

My Continuing Journey From FuZhou to City Tech

Xiaona Zhou

I grew up in FuZhou, China and moved here before my senior year of high school. Now I'm a rising junior, majoring in Applied Mathematics. Prior to beginning college, I took a detour and worked in the restaurant industry, where I made progress in my independence. I realized that it was important to get an education and obtained GED credentials in March 2017. I enrolled as a Marketing major at City Tech that fall. After one semester of studying, I realized that Marketing was not what I wanted, but I didn't know what to do at the time. Then I met Prof. Boyan Kostadinov through his Calculus I class; he encouraged me to study Mathematics. I changed my major from Marketing to Applied Mathematics after freshman year and never looked back. I would like to share my research experiences in programming at City Tech so that other students might follow along my path.

I started doing research projects in the first semester of my sophomore year. I'm a member of the Honors Program, which gives us the opportunity to earn honors credit in a regular course if we complete a project with the instructor. I was taking two math courses, Statistics I and Linear Algebra. I couldn't decide which class I wanted, so I gave my application to both instructors. They were both willing to work with me! As a result, I did four projects during my sophomore year. Some of you may think that doing four projects in one year is too much work, but that's not really true. The projects you may end up doing in this program likely have some kind of similarity with each other, and the expert help and guidance at City Tech make the process streamlined and painless.

In my very first project, I worked on analyzing winning numbers of the New York Pick 4 lottery with Professor Natov. I was able to conclude that Pick 4 is a fair lottery game using a combination of R and MATLAB software, which is a programming language widely used by mathematicians for computation, plotting functions, and more. In this project, we also explored the lucky sums of Pick 4, the sum of the four numbers picked in this lottery game. Modeling techniques were used to generate fair models of lucky sums in Pick 4, and a function was found which fits the fair model with $r^2 = .0999$. I made an R Markdown file for my project, which I presented at MAA Math Fest. To demonstrate my results to the audience effectively, I built interactive dashboards within R Markdown.

The second and third projects I did were about fractals and bivariate normal data. Professor El Hitti was my mentor on the second project. Even though we didn't dive deep into fractals due to time constraints, I learned about the interesting properties of a fractal, and how we can use matrices to generate our own fractal in MATLAB. Besides that, I also learned the basics of MATLAB, such as how to write loops and functions with the software. I started on my third project with Prof. Singh

during the winter break. In this study, we simulated bivariate normal data in MATLAB, gaining intuition about the bivariate normal distribution, and compared the generated data to the associated bivariate normal density surface. We also studied the covariance and correlation of bivariate normal data. Furthermore, we applied linear transformation to bivariate normal data, analyzing the resulting data. I presented my work at the Women in Computing conference at Microsoft.

During the spring semester, Prof. Dastidar offered me another research project. She asked me to do data analysis and MATLAB modeling of experimental data on the curing reaction of epoxy resins, polymers containing more than one epoxy group (or cyclic ether) that can be used in paints, coatings, adhesives, and electronics. I was able to finish all the computation and modeling within a week because of my MATLAB experience. Currently, I'm working on a project with Prof. Singh about primes of the shape $p = x^2 + y^2$. This project is different from what I have done before. All the other projects I have done involved programming. However, in this project, we focus on studying the mathematics and writing proofs. The project is therefore a totally different research experience, and I'm looking forward to completing it. I recently presented some of my results in this project at the MAA NY and NJ joint meeting; they were well received by the audience.

I learned extensively through doing these projects. First of all, I learned how to work seamlessly with mentors and research partners, of which City Tech has an abundance. I also learned several programming languages, such as MATLAB, Python, and R, and so on. Doing projects provided me with a more challenging aspect of my courses. Besides that, there are many positive outcomes that I gained from this experience. First of all, doing a project is a great way to learn more about the subject. Furthermore, working on projects helps professors to know you in person, and gives you the opportunity to receive personalized recommendation letters from them. Additionally, doing research helps you grow as a scholar. You can practice the skills of giving a presentation and communicating your ideas with other people in the academic community. You can also get funding to go to conferences to present your work and meet awesome people. Last but not least, research experience is also a big plus when you look for an internship or a job.

I will continue doing more interesting projects as an undergraduate student. I'm planning to go to graduate school after I get my bachelor's degree. I'm not sure what I'll be studying in graduate school yet, but it would definitely be something related to math. In the future, I want to be a mathematician and data scientist, as well as a professor, when I get older. I want to thank all the professors at City Tech who took the time and patience to guide me in my studies, make me an excellent researcher, and help chart an exciting academic trajectory, from FuZhou to CityTech and beyond.