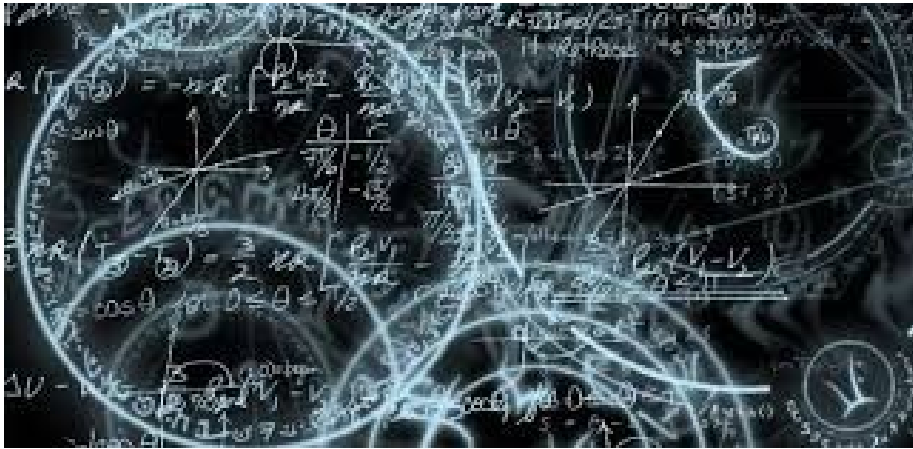


# Psychological Sciences

## PSYC40012 Models of Psychological Processes

### Subject Description 2021



This subject is designed to introduce students to the development and testing of quantitative models of psychological data. Quantitative data is a feature of all areas of psychology. Such data can only be interpreted by use of an appropriate model. Modeling in psychology has two main aims: The first is to find a quantitative description that accurately captures and expresses the underlying regularities of the data. The second is to test competing hypotheses about the psychological processes that generated the data. The methods of psychological modeling will be introduced and illustrated in selected areas of psychology.

# Models of Psychological Processes

## Lecture Program (2021)

WEEK	TOPIC AND REQUIRED READING	LECTURE	LAB CLASS	ASSESSMENT DUE DATES
1. 26 July	<b>Introduction to Computational Modeling</b> (Daniel Little)	Mon 12pm – 2pm	Wed 2.15pm-4.15pm	Homework from Lab 1 self-assessed
2. 2 August	<b>Introduction to Probability and Model Selection</b> (Daniel Little)	Mon 12pm – 2pm	Wed 2.15pm-4.15pm	Homework from Lab 2 self-assessed
3. 9 August	<b>Introduction to Concepts in Bayesian Hierarchical Modeling</b> (Daniel Little)	Mon 12pm – 2pm	Wed 2.15pm-4.15pm	Homework from Lab 3 self-assessed
4. 16 August	<b>Probability Concepts for Response Time; Models for Time-Controlled Processing</b> (Philip Smith)	Mon 12pm – 2pm	Wed 2.15pm-4.15pm	Homework from Lab 4 self-assessed
5. 23 August	<b>Models for Response Times and Accuracy: Counting Models</b> (Philip Smith)	Mon 12pm – 2pm	Wed 2.15pm-4.15pm	Homework from Lab 5 self-assessed
6. 30 August	<b>Models for Response Times and Accuracy: The Diffusion Model</b> (Philip Smith)	Mon 12pm – 2pm	Wed 2.15pm-4.15pm	Homework from Lab 6 self-assessed
7. 6 September		Mon <b>No Lecture</b>	Wed 2.15pm-4.15pm	Mid-semester test 2-hour in-class, take-away test
8. 13 September	<b>Models of Decision Making: Utility Theory and Multiattribute Decision Field Theory (MDFT)</b> (Piers Howe)	Mon 12pm – 2pm	Wed 2.15pm-4.15pm	
<b>20 September - 26 September</b> <b>Non-Teaching Week</b>				
9. 27 September	<b>Models of Decision Making: Leaky, Competing Accumulator Model (LCA)</b> (Piers Howe)	Mon 12pm – 2pm	Wed 2.15pm-4.15pm	

