Mathematics and Statistics
Student Handbook
Melbourne Campus
2015
A guide for students enhancing their studies with subjects in mathematics and statistics

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Department of Mathematics and Statistics
latrobe.edu.au/mathstats

2015 Edition
Issue 1
Department of Mathematics and Statistics
latrobe.edu.au/mathstats
Benefits in studying mathematics and statistics

Why Mathematics and Statistics?

- Our staff have strong teaching credentials; several of our staff members and our first-year teaching team have received prestigious awards for excellence in teaching, including two national awards.
- Our graduates are extremely satisfied with their experiences; in the most recent survey (2012), graduates placed La Trobe Math and Stats 1st in Victoria, and 3rd in Australia.
- Our statistics program is the only undergraduate statistics program in Victoria accredited by the Statistical Society of Australia Inc.
- La Trobe is a full member of the Australian Mathematical Sciences Institute (AMSI), and through this and other activities, La Trobe plays an important role on the national stage.
- La Trobe maintains links with high school teachers directly and through the Mathematical Association of Victoria (the MAV). La Trobe University annually hosts both the MAV Math Talent Quest and the MAV annual conference.
- Our Department is also an active research department; it includes two ARC Future Fellows and an ARC Professional Fellow.

Careers in Mathematics and Statistics

Mathematician and statistician feature at the top of the rankings for the best jobs in the United States for 2014. The ranking comes from jobsrated.com, where 200 different jobs are compared and ranked according to criteria including work environment, income, stress level and hiring prospects. Other jobs in the top ten count on mathematics and statistics skills: actuary, software engineer and computer systems analyst.

"Math is experiencing something of a Renaissance period, and analytics are the driving force. Mathematical analyses of trends are used to guide many activities, ranging from Internet user tendencies to airport traffic control."

—Victor Krieger, JobsRated.com

For more information about this ranking visit JobsRated.com

National shortage of statisticians

Professional statistics graduates are employed as consultants in a wide range of activities including medicine, epidemiology, health sciences, psychological science, bioinformatics, biostatistics, econometrics, market research, business forecasting, finance, insurance, engineering, environmental science, biological science and agriculture. There is a serious continuing shortfall of graduates from professional statistics programs.

To give yourself the best career options, and position yourself for the best jobs, we recommend you take a double major in Maths and Stats. There are many great jobs available in statistics; students who have a double major get their pick of the best positions.

For more information on careers in mathematics and statistics, go to www.mathscareers.org.au and the National Association of Career Placement website www.statsci.org/jobs

Honours in Mathematics and Statistics

Going on to honours in mathematics and/or statistics is an excellent choice. The honours classes are quite small and you will receive a lot of one-on-one help from staff. Honours classes are more advanced than third year classes, and you will have the opportunity to learn advanced ideas and techniques, giving you a cutting edge in the workforce. An honours degree will also keep open for you the option of going on to postgraduate study. As a general rule, only students in the top one third of the third year class are invited to enrol in honours. If you do receive an invitation, you are warmly encouraged to take up this excellent opportunity.

Get a jump on your career, visit these mathematics and statistics career resources: www.austms.org.au/Job_opportunities
www.statsci.org/jobs
www.amsi.org.au
www.mycareer.com.au
www.careerone.com.au
www.graduatecareers.com.au
www.austms.org.au/Job_opportunities
www.statsci.org/jobs
www.amsi.org.au
# Academic Staff

List includes staff members that undergraduate students may need to contact including honours supervisors, subject coordinators, subject lecturers and demonstrators. For a complete list of staff in the Department of Mathematics and Statistics, please visit our website [latrobe.edu.au/mathstats](http://latrobe.edu.au/mathstats).

<table>
<thead>
<tr>
<th>Name</th>
<th>Room</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kevin Bicknell</td>
<td>PS2 219</td>
<td>03 9479 2602</td>
<td><a href="mailto:K.Bicknell@latrobe.edu.au">K.Bicknell@latrobe.edu.au</a></td>
</tr>
<tr>
<td>Prof Philip Broadbridge</td>
<td>PS2 216</td>
<td>03 9479 3714</td>
<td><a href="mailto:P.Broadbridge@latrobe.edu.au">P.Broadbridge@latrobe.edu.au</a></td>
</tr>
<tr>
<td>A/Prof Grant Cairns</td>
<td>PS2 217</td>
<td>03 9479 1106</td>
<td><a href="mailto:G.Cairns@latrobe.edu.au">G.Cairns@latrobe.edu.au</a></td>
</tr>
<tr>
<td>Emer Prof Brian Davey</td>
<td>PS2 318</td>
<td>03 9479 2599</td>
<td><a href="mailto:B.Davey@latrobe.edu.au">B.Davey@latrobe.edu.au</a></td>
</tr>
<tr>
<td>Dr David Farchione</td>
<td>PS2 226</td>
<td>03 9479 2091</td>
<td><a href="mailto:D.Farchione@latrobe.edu.au">D.Farchione@latrobe.edu.au</a></td>
</tr>
<tr>
<td>Dr Deborah Jackson</td>
<td>PS2 316</td>
<td>03 9479 1006</td>
<td><a href="mailto:D.Jackson@latrobe.edu.au">D.Jackson@latrobe.edu.au</a></td>
</tr>
<tr>
<td>A/Prof Marcel Jackson</td>
<td>PS2 317</td>
<td>03 9479 1570</td>
<td><a href="mailto:M.G.Jackson@latrobe.edu.au">M.G.Jackson@latrobe.edu.au</a></td>
</tr>
<tr>
<td>Mitra Jazayeri</td>
<td>PS2 222</td>
<td>03 9479 3665</td>
<td><a href="mailto:M.Jazayeri@latrobe.edu.au">M.Jazayeri@latrobe.edu.au</a></td>
</tr>
<tr>
<td>A/Prof Paul Kabaila</td>
<td>PS2 225</td>
<td>03 9479 2594</td>
<td><a href="mailto:P.Kabaila@latrobe.edu.au">P.Kabaila@latrobe.edu.au</a></td>
</tr>
<tr>
<td>Dr Theodoros Kouloukas</td>
<td>PS2 308B</td>
<td>03 9479 2614</td>
<td><a href="mailto:T.Kouloukas@latrobe.edu.au">T.Kouloukas@latrobe.edu.au</a></td>
</tr>
<tr>
<td>A/Prof Tomasz Kowalski</td>
<td>PS2 322</td>
<td>03 9479 2595</td>
<td><a href="mailto:T.Kowalski@latrobe.edu.au">T.Kowalski@latrobe.edu.au</a></td>
</tr>
<tr>
<td>Dr Yuri Nikolayevsky</td>
<td>PS2 324</td>
<td>03 9479 1644</td>
<td><a href="mailto:Y.Nikolayevsky@latrobe.edu.au">Y.Nikolayevsky@latrobe.edu.au</a></td>
</tr>
<tr>
<td>Dr Andriy Olenko</td>
<td>PS2 224</td>
<td>03 9479 2609</td>
<td><a href="mailto:A.Olenko@latrobe.edu.au">A.Olenko@latrobe.edu.au</a></td>
</tr>
<tr>
<td>Dr Narwin Perkal</td>
<td>PS2 323</td>
<td>03 9479 2592</td>
<td><a href="mailto:N.Perkal@latrobe.edu.au">N.Perkal@latrobe.edu.au</a></td>
</tr>
<tr>
<td>A/Prof Luke Prendergast</td>
<td>PS2 228</td>
<td>03 9479 2610</td>
<td><a href="mailto:Luke.Prendergast@latrobe.edu.au">Luke.Prendergast@latrobe.edu.au</a></td>
</tr>
<tr>
<td>Prof Reinout Quispel</td>
<td>PS2 307</td>
<td>03 9479 1201</td>
<td><a href="mailto:R.Quispel@latrobe.edu.au">R.Quispel@latrobe.edu.au</a></td>
</tr>
<tr>
<td>Dr Agus Salim</td>
<td>PS2 220A</td>
<td>03 9479 1466</td>
<td><a href="mailto:A.Salim@latrobe.edu.au">A.Salim@latrobe.edu.au</a></td>
</tr>
<tr>
<td>A/Prof Katherine Seaton</td>
<td>PS2 214</td>
<td>03 9479 1030</td>
<td><a href="mailto:K.Seaton@latrobe.edu.au">K.Seaton@latrobe.edu.au</a></td>
</tr>
<tr>
<td>Emer Prof Robert Staudte</td>
<td>PS2 228</td>
<td>03 9479 2608</td>
<td><a href="mailto:R.Staudte@latrobe.edu.au">R.Staudte@latrobe.edu.au</a></td>
</tr>
<tr>
<td>Dr Dinh Tran</td>
<td>PS2 321</td>
<td>03 9479 1068</td>
<td><a href="mailto:Dinh.Tran@latrobe.edu.au">Dinh.Tran@latrobe.edu.au</a></td>
</tr>
<tr>
<td>Dr Peter van der Kamp</td>
<td>PS2 319</td>
<td>03 9479 1614</td>
<td><a href="mailto:P.vanderKamp@latrobe.edu.au">P.vanderKamp@latrobe.edu.au</a></td>
</tr>
</tbody>
</table>
Administrative Contacts

Head of Department
A/Prof Luke Prendergast
PS2 228 03 9479 2610
Luke.Prendergast@latrobe.edu.au

Advisors of Studies
Mathematics
Dr Yuri Nikolayevsky
PS2 324 03 9479 1644
Y.Nikolayevsky@latrobe.edu.au

Statistics
Dr Andriy Olenko
PS2 224 03 9479 2609
A.Olenko@latrobe.edu.au

Year Coordinators
First Year Mathematics
Dr Narwin Perkal
PS2 323 03 9479 2592
N.Perkal@latrobe.edu.au

First Year Statistics
A/Prof Luke Prendergast
PS2 228 03 9479 2610
Luke.Prendergast@latrobe.edu.au

Second Year
Dr Yuri Nikolayevsky
PS2 324 03 9479 1644
Y.Nikolayevsky@latrobe.edu.au

Third Year
A/Prof Grant Cairns
PS2 317 03 9479 1106
G.Cairns@latrobe.edu.au

Honours
A/Prof Marcel Jackson
PS2 317 03 9479 1570
M.G.Jackson@latrobe.edu.au

Postgraduate
Dr David Farchione
PS2 226 03 9479 2091
D.Farchione@latrobe.edu.au

Course Coordinators

Bachelor of Science
Dr Andriy Olenko
PS2 224 03 9479 2609
A.Olenko@latrobe.edu.au

Bachelor of Science / Bachelor of Science Education
Bachelor of Science / Master of Teaching
A/Prof Katherine Seaton
PS2 214 03 9479 1030
K.Seaton@latrobe.edu.au

Master of Statistical Science
A/Prof Paul Kabaila
PS2 225 03 9479 2594
P.Kabaila@latrobe.edu.au

University Contacts

Student Centre
03 9479 2005
studentcentre@latrobe.edu.au

La Trobe International
03 9479 1199
international@latrobe.edu.au

Research Services
03 9479 1976
teamsgso@latrobe.edu.au

ICT Service Desk
03 9479 1500
ict.servicedesk@latrobe.edu.au

Security and Safety
03 9479 2012

Emergencies
03 9479 2222

University Reception
03 9479 1111

Lists current at 13 November 2014. Coordinators for 2015 will be updated at the department website latrobe.edu.au/mathstats
Prizes and Scholarships

List current at 13 November 2014. For updates, please visit the department website latrobe.edu.au/mathstats

First Year Prizes

First Year Scholarship in Mathematics and Statistics
Awarded to a first year student with high overall performance in VCE studies (or equivalent) who has a demonstrated interest and intention to pursue major studies in mathematics or statistics.
Prize – $1000

Texas Instruments Prize
Awarded to the most outstanding first year mathematics student who continues with second year mathematics.
Prize – Advanced Texas Instruments programmable calculator

The Department Prize in First Year Mathematics
Awarded to the most outstanding first year mathematics student based on their performance in core first year mathematics subjects.
Prize – $200

The Department Prize in First Year Statistics
Awarded to the most outstanding student in first year statistics subjects.
Prize – $200 for each recipient

Second Year Prizes

Arthur Jones Essay Prize
Awarded annually to a student enrolled in at least one second-year or third-year mathematics subject, for a mathematical essay on a topic not covered in undergraduate subjects.
Prize – $250

Professor C.J. Eliezer Prize in Second Year Mathematics
Awarded annually to the most outstanding second year mathematics student.
Prize – $200

The Department Prize in Second Year Statistics
Awarded to the most outstanding student in second year statistics subjects.
Prize – $200

Third Year Prizes

Arthur Jones Essay Prize
Awarded annually to a student enrolled in at least one second-year or third-year mathematics subject, for a mathematical essay on a topic not covered in undergraduate subjects.
Prize – $250

E.J. Hannan Prize for Third Year Statistics
Awarded annually to the student who has completed both a major in Mathematics and the Accredited Major in Statistics, with the best average mark over third year subjects that comprise the Accredited Major in Statistics.
Prize – $250

The Department Prize in Third Year Statistics
Awarded to the most outstanding student in third year statistics subjects.
Prize – $200

The National Bank of Australia Prize in Third Year Mathematics
Awarded annually to the most outstanding third year mathematics student.
Prize – $500

Honours Prizes

Professor C.J. Eliezer Prize in Fourth Year Mathematics
Awarded annually to the most outstanding fourth year mathematics student.
Prize – $300

The Department Prize in Fourth Year Statistics
Awarded to the most outstanding student in fourth year statistics subjects.
Prize – $200

Postgraduate Scholarship

Professor Edgar Smith Scholarship
The Professor Edgar Smith Scholarship is a travel award, awarded annually to a full-time PhD student of outstanding merit from the Department of Mathematics and Statistics, to allow the recipient to undertake an extended overseas visit. The award is normally made in the area of applied mathematics (including mathematical physics), which was Professor Edgar Smith’s own discipline area.
Prize – $8000 travel scholarship.
What subjects should you enrol in?

