An-Najah National University
Faculty of Graduate Studies

Transferability of Trip Generation Models for Palestinian Cities: Jericho and Salfit

By
Ahmad Amer Abdel Latif Amer

Supervisor
Prof. Sameer Abu-Eisheh

This Thesis is submitted in Partial Fulfillment of the Requirements for the Degree of Master of Roads and Transportation Engineering, Faculty of Graduate Studies, An-Najah National University, Nablus, Palestine.
2018

Transferability of Trip Generation Models for Palestinian Cities: Jericho and Salfit

By

Ahmad Amer Abdel Latif Amer

This thesis was defended successfully on 21/1/2018 and approved by:

Defense Committee Members	**Signature**
- **Prof. Sameer Abu-Eisheh / Supervisor**	……
- **Dr. Yahya Sarraj / External Examiner**	……
- **Dr. Khaled Al-Sahili / Internal Examiner**	……

Dedication

This thesis was carried out at An-Najah National University. This thesis is dedicated to my family, colleagues and friends. Without their encouragement and advices this study would not have been possible. The supervisor for this thesis was Prof. Sameer Abu-Eisheh. I am greatly indebted to him for his advices and support during my studies.

Acknowledgement

At first, thanks to Allah for giving me the strength and the patience to complete this thesis.

I express my sincere gratitude to each one who has contributed to the completion of this research, and would like to take this opportunity to thank Prof. Sameer Abu-Eisheh who helped me to complete this challenge and for his dedication to reviewing this thesis.

I would also like to thank my friends at An-Najah University for their support throughout the last three years and to thank the employees at Salfit Municipality for their assistance, who provided me with the required data.

Finally and most importantly, I am grateful to my family for their encouragement and advices throughout my life and helped me in data collection and analysis and for their pride in this accomplishment.

الإقرار

أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

Transferability of Trip Generation Models for Palestinian Cities: Jericho and Salfit

أقر بأن ما اشتملت عليه هذه الرسالة ، إنما هي نتاج جهدي الخاص ، باستثناء ما تمت الإشارة إليه حيثما ورد ، و أن هذه الرسالة ككل ، و أي جزء منها لم يقدم من قبل لنيل درجة علمية أو بحث علمي لدى أي مؤسسة تعليمية أو بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student's name: **اسم الطالب : أحمد عامر عبد اللطيف عامر**

Signature: **التوقيع :**

Date: **التاريخ: 2018/1/21**

Table of Contents

List of Tables

List of Figures

List of Abbreviations

Abbreviation	Explanation
PCBS	Palestinian Central Bureau of Statistics
TGM	Trip Generation Models
MCA	Multiple Classification Analysis
GLM	Generalized Linear Model
SPSS	Statistical Package for Social Sciences
MLR	Multiple Linear Regression
TAZ	Traffic Analysis Zones
BPR	Bureau of Public Roads
VIF	Variance Inflation Factor
GOF	Goodness-Of-fit
%RTE	Relative Transfer Error
RMSE	Root Mean Square Error
REM	Relative Error Measure

List of Appendices

Transferability of Trip Generation Models for Palestinian Cities: Jericho and Salfit

By
Ahmad Amer Abdel Latif Amer
Supervisor
Prof. Sameer Abu-Eisheh

Abstract

Trip generation modeling forms the basic and first step in the four-step urban transportation planning process. Limited work has been done in this field in Palestine. The preparation of trip generation models requires extensive surveys, in depth analysis, and considerable time, cost, and effort for model development. Therefore, this study deals with examining the potential for the transferability of estimated trip generation models between cities. This study has two primary research objectives; to model vehicular trips generated in Salfit City, and to study the spatial transferability of already estimated trip generation models for Jericho City to Salfit City.

This research considers a general model for all trips generated by a household, and then deals with trip generation models based on trip purpose and trip making period. Five trip purposes are considered; work, educational, shopping, social, and recreational. The models based on trip making period include the trip generation model for trips made by household before 8:00 AM, between 8:00 – 9:00 AM, between 9:00 AM – 12:00 PM, between 12:00– 4:00 PM, and after 4:00 PM.

A questionnaire was designed and utilized to collect data from a randomly selected sample of 256 households in Salfit City. The data were analyzed and trip generation models were then estimated. Regression analysis was

conducted considering sixteen potential independent variables. Each independent variable in each model was evaluated using statistical tests such as Pearson's correlation, P-value, T-test, F-test, the coefficient of determination, and variance inflation factor. The results of this research show that the models of general, work, educational, trips made before 8:00 AM and the model of trips made after 4:00 PM for Salfit City are proposed to be considered for the future transportation planning for the city.

