1. Information about the course

The course content is coordinated by Associate Professor Daniel Falster and is delivered with contributions from Professor Alistair Poore, Professor Katrin Meissner, and Dr Adrian Fisher.

Year of Delivery	2022
Course Code	BEES 2041
Course Name	Data Analysis for Life and Earth Sciences
Academic Unit	School of Biological, Earth and Environmental Sciences Faculty of Science
Level of Course	Second year, undergraduate
Units of Credit	6 UOC
Session(s) Offered	Term 1
Assumed Knowledge, Prerequisites or Co-requisites	MATH1041
Hours per Week	7
Number of Weeks	10
Commencement Date	Feb 14th 2022

Summary of Course Structure (for details see 'Course Schedule' - not all lecture times are used in every week)*

Component	HPW	Time	Day	Location
Lectures	1-3	Available online- no scheduled times		
Lab – Option 1	2 2	10 am – 12 pm 12 pm - 2 pm	Monday Wednesday	Online within Moodle. Drop in help desks in G29 Biological Sciences
Lab – Option 2	2 2	10 am -12 pm 10 am - 12 pm	Monday Wednesday	Online within Moodle. Drop in help desks in G29 Biological Sciences
Lab – Option 3	2 2	12 pm - 2 pm 12 pm -2 pm	Monday Wednesday	Online within Moodle. Drop in help desks in G29 Biological Sciences
TOTAL	7			

NB: Some of this information is available on the UNSW Virtual Handbook

2. Staff involved in the course

Role	Name	Contact details	Consultation times
Course convenor	Associate Professor Daniel Falster, daniel.falster@unsw.edu.au	Level 5, E26	Arrange by email
Lecturers	Professor Katrin Meissner		
	Dr Adrian Fisher		
	Professor Alistair Poore		

Demonstrators	Gary Truong Rebecca Stolper Ben Walker Charlotte Page		

3. Course details

Course description	Development of skills in applying statistics to biological, earth and spatial data; design and analysis of experiments in life and earth sciences; sampling strategies for estimating sample size; analysis of community and environment structure using multivariate statistics; simulation modeling in population biology, and statistical fitting of non-linear models to population growth data; correlation and both simple and multiple regression; improving statistical models using analysis of residuals; analysis of spatial data. Examples are drawn from ecological, geographical, earth, behavioural, and genetic and immunological data. Practical work emphasis problem-solving and hands-on experience with R and other specialist software. Assumed Knowledge: MATH1041
Course aims	The aim of the course (BEES2041) is the development of skills in: • applying quantitative methods to biological, earth and spatial data • the design of sampling and experimental research • interpretation and communication of statistical results The course will be based on a series of worked examples from a wide variety of disciplines, and practical work emphasises problem-solving and hands-on experience with the statistical software R and other specialist software. The course is designed to provide you with skills in performing a variety of statistical tests and in recognising when to apply which statistical test. A number of different types of tests will be covered and at the end of the course you will be expected to know how and when to apply each of these tests. We will cover a suite of tests that are relevant to most areas of life and earth sciences including medicine, physiology, ecology, environmental science, geography, geology, genetics, and behavioural biology.
Student learning outcomes	After studying this subject, you should be able to: • Outline the logical process involved in hypothesis testing • Identify appropriate statistical tests for a given sampling or experimental design, execute and interpret the results of such tests • Conduct and interpret contingency table analyses • Explain the assumptions of linear models (regression, ANOVA) • Test the assumptions of linear models and outline appropriate options if assumptions are violated • Outline the logical process of conducting, interpreting and reporting results from linear models • Calculate the key components of linear models • Explain the basic principles of geostatistical analysis • Interpret figures and statistical output derived from multivariate analyses (cluster analyses, MDS, PCA) • Communicate the results of experiments or sampling exercises with appropriate integration of text, figures and statistical support for results.

