

# ST409-15 Medical Statistics with Advanced Topics

**20/21**

**Department**

Statistics

**Level**

Undergraduate Level 4

**Module leader**

Simon Spencer

**Credit value**

15

**Module duration**

10 weeks

**Assessment**

Multiple

**Study location**

University of Warwick main campus, Coventry

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## Description

### Introductory description

This module runs in Term 2 and aims to introduce applications of statistics in medicine, and some of the statistical methods commonly used in medical research.

It 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

Results from this module can be partly used to determine exemption eligibility in the Institute and Faculty of Actuaries (IFoA) modules CS1.

[Module web page](#)

### Module aims

Modern applications of statistics to medicine are highly developed, and many medical research

papers employ statistical techniques. Large numbers of statisticians are employed in medical research establishments, particularly in pharmaceutical companies and medical schools. Medical statistics continues to be a buoyant area for statistical recruitment. The course will explain why and how statistics is used in medicine, and study some of the statistical methods commonly used in medical research. We will include examples from our own research. The statistical techniques applied to medical data are also relevant in other applications.

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

## 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.

Generalised linear models: Linear models as an extension of linear regression; analysis of binary data; analysis of counts and proportions. Assessment of model fit. Two by two tables.

Study designs: cohort, case-control and survey designs; randomised clinical trials

Analysis of censored survival data: Life tables; hazard and survival functions; KaplanMeier survival curves; parametric survival models, the proportional hazards regression model.

Systematic reviews and meta-analysis Systematic reviews summarise evidence on particular medical topics. Meta-analyses use statistical methods such as glms to summarise studies included in systematic reviews.

## Learning outcomes

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

- understand how to use and interpret generalised linear models and survival analysis in medical data analysis
- appreciate the role of statistics in medical research
- understand some of the statistical principles of good practice in medical investigations

## Indicative reading list

The books listed are suggestions. Some provide general background [1, 2, 3, 5, 11, 12, 16]; others are more focussed on statistical methodology [4, 6, 7, 8, 9, 10, 13, 14, 15]. In many cases, there will be other editions, which you can easily find through the library. I requested multiple copies of the most popular books; the essential material is in the older as well as newer editions. In addition, some e-books are now available through the library.

[1] D.G. Altman. Practical Statistics for Medical Research. Chapman and Hall, London, 1991.

[2] P Armitage and G Berry. Statistical Methods in Medical Research. Blackwell, Oxford, 2 edition, 1987.

[3] M Bland. An introduction to medical statistics. Oxford University Press, Oxford, 2 edition, 1995.

[4] M Borenstein. Introduction to meta-analysis. John Wiley & Sons, Chichester, U.K., 2009.

[5] M J Campbell and D Machin. Medical statistics: a commonsense approach. Wiley, Chichester, 3 edition, 1999.

- [6] D. Collett. Modelling binary data. Chapman & Hall, London, 1991. 0412387905.
- [7] D. Collett. Modelling survival data in medical research. Chapman & Hall, London, 3 edition, 2014.
- [8] D R Cox and D Oakes. Analysis of Survival Data. Chapman & Hall, London, 1984.
- [9] D R Cox and E J Snell. Analysis of Binary data. Chapman & Hall, London, 2 edition, 1989.
- [10] AJ Dobson and AG Barnett. An introduction to generalized linear models. CRC Press, Boca Raton, 2008. 3rd ed.
- [11] JV Freeman, SJ Walters, and MJ Campbell. How to display data. Blackwell (BMJ books), Oxford, 2008.
- [12] S M Gore and D G Altman. Statistics in Practice. British Medical Association, London, 1982.
- [13] M.K.B Parmar and D Machin. Survival analysis: a practical approach. Wiley, Chichester, 1995. 0471936405.
- [14] G Schwarzer, JR Carpenter, and G Rücker. Meta-analysis with R. Springer, Cham, 2015.
- [15] AJ Sutton, KR Abrams, DR Jones, RA Sheldon, and F Sung. Methods for meta-analysis in medical research. Wiley, Chichester, 2000.
- [16] E R Tufte. The Visual display of quantitative information. Graphics Press, Cheshire, 1983.

