SCHOOL OF MATHEMATICS AND STATISTICS

JUNIOR MATHEMATICS AND STATISTICS

2024 Handbook

Web: http://www.maths.usyd.edu.au/u/UG/JM

Contents

1 Introduction

This handbook contains information relating to various aspects of studying mathematics at junior level at the University of Sydney. It includes a brief description of the content of each junior unit, and some advice on which units to choose. It also contains some information on assessment and administrative matters. If you have a question about junior mathematics, and cannot find the answer in this book, there are other sources of information.

1.1 Where to find out more:

- The Junior Mathematics website:

  http://www.maths.usyd.edu.au/u/UG/JM

- The Frequently Asked Questions webpage:

  http://www.maths.usyd.edu.au/u/UG/JM/FAQ.html

  If there is something you want to know, please check this page before you contact us.

- The Student Services Office:

  - Carslaw Room 520 (Helpdesk on Level 5)
  - Phone: 9351 5787
  - Email: fy.maths@sydney.edu.au

  We expect that any emails written to us will be courteous, and will include your name and SID. Emails need to be sent from your official university of Sydney email account. We will not respond to anonymous emails.

- The First Year Director: Sharon Stephen, Carslaw Room 525.

  Deputy First Year Directors: Brad Roberts, Carslaw 605, Di Warren, Carslaw Room 527, Haotian Wu, Carslaw Room 615.

1.2 How we communicate with you

There are over 5000 students doing a first year mathematics unit. When we have something to tell you we clearly cannot do so on an individual basis. You will have to take far more responsibility for seeking out information than you may have been used to doing at school. Here are the ways in which we communicate with you:

Announcements in Lectures Important announcements relating to all aspects of a unit of study are often made in lectures. You should listen carefully to all such announcements. If you do not attend lectures regularly then it is your responsibility to find out the content of any such announcements in the event that you were absent when they were made.

Canvas Announcements Usually, important announcements are also posted through the Learning Management System (Canvas). You can configure yourself how you want to receive such announcements (through email, app or other option).

Email We will sometimes email you at your Unikey email address, either as an individual student, or as a member of a particular class. You should check for email sent to your Unikey address on a regular basis.

Some units of study may also make announcements through the discussion forum (Edstem).

1.3 Junior units of study

Junior units are offered at four different levels: advanced, mainstream, fundamental and introductory. The level at which you study mathematics should be determined by your mathematical background and your ability, as well as the degree program and major you intend to complete.

As a general rule, if you have done HSC Mathematics Extension 2 then you should take advanced units; if you have done HSC Mathematics Extension 1 then you should take mainstream units; if you have done HSC Mathematics Advanced then you should take fundamental units. Later chapters in this book give more detailed advice as to which level you should choose.

Advanced Units of Study in Semester 1.

- MATH1961 *Mathematics 1A (Advanced)*
- MATH1971 *Mathematics 1A (Special Studies Program)*
- DATA1901 *Foundations of Data Science (advanced)*

Advanced Units of Study in Semester 2.

- MATH1962 *Mathematics 1B (Advanced)*
- MATH1972 *Mathematics 1B (Special Studies Program)*
- MATH1964 *Discrete Mathematics (Advanced)*
- DATA1901 *Foundations of Data Science (advanced)*

Mainstream Units of Study in Semester 1.

- MATH1961 *Mathematics 1A*
- MATH1962 *Mathematics 1B*
- DATA1001 *Foundations of Data Science*

Mainstream Units of Study in Semester 2.

- MATH1961 *Mathematics 1A*
- MATH1962 *Mathematics 1B*
- MATH1064 *Discrete Mathematics for Computation*
- DATA1001 *Foundations of Data Science*

Fundamental Units of Study in Semester 1.

- MATH1050: *Mathematics Toolbox for Science*
- DATA1001 *Foundations of Data Science*

Fundamental Units of Study in Semester 2.

- MATH1050: *Mathematics Toolbox for Science*
- DATA1001 *Foundations of Data Science*

Introduction to Calculus. MATH1111: *Introduction to Calculus* is a 6 credit point unit of study and is available only to students who have not done HSC Mathematics Advanced, HSC Mathematics Ext 1 or HSC Mathematics Ext 2 (or equivalent).

Students in the Faculty of Science

Science students are required to complete at least 12 credit points of mathematics and/or statistics and/or data science and/or general science SCIE1001 (new for 2021). The choice depends on whether students are doing a major in Mathematics, Statistics, Financial Mathematics or Data Science, or taking mathematical units to satisfy a Science Degree Core requirement. The definitive rules for the Degree Core units of study can be found at

sydney.edu.au/handbooks/science/subject_areas_ae/tableA_core.shtml

The level is usually determined by background and partly by the major/minor. Some streams or degree programs (in particular the Mathematical Sciences Program) have specific requirements. Check the handbook at

sydney.edu.au/handbooks/science/subject_areas_ae/tableA_overview.shtml

For the Mathematical Sciences program see

sydney.edu.au/handbooks/science/subject_areas_fm/mathematical_sciences.shtml

Here are recommendations that apply to most students:

Students with HSC Mathematics Extension 2 (or equivalent). Generally take MATH1961 and MATH1962. If there is space for electives DATA1901 and/or MATH1964 may also be taken.

Students with HSC Mathematics Extension 1 (or equivalent). Generally take MATH1061 and MATH1062. Students intending to complete a Data Science major will generally take (MATH1061 or MATH1062) and DATA1001.

Students with HSC Mathematics Advanced (or equivalent). Generally take DATA1001 and MATH1050.

