Rutgers University, Department of Psychology

Statistical Methods, Fall 2022

Psych 596	Smith Hall	Rm 371	Thursdays	10:00 am – 1:00 pm

PROFESSOR

	Office Hours	Office	Phone	Email/Web
Vanessa LoBue	Thursdays 1:00-2:00pm	Smith 341	973-353-3950	vlobue@psychology.rutgers.edu

	Office Hours	Office	Phone	Email/Web
Jamil Bhanji	Thursdays 1:00-2:00pm	Smith 4-114	201-588-6008 (googlevoice)	bhanji@psychology.rutgers.edu

CLASS FORMAT

This class will meet once a week for three hours, the majority of which will be spent engaged in hands-on statistical training. Each class will begin with a short (~30 minute) lecture to provide you with a conceptual framework for the topic of the week. After the lecture, you will be introduced to the tools you need to complete a lab assignment, first in SPSS and then in R. You will then work through the lab assignment independently (~2 hours) with the help of the instructors. All labs will require you to work through the same set of questions first in SPSS, and then in R. Any questions that you have while working on the lab can either be addressed to the instructors or to the entire class so that issues can be potentially worked out as a group. During the last 10 minutes of the class period, the instructors will go over the solutions to the lab with the entire class, so that any outstanding questions can be answered. Besides the weekly class topics, there will be two class periods ("Data Day," see schedule below) where we will work together to analyze data sets that you submit early in the semester, so that you gain hands-on experience analyzing data that come from your own labs.

REQUIRED READINGS AND MATERIALS

The readings will provide background and a theoretical basis for each topic. The required textbook for the class is: Field, A. (2017). *Discovering statistics using IBM SPSS statistics*. 5th Edition. Sage Publishing.

A pdf of the textbook can be found on Canvas. In addition to the textbook, there are several additional assigned readings, also available for download on Canvas. You are responsible for read all of the required chapters and articles (listed below) **before** the start of every class.

This class also requires that you have access to a laptop that you bring with you to class every week, as well as SPSS and R Studio. If you don't have access to laptop, please contact us and we will arrange to loan you one for class. We will walk you through downloading R Studio on the first day (it's free). If you don't have access to SPSS through your lab, you can access it with your Rutgers login via Rutgers Virtual Computing: https://it.rutgers.edu/virtual-computer-labs/

CANVAS

The syllabus and course readings are available on Canvas. The syllabus is subject to change, and we may post revised versions periodically.

ATTENDANCE

This is a lab-based course, and class attendance is **mandatory**. For every unexcused absence, ½ letter grade will be deducted from your final grade (5 percentage points). For excused absences, you will be required to

make up the in-class lab on your own time and hand it in **within one week** of the missed class date.

COMMUNICATION

You are responsible for making sure that the email address on Canvas and in the Rutgers online directory is a current address where we can reach you. You are also responsible for checking Canvas regularly for announcements and information.

LEARNING GOALS

The overall goal of this course is for you to learn how to fully plan and execute a data analysis strategy in both SPSS and R using a variety of techniques. Specifically, you will learn to:

1. Choose an appropriate statistical test for a variety of data types and empirical questions.
2. Calculate statistical power and decide on an appropriately powered sample size to answer your empirical questions.
3. Use data visualization to present your data clearly, and to explore your data for extreme cases and normality.
4. Choose from and execute a variety of statistical tests to examine differences between groups.
5. Choose from and execute a variety of statistical tests to examine associations between variables.
6. Write APA style narratives reporting your data analyses, complete with confidence intervals and effect sizes.
7. Practice responsible and rigorous habits for your statistical analyses that promote transparency and reproducibility.

REQUIREMENTS & EVALUATION

Your grades will be based on a combination of class participation, completing a protocol description, and a final paper.

