BIO STATISTICS COLLABORATION OF AUSTRALIA

BCA PROGRAM OUTLINE – **2022**

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BCA Coordinating Office

The BCA Coordinating Office is the central liaison point for the BCA. Staff at this office can help with enquiries about the program and are available at all times to assist enrolled students.

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The coordinating office is housed at the NHMRC Clinical Trials Centre.

What is the BCA?

The Biostatistics Collaboration of Australia (BCA) is a consortium of biostatistical experts from around Australia with representatives from universities, government and the pharmaceutical industry.

In order to address the ongoing shortage of highly skilled biostatisticians, the BCA has developed a program of postgraduate courses that aims to fill a serious gap between current programs in public health and epidemiology (which train users of biostatistical methods, not professional biostatisticians), and general statistics courses (which do not cater to the increasingly diverse and specialised needs of health research).

By combining the best talents from around the country, this collaboration has developed a focussed curriculum with a mission to provide Australia with well-trained professional biostatisticians. The courses provide a sound mathematically-based grounding in statistical methods with a strong emphasis on applications in all areas of health and medical research.

A three tier award structure is available to postgraduate students:
Graduate Certificate; Graduate Diploma*; Masters Degree

The BCA consortium currently comprises the following (consortium) universities:

The University of Adelaide
Monash University
The University of Queensland
The University of Sydney

All units of study are delivered by distance learning.
Units of study are called variously units, subjects, courses or papers at different universities.

The University of Melbourne is a BCA Affiliated University. Some BCA units of study are delivered by this university.

*Consult university about the availability of the Graduate Certificate and Graduate Diploma.

Course Objectives

Masters Degree

On completion of this course, students will:

1. have developed a sound understanding of epidemiological study design and the theory and application of the major areas of bio-statistics relevant to professional practice
2. have acquired skills in complex statistical analyses to handle a variety of practical problems using modern statistical techniques and software
3. have acquired skills in data collection and data management, including quality control procedures and the ethical handling of data
4. have developed skills to identify the relevant statistical issues in practical problems in medical/health settings and to propose and implement an appropriate statistical design and/or analysis methodology
5. have developed skills and had experience in communication of biostatistical issues with clinical/health personnel and the presentation of statistical results in a format suitable for publication in health-related journals or professional reports
6. have acquired the technical skills to be able to read methodological papers in the biostatistical literature and apply the methods described therein to practical problems
7. have developed the practical and technical skills to commence professional careers as independent biostatisticians and/or to progress to further postgraduate research studies
8. be able to demonstrate an understanding of professional codes of conduct and ethical standards such as those of the Statistical Society of Australia
9. have developed problem solving abilities in biostatistics, characterised by flexibility of approach

Graduate Diploma

On completion of this course, students will:

1. be able to demonstrate a broad understanding of the mathematical background, theory and application of the principles of epidemiology and biostatistical methods in health and medical research
2. have acquired skills in complex statistical analyses to handle a variety of practical problems using modern statistical techniques and software
3. have acquired skills in data collection and data management, including database design, quality control procedures and the ethical handling of data
4. have developed skills to identify the relevant statistical issues in practical problems in medical/health settings and to propose and implement an appropriate statistical design and/or analysis methodology
5. have developed skills and demonstrated ability to present statistical results in a format suitable for publication in health-related journals or professional reports
6. have acquired the technical skills to be able to read methodological papers in the biostatistical literature and apply the methods described therein to practical problems
7. have developed the practical and technical skills to progress to further postgraduate studies in biostatistics
8. be aware of professional codes of conduct and ethical standards such as those of the Statistical Society of Australia

Graduate Certificate

On completion of this course, students will:

1. be able to demonstrate a broad understanding of the value and basic principles of biostatistical methods in health and medical research
2. be able to demonstrate an understanding of the principles of epidemiology and its biostatistical underpinnings
3. have acquired skills in data management and basic statistical analyses
4. have developed the practical and technical skills to progress to further postgraduate studies in biostatistics

Entry requirements and enrolment advice

What is biostatistics?

Biostatistics is the discipline that underpins the use of statistical methods in health and medical research. Its foundation is the mathematics of variability and it encompasses the science of designing quantitative research studies and other data collections, managing and analysing data, and interpreting the results.

Who is the program for?

The program has been designed to provide advanced biostatistical training for a diverse range of students. The main thing is that you should have an aptitude for advanced mathematics, and a desire to learn biostatistics.

The program includes units designed to provide the background in mathematical and statistical theory to those without a first degree in mathematics or statistics. The compulsory unit in epidemiology introduces those unfamiliar with research in population health to critical appraisal of the health and medical literature.

Graduates with a health sciences background, e.g. Masters degree in Public Health or Clinical Epidemiology, will gain increased and more sophisticated statistical skills, while those from a mathematical background will further their health and medical statistics application techniques. On completion of the Masters Degree or Graduate Diploma, graduates will have attained the required skills for employment as a biostatistician, while those completing the Graduate Certificate will have an understanding of the principles of epidemiology and some aspects of biostatistics.

Entry requirements - who is eligible to apply?

Applicants should have:

- a Bachelor degree in Statistics, Mathematics, Science, Psychology, Medicine, Pharmacy, Nursing, Health Sciences or other appropriate discipline from an approved university (or equivalent qualification)
- a proven aptitude for advanced mathematical work, indicated for example by a high level of achievement in high school mathematics

Each consortium university may have additional entry requirements. You should check the details with the university of your choice.

Students should note that *Regression Modelling for Biostatistics 1* is an important foundation unit. Students who do not develop a strong grasp of this material will struggle to become successful biostatisticians.

How and where will I study?

The way the program is structured by the Consortium of universities is a little different to programs offered within the one university. The BCA model involves partner universities fully recognising units taught by other consortium universities.

Teaching is done by distance delivery, with course materials sent to students in printed form, and an online learning management system used to generate class interaction and to manage assessment.

You should apply to enrol at your choice of the consortium universities. Although the program is delivered by distance, it is advisable to consider the availability of local support and supervision, particularly for the Biostatistics Research/Practical Project at the Masters level.

