Research Statement

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I am a Ph.D. Candidate in the Department of Civil and Environmental Engineering at Imperial College London. I have a centralized yet diverse approach to research, with a centrality on econometric and statistical models of human choice behaviour, serving as the foundation for all other aspects. However, I also branch out in multiple directions, exploring consumer and travel demand modelling, relationships between land-use and travel behaviour, accessibility, and the adoption of novel technologies such as autonomous vehicles. I employ experiments based on revealed and stated preference surveys to better understand economic decision-making and its psychological underpinnings, generating insights to inform theory and real-world decision-makers in the areas of consumer research, transport and urban planning, and policy. My research papers are co-authored with colleagues at 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 worldwide academic community. I intend to harness this research capital, as well as my personal contacts with academics, researchers, industry partners, and government officials, during the next years of my career for several additional projects. My research statement is in three parts; the first part is about my work in decision sciences and choice modelling, the second part is about my work on travel behaviour and urban planning, and the third part is about urban policy.

Decision Sciences and Choice Modelling

Past and Current work

My research focuses on addressing the formation of consideration sets in residential location choices. I have introduced a novel implementation of a machine learning-based decision tree framework to account for non-compensatory choice considerations. The decision trees resolve ambiguity by deriving exact conditions for each observation by using disjunctions-of-conjunctions decision rules. To the best of my knowledge, this is the first application of probabilistic decision trees to model consideration process in a residential location choice context. The research results have important implications for improving probabilistic predictions, representing population diversity in decision making, accommodating multiple choices and reducing independence in consideration set formation. In addition to a deeper understanding of factors that contribute to residential location choice, this analysis provides us factors that lead to consideration or rejection of neighbourhoods based on socio-economic and demographic differences by income level, vehicle ownership and household structure. This information is then utilized for policies to provide equitable residential neighbourhoods and provide a deeper perspective into causes of residential segregation in London.

In another ongoing research paper, I address the simultaneity endogeneity between residential location and travel behaviour. I proposed a modelling framework that simultaneously considers the residential location choice (represented by accessibility measures) and travel behaviour (represented by the number of household trips by different transport modes). I hypothesize that using accessibility alone as the endogenous built environment variable facilitates a clearer identification of the "true" effect of the built environment as well as any remaining self-selection effects in explaining household trips without problems of multi-collinearity with other built environment characteristics. This analysis fills a major gap in disentangling the bidirectional endogenous relationship and demonstrates an empirical context where the bidirectional relationship between travel behaviour and residential location choice is explicitly identified and disentangled. From a policy perspective I show that providing greater transit facilities with better connectivity and employment reach can have a positive effect on the desired decrease in driving trips. Further, I highlight the residential neighbourhood dissonance of transit riders and demonstrate that locations with higher transit accessibility are not necessarily locations 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 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

Contributing to the understanding of the factors affecting Vehicle Miles Travelled (VMT), my previous research proposed a generalizable framework that can be applied in any geographical context. The factors affecting VMT include household and individual socio-economic and demographic characteristics, residential built environment attributes, self-selection effects based on lifestyle preference, and social-spatial dependency effects. This research recognizes the correlation between residential density and VMT and isolates the causal effects of high-density living on VMT. The findings suggest that household socio-economic and demographic characteristics play a larger role in shaping household VMT compared to the built environment and self-selection. Furthering this line of research, I developed a model to measure an individual's willingness to adopt an AV based on lifestyle latent constructs, opinions on productive use of time, safety perception, automation levels, and socio-demographic variables. The methodology used an endogenous latent-class segmentation model to account for group taste heterogeneity. The results show that consumers who are willing to pay more for the technology do so due to the perception of increased productivity and safety during commuting. Another research paper used latent psychological constructs to capture individual taste heterogeneity and develop classes of individuals with similar attitudes towards AV acceptance. These efforts incorporated psychological theories of new technology adoption into econometric methods, opening up the possibility of developing psychometric behaviour choice models.

Future work

Continuing the work on understanding the factors influencing Vehicle Miles Travelled (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 through the use of big data, technological advancements, sustainable policy, and a growing societal and policy emphasis on equity, affordability, and quality of life. One paper critiques traditional accessibility measurement and provides a new framework, leveraging technology, for designing accessibility-focused transport services. Another study examines accessibility to education destinations, which is particularly important for families with children. This research finds that current accessibility measures may not accurately reflect equity in urban areas due to a lack of consideration for inter-individual and inter-household differences. A new framework is proposed, incorporating factors such as air pollutants, crime, and destination quality. On average, accessibility scores were 8

Future work

I aim to develop more comprehensive and multi-dimensional accessibility indicators for employment, education, and healthcare opportunities. A natural extension of our 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.