STAT727

Survival Analysis

S1 External 2018

Dept of Statistics

Contents

General Information

Unit convenor and teaching staff
Unit Convenor
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Credit points
4

Prerequisites
Admission to MRes

Corequisites
STAT710

Co-badged status
Unit SVA in the Biostatistics Collabaration Australia (BCA) programme, STAT827

Unit description
This unit explores biostatistical applications of survival analysis. These begin with the Kaplan-Meier curve definition and its extension to the comparison of survival of several groups of subjects. The Cox proportional hazards model is introduced as a method for handling continuous covariates and parametric accelerated failure-time models are also covered. Time-dependent covariates and multiple outcomes are also considered.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

Understand the nature of survival data.

Be able to summarise and display survival data using nonparametric methods.

Understand and be able to analyse survival data using the Cox proportional hazards model, including time-dependent covariates.

Be able to analyse survival data using parametric models.

Be able to analyse data using multi-event models.

Be able to determine sample size for simple survival analysis.

Be able to produce appropriate displays for publication.

Assessment Tasks

Name	Weighting	Hurdle	Due
Early assessment quiz	0%	No	12 March
Assignment 1	30%	No	2 April
Assignment 2	40%	No	7 May
Assignment 3	30%	No	4 June

Early assessment quiz

Due: **12 March**
Weighting: **0%**

Feedback only online assessment.

On successful completion you will be able to:
- Understand the nature of survival data.

Assignment 1

Due: **2 April**
Weighting: **30%**

Covers Modules 1 and 2

On successful completion you will be able to:
- Understand the nature of survival data.
- Be able to summarise and display survival data using nonparametric methods.
- Understand and be able to analyse survival data using the Cox proportional hazards model, including time-dependent covariates.

Assignment 2

Due: **7 May**
Weighting: **40%**

Covers mainly Modules 3 and 4,

On successful completion you will be able to:

- Understand the nature of survival data.
- Be able to summarise and display survival data using nonparametric methods.
- Understand and be able to analyse survival data using the Cox proportional hazards model, including time-dependent covariates.

Assignment 3

Due: **4 June**
Weighting: **30%**

Covers mainly Modules 5, 6 and 7

On successful completion you will be able to:

- Understand the nature of survival data.
- Be able to summarise and display survival data using nonparametric methods.
- Understand and be able to analyse survival data using the Cox proportional hazards model, including time-dependent covariates.
- Be able to analyse survival data using parametric models.
- Be able to analyse data using multi-event models.
- Be able to determine sample size for simple survival analysis.
- Be able to produce appropriate displays for publication.

Delivery and Resources

The unit is offered only in distance mode. Our means of communication will be via notes which can be obtained from ilearn, e-mail, and forums on ilearn. Our primary communication method is via ilearn and we expect you to log in at least weekly to check for announcements and release of assignments and so on.

The unit relies heavily on the prescribed text Hosmer, Lemeshow and May (see below). The study notes provide a guide to readings in this text, as well as sometimes to other readings, which will be provided. They also provide additional explanation where this is needed. In the study notes for each module, tutorial exercises are given, mostly referring to exercises in Hosmer, Lemeshow and May.

We will be using ilearn for online discussions, posting of course notes, assignments, solutions and data sets, and submission of exercises, and assignments.

Textbooks

The prescribed text is Hosmer DW, Lemeshow S and May S (2008). Applied Survival Analysis, John Wiley and Sons, Second Edition. This is essential as it has readings which are required. Online copies are available from the library. There are numerous texts on survival analysis which you may wish to consult, but the following may be particularly helpful because of its use of

Stata:

Cleves MA, Gould WW, Gutierrez RG and Marchenko Y (2010). An Introduction to Survival Analysis using Stata, Third Edition, Stata Press.

Other useful texts are:

Klein JP and Moeschberger ML (2003). Survival analysis : techniques for censored and truncated data, Springer.

Kleinbaum DG (2012). Survival analysis : a self-learning text, Springer-Verlag.

