Modeling travel behavior based on household characteristics

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Abstract. This paper presents the relationship between travel behaviour based on demographic and socioeconomic characteristics of households in the City of Jericho, within the context of trips generation. The significance of this study is being the first comprehensive study to correlate a city-wide household travels to its characteristics in Palestine. Another significant part for the study is the consideration of different land uses to assess the correlation. This study uses a multivariable regression analysis (MRA) model to analyse the household collected data in order to correlate generated trips to the demographic and socioeconomic characteristics of households. The study results revealed the most significant socioeconomic and demographic characteristics that are associated with quantifying the overall household's travel behaviours in the City of Jericho. The importance of this paper is derived from being the first comprehensive large-scale travel behaviour study that was conducted for an entire city in Palestine. The paper also paves the road to investigate the transferability of its findings to other Palestinian cities with different sizes.

1 Introduction

Transportation planning processes are extensively used to forecast future travel demand [1]. The estimated travel demand is usually used by planners and traffic engineers as benchmarks for future transportation studies, roadway facilities, and traffic services [2]. Following the traditional four-step transportation planning model, the first step to forecast travel demand usually starts with trip generation models [3]. Therefore, trip generation models get special attention in transportation planning studies for both developed and developing countries [4-6].

The State of Palestine has a unique condition because of the economic, social, and political challenges it faces [7-9]. These challenges have made it difficult in the past to perform comprehensive large-scale travel behavior studies. In this study, The City of Jericho is chosen as the study area to develop trip generation models for its local conditions [7, 10]. The City of Jericho is an example of urban areas in Palestine. It is located in the eastern part of the middle of the West Bank as shown in Fig 1.

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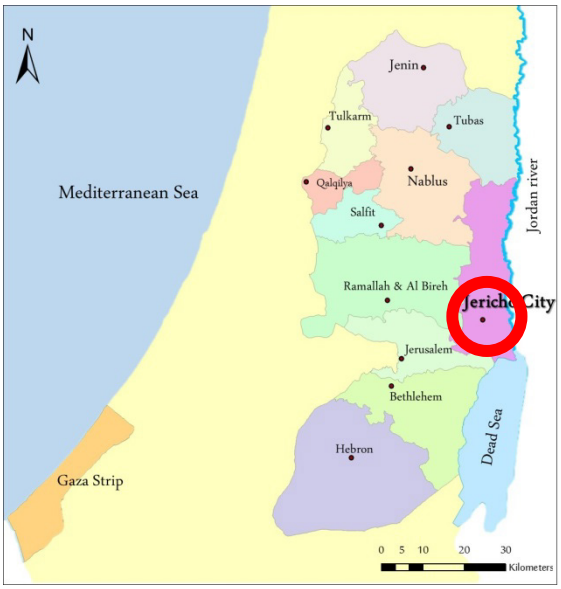

Fig 1. The Location of the City of Jericho in the West Bank, Palestine.

2 Research objectives

The objective of the study is to correlate generated trips for the City of Jericho to the demographic and socioeconomic characteristics of households for different traffic analysis zones. This relationship can be integrated with the transportation planning process for the City of Jericho. Multivariable regression analysis approach is used to develop this relationship between socioeconomic and demographic characteristics of traffic analysis zones and number of daily trips generated by households.

3 Data collection

In order to proceed with this study, the City of Jericho was divided into different traffic analysis zones (TAZs). The selection of these zones considered different factors, such as the existing and proposed land uses, population distribution, residential densities, and the existing natural or man-made boundaries [11]. Accordingly, the City was divided into 14 different zones, as can be found in Table 1.

With respect to the household socioeconomic and demographic characteristics, face-to-face interviews with different households from the different TAZ areas were done. This approach is used to assure the highest respond rates and data accuracy level as well. The collected data included several related factors such as household size, age and gender distribution, and household income. All the considered factors can be found in Table 2.

Table 1. Traffic Analysis Zones and Corresponding Characteristics [11].