There is a variety of different degree programs, and within them there is a number of options for studying mathematics and statistics, and combining them with their other areas of interest.

There is a number of streams that you might wish to study: applied mathematics, pure mathematics, statistics, applied statistics. Whatever you do, make sure you keep your options open for the future. For example, to be a teacher you should aim for majors in two different areas of study. Also, your job prospects in other science disciplines can be expanded the more mathematics and statistics that you take.

The main option for students wishing to take a major in mathematics or statistics (or both) is the Bachelor of Science.

Students can also take a mathematics major or a statistics major in the new science degree, Bachelor of Science (Applications in Society).

It is also possible to take a major in mathematics (only) in the Bachelor of Arts, alongside a major from an humanities discipline.

In the double degree Bachelor of Science/Bachelor of Science Education, it is possible to take a major in either mathematics or statistics or a combination of them (including 60 credit points at third year) or a minor sequence (including 30 credit points at third year). This degree prepares you, without further study, to be a science and mathematics teacher. The course includes in-school experience and education subjects, beginning second year.

Note that from 2015 the Bachelor of Science/Bachelor of Science Education is being replaced by the Bachelor of Science / Master of Teaching combined degree.

Choosing Statistics Subjects

The demand for professional statisticians far exceeds supply. Statistics works well in tandem with most scientific disciplines (such as Environmental Science, Genetics, Biology, Health Sciences, etc) and many others such as Finance. Consider these ways to include significant choices of statistics subjects in your degree:

Accredited Professional Statistics Program (accredited major)

The Statistics program at La Trobe University is the only Victorian undergraduate Statistics Program accredited by the Statistical Society of Australia Inc. This accredited program is the major in statistics consisting of the subjects STA2ABS or STA2AMS, STA2BS/STA3BS and STM2PM/STA2MD in second year and STA3AS, STA3LM, and STA3SI in third year. This major entitles the holder to Graduate Statistician status upon joining Statistical Society of Australia Inc. Students wanting to take this major need to take STA1LS or STA1SS. It is also recommended that these students take the mathematics subjects MAT1NLA and MAT2LAL.

Students who have taken major studies in statistics may be eligible for Honours study in Statistics (see later section) which further enhances employability and can lead to postgraduate research in Statistics. Combining statistics with mathematics in third year also leaves open the possibility of combining these subjects in honours.

Applied Statistics Stream

Students in the experimental and related areas, for example, biology, nutrition, medical sciences, health sciences, agricultural sciences, and animal sciences are advised to choose the following subjects:

- First Year – STA1LS
- Second Year – One or more of STA2ABS, STA2AMS, STM2PM/STA2MD, STA2BS

Students majoring in Psychology are advised to choose the following:

- First Year – STA1PSY
- Second Year – Either STA2ABS or STA2AMS

If you go on to include two statistics subjects at third year level, you will have completed the Applied Statistics Stream.

STM Subjects

Recognising the interrelationship of mathematics and statistics, several subjects will be taught under ‘STM’ subject codes from 2015 and will count towards either major.

STM2PM replaces STA2MD.
STM3SC replaces MAT3SC.

Choosing Mathematics Subjects

Mathematics is currently experiencing a remarkable period of growth. Problems that have been open for hundreds of years have been solved in the last decade or two, and there is optimism that some of the remaining great unsolved problems of mathematics may also soon be solved. Advances in computing capabilities have also made mathematics an increasingly powerful tool with many new applications. In addition to their traditional employment avenues, mathematics graduates are now finding new positions in areas including computing, banking, medical sciences for example.

The minimum requirement to have a major in mathematics on your academic transcript (Bachelor of Science or Bachelor of Arts) is 135 credit points overall, normally made up of:

- MAT1NLA and MAT1CDE
- Three subjects (45 credit points) at second year level, or two at a minimum (which limits third year choices)
- Four subjects (60 credit points) at third year level

If you want to study mathematics at second and third year we strongly advise that you take MAT1NLA, MAT1CDE and MAT1DM.

The second year subjects all grow out of topics introduced in first year subjects MAT1NLA, MAT1CDE or MAT1DM (note that MAT1NLA and MAT1CDE are prerequisites for most of the options). Our approach to teaching second year is also very similar to that used in MAT1NLA, MAT1CDE and MAT1DM: subjects texts are generally available and there are twice weekly practice classes where students learn to solve problems under the guidance of experienced supervisors. There are also fortnightly assignments.

The various mathematics subjects offered in second year are natural partners for subjects in statistics, computer science and physics. Students who like mathematics or who wish to major in it are strongly encouraged to take all the main second year mathematics subjects (see later section). Without a broad base at second year level, your choices of mathematics subjects in third and fourth year will be restricted.

Our third year offerings build upon your experience at first and second year and cover a very wide range of modern mathematics and its applications. You will be able to choose subjects according to your interest and ability. Most of the subjects involve practice classes, usually once a week.

A significant number of our graduates go on to Honours study in Mathematics and we strongly recommend that prospective Honours students in Mathematics take as many mathematics subjects at third year as possible. However, combinations at third year such as Maths and Physics, Maths and Statistics and Maths and Computer Science can also be good preparations for Honours in Mathematics. You should read the Honours section of this handbook before choosing your third year subjects.
Prerequisites

**Mathematics**

- MAT1DM₁
- MAT1NL₂
- MAT1CDE₂
- MAT2ALC₂
- MAT2ANA₁
- MAT2VCA₁
- MAT2LAL₂
- MAT2MEC₂
- MAT3CS₂
- MAT3DSA₂
- MAT3CZ₁
- MAT3AC₂
- MAT3LM₁
- MAT3SS₁
- MAT3AS₁
- MAT4GA
- MAT4GG
- MAT4MT
- MAT4CS
- MAT4TOP
- MAT4AA
- MAT4PDE
- MAT4GM
- MAT4NT

**Statistics**

- STA1SS/L5/PSY₂
- STA1DCT₁
- STA2MD/STM2PM₂
- STA2ABS/AMS₁
- STA2BS/3BS₂
- STM3CS₁
- STA3SI₁
- STA3AS₁
- STA3LM₂

**Key:**

- 🗺️ semester
- 🔵 capstone
- and
- ☑️ or

FOR MORE INFORMATION  ➤ latrobe.edu.au/mathstats
# Course map

**Bachelor of Science (Melbourne)**  
**Mathematics Major 2015**  
College of Science, Health and Engineering (SHE)

## Course Map

### Bachelor of Science (Melbourne)  
**Mathematics Major 2015**  
College of Science, Health and Engineering (SHE)

### Year 1

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<td>MAT1112D</td>
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<td>Number Systems and Linear Algebra</td>
<td>Calculus and Differential Equations</td>
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### Year 2

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### Year 3

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<td>CORE CHOICE YEAR 3 LEVEL Sem 1 or 2</td>
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### Core Choice Year 2 Level

Year 2 Level Mathematics subjects should be chosen in consultation with your course adviser. The three core choice subjects can be taken in any combination provided all core requirements have been obtained.

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<th>Teaching Period</th>
<th>Subject Code</th>
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<tr>
<td>TE-SEM-1</td>
<td>MAT22NA</td>
<td>Analysis of Real Numbers and Functions</td>
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<tr>
<td>TE-SEM-1</td>
<td>MAT22CA</td>
<td>Vector Calculus</td>
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<tr>
<td>TE-SEM-2</td>
<td>MAT22LC</td>
<td>Algebra, Linear Codes and Automata</td>
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<tr>
<td>TE-SEM-2</td>
<td>MAT22AL</td>
<td>Linear Algebra</td>
</tr>
<tr>
<td>TE-SEM-2</td>
<td>MAT22MEC</td>
<td>Mechanics</td>
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<td>TE-SEM-2</td>
<td>STM2PM</td>
<td>Probability Models</td>
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### Core Choice Year 3 Level

Year 3 Level Mathematics subjects should be chosen in consultation with your course adviser. The four core choice subjects can be taken in any combination provided core requirements have been obtained.

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<tr>
<td>TE-SEM-1</td>
<td>MAT32CZ</td>
<td>Complex Analysis</td>
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<td>TE-SEM-1</td>
<td>STM3CS</td>
<td>Computation and Simulation</td>
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<tr>
<td>TE-SEM-2</td>
<td>MAT32AC</td>
<td>Advanced Calculus and Curvature</td>
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<tr>
<td>TE-SEM-2</td>
<td>MAT32SA</td>
<td>Discrete Structures and Algorithms</td>
</tr>
<tr>
<td>TE-SEM-2</td>
<td>MAT32PG</td>
<td>Linear Programming and Game Theory</td>
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Please note:
A major in Mathematics is offered through the following courses. Please refer to the relevant course maps for more information.

- Bachelor of Arts
- Bachelor of Science
- Bachelor of Science and Society
- Bachelor of Science / Master of Teaching

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For more information, visit the La Trobe University handbook at [www.latrobe.edu.au/handbook](http://www.latrobe.edu.au/handbook)
# Course map

## Bachelor of Science (Melbourne)

### Statistics Major 2015

College of Science, Health and Engineering (SHE)

## Course map

### Bachelor of Science (Melbourne) Statistics Major 2015

#### College of Science, Health and Engineering (SHE)

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<th>Year 3</th>
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<td>ST43AS Applied Statistics</td>
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<td>CORE CHOICE YEAR 2 LEVEL Sem 1 or 2</td>
<td>STM2PM Probability Models</td>
<td>STA33S Statistical Inference</td>
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<td>STA233</td>
<td>STA33M Analyses of Linear Models</td>
<td>CORE CHOICE YEAR 3 LEVEL Sem 1 or 2</td>
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</table>

### Note

1. Core Choice Year 1 Level - Group A
   - **Teaching Period**: Subject Code | Subject Title
   - TE-SEM-1: MAT120 | Discrete Mathematics
   - TE-SEM-2: MAT125 | Calculus

2. Core Choice Year 1 Level - Group B
   - **Teaching Period**: Subject Code | Subject Title
   - TE-SEM-1: STA11S | Statistics for Life Sciences (Recommended; or STA1SS)
   - TE-SEM-2: STA1PSY | Statistics for Psychology
   - TE-SEM-3: STA18S | Statistical Science (Recommended; or STA1LS)

3. Alternative to Core Choice Year 1 Level
   - Please note that if a first-year core choice subject is not taken, it is still possible to complete a Statistics major by choosing an additional subject from the core choice Year 2 level subjects as an alternative.

4. Core Choice Year 2 Level
   - **Teaching Period**: Subject Code | Subject Title
   - TE-SEM-1: MAT20A | Analysis of Real Numbers and Functions
   - TE-SEM-2: STA2ABS | Applied Biostatistics
   - TE-SEM-3: STA2MEC | Mechanics

5. Core Choice Year 3 Level
   - **Teaching Period**: Subject Code | Subject Title
   - TE-SEM-1: STA33 | Complex Analysis
   - TE-SEM-2: STA33S | Computation and Simulation
   - TE-SEM-3: STA33M | Advanced Calculus and Curvature
   - TE-SEM-4: STA33PS | Linear Programming and Game Theory

### Additional Information

- **Course Map**: [LATROBE UNIVERSITY DEPARTMENT OF MATHEMATICS AND STATISTICS](http://latrobe.edu.au/mathstats)

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**Last updated: 10 Oct 2014**

**CRICOS Provider 00116M**

This information is correct at the time of printing but subject to change.
## Course map

### Bachelor of Science (Melbourne)

**Mathematics and Statistics Major 2015**

College of Science, Health and Engineering (SHE)

### Course Map

#### Year 1
- **Semester 1**
  - MAT114A Number Systems and Linear Algebra
  - CP: Critical Thinking
- **Semester 2**
  - MAT114D Calculus and Differential Equations

#### Year 2
- **Semester 1**
  - Core Choice Year 2 Level
    - Sem 1 or 2
- **Semester 2**
  - Core Choice Year 2 Level
    - Sem 1 or 2

#### Year 3
- **Semester 1**
  - Core Choice Year 3 Level
    - Sem 1 or 2
- **Semester 2**
  - Core Choice Year 3 Level
    - Sem 1 or 2

### Subject Map

**Legend:** Core (or core choice) vs. Elective

**Core Choice Year 2 Level**

Choose 45 credit points of Mathematics and Statistics subjects in consultation with your course adviser from the following list, including at least one STA2 or MST2 subject and at least one MAT2 subject.

