

PSY 5320 - Principles of Measurement and Statistics

Texas State University
Fall 2017

Instructor Information	Instructor: Alessandro De Nadai, Ph.D. Office: UAC 253L Email: adenadai@txstate.edu	Class Information	Meeting Times: Tuesdays 2:00-4:50 PM Rooms: UAC 206/UAC 008 Credit Hours: 3 Office Hours: Wednesdays 2:00-4:00 PM, or by appointment
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Course Overview

"To consult the statistician after an experiment is finished is often merely to ask him/her to conduct a post mortem examination. He/she can perhaps say what the experiment died of."

Ronald Fisher (1938; gender pronouns updated)

In today's world, a number of fields are demanding empirical data to justify decision-making. This is true not only in psychology, but also in business, engineering, public policy, and many other professions. To use such data effectively, knowledge of contemporary research methods is critical. The central focus of this class is the data analysis stage of research in the context of what comes before and after this stage.

Today, data analysis is almost always done with specialized software. This class will teach you how to process and analyze data with multiple software packages, and at the same time consolidate previously learned methodology and statistics knowledge through repeated practice and implementation. Vivally, we will address how decisions that might be made during analysis can affect study design, research conduct and reporting of results (i.e., stages before and after analysis), as disconnects can often occur between these stages in real-world research. We will also address how measurement and psychometrics affect the implications of research findings.

Ronald Fisher's view continues to be relevant - the linkage between research conceptualization, data collection, data analysis with software, and reporting of results is so intertwined that knowledge of each domain is extremely valuable when making data-based decisions. Along the way, we will highlight a number of misconceptions in research design and statistics and discuss preferred methods to address such issues.

Through this approach, this class attempts to unify all stages of research with the goal of facilitating cohesive research products. By the end of the class, you will be able to identify appropriate methodological designs for your research, work with collected data, and generate material appropriate for academic and professional publication/presentation.

Specific Course Objectives

- To improve skills in research so that design, analysis, and reporting are integrated
- To be able to identify a number of common study designs in behavioral research
- To be able to quickly manipulate datasets in common statistics programs
- To be able to run the majority of commonly used analyses in the behavioral sciences in multiple statistics programs
- To see how to translate research ideas and hypotheses into statistical syntax in multiple software programs
- To be able to quickly interpret output from statistics programs into publication-quality text
- To address common errors and troubleshoot novel problems that occur when performing analyses
- To gain confidence in working with statistical syntax
- To develop skills to take on personal projects that are just beyond your immediate capacity
- To consolidate prior statistical learning by repeated practice in new contexts
- To gain experience in presenting statistical concepts through writing and oration

- To be able to evaluate benefits and drawbacks of different research approaches and to appropriately critique other academic and lay press reporting of statistics

Central Methods Used to Achieve Course Objectives

1. Instructor lecture
2. Instructor-guided practice
3. Independent practice of statistical programming with subsequent feedback
4. Writing and presentation-based assignments with feedback

Supplemental Methods Used to Achieve Course Objectives

- Practice teaching yourself new statistical concepts, with helpful techniques provided by the instructor
- Practice troubleshooting errors that arise when conducting analyses
- Complete a personal project using course-related strategies (which can directly contribute to your career advancement)
- Assist other class members - Learn by teaching them and receiving instruction from them

Course Readings

We will use the TRACS online course management system provided by Texas State for all course readings, which are provided in PDF format. A list of the books and specific articles used can be found at the end of this document.

Other Course Materials

We will be using three software packages predominantly this semester: SPSS, SAS, and Mplus. We will also briefly use the statistical package R.

- SPSS
- SAS University Edition can be obtained for free at https://www.sas.com/en_us/software/university-edition/download-software.html.
- The Mplus demo version (which will be sufficient for all assignments this semester) can be found at <http://www.statmodel.com>.
- R is freely downloadable at <http://www.r-project.org>. RStudio is freely downloadable at <https://www.rstudio.com/>. Be sure to completely install R before installing RStudio (RStudio depends on R).

