



## UNSW Course Outline

# CEIC6789 Data-driven Decision Making in Chemical Engineering and Food Science - 2024

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## General Course Information

**Course Code :** CEIC6789

**Year :** 2024

**Term :** Term 2

**Teaching Period :** T2

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

**Faculty :** Faculty of Engineering

**Academic Unit :** School of Chemical Engineering

**Delivery Mode :** In Person

**Delivery Format :** Standard

**Delivery Location :** Kensington

**Campus :** Sydney

**Study Level :** Postgraduate, Undergraduate

**Units of Credit :** 6

### Useful Links

[Handbook Class Timetable](#)

## Course Details & Outcomes

### Course Description

The recent surge in the volume of data collected owing to technological advances provides

opportunities to improve processes and take better decisions across various industries. However, in order to turn large data sets into useful insights, combining the knowledge of right data with right analytical tools is important. Data-driven decision making is an industry-oriented course where students learn data management and analytic skills through a major project and real case studies from the School's research strengths/industrial experience in chemical engineering and food science.

In this course, you will discover advanced methods for obtaining, handling and summarising various categories of data with databases. The course will also focus on how to analyse the collected data efficiently by applying sophisticated analytical techniques including statistical tests, inferences and regression analysis.

A working knowledge of introductory statistics and introductory programming is assumed.

## Course Aims

CEIC6789 is an undergraduate elective/postgraduate disciplinary knowledge course where the primary aim is for the students to learn data management and analytic skills in chemical engineering and food science through real case studies and hands-on coding exercises. The course builds upon previous mathematics, computing and experimental courses to develop skills in obtaining, handling and summarizing various categories of data through the use of databases. The course will also focus on how to analyze the collected data efficiently by applying relevant statistical analytical techniques including statistical tests, inferences and regression analysis with a focus on the types of data used by chemical engineers and food scientists. Thus, the aim of the course is to provide practical training to equip students with a range of skills necessary for rapidly increasing data science jobs in industries.

## Course Learning Outcomes

Course Learning Outcomes
CLO1 : Acquire and verify large data sets from various real-life applications in chemical engineering and food science.
CLO2 : Describe the nature of data and distinguish between raw, incomplete, noisy and corrupted data for further analysis.
CLO3 : Choose and apply appropriate statistical tools to analyse data sets across industries in chemical engineering and food science.
CLO4 : Apply their pre-existing knowledge of food science or chemical engineering to formulate and defend models for selected data sets.

Course Learning Outcomes	Assessment Item
CLO1 : Acquire and verify large data sets from various real-life applications in chemical engineering and food science.	<ul style="list-style-type: none"> <li>• Project - Part 1</li> </ul>
CLO2 : Describe the nature of data and distinguish between raw, incomplete, noisy and corrupted data for further analysis.	<ul style="list-style-type: none"> <li>• Quiz 1</li> <li>• Quiz 2</li> <li>• Project - Part 2</li> <li>• Project - Part 1</li> </ul>
CLO3 : Choose and apply appropriate statistical tools to analyse data sets across industries in chemical engineering and food science.	<ul style="list-style-type: none"> <li>• Quiz 1</li> <li>• Quiz 2</li> <li>• Project - Part 2</li> <li>• Project - Part 1</li> </ul>
CLO4 : Apply their pre-existing knowledge of food science or chemical engineering to formulate and defend models for selected data sets.	<ul style="list-style-type: none"> <li>• Project - Part 2</li> <li>• Project - Part 1</li> </ul>

## Learning and Teaching Technologies

Moodle - Learning Management System | Moodle - Learning Management System | Microsoft Teams

## Other Professional Outcomes

Engineers Australia, Professional Engineer Stage 1 Competencies

This course contributes to your development of the following EA Professional Engineer competencies:

- PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing
- PE2.2 Fluent application of engineering techniques, tools and resources
- PE3.2 Effective oral and written communication in professional and lay domains
- PE3.6 Effective team membership and team leadership

## Additional Course Information

Some requisite knowledge is assumed for this course:

- Introductory statistics and data handling from any relevant courses including MATH1231, MATH2089, MATH1041.
- Discipline specific knowledge from relevant courses, for example CEIC3000, CEIC3004, CEIC3005, FOOD2320, FOOD3801, FOOD3220.