<table>
<thead>
<tr>
<th>Teaching Code</th>
<th>Subject Code</th>
<th>Subject Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>TE-SEM-1</td>
<td>MAT2ANA</td>
<td>Analysis of Real Numbers and Functions</td>
</tr>
<tr>
<td>TE-SEM-1</td>
<td>MAT2BCA</td>
<td>Vector Calculus</td>
</tr>
<tr>
<td>TE-SEM-1</td>
<td>STA2ABS</td>
<td>Applied Biostatistics</td>
</tr>
<tr>
<td>TE-SEM-1</td>
<td>STA2AMS</td>
<td>Applied Medical Statistics</td>
</tr>
<tr>
<td>TE-SEM-2</td>
<td>MAT2ALC</td>
<td>Algebra, Linear Codes and Automata</td>
</tr>
<tr>
<td>TE-SEM-2</td>
<td>MAT2ALM</td>
<td>Linear Algebra</td>
</tr>
<tr>
<td>TE-SEM-2</td>
<td>MAT2MEC</td>
<td>Mechanics</td>
</tr>
<tr>
<td>TE-SEM-2</td>
<td>STA2BS</td>
<td>Biostatistics</td>
</tr>
<tr>
<td>TE-SEM-2</td>
<td>STM2PM</td>
<td>Probability Models</td>
</tr>
</tbody>
</table>

**Core Choice Year 3 Level**

Choose 60 credit points of Mathematics and Statistics subjects in consultation with your course adviser from the following list, including at least one STA3 subject and at least two MAT3 or MST3 subjects.

<table>
<thead>
<tr>
<th>Teaching Code</th>
<th>Subject Code</th>
<th>Subject Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>TE-SEM-1</td>
<td>MAT3CZ</td>
<td>Complex Analysis</td>
</tr>
<tr>
<td>TE-SEM-1</td>
<td>STA3AS</td>
<td>Applied Statistics (Sem 1 for 2015 only)</td>
</tr>
<tr>
<td>TE-SEM-1</td>
<td>STA3SI</td>
<td>Statistical Inference</td>
</tr>
<tr>
<td>TE-SEM-1</td>
<td>STM3CS</td>
<td>Computation and Simulation</td>
</tr>
<tr>
<td>TE-SEM-2</td>
<td>MAT34C</td>
<td>Advanced Calculus and Curvature</td>
</tr>
<tr>
<td>TE-SEM-2</td>
<td>MAT30DA</td>
<td>Discrete Structures and Algorithms</td>
</tr>
<tr>
<td>TE-SEM-2</td>
<td>MAT3LP</td>
<td>Linear Programming and Game Theory</td>
</tr>
<tr>
<td>TE-SEM-2</td>
<td>STA3BS</td>
<td>Biostatistics</td>
</tr>
<tr>
<td>TE-SEM-2</td>
<td>STA3LM</td>
<td>Analyses of Linear Models</td>
</tr>
</tbody>
</table>

**Please note:**
A major in Mathematics and Statistics is offered through the following courses. Please refer to the relevant course maps for more information.

- Bachelor of Science
- Bachelor of Science and Society
- Bachelor of Science / Master of Teaching

*FOR MORE INFORMATION*  [latrobe.edu.au/mathstats](latrobe.edu.au/mathstats)

*Last updated: 17 Oct 2014*
# Course map

## Master of Statistical Science (Melbourne)

*Master of Statistical Science 2015*

**College of Science, Health and Engineering (SHE)**

### Course map

#### Master of Statistical Science (Melbourne)

#### 2015

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semester 1</td>
<td>Semester 2</td>
</tr>
<tr>
<td>Core Elective</td>
<td>Elective</td>
</tr>
<tr>
<td>Key Centre of Statistical Sciences (KCSS), Access Grid Room (AGR) or other approved subject</td>
<td>KCSS, AGR or other approved subject</td>
</tr>
<tr>
<td>Sem 1 or 2</td>
<td>Sem 1 or 2</td>
</tr>
</tbody>
</table>

All subjects are 15 credit points (CP) unless otherwise indicated.  
Subjects may have requisites. Visit the La Trobe University handbook at www.latrobe.edu.au/handbook

### Course structure

**During the first year of the course students complete eight subjects, each worth 15 credit points. Elective subjects are chosen from the Level 4 subjects offered in the Department of Mathematics and Statistics; the Key Centre of Statistical Sciences (KCSS) offered by RMIT University or Monash University; or the Access Grid Room (AGR) network. Students may select up to 3 fourth year level subjects (45 credit points) from other areas dependent on appropriate statistical or mathematical content and approval from the Course Coordinator.**

**During the second year, students complete five subjects, each worth 15 credit points and write a minor thesis (45 credit points). Students can choose to do the Consulting Practical (15 credit points) depending on project and supervisor availability. Elective subjects are chosen from the Level 5 subjects offered by the Department of Mathematics and Statistics; the Key Centre of Statistical Sciences (KCSS) offered by RMIT University or Monash University; or the Access Grid Room (AGR) network. Students may select up to 2 fifth year level subjects (30 credit points) from other areas dependent on appropriate statistical or mathematical content and approval from the Course Coordinator.**

The Elective Subjects in the lists below are a partial listing of potential first and second year electives. Elective components require Course Coordinator approval and some electives require pre-requisite subjects to have been completed. Other electives are available and may be discussed with the Course Coordinator.

### First Year Elective Subjects

<table>
<thead>
<tr>
<th>Teaching Period</th>
<th>Subject Code</th>
<th>Subject Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>TE-SEM-1</td>
<td>STA4AMD</td>
<td>Analysis of Medical Data</td>
</tr>
<tr>
<td>TE-SEM-1</td>
<td>STA4AN</td>
<td>Real Numbers and Functions</td>
</tr>
<tr>
<td>TE-SEM-1</td>
<td>STA4SA</td>
<td>Spatial Analysis</td>
</tr>
<tr>
<td>TE-SEM-1</td>
<td>STA4SI</td>
<td>Statistical Inference</td>
</tr>
<tr>
<td>TE-SEM-1 or 2</td>
<td>MAT4CI</td>
<td>Computability and Intractability</td>
</tr>
<tr>
<td>TE-SEM-1 or 2</td>
<td>MAT4GA</td>
<td>General Algebra</td>
</tr>
<tr>
<td>TE-SEM-1 or 2</td>
<td>MAT4QG</td>
<td>Group Action</td>
</tr>
<tr>
<td>TE-SEM-1 or 2</td>
<td>STA4RA</td>
<td>Regression Analysis</td>
</tr>
<tr>
<td>TE-SEM-2</td>
<td>MAT4AA</td>
<td>Asymptotic Analysis *</td>
</tr>
<tr>
<td>TE-SEM-2</td>
<td>MAT4GM</td>
<td>Geometric Method for Differential Equations *</td>
</tr>
<tr>
<td>TE-SEM-2</td>
<td>STA4AS</td>
<td>Applied Statistics</td>
</tr>
<tr>
<td>TE-SEM-2</td>
<td>STA4LM</td>
<td>Analyses of Linear Models</td>
</tr>
<tr>
<td>TE-SEM-2</td>
<td>STA4TS</td>
<td>Theory of Statistics</td>
</tr>
</tbody>
</table>

* These subjects are not currently offered

### Second Year Elective Subjects

<table>
<thead>
<tr>
<th>Teaching Period</th>
<th>Subject Code</th>
<th>Subject Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>TE-SEM-1 and 2</td>
<td>STA5AMD</td>
<td>Analysis of Medical Data</td>
</tr>
<tr>
<td>TE-SEM-1</td>
<td>STA5AKA</td>
<td>Regression Analysis</td>
</tr>
<tr>
<td>TE-SEM-2</td>
<td>STA5TS</td>
<td>Theory of Statistics</td>
</tr>
</tbody>
</table>

### Potential CSS Subject Elective Subjects

- Financial Economics 2
- Game Theory and Applications
- Statistics for Quality and Productivity in Industry
- Stochastic Processes I - Linear Systems
- Stochastic Processes II - Random Walks & Markov Chains Principles of Econometrics
- Stochastic Calculus and Mathematical Finance
- Time Series Analysis

Key Centre elective subjects offered vary, but usually include most of the subjects listed above. These subjects will be selected upon enrolment, depending on the subject availability and upon consultation with the Course Coordinator.

### Potential AGR Elective Subjects

- Advanced Data Analysis
- Advanced Optimization
- Financial Mathematics
- Financial Time Series
- Statistical Consulting

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**Course coordinator: Dr Luke Prendergast**

Last updated: 9 Oct 2014

This information is correct at time of printing but subject to change
First Year Subjects

Semester 1

MAT1CDE
CALCULUS AND DIFFERENTIAL EQUATIONS

MAT1ICA
INTRODUCTORY CALCULUS

MAT1NLA
NUMBER SYSTEMS AND LINEAR ALGEBRA

STA1DCT
DATA-BASED CRITICAL THINKING

Semester 2

MAT1DM
DISCRETE MATHEMATICS

MAT1MAB
MATHEMATICAL APPLICATIONS IN BIOLOGY

STA1SS
STATISTICAL SCIENCE

STA1LS
STATISTICS FOR LIFE SCIENCES

STA1PSY
STATISTICS FOR PSYCHOLOGY

Recommended Reading: First Year Survival Guide, La Trobe University.

These subjects have been developed in accordance with the guidelines for an inclusive curriculum. Students will not be disadvantaged with respect to their culture, gender, socio-economic background or disability.

Recommended Reading:


For more information, visit latrobe.edu.au/students/subjects.

LA TROBE UNIVERSITY
DEPARTMENT OF MATHEMATICS AND STATISTICS

STUDENT HANDBOOK
MELBOURNE CAMPUS
2015

FIRST YEAR SUBJECTS
MAT1NLA

NUMBER SYSTEMS AND LINEAR ALGEBRA

15 Credit Points.
Bendigo, Melbourne, Semester 1, Day.

Subject outline: In this subject, students learn and apply mathematical concepts and develop skills that provide a foundation for all studies in mathematical sciences. Students review and evaluate their knowledge of algebra, functions, sets and number systems with significant coverage of complex numbers adding to their repertoire. After consideration of sequences and series, students proceed to a module on either Probability (Engineering students) or Logic and Proof. Students also explore a coherent treatment of vectors and vector geometry that includes matrices and solutions of systems of linear equations via the Gauss-Jordan algorithm, and brief treatment of eigenvalues and eigenvectors. An emphasis is placed on students improving their understanding of mathematical data into information, so they can be appropriately applied, and development of their reasoning skills and ability to clearly present written arguments, essential in both study and employment.

Prerequisites: VCE Mathematical Methods 3/4 or equivalent.

Incompatibles: MAT1CNS, MAT1CPE, MAT1CLA, MAT1CA, MAT1CB. May not be taken by students who are currently enrolled in MAT1ICA.

Class requirements: Two 1.0 hours lecture per week face-to-face. Two 1.0 hours practical per week face-to-face.

Assessments: 3 hour exam (70%), 5 assignments (typically 3-4 pages each) (15%), 5 online diagnostic tasks (15%).

Hurdle requirement: Students will be required to achieve a mark of at least 40% on the exam, as well as an overall mark of at least 50%, in order to pass this subject.

STATA1DCT

DATA-BASED CRITICAL THINKING

15 Credit Points.
Melbourne, Semester 1, Day.

Subject outline: This subject helps the student evaluate data-based evidence encountered in everyday life. It provides the fundamental numeracy skills required by business people, scientists, lawyers, nurses, journalists, social scientists, teachers and other professionals who need to evaluate data-based arguments found in newspapers, television or on-line websites. This is achieved by a combination of studying newsworthy stories introduced in lectures, laboratory work which encourage engagement with others and online quizzes that assess numeracy skills. The four themes covered in this subject are gathering useful data, evaluating data, interpreting data, and making decisions. This subject is co-taught with STA2DCT.

Incompatibles: STA2DCT.


Class requirements: One 1.0 hours computer laboratory per week on weekdays during the day from week 11 to week 22 and face-to-face. Two 1.0 hours lecture per week face-to-face. One 1.0 hours practical per study period on weekdays during the day from week 12 to week 16 and face-to-face.

These five additional classes are optional and intended for students who need help with the online quizzes.

Assessments: 2.5-hour short answer final examination (60%), Assignments (5 assignments, equivalent to 1800 words) (30%), online numeracy skills quizzes (7 online quizzes, equivalent to 600 words) (10%).