The transferability of Jericho City models estimated in 2014 to Salfit City was investigated, where the results were compared with those resulting from the trip generation models generated first for Salfit. Two approaches to test the transferability of the models were used; "Native Transfer" and "Updating Constant". The outcome of the verification of transferability tests to transfer the trip generation models estimated for Jericho City to Salfit City show that the models of general, work, educational trips, and the model of trips made before 8:00 AM are transferable using the "Native Transfer" and "Updating Constant" methods, while the others are not. This research shows that when the variables, which have similarity in socioeconomic characteristics between two cities exist in relevant model, transfer effectiveness will improve. The transferability of the general of key trip generation models between cities is generally feasible, and therefore will save cost, time, and effort.

Chapter One

Introduction

Chapter One

Introduction

1.1 Introduction

Urban transportation is a basic component in the urban areas, which has a considerable effect on land accessibility, movement of people and goods, growth and economic development. The primary purpose for planning is to generate information useful to decision makers. For urban transportation planning, the planners shall attempt to understand urban areas context. The relationships between land use, travel and the socio-demographic characteristics shall be taken into consideration to achieve representative urban planning.

In the Palestinian cities, there is little documented experience concerning transportation planning in general and development of trip generation models at specific. Urban transportation planning is important for the attempt of forecasting the number of vehicles that will use transportation facilities in the future, which will help in the identification of the future transport needs. Trip generation, which is the first step in the transportation forecasting process, is used to predict the number of trips generated and attracted for each traffic analysis zone of the study area.

Therefore, there is a need to determine the suitability of using trip generation models developed in one of the Palestinian cities for transportation planning through transferring such models to other cities, which is called the examination of transferability of trip generation models. Such model transfer

would consider the variables that mostly affect trip generation such as number of persons in a household, number of persons who are receiving education, number of persons who are employed, driving license holders and household monthly income. Transfer of models saves a lot of effort and cost by reducing the size of the data to be collected in the new application context. Palestinian transportation planners can use the generated models to dissect the effectiveness of various transportation alternative strategies and arrive at more appropriate transportation infrastructure planning decisions.

The precision of trip generation models depends on the size of the sample size. However, the cost of collecting data in such case will be high; this means that the agencies responsible for this task need considerable budgets and this is difficult to secure for Palestinian cities now.

In Palestine, trip generation models were estimated for Jericho and Gaza cities, based on collected data. The characteristics of Gaza Strip cities, such as the income level, car ownership, density of population, unemployment rate, household size, and mobility constraints, are different from those of West Bank cities. Therefore, this research takes into consideration Jericho City study only.

1.2 General Background

Travel demand models are utilized to forecast trips. The cost of collecting and analyzing required data for travel demand modeling is high and increasing yearly. Wilmot and Stopher (2001) indicated that the cost of collecting data through these surveys is so high that it could easily exceed

the annual budget of a planning organization responsible for this task. Many of these organizations borrow or transfer data and/or models from other areas since they cannot afford the cost of collecting local data. Spatial transferability of travel forecasting models from one region to another can help in significant cost savings for transport planning organizations and regions.

It is important to achieve efficient management of using transportation system and to reduce traffic pollution. Transportation planning includes monitoring existing conditions, forecasting future population growth, identifying current and projected future transportation needs and problems, dissecting and estimating the impact of recommended future improvements to the transportation system on environmental features, including air quality. Urban planning is important for future developments and needs for developed and developing countries. The integration between transportation planning and land use planning is important and critical for city and town development.

The transportation forecasting process consist of four steps; the first step is trip generation, which is defined as the number of trips, which originate in a zone or number of trips that are attracted to a zone. The second step is trip distribution, which defines the number of trips going from each origin to each destination. The third step is mode choice, which defines the mode of transport that will be used by travelers. The fourth step is route assignment, which defines the selection of routes between origins and destinations.

1.3 Research Problem

In Palestine, the development of transport networks is limited and depends to a large extent on funding by external agencies. The models of travel demand are important to municipalities, transportation ministry, and planning agencies. Having travel demand models for each city will help to better plan for transportation. Urban planners responsible for conducting both short- and long-term transportation planning are facing the following important questions: What are the travel demand models for forecasting traffic for the West Bank cities, which could be used, considering need for cost effective travel forecasting models with limited available data? And what is the possibility of transferring models from an estimation context to a new application context? This study will address these questions.