# Assessments

## Assessment Structure

Assessment Item	Weight	Relevant Dates
Quiz 1 Assessment Format: Individual	15%	Start Date: 21/06/2024 10:00 AM Due Date: 21/06/2024 10:00 PM
Project - Part 1 Assessment Format: Group	20%	Start Date: Not Applicable Due Date: 12/07/2024 06:00 PM
Quiz 2 Assessment Format: Individual	25%	Start Date: 26/07/2024 10:00 AM Due Date: 26/07/2024 10:00 PM
Project - Part 2 Assessment Format: Group	40%	Start Date: Not Applicable Due Date: 08/08/2024 06:00 PM

## Assessment Details

### Quiz 1

#### Assessment Overview

The quiz will assess understanding of lecture content. It will be administered online, which must be completed individually. The quiz will give students a quick source of formative feedback to track their progress throughout the course.

#### Course Learning Outcomes

- CLO2 : Describe the nature of data and distinguish between raw, incomplete, noisy and corrupted data for further analysis.
- CLO3 : Choose and apply appropriate statistical tools to analyse data sets across industries in chemical engineering and food science.

#### Detailed Assessment Description

The quiz is intended to be open book and will be delivered through Moodle.

#### Submission notes

Via Moodle

### Project - Part 1

#### Assessment Overview

The team project is a core part of this course and is a team-based activity, giving students an opportunity to apply the knowledge gained throughout the term, study a topic of interest, and practice team working skills which is integral to any workplace. The project is divided into two parts over the term and with Part 1 consisting of data preprocessing, communicated via a report

and presentation.

Report marks will be moderated by team assessment of individual contributions to the submission. Presentations will be marked individually and so each team member must speak in order to receive a mark.

#### Course Learning Outcomes

- CLO1 : Acquire and verify large data sets from various real-life applications in chemical engineering and food science.
- CLO2 : Describe the nature of data and distinguish between raw, incomplete, noisy and corrupted data for further analysis.
- CLO3 : Choose and apply appropriate statistical tools to analyse data sets across industries in chemical engineering and food science.
- CLO4 : Apply their pre-existing knowledge of food science or chemical engineering to formulate and defend models for selected data sets.

## Quiz 2

#### Assessment Overview

The quiz will assess understanding of lecture content. It will be administered online, which must be completed individually. The quiz will give students a quick source of formative feedback to track their progress throughout the course.

#### Course Learning Outcomes

- CLO2 : Describe the nature of data and distinguish between raw, incomplete, noisy and corrupted data for further analysis.
- CLO3 : Choose and apply appropriate statistical tools to analyse data sets across industries in chemical engineering and food science.

#### Detailed Assessment Description

The quiz is intended to be open book and will be delivered through Moodle.

#### Submission notes

Via Moodle

## Project - Part 2

#### Assessment Overview

The team project is a core part of this course and is a team-based activity, giving students an opportunity to apply the knowledge gained throughout the term, study a topic of interest, and practice team working skills which is integral to any workplace. The project is divided into two parts over the term and with Part 1 consisting of data analytics, communicated via a report and

presentation.

Report marks will be moderated by team assessment of individual contributions to the submission. Presentations will be marked individually and so each team member must speak in order to receive a mark.

#### **Course Learning Outcomes**

- CLO2 : Describe the nature of data and distinguish between raw, incomplete, noisy and corrupted data for further analysis.
- CLO3 : Choose and apply appropriate statistical tools to analyse data sets across industries in chemical engineering and food science.
- CLO4 : Apply their pre-existing knowledge of food science or chemical engineering to formulate and defend models for selected data sets.

#### **Detailed Assessment Description**

Part 2 will be more elaborate compared to Part 1. It will involve some more advanced tasks that will be covered in the second half of the course.

