



## UNSW Course Outline

# MATH5271 Environmental Data Science and Statistics - 2024

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## General Course Information

**Course Code :** MATH5271

**Year :** 2024

**Term :** Term 1

**Teaching Period :** T1

**Is a multi-term course? :** No

**Faculty :** Faculty of Science

**Academic Unit :** School of Mathematics & Statistics

**Delivery Mode :** In Person

**Delivery Format :** Standard

**Delivery Location :** Kensington

**Campus :** Sydney

**Study Level :** Postgraduate

**Units of Credit :** 6

### Useful Links

[Handbook Class Timetable](#)

## Course Details & Outcomes

### Course Description

This course is a graduate level overview of the applications of data science in an environmental context. Although applications and motivations will be drawn primarily from the ocean, atmospheric and climate sciences, the material covered will apply generally across various

environmental and non-environmental science and industry areas. A key focus of this course is an emphasis on practical real-world problems. These include practical approaches to data handling and quality control, consideration of real-world examples of good and bad data science practice, the application of various statistical methods to real world data sets, the integration of statistical approaches with physically based forecast methods, and a project component involving independent exploration and exposition of cutting-edge machine learning methods.

## Course Aims

The aim of this course is to give an overview of environmental data science. The course will give students the tools to overcome issues relating to the treatment of raw observational data, practically implement various analysis methods and skillfully interpret the resulting analysis. While practical in nature, the course will rigorously cover underlying fundamentals and aims to give students a powerful and critical framework with which to approach data science issues generally.

## Course Learning Outcomes

| Course Learning Outcomes                                                                    |
|---------------------------------------------------------------------------------------------|
| CLO1 : Explain the necessary framework for approaching environmental data science problems. |
| CLO2 : Evaluate data efficacy and statistical methods in the environmental sciences.        |
| CLO3 : Apply a range of techniques for the analysis of environmental data.                  |
| CLO4 : Communicate and critically evaluate ideas in environmental data science.             |

| Course Learning Outcomes                                                                    | Assessment Item                                                                                                                                |
|---------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| CLO1 : Explain the necessary framework for approaching environmental data science problems. | <ul style="list-style-type: none"><li>• Data handling essay</li><li>• Portfolio</li><li>• Final exam</li></ul>                                 |
| CLO2 : Evaluate data efficacy and statistical methods in the environmental sciences.        | <ul style="list-style-type: none"><li>• Portfolio peer review</li><li>• Portfolio</li><li>• Final exam</li></ul>                               |
| CLO3 : Apply a range of techniques for the analysis of environmental data.                  | <ul style="list-style-type: none"><li>• Portfolio peer review</li><li>• Portfolio</li><li>• Final exam</li></ul>                               |
| CLO4 : Communicate and critically evaluate ideas in environmental data science.             | <ul style="list-style-type: none"><li>• Data handling essay</li><li>• Portfolio peer review</li><li>• Portfolio</li><li>• Final exam</li></ul> |

# Learning and Teaching Technologies

Moodle - Learning Management System | Blackboard Collaborate

## Assessments

### Assessment Structure

| Assessment Item                                        | Weight | Relevant Dates                                                 |
|--------------------------------------------------------|--------|----------------------------------------------------------------|
| Data handling essay<br>Assessment Format: Individual   | 10%    | Start Date: Week 1<br>Due Date: Week 3: 26 February - 03 March |
| Portfolio<br>Assessment Format: Individual             | 50%    | Start Date: Week 8<br>Due Date: Week 10: 15 April - 21 April   |
| Final exam<br>Assessment Format: Individual            | 30%    |                                                                |
| Portfolio peer review<br>Assessment Format: Individual | 10%    |                                                                |

### Assessment Details

#### Data handling essay

##### Assessment Overview

The first week of the course will cover the largely qualitative subject of data handling. The aim of this section is to encourage you to think critically about different challenges and considerations in environmental data science.

