LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

MODULE SPECIFICATION

Academic Year (student cohort covered by specification)	2021-22
Module Code	2463
Module Title	Survival Analysis and Bayesian Statistics
Module Organiser(s)	Prof Ruth Keogh (Survival), Prof Claudia Allemani (Survival) Dr Alex Lewin (Bayesian) and Dr Alexina Mason (Bayesian)
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	For 2021-22 this module is currently planned as a mixture of online and face-to-face teaching. Teaching will comprise a combination of face-to-face teaching, live online 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 knowledge of linear regression, analysis of variance, logistic regression, maximum likelihood estimation and simple methods of analysing quantitative and categorical data is essential (t-test, RR, OR). Have attended term-1 medical statistics modules and Generalised Linear Models or have equivalent knowledge. Have attended the "Introduction to Bayesian Statistics" lectures in term 1 or have equivalent knowledge. Knowledge of classical inference and the idea of likelihood is needed. Knowledge of hierarchical models (mixed models) would be beneficial, but hierarchical Bayesian models will be motivated and introduced from scratch. Familiarity with Stata and R is needed.
Accreditation by Professional Statutory and Regulatory Body	None
Module Cap (indicative number of students)	60 (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	Survival analysis methods are widely used in medical statistics, epidemiology, data science and beyond to study outcomes which are the time to occurrence of an event, and how that time may be influenced by individual characteristics or exposures. Specialised methods are needed to study time-to-event outcomes. This module equips students with the knowledge and practical skills needed to analyse and interpret time-event data The Bayesian approach to statistics is based on a subjective interpretation of probability, meaning that the uncertainty about the occurrence of some event of interest relates to the individual expressing the evaluation as well as the event itself. It allows external evidence to be incorporated into an analysis, and is of increasing interest for the design and analysis of clinical trial and other medical data. 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)	September 2021

Programme(s) This module is linked to the following programme(s)	**Status**
MSc Medical Statistics	Compulsory
MSc Health Data Science	Recommended Option

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 the techniques of Survival Analysis and 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 Survival Analysis and assumptions related to different Survival Analysis models 2. Compare different models for analysis of survival data, employ techniques to select an appropriate model, and interpret findings. 3. Use Survival Analysis for analysis of data in Stata and/or R 4. Demonstrate an understanding of the theoretical basis of Bayesian reasoning and Bayesian inference 5. Understand the consequences of using different prior knowledge, including vague priors 6. Write and estimate Bayesian models with MCMC algorithms using the statistical software packages OpenBUGS and R

Indicative Syllabus

Session Content
The module is expected to cover the following topics: **Survival Analysis:** • Non parametric and parametric estimation of survival curves • Functions used in the description and analysis of survival data, including hazard and survivor functions • The theory and use of proportional hazard models, including parametric models and the Cox model. • Assessment of model assumptions • Time dependent covariates • Non-proportional hazards models • Competing risks **Bayesian statistics:** • Bayesian reasoning and Bayesian inference • Prior and posterior distributions • Bayesian analysis with conjugate priors • Bayesian analysis with MCMC methods • Use of OpenBUGS and R statistical packages for Bayesian analysis • Interpretation of and reporting the results of Bayesian analyses

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. 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 lectures accompanied by computer or non-computer practical sessions. Following each lecture, 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 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
Students will carry out a single assessment which combines survival analysis and Bayesian statistics. The assessment will consist of an analysis of time-to-event data using standard survival analysis techniques (frequentist) and using Bayesian analysis. Students will submit a short 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	4-5 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

Survival Analysis:

Collett D (2003): "Modelling Survival Data in Medical Research"

Cox DR and Oakes D (1984): "Analysis of survival data"

Marubini and Valsecchi (1995): "Analysing Survival Data from Clinical Trials and Observational Studies", Machin D., Cheung Y.B. and Parmar M.K.B: "Survival Analysis. A practical approach (2006).

Aalen, Borgan, Gjessing. (2008) "Survival and Event History Analysis". Springer

Bayesian Statistics:

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

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.