

# Unit Choice Supplement for Studies in Probability and Statistics

We outline three pathways for unit choices involving probability and statistics. This document serves as a supplement to the document “Guide to making Your Unit Choices for 2015-16”. The purpose of this document is to give perspective to students on how their unit choices may work together throughout their studies. **Please always consult the “Prerequisite Flowcharts” and other available information as well, this document is not intended as a replacement to any of those.** The three respective pathways are designed to provide coherent and strong foundation in

- Probability Theory and Stochastic Processes;
- Decision Making, Computational Statistics and Optimization;
- Statistical Modelling and Inference.

Units featured in this document are very important for a mathematician / statistician with specialization in the respective pathway.

## Probability Theory and Stochastic Processes

This pathway is intended for students interested in a more detailed understanding of probability theory and stochastic processes. It also lists supplementary courses (mostly from analysis) which we think are essential for a solid foundation. Completing this pathway will make anyone familiar with the basic concepts and techniques that are in the heart of the theory of probability and stochastic processes. Today this area forms an essential part of pure mathematics, and therefore this pathway is a valuable step towards frontier-line research in pure mathematics as well as applied probability.

Units typed in **red** are essential and indispensable. In particular, the earlier ones (like *Metric Spaces* and *Measure Theory and Integration*) contain fundamental prerequisites without which later, more advanced units cannot be efficiently followed.

Units typed in **green** are still very important in this pathway. We suggest these ones as further optional – but still strongly recommended – choices. Some units which are available both on levels H/6 and M/7 are featured twice in our list. A few of these are green in H/6 and red in M/7 meaning that we think it essential and indispensable by Year 4, but can already be taken at an earlier level.

# Probability Theory and Stochastic Processes

## LEVEL I/5, 1ST TEACHING BLOCK

Metric Spaces (20cp)

Statistics 2 (20cp)

Ordinary Differential Equations (20cp)

Multivariable Calculus (10cp)

## LEVEL I/5, 2ND TEACHING BLOCK

Applied Probability 2 (20cp)

Combinatorics (20cp)

## LEVEL H/6, 1ST TEACHING BLOCK

Measure Theory and Integration (20cp)

Dynamical Systems and Ergodic Theory (20cp)

Martingale Theory with Applications (10cp)

Complex Networks (20cp)

Complex Function Theory (20cp)

Introduction to Queuing Networks (10cp)

## LEVEL H/6, 2ND TEACHING BLOCK

Further Topics in Probability (20cp)

Random Matrix Theory (10cp)

Functional Analysis (20cp)

Financial Mathematics (20cp)

## LEVEL M/7, 1ST TEACHING BLOCK

Martingale Theory with Applications (10cp)

Stochastic Processes (10cp)

Complex Networks (20cp)

Complex Function Theory (20cp)

Introduction to Queuing Networks (10cp)

## LEVEL M/7, 2ND TEACHING BLOCK

Financial Mathematics (20cp)

Functional Analysis (20cp)

## **Decision Making, Computational Statistics and Optimization**

This collection of units is suitable for students interested in topics which straddle the boundary between statistics and applied probability. The topics covered here will provide students with insight into a variety of modelling techniques, associated computational methods and the mathematical tools needed for their rigorous understanding and analysis. No units are highlighted in red, however students making their second year choices are strongly advised to carefully consider prerequisites of their preferred units of later years. Statistics 2 and Applied Probability 2 are the sole level I Statistics and Probability units. Although they are not prerequisites for many third year statistical units, it is naturally a good idea to take these units if you have an interest in Statistics or Probability.

# Decision Making, Computational Statistics and Optimization

## LEVEL I/5, 1ST TEACHING BLOCK

Statistics 2 (20cp)  
Methods of Complex Functions (10cp)  
Multivariable Calculus (10cp)  
Metric Spaces (20cp)  
Optimization (20cp)  
Ordinary Differential Equations (20cp)

## LEVEL I/5, 2ND TEACHING BLOCK

Applied Probability 2 (20cp)

## LEVEL H/6, 1ST TEACHING BLOCK

Bayesian Modelling A (10cp)  
Complex Networks (20cp)<sup>1</sup>  
Generalized Linear Models (10cp)<sup>1</sup>  
Introduction to Queuing Networks (10cp)<sup>1</sup>  
Linear Models (10cp)  
Martingale Theory with Applications (10cp)<sup>1</sup>  
Measure Theory and Integration (20cp)

## LEVEL H/6, 2ND TEACHING BLOCK

Bayesian Modelling B (10cp)  
Financial Mathematics (20cp)<sup>1</sup>  
Functional Analysis (20cp)<sup>1</sup>  
Theory of Inference (10cp)

## LEVEL M/7, 1ST TEACHING BLOCK

Monte Carlo Methods (10cp)  
Stochastic Processes (10cp)

## LEVEL M/7, 2ND TEACHING BLOCK

Graphical Models (10cp)  
Stochastic Optimization (10cp)

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<sup>1</sup> These modules listed at level H are also available at level M.

# Statistical Modelling and Inference

This collection of units is suitable for students interested in statistical approaches to modelling, analysis and interpretation of data, and the mathematical foundations of these techniques. No units are highlighted in red, however students making their second year choices are strongly advised to carefully consider prerequisites of their preferred units of later years. Statistics 2 is the sole level I statistical unit; although it is not a prerequisite for many third year statistical units, it is naturally a good idea to take this unit if you have an interest in Statistics. Beyond that there are a variety of possible combinations of units, some more practical, some more theoretical.

## **LEVEL I/5, 1ST TEACHING BLOCK**

**Statistics 2 (20cp)**  
**Multivariable Calculus (10cp)**  
**Optimisation (20cp)**

## **LEVEL I/5, 2ND TEACHING BLOCK**

**Applied Probability 2 (20cp)**

## **LEVEL H/6, 1ST TEACHING BLOCK**

**Bayesian Modelling A (10cp)**  
**Generalised Linear Models (10cp)<sup>1</sup>**  
**Linear Models (10cp)**  
**Multivariate Analysis (10cp)<sup>1</sup>**  
**Time Series Analysis (20cp)**

## **LEVEL H/6, 2ND TEACHING BLOCK**

**Bayesian Modelling B (10cp)**  
**Financial Mathematics (20cp)<sup>1</sup>**  
**Theory of Inference (10cp)**

## **LEVEL M/7, 1ST TEACHING BLOCK**

**Monte Carlo methods (10cp)**  
**Nonparametric regression (10cp)**

## **LEVEL M/7, 2ND TEACHING BLOCK**

**Advanced time series (10cp)**  
**Graphical Models (10cp)**

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<sup>1</sup> These modules listed at level H are also available at level M.