Class Participation – 40%

Since there are no tests and the course relies heavily on in-class laboratory assignments, class attendance and participation will be weighted heavily. All students are encouraged to participate fully in discussion through comments, questions, and contributions from personal experience. Thoughtful involvement in every aspect of the class enhances the educational experience of the entire class. Please also be mindful that your classmates need a chance to be heard too. If you have to miss a class for any reason, you will be required to make up the in-class lab on your own time and hand it in **within one week** of the missed class date. Part of the participation grade includes taking part in the collaborative dataset activity by entering information about publications you read over the semester. The activity is described below under the "Collaborative Dataset Activity" heading.

"Data Day" Dataset – 10%

In order to complete the graded class assignments discussed below, you will need to provide us with a dataset from your lab. If you do not work in a lab and/or do not have access to a dataset, please let us know and we will provide you with one. Datasets should include variable names and a description of each of the variables with a variable type for each (e.g., ordinal, nominal etc.). These datasets will be used for our "data days," where we will troubleshoot and analyze datasets from your own labs as a class.

Protocol Description – 25%

All students will be required to submit a detailed protocol for analyzing their submitted dataset. A template for the protocol will be provided to you. In involves providing a theoretical background for your analysis, along with

a detailed description of your analysis plan that includes considerations of power, a plan for extreme cases, and exploratory analyses.

Final Paper – 25%

The final paper for the class will require you to write an APA style report of your fully executed data analysis, as outlined in your protocol description. The paper will read like an empirical article, with an introduction, methods, results, discussion, and references. The results section must have a detailed data analysis plan, again derived from your protocol description.

No Make-Up Assignments

There are absolutely no make-ups. Late assignments will not be graded.

COLLABORATIVE DATASET ACTIVITY

In the lab activity on November 21, we will work with a dataset containing information about participant samples in psychology publications. This dataset will be created by you. Throughout the semester, each student is responsible for entering information about 10 publications in psychology into a collaborative spreadsheet on Google Drive. You should choose publications that you read outside of this class that involve human participant samples. The information you will enter in the spreadsheet is focused on characteristics of human participant samples used (sorry, reviews, meta-analyses, and non-human animal research do not fit here). See the first module on Canvas for links to the Google Drive Sheet and Data Dictionary. To allow the instructors to set up the lab activity in time, your 10 publications must be entered on or before Wednesday, November 10. When you enter each publication, please check to make sure another student has not already entered the same one.

PRINCIPLES FOR DOCUMENTING YOUR DATA AND ANALYSIS

Every lab has its own conventions for record-keeping, but here are some general principles for documenting the data analysis part of your research:

- The goal of your documentation is for a researcher (including your future self) to be able to recreate your results, starting from the same data
- Organize all project files in a sensible manner, with a consistent system for naming files, and regularly backing up all project files
- Preserve copies of your data file(s) in their original state
- Keep sensitive data in a sequestered, protected part of your project
- Create some form of data dictionary to describe variables in your dataset. This info may be within a SPSS file, or a separate file to accompany your data. Name variables in a consistent manner and avoid using spaces or special characters (use "_" for spaces) in variable names.
- Create reader-friendly notes in your project folder to record every step of data processing/analysis
- When you reach a project milestone (e.g., publication), save file versions of all necessary files with easily identifiable filenames and do not edit them further (do any further work on a copy)

DATA FOR CLASS SUBMISSION—DATA DAY

For "Data Day" submit your data file in a plain text format (tab-delimited or comma-separated values, tsv or csv) with variable names in the first row, and subsequent rows containing cases (SPSS: File->Export; RStudio: write_delim()). In addition to the data file, submit a data dictionary file (same file format) containing the following columns: variable name, data type, measurement level, label/description (include units when needed), possible values, and (if needed) value labels. The first row should contain the column labels, subsequent rows contain information about each variable in your dataset, as in the example below (note that a single variable may appear on multiple rows, to allow description

of possible values that occur for that variable). You can create the data dictionary using a spreadsheet (Excel, Google Sheets), text editor, or use an automated tool if you already have the information entered in your favorite software.