[View reading list on Talis Aspire](#)

## Research element

Sourcing and summarizing medical research articles.

Novel secondary analysis of data.

Defining research questions and evaluating appropriate study designs.

## Interdisciplinary

Students are required to study medical research articles, learn some medical terms, and translate the results of statistical analyses into summaries suitable for medical professionals and for the general public.

## International

Students will be expected to review medical articles published by non-UK research groups.

## Subject specific skills

- To understand the relevance of generalized linear models in analysis of medical data, and good practice in fitting and interpreting such models.
- To understand the analysis of survival data from medical studies, and good practice in fitting and interpreting such models.
- To appreciate the particular study the role of statistics in the design.

## Transferable skills

Appreciation of the role of statistics in the design and analysis of studies addressing questions related to health and other aspects of society.

Competence in using descriptive statistics, generalized linear models and survival analysis to investigate and summarise data.

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## Study

### Study time

Type	Required	Optional
Lectures	15 sessions of 1 hour (10%)	2 sessions of 1 hour
Practical classes	5 sessions of 1 hour (3%)	
Private study	55 hours (37%)	
Assessment	75 hours (50%)	
Total	150 hours	

### Private study description

Study of advanced topics, weekly revision of lecture notes and materials, wider reading, practice exercises.

### Costs

No further costs have been identified for this module.

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## Assessment

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

Students can register for this module without taking any assessment.

### Assessment group C

	Weighting	Study time	Eligible for self-certification
Project 1	10%	15 hours	No

Due in Term 2 Week 4.

You will work in a group to use specified data sets to address questions related to ordinary linear regression, carry out analysis and then present, discuss and evaluate the results. In addition to the word limit, you may include up to three figures and three tables. You must give a word count. Your ST409 Project 1 must include a statement of the contributions of each group member; this is

	<b>Weighting</b>	<b>Study time</b>	<b>Eligible for self-certification</b>
not included in the word count.			

Project 2	20%	30 hours	No
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Due in Term 2 Week 7.

You will work in a group to use specified data sets and research articles to address questions related to generalised linear regression, carry out analysis and then present, discuss and evaluate the results. In addition to the word limit, you may include up to five figures and five tables. You must give a word count. Your ST409 Project 2 must include a statement of the contributions of each group member; this is not included in the word count.

Project 3	20%	30 hours	No
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Due in Term 2 Week 10.

You will work in a group to use specified data sets and research articles to address questions related to generalised linear regression, carry out analysis and then present, discuss and evaluate the results. In addition to the word limit, you may include up to four figures and four tables. You must give a word count. Your ST409 Project 3 must include a statement of the contributions of each group member; this is not included in the word count.

Online Examination	50%		No
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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
- Cambridge Statistical Tables (blue)

## Assessment group R

	<b>Weighting</b>	<b>Study time</b>	<b>Eligible for self-certification</b>
Online Examination - Resit	100%		No

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

**Weighting**

**Study time**

**Eligible for self-  
certification**

- Graph paper

## 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 ST409](#)

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## Availability

### Pre-requisites

Either ST218 and ST219 or ST220. Menu does not allow this.

For M.Sc students, ST952.

ST346 is strongly recommended.

To take this module, you must have passed:

- Any of
  - [ST218-12 Mathematical Statistics Part A](#)
  - [ST219-12 Mathematical Statistics Part B](#)
  - [ST220-12 Introduction to Mathematical Statistics](#)
  - [ST952-15 An Introduction to Statistical Practice](#)

### Anti-requisite modules

If you take this module, you cannot also take:

- ST332-15 Medical Statistics

## 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-G1P0 Postgraduate Taught Mathematics

- Year 1 of TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
- 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:

- 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)
- 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)
- Year 4 of USTA-G1G4 Undergraduate 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)