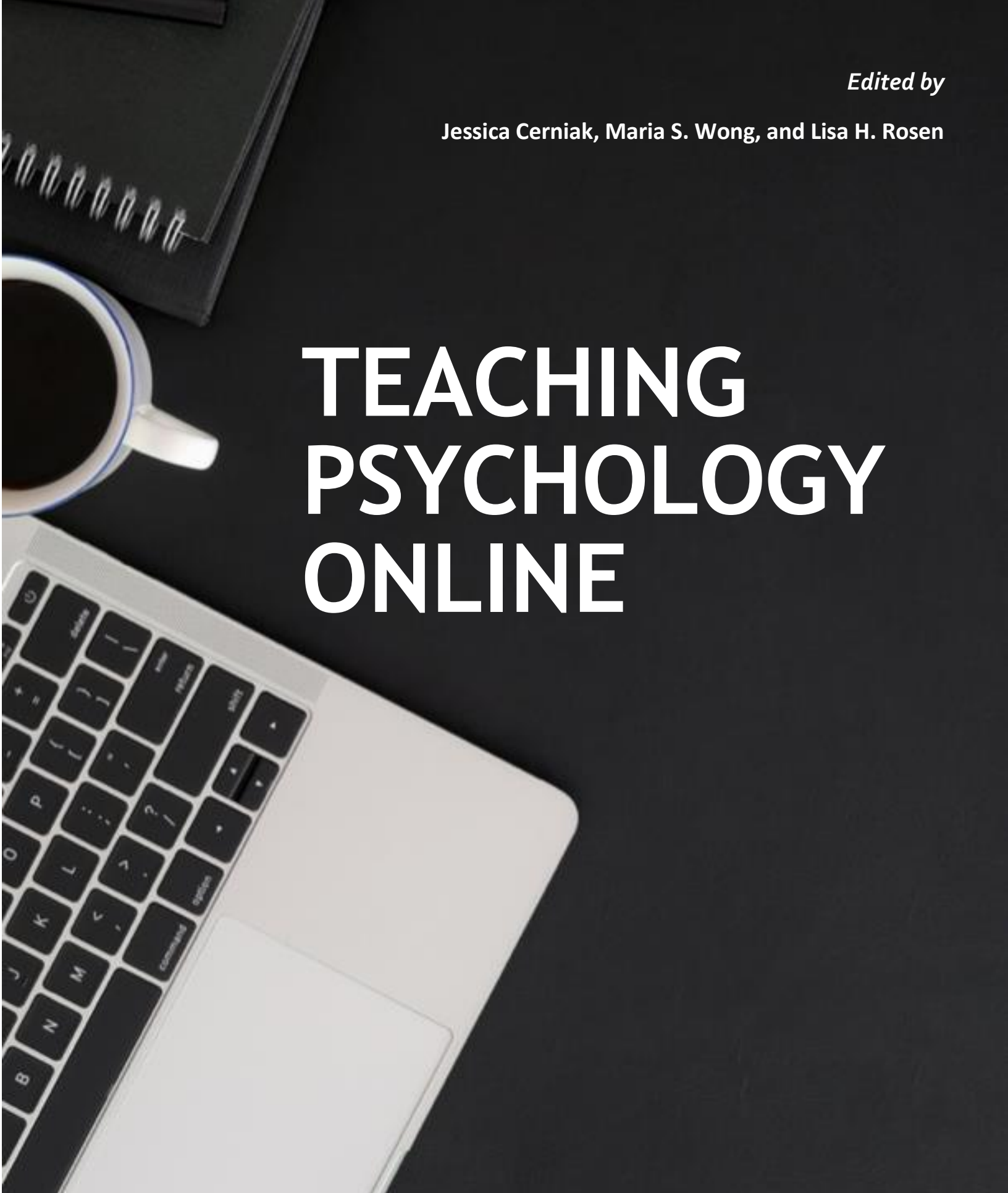




Edited by

Jessica Cerniak, Maria S. Wong, and Lisa H. Rosen

TEACHING PSYCHOLOGY ONLINE



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Adapting the Passion-Driven Statistics Curriculum for an Online Graduate Multivariate Statistics Course

Lisa H. Rosen and Kristin R. Flaming
Texas Woman's University

Abstract

This chapter describes the adaptation of the Passion-Driven Statistics curriculum to an online graduate statistics course. Employing this project-based approach, students worked in teams applying different multivariate methods to answer research questions using large, publicly available datasets. Students were able to formulate research questions based on their interests, and the class culminated in a final project for which students created a scientific poster and presented it to their colleagues. Students viewed the Passion-Driven Statistics approach favorably, and the majority felt prepared for more advanced coursework and indicated what they learned in class would assist with completion of their thesis work.

