UNSW Course Outline

ZPEM2302 Mathematical Tools for Science - 2024

Published on the 11 Feb 2024

General Course Information

Course Code : ZPEM2302
Year : 2024
Term : Semester 1
Teaching Period : Z1
Is a multi-term course? : No
Faculty : UNSW Canberra
Academic Unit : UC Science
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : UNSW Canberra at ADFA
Campus : UNSW Canberra
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

The emphasis of this course is on developing mathematical tools for a variety of different modelling contexts from the Sciences. The course is taught in two strands, Data Analysis and Multivariable Calculus. The Data Analysis strand uses data from simple experimental and

observational studies, and introduces graphical methods for data presentation and exploration. It discusses the important concepts of populations, samples and randomness, and explains how to relate sample values to population values and test claims about population parameters. Association between different measurements is quantified, and methods of modelling the relationship between two variables are studied. The Multivariable Calculus strand describes surfaces in three dimensions using contour plots, partial derivatives and the gradient vector. Of great importance is the location of maxima or minima of the function, leading to a discussion of the methods of optimisation for functions of several variables, especially when auxiliary constraints must also be satisfied. Case studies in both strands will illustrate how the mathematical tools operate in a wide range of disciplines including Geography, Chemistry, Physics and Oceanography. The computer package MATLAB will be used throughout the course, particularly for its powerful graphics capabilities.

Course Aims

The aim of this course is to develop mathematical tools for a variety of different modelling contexts from the Sciences. The course is taught in two strands, Data Analysis (DA) and Multivariable Calculus (MVC).

Course Learning Outcomes

Course Learning Outcomes
CLO1 : At the successful completion of this course, students should be able to solve life-related problems involving population distributions (such as the Normal and Binomial distributions), and sampling distributions;
CLO2 : At the successful completion of this course, students should be able to calculate confidence intervals for population proportions and population means for one or two samples, and interpret the results;
CLO3 : At the successful completion of this course, students should be able to perform hypothesis tests for population proportions for one or two samples, and population means for one, two or more samples, and interpret the results;
CLO4 : At the successful completion of this course, students should be able to investigate the properties of double and triple integrals in different coordinate systems and apply them to physical processes;
CLO5 : At the successful completion of this course, students should be able to investigate the properties of vector fields via their divergence and curl and their physical interpretation;
CLO6 : At the successful completion of this course, students should be able to apply the Divergence theorem and Stoke's theorem to problems arising in fluid dynamics and electrodynamics.

Course Learning Outcomes	Assessment Item
CLO1 : At the successful completion of this course, students should be able to solve life-related problems involving population distributions (such as the Normal and Binomial distributions), and sampling distributions;	• class test 1 • tutorial quizzes • final exam
CLO2 : At the successful completion of this course, students should be able to calculate confidence intervals for population proportions and population means for one or two samples, and interpret the results;	• class test 2 • class test 1 • tutorial quizzes • final exam
CLO3 : At the successful completion of this course, students should be able to perform hypothesis tests for population proportions for one or two samples, and population means for one, two or more samples, and interpret the results;	• class test 2 • tutorial quizzes • final exam
CLO4 : At the successful completion of this course, students should be able to investigate the properties of double and triple integrals in different coordinate systems and apply them to physical processes;	• class test 1 • tutorial quizzes • final exam
CLO5 : At the successful completion of this course, students should be able to investigate the properties of vector fields via their divergence and curl and their physical interpretation;	• class test 2 • class test 1 • tutorial quizzes • final exam
CLO6 : At the successful completion of this course, students should be able to apply the Divergence theorem and Stoke's theorem to problems arising in fluid dynamics and electrodynamics.	• class test 2 • tutorial quizzes • final exam

Learning and Teaching Technologies

Moodle - Learning Management System

Learning and Teaching in this course

The computer package MATLAB will be used throughout the course, particularly for its powerful graphics capabilities.

