
MASTER'S THESIS

**Revisiting the First-Last Mile Problem in the
Singaporean Context and Evaluating the Potential Net
User Benefit of both Innovative and Practical Solutions
by way of a Discrete Choice Model**

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Abstract

The “first-last mile problem” moniker is not unfounded. It is pervasive within virtually all public transportation networks and its subversion remains unattainable. However, to assuage the disutility these trip segments present, further understanding of the problem is warranted. Pragmatic solutions can be revisited or entirely new or emerging concepts can be applied wherein electromobility may play a role. This thesis concentrates on the former with extensions into the latter.

A study area is strategically selected based on criteria that makes it a suitable candidate for amelioration of the problem; the applicable data associated with it also plays a role in determining its use as a study area. This revealed choice data is purposefully structured and augmented with methodologically generated data for the non-chosen and oft multimodal alternatives. Much of the underlying work of the thesis comprises this step owing to its relative laboriousness. Special attention is given to the first mile segments of trips. A multinomial logit model is then employed to aid in addressing interim objectives and arrive at the underlying objective of the thesis. Targeted model specifications assist in providing a build-up to a final model used to evaluate expected consumer surplus.

Hypothetical situations of time reductions in the relevant attributes are created and then parameterised according to constant Euclidean distances between home origins and a mass transit station. Quasi-scenarios are developed based on level of service changes under presumptions of new or improved infrastructure and the introduction of electric bicycles. Their expected consumer surpluses are evaluated by making use of the earlier parameterisation and final conclusions and recommendations are given.

Scope:

The scope of the work within this thesis is as follows:

- A non-exhaustive review of the first-last mile problem from the perspective of demand – how it is perceived and its effect on use of mass transit, and from the perspective of supply – what concepts or solutions have previously been employed or conceptualised.
- An in depth review of the theory of discrete choice modelling and its multifarious applications, as well as some limitations.
- The selection of a station area deemed favourable to serve as a study area for where solutions may prove warranted and where the data exists to do so.
- The crucial and detailed generation of alternative choice sets. This step makes probabilistic and judicious assumptions on route assignment which is beyond the scope of the work, i.e. only short-run mode choice is modelled.
- A representative pedestrian (and cycle) network is constructed, which serves as the foundation for first mile routes based on shortest paths and provides additional mode attributes.

- Multinomial logit models are specified and estimated.
- The results of the model are used to calculate expected consumer surpluses given changes to observable attributes and assumed to be representative of the area's whole population. In the case herein, the observable attributes are travel time components.
- These changes are based on quasi-scenarios and are not intended to be fully workable final solutions but do give indication into what may be the most beneficial.

Objective:

The objective of the thesis is to examine which trip segments and specifically the travel time components within them pose the greatest user disutility. The first mile remains the focus. Appropriate measures that could reduce said disutility are conceptualised on the basis of which mode(s) and in which first mile attribute they would have the most effect. The primary objective is to quantifiably determine the expected benefits that these measures may bring about.

Approach:

Available data revealing trips that individuals have taken on a given day is used and structured appropriately. To allow for representation of the likely choice situation they would have faced, much time is spent on developing detailed alternative choice sets. Each mode or mode combination comes with observable attributes such as time and cost. In keeping to the desired level of detail, these times are decomposed into both trip segments, be it the first, main or last mile and type – walking, waiting and in vehicle times. Costs are also determined. Web based journey planners are used to do this, but trips are individually and successively regarded; the results of the journey planners are not always taken as accurate on the onset although attempts were made to make the process more automatized.

Furthermore, the statistical R program is used for much of the data handling and processing, as well as much of the spatial analysis. It also contains the package that is capable of formulating and estimating multinomial logit models among others. Much additional scripting is done throughout. QGIS is also heavily employed for better visualisation and further spatial analysis.