Discrete Choice Models for Location and Travel in the Context of Developing Countries

K.V. Krishna Rao
Associate Professor
Civil Engineering Department
Indian Institute of Technology Bombay

M. Kumar
Research Scholar
Civil Engineering Department
Indian Institute of Technology Bombay

Decisions relating to location, travel and other related choices, such as residential location, shopping destination, recreational destination, trip frequency, mode of travel, route, car ownership, etc., have increasingly been modelled by using the discrete choice theory developed based on the concept of utility maximisation. Attempts have been made by many researchers to develop integrated urban activity and transport models. In the above context, the authors have taken up a study to explore the applicability of discrete choice models in arriving at a realistic decision framework for the various alternative choices involved in location and travel aspects in the cities of developing countries. As a first step towards this goal, in this paper, the experiences of the authors in designing the stated preference (SP) experiments, their execution, calibration of the choice models, validation and prediction will be discussed. These SP experiments have been carried out in Mumbai Metropolitan Region of Maharashtra State of India. Also a framework for integrated land use transport model is suggested.

1. Introduction

Travel demand in general depends on land use activity levels and their spread. Land use means the utilisation of land for different activities like residential, commercial, industrial, educational etc., and travel is the link between these activities. More commonly the land use models are used to project demographic and socioeconomic inputs to travel demand models. The transportation infrastructure, including public transportation system is an important determinant of the pattern and intensity of land use. In turn, the land use pattern determines the direction, purpose, magnitude and spatial distribution of travel to be accommodated by the overall transportation system. Therefore, the urban system is composed of different types of spatially separated human activities connected by movement of people and goods etc. The potential for movement between different land uses is subject to usual obstruction of traveling through the transport network. Therefore, the land use transportation interaction is significant and must be understood, analysed, and accounted for in order to ensure that land use and transportation plans and policies are effective and can succeed. Most important, there is a growing appreciation of the idea that transportation and land use policies cannot be formulated independently of one another. Over the last four decades, numerous attempts have been made to model land use and transport changes and their interactions. The main theme of this research describes household's choice of location together with a bundle of other choices for construction of integrated land use transportation in a disaggregate way.

A brief review of the literature on land use transport modeling and a suggested frame work for an integrated land use transport model with disaggregate choice models are provided in the next two sections. The importance of Stated Preference (SP) and Revealed Preference (RP) techniques in the development of constituent choice models of the integrated model, design of SP experiment, its execution, use of computers in SP data collection, calibration of choice models, details of choice models developed by the authors are presented in the subsequent sections.

2. The Land Use Transport Modelling Tradition

In the field of urban economics, Von Thunen (1826), Losch (1954), Wingo (1961) and Alonso (1964), among others, tried to understand the functioning of a city from an analytic point of view with as few and general assumptions as possible. The purpose was to describe the aggregate behavior of a city in terms of land prices, lot sizes, commuting patterns, location of citizens of different categories, etc. This helped planners and scientists to achieve a better understanding of what planning could accomplish and what it could not, and which kinds of measures that could improve the functioning of a city. However, this resulted in virtually no operational models. This should be no surprise, since the basic assumptions were clearly unrealistic and too far-reaching. The main contribution to the initial operational models was the bid-rent approach, introducing (among other things) the possibility to model the land rent market in a consistent way. This idea has been successfully implemented in urban models such as MUSSA (e.g. Martinez, 1992) and RURBAN (e.g. Miyamoto, 1996).

The origin of the wellknown aggregate spatial interaction land use models of gravity type can be said to be Hansen (1959). Some of the earliest models were developed by Lowry (1964) and Echenique (1968). It must be considered as a remarkable accomplishment that this type of models, having been operational for almost a decade, could later be "filled with theory" by the works of Wilson (1967, 1970), Senior and