Example data dictionary file (shown as a table but you should save your file as tab-delimited or comma separated):

var_name	var_ dtype	var_measurelvl	var_ label	var_ value	value_label
ID	string	nominal	Participant ID	"S1001"-"S1090"	none
diet	string	nominal	diet category	"low-carb"	low carb diet
diet	string	nominal	diet category	"vegan"	vegan diet
diet	string	nominal	diet category	"NA"	missing
exp_cond	string	ordinal	experimental condition	"control"	no prime
exp_cond	string	ordinal	experimental condition	"health1"	weak health prime
exp_cond	string	ordinal	experimental condition	"health2"	strong health prime
food_rt	numeric	scale	Reaction time to pizza image (s)	NA	no response within 10s
food_rt	numeric	scale	Reaction time to pizza image (s)	.001-9.999	response time in seconds

MANAGING DATA AND DOCUMENTION FOR LAB ACTIVITIES

Please use the example file structure below to match with the instructors and other students – this will save time if we need to troubleshoot with you. This is the structure suggested in Prof Andy Field's "Working in RStudio" video (http://milton-the-cat.rocks/learnr/r/r_getting_started/), with an added folder for spss files within the project folder.

```
class-activities/
    ├── week1-setup-import
    │   ├── week1-setup-import.Rproj      # RStudio project file
    │   ├── data # save raw datasets here
    │   │   └── dataset.csv
    │   ├── r_docs          # save R analysis work here
    │   │   ├── week1-setup-import.Rmd  # analysis code, charts, & notes
    │   │   └── week1-setup-import.html # knit version of *.Rmd file
    │   ├── spss # save all spss files here
    │   │   ├── week1-setup-import.sav              # spss datafile
    │   │   ├── week1-setup-import-syntax.sps     # spss syntax (analysis code)
    │   │   ├── week1-setup-import-output.spv     # spss output file (code & charts)
```

```
│   │   └── week1-setup-import-notes.{txt/md/doc/etc}# notes in your fave format
│   └── images        #if needed, save chart images here
│       ├── fig1.png
│       └── fig1.svg
└── week2-descriptives
    ├── etc.
```

DIFFERENT FILE TYPES

*.Rproj – An R project file stores very basic information, including RStudio preferences for the project, importantly, when you open an Rproj file, RStudio will set the working directory to your project folder. It is a good general practice to first open the Rpoj file rather than directly open an R markdown document for editing.

*.Rmd - R Markdown is a file format for combining R code, charts, and text notes in a single document. Can be converted to a html or pdf file for sharing, using the knitr utility in RStudio.

*.sav – SPSS datafile – includes data and variable info

.sps – SPSS syntax file – for saving SPSS commands in text format. When you run commands through the menus, you can use the "Paste" option to paste the command into a syntax file. Later, you can replicate analysis steps by running the commands from the syntax file. You can include your own notes by designating a line of text as a "comment" by starting it with ""

*.spv – SPSS output file. Saves results of SPSS commands (whether run through the syntax window or through menus), including the executed code and tables/charts that are generated.

ACADEMIC INTEGRITY

As an academic community dedicated to the creation, dissemination, and application of knowledge, Rutgers University is committed to fostering an intellectual and ethical environment based on the principles of academic integrity. Academic integrity is essential to the success of the University's educational and research missions, and violations of academic integrity constitute serious offenses against the entire academic community. The entire academic integrity policy can be found here: http://academicintegrity.rutgers.edu/

The Department of Psychology at Rutgers University-Newark has established specific guidelines for handling all potential incidents of Academic Integrity violations. Since Academic Integrity is a core component of the guidelines set forth by the American Psychological Association, all students will be expected to follow both the Rutgers University Academic Integrity Policy and the American Psychological Association ethical code, specifically, APA's Ethical Code 8.11 Plagiarism: "Psychologists do not present portions of another's work or data as their own, even if the other work or data source is cited occasionally". As such, every potential violation of the Rutgers Academic Integrity Policy or APA's Ethical Principles may be reported and handled by either an Academic Integrity Facilitator or the Instructor. Failure to abide by the department's policies can result in the student becoming ineligible to pursue a major in psychology at Rutgers University-Newark.

