EAB 6750: Quantitative Methods

General

Hall: PSY

Room: 129

Tue: *Period 8 – 9 (3:00 PM – 4:55 PM)

Instructor

Dr. Jesse Dallery

Room 92, Psychology

Office Hours: by appt.

Email: dallery@ufl.edu

Phone: 273-2182

*Note: This is not what appears in One UF. One UF specifies Periods 7-9. The correct periods are 8-9.

Overview

One goal of a science of behavior is to discover invariance, or regularity in nature. As defined by the mathematician E. T. Bell, "invariance is changelessness in the midst of change, permanence in a world of flux, the persistence of configurations that remain the same despite the swirl and stress of countless transformations."

This course will introduce statistical and quantitative techniques in single-case research. These techniques attempt to detect and describe - amidst the flux - regularities in nature, whether treatment effects or physical processes. Among other questions, we will ask: What are the strengths and limitations of our approaches? How can we improve our detection techniques? What are contemporary mathematical models of operant behavior? How do we evaluate these models? Why are they important? Skinner provided the beginning of an answer to the last question:

Beyond the collection of uniform relationships lies the need for a formal representation of the data reduced to a minimal number of terms. A theoretical construction may yield greater generality than any assemblage of facts... It will not stand in the way of our search for functional relations because it will arise only after relevant variables have been found and studied. Though it may be difficult to understand, it will not be easily misunderstood…" (Skinner, 1950/1972, p. 100).

Skinner's assessment of theory, however, was tempered by an emphatic recommendation that we must first establish an experimental analysis of how relevant variables affect behavior (Skinner, 1950/1972). In the case of a quantitative theory, for instance, the progression from experimental analysis to theory should increase the likelihood that the theory's parameters reflect the operation of definite variables and processes, rather than simply being "arbitrary constants." Of course, a progression from theory to further experimental analysis may also reveal novel functional relations and behavioral processes. Regardless of the sequence, quantitative theory may increase the generality and precision of our understanding of environment-behavior relations. Just as the universal law of gravitation yields considerable predictive and practical advantages over the statement that objects fall when dropped, a quantitative theory of behavior can move us beyond the statement that operant responding increases when reinforced (or any similar "assemblage of facts"). In short, a quantitative theory should improve our ability to predict and influence behavior, which is a hallmark of behavior-analytic science.

As we progress through quantitative methods, which will be applicable to a wide variety of biological and behavioral systems, we will also explore several models of operant behavior. These models will provide some theoretical content, some backbone, as we tackle some techniques to analyze them.

If you do not have a background in basic EAB, this course will be challenging. Please note that if you are not a student in the Behavior Analysis Program, we will need to discuss your enrollment in the course.

I have also selected readings to broaden your scholarly repertoires with respect to statistics, statistical thinking, and especially null hypothesis significance testing. The focus will be on thinking about statistics as opposed to calculating statistics.

The course will involve lecture, small group activities, discussion, and several hands-on assignments. We will make extensive use of Microsoft Excel for graphing, and statistical and quantitative analysis.

Readings

The required text is Intuitive Biostatistics, Fourth Edition by Harvey Motulsky. It is available at the bookstore and online. I am also recommending: Fitting models to biological data using linear and nonlinear regression (by Motulsky and Christopoulis). A pdf of the Fitting models book will be available in Canvas. You should also consider purchasing the book, particularly if you will be doing curve fitting and other quantitative techniques. Other readings will be available in Canvas.

I expect you to read the chapters and articles carefully. Write down any questions you have about the readings. Some of the material will be difficult, so take your time, re-read, and use me as a resource (e.g., email me if you have questions as you are reading).

Grading

Exams: There will be two exams, each worth 100 pts. I will provide a study guide for each test.

Class engagement: Class participation will be worth 50 points. I will use several sources to generate this grade – your general involvement in class, whether you can answer questions about the readings when asked in class, whether I see evidence of engagement or evidence of avoidance, etc.

Category	Points	Grade	Percentage
		A	93-100
Exams	200	A-	90-93
		B+	87-90
Engagement	50	B	83-87
		B-	80-83
Total Points	250	C+	77-80

Note: This syllabus is subject to change. Changes will be announced in class and an updated syllabus will be available on the web site.

Jan 8

Introduction and Overview

Jan 15

Introduction to quantitative methods: Matching theory and delay discounting

- Dallery, J. & Soto, P. (2013). Quantitative description of environment-behavior relations. Read pages 1-30.
- Motulsky 33

Recommended

- M&C Chapters A and B (Fitting data with nonlinear regression, Linear regression).
- McDowell, J. J (1989). Two modern developments in matching theory. *The Behavior Analyst*, 12, 153-166.
- Fisher, W. W., & Mazur, J. E. (1997). Basic and applied research on choice responding. *Journal of Applied Behavior Analysis*, 30, 387-410
- Shull, R. L. (1991). Mathematical description of operant behavior: an introduction. In I. H. Iversen & K. A. Lattal (Eds.), Experimental

Analysis of Behavior (Vol. 2, pp. 243-282). New York: Elsevier. (Call#: BF 319.5.O6 E97 1991).

