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Determination of Attributes Reflecting Household Preferences in Location Choice Models

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Abstract

Challenges coming along with changing mobility behaviour patterns require planning decisions to mitigating negative effects. Land-use and transport interaction models can provide valuable decision support for this purpose. But they require tremendous effort in terms of model design as well as data collection and preparation. We introduce a methodology and procedures with the aim to minimize the magnitude of modelling work with particular attention to the selection of model segmentation and model parameters in a structured and efficient way. The methodology combines literature and statistical analyses for model design. The paper outlines the methodology and presents its application to the design of a location choice model for the city of Berlin, Germany. We demonstrate how household types exhibiting specific location patterns and related accessibility parameters can be identified from the literature and how standard deviation maps and correlation analysis can be used to detect these households and test hypotheses. The results suggest that the methodology is capable to identify segmentations and parameters for usage in choice models, such as location decisions, in an efficient way.

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Keywords: residential location choice; land-use and transport interaction model; accessibility; census data; Berlin

1. Introduction

Where and how we move from one place to another everyday depends on the purpose of activities and on the distribution of locations related to these activities, also referred to as land-use. Since both the ongoing

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transformation of land-use patterns and travel patterns and the associated infrastructures keep changing, understanding the interaction of both phenomena is crucial to perform comprehensive planning processes to mitigate resulting negative effects on the environment.

Quantitative models are an instrument to help decision-making by predicting future changes of both the composition of land-use and corresponding travel patterns. The purpose of these models is to reduce the complex reality in a way that general phenomena can be forecasted. Because land-use and transport interact, models need to predict both simultaneously and consequently integrate land-use pattern analysis and transport analysis in so-called land-use and transport interaction models (LUTI). A common assumption for modelling approaches is that land-use and travel patterns are the results of household decisions based on choice alternatives that are subject to constraints, e.g. resources or regulation of supply (De la Barra, 1989; McFadden, 1978; Straszheim, 1987; Wegener, 2014). While land-use patterns result from location decisions, travel patterns are the outcome of decisions about transport mode, destination, route etc. Discrete-choice models explain these decisions by analysing preferences from patterns discovered in observed data. In order to reduce the complexity of reality, discrete-choice based LUTI group similar households into segments (de Dios Ortuzar & Willumsen, 2011) where similarity refers to location patterns and corresponding decisions. Considering the location choice part of LUTI-models that is tailored to predict land-use, complexity is reduced by applying aggregate spatial concepts – choices are analysed for real estates in zones that intend to represent neighbourhoods. Location choice models thus consider an extensive amount of different attributes that aim to reflect or approximate real influence factors on choice of a real estate and neighbourhood. By incorporating accessibility measures as one group of these factors, they establish the crucial link to transport models (de Dios Ortuzar & Willumsen, 2011; Francisco J. Martinez, 1995; Wegener, 2014). Alongside with accessibility, location factors obviously include attributes related to the neighbourhood, but also the dwelling, and characteristics of the households themselves (Hurtubia, 2012; Hurtubia, Gallay, & Bierlaire, 2010; Schirmer, Van Eggermond, & Axhausen, 2014). The relevance of these attributes then varies by household type or segment since different households exhibit different location preferences.

Designing a model to predict location choice requires two main decisions: First, how to segment households that exhibit similar choice behaviour (and patterns), and second, which attributes to include in the explanation and prediction of location choice. Considering the many possibilities to designing discrete-choice models, misspecification is likely and it becomes clear that the high complexity associated with model design challenges validity and efficiency (D. B. Lee, 1994; Lee Jr, 1973). Using simple methods to determine eligible household segments and location attributes facilitates and improves the development of these models. Applying such a framework is important to save time and therefore resources in model development.

In this article, we present a comprehensive analysis framework that combines methods to determine household types with similar location preferences with methods to identify location attributes that are associated with the distribution of these household types. We describe this methodology in the first part of the paper. In the second part, we apply it to a case study that involves the development of a location choice model for Berlin, Germany, called "SALSA" (**S**imul**A**ting **L**ocation Demand and **S**upply in Urban **A**gglomerations). We outline the framework underlying SALSA as foundation for the subsequent analysis in which we apply the methodology introduced in the first part. Finally, we turn to the results of the application of our analyses, i.e. the literature review, and statistical analyses, eventually showing the efficiency of the proposed framework.

2. Methodology

The approach basically combines a literature review with descriptive statistical and geovisual analysis. The steps are shown in Fig. 1.