Introduction to the Course

As instructors of statistics courses, we are accustomed to students reluctantly registering for our classes in order to fulfill programmatic requirements. Graduate students frequently have unfavorable perceptions of statistics coursework (DeVaney, 2010; Lalayants, 2012). For instance, they may expect the material to be dull, fail to see the utility of statistics, and believe the subject lacks relevance for their future careers. Graduate students may also be anxious and apprehensive about taking a statistics course; 66-80% of graduate students report experiences of statistics anxiety (Onwuegbuzie, 2004; Onwuegbuzie & Wilson, 2003). Moreover, statistics anxiety is associated with procrastination and can contribute to students delaying statistics coursework until the end of their degree program (Onwuegbuzie, 2004). Negative perceptions and anxiety surrounding statistics coursework appear heightened when the course is online as compared to on-ground instruction (Lalayants, 2012).

This chapter discusses the Passion-Driven Statistics approach that seeks to address these student concerns and, as the title of the approach implies, infuses passion into the study of statistics. Dierker and colleagues (2012) designed this approach with funding from the National Science Foundation to allow students to use real datasets and to formulate their own research questions in order to highlight the utility of statistics using questions of interest to the students. The Passion-Driven Statistics approach offers a multi-disciplinary curriculum with datasets relevant to multiple fields of study, and the nature of the approach illustrates how statistics can be of relevance as students continue through their programs and careers.

Before launching into a detailed description of the approach, we wanted to provide some background on our course, officially titled Advanced Psychological Statistics II and unofficially referred to as Multivariate Statistics. The course is the second in our departmental sequence of graduate statistics and is required for doctoral students in both the counseling and school psychology programs, as well as master's students in the psychological sciences program. Typically, we have 20-30 students each semester. These students are often on different trajectories, with those in the counseling and school psychology programs on an applied path, whereas those in the masters of psychological sciences program are typically pursuing a research track. It is sometimes challenging to illustrate the importance of multivariate statistics to those working toward an applied career; however, the Passion-Driven Statistics curriculum can highlight how statistics can answer important questions across disciplines and settings.

Multivariate Statistics is offered as an eight-week course over the summer. The learning objectives are for students to: a) demonstrate working knowledge of multivariate methods commonly used in the context of psychological research; b) critically evaluate conclusions drawn from published research utilizing multivariate methods; c) perform multivariate analyses using SPSS and appropriately interpret output; d) apply multivariate methods to answer research questions of interest; and e) develop effective technical writing skills to report different forms of multivariate analyses in APA style. Building on what was covered in Advanced Psychological Statistics I, students learn an array of multivariate methods including multiple regression, logistic regression, multivariate analysis of variance (MANOVA), factor analysis, and path analysis.

Although previously held in hybrid format, the course transitioned to fully online during the summer of 2020 because of the pandemic, and it will remain this way due to the success of applying the Passion-Driven Statistics approach. As discussed below, the Passion-Driven Statistics approach was adopted to provide students the chance to collaborate and apply multivariate techniques to real world data, which we believed would better prepare them for future coursework and program milestones (e.g., thesis, dissertation). Prior to this transition, students completed homework assignments using textbook data provided for each chapter rather than a common dataset throughout the semester.

Passion-Driven Statistics: A Project-Based Approach

Passion-Driven Statistics is a multidisciplinary project-based approach (Dierker et al., 2012; Dierker et al., 2018; Gallagher et al., 2020) for students to spend the semester fully engaged in project-based learning. Although originally used in on-ground courses, recent research has shown that project-based learning can be successfully employed in online courses (Arantes do Amoral & Fregni, 2020; Kokotsaki et al., 2016; Savin-Baden & Wilkie, 2006). As a form of experiential learning, project-based courses foster “learning by doing,” which can involve the addition of “real research” to the course (Simmons, 2012). Passion-Driven Statistics incorporates “real research” as students work on projects using large, publically available datasets. As the name ‘project-based learning’ suggests, the project (i.e., final product) is a key aspect and helps distinguish this from other forms of experiential learning, such as problem-based learning (Kokotsaki et al., 2016). Project-based learning has been defined as a “teaching method in which students gain knowledge and skills by working for an extended period of time to investigate and respond to an authentic, engaging, and complex question, problem, or challenge” (Buck Institute of Education, 2020, para. 3). Courses using the Passion-Driven Statistics curriculum culminate in presentation of a final research project in the form of a scientific poster and this final project serves to highlight what students learned in the course (Kokotsaki et al., 2016). In the class, working with the data and completing the final project is what drives students’ learning, as has been noted by researchers examining project-based learning (Daniel-Gittens et al., 2014; Helle et al., 2006).