1.4 Objectives of the Study

In Palestine, there has been limited number of studies related to modeling travel demand, and there is no presented studies related to transfer trip generation models between cities. This study has two primary research objectives. The first objective is to predict current and future vehicular traffic trips generated in Salfit City. The second objective is to study the spatial transferability of trip generation models between Jericho and Salfit cities. The study in this research relies on examining transferring models developed for Jericho City (Dodeen, 2014) to Salfit City. It will take into consideration the three types of developed models; the general trip generation model, trip

generation models based on trip purpose, and trip generation models based on the trip making period.

1.5 Study Area

Jericho and Salfit cities are chosen for the study area. Salfit City was selected because there is interest of Salfit Municipality in future transportation planning and to the relative similarity in population, where both are medium-size cities and have similar population density, considering the Palestinian Central Bureau of Statistics (PCBS) publications. Jericho City is selected as there was a study recently conducted there in developing trip generation models.

The Jericho study depended on Palestinian statistics generated in 2012, while Salfit study depends on Palestinian statistics generated in 2016. Jericho is a Palestinian city located near the Jordan River in the West Bank, with a total area 45 km^2. The population of Jericho City was estimated to be about 23,220 in 2012. The number of households was estimated to be 3,510 living in 3,386 buildings. The average of household size was estimated to be 5.2, while the population density was estimated to be 516 inhabitants/km^2.

Salfit is a Palestinian city located in the central area of the West Bank, with a total area 23 km^2. The population of Salfit City was estimated to be about 10,673 in 2016. The number of households was estimated to be 1,840 living in 1,590 buildings. The average of household size was estimated to be 4.8, while the population density was estimated to be 464 inhabitants/km^2.

1.6 Thesis Structure

This thesis contains six chapters. Chapter One gives and introduces an introduction to the research, including the research problem, the objectives of the study, and presents study structure. Chapter Two reviews literature on the topic investigated. Chapter Three presents the methodology, while Chapter Four discusses and summarizes the field survey and data collection. Chapter Five provides data analysis and discuses model estimation and transferability results. At the final of this study, Chapter Six presents the main summary, conclusions and recommendations of the study.

Chapter Two

Literature Review

Chapter Two

Literature Review

2.1 Introduction

The development and transfer of trip generation models (TGM) was discussed in many researches and papers in several countries. In order to transfer a travel forecasting model between selected cities, it was necessary to have some basis for accepting the model transfer as being suitable (Lawrence and Michael, 1978). Accordingly, area classification schemes were examined in the hope that a set of city characteristics could be established to show where models could be transferable.

Koppelman and Wilmot (1982) defined transferability as the usefulness of the transferred model, information or theory, in the new context. Spatial transferability of travel forecasting models refers to the appropriateness of using models developed with data and information from one geographical region for travel forecasting purposes in another region.

This chapter is divided into two sections. The first section is for developing trip generation models. The second section is for spatial transferability of trip generation models between different districts. Moreover, each of these sections is divided into four parts. The first part introduces the overview of trip generation or transferring trip generation models. The second part reviews some empirical researches conducted in developed countries while the third part includes those conducted in developing countries. The last part

introduces empirical studies conducted in Palestine, specifically as related to developing trip generation models.

2.2 Developing Trip Generation Models

The trip generation models were developed between the 1950's and 1960's, when planning major highway facilities studies were conducted. Trip generation models are often developed from travel surveys. The data collected from these surveys are used in determining and selecting the trip making pattern for a sample of households in the studied area. The socioeconomic and land use factors, which are considered to affect travel patterns is related to trip making pattern.

2.2.1 Overview of Trip Generation

The objective of the trip generation process, which is considered as the first stage of travel demand forecasting stages, is to define the volume of total daily travel for various activities such as education, work, shopping, recreational and social in the model system at the household or zonal levels. This process transfers urban activities into number of trips. The trip generation modeling help planners to forecast the number of generated daily trips made by households that will be made in the future and attempt to quantify the relationship between urban activity and travel.

Trip Generation usually considers some socio-economic data as input to producing trip production/attraction values, considered as the output. The three major techniques used for trip generation analysis are cross or multiple

cross-classification, multiple regression analysis, and experience based analysis. A trip generation model considering multiple regression consists of a dependent variable and explanatory variables. There are two types of trip generation models, which are trip-production and trip attraction. Concentration in literature review is on trip production, which is the target of this study.

2.2.2 Trip Generation in the Developed Countries

Mansfield (1969) undertook an empirical study in the north of England to analyze the demand for recreation trips by means of a model describing the generation of trips to recreation facilities. One of the study purposes was to determine how much of the observed variations in trip demand during a single year could be attributed to a few simple factors affecting relative journey costs. This was done by making a cross section analysis of a single year's traffic data. The study showed that the trips variations are largely explained by cost and car ownership levels; while competing opportunities for recreation seem to have little effect.

