Bicycle route choice model for the Greater Copenhagen Area, Denmark

Based on GPS observations

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1 Introduction

With increasing health problems and growing interest in sustainable transportation systems, the emphasis on encouraging more bicycling has increased. In this paper, cyclists' route choices are analysed in order to contribute to the understanding on which factors influence cyclists route choice and evaluate their trade-offs.

There is a substantial amount of studies that focus on bicycle route choice (for a review, see [1]). Most studies have been based on stated preference (SP) data, and few on revealed preference (RP) data. Although SP data have a lot of benefits, there are some disadvantages related to the challenge to predefine what cyclists consider in route choice without introducing bias. Also, SP data only explain typical behaviour, while RP data explain actual behaviour.

Collecting travel information with GPS trackers has become increasingly important. There have been few studies on bicycle route choice models estimated from GPS observations. Menghini et al. [2] estimated a path-size logit model of the route choice of cyclists in Zürich, and concluded that cyclists are mostly affected by the length, with little effect of other factors, i.e. gradient, traffic lights and bicycle paths. Broach et al. [3] estimated a path-size logit model of the route choice of cyclists in the Portland metropolitan area, analysing a larger set of network attributes. Hood et al. [4] estimated a path-size logit model on a sample of cyclists in San Francisco and analysed a large set of network attributes alongside a few environmental attributes.

The level of bicycle use in Denmark is relatively high when compared to other countries. The main objective of this paper is to develop a model that focuses on the route choice characteristics in an established bicycle city, thus providing inspiration for emerging cycling cities by focusing in particular on the interaction between infrastructure and cyclists' route choice.

2 Data

Cyclists were given GPS trackers for a period of seven days, resulting in a large dataset, or approximately 1800 bicycle stages, carried out by 104 persons living in the Greater Copenhagen Area, Denmark. Travel diaries were also collected from the participants, providing their travel information on a selected day, trip purpose, and socio-economic variables. Collecting GPS data, combined with in-depth interviews, enables more accurate analysis of individuals travel activities.

The post-processing procedure used is described in detail in Schüssler and Axhausen [5]. The travel diaries were used for validation of the post-processing. Various sources were compiled together to obtain a more detailed network, with characteristics considered imported for cyclists. This resulted in a very detailed network, comprising of 362,054 links and 269,396 nodes.

3 Methodology

The alternative routes were generated using a doubly stochastic generation function [6,7]. The method accounts for variation in travellers' perceived route costs with error alongside differences among travellers' attribute preferences with error. Advantages of this method are the heterogeneity of the generated alternatives and its computational efficiency in large networks.

Model estimates and performance for different route choice specifications were examined. A path-size logit model does not capture the difference in preferences across cyclists or take into account the panel effect of repeated observations for the same cyclist. To this extent, a mixed path-size logit model was estimated.

A rich set of network attributes was analysed, e.g. distance, facility type, bicycle bridges, roundabouts, traffic lights, pavement type, turn frequency, accident patterns, and gradient. We also focused on the physical conditions along the routes, e.g. motorized traffic type, time-depended traffic volumes, speed limit, land-use, and scenery. It was investigated how personal attributes influences the route choice, e.g. gender, age, trip purpose, etc. We also analysed whether there were differences in route preference between day and night times, along with including environmental attributes, e.g. rainfall, temperature, wind, etc.

4 Conclusion

The paper examines which factors relate to route selection and which conditions promote bicycling, in an established cycling city. Comparing different types of cyclists and evaluating their routes can establish deeper understanding on what effects cyclists' choice of different types of facilities.

The model estimates report on the sensitivity of cyclists to the effects of distance, traffic lights, and turn frequency. The results emphasize the importance of a well build bicycle facilities, such as segregated bicycle lanes with a raised curb on each side. The model estimates report on cyclists' route choice preferences of network attributes, e.g. gradient, motorized traffic volumes, etc. The model estimates also report on the effect of accident patterns on route choice and whether cyclists prefer scenic routes weighted against the travel distance, such as routes along the lakes in Copenhagen, forest, and park areas. Additionally, the model estimates report on whether there are differences in route choice preference between day and night times, such as dispreference of forest areas.

References

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