You will submit a short essay (500-1000 words) describing key lessons from one of a number of case studies presented during the first week.

The essay is due in Week 3, with feedback provided within two weeks of submission.

##### Course Learning Outcomes

- CLO1 : Explain the necessary framework for approaching environmental data science problems.
- CLO4 : Communicate and critically evaluate ideas in environmental data science.

##### Assessment information

Late submission rule: Standard late submission penalties apply.

# Portfolio

## Assessment Overview

Throughout the term, you will prepare a portfolio involving the application and discussion of the various methods presented in the course. The portfolio will involve three specific tasks related directly to the course material and one additional task which is more open-ended and will encourage you to undertake independent exploration of data science methods. Feedback will be given by lecturers and tutors for portfolio tasks both in tutorials and via the Moodle workshop where appropriate. Final portfolios will be submitted (including completion of all four tasks) in Week 10.

## Course Learning Outcomes

- CLO1 : Explain the necessary framework for approaching environmental data science problems.
- CLO2 : Evaluate data efficacy and statistical methods in the environmental sciences.
- CLO3 : Apply a range of techniques for the analysis of environmental data.
- CLO4 : Communicate and critically evaluate ideas in environmental data science.

## Assessment information

Late submission rule: Standard late submission penalties apply.

# Final exam

## Assessment Overview

The final exam is designed to assess your learning and problem-solving skills on all topics delivered across the term. The exam is 2 hours long and will occur during official university examination period. The exam will focus on quantitative material covered in the required reading in the textbook. There will also be some additional short answer questions relating to more qualitative aspects discussed in the course such as data handling.

Feedback is available through inquiry with the course convenor.

## Course Learning Outcomes

- CLO1 : Explain the necessary framework for approaching environmental data science problems.
- CLO2 : Evaluate data efficacy and statistical methods in the environmental sciences.
- CLO3 : Apply a range of techniques for the analysis of environmental data.
- CLO4 : Communicate and critically evaluate ideas in environmental data science.

## **Portfolio peer review**

### **Assessment Overview**

To encourage collaboration, critical thinking and skepticism, you will review drafts of the portfolio task reports submitted by your fellow students using the Moodle workshop feature. You will be asked to give feedback on initial attempts at tasks throughout the term and at the end of term you will be given a final opportunity to assess whether all tasks have been completed satisfactorily. Summative assessment of your peer reviews will depend on whether the reviews gave appropriate and constructive feedback. Part 1 (5%) is due in week 4, part 2 (5%) is due in week 7.

### **Course Learning Outcomes**

- CLO2 : Evaluate data efficacy and statistical methods in the environmental sciences.
- CLO3 : Apply a range of techniques for the analysis of environmental data.
- CLO4 : Communicate and critically evaluate ideas in environmental data science.

