

## Faculty of Science Course Syllabus

Department of Mathematics & Statistics  
AND  
Department of Oceanography

STAT 4390/5390, OCEAN 4210/5210

### Time Series Analysis

Winter 2026

*Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people.*

*Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.*

**Instructor:**

Michael Dowd

Email: [michael.dowd@dal.ca](mailto:michael.dowd@dal.ca)

Office: Chase 104

**Lectures:**

Monday and Wednesday, 2:30-4:00PM, LSC C244

**Office Hours:**

Monday and Wednesday, 4:00-5:00PM, or by appointment.

**Course delivery: In Person**

**Zoom link:**

However, in the event of unforeseen issues (e.g., instructor illness, bad weather), a Zoom link is available, and any affected lectures will be delivered online. Students will be informed in advance via Brightspace. We also use this Zoom link for office hours and extra help as needed.

### Course Description

Time series analysis in both the time and frequency domain is introduced. The course is targeted at applications, as well as introducing the relevant theory. Illustrative examples are drawn primarily from the marine sciences. Topics covered include the nature of time series, stationarity, auto- and cross- covariance functions, auto-regressive moving-average models, and auto- and cross- spectra. Modern state space methods for time series are also briefly introduced.

### Course Prerequisites

The formal pre-requisites are:

- **STAT 3340 - Regression**
- **STAT 3360 & STAT 3460 – Probability, Inference**

or *Permission of the Instructor.*

It is understood that many of the Oceanography students taking the course will not have these specific courses. Note that a fairly high level of mathematical and statistical skill is required to successfully complete the course. Specific knowledge is required in the following areas:

- Basic concepts in Statistics including: random variables, probability distributions, expectation, matrix-based regression
- Familiarity with differential and integral calculus, matrix algebra, and complex numbers

If you are unsure if you have a suitable background for successful completion of the course, please contact me beforehand, or as soon as the course starts.

### Course Objectives & Learning Outcomes

This class deals with the analysis of systems characterized by dependence structure, such as variables recorded over time (but this feature also applies to spatial data). The emphasis is on both theory and application. The main objective of this course is to provide a solid grounding in time series analysis. The Learning Outcomes are:

- Develop an understanding of the theory underlying time series in the time and frequency domain, as well as for state space models.
- Provide an understanding of the practice of time series analysis, including the ability to apply methods to real data sets and to interpret the results.
- Provide experience in *technical writing skills*, and also with the use of *modern statistical software* (R) for time series analysis.

## Course Materials

There is a textbook for the course is “*Time Series Analysis and Its Applications With R Examples*” by Robert H. Shumway and David S. Stoffer. I will be following this textbook in a broad sense, and it is a useful reference. It is not required, but might be useful to access to (any edition should be OK for use).

## Course Delivery

The course will be delivered in via the traditional lecture model (using a combination of slides, whiteboard/blackboard, and interactive illustration and examples using R-code).

*Brightspace:* The course Brightspace site is available to all registered students. Brightspace is our main course platform. It will be used for all announcements/information, for posting the course materials (notes, computer codes, assignment materials), submitting the assignments, and disseminating your marks.

*R statistical software:* We will be using the R statistical software extensively in the course. R is available for download at <http://www.r-project.org/> . This is state-of-the-art free, open source software for statistical computing. It is available for all platforms. Many people find R-Studio (an integrated development environment – IDE - built on base R) to be a useful tool. It can be found at [rstudio.com](http://rstudio.com) and is free and open-source.

## Course Assessment:

Component	Weight (% of final grade)*	Date(s)
<i>Assignments</i>	80%	<i>weekly to biweekly</i>
<i>Final Exam</i>	20%	<i>April 8, 2026 (last class)</i>

*Weekly assignments.* These will involve interpretation and analysis of real time series, theoretical questions, the development of computer code (R), and technical writing skills. The central idea is that these assignments guide and facilitate your self-learning of the topics. For assessment, your marks will reflect both the technical correctness of your answers, as well as clarity and organization written presentation of your answers, and supporting code. These assignments are expected to be submitted to the BrightSpace site as a single pdf file, with the questions answered in the order that they are given.

*Final Exam:* A final exam will take place of the last day of class and will be worth 20% of your grade. It will be a written exam.

***Undergraduate students will have their lowest assignment grade dropped (with the final mark computed from the remainder not dropped). Graduate students will have all the assignments counted for their final grade (i.e. no assignment can be dropped).***

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+ (90-100)	B+ (77-79)	C+ (65-69)	D	(50-54)
A (85-89)	B (73-76)	C (60-64)	F	(<50)
A- (80-84)	B- (70-72)	C- (55-59)		

### Course Policies

- This course will NOT be using the new Student Declaration of Absence form
- *Assignments:* Assignments are due at their designated time/date. Late assignments will receive a zero grade.
- Any disputes over grading will be resolved by a re-grading of the entire assignment.
- It is acknowledged and accepted that students will work together and consult with one another with regard to completion of assignments. The guiding principle, however, is that assignment answers must be written up and submitted independently. Any answers that are close copies of other students will result in a zero-grade on the assignment for both students.

### Course Content

Listed below are the topics to be covered.

- Introduction to Time Series and their main statistical properties, as well as practical exploratory data analysis
- The time domain: time series models, links with dynamical systems, auto-regressive moving average models
- The frequency domain: Spectral Analysis including auto-spectra and cross-spectra
- State space models: linear and nonlinear methods including the Kalman filter. This is topic is covered only if time permitting.