Stopher and Mcdonald (1983) discussed in their study the variables used to predict household trip generation rates; these variables included income, number of vehicles owned, and household size. The results of a trip-generation analysis performed on data from the Midwest in the USA by using multiple classification analysis (MCA) in contrast to linear regression were described. The analysis reported in this paper applied traditional cross-classification models that used MCA to predict cell-by-cell trip rates. The

final model consisted of household size, number of vehicles, and housing type. The study showed that household structure cannot be used as a policy variable, whereas other variables, particularly housing type, could be used.

Golob (1989) conducted an empirical study in Germany to model the causal relationship, at the household level, among income and car ownership, with trip generation. The results showed that car ownership directly affects public transport trip making, with additional effects from income.

Cubukcu (2001) attempted in the conducted study in North American metropolitan areas to answer the question on the factors that affect the total number of shopping trips. The estimated model was linear in the continuous independent variables and linear in the logarithms of the continuous dependent variable. The dependent variable in the model was the total annual number of shopping trips. The independent variables included technology related trip maker characteristics, characteristics of the metropolitan areas and socio-economic characteristics of the trip makers. The results showed that the temperature, population size, computer ownership and the percentage of the population between ages 34-54 were positively related to shopping trip generation rate.

Giuliano and Narayan (2003) found in their study that there is a significant difference in travel behavior between different demographic groups in the UK and the USA. The authors found that differences in daily trips and miles travelled are explained by differences in both the urban form and household income.

Giuliano and Dargay (2006) conducted an international comparative analysis of relationships between daily travel, car ownership and urban form in the UK and the USA. The analysis results showed that the significantly higher transport costs in the UK led to a decrease in generated trips. Metropolitan size affects travel only in the largest metropolitan areas of the USA.

Newbold et al., (2005) conducted a research to study the travel behaviors of Canadians aged 65 years or more to determine if their travel patterns were different from younger Canadians. The result of analysis indicated that younger Canadians make more daily trips than older Canadians. Thus, the numbers of daily generated trips and duration decreased significantly due to changes in health status and employment.

Moriarty and Honnery (2005) discussed in their study urban travel in all Australian State capital cities. The authors found that men on average travel more often and for longer distances than women.

Best and Lanzendorf (2005) conducted a research to determine the relation of gender differences on travel patterns and car use in Cologne, Germany. The researchers found that men made more journeys to work by car than women, and fewer journeys for non-work activities such as shopping and child-care than women.

Hunt and Broadstock (2010) conducted a study to develop a trip generation model around UK for a cross section of residential developments. The results of the study showed that the trip generation is dependent on many explanatory variables, which are the socio-economic factors, car ownership, and site-specific characteristics, in particular, land-zone type.

2.2.3 Trip Generation in the Developing Countries

Said (1990) estimated work trip rates in Kuwait and conducted a study using a generalized linear model (GLM). The results of this study showed that the two explanatory variables; household size and car ownership affecting work trip rates.

Abdel-Aal (2004) conducted a study in the city of Alexandria and used cross-classification technique to develop a trip production model. The author used the data-efficient MCA for modeling trip production. The proposed model was carried out using data sample collected. The author tested attributes of different households.

Tom and Krishna Rao (2006) showed in the conducted research in India that the income, household structure, family size, and vehicle ownership affect personal trip production. In addition, factors like residential density in analysis zone, value of land, and accessibility were also taken into consideration for modeling trip production.

Al-Taei and Taher (2006) used in their study a cross-classification technique to predict the travel pattern behavior of residents related to their socio-economic and travel trend characteristics among zones located within Dohuk City in Iraq. The results showed that the workers number, car ownership, and family size were the most effective independent variables. For total private trips, the independent variable income level yielded better estimation than family size variable. The authors showed that number of cells could be reduced if larger sample size were used in the prediction analysis as well.

Arabani and Amani (2007) evaluated in their study the parameters affecting urban trip-generation in Iran. The authors found that the most important variable of household characteristics, which have the highest effect on the dependent variable, was the income level, and then the second and third variables were family-size and car ownership, respectively.

Joeph and Opeyemi (2009) conducted a study in Ado-Ekiti Township in Nigeria to get a detailed information on travel characteristics of household and to replicate the information on demography and socioeconomic parameters by developing mathematical models. The authors developed in their study three regression models of household trip generation for three zones. The data collection on demographic and socio-economic characteristics of the area was by household interviews were used through the administration of questionnaires. The results of analysis showed that people with less automobile availability and low income made less trip than people with more automobile availability and higher income. Moreover, the results of analysis showed that age group 31-50 years made more trips than other groups.