STATA1SS

STATISTICAL SCIENCE

15 Credit Points.
Melbourne, Semester 2, Day.

Subject outline: This subject provides an introduction to applied and theoretical statistics. (The applied component of this subject is identical to the content covered in STA1LS.) It introduces students to the basic applied statistical methods used in the biological sciences, medical sciences, agricultural sciences, nutrition, and health sciences and also provides an introduction to the mathematical theory used in the area of statistics. The three main areas of study are descriptive statistics, probability, and statistical inference and the use of a statistical computing package is an integral part of this subject. This subject is a possible pre-requisite for the second-year subjects in statistics.

Prerequisites: Year-12 mathematics.

Incompatibles: STA1LS; STA1PSY; STA1STM; STA1ICTS; ECO1ISB


Class requirements: One 1.0 hours computer laboratory per week face-to-face. Three 1.0 hours lecture per week face-to-face. One 1.0 hours practical per week face-to-face.

Assessments: one 3-hour examination (60%), five assignments (equivalent to 1800 words) (40%).

STATA1PSY

STATISTICS FOR PSYCHOLOGY

15 Credit Points.
Melbourne, Semester 2, Day.

Subject outline: This subject is designed to introduce students undertaking the major stream of psychology to a range of statistical methods used in contemporary psychological research. The material covered in this subject aims to help students understand statistical principles through the introduction of basic statistical procedures. This subject will also help students comprehend statistical analyses in scientific research papers. The statistical computing package SPSS is an integral part of this subject with weekly practice classes held in a computer laboratory. (This subject is normally co-requisite for PSY1FCF and pre-requisite for PSY2PRM.)

Co-requisites: For students in the Faculty of Science, Technology and Engineering, and the Bachelor of Law/Bachelor of Psychological Science (LWLPS, LWLPP and LWLPPB), this subject is normally a co-requisite for PSY1FCF.

Incompatibles: STA1LS, STA1SS, STA2SS, STA1ICTS, STA1STM, ECO1ISB


Class requirements: One 1.0 hours computer laboratory per week face-to-face. Three 1.0 hours lecture per week face-to-face. One 1.0 hours practical per week face-to-face.

Assessments: Eleven 100-word assignments (20%), one 2-hour examination (50%), two 45-minute computer tests (30%).

FOR MORE INFORMATION    latrobe.edu.au/mathstats
Second Year Subjects

Semester 1

**BIO2POS**  
**PRACTICE OF SCIENCE**  
15 Credit Points.  
Melbourne, Semester 1, Day.  
**Subject outline:** The subject provides an introduction to the practice of science and is core for a range of 3rd year science subjects. It explores how science proceeds and how to identify scientific questions. It examines the purpose of null and alternative hypotheses, how to design experiments and explores sampling methods. The course has a strong emphasis on statistical testing of hypotheses. Students will learn the mechanics and limitations of a range of important statistical tests, allowing them to choose appropriate tests and interpret and critically assess the reliability of experimental results. The course will explore the conventions of written and oral scientific communication and the challenges of communicating science to the general public and policy makers. Finally, students will be introduced to ethical behaviour in the practice of science.  
**Prerequisites:** From 2013: Year 12 Mathematics (any).  
**Readings:** Recommended - Essential Statistics.  
**Assessments:** 3 hr Exam (short answer & multiple choice) (50%), Article critique (1000 words) (10%), Excel training and language test (Online hurdle requirement) (5%), Oral presentation (5 mins to tutorial group) (8%), Statistics assignments (x2) (25%).  
**Recommended Reading:** First Year Survival Guide, La Trobe University.

**MAT2ANA**  
**ANALYSIS OF REAL NUMBERS AND FUNCTIONS**  
15 Credit Points.  
Melbourne, Semester 1, Day.  
**Subject outline:** The limits of sequences and limits of functions are studied in this subject. Initially we study them in one-dimensional space and then in higher dimensions. We also study series and various tests are derived to determine the convergence or otherwise of these series. We then extend the basic idea of limit to include sequences of functions and sequences in metric spaces. A powerful theorem called The Contraction Mapping Theorem will be derived. This theorem plays a fundamental role in analysis and its applications. We will use it to establish the existence and uniqueness of solutions to certain differential equations.  
**Prerequisites:** MAT1CLA or (MAT1NLA and MAT1CDE)  
**Readings:** Prescribed - Printed subject text available from University Bookshop.  
**Class requirements:** Two 1.0 hours lecture per week face-to-face. Two 1.0 hours practical per week face-to-face.  
**Assessments:** fortnightly assignments (30%), one 3-hour examination (70%).

**MAT2ALC**  
**ALGEBRA, LINEAR CODES AND AUTOMATA**  
15 Credit Points.  
Melbourne, Semester 2, Day.  
**Subject outline:** This subject, delivered in two parallel streams, introduces a range of concepts from number theory, group theory and formal language theory. The formal language stream deals with regular expressions, regular languages and their relationship with automata. Context free languages are studied along with their related automata. An introductory discussion of Turing machines leads to model for computation.  
**Prerequisites:** MAT1DM or MAT1NLA  
**Class requirements:** Two 1.0 hours lecture per week on weekdays during the day and face-to-face. Two 1.0 hours practical per week on weekdays during the day and face-to-face.  
**Assessments:** One 3-hour examination (70%), Written Assignments (30%).

Semester 2

**BIO2POS**  
**PRACTICE OF SCIENCE**  
15 Credit Points.  
Melbourne, Semester 1, Day.  
**Subject outline:** The subject provides an introduction to the practice of science and is core for a range of 3rd year science subjects. It explores how science proceeds and how to identify scientific questions. It examines the purpose of null and alternative hypotheses, how to design experiments and explores sampling methods. The course has a strong emphasis on statistical testing of hypotheses. Students will learn the mechanics and limitations of a range of important statistical tests, allowing them to choose appropriate tests and interpret and critically assess the reliability of experimental results. The course will explore the conventions of written and oral scientific communication and the challenges of communicating science to the general public and policy makers. Finally, students will be introduced to ethical behaviour in the practice of science.  
**Prerequisites:** From 2013: Year 12 Mathematics (any).  
**Readings:** Recommended - Essential Statistics.  
**Assessments:** 3 hr Exam (short answer & multiple choice) (50%), Article critique (1000 words) (10%), Excel training and language test (Online hurdle requirement) (5%), Oral presentation (5 mins to tutorial group) (8%), Statistics assignments (x2) (25%).  
**Recommended Reading:** First Year Survival Guide, La Trobe University.

**MAT2ANA**  
**ANALYSIS OF REAL NUMBERS AND FUNCTIONS**  
15 Credit Points.  
Melbourne, Semester 1, Day.  
**Subject outline:** The limits of sequences and limits of functions are studied in this subject. Initially we study them in one-dimensional space and then in higher dimensions. We also study series and various tests are derived to determine the convergence or otherwise of these series. We then extend the basic idea of limit to include sequences of functions and sequences in metric spaces. A powerful theorem called The Contraction Mapping Theorem will be derived. This theorem plays a fundamental role in analysis and its applications. We will use it to establish the existence and uniqueness of solutions to certain differential equations.  
**Prerequisites:** MAT1CLA or (MAT1NLA and MAT1CDE)  
**Readings:** Prescribed - Printed subject text available from University Bookshop.  
**Class requirements:** Two 1.0 hours lecture per week face-to-face. Two 1.0 hours practical per week face-to-face.  
**Assessments:** fortnightly assignments (30%), one 3-hour examination (70%).

**MAT2ALC**  
**ALGEBRA, LINEAR CODES AND AUTOMATA**  
15 Credit Points.  
Melbourne, Semester 2, Day.  
**Subject outline:** This subject, delivered in two parallel streams, introduces a range of concepts from number theory, group theory and formal language theory. The formal language stream deals with regular expressions, regular languages and their relationship with automata. Context free languages are studied along with their related automata. An introductory discussion of Turing machines leads to model for computation.  
**Prerequisites:** MAT1DM or MAT1NLA  
**Class requirements:** Two 1.0 hours lecture per week on weekdays during the day and face-to-face. Two 1.0 hours practical per week on weekdays during the day and face-to-face.  
**Assessments:** One 3-hour examination (70%), Written Assignments (30%).
considered are solutions of second order differential equations with non-constant coefficients, with expansions about ordinary points and regular singular points. The subject covers applications of forces, momentum and kinetic potential energy, for particles and rigid bodies, with a focus on orbits of planets. The subject also covers the solution of wave equations in two and three dimensions. The main tools used are derived from concepts in MAT2VCA.

**Prerequisites:** MAT2VCA

**Class requirements:** Two 1.0 hours practical per week face-to-face. Two 1.0 hours lecture per week face-to-face.

**Assessments:** Active participation in blackboard practice classes (5%), fortnightly assignments (25%), one 3-hour examination (70%).

**MAT2VCA VECTOR CALCULUS**

15 Credit Points.

Melbourne, Semester 1, Day.

**Subject outline:** Many quantities in the physical world can be represented by smoothly varying functions of position in two or three dimensions. This subject develops, with an emphasis on relevant calculations, the differential and integral calculus of scalar and vector fields in cartesian and curvilinear coordinates. Three important partial differential equations are introduced: the wave equation, the heat equation and Laplace’s equation; to solve them, they are reduced to several ordinary differential equations by the technique of separation of variables. Laplace transforms are introduced as a technique for solving constant coefficient ordinary differential equations with discontinuous forcing terms, such as those which arise in electronics. Thus we generalize many of the techniques used in first year (to analyse functions of a single variable) to the several variable case, as most real-world systems depend crucially on multiple factors.

**Prerequisites:** MAT1CLA or (MAT1NLA and MAT1CDE)

**Readings:** Prescribed - Printed subject text available from University Bookshop.

**Class requirements:** Two 1.0 hours lecture per week face-to-face. Two 1.0 hours practical per week face-to-face.

**Assessments:** Written test on Laplace Transforms (30 mins) (10%), fortnightly written assignments (20%), one 2.5-hour examination (70%).

**STA2ABS APPLIED BIOSTATISTICS**

15 Credit Points.

Melbourne, Semester 1, Day.

**Subject outline:** Building on the understanding of applied statistical methods developed in first year statistics subjects, STA2AMS provides an understanding of these methods at an intermediate level. In terms of content, STA2AMS is similar to STA2ABS, but the subject places a special emphasis on medical applications. There are specific questions in the assignments, project, test and examination that reflect such an emphasis. This subject does not require a knowledge of calculus. An introduction to the open source statistical computing package R is included.

**Prerequisites:** STA1PSY or STA1LS or STA1SS or ECO1ISB

**Incompatibles:** STA2AS, STA2MS, STA2RSP, STA2ABS

**Class requirements:** One 1.0 hours computer laboratory per week face-to-face. One 1.0 hours laboratory class per week face-to-face. One 1.0 hours lecture per week face-to-face. One 1.0 hours lecture/workshop per week face-to-face.

**Assessments:** 2.5 hour exam (55%), in-class computer test (15%), Computing project (equivalent to 600 words) (10%). Four written assignments (equivalent to 1200 words) (20%).

**STA2AMS APPLIED MEDICAL STATISTICS**

15 Credit Points.

Melbourne, Semester 1, Day.

**Subject outline:** Building on the understanding of applied statistical methods developed in first year statistics subjects, STA2AMS provides an understanding of these methods at an intermediate level. In terms of content, STA2AMS is similar to STA2ABS, but the subject places a special emphasis on medical applications. There are specific questions in the assignments, project, test and examination that reflect such an emphasis. This subject does not require a knowledge of calculus. An introduction to the open source statistical computing package R is included.

**Prerequisites:** (MAT1CDE and MAT1NLA) or MAT1CLA or STA1SS or STA1LS or STA1PSY

**Incompatibles:** STA2MD AND STA2MDA

**Class requirements:** Three 1.0 hours lecture per week on weekdays during the day and face-to-face. One 1.0 hours tutorial per week on weekdays during the day and face-to-face.

**Assessments:** 2.5 hour Exam (70%), 5 assignments (30%).
Third Year Subjects

This subject information is correct at time of printing. The Subject Learning Guides in LMS and the Subject Search provide the most recent, updated information. For a list of current subject coordinators and subject details featured here, visit latrobe.edu.au/students/subjects

Semester 1
MAT3CZ
COMPLEX ANALYSIS
15 Credit Points.
Melbourne, Semester 1, Day.
Subject outline: This subject extends calculus to the complex domain, where many beautiful new features appear. This gives a new perspective to many topics studied in first and second year. The new tools covered are also very useful in applications to a wide variety of areas within mathematics, as well as in other mathematically oriented sciences. The practice classes within the subject play a key role in helping the students to learn the subject content and develop graduate capabilities.

Prerequisites: MAT2ANa or MAT2VCA
Readings: Subject printed text Complex Analysis available from Bookshop.
Class requirements: Two 1.0 hours lecture per week face-to-face. One 1.0 hours practical per week face-to-face.
Assessments: Four mathematical assignments (30%), One 1-hour written exam (70%).