The university in which you enrol will become your home university. All BCA units are accredited at all consortium universities and each unit is delivered by one and only one of these universities in any semester. Students enrolled in the same unit at different universities receive identical unit of study materials and instruction. A central BCA coordinating office function is to act as a liaison and communication centre for students, coordinators and administrators at all BCA participating universities.

A brief outline of why the postgraduate courses in biostatistics are delivered by a consortium, and how the BCA works can be found here. Contact details for BCA program coordinators and student administrators at these universities can be found here.

Using this Outline and seeking further assistance

This Outline lists unit outlines for all units of study, core and elective, within the program. The curriculum table on page 5 lists required units for each course, semester availability and pre and co-requisites. The Study Schedules on pages 6 and 7 provide examples of how you might structure your program of study.

Should you decide to enrol, the BCA program coordinator at your home university would be your academic advisor. Postgraduate administrative staff can help you with enrolment advice. Having considered your options with the aid of this document, we recommend that you discuss study options with the BCA program coordinator at your chosen university.

Fees

The program attracts standard postgraduate coursework fees. Prices may differ a little between universities and fee scales may change each year at each consortium university. You will need to ask about the fees when making enquiries at the university/s.

A postgraduate loans scheme, FEE-HELP, is available to domestic postgraduate students, by the Australian Government Department of Education, Employment and Workplace Relations (DEEWR)

If you are not a citizen or permanent resident of Australia or New Zealand, you will be charged international fee rates and must study from overseas (because the Australian Government does not permit international students WHO HAVE ENTERED AUSTRALIA on a STUDENT VISA to enrol in part-time distance study courses such as the BCA program).

What are the study requirements?

Access to a computer and the internet are essential study requirements.

An online learning management system, eLearning, is a central component of the distance delivery. It is used for a variety of functions, the most important of which is as a communication tool, for student/student and student/coordinator discussion. Email is also used, particularly as the first point of contact from BCA administrators and unit coordinators. Hard copy materials may be sent by post and can also be accessed via eLearning.

Advice about textbook and software requirements can be found on pages 8 and 9.

If you are not familiar with required software packages we strongly advise you to familiarise yourself with them before you start your studies. If you need further help with access to these resources, contact the BCA Coordinating Office, see page 1 for contact details.

Course load

Graduate Certificate; Graduate Diploma; and Master of Biostatistics, where the qualifications are subsets of each other with an increasing degree of mathematical maturity and rigor required as the level of qualification increases.

Masters

For the Masters degree 10 or 11 coursework units of study are required plus a 1 or 2 unit Biostatistics Research/Practical Project. Students may be waived the requirement to complete either Epidemiology (students coming from a background in health research), or Mathematical Foundations for Biostatistics and Principles of Statistical Inference (students coming from from a background in mathematics and/or statistics). This will leave room to complete additional elective units in addition to the compulsory Biostatistics Research/Practical Project. Students can complete up to two local electives chosen from the list of endorsed courses/programs in Table D below.

Graduate Diploma

For the Graduate Diploma, the Biostatistics Research/Practical Project is not a requirement. Some students may substitute electives for units of study such as Epidemiology, Foundations for Biostatistics or Principles of Statistical Inference, if they have equivalent prior study. Students can complete one local elective chosen from the list of endorsed courses/programs in Table D below.

Graduate Certificate

For the Graduate Certificate only, Epidemiology is compulsory, allowing maximum flexibility (within the constraints of other unit-specific prerequisites, as indicated).

NOTE: In BCA coursework information, course load is tallied by unit of study. The way that credit points are tallied per unit differs between universities. In order for students to understand the performance indicators noted in university handbooks and student records at the university in which they are enrolled, students should familiarise themselves with the relevant classification methods at their home university. This information is available on university websites and in graduate handbooks.

Studying from overseas

Australian Government laws do not permit international students WHO HAVE ENTERED AUSTRALIA on a STUDENT VISA to enrol in part-time distance study courses.

However, this restriction does NOT apply if you are studying from overseas.

A major issue associated with studying the Masters degree from overseas is the unit called Biostatistics Research/Practical Project (WPP), the aim of which is for students to gain practical experience, usually in workplace settings, in the application of knowledge and skills learnt during the course-work of the Masters program. The student will provide evidence of having met this goal by presenting a portfolio or thesis made up of a preface and project reports.

Arrangements would need to be put in place to ensure suitable supervision and appropriate project/s. (This issue doesn't arise at the Graduate Diploma level as WPP is not a requirement.)

It is essential to discuss this with the BCA program coordinator at the university at which you wish to enrol.

See BCA Universities

BCA curriculum 2022

Required units of study for each award course (unless an exemption or credit has been granted)

Semester	BCA Code	Unit of study	Co/Prerequisites	Grad Cert	Grad Dip	Masters
1 & 2	EPI	☐ Epidemiology	-	✓	✓	✓
1 & 2	MFB	Mathematical Foundations for Biostatistics	-		✓	✓
1	HIS	Health Indicators & Health Surveys	*MFB (or MBB)			
1 & 2	DMC	Data Management & Statistical Computing	-		✓	✓
1 & 2	PSI	Principles of Statistical Inference	MFB (or MBB+ PDT)		✓	✓
2	CLB	Clinical Biostatistics	EPI, MFB (or MBB+PDT), PSI, *DES, *RM1 (or *LMR)			
2	DES	Design of Randomised Controlled Trials	EPI, MFB (or MBB+PDT)			
1 & 2	RM1	Regression Modelling for Biostatistics 1	◆EPI, MFB (or MBB+PDT), *PSI		✓	✓
1 & 2	RM2	Regression Modelling for Biostatistics 2	EPI, MFB (or MBB+PDT), PSI, RM1 (or LMR)		✓	✓
1 & 2	WPP	✪Biostatistics Research/Practical Project	minimum of 4 units, including RM1 (or LMR) & DMC			✓
1®	LCD	Longitudinal & Correlated Data	EPI, MFB (or MBB+PDT), PSI, RM1 (or LMR+CDA)			
2®	CSI	Causal Inference	EPI, MFB (or MBB+PDT), ❖ RM1 (or LMR)			
2	MLB	Machine Learning for Biostatistics	EPI, MFB (or MBB+PDT), PSI, RM1 (or LMR+*CDA)			
2	BAY	Bayesian Statistical Methods (2022)	EPI, MFB (or MBB+PDT), PSI, RM1 (or LMR+CDA)			
2	SGX	Statistical Genomics (2023)	MFB (or MBB+PDT), DMC, PSI, RM1 (or LMR)			

✓ **unit is compulsory**

☐ EPI: See pages 8 and 10 for notes about Epidemiology.