Students who have not successfully completed calculus at school. There is a possibility to enrol in MATH1111 in first semester, but that requires departmental permission. Note that from 2021 onwards, MATH1111 is not included in the list of core Science units. Students who are contemplating enroling in MATH1111 should contact the First Year Director for advice.

Students in the Faculty of Engineering

Engineering students are required to study mathematics in both first and second year. Different engineering degrees and majors have different requirement. These requirements can be found in the Engineering Handbook at

https://sydney.edu.au/handbooks/engineering/.

Most first year engineering students will take MATH1061 and MATH1062.

Engineering students with HSC Mathematics Extension 2 (or equivalent) are encouraged to choose the advanced units MATH1961 and MATH1962.

Engineering students who do not have Mathematics Extension 1 (or equivalent) are strongly advised to do a Bridging Course before semester starts. Details of Bridging Courses are available from the Student Services Office (Carslaw room 520), or at http://www.maths.usyd.edu.au/u/BC/.

Students in the Faculties of Arts, Economics and Education

Junior mathematics units may be taken by students in these faculties. Consult the relevant Faculty Handbook at http://sydney.edu.au/handbooks/ for details.

1.4 Advice on choice of junior mathematics units

Students doing a major in the School of Mathematics and Statistics

If you are a Science student the units you enrol in for a major in Mathematics, Statistics, Financial Mathematics and Statistics, or Data Science will also count towards the “Science Degree Core” requirements.

Students intending to specialise in Mathematics (Pure or Applied) should take two or three junior units. Students with the appropriate background should take advanced units, or Special Studies Units if invited to do so. It is important that one of the units MATH1962, MATH1972 or MATH1062 be selected: seek the advice of the Mathematics Student Services Office if you do not wish to do this.

Students intending to specialise in Statistics should take the following units:

- (MATH1061 or MATH1961 or MATH1971)

and

- (MATH1062 or MATH1962 or MATH1972 or DATA1001 or DATA1901)

Students in the *Mathematical Sciences program* should take the following units:

- (MATH1061 or MATH1961 or MATH1971)

and

- (MATH1062 or MATH1962 or MATH1972)

Students intending to specialise in Financial Mathematics and Statistics should take the following units:

- (MATH1061 or MATH1961 or MATH1971)

and

- (MATH1062 or MATH1962 or MATH1972)

If there is enough room for electives, DATA1001 or DATA1901 may also be taken.

Students who wish to specialise in Data Science should take

- (DATA1001 or DATA1901) and (MATH1061 or MATH1961)

The second option is a requirement if you are in the Mathematical Sciences Program.

To fulfill the requirements of your degree you may need to take some mathematics units. A recommendation is to take one of MATH1050, MATH1061 or MATH1961 (see Section 1.3).

Students in other Degree Programs and Majors/Minors

Students who want Mathematics as a support for a major in another area have a wide range of choices. Some faculties, schools and departments prescribe and/or recommend mathematics units: refer to the appropriate handbooks or advisers. In general, take as many mathematics units as you can fit in; if you satisfy prerequisites, take advanced units rather than mainstream units and mainstream units rather than fundamental units. If you intend to take intermediate units in mathematics, take MATH1962 or MATH1062 or seek the advice of the Mathematics Student Services Office if you do not wish to do this.

Students who want Statistics as a support for a major in another area should take MATH1962 or MATH1062 or DATA1001. Students who wish (at a later stage) to take DATA2002, DATA2902, STAT3022 or STAT3922 should also take MATH1961 or MATH1061.

1.5 Intermediate, Senior and Honours Units of Study

It is possible to proceed as far as Honours in any of five disciplines: Pure Mathematics, Applied Mathematics , Financial Mathematics and Statistic, Mathematical Statistics or Data Science. The School's intermediate and senior units of study are offered at two levels, advanced and mainstream. Intending Honours students are strongly encouraged to select advanced units of study.

There are intermediate and senior units of study offered by the School of Mathematics and Statistics which complement specialised studies in other discipline areas. In particular, students who seek to specialise in certain other Science discipline areas such as Physics and Computer Science, should bear in mind the requirement to complete intermediate mathematics units in their degree.

1.6 What to do before semester starts

Once you have your timetable, check whether classes start in week 1 or 2. All lectures start in week 1, and tutorials start in week 1 or 2.

It is not essential to buy textbooks for mathematics units of study before semester starts, but you may do so if you wish. For several junior units of study the text is a set of course notes written by lecturers within the School of Mathematics and Statistics. All such notes may be purchased from KOPYSTOP, 55 Mountain St Broadway. They are *not* available from the University Copy Centre.

2 Advanced Units

2.1 Who should take advanced units?

Advanced units of study are designed for students who have both a strong background and a keen interest in mathematics, and who wish to study mathematics at a higher level. Advanced units are challenging but rewarding. They treat topics at a greater depth and with more mathematical rigour than do mainstream units.

In advanced units, you will see more of the conceptual foundation for methods and theorems, more proofs, and more sophisticated mathematical/statistical reasoning. You will do less computation (though there is computation involved in all of mathematics) and you will take less multiple-choice tests. You will have more opportunity to construct your own proofs and arguments, hone your mathematical writing skills, and receive feedback on your written work. Advanced units are smaller, so you can expect more personal interaction with your lecturers. Women and gender diverse students are invited to join the new Advanced Women's Mentoring Program at the School.

2.2 Assumed knowledge

The assumed knowledge for advanced units is the NSW Mathematics Extension 2 HSC course (or equivalent). The depth of study required for that HSC course is similar to that needed for advanced units here. Students who achieved Band E4 in the NSW Extension 1 HSC course (or equivalent) and who are enthusiastic about mathematics may also consider advanced units, although they will be missing some background knowledge. All students who wish to enrol in advanced units must apply for Departmental Permission through Sydney Student.

