STAT 7042
Survival Models

Course Description
This course introduces survival models and discusses their rationale, their estimation and their application to mortality. Topics covered will include: an introduction to the life table; survival models; estimation procedures for lifetime distributions; statistical models of transfers between multiple states; maximum likelihood estimation of transition intensities for such models; binomial model of mortality including estimation and comparison with multi-state models; exposed-to-risk and graduation methods (for smoothing crude mortality rate data).

<table>
<thead>
<tr>
<th>Mode of Delivery</th>
<th>On campus (plus online materials)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prerequisites</td>
<td>STAT2001 (compulsory); STAT2008 (recommended)</td>
</tr>
<tr>
<td>Incompatible Courses</td>
<td>STAT4072 / STAT7042 / STAT8003 (co-taught)</td>
</tr>
</tbody>
</table>

**Course Convener**
Grace Chiu, Ph.D.
Email: grace.chiu@anu.edu.au
Tel: 02 6125 7292
Office: CBE 4.35
Consultation hours: Fridays 12:15-1:15pm

**Student Administrator**
Ms. Anna Pickering
Email: anna.pickering@anu.edu.au
Tel: 02 6125 9045

**Tutor(s)**
Emma Ai
emma.ai@anu.edu.au

Stacey (Xi) Lin
staceyxi.lin@anu.edu.au

COURSE OVERVIEW

Learning Outcomes
1. Communicate the concept of survival models.
2. Communicate in detail the estimation procedures for lifetime distributions.
3. Implement statistical models of transfer between multiple states, including processes with single or multiple decrements, and derive relationships between probabilities of transfer and transition intensities.
4. Derive maximum likelihood estimators for the transition intensities in models of transfers between states with piecewise constant transition intensities.
5. Comprehensively describe how to estimate transition intensities depending on age, exactly or using the census approximation.
6. Communicate in detail how to test crude estimates for consistency with a standard table or a set of graduated estimates, and describe the process of graduation.

Assessment Summary

<table>
<thead>
<tr>
<th>Assessment Task</th>
<th>Value</th>
<th>Due Date</th>
<th>Date for Return of Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Midterm Exam (redeemable)</td>
<td>20% (or 0%)</td>
<td>Week 7</td>
<td>Week 8</td>
</tr>
<tr>
<td>2. Term Project</td>
<td>15%</td>
<td>Week 12</td>
<td>Week 13</td>
</tr>
<tr>
<td>3. Final Exam</td>
<td>65% (or 85%)</td>
<td>Exam Period</td>
<td>TBA by RSFAS</td>
</tr>
</tbody>
</table>

Research-Led Teaching
This course builds upon the foundation in statistical thinking and evidence-based logic that you have acquired from previous statistics courses. The course contents and activities are designed to help you to learn to apply and hone this foundation to achieve the above learning outcomes, and to prepare yourself for the remainder of your academic program and life in the work force. Course contents and activities involve statistical computing with R (https://www.r-project.org) interfaced through R Studio (https://www.rstudio.com) at an intermediate level to demonstrate the practical use of course materials on real-life datasets. Additional research articles (e.g., reports, journal publications) will be discussed as examples and case studies in which research questions relevant to the course are tackled step-by-step.

Feedback
Staff Feedback
Feedback from the lecturer and/or tutors will aim to facilitate the learner’s ongoing self-assessment of his/her progress in achieving the learning objectives of the course. In the recent offerings of the course, such feedback might have been limited to in-person consultation during staff office hours. In this semester, the Course Convenor will explore different modes of administering such feedback in addition to individualised consultation, e.g., through not-for-marks pop quizzes for which the entire audience takes part in the grading. Limited written comments will also be provided through the grading of formal assessments (for marks). Due to the large combined enrolment, in-person consultation remains to be the only guarantee for staff feedback on the learner’s progress in the course.

Student Feedback
ANU is committed to the demonstration of educational excellence and regularly seeks feedback from students. One of the key formal ways students have to provide feedback is
through Student Experience of Learning Support (SELS) surveys. The feedback given in these surveys is anonymous and provides the Colleges, University Education Committee and Academic Board with opportunities to recognise excellent teaching, and opportunities for improvement.

For more information on student surveys at ANU and reports on the feedback provided on ANU courses, go to http://unistats.anu.edu.au/surveys/selt/students/ and http://unistats.anu.edu.au/surveys/selt/results/learning/

Policies
ANU has educational policies, procedures and guidelines, which are designed to ensure that staff and students are aware of the University’s academic standards, and implement them. You can find the University’s education policies and an explanatory glossary at: http://policies.anu.edu.au/

Students are expected to have read the Academic Misconduct Rules 2014 before the commencement of their course.

Other key policies include:
- Student Assessment (Coursework)
- Student Surveys and Evaluations

Required Resources
- Course text: *Applied Survival Analysis: Regression Modeling of Time to Event Data, 2nd Edition* by Hosmer DW, Lemeshow S, May S

Examination material or equipment
This information will be provided on the course Wattle site.