Assignments Contributing to Final Grade

Homework + Contribution to Class Wiki: 50% (equal contribution among all assignments)

Teaching a Novel Statistical Approach: 10%

Final Exam: 20%

Final Paper: 20%

Grading

Grades will be based on your performance on course assignments and course attendance (see below for detail on course attendance). Your final grade will be on the following scale.

90% and above	A
80% - 89%	B
70% - 79%	C
60% - 69%	D
Below 60%	F

Attendance

Because much of the course is demonstration and practice with feedback, attendance will be necessary for learning. However, attendance will be used as part of the final grade in only one circumstance - when a student's final grade is within the range of one percentage point below a higher grade.

In this instance, if a student attends 90% of classes or more (i.e., one or fewer absences), then his/her grade will be rounded up to the next letter grade. To illustrate, if a student has an 89.3% grade on assignments and attends 100% of classes, this student will receive an A. If a student has an 89.3% grade on assignments and attends 80% of classes, this student will receive a B. If a student has an 88.9% grade on assignments and attends 100% of classes, this student will still receive a B (because 88.9% is not within one percentage point of the higher grade).

Excused absences will only be provided with documentation from a medical provider or other appropriate professional.

Late Work

Late work is marked down 20% for each business day that it is late. Work is considered one day late if it is not provided to the instructor within the first 10 minutes of the class date on which it is due. Late work can be brought to the Psychology Suite (UAC 253; open 8 AM-5 PM on Monday-Friday) and time-stamped by the department assistants, who can place the completed work in my mailbox.

Note Taking and Recording

You are encouraged to take notes on the lectures/discussions. However, you are not permitted to take notes or audio/video record for purposes of sale and/or distribution.

Some class demonstrations may be recorded in video format and provided to you. These are intended to serve as helpful reminders from class instruction. Distribution of these videos to others is not permitted.

Accommodations for Students with Disabilities

Texas State University does not discriminate on the basis of disability in the recruitment and admissions of students or in the operation of any of its programs and activities. If you have a disability or other need that may require special accommodations, please speak with me before the end of the second class meeting, so that I can work to implement accommodations as you need. You will be asked to provide documentation from the Office of Disability Services (Suite 5-5.1, LBJ Student Center, telephone 245-3451). For further information, see: <http://www.txstate.edu/effective/upps/upps-07-11-01.html>.

Absences Due to Religious Observances

No student shall be compelled to attend class or sit for an examination at a day or time prohibited by his or her religious belief. Students are requested to notify the instructor by the end of the second class meeting if they intend to be absent for a class or announced examination. Official policy documentation can be found at <http://policies.txstate.edu/university-policies/02-06-01.html>.

Drops and Withdrawals

Students are responsible for initiating all drops and withdrawals. The deadline to drop this class is October 30. After this date, you may only withdraw from a class for a very serious reason that is clearly beyond your control, such as injury or accident (which must be documented). Usually, such circumstances mean that you withdraw from all of your classes at the university. For further information, see: <http://www.registrar.txstate.edu/registration/drop-a-class>.

Academic Dishonesty and Academic Grievance Procedures

University Policy: The honor code at Texas State University can be accessed at <http://www.txstate.edu/honorcodecouncil/Academic-Integrity.html>, and the code of student conduct can be found at <http://www.dos.txstate.edu/handbook/rules/cosc.html>. Instances of cheating will result in conference with the student and an academic penalty (which includes the possibility of an "F" in the course). In addition, the matter may be referred to the Honor Code Council Chair, the Associate Vice President for Academic Affairs, and/or the Dean of Students for further action. If you have any questions about whether your actions may violate the honor code or code of student conduct, please contact the course instructor for clarification.