Rahman (2009) conducted a study in Skudai Town in Malaysia and estimated primary school trip production and attraction rate. The author used multiple linear regression method for the modeling process. Four parameters were included in the study to establish the trip generation model. The independent parameters were holding capacity of the town, accessibility, cost index and school trip by a household. The school trip generation had three independent variables that influence the number of trip production and

attraction, which were accessibility and holding capacity as measures of quantity, and cost index as a qualitative measure. The study showed that the most variable, which had more influence on school trip generation in Skudai Town, was the accessibility.

Priyanto and Friandi (2010) conducted a study to develop a trip generation model to predict the number of public transport passenger in Yogyakarta City in Indonesia. The authors established a relationship between trip number and socioeconomic attributes using multiple linear regression analysis. The results showed that public transportation trip had negative correlation with motorcycle ownership, car ownership and income; furthermore, public transportation trip had positive relation with the family size. The study showed that the number of general trips in Yogyakarta City increased with increasing of income, motorcycle and car ownership.

Sofia et al., (2012) developed in the conducted study in Al-Diwaniyah City in Iraq a relationship between the daily household trips and socio-economic characteristics. The study used multiple linear regression technique to develop trip generation models. The results of the study showed that gender, the number of students, family size and the number of workers in the household were the primary factors, which affect trip generation models in the city.

2.2.4 Trip Generation in Palestine

Moussa (2013) developed trip generation and attraction models for Gaza City. The researcher used Multiple Linear Regression (MLR) technique.

Furthermore, the researcher aimed to compare trip rates modeled by way of Conventional Cross Classification and that of Multiple Cross Classification in Gaza City.

A household interview survey was conducted to determine the appropriate model that represents trip generation. A sample of 425 households was surveyed, which were randomly selected from different districts of Gaza City. The study showed that income level, household size, vehicle ownership, and total number of licensed drivers are the primary factors that affect trip production in Gaza City. Furthermore, the study indicated that Conventional Cross Classification models are less effective in expressing trip rates for trip production than Multiple Cross Classification models. It was found that an increase in sample size lead to an increase of the performance of both Multiple Cross Classification and Conventional Cross Classification matrices in predicting trip rates.

Dodeen (2014) developed trip generation models for Jericho City, where three types were developed. The first type was the general trip generation model. The second was related to the trip generation models based on trip purpose while the third type was related to trip generation models based on trip period.

The study used multiple linear regression in developing trip generation models. A household interview survey was conducted to collect primary data. The survey was distributed to 713 randomly selected households in different districts of Jericho City.

The results of analysis showed that the household monthly income, the number of persons who are receiving education and the number of persons who are employed in the household were the main factors that affect general trip production model. Furthermore, the results of the study indicated that for specific trip purposes, or trip production periods, other factors were found to be relevant.

Al-Sahili, Abu-Eisheh and Kobari (2017) conducted a research to estimate the impact of new development trips through trip generation rates for major land uses in Palestine. The research established trip generation rates for land uses that include residential, office, commercial, school, hospital, and hotel. Based on conducted traffic counting surveys for the selected sample, trip generation rates and equations were estimated for the selected land uses.

2.3 Spatial Transferability

The transfer of an estimated trip generation model from estimation context to a new application context can reduce and minimize the need for large data collection and model development effort in the application context. Several studies have been conducted to study the effectiveness of model transfer from estimation context to application context. This section reviews selected studies conducted in this context in developed as well as developing countries. However, in Palestine, there are no previous studies related to spatial transferability of trip generation models, as this study is the first of its type in Palestine.

2.3.1 Spatial Transferability in the Developed Countries

Martinson (1974) and Chatterjee et al., (1977) evaluated in their study the spatial transferability of cross-classified trip rates between large urban area, Milwaukee, to both a rural area and two smaller urban areas, Kenosha and Racine, in southeastern Wisconsin region. The authors found significant difference between large urban and rural trip rates for all trip purposes. However, the difference in the trip rates between the large urban areas (population equal to or more than 1,000,000) and the small urban areas was not significant except in non-home-based trip rates for Kenosha and Milwaukee and home-based shopping rates for Racine and Milwaukee.

Lawrence and Michael (1978) conducted an evaluation study in Virginia, USA of the transferability of cross-classification trip generation model and demonstrated that the average rates given by a cross classification table that are applied at a disaggregate level were not sensitive to locational (zonal) variations. Cross classification models were found to be transferred between cities; however, good judgment should be used in selecting similar cities between, which the models are to be transferred.