DISABILITY SERVICES

Rutgers University welcomes students with disabilities into all of the University's educational programs. In order to receive consideration for reasonable accommodations, a student with a disability must contact the RU-N Office of Disability Services at https://myrun.newark.rutgers.edu/disability-services, participate in an intake interview, and provide documentation. Information about documentation can be found here: https://ods.rutgers.edu/students/documentation-guidelines. If the documentation supports your request for reasonable accommodations, the Office of Disability Services will provide you with a Letter of

Accommodations. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible.

INFORMATION ABOUT LEARNING RESOURCES

Rutgers Learning Center (tutoring services): https://myrun.newark.rutgers.edu/learning-center
Writing Center (writing support): https://myrun.newark.rutgers.edu/writing-center

COURSE OVERVIEW

Part 1: Preparing Data
- Reading data into SPSS and R
- Choosing a Statistical Test
- Calculating means, medians, confidence intervals
- Comparison means to chance
- Power Analysis and Sample Size
- Protocol Preparation
- Effect Sizes
- Visualizing Data

Part 2: Associations Between Variables
- Correlations
- Regression
- Logistic Regression
- Longitudinal Designs
- Mediation and Moderation

Part 3: Comparing Groups
- T-tests
- ANOVA
- Repeated Measures
- Mixed Models
- Chi-Square
- Non-parametric Tests

LECTURE TOPICS & REQUIRED READING

Thursday, 9/8	**(1) INTRODUCTION** *Overview of Syllabus and Class Policies* Lab: SPSS and R Setup Readings: 1. Syllabus 2. Protocol Template Supplemental Videos: R—Dr. Andy Field: http://milton-the-cat.rocks/learnr/r/r_getting_started/ (tutorial with series of videos) SPSS—Dr. Todd Daniel: https://youtu.be/gyzTW08IceU (~23min)

Thursday 9/15	**(2) PREPARING DATA** *Choosing a statistical test* Lab: Preparing Data - Importing data - Descriptive statistics - Distribution visualization - Working with different data formats: wide, long, tidy Readings: 1. *Discovering Statistics Using SPSS*, Chapter 1 2. Jaykaran, C. (2010). How to select appropriate statistical test? *Journal of Pharmaceutical Negative Results*| *October*, *1*(2), 61. 3. McCrum-Gardner, E. (2008). Which is the correct statistical test to use? *British Journal of Oral and Maxillofacial Surgery*, *46*(1), 38-41. Supplemental Video: Tidy Data— from the RStudio YouTube channel: https://www.youtube.com/watch?v=1ELALQlO-yM (~18min)

Thursday 9/22	**(3) PREPARING DATA**
	Hypothesis Testing: Do's and Don'ts
	
	Lab: Power Analysis and Protocol Preparation
	- Power analysis (G*Power) based on expected/meaningful effect size
	  ○ 1 group, 1 variable (t-test)—d
	  ○ 1 group, 2 variable (correlation)—r
	  ○ 2 groups, 1 variable (independent samples t-test)—d (pooled SD)
	  ○ >2 groups, 1 variable (ANOVA)—eta^2 or Cohen f
	  ○ 1 group, 2 within × 2 within (repeated measures ANOVA)
	  ○ 2 group, 2 between × 2 within (mixed ANOVA)
	- Example of correcting for multiple tests—Bonferroni correction for post-hoc pairwise comparisons in 2 × 2 ANOVA
	
	Software:
	Install G*Power before class:
	https://www.psychologie.hhu.de/arbeitsgruppen/allgemeine-psychologie-und-arbeitspsychologie/gpower
	
	Readings:
	1. *Discovering Statistics Using SPSS*, Chapters 2 and 3
	
	2. Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*(1), 155.
	