Psychology Department Policy: The study of psychology is done best in an environment of mutual trust and respect. Academic dishonesty in any form spoils this environment. Academic dishonesty consists of any of a number of things that interfere with a good student-teacher relationship. A list of academically dishonest behaviors includes but is not limited to: (1) passing off others' work as one's own, (2) copying off of another person during an examination, (3) signing another person's name on an attendance sheet, (4) in written papers, paraphrasing from an outside source while failing to credit the source or copying more than four words in sequence without quotation marks and appropriate citation.

Technical Support

If you experience software difficulties (e.g., logging into TRACS, downloading or uploading a file, completing an assessment, accessing your grades, etc.), please choose one of the options below. If the issue is preventing you from completing a deadline-based assignment, then also contact the course instructor via email. All emails to the course instructor will receive a reply within two business days.

Options for help:

- Contact TRACS support staff at: 512.245.5566 or tracs@txstate.edu
- Chat with TRACS staff at: <http://tracsfacts.its.txstate.edu/chatwithtracs/tracschat.html>
- Obtain information at: <http://tracsfacts.its.txstate.edu/Documents/Student-Guides.html>

Syllabus Modification

The goal of this syllabus is to provide a general overview and outline a plan for the semester. This syllabus may be modified throughout the semester. Any modifications will be mentioned in class and also posted on TRACS.

Class and Assignment Schedule

Class Week	Date	Topics	Assignments Due This Week	Readings for Next Week
1	8/29	<ul style="list-style-type: none"> • Introduction to class • Introduction to common programs and syntax/scripting structures 		<ul style="list-style-type: none"> • Kline (2009) • Obtain access to SPSS, SAS, Mplus, and R/RStudio
2	9/5	<ul style="list-style-type: none"> • Data manipulation • Data screening 	<ul style="list-style-type: none"> • Have working copies of SPSS, SAS, Mplus, and R/RStudio 	<ul style="list-style-type: none"> • Knapp and Mueller (2010) • Consider statistical technique to teach class, and class project topic
3	9/12	<ul style="list-style-type: none"> • Data manipulation and screening (continued) • Measurement reliability and validity 		<ul style="list-style-type: none"> • Randolph and Myers (2013), pp. 74-76 and 100-108 (pp. 4-6 and 23-30 of PDF) • Aiken et al. (2012)
4	9/19	<ul style="list-style-type: none"> • Bivariate correlation, multiple regression, ANCOVA 	<ul style="list-style-type: none"> • Homework 1 	<ul style="list-style-type: none"> • Hayes and Rockwood (in press) • Consider statistical technique to teach class, and class project topic
	9/26	<ul style="list-style-type: none"> • Moderation/mediation 	<ul style="list-style-type: none"> • Turn in worksheet on new statistical technique to teach class • Turn in worksheet on class project 	<ul style="list-style-type: none"> • Randolph and Myers (2013), pp. 163-186 (pp. 1-18 of PDF) • McArdle and Kadlec (2013) •
5	10/3	<ul style="list-style-type: none"> • Path analysis, confirmatory factor analysis, and structural equation modeling (SEM) 	<ul style="list-style-type: none"> • Homeworks 2 and 3 	<ul style="list-style-type: none"> • McNeish (in press) • Brown (2015), pp. 206-286 and 301-308
6	10/10	<ul style="list-style-type: none"> • Advanced SEM concepts 1 <ul style="list-style-type: none"> ○ Reliability revisited (omega and related models) ○ Measurement model validity (bifactor models, measurement invariance) 	<ul style="list-style-type: none"> • Homework 4 	<ul style="list-style-type: none"> • Hox (2013) • Lubke and Luningham (in press)
7	10/17	<ul style="list-style-type: none"> • Advanced SEM concepts 2 <ul style="list-style-type: none"> ○ Latent growth models ○ Mixture models 		<ul style="list-style-type: none"> • Formulate questions for catch up if needed • Make headway for exam and final assignments
8	10/24 ^{a,b}	<ul style="list-style-type: none"> • Review of SEM and psychometric models 	<ul style="list-style-type: none"> • Homeworks 5 and 6 	<ul style="list-style-type: none"> • Graham (2009) • Baraldi & Enders (2010)

