UNIVERSITY OF GUAM
COLLEGE OF NATURAL & APPLIED SCIENCES

MA 694-01 Time Series Analysis (3 credits)

Section Information
Course Delivery Mode: Face-to-Face
M, W: 4:00 PM – 5:20 PM

Instructor Information
Grazyna Badowski
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Office Location – SC201
Office Hours – By appointment
Office Phone Number: 735-2840

COURSE CATALOG DESCRIPTION

This course covers foundational methods of time series analysis and forecasting. Topics include stationary and nonstationary processes, ARMA and seasonal ARIMA models, spectral analysis, state-space models, and multivariate time series. Emphasis is placed on model identification, estimation, diagnostic checking, and forecasting. Students will apply these methods to real-world data using the R statistical software.
Prerequisite: MA541 or consent of Instructor

COURSE LEARNING OUTCOMES

Upon successful completion of this course, students will be able to:

1. Perform exploratory time series analysis, identifying patterns such as trend, seasonality, and autocorrelation.
2. Understand, explain, and compare classical time series models, including AR, MA, ARMA, ARIMA, and state-space models.
3. Implement time series models in R, conduct forecasting, and assess model performance using accuracy metrics such as MAE, RMSE, and MAPE.
4. Interpret and communicate time series results, presenting findings clearly through written summaries, data visualizations, and applied case studies.

Course SLOs:	Program Learning Outcomes (PLOs)	University Graduate Learning Outcomes (IGLOs)	Method of Assessment
SLO-1	PR-1, PR-2, PR-3	IGLO-1, IGLO-2	HW, Project
SLO-2	PR-1, PR-2, PR-3, PR-4, PR-5	IGLO-1, IGLO-2, IGLO-3	HW, Project
SLO-3	PR-1, PR-2, PR-3, PR-4, PR-5	IGLO-1, IGLO-2, IGLO-3, IGLO-4	HW, Project
SLO-4	PR-3, PR- 4, PR-5, PR-6	IGLO-1, IGLO-2, IGLO-3, IGLO-4, IGLO-5	HW, Project

MS in Data Science Program Learning Outcomes (PLOs)

PR-1 Design and execute statistical experiments and hypothesis tests to extract meaningful insights from data.
PR-2 Analyze and interpret complex statistical data using advanced statistical methodologies and tools.
PR-3 Visualize data for exploration, analysis, and communication.
PR-4 Develop and implement predictive models and machine learning algorithms to make data-driven decisions.
PR-5 Communicate statistical analyses, findings, and recommendations to both technical and non-technical audiences effectively.
PR-6 Collaborate with interdisciplinary teams to design, implement, and evaluate statistical projects.

Institutional Graduate Learning Outcomes (IGLOs)

IGLO-1: Demonstrate mastery of critical skills, theories, methodologies, and other content knowledge at a level that will enable them to address fundamental questions in their primary area of study.
IGLO-2: Plan, conduct, and complete significant research or creative project;
IGLO-3: Exercise oral and written communication skills sufficient to publish and present work in their field.
IGLO-4: Adhere to the ethical principles of academia and their respective disciplines in coursework, fieldwork, and other appropriate situations; and
IGLO-5: Exemplify, through service, the value of their discipline to the academy and the community at large, interacting productively and professionally with people from diverse backgrounds.

COURSE TOPICS AND SCHEDULE

Week 1: Introduction to Time Series; Examples, Goals, Notation; Trend & Seasonality;
Week 2: Stationarity, Detrending, Regression, and White Noise
Week 3: Autocovariance & Autocorrelation Functions; Ergodicity; Introduction to AR Models
Week 4: Moving Average (MA) Models; Linear Processes; Backward Shift Operator
Week 5: ARMA Models: Properties, ACF, PACF; Forecasting Stationary Time Series
Week 6: ARMA Estimation: Preliminary and MLE; Model Diagnostics; Order Selection
Week 7: ARIMA Models: Identification, Differencing, Unit Roots
Week 8: Seasonal ARIMA Models; Regression with ARMA Errors
Week 9: Spectral Analysis I: Spectral Density, Filtering, Periodicity
Week 10: Spectral Analysis II: Periodogram, Cumulative Periodogram, Spectra of ARMA
Week 11: State-Space Models I: Representations, Structural Models, Kalman Recursions
Week 12: State-Space Models II: Estimation, ARIMA in State-Space, Forecasting
Week 13: Forecasting Techniques: ARAR, Holt-Winters, MMSE Forecasting
Week 14: Multivariate Time Series: Covariance, VAR Models, Multivariate Forecasting
Week 15: Advanced Topics: Model Selection
Week 16: Student Project Presentations
Attendance is mandatory.

