Teaching Statement

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It has been an absolute pleasure for me to share my knowledge and understanding of statistics with young minds. I have been a professor at the University of New Mexico since August 2008. Prior to joining UNM, I worked as a teaching assistant at Arizona State University. My primary objective is to equip my students with the necessary knowledge and confidence to succeed. I strive for them to grasp the fundamental concepts of the course, analyze and solve problems independently, and develop a solid foundation for their future endeavors.

My teaching philosophy is built on meticulous preparation, effective classroom instruction, and an open-door policy. For each class, I devote considerable effort to organize my lecture notes, incorporate real-life examples, and present complex material in a simplified manner. Moreover, fostering a good rapport with my students is of utmost importance to me. Apart from being easily accessible to students (I welcome appointments and drop-ins), I consistently remind and encourage them to complete their assignments on time. My aim is for students to develop positive habits that will not only contribute to their success in my class but also in their future work. Additionally, I integrate my research into teaching and encourage students to grasp statistical theories through hands-on projects. I derive great satisfaction from teaching both theoretical and applied statistics and have a particular interest in developing specialized courses on topics such as smoothing splines and data mining.

In my department, the standard teaching load used to be four courses per year, which has now been reduced to three courses per year. During my recent one-year fellowship at the National Center for Health Statistics, my focus is directed towards the collaborative project titled "Small Area Estimation using Machine Learning methods". Between Fall 2008 and Spring 2022, I had taught 11 different courses, as summarized in Table 1. I have supervised 12 individual reading/research courses for graduate students. In Spring 2018, I developed a new curriculum for "Statistical Computing" (Stat 590), and in Spring 2012, I designed the course "Nonparametric Curve Estimation" (Stat 586), which I continue to update each time I teach it. The diverse range of courses I teach is a result of both my wide-ranging interests and the extensive curriculum offered by our department.

Section 1 provides an overview of the courses I have taught from Fall 2008 to Spring 2022; Section 2 offers a detailed discussion of four courses to exemplify my teaching approach, including two graduate courses, Statistical Computing and Nonparametric Curve Estimation, a frequently taught cross-labeled course, Stat 445/545: Analysis of Variance and Experimental Design, and one undergraduate course, Stat 345: Elements of Mathemat-

ical Statistics; Section 3 delves into my experience mentoring undergraduate and graduate students. Because of staffing issues, Statistics faculty rarely teach lower division courses.

1 Summary of courses taught (2008-2022)

Table 1: Summary of Courses Taught at UNM from Fall 2008 to Spring 2022

Name	Text Author(s)	Description
Statistical Computing (STAT 598)	Lecture notes	Algorithm development for problem-solving using resampling and simulation techniques, tailored for graduate students
Nonparametric Curve Estimation (STAT 586)	Eubank	Theoretical and practical knowledge of smoothing and nonparametric regression techniques for graduate students
Stochastic Processes (STAT 565)	Ross	Application of stochastic models for graduate students
Probability (STAT 561)	Casella & Berger	Probability theory for undergraduate and graduate students
Statistical Inference with Applications (STAT 553)	Casella & Berger	Theory of statistical inference for undergraduate and graduate students
Regression Analysis (STAT 540)	Kutner, Nachtsheim, Neter, & Li	Comprehensive analysis of regression techniques for undergraduate and graduate students
Analysis of Variance (STAT 545)	Kutner, Nachtsheim, Neter, & Li	Analysis of Variance and Experimental Design for undergraduate and graduate students
Sampling: Design and Analysis (STAT 572)	Lohr	Theory and practice of sampling techniques for undergraduate and graduate students
Industrial Statistics (STAT 570)	Vardeman & Jobe	Statistical methods tailored for solving industrial problems, suitable for undergraduate and graduate students
Introduction to Statistics and Probability (STAT 345)	Montgomery & Runger	Introduction to mathematical statistics and probability concepts for undergraduate students
Introduction to Statistics (STAT 145)	Moore	Fundamentals of statistics for undergraduate students

Courses taught as overload

1. 2023 Fall, Stat 650, Reading and Research, 1 student.
2. 2022 Spring, Stat 699, Dissertation, 1 student.
3. 2021 Fall, Stat 699, Dissertation, 1 student.
4. 2021 Spring, Stat 699, Dissertation, 1 student.
5. 2020 Fall, Stat 699, Dissertation, 1 student.
6. 2020 Fall, Stat 649, Seminar of Prob and Stats, 1 student.
7. 2020 Spring, Stat 650, Reading and Research, 3 students.
8. 2019 Fall, Stat 650, Reading and Research, 1 student.
9. 2018 Fall, Stat 650, Reading and Research, 2 students.
10. 2017 Spring, Stat 650, Reading and Research, 1 student.
11. 2016 Spring, Stat 650, Reading and Research, 1 student.
12. 2015 Fall, Reading and Research, Stat 650, 1 student.
13. 2014 Spring, Master Thesis, Stat 599, 1 student.
14. 2012 Spring, Reading and Research, Stat 650, 2 students.