MAT3DA
DISCRETE STRUCTURES AND ALGORITHMS
15 Credit Points.
Melbourne, Semester 2, Day.
Subject outline: This capstone mathematics subject covers an array of fundamental concepts from discrete mathematics and algebra as well as developing fundamental skills for both further mathematics and for mathematics in the workplace. The subject is a continuation and expansion of MAT2AAL, with a deeper treatment of the theory of groups emphasised by applications to counting, games and patterns. Around two thirds of the subject concerns ordered sets and lattices, and their role in mathematical foundations, algebra, information analysis and computer science.

Prerequisites: MAT2AAL or MAT2ALC
Incompatibles: MAT3DS

MAT3CA
ADVANCED CALCULUS AND CURVATURE
15 Credit Points.
Melbourne, Semester 2, Day.
Subject outline: This subject unifies linear algebra and vector calculus from second year into the sort of calculus used in differential geometry and analysis. The central idea is the study of geometry of curves and surfaces in the space by means of calculus. Topics include: the implicit and inverse function theorems, manifolds and tangent space, curvature and torsion for curves, intrinsic and extrinsic curvature for surfaces, and the Theorema Egregium of Gauss.

Prerequisites: MAT2LAL and MAT2VCA
Readings: Prescribed - Booklist available from the Department of Mathematics.
Class requirements: One 1.0 hours practical per week face-to-face. Two 1.0 hours lecture per week face-to-face.
Assessments: Four written mathematics assignments (20%), One 1000-1500 word essay (10%), One 2-hour written exam (70%).

MAT3CS
COMPUTATION AND SIMULATION

Semester 2
MAT3AC
ADVANCED CALCULUS AND CURVATURE
15 Credit Points.
Melbourne, Semester 2, Day.
Subject outline: This subject unifies linear algebra and vector calculus from second year into the sort of calculus used in differential geometry and analysis. The central idea is the study of geometry of curves and surfaces in the space by means of calculus. Topics include: the implicit and inverse function theorems, manifolds and tangent space, curvature and torsion for curves, intrinsic and extrinsic curvature for surfaces, and the Theorema Egregium of Gauss.

Prerequisites: MAT2LAL and MAT2VCA
Readings: Prescribed - Booklist available from the Department of Mathematics.
Class requirements: One 1.0 hours practical per week face-to-face. Two 1.0 hours lecture per week face-to-face.
Assessments: Four written mathematics assignments (20%), One 1000-1500 word essay (10%), One 2-hour written exam (70%).

MAT3DA
DISCRETE STRUCTURES AND ALGORITHMS
15 Credit Points.
Melbourne, Semester 2, Day.
Subject outline: This subject extends calculus to the complex domain, where many beautiful new features appear. This gives a new perspective to many topics studied in first and second year. The new tools covered are also very useful in applications to a wide variety of areas within mathematics, as well as in other mathematically oriented sciences. The practice classes within the subject play a key role in helping the students to learn the subject content and develop graduate capabilities.

Prerequisites: MAT2ANa or MAT2VCA
Readings: Subject printed text Complex Analysis available from Bookshop.
Class requirements: Two 1.0 hours lecture per week face-to-face. One 1.0 hours practical per week face-to-face.
Assessments: Four mathematical assignments (30%), One 3 hour written exam (70%).

MAT3LM
ANALYSES OF LINEAR MODELS
15 Credit Points.
Melbourne, Semester 2, Day.
Subject outline: Modern research often involves the analysis of data for more than one variable and in this regard, linear models are the most widely used class of models. They relate a response variable to one or more explanatory variables enabling researchers to answer important research questions as well as make future predictions. The methods are used in many areas including biological science, economics, engineering, medical science and psychological science. Topics include simple and multiple linear regression, response and explanatory variable transformations, ANOVA and ANCOVA, as well as more modern methodologies such as generalized linear models and linear mixed effects models. This subject has a stong emphasis on preparing students for future careers in statistics.

Prerequisites: One of STA2ABS or STA2AMS or STA2AL or STA2PM
Incompatibles: STA4LM
Class requirements: One 1.0 hours computer laboratory per week on weekdays during the day from week 32 to week 43 and face-to-face. Two 1.0 hours lecture per week face-to-face. One 1.0 hours practical per week on weekdays during the day from week 32 to week 43 and face-to-face.
Assessments: Two Assignments (approx. 800 words each) (20%), 2-hour short answer Final Examination (50%), 5-minute oral presentation briefly describing an applied research paper, (5%), 5-minute oral
presentation of a current job ad (Hurdle Speaking preparation/practice) (0%), Consulting role-play (25%).

STA3AS
APPLIED STATISTICS

15 Credit Points.
Melbourne, Semester 1, Day.

Subject outline: The purpose of STA3AS is to equip graduates with an in-depth understanding of modern statistical methods in the following three key topics: 1. Sample surveys with an emphasis on simple random sampling and stratified random sampling. 2. Multivariate analysis with an emphasis on inference for the multivariate mean, checking for underlying multivariate normality, principal component analysis and discriminant analysis. This topic includes an introduction/review of common linear algebra results. 3. Time series analysis with an introduction into the theoretical foundation of Box-Jenkins univariate time series models which form a basis for empirical work with time series data. The software used in this subject is R.

Prerequisites: STA2MDA or STA2MD or STM2PM

Incompatibles: STA4AS


Class requirements: Three 1.0 hours lecture per week face-to-face. One 1.0 hours practical per week face-to-face.

Assessments: 3-hour short answer Final Examination (70%), 5 Assignments (approx. 240 words each) (30%).

STA3BS
BIOSTATISTICS

15 Credit Points.
Melbourne, Semester 2, Day.

Subject outline: Students will learn to design and analyse experiments in the life sciences and agriculture. The topics covered in this subject include a brief review of non-parametric methods; randomisation, blocking and randomised block designs; one-way and two-way layouts; multiple comparison procedures; fixed and random effects; mixed models; multiple linear regression; analysis of covariance; factorial designs; fractional factorial designs; and an introduction to cluster analysis. This subject makes use of the freely available software package R.

Prerequisites: one of STA2ABS, STA2AMS, STA2MD, STM2PM

Incompatibles: AGR41EXP, AGR4AED, STA2BS

Special conditions: STA3BS is co-taught with STA2BS

Readings: Recommended - Biostatistics with R, Shahbaba, Babak. Recommended - Introduction to Linear Regression Analysis, Montgomery, DC, Peck, EA and Vining, G.

Class requirements: Two 1.0 hours lecture per week face-to-face. Two 1.0 hours practical per week face-to-face.

Assessments: 10 Assignments (approx. 200 words each) (30%), 3-hour short answer Final Examination (70%).

STA3SI
STATISTICAL INFERENCE

15 Credit Points.
Melbourne, Semester 1, Day.

Subject outline: Statistical inference is used to describe procedures that draw conclusions from datasets arising from systems affected by random variation. This subject comprises components in estimation and testing hypotheses. Topics in the first component include method of moments and maximum likelihood, reduction by sufficiency and invariance, unbiasedness, consistency, efficiency and robustness. The second component examines size and power of tests. Neyman-Pearson lemma, optimality of tests, the likelihood ratio test and relationship to confidence interval estimation.

Prerequisites: STA2MD or STM2PM

Readings: Recommended - Introduction to Probability and Mathematical Statistics, Bain, LJ and Engelhardt, M.

Class requirements: Three 1.0 hours lecture per week face-to-face. One 1.0 hours practical per week face-to-face.

Assessments: 10 Assignments (approx. 250-300 words each) (30%), 3-hour short answer Final Examination (70%).

STM3CS
COMPUTATION AND SIMULATION

15 Credit Points.
Melbourne, Semester 1, Day.

Subject outline: In mathematics, one uses algebra and calculus to find 'exact' solutions to mathematical problems. In statistics, engineering, physics, and applied mathematics, when dealing with 'the real world', one encounters situations where the best one can do is to find an approximate solution to a problem. This is where computation and simulation plays a vital role. As well as appreciating the numerical methods for obtaining approximate solutions in their own right, understanding concepts such as accuracy and computational efficiency are important. Naturally, computing and simulation are carried out using software programs such as Excel spreadsheets and the technical computing languages MATLAB, Maple or R; in this subject students will gain experience with these. The specific topics studied are: nonlinear equations, interpolation, smoothing and optimization, numerical integration, pseudorandom numbers and simulation.

Prerequisites: MAT1CDE or MAT1CLA or STM2PM

Incompatibles: MAT3SC

Class requirements: Two 1.0 hours computer laboratory per week on weekdays during the day and face-to-face. One 1.0 hours lecture per week on weekdays during the day and face-to-face.

Assessments: Examination (60%), Four assignments (approx 350 words each) (40%).
Honours and Coursework Masters

**Honours Coordinator**
A/Prof Marcel Jackson
Room 317 / Physical Sciences 2
T 03 9479 1570
E M.G.Jackson@latrobe.edu.au

An honours year in some combination of mathematics and statistics is a great enrichment to a straight bachelor degree, and it isn't just for those who want to continue to postgraduate studies. A good performance at honours level is the main pathway to postgraduate study, but there are a host of other reasons to take advantage of our programme.

- Enrich your mathematical and statistical knowledge by adding breadth to your studies, opening greater flexibility in employment.
- An honours thesis provides great evidence to employers of your ability to produce an integrated, fully developed extended piece of writing and investigation at a technical scientific level. Thesis work is also widely enjoyed by students.
- Mix your mathematical and statistical studies: maths students including two statistics subjects in their honours year can subsequently enrol in the statistics coursework masters, and after just one further year complete a coursework masters in statistics. Two of our STA4 statistics subjects are suitable for students with little or no statistics background.
- Broaden your maths or stats honours studies with a subject or two from a different discipline: computer science, bioinformatics, physics, economics and finance all provide options that have been popular with past students.

Recent projects at honours and coursework masters level include topics with the Victoria Police Forensic Services Department (based on the edge of the main LTU campus), projects linked with biostatistics and proteomics, statistical projects in statistics finance, and maths projects ranging from the mathematical modeling of landslides, to qualitative reasoning, and across topology, algebra, graphs, differential equations and symmetry.

**Am I eligible?**
Entry into mathematics honours requires completion of a suitable undergraduate degree (such as BSc or similar) with an average mark of at least 70% over 60 credit points of MAT3xx subjects. Honours in statistics requires an average mark of at least 70% over 60 credit points of STA3xx subjects. The easiest entry is to honours in 'mathematics and statistics', which requires an average of 70% over 60 credit point of some combination of MAT3xx, STA3xx or STM3xx.

**How does it work?**
You can start honours in either semester, and honours can be done part-time, after discussion with the honours coordinator.

Honours involves five 15 credit point subjects of coursework and one 45 credit point thesis, done over two consecutive semesters (even for part-time). In a full time enrolment 3 subjects are taken in the first semester of honours, and 2 are taken in the second semester. You need to get the support of a supervisor for your thesis before you commence: normally students would start to enquire about prospective topics and supervisors toward the middle of their final semester before commencing honours. If you are unsure if you are going on to honours, this should not prevent you from enquiring!

**Structure of the Honours Course**

**Important note:** All enrolments must be approved by the Mathematics and Statistics Honours Coordinator.

The honours year in mathematics and statistics consists of 120 credit points usually taken across two full time semesters (60 credit points each): 45 credit points are allocated to work on an honours project thesis (some potential projects that may be offered in 2014 are listed at the end of this entry) and the remaining 75 credit points consist of coursework subjects. Further details are provided below.

Students must complete 120 credit points which includes either

- MAT4THA (Mathematics Thesis A, 15 credit points) and MAT4THB (Mathematics Thesis B, 30 credit points) or
- STA4THA (Statistics Thesis A, 15 credit points) and STA4THB (Statistics Thesis B, 30 credit points).

The remaining 75 credit points consist of

- MAT4 (15 credit points each) and/or STA4 (15 credit points each) honours level subjects (not including the thesis subjects).
- Up to two approved MAT3, STA3 or STM3 subjects (15 credit points each). Example of appropriate subjects include MAT3DSA (Discrete Structures and Algorithms, 15 credit points) and STA3SI (Statistical Inference, 15 credit points) for students who have not yet completed these subjects (or equivalent at other institutions).
- Up to two fourth year level subjects (15 credit points each) from related disciplines where the subjects have sufficient mathematical or statistical content. An example appropriate subject is ECO4ATE (Advanced Time-Series Econometrics, 15 credit points) for students wishing to pursue an analytical career in finance.
- At least 45 credit points must consist of MAT4 and/or STA4 subjects (not including the thesis subjects).

Access Grid Room (AGR), Key Centre of Statistical Science (KCSS) and Australian Mathematical Sciences Institute (AMSI) summer school subjects offered from external institutions:

- MAT4ATA and MAT4ATB (Advanced Topics in Mathematics A & B, 15 credit points each) are shell subjects that allow students to enrol in honours level AGR subjects or AMSI summer school subjects.
- STA4ATA, STA4ATB, STA4ATC, STA4ATD and STA4ATE (Advanced Topics in Statistics A, B, C, D & E, 15 credit points each) are shell subjects that allow students to enrol in honours level KCSS subjects, honours level AGR subjects or AMSI summer school subjects.

