Statistical literacy is becoming an increasingly valued characteristic of the informed citizen. People should understand ideas of uncertainty and forecasts when they listen to the news. Additionally, many disciplines and jobs today require students to be familiar with certain statistical concepts such as data analysis and hypothesis testing. As such, there is often much diversity in the statistical classroom, with various motivations for enrolling in the course. When teaching an introductory statistics course at Duke University, I had students spanning several majors, student-athletes, foreign exchange students, students who had previously taken a statistics course, and students who simply needed a passing grade in the course to graduate. However, early on, I also realized that these students shared something in common: they all experienced some degree of statistical anxiety. Students enrolling in statistics courses often enter with a preconceived notion that they will not excel; they have anxiety before and during the course. Interestingly, when I taught an introductory *data science* course, the diversity of students was roughly the same, but the anxiety was notably absent. What is it about data science that makes students excited to learn? Moving forward in my statistical teaching, I aim to incorporate into my methods what I believe are the aspects of data science education that resonate with students. As an educator of statistics, I work to dismantle the misconceptions of inadequacy, and I encourage students to become active participants in their learning. Specifically, I actively work to (1) employ teaching techniques that aid in developing statistical intuition, (2) help students utilize data to gain insights and properly evaluate claims, and (3) foster an accepting classroom environment that gives students agency in their learning

Introductory statistics courses have a reputation for being confusing because they often dive right into complicated procedures, rather than begin by developing a strong statistical foundation. Students in statistics courses commonly experience anxiety when they hear the terms “standard deviation” or “variance” because many educators do not teach these concepts in an intuitive manner. This is truly unfortunate because uncertainty or variability is one of the most fundamental components of statistics. Students are usually taught the formula for how to calculate the standard deviation, yet knowing the formula does not aid students in their understanding of variability. Rather than just writing the formula on the board and having students calculate the standard deviation of a dataset, I present examples that help illuminate the concept of variability. The examples may be visual, theoretical, story-driven, etc., in order to accommodate all learners. By extrapolating the learning of standard deviation beyond a robotic calculation, I aim to help students better understand the concept of variability. Providing examples rather than emphasizing formulas in order to establish a solid foundation is one technique for developing statistical intuition. By grounding statistical concepts in fun, captivating examples such as the famous Monty Hall problem, the “birthday” problem, or estimating the value of pi using only a square and a circle, I work to simultaneously grow the students’ curiosity but also to help them extrapolate beyond the details/formulas and view concepts from a bigger picture. Additionally, when teaching the introduction to data science course, I found that students were able to quickly understand or grasp statistical concepts through the lens of an illustrative dataset or research article. Some examples include motivating Simpson’s Paradox using the UC Berkeley gender bias case, and using a two-sample difference in proportions test to test a Mythbusters claim that yawning is contagious.

My second goal as a statistical educator is to help students interpret their data in a proper and meaningful manner. This is especially crucial because many students—especially those in

disciplines such as Psychology or Biology—will be expected to perform hypothesis tests or fit regression models in future classes or jobs. In fact, many non-STEM fields are now requiring STEM skills, including data analysis. Many of my students—both in the introductory statistics course as well as the data science course—would attempt to perform a statistical test on categorical data that is only valid for numerical data, simply because they never asked questions of the data in a pre-modeling stage. From this experience, I learned that students struggle in performing the proper test because they did not understand or interrogate the data they were working with. As a result, I now emphasize the importance of "getting dirty with the data". One crucial component of any data-driven project is exploratory data analysis (EDA), where we visualize the data and obtain summary information prior to any modeling or formal testing. I ask my students to perform thorough EDA so they better understand the data before moving forward with the more complicated modeling procedures. For example, for the final project in the introductory data science course, I required my students to submit a proposal that contained at least two forms of EDA before developing a research question. I asked them to reveal insights obtained through EDA alone in order to motivate their research questions. This emphasis on EDA helps to develop awareness for the kinds of models that are valid and proper for the data. I also emphasize the importance of interpreting statistical results; conclusions from a statistical test are meaningless unless the audience of interest can understand them. Contextualizing results for the layperson or audience is a crucial, especially for fields other than statistics. Additionally, emphasis on interpretation helps students see beyond a formulaic approach to a data analysis problem, and instead to view the process as a holistic, multidisciplinary process.