Allison PD (2010). Survival Analysis Using SAS: A Practical Guide}, SAS Instiutute. (for those using SAS)

Moore, DF (2010). Applied Survival Analysis using R, Springer. (for those using R)

Therneau, TM and Grambsch, PM (2001). Modeling Survival Data: Extending the Cox Model, Springer. (more advanced treatment with code for SAS and R)

Software

We will be using Stata (version 12, preferably 13 or later). While Stata has a GUI we will be using the command language. It is still useful to experiment with the GUI, as the corresponding commands are available in the Review pane. Stata should be available on iLab, see instructions to set this up at https://wiki.mq.edu.au/display/iLab/About. This will allow access through the lab computers, as well as though your laptop at Macquarie university or over the internet. Alternatively you can obtain your own copy of Stata, and will need to purchase it directly from the suppliers. You can place your order via the Survey Design website at http://www.survey design.com.au/buygradplan.html . The following options are recommended:

GradPlan Stata IC 14 with perpetual licence (consisting of CD for Windows, Mac or Linux, including PDF of manuals) = $AUD264

GradPlan Stata IC 14 - as above but with a one-year licence = $AUD119

GradPlan Stata IC 14 - as above but with a six month licence = $AUD60 (this will be sufficient time to complete the course)

These prices are for the downloadable version. A DVD can be sent for an additional $AUD56. A valid Australian or NZ university e-mail address is required.

There is also a Small Stata option; however, this is limited to around 1,000 observations which will not be sufficient. Any of the other options have capabilities beyond what is needed for the course.

For those that haven't used Stata previously there is much introductory material on the web. A useful starting point is http://www.stata.com/links/resources-for-learning-stata/, and particularly good is http://www.ats.ucla.edu/stat/stata You should especially learn the use of do files, as these allow for storing a series of commands. If you do wish to buy an introductory text on Stata then "An Introduction to Stata for Health Researchers" by S. Juul and M. Frydenberg, Stata Press. 4th ed, 2014 is good. There are other texts available in the library.

Unit Schedule

The unit timetable is based on the University of Sydney timetable, which this year starts at the same date, but has only a one week mid-semester break and in a different week.

Module	Weeks	Content
1	1,2 (26 Feb)	The nature of survival data, including censoring; the survival (or survivorship) function: definition and estimation via the Kaplan-Meier curve; the stset command in Stata;Kaplan-Meier estimate of the survival (or survivorship) function: confidence intervals and hypothesis testing.
2	3,4 (12 March)	The density, survival, hazard and cumulative hazard functions; the Nelson-Aalen estimate of the cumulative hazard function; Definition of the proportional hazards model; construction of the partial likelihood for the Cox model; the treatment of tied failure times; hypothesis testing on the coefficients, using Wald and partial likelihood ratio tests.
3	5,6 (26 Mar)	For the Cox PH model: hypothesis testing on the coefficients, contd; estimation of the baseline functions $S_0(t)$ and $H_0(t)$, and their adjustment for covariate values; the effect of a change in scale and origin of units of measurement of covariates.
4	7,8 (16 April)	Model diagnostics for the Cox PH model; the stratified Cox model
5	9,10 (30 April)	Time-dependent covariates in the Cox model; parametric survival time models, in particular the accelerated failure time model, with an exponential and Weibull distrubution; discrete-time logistic model
6	11,12 (14 May)	Correlated survival data; clustered survival data; recurrent events models;competing-risks models
7	13 (28 May)	Sample size determination for comparing two response rates and two survival distributions; good practice for the display of survival analysis results in scientific publications. (Only 1 week)

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy

- Fitness to Practice Procedure

- Grade Appeal Policy

- Complaint Management Procedure for Students and Members of the Public

- Special Consideration Policy *(**Note:** The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.)*

Undergraduate students seeking more policy resources can visit the Student Policy Gateway (https://students.mq.edu.au/support/study/student-policy-gateway). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central).

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/study/getting-started/student-conduct

Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au.

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops

- StudyWise

- Academic Integrity Module for Students

- Ask a Learning Adviser

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

PG - Capable of Professional and Personal Judgment and Initiative

Our postgraduates will demonstrate a high standard of discernment and common sense in their professional and personal judgment. They will have the ability to make informed choices and decisions that reflect both the nature of their professional work and their personal perspectives.