The selection of MAT4 and STA4 subjects available to honours students is subject to enrolment numbers and student interest.

**Thesis Work**
The independence with which students conduct their project work is a significant part of the assessment of the thesis. The thesis supervisor is required to report to the honours examiners’ meeting on the level of independence. This being the case, students should endeavour to pursue their research topic as independently as possible, following up their own ideas and leads. However, students should balance the need to work independently with the need to complete the thesis on time. If students find themselves unable to make any progress for more than a week, they should not hesitate to seek assistance from their supervisor. In any case, it is recommended that students report their progress to their supervisor at least once per week. The department has copies of honours theses from previous years. They provide a useful guide to the expected style and scope of an honours thesis. Supervisors can arrange to make copies available to students.

The department will provide a form of binding for students theses submitted for grading and storage. Other appropriate forms of binding may be acceptable but must be paid for by the student and agreed to by the Honours Coordinator. Three bound copies of each honours thesis are to be submitted to the supervisor by the thesis submission date for assessment. One of these will be returned to the student and one of these will be stored in the departmental library. A PDF version of each thesis should also be sent to the Honours Coordinator for electronic storage.

**Facilities**
- Each full-time honours student will be provided with a desk for personal use throughout the duration of their enrolment. The desk will be situated in a room nominated for use exclusively by Honours and/or Masters by Coursework students. Part-time honours students may be asked to share a desk.
Each honours student will also be provided with a computer for personal use throughout the duration of their enrolment. The computer will include all relevant freeware and software that is provided to undergraduate students within the department’s computer laboratories. The installation of software packages that require individual licence agreements (such as MATLAB) may be requested but must also be agreed to by the Head of Department in consultation with the student’s thesis supervisor. Part-time students may be asked to share a computer.

Students will have after-hours building access via their student identification card.

Students will have access to a network printer within the department. In the semester where students submit their thesis, they will be provided with a $50 credit with CafeDigital.

**Preliminary Talks**

- Each honours student will give a 10 minute presentation outlining their chosen topic once they have completed one semester’s work on their honours thesis.

- For students who commence the honours program at the beginning of the academic year, these talks will be held during the break between the semesters on a day and time determined by the Honours Coordinator.

- For students who commence honours mid-year, these talks will be held in the month after the end of the semester on a day and time determined by the Honours Coordinator.

- These preliminary talks are not graded and therefore do not form part of the honours year assessment. They are, however, compulsory for all students.

**Final Talks**

- Each honours student will give a 20 minute presentation detailing work that they covered in their thesis topic.

- For full-time students who commence the honours program at the beginning of the academic year, these talks will be held in the month after the end of second semester on a day and time determined by the Honours Coordinator.

- For fulltime students who commence honours mid-year, these talks will be held during the break between the semesters the following year on a day and time determined by the Honours Coordinator.

- These final talks are not graded and therefore do not form part of the honours year assessment. They are, however, compulsory for all students.
MAT4CI

COMPUTABILITY AND INTRACTABILITY
15 Credit Points
Semester 1 Melbourne Semester 2 Melbourne

Special Conditions: Offered subject to sufficient enrolments.

Subject Description: When does a problem have an effective algorithmic solution? What does it mean for an algorithm to be effective? In this subject we attempt to give rigorous meaning to questions of this type and investigate some possible answers. Abstract computing machines and their role in the definitions of various notions of computational complexity will be discussed. Classes of problems such as P, NP will be defined and a number of well known problems in graph theory, algebra and applied discrete mathematics will be classified according to their computational complexity. The second half of the subject covers undecidability for decision problems: problems for which no algorithmic solution is possible. This property is found amongst problems from computing, abstract algebra, combinatorics, matrices and the theory of tilings.

Prerequisite: MAT1DM and MAT2AAL and MAT1CLA, or any third year mathematics subject and requires coordinators approval. (Note: MAT3DSA is recommended though not essential.)

Class requirements: Two 1-hour seminars per week requiring extensive preparation for class presentations.

Assessment: Four assignments each equivalent to 700 words (60%), One assignment equivalent to 1,100 words (40%).

MAT4GM

GEOMETRIC METHODS FOR DIFFERENTIAL EQUATIONS
15 Credit Points
Semester 2 Melbourne

Special Conditions: Offered subject to sufficient enrolments.

Subject Description: This subject aims to show how geometric symmetry of the solutions of differential equations can be used to find those solutions using integrating factors. These integrating factors exist for all ordinary differential equations, not just the ones you learnt about in first year Mathematics. The mathematics developed includes: calculus on manifolds, one-parameter Lie groups and flows, exterior calculus and of course lots of differential equation theory. Computer algebra is used, though no prior knowledge is required.

Prerequisite: MAT3AC and requires coordinators approval.

Class requirements: Two 1-hour lectures per week.

Assessment: Four assignments (70%), one 30-minute oral examination (30%).

MAT4AA

ASYMPTOTIC ANALYSIS
15 Credit Points
Semester 2 Melbourne

Special Conditions: This subject is offered subject to sufficient enrolments.

Subject Description: This subject examines how we can describe a function as its argument becomes large. We first define the language of asymptotics and then consider various techniques for obtaining asymptotic expansions. This subject also introduces or expands your knowledge of special functions, such as the Bessel functions and the Airy functions.

Prerequisite: MAT3CZ, and requires coordinators approval.

Class requirements: two 1-hour lectures per week.

Assessment: One take home exam (40%), three written assignments (60%).

MAT4AT, MAT4ATB

ADVANCED TOPICS IN MATHEMATICS A, B
15 Credit Points
Semester 1 Melbourne Semester 2 Melbourne

Special Conditions: Offered subject to sufficient enrolments in 4th year Mathematics. Specific content may depend on preferences of 4th year mathematics students.

Subject Description: This subject is offered from time-to-time as a seminar series. The majority of the seminars are conducted by experts with an international reputation. Topics are determined by the Department based on interest and demand.

Prerequisite: Dependent on specific content and will be advised by the Department of Mathematics and Statistics Honours Coordinator.

Class requirements: Two 1-hour seminars per week requiring extensive preparation for class presentations.

Assessment: Five assignments (100%).

MAT44A

GENERAL ALGEBRA
15 Credit Points
Semester 1 Melbourne Semester 2 Melbourne

Special Conditions: Offered subject to sufficient enrolments.

Subject Description: General algebra, otherwise known as universal algebra, provides a theory within which to study the common features of all algebraic systems such as vector spaces, groups, rings, lattices and semigroups. The subject will present all of the basic results in the theory as well as providing an introduction to important recent developments. The close relationship between general algebra and lattice theory will be emphasised throughout.

Prerequisite: MAT3DS or MAT3DSA and requires coordinators approval.

Class requirements: Three 1-hour lectures a week.

Assessment: Four assignments each equivalent to 500 words (70%). Take-home exam (30%).

MAT44G

GROUPS AND GEOMETRY
15 Credit Points

Subject Description: This subject examines group actions in the plane and the related classical geometries: Euclidean, hyperbolic, projective and Minkowski.

Prerequisites: MAT3DS or MAT3DSA

Assessment: Six assignments (100%).

MAT44T

NUMBER THEORY
15 Credit Points
Semester 1 Melbourne

Special Conditions: This subject will be offered subject to sufficient enrolments.

Subject Description: We will commence this subject with an introduction to number theory. In the later parts of the subject we will treat topics such as congruences, residues, continued fractions, diophantine equations, transcendental numbers, and/or primality and factoring. We will also touch on tantalizing connections to cryptography and/or one or more of the recent analytic and algorithmic advances in the areas of Mersenne primes, the Riemann hypothesis, and primality proving. This subject will be accessible and interesting to a varied audience, including students with interests in applied mathematics, pure mathematics, or computer science.

Prerequisite: MAT1DM and MAT1CLA and MAT2AAL, or 30 credit points of second year mathematics subjects, or any third year mathematics subject and requires coordinators approval.

Class requirements: two 1-hour lectures per week requiring extensive preparation.

Assessment: one project (35%), one oral examination (approximately 30 minutes) (35%), two - four assignments (30%).

MAT44D

TOPOLOGY AND DYNAMICS
15 Credit Points
Semester 1 Melbourne

Special Conditions: This subject will only be available subject to sufficient enrolments.

Subject Description: We commence with some ideas of very general application in point set topology that lead to proofs of the Alexander lemma and Tychonoff’s theorem. These ideas underpin an
exploration of the theory of topological dynamics, where we study the behaviour of dynamical systems using topological concepts. We focus on the way in which open sets evolve dynamically and other concepts underlying the definition of chaos. Particular emphasis will be given to symbolic dynamics.

Prerequisite: Requires coordinators approval.  
Class requirements: two 1-hour seminars per week requiring extensive preparation for class presentations.

Assessment: a project equivalent to 2,700-words (60%), two-assignments (40%).

MAT4THA  
MATHEMATICS THESIS A
15 Credit Points
Semester 1 Melbourne Semester 2 Melbourne

Special Conditions: This subject is part of a 45 credit point thesis program. Students will not be given a final mark until they complete MAT4THB.

Subject Description: Students commence a project that takes the equivalent of six months of continuous work under the supervision of a member of staff. The project is completed and written up as a thesis when the student completes the subject MAT4THB. All students are required to present a 10-minute talk outlining the proposed project at a time to be determined by the mathematics honours coordinator. A list of prospective topics and supervisors is available from the Department of Mathematics and Statistics.

Prerequisite: A pass in 60 credit points of third year Mathematics subjects with at least a B average. Enrolment requires coordinators approval.

Class requirements: Supervised research under the direction of a member of staff equivalent to a total of 150 hours.

Assessment: a thesis equivalent to 13,000-words (100%) This is the combined assessment for MAT4THA and MAT4THB.

MAT4THB  
MATHEMATICS THESIS B
30 Credit Points
Semester 1 Melbourne Semester 2 Melbourne

Special Conditions: This subject is part of a 45 credit point thesis program. Students are required to present a 20-minute talk on their project after the thesis has been submitted. A list of prospective topics and supervisors is available from the Department of Mathematics and Statistics.

Prerequisite: Enrolment requires coordinators approval.

Class requirements: Supervised research under the direction of a member of staff equivalent to a total of 450 hours.

Assessment: a thesis equivalent to 13,000-words (100%) Combined assessment for MAT4THB and MAT4THA.

MAT4TOP  
TOPOLOGY
15 Credit Points
Semester 1 Melbourne

Subject Description: This subject begins with a careful discussion of the various set theoretical results that are required for the subsequent material. This is followed by a discussion of the theory of metric spaces. The most basic properties of open sets in metric spaces can be used to motivate a more generally applicable definition of open sets, which leads to the idea of a topological space. A study of fundamental concepts in the theory of topological spaces such as compactness and connectedness yields results of very general application. The subject concludes with a treatment of quotients and products of topological spaces.

Prerequisite: MAT3DSA or MAT3AC.

Incompatibles: MAT3TA.

Assessment: one 2-hour written exam (50%), 5 fortnightly written assignments (30%), student classroom presentations (10%).

Prerequisites: Requires coordinators approval.

Class requirements: two 1-hour seminars per week requiring extensive preparation for class presentations.

Assessment: a project equivalent to 2,700-words (60%), two-assignments (40%).

AGR SUBJECTS
Some subjects that may be available to students in 2015 through the Access Grid Room (AGR) include:

- Advanced Data Analysis
- Advanced Operations Research
- Communicative Algebra
- Cryptography, Computer and Network Security
- Discrete Optimisation
- General Relativity
- Statistical Consulting
- Time Series Analysis
- Topological Groups

The list of subjects offered in 2014 may be found on the AMSI website (www.amsi.org.au) on the Research & Higher Education tab.

STA4AAM  
ANALYSIS OF MEDICAL DATA
15 Credit Points
Semester 1 Melbourne Semester 2 Melbourne

Subject Description: With emphasis on case-control and cohort study, this course introduces statistical concepts and analytical methods as applied to data encountered in biomedical and clinical sciences. Topics include moment and characteristic functions, odds and rate ratios, Fisher exact and chi-square tests for association, likelihood and profile likelihood functions, Mantel-Haenszel and Woolf estimation, matching and sample size calculation, logistic regression (matched and unmatched), Poisson regression and related techniques (zero-inflated and negative Binomial), and receiver operating characteristic curve. The course provides students a foundation to evaluate information critically to support clinical research objectives.

Prerequisite: STA2BS or STA3BS.

Class requirements: one 1-hour lecture and one 1-hour problem solving class per week.

Assessment: four assignments (20%), one 2-hour examination (80%).

