

## 33230 Mathematics 2

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| <b>Course area</b>   | UTS: Science                                                                                                                                                      |
| <b>Delivery</b>      | Summer 2022; City                                                                                                                                                 |
| <b>Credit points</b> | 6cp                                                                                                                                                               |
| <b>Requisite(s)</b>  | <a href="#">33130</a> Mathematics 1 OR <a href="#">33190</a> Mathematical Modelling for Science OR <a href="#">37131</a> Introduction to Linear Dynamical Systems |
| <b>Result type</b>   | Grade and marks                                                                                                                                                   |

Attendance: 2 x 1.5hpw (lecture, online), 1hpw (tutorial), 3 x 1hr (computer lab)

### Subject coordinator

Jason Stanley, Email: [Jason.Stanley@uts.edu.au](mailto:Jason.Stanley@uts.edu.au)

### Teaching staff

Dr. Scott Alexander (Statistics Component), Email: [Scott.Alexander@uts.edu.au](mailto:Scott.Alexander@uts.edu.au)

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### Subject description

This subject consists of two parts: multivariate calculus and an introduction to statistics. The mathematical part develops the mathematical skills required for mathematical modelling of systems involving more than one independent variable. The statistics part is an introduction to descriptive statistics, statistical inference and simple linear regression. Topics include linear algebra, solutions to sets of equations resulting from particular problems, eigenvectors and eigenvalues, partial derivatives, optimisation, multiple integrals and their applications, and probability with a focus on the determination of the reliability of a system of components in various engineering contexts.

### Subject learning objectives (SLOs)

Upon successful completion of this subject students should be able to:

1. model real world problems in engineering practice using mathematical and statistical tools and resources
2. use formal mathematical and statistical terminology and also informal (lay) language to express the concepts presented in the subject
3. demonstrate a high level of skill in the mathematical and statistical techniques covered in the subject by both formulating and solving problems in engineering and science
4. demonstrate understanding of the theoretical results which justify the use of these techniques
5. communicate mathematical and statistical knowledge clearly, logically and critically
6. use appropriate mathematical and statistical software packages to perform calculations and explore ideas relevant to the subject content
7. apply the subject matter covered in lectures, computer labs, tutorials and assignments to previously unseen problems and proofs, especially in engineering and science.

### Course intended learning outcomes (CILOs)

This subject also contributes specifically to the development of following course intended learning outcomes:

- Technically Proficient: FEIT graduates apply abstraction, mathematics and discipline fundamentals, software, tools and techniques to evaluate, implement and operate systems. (D.1)
- Collaborative and Communicative: FEIT graduates work as an effective member or leader of diverse teams, communicating effectively and operating within cross-disciplinary and cross-cultural contexts in the workplace. (E.1)

## Contribution to the development of graduate attributes

### Engineers Australia Stage 1 Competencies

This subject contributes to the development of the following Engineers Australia Stage 1 Competencies:

- 1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.

### Faculty of Science Graduate Attributes:

#### *Graduate Attribute 1 - Disciplinary knowledge*

An understanding of the nature, practice & application of the chosen science discipline,

#### *Graduate Attribute 2 - Research, inquiry and critical thinking*

An understanding of the scientific method of knowledge acquisition. Encompasses problem solving, critical thinking and analysis attributes, and the ability to discover new understandings.

#### *Graduate Attribute 3 - Professional, ethical and social responsibility*

The ability to acquire, develop, employ and integrate a range of technical, practical and professional skills, in appropriate and ethical ways within a professional context, autonomously and collaboratively and across a range of disciplinary and professional areas. Time management skills, personal organisation skills, teamwork skills, computing skills, laboratory skills, data handling, quantitative and graphical literacy skills.

#### *Graduate Attribute 5 - Communication*

An understanding of the different forms of communication - writing, reading, speaking, listening - including visual and graphical, within science and beyond and the ability to apply these appropriately and effectively for different audiences.

## Teaching and learning strategies

**Lectures:** Two 90 minute lectures per week

Lecture materials including detailed notes are provided in Canvas for students to read before the class. Concepts and definitions are explored through the use of both pure and applied examples. Students have the opportunity to make notes and question concepts.

**Tutorials:** One one-hour tutorial per week

Students are required to attempt problems posted in Canvas before they come to the tutorial. These problems develop the concepts delivered in the previous lecture. In class students can ask questions about areas they don't understand with either their peers or their tutors.