9	10/31	<ul style="list-style-type: none"> Missing data (full information maximum likelihood estimation, multiple imputation) 		<ul style="list-style-type: none"> Kelley and Maxwell (2012) Hoezle and Meyer (2013)
10	11/7	<ul style="list-style-type: none"> Power analysis Exploratory factor analysis 		<ul style="list-style-type: none"> If needed, prepare questions about exam
11	11/14 ^a	<ul style="list-style-type: none"> Troubleshooting common and uncommon errors Methods to learn more after the end of class Review for exam 	<ul style="list-style-type: none"> Homeworks 7 and 8 Email any questions to address before 11/10^a 	<ul style="list-style-type: none"> Prepare for exam
12	11/21	<ul style="list-style-type: none"> Exam 	<ul style="list-style-type: none"> Exam conducted this class 	<ul style="list-style-type: none"> Post to class wiki if have not done so already
13	11/28	<ul style="list-style-type: none"> Workshop for presentation and class project Review of core concepts 	<ul style="list-style-type: none"> Post to class wiki if have not done so already 	<ul style="list-style-type: none"> Finalize presentation of new statistical technique
14	12/5	<ul style="list-style-type: none"> Presentation of new statistical technique Question and answer 	<ul style="list-style-type: none"> 10-minute presentation of new statistical technique 	<ul style="list-style-type: none"> Finalize class project
15	12/12 (exam week) ^b	<ul style="list-style-type: none"> Presentation of final paper 	<ul style="list-style-type: none"> 10-minute presentation of final paper 	

^aClass dates on 10/24 and 11/14 have time devoted specifically to catching up on any residual issues. If you have specific questions, email me before the Monday of class week so that I can prepare any specific material for class. This advance notice will allow me to better help you.

^bOctober 30 is the last date possible to drop the course and still receive an automatic "W" grade (see University Academic Calendar for details at <http://www.registrar.txstate.edu/persistent-links/academic-calendar.html>)

^cThe location of meeting for exam week is subject to change; updates will be provided when available

Instructional Course Readings

- Aiken, L. S., West, S. G., Pitts, S. C., Baraldi, A. N., & Wurpts, I. C. (2013). Multiple linear regression. In I. B. Weiner, J. A. Schinka, & W. F. Velicer (Eds.), *Handbook of psychology: Research methods in psychology* (2nd ed., pp. 511-542). Hoboken, NJ: John Wiley & Sons.
- Baraldi, A. N., & Enders, C. K. (2010). An introduction to modern missing data analyses. *Journal of School Psychology, 48*, 5-37. doi:10.1016/j.jsp.2009.10.001
- Brown, T. A. (2015). CFA with equality constraints, multiple groups, and mean structures. In T. A. Brown, *Confirmatory factor analysis for applied research* (pp. 206-286). New York: Guilford Press.
- Brown, T. A. (2015). Other types of CFA models: Higher-order factor analysis, scale reliability evaluation, and formative indicators. In T. A. Brown, *Confirmatory factor analysis for applied research* (pp. 287-332). New York: Guilford Press.
- Graham, J. W. (2009). Missing data analysis: Making it work in the real world. *Annual Review of Psychology, 60*, 549-576. doi:10.1146/annurev.psych.58.110405.085530
- Hayes, A. F., & Rockwood, N. J. (in press). Regression-based statistical mediation and moderation analysis in clinical research: Observations, recommendations, and implementation. *Behaviour Research and Therapy*.
- Hoelzle, J. B., & Meyer, G. J. (2013). Exploratory factor analysis: Basics and beyond. In I. B. Weiner, J. A. Schinka, & W. F. Velicer (Eds.), *Handbook of psychology: Research methods in psychology* (2nd ed., pp. 164-188). Hoboken, NJ: John Wiley & Sons.
- Hox, J. J. (2013). Multilevel regression and multilevel structural equation modeling. In T. D. Little (Ed.), *The Oxford handbook of quantitative methods* (Vol. 2, pp. 281-294). New York: Oxford University Press.
- Kelley, K., & Maxwell, S. E. (2012). Sample size planning. In H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. Rindskopf, & K. J. Sher (Eds.), *APA handbook of research methods in psychology* (Vol. 2, pp. 181-202). Washington, DC: American Psychological Association.
- McArdle, J. J., & Kadlec, K. M. (2013). Structural equation models. In T. D. Little (Ed.), *The Oxford handbook of quantitative methods* (Vol. 2, pp. 295-337). New York: Oxford University Press.
- Lubke, G. H., & Luningham, J. (in press). Fitting latent variable mixture models. *Behaviour Research and Therapy*.
- McNeish, D. (in press). Thanks coefficient alpha, we'll take it from here. *Psychological Methods*.
- Kline, R. B. (2009). Practical data analysis. In R. B. Kline, *Becoming a behavioral science researcher: A guide to producing research that matters* (pp. 225-251). New York, NY: Guilford Press.
- Knapp, T. R., & Mueller, R. O. (2010). Reliability and validity of instruments. In G. R. Hancock, R. O. Mueller, & L. M. Stapleton (Eds.), *The reviewer's guide to quantitative methods in the social sciences* (pp.337-341). New York: Routledge.
- Randolph, K. A., & Myers, L. L. (2013). Bivariate statistical methods. In K. A. Randolph & L. L. Myers, *Basic statistics in multivariate analysis* (pp. 69-108). New York: Oxford University Press.
- Randolph, K. A., & Myers, L. L. (2013). Path analysis. In K. A. Randolph & L. L. Myers, *Basic statistics in multivariate analysis* (pp. 163-186). New York: Oxford University Press.