STA4AS  
APPLIED STATISTICS
15 Credit Points
Semester 2 Melbourne

Subject Description: The purpose of STA4AS is to equip graduates with an in depth understanding of modern statistical methods in the following four key topics:

1. Sample surveys with an emphasis on simple random sampling and stratified random sampling.
2. Multivariate analysis with an emphasis on inference for the multivariate mean, checking for underlying multivariate normality, principal component analysis and discriminant analysis. This topic includes an introduction/review of common linear algebra results.
3. Time series analysis with an introduction into the theoretical foundation of Box-Jenkins univariate time series models which form a basis for empirical work with time series data.
4. Introduction to statistical consulting with an emphasis on providing an introduction to the statistical and non-statistical matters that may arise in consulting practice.

This subject is co-taught with STA3AS. However, independent research regarding some advanced topics is required and assessed in STA4AS.

Prerequisite: STA2MD or STM2PM.

Incompatibles: STA3AS.

Class requirements: Three 1-hour lectures and one 1-hour problem class per week.

Assessment: 10 Assignments (approx. 120 words each) (15%), Consulting role-play (5%), 3-hour Final Examination (80%)


STA4AAT, STA4ABT, STA4ACT, STA4ADD, STA4ATE  
ADVANCED TOPICS IN STATISTICS
A, B, C, D, E

15 Credit Points
Semester 1 Melbourne Semester 2 Melbourne

Subject Description: This subject enables 4th year statistics students to enrol in subjects offered through the Key Centre of Statistical Science (KCSS) or through the Department of Mathematics and Statistics Access Grid Room. Subject syllabus is dependent on the subject chosen and students are advised to refer to the departmental website or the Department of Mathematics and Statistics Honours Coordinator prior to enrolment for more details. Enrolment into this subject must be approved by the Department of Mathematics and
Statistics Honours Coordinator.

**Prerequisite:** Students must have been accepted into the Department of Mathematics and Statistics Honours program.

**Class requirements:** This is dependent on the subject chosen though subjects typically consist of two contact hours per week. Students should refer to the departmental website or the Department of Mathematics and Statistics Honours Coordinator for further information.

**Assessment:** This is dependent on the subject (100%). Students should refer to the Department of Mathematics and Statistics Honours Coordinator for further information.

### STA4LM

**ANALYSES OF LINEAR MODELS**

15 Credit Points
Semester 2 Melbourne

**Subject Description:** Modern research often involves the analysis of data for more than one variable and in this regard, linear models are the most widely used class of models. They relate a response variable to one or more explanatory variables enabling researchers to answer important research questions as well as make future predictions. The methods are used in many areas including biological science, economics, engineering, medical science and psychological science. Topics include simple and multiple linear regression, response and explanatory variable transformations, ANOVA and ANCOVA, as well as more modern methodologies such as generalized linear models and linear mixed effects models. This subject has a strong emphasis on preparing students for future careers in statistics. This subject is co-offered with STA3LM although assumes a deeper level of understanding of the subject content.

**Prerequisite:** one of STA2ABS or STA2AMS or STA2MD or STM2PM or approval of honours or masters by coursework coordinator.

**Incompatibles:** STA3LM

**Class requirements:** Two 1-hour Lectures and one 1-hour Computer Lab Class & one 1-hour Problem Class per week.

**Assessment:** 2-hour short answer Final Examination (50%), 5-minute oral presentation briefly describing an applied research paper (5%), 2 Assignments (approx. 800 words each) (20%), 5-minute oral presentation of a current job ad (0%), Hurdle Spreading Preparation/Practice, Consulting role-play (25%).


### STA4ARA

**REGRESSION ANALYSIS**

15 Credit Points
Semester 1 Melbourne Semester 2 Melbourne

**Subject Description:** The main objective of this subject is to provide an introduction to the theory of regression analysis. The topics for this subject include; multiple linear regression; classical estimation and testing; residual analysis; diagnostics; robust regression and modern dimension reduction. This subject considers both theoretical derivations and practical applications through the use of the freely available statistics software package R (see http://www.r-project.org/). Previous knowledge of R is not required.

**Prerequisite:** STA3LM and STA3AS.

**Class requirements:** two 2-hour lecture per week. Students should refer to the departmental website or the Department of Mathematics and statistics Honours Coordinator for further information.

**Assessment:** four assignments (20%), one 2-hour examination (80%).

### STA4SA

**SPATIAL ANALYSIS**

15 Credit Points
Semester 1 Melbourne Semester 2 Melbourne

**Subject Description:** The subject surveys the theory of random fields, spatial processes, spatial statistics models, and their applications to a wide range of areas, including image analysis and GIS (geographic information system). The subject will cover the methodology and modern developments for spatial-temporal modelling, estimation and prediction, and spectral analysis of spatial processes. All the methods presented will be introduced in the context of specific datasets with GRASS and R software.

**Prerequisite:** STA3AS or STA4AS and STA3SI or STA4SI.

**Class requirements:** Two contact hours per week. Students should refer to the departmental website or the Department of Mathematics and Statistics Honours Coordinator for further information.

**Assessment:** Four assignments (40%), one 3-hour examination (60%).


### STA4SI

**STATISTICAL INFERENCE**

15 Credit Points
Semester 1 Melbourne

**Subject Description:** Statistical inference is used to describe procedures that draw conclusions from datasets arising from systems affected by random variation. This subject comprises components in estimation and testing hypotheses. Topics in the first component include method of moments and maximum likelihood, reduction by sufficiency and invariance, unbiasedness, consistency, efficiency and robustness. The second component examines size and power of tests, Neyman-Pearson lemma, optimality of tests, the likelihood ratio test and relationship to confidence interval estimation. This subject is co-taught with STA3SI. For STA4SI there is greater emphasis on research and inquiry with an explication that students independently formulate proofs for extension questions related to the subject material.

**Prerequisite:** STA2MDA or STA2MD or STM2PM.

**Incompatibles:** STA3SI.

**Class requirements:** Three 1-hour lectures and one 1-hour practice class per week.

**Assessment:** 10 Assignments (approx. 250-300 words each) (30%), 3-hour short answer Final Examination (70%).

**Recommended Reading:** Bain LJ, Engelhardt M 2000, Introduction to Probability and Mathematical Statistics, 2nd ed, Duxbury.

### STA4THA

**STATISTICS THESIS A**

15 Credit Points
Semester 1 Melbourne Semester 2 Melbourne

**Special Conditions:** This subject is part of the 45-credit-point thesis program. Students are given a final mark when they complete STA4THB.

**Subject Description:** Students commence a project that takes the equivalent of six months of continuous work under the supervision of a staff member. The project is completed and written up as a thesis when the student completes the subject STA4THB. All students are required to present a 10-minute talk outlining the proposed project at a time determined by the Department of Mathematics and Statistics Honours Coordinator. A list of prospective topics and supervisors is available from the Department of Mathematics and Statistics.

**Prerequisite:** A pass in 60 credit points of third-year statistics subjects with at least a B average, and Coordinators approval.

**Class requirements:** Supervised research under the direction of a staff member equivalent to a total of 150 hours.

This subject is not available for ‘Study Abroad’ students.

**Assessment:** a thesis equivalent to 13,000-words (100%) This is the combined assessment for STA4THA and STA4THB.

### STA4THB

**STATISTICS THESIS B**

30 Credit Points
Semester 1 Melbourne Semester 2 Melbourne

**Special Conditions:** This subject is part of the 45-credit-point thesis program.
Subject Description: Students complete the project commenced in STA4THA, writing up the results as a thesis. All students are required to present a 20-minute talk on their project after the thesis has been submitted. A list of prospective topics and supervisors is available from the Department of Mathematics and Statistics.

Prerequisite: A pass in 60 credit points of third-year statistics subjects with at least a B average, and Coordinators approval.

Class requirements: Supervised research under the direction of a staff member equivalent to a total of 450 hours. This subject is not available for 'Study Abroad' students.

Assessment: A thesis equivalent to 13,000-words (100%) This is the combined assessment for STA4THA and STA4THB.

STA4TS
THEORY OF STATISTICS

15 Credit Points
Semester 1 Melbourne Semester 2 Melbourne

Special Conditions: The prerequisite for non-LTU students is a third year statistical inference subject.

Subject Description: This subject builds on the knowledge of classical statistical inference developed in either STA3SI (Statistical Inference) or STA4SI (Statistical Inference). It consists of a selection of material from the following chapters of Casella and Berger (2002): Chapter 6 (Principles of Data Reduction), Chapter 7 (Point Estimation), Chapter 8 (Hypothesis Testing), Chapter 9 (Interval Estimation) and Chapter 10 (Asymptotic Evaluations). This also includes an introduction to the effect of model selection on confidence intervals.

Prerequisite: STA3SI or STA4SI.

Incompatibles: STA4TS.

Class requirements: Two 1-hour lectures per week.

Assessment: Seven assignments (approx. 400 words each) (40%), Final examination (2-hour short answer) (60%).


STA4RA
REGRESSION ANALYSIS

15 Credit Points
Semester 1 Melbourne Semester 2 Melbourne

Special Conditions: Non-LTU students (i.e. RMIT or Monash University students) are expected to have a pre-requisite intermediate knowledge of linear models including associated linear algebra results and also of theory related to statistical inference.

Subject Description: The main objective of this subject is to provide an introduction to the theory of regression analysis. The topics for this subject include: multiple linear regression; classical estimation and testing; residual analysis; diagnostics; robust regression and modern dimension reduction. This subject considers both theoretical derivations and practical applications through the use of the freely available statistics software package R (see http://www.r-project.org/). Previous knowledge of R is not required. This subject is co-offered with STA4RA although assumes a deeper level of understanding of the subject content.

Prerequisite: STA3LM or STA4LM and STA3SI or STA4SI.

Incompatibles: STA4RA.

Class requirements: One 2-hour lecture/problem class (split determined by material to be covered each week).

Assessment: Final exam (2 hours) (80%), Four assignments (approx. 400 words each) (20%).


KEY CENTRE FOR STATISTICAL SCIENCE SUBJECTS

The Key Centre for Statistical Science (KCSS) links statisticians and econometricians from La Trobe University and other leading institutions, with the aim being to offer courses leading to a BSc(Hons), BCom(Hons), or a Masters degree. Some of the subjects that may be available to students in 2014 through the Key Centre for Statistical Science (KCSS) include

- Financial Econometrics
- Game Theory and Applications
- Stochastic Calculus
- Time Series Analysis

For further information, please visit www.latrobe.edu.au/mathstats
Thesis Topics

The topics listed below are just some of the possible topics from which students can choose. Most supervisors are happy to discuss other possible topics with you personally. If you have a particular area of research that you wish to pursue and you do not know who to discuss this with, then contact the Honours Coordinator who can arrange a meeting with a potential supervisor.

A/Prof Grant Cairns

General Research Interest Areas
- Topology and topological dynamics
- Graph Theory and combinatorics
- Lie groups and Lie algebras

Example Project

Subtraction games
Joint project with Dr Yuri Nikolayevsky.
In combinatorial game theory, a subtraction game is determined by a set S of natural numbers. The games starts with n counters and on each turn the player must subtract s counters, for some s in S. The winner is the player who removes the last counter. It is well known that subtraction games are periodic, but the possible ways in which a game can be periodic are not well understood. There are several open conjectures. In this project, the aim is to investigate these specific conjectures, perform computer studies to see how plausible they are, and if possible, prove one of the conjectures.

Between Artin’s conjecture and the Mersenne prime conjecture
Joint project with Dr Yuri Nikolayevsky.
Artin’s conjecture says that there are infinitely many primes p with ord(2)p-1 in the multiplicative group Z*p. Note that the smallest order of 2 is attained when p is a Mersenne prime; here p=2q-1, for some prime q, and then ord(2)=q. In general Z*p, where n must be an odd integer. The Mersenne primes have n=1, and it is conjectured that there are infinitely many of these. The Artin primes are at the other extreme; here n is as large as possible. Again, it is conjectured that there are infinitely many of these. I don’t know of any prime p=5 where n=3. If there are any, then clearly p is congruent to 1 mod 4, and congruent to 5 mod 8, and congruent to 5 mod 16, and congruent to 21 mod 32... and congruent to 85 mod 256... The object of this project is for the candidate to enjoy themselves learning about Mersenne primes and Artin’s conjecture, and exploring the world that exists between the two.

Regular primes and primes with class number 1
Joint project with Dr Yuri Nikolayevsky.
Consider the set A of primes for which the real quadratic number fields Q(√p)[i] has class number 1. And consider the set B of regular primes (calculations indicate that probably about 2/3 of primes are regular). It is conjectured that A and B are both infinite; both are these conjectures are still open problems. Curiously, it seems that the intersection of the sets A and B is itself quite large. The object of this project is for the candidate to learn about quadratic number fields, class numbers and regular primes, and do computations of the intersection of the sets A and B.

Emer Prof Brian Davey

General Research Interest Areas
- Universal (= universal) algebra
- The theory of natural dualities
- Lattice theory particularly distributive-lattice based algebras

Example Projects

Finitely related algebras
It is easy to prove that a n-ary function on the two-element lattice is a term function (i.e., can be expressed using only the operations join and meet) if and only if it is order-preserving. In general, an algebra is called finitely related if there is a finite set of relations such that the term functions of the algebra are precisely those that preserve these relations. This project would look at recent results on finitely related algebras.