<b>10.</b> 4 October	<b>Models of Decision Making: Comparing MDFT to LCA (Piers Howe)</b>	Mon 12pm – 2pm	Wed 2.15pm-4.15pm	<b>Essay Assignment due Friday, 5 November</b>
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## Academic Staff

A/Prof **Daniel Little**

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Lectures weeks 1, 2, 3



**Prof. Philip Smith**

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Lectures week 4, 5, 6



A/Prof **Piers Howe**

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Lectures weeks 8, 9, 10



## Lectures

In 2021, the lectures and laboratory classes will be taught in hybrid mode, face-to-face and online, via Zoom. The lectures will be taught face-to-face in Room 1120 of Redmond-Barry Building and the laboratory classes will be taught in Room 408 of Redmond-Barry Building. The classes will be Zoom-enabled for those unable, or who do not wish to attend, face-to-face classes. In the event of further lockdowns, we will revert to pure online delivery. The lectures will occur on Mondays 12pm – 2pm. There are 18 hours of lectures (9 weeks x 2 hours per lecture per week). The lectures will run from Week 1-6 to Weeks 8-10 of semester.

## Laboratory Classes

Each laboratory class will run for two hours for a total of 18 total of 18 hours (9 weeks x 2 hours per lab per week = 18 hrs). The laboratory classes will be held in Weeks 1-6 and Weeks 8-10 of semester.

**There will be a two-hour test scheduled during the Week 7 laboratory class period.** The test will open at 2.15 pm on the Wednesday, with supervised assistance for the two hours of the class. You may complete the test overnight if you wish. The final submission time will be 9 am on the following Thursday morning.

## Assessment

- Weekly self-assessed homework assignments based on the in-class lab exercises (weeks 1-6). These assignments are self-assessed but it is essential for your learning to complete them diligently.
- Two-hour, in-class/take-home test, scheduled during the laboratory class of Week 7 (40% of the final grade). It is expected that you will be able to complete the test comfortably during the laboratory class, and there will staff on hand to assist you during this time, but the **final submission time is 9 am the following day**. The purpose of the 9 am submission deadline is because we want this assessment to be a test of understanding, not of speed.
- One essay of 2,000 words (60% of final grade)

Attendance of at least 80% of the laboratory/tutorial classes is a hurdle requirement. In the case of failure to meet the hurdle requirement, additional work will be required before a passing grade can be awarded.

## **Laboratory Assignments**

The course includes weekly laboratory exercises based on materials covered in the laboratory classes. These are self-assessed but it is essential for your learning for you to complete them diligently because of the cumulative, skill-building nature of the course.

## **Essay**

The other assessment for this course is a 2,000 word essay based on the lecture and laboratory exercises from weeks 8-10. The essay should be handed in via LMS TurnItIn by 8:00 AM on Friday, 5 November, 2021. Late essays will incur penalties. Your assignments will be returned to you after approximately 3 weeks.

## **Course Website**

The Learning Management System (Canvas) course website contains a wealth of information including: a description of the course, copies of the lecturers' slides, the readings, assignments, a discussion forum, and the MATLAB tutorial videos.

## **MATLAB Tutorial Videos**

The lab classes for this class all utilize the programming software package MATLAB (or you may also use its open-sourced sibling Octave). MATLAB is proprietary software but may be downloaded to your own computer if you are an enrolled student at the University of Melbourne. It is also available remotely through the MyUnApps website. The University IT help pages will give you information on accessing MATLAB. Octave is a Matlab work-alike language, but its user interface is a bit different. You can find out about how to download and install Octave for Windows/MacOS/Windows at <https://www.gnu.org/software/octave/>

Although, we will assume no experience in programming with MATLAB, the lab classes will assume that you have watched the five introductory MATLAB tutorial videos which have been uploaded to LMS. Each video contains a short 10-15 minute introduction on a different MATLAB concept, a "cheat-sheet" which is the transcription of the video along with some helpful tips, and some review questions which you can do to make sure you understand the content of the video. Interactive versions of the video are also made available but may not work on all browsers. These videos provide some additional tips and in-video test questions for enhanced learning.