	3. Lakens, D. (2022). Sample size justification. *Collabra: Psycholog, 8(1),* 33267. https://doi.org/10.1525/collabra.33267
	
	4. Markowetz, F. (2015). Five selfish reasons to work reproducibly. *Genome*

	biology, *16*(1), 1-4. 5. Open Science Collaboration. (2015). Estimating the reproducibility of psychological science. *Science, 349(6251).* Supplemental Video: Dr. Alexander Swan—Power analysis for t-test in G*Power: https://www.youtube.com/watch?v=FelgUtL-8Sg (~11min)
Thursday 9/29	**(4) PREPARING DATA** *Data Visualization* Lab: Visualizing data - Plot means with error bars (bar, line plots) - Scatter plots - Approaches to depict variability (box plot, violin plot, 1D scatter and combinations) Readings: 1. *Discovering Statistics Using SPSS*, Chapter 5 and 6 2. Broman, K. W., & Woo, K. H. (2018). Data organization in spreadsheets. *The American Statistician, 72(1*), 2-10. 3. Rougier, N. P., Droettboom, M., & Bourne, P. E. (2014). Ten simple rules for better figures. *PLoS Comput Biol*, *10*(9), e1003833. 4. Zacks, J. M., & Franconeri, S. L. (2020). Designing Graphs for Decision-Makers. *Policy Insights from the Behavioral and Brain Sciences*, *7*(1), 52-63.

Thursday 10/6	**(5) ASSOCIATIONS BETWEEN VARIABLES**
	Associations Between Groups
	
	Lab: Associations between variables, correlation and contingency coefficients
	- 2 Continuous variables:
	  o Pearson's r
	  o Nonparametric: Spearman's Rho, Kendall's Tau
	- 2 Nominal variables:
	  o Contingency coefficients or Cramer's V
	- 3 continuous variables—partial & semi-partial correlation
	- Linearity violations
	- Effect size: r, rho
	
	Readings:
	1. *Discovering Statistics Using SPSS*, Chapter 8
	
	2. Altman, N., & Krzywinski, M. (2015). Points of Significance: Association, correlation and causation. *Nature methods*, *12*(10).

	Supplemental Video: Dr. Andy Field—Correlation using SPSS: https://www.youtube.com/watch?v=ltOSxnNc3Tg&list=PL25257A24840423AE&index=10 (~7min)
Thursday 10/13	**(6) ASSOCIATIONS BETWEEN VARIABLES** *Making Predictions* Lab: Linear regression with 1 or more predictors ○ Checking linearity assumption using scatterplot ○ Create formula and estimate model ○ How to check linearity, homoscedasticity, normality, independence of residuals - Model R^2, F-statistic, beta coefficients (standardized, unstandardized) and intercept - F-statistic for model comparison—AIC, BIC - How to examine a quadratic/curvilinear relation - Multi-collinearity and indicators (VIF) - Logistic regression with dichotomous outcome variable ○ Predicted values represent probability, coefficients as change in log(odds) ○ Effect size using odds ratio ○ Different assumptions, focus on extreme cases - Reporting effect sizes: delta R^2, f^2 - Robust regression options (e.g., for outlier issues) Readings: 1. *Discovering Statistics Using SPSS*, Chapters 9 and 20 2. Cohen, J. (1994). The earth is round (p<. 05). *American psychologist*, *49*(12), 997. 3. Lakens, D. (2021). The practical alternative to the p-value is the correctly used p-value. *Current Direction in Psychological Science.* Supplemental Video: Dr. Andy Field—Standard Error of Regression Coefficients: https://youtu.be/3L9ZMdzJyyI (~8min) **!! DATA DAY DATASETS DUE !!**
Thursday 10/20	**(7) ASSOCIATIONS BETWEEN VARIABLES** *Mediation and Moderation* Lab: Associations between variables, moderation, and mediation - Interaction term for 2 continuous predictors in regression model ○ Visualization (+/- 1 SD of 1 variable) and interpretation ○ Centering for interpretation of main effects ○ Use *PROCESS* to test the same moderation model ▪ Extra visualization, zone of significance

