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Modeling choice behavior of non-mandatory tour locations in California – An experience

Debasis Basu [a,*], Kevin John Stefan [b], John Douglas Hunt [c], Michael McCoy [d]

[a] Indian Institute of Technology Bhubaneswar, Bhubaneswar, India
[b] HBA Specto Incorporated, Calgary, Canada
[c] University of Calgary, Calgary, Canada
[d] University of California at Davis, USA

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ABSTRACT

The paper presents behavioral model of a primary location choice for home-based non-mandatory tours. The choice model addresses an array of non-mandatory tour purposes. Though some of them are found in literature, such as shopping, recreation and entertainment, many of them such as personal business, social, eat and escort are not explicitly addressed in literature. In this study, the primary location choice model is developed under a certain nesting hierarchy of a joint tour location and mode choice, where tour mode choice is generally found a foregone conclusion upon which location choice is conditioned. The work reveals a list of attractors influencing the primary location choice behavior of an individual for a specific non-mandatory tour purpose. The study highlights the need for more introduction of transit-oriented service across the state of California, which is found a preferred option by individuals for non-mandatory tours such as shopping, recreation or entertainment, social etc. The study is demonstrated using household travel diary data for California, which is revealed preference in nature.

1. Introduction

The trend in demand modeling is shifting from four-step towards more integrated one like tour/activity based model (Axhausen and Garling, 1992; Bowman and Ben-Akiva, 2000; Jonnalagadda et al., 2001; Ben-Akiva, 2010; He and Hu, 2015). In this integrated modeling framework, modeling location choice behavior is identified as one of the crucial elements, which predicts the probability that an individual travelling from a given origin will choose a particular location among many available alternative locations for her/his desired tour purpose. In this modeling framework, two types of location choice models are encountered to allocate tours and their trips among potential traffic analysis zones (TAZs) i.e. a tour-level location choice that determines primary location of a tour, and a trip-level location choice that determines intermediate stop-locations. Based on reported purpose at primary location, tours can be categorized under two heads such as mandatory (such as home-based work/business, school) and non-mandatory (such as home-based social, recreation/entertainment, shopping etc.) tours. Unlike mandatory tours, non-mandatory tours never pose as obligatory for any individual to make for a given time period and travel condition. An individual may wish to make or drop, or may even wish to prepone or postpone a non-mandatory tour. The primary location of a mandatory tour mostly remains fixed (Hunt et al., 2012) in decision process. But in contrast to mandatory tours, primary location of non-mandatory tours can be characterized by more spatial flexibility (Sivakumar and Bhat, 2007). The choice location of a given non-mandatory purpose could vary not only across individuals, but also across choice situations. Therefore, modeling location choice behavior for non-mandatory travel is a challenging task. Understanding location choice behavior for non-mandatory purpose is not only interesting for transportation and land-use planners, but also required to know for identifying future locations of industry sectors in service, retail, and real estate business.

Literature shows that a number of studies were carried out on tour-level location choice model for mandatory (Shiftan, 1998; Jonnalagadda et al., 2001; Bowman and Bradley, 2005) and non-mandatory (Richards and Ben-Akiva, 1974; Timmermans, 1996; Dellaert et al., 1998; Sivakumar and Bhat, 2007; Yagi and Mohammadian, 2008; Horni et al., 2009) tours. Besides, it is observed in many of the previous studies that some primary location choice models are good from the perspective of analysis with a number of causal attributes, but many a times they do not offer much convenience for direct application in a tour or activity based

* Corresponding author.
E-mail address: basudebasis2k@gmail.com (D. Basu).

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demand modeling framework (Newman and Bernardin, 2010). In addition, a thorough literature survey on primary location choice model for non-mandatory travel indicates that most of the previous studies focused primarily on purposes such as shopping, recreation, and entertainment (Timmermans, 1996; Dellaert et al., 1998; Pozsgay and Bhat, 2001; Sivakumar and Bhat, 2007; Bekhor and Prashker, 2008; Horni et al., 2009). But, there have not been enough evidences on studies that address other equally important non-mandatory purposes such as personal-business like visiting bank, post-office, social like meeting friends, relatives etc., eat like dinning in some location, and escort like escorting elders to a clinic or hospital, or dropping off and picking up kids at/from schools (Fig. 1). Therefore an understanding of the factors influencing these tour purposes also becomes imperative.

The objective of this work is to develop a primary (i.e. tour-level) location choice model, which will address all important non-mandatory tour purposes including those not previously addressed explicitly such as personal business, social, eat, escort. Besides, the aim of the work is also to develop an operational model, which can conveniently be integrated into a tour-based travel demand modeling framework for its application. The work identifies a number of specific attractors of the primary location (i.e. TAZ) that primarily attract tours of a particular purpose into that location. The location choice model is developed under a certain circumstance, where ordering nest of joint tour location and mode choice model becomes reversed from the usual sequence. In such circumstance of joint tour mode and location choice model estimation, information of the lower nest (i.e. location choice model) is passed up to the upper nest (i.e. tour-mode choice model) in the form of an inclusive value. The scopes of the present study do not include development of a tour-mode choice model that locates in upper nest of the said hierarchical nesting structure. The empirical investigation of developing primary location choice model is demonstrated using household travel diary data for the state of California.