Enrolment in this course or participation in any activity that is recorded constitutes consent to be recorded during tutorial and other teaching sessions. Recordings will only be used for the purposes of teaching this course. If you do not consent to be recorded, you must notify your course convenor immediately so other arrangements can be made.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
class test 1 Assessment Format: Individual	20%	Start Date: Week 6
tutorial quizzes Assessment Format: Individual	20%	Start Date: Weeks 3-10
class test 2 Assessment Format: Individual	30%	Start Date: Week 12
final exam Assessment Format: Individual	30%	Start Date: Not Applicable

Assessment Details

class test 1

Course Learning Outcomes

- CLO1 : At the successful completion of this course, students should be able to solve life-related problems involving population distributions (such as the Normal and Binomial distributions), and sampling distributions;
- CLO2 : At the successful completion of this course, students should be able to calculate confidence intervals for population proportions and population means for one or two samples, and interpret the results;
- CLO4 : At the successful completion of this course, students should be able to investigate the properties of double and triple integrals in different coordinate systems and apply them to physical processes;
- CLO5 : At the successful completion of this course, students should be able to investigate the properties of vector fields via their divergence and curl and their physical interpretation;

tutorial quizzes

Course Learning Outcomes

- CLO1 : At the successful completion of this course, students should be able to solve life-related problems involving population distributions (such as the Normal and Binomial distributions), and sampling distributions;
- CLO2 : At the successful completion of this course, students should be able to calculate confidence intervals for population proportions and population means for one or two samples, and interpret the results;
- CLO3 : At the successful completion of this course, students should be able to perform hypothesis tests for population proportions for one or two samples, and population means for one, two or more samples, and interpret the results;
- CLO4 : At the successful completion of this course, students should be able to investigate the properties of double and triple integrals in different coordinate systems and apply them to

physical processes;
- CLO5 : At the successful completion of this course, students should be able to investigate the properties of vector fields via their divergence and curl and their physical interpretation;
- CLO6 : At the successful completion of this course, students should be able to apply the Divergence theorem and Stoke's theorem to problems arising in fluid dynamics and electrodynamics.

Assessment information

Alternating according to whether MVC or DA.

class test 2

Course Learning Outcomes

- CLO2 : At the successful completion of this course, students should be able to calculate confidence intervals for population proportions and population means for one or two samples, and interpret the results;
- CLO3 : At the successful completion of this course, students should be able to perform hypothesis tests for population proportions for one or two samples, and population means for one, two or more samples, and interpret the results;
- CLO5 : At the successful completion of this course, students should be able to investigate the properties of vector fields via their divergence and curl and their physical interpretation;
- CLO6 : At the successful completion of this course, students should be able to apply the Divergence theorem and Stoke's theorem to problems arising in fluid dynamics and electrodynamics.

final exam

Course Learning Outcomes

- CLO1 : At the successful completion of this course, students should be able to solve life-related problems involving population distributions (such as the Normal and Binomial distributions), and sampling distributions;
- CLO2 : At the successful completion of this course, students should be able to calculate confidence intervals for population proportions and population means for one or two samples, and interpret the results;
- CLO3 : At the successful completion of this course, students should be able to perform hypothesis tests for population proportions for one or two samples, and population means for one, two or more samples, and interpret the results;
- CLO4 : At the successful completion of this course, students should be able to investigate the properties of double and triple integrals in different coordinate systems and apply them to physical processes;
- CLO5 : At the successful completion of this course, students should be able to investigate the properties of vector fields via their divergence and curl and their physical interpretation;
- CLO6 : At the successful completion of this course, students should be able to apply the Divergence theorem and Stoke's theorem to problems arising in fluid dynamics and electrodynamics.

Assessment Length

3 hours

General Assessment Information

All marks obtained for assessment items during the session are provisional. The final mark as published by the university following the assessment review group meeting is the only official mark.

Assessment for this course consists of quizzes, class tests, and an exam.

Missed Assessment: If circumstances cause you to miss classes or assessments, contact the Course Coordinator as soon as possible. A medical certificate, minute signed by your Divisional Officer or other appropriate supporting documentation must accompany all requests for consideration. If under these circumstances you miss some assessment, we will endeavour to make arrangements for you to complete the assessment; if this is not possible, the rest of your marks will be pro-rata weighted accordingly. If you miss a significant part of the course, you should apply for formal Academic Consideration at Student Administrative Services. All requests for Academic Consideration should be lodged promptly.

Use of AI:

NO ASSISTANCE
It is prohibited to use any software or service to search for or generate information or answers. If its use is detected, it will be regarded as serious academic misconduct and subject to the standard penalties, which may include 00FL, suspension and exclusion.