2.3 Objectives of advanced units

In addition to extending and deepening students' knowledge in key areas of mathematics and statistics, and preparing students for later units in mathematics and statistics, the advanced units are designed to

- provide challenging and stimulating material for students with an interest and strong backgrouond in mathematics;
- give students an appreciation of the power and beauty of mathematics;

- provide an insight into the way in which professional mathematicians think about mathematics;
- develop a student's ability to reason mathematically;
- give students an appreciation of the need for rigour in mathematics.

Outcomes for individual units are listed on the unit information sheets.

2.4 Mentoring Program for Women and Gender Diverse Students

As part of our commitment to diversity and inclusion in the Advanced Stream, the School offers a mentoring program for women and gender-diverse students in advanced mathematics, statistics and data science units at all year levels. In the program, you will be matched with a small group of peers, an academic mentor from the School, and senior student (usually honours or third year) who will act as a peer mentor and organiser. The academic mentor will meet with you regularly in an informal setting, to talk about maths or data science, university life, courses, careers, and more. They will be available for general support or advice, and can help with specific questions as they come up. The meetings will be a combination of in-person and virtual, depending on the needs and preferences of the group.

To enrol in the program, there will be a short registration form advertised in advanced units in week 2-3, once timetables are settled. If you identify as a woman or as gender diverse and are enrolled in any advanced mathematics, statistics or data science unit(s) at the School, you are warmly invited to join the program. If you have any questions, please email Dr Zsuzsanna Dancso at zsuzsanna.dancso@sydney.edu.au.

2.5 Special Studies Program (SSP) units

These units are offered to a relatively small group of talented and committed students. The two SSP units are MATH1971 and MATH1972. MATH1971 includes all the material in MATH1961 as well as special topics which are not available elsewhere in the Mathematics and Statistics programs. Students attend the MATH1961 lectures and complete all MATH1961 assessment tasks, but have their own seminar and tutorial. The special topics will be assessed by means of assignments.

Similarly MATH1972 has the same lectures as MATH1962 plus seminars on special topics. For the purposes of Science Faculty regulations, SSP units count as Advanced units.

Selection into MATH1971 and/or MATH1972 is based on interest in and commitment to mathematics, and on HSC (or equivalent) results. A NSW ATAR score of at least 98.5 and a score of 95% in Mathematics Extension 2 is generally expected, although students with lower scores and a serious commitment to mathematics may apply for selection. Students interested in obtaining entry to the Special Studies Program should enrol in MATH1961 (unless informed otherwise) and subsequently apply for entry into MATH1971. The application form for MATH1971 is available from https://www.maths.usyd.edu.au/ub/daners/uni/math1971/application.cgi

2.6 List of Advanced Units

MATH1961: Mathematics 1A (Advanced)

Mathematics is both a powerful tool with many diverse applications and a subject that is beautiful in itself. This unit provides solid foundations for higher level university mathematics and its applications by building on what you have already learnt. It contains material on calculus, linear algebra and complex numbers, all of which have profound applications in science, engineering, statistics, and economics. This unit investigates differential and integral calculus of one variable and the diverse applications of this theory. Linear algebra begins with vectors and vector algebra. From there we consider matrices, determinants, eigenvalues and eigenvectors which are powerful tools used to solve systems of linear equations and in many other applications. As an advanced unit MATH1961 introduces you to formal mathematical language, proof and rigour. At the end of this unit you will be equipped with mathematical knowledge and rigorous thinking skills that you will use in a broad range of applications and/or as a foundation for further mathematical studies at University.

Classes: 2x2-hr lectures; 2x1-hr tutorial/wk

Assumed knowledge: (HSC Mathematics Extension 2) or (90 or above in HSC Mathematics Extension 1) or equivalent

Prohibitions: MATH1901 or MATH1902 or MATH1921 or MATH1906 or MATH1931 or MATH1001 or MATH1021 or MATH1061 or MATH1971 or MATH1002 or MATH1014

Offered: Semester 1

Credit points: 6.0

Note: Faculty/department permission required

MATH1971: Mathematics 1A (SSP)

Mathematics is both a powerful tool with many diverse applications and a subject that is beautiful in itself. This unit provides solid foundations for higher level university mathematics and its applications by building on what you have already learnt. It contains material on calculus, linear algebra and complex numbers, all of which have profound applications in science, engineering, statistics, and economics. This unit investigates differential and integral calculus of one variable and the diverse applications of this theory. Linear algebra begins with vectors and vector algebra. From there we consider matrices, determinants, eigenvalues and eigenvectors which are powerful tools used to solve systems of linear equations and in many other applications. As an advanced unit MATH1971 introduces you to formal mathematical language, proof and rigour. The unit includes a series of seminars showcasing a diverse range of topics not covered in regular units. At the end of this unit you will be equipped with mathematical knowledge and rigorous thinking skills that you will use in a broad range of applications and/or as a foundation for further mathematical studies at University.

Classes: 2x2-hr lectures; 2x1-hr tutorial; and 1x1-hr seminar/wk

Assumed knowledge: (HSC Mathematics Extension 2) or (Band E4 in HSC Mathematics Extension 1) or equivalent.

Prohibitions: MATH1901 or MATH1902 or MATH1921 or MATH1906 or MATH1931 or MATH1001 or MATH1021 or MATH1061 or MATH1961 or MATH1002 or MATH1014

Offered: Semester 1

Credit points: 6.0

Note: Faculty/department permission required. Application required.