Video Overviews

- D. Bauer (2017, August 11). Regression episode 2: Ordinary least squares explained. Retrieved from <https://www.youtube.com/watch?v=SnONtEma98o>
- D. Bauer (2017, August 11). Introduction to latent class / profile analysis. Retrieved from https://www.youtube.com/watch?v=NIZFm_EI8OM
- H. M. Crawson (2017, August 11). Intro to SEM. Retrieved from <https://www.youtube.com/watch?v=CpfE5LMnrVY>

Example Method and Results Sections from Published Manuscripts

Regression/ANCOVA

Storch, E. A., Lewin, A. B., Collier, A. B., Arnold, E., De Nadai, A. S., Dane, B. F., Nadeau, J. M., Mutch, P. J., & Murphy, T. K. (2015). A randomized controlled trial of cognitive-behavioral therapy versus treatment as usual for adolescents with autism spectrum disorders and comorbid anxiety. *Depression and Anxiety, 32*, 174-181. doi: 10.1002/da.22332

Moderation/Simple Slopes

Kopala-Sibley, D. C., Zuroff, D. C., Leybman, M. J., & Hope, N. (2013). Recalled peer relationship experiences and current levels of self-criticism and self-reassurance. *Psychology and Psychotherapy: Theory, Research and Practice, 86*, 33-51. doi: 10.1111/j.2044-8341.2011.02044.x

Tull, M. T., Bardeen, J. R., DiLillo, D., Messman-Moore, T., & Gratz, K. L. (2015). A prospective investigation of emotion dysregulation as a moderator of the relation between posttraumatic stress symptoms and substance use severity. *Journal of Anxiety Disorders, 29*, 52-60. doi: 10.1016/j.janxdis.2014.11.003

Mediation/Indirect Effects

Capron, D. W., & Schmidt, N. B. (2016). Development and randomized trial evaluation of a novel computer-delivered anxiety sensitivity intervention. *Behaviour Research and Therapy, 81*, 47-55. doi: 10.1016/j.brat.2016.04.001

Dixon, L. J., Tull, M. T., Lee, A. A., Kimbrel, N. A., & Gratz, K. L. (2017). The role of emotion-driven impulse control difficulties in the relation between social anxiety and aggression. *Journal of Clinical Psychology, 73*, 722-732. doi: 10.1002/jclp.22372