Mahmassani and Sinha (1978) conducted a study in Indiana for small urban areas and discussed the transferability of trip generation parameters. The results showed that the transferability of the internal vehicle trip production equations was investigated at two levels of detail. The first one was that for each urban area, the mean zonal value of trips produced for each purpose would be predicted using the equations calibrated in other areas. The second one was the percent standard error of the estimate, expressed as a percentage

of the mean value, which is a measure of the accuracy of a value predicted using the regression equation. A value below 25 percent would be excellent, below 50 percent good, but above 100 percent would be no good. This study showed that home-work production equations had more potential for transferability than home-other equations, this was due the nature of the work trip. Socio-economic characteristics for small urban areas were constituted the major differentiating elements affecting trip frequency.

Caldwell and Demetsky (1980) examined spatial transferability of linear regression models of zonal-level trip generation and household-level trip generation, using data from three cities in Virginia: Harrisonburg, Roanoke, and Winchester, USA. The authors used household size and auto ownership as explanatory variables and considered the dependent variable (total generated trips by a household) in the household-level model. In the zonal-level model, they used a zonal level number of cars as the explanatory variable, with total zonal trip productions classified by home-based work, home-based non-work, and non-home-based productions as the dependent variable. The study showed that household-level trip generation models applied at the household level were more transferable than the same model applied at an aggregate, zonal level. Moreover, the authors indicated that transferability of cross-classification model is better between areas with similar household auto ownership levels, similar household size, and per capita income.

Koppelman and Wilmot (1982) studied transferability of disaggregate choice models between three sectors in Washington, D.C., region. The authors

claimed that updating the constants in the model can significantly improve the performance of a transferred model in terms of improved log-likelihood based measures (e.g., transfer index) and improved aggregate-level predictions.

Koppelman and Rose (1985) explained that aggregate models are not likely to be temporally and spatially transferable. This is because of differences in the characteristics of the application and estimation contexts. The authors also examined the intra-regional transferability of household-level linear regression trip generation models between two sectors of each of three urban areas: Baltimore, Minneapolis-St. Paul, and Washington, D.C. The results showed large differences in parameter estimates of the trip generation model between sectors in each urban region. However, the authors found reasonable predictive ability of the transferred models based on typical goodness-of-fit and prediction measure comparisons between the transferred models and locally estimated models. At the same time, their statistical tests rejected transferability, despite the closeness of goodness-of-fit and small prediction errors.

Karasmaa (2003) conducted an evaluation study based on mobility surveys conducted in the Helsinki Metropolitan Area in 1995 and in the Turku region in 1997 to assess transfer methods for spatial travel demand models. The transfer methods were transfer scaling, joint context estimation, Bayesian approach and combined transfer estimation. The author assumed that model transfer is only possible if the coefficients used in the application and estimation contexts are quite similar. The author found that the best transfer

method in most cases is the joint context estimation. Karasmaa (2001) introduced that the application of previously estimated model variables into a new context is considered the main concept of model transferability.

Everett (2009) introduced in the study a primary question, which is more appropriate, transferring from a similar sized urban area in a different region or state of the country, or transferring from an urban area of a different size that is located within the same state? A large number of comparisons were made of trip generation models for different areas of two states, Tennessee and Ohio. The results led to a clear conclusion regarding this question, which was that the results were too mixed for one to make a solid determination.

2.3.2 Spatial Transferability in the Developing Countries

Wilmot (1995) studied the transferability of household-based linear regression trip generation models. The author considered the total generated trips by a household as the dependent variable, and for the explanatory variables used household size and number of workers in the household. Wilmot conducted this study to examine transferability between areas in a city, within cities, and between several cities in South Africa. The results indicated that the model specification did influence the level of transferability, as did the difference in average income between the application and estimation contexts. Moreover, Wilmot also indicated that there was need to have quality data in the application context to evaluate transferability.

Cotrus et al, (2003) investigated transferability performances of disaggregate trip generation models in space and time for the Haifa and Tel Aviv metropolitan areas using two model specifications: Tobit and MLR at the person level. The transferability tests showed that the null hypothesis that the coefficients of the models were equal was rejected at a 95% confidence level (i.e., the models vary in time and in space). The authors found that the differentiation in the variables, structure, investigation period, range, and definition of the variables as well as in the database structure affected the transferability of the estimated models.

Kawamoto (2003) conducted a study in Brazil to evaluate the spatial transferability of a linear regression model of total home-based trip productions at the person-level between Bauru and Sao Paulo. To check and evaluate the transferability, the author used a Wald test statistic of parameter equality in the regression models in the application and estimation contexts after accounting for variance differences in the two contexts. The independent variables considered in this research included education status, number of cars in household, relationship with householder, employment status, student status, and if the individual is a child younger than 11 years. The results suggested that the standardized regression models were transferable between the two cities but the unstandardized versions are not.