2 Illustration of teaching graduate, cross-labeled (both undergraduate and graduate), and undergraduate courses

2.1 Nonparametric Curve Estimation (Stat 586, graduate course)

I have taught Stat 586 in Fall 2010, Spring 2012, Fall 2015, and Spring 2020. This course is designed to provide graduate students in statistics with both theoretical and practical knowledge of modern smoothing and nonparametric regression methodologies. The topics covered include Kernel estimators, smoothing splines, density estimation, generalized additive models, higher dimensional splines, and model selection. Emphasis is placed on the important task of selecting tuning parameters, such as smoothing parameters in smoothing

splines and bandwidth parameters in kernel smoothers. Smoothing splines gained recognition as a significant statistical tool largely due to Wahba's contributions in the late 1980s. Over the past years, we have witnessed numerous applications of smoothing splines across various disciplines.

During the course, I explore both theory and application in great detail. I aim to provide students with a comprehensive understanding of the underlying motivation behind each method and offer a broad perspective on statistics as a whole. As nonparametric function estimation is my primary research area, I have the opportunity to incorporate my research ideas into the classroom. Each student is assigned a manageable research topic for their final project, as I believe that engaging in a research project effectively reinforces the course material, particularly at the graduate level. Although these projects have proven to be challenging, students embrace the opportunity and find fulfillment in the class. Some students' interest in their research projects has extended beyond the semester, leading to collaborations on subsequent research papers:

1. Guoyi Zhang, Gongzhen Mao, and Yang Cheng, Adjusted Confidence Band for Complex Survey Data, *Communications in Statistics-Simulation and Computation*, Volume 45, No. 6, 1896-1904, 2016.

2. Guoyi Zhang, Fletcher Christensen, and Wei Zheng, Nonparametric Regression Estimators in Complex Surveys, *Journal of Statistical Computation and Simulation*, Volume 85, Issue 5, 1026-1034, 2015.

3. Sheng-Yang Wang and Guoyi Zhang, Price Pattern Recognition Utilizing Local Polynomial Regression, *Journal of Trading*, Vol 7, No. 2, p 37-43, 2012.

The response from students was overwhelmingly positive. Here are some sample comments from students:

> *"Great class. It helps me a lot for my dissertation. Instructor knows the material intimately, set a good pace for the course, was very responsive to outside emails/questions, lectured clearly often repeating ideas for retention".*
>
> *"Dr. Zhang is one of the best in business, data processing and project research. It's a very good course for doing research in the future."*
>
> *"Zhang is a true expert in this area. Although there is an enormous amount of material to cover for even a basic understanding of the nonparametric curve fitting methods,*

Zhang somehow managed to succeed in imparting a good deal of theoretical and applied knowledge, especially in regard to designing simulations, and utilizing data-driven methods. An excellent research area that should probably be expanded into general courses."

"It is a very good class and Prof. Zhang is definitely an expert in this area. He is very knowledgeable and the class covers a large area of nonparametric statistics from basic theorem to the application. Also, Professor Zhang is a very nice and kind person, he provided us with good assistance on R program and he would carefully explain the problem if we have questions. In the final project, he is very helpful in helping me to identify and solve the problem. In general, Prof. Zhang is very nice and knowledgeable and I learned a lot from the class. This is a very interesting class and I would recommend it to anyone who is interested in Nonparametrics."

2.2 Statistical Computing (Stat 590, graduate course)

In Spring 2018, I had the opportunity to teach statistical computing and develop a new curriculum for the course. The focus of the course was on advanced statistical modeling and modern computational methods used for solving integration and approximation problems in statistical inference. During the classes, I placed emphasis on developing algorithms to tackle various statistical problems through resampling and simulation techniques, such as the bootstrap, Monte Carlo methods, and Markov chain methods for approximating probability distributions.