Translating quantitative models of choice: Matching theory and delay discounting

- Critchfield, T. S. (2009). What are we doing when we translate from quantitative models? The Behavior Analyst.
- Motulsky 34

Recommended

Jan 22

- Jacobs, E. A., Borrero, J. C., Vollmer, T. R. (in press). Translational Applications of Quantitative Choice Models
- Critchfield, T. S., & Kollins, S. H. (2001). Temporal discounting: Basic research and the analysis of socially important behavior. *Journal of Applied Behavior Analysis*, 34, 101-122.
- Rachlin, H. (2006). Notes on discounting. *Journal of the Experimental Analysis of Behavior*, 85, 425- 435.

Behavioral economics

- Hursh, S. R., Madden, G. J., Spiga, R., DeLeon, I., Francisco, M. T. The translational utility of behavioral economics: The experimental analysis of consumption and choice.

Recommended

Jan 29

- Francisco, Monica T.; Madden, Gregory J.; Borrero, John. Behavioral economics: (2009). Principles, procedures, and utility for applied behavior analysis. The Behavior Analyst Today, Vol 10(2). Special issue: Bridge studies. pp. 277-294.
- Hursh, Steven R.; Silberberg, Alan (2008). Economic demand and essential value. Psychological Review, Vol 115(1), pp. 186-198.

Feb 5 **Behavioral Momentum**

	• Greer, B. D., Fisher, W. W., Romani, P. W., Saini, V. (2016). Behavioral Momentum Theory: A tutorial on response persistence. The Behavior Analyst, 39, 269-291. Recommended • Nevin, J. A., Grace, R. Behavioral momentum and the law of effect. Behavioural and Brain Sciences
Feb 12	**Models of choice** • Dallery & Soto. Pages 30-39. • Mazur, J. E. (2006). Mathematical models and the experimental analysis of behavior. *Journal of the Experimental Analysis of Behavior,* 85, 275-291 Recommended • McDowell, J. J (2005). On the classic and modern theories of matching. JEAB.
Feb 19	**Models of choice** • Mazur, J. E. (2001). Hyperbolic value addition and general models of animal choice. *Psychological Review*, 108, 96-112.
Feb 26	**Exam 1**
Mar 12	**Statistical thinking** • Motulsky 1, 2, 10, 11, 12, 14, Appendix E • Hasley et al. (2015). The fickle P value generates irreproducible results. Nature Methods 12, 179–185 Recommended:

- Cumming, G. (2008) Replication and p intervals: p values predict the future only vaguely, but confidence intervals to much better. Perspectives on Psychological Science, 3, 286-300

Mar 19

Interpreting *p* values

- Motulsky 15, 16, 17, 18
- Branch, M. (2014). Malignant side-effects of null-hypothesis significance testing. *Theory and Psychology*.

Recommended

- Ioannidis, J. P. A.. (2005). Why Most Published Research Findings Are False. PLoS Medicine.
- Leland Wilkinson and the Task Force on Statistical Inference (1999). Statistical Methods in Psychology Journals: Guidelines and Explanations. *The American Psychologist.*
- Cohen, J. (1994). The earth is round (p < .05). American Psychologist, 49, 997–1003.

Mar 26

Analysis of single-case data

- Parker, R. I., Vammest. K. J. (2011). Bottom-Up Analysis of Single-Case Research Designs. *Journal of Behavioral Education*.
- Shadish, W. R. (2014). Statistical Analyses of Single-Case Designs: The Shape of Things to Come. *Current Directions in Psychological Science,* 23: 139

Recommended

- Richard I. Parker, Daniel F. Brossart, and Kimberly J. Vannest (2005). Effect Sizes in Single Case Research: How Large is Large? *School Psychology Review.*
- Parker, R. I., Vannest, K. J., & Davis, J. L. (2011). Effect size in single-case research: A review of nine nonoverlap techniques. *Behavior Modification,* 35, 03–322. doi:10.1177/ 0145445511399147
- Shadish, W. R., Hedges, L. V., Pustejovsky, J. E., Boyajian, J. G., Sullivan, K. J., Andrade, A., & Barrientos, J. L. (2013). A d-statistic for single-case designs that is equivalent to the usual between-groups d-statistic. Neuropsychological *Rehabilitation*. Advance online publication. doi:10.1080/09602011.2013.819021

Apr 2	**Analysis of single-case data** • Fisher, Kelly, & Lomas. (2003). Visual aids and structured criteria for improving visual inspection and interpretation of single-case designs. *JABA*. • Ratio effect size? Recommended • Parsonson, B. S., & Baer, D. M. The visual analysis of data, and current research into the stimuli controlling it.
Apr 9	**Power analysis** • Kyonka, E. G. E. (2018). Tutorial: Small-N power analysis. Perspectives in Behavior Science. Recommended • Prajapati, Dunne, &Armstrong (2017). Sample size estimation and statistical power analysis. Optometry Today.
Apr 16	**Meta-analysis** • Sham & Smith (2014). Publication bias in studies of an applied behavior-analytic intervention: An initial analysis. JABA. • Motulsky 44 Recommended • Shadish, W. R., Zelinsky, N. A. M., Vevea, J. L. and Kratochwill, T. R. (2016), A survey of publication practices of single-case design researchers when treatments have small or large effects. Jnl of Applied Behav Analysis. doi:10.1002/jaba.308
Apr 23	Choosing statistical tests • Motulsky: 41, 44, 45, 46 Recommended

- Loftus, G. R. (1996) Psychology will be a much better science when we change the way we analyze data. Current Directions in Psychological Science, 5, 161-171.