## **General Assessment Information**

### **Grading Basis**

Standard

# Course Schedule

| Teaching Week/Module               | Activity Type | Content                                                         |
|------------------------------------|---------------|-----------------------------------------------------------------|
| Week 1 : 12 February - 18 February | Lecture       | Lecture 1: Data and data handling.                              |
|                                    | Laboratory    | Lab 1: Exploratory data analysis                                |
| Week 2 : 19 February - 25 February | Lecture       | Lecture 2: Statistical forecasting                              |
|                                    | Laboratory    | Lab 2: Statistical forecasting                                  |
| Week 3 : 26 February - 3 March     | Assessment    | Data handling essay                                             |
|                                    | Lecture       | Lecture 3: Time series analysis Part 1.                         |
|                                    | Laboratory    | Lab 3: Time series analysis Part 1.                             |
| Week 4 : 4 March - 10 March        | Assessment    | Portfolio: Draft of lab tasks 1 and 2                           |
|                                    | Lecture       | Lecture 4: Time series analysis Part 2.                         |
|                                    | Laboratory    | Lab 4: Time series analysis Part 2.                             |
| Week 5 : 11 March - 17 March       | Assessment    | Portfolio peer review                                           |
|                                    | Lecture       | Lecture 5: Principal component analysis.                        |
|                                    | Laboratory    | Lab 5: Principal component analysis.                            |
| Week 7 : 25 March - 31 March       | Assessment    | Portfolio: Draft of lab tasks 3-5.                              |
|                                    | Laboratory    | Lab 6: Discrimination, classification, and cluster analysis     |
|                                    | Lecture       | Lecture 6: Discrimination, classification, and cluster analysis |
| Week 8 : 1 April - 7 April         | Assessment    | Portfolio: Peer feedback                                        |
|                                    | Lecture       | Lecture 7: Machine learning                                     |
|                                    | Laboratory    | Lab 7: Machine learning                                         |
| Week 9 : 8 April - 14 April        | Group Work    | Final project consultations.                                    |
| Week 10 : 15 April - 21 April      | Assessment    | Final project presentations.                                    |
|                                    | Tutorial      | Final exam revision.                                            |
| Week 11 : 22 April - 28 April      | Assessment    | Final portfolio due.                                            |

## Attendance Requirements

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

## Course Resources

### Recommended Resources

Wilks, D.S. (2011), *Statistical Methods in the Atmospheric Sciences*, 3rd Edition, Academic Press, Oxford

## Staff Details

| Position | Name          | Email | Location | Phone | Availability | Equitable Learning Services Contact | Primary Contact |
|----------|---------------|-------|----------|-------|--------------|-------------------------------------|-----------------|
|          | Shane Keating |       |          |       |              | No                                  | Yes             |

# Other Useful Information

## Academic Information

Upon your enrolment at UNSW, you share responsibility with us for maintaining a safe, harmonious and tolerant University environment.

You are required to:

- Comply with the University's conditions of enrolment.
- Act responsibly, ethically, safely and with integrity.
- Observe standards of equity and respect in dealing with every member of the UNSW community.
- Engage in lawful behaviour.
- Use and care for University resources in a responsible and appropriate manner.
- Maintain the University's reputation and good standing.

For more information, visit the [UNSW Student Code of Conduct Website](#).

## Academic Honesty and Plagiarism

**Referencing** is a way of acknowledging the sources of information that you use to research your assignments. You need to provide a reference whenever you draw on someone else's words, ideas or research. Not referencing other people's work can constitute plagiarism.

Further information about referencing styles can be located at <https://student.unsw.edu.au/referencing>

**Academic integrity** is fundamental to success at university. Academic integrity can be defined as a commitment to six fundamental values in academic pursuits: honesty, trust, fairness, respect, responsibility and courage. At UNSW, this means that your work must be your own, and others' ideas should be appropriately acknowledged. If you don't follow these rules, plagiarism may be detected in your work.

Further information about academic integrity, plagiarism and the use of AI in assessments can be located at:

- The [Current Students site](#),
- The [ELISE training site](#), and
- The [Use of AI for assessments](#) site.

The Student Conduct and Integrity Unit provides further resources to assist you to understand your conduct obligations as a student: <https://student.unsw.edu.au/conduct>

# Submission of Assessment Tasks

## Penalty for Late Submissions

UNSW has a standard late submission penalty of:

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

*Any variations to the above will be explicitly stated in the Course Outline for a given course or assessment task.*

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

## Special Consideration

If circumstances prevent you from attending/completing an assessment task, you must officially apply for special consideration, usually within 3 days of the sitting date/due date. You can apply by logging onto myUNSW and following the link in the My Student Profile Tab. Medical documentation or other documentation explaining your absence must be submitted with your application. Once your application has been assessed, you will be contacted via your student email address to be advised of the official outcome and any actions that need to be taken from there. For more information about special consideration, please visit: <https://student.unsw.edu.au/special-consideration>

**Important note:** UNSW has a “fit to sit/submit” rule, which means that if you sit an exam or submit a piece of assessment, you are declaring yourself fit to do so and cannot later apply for Special Consideration. This is to ensure that if you feel unwell or are faced with significant circumstances beyond your control that affect your ability to study, you do not sit an examination or submit an assessment that does not reflect your best performance. Instead, you should apply for Special Consideration as soon as you realise you are not well enough or are otherwise unable to sit or submit an assessment.