Teaching this course presented significant challenges due to the high level of required theoretical and computational skills, coupled with varying levels of background knowledge among students. To manage these challenges, I provided an overview of key statistical techniques and methods, encouraged students to collaborate in small groups on topics of their interest, and offered support through email, office hours, and scheduled appointments. Please allow me to share some student comments that highlight my teaching approach and demonstrate the students' enjoyment of the class.

"There was a great deal of material in this course that I probably would not have run into any other class the department offers. I learned huge amounts of highly relevant material. I would highly recommend that this course be offered regularly."

"There was a very helpful overview of various computing techniques and non-parametric regression, which may be very useful."

"I enjoyed the balance of the theory and the r code. The HW was effective in reinforcing and exploring ideas. I loved the open ended format of the final project!"

"The professor always replies extensively to the questions and it is obvious that he is very proficient in his field. It was great that we focused on aspects of nonparametric methods and had lessons about sampling and generalized additive models. Homework were of good quality and it was fun doing them."

"I like that students were given freedom of creativity on their final projects; I feel that everyone has got their favorite project topics. So there are many reasons that students have enjoyed this class. A bonus is that we have covered code for all the interesting models - this will surely prove useful in our future study/careers."

I find great fulfillment in teaching this class, as it nurtures an exceptionally interactive atmosphere. It brings me immense happiness to observe students truly comprehend the material and exhibit their capability to apply it in practical problem-solving. Here are a few illustrations:

1. Nikolay Miller, Yiming Yang, Bruce Sun, and Guoyi Zhang, Identification of Technical Analysis Patterns with Smoothing Splines for Bitcoin Prices, *Journal of Applied Statistics*, Volume 46, No. 12, 2289-2297, 2019.

2. Dominic Lewinski, Yiming Yang, Zhongxue Chen, and Guoyi Zhang, Reversion and Location Trends in the Bitcoin Market, *International Journal of Data Science*, Volume 4, No. 4, 275-287, 2019.

3 Analysis of Variance and Experimental Design (Stat 445/545, offered to both undergraduate and graduate students)

This course is divided into two parts: analysis of variance (ANOVA) and design of experiments. In the ANOVA portion, students will explore topics such as single-factor ANOVA, two-factor ANOVA with balanced designs, unbalanced factorial designs, and general multifactor studies. The design of experiments component covers important concepts like randomization, randomized complete block designs, nested and split plot designs, and repeated measures. Together, these topics provide a comprehensive understanding of both ANOVA

and design of experiments, offering students a solid foundation in statistical analysis and research methodology.

Stat 445/545 holds a significant role as a core course for the department's Ph.D. qualifying exam, attracting both undergraduate and graduate students from diverse academic backgrounds. The student cohort includes majors in Math and Stats (the majority), Biology, Economics, Sociology, the College of Education, the School of Medicine, and the School of Engineering.

Teaching students with varying backgrounds, encompassing both undergraduate and graduate levels, presents a considerable challenge during lectures. To address this, I dedicate the initial lectures to reviewing introductory statistics. For instance, I reintroduce Student's t-statistic in a rigorous manner, drawing on linear model theories and mathematical statistics. This approach instills in students the importance of comprehending the underlying theory and assumptions behind statistical procedures, rather than viewing them as mere formulas to memorize. Throughout the course, I demonstrate the consequences of violating fundamental assumptions and teach strategies to address such violations. As a result, many students have developed an increased awareness of the significance of diagnostics and remedial measures.

Based on conversations with students, it has become evident that mixed models and design of experiments are particularly intriguing to them. Consequently, I devote approximately half of the semester to introducing mixed models, repeated measures, and classical designs such as randomized complete block designs, nested and split plot designs. Given that Stat 445/545 is among the courses that lay the foundation for the take-home data analysis qualifying exam, I have integrated a midterm project into the curriculum to assist students in their exam preparation. The students' overwhelmingly positive response to this approach, along with the overall feedback they have provided about the class, has been incredibly encouraging.