MATH1962: Mathematics 1B (Adv)

This unit provides an introduction to multivariable differential calculus and modelling as well as mathematical statistics. Emphasis is given both to the theoretical and foundational aspects of the subject, as well as developing the valuable skill of applying the mathematical theory to solve practical problems. Topics covered in this unit of study include mathematical modelling, first order differential equations, second order differential equations, systems of linear equations, visualisation in 2 and 3 dimensions, partial derivatives, directional derivatives, the gradient vector, and optimisation for functions of more than one variable. The statistics part provides an introduction to mathematical statistics including descriptive statistics, the normal model and hypothesis testing. Concepts will be illustrated using statistical software.

Classes: 2x2-hr lectures; and 2x1-hr tutorial/wk

Assumed knowledge: (HSC Mathematics Extension 2) or equivalent.

Prohibitions: MATH1905 or MATH1903 or MATH1923 or MATH1907 or MATH1933 or MATH1062 or MATH1972 or MATH1003 or MATH1023 or MATH1005 or MATH1015

Offered: Semester 2

Credit points: 6.0

Note: Faculty/department permission required

MATH1972: Mathematics 1B (SSP)

This unit provides an introduction to multivariable differential calculus and modelling as well as mathematical statistics. Emphasis is given both to the theoretical and foundational aspects of the subject, as well as developing the valuable skill of applying the mathematical theory to solve practical problems. Topics covered in this unit of study include mathematical modelling, first order differential equations, second order differential equations, systems of linear equations, visualisation in 2 and 3 dimensions, partial derivatives, directional derivatives, the gradient vector, and optimisation for functions of more than one variable. The statistics part provides an introduction to mathematical statistics including descriptive statistics, the normal model and hypothesis testing. Concepts will be illustrated using statistical software. The unit includes a series of seminars showcasing a diverse range of topics not covered in regular units.

Classes: 2x2-hr lectures; 2x1-hr tutorial; and 1x1-hr seminar/wk

Assumed knowledge: (HSC Mathematics Extension 2) or (Band E4 in HSC Mathematics Extension 1) or equivalent.

Prohibitions: MATH1905 or MATH1903 or MATH1907 or MATH1923 or MATH1933 or MATH1062 or MATH1962 or MATH1003 or MATH1023 or MATH1005 or MATH1015

Offered: Semester 2

Credit points: 6.0

Note: Faculty/department permission required

MATH1964: Discrete Mathematics (Advanced)

This advanced unit will introduce you to the language and key methods of the area of Discrete Mathematics. It provides an introduction to discrete mathematics that addresses very similar material to MATH1064, while looking at mathematical concepts and their foundations in more depth. This includes an introduction into mathematical logic and set theory, concepts of proof including mathematical induction, a solid foundation in fundemental mathematical objects sucha as functions including generating functions, relations, orders, sequences, and graphs. It will delve into counting problems arising from algebraic combinatorics, such as Young tableaux and Mobius functions. The unit will also cover the foundations of asymptotic growth and computational complexity, such as O-notation, and it will cover basic ideas from the theory of computations. When you complete this unit you will (1) have the mathematical foundations to continue your studies in combinatorics, graph theory and other areas of pure mathematics; (2) to be able to understand, develop, and

apply modeling techniques from discrete mathematics to fields in applied mathematics, computer science, and other disciplines; (3) be able to independently solve problems and find proofs of mathematical statements.

Classes: 3x1-hr lectures; 1x1-hr tutorial; and 1x1-hr practice class/wk

Assumed knowledge: (HSC Mathematics Extension 2) or (Band E4 in HSC Mathematics Extension 1) or equivalent

Prohibitions: MATH1004 or MATH1904 or MATH1064

Offered: Semester 2

Credit points: 6.0

Note: Faculty/department permission required

DATA1901: Foundations of Data Science (Adv)

DATA1901 is an advanced level unit (matching DATA1001) that is foundational to the new major in Data Science. The unit focuses on developing critical and statistical thinking skills for all students. Does mobile phone usage increase the incidence of brain tumours? What is the public's attitude to shark baiting following a fatal attack? Statistics is the science of decision making, essential in every industry and undergirds all research which relies on data. Students will use problems and data from the physical, health, life and social sciences to develop adaptive problem solving skills in a team setting. Taught interactively with embedded technology and masterclasses, DATA1901 develops critical thinking and skills to problem-solve with data at an advanced level. By completing this unit you will have an excellent foundation for pursuing data science, whether directly through the data science major, or indirectly in whatever field you major in. The advanced unit has the same overall concepts as the regular unit but material is discussed in a manner that offers a greater level of challenge and academic rigour.

Classes: Lecture 3 hrs/week + Computer lab 2 hr/week

Assumed knowledge: An ATAR of 95 or more

Prohibitions: MATH1005 or MATH1905 or ECMT1010 or ENVX1001 or ENVX1002 or BUSS1020 or DATA1001 or MATH1115 or MATH1015 or STAT1021

Offered: Semester 1, Semester 2

Credit points: 6.0

3 Mainstream Units

3.1 Who should take mainstream units?

Mainstream Units of Study are designed for students who have both the necessary background and interest in mathematics, and who want to study mathematics beyond junior units, or need to do so in order to satisfy degree requirements. Mainstream units cover much the same material as advanced units, but less rigourously.

3.2 Assumed knowledge

The assumed knowledge for MATH1061 is NSW HSC Mathematics Extension 1 (or equivalent). Students who have done well in the HSC Mathematics Advanced (or equivalent) may consider enrolling in MATH1061. Before doing so it is highly recommended to discuss the option with a mathematics adviser during enrolment.

There is no assumed knowledge for DATA1001.

The assumed knowledge for MATH1062 is knowledge of complex numbers and methods of differential and integral calculus including integration by partial fractions and integration by parts as for example in MATH1021 or MATH1921 or MATH1931 or MATH1061 or HSC Mathematics Extension 2.