	▪ Interpreting main effects and interaction coefficients - Mediation for 1 predictor, 1 mediator, 1 outcome o Examine X1->Y, X1->X2, X2->Y with regression models o Use *PROCESS to e*xamine *total effect, indirect effect, direct effect* ▪ Interpretation of coefficients ▪ Discussion of causal interpretations, effect size - More complex models: mediated moderation, moderated mediation Readings: 1. *Discovering Statistics Using SPSS*, Chapter 11 2. Hayes, A. F. (2018). Introduction. In *Introduction to Mediation, Moderation, and Conditional Process Analysis.* pp 3-27. Guildford Press, New York, New York. 3. Hayes, A. F. (2018). Using PROCESS. In *Introduction to Mediation, Moderation, and Conditional Process Analysis.* pp 551-583. Guildford Press, New York, New York. Supplemental Video: Dr. Andy Field—Moderation and Mediation in SPSS: https://www.youtube.com/watch?v=RqkGMqDU20Q Supplemental Resource: Hayes, A. F. (2018). PROCESS Model Templates. In *Introduction to Mediation, Moderation, and Conditional Process Analysis.* pp 584-612. Guildford Press, New York, New York.
Thursday 10/27	**(8) COMPARING GROUPS** *Comparing Two Groups* Lab: Comparing two groups - Independent samples t-test, equal variance assumed or not o Same GLM assumptions o Effect size: Cohen d (pooled variance) - Independent samples, Nonparametric tests: Wilcoxon Rank-Sum W, Mann-Whitney U o Effect size: z-to-r o Bootstrapped confidence intervals - Dependent/paired samples t-test o Assumptions (based on GLM) o Effect size: Cohen d (difference between pairs) - Dependent/matched groups: Wilcoxon signed rank test o Effect size: z-to-r Readings: 1. *Discovering Statistics Using SPSS*, Chapters 7 and 10

	2. Ferguson, C. J. (2016). An effect size primer: A guide for clinicians and researchers. In A. E. Kazdin (Ed.), *Methodological issues and strategies in clinical research* (p. 301–310). American Psychological Association. 3. Lakens, D. (2013). Calculating and reporting effect sizes to facilitate cumulative science: a practical primer for t-tests and ANOVAs. *Frontiers in Psychology, 4,* 863. Supplemental Video: Dr. Andy Field—T-tests in SPSS - https://www.youtube.com/watch?v=EkbkI7x6bNA&list=PL25257A24840423AE&index=12
Thursday 11/3	**(9) DATA DAY** **!! PROTOCOL SUMMARY DUE !!**

Thursday 11/10	**(10) COMPARING GROUPS**
	Comparison of Three or More Groups
	
	Lab: Comparing 3 or more groups
	- ANOVA (1 factor, 3 levels)
	  ○ Assumptions (based on GLM)
	  ○ Analysis of Variance in R, 1-way ANOVA in SPSS
	  ○ Interpret SS between, SS within, F-stat
	  ○ Effect size: R-squared/eta-squared, ω
	  ○ Planned contrasts including linear and quadratic trend contrasts
	- Factorial ANOVA
	  ○ 2 × 2 (independent groups)
	  ○ Simple effects tests
	  ○ ANCOVA: 1 continuous covariate
	
	- Non-parametric Kruskal Wallis H, Welch's F
	
	Readings:
	1. *Discovering Statistics Using SPSS*, Chapters 12, 13, and 14

Thursday 11/17	**(11) COMPARING GROUPS**
	Repeated Measures and Longitudinal Designs
	
	!! 10 ENTRIES IN THE COLLABORATIVE DATASET ARE DUE !!
	