Abdel-Latif et al. (2015) conducted a study for transferability of trip generation models in Egypt. The authors found that the updating of parameter scale and the alternative specific constants improves transfer effectiveness. Further, the authors concluded that the sample size necessary

to obtain a substantial improvement in model transferability is a small fraction of that needed to estimate a complete model in the application context.

2.4 Chapter Summary

With regard to model trip generation, the results of literature review showed that the socio-demographic variables used to predict household trip generation rates include gender, age, household income, number of workers in the household, employment status, education status, type of house, household size, and number of vehicles owned. The results showed, for example, that men made more journeys to work by car than women, and fewer journeys for non-work activities such as shopping and child-care than women.

With reference to the methods used for the modeling process, the literature showed that there is a number of used methods such as the simple linear regression and multiple linear regression analysis technique, cross-classification technique, and discrete choice models such as probit and logit. The studies showed that the main problem of the regression models is the treat of trip rates as continuous rather than discrete variables. However, regression analysis technique is the most widely used.

For the transferring of trip generation models, the literature discussed four different transfer methods, which were joint context estimation, combined transfer estimation, bayesian approach and transfer scaling.

The literature showed significant difference between large urban and rural trip rates for all trip purposes and some literature indicated that transferability of cross-classification model is better between areas with similar cities (household auto ownership levels, similar household size, and per capita income).

In general, the results of literature review related to model transfer have been controversial. Some studies showed that model transfer is possible when the estimation context models are well defined and the data quality is good.

Chapter Three

Methodology

Chapter Three

Methodology

3.1 Introduction

In this study, trip generation models will be generated for Salfit City as a case study. This study will take into consideration the common approach conducted for Jericho City, for sake of comparison, where the three types of models that were generated by Dodeen (2014) will be also considered in estimating trip generation models for Salfit City.

After developing trip generation models for Salfit City. The transferability of Jericho models to Salfit City will be studied, analyzed and compared to trip generation models generated in the first step. Salfit City will be called the application context and Jericho City will be called estimation context because the models will be transferred from Jericho to Salfit. This chapter will discuss the methodology applied to achieve the objectives of this study. The methodology of research is divided into two parts. In the first part, the methodology for developing trip generation models for Salfit City using linear regression analysis will be discussed, while the second part will discuss the methodology to transfer trip generation models that were developed for Jericho City by Dodeen (2014) to Salfit City.

3.2 Developing Trip Generation Models

This section discusses the general steps of methodology that used in this research to develop trip generation models for Salfit City utilizing linear

regression analysis. It contains desk and internet research, study area selection and zones definition, selecting sample size, designing household questionnaire, collecting the required data, analyzing the collected data, building models and models verification. These are briefly explained hereafter.

1) **Desk and Internet Research:** This is done by reviewing the internet websites and related literature including published researches and studies on developing trip generation models using linear regression models.
2) **Study Area Selection and Zones Definition:** One of the important steps in any transportation research is study area definition. This is conducted by referring to the maps and zonal boundaries defined by the Municipality of Salfit and the Palestinian Central Bureau of Statistics, which take into consideration the developed and expanding area's in the city, areas that could to be developed in the future, and the adjacent areas to developed area. Zoning is the process of dividing the study area after defining the boundary into smaller homogeneous land use areas called traffic analysis zones (TAZ). Zoning include dividing study area based mainly on the types of activities and land use such as residential use, agricultural use, commercial or industrial use. The following points highlight applicable recommendations on the best practices in delineating TAZs (Ortuzar and Willusmen, 1996), which have been considered in this study:

1. The number of people per TAZ should be greater than 1,200, but less than 3,000 for the base and future years.
2. The size of each TAZ is between 0.25 to one square mile in area (0.46 to 2.59 Km^2).
3. There are no irregular-shaped TAZs.
4. The study area is large enough so that nearly all (over 90 percent) of the trips begin and end within the study area.
5. The TAZ structure is compatible with the base and future year highway and transit network
6. The centroid connectors represent realistic access points onto the highway network.
7. Transit access is represented realistically.
8. The TAZ structure is compatible with census, physical, political, and planning district/sector boundaries.
9. The TAZs are based on homogeneous land uses, when feasible, in both the base and future year.

The study area of Salfit City is divided to traffic analysis zones by considering the major roads as zone borders. The study area “Salfit City” was divided into external and internal zones. The internal zones were divided to six zones and external zones were divided to five zones. Trip generation analysis taking into consideration internal (trips with both ends within the study area) and external (trips with one end outside of the study area) production trips between traffic zones. The divided zones are illustrated in Figure 3.1.