• co-requisite, may be taken before or concurrently

◆ RM1: Program coordinator approval is required for taking RM1 & EPI simultaneously.
See note 6, page 8 for information about studying RM1.

✪ WPP: Students wishing to complete the Masters Degree must discuss options for this unit with the BCA program coordinator at their home university. The minimum number of prerequisite units may differ across universities. See note 7, page 8, and page 19 for important information about preparing for WPP.

❖ Prerequisites for CSI are EPI, MFB, and RM1 ***or*** a multivariable regression unit of study from an MPH course or equivalent.

® From 2023, CSI will be in seme 1 and LCD in both semesters
SGX and BAY are delivered in alternate years: BAY will be delivered in semester 2 2022, SGX in semester 2 2023.

Study schedules

The tables below are suggested study schedules for students enrolled in 1, 2 or 4 units per semester, and with a range of possible exemptions from foundational units:

TABLE A: for students studying part-time, starting in Semester 1 and studying **two units per semester**

	EXEMPTIONS			
	No exemptions	**EPI only**	**MFB only**	**MFB+PSI**
Year 1				
Sem 1	EPI + MFB	MFB + DMC	EPI + DMC	EPI + DMC
Sem 2	PSI + DMC	PSI + elective	PSI +elective	RM1 + elective
Year 2				
Sem 1	RM1 + elective	RM1 + elective	RM1 + elective	RM2 + elective
Sem 2	RM2 + elective	RM2 + elective	RM2 + elective	2 electives
Year 3				
Sem 1	2 of *WPP/elective	2 of *WPP/elective	2 of *WPP/elective	2 of *WPP/elective
Sem 2	2 of *WPP/elective	2 of *WPP/elective	2 of *WPP/elective	2 of *WPP/elective

*Students undertaking a single-unit WPP would typically enrol in this in their final semester, although this is not mandated.

TABLE B: for students studying part-time, starting in Semester 1 and studying **one unit per semester**

	EXEMPTIONS			
	No exemptions	**EPI only**	**MFB only**	**MFB+PSI**
Year 1				
Sem 1	MFB	MFB	DMC	EPI
Sem 2	DMC	DMC	PSI	DMC
Year 2				
Sem 1	EPI	PSI	EPI	RM1
Sem 2	PSI	RM1	RM1	RM2
Year 3				
Sem 1	RM1	RM2	RM2	elective
Sem 2	RM2	elective	elective	elective
Year 4				
Sem 1	elective	elective	elective	elective
Sem 2	elective	elective	elective	elective
Year 5				
Sem 1	*WPP/elective	*WPP/elective	*WPP/elective	*WPP/elective
Sem 2	*WPP/elective	*WPP/elective	*WPP/elective	*WPP/elective
Year 6				
Sem 1	*WPP/elective	*WPP/elective	*WPP/elective	*WPP/elective
Sem 2	*WPP/elective	*WPP/elective	*WPP/elective	*WPP/elective

*Students undertaking a single-unit WPP would typically enrol in this in their final semester, although this is not mandated.

TABLE C: for students studying full-time and starting in Semester 1

	EXEMPTIONS			
	No exemptions	**EPI only**	**MFB only**	**MFB+PSI**
Year 1				
Sem 1	EPI + MFB + DMC + elective	MFB + DMC + 2 electives	EPI + DMC + PSI + elective	EPI + DMC + ◆RM1 + elective
Sem 2	PSI + RM1 + 2 electives	PSI + RM1 + 2 electives	RM1 + 3 electives	RM2 + 3 electives
Year 2				
Sem 1	RM2 +WPP + electives	RM2 + WPP + electives	RM2 + WPP + electives	WPP + electives

◆ RM1: Program coordinator approval is required for taking RM1 & EPI simultaneously.

Table D: BCA Endorsed Courses for Electives

Students interested in enrolling in non-BCA electives should consult the Program Coordinator of their home university to discuss the suitability of their planned unit(s).

University	Endorsed award program	Excluded units
Monash	Master of Data Science	FIT5197 Statistical Data Modelling
	Master of Business Analytics	ETC5510 Introduction to data analysis
	Master of Clinical Research	MPH5041 Introductory Biostatistics MPH5200 Regression Analysis for Epidemiology
	Master of Public Health	MPH5041 Introductory Biostatistics MPH5200 Regression Analysis for Epidemiology MPH5270 Advanced Statistical Methods for Clinical Research
Sydney	Master of Public Health (includes health policy, clinical epidemiology, and bioethics unit options)	FMHU5002 / PUBH5018 Introductory Biostatistics PUBH5217 Biostatistics: Statistical Modelling PUBH5218 Advanced Statistical Modelling PUBH5216 Controlled Clinical Trials SEXH#### MBHT#### NTDT#### GLOH####
	Master of Data Science (Core Units or Data Science Electives)	COMP5318 Machine Learning and Data Mining STAT5003 Computational Statistical Methods INFO#### QBUS####
Queensland	Master of Public Health	PUBH7630 Intro to Biostatistics
	Master of Epidemiology	PUBH7630 Intro to Biostatistics PUBH7653 Methods of Clinical Epidemiology
	Master of Data Science	
	Master of Health Economics	
Adelaide	Master of Public Health	PUB HLTH 7074 Introduction to Biostatistics PUB HLTH 7104 Biostatistics

Unit of study outlines

Units of study available for the program of postgraduate courses in biostatistics

Notes

1. Where ***co-requisite** is noted in unit outlines, the unit/s may be taken concurrently
2. **Units of study (units)** may be referred to at different universities as units, subjects, courses or papers. At the University of Queensland (UQ) a course is equivalent to a BCA unit of study and is comprised of 2 UQ units.
3. In this document, **a BCA course** means an academic award of Masters, Graduate Diploma or Graduate Certificate.
4. **Epidemiology (EPI)**

   All units of study in the BCA curriculum were developed specifically for the program, with the exception of EPI which was a pre-existing unit at most universities. This means that students may have a choice of options for studying EPI in one or both semesters, depending on their home university. Home university postgraduate advisors may direct students to the EPI offered at that university, or students may be able to choose between units delivered face-to-face locally or, alternatively, by distance elsewhere. *This is the only instance in the BCA curriculum where a choice for study options may exist. All other BCA units are delivered by distance by one university only in any semester.*

   Program coordinators at each consortium university can advise about Epidemiology choices.