Students who have only completed NSW HSC Mathematics Advanced but are required to enrol in MATH1061 should complete a bridging course in February. Details of Bridging Courses are available from the Student Services Office, or from mathematics advisers at enrolment.

Students with a Distinction or High Distinction in MATH1061 are encouraged to discuss the possibility of enrolling in the second semester advanced unit MATH1962 with the First Year Director.

3.3 Objectives of mainstream units

In addition to extending students' knowledge in key areas of mathematics and statistics, and preparing students for later units in mathematics and statistics, the mainstream units are designed to

- give students an appreciation of the power and beauty of mathematics;

- demonstrate the application of mathematics to a wide variety of physical problems;
- develop a student's ability to reason mathematically;
- give students an appreciation of the need for rigour in mathematics.

Outcomes for individual units are listed on the unit information sheets.

3.4 List of Mainstream Units

MATH1061: Mathematics 1A

Mathematics is both a powerful tool with many diverse applications and a subject that is beautiful in itself. Mathematics 1A introduces you to university mathematics by building on what you have already learnt and open doors to new ideas and to give new perspectives on what you already know. The unit contains material on Calculus, Linear Algebra and Complex Numbers, all of which have profound applications in science, engineering, statistics, and economics. This unit investigates differential and integral calculus of one variable and the diverse applications of this theory. Linear algebra begins with vectors and vector algebra. From there we consider matrices, determinants eigenvalues and eigenvectors as tools to solve systems of linear equations and other applications. At the end of this unit you will be equipped with mathematical knowledge that you will use in many different context and to continue mathematical studies at University. Students are very strongly recommended to complete MATH1061 Mathematics 1A before starting MATH1062 Mathematics 1B.

Classes: 3x1-hr lectures; 2x1-hr tutorial/wk

Assumed knowledge: NSW HSC Extension 1 Mathematics or equivalent

Prohibitions: MATH1901 or MATH1902 or MATH1921 or MATH1906 or MATH1931 or MATH1001 or MATH1021 or MATH1961 or MATH1971 or MATH1002 or MATH1014

Offered: Semester 1, Semester 2

Credit points: 6.0

MATH1062: Mathematics 1B

Mathematics and Statistics provide powerful quantitative tools to solve problems and make informed decisions in a very diverse range of real-life applications. This unit builds on the calculus that you learnt in Mathematics 1A and introduces you to mathematical statistics. Mathematics 1B gives you a foundational knowledge of the theory of multivariable calculus, differential equations and mathematical statistics that will underpin examples of applications in this unit and in other areas that you will study. At the end of this unit, you will be equipped with the theory and tools that you need to use mathematics and statistics for mathematical and statistical modelling and problem solving. You will also be prepared to continue your studies in mathematics, statistics and financial mathematics and statistics at this university. Please note that this unit is not part of the Data Science major. Students are very strongly recommended to complete MATH1061 Mathematics 1A before starting MATH1062 Mathematics 1B.

Classes: 3x1-hr lectures; 2x1-hr tutorial/wk

Assumed knowledge: Knowledge of complex numbers and methods of differential and integral calculus including integration by partial fractions and integration by parts as for example in MATH1021 or MATH1921 or MATH1931 or MATH1061 or HSC Mathematics Extension 2

Prohibitions: MATH1905 or MATH1903 or MATH1907 or MATH1923 or MATH1933 or MATH1972 or MATH1962 or MATH1003 or MATH1023 or MATH1005 or MATH1015

Offered: Semester 1, Semester 2

Credit points: 6.0

MATH1064: Discrete Mathematics for Computation

This unit introduces students to the language and key methods of the area of Discrete Mathematics. The focus is on mathematical concepts in discrete mathematics and their applications, with an emphasis on computation. For instance, to specify a computational problem precisely one needs to give an abstract formulation using mathematical objects such as sets, functions, relations, orders, and sequences. In order to prove that a proposed solution is correct, one needs to apply the principles of mathematical logic, and to use proof techniques such as induction. To reason about the efficiency of an algorithm, one often needs to estimate the growth of functions or count the size of complex mathematical objects. This unit provides the necessary mathematical background for such applications of discrete mathematics. Students will be introduced to mathematical logic and proof techniques; sets, functions, relations, orders, and sequences; counting and discrete probability; asymptotic growth; and basic graph theory.

Classes: 3x1-hr lecture/wk for 13 weeks; 1x1-hr practice class/wk for 13 weeks; 1x1-hr tutorial/wk for 12 wks.

Assumed knowledge: Coordinate geometry, basic integral and differential calculus, polynomial equations and algebraic manipulations, equivalent to HSC Mathematics

Prohibitions: MATH1004 or MATH1904

Offered: Semester 2

Credit points: 6.0

DATA1001: Foundations of Data Science

DATA1001 is a foundational unit in the Data Science major. The unit focuses on developing critical and statistical thinking skills for all students. Does mobile phone usage increase the incidence of brain tumours? What is the public's attitude to shark baiting following a fatal attack? Statistics is the science of decision making, essential in every industry and undergirds all research which relies on data. Students will use problems and data from the physical, health, life and social sciences to develop adaptive problem solving skills in a team setting. Taught interactively with embedded technology, DATA1001 develops critical thinking and skills to problem-solve with data. It is the prerequisite for DATA2002.

