

# Discrete Time Series Analysis

## Course Syllabus

Instructor	Office	email
Glen Takahara	Jeffery 407	takahara@queensu.ca

**OnQ** The online portal for the course will be its OnQ page. **All lectures, assignments, solutions, important announcements, and resources will be posted here.**

**Lectures** Mondays, 2:30 - 3:20; Tuesdays, 4:30 - 5:20; Thursdays, 3:30 - 4:20  
in **Jeffery 225**, starting Tuesday, Sep.5 and ending Tuesday, Dec.5.

**Online Resources** Besides OnQ, the course will use **crowdmark** for submission of homeworks and **zoom** to conduct office hours and scheduled meetings. Instructions on the use of crowdmark to submit assignments are [here](#).

**Office Hours** Wednesdays, 11:30-12:30 via zoom ([zoom link](#)).

**Teaching Assistant** Skyepaphora Griffith

**TA Office Hours** Wednesdays, 3:00-4:00 via zoom (link TBD).

**TA Email** spg5@queensu.ca

**Text (required)** [Introduction to Time Series and Forecasting, 3rd Ed.](#) by Peter Brockwell and Richard Davis, Springer, 2016.

### Purpose and Course Description

**Description:** Time series are data collected over time, e.g., daily temperature. The interesting structures in time series are over time, either probabilistic or deterministic (so independent observations over time do not make interesting time series). This course will spend most of its time looking at probabilistic models for time series in which the observations are collected at regular intervals (because in practice they often are and irregular sampling times are harder to deal with mathematically). We will see how we can use these models to do forecasting. We will also look at some ways we can deal with deterministic temporal structure in the data.

**Outline:** The plan for the course is to cover

- Introduction to time series (chapter 1)
- Stationarity (chapter 2)
- ARMA models (chapter 3)
- Estimation techniques (chapter 5)

**Learning Outcomes** By the end of the course, students will learn about:

1. methods to estimate and eliminate trends and seasonal components.
2. concepts of stationarity, autocovariance, and autocorrelation.
3. linear filters.
4. relevant hypothesis tests and confidence intervals.
5. optimal linear forecasting for a variety of time series models.
6.  $AR(p)$ ,  $MA(q)$ , and  $ARMA(p,q)$  models.
7. estimation techniques for ARMA models.
8. the use of R for working with time series.

**Required Work and Grading Criteria** The required work consists of homework problems, one midterm exam, and one final exam. The breakdown of marks is:

Assignments 40% , Midterm 20%, Final 40%.

If dropping the midterm mark and making the final exam worth 60% results in a higher final mark, then this will be done.

**Homework Assignments:** There will be 4 homework assignments based on the material presented in the lectures. These will be posted to the OnQ page content browser. Solutions will also be posted here. Solutions are to be submitted to **crowdmark**.

Doing the homework problems is an integral part of the course. **Do not start homeworks the day before they are due.** I encourage discussion of homework problems with your classmates, but all assignments must be written up individually. I will accept one late assignment without deducting marks, as long as the assignment is handed in before solutions are posted. Additional late assignments will be accepted if there is a valid medical reason. No assignments will be accepted after solutions have been posted.

**Computing:** Computing is critical to analysing time series. The required computing environment for this course is the **R statistical environment**. You must download and install the **Rstudio** program to do the computing in this course. Rstudio runs on windows, mac and linux operating systems, and is free. Computing will not be a part of the midterm exam or the final exam, so all the computing you will do will be in the homework problems. I will cover some aspects of this environment in class and in videos, as pertains to homework problems. The textbook uses a computing program

called ITSM2000, which runs only on the windows platform. There is an R package called **itsmr**, which contains many of the functions from ITSM2000 that you will use for the course. You should install this package in Rstudio.

**Midterm and Final Exams:** The midterm exam will be in class and the final exam will be scheduled by the university and proctored in an exam hall. Details for the midterm will be provided within the first two weeks of the course.

**Copyright:** Course materials created by the course instructor, including all slides, presentations, synchronous and asynchronous course recordings, handouts, tests, exams, and other similar course materials, are the intellectual property of the instructor. It is a departure from academic integrity to distribute, publicly post, sell or otherwise disseminate an instructor's course materials or to provide an instructor's course materials to anyone else for distribution, posting, sale or other means of dissemination, without the instructor's express consent. A student who engages in such conduct may be subject to penalty for a departure from academic integrity and may also face adverse legal consequences for infringement of intellectual property rights and, with respect to recordings, potentially privacy violations of other students.

**Academic Integrity:** Information on policies concerning academic integrity is available in the Queen's University Code of Conduct, in the Senate Academic Integrity Policy Statement, on the Faculty of Engineering and Applied Science website, and from your instructor. Departures from academic integrity include plagiarism, use of unauthorized materials or services, facilitation, forgery, falsification, unauthorized use of intellectual property, and collaboration, and are antithetical to the development of an academic community at Queen's. Given the seriousness of these matters, actions which contravene the regulation on academic integrity carry sanctions that can range from a warning or the loss of grades on an assignment to the failure of a course to a requirement to withdraw from the University.