MODULE SPECIFICATION

Academic Year (student cohort covered by specification)	2023-24
Module Code	2496
Module Title	Bayesian Analysis
Module Organiser(s)	Dr Alex Lewin, Dr Alex De Figueiredo
Faculty	Epidemiology & Population Health
FHEQ Level	Level 7
Credit Value	**CATS:** 15 **ECTS:** 7.5
HECoS Code	101031 : 101030 : 101034
Term of Delivery	Term 2
Mode of Delivery	This module will be delivered by predominantly face-to-face teaching modes. Where specific teaching methods (lectures, seminars, discussion groups) are noted in this module specification these will be delivered by predominantly face-to-face sessions. There will be a combination of live and interactive activities (synchronous learning) as well as 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), logistic regression, likelihoods and maximum likelihood estimation, and simple methods of analysing quantitative and categorical data is essential. Have attended Term 1 Medical Statistics modules and Term 2 modules (2462: Statistical Models for Discrete Outcomes and 2497: Survival Analysis) or have equivalent knowledge. Familiarity with R is needed.
Accreditation by Professional Statutory and Regulatory Body	None

Module Cap (indicative number of students)	35 (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 backgrounds (undergraduate degree level in joint mathematics/statistics for example) intending to pursue a career in medical statistics.
Module Description	The Bayesian approach to statistics models joint distributions of all data and parameters relevant to a particular scientific question. It produces direct statements of probabilities and uncertainty about parameters and estimands, and allows external evidence to be incorporated into the analysis. Bayesian methods are of increasing interest for the design and analysis of clinical trials and other medical data, and are widely used in complex analyses involving structured data such as longitudinal, temporal and spatial structure. They are also important in evidence synthesis. This module provides students with the ability and tools to perform and interpret a Bayesian analysis. The module is assessed through an analysis and reporting exercise.
Duration	5 weeks at 2.5 days per week
Timetabling slot	Slot D2
Last Revised (e.g. year changes approved)	June 2023

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 understand the principles and apply techniques of Bayesian statistics.

Module Intended Learning Outcomes
Upon successful completion of the module a student will be able to: 1. Demonstrate an understanding of the theoretical basis of Bayesian reasoning and Bayesian inference. 2. Choose appropriate likelihoods and priors for a range of standard statistical models, including Generalised Linear Models, Time to event models and Hierarchical models. 3. Write and estimate Bayesian models using the JAGS statistical software packages in R. 4. Carry out model diagnostic checks and sensitivity analyses, including sensitivity to prior specification. 5. Present results clearly and accurately in a structured report.

Indicative Syllabus

Session Content
The module is expected to cover the following topics: • Bayesian reasoning, likelihood, prior, posterior, posterior prediction. • Overview of computational approaches for estimating Bayesian models. • Use of JAGS and R statistical software for fitting Bayesian models. • Bayesian estimation of generalised linear models, time to event models, hierarchical models.

Teaching and Learning

Notional Learning Hours

Type of Learning Time	Number of Hours	Expressed as Percentage (%)
Contact time	50	33
Directed self-study	30	20
Self-directed learning	20	14
Assessment, review and revision	50	33
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.

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

Teaching and Learning Strategy
The teaching and learning strategy is structured around a combination of live lectures accompanied 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. They provide students with "hands on" experience in analysing and interpreting data, using a range of data sets . Students are provided with detailed solutions to the tasks set in practical sessions, enabling them to check their understanding of the material. 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 will consist of an analysis of time-to-event data. Students will submit a report on their results and interpretation. Resit/deferred/new attempts - The tasks will be similar to the original assessment although the data set to be analysed will be different.

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

Emmanuel Lesaffre and Andrew B. Lawson “Bayesian Biostatistics” Wiley (2012);

David Spiegelhalter et al “Bayesian approaches to clinical trials and health-care evaluations” Wiley (2004);

Gelman et al. “Bayesian data analysis” Chapman & Hall (2013).

David Lunn et al “The BUGS Book: A Practical Introduction to Bayesian Analysis” Chapman & Hall (2013);

Other resources
Extensive lecture notes, exercises and practical exercises are provided. Module Information can be found on the Virtual Learning Environment (MOODLE) containing information about each session and key references for the module.

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.