P648 Choice Behavior

Choice is the behavioral interface between the brain and the environment, and consequently, understanding this basic process is fundamental to all fields of human activity. This course will begin with what is considered the optimal way of making choices – expected utility theory -- which prescribes how to combine beliefs with values. The synthesis of expected utility with Bayesian inference produces the well known signal detection model of decision making. However, the signal detection model is a static model, and its dynamic extension is known as the random walk or diffusion model of decision making. Random walk/diffusion models have been used to model decisions ranging from sensation, perception, memory, categorization, and even consumer preferences. Artificial neural network models of choice can be viewed as nonlinear extensions of diffusion models. Finally this course will briefly examine a new theory of choice based on quantum probability principles. This course will link together all of these theories, describe how to use these models to explain data, and review empirical for and against these theories.

This will be an in-person class for Fall 2021.

Instructor:

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Book: Cognitive Choice Modeling (MIT press)

Office Hours: Tue, Thur 2:30 to 3:15 pm or appointment

Teaching Method

For most classes I will lecture from notes that are available on the web from my home page. Readings listed below are assigned and sometimes the class will discuss them, so be prepared for discussion for the articles that contain a star*. On several classes, each class member will present a preliminary report on progress toward the final project. This will be a power point presentation for about 10 minutes each.

Grading Policy:

Grades will be based on classroom participation during discussions of readings (25%), presentations of projects in class (25%), and your score on your final project (50%). The final project requires you to write an NSF type proposal for research on a topic of your interest that concerns choice behavior. An NSF proposal is 15 pages maximum and it usually contains an introduction that briefly states the issue and the research strategy,

followed by a background review of literature, and finally followed by a description of the proposed research. The proposed research may be to formulate new theory and apply it to some existing data sets, or test and compare competing theories using new experiments.

Topics

0. Introduction to cognitive modeling of choice

*Chapter 1,2 *Cognitive Choice Modeling*

8-24 Introduction and Overview of Field

1. Deterministic Utility Theories

*Tversky, A. & Kahneman, D. (1981) The framing of decisions and the psychology of choice. *Science, 211*, 453- 458.

Tversky, A., & Kahneman, D. (1992). Advances in Prospect Theory: Cumulative Representations of Uncertainty. *Journal of Risk and Uncertainty, 5*, 297-323.

Birnbaum, M. (2008). New paradoxes of risky decision-making. *Psychological Review, 115*, 463-500.

8-26 Lecture 1 on utility theory
8 -31 Lecture 2 on utility theory
9- 2 Class discussion of readings.

2. Probabilistic Utility Theories

Chapters 3,4 *Cognitive Choice Modeling* Book

*Rieskamp, J., Busemeyer, J. R., & Mellers, B. A. (2004) Extending the bounds of rationality : A review of research on preferential choice. *Journal of Economic Literature, 44,* 631-661.

9-7 Mathematical Preliminaries
9-9 Lecture 1 on random utility
9-14 Lecture 2 on random utility
9-16 Model Fitting and estimation
Claudia Program

3. Heuristic Choice Theories

Tversky, A. (1969) Intransitivity of preferences. *Psychological Review, 76* (1), 31-48. Pdf

*Tversky, A. (1972). Elimination by aspects: A theory of choice. *Psychological Review, 79* (4), 281-299. Pdf

Payne, J., Bettman, J. R., & Johnson, E. J. (1988). Adaptive strategy selection in decision making. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 14*, 534-552.

*Brandstatter, E., Gigerenzer, G., & Hertwig, R. (2006). The priority heuristic: Choices without tradeoffs. *Psychological Review, 113,* 409–432.

Rieskamp, J. (2008). The probabilistic nature of preferential choice. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 34*, 1446-1465. pdf

9-21 Multi-alternative choice
9-23 Heuristic Choice models 1
9-28 Heuristic Choice models 2
9-30 Discussion of readings on random utility and heuristic choice

4. Signal Detection Theories

Chapter 5 *Cognitive Choice Modeling* Book

Ashby, G. F. & Soto, F. A. (2015) Multidimensional signal detection theory. Oxford Handbook of Computational and Mathematical Psychology. Ch 2.

