ACE Network Subject Information Guide

Mathematical Epidemiology

Semester 2, 2021

Administration and contact details

Host Department	**School of Science (Mathematical Sciences)**
Host Institution	**RMIT University**
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Subject details

Handbook entry URL	NA
Subject homepage URL	NA
Honours student hand-out URL	NA
Start date:	**Wednesday 28 July, 2021**
End date:	**Wednesday 13 October, 2021**
Contact hours per week:	**1 hour lectorial**
Lectorial day and time:	**Wednesday 11am – 1pm (TBC)**
Census date:	**17 September**
Description of electronic access arrangements for students (for example, WebCT)	**Course materials are shared via DropBox; lectorials are conducted over Zoom.**

Subject content

1. Subject content description

This course will immerse students in the epidemic theory that underpins our management of infectious diseases of humans and animals, including of course the ongoing global pandemic caused by the SARS-CoV-2 virus. The course will cover simple models for closed populations

of hosts, compartment models, multi-host pathogens, spatial dynamics, within-host dynamics and the type reproduction number.

2. Week-by-week topic overview

RMIT Week	Topics covered	Dates	Sections	Paper
1	-	19-23 July		-
2	R0; r; doubling time	26-30 July	1.1 -- 1.1.5	How will country-based mitigation measures influence the course of the COVID-19 epidemic?
3	SIR model; final size equation	2-6 Aug	1.2 -- 1.2.1	Appendices of How will country-based mitigation measures influence the course of the COVID-19 epidemic?
4	Solving the SIR model; SIR model with births and deaths; stability analysis	9-13 Aug	1.2.2 --1.2.3, 2.1--2.2.3	Key questions for modelling Covid-19 exit strategies
5	Mean age at infection; SEI model for canine rabies	16-20 Aug	2.2.4	Synchronous cycles of domestic dog rabies in sub-Saharan Africa and the impact of control efforts
6	Probability of extinction; the dispersion parameter k; heterogeneity and superspreaders	23-27 Aug	3	Superspreading and the effect of individual variation on disease emergence
Mid-Semester Break				

7	Multi-host disease systems; Next Generation Matrix	6-10 Sep	4.1--4.2	The Basic Reproduction Number for Complex Disease Systems: Defining R0 for Tick-Borne Infections
8	Type reproduction number; NGM recipe for compartment models	13-17 Sep	4.3--4.4	A new method for estimating the effort required to control an infectious disease
9	Waning immunity	20-24 Sep	None	Pertussis models to inform vaccine policy
10	Seasonality; Cyprinid Herpes Virus 3	27 Sep - 1 Oct	5.1 -- 5.2.2	An epidemiological model of koi herpesvirus (KHV) biocontrol for carp in Australia
11	Spatial spread; percolation; plague in Kazakhstan	4-8 Oct	6.1 -- 6.4.3	The two main papers on the Kazakhstan plague system - Davis et al. (2005) & Davis et al. (2008).
12	Within-host infection dynamics	11-15 Oct	Review article by Jane Hefferman.	Should we expect population thresholds for wildlife disease?

3. Assumed prerequisite knowledge and capabilities

Students will be assumed to be familiar with systems of differential equations and the techniques used to analyse their behaviour and dynamics; it is advantageous to have completed an undergraduate course in differential equations or modelling with differential equations.

It is also assumed that students are comfortable with writing/modifying code in one or more programming environments such as R or Matlab.

4. Learning outcomes and objectives

Students will acquire a working knowledge of the mathematical techniques used to generate insight into biological systems. They will gain experience in translating the known biological properties of a system into a set of mathematical equations (a model) and vice versa be able to interpret equations in terms of the biology they capture. Students will be able to use epidemiological reasoning to characterise a pathogen in terms of its basic reproduction ratio and understand the usefulness and limitations of this quantity. Students will be able to numerically solve systems of differential equations to explore their behaviour and dynamics and draw biological conclusions.

AQF specific Program Learning Outcomes and Learning Outcome Descriptors (if available):

AQF Program Learning Outcomes addressed in this subject	**Associated AQF Learning Outcome Descriptors for this subject**
Problem Solving - You will have the ability to apply knowledge and skill to characterise, analyse and solve a wide range of problems.	**S1: cognitive skills to review, analyse, consolidate and synthesise knowledge to identify and provide solutions to complex problem with intellectual independence** **S2: cognitive and technical skills to demonstrate a broad understanding of a body of knowledge and theoretical concepts with advanced understanding in some areas** **A2: to adapt knowledge and skills in diverse contexts**

Learning Outcome Descriptors at AQF Level 8

Knowledge

K1: coherent and advanced knowledge of the underlying principles and concepts in one or more disciplines

K2: knowledge of research principles and methods

Skills

S1: cognitive skills to review, analyse, consolidate and synthesise knowledge to identify and provide solutions to complex problem with intellectual independence

S2: cognitive and technical skills to demonstrate a broad understanding of a body of knowledge and theoretical concepts with advanced understanding in some areas

S3: cognitive skills to exercise critical thinking and judgement in developing new understanding

S4: technical skills to design and use in a research project

S5: communication skills to present clear and coherent exposition of knowledge and ideas to a variety of audiences

Application of Knowledge and Skills

A1: with initiative and judgement in professional practice and/or scholarship

A2: to adapt knowledge and skills in diverse contexts

A3: with responsibility and accountability for own learning and practice and in collaboration with others within broad parameters

A4: to plan and execute project work and/or a piece of research and scholarship with some independence

5. Learning resources

Lecture notes, recommended journal articles and recommended books will be made available over the course of the semester.

6. Assessment

Exam/assignment/classwork breakdown					
Exam	**40%**	**Assignment**	**20%+20%+20%**	**Class work**	**-**
Assignment due dates		**03/09/2020**	**24/09/2020**	**15/10/2020**	
Approximate exam date				**3/11/2018**	

Institution Honours program details

Weight of subject in total honours assessment at host department	**12.5%**
Thesis/subject split at host department	**37.5% thesis/62.5% course work**
Honours grade ranges at host department:	
H1	**80-100 %**
H2a	**75-79 %**
H2b	**70-74 %**
H3	**65-69 %**