Statistical Theory

Lecturer: Anthony C. Brooms  
http://www.bbk.ac.uk/ms/brooms/acb.htm  
Office Hours: I am very happy to meet with students outside the normal lecture sessions. However, because I operate according to a very tight schedule, I must insist that meetings are by prior arrangement only - this can be done via email.

This course is a follow up to the Introductory Statistics course for students on the following programmes:

B.Sc. Mathematics and Statistics  
B.Sc. Statistics and Management  
B.Sc. Statistics and Economics.

It also forms part of the Qualifying Course for the M.Sc. in Applied Statistics (+Operational Research/Stochastic Modelling), and Certificate programmes more generally.

Teaching Time  
Autumn term, 10 lectures, up to a total of 30 hours + 1 reading week.

Learning Objectives  
By the end of the course, students should:

• have developed a rigorous understanding of the main ideas, concepts and definitions underpinning the theory of Probability and Statistics;
• be able to develop simple probabilistic models for a variety of situations, and to draw appropriate conclusions from them;
• be able to understand the assumptions and limitations of a variety of elementary statistical procedures, to carry out the procedures competently, and to draw appropriate conclusions from them for a variety of situations.

Course Outline  
Probability space, conditional probability, independence, Bayes’ theorem.

Discrete and continuous random variables, expected values and moments, probability and moment generating functions. Distributions to be covered include: Binomial, Poisson, Uniform, Exponential, Normal. Poisson approximation to the Normal distribution.

The joint distribution of a pair of random variables, the conditional and marginal distributions, independence, expectation, covariance and correlation.  
Introduction to the joint distribution of several random variables.  
The Weak Law of Large Numbers and the Central Limit theorem.  
Samples from populations. The distribution of the sample mean and variance.

Confidence intervals based on the Normal, Chi-square, Student-t, and Fisher distributions.
Hypothesis testing. One and two sample t-tests. Tests of homogeneity (F-test). Chi-square goodness-of-fit test.

Note: Proofs presented in the course will not be examinable unless specifically indicated!!!!!

Examination Methods
1 written paper (80%): 2 hour examination in June.
2 assignments (20%):
   1st assignment (10%):- to be handed out at around week 4, with a deadline for around week 8.
   2nd assignment (10%):- to be handed out at the end of term, with a deadline for early January.

Lectures
A printed set of notes will be provided at the start of each lecture, or at the start of each major topic. ‘Sketch notes’ will be written up on the board, and sometimes on the OHP, in order to expound the material in the notes. Students can read around the course by using one or more of the recommended texts, perhaps for extra clarification; however, the printed notes are intended to be fairly self-contained.

Recommended Texts

The following book is also good to consult from time to time if you can find it in the library.
G. R. Grimmett & D. R. Stirzaker Probability & Random Processes, OUP.

We will use the following statistical tables:
D. V. Lindley & W. F. Scott New Cambridge Statistical Tables, CUP.
• Please bring a copy of these tables with you to the lectures from week 6 onwards.

Problems Sheets
A problems sheet will be handed out from time to time. Students will be able to get a feel for their progress by comparing their answers to the solutions sheet, which will be handed out after some suitable time lag. It is important to work through these sheets. I can not rule out the possibility of setting an examination with questions bearing strong similarities to those posed in the problems sheets!!

Don’t worry if you can’t answer all questions on the problems sheets. Make as good an attempt as possible, and then work through them again with the aid of the solutions sheets.