Graduate attributes developed in this course

Science Graduate Attributes	Select the level of FOCUS 0 = NO FOCUS 1 = MINIMAL 2 = MINOR 3 = MAJOR	Activities/Assessment
Research, inquiry and analytical thinking abilities	3	Practical projects and fieldtrip. Assessment by written reports & final exam.
Capability and motivation for intellectual development	3	Practical projects, fieldtrip. Assessment by written reports. Emphasis on the need for statistical analyses in the students' disciplines
Ethical, social and professional understanding	3	Environmental and resource-management issues and case studies considered in lectures & practicals. Assessment by written reports.
Communication	3	Practical reports (for scientific audiences) Critical assessment of published results from statistical analyses
Teamwork, collaborative and management skills	1	Collaborative data collection on fieldtrip Assessment by written reports.
Information literacy	1	Practical & fieldtrip projects. Assessment by written reports.

4. Major topics

Introduction to statistical analyses	The first lectures and practicals introduce you to why we need quantitative skills in the life and earth sciences, the basic logic of hypothesis testing, and some simple, commonly used tests (*t*-tests for independent and paired samples; chi-square (χ^2) and contingency tables for the analysis of categorical data).
Linear models	Linear models (regression and analyses of variance) are among the most commonly used statistical tests. Linear regression is a technique used to analyze the relationship between 2 or more continuous variables. These lectures cover the basic principles of linear-regression modeling, including how to formulate biological problems in terms of regression models, how to fit models using a statistical package, how to test the validity of the underlying assumptions, and what to do when the assumptions are violated. Analysis of variance (ANOVA) is a form of linear modeling for categorical variables, and is one of the most useful and powerful tools in the analysis of biological data. We will cover the development of ANOVA models for hypothesis testing as well as testing the underlying assumptions. We will examine post-hoc tests (to determine which treatments differ in a significant ANOVA), Other lectures concern the range of linear models for more complex experiments (two-factor and nested ANOVA, analysis of covariance, ANCOVA, multiple regression).
Communicating results	This practical will involve examining published examples of the use of a wide range of statistical tests, and learning effective methods of communicating the results from sampling or experimental work by the appropriate integration of text, figures and statistical output.

Multivariate analyses	These lectures and practicals will provide an introduction to multivariate statistical techniques. The focus will be on techniques that aim to visualise data with more than one dependent variable (e.g., samples that include the abundance of several species). We will cover the concepts of classification and ordination, including techniques that are commonly used in biology such as PCA (principal components analysis) and MDS (multidimensional scaling).
Exploring spatial data	This section of the course will introduce you to the collection, visualisation and interpretation of spatial data. Mapping and understanding biotic and abiotic processes across the landscape requires skills in handling data that have been collected from known locations. There will be introduction spatial interpolation, the process by which sample data are transformed into a continuous surface, estimating the value of a phenomenon or process at any point.

5. Rationale and strategies underpinning the course

Teaching strategies	Lectures provide students with basic concepts and key statistical information from statistical references and research publications. Lectures provide theory and techniques that will be the basis of practicals. Practicals involve use of statistical packages to solve exercises and to analyse data collected by students on the field trip. These computer tasks are at an appropriate level of complexity so students will understand and learn important statistical principles and techniques, yet not become confused by statistical detail.
Rationale for learning and teaching in this course	The course uses a variety of teaching methods (lectures, practicals on each of the major topics, a half-day field excursion). Practicals are based on a series of worked examples from ecological, geographical, earth, genetic, and environmental data. Practical work emphasises problem-solving and hands-on experience with R and other specialist software in the computer laboratory.

6. Course evaluation and development

Student feedback is gathered periodically by various means. Such feedback is considered carefully with a view to acting on it constructively wherever possible. This course outline conveys how feedback has helped to shape and develop this course.