## **General Assessment Information**

#### **Grading Basis**

Standard

# Course Schedule

Teaching Week/Module	Activity Type	Content
Week 0 : 20 May - 26 May	Reading	Revision and light reading of pre-requisites
Week 1 : 27 May - 2 June	Lecture	Introduction to data science and pre-processing
	Workshop	Introduction to Jupyter and programming in python
Week 2 : 3 June - 9 June	Lecture	Simple and Multiple linear regression
	Workshop	Performing simple and multiple linear regression analysis on data sets
Week 3 : 10 June - 16 June	Lecture	Additional concepts related to multiple linear regression
	Workshop	Performing multiple linear regression analysis on data analysis with emphasis on additional concepts
Week 4 : 17 June - 23 June	Lecture	Simple and multiple logistic regression
	Workshop	Performing logistic regression analysis on data sets
Week 5 : 24 June - 30 June	Lecture	Advanced non-linear regression concepts
	Workshop	Performing data analytics with non-linear regression models
Week 6 : 1 July - 7 July	Lecture	No lectures/new content in flexibility week; Revision and consolidation of Week 1-5; Project discussion
	Workshop	No new content in flexibility week; Revision and consolidation of Week 1-5; Project discussion
Week 7 : 8 July - 14 July	Lecture	K-means clustering
	Workshop	Performing K-means clustering on data sets
Week 8 : 15 July - 21 July	Lecture	Principal component analysis and other unsupervised learning concepts
	Workshop	Application of unsupervised learning concepts on datasets
Week 9 : 22 July - 28 July	Workshop	Case studies; project meetings and discussion
Week 10 : 29 July - 4 August	Workshop	Case studies; project meetings and discussion

## Attendance Requirements

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

## Course Resources

### Recommended Resources

Course materials and assessment tasks are delivered through Moodle and students should check regularly for updates. You can also obtain assistance from the UNSW Library. One starting point for assistance is: <http://www.library.unsw.edu.au/servicesfor/students.html>. Students will also be required to find information to augment lectures and help with their product development projects.

Some useful references are:

- Jacob T. Vanderplas, Python data science handbook: Essential tools for working with data. O'Reilly media Inc., 2017

- U. Dinesh Kumar, Business Analytics: The Science of Data-Driven Decision Making, Wiley. ISBN: 9788126568772
- Andrew Ng, Machine Learning, Coursera (<https://www.coursera.org/learn/machine-learning>)
- Kevin Dunn, Process Improvement Using Data (<https://learnche.org/pid/preface/index>)
- G.E.P. Box, J.S. Hunter, and W.G. Hunter, Statistics for Experimenters - Design, Innovation and Discovery, 2nd edition, Wiley. ISBN: 978-0471718130.

## Course Evaluation and Development

The School of Chemical Engineering evaluates each course each time it is run through (i) myExperience Surveys, and (ii) Focus Group Meetings. As part of the myExperience process, your student evaluations on various aspects of the course are graded; the Course Coordinator prepares a summary report for the Head of School. Any problem areas are identified for remedial action, and ideas for making improvements to the course are noted for action the next time that the course is run. Focus Group Meetings are conducted each term. Student comments on each course are collected and disseminated to the Lecturers concerned, noting any points which can help improve the course.

All of the activities in this course from the online lessons through to the team project have been designed in response to student feedback.

## Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Priyank Vijaya Kumar		Science and Engineering Building, E8, 334		Via Teams or Email	No	Yes

## Other Useful Information

### Academic Information

#### I. Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to, or

within 3 working days of, submitting an assessment or sitting an exam.

Please note that 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 enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's [Special Consideration page](#).

## II. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- [Attendance](#)
- [UNSW Email Address](#)
- [Special Consideration](#)
- [Exams](#)
- [Approved Calculators](#)
- [Academic Honesty and Plagiarism](#)
- [Equitable Learning Services](#)

## III. 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 convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. 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.

*Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle or your primary learning management system (LMS) should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.*

## Academic Honesty and Plagiarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: [student.unsw.edu.au/plagiarism](http://student.unsw.edu.au/plagiarism). The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

[www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf](http://www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf)

## Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be

awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

## **Faculty-specific Information**

[Engineering Student Support Services](#) – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

[Engineering Industrial Training](#) – Industrial training questions

[UNSW Study Abroad](#) – study abroad student enquiries (for inbound students)

[UNSW Exchange](#) – student exchange enquiries (for inbound students)

[UNSW Future Students](#) – potential student enquiries e.g. admissions, fees, programs, credit transfer

## **Phone**

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

## **School-specific Information**

### **Course Workload**

Course workload is calculated using the Units-Of-Credit (UOC). The normal workload expectation for one UOC is approximately 25 hours per term. This includes class contact hours, private study,

other learning activities, preparation and time spent on all assessable work.

Most coursework courses at UNSW are 6 UOC and involve an estimated 150 hours to complete, for both regular and intensive terms. Each course includes a prescribed number of hours per week (h/w) of scheduled face-to-face and/or online contact. Any additional time beyond the prescribed contact hours should be spent in making sure that you understand the lecture material, completing the set assignments, further reading, and revising for any examinations. Most 6 UoC courses will involve approximately 10-12 hours per week of work on your part. If you're not sure what to do in these hours of independent study, the resources on the [UNSW Academic Skills](#) pages offer some suggestions including: making summaries of lectures, read/summarise sections from the textbook, attempt workshop problems, reattempting workshop problems with some hints from the solutions, looking for additional problems in the textbook.

Full-time enrolment at university means that it is a *full-time* occupation for you and so you would typically need to devote 35 hours per week to your studies to succeed. Full-time enrolment at university is definitely incompatible with full-time employment. Part-time/casual employment can certainly fit into your study schedule but you will have to carefully balance your study obligations with that work and decide how much time for leisure, family, and sleep you want left after fulfilling your commitments to study and work. Everyone only gets 168 hours per week; overloading yourself with both study commitments and work commitments leads to poor outcomes and dissatisfaction with both, overtiredness, mental health issues, and general poor quality of life.

### On-campus Class Attendance

Most classes at UNSW are "In Person" and run in a face-to-face mode only. Attendance and participation in the classes is expected. As an evidence-driven engineer or scientist, you'll be interested to know that education research has shown students learn more effectively when they come to class, and less effectively from lecture catch-up recordings. If you have to miss a class due to illness, for example, we expect you to catch up in your time, and within the coming couple of days.

For most courses that are running in an "in person" mode:

- Lectures are normally recorded to provide an opportunity to review material after the lecture; lecture recordings are not a substitute for attending and engaging with the live class.
- Workshops/tutorials are not normally recorded as the activities that are run within those sessions normally cannot be captured by a recording. These activities may also include

assessable activities in some or all weeks of the term.

- Laboratories are not recorded and require in-person attendance. Missing laboratory sessions may require you to do a make-up session later in the term; if you miss too many laboratory sessions, it may be necessary to seek a Permitted Withdrawal from the course and reattempt it next year, or end up with an Unsatisfactory Fail for the course.
- Assessments will often require in-person attendance in a timetabled class or a scheduled examination.

## Submission of Assessment Tasks

In the School of Chemical Engineering, all written work will be submitted for assessment via Moodle unless otherwise specified. Attaching cover sheets to uploaded work is *not* required unless specifically requested for an individual assessment task; when you submit work through Moodle for assessment you are agreeing to uphold the Student Code.

Some assessments will require you to complete the work online and it may be difficult for the course coordinator to intervene in the system after the due date. You should ensure that you are familiar with assessment systems well before the due date. If you do this, you will have time to get assistance before the assessment closes.

All submissions are expected to be neat and clearly set out. Your results are the pinnacle of all your hard work and should be treated with respect. Presenting results clearly gives the marker the best chance of understanding your method; even if the numerical results are incorrect.

Please make it easy for the markers who are looking at your work to see your achievement and give you due credit.

Marking guidelines for assignment submissions will be provided at the same time as assignment details to assist with meeting assessable requirements. Submissions will be marked according to the marking guidelines provided.

