Australian National University

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.

Mode of Delivery	On campus
Prerequisites	As listed in *Programs and Courses*
Incompatible Courses	As listed in *Programs and Courses*
Co-taught Courses	STAT4027, Stat8027. Graduate students attend joint classes with undergraduates but are assessed separately.
Course Convener:	Dr. Anton Westveld
Phone:	02 6125 5122
Email:	anton.westveld@anu.edu.au
Office hours for student consultation:	TBD
Research Interests	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.
Relevant administrator	Ms. Anna Pickering
Email:	anna.pickering@anu.edu.au
Tutor	Mr. Souveek Halder
Email:	souveek.halder@anu.edu.au
Office hours for student consultation:	TBD

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SEMESTER

2017

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

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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.

- asses 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

Assessment Task	Value	Due Date	Date for Return of Assessment
1. Tutorial questions	5%	Weeks 2-4, Weeks 8-10	Two weeks after the due date
2. Online quiz	0%	Week 5	End of Week 5
3. Mid-semester examination	20% or 0%, redeemable in favour of the final	Either Week 6 or Week 7	Two weeks after the exam date (not including non-teaching weeks)
4. Project	15% of the total mark	Submitted online at the end of Week 11	Two weeks after the last presentation
5. Final exam	60% or 80%	Exam period	

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 be given feedback in the following forms in this course:

- Written comments, both individually as well as to the whole class.

- Verbal comments to the whole class.

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 Rule before the commencement of their course.

Other key policies include:

- Student Assessment (Coursework)

- Student Surveys and Evaluations

Required Resources

Prescribed Texts

1. J. Rice
   Mathematical Statistics and Data Analysis (third edition)
   Brooks/Cole - Cengage Learning

Some examples provided in lectures, tutorials, and work related to the assignments and project will entail the use of the statistical computer packages R and RStudio, which are freely available at www.r-project.org and https://www.rstudio.com. The program code used for examples provided in lectures and tutorials will be available on the course Wattle site. Note: students will not be able to use any statistical package during the exam.

Recomended Texts

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

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

3. J. Kadane
   Principles of Uncertainty
   http : //uncertainty.stat.cmu.edu/wp−content/uploads/2011/05/principles−of−uncertainty.pdf
   CRC Press

4. C. Robert
   The Bayesian Choice: From Decision-theoretic Foundations to Computational Implementation
   Springer

5. S. Stern
   A set of notes previously used for this course by Dr. Steven Stern will be placed on Wattle.
   ANU

Examination material or equipment

The permitted material for the final exam will be:

- Two sheets of A4 paper with notes on both sides

- Paper-based dictionary, no approval required (must be clear of ALL annotations)

- Calculator (Any - programmable or not)

COURSE SCHEDULE - Rough Schedule

Week/ Session	Summary of Activities	Assessment
0	Orientation Week	
1	Introduction - Limit theorems	
2	Sampling from a Distribution	Tutorial Questions
3	Distributions Derived from the Normal Distribution	Tutorial Questions
4	More on Sampling	Tutorial Questions
5	Point Estimation	Quiz
6	Point Estimation	Midterm (possible)
7	Point Estimation	Midterm (possible)
	Two-Week Teaching Break	
8	Interval Estimation	Tutorial Questions
9	Interval Estimation	Tutorial Questions
10	Hypothesis Testing	Tutorial Questions
11	Hypothesis Testing	
12	Presentations	Project
	Examination Period	Final exam

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.

<u>Assessment Tasks</u>

Assessment Task 2: Compulsory Tutorial Questions
Details of task: Before many 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.
Value: 5% of the total mark.

Assessment Task 2: Compulsory Quiz
Details of task: There will be an online quiz. Results will be made available at the end of Week 5.
Value: 0% of the total mark.

Assessment Task 3: Mid-Semester Examination
Details of task: This exam is redeemable, thus it is worth either 20% of the total assessment, or 0% depending on your final examination score. This exam will be in Week 6 of 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 two weeks after the exam (not including non-teaching weeks).
Value: 20% or 0%

Assessment Task 3: Compulsory Presentation/Project
Details of task: In groups of 2-5 (exact size TBD - **if the class size is prohibitive this will be switched to a group report**), 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. **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.**
Value: 15%

Assessment Task 4: Compulsory Final Exam
Details of task: 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.
Writing time: 3 hours
Value: 80% or 60%

Examination(s)

There is a compulsory 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

Assignments may not be resubmitted.

Referencing requirements

Appropriate referencing will be necessary for the presentations. For more information see: http : //www.anu.edu.au/students/learning − development/academic − integrity/how − referencing − works

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.

Privacy Notice

The ANU has made a number of third party, online, databases available for students to use. Use of each online database is conditional on student end users first agreeing to the database licensors terms of service and/or privacy policy. Students should read these carefully.

In some cases student end users will be required to register an account with the database licensor and submit personal information, including their: first name; last name; ANU email address; and other information.

In cases where student end users are asked to submit content to a database, such as an assignment or short answers, the database licensor may only use the student's content in accordance with the terms of service including any (copyright) licence the student grants to the database licensor.

Any personal information or content a student submits may be stored by the licensor, potentially offshore, and will be used to process the database service in accordance with the licensors terms of service and/or privacy policy.

If any student chooses not to agree to the database licensor's terms of service or privacy policy, the student will not be able to access and use the database. In these circumstances students should contact their lecturer to enquire about alternative arrangements that are available.

Tutorial Seminar Registration

Tutorial signup for this course will be done via the Wattle website. Detailed information about signup times will be provided on Wattle or during your first lecture. When tutorials are available for enrolment, follow these steps:

1. Log on to Wattle, and go to the course site

2. Click on the link 'Tutorial enrolment'

3. On the right of the screen, click on the tab 'Become Member of . . . .' for the tutorial class you wish to enter

4. Confirm your choice

If you need to change your enrolment, you will be able to do so by clicking on the tab 'Leave group. . . .' and then re-enrol in another group. You will not be able to enrol in groups that have reached their maximum number. Please note that enrolment in ISIS must be finalised for you to have access to Wattle.

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/