Subject Information Guide

Introduction to Pure and Applied Experimental Mathematics

Semester Two, 2014

Administration and contact details

Host Department	**CARMA**
Host Institution	**University of Newcastle**
Name of lecturer	**Jonathan Borwein**
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Subject details

Handbook entry URL	Click here to enter text.
Subject homepage URL	http://www.carma.newcastle.edu.au/jon/honours10.html
Honours student hand-out URL	Click here to enter text.
Start date:	**29/07/2014**
End date:	**4/11/2014**
Contact hours per week:	**Two +**
Lecture day and time:	**Tuesday 10-12**
Description of electronic access arrangements for students (for example, WebCT)	**Dropbox and Web**

Subject content

1. Subject content description

Experimental Mathematics is the use of a computer to run computations - sometimes no more than trial-and-error tests - to look for patterns, to identify particular numbers and sequences, to gather evidence in support of specific mathematical assertions, assertions that may themselves arise by

computational means, including search. Like contemporary chemists - and before them the alchemists of old - who mix various substances together in a crucible and heat them to a high temperature to see what would happen, today's experimental mathematician puts a hopefully potent mix of numbers, formulas, and algorithms into a computer in the hope that something of interest emerges.

This course will provide a rigorous introduction to Experimental Mathematics while also exploring a variety of pure and applied mathematical topics that the student may well not have seen during an undergraduate degree.

2. Week-by-week topic overview

We will follow Chapters 1-7 of the textbook spending roughly two weeks on each:

J.M. Borwein and D.H. Bailey, **Mathematics by Experiment**: Plausible Reasoning in the 21st Century, Expanded 2nd edition, AK Peters, 2008.

3. Assumed prerequisite knowledge and capabilities

A third year course in analysis is desirable.
Some familiarity with Maple or Mathematica is useful but not essential.

4. Learning outcomes and objectives

Course Goals

The successful student will emerge from this course with much enhanced abilities to:

- Use current mathematical computation tools
- Learn mathematics independently
- Formulate and refine conjectures
- Develop strategies for proof or refutation of new mathematics

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
Insert Program Learning Outcome here	Choose from list below
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Insert Program Learning Outcome here	Choose from list below
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Insert Program Learning Outcome here	Choose from list below
Insert Program Learning Outcome here	Choose from list below
Insert Program Learning Outcome here	Choose from list below

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

Text J.M. Borwein and D.H. Bailey, **Mathematics by Experiment**: Plausible Reasoning in the 21st Century, Expanded 2nd edition, AK Peters, 2008. (PDF versions of this and related texts will be available in the course Dropbox). The website for the course is

http://www.carma.newcastle.edu.au/jon/honours14.html

6. **Assessment** There will be three graded assignments each counting for 33.333...% of the final mark. In each case you will be asked to select 12 exercises (with my approval) from chapters in the Text and produce full answers in LaTeX, Maple documents, or similar form.

   - Week 4 Assignment 1 due (Chapters 1, 2 and 3)
   - Week 9 Assignment 2 due (Chapters 4 , 5 and 6)
   - Week 14 Assignment 3 due (Chapters 7)

Exam/assignment/classwork breakdown					
Exam	Enter %	**Assignment**	Enter %	**Class work**	Enter %
Assignment due dates		Click here to enter a date.	Click here to enter a date.	Click here to enter a date.	Click here to enter a date.
Approximate exam date				Click here to enter a date.	

Institution Honours program details

Weight of subject in total honours assessment at host department	10 units from a total of 80 for the Honours year
Thesis/subject split at host department	50 units for courses and 30 units for thesis
Honours grade ranges at host department:	
H1	85-100 %
H2a	75-84 %
H2b	65-74 %
H3	50-65 %