## University Policies and Statements

### **Recognition of Mi'kmaq Territory**

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit or e-mail the Indigenous Student Centre at 1321 Edward St or [elders@dal.ca](mailto:elders@dal.ca). Additional information regarding the Indigenous Student Centre can be found at: [https://www.dal.ca/campus\\_life/communities/indigenous.html](https://www.dal.ca/campus_life/communities/indigenous.html)

### **Internationalization**

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: <https://www.dal.ca/about-dal/internationalization.html>

### **Academic Integrity**

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity. Additional academic integrity information can be found at: [https://www.dal.ca/dept/university\\_secretariat/academic-integrity.html](https://www.dal.ca/dept/university_secretariat/academic-integrity.html)

### **Accessibility**

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre ([https://www.dal.ca/campus\\_life/academic-support/accessibility.html](https://www.dal.ca/campus_life/academic-support/accessibility.html)) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (<https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html>)

### **Conduct in the Classroom – Culture of Respect**

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

### **Diversity and Inclusion – Culture of Respect**

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: <http://www.dal.ca/cultureofrespect.html>

### **Student Code of Conduct**

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner - perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution. The full Code of Student Conduct can be found at:

[https://www.dal.ca/dept/university\\_secretariat/policies/student-life/code-of-student-conduct.html](https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html)

### **Fair Dealing Policy**

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: [https://www.dal.ca/dept/university\\_secretariat/policies/academic/fair-dealing-policy-.html](https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html)

### **Originality Checking Software**

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at:

[https://www.dal.ca/dept/university\\_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.html](https://www.dal.ca/dept/university_secretariat/policies/academic/student-submission-of-assignments-and-use-of-originality-checking-software-policy-.html)

### **Student Use of Course Materials**

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course

material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.

## **Student Resources and Support**

### University Policies and Programs

Important Dates in the Academic Year (including add/drop dates):

[http://www.dal.ca/academics/important\\_dates.html](http://www.dal.ca/academics/important_dates.html)

Classroom Recording Protocol:

[https://www.dal.ca/dept/university\\_secretariat/policies/academic/classroom-recording-protocol.html](https://www.dal.ca/dept/university_secretariat/policies/academic/classroom-recording-protocol.html)

Dalhousie Grading Practices Policies:

[https://www.dal.ca/dept/university\\_secretariat/policies/academic/grading-practices-policy.html](https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html)

Grade Appeal Process: [https://www.dal.ca/campus\\_life/academic-support/grades-and-student-records/appealing-a-grade.html](https://www.dal.ca/campus_life/academic-support/grades-and-student-records/appealing-a-grade.html)

Sexualized Violence Policy:

[https://www.dal.ca/dept/university\\_secretariat/policies/health-and-safety/sexualized-violence-policy.html](https://www.dal.ca/dept/university_secretariat/policies/health-and-safety/sexualized-violence-policy.html)

Scent-Free Program: <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>

### Learning and Support Resources

General Academic Support – Advising (Halifax):

[https://www.dal.ca/campus\\_life/academic-support/advising.html](https://www.dal.ca/campus_life/academic-support/advising.html)



General Academic Support – Advising (Truro): <https://www.dal.ca/about-dal/agricultural-campus/ssc/academic-support/advising.html>

Student Health & Wellness Centre: [https://www.dal.ca/campus\\_life/health-and-wellness.html](https://www.dal.ca/campus_life/health-and-wellness.html)

On Track (helps you transition into university, and supports you through your first year at Dalhousie and beyond): [https://www.dal.ca/campus\\_life/academic-support/On-track.html](https://www.dal.ca/campus_life/academic-support/On-track.html)

Indigenous Student Centre:

[https://www.dal.ca/campus\\_life/communities/indigenous.html](https://www.dal.ca/campus_life/communities/indigenous.html)

Indigenous Connection: <https://www.dal.ca/about-dal/indigenous-connection.html>

Elders-in-Residence (The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit the office in the Indigenous Student Centre or contact the program at [elders@dal.ca](mailto:elders@dal.ca) or 902-494-6803:

<https://cdn.dal.ca/content/dam/dalhousie/pdf/academics/UG/indigenous-studies/Elder-Protocol-July2018.pdf>

Black Student Advising Centre:

[https://www.dal.ca/campus\\_life/communities/black-student-advising.html](https://www.dal.ca/campus_life/communities/black-student-advising.html)

International Centre: [https://www.dal.ca/campus\\_life/international-centre.html](https://www.dal.ca/campus_life/international-centre.html)

South House Sexual and Gender Resource Centre:

<https://southhousehalifax.ca/about/>

LGBTQ2SIA+ Collaborative:

<https://www.dal.ca/dept/vpei/edia/education/community-specific-spaces/LGBTQ2SIA-collaborative.html>

Dalhousie Libraries: <http://libraries.dal.ca/>

Copyright Office: <https://libraries.dal.ca/services/copyright-office.html>



Dalhousie Student Advocacy Services:

<https://www.dsu.ca/dsas?rq=student%20advocacy>

Dalhousie Ombudsperson: [https://www.dal.ca/campus\\_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html](https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html)

Human Rights and Equity Services: <https://www.dal.ca/dept/hres.html>

Writing Centre: [https://www.dal.ca/campus\\_life/academic-support/writing-and-study-skills.html](https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html)

Study Skills/Tutoring: [http://www.dal.ca/campus\\_life/academic-support/study-skills-and-tutoring.html](http://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html)

Faculty of Science Advising Support: <https://www.dal.ca/faculty/science/current-students/undergrad-students/degree-planning.html>

Safety

Biosafety: <http://www.dal.ca/dept/safety/programs-services/biosafety.html>

Chemical Safety: <https://www.dal.ca/dept/safety/programs-services/chemical-safety.html>

Radiation Safety: <http://www.dal.ca/dept/safety/programs-services/radiation-safety.html>

Laser Safety: <https://www.dal.ca/dept/safety/programs-services/radiation-safety/laser-safety.html>