> *"After having had two semesters with Professor Zhang, I have to admit, he really does his best to introduce and explain difficult concepts to the students in the simplest/most intuitive way possible. He deserves a lot of credit for that, and I really appreciate his effort. Furthermore, topics like ANOVA, which aren't necessarily intuitive when you are first introduced to them, are much easier to understand with context. Professor Zhang motivated each section sufficiently, provided context, and gave plenty of examples. It made following along in the book a lot easier after attending lecture. I also found the homework assignments useful in reinforcing the concepts presented in class. The midterm project was actually a highlight of the course for me because it allowed us as*

students to apply ourselves and what we had a learned to a real problem! In retrospect, the midterm project itself wasn't all that difficult, but it forced students to THINK, which I appreciate. Furthermore, it is critical for future statisticians to be able to think through real-world problems because rarely are real-world problems as simple to solve as homework (and many times they don't have a "right" answer). Professor Zhang always does a nice job of accommodating the students and answering each student's question thoroughly. I also really like that he is able to share his experiences in doing real research in class with us. I don't regularly write reviews, but I really want to communicate to Professor Zhang and the department that his course was useful and taught well. I hope that he continues to teach with the honesty and enthusiasm that I have become so accustomed to."

"*Professor Zhang is very approachable. He presents material clearly with lots of context. He frequently presents areas where there is debate within the field and explains why there are disagreements between practitioners. He is clearly enthusiastic about the material. Prof. Zhang's overall level of knowledge and presentation style guarantee that I will actively seek out classes that he teaches in the future."*

"Prof. Zhang spends a long time to go over every concept in great depth. By the time we are finished with a topic I feel like I know the subject at the level needed to pass the qualifier exam. The midterm was challenging and excellent practice for preparing for the take home part of the QE, I think that this was much more useful than having a standard midterm test. I know it must have been a lot of work to grade the entire class's reports but it gave me an good idea of where I stand, what I should practice, and where I am rock solid for the QE take home."

"Dr. Zhang is very thorough in making sure we are aware of different and sometimes conflicting ideas between statisticians, and I feel it has given me a realistic perspective of the new career I will be heading into."

"Dr. Zhang has done an excellent job teaching this class. This class became one of my favorite classes this semester. Dr. Zhang is funny in this class, a side of him I didn't see when I was in his other classes. This was very cool!"

"Although a lot of this material has been covered in previous courses. I have enjoyed this class. Professor Zhang does a good job explaining concepts and encouraging students to think independently. I like being required to write up reports for more in-depth analysis problems. I feel this should be required in all statistics classes. It is an important skill."

4 Elements of Mathematical Statistics and Probability Theory (Stat 345, undergraduate course)

This introductory course functions primarily as an undergraduate service course, aiming to provide students from various programs with a solid foundation in probability theory and statistical inference, despite their limited statistical background. After all, we do require it of all our majors. To foster their interest and enhance their engagement, I employ a motivating approach. For instance, I use students' own homework scores as data to introduce fundamental concepts such as mean, median, quantile, and variance. I have observed that using their own scores as examples captures their attention and boosts their interest. Throughout the semester, I incorporate real-life examples to illustrate key concepts like randomness, point estimation, confidence intervals, and hypothesis testing. This approach not only captivates the students but also deepens their understanding of the subject matter.

To ensure continuous progress and success, the course includes regular homework problems, weekly quizzes, two midterm exams, and a final exam. I strongly believe that this structure assists students in maintaining pace with the material and ultimately achieving positive outcomes. Some comments from students in the course include:

> *"Dr. Zhang runs the class professionally in a way that encourages students to hold themselves to high standards and ask questions. Excellent course/instructor!"*
>
> *"Professor Zhang somehow made me appreciate statistics, something, I would never think possible. He teaches the most important material and has high, but not impossible standards."*
>
> *"Dr. Zhang was available to help outside of class, and even assisted me with a problem for a project that covered material we hadn't yet discussed in class. Thanks!"*
>
> *"Professor Zhang is extremely straight forward with what he expects out of us in the class and what we need to focus on. Lots of homework and periodic quizzes helped me make sure I didn't fall too behind in the course. I always enjoy the 2 midterms and 1 final approach for any class. Going over lots of examples for each topic and before exams was also a big help. Great professor."*
>
> *"Every start of the class, Dr. Zhang does the review of previous topic that we covered. This always helps, because even it was just two days ago, I forget. This always helps to refresh my memory. Because Dr. Zhang office hours conflict with my classes, he was*

able to set-up appointment outside his office hours, which I'm thankful for. Dr. Zhang is very helpful and approachable!"

" I really like the lectures that you give. You move quickly and do lots of examples and are always prepared to give lectures. Quizzes are difficult and I have a pretty bad average, but they help for preparing for exams since they give a very good overview of the equations and the types of problems we will do on the exam. Formula sheets are nice and for a professor to still do reviews before exam is a rarity but highly appreciated."

