STAT3013
Statistical Inference

This course introduces students to the basic theory behind the development and assessment of statistical analysis techniques in the areas of point and interval estimation and hypothesis testing.

Topics include: Point estimation methods, including method of moments and maximum likelihood; Bias and variance; Mean-squared error and the Cramer-Rao inequality; Sufficiency, completeness and exponential families; the Rao-Blackwell theorem and uniformly minimum variance unbiased estimators; Bayesian estimation methods; Resampling estimation methods, including the jackknife and the bootstrap; Confidence interval construction methods, including likelihood-based intervals, inversion methods, intervals based on pivots and simple resampling-based percentile intervals; Highest posterior density and Bayesian credibility regions; Likelihood ratio tests and the Neymann-Pearson lemma; Power calculations and uniformly most powerful tests; Rank-based non-parametric tests, including the sign-test and Wilcoxon tests.

<table>
<thead>
<tr>
<th>Mode of Delivery</th>
<th>On campus</th>
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<tbody>
<tr>
<td>Prerequisites</td>
<td>As listed in Programs and Courses</td>
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<tr>
<td>Incompatible Courses</td>
<td>As listed in Programs and Courses</td>
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<tr>
<td>Course Convener</td>
<td>Dr. Anton Westveld</td>
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<td>+61 2 6125 5122</td>
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<td>Email:</td>
<td><a href="mailto:anton.westveld@anu.edu.au">anton.westveld@anu.edu.au</a></td>
</tr>
<tr>
<td>Office hours for student consultation:</td>
<td>To be determined during the first week of class.</td>
</tr>
<tr>
<td>Research Interests</td>
<td>Anton Westveld is a Lecturer in RSFAS. His research interests include Bayesian methodology and theory, statistical methods for interaction/relational data (network, game theoretic), statistical applications in social (economics, political science, public policy), environmental, and biological sciences.</td>
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<tr>
<td>Relevant administrator if any (optional)</td>
<td>Ms. Anna Pickering</td>
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<td>Phone:</td>
<td>(02) 61259045</td>
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<td>Email:</td>
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<tr>
<td>Lecturer</td>
<td>Dr. Anton Westveld</td>
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<tr>
<td>Tutor(s)</td>
<td>Tutors will be discussed the first week of class.</td>
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SEMESTER 1
2016

http://programsandcourses.anu.edu.au/course/STAT3013
COURSE OVERVIEW

Learning Outcomes

Upon successful completion of the requirements of this course, students should have the knowledge and skills to:

- explain the notion of a parametric model and point estimation of the parameters of those models.
- explain and apply approaches to include a measure of accuracy for estimation procedures and our confidence in them by examining the area of interval estimation.
- assess the plausibility of pre-specified ideas about the parameters of a model by examining the area of hypothesis testing.
- explain and apply the idea of non-parametric statistics, wherein estimation and analysis techniques are developed that are not heavily dependent on the specifications of an underlying parametric model.
- understand the computational issues related to the implementation of various statistical inferential approaches.

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. Tutorial questions</td>
<td>5%</td>
<td>Weeks 3-5, Weeks 8-10</td>
<td>The week after they are due</td>
</tr>
<tr>
<td>2. Presentation/Project</td>
<td>15%</td>
<td>In Week 12 of the course</td>
<td>End of Week 13</td>
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<td></td>
<td></td>
<td>(materials should be submitted at the beginning of the week).</td>
<td></td>
</tr>
<tr>
<td>3. Mid-semester examination</td>
<td>20% or 0%, redeemable in favour of the final</td>
<td>In Week 7</td>
<td>During Week 8</td>
</tr>
<tr>
<td>4. Compulsory final exam</td>
<td>60% or 80%</td>
<td>During the final exam period</td>
<td>Determined by ANU</td>
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</table>

Research-Led Teaching

The topic of statistical inference seeks to provide answers to questions of point estimation, interval estimation, and hypothesis testing that are based on observable data. Not surprisingly, through the development of this topic over the past several centuries, there exist diverse approaches to these problems. Examination and application of these diverse approaches will provide insight into the past and potentially future development of statistical science.

Feedback

Staff Feedback

Students will receive both written and verbal feedback throughout the semester.
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
Throughout the semester we will make use of R (https://www.r-project.org) and R-studio (https://www.rstudio.com). Both are open source/freely available.