Classes: 3x1-hr lectures; 1x2-hr lab/wk

Prohibitions: DATA1901 or MATH1005 or MATH1905 or MATH1015 or MATH1115 or ENVX1001 or ENVX1002 or ECMT1010 or BUSS1020 or STAT1021

Offered: Semester 1, Semester 2

Credit points: 6.0

4 Fundamental Units

4.1 Who should take fundamental units?

Fundamental units are designed for students whose major interest lies outside mathematics, but who require mathematics and statistics to support the study of other scientific disciplines. In general, students who take fundamental units will not be interested in studying mathematics after first year. Students who wish to continue studying mathematics after first year, or who are enrolled in a degree program which requires intermediate mathematics, should aim for at least credits in fundamental junior units or choose mainstream junior units.

4.2 Assumed knowledge

HSC Mathematics Advanced (or equivalent) is the assumed knowledge for all fundamental units.

4.3 Objectives of fundamental units

The fundamental units are designed to:

- illustrate ways in which students' existing mathematical knowledge can be applied to problems that arise in the life sciences;
- demonstrate applications of mathematics and statistics;
- give students an appreciation of mathematics as vital to all scientific disciplines.

Outcomes for individual units are listed on the unit information sheets.

4.4 List of Fundamental Units

MATH1050: Mathematics Toolbox for Science

This unit is designed for science students who do not intend to undertake higher year mathematics and statistics. It establishes and reinforces the fundamentals of calculus, illustrated where possible with context and applications. Mathematics is a powerful tool in Science. It is used to interpret observations, to formulate predictions, create models, refine

theory and communicate scientific reasoning in many disciplines. In this unit you will learn how Mathematical ideas are applied across Science. You will see that Mathematics plays a fundamental role in the Life and Environmental Sciences, in Medicine and in Health, as well as in physical sciences. You will meet familiar ideas such as calculus and exponentials now put to work to solve practical scientific problems, and you will be introduced to powerful new concepts such as matrices and differential equations. You will use public domain technology to perform calculations, do algebra and draw graphs which will enable you to work on interesting real-world scenarios. At the end of this unit you will be equipped to use mathematical ideas confidently in the disciplinary and interdisciplinary contexts that you will meet in your degree and beyond. This unit is designed to complement DATA1001 in the Science core.

Classes: 1x1-hr lecture and 1x2-hr lecture; 1x2-hr workshop/wk

Assumed knowledge: HSC Mathematics Advanced. Please note: this unit does not normally lead to a major in Mathematics or Statistics or Financial Mathematics and Statistics.

Prohibitions: MATH1002 or MATH1021 or MATH1023 or MATH1921 or MATH1902 or MATH1923 or MATH1933 or MATH1931 or (MATH1011 and MATH1014) or (MATH1013 and MATH1014) or (MATH1011 and MATH1013) or MATH1001 or MATH1003 or MATH1901 or MATH1906 or MATH1903 or MATH1907

Offered: Semester 1, Semester 2

Credit points: 6.0

DATA1001: Foundations of Data Science

DATA1001 is a foundational unit in the Data Science major. The unit focuses on developing critical and statistical thinking skills for all students. Does mobile phone usage increase the incidence of brain tumours? What is the public's attitude to shark baiting following a fatal attack? Statistics is the science of decision making, essential in every industry and undergirds all research which relies on data. Students will use problems and data from the physical, health, life and social sciences to develop adaptive problem solving skills in a team setting. Taught interactively with embedded technology, DATA1001 develops critical thinking and skills to problem-solve with data. It is the prerequisite for DATA2002.

Classes: 3x1-hr lectures; 1x2-hr lab/wk

Prohibitions: DATA1901 or MATH1005 or MATH1905 or MATH1015 or MATH1115 or ENVX1001 or ENVX1002 or ECMT1010 or BUSS1020 or STAT1021

Offered: Semester 1, Semester 2

Credit points: 6.0

5 MATH1111 Introduction to Calculus

5.1 Who should take this unit?

This unit of study is available only to those students who have not successfully completed a calculus course at school. Students with HSC Mathematics Standard 1 or 2 or only Year 10 Mathematics are eligible to enrol in this unit. Permission must be sought from the School of Mathematics and Statistics in order to enrol. The unit is offered only in semester 1.

5.2 Objectives

This unit is designed to:

- provide students with a clear understanding of the ideas of calculus;
- build a solid foundation for subsequent courses in mathematics;
- demonstrate the power of the calculus as a tool for solving problems in science and engineering.

Outcomes are listed on the unit information sheet.

5.3 Description

MATH1111: Introduction to Calculus

This unit is an introduction to the calculus of one variable. Topics covered include elementary functions, differentiation, basic integration techniques and coordinate geometry in three dimensions. Applications in science and engineering are emphasised.

Classes: 3x1-hr lectures; 2x1-hr tutorials/wk

Assumed knowledge: Knowledge of algebra and trigonometry equivalent to NSW Year 10

Prohibitions: MATH1011 or MATH1901 or MATH1906 or MATH1001 or HSC Mathematics Extension 1 or HSC Mathematics Extension 2 or ENVX1001 or MATH1021 or MATH1921 or MATH1931

Offered: Semester 1

Credit points: 6.0

Note: Faculty/department permission required

Additional Resources.

- Online Resource
  - MOOC: Introduction to Calculus (https://www.coursera.org/learn/introduction-to-calculus)
- Reference Book:
  - Anton, H., Biven, I. and Davis, S., *Calculus: Early Transcendentals Single Variable.* Wiley (Library 515/77C).

6 Classes

All junior units of study require attendance at both lectures and tutorials or computer lab sessions. The number of classes in any particular unit is given in previous sections.

6.1 Lectures

Most content of a unit of study is delivered via lectures. Generally junior units have very large class sizes. The pace at which material is delivered is usually quicker than you will have encountered at school, and you are required to work much more independently. Lecturers may provide you with text references during lectures. It is important to listen, and to try to follow the material being presented, and take abbreviated notes rather than comprehensively write down everything.