   If a local study option is not offered at a home university, students will be doing (Introduction to) Epidemiology delivered by distance from the University of Queensland.
5. **Data Management and Statistical Computing (DMC)**

   Students who do not have experience in the use of R or Stata will need to include DMC in their curriculum choices. R **and** Stata software are compulsory for this unit. See *Statistical Software* below.
6. **Regression Modelling for Biostatistics 1 (RM1)**

   RM1 is an important foundation unit. Students who do not develop a strong grasp of this material will struggle to become successful biostatisticians.
7. **Biostatistics Research/Practical Project* (WPP)**

   Adequate supervisory arrangements must be in place before students commence WPP. Students wishing to complete the Masters Degree must discuss options for this unit with the BCA program coordinator at their home university. The requirements of individual universities may differ. Depending on the university, 1, 2 and 4 unit options may be available for WPP. See page 19 for more details.

   *Title differs across universities. Called the *Biostatistics Research Project* at The University of Adelaide, Macquarie University and The University of Sydney; the *Biostatistics Practical Project* at Monash University; and *Special Topic/Thesis in Biostatistics* at The University of Queensland. The unit code WPP is used in BCA documentation. As is the case for all BCA units, the university unit/course/subject code will be used at respective universities. (WPP is a legacy acronym for Workplace Project Portfolio, which was the original name of the unit.)
8. **TEACHING STAFF**

   Details for coordinators of BCA units of study in the current year can be found here.
9. **STUDY RESOURCES**

   Requirements for compulsory textbooks and software are included in the unit outlines listed below. Complete listings for compulsory and recommended readings and guidelines for software use are provided in unit Study Guides provided to students who have enrolled in the relevant unit/s.

   Additional resources can be found on the BCA Student Resources Canvas site.

   Details for compulsory textbooks and statistical software packages, including purchasing advice, can be found in the BCA Textbook and Software Guide

- **Textbooks**

  Compulsory references generally contain sections that are relevant to assessment tasks. Recommended references – books, book chapters, papers and journals – provide further background reading.

  NB: *ISBN numbers* are listed in the BCA Textbook and Software Guide. The length of ISBN codes increased from 10 to 13 digits in Jan 2007. All ISBN-10s were officially changed to ISBN-13s (by adding the Bookland EAN prefix '978' and recalculating the final check digit).

  All ISBNs listed BCA guides are 13-digit codes.

- **Statistical Software**

  Coordinators are aware that many students will be familiar with a range of packages. The choice has been limited in the interests of teaching efficiency and industry standards.

  Most units of study present materials using both Stata and R statistical software, and students are free to use whichever of these two packages they prefer. However, both Stata and R are *required* for Data Management and Statistical Computing (DMC), and Machine Learning for Biostatistics (MLB) and Statistical Genomics (SGX) use R software only (i.e., not Stata). If you don't have the required software on your home computer, you will need to be able to access it somewhere regularly throughout the semester.

  See the BCA Textbook and Software Guide for details about how to buy Stata and access R online.

- **Learning Management Systems (LMS) - eLearning**

  All BCA units use the online facility eLearning via the BCA online learning site, using *Canvas* administered by the University of Sydney. The exception is **Epidemiology** (EPI), which is delivered via the online facilities at the relevant delivering university. This is because this unit is included in the curriculum of a range of courses at each university. EPI units delivered face-to-face and/or by distance at some consortium universities may include the use of online facilities available at the relevant university.

  If students are not enrolling in EPI at their home university, they will be likely be enrolling in (Introduction to) Epidemiology delivered by distance by the University of Queensland (UQ).

Epidemiology (EPI)

Coordinator: Coordinator will depend on university.

This unit is offered on-campus (face-to-face) and/or by distance at some universities. Home university postgraduate advisors may offer students the option to enrol in the epidemiology unit offered at that university, face-to-face or by distance. See the note on page 8 for further details.

If students are **not** doing EPI at their home university, they will be doing (Introduction to) Epidemiology delivered by distance means at the University of Queensland (UQ).

UQ specifications:

Assessment:	Three assessments (25%-calculations and interpretation, 50%-structured critical appraisal, 25%-timed MCQ)
Prescribed text:	*Essential Epidemiology* by Webb and Bain, 4th edition, 2020, (Cambridge University Press)
Online resources:	Online self-paced course materials and activities, tutor support, workshop recordings, interaction facilities and assignment completion. A UQ username and password and access to edX course will be provided.

General outline for EPI:

Prerequisites:	None
Time commitment:	8-12 hours total study time per week
Semester availability:	Semester 1 and Semester 2
Aim:	On completion of this unit students should be familiar with the major concepts and tools of epidemiology, the study of health in populations, and should be able to judge the quality of evidence in health-related research literature.
Content:	Topics include: historical developments in epidemiology; sources of data on mortality and morbidity; disease rates and standardisation; prevalence and incidence; life expectancy; linking exposure and disease (eg. relative risk, attributable risk); main types of study designs – case series, ecological studies, cross-sectional surveys, case-control studies, cohort or follow-up studies, randomised controlled trials; sources of error (chance, bias, confounding); association and causality; evaluating published papers; epidemics and epidemic investigation; surveillance; prevention; screening.
Assessment:	As prescribed by university
Prescribed texts:	As prescribed by university
Special computer requirements:	Nil
Online resources:	Resources dependent on delivering university facilities.

