



## **Statistical Modeling of the Fundamental Diagram of Traffic Flow**

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**Advisor: Yong Chen**

Over the course of my 10-week research experience through PURM, I engaged in a multi-disciplinary project on traffic flow. I worked under Dr. Yong Chen, from Penn's Biostatistics and Epidemiology department, and alongside our collaborators, Benedetto Piccoli and Maria Laura della Monache from Rutgers-Camden and Jingmei Qiu from University of Houston, all in the Mathematics departments at their respective institutions. Together, we sought to understand the intrinsic properties of traffic flow and to improve on existing models for decision making regarding transportation.

Dr. Chen and I employed various statistical methods, such as hypothesis testing, linear regression, and transformation, as well as techniques of big data, namely cluster analysis, to process data previously collected in places from Nevada to Rome. The results that we obtained helped drive the mathematical modeling aspect that our collaborators presided over. Through our symbiotic efforts on this project, we were able to learn many things. For instance, we realized that there may exist a phase of traffic previously unidentified by the field. Previous knowledge suggested that two phases exist: Free Flow and Congestion. Our research found that there may be a third phase, which we termed the Free Choice phase, that is part of the original Free Flow phase and that represents the situation of an empty road when drivers can choose the speed at which they travel without influence from other vehicles. We also measured the validity of several propositions related to the nature of traffic phase transition, discovering that the Free Choice and remaining part of the original Free Flow phase are separate from Congestion. We are now using our findings to develop a flexible model that describes the conditions of congestion and can be used for predictive purposes.

Throughout the duration of PURM, I gained invaluable mentorship, engaged in scientific collaboration, had the opportunity to apply concepts, old and new, to this interesting research project on traffic flow. I will remain on the project during the semester and look forward to continuing my research experience!