The Passion-Driven Statistics curriculum is flexible and has been used with high school students, undergraduate students, as well as graduate students (Dierker et al., 2012; Dierker et al., 2018; Gallagher et al., 2020). Gallagher and colleagues (2020) describe the Passion-Driven Statistics approach in an undergraduate course in chapter 5 of *For the Love of Teaching Undergraduate Statistics*, another recent and freely available [e-book](#) through the Society for the Teaching of Psychology. In what follows, we present an adaptation of this curriculum to Advanced Psychological Statistics II, our graduate multivariate statistics course, in the summer of 2020. Although we describe application to an online graduate course, it is important to note this is a highly flexible curriculum that can be adjusted for level of student and format of the class.

Course Structure

Given Advanced Psychological Statistics II was offered asynchronously, students were provided multiple opportunities to collaborate with other students and to consult with the instructor throughout the semester. The course was hosted in the Canvas learning management system (LMS) with the material divided into weekly modules. Each weekly module focused on a particular multivariate analysis (e.g., logistic regression, factor analysis). The modules began with an overview, which included objectives of the module, links to instructor recorded lectures and other resources, and detailed instructions for the weekly assignment.

In terms of course materials, students were assigned a standard multivariate statistics textbook (Meyers et al., 2017) as well as the free [e-book](#) (Dierker, 2014) that accompanies the [Passion-Driven Statistics Curriculum](#). Included as part of the e-book were code/syntax to accompany each chapter and links to a series of [videos](#), many of which are specialized for different statistical software that students may have access to in their statistics class (i.e., Python, R, SAS, SPSS, and Stata). Students in this course had free access to SPSS through the university. We incorporated several chapters directly from the Passion-Driven Statistics e-book, including Datasets and Codebooks, Data Management, and Writing for Poster Presentations. There was a multivariate chapter that we used (Dierker, 2014); however, we expanded the content in Canvas to feature a greater range of multivariate techniques. Although we did not cover several of the chapters in Passion-Driven Statistics that focused on univariate and bivariate statistics, students who needed a refresher had the opportunity to review these methods (e.g., students could review the ANOVA chapter prior to completing the MANOVA module).

In addition to the videos and materials provided through the Passion-Driven Statistics curriculum, the instructor recorded a series of video microlectures for each module. The instructor created videos for each module that included a conceptual overview of the focal analytic technique, discussion of the assumptions of the focal analytic technique, and several examples conducted in SPSS. Instructor videos were created using the recommendations for effective microlectures put forth by the Association of College and University Educators (ACUE; 2020) and were less than 10 minutes in length (for free resources on developing microlectures see the [ACUE website](#)).

Weekly Assignments

To foster collaborative learning, which is an advantage of the project-based approach (Savin-Baden & Wilkie, 2006), students worked on their final project with one or more colleagues. At the start of the semester, students selected a dataset, which they used throughout the semester. The free instructor resources that accompany the Passion-Driven Statistics e-book include a number of large, publicly available datasets with corresponding codebooks. For this course, students were given the choice of five datasets from the following projects: [The National Longitudinal Study of Adolescent to Adult Health \(Add Health\)](#), [The Behavioral Risk Factor Surveillance System \(BRFSS\)](#), [The National Epidemiologic Survey on Alcohol and Related Conditions \(NESARC\)](#), [Outlook on Life Survey](#), and the Pew Research Center's American Trends Panel from March 2020 that addressed COVID-19. Students were able to form groups based on interest in using particular datasets. Using these datasets provided students the opportunity to work with real-world data, which offered greater authenticity and complexity than simulated data. Moreover, providing students the opportunity to select their dataset and research questions can lead to greater motivation and engagement (Blumenfeld et al., 1991; Savin-Baden & Wilkie, 2006).

Throughout the semester, students worked with the dataset they selected by applying the concepts and techniques presented in each module. Weekly assignments, which were modeled after those presented in the *Passion-Driven Statistics* e-book, required students to apply the analytic technique featured in the module to their dataset. For example, for the MANOVA module students would formulate research questions to test using MANOVA with their dataset, carry out the analyses, and report their findings.

Final Project

The class culminated in a final project in which students prepared a scientific poster and presented it to the class. The requirement was that the final project feature at least one multivariate technique. As mentioned previously, students in the course came from multiple graduate programs and could select topics congruent with their interests. Sample final projects included school psychology students examining predictors of suicidal ideation in adolescents and counseling students examining the burden of combating racism of people of color. We observed that the most well received projects by the class were those that examined stress and anxiety surrounding COVID-19, as many students pointed out this had tremendous relevance to their lives and current experiences.