COURSE REQUIREMENTS

Recommended textbooks:

- Shumway, R. H., & Stoffer, D. S. (2017). Time Series Analysis and Its Applications: With R Examples. Springer.
- Hyndman, R. J., & Athanasopoulos, G. (2021). Forecasting: Principles and Practice (3rd ed.). Freely available online: https://otexts.com/fpp3/
- Cryer, J. D., & Chan, K.-S. (2008). Time Series Analysis With Applications in R. Springer.
- Woodward, W. A., Gray, H. L., & Elliott, A. C. (2017). Applied Time Series Analysis with R (2nd ed.). CRC Press.
- Lyubchich, V. and Gel, Y. R. (2023) Time Series Analysis: Lecture Notes with Examples in R. Edition 2023-09. https://vlyubchich.github.io/tsar/

Course Technology/Software

- Laptop or desktop computer (*required*)
- Internet connection (DSL, LAN, or cable connection desirable)
- R statistical software (free download; http://cran.r-project.org)
- Students must typeset homework and the project using R Markdown (free download: http://rmarkdown.rstudio.com)
- Adobe Acrobat PDF reader (free download; https://get.adobe.com/reader)

Access Statement

"Students must have access to a computer daily. The computer should have access to general software applications for word processing software, electronic spreadsheets, graphic presentation, video viewing software, the recommended web browser and a reliable internet connection. The student must be able to navigate the Learning Management System site, upload and download materials, participate in assigned online activities, and follow generally accepted online etiquette." (direct statement from: UOG, 2022, Log No. 6771 "Faculty Guide for Developing Course Syllabus for Traditional and Online Learning Delivered Courses", p. 6).

GRADING INFORMATION

Course Grade Scale (Letter to Percent Range)

A+	98-100%
A	93-97%
A-	90-92%
B+	87-89%
B	83-86%
B-	80-82%
C+	77-79%
C	70-76%
D	60-69%
F	<60%

UW: Unofficial withdrawal assigned by Registrar—Student stopped attending classes and did not submit/file required documents.
W: Withdrawal assigned by Registrar—Student stopped attending classes and submits/files required documents.

GRADE CATEGORIES: ASSIGNMENTS AND PERCENTAGES

Assessments/Assignments and Grade Percentage
1. Homework – 60%
2. Final Project – 40%

Assignments will be posted and submitted via Moodle. Students will have two weeks to complete each assignment.
For problems requiring the use of R, solutions must be written using R Markdown, with all relevant code included to ensure reproducibility. Raw R output alone will not be considered a complete solution. Students are expected to clearly explain the results in words and support their answers with well-annotated graphics and tables as appropriate.

Course Project

As part of the course requirements, each student will complete an independent data analysis project using an approved or self-selected dataset. The project will serve as a cumulative demonstration of your ability to apply time series analysis methods in a real-world context.

Your final submission will consist of a written report and a complete set of R code required to replicate your analysis. The report should include the following:
Abstract: A brief summary of your main findings.
Introduction: Background and motivation for the project, description of the dataset, and clearly stated scientific goals or hypotheses.
Exploratory Data Analysis: Summary statistics and graphical analysis to understand the structure of the time series.
Statistical Methods: Justification and application of at least two methods covered in the course (e.g., ARIMA, state-space models, spectral analysis). Clearly explain the model selection process and diagnostics used.
Results: Presentation and interpretation of your findings, emphasizing both statistical and practical significance.
Discussion: Summary of key results, limitations of your analysis, and potential directions for future work. Aim to explain your conclusions in terms that a non-statistical audience can understand.

EEO and ADA Statement

Americans with Disabilities Act Amendments Act (ADAAA) Accommodation Services

The University is committed to providing an inclusive and welcoming environment for all members of our community free of all forms of discrimination and harassment in all programs, activities, and employment practices as required by Title VII and Title IX and other applicable statutes and policies. If you experience harassment or discrimination, report it immediately to the

Director of EEO/ADA & TITLE IX Office, at 671-735-2244, 671-735-2971, 671-735-2244 (TTY) or eeo-ada@triton.uog.edu. For immediate assistance in an emergency call 911.

