M.Sc. Applied Statistics programmes
- Stochastic Models and Time Series
Spring Term 2020

Lecturer: Anthony C. Brooms
https://moodle.bbk.ac.uk/course/view.php?id=28456
Office Hours: I am happy to meet with students outside the normal lecture sessions, by appointment - this can be arranged via email.

This course forms part of the provision for the *M.Sc. Applied Statistics programmes*.

Teaching
Fridays between 6 and 9p.m.
• Weeks 1-5 and 7-11 (week 6 will be a reading week): Fridays between 6 and 9 p.m. - Rm 421 in the Malet Street Main Building.

Outline of Topics to be covered:
1. Introduction to Markov Chains
2. Stationary processes and autocorrelations
3. The properties of AR(1) and MA processes
4. General autoregressive processes
5. ARMA and ARIMA processes
6. Fitting an ARIMA model
7. Diagnostic checking
8. Forecasting

Examination Methods
3 Section B questions on Paper 1 of the written examination in the summer
+ 2 assignments (altogether worth 10% of the Probability and Stochastic Modelling module): one to be handed out during week 5 of term and the other during week 11. Both assignments are equally weighted.

Lectures
A set of notes will be provided at the start of each lecture, or at the start of each major topic. Notes will be written up on the board to emphasize particular points. Students can read around the material by using one or more of the recommended texts, perhaps for extra clarification; however, the notes are intended to be fairly self-contained.

Recommended Texts
Later editions of these may be available from bookstores, however, those listed below should suffice.

Markov Chains

G. R. Grimmett & D. R. Stirzaker *Probability and Random Processes* (3rd Edition), OUP, 2001.
J. R. Norris *Markov Chains*, CUP, 1998.
S. M. Ross *Applied Probability Models and Optimization Applications*, Dover, 1970.

Time Series

P. J. Brockwell & R. A. Davis *Introduction to Time Series and Forecasting*, (2nd Edition), Springer, 2002.
A. C. Harvey *Time Series Models* (2nd Edition), Harvester Wheatsheaf, 1993.
C. Chatfield *The Analysis of Time Series: an Introduction* (6th Edition), Chapman & Hall, 2003.

The R statistical package

J. Verzani *Using R for Introductory Statistics* (2nd Edition), CRC Press, 2014.
P. Dalgaard Introductory Statistics with R (2nd Edition), Springer, 2008.
M. D. Ugarte, A. F. Militino & A. T. Arnholt Probability and Statistics with R (2nd Edition), Springer, 2015.
P. S. P. Cowpertwait & A. V. Metcalfe Introductory Time Series with R, Springer, 2009.

Statistical Tables
We will use the following statistical tables:
D. V. Lindley & W. F. Scott *New Cambridge Statistical Tables.*
These are the ones that will be available at examination.

Statistical Computing with R

The main statistical package for use on this module will be R alongside the graphical user interface RStudio.
RStudio is available for use on College workstations. You can also download R and RStudio to your PC at home (at no cost - it is freeware): this can be done by first downloading and installing R from `http://www.r-project.org/` followed by downloading and installing RStudio from `http://www.rstudio.com/`
Click on the appropriate default options that are recommendeed to you during the process.

Using RStudio on a workstation

The College workstation rooms in the Birkbeck College Main Building are similar in layout. Relevant ITS documentation may be obtained from the ITS Reception and Helpdesk on the Ground floor. After you have logged on, you may open RStudio via the Start button in the bottom left hand corner of the screen:
Start>All Programs>Statistical Applications> RStudio

There is a very good *help* facility within the package: individual commands can be looked up by clicking into *Help>R Help>* and typing into the search bar in the top RHS of the Help tab. You can also access a help manual by running the command `help.start()`

One approach to becoming acquainted with R is to start working through the book by VERZANI *Using R for Introductory Statistics*. You should also work through the exercises provided in class.

The *Console* window (equivalent to the *Commands* in S+) may be used for typing in the R commands, and in the lecture notes that is the way in which things will be presented. You should get into the habit of implementing all of your code in the form of a script file. Running the code from a script file will result in it being echoed in the console window as if it had been run directly there; it is also very easy to save your code in the form of a script file for future use.

• If you are a new user of the Birkbeck workstations, note that you must use the N: drive for storing personal files; if you are using a temporary account, you will need to save your work on portable media (or save it to the machine and then email it to yourself as an attachment).

• Useful functions in R include:
objects() which gives a listing of the objects on your workspace;
rm(...) may be used to remove objects that are no longer required;
help(...) will provide information on the specified function;
read.table may be used to read a data file and create an R data frame from it.
write.table may be used to write R data into an external text file.