**Computer labs:** Three one-hour computer labs and eight mastery test sessions (four tests with a second chance sitting)

Students work in the computer labs individually and in pairs. There is a problem sheet made available in Canvas which students use to prepare before they come to the lab. During the class students interact with the tutors and other students to complete the problems. The three labs make use of a program called Excel. This practice allows students the opportunity to get feedback in preparation for the Mastery Tests.

The Mastery Tests are interspersed between the computer labs. The material covered in the computer lab relates to the subsequent Mastery tests. After each test submission students get immediate feedback on correct or incorrect responses. The maths study centre is then available as a support mechanism for students to get feedback on incorrect responses and work through correct solutions. The subject coordinator will offer further feedback as a third step.

Webassign is the program used for practice tests. These can be accessed online by students at any time during the semester and students receive immediate feedback after each question is submitted. These questions cover all of the subject materials.

*Forms of attendance in this subject online flexible. There will be subject announcements indicating opportunities to attend campus, alternatively all activities can be completed online.*

## Content (topics)

Topics include: linear algebra including eigenvalues and eigenvectors and applications; 3D geometry and functions of several variables; partial derivatives; optimisation; multiple integrals and their applications; probability with a focus on the determination of the reliability of a system of components in various engineering contexts; descriptive statistics, probability distributions, statistical inference, introduction to linear regression.

Excel is used in the statistics part of the subject. Other software will be used as appropriate.

## Program

| Week/Session | Dates       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1            | 5 - 9 Dec   | <p><b>Lectures begin this week</b></p> <p><b>Maths:</b><br/>           Linear Algebra<br/>           • Problem formulation<br/>           • Review matrices and determinants.</p> <p><b>Stats:</b><br/>           What is Statistics?<br/>           Types of Data<br/>           Introduction to Excel for statistics</p> <p><b>Notes:</b><br/>           Attempt Practice Mastery Test 1.<br/>           Attempt the Preparation Week exercises</p> |
| 2            | 12 - 16 Dec | <p><b>Maths:</b><br/>           Linear Algebra:<br/>           • Some applications of matrices<br/>           • Gaussian reduction</p> <p><b>Stats:</b><br/>           Data Summary and Presentation</p> <p><b>Notes:</b><br/> <b>Computer Labs begin this week</b><br/> <b>Skills Test 1- Part of MT1</b></p>                                                                                                                                        |
| 3            | 19 - 23 Dec | <p><b>Maths:</b><br/>           Linear Algebra:<br/>           • Co-factor expansions and determinants.<br/>           • Solving linear systems</p> <p><b>Stats:</b><br/>           Discrete random variables<br/>           Binomial Distribution</p> <p><b>Notes:</b><br/> <b>Skills Test 2- Part of MT1</b><br/>           Tutorials begin this week<br/>           Tutorial 1</p>                                                                 |

|         |             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Stu Vac | 26 - 30 Dec | StuVac (Study Vacation) No classes this week                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 4       | 3 - 6 Jan   | <p><b>Maths:</b></p> <p>Linear Algebra:</p> <ul style="list-style-type: none"> <li>• Vector notations</li> <li>• Eigenvalues and eigenvectors</li> </ul> <p><b>Stats:</b></p> <p>Poisson Distribution</p> <p>Continuous random variables:</p> <p>Exponential Distribution</p> <p><b>Notes:</b></p> <p>Monday 2nd January is public holiday activities scheduled for this day will be posted online only - do NOT attend campus on the Monday</p> <p>Computer Lab 1</p> <p>Tutorial 2</p> |
| 5       | 9 - 13 Jan  | <p><b>Maths:</b></p> <p>Functions of several variables; limits and continuity; partial derivatives</p> <p><b>Stats:</b></p> <p>Normal Distribution</p> <p><b>Notes:</b></p> <p><b>SkillsTest 3- Part of MT2</b></p> <p>Tutorial 3</p>                                                                                                                                                                                                                                                    |
| 6       | 16 - 20 Jan | <p><b>Maths:</b></p> <p>Tangent plane, linear approximations, differentials; chain rule</p> <p><b>Stats:</b></p> <p>Systems of Independent Components</p> <p>Linear Combinations of Random Variables</p> <p>Central Limit Theorem</p> <p>Confidence Intervals</p> <p>Sample Size Determination</p> <p><b>Notes:</b></p> <p><b>Skills Test 4 - Part of MT2</b></p> <p>Tutorial 4</p>                                                                                                      |

**Maths:**

Directional derivatives and gradients; Introduction to Optimisation

**Stats:**

Statistical Inference (mean – variance known)

**Notes:**

Thursday 26th January public holiday does not affect this subject.