Finite algebras with finitely many compatible relations
This project would begin with the study of the basic theory of finite algebras with finitely many compatible relations as set out in a paper by Davey and Pitkethly in 2010. It would then go on to survey the know examples and find new examples. While most of the examples considered will be lattices with extra structure, the project will also look at finite rings.

A/Prof Marcel Jackson

General Research Interest Areas
- Universal algebra and semigroup theory.
- Interactions between algebra, constraint problems and graph colouring problems.
- Logic and computational complexity issues for algebraic structures.
- Algebras of relations and algebraic foundations to issues in computer science.
- Boolean topological algebras.

Example Projects

Finite basis problems for finite algebras
It is a somewhat surprising fact that the set of true equations that hold on a finite algebra may have no finite axiomatisation. Understanding when a finite algebra has a finite equational axiomatisation has presented a challenging problem in algebra, and has connections through semigroups to recognising properties of formal languages.

Polymorphisms of directed graphs
A very wide class of computational problems are known to be equivalent to homomorphism problems between directed graphs. Recent techniques in analysing the complexity of such problems involve the construction of unusual algebraic objects built from special functions known as polymorphisms. Understanding which directed graphs admit what kind of polymorphism properties presents an entertaining mix of algebra and combinatorics to provide a powerful tool for understanding the complexity of problems.

Dr Peter van der Kamp

General Research Interest Areas
- Integrable systems, evolution equations, moving frames
- Discrete integrable systems, initial value problems, growth of degrees

Example Projects

Classification of extended B-systems to include cubic terms
A complete classification of general two component systems with infinitely many approximate symmetries up to quadratic terms has been obtained. This project is the first step towards investigating the inclusion of cubic terms.

Devise an algorithm to construct initial value problems for systems of lattice equations
I propose to investigate the following conjecture: That for any system of lattice equations, on arbitrary stencils, there are finitely many directions where one can pose a Goursat problem. In all other directions one can pose a Cauchy problem.

Students may wish to propose other areas in which to conduct a project. I would agree to supervise (or co-supervise) a project in the areas of number theory and bio-informatics.

Dr Yuri Nikolayevsky

General Research Interest Areas
- Lie groups and Lie algebras
- Riemannian and geometry
- Graph Theory

Example Projects

Lie subspace topologies
Joint project with A/Prof Grant Cairns.
For a given subset B of a topological space A, one considers the topology whose open sets are the connected components of the intersection of B with the open sets in A. This topology is finer than the usual “subspace topology”. In Lie theory, this finer topology is the “Lie subgroup” topology. It is well understood for Lie groups, but it hasn’t been investigated in the general context of subspaces of arbitrary topological spaces. The goal of this project is to investigate the properties of A that are inherited by B when equipped with this topology. This is a project in pure topology, and doesn’t require any knowledge of Lie groups.

Geometry of Lie groups and Lie algebras
Dr David Farchione

General Research Interest Areas
- Longitudinal data models
- Multilevel modelling

Example Project
A comparison of longitudinal data models that include time-varying covariates
Joint project with A/Prof Luke Prendergast.

The linear mixed model is a standard approach for analyzing data in which subjects are indexed by a random intercept and a random slope. In this model, two types of variation can be captured: variation between subjects and variation within subjects.

A/Prof Paul Kabaila

General Research Interest Areas
- The harmful effect of preliminary statistical model selection on confidence and prediction intervals.
- The properties of confidence intervals obtained by model averaging.
- Confidence intervals that utilize uncertain prior information.

Example Projects
The coverage probability of prediction intervals after a preliminary hypothesis test

In applied statistics, it is common to select a model by carrying out preliminary hypothesis tests. Such preliminary tests can have a harmful effect on subsequently constructed confidence intervals and prediction intervals. The purpose of the project is to evaluate the extent of this harmful effect on a prediction interval in the context of a linear regression model, when we carry out a single preliminary hypothesis test.

Dr Andriy Olenko

General Research Interest Areas
- Theory and statistical applications of spatial stochastic processes
- Wavelet and Shannon approximations of random processes
- Similarity measures of random events

Example Projects
New Metrics for Multi-Class Classification of Waveforms

Biomedical engineering often needs to assess the relationship between two variables that both vary over time. This model works well when examining the relationship between a time invariant covariate (a covariate that does not change over time) and a response variable that changes over time. However, in many real-life modeling problems, the question of interest is focused on examining the relationship between two variables that both vary over time. Under this scenario, the level-2 covariates assumption in a linear mixed model is usually not met which can produce very misleading results. In this project, we will compare three mixed models that are supposedly able to deal with the analysis of time-varying covariates.

A/Prof Luke Prendergast

General Research Interest Areas
- Modeling complex regression structures in modern data
- High dimensional data visualization

Example Projects
Methods for multiple index estimation using ordinary least squares regression

Methods such as Sliced Inverse Regression (SIR) seek K vectors of predictor coefficients that can be used to reduce the dimension of a set of high-dimensional predictor vectors. When K = 1, it is a little known fact that ordinary least squares (OLS) can also be used to achieve this for a very wide class of models under some mild conditions. In her PhD dissertation, Alexandra Garnham showed that OLS can actually retrieve more than one direction by using response transformations. This thesis will further explore this extension to OLS and potentially consider new approaches based on this finding. Comparisons with existing methods that can deal with K > 1 will also be made.

Dr Agus Salim

General Research Interest Areas
- Survival analysis (Cox’s PH) and its extensions for sub-cohort studies
- Analysis of next-generation sequencing data
- Statistical methods for missing data

Examples of Projects
Absolute risk estimation from nested case-control and case-cohort data

Absolute risk estimation is important for disease prevention and treatment. This project will look at recent trends of estimating absolute risk using sub-cohort data, evaluate current approaches and suggest a new approach based on weighted likelihood.

Estimating isoform expression from RNA-sequencing data

RNA-sequencing data allows estimation of expression of different version of the same gene. These versions, called isoforms, have been shown to be associated with disease risk and progression. This project will compare current approaches for estimating isoform expressions.

Model selection for multiply-imputed datasets

Incomplete or missing observations are ubiquitous feature of modern medical research. Multiple imputation is often used to handle the incomplete observations. There is still no agreement on how to perform model selection after multiple imputation. This project will compare several current ad-hoc approaches with a proposed approach based on likelihood-ratio test for multiple datasets.
Policies relating to students

AVAILABILITY OF SUBJECT MATERIAL
Most subjects have their own web page via LMS Moodle, which may include practice class sheets, assignments, old exams and lecture notes or slides. These sheets and their solutions are provided so that you can prepare before class, and for those students who occasionally miss class or lose their sheets. They are no substitute for participation in the classes. You can connect to the LMS Moodle by starting from:
latrobe.edu.au/lms/login

SUBJECT LEARNING GUIDES
A subject learning guide is available for each subject, via its LMS page, and also from the department website. Subject Learning Guides provide detailed information regarding lecturers, lecture times/venues, assessment, and policy information. You are assumed to be aware of the contents.

PAST EXAMS
If you can't find past exams on your subject’s LMS page, you may be able to access them from the Library Catalogue. This can be found at:
latrobe.edu.au/library

ASSIGNMENTS
First and Second Year
Every second week you will be asked to hand in solutions to a set of assignment problems. These assignments give you valuable feedback on how you are going, enabling you to seek help if you should need it. Assignments will be marked by your demonstrator and returned during your practice class, together with feedback and solutions.

Late submissions will be accepted only in special circumstances, usually only by prior arrangement, and must be handed in personally to the relevant staff member.

Third and Fourth Year
Assignments at these levels generally contribute more highly to your final mark. Each subject will have its own submission dates and arrangements, which will be included in the Subject Learning Guide.

Further, assessable work (exam papers or assignments at any year level) written in pencil will not usually be accepted.

ACADEMIC INTEGRITY AND PLAGIARISM
While the Department of Mathematics and Statistics encourages discussion amongst students in learning mathematics, we make a clear distinction between this, and collusion or copying. Producing assignments which should be your own independent work in collusion with, and/or using the work of, other people is plagiarism, and will be reported through the Subject Coordinator to the Head of School. The University’s policy on plagiarism along with further information about acting with integrity in your assessment is to be found at:
latrobe.edu.au/students/academic-integrity

Statement of Originality
At the top of the first page of each assignment you must write, sign and date the following Statement of Originality: “This is my own work. I have not copied it from anyone else”.

In signing this statement you confirm that you have done all the work yourself, that you understand what plagiarism is, that you know it is not acceptable and that you have seen the Academic Misconduct Policy and other University regulations relating to plagiarism. In submitting your work, you are consenting that it may be copied and transmitted by the University for the detection of plagiarism.

SPECIAL CONSIDERATION
If you are unable to attend an exam or complete an assessment task worth 15% or more due to a serious illness, emotional disturbance or misadventure, you can apply for special consideration. Applications are due within three working days of your assessment deadline.

For more information, see
latrobe.edu.au/special-consideration

SUPPLEMENTARY ASSESSMENT
Supplementary Assessment is also controlled by a University policy which was revised significantly in 2011. In the form of conceded passes and hurdle assessment, it now applies only to a very limited and tightly prescribed set of circumstances. The University regulations are available online at:
latrobe.edu.au/policy

Again, the department uses central scheduling by AEGO and does not make individual arrangements.

REVIEW OF SUBJECTS
A Student Feedback Survey is provided in each subject, to all students, towards the end of semester. Your responses to the surveys are an important factor in assessing the effectiveness of the department’s subjects.

COMPLAINTS
Any student who feels that they have a serious complaint about one of their lecturers or demonstrators is advised to discuss this with the Head of Department. Such discussions will be treated as strictly confidential.

When contacting staff, use your La Trobe student email account; this will also be used to contact you (as per University policy). Ensure that you provide your student number in your correspondence.

FOR MORE INFORMATION
latrobe.edu.au/mathstats
Benefits in studying mathematics and statistics

Why Mathematics and Statistics?

- Our staff have strong teaching credentials: several of our staff members and our first-year teaching team have received prestigious awards for excellence in teaching, including two national awards.
- Our graduates are extremely satisfied with their experiences; in the most recent survey (2012), graduates placed La Trobe Maths and Stats 1st in Victoria, and 3rd in Australia.
- Our statistics program is the only undergraduate statistics program in Victoria accredited by the Statistical Society of Australia Inc.
- La Trobe is a full member of the Australian Mathematical Sciences Institute (AMSI), and through this and other activities, La Trobe plays an important role on the national stage.
- La Trobe maintains links with high school teachers directly and through the Mathematical Association of Victoria (the MAV), La Trobe University annually hosts both the MAV Maths Talent Quest and the MAV annual conference.
- Our Department is also an active research department; it includes two ARC Future Fellows and an ARC Professional Fellow.

Careers in Mathematics and Statistics

“Mathematicians and statisticians are among the top 10 jobs in the United States for 2014. The ranking comes from jobsrated.com, where 200 different jobs are compared and ranked according to criteria including work environment, income, stress level and hiring prospects. Other jobs in the top ten count on mathematics and statistics skills: actuary, software engineer and computer systems analyst.

“Math is experiencing something of a Renaissance period, and analytics are the driving force. Mathematical and statistical skills are used to guide many activities, ranging from Internet ‘Cheat Tendencies to Airport Traffic Control.”

—Vijay Keswani, JobsRated.com

For more information about this ranking visit JobsRated.com

National shortage of statisticians

Professional statistics graduates are employed as consultants in a wide range of activities including medicine, epidemiology, health sciences, psychological science, bioinformatics, biostatistics, econometrics, market research, business forecasting, finance, insurance, engineering, environmental science, biological science and agriculture. There is a serious continuing shortfall of graduates from professional statistics programs.

To give yourself the best career options, and position yourself for the best jobs, we recommend you take a double major in Maths and Stats. There are many great jobs available in statistics; students who have a double major get their pick of the best positions.

For more information on careers in mathematics and statistics, go to www.mathscareers.org.au and statsci.org/jobs

Honours in Mathematics and Statistics

Going on to honours in mathematics or statistics is an excellent choice. The honours classes are quite small and you will receive a lot of one-on-one help from staff. Our honours students have a very positive experience. We encourage you to learn advanced ideas and techniques, giving you a cutting edge in the workforce. An honours degree will also keep open for you the option of going on to postgraduate study. As a general rule, only students in the top one third of the third year class are invited to enrol in honours. If you do receive an invitation, you are warmly encouraged to take up this excellent opportunity.
Want to know more? Get in touch!

Future students and general enquiries
T +61 (0)3 9479 2500
E mathstat@latrobe.edu.au

Advisors of Studies

Mathematics
Dr Yuri Nikolayevsky
T +61 (0)3 9479 1644
E Y.Nikolayevsky@latrobe.edu.au

Statistics
Dr Andriy Olenko
T +61 (0)3 9479 2609
E A.Olenko@latrobe.edu.au

Any questions?
latrobe.edu.au/mathstats

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