Grading Basis

Standard

Requirements to pass course

The assessment for the course has been designed so that an overall mark of 50% or greater indicates that the student has unambiguously demonstrated satisfactory completion of each learning outcome. For this reason, and consistent with the UNSW policy of abolishing the Pass Conceded grade, students who receive less than 50% overall for the course will receive a fail grade. Written work submitted on or before the due date will normally be returned within 10 days of the due date. Late work will be returned at the lecturer's convenience.

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 26 February - 1 March	Lecture	• DA, Tue: Intro, Data and sampling • DA, Wed: Review of probability • Calculus: Introduction to partial differentiations
Week 2 : 4 March - 8 March	Lecture	• DA, Tue: Random variables and probability distributions • DA, Wed: q-q plots, testing for normality • Calculus: Introduction to directional derivatives
Week 3 : 11 March - 15 March	Lecture	• DA, Tue: Central Limit Theorem • DA, Wed: Confidence intervals • Calculus: Introduction to grad, and div, review of linear algebra
Week 4 : 18 March - 22 March	Lecture	• DA, Tue: Confidence intervals • DA, Wed: Hypothesis testing • Calculus: Introduction to multi-variable integration
Week 5 : 25 March - 29 March	Lecture	• DA, Tue: Hypothesis testing • DA, Wed: Revision • Calculus: Revision of multi-variable integration
Week 6 : 1 April - 5 April	Lecture	• DA, Tue: Revision • Wed: Class Test 1 • Calculus: continuation of multi-variable integration
Week 7 : 22 April - 26 April	Lecture	• DA, Tue: Comparing two population means: intro • Wed: Military Training Day • Calculus: Introduction to multi-variable integration
Week 8 : 29 April - 3 May	Lecture	• DA, Tue: Comparing two population means: paired samples • DA, Wed: Comparing two population means: further examples • Calculus: Introduction to multi-variable integration
Week 9 : 6 May - 10 May	Lecture	• DA, Tue: Comparing several means: F distribution • DA, Wed: Comparing several means: Analysis of Variance table • Calculus: Introduction to line integrals
Week 10 : 13 May - 17 May	Lecture	• DA, Tue: Comparing several means: Blocking effects and two-way designs • DA, Wed: Comparing several means: interactions • Calculus: Continuation of study on line integrals.
Week 11 : 20 May - 24 May	Lecture	• DA, Tue: Revision • DA, Wed: Revision • Calculus: Introduction to Green's Theorem
Week 12 : 27 May - 31 May	Lecture	• Tue: Monday's Timetable • DA, Wed: Class Test 2 • Calculus: Introduction to Stokes' theorem
Week 13 : 3 June - 7 June	Lecture	• DA, Tue: Correlation • DA, Wed: Correlation • Calculus: Revision

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

General Schedule Information

- Multi-variable calculus lectures will progress through the course notes. We will cover the following topics, broadly in this order: partial derivatives, multi-variable integration, vector calculus.
- Data Analysis lectures will progress through the course notes. We will cover the following topics, broadly in this order: discrete and continuous probability distributions, sampling distributions and Central Limit Theorem, confidence intervals and hypothesis tests for population means, comparing population means.

Course Resources

Prescribed Resources

1. The course notes, tutorial sheets and solutions, and supplementary teaching materials will be available on Moodle. You can find the textbook for MVC here: https://open.umn.edu/opentextbooks/textbooks/780. Please ensure you check Moodle regularly.

2. A Casio FX82 Scientific calculator will be required.

3. MATLAB software should be obtained from: https://www.it.unsw.edu.au/students/software/matlab.html

4. Stewart's Calculus (any edition) can be obtained via the library or online.

Recommended Resources

Data Analysis

1. **Probability:** Ross, Sheldon M. *A First Course in Probability*. 10th ed. Harlow: Pearson Education Limited, 2020.
2. **Statistics:** McClave, James T.; Sincich, Terry. *A First Course in Statistics*. 12th ed. Harlow: Pearson Education Limited, 2018.

Course Evaluation and Development

One of the key priorities in the 2025 Strategy for UNSW is a drive for academic excellence in education. One of the ways of determining how well UNSW is progressing towards this goal is by listening to our own students. Students will be asked to complete the myExperience survey towards the end of this course.

Students can also provide feedback during the semester via: direct contact with the lecturer, the "On-going Student Feedback" link in Moodle, Student-Staff Liaison Committee meetings in schools, informal feedback conducted by staff, and focus groups. Student opinions really do make a difference. Refer to the Moodle site for this course to see how the feedback from previous students has contributed to the course development.