Computer Lab 2

Tutorial 5

**Maths:**

Maxima, minima and saddle points; Lagrange multipliers

**Stats:**

Statistical Inference (mean – variance known)

**Notes:****Skills Test 5 - Part of MT3**

Tutorial 6

**Maths:**

Double integrals: basics, change of order

**Stats:**

Statistical Inference (mean – variance unknown)

**Notes:****Skills Test 6 - Part of MT3**

Tutorial 7

**Maths: - Final examination****Stats: - Final examination****Notes:****Labs and Tutorials - Revision****Additional information**

*Students must achieve 40% in each of the final examinations in order to pass the subject. A student who receives less than 40% for the examination, yet manages to achieve 50% or greater overall, will be awarded an X grade.*

**Assessment****Assessment task 1: Mastery Test 1**

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Intent:</b>       | To reaffirm required knowledge for success in 33230, and to become acquainted with the mastery process.<br><br>This assessment task contributes to the development of the following science graduate attributes:<br>1. disciplinary knowledge<br><br>Mastery Tests targets <i>Problem posing and solving – ability to identify, assess and formulate problems relevant to one’s academic discipline and apply appropriate approaches and methods of problem solving.</i> |
| <b>Objective(s):</b> | This assessment task addresses subject learning objective(s):<br>2<br><br>This assessment task contributes to the development of course intended learning outcome(s):<br>D.1                                                                                                                                                                                                                                                                                             |
| <b>Groupwork:</b>    | Individual                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Weight:</b>       | 5%                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Task:</b>         | An online mastery quiz to be completed in the computer lab that week. This task will be a combination of multiple choice, numerical answer and symbolic answer questions in a similar format to the provided sample quiz.                                                                                                                                                                                                                                                |
| <b>Length:</b>       | 50 min                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Due:</b>          | Week As scheduled                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Criteria:</b>     | Correct interpretation of terminology,<br><br>Correct choice of problem solving strategies and procedures.<br><br>Correct choice of reasoning.                                                                                                                                                                                                                                                                                                                           |

## Assessment task 2: Mastery Test 2

|                      |                                                                                                                                                                                                                                                                                               |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Intent:</b>       | To provide feedback on basic skills and concepts in the material covered in weeks 1-3 of the statistics strand and weeks 1-2 of the mathematics strand.<br><br>This assessment task contributes to the development of the following science graduate attributes:<br>1. disciplinary knowledge |
| <b>Objective(s):</b> | This assessment task addresses subject learning objective(s):<br>2, 3, 6 and 7<br><br>This assessment task contributes to the development of course intended learning outcome(s):<br>D.1                                                                                                      |
| <b>Groupwork:</b>    | Individual                                                                                                                                                                                                                                                                                    |
| <b>Weight:</b>       | 15%                                                                                                                                                                                                                                                                                           |

|                  |                                                                                                                                                                                                                           |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Task:</b>     | An online mastery quiz to be completed in the computer lab that week. This task will be a combination of multiple choice, numerical answer and symbolic answer questions in a similar format to the provided sample quiz. |
| <b>Length:</b>   | 50 min                                                                                                                                                                                                                    |
| <b>Due:</b>      | Week As scheduled                                                                                                                                                                                                         |
| <b>Criteria:</b> | Correct use of terminology<br>Correct choice and use of problem solving strategies and procedures<br>Accurate mathematical reasoning                                                                                      |

### Assessment task 3: Mastery Test 3

|                      |                                                                                                                                                                                                                                                                                               |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Intent:</b>       | To provide feedback on basic skills and concepts in the material covered in weeks 4-6 of the statistics strand and weeks 3-6 of the mathematics strand.<br><br>This assessment task contributes to the development of the following science graduate attributes:<br>1. disciplinary knowledge |
| <b>Objective(s):</b> | This assessment task addresses subject learning objective(s):<br>2, 3, 6 and 7<br><br>This assessment task contributes to the development of course intended learning outcome(s):<br>D.1                                                                                                      |
| <b>Groupwork:</b>    | Individual                                                                                                                                                                                                                                                                                    |
| <b>Weight:</b>       | 15%                                                                                                                                                                                                                                                                                           |
| <b>Task:</b>         | An online mastery quiz to be completed in the computer lab that week. This task will be a combination of multiple choice, numerical answer and symbolic answer questions in a similar format to the provided sample quiz.                                                                     |
| <b>Length:</b>       | 50 min                                                                                                                                                                                                                                                                                        |
| <b>Due:</b>          | Week As scheduled                                                                                                                                                                                                                                                                             |
| <b>Criteria:</b>     | Correct interpretation of terminology,<br>Correct choice of problem solving strategies and procedures.<br>Correct choice of reasoning.                                                                                                                                                        |