Mechanisms of Review	Last Review Date	Comments or Changes Resulting from Reviews
Major Course Review	June 2008	Refinement of lectures and practicals following introduction of 12-week session; Improvements to course manual. Modified lectures and laboratory on Spatial Data Analysis (Week 7).
	February 2010	In 2010 the course was revised to: reduce the number of submitted assignments, removal of lectures on population modeling, and expand the lectures on spatial data analyses.
	February 2011	In 2011, after changes in teaching staff, the course was revised to present linear models (regression and ANOVA) in a more organized fashion, the field trip was revised to collect data for several of the later practicals, and new practical sessions were designed to give students greater skills in sampling and experimental design, and in communicating results.
	February 2014	Major revision of the practical classes to begin using the statistical software package R for most analyses. The use of R is increasingly becoming necessary for biological and environmental scientists.
	May 2015	Launch of Quantitative skills for BEES, a Moodle site with help for data entry, analysis and graphical techniques. The site uses course material from BEES2041 and more advanced material that can be accessed by BEES students throughout their degree.
	May 2016	Launch of Environmental Computing, an open access web site with a wide variety of short tutorials to support students from the biological, earth and environmental sciences throughout their degree at UNSW. Much of the course material is represented on this site to provide further help for BEES2041 students.

	February 2018	Revision of spatial analysis section with new lectures, field data collection exercise and practical classes.
	February 2020	Revision of assessments and exam format
	February 2022	New course convenor

7. Administration matters

Expecations of students	You are required to complete all assessments during the course. If you are unable to do so for legitimate reasons, you must consult the lecturer. The requirements for individual assessments are set out in the outlines. Before starting the course, you are expected to have the following knowledge, skills and attitudes: • A solid understanding of the notion of variables or factors governing processes in biological systems and/or earth systems, although there is no assumption that you have taken any specific first year science courses. • Understanding of the need to assess the relative contributions of different factors which structure biological and earth systems. • A grasp of the inherent (often dramatic) natural variability in all biological and earth systems • Facility with simple statistical concepts such as likelihood and probability, the distribution of data, and hypothesis generation The official “Assumed Knowledge” for BEES2041 is the course MATH1041 (Statistics for Life Sciences). If you have not done MATH1041, you will need to study the material covered in that course and read the relevant sections of the text book for MATH1041 (Moore & McCabe 1998). Attendance at all practicals is expected, during the specified time. Without attending you'll miss the opportunity to get explanations from the lecturers and demonstrators, who are only available in those times. We won't be recording the practicals, so please make sure you can attend.
Assignment submissions	Detailed instructions for submitting each of the practical reports will be given when the instructions for those reports are released. **School policy for late report submission:** For reports submitted up to five (5) days late, a 5% per day penalty applies. Reports submitted more than five (5) days (120 hours) late will not be marked. There is no permitted variation to this policy. If medical grounds preclude submission of a report by the due date, contact should be made with the course convenor as quickly as possible. A medical certificate will be required for late submission on medical grounds and must be appropriate for extension period.
Occupational Health and Safety	Information on relevant Occupational Health and Safety policies can be found at: • http://www.bees.unsw.edu.au/health-and-safety
Assessment proceedures	The final examination will be scheduled by the Examinations Office. Students should be available for examination throughout the entire UNSW end-of-session examination period. Supplementary examinations will only be granted to students who miss the final examination due to illness or other unexpected reasons outside their control. A student who wishes to apply for a supplementary examination should contact the course coordinator as soon as the problem becomes apparent, and should apply for special consideration. (Special consideration cannot be given for students who have planned or wish to plan any holiday trips or return flights home before the end of the examination period.) If a supplementary examination is granted, it will normally be held before the beginning of the next session. Until then, you should maintain a current address with SIS, and be available for contact and assessment. For information on examinations see

	• https://my.unsw.edu.au/student/academiclife/assessment/examinations/examinations.html The conditions for special consideration are given at • https://my.unsw.edu.au/student/atoz/SpecialConsideration.html
Equity and diversity	Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course Convenor prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equity and Diversity Unit (9385 4734 or http://www.studentequity.unsw.edu.au/). Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

Grievance policy

School contact	Faculty contact	University contact
BEES Grievance Officer Associate Professor Jes Sammut j.sammut@unsw.edu.au Phone: 9385 8281	Dr Gavin Edwards Associate Dean (Undergraduate Programs) g.edwards@unsw.edu.au Phone: 9385 4652	Student Conduct and Appeals Office The Student Conduct and Appeals Office (Student Life and Learning) can help you at any stage of the complaints process. Phone: (02) 9385 8515 Email: studentcomplaints@unsw.edu.au