	Lab: Repeated Measures and longitudinal designs
	- 1 factor, 3 level repeated measures ANOVA
	  ○ Assumptions (based on GLM)
	- Within subject 2 × 2 design, repeated measures ANOVA
	  ○ Effect size: R-squared/eta-squared, ω
	- Formulate ANOVA as regression model
	- Robust regression options for outlier issues

	Readings: 1. *Discovering Statistics Using SPSS*, Chapter 15 Special Topic Readings—Representativeness of Our Data: 2. Nielsen, M., Haun, D., Kärtner, J., & Legare, C. H. (2017). The persistent sampling bias in developmental psychology: A call to action. *Journal of Experimental Child Psychology*, *162*, 31-38. 3. Qu, Y., Jorgensen, N. A., & Telzer, E. H. (2021). A Call for Greater Attention to Culture in the Study of Brain and Development. *Perspectives on Psychological Science*, *16*(2), 275-293. 4. Roberts, S. O., Bareket-Shavit, C., Dollins, F. A., Goldie, P. D., & Mortenson, E. (2020). Racial inequality in psychological research: Trends of the past and recommendations for the future. *Perspectives on psychological science*, *15*(6), 1295-1309. 5. Simons, D. J., Shoda, Y., & Lindsay, D. S. (2017). Constraints on generality (COG): A proposed addition to all empirical papers. *Perspectives on Psychological Science, 12(6),* 1123-1128.
Tuesday 11/22 (Thursday class designation day due to Thanksgiving)	**(12) COMPARING GROUPS** *Chi-Square and Loglinear Analysis* Lab: Chi-squared test, loglinear analysis - Chi-squared for 1 frequency variable, two or more groups o Formulating test as difference between observed and expected - Chi-squared independence test for two categorical variables, two or more groups - Loglinear analysis for more than two groups - Assumptions: independent groups, minimum expected count >=5 - Effect size: odds ratio Readings: 1. *Discovering Statistics Using SPSS*, Chapter 19 Special Topic Readings—Socioeconomic Status: 2. Frankenhuis, W. E., & Nettle, D. (2020). The strengths of people in poverty. *Current Directions in Psychological Science*, *29*(1), 16-21. 3. Muscatell, K. A. (2018). Socioeconomic influences on brain function: implications for health. *Annals of the New York Academy of Sciences*, *1428*(1), 14-32. Supplemental Video: Dr. Andy Field—Chi squared test in SPSS: https://www.youtube.com/watch?v=532QXt1PM-Q

Thursday 11/24	**Thanksgiving—No Class**
Thursday 12/1	**(13) DATA DAY**
Thursday 12/8	**(14) COMPARING GROUPS** *Mixed Effects Models* Lab: Mixed Effects and trial-level data - Multi-level model example: treatment effect with levels for students, class - Multi-level example: within-subject treatment, analysis of trial-level responses - Dichotomous outcome—mixed effects logistic regression example: yes/no choice with within-subject treatment, analyze trial-level responses - Effect size: pseudo R-squared (marginal, conditional) Supplemental Videos: Violet A. Brown—Multi-level Modeling: Part 1: https://www.youtube.com/watch?v=3OFXxh4yORU (~20 min) Part 2: https://www.youtube.com/watch?v=_UmY-3brJJ0 (~25min) Readings: 1. *Discovering Statistics Using SPSS*, Chapter 16 2. Brown, V.A. (2021). Introduction to Linear Mixed Effects Models in R. *Advances in Methods and Practices in Psychological Science.* https://doi.org/10.1177/2515245920960351 3. Judd, C. M., Westfall, J., & Kenny, D. A. (2012). Treating stimuli as a random factor in social psychology: A new and comprehensive solution to a pervasive but largely ignored problem. *Journal of personality and social psychology*, *103*(1), 54. **!! FINAL PAPER DUE !!**