Zone	Land Use Type								Area, Km^2	Population	Number of Housing Units
	Residential	Commercial	Public Facilities	Agricultural	Cultural Heritage	Parking	Industrial	Parks			
1	x	x	x						0.547	946	188
2	x	x	x	x					2.479	2458	489
3	x			x	x				2.409	958	190
4	x	x	x	x		x	x		1.254	3,688	733
5	x	x	x	x	x				3.726	1,453	289
6	x	x	x	x	x			x	2.049	3256	647
7	x	x	x	x	x			x	1.668	2816	560
8	x	x	x	x					2.142	3047	606
9	x		x	x					2.113	275	55
10	x	x	x	x					4.185	1512	301
11	x	x	x	x					1.262	2915	580
12	x	x	x	x		x	x		3.864	814	162
13	x	x	x	x		x	x		10.182	3179	632
14	x	x	x	x		x			3.005	8,838	1703
Total									40.885	35,886	7,134

Table 2. Independent Variables and Their Descriptions.

Variable	Description
SIZE	Number of persons in the household
EMP	Number of employed persons in the household
EDU	Number of persons receiving education in the household
AGE_A	Number of persons under 16 years in the household
AGE_B	Number of persons between 17 and 30 years in the household
AGE_C	Number of persons between 31 and 50 years in the household
AGE_D	Number of persons between 51 and 64 years in the household
AGE_E	Number of persons above 65 years in the household
INC	Monthly household income (Thousand New Israeli Shekel)

The independent variable that is discussed in this study is the number of daily trips made by household (ALLTRIP). It should be made clear that are many other trip-related dependent variables (such as trips per activity and trips per time-of-day) that are considered, but they are beyond the scope of this study, and are not described in this manuscript.

Household characteristics were collected from 713 respondents in the form of personal interviews of randomly selected household for each analysis zone. This sample size is chosen to meet the minimum sample size required for this study at 95% confidence level and ±0.02 margin of error. The sample size also meets the U.S. Bureau of Public Roads (BPR) guidelines, which states that 10% of the dwelling units should be examined, if the population is less than 50,000 persons [3].

4 Data analysis

4.1 Multivariable regression analysis

A stepwise multivariable regression analysis is used using SPSS. Under this method, the fitness of the regression analysis is evaluated based on different statistical tests that would quantify the significance of each independent variable that is assumed to be relevant. Accordingly, independent variables with coefficients that are least significant are excluded. The model only returns coefficients that have significant t-test values.

Equation 1 below shows the coefficients of independent variables that are significant. The dependent variable is *ALLTRIP*. Table 3 summarizes the regression results for the estimated general trip generation model.

$$\boldsymbol{ALLTRIP} = 0.569SIZE + 1.069EDU + 1.384EMP - 0.245AGE_B + 0.116INC \quad (1)$$

Equation 1 suggests that the best independent variables (among others) that would explain the number daily trips per household are the variables that are associated with the household size, education, employment, young family members (between 17 and 30), and monthly income. For all of the independent variable (except AGE_B), the directly proportional relationship between the independent and dependent variables are logical, and the number of daily trips tends to increase with the increase of household size, education, employment, and income. However, it was noticed that the number of household's daily trips tend to be less for families with more members who are aged between 17-30 years. Although this finding seems to contradict the common sense, but it is consistent with the general economic, political, and social conditions in Palestine. For instance, the unemployment rate is high for this age group in Palestine, especially for females within this age group, where they even have lower employment opportunities.

Table 3. Regression Results for the General Trip Generation Model (Number of Daily Trips per Household).

Intercept & Variables	Coefficient	Standard Error	t-Value
SIZE	0.569	0.061	9.297
EDU	1.069	0.072	14.795
EMP	1.384	0.109	12.703
AGE_B	-0.245	0.064	-3.844
INC	0.116	0.034	3.371
Summary:	***R^2: 0.944***	***F-value: 2397.622***	***Sample Size: 713***

5 Conclusions and recommendations

This study demonstrates the process of quantifying household's travel behaviour for the City of Jericho in Palestine based on socioeconomic and demographic characteristics. It uses a multivariable regression analysis approach in identifying the most significant variables in determining the number of daily trips per household.

The study has experienced several political, social, and economic challenges, but the study team proposed countermeasures to overcome these challenges, which lead to the success of the study. These measures can be deployed for other city-wide studies targeting easier and efficient deployment. The significance of this study is being the first initiative toward comprehensive trip generation models for Palestinian cities. The models will then be integrated within a large-scale transportation planning strategies at the national level. Furthermore, this study is envisaged to be in its potential for transferability. Since the Palestinian cities share similar demographic, social, and economic characteristics. However, further studies are needed to assure the applicability of transferability process.

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