MODULE SPECIFICATION

Academic Year (student cohort covered by specification)	2021-22
Module Code	2462
Module Title	Generalized Linear Models
Module Organiser(s)	Professor Chris Frost
Faculty	Epidemiology & Population Health
FHEQ Level	Level 7
Credit Value	**CATS:** 15 **ECTS:** 7.5
HECoS Code	101031
Term of Delivery	Term 2
Mode of Delivery	For 2021-22 this module is delivered both face-to-face and online. There is the option of taking the module entirely online. Teaching will comprise a combination of live and interactive activities (synchronous learning) as well as recorded or self-directed study (asynchronous learning).
Mode of Study	Full-time
Language of Study	English
Pre-Requisites	A good understanding of linear regression (including multiple linear regression models with interaction terms), analysis of variance, likelihood theory and simple methods of analysing quantitative and categorical data is essential.
Accreditation by Professional Statutory and Regulatory Body	None
Module Cap (indicative number of students)	45 (numbers may be capped due to limitations in facilities or staffing)
Target Audience	This module is intended for people with both mathematical (up to first year undergraduate level) and statistical background (undergraduate degree level in joint mathematics/statistics for example) intending to pursue a career in medical statistics.
Module Description	Linear regression models have wide applicability to studies where a continuous outcome is related to one or more predictor variables. The family of generalized linear models (GLMs) is a larger class of models applicable to a wider range of outcome types, including binary, count

	and categorical outcomes. This module gives a methodological introduction to this family of models and equips students with the skills needed to analyse and interpret data from cohort, case-control and cross-sectional studies that can be appropriately analysed with GLMs. It is assessed through an analysis and reporting exercise.
Duration	5 weeks at 2 days per week
Timetabling slot	Slot C1
Last Revised (e.g. year changes approved)	September 2021

Programme(s) This module is linked to the following programme(s)	**Status**
MSc Medical Statistics	Compulsory

Module Aim and Intended Learning Outcomes

Overall aim of the module
The overall module aim is to: equip students with the necessary skills to (i) understand the principles of Generalized Linear Modelling, and (ii) be able to analyse data using Generalized Linear Models.

Module Intended Learning Outcomes
Upon successful completion of the module a student will be able to: - Demonstrate an understanding of the theoretical basis of Generalized Linear Models.   - Use Generalized Linear Models and other related models for analysis of discrete data.   - Present results clearly and accurately in a structured report, such as might form the basis of a report by a statistical consultant.   - Demonstrate an understanding of the concepts of confounding and associations versus causation, and how to apply these in modelling choices and interpretation.   - Have an appreciation of different analysis strategies.

Indicative Syllabus

Session Content
The module is expected to cover the following topics: - Formalisation of Generalized Linear Models   - Log likelihood and deviance   - Comparison of nested regression models   - Logistic regression for binary data

Session Content
• Ordinal and multinomial logistic regression • Poisson regression for rates • Linking research questions to analysis strategies • Marginal and conditional estimates • Confounding, adjustment and non-collapsibility • Model checking and assessment of model performance • Application of logistic regression to prospective and case-control studies • Matched studies and conditional logistic regression

Teaching and Learning

Notional Learning Hours

Type of Learning Time	Number of Hours	Expressed as Percentage (%)
Contact time	35	23
Directed self-study	75	50
Self-directed learning	10	7
Assessment, review and revision	30	20
Total	**150**	**100**

Student contact time refers to the tutor-mediated time allocated to teaching, provision of guidance and feedback to students. This time includes activities that take place in face-to-face contexts such as lectures, seminars, demonstrations, tutorials, supervised laboratory workshops, practical classes, project supervision as well as where tutors are available for one-to-one discussions and interaction by email. Student contact time also includes tutor-mediated activities that take place in online environments, which may be synchronous (using real-time digital tools such as Zoom or Blackboard Collaborate Ultra) or asynchronous (using digital tools such as tutor-moderated discussion forums or blogs often delivered through the School's virtual learning environment, Moodle).

The division of notional learning hours listed above is indicative and is designed to inform students as to the relative split between interactive (online or on-campus) and self-directed study.

Teaching and Learning Strategy
The teaching and learning strategy is structured around a combination of pre-recorded lectures followed by computer or non-computer practical sessions and question and answer sessions. Practical sessions ensure that students have the opportunity to apply the concepts and methods covered by lecture content. The practical sessions provide students with "hands on" experience in analysing and interpreting data, using data sets drawn from research work of staff in the faculty. Students are provided with detailed solutions to the tasks set in practical sessions, enabling them to check their understanding of the material. The question and answer sessions

Teaching and Learning Strategy
allow the students to ask questions about the material in the pre-recorded lectures. The assessment task, which comes towards the end of the module, is the point at which students demonstrate a consolidation of their learning across the whole module.

Assessment

Assessment Strategy
The assessment for this module has been designed to measure student learning against the module intended learning outcomes (ILOs) as listed above. The grade for summative assessment(s) only will go towards the overall award GPA. The assessment for this module will be online.

Summative Assessment

Assessment Type	Assessment Length (i.e. Word Count, Length of presentation in minutes)	Weighting (%)	Intended Module Learning Outcomes Tested
Coursework	4 pages	100	1 – 5

Resitting assessment
Resits will accord with the LSHTM's Resits Policy Resit/deferred/new attempts - The task will be a data analysis report. The next assessment deadline for coursework will be during mid/late September of the current academic year.

Resources

Indicative reading list
Some text books which may be found useful are as follows:
- Dobson, A.J and Barnett, A.G. (2008) An Introduction to Generalized Linear Models, Third Edition. Chapman & Hall.
- Collett, D. (2002) Modelling Binary Data. Chapman & Hall.
- Hosmer, D.W. and Lemeshow, S. (2013) Applied Logistic Regression. Wiley Interscience.
- Hardin, J.W. and Hilbe, J.M. (2012) Generalized Linear Models and extensions, Third Edition. Stata Press.
- Pawitan, Y. In All Likelihood: statistical modelling and inference using likelihood. Oxford University Press.
- Harrell, F.E. Regression Modeling Strategies. Springer.
- Agresti, A. (1996) An introduction to categorical data analysis. Wiley.
- McCullagh, P. and Nelder, J.A. (1989) Generalized Linear Models, Second Edition. Chapman & Hall.
- Pearl J, Glymour M, Jewell N.P. (2016) Causal Inference in Statistics: A Primer. Wiley.
- Breslow N.E, Day N.E. (1980) Statistical Methods in Cancer Research Volume I: The Analysis of Case-Control Studies. IARC Scientific Publication No. 32.

Other resources
Students will be provided with additional references, and links to resources in the lecture notes.

Teaching for Disabilities and Learning Differences

The module-specific site on Moodle gives students access to lecture notes and copies of the slides used during the lecture. Where appropriate, lectures are recorded and made available on Moodle. All materials posted on Moodle, including computer-based sessions, have been made accessible where possible.

LSHTM Moodle is accessible to the widest possible audience, regardless of specific needs or disabilities. More detail can be found in the Moodle Accessibility Statement which can also be found within the footer of the Moodle pages. All students have access to "SensusAccess" software which allows conversion of files into alternative formats.

Student Support Services can arrange learning or assessment adjustments for students where needed. Details and how to request support can be found on the LSHTM Disability Support pages.