Ashby, F. G., & Townsend, J. T. (1986). Varieties of perceptual independence. *Psychological Review, 93,* 154-179. [PDF]

10-5 Signal Detection theory 1
10-7 Signal Detection theor 2

10 8 fall break
10 10 fall break

5. Random Walk Theory

*Chapter 6 *Cognitive Choice Modeling* Book

https://jbusemey.pages.iu.edu/P648/P648ChoiceBehavior.pdf
also Chapter4A.pdf

10-12 Random Walk Theory 1
10-14 Random Walk Theory 2

6. Diffusion Models

*Ratcliff, R., Smith, P. L., Brown, S. D., & McKoon, G. (2016). Diffusion decision model: Current issues and history. Trends in cognitive sciences, 20(4), 260-281. https://www.sciencedirect.com/science/article/pii/S1364661316000255

Pleskac, T. J., & Busemeyer, J. R. (2010). Two-stage dynamic signal detection: A theory of choice, decision time, and confidence. *Psychological Review*, *117,* 864-901. PMID: 20658856

10-19 Program for fitting diffusion model
10-21 Discussion of Signal Detection and Random Walk theories

7. Computational Models of Choice

Chapter 7,8 *Cognitive Choice Modeling* Book

*Busemeyer, J. R. & Johnson, J. G. (2004) Computational models of decision making. In D. Koehler & N. Harvey (Eds.) *Handbook of Judgment and Decision Making*. Oxford: UK: Blackwell Publishing Co. Ch. 7, Pp 133-154.

* Busemeyer, J., & Townsend, J. T. (1993). Decision Field Theory: A dynamic cognitive approach to decision making. *Psychological Review, 100*, 432-459.

Roe, R. M., Busemeyer, J. R., & Townsend, J. T. (2001). Multi-alternative decision field theory: A dynamic artificial neural network model of decision-making. *Psychological Review, 108*, 370-392.

Usher & McClelland Usher, M. & McClelland, J. L. (2004). Decisions, decisions: Loss aversion, information leakage, and inhibition in multi-attribute choice situations. *Psychological Review, 111*, 757 – 769.

Krajbich, I., Lu, D., Camerer, C., & Rangel, A. (2012). The attentional drift-diffusion model extends to simple purchasing decisions. Frontiers in psychology, 3.

http://authors.library.caltech.edu/32054/1/fpsyg-03-00193.pdf

Trueblood, J. S., Brown, S. D., & Heathcote, A. (2014). The multiattribute linear ballistic accumulator model of context effects in multialternative choice. Psychological review, 121(2), 179.

Bhatia, S. (2013). Associations and the accumulation of preference. Psychological review, 120(3), 522.

10- 26 Decision field theory 1
10 - 28 Decision field theory 2
11- 2 Leaky accumulator and others.

8. Decisions from experience

Chapter 9 Cognitive Choice Modeling Book

Hertwig, R., Baron, G., Weber, E. U., Erev, I. (2004) Decisions from experience and the effects of rare events in risky choices. *Psychological Science, 15,* 534-539

*Hertwig, R. & Erev, I. (2009) The description experience gap in risk choice. *Trends in Cognitive Science*, 13.12, 517-523. PDF

*Jessup, R. K., Bishara, A. , & Busemeyer, J. R. (2008). Feedback produces divergence from prospect theory in descriptive choice. *Psychological Science*, *19*, 1015-1022.

*Yehiam, E., & Busemeyer
, J. R., Stout, J. C., & Bechara, A. (2005) Using cognitive models to map relations between neuropsychological disorders and human decision making deficits. *Psychological Science*, *16 (12),* 973-978.

11-4 Experience based decisions
11-9 Discussion of experience versus description

11-11 Present initial ideas for final project

9. Neural Models of Choice

Chapter 10 *Cognitive Choice Modeling* Book

Schall, J. D. (2001) Neural basis of deciding, choosing and acting. *Nature Neuroscience Reviews, 2*, 33-42.

*Smith, P.L., & Ratcliff, R. (2004). Psychology and neurobiology of simple decisions. *Trends in Neuroscience*, *27*, 161-168.

Shadlen, M. N. & Kiani, R. (2013) Decision making as a window on Cognition. Neuron, 80,791-806.
https://www.shadlenlab.columbia.edu/publications/publications/mike/Shadlen_Decision Making2013.pdf

11-16 Discussion of neural models.

10. A Quantum Choice Model

Chapter 11,12 Cognitive Choice Modeling Book

Quantum Cognition web site
http://mypage.iu.edu/~jbusemey/quantum/Quantum%20Cognition%20Notes.htm
Trends in Cognitive Science Article 2015

11- 18 Quantum choice models
11- 30 Quantum choice models

12-2 Discussion and problem solving

12-7 Presentation of Final Project
12 -9 Presentation of Final Project

Final Project Due on Dec 17 by 5 pm, emailed to me