieve assignment data and, review links to additional materials, and receive special announcements. You are required to visit the course website once per day. Please notify ITU (and, if necessary, the instructor) if you encounter any problems accessing this website.

12. Electronic communication:

All course related correspondence, should be made through GMU email accounts. Please always use only your GMU email to contact the Instructor. You may not receive a reply immediately, but typically emails will be answered within 2 business days.

13. Course Recordings:

Some of our synchronous meetings in this class may be recorded by the instructor to provide necessary information for students in this class. Recordings will be stored only on Blackboard and will only be accessible to students taking this course during this semester.

14. No Recording and No Distribution of Course Materials policy:

Dr. Gkountouna **does not** authorize in anyway the recording of any lecture content in this course beyond for student's exclusive personal use. Sharing of video lecture or lab content violates student privacy governed by the Family Education Rights and Privacy Act (FERPA). **Additionally, any written, video, or audio content built by Dr. Gkountouna for CDS 302 instruction or built by the TAs assigned to CDS 302 shared online external to GMU is a clear and punishable violation of GMU's Honor Code.** This includes slides, videos, notes, assignments, and exams.

15. Snow day policy

If Mason is closed due to Inclement Weather: Classes scheduled to meet on-campus are canceled. Classes scheduled to meet on-line are not canceled.

16. Student Expectations

- **Academic Integrity:** Students must be responsible for their own work, and students and faculty must take on the responsibility of dealing explicitly with violations. The tenet must be a foundation of our university culture. [See <http://academicintegrity.gmu.edu/distance>].
- **Honor Code:** Students must adhere to the guidelines of the George Mason University Honor Code [See <http://oai.gmu.edu/the-mason-honor-code/>].
- **MasonLive/Email (GMU Email):** Students are responsible for the content of university communications sent to their George Mason University email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students solely through their Mason email account. [See <https://masonlivelogin.gmu.edu>].
- **Patriot Pass:** Once you sign up for your Patriot Pass, your passwords will be synchronized, and you will use your Patriot Pass username and password to log in to the following systems: Blackboard, University Libraries, MasonLive, myMason, Patriot Web, Virtual Computing Lab, and WEMS. [See <https://password.gmu.edu/index.jsp>].
- **University Policies:** Students must follow the university policies. [See <http://universitypolicy.gmu.edu>]. Responsible Use of Computing - Students must follow the university policy for Responsible Use of Computing. [See <http://universitypolicy.gmu.edu/policies/responsible-use-of-computing>].
- **University Calendar:** Details regarding the current Academic Calendar. [See <http://registrar.gmu.edu/calendars/index.html>].
- **Students with Disabilities:** Students with disabilities who seek accommodations in a course must be registered with the George Mason University Office of Disability Services (ODS) and inform their instructor, in writing, at the beginning of the semester [See <http://ods.gmu.edu>].
- Students are expected to follow courteous Internet etiquette at all times; see <http://www.albion.com/netiquette/corerules.html> for more information regarding these expectations.

17. Student Services

- **University Libraries:** University Libraries provides resources for distance students. [See <http://library.gmu.edu/distance> and http://infoguides.gmu.edu/distance_students].
- **Writing Center:** The George Mason University Writing Center staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing. [See <http://writingcenter.gmu.edu>]. You can now sign up for an Online Writing Lab (OWL) session just like you sign up for a face-to-face session in the Writing Center, which means that you set the date and time of the appointment! Learn more about the Online Writing Lab (OWL).
- **Counseling and Psychological Services:** The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance [See <http://caps.gmu.edu>].
- **Family Educational Rights and Privacy Act (FERPA):** The Family Educational Rights and Privacy Act of 1974 (FERPA), also known as the "Buckley Amendment," is a federal law that gives protection to student educational records and provides students with certain rights. [See <http://registrar.gmu.edu/privacy>].

18. Disability Accommodations

Disability Services at George Mason University is committed to upholding the letter and spirit of the laws that ensure equal treatment of people with disabilities. Under the administration of University Life, Disability Services implements and coordinates reasonable accommodations and disability-related services that afford equal access to university programs and activities. Students can begin the registration process with Disability Services at any time during their enrollment at George Mason University.

If you are seeking accommodations for detailed information about the Disability Services registration process, Disability Services is located in Student Union Building I (SUB I), Suite 2500. Email:ods@gmu.edu | Phone: (703) 993-2474

If students have a documented learning disability or other condition that may affect academic performance, they must:

- Have the need for accommodation on file with Office of Disability Services, please visit <http://ds.gmu.edu/>
- Provide the Instructor with a copy of the Office of Disability Services accommodation determination prior to receiving any accommodations. The Instructor will closely protect this information as private and will not share the information with anyone other than the class assistants unless authorized in writing by the student or the Office of Disability Services.
- If you are having any difficulties with the course due to personal limitations, please discuss them with your instructor.

19. Diversity and Inclusion

The CDS Department seeks to create a learning environment that fosters respect for people across identities. We welcome and value individuals and their differences, including gender expression and identity, race, economic status, sex, sexuality, ethnicity, national origin, first language, religion, age and ability. We encourage all members of the learning environment to engage with the material personally, but to also be open to exploring and learning from experiences different than their own.

20. Sexual Harassment, Sexual Misconduct, and Interpersonal Violence

George Mason University is committed to providing a learning, living, and working environment that is free from discrimination and a campus that is free of sexual misconduct and other acts of interpersonal violence in order to promote community well-being and student success. We encourage students who believe that they have been sexually harassed, assaulted or subjected to sexual misconduct to seek assistance and support. University Policy 1202: Sexual Harassment and Misconduct speaks to the specifics of Mason's process, the resources, and the options available to students.

21. Notice of mandatory reporting of sexual assault, interpersonal violence, and stalking

As a faculty member, I am designated as a "Responsible Employee," and must report all disclosures of sexual assault, interpersonal violence, and stalking to Mason's Title IX Coordinator per University Policy 1202. If you wish to speak with someone confidentially, please contact one of Mason's confidential resources, such as Student Support and Advocacy Center (SSAC) at 703-380-1434 or Counseling and Psychological Services (CAPS) at 703-993-2380. You may also seek assistance from Mason's Title IX Coordinator by calling 703-993-8730, or emailing titleix@gmu.edu.

22. Student Support Resources

The following resources are available to students:

- Counseling and Psychological Services
- The Learning Services Office or field-specific tutoring
- The Office of Diversity, Inclusion, and Multicultural Education (ODIME)
- University Career Services
- University Writing Center

Information and links regarding these and other student support offices are available on our Student Support Resources on Campus page.

Disclaimer: Any typographical errors in this Course Outline are subject to change and will be announced in class. The date of the final examination is set by the Registrar and takes precedence over the final examination date reported by the instructor.

Note: Recording is permitted *only with the prior written consent of the professor.*