5 Undergraduate and Graduate Students Mentoring

Mentoring both undergraduate and graduate students is an immensely rewarding aspect of my work. Over the years, I have had the privilege of supervising the dissertations of 5 Ph.D. students and the thesis of 1 master's student. In addition to these supervisory roles, I have provided mentorship to numerous graduate and undergraduate students, offering guidance on various aspects such as course selection, academic pursuits, and career development.

Furthermore, I take great pride in actively participating as a member of thesis committees, providing valuable insights and guidance during the research and writing process. Additionally, I have been dedicated to supporting students in their academic and professional pursuits by writing numerous recommendation letters. Through these letters, I aim to provide strong endorsements that highlight their strengths and potential. These efforts reflect my commitment to helping students achieve their goals and succeed in their chosen paths.

I am particularly proud to share that, under my guidance, 11 research papers authored by students have been successfully published in reputable statistical journals. This achievement is a testament to the dedication and hard work of these talented individuals, and I am honored to have played a part in their research journey.

Ph.D advisement:

- Haiyang Zhu, Expected May 2025
  Dissertation Title: Small area estimation using machine learning methods

- Nikolay Miller, August 2022
  Dissertation Title: Statistical Extensions of Multi-task learning with Semi-parametric methods and Task Diagnostics.

- Sarah Alver, May 2022
  Co-advised with Dr. James Degnan
  Dissertation title: Measurement Error Modeling Applied to Phylogenetic Inference and Parametric Bootstrap Approach to Multi-factor ANOVA Models with Unequal Variances and Unbalanced Data

- John Pesko, May 2017
  Co-advised with Dr. Ronald Christensen
  Dissertation title: Contributions to Statistical Testing, Prediction, and Modeling.

- Lang Zhou, May 2016
  Co-advised with Dr. Yan Lu
  Dissertation Title: Neyman Smooth-Type Goodness of Fit Tests in Complex Surveys.

Master advisement:

- Bose Falk, December 2014
  Thesis title: A Generalized Confidence Interval Approach to Comparing Log-normal Means, with Application.

Graduate student research achievement under my supervision:

1. Mentored graduate student Nikolay Miller on research and wrote a paper "Additive Multi-task Learning Models and Task Diagnostics", *Communications in Statistics - Simulation and Computation*, accepted, Apr 2023.

2. Mentored graduate student Sarah Alver on research and wrote a paper "Multiple Comparisons of Treatment vs Control Under Unequal Variances Using Parametric Bootstrap", *Journal of Applied Statistics*, accepted, 2023.

3. Mentored graduate student Sarah Alver on research and wrote a paper "Simultaneous Confidence Intervals for Pairwise Multiple Comparisons in Multi-Way Unbalanced

Design with Unequal Variances", *Communication in Statistics - Simulation and Computation*, Published online: 3 Aug 2022.

4. Mentored graduate student Lang Zhou on research and wrote a paper "A Neyman Smooth Type Goodness of Fit test with Survey data", *Journal of Survey Statistics and Methodology*, under review.

5. Mentored graduate student John Pesko on research and wrote a paper "Parametric Bootstrap and Objective Bayesian Testing for Heteroscedastic One-way ANOVA", *Statistics & Probability Letters*, accepted March 2021.

6. Mentored graduate students Dominic Lewinski and Yiming Yang, wrote a paper "Reversion and Location Trends in the Bitcoin Market", *International Journal of Data Science*, Volume 4, No. 4, pages 275-287, 2019.

7. Mentored graduate students Nikolay Miller and Yiming Yang on research and wrote a paper "Identification of Technical Analysis Patterns with Smoothing Splines for Bitcoin Prices", *Journal of Applied Statistics*, Volume 46, No. 12, pages 2289-2297, 2019.

8. Mentored graduate student Bose Falk on research and wrote a paper "Inference of Several Log-normal Distributions", *International Journal of Mathematics and Statistics*, Volume 20, No.3, 1-10, 2019.

9. Mentored graduate student Maozhen Gong on research and published a paper "Adjusted Confidence Band for Complex Survey Data" in *Communications in Statistics-Simulation and Computation*, Volume 45, No.6, 1896-1904, 2016.

10. Mentored graduate student Fletcher Christensen on research and published a paper "Nonparametric Regression Estimators in Complex Surveys" in *Journal of Statistical Computation and Simulation*, Volume 85, Issue 5, 1026-1034, 2015.

11. Mentored graduate student Sheng-Yang Wang on research and published a paper "Price Pattern Recognition Utilizing Local Polynomial Regression" in *Journal of Trading*, Volume 7, No.2, 37-43, 2012.