## Faculty-specific Information

### Additional support for students

- [The Current Students Gateway](#)
- [Student Support](#)
- [Academic Skills and Support](#)
- [Student Wellbeing, Health and Safety](#)
- [Equitable Learning Services](#)
- [UNSW IT Service Centre](#)
- Science EDI Student [Initiatives](#), [Offerings](#) and [Guidelines](#)

## School-specific Information

### School of Mathematics and Statistics and UNSW Policies

The School of Mathematics and Statistics has adopted a number of policies relating to enrolment, attendance, assessment, plagiarism, cheating, special consideration etc. These are in addition to the Policies of The University of New South Wales. Individual courses may also adopt other policies in addition to or replacing some of the School ones. These will be clearly notified in the Course Initial Handout and on the Course Home Pages on the Maths Stats web site. Students in courses run by the School of Mathematics and Statistics should be aware of the School and Course policies by reading the appropriate pages on the web site starting at: [The School of Mathematics and Statistics assessment policies](#)

The School of Mathematics and Statistics will assume that all its students have read and understood the School policies on the above pages and any individual course policies on the Course Initial Handout and Course Home Page. Lack of knowledge about a policy will not be an excuse for failing to follow the procedure in it.

### Special Consideration - Short Extension Policy

The School of Mathematics and Statistics has carefully reviewed its range of assignments and projects to determine their suitability for automatic short extensions as set out by the UNSW Short Extension Policy. Upon comprehensive examination of our course offerings that incorporate these types of assessments, we have concluded that our current deadline structures already accommodate the possibility of unexpected circumstances that may lead students to require additional days for submission. Consequently, the School of Mathematics and Statistics has decided to universally opt out of the Short Extension provision for all its courses, having pre-emptively integrated flexibility into our assessment deadlines. The decision is subject to revision in response to the introduction of new course offerings. Students may still apply for Special Consideration via the usual procedures.

## **Computing Lab**

The main computing laboratory is room G012 of the Anita B.Lawrence Centre (formerly Red Centre). You can get to this lab by entering the building through the main entrance to the School of Mathematics (on the Mezzanine Level) and then going down the stairs to the Ground Level. A second smaller lab is Room M020, located on the mezzanine level through the glass door (and along the corridor) opposite the School's entrance.

For more information, including opening hours, see the [computing facilities webpage](#). Remember that there will always be unscheduled periods when the computers are not working because of equipment problems and that this is not a valid excuse for not completing assessments on time.

## **School Contact Information**

### **School Contact Information**

Please visit the [School of Mathematics and Statistics website](#) for a range of information.

For information on Courses, please go to "Student life & resources" and either Undergraduate and/or Postgraduate and respective "Undergraduate courses" and "Postgraduate courses" for information on all course offerings.

All school policies, forms and help for students can be located by going to the "Student Services" within "Student life & resources" page. We also post notices in "Student noticeboard" for your information. Please familiarise yourself with the information found in these locations. If you cannot find the answer to your queries on the web you are welcome to contact the Student Services Office directly.

### **Undergraduate**

E: ug.mathsstats@unsw.edu.au

P: 9385 7011 or 9385 7053

### **Postgraduate**

E: pg.mathsstats@unsw.edu.au

P: 9385 7053

Should we need to contact you, we will use your official UNSW email address of in the first instance. **It is your responsibility to regularly check your university email account. Please use your UNSW student email and state your student number in all emails to us.**