Mathematical Foundations for Biostatistics (MFB)

Coordinators:	Prof Andrew Forbes, School of Public Health and Preventive Medicine, Monash University Dr Murthy Mittinty, School of Public Health, University of Adelaide
Prerequisites:	None
Semester availability:	Semester 1 and Semester 2
Time commitment:	8 -12 hours total study time per week
Aim:	This unit aims to develop and apply calculus and other mathematically-based techniques to the study of probability and statistical distributions. These two units, together with the subsequent Principles of Statistical Inference (PSI) unit, will provide the core prerequisite mathematical statistics background required for the study of later units in the Graduate Diploma or Masters degree
Content:	This unit covers the foundational mathematical methods and probability distribution concepts necessary for an in depth understanding of biostatistical methods. The unit commences with an introduction to mathematical expressions, followed by the fundamental calculus techniques of differentiation and integration, and essential elements of matrix algebra. The concepts and rules of probability are then introduced, followed by the application of the calculus methods covered earlier in the unit to calculate fundamental quantities of probability distributions, such as mean and variance. Random variables, their meaning and use in biostatistical applications is presented, together with the role of numerical simulation as a tool to demonstrate the properties of random variables.
Assessment:	Two written assignments, each worth 35% and submission of selected practical written exercises from modules, worth 30%.
Prescribed texts:	Wackerly DD, Mendenhall W, Scheaffer RL. *Mathematical Statistics with Applications*, 7th edition, 2007, Wadsworth Publishing (ex Duxbury Press, USA) For details, including correct ISBN (**note that different versions exist with different ISBNs**), see the BCA Textbook and Software Guide Useful but not essential text: Healy, MJR. *Matrices for Statistics*, 2nd edition. Oxford University Press, 2000
Special computer requirements:	Stata or R statistical software, and Wolfram Alpha (online free resource)
Online resources:	Course notes, online mini-lecture videos, online tutorials, discussion board

Data Management and Statistical Computing (DMC)

Coordinators:	Semester 1: TBA School of Public Health, University of Adelaide Semester 2: TBC School of Public Health, University of Queensland
Prerequisites:	None
Semester availability:	Semester 1 and Semester 2
Time commitment:	8-12 hours total study time per week
Aim:	The aim of this unit is to provide students with the knowledge and skills required to undertake moderate to high level data manipulation and management in preparation for statistical analysis of data typically arising in health and medical research. Specific objectives are for students to: • Gain experience in data manipulation and management using two major statistical software packages (Stata and R) • Learn how to display and summarise data using statistical software • Become familiar with the checking and cleaning of data • Learn how to link files through use of unique and non-unique identifiers • Acquire fundamental programming skills for efficient use of software packages • Learn key principles regarding confidentiality and privacy in data storage, management and analysis
Content:	The topics covered are: • Module 1 – Stata and R: The basics (importing and exporting data, recoding data, formatting data, labelling variable names and data values; using dates, data display and summary presentation, and creating programs) • Module 2 – Stata and R: graphs, data management and statistical quality assurance methods (including advanced graphics to produce publication-quality graphs) • Module 3 – Data management using Stata and R (using functions to generate new variables, appending, merging, transposing longitudinal data; programming skills for efficient and reproducible use of these packages, including loops and arguments
Assessment:	Three written assignments worth 30%, 35% and 35%
Recommended texts:	If you have not used R or Stata previously, it is recommended that you have access to the text for the relevant software. Hadley Wickham and Garrett Grolemund, *R for Data Science: Import, Tidy, Transform, Visualize, and Model Data*. O'Reilly Media, 2017. Svend Juul and Morten Frydenberg. *An Introduction to Stata for Health Researchers.* Stata Press 2014 For details, including ISBN, see the BCA Textbook and Software Guide
Special computer requirements:	R and Stata software; RStudio is also strongly recommended. For advice about buying these packages (at education license prices), see the BCA *Textbook and Software Guide* If you have further questions you can consult the BCA program coordinator at your home university or the BCA coordinating office.
Online resources:	Course notes, online mini-lecture videos, online tutorials, discussion board

Principles of Statistical Inference (PSI)

Coordinators:	Semester 1: Ms Liz Barnes NHMRC Clinical Trials Centre, University of Sydney Semester 2: Dr Erin Cvejic Sydney School of Public Health, University of Sydney
Prerequisites:	Mathematical Foundations for Biostatistics (or Mathematical Background for Biostatistics and Probability and Distribution Theory)
Semester availability:	Semester 1 and Semester 2
Time commitment:	8-12 hours total study time per week
Aim:	To develop a strong mathematical and conceptual foundation in the methods of statistical inference, which underlie many of the methods utilised in subsequent units of study, and in biostatistical practice.
Content:	The unit provides an overview of the concepts and properties of estimators of statistical model parameters, then proceeds to a general study of the likelihood function from first principles. This will serve as the basis for likelihood-based methodology, including maximum likelihood estimation, and the likelihood ratio, Wald, and score tests. Core statistical inference concepts including estimators and their ideal properties, hypothesis testing, p-values, confidence intervals, and power under a frequentist framework will be examined with an emphasis on both their mathematical derivation, and their interpretation and communication in a health and medical research setting. Other methods for estimation and hypothesis testing, including a brief introduction to the Bayesian approach to inference, exact and non-parametric methods, and simulation-based approaches will also be explored.
Assessment:	Two major assignments worth 40% each and module exercises worth a total of 20%
Prescribed texts:	Marschner IC. *Inference Principles for Biostatisticians.* Chapman & Hall / CRC Pr, 2014 For details, including ISBN, see the BCA Textbook and Software Guide
Special computer requirements:	R or Stata software
Online resources:	Course notes, online mini-lecture videos, online tutorials, discussion board

Design of Randomised Controlled Trials (DES)

