Research Statement

Abhilash Chandra Singh

I am a Ph.D. candidate in the Department of Civil and Environmental Engineering at Imperial College London. My approach to research is centralized yet diverse, with a focus on econometric and statistical models of human choice behaviour serving as the foundation for all other aspects. I also branch out in multiple directions, exploring consumer and travel demand modelling, the relationship between land-use and travel behaviour, accessibility, and the adoption of novel technologies such as autonomous vehicles. I conduct experiments based on revealed and stated preference surveys to better understand economic decision-making and its psychological underpinnings, generating insights to inform theory and decision-makers in the fields of consumer research, transportation and urban planning, and policy. My research papers have been co-authored with colleagues from institutions such as the University of Texas, University of Toronto, Imperial College London, University of Tokyo, and Technical University of Munich. This research network forms the basis of my current and future research efforts and dissemination of science to the academic community worldwide. In the next years of my career, I plan to harness this research capital and my network of academics, researchers, industry partners, and government officials for several additional projects. My research statement is divided into three parts: the first part focuses on my work in decision sciences and choice modelling, the second part focuses on my work in travel behaviour and urban planning, and the third part focuses on urban policy.

Decision Sciences and Choice Modelling

Past and Current work

My research focuses on the formation of consideration sets in residential location choices and addresses the simultaneity and endogeneity between residential location and travel behaviour. I have introduced a novel implementation of a machine learning-based decision tree framework to account for non-compensatory choice considerations. This framework provides exact conditions for each observation by using disjunctions-of-conjunctions decision rules, making it the first application of probabilistic decision trees in modelling consideration processes in a residential location context. The results of this analysis have important implications for improving probabilistic predictions and represent population diversity in decision making. It also provides insight into factors that lead to the consideration or rejection of neighbourhoods based on socio-economic and demographic differences, such as income level, vehicle ownership, and household structure. This research provides a deeper perspective into the causes of residential segregation and provides policymakers with information to promote equitable residential neighbourhoods. In another research paper, I address the bidirectional relationship between residential location choice (represented by accessibility measures) and travel behaviour (represented by the number of household trips by different modes of transportation). I propose a modelling framework that simultaneously considers both variables to provide a clearer identification of the "true" effect of the built environment on household trips without problems of multi-collinearity with other built environment characteristics. This analysis highlights the positive effect that greater transit facilities with better connectivity and employment reach can have on reducing driving trips and demonstrates the residential neighbourhood dissonance of transit riders. It also shows the residential neighbourhood dissonance of transit riders, such that locations with higher transit accessibility are not necessarily where people who make more transit trips reside.

Future work

Continuing the work addressing endogeneity and consideration issues in choice modelling, my future research aims to develop a multivariate modelling framework to capture the dependencies between the choice set formation, discrete choice, and endogenous variable models through the error structure of a multivariate normal distribution. By accommodating instrumental variables in the endogenous variable model, this framework will simultaneously correct the endogeneity bias on the estimates of the corresponding parameters in the discrete choice and its choice set formation models. The usual maximum likelihood estimation does not work well because it has a high-dimensional open-form structure. Thus, I will develop an efficient

(44) 745 933 4955 • *abhilash.singh19@imperial.ac.uk*
https://abhilashcsingh.github.io

Markov Chain Monte Carlo algorithm consisting of the Gibbs sampler and MH algorithms at different estimation steps. This study is also proposed as my first grant application to be submitted for the Marie Skłodowska-Curie Actions Postdoctoral Fellowship.

Travel Behaviour and Urban Planning

Past and Current work

My research focuses on understanding the factors that impact Vehicle Miles Travelled (VMT). In a previous study, I proposed a generalizable framework that considers household and individual socio-economic and demographic characteristics, residential built environment attributes, self-selection effects, and social-spatial dependency effects. The research shows that household socio-economic and demographic characteristics have a greater impact on VMT than the built environment and self-selection. In another paper, I developed a model to measure an individual's willingness to adopt an Autonomous Vehicle (AV) based on factors such as lifestyle, opinion on productive use of time, safety perception, automation levels, and socio-demographic variables. The results indicate that consumers who are willing to pay more for the technology do so due to increased productivity and safety during commuting. Another paper used psychological theories to capture individual attitudes towards AV acceptance, opening up the possibility of developing psychometric behaviour choice models.

Future work

Continuing the work on understanding the factors influencing VMT, my future research aims to develop a multivariate modelling formulation that separately measures residential self-selection effects and true built environment effects, considering the presence of multicollinearity between the residential location choice descriptor(s) and built environment attributes. I will also develop a methodology that unravels true effects from self-selection effects when explanatory variables are correlated with the endogenous descriptor used in VMT equation modelling. Additionally, I will further explore social-spatial dependency effects in joint models of discrete-continuous variables. Furthermore, I plan to investigate the adoption of new technologies, such as autonomous vehicles, by developing socio-psychological econometric models based on the Theory of Reasoned Action and socio-domestic acceptance models based on the Technology Acceptability Model.

Urban Policy

Past and Current work

Accessibility refers to the availability and ease of reaching destinations through various modes of transportation, as well as the level and type of activities found there. My research focuses on improving accessibility measurement, incorporating factors such as big data, technological advancements, sustainable policy, and a growing emphasis on equity, affordability, and quality of life. In one paper, I propose a new framework that leverages technology to design accessibility-focused transport services. Another study examines accessibility to education destinations, with a particular focus on families with children. This research finds that current measures may not accurately reflect equity in urban areas, due to a lack of consideration for differences between individuals and households. I propose a new framework that incorporates factors such as air pollutants, crime, and destination quality. On average, accessibility scores were 8 percent lower than expected, highlighting the significant impact of environmental and crime factors. Another paper looks at declining accessibility to healthy food for low-income populations and its long-term health consequences. I use a location-choice model to analyse food accessibility for these households and determine the impact of factors such as socio-demographic characteristics, mobility, and the built environment on food shopping location appeal.

Future work

I aim to develop more comprehensive and multi-dimensional accessibility indicators for employment, education, and healthcare opportunities. A natural extension of my research is to apply this framework to the choices that low-income individuals make when purchasing food inside of the store. This may include a metric of the relative healthy choices of the total purchases made at the grocery store as the outcome, with the goal of determining what factors influence the choices to buy healthy or processed foods. Uncovering these effects might help food researchers to better formulate strategies that encourage low-income individuals to purchase healthier food.