## Academic Integrity

**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 (International Center for Academic Integrity, 'The Fundamental Values of Academic Integrity', T. Fishman (ed), Clemson University, 2013). 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 and plagiarism can be located at:

- The [Current Students site](#)
- The [ELISE training site](#)

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

To help describe what we are looking for, here are some things that we consider to be quite acceptable (even desirable!) actions for many assessments, and some that we consider to be unacceptable in most circumstances. Please check with the instructions for your assessments and your course coordinator if you're unsure. As a rule of thumb, if you don't think you could look the lecturer in the eye and say "this is my own work", then it's not acceptable.

### Acceptable actions

- ☒ reading/searching through material we have given you, including lecture slides, course notes, sample problems, workshop problem solutions
- ☒ reading/searching lecture transcripts
- ☒ reading/searching resources that we have pointed you to as part of this course, including textbooks, journal articles, websites
- ☒ reading/searching through your own notes for this course
- ☒ all of the above, for any previous courses
- ☒ using spell checkers, grammar checkers etc to improve the quality of your writing
- ☒ studying course material with other students

### Unacceptable actions

- ☒ asking for help completing an assessment from other students, friends, family
- ☒ asking for help on Q&A or homework help websites
- ☒ searching for answers to the specific assessment questions online or in shared documents
- ☒ copying material from any source into your answers
- ☒ using generative AI tools to complete or substantially complete an assessment for you

☒ paying someone else to do the assessment for you

**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>.

For assessments in the School of Chemical Engineering, we recommend the use of referencing software such as [Mendeley](#) or [EndNote](#) for managing references and citations. Unless required otherwise specified (i.e. in the assignment instructions) students in the School of Chemical Engineering should use either the APA 7th edition, or the American Chemical Society (ACS) referencing style as canonical author-date and numbered styles respectively.

**Artificial intelligence tools** such as ChatGPT, CodePilot, and built-in tools within Word are modern tools that are useful in some circumstances. In your degree at UNSW, we're teaching you skills that are needed for your professional life, which will include how to use AI tools responsibly plus lots of things that AI tools cannot do for you. AI tools already are (or will soon be) part of professional practice for all of us. However, if we were only teaching you things that AI could do, your degree would be worthless, and you wouldn't have a job in 5 years.

Whether the use of AI tools in an assessment is appropriate will depend on the goals of that assessment. As ever, you should discuss this with your lecturers – there will certainly be assessments where the use of AI tools is encouraged, as well as others where it would interfere with your learning and place you at a disadvantage later. Our goal is to help you learn how to ethically and professionally use the tools available to you. To learn more about the use of AI, [see this discussion we have written](#) where we analyse the strengths and weaknesses of generative AI tools and discuss when it is professionally and ethically appropriate to use them.

While AI may might provide useful tools to help with some assessments, UNSW's policy is quite clear that taking the output of generative AI and submitting it as your own work will never be appropriate, just as paying someone else to complete an assessment for you is serious misconduct.

## Asking Questions

Asking questions is an important part of learning. Learning to ask good questions and building the confidence to do so in front of others is an important professional skill that you need to develop. The best place to ask questions is during the scheduled classes for this course, with the

obvious exception being questions that are private in nature such as special consideration or equitable learning plans. Between classes, you might also think of questions – some of those you might save up for the next class (write them down!), and some of them you might ask in a Q&A channel on Teams or a Q&A forum on Moodle. Please understand that staff won't be able to answer questions on Teams/Moodle immediately but will endeavour to do so during their regular working hours (i.e. probably not at midnight!) and when they are next working on this particular course (i.e. it might be a day or two). Please respect that staff are juggling multiple work responsibilities (teaching more than one course, supervising research students, doing experiments, writing grants, ...) and also need to have balance between work and the rest of their life.

## School Contact Information

For assistance with enrolment, class registration, progression checks and other administrative matters, please see [the Nucleus: Student Hub](#). They are located inside the Library – first right as you enter the main library entrance. You can also contact them via <http://unsw.to/webforms> or reserve a place in the face-to-face queue using the UniVerse app.

For course administration matters, please contact the Course Coordinator.

Questions about this course should normally be asked during the scheduled class so that everyone can benefit from the answer and discussion.