Coordinators:	TBA School of Public Health, University of Adelaide
Prerequisites:	Epidemiology, Mathematical Foundations for Biostatistics (or Mathematical Background for Biostatistics and Probability and Distribution Theory)
Semester availability:	Semester 2
Time commitment:	8-12 hours total study time per week
Aim:	To enable students to understand and apply the principles of design and analysis of experiments, with a particular focus on randomised controlled trials (RCTs), to a level where they are able to contribute effectively as a statistician to the planning, conduct and reporting of a standard RCT.
Content:	Topics include: ethical considerations; principles and methods of randomisation in controlled trials; treatment allocation, blocking, stratification and allocation concealment; parallel, factorial and crossover designs, including n-of-1 studies; practical issues in sample size determination; intention-to-treat principle; phase I dose finding studies; phase II safety and efficacy studies; interim analyses and early stopping; multiple outcomes/endpoints, including surrogate outcomes, multiple tests and subgroup analyses, including adjustment of significance levels and P-values; missing data; reporting trial results and use of the CONSORT statement.
Assessment:	Assignments 100% (three written assignments, the first two worth 30% each and the final assignment worth 40%
Prescribed tests:	Matthews JNS, Introduction to Randomized Controlled Clinical Trials, 2nd edition, Chapman and Hall 2006 For details, including ISBN, see the BCA Textbook and Software Guide
Special computer requirements:	R or Stata software
Online resources:	Course notes, online mini-lecture videos, online tutorials, discussion board

Regression Modelling for Biostatistics 1

Coordinators:	Semester 1: Dr Timothy Schlub, Sydney School of Public Health, University of Sydney Semester 2: Prof Stephane Heritier, School of Public Health & Preventive Medicine, Monash University
Prerequisites:	Epidemiology, Mathematical Foundations for Biostatistics (or Mathematical Background for Biostatistics and Probability and Distribution Theory)
Co-requisite*:	Principles of Statistical Inference
Semester availability:	Semester 1 and Semester 2
Time commitment:	8-12 hours total study time per week
Aim:	To enable students to apply methods based on linear and logistic regression models to biostatistical data analysis, with proper attention to underlying assumptions and a major emphasis on the practical interpretation and communication of results.
Content:	This unit lays the foundation of biostatistical modelling to analyse data from randomised or observational studies. These skills are essential for biostatistics in practice and will be used by students for the remainder of their BCA studies. This unit will introduce the motivation for different regression analyses and how to choose an appropriate modelling strategy. This unit will teach how to use linear regression to analyse continuous outcomes and logistic regression for binary outcomes. Emphasis will be placed on interpretation of results and checking the model assumptions. Stata and R software will be used to apply the methods to real study datasets
Assessment:	Three assignments worth 30%, 30% and 40%.
Prescribed texts:	Vittinghoff E, Glidden D, Shiboski S, McCulloch C. Regression Methods in Biostatistics: Linear, logistic, survival and repeated measures models. 2nd Edition. Springer Verlag 2012 For details, including ISBN, see the BCA Textbook and Software Guide
Special computer requirements:	R or Stata statistical software
Online resources:	Course notes, online mini-lecture videos, online tutorials, discussion board

NOTE
RM1 is an important foundation unit. Students who do not develop a strong grasp of this material will struggle to become successful biostatisticians.

*co-requisite, may be taken before or concurrently

Regression Modelling for Biostatistics 2

Coordinator:	Semester 1: Dr Michael Waller School of Public Health, University of Queensland Semester 2: Prof Gillian Heller, NHMRC Clinical Trials Centre, University of Sydney
Prerequisites:	Epidemiology, Mathematical Foundations for Biostatistics (or Mathematical Background for Biostatistics and Probability and Distribution Theory), Principles of Statistical Inference, Regression Modelling for Biostatistics 1 (or Linear Models)
Semester availability:	Semester 1 and Semester 2
Time commitment:	8-12 hours total study time per week
Aim:	To enable students to implement generalized linear models (GLMs) for analysis of categorical data, and survival analysis methods for time-to-event data, with proper attention to the underlying assumptions. A major focus is on selection of appropriate methods, assessing the model fit and diagnostics of GLMs and survival models, and the practical interpretation and communication of model results.
Content:	This unit presents the theory and application of generalised linear models (GLMs) and survival analysis. The unit covers the implementation of GLMs to analyse count data using Poisson and negative binomial regression; how logistic regression models can be applied to binary, multinomial, and ordinal data; and the use of GLMs with continuous data. The unit presents methods to analyse time to event survival data including the Kaplan Meier curve and the Cox proportional hazards model.
Assessment:	3 assignments, worth 30%, 30% and 40%.
Prescribed texts:	Vittinghoff E, Glidden D, Shiboski S, McCulloch C. Regression Methods in Biostatistics: Linear, logistic, survival and repeated measures models. 2nd Edition. Springer Verlag 2012 For details, including ISBN, see the BCA Textbook and Software Guide
Special computer requirements:	R or Stata statistical software
Online resources:	Course notes, online mini-lecture videos, online tutorials, discussion board

Biostatistics Research/Practical Project (WPP)*

Coordinator: Supervisor will depend on university.

Prerequisites: Minimum of 4 units, including Regression Modelling for Biostatistics 1 (or Linear Models) and Data Management & Statistical Computing

Semester availability: Semesters 1 and 2 - upon arrangement with BCA Program Coordinator at the student's home university

Unit options:

- a one-project unit - worth equivalent credit points to a single unit;

  Note that this option is not available at all BCA universities. Please check the Graduate Handbook and consult the program coordinator at your home university.

- a two-project unit – worth equivalent credit points to 2 units (generally offered as 2 separate units); and

only available at the University of Queensland:

- a four-project unit – worth equivalent credit points to 4 (BCA) units (8 UQ units)

The schedule of study for students will be determined on a case-by-case basis with the BCA Program Coordinator at the students' home university, based on student needs and goals.

Students choosing the one-project unit will need to make up credit points equal to the Masters Degree by choosing an elective.

Aim: The aim of this unit is that the student gains practical experience, usually in workplace settings, in the application of knowledge and skills learnt during the coursework of the masters program.

Content: The student will usually provide evidence of having met this goal by presenting a **portfolio** or **thesis** made up of a **preface** and **project reports**.

An outline of the options for the structure of this unit, including supervision and assessment requirements, is available here.

PLEASE NOTE

Adequate supervisory arrangements must be in place before students commence this unit. Students wishing to complete the Masters Degree should discuss options for WPP with the BCA program coordinator at their home university.

