STAT827

Survival Analysis

S1 External 2014

Statistics

Contents

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General Information

Unit convenor and teaching staff
Unit Convenor
Kenneth Beath
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Contact via ken.beath@mq.edu.au
E4A 507
Friday 2-4

Credit points
4

Prerequisites
BCA808 or Admission to MAppStat or PGDipAppStat or PGCertAppStat

Corequisites
STAT806 or STAT810 or BCA817

Co-badged status
Unit SVA in the Biostatistics Collaboration Australia (BCA) programme.

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 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.

Summarise and display survival data using nonparametric methods.

Analyse survival data using the Cox proportional hazards model, including time-dependent covariates.

Analyse survival data using parametric models.

Analyse data using multi-event models.

Determine sample size for simple survival analysis.

Produce appropriate displays for publication.

Assessment Tasks

Name	Weighting	Due
Exercises	10%	24 March, 28 April
Assignment 1	26%	7 April
Assignment 2	36%	12 May
Assignment 3	28%	10 June

Exercises

Due: **24 March, 28 April**
Weighting: **10%**

2 short answer exercises each worth 5%. These will be made available at least 2 weeks before the due date. They will require brief answers and no data analysis.

On successful completion you will be able to:

- Understand the nature of survival data.
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- Analyse survival data using the Cox proportional hazards model, including time-dependent covariates.
- Analyse survival data using parametric models.
- Analyse data using multi-event models.
- Determine sample size for simple survival analysis.
- Produce appropriate displays for publication.

Assignment 1

Due: **7 April**
Weighting: **26%**

On successful completion you will be able to:

- Understand the nature of survival data.
- Summarise and display survival data using nonparametric methods.
- Analyse survival data using the Cox proportional hazards model, including time-

dependent covariates.
- Analyse survival data using parametric models.
- Analyse data using multi-event models.
- Determine sample size for simple survival analysis.
- Produce appropriate displays for publication.

Assignment 2

Due: **12 May**
Weighting: **36%**

On successful completion you will be able to:
- Understand the nature of survival data.
- Summarise and display survival data using nonparametric methods.
- Analyse survival data using the Cox proportional hazards model, including time-dependent covariates.
- Analyse survival data using parametric models.
- Analyse data using multi-event models.
- Determine sample size for simple survival analysis.
- Produce appropriate displays for publication.

Assignment 3

Due: **10 June**
Weighting: **28%**

On successful completion you will be able to:
- Understand the nature of survival data.
- Summarise and display survival data using nonparametric methods.
- Analyse survival data using the Cox proportional hazards model, including time-dependent covariates.
- Analyse survival data using parametric models.
- Analyse data using multi-event models.
- Determine sample size for simple survival analysis.
- Produce appropriate displays for publication.

Delivery and Resources

The unit is offered in distance mode. Our means of communication will be via printed notes which will be mailed out, e-mail, and elearning (http://elearning.sydney.edu.au/), the University of Sydney's e-learning site. Our primary communication method is via elearning and

we expect you to log in at least weekly to check for announcements and release of assignments and so on. To access elearning a uniKey is required. If you have not been sent one then contact Ken Beath.

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.

Study notes will be mailed to you, at the beginning of semester and will also be posted on the iLearn site. If you do not receive these within a few days then please contact Lesley Mooney.

We will be using elearning for online, posting of course notes, assignments, solutions and data sets, and submission of exercises, assignments and the take-home test.

Textbooks

The prescribed text is Hosmer DW, Lemeshow S and May S (2008). Applied Survival Analysis}, John Wiley and Sons, Second Edition. 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 (1995). Survival analysis : a self-learning text}, Springer-Verlag.

Software

We will be using Stata (version 11 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.You will need 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. 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/resources1.html, and particularly good ishttp://www.ats.ucla.edu/stat/stata

Advanced GradPlan Intercooled Stata 13 with perpetual licence (consisting of CD for Windows, Mac or Linux, including PDF of manuals) = AU\$212 (+ postage)

Basic GradPlan Intercooled Stata 13 - as above but with a one-year licence = AU\$118 (+ postage)

Basic GradPlan Intercooled Stata 13 - as above but with a six month licence = AU\$88 (+ postage)

There is also a Small Stata option; however, this is limited to around 1,000 observations which will not be sufficient.

Go to the Survey Design website listed above and go to the Grad Plan page (LH column `GradPlan' link). Above the prices is a link to an order form. Followthe instructions and you should order a GradPlan Intercooled package. On the order form you should note that you are enrolled in a BCA course (BCA students) or STAT827 (MU students), your student ID number, the university in which you are enrolled, and the operating system of the computer that you will be using. For GradPlan orders delivery is normally within a few days of payment being cleared.

Changes from previous offereings

Removed take-home test and one exercise. Expanded use of new categorical variables.

Unit Schedule

The unit timetable is based on the University of Sydney timetable, which starts a week later than Macquarie University, and has only a one week mid-semester break, at a different time.

Module	Weeks	Content
1	1,2 (3 March)	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 (17 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 (31 March)	For the Cox PH model: hypothesis testing on the coefficients, contd; estimation of the baseline functions S0(t) and H0(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 (14 April)	Model diagnostics for the Cox PH model; the stratified Cox model
5	9,10 (5 May)	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 (19 May)	Correlated survival data; clustered survival data; recurrent events models;competing-risks models
7	13 (2 June)	Sample size determination for comparing two response rates and two survival distributions; good practice for the display of survival analysis results in scientific publications

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central. Students should be aware of the following policies in particular with regard to Learning and Teaching:

Academic Honesty Policy http://mq.edu.au/policy/docs/academic_honesty/policy.html

Assessment Policy http://mq.edu.au/policy/docs/assessment/policy.html

Grading Policy http://mq.edu.au/policy/docs/grading/policy.html

Grade Appeal Policy http://mq.edu.au/policy/docs/gradeappeal/policy.html

Grievance Management Policy http://mq.edu.au/policy/docs/grievance_management/policy.html

Disruption to Studies Policy http://www.mq.edu.au/policy/docs/disruption_studies/policy.html *The Disruption to Studies Policy is effective from March 3 2014 and replaces the Special Consideration Policy.*

In addition, a number of other policies can be found in the Learning and Teaching Category of 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/support/student_conduct/

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://informatics.mq.edu.au/help/.

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

Graduate Capabilities

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.
- Summarise and display survival data using nonparametric methods.
- Analyse survival data using the Cox proportional hazards model, including time-dependent covariates.
- Analyse survival data using parametric models.
- Analyse data using multi-event models.
- Determine sample size for simple survival analysis.
- Produce appropriate displays for publication.

Assessment tasks

- Exercises
- 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.
- Summarise and display survival data using nonparametric methods.
- Analyse survival data using the Cox proportional hazards model, including time-dependent covariates.
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Assessment tasks

- Exercises
- 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.
- Summarise and display survival data using nonparametric methods.
- Analyse survival data using the Cox proportional hazards model, including time-dependent covariates.
- Analyse survival data using parametric models.
- Analyse data using multi-event models.
- Determine sample size for simple survival analysis.
- Produce appropriate displays for publication.

Assessment tasks

- Exercises
- 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

- Summarise and display survival data using nonparametric methods.
- Produce appropriate displays for publication.

Assessment tasks

- Exercises
- 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

- Exercises
- Assignment 1
- Assignment 2
- Assignment 3

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.
- Summarise and display survival data using nonparametric methods.
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Assessment tasks

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- 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 vdirectly 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%, and that the final mark for the subject cannot be reduced to a fail.

Changes since First Published

Date	Description
22/01/2014	The Prerequisites and Corequisites were updated.