An online, asynchronous conference at the conclusion of the course provided an opportunity to feature student work. In on-ground courses, *Passion-Driven Statistics* lends itself to hosting a poster symposium for students to share their work. Although an on-ground symposium was not possible given the online course format and COVID-19 conditions, students posted a PDF of their poster to a discussion board on Canvas, accompanied by a brief video presenting their findings. Students in the course watched each presentation and provided feedback to their colleagues for improving their poster. The instructor also provided feedback to each group of students on their final project using a rubric. The last step before the semester ended was for students to revise their posters in response to peer and instructor feedback and to post the updated draft.

Instructor Presence

In this course, the instructor served as a facilitator and monitored student progress throughout the semester (Arantes do Amoral & Fregni, 2020; Hmelo-Silver, 2004). Courses using the *Passion-Driven Statistics* method often employ a flipped classroom approach in which students watch videos outside of class and use face-to-face class time to work with their dataset (Gallagher et al., 2020). For the online, asynchronous format of the class, we tried to employ a similar approach. The instructor was available for 90 minutes each week for drop-in hours over Zoom, and students could ask questions about different analytic techniques and work on their project with instructor support.

In addition to these drop-in hours, each group of students met three times with the instructor over the course of the semester. Students signed-up for Zoom conferences at the start, midpoint, and end of the semester. At the initial conference, students presented their research question for the final project and had the opportunity to ask any questions about the course. At the mid-semester meeting, students shared their progress on the project and presented any challenges they faced in completing the project. At the final meeting, students shared their findings with the instructor and asked any remaining questions prior to sharing their work in the online conference. During the final meeting, students also were given the opportunity to reflect on the semester and their experiences working on the project. Students were encouraged to schedule additional times throughout the semester should they need additional support with their project. These meetings served as one way to demonstrate instructor presence in this online course, as students had multiple opportunities to interact with the professor

synchronously and at times that fit their schedules during a semester that was challenging given the ongoing pandemic.

Teaching Reflections and Tips

Teaching this course online for the first time was made easier by the many free resources available through Passion-Driven Statistics. Course materials were made available from faculty employing this approach (e.g., sample syllabi, datasets, and assignment instructions) via the [Passion-Driven Statistics Schoology account](#). Further support was available from project staff to assist in implementing this approach, including the opportunity to discuss ways to modify the Passion-Driven Statistics approach to meet instructors' needs given the format and level of their courses.

At a broad level, project-based learning has been associated with positive learning outcomes. A recent meta-analysis indicated positive effects of project-based learning on academic achievement with medium to large effect sizes (Chen & Yang, 2019). More specifically, Passion-Driven Statistics has demonstrated favorable outcomes. The Passion-Driven Statistics curriculum has been rigorously evaluated, yielding positive effects. Undergraduate students considered the Passion-Driven Statistics approach to be more "rewarding" than traditional approaches to teaching statistics (Dierker et al., 2018; Gallagher et al., 2020). Undergraduate students in courses using the Passion-Driven Statistics framework were also more likely to indicate wanting to take additional statistics coursework (Dierker et al., 2018). Specifically, focusing on our Advanced Statistics II course, the Passion-Driven Statistics approach also worked well for graduate multivariate statistics. Students in Advanced Psychological Statistics II reported greatly enjoying the experience of using the Passion-Drive Statistics framework as part of their online coursework. One student reported that the format "give[s] invaluable experience down the road for other courses." Another student noted they appreciated the opportunity to work "with real-life data, which are not always perfect." When surveyed, 87% of students indicated the course had prepared them for advanced coursework or thesis work.

The main challenges of the class revolved around group work, which can be even more complicated when implemented in an online course (Chang & Kang, 2016). At the start of the semester, students completed a team contract indicating how members would communicate, expectations for group members, and ramifications for failing to do one's part. However, students who were uncomfortable with the material may have leaned on other group members. One student shared the observation that, "if a student in the group didn't understand how to run the data themselves, they would just hang back and let the other students do the work and never learn it for themselves." The next time this course is offered, students will be asked to submit their own individual syntax and write-up, which may reduce the number of issues surrounding collaborative work.

In conclusion, the Passion-Driven Statistics curriculum was successfully adapted to a graduate multivariate statistics course. Students formulated and tested research questions for topics they were passionate about, and in so doing, gained experience with real-world datasets that helped prepare them for their programs' future milestones and for their careers. We encourage you to visit the [Passion Driven Statistics website](#) to request access to the free and open-source materials, and to learn more about this approach to engage your students in answering interesting and authentic research questions with large, publicly available datasets.

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Contact Information

Lisa Rosen, Ph.D.
Associate Professor
Department of Psychology and Philosophy
Texas Woman's University
lrosen@twu.edu

Kristin Flaming, M.A.
Instructor
Department of Psychological Science
Valdosta State University
kflaming@valdosta.edu

Author Note

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