MATH60046/70046
Time Series Analysis
Module Guide

Module lead and lecturer

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Outline

A time series is a series of data points indexed and evolving in time. They are prevalent in many areas of modern life, including science, engineering, business, economics, and finance. This module is a self-contained introduction to the analysis of time series. Weight is given to both the time domain and frequency domain viewpoints, and important structural features (e.g. stationarity, invertibility) are treated rigorously. Attention is given to estimation and prediction (forecasting), and useful computational algorithms and approaches are introduced.

Content

Discrete time stochastic processes and examples. AR, MA and ARMA processes. Trend removal and seasonal adjustment. General linear process. Invertibility. Spectral representation. Aliasing. Linear time invariant filters. Estimation of mean and autocovariance sequence. The periodogram. Tapering for bias reduction. Parametric model fitting. Model selection. Bivariate time series. Forecasting.

Intended learning objectives

On successful completion of this module, you will be able to:

- Appreciate that time series should be considered observations from an underlying stochastic process.

- Be aware that time series data are typically correlated and understand the notion of stationarity.
- Work with standard models of time series.
- Appreciate that time series can exhibit trend and seasonality and know how to adjust for these.
- Understand that stationary time series have a spectral representation and that the spectral density function provides an alternative viewpoint of second-order structure.
- Derive and implement estimators of mean, correlation and spectral properties.
- Extend time series models, the notion of stationarity, and frequency domain representations to multivariate time series.
- Derive forecasts from standard time series models and quantify their uncertainty.
- (M4/M5) Demonstrate an integrated understanding of the concepts of this module by independent study of related material.

Assessment

Exam (Summer 2023): 90%.
Coursework (Weeks 8-11, Autumn Term 2022): 10%. This will explore the applied and computational aspects of the module.

Problem sheets

5 problem sheets
Non-assessed multiple choice quiz questions.

Mode of delivery and timetable

Notes

This module adopts a "gappy" notes approach. The full set of gappy notes are found on blackboard, and you are encouraged to fill them out and annotate them with the lecturer during the lectures. The lecturer's completed version of the notes will be made available on a week by week basis.

Lectures and problems classes

The module has 30 hours scheduled, 3 hours every week from weeks 2-11. These are

- Monday 4pm - 6pm,
- Friday 1pm - 2pm.

Five of these thirty hours will be problems classes.

Office Hour

Office hour will be at 2pm on Fridays in Huxley 536.

Pre-requisites

A good understanding of Years 1 and 2 undergraduate statistics and probability material. Required (BSc/MSci): Probability for Statistics. Preferred: Statistical Modelling I.

Feedback

Quiz questions and problem sheets will be accompanied by solutions and will provide a method of continuous formative feedback on the learner's understanding of the course materials. Additional formative feedback on student understanding is available during Office Hours, which will provide an opportunity to engage directly with the module lead. Individual summative feedback is provided by individual comments on coursework reports.