

ST418-15 Statistical Genetics and Advanced Topics

22/23

Department

Statistics

Level

Undergraduate Level 4

Module leader

Jere Koskela

Credit value

15

Module duration

10 weeks

Assessment

Multiple

Study location

University of Warwick main campus, Coventry

Description

Introductory description

This module runs in Term 2 and will introduce students to probabilistic models and statistical methods used in the analysis of genetic data.

Students will be given selected advanced research material for independent study and examination.

This module is available for students on a course where it is a listed option and as an Unusual Option to students who have completed the prerequisite modules.

Pre-requisites:

Statistics Students: ST218 Mathematical Statistics A AND ST219 Mathematical Statistics B

Non-Statistics Students: ST220 Introduction to Mathematical Statistics

[Module web page](#)

Module aims

Students will gain a basic understanding of the probabilistic models underlying the field of population genetics, and be exposed to practical applications of common statistical tests.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

Discrete-time reproductive models - Wright-Fisher, Moran. Coalescent limit. Properties of the standard coalescent, models of mutation, summary statistics and tests for neutrality, e.g. Tajima's D. Hardy-Weinberg laws, recombination, linkage mapping, linkage disequilibrium, association testing, an overview of genome-wide association studies. Diffusion models of evolution.

Learning outcomes

By the end of the module, students should be able to:

- Discuss the practical issues involved in scaling up association testing to whole genomes.
- Describe simple discrete-time reproductive models and use them to derive the standard coalescent model
- Apply the predictions of coalescent theory to test for departures from neutrality, using simple datasets of DNA sequence variation
- Use simple datasets to evaluate the evidence for associations between genetic loci and Mendelian diseases

Indicative reading list

[View reading list on Talis Aspire](#)

Subject specific skills

Formulation of models for population genetic data, model-based predictions of genetic diversity, parameter estimation and hypothesis testing from DNA sequence data, genome-wide association studies, basic diffusion theory

Transferable skills

Inference from data, assessment of uncertainty, evaluation of evidence, academic writing, computation, independent study of advanced material

Study

Study time

Type	Required	Optional
Lectures	30 sessions of 1 hour (25%)	2 sessions of 1 hour
Total	120 hours	

Type	Required	Optional
Private study	90 hours (75%)	
Total	120 hours	

Private study description

Study of advanced topic, weekly revision of lecture notes and materials, wider reading, practice exercises and preparing for examination.

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group D3

	Weighting	Study time
Assignment 1	10%	15 hours
Due in Term 2 Week 7.		
The assignment will contain a number of questions for which solutions and / or written responses will be required.		
The number of words noted refers to the amount of time in hours that a well-prepared student who has attended lectures and carried out an appropriate amount of independent study on the material could expect to spend on this assignment. 500 words is equivalent to one page of text, diagrams, formula or equations; your ST418 Assignment 1 should not exceed 15 pages in length.		
Assignment 2	10%	15 hours
Due in Term 2 Week 10.		
The assignment will contain a number of questions for which solutions and / or written responses will be required.		
The number of words noted refers to the amount of time in hours that a well-prepared student who has attended lectures and carried out an appropriate amount of independent study on the material could expect to spend on this assignment. 500 words is equivalent to one page of text, diagrams, formula or equations; your ST418 Assignment 2 should not exceed 15 pages in length.		
In-person Examination	80%	
The examination will contain one compulsory question on the advanced topic and four additional questions of which the best marks of TWO questions will be used to calculate your grade.		

Weighting

Study time

- Answerbook Pink (12 page)
- Students may use a calculator

Assessment group R1

Weighting

Study time

In-person Examination - Resit

100%

The examination will contain one compulsory question on the advanced topic and four additional questions of which the best marks of TWO questions will be used to calculate your grade.

~Platforms - Moodle

- Answerbook Pink (12 page)
- Students may use a calculator

Feedback on assessment

Marked assignments will be available for viewing at the support office within 20 working days of the submission deadline. Cohort level feedback and solutions will be provided, and students will be given the opportunity to receive feedback via face-to-face meetings.

Solutions and cohort level feedback will be provided for the examination.

[Past exam papers for ST418](#)

Availability

Courses

This module is Optional for:

- TMAA-G1PE Master of Advanced Study in Mathematical Sciences
 - Year 1 of G1PE Master of Advanced Study in Mathematical Sciences
 - Year 1 of G1PE Master of Advanced Study in Mathematical Sciences
- Year 1 of TMAA-G1P9 Postgraduate Taught Interdisciplinary Mathematics
- Year 1 of TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)
- Year 1 of TMAA-G1P0 Postgraduate Taught Mathematics
- Year 1 of TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
- TMAA-G1PF Postgraduate Taught Mathematics of Systems

- Year 1 of G1PF Mathematics of Systems
- Year 1 of G1PF Mathematics of Systems
- Year 1 of TSTA-G4P1 Postgraduate Taught Statistics
- USTA-G300 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics
 - Year 3 of G300 Mathematics, Operational Research, Statistics and Economics
 - Year 4 of G300 Mathematics, Operational Research, Statistics and Economics

This module is Option list A for:

- USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
 - Year 3 of G1G3 Mathematics and Statistics (BSc MMathStat)
 - Year 4 of G1G3 Mathematics and Statistics (BSc MMathStat)
- USTA-G1G4 Undergraduate Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)
 - Year 4 of G1G4 Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)
 - Year 5 of G1G4 Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)

This module is Option list B for:

- Year 4 of USTA-G304 Undergraduate Data Science (MSci)

This module is Option list D for:

- Year 4 of USTA-G300 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics
- Year 5 of USTA-G301 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics (with Intercalated

This module is Option list E for:

- Year 4 of USTA-G300 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics
- Year 5 of USTA-G301 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics (with Intercalated

This module is Option list F for:

- Year 3 of USTA-G300 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics
- USTA-G301 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics (with Intercalated
 - Year 3 of G30H Master of Maths, Op.Res, Stats & Economics (Statistics with Mathematics Stream)
 - Year 4 of G30H Master of Maths, Op.Res, Stats & Economics (Statistics with Mathematics Stream)