### Assessment task 4: Mastery Test 4

|                |                                                                                                                                                                                                                                                                                                |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Intent:</b> | To provide feedback on basic skills and concepts in the material covered in weeks 7-9 of the statistics strand and weeks 7-10 of the mathematics strand.<br><br>This assessment task contributes to the development of the following science graduate attributes:<br>1. disciplinary knowledge |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Objective(s):** This assessment task addresses subject learning objective(s):

2, 3, 6 and 7

This assessment task contributes to the development of course intended learning outcome(s):

D.1

**Groupwork:** Individual

**Weight:** 15%

**Task:** An online mastery quiz to be completed in the computer lab that week. This task will be a combination of multiple choice, numerical answer and symbolic answer questions in a similar format to the provided sample quiz.

**Length:** 50 min

**Due:** Week As scheduled

**Criteria:** Correct interpretation of terminology,  
Correct choice of problem solving strategies and procedures.  
Correct choice of reasoning.

### Assessment task 5: Final Exam

**Intent:** To comprehensively assess more advanced material across the subject, including material taken from all of the lectures in both the statistics and mathematics strands.

This assessment task contributes to the development of the following graduate attributes:

1. Disciplinary Knowledge
2. Research, inquiry and critical thinking
3. Professional, ethical and social responsibility
5. Communication

**Objective(s):** This assessment task addresses subject learning objective(s):

1, 2, 3, 4, 5 and 7

This assessment task contributes to the development of course intended learning outcome(s):

D.1 and E.1

**Groupwork:** Individual

**Weight:** 50%

**Task:** Extended responses to several questions including seen and unseen problems, definitions, and applications of concepts to specific problems. The final exam is compulsory.

**Length:** 2 hours plus 10 minutes reading time

**Due:** UTS Exam period

**Criteria:** Correct use of terminology  
Correct choice and use of problem solving strategies and procedures  
Accurate Mathematical Reasoning  
Clarity of communication

**Further information:** The list of formulae and statistical tables provided for use in the final exam is available on Canvas.

## Minimum requirements

Students must achieve 50% in the final examination in order to pass the subject. A student who receives less than 50% for the examination, yet manages to achieve 50% or greater overall, will be awarded an X grade.

## Recommended texts

Devore, Jay (2014) *Probability and Statistics for Engineering and the Sciences Ninth Edition* Cengage.

Stewart: "Calculus, Concepts and Contexts", 4e (2010), Cengage.

## References

Mathematics:

McLelland, G. J. (1999) An Introduction to Matrices, Determinants and Linear Equations.  
Department of Mathematical Sciences, UTS. (available on UTS Online)

Statistics:

Montgomery, D. C., Runger, G. C. & Hubele, N. F. (2011) *Engineering Statistics*, 5th edition, Wiley.

## Other resources

Students are encouraged to make use of the collection of online videos made available on Canvas, as well as practise quizzes and weekly homework exercises on Webassign.

## U:PASS

(UTS Peer Assisted Study Success) is a voluntary "study session" where you will be studying the subject with other students in a group. It is led by a student who has previously achieved a distinction or high distinction in the subject area, and who has a good WAM. Leaders will prepare activities for you to work on in groups based on the content you are learning in lectures and tutorials. It's really relaxed, friendly, and informal. Because the leader is a student just like you, they understand what it's like to study the subject and how to do well, and they can pass those tips along to you. Students also say it's a great way to meet new people and a "guaranteed study hour".

You can sign up for U:PASS sessions via U:PASS website <http://tinyurl.com/upass2017> Note that sign up is not open until week 2, as it's voluntary and only students who want to go should sign up. If you have any questions or concerns about U:PASS, please contact Georgina at [upass@uts.edu.au](mailto:upass@uts.edu.au), or check out the website.

## Academic liaison officer

### Academic liaison officers

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## Support

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**w:** [lib.uts.edu.au](http://lib.uts.edu.au) **facebook:** [utslibrary](#) **twitter:** [@utslibrary](#) **ph:** 9514 3666

### Mathematics & Science Study Centre

The Mathematics and Science Study Centre (MSSC) operates a Drop-in Room located on UTS City Campus, in

Building 4, level 3, room 331 (CB04.03.331). Academic staff members are available for one-to-one assistance. For timetabling and other MSSC resources see:

w: <https://tinyurl.com/UTS-maths-study-centre>

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2. consult the [plagiarism](#) help site
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