Course content for MT3340/4340, Time Series Analysis

Prerequisites:
MT1300 and MT2300

Aims:
Time series are observations collected through time and there are correlations among successive observations. Time series data are collected in many fields: finance, economics, medicine, meteorology, agriculture etc. This course aims to introduce some of the descriptive methods and theoretical techniques that are used to analyse time series.

Learning outcomes:
On completion of the course the students should be able to:
- understand basic concepts and notions of time series analysis;
- understand the standard theory around several prototype classes of time series models;
- apply appropriate methods of times series analysis and forecasting to a given set of data using an appropriate statistical computing package;
- appreciate inferential and associated algorithmic aspects of time-series modelling;
- simulate time series based on several prototype classes and using an appropriate statistical computing package;
- MT4340: appreciate the mathematical tools used in time series analysis, in particular be able to reproduce proofs of selected mathematical results.

Course content:
Introduction and simple descriptive techniques: Some simple time series models; notions of trend and seasonality; linear filters; convolutions; local regression; estimation and elimination of trend and seasonal components; introduction to relevant functions of a
suitable software package.
Stationarity: Notions of weak and strict stationarity; auto-covariance and autocorrelation functions; linear processes; modes of stochastic convergence
ARMA modelling: AR(p), MA(p), and ARMA(p,q) models; characteristic polynomials; conditions for stationarity; causality; model identification and invertibility;
Inference: parameter estimation; confidence intervals and tests of hypotheses; forecasting; prediction intervals; Bartlett's formula; Durbin-Levinson algorithm
Non-stationary time series: ARIMA models; random walk; identification and forecasting.
Further topics: state-space representation