*Personal testimonial from Dan Little: Of the few skills acquired during honours, learning MATLAB has served me more than any of the others. Consequently, I would implore you to watch the videos and experiment with MATLAB before the first lab class.*

## **Questions**

General questions about course administration and course content should be placed on the LMS Discussion forum. The lecturers and coordinator will monitor the discussion board and answer questions as needed. If a question posted on the Discussion board has not been answered within 24 hours, you may email the appropriate lecturer to draw his/her attention to this. As a matter of fairness, the lecturers are requested not to answer individual emails from students but rather to place comments/answers on the Discussion board so that all students receive the same information. Before posting a question on the Discussion board, please check that it has not already been answered in this document or on the course website. Other specific questions should be addressed to the course coordinator.

## **Penalty For Late Work**

Work submitted after the due date and without an approved extension will be penalized. Please see the 4th year manual for further details.

## **Extensions**

As you are given the submission dates for assignments well in advance, extensions will only be granted in exceptional circumstances. We expect students to arrange their schedules to allow for any minor illness, computer problems, heavy workloads, transport problems, etc. Written proof of the difficulty will usually be required (e.g., a letter from a GP or statutory declaration). Extensions are not normally given for periods greater than one week. Extensions must be applied for online. Please see the 4th year manual for further details.

## **Other Information**

Other information regarding a variety of topics such as enrolment changes, subject evaluations, plagiarism, special consideration, private tutoring etc. can be found on the relevant sections of the department's website:

<http://psychologicalsciences.unimelb.edu.au/study/fourth-year-honours>

## Readings

Most readings are available on the course website in the “Readings” folder on the left toolbar or in the library. If you have problems opening any of the pdf’s please download the latest version of Adobe Reader (for free) from this website:

<http://get.adobe.com/reader/>

**There is no prescribed text for this course. However, the following texts may be useful**

- Busemeyer, J. R. & Diederich, A. (2010). *Cognitive Modeling*. Thousand Oaks, CA: Sage.
- Lewandowsky, S. & Farrell, S. (2011). *Computational Modeling in Cognition: Principles and Practice*. Thousand Oaks, CA: Sage.

### **Dr. Daniel Little: Introduction to Modeling**

#### ***Lecture 1: Introduction to Quantitative Psychology and Computational Modelling***

- Lewandowsky, S. & Farrell, S. (2011). *Computational Modeling in Cognition: Principles and Practice*. Thousand Oaks, CA: Sage.  
Chapter 1: Introduction.

*Specific Examples used in this lecture: Generalized Context Model*

- Nosofsky, R. M. (1986). Attention, similarity, and the identification-categorization relationship. *Journal of Experimental Psychology: General*, *115*(1), 39-57.
- Nosofsky, R. M. (2011). The generalized context model: An exemplar model of classification. In E.M. Pothos and A. J. Wills (Eds.) *Formal Approaches in Categorization* (pp. 18-39). Cambridge: Cambridge University Press.

#### ***Laboratory 1: Introduction to MATLAB***

- Lewandowsky, S. & Farrell, S. (2011). *Computational Modeling in Cognition: Principles and Practice*. Thousand Oaks, CA: Sage.  
Chapter 2: From Words to Models
- Lewandowsky, S. & Farrell, S. (2011). *Computational Modeling in Cognition: Principles and Practice*. Thousand Oaks, CA: Sage.  
Chapter 3: Parameter Estimation



- Nosofsky, R. M. (1984). Choice, similarity, and the context theory of classification. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 10(1), 104-114.

### **Lecture 2: Introduction to Probability and Model Selection**

- \* Kruschke, J. K. (2010). Chapter 2: Models we believe in. In *Doing Bayesian Data Analysis: A Tutorial with R and BUGS*. (pp. 9-14).
- \* Kruschke, J. K. (2010). Chapter 3: What is this stuff called probability? In *Doing Bayesian Data Analysis: A Tutorial with R and BUGS*. (pp. 21-39).

