

Experimental Design and Time Series (36-618)

Spring 2019

Schedule: Tuesdays & Thursdays, 9:00–10:20 am, Wean Hall 5409

Instructor: Mikael Kuusela (mkuusela@andrew.cmu.edu)

Instructor office hours: TBA

Teaching assistant: Benjamin LeRoy (bpleroy@stat.cmu.edu)

TA office hours: TBA

Website <https://canvas.cmu.edu>

Objectives

Upon completing this course, students should be able to:

- select, execute and interpret analyses of time series data using R;
- effectively communicate results of a time series analysis to a client;
- advise experimental design based on a client's goals and restrictions.

Course outline

Time series:

- Exploratory data analysis
- Models for stationary time series (AR, MA, ARMA)
- Non-stationary models (ARIMA, SARIMA)
- Forecasting
- GARCH
- Multivariate ARMA models

- Spectral analysis and other topics (time allowing)

Experimental design:

- Randomization and potential outcomes
- Factorial designs
- Power analysis
- Multiple comparisons

A tentative schedule (subject to change) is provided on the course Canvas page.

Textbooks

Text for the time series part:

- Time Series Analysis and Its Applications: With R Examples, R.H. Shumway & D.S. Stoffer, 4th edition, Springer, 2017. Pdf available for free through CMU library at <https://link.springer.com/book/10.1007%2F978-3-319-52452-8>.

There is no required textbook for the experimental design part (we will be working from lecture notes).

Optional additional reading:

- Introduction to Time Series and Forecasting, P.J. Brockwell and R.A. Davis, 3rd edition, Springer, 2016.
- The Theory of the Design of Experiments, D.R. Cox and N. Reid, Chapman & Hall/CRC, 2000.
- Statistical Models, A.C. Davison, Cambridge University Press, 2008.

Homework

Homeworks are due approximately once every 2 weeks, and should be downloaded and submitted via Canvas. Clear writing and presentation are important parts of the assignments. Thus, writing clarity will be weighted highly along with correct analyses.

You are encouraged to discuss assignments with other students unless otherwise noted; however, you must write up homework on your own. See the section on Academic Integrity below for more details, and feel free to ask the instructor if you have questions.

Quizzes and exams

There will be short in-class quizzes approximately once every 2 weeks. The quizzes are graded and will form part of the final course grade. The goal of the quizzes is to encourage you to actively study the course material throughout the course. This course will not have a midterm or final exam.

Course project

There will be a data analysis project that forms an integral part of the course grade. The project will be done collaboratively in a small group and consists of planning and executing analysis of time series data as well as communicating the results in both oral and written form.

Computing

The statistical software we will use in this course is R. You may download R free of charge from www.r-project.org. RStudio is a free, open-source R programming environment available at www.rstudio.com. It contains a built-in code editor, many features making working with R easier and works the same way across different operating systems. You will need to have R and RStudio installed on your laptop in order to do the homeworks and the course project.

Participation and attendance

You are actively encouraged to participate in class. This will help you become more comfortable with the material, and will help bring more diverse perspectives to our discussions.

If you do not attend any particular class, it is your responsibility to check with other students to find out what you missed.

Grading

Grades will be weighted as follows:

Homework	30%
In-class quizzes	20%
Course project	40%
Participation	10%

Extensions

In general, extensions will not be granted for students because they are behind on work, had a busy week, etc. Extensions for reasonable academic purposes (e.g., job interview), extreme circumstances (e.g., hospitalization) or religious reasons may be granted at the instructor's discretion. If you believe you have a reasonable request for an extension, you must request this at least 72 hours before an assignment is due.

Make-up work

You may replace one homework or quiz (one in total, not one of both) by handing in optional extra work as assigned by the instructor. Make-up work for more than one homework or quiz may only be considered under exceptional circumstances and must be discussed separately with the instructor well before the end of the semester.

Communication and email

Course information will be primarily communicated during classes and using Canvas. Students may ask questions during classes and office hours or via email. We encourage you to ask questions about course assignments primarily in-person during classes and office hours. Students should not assume that emails will be responded right away. Complicated questions via email may be deferred to in-person office hours. We will strive to answer emails within a reasonable time, but please be advised that sending email to the instructor or the TA does not create a responsibility or obligation to respond to it. Sending us email does not shift any responsibility from you to us; you are still responsible for the on-time, high quality completion of assignments.

Academic integrity

Plagiarism is a serious offense at CMU. For a clear description of what counts as plagiarism, cheating and/or the use of unauthorized sources, please see the University's Policy on Academic Integrity:

www.cmu.edu/policies/student-and-student-life/academic-integrity.html

Copying answers from anyone else without attribution, allowing another student to copy your own answers, or any other form of cheating as defined by the official policy are all typically grounds for failure. I am obliged to report such incidents to the appropriate University authorities. Ask if you are unsure of what constitutes plagiarism, cheating or policy violation.

Student recording of class

No student may record or tape any classroom activity without the express written consent of the instructor. If a student believes that he/she has a disability and needs to record or

tape classroom activities, he/she should contact the Office of Equal Opportunity Services, Disability Resources to request an appropriate accommodation.

Accommodations for students with disabilities

If you have a disability and have an accommodations letter from the Disability Resources office, I encourage you to discuss your accommodations and needs with me as early in the semester as possible. I will work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, I encourage you to contact them at access@andrew.cmu.edu.

Health and well-being

Take care of yourself. Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.

All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus and an important part of the university experience is learning how to ask for help. Asking for support sooner rather than later is often helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their website at <http://www.cmu.edu/counseling/>. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help.

If you or someone you know is feeling suicidal or in danger of self-harm, call someone immediately, day or night:

CaPS: 412-268-2922

Re:solve Crisis Network: 888-796-8226

If the situation is life threatening, call the police:

On campus: CMU Police 412-268-2323

Off campus: 911

Other campus resources

Consider visiting the Global Communication Center on the first floor of the Hunt Library. The Center provides support for communication practices (including written, visual and

oral communication) across the disciplines. For more information, please contact the GCC at gcc-cmu@andrew.cmu.edu. Or, go to www.cmu.edu/gcc.