The requirements of individual universities may differ. Depending on the university, 1, 2 and 4 unit options may be available for WPP.

* Name of unit differs across universities, eg may be called ***Biostatistics Research Project***. The unit code WPP is used in BCA documentation. As is the case for all BCA units, the university unit/course/subject code will be used at respective universities. (WPP is a legacy acronym for Workplace Project Portfolio, which was the original name of the unit.)

Health Indicators and Health Surveys (HIS)

Coordinator:	A/Prof Kevin McGeechan, Sydney School of Public Health, University of Sydney
Co/prerequisite*:	Mathematical Foundations for Biostatistics (or Mathematical Background for Biostatistics)
Semester availability:	Semester 1
Time commitment:	8-12 hours total study time per week
Aim:	On completion of this unit students should be able to derive and compare population measures of mortality, illness, fertility and survival, be aware of the main sources of routinely collected health data and their advantages and disadvantages, and be able to collect primary data by a well-designed survey and analyse and interpret it appropriately.
Content:	Routinely collected health-related data; quantitative methods in demography, including standardisation and life tables; health differentials; design and analysis of population health surveys including the roles of stratification, clustering and weighting.
Assessment:	Assignments 100% (4 written assignments worth 25% each)
Prescribed texts	Paul S. Levy, Stanley Lemeshow. *Sampling of Populations: Methods and Applications.* 4th edition. Wiley Interscience 2008 For details, including ISBN, see the BCA Textbook and Software Guide
Special computer requirements:	R or Stata statistical software, and Microsoft Excel
Online resources:	Course notes, online mini-lecture videos, online tutorials, discussion board

* co-requisite, may be taken before or concurrently

Clinical Biostatistics (CLB)

Coordinators:	Dr Michael Waller School of Public Health, University of Queensland
Prerequisites:	Epidemiology, Mathematical Foundations for Biostatistics (or Mathematical Background for Biostatistics and Probability and Distribution Theory), Principles of Statistical Inference
Co-requisite*:	Design of Randomised Controlled Trials, Regression Modelling for Biostatistics 1 (or Linear Models)
Semester availability:	Semester 2
Time commitment:	8-12 hours total study time per week
Aim:	To enable students to use correctly statistical methods of particular relevance to evidence-based health care and to advise clinicians on the application of these methods and interpretation of the results.
Content:	Clinical trials (equivalence trials, cross-over trials); Clinical agreement (Bland-Altman methods, kappa statistics, intraclass correlation); Statistical process control (special and common causes of variation; quality control charts); Diagnostic tests (sensitivity, specificity, ROC curves); Meta-analysis (systematic reviews, assessing heterogeneity, publication bias, estimating effects from randomised controlled trials, diagnostic tests and observational studies).
Assessment:	Assignments 100% (3 written assignments worth 30%, 35%, 35%)
Prescribed texts:	References will be listed in the unit Study Guide
Special computer requirements:	Stata or R statistical software
Online resources:	Course notes, online mini-lecture videos, online tutorials, discussion board

* co-requisite, may be taken before or concurrently

Longitudinal & Correlated Data (LCD)

Coordinators:	Prof Lyle Gurrin, Dr John Holmes School of Population and Global Health, University of Melbourne
Prerequisites:	Epidemiology, Mathematical Foundations for Biostatistics (or Mathematical Background for Biostatistics and Probability and Distribution Theory), Principles of Statistical Inference, Regression Modeling for Biostatistics 1 (or Linear Models and Categorical Data & Generalised Linear Models)
Semester availability:	Semester 1
Time commitment:	8-12 hours total study time per week
Aim:	To enable students to apply appropriate methods to the analysis of data arising from longitudinal (repeated measures) epidemiological or clinical studies, and from studies with other forms of clustering (cluster sample surveys, cluster randomised trials, family studies) that will produce non-exchangeable outcomes.
Content:	Paired data; the effect of non-independence on comparisons within and between clusters of observations; methods for continuous outcomes: normal mixed effects (hierarchical or multilevel) models and generalised estimating equations (GEE); role and limitations of repeated measures ANOVA; methods for discrete data: GEE and generalized linear mixed models (GLMM); methods for count data.
Assessment:	Assignments 100% (two major assignments worth 30% each (8 hours) and 5 shorter assignments each worth 8%.
Prescribed texts:	Recommended – not compulsory: Fitzmaurice G, Laird N, Ware J. *Applied Longitudinal Analysis*. John Wiley and Sons, 2011. For details, including ISBN, see the BCA Textbook and Software Guide
Special computer requirements:	R or Stata statistical software
Online resources:	Course notes, online mini-lecture videos, online tutorials, discussion board

Causal Inference (CSI)

Coordinators:	Dr Jessica Kasza, Prof Andrew Forbes School of Public Health and Preventive Medicine, Monash University
Prerequisites:	Epidemiology, Mathematical Foundations for Biostatistics (or Mathematical Background for Biostatistics and Probability and Distribution Theory), Regression Modeling for Biostatistics 1 (or Linear Models) or a multivariable regression unit of study from a Master of Public Health course or equivalent
Semester availability:	Semester 2
Time commitment:	8-12 hours total study time per week
Aim:	This unit covers modern statistical methods for assessing the causal effect of a treatment or exposure from randomised or observational studies.
Content:	The unit begins by explaining the fundamental concept of counterfactual or potential outcomes and introduces causal diagrams (or directed acyclic graphs (DAGs) to visually identify confounding, selection and other biases that prevent unbiased estimation of causal effects. Key issues in defining causal effects that are able to be estimated in a range of contexts are presented using the concept of the "target trial" to clarify exactly what the analysis seeks to estimate. A range of statistical methods for analysing data to produce estimates of causal effects are then introduced. Propensity score and related methods for estimating the causal effect of a single time point exposure are presented, together with extensions to longitudinal data with multiple exposure measurements, and methods to assess whether the effect of an exposure on an outcome is mediated by one or more intermediate variables. Comparisons will be made throughout with "conventional" statistical methods. Emphasis will be placed on interpretation of results and understanding the assumptions required to allow causal conclusions. Stata and R software will be used to apply the methods to real study datasets.
Assessment:	Two major assignments worth 30% each, and 4 shorter assignments worth 10% each concerning concepts, derivations or applications.
Prescribed texts:	Hernán MA, Robins JM (2020). *Causal Inference*. Boca Raton: Chapman & Hall/CRC [but free to download (as of August 2021)] https://www.hsph.harvard.edu/miguel-hernan/causal-inference-book/] For details, including ISBN, see the BCA Textbook and Software Guide
Special computer requirements:	Stata or R statistical software
Online resources:	Course notes, online mini-lecture videos, online tutorials, discussion board