The paper is presented as under. The data used in this study is described in Database section, which is followed by section called Modeling Primary Location Choice Behavior of Non-mandatory Tours. In this section, the approach and assumption adopted in this study is mentioned. The summary of the work, conclusions drawn and policy implications are mentioned in the last section called Summary, Conclusion and Policy Implication.

2. Database

The development of a primary location choice model for non-mandatory tours is demonstrated using geo-coded household travel diary data for the state of California, which is revealed preference in nature. The choice model is estimated as a part of the California Statewide Travel Demand Model (CSTDM) (Hunt et al., 2012; Basu and Hunt, 2014; Circella et al., 2014). It is a micro-simulation assisted tour-based travel demand modeling framework of all individuals in the state of California. The modeling framework of the CSTDM consists of 5191 TAZs with a detailed representation of all means of transportation modes. The calibration year of the model is 2000. The location choice model is developed as a part of short distance personal travel demand (SDPTD) model (Hunt et al., 2012) of all individual travelers in the CSTDM on a typical weekday, when schools are in session. The SDPTD model refers to those trips of individuals, where any trip distance of a tour is less than or equal to 100 miles. The database is primarily consisted of the California statewide household travel diary data. This database is supplemented by household travel diary data of three Metropolitan Planning Organizations (MPOs) in California. They are the San Diego Association of Governments (SANDAG), the Southern California Association of Governments (SCAG), and the Metropolitan Transportation Commission (MTC) - San Francisco Bay area. The refined database has travel survey records of 37,145 households. It represents households from various regions with different zonal, demographic, and land use characteristics of the California. The trip records of the CSTDM database are processed to generate tour information. The database includes the following trip modes: auto modes such as single occupancy vehicle

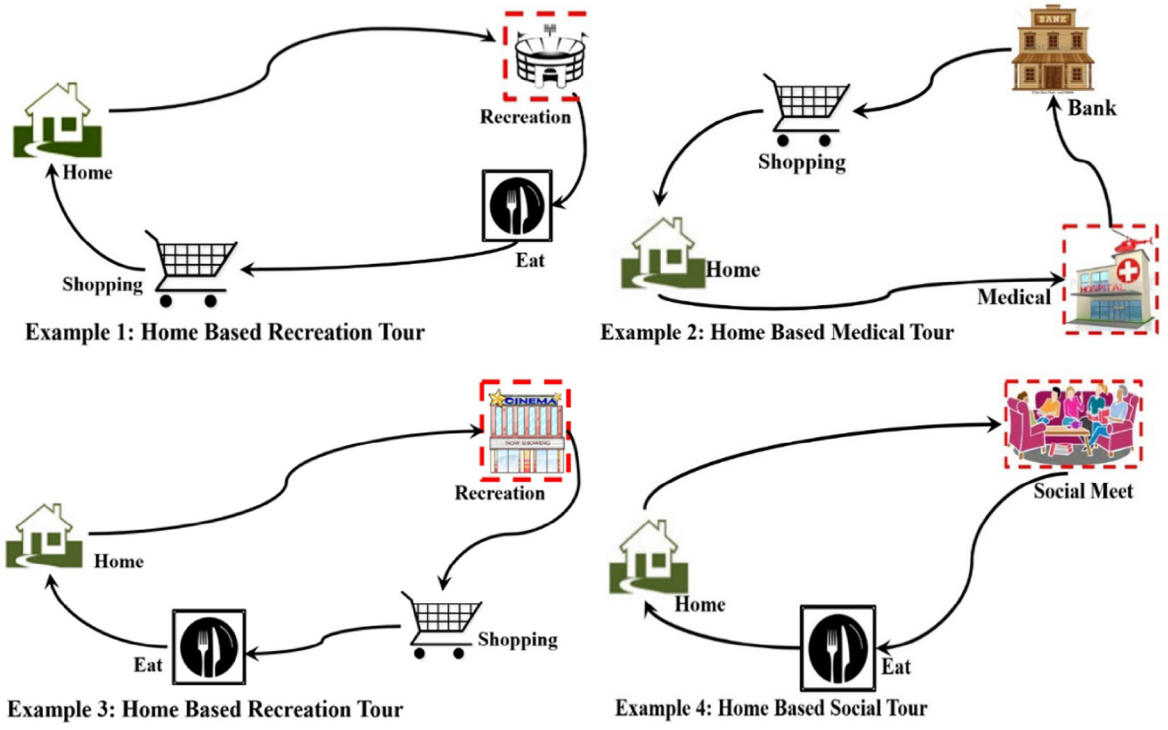

Fig. 1. Typical examples of home-based non-mandatory tours.

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