Prescribed Text
G. Casella and R. Berger
Statistical Inference (second edition)
Brooks/Cole Cengage Learning

Examination material or equipment
The permitted material for the mid-semester and final exams will be:
- A4 pages (Two sheets) with had-written notes on both sides
- Paper-based dictionary, no approval required (must be clear of ALL annotations)
- Calculator (Any - programmable or not)

Recommended Texts
G. Givens and J. Hoeting
Computational Statistics (second edition)
Wiley

J. Kadane
Principles of Uncertainty
CRC Press

C. Robert
The Bayesian Choice: From Decision-theoretic Foundations to Computational Implementation
Springer
S. Stern
A set of notes previously used for this course by Dr. Steven Stern will be placed on Wattle.
ANU

COURSE SCHEDULE (Approximate)

<table>
<thead>
<tr>
<th>Week</th>
<th>Summary of Activities</th>
<th>Assessment</th>
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<tr>
<td>0</td>
<td>Orientation Week</td>
<td></td>
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<tr>
<td>1</td>
<td>Introduction and Properties of a Random Sample</td>
<td>tutorial questions</td>
</tr>
<tr>
<td>2</td>
<td>Properties of a Random Sample</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Principles of Data Reduction</td>
<td>tutorial questions</td>
</tr>
<tr>
<td>4</td>
<td>Principles of Data Reduction</td>
<td>tutorial questions</td>
</tr>
<tr>
<td>5</td>
<td>Point Estimation</td>
<td>tutorial questions</td>
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<tr>
<td>6</td>
<td>Point Estimation</td>
<td></td>
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<tr>
<td>7</td>
<td>Point Estimation</td>
<td>mid-semester exam</td>
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<tr>
<td>8</td>
<td>Interval Estimation</td>
<td>tutorial questions</td>
</tr>
<tr>
<td>9</td>
<td>Interval Estimation</td>
<td>tutorial questions</td>
</tr>
<tr>
<td>10</td>
<td>Hypothesis Testing</td>
<td>tutorial questions</td>
</tr>
<tr>
<td>11</td>
<td>Hypothesis Testing</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Presentations</td>
<td>presentations</td>
</tr>
<tr>
<td>13</td>
<td>Wrap-Up</td>
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<tr>
<td></td>
<td>Examination period</td>
<td>final exam</td>
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</tbody>
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ASSESSMENT REQUIREMENTS

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 ANU Online website.

Students may choose not to submit assessment items through Turnitin. In this instance you will be required to submit, alongside the assessment item itself, copies of all references included in the assessment item.

Assessment Tasks

Assessment Task 1: Tutorial Questions
Details of task: Before most tutorials you should submit your answers to the tutorial questions online via Wattle. These will be graded for “performance” (whether you made a reasonable attempt on the questions) and not whether you got the answer correct. Each week the “performance” will be graded as 0 or 100. Students may be asked to present their solutions during tutorial.

Assessment Task 2: Presentation/Project
Details of task: In groups of 2-4 (exact size TBD), based on your cohort (STAT3013 or STAT4027/STAT8027), you will read and present an academic paper. In addition, you will have to consider some type of “extension”. This may be by simplifying the problem and considering another estimator and its properties, extending the inferential method, or even considering other data sets. Each presentation will last 15-20 minutes (TBD) and each member of the group must speak. Every presenter in a group will be given the same grade. Your presentation materials must be submitted on Wattle by the beginning of Week 12 (each member in the group should submit the same material). I will have some possible papers on Wattle or you may choose your own. All paper
choices must be approved by me. The project will be graded by the end of Week 13. You are required to attend the talks of other students, unless you have an approved exemption (medical certificate, etc). Otherwise, a penalty of 10% will be applied to the student’s final score for the course.

**Assessment Task 3: Mid-Semester Examination**
**Details of task:** Reading time: 15 minutes. Writing time: 90 minutes. This exam is redeemable, thus it is worth either 20% of the total assessment, or 0% depending on your final examination score (see Examinations below). This exam will be in Week 7. The exact coverage of the exam will be made known at least one week before the examination and will be discussed in lecture as well as posted on Wattle. There will be no special examinations for the mid-semester exam, instead the weighting will be moved to the final exam. The grades will be returned during Week 8.

**Assessment Task 4: Final Examination**
**Details of task:** Reading time: 15 minutes. Writing time: 3 hours. This exam is worth 60% or 80% of the total assessment. The exam will be in the final examination period. The exact coverage of the exam will be made known at least one week before the examination and will be discussed in lecture as well as posted on Wattle.

**Examination(s)**
The course has a redeemable mid-semester exam and a compulsory final exam. The mid-semester exam is redeemable, meaning that you will get the better of the two breakdowns 20%+60% and 0%+80%. That is, if you do better in the final exam than in the mid-semester exam, your mid-semester exam will not count and your final exam will count for 80%. If you do not sit the mid-semester exam, your final exam will count for 80%.

Although the mid-semester exam is redeemable and optional, it is advised that students do it if possible. No special provision will be made for students who cannot sit the mid-semester exam, instead the weighting will be moved to the final exam.

**Assignment submission**
**Online Submission:** Assignments are submitted using Turnitin in the course Wattle site. 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.

No submission of assessment tasks without an extension after the due date will be permitted. If an assessment task is not submitted by the due date, a mark of 0 will be awarded.

**Returning assignments**
Assignment will be returned online.

**Resubmission of assignments**
It will not be possible for tutorial solutions and the presentation to be resubmitted.
Referencing requirements
Appropriate referencing will be necessary for the presentations. 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.

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/