My third goal is to create and maintain a classroom where students are active participants in their learning. When students feel like they have agency in their learning, they become more involved in and naturally curious about the material. I work to present myself as a peer, rather than strictly as an authority figure. I encourage students to ask questions, and I make myself available before/after class, during office hours, and via e-mail. I want students to know that asking questions is not a sign of poor performance, but rather a signal of engagement. Speaking from my own experience as a student, often if no one asks questions, it is because they are too lost to know what to ask. Therefore, I ask for questions from the students early on in the lecture in order to give them ample opportunity to gain clarity and avoid feeling lost. Additionally, I encourage students to explore data analysis projects related to their field or hobbies, and I also construct examples related to their disciplines. For the final project in my data science course, about half of the students used data related to their discipline or research, and it was clear that they were invested in the project not for the sake of a good grade, but because they were genuinely interested in answering their research questions. I have also found that students have more agency in their learning when their feedback and issues are addressed by the professor. Therefore, I ask students to complete midterm evaluations so I can receive feedback and adjust the material to their needs.

Beyond classroom activities, I also strive to ensure all students feel welcome and capable in the class. I am aware that women, non-binary people, and minorities are underrepresented in the STEM disciplines. They often experience stereotype threat, have less of a technical background or familiarity with computing, and/or often do not feel comfortable asking questions or participating in class. As a STEM educator, I see it as my duty and privilege to foster an environment where such students are able to realize their potential. I try to encourage these

students to speak up more, both in class and online. I enjoy using online platforms such as Piazza because such tools allow students to contribute and actively participate without putting them on the spot in class. To help forge connections amongst the student body, I will also create support systems such as mentorship groups or a "Women/Nonbinary in Statistics" clubs.

An example of how I put my philosophy into practice occurred during my experience teaching the introductory statistics course. From the mid-course evaluation, I learned that many of my students experienced testing anxiety during the midterm exam and did not perform as well as they were capable of. I took this information and modified the final exam by including both a written and oral component to the final. The students completed the written potion, and the following day, my TA and I sat down with each student individually to go over the questions that the students struggled with. Additionally, I posed new questions that were more targeted towards students' statistical intuition, such as asking what kind of statistical tests would be suitable for a given set of data. The students were much more relaxed during these conversations, and by having them talk through their thought processes, I was able to obtain a much clearer understanding of their mastery over the material.

In addition to teaching my own courses, I have had the opportunity to develop teaching skills through other experiences. I have served as head teaching assistant (TA) for two courses, where I led lab sessions, teaching students how to use RStudio and supervising data analysis exercises. I held weekly office hours, met with students on weekends, and graded assignments and exams. I believe that TAing the classes I eventually taught was a tremendous asset. As a TA, I was able to learn directly from the students what was and was not clicking, and I had the opportunity to try explaining concepts in various ways to accommodate different learners. Therefore, as an instructor, I better equipped to teach these difficult concepts. Additionally, I helped develop lab assignments for my department's introductory Bayesian Statistics course. In doing so, I designed the labs such that they could be adapted for either an undergraduate or graduate level course. As part of Duke's Data Expedition program, I also designed and taught two lectures on text analysis to undergraduate statistics students. During the 2020-2021 academic year, I tutored a local high school student in mathematics and statistics through the Emily K Center in Durham, North Carolina. From all of these experiences, I have gained insight into what introductory statistics topics are typically challenging for students, and I have developed a toolbox of methods to explain these topics. I believe that the skills I have developed will also translate into my teaching of more advanced statistics courses.

In order to further improve my teaching skills, I am enrolled in Duke Graduate School's Certificate in College Teaching program (CCT). This program provides pedagogical training to help prepare graduate students develop as future educators. Beyond coursework, I participated in a Teaching Triangle where three graduate students in the CCT program observe and peer-review each other's teaching. Through this program, I have learned valuable teaching techniques from other students, engaged in critique of my own teaching style, and learned more about how to best teach statistics to a diverse audience. After teaching my first course, I immediately reflected on what did and did not go well, and I interrogated what I could change about my teaching style to better serve the students. I compiled some of these reflections into writing and contributed a chapter to *Teaching Gradually: Practical Pedagogy for Graduate Students, by Graduate Students*, a guide for people new to teaching and learning in higher education. When I taught my

second course, I employed changes in my teaching style based on these reflections. Based on student feedback, I believe that these changes really did improve my ability to teach statistics.

Ultimately, I strive for my students to enjoy the course and leave each day feeling like they learned something new and meaningful, whether it be statistical methodology or insights gained from data analysis. I aim for students to leave my course with both a statistical toolkit and a more nuanced intuition for evaluating the world around them. For me, teaching statistics is a dynamic process that requires frequent reflection. I am constantly learning from my teaching experiences and from my students, and I will continue to adapt my teaching methods and learn new skills in order to best accommodate my students.