Important note: Students are reminded that any feedback provided should be constructive and professional and that they are bound by the Student Code of Conduct Policy https://

www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Timothy T rudgian		Room G26, Science South	(02) 5114 5026	Available for consultation during normal working hours, either face-to-face or by email. Please phone or email to make an appointment.	No	Yes
Lecturer	Aleksande r Simonic				Available for consultation during normal working hours, either face-to-face or by email. Please phone or email to make an appointment.	No	No
	Zlatko Jov anoski					No	No

Other Useful Information

Academic Information

Course Evaluation and Development

One of the key priorities in the 2025 Strategy for UNSW is a drive for academic excellence in education. One of the ways of determining how well UNSW is progressing towards this goal is by listening to our own students. Students will be asked to complete the myExperience survey towards the end of each course.

Students can also provide feedback during the semester via: direct contact with the lecturer, the “On-going Student Feedback” link in Moodle, Student-Staff Liaison Committee meetings in schools, informal feedback conducted by staff, and focus groups (where applicable). Student opinions really do make a difference. Refer to the Moodle site for your course to see how the feedback from previous students has contributed to the course development.

Important note: Students are reminded that any feedback provided should be constructive and professional and that they are bound by the Student Code of Conduct.

https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf

Equitable Learning Services (ELS)

Students living with neurodivergent, physical and/or mental health conditions or caring for someone with these conditions may be eligible for support through the Equitible Learning

Services team. Equitable Learning Services is a free and confidential service that provides practical support to ensure your mental or physical health conditions do not adversely affect your studies.

Our team of dedicated **Equitable Learning Facilitators** (ELFs) are here to assist you through this process. We offer a number of services to make your education at UNSW easier and more equitable.

Further information about ELS for currently enrolled students can be found at: https://www.student.unsw.edu.au/equitable-learning

Academic Honesty and Plagarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW staff and students have a responsibility to adhere to this principle of academic integrity. All students are expected to adhere to UNSW's Student Code of Conduct. Find relevant information at: Student Code of Conduct (unsw.edu.au)

Plagiarism undermines academic integrity and is not tolerated at UNSW. It is defined as using the words or ideas of others and passing them off as your own, and can take many forms, from deliberate cheating to accidental copying from a source without acknowledgement.

For more information, please refer to the following:

https://student.unsw.edu.au/plagiarism

Submission of Assessment Tasks

Special Consideration

Special Consideration is the process for assessing and addressing the impact on students of short-term events, that are beyond the control of the student, and that affect performance in a specific assessment task or tasks.

Applications for Special Consideration will be accepted in the following circumstances only:

- Where academic work has been hampered to a substantial degree by illness or other cause;
- The circumstances are unexpected and beyond the student's control;
- The circumstances could not have reasonably been anticipated, avoided or guarded against by the student; and either:

(i) they occurred during a critical study period and was 3 consecutive days or more duration, or a total of 5 days within the critical study period; or

(ii) they prevented the ability to complete, attend or submit an assessment task for a specific date (e.g. final exam, in class test/quiz, in class presentation)

Applications for Special Consideration must be made as soon as practicable after the problem occurs and at the latest within three working days of the assessment or the period covered by the supporting documentation.

By sitting or submitting the assessment task the student is declaring that they are fit to do so and cannot later apply for Special Consideration (UNSW 'fit to sit or submit' requirement).

Sitting, accessing or submitting an assessment task on the scheduled assessment date, after applying for special consideration, renders the special consideration application void.

Find more information about special consideration at: https://www.student.unsw.edu.au/special/consideration/guide

Or apply for special consideration through your MyUNSW portal.

Late Submission of assessment tasks (other than examinations)

UNSW has a standard late submission penalty of:

- 5% per day,
- capped at five days (120 hours) from the assessment deadline, after which a student cannot submit an assessment, and
- no permitted variation.

Students are expected to manage their time to meet deadlines and to request extensions as early as possible before the deadline.

Electronic submission of assessment

Except where the nature of an assessment task precludes its electronic submission, all assessments must be submitted to an electronic repository, approved by UNSW or the Faculty, for archiving and subsequent marking and analysis.

Release of final mark

All marks obtained for assessment items during the session are provisional. The final mark as published by the university following the assessment review group meeting is the only official mark.