You are expected to attend lectures. If you do not attend lectures you should at least follow the lecture recordings available through Canvas. Remember lectures may contain important announcements and that it is your responsibility to find out the content of any such announcements.

6.2 Tutorials

Mathematical skills and understanding cannot be acquired passively, for example by attendance at lectures and reading solutions to problems alone. On the contrary, it is essential that you work through as many relevant problems as possible by yourself.

Tutorials are small classes in which you are expected to work through some set exercises. Most units run board tutorials, in which you collaroratively solve problems in small groups on the white board. The role of the tutor is to provide support and to some extent give feedback on your solutions written on the board.

Problem sheets and solutions will be available from the unit of study Canvas site. When available, you will gain maximum benefit from a tutorial if you have attempted the pre-tutorial exercises.

A record of your tutorial attendance is kept. You should attend the tutorial to which you have been assigned on your timetable. When you attend your first tutorial you should check that your name is *typed* onto your tutor's roll. Timetable changes can be requested during the first week of semester through MyUni. The assessment for most units includes a small tutorial participation component.

6.3 Computer Laboratory

Statistics and Data Science units (MATH1062 and DATA1001) have computer labs. Similar to tutorials they provide opportunity to practice problem solving and coding. You may need to download and install required software to use at home or during lab classes. Some classes require to bring your own device. Please look at the information provided for the relevant units of study.

6.4 Discussion Forum and Consultations

Every unit will offer a discussion forum (Ed Discussion). You should be invited to participate. If not, for instance because you enrolled late, you can go to the Canvas site and click onto the Ed Discussion link. That gets you enrolled and you can participate immediately.

Use the discussion forum to ask any questions relevant to content or organisation of the unit. If you know answers you can post responses to questions. That way others can benefit from questions and answers.

If the discussion forum does not answer your questions, you can consult your lecturer. All lecturers in junior mathematics units will have a scheduled consultation hour. Consultation hours will be announced early in the semester.

7 Assessment

In general, assessment in junior mathematics units will be based on tasks to be completed during the semester as well as the end of semester exam. Precise details of the assessment procedures in each unit will be included in the unit outline which will be made available online through the Learning Management System. For all assessments please note the University's "Academic Dishonesty and Plagiarism in Coursework". For more detail see

https://sydney.edu.au/students/academic-dishonesty.html.

You must complete the *Academic honesty education module* available from within Canvas.

7.1 Grades

Final grades in mathematics units of study are returned within one of the following bands:

Grade	Mark Range	Standard
High Distinction (HD)	85–100	representing complete or close to complete mastery of the material;
Distinction (D)	75–84	representing excellence, but substantially less than complete mastery;
Credit (CR)	65–74	representing a creditable performance that goes beyond routine knowledge and understanding, but less than excellence;
Pass (P)	50–64	representing at least routine knowledge and understanding over a spectrum of topics and important ideas and concepts in the course.
Fail (F)	0-49	does not meet the minimal requirements for the course.

A student with a passing or higher grade should be well prepared to undertake further studies in mathematics. Students hoping to continue with advanced units of study should be aiming for credits or higher grades.

7.2 Examinations

Each junior mathematics unit has an examination during the University examination period at the end of the semester in which the unit is offered. The dates of the exam period, and

information concerning the exam timetable, can be found at:

https://sydney.edu.au/students/exams.html

7.3 In Semester Assessments

Assignments

Assignments are set and marked in order to give you extra practice, and to provide you with feedback on how you are handling the material.

Some collaboration between students on assignments is encouraged, since it can be a real aid to understanding. Thus it is legitimate for students to discuss assignment questions at a general level, provided everybody involved makes a contribution. However, if an assignment is to count as part of the assessment, then you must produce your own individual written solution. Copying someone else's assignment, or allowing your assignment to be copied by someone else, is academic dishonesty and will be dealt with as such, see above.

Submission and return of assignments. The assignments must be submitted electronically via the Learning Management System (Canvas) site by the deadline. It is passed through a text matching software (Turnitin) to check for plagiarism. Your submission should include your SID, tutorial day and time. Your assignment will be marked anonymously with useful comments and feedback, which you can view online from the Learning Management System (Canvas).

Quizzes

Many junior units of study will have an online quiz. These will usually be conducted in a 24-hour window.

Online Quizzes

Many units have weekly online quizzes that count towards the final mark. Precise instructions vary. Please take note of the instructions provided on the Learning Management System.

Projects and Presentations

Some units (statistics and data) have groupwork projects and presentations. Similar to assignments, groupwork projects are submitted electronically through the Learning Management System (Canvas).

Final Results

Your final result in each unit will be posted on MyUni and later you will receive notice of examination results by mail. If you have a concern about your results, contact the Student Services Office. We will not generally release any marks unofficially.

8 Special consideration and special arrangements

8.1 General Information

While studying at the University of Sydney, a student may need to apply for special consideration or special arrangements as follows:

Special Consideration may be granted where well-documented illness, injury or misadventure occurs to the student (or someone the student has carer's responsibility for) during semester or the exam period.

Longer term health or emotional issues are best managed with adjustments to course assessments as part of an Academic Plan developed in discussion between the student and Disabilities Service.

Special Arrangements may be granted for certain personal circumstances - for example the birth of a child, or religious or cultural commitments - or for essential community commitments - for example compulsory legal absence (e.g. Jury duty), elite sporting or cultural commitments (representing the University, state or country), or Australian Defence Force or Emergency Service commitments (e.g. Army Reserve).

Further information on deadlines, eligibility, document requirements and how to apply is available at

https://sydney.edu.au/students/special-consideration.html.