For individuals covered under the ADA (Americans with Disabilities Act), if you are a student with a disability requiring academic accommodation(s), please contact the Student Counseling and Advising Service Accommodations Office to discuss your confidential request. Please provide an accommodation letter from the Disability Support Services Student Counseling and Advising Service Accommodation counselor. To register for academic accommodations, please contact or visit the School of Education, Room #110, disabilitysupport@triton.uog.edu , or telephone/(TTY) 671-735-2460.

For applicants or employees with a disability requiring employment or workplace accommodation(s), please contact the Director of EEO/ADA & TITLE IX Office to discuss your specific needs. Please provide documentation concerning your disability and the need for employment or workplace accommodation. Our office is located at the Lya Hami Hall, Dorm 2, right side entrance, first floor, Room #104, and our contact numbers are 671-735-2244, 671-735-2971, 671-735-2244 (TTY).

Student Evaluation of Faculty Information

The student course and faculty evaluations for courses will be administered at the completion of the semester within CollegeNet. Student participation is essential and appreciated. Student responses are anonymous and cannot be traced back to individual students. You will need your WebAdvisor login credentials to complete the evaluation. If you experience login issues, please refer inquiries to OIT staff to assist at 735-2630/40.

Plagiarism Statement

Academic dishonesty cannot be condoned by the University. Such dishonesty includes cheating and plagiarism (examples of which are given below), which violate the Student Conduct Code and could result in expulsion from the University.

Cheating includes but is not limited to giving unauthorized help during an examination, obtaining unauthorized information about an examination before it is administered, using inappropriate sources of information during an examination, altering the record of any grades, altering answers after an examination has been submitted, falsifying any official University record, and misrepresenting the facts in order to obtain exemptions from course requirements.

Plagiarism includes but is not limited to submitting any document, to satisfy an academic requirement, that has been copied in whole or part from another individual's work without identifying that individual; neglecting to identify as a quotation a documented idea that has not been assimilated into the student's language and style, or paraphrasing a passage so closely that the reader is misled as to the source; submitting the same written or oral material in more than one course without obtaining authorization from the instructors involved; or dry-labbing, which includes (a) obtaining and using experimental data from other students without the express consent of the instructor, (b) utilizing experimental data and laboratory write-ups from other sections of the course or from previous terms during which the course was conducted, and (c) fabricating data to fit the expected results.

Communication Policy

University policy states that official communications will be sent using university assigned (@gotriton or @triton) email addresses. University electronic mail and messaging is to be used to enhance and facilitate teaching, learning, scholarly research, support academic experiences, and to facilitate the effective business and administrative processes of the University. (OIT policy manual, 3.10, p. 36)

Tobacco-Free and Smoke-Free Campus

The University of Guam has in place a Tobacco-Free Policy. Please read the policy at: https://www.uog.edu/smoke-free-uog.php

Netiquette:

Remember your "netiquette," or network etiquette. Although you may traditionally interact informally with friends and family when you are online, it is important to note that this is a classroom environment, and students must adhere to high standards of academic behavior. This classroom is a safe haven for all ideas. We are all unique individuals entitled to our own opinions and beliefs. Any comments, jokes, or remarks that denigrate the worth of an individual's physical/mental ability, body size, religion, race, creed, ethnic background, sexual preference, or gender are inappropriate and will not be tolerated.

a. Do not say things in an email or forum post that you would not say face to face.
b. Be polite, concise, and remember that all-caps signify yelling.
c. Do not send forwards to the class list or to the professor.
d. Proofread. Please avoid texting language, lack of punctuation, capitalization, or inappropriate signatures.
e. Emojis should not be used in graded assignments. You are welcome to use them in informal writing.

Use of Generative AI Tools

Generative AI tools are becoming increasingly integrated into learning, offering both opportunities and risks. While they may help clarify concepts or assist with coding tasks, overreliance can hinder deep learning, critical thinking, and the ability to perform rigorous, reproducible analysis independently. These tools can also generate incorrect or misleading information.

In this course, using Generative AI tools (e.g., ChatGPT, Copilot) is permitted only in ways similar to consulting with classmates: to explore concepts or seek clarification—not to generate or complete assignments, exams, or reports.

Acceptable Uses:

- Clarifying basic time series concepts (with caution regarding accuracy)
- Exploring alternative R coding approaches to complement course materials

Unacceptable Uses (Honor Code Violations):

- Submitting AI-generated responses to homework or exams
- Using AI tools to write or revise your project report

All submitted work must be your own. If you use AI-generated content, it must be properly cited and used only for learning support—not as a substitute for your own work. Misuse may be considered a violation of the academic honor code.