\* Note that the last section of these chapters is on the [R] language. You can ignore that since we are using MATLAB instead.

### **Laboratory 2: Model Selection using MATLAB**

- Myung, J. & Pitt, M. A. (2004). Model comparison methods. In L. Brand and M. L. Johnson (Eds.). *Numerical Computer Methods*.

### **Lecture 3: Bayesian Hierarchical Modelling**

- Lee, M. D. & Wagenmakers, E-J. Chapter 1: Bayesian Basics. In *Bayesian Cognitive Modeling: A Practical Course*. (pp. 3-13).
- Lee, M. D. & Wagenmakers, E-J. Chapter 3: Inferences with Binomials. In *Bayesian Cognitive Modeling: A Practical Course*. (pp. 37-49).

### **Lab 3: Implementing a Bayesian Model in MATLAB**

- Vanpaemel, W. (2009). BayesGCM: Software for Bayesian inference with the Generalized Context Model. *Behavior Research Methods*, 41, 1111-1120.
- Vanpaemel, W. & Lee, M. D. (2009). *Using priors to formalize theory: Attention and the Generalized Context Model*.
- Lee, M. D. & Wagenmakers, E-J. Chapter 17: The Generalized Context Model. In *Bayesian Cognitive Modeling: A Practical Course*. (pp. 212-218).

### **Prof. Philip Smith: Introduction to Models of Response Time**

### **Week 4. Probability Concepts for Response Time Models / Time Controlled Processing**

- Carrasco, M., & McElree, B. (2001). Covert attention accelerates the speed of information processing. *Proceedings of the National Academy of Sciences*, 98, 5364-5367.

- Doshier, B. A. (1979). Empirical approaches to information processing: Speed-accuracy tradeoff functions or reaction time – A reply. *Acta Psychologica*, 347-359.
- Syski, R. (1979) Easy life and good times, from *Random Processes: A First Look* (chap. 1). Marcel Dekker. (Also available as a preview on Google books)

### **Week 5: Models for Response Times and Accuracy: Counting Models**

- Townsend, J. T., & Ashby, F. G. (1983). Stochastic modeling of elementary psychological processes (Counting models, pp. 272-280).
- Van Zandt, T., Colonius, H., & Proctor, R. A comparison of two alternative response time models applied to perceptual matching. *Psychonomic Bulletin & Review*, 7, 208-256.
- Van Zandt, T. How to fit a response time distribution. *Psychonomic Bulletin & Review*, 7, 425-465.

### **Week 6: Models for Response Times and Accuracy: The Diffusion Model**

- Ratcliff, R. , & Smith, P. L. (2004). A comparison of sequential sampling models for two-choice reaction time *Psychological Review*, 111, 333-367.
- Ratcliff, R., & McKoon. G. (2008). The diffusion decision model: Theory and data for two-choice decision tasks. *Neural Computation*, 20, 873-922.
- Smith, P. L., & Ratcliff, R. (2015). An introduction to the diffusion model of decision-making. In E. J. Wagenmakers and B. U. Forstmann (Eds.) *An introduction to model-based cognitive neuroscience* (Chapter 3). Springer.

### **Dr. Piers Howe: Introduction to Models of Decision Making**

#### **Week 8: Utility Theory**

- Berger, J. O. (2006). *Statistical Decision Theory and Bayesian Analysis*. New York: Springer. [Chapter 2: Utility and Loss, p. 46-73].
- Roe, R. M., Busemeyer, J. R. and Townsend, J. T. (2001). Multialternative decision field theory: A dynamic connectionist model of decision making. *Psychological Review*, 108, 370-392.

#### **Week 9: Leaky, Competing Accumulator Model (LCA)**

- Usher, M. & McClelland, J. L. (2004). Loss aversion and inhibition in dynamical models of multi-alternative choice. *Psychological Review*, *111*, 757-769

**Week 10: Comparing MDFT to LCA**

- Tsetsos, K., Usher, M. & Chater, N. (2010). Preference reversals in multiattribute choice. *Psychological Review*, *117*, 1275-1293.