This graduate capability is supported by:

Learning outcomes

- Understand the nature of survival data.
- Be able to summarise and display survival data using nonparametric methods.
- Understand and be able to analyse survival data using the Cox proportional hazards model, including time-dependent covariates.
- Be able to analyse survival data using parametric models.
- Be able to analyse data using multi-event models.
- Be able to determine sample size for simple survival analysis.
- Be able to produce appropriate displays for publication.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3

PG - Discipline Knowledge and Skills

Our postgraduates will be able to demonstrate a significantly enhanced depth and breadth of knowledge, scholarly understanding, and specific subject content knowledge in their chosen fields.

This graduate capability is supported by:

Learning outcomes

- Understand the nature of survival data.
- Be able to summarise and display survival data using nonparametric methods.

- Understand and be able to analyse survival data using the Cox proportional hazards model, including time-dependent covariates.

- Be able to analyse survival data using parametric models.

- Be able to analyse data using multi-event models.

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- Be able to produce appropriate displays for publication.

Assessment tasks

- Early assessment quiz

- Assignment 1

- Assignment 2

- Assignment 3

PG - Critical, Analytical and Integrative Thinking

Our postgraduates will be capable of utilising and reflecting on prior knowledge and experience, of applying higher level critical thinking skills, and of integrating and synthesising learning and knowledge from a range of sources and environments. A characteristic of this form of thinking is the generation of new, professionally oriented knowledge through personal or group-based critique of practice and theory.

This graduate capability is supported by:

Learning outcomes

- Understand the nature of survival data.

- Be able to summarise and display survival data using nonparametric methods.

- Understand and be able to analyse survival data using the Cox proportional hazards model, including time-dependent covariates.

- Be able to analyse survival data using parametric models.

- Be able to analyse data using multi-event models.

- Be able to determine sample size for simple survival analysis.

- Be able to produce appropriate displays for publication.

Assessment tasks

- Assignment 1

- Assignment 2

- Assignment 3

PG - Research and Problem Solving Capability

Our postgraduates will be capable of systematic enquiry; able to use research skills to create new knowledge that can be applied to real world issues, or contribute to a field of study or

practice to enhance society. They will be capable of creative questioning, problem finding and problem solving.

This graduate capability is supported by:

Learning outcomes

- Understand the nature of survival data.
- Be able to summarise and display survival data using nonparametric methods.
- Understand and be able to analyse survival data using the Cox proportional hazards model, including time-dependent covariates.
- Be able to analyse survival data using parametric models.
- Be able to analyse data using multi-event models.
- Be able to determine sample size for simple survival analysis.
- Be able to produce appropriate displays for publication.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3

PG - Effective Communication

Our postgraduates will be able to communicate effectively and convey their views to different social, cultural, and professional audiences. They will be able to use a variety of technologically supported media to communicate with empathy using a range of written, spoken or visual formats.

This graduate capability is supported by:

Learning outcomes

- Be able to summarise and display survival data using nonparametric methods.
- Be able to produce appropriate displays for publication.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3

PG - Engaged and Responsible, Active and Ethical Citizens

Our postgraduates will be ethically aware and capable of confident transformative action in relation to their professional responsibilities and the wider community. They will have a sense of connectedness with others and country and have a sense of mutual obligation. They will be able to appreciate the impact of their professional roles for social justice and inclusion related to

national and global issues

This graduate capability is supported by:

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3

Late Submission

Requests for an extension of the due date for an assignment must be made in advance of the due date for that assessment. These requests must be made directly to the unit coordinator by email. The unit coordinator will reply by email with the decision as to whether an extension has been granted and the new due date.

The penalty for late submission, where permission has not been granted, is as follows: 5% (of earned mark) will be deducted for each day that an assignment is late, up to a maximum of 50%. The final mark cannot be reduced to a fail due to late submissions.

Note: I have made the submission dates a week after the end of the material, so there should be sufficient time to complete the assessments allowing for routine work demands etc. Extensions will only be granted for unexpected events.