Recommended Resources
This information will be provided on the course Wattle site.
### COURSE SCHEDULE

<table>
<thead>
<tr>
<th>Week</th>
<th>Summary of Activities</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(15–19 Feb) Introduction to survival models</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>(22–26 Feb) Introduction to survival models – continued</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>(29 Feb – 4 Mar) Overview of estimation methods</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>(7–11 Mar) Kaplan–Meier estimation</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>(15–18 Mar) Kaplan–Meier estimation – continued; Nelson–Aalen estimation</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>(21–24 Mar) Cox proportional hazards (regression) model; two-state models</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>(29 Mar – 1 Apr) Two-state models – continued</td>
<td>Midterm Exam</td>
</tr>
<tr>
<td>8</td>
<td>(18–22 Apr) Multi-state models</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>(26–29 Apr) Exposed-to-risk and mortality rates</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>(2–6 May) Graduation methods for crude mortality rates</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>(9–13 May) Graduation methods – continued</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>(16–20 May) Graduation methods – continued</td>
<td>Term Project</td>
</tr>
<tr>
<td>13</td>
<td>(23–27 May) Case studies / Catch-up / Review</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2–18 Jun) Examination period</td>
<td>Final Exam</td>
</tr>
</tbody>
</table>
ASSESSMENT REQUIREMENTS

The value of each assessment task can be a rough guideline for the relative work load you might invest in the task. For example, if you require 20 hours of studying to excel in the Midterm Exam, you might spend roughly 15 hours on the Term Project in order to excel in that assessment task.

Assessment Tasks

Assessment Task 1: Midterm Exam (redeemable)
Details of task:
90-minute closed-book exam covering materials from Weeks 1–6. There will be no special examinations for the Midterm Exam, as the weighting can be moved to the final exam.
Value: 20% (redeemable)
Estimated return date: Week 8

Assessment Task 2: Term Project (Assignment)
Details of task:
In a team of approximately 3 students (the exact size requirement TBA on the Wattle course site), you will be required to conduct a mini case study based on an assigned news article / technical report / journal article which includes a dataset. For the case study, your team will be required to produce a formal scientific report that includes a write-up on each of these items: the research question(s), the approach(es) taken by the investigators in the provided article/report, your data analysis using R (https://www.r-project.org) that reproduces the investigators’ findings, the limitations of the investigators’ approach(es), and what (and why) you believe the investigators should have done differently. Appropriate referencing must be included throughout your report. To produce your scientific report, you are highly encouraged to utilise R Markdown interfaced through R Studio (http://rmarkdown.rstudio.com).
Value: 15% (Note: Unless an individual has been approved for special considerations, each student on your team will receive an identical grade for this assessment, irrespective of the actual amount of effort an individual contributes.)
Estimated return date: Week 13

Assessment Task 3: Final Exam
Details of task:
3-hour closed-book exam covering all course materials
Value: 65% or 85%, whichever is more favourable to the student
Estimated return date: TBA on the course Wattle site

Examinations

Allowed materials:
hand-held calculator (any type), pen(cil)s, paper dictionary, notes on double-sided A4 sheets (1 sheet for Midterm Exam, 3 sheets for Final Exam)

Prohibited materials:
communication devices (computers, tablets, mobile phones, smart watches, etc.)
Term Project submission
The ANU is using Turnitin to enhance student citation and referencing techniques, and to assess assignment submissions as a component of the University's approach to managing Academic Integrity. For additional information regarding Turnitin please visit the Turnitin FAQs website.

Online Submission: You will be required to electronically sign a declaration as part of the submission of your assignment. Please keep a copy of the assignment for your records.

Extensions and penalties
Extensions and late submission of assessment pieces are covered by the Student Assessment (Coursework) Policy and Procedure.

The Course Convener may grant extensions for assessment pieces that are not examinations or take-home examinations. If you need an extension, you must request it in writing on or before the due date. If you have documented and appropriate medical evidence that demonstrates you were not able to request an extension on or before the due date, you may be able to request it after the due date.

Late submission of assessment tasks without an extension are penalised at the rate of 5% of the possible marks available per working day or part thereof. Late submission of assessment tasks is not accepted after 10 working days after the due date, or on or after the date specified in the course outline for the return of the assessment item.

Returning assignments
The Term Project will be graded and returned electronically via Wattle.

Resubmission of assignments
Resubmission of the Term Project is not allowed under any circumstance.

Referencing requirements
Appropriate scholarly referencing must be included in your report for the Term Project. For more information, see https://academicskills.anu.edu.au/resources/handouts/referencing-basics

Scaling
Your final mark for the course will be based on the raw marks allocated for each of your assessment items. However, your final mark may not be the same number as produced by that formula, as marks may be scaled. Any scaling applied will preserve the rank order of raw marks (i.e. if your raw mark exceeds that of another student, then your scaled mark will exceed the scaled mark of that student), and may be either up or down.

Tutorial Registration
Enrolment in tutorials will be completed online using the CBE Electronic Teaching Assistant (ETA). To enrol, follow these instructions:

1. Go to http://eta.fec.anu.edu.au
2. You will see the Student Login page. To log into the system, enter your University ID (your student number) and password (your ISIS password) in the appropriate fields and hit the Login button.
3. Read any news items or announcements.
4. Select "Sign Up!" from the left-hand navigation bar.
5. Select your courses from the list. To select multiple courses, hold down the control key. On PCs, this is the Ctrl key; on Macs, it is the key. Hold this key down while selecting courses with the mouse. Once courses are selected, hit the SUBMIT button.

6. A confirmation of class enrolments will be displayed. In addition, an email confirmation of class enrolments will be sent to your student account.

7. For security purposes, please ensure that you click the LOGOUT link on the confirmation page, or close the browser window when you have finished your selections.

8. If you experience any difficulties, please contact the School Office (see page 1 for contact details).

9. Students will have until 5pm February 25 to finalise their enrolment in tutorials. After this time, students will be unable to change their tutorial enrolment.

**SUPPORT FOR STUDENTS**
The University offers a number of support services for students. Information on these is available online from [http://students.anu.edu.au/studentlife/](http://students.anu.edu.au/studentlife/)