Machine Learning for Biostatistics (MLB)

Coordinators:	Prof Armando Teixeira-Pinto Sydney School of Public Health, University of Sydney
Prerequisites:	Epidemiology, Mathematical Foundations for Biostatistics (or Mathematical Background for Biostatistics and Probability and Distribution Theory), Principles of Statistical Inference, Regression Modelling for Biostatistics 1 (or Linear Models and Categorical Data & Generalised Linear Models)
Semester availability:	Semester 2
Time commitment:	8-12 hours total study time per week
Aim:	Recent years have brought a rapid growth in the amount and complexity of health data captured, requiring new statistical techniques in both predictive and descriptive learning. Machine learning algorithms for classification and prediction, complement classical statistical tools in the analysis of these data. This unit will cover modern machine learning methods particularly useful for large and complex health data.
Content:	The topics covered include: Linear Regression and K -Nearest Neighbors; Classification (logistic regression, linear discriminant analysis); Resampling Methods (Cross-Validation, Bootstrap); Model Selection and Regularization (subset selection, shrinkage methods, dimension reduction methods); Beyond Linearity (fractional polynomials, basis functions, splines, generalized additive models); Tree-Based Methods (decision trees, bagging, random forests, boosting).
Assessment:	Two major assignments worth 40% each (equivalent to 2 x 2000 words) and two short assignments worth 10% each.
Prescribed texts:	James G, Witten D, Hastie T, Tibshirani R. *An Introduction to Statistical Learning with Applications in R*. Springer, 2003. (freely available online: http://www-bcf.usc.edu/~gareth/ISL/ISLR%20Seventh%20Printing.pdf) For details, including ISBN, see the BCA Textbook and Software Guide
Special computer requirements:	R and RStudio
Online resources:	Course notes, online mini-lecture videos, online tutorials, discussion board

Bayesian Statistical Methods (BAY)

Annual availability:	BAY is delivered in alternate years. It is offered in 2022.
Coordinator:	Prof Lyle Gurrin, Dr Koen Simons Melbourne School of Population & Global Health, University of Melbourne
Prerequisites:	Epidemiology, Mathematical Foundations for Biostatistics (or Mathematical Background for Biostatistics and Probability and Distribution Theory), Principles of Statistical Inference, Regression Modeling for Biostatistics 1 (or Linear Models and Categorical Data & Generalised Linear Models)
Semester availability:	Semester 2 in year of delivery
Time commitment:	8-12 hours total study time per week
Aim:	To achieve an understanding of the logic of Bayesian statistical inference, i.e. the use of probability models to quantify uncertainty in statistical conclusions, and acquire skills to perform practical Bayesian analysis relating to health research problems.
Content:	Topics include simple one-parameter models with conjugate prior distributions; standard models containing two or more parameters, including specifics for the normal location-scale model; the role of noninformative prior distributions; the relationship between Bayesian methods and standard "classical" approaches to statistics, especially those based on likelihood methods; computational techniques for use in Bayesian analysis, especially the use of simulation from posterior distributions,; application of Bayesian methods for fitting hierarchical models to complex data structures.
Assessment:	Assignments 60% (two major assignments worth 30% each) and submission of selected practical exercises 40%
	Prescribed texts: Gelman A, Carlin JB, Stern HS, Dunson DB, Vehtari A and Rubin DB. *Bayesian Data Analysis*. 2nd edition. Chapman and Hall / CRC Press 2014 For details, including ISBN, see the BCA Textbook and Software Guide
Special computer requirements:	Microsoft Excel, Stata or R for simple calculations. R for simulations and model fitting using MCMC routines.
Online resources:	Course notes, online mini-lecture videos, online tutorials, discussion board

Statistical Genomics (SGX)

Annual availability:	SGX is delivered in alternate years. It is not available in 2022.
Coordinator:	Prof David Balding, Melbourne Integrative Genomics, School of BioSciences and School of Mathematics & Statistics, University of Melbourne
Prerequisites:	Mathematical Foundations for Biostatistics (or Mathematical Background for Biostatistics and Probability and Distribution Theory), Data Management and Statistical Computing, Principles of Statistical Inference, Regression Modeling for Biostatistics 1 (or Linear Models)
Semester availability:	Semester 2 in year of delivery
Time commitment:	8-12 hours total study time per week
Aim:	To learn about relevant biology and terminology, to understand the most important mathematical models and inference methods in statistical genetics, to be able to test for association between genetic variants and outcomes of interest, and to use genome-wide statistical models to help understand the genetic mechanisms underlying a trait and to predict outcomes.
Content:	Statistical genomics is the application of statistical methods to understand genomes, their structure, function and history, in many different scientific contexts, including understanding biological mechanisms in health and disease. Statistical genomics is characterised by large datasets, high-dimensional regression models, stochastic processes, and computationally-intensive statistical methods. We will use the statistical package R to perform regression-based analyses of genetic data.
Assessment:	Assignments 60%: three written assignments, each worth 20% and a final assignment (at-home) written examination 40%.
Prescribed texts:	Handbook of Statistical Genomics (Eds: Balding, Marioni and Moltke, 4th ed, Wiley 2019). This is an expensive reference that few will be able to buy, but online access should be available through your university library; if not, arrangements will be made. For details, including ISBN, see the BCA Textbook and Software Guide
Special computer requirements	"R" (freeware – coordinator will give instructions on how to download)
Online resources:	Course notes, online mini-lecture videos, online tutorials, discussion board. We will also use some of the 18 online lectures on Statistical Genetics offered by Henry Stewart Talks, available at https://hstalks.com/playlist/963/statistical-genetics/. Access details will be provided.