אוניברסיטת בן-גוריון בנגב

Ben-Gurion University of the Negev
Cognitive Psychology
Brain and Cognition
Advanced Topics in Cognitive Psychology
2017-2018

101-2-0022 First Semester Prof. Nachshon Meiran

101-2-0032 Second Semester Dr. Tal Eyal

Important comment #1: The methods that will be taught in the course will be practiced using the R language. Students will need to acquire (quite minimal) mastery of the language.

Important comment #2: If there will be a foreign student in the class, the classes will be given in English (though students can ask questions in Hebrew, and can write their tests and assignment in Hebrew).

The goals of the course is to present students with advances topics in cognitive psychology. These include substantial issues currently studied by BGU researchers who will present their most recent works in guest lectures. These lectures will be accompanied by reading material. Aside from these, the course will introduce students to methods, concepts and unique methodologies needed for high quality cognitive research. These methodologies deal primarily with reaction times, error rates, and their interplay.

Course assignments include two exams (35%, each), each given at the end of its respective semester, covering both the methodologies studied during that semester as well as the guest lectures (and accompanying material). In addition, students will hand the methods assignments specified at the bottom of the syllabus (30%). The integrated mark across the full year is the course mark that tells if you passed the course. This means that failure in an exam, for example, does not necessarily imply failing the course.

The methodological topics include:

Accuracy and response quality:

1. Assessing the probability of success of a cognitive process using multinomial processing tree models (including an introduction to modeling, in general).
2. Signal-detection models

Reaction times:

1. Statistical power considerations when choosing to use mathematical transformations or trimming of outliers.
2. Qualitative estimates: Vincentizing and Delta-Plots
3. Using ex-Gaussian distribution fitting for model based exploration of the RT distribution

4. Studying cognitive architecture using additive factors methodology and Systems Factorial Technology

Relationship between speed and accuracy

1. Speed-accuracy tradeoff
2. Modeling the decision process using evidence-accumulation modeling
3. Comparing between populations (no assignment given)
    1. Considerations for studying differences between populations
    2. Psychometric reliability of process estimates

The timetable for the guest lectures will be posted on the moodle website after their coordination

Methodology assignments:
Within 3 weeks after completing studying a given methodology, students will submit their assignments via email (details will be provided in the web site)
Each assignment will include a very brief background/theory introduction, brief description of the experiment, the analysis and its results, and the R-code used for the analysis.

INSTRUCTIONS FOR SOFTWARE INSTALLATION (TO BE DONE BEFORE THE COURSE!)

You need to install R, R-Studio and the required packages:
R
https://www.r-project.org/

R-Studio
https://www.rstudio.com/products/rstudio/download2/

and the RSCOREPLUS software for SDT analysis (unfortunately, it is still better than the existing R-packages)

http://psych.colorado.edu/~lharvey/html/software.html

You also need to gain some familiarity with R. There is a variety of relatively easy and accessible R training software, but you may simply use the R-Package "swirl", which teaches you R in R.

To do that, open R-Studio as an administrator (right click on the r-studio icon, choose "run as administrator" and say yes to the questions that follow)
and in the console do that:

>Install.packages("swirl") <PRESS ENTER>
>swirl <PRESS ENTER>

And then just follow the tutorial

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Assignments

Assignments include (students are STRONGLY encouraged to analyze their own data, but this is NOT a requirement): (5 points each, except for #2, which is 4 points)

1. Multinomial Processing Tree Models: Describe the experiment, the processing model (including (a) graphic description, (b) equations, and (c) theoretical justification), the modelling results including model selection, and conclusions. If you do not have data, you can either find data or even generate fictitious data.
2. Signal-Detection Theory analysis using the RSCOREPLUS program. If you do not have data, you can either find data or even generate fictitious data.
3. Analyze one of the effects of a reaction-time experiment including (a) a figure presenting the F-value (or t-value) as a function of trimming method and transformation. Vincentize + Delta-Plot the effect, and, based on equivalent analyses of mean RT and errors, assess whether speed-accuracy tradeoff exists for your effect.
4. Take a reaction-time experiment with sufficient (>80) trials per condition, model the RT distributions for each subject x condition using the ex-Gaussian model. Present the QQ-Plot and analyze the ex-Gaussian parameters using a series of ANOVAs.
5. Plan in detail an additive-factors experiment used to address a question concerning cognitive architecture (e.g., which processing stage is involved in a given effect?)
6. (a) Plan in detail an experiment using SFT (SIC, mainly) in order to address a cognitive-architecture question (such as serial vs. parallel, etc.). (b) Analyze existing RT data with a SIC plot and draw conclusions (check whether the assumptions are met using selective-influence tests).
7. Model RT and accuracy results with an evidence accumulation model, interpret the results and assess model fit.

Background bibliography (the material will be presented in class)

Marks: 33 points in each of the semesterial exams, and 34 points for the 7 assignments

1. **AS GENERAL BACKGROUND**: Jeff Rouder's Process Models Book http://pcl.missouri.edu/jeff/sites/pcl.missouri.edu.jeff/files/b1_0.pdf

2. Riefer, D. M. & Bachelder, W. H. (1988). Mutinomial modeling and the measurement of cognitive processes. *Psychological Review, 95,* 318-119.
3. Macmillan, N., A., & Creelman, C. D. (1991). *Detection theory: A user's guide.* New York, NY, US: Cambridge University Press.
4. Ratcliff, R. (1993). Methods for dealing with reaction time outliers. *Psychological Bulletin, 114,* 510-532.
5. Ratcliff, R. (1979). Group reaction time distributions and an analysis of distribution statistics. *Psychological Bulletin*, *86*, 446-461. (Vincentizing)
6. Sternberg, S. (1969). The discovery of processing stages: Extensions of Donder's method. *Acta Psychologica, 30,* 276-315. (Additive Factors)

7. Townsend, J. T. & Nozawa, G. (1995). Spatio-temporal properties of elementary perception: An investigation of parallel, serial and coactive theories. *Journal of Mathematical Psychology, 39,* 321-360. (Systems Factorial Technology)
8. Miller, J. O. (1982). Divided attention: Evidence for coactivation with redundant signals. *Cognitive Psychology, 14,* 247-279. (Miller's inequality)
9. Balota, D. A., & Yap, M. J. (2011). Moving beyond the mean in studies of mental chronometry the power of response time distributional analyses. *Current Directions in Psychological Science, 20*, 160–166. doi:10.1177/0963721411408885 (ex-Gaussian RT model)
10. Ratcliff, R., Smith, P. L., Brown, S. D., & McKoon, G. (2016). Diffusion decision model: Current issues and history. *Trends in Cognitive Sciences*, *20*, 260–281. http://doi.org/10.1016/j.tics.2016.01.007
11. Brown, S. D., & Heathcote, A. (2008). The simplest complete model of choice response time: Linear ballistic accumulation. *Cognitive Psychology*, *57*, 153–178. http://doi.org/10.1016/j.cogpsych.2007.12.002