When completing the online application, ensure you choose an Assessment Category and Type that matches the description of the assessment given in the Unit Outline.

Students should not submit an application of either type if

- there is no assessment associated with a missed class, or
- there is a reasonable opportunity to make up any work you missed.

Note that occasional brief or trivial illness will not generally warrant special consideration. Also, an application for special consideration or special arrangements is a request only, and not a guarantee that special consideration will be granted or special arrangements made.

8.2 Special consideration relating to assignments.

If you encounter a problem submitting an assignment or project on time, you need to apply for special considerations. Extensions longer than one week are generally not possible. See the link given above for more information and details on how to apply. Simple extension requests will not be granted, rather students will be directed to apply for special consideration.

Written assignments or projects submitted late without permission will incur a late penalty equal to 5% of the maximum awardable mark per day. These deductions begin immediately after the time the assignment is due and continue for 10 calendar days or until a solution for the assignment is released or marked assignments are returned to other students. At that point the mark awarded will be zero. A mark of zero will be awarded for all submissions more than 10 days past the original due date. Further extensions past this time will not be permitted.

8.3 Special consideration relating to quizzes.

If you miss a quiz due to illness or misadventure you may be eligible to apply for Special Consideration if the *bettermark principle* does not apply.

If your application for Special Consideration relating to missing a quiz is successful then you gain exemption from the quiz and the credit is transferred to the final examination.

Bettermark principle. Most units of study use a *bettermark principle*, which means that credit for a missed quiz is automatically transferred to the exam. Please consult the unit outline for the precise rules applying to your unit.

Special consideration relating to end-of-semester examinations.

If you believe that your performance on an exam was impaired due to illness or misadventure during the week preceding the exam, then you should apply for Special Consideration. If your application is successful you may be offered the opportunity to sit a replacement exam. Please note that illness or misadventure during the week preceding the exam is not usually an acceptable reason for missing an exam.

If you miss an exam due to illness or misadventure on the day of the exam then you should apply for Special Consideration. If your application is successful you will be granted the opportunity to sit a supplementary examination.

8.4 Special consideration relating to attendance.

The University policy is that all students should attend at least 80 per cent of timetabled classes in their respective units of study. Attendance is monitored in tutorials, but generally no marks are allocated for attendance, except where it is incorporated in some scheduled assessed activity. Applications for Special Consideration or for Special Arrangements for absences that do not involve a scheduled assessed activity should not be made.

8.5 Jury duty, military service, national sporting and religious or cultural commitments.

Students who will miss an assessment due to commitments such as these may apply for special arrangements to be made, as detailed above.

9 Additional information

9.1 Variation of enrolment

Any variation to enrolment must be made before the relevant HECS cut-off date in each semester (usually some time in March for first semester, and some time in August for second semester).

After the cut-off dates it may not be possible to enrol in additional units, nor to withdraw from a unit without incurring HECS fees. Note that it is generally not possible to enrol in additional units of study after the end of the second week of each semester.

It is your responsibility to make any desired changes to your enrolment before the relevant dates. This includes changing the level at which you are studying mathematics, for example from advanced to mainstream, or vice versa. You are strongly advised to consult the Director of First Year Studies if you wish to make such a change. Even though advanced and mainstream units have similar syllabuses, changing from one to the other may be disruptive. If it is necessary to make such a change, try to change earlier rather than later. Because advanced and mainstream units have completely different syllabuses from fundamental units, changes to and from fundamental units may be even more disruptive. In general, such changes should not be made after the end of the second week of each semester.

9.2 Learning Hub (Mathematics)

Students who have difficulties with current course work as a result of inadequate understanding of the assumed knowledge for the unit of study may find that the Learning Hub (Mathematics) can help.

The Learning Hub (Mathematics) can be of particular assistance if you:

- You have not studied the mathematics which is assumed knowledge for your course.
- You are a mature age student who has not studied mathematics in several years.
- You are from overseas and find you have gaps in your knowledge, or are not familiar with mathematical terms in English.
- Your studies have been interrupted by either illness or accident or some other cause.

The Learning Hub (Mathematics) offers advice about supplementary work needed and has self-study materials, in a variety of forms, which students can use. Small classes or one-to-one assistance are provided where needed. The Learning Hub (Mathematics) also helps students to improve their study skills. More information is at

https://www.sydney.edu.au/students/learning-hub-mathematics.html

You can make use of the online resources regardless of your background and eligibility.

The Learning Hub (Mathematics) is in Room N293 in the Quadrangle.

9.3 Sydney University Mathematical Society

ΣUMS (pronounced sums) is an informal group, organised by students, that aims to promote interest in mathematics. Every mathematics student is automatically a member. ΣUMS organises talks by mathematicians, an annual problem solving competition and various other events such as the ΣUMS musical. Everybody is very welcome to attend and be involved. Contributions to the ΣUMS newsletter (ΣUMS+Plus) are also welcome. Websites:

- https://www.facebook.com/usydsums

9.4 Sydney University Science Association

The University of Sydney Science Society, SciSoc, is the undergraduate society for students in the Science Faculty at the University of Sydney. All students enrolled in Science at the University of Sydney are automatically members of SciSoc. Part of the mission of SciSoc is to provide a form of social support for Science students.

9.5 Fire alarms and evacuation procedures

If you are in a building and the fire alarm sounds, then you must evacuate the building immediately. You should familiarise yourself with the evacuation procedures from any rooms in which you have classes.

9.6 Timetables

Once semester has started you find timetables for all units offered by the School of Mathematics and Statistics at

https://www.maths.usyd.edu.au/u/UG/mathstattimetable.html.

How to get your personal timetable, enter preferences etc you find at

https://sydney.edu.au/students/timetables.html