Path Analysis

Woerner, M., Selles, R. R., De Nadai, A. S., Salloum, A., & Storch, E. A. (2017). Hoarding in college students: Exploring relationships with the obsessive compulsive spectrum and ADHD. *Journal of Obsessive Compulsive and Related Disorders, 12*, 95-101. doi: 10.1016/j.jocrd.2017.01.004

Confirmatory Factor Analysis

De Nadai, A. S., Nagpal, P. S., Piacentini, J., Peris, T. S., Geffken, G. R., Geller, D. A., Murphy, T. K., Storch, E. A., & Lewin, A. B. (2015). Contemporary models of pediatric obsessive compulsive disorder: An evaluation with a large clinical sample. *Psychiatry Research, 229*, 620-622. doi: 10.1016/j.psychres.2015.03.034

Structural Equation Modeling

Candela, L., Gutierrez, A. P., & Keating, S. (2015). What predicts nurse faculty members' intent to stay in the academic organization? A structural equation model of a national survey of nursing faculty. *Nurse Education Today*, *35*, 580-589. doi: 10.1016/j.nedt.2014.12.018

Bifactor Modeling

Olatunji, B. O., Ebesutani, C., Haidt, J., & Sawchuk, C. N. (2014). Specificity of disgust domains in the prediction of contamination anxiety and avoidance: a multimodal examination. *Behavior Therapy*, *45*, 469-481. doi: 10.1016/j.beth.2014.02.006

Measurement Invariance

Dedrick, R. F., Shaunessy-Dedrick, E., Suldo, S. M., & Ferron, J. M. (2015). Psychometric properties of the School Attitude Assessment Survey-Revised with International Baccalaureate high school students. *Gifted Child Quarterly*, *59*, 38-54. doi: 10.1177/0016986214559596

Ogg, J., McMahan, M. M., Dedrick, R. F., & Mendez, L. R. (2013). Middle school students' willingness to engage in activities with peers with ADHD symptoms: A multiple indicators multiple causes (MIMIC) model. *Journal of School Psychology*, *51*, 407-420. doi: 10.1016/j.jsp.2013.01.002

Mixture Modeling

Lau-Barraco, C., Braitman, A. L., Stamatos, A. L., & Linden-Carmichael, A. N. (2016). A latent profile analysis of drinking patterns among nonstudent emerging adults. *Addictive Behaviors*, *62*, 14-19. doi: 10.1016/j.addbeh.2016.06.001

McGinty, H. L., Small, B. J., Laronga, C., & Jacobsen, P. B. (2016). Predictors and patterns of fear of cancer recurrence in breast cancer survivors. *Health Psychology*, *35*, 1-9. doi: 10.1037/hea0000238

Missing Data

Storch, E. A., Lewin, A. B., Collier, A. B., Arnold, E., De Nadai, A. S., Dane, B. F., Nadeau, J. M., Mutch, P. J., & Murphy, T. K. (2015). A randomized controlled trial of cognitive-behavioral therapy versus treatment as usual for adolescents with autism spectrum disorders and comorbid anxiety. *Depression and Anxiety*, *32*, 174-181. doi: 10.1002/da.22332

Exploratory Factor Analysis

Copenhaver, M., Shrestha, R., Wickersham, J. A., Weikum, D., & Altice, F. L. (2016). An exploratory factor analysis of a brief self-report scale to detect neurocognitive impairment among participants enrolled in methadone maintenance therapy. *Journal of Substance Abuse Treatment*, *63*, 61-65. doi: 10.1016/j.jsat.2016.01.002

Rasmussen, J. L., Steketee, G., Frost, R. O., Tolin, D. F., & Brown, T. A. (2014). Assessing squalor in hoarding: The Home Environment Index. *Community Mental Health Journal*, *50*, 591-596. doi: 10.1007/s10597-013-9665-8