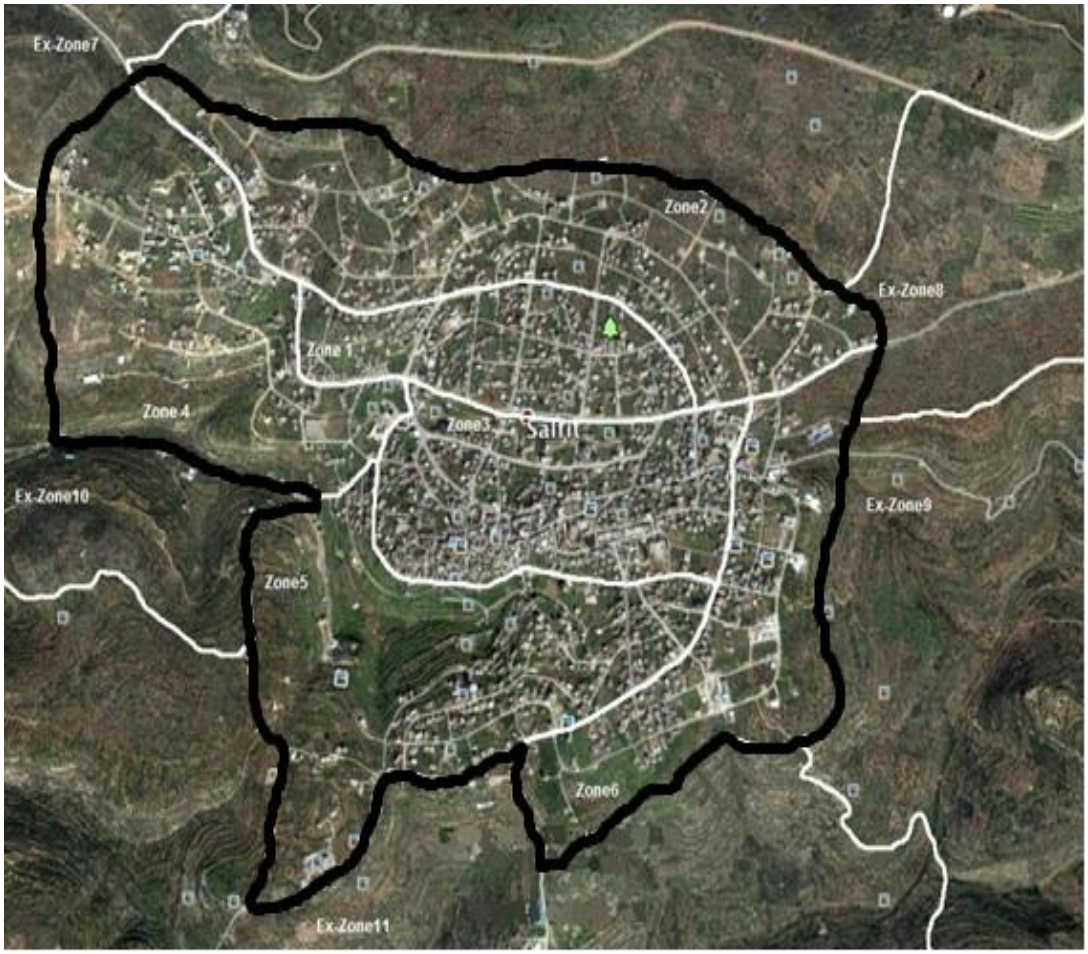

Figure 3.1: The external and internal zones distributed for the study area of Salfit City

3) **Selecting Sample Size**: The sample size selection is based on the procedure and standards given by the USA Bureau of Public Roads

(1967). The sample size depends on the population and the number of household's in the study area. By referring to Table 3.1, the minimum sample size is equal 10% of number of households if the population of study area is less than 50,000.

Table 3.1: Standards of Bureau of Public Roads (BPR) for Sample Size Selection

Population of Study Area	Sample size (Dwelling Units)	
	Recommended	Minimum
Under 50,000	1 in 5 (20%)	1 in 10 (10%)
50,000 – 150,000	1 in 8 (12%)	1 in 20 (5%)
150,000 – 300,000	1 in 10 (10%)	1 in 35(2.86%)
300,000 – 500,000	1 in 15 (6.67%)	1 in 50 (2%)
500,000 – 1,000,000	1 in 20 (5%)	1 in 70 (1.43%)
Over 1,000,000	1 in 25 (4%)	1 in 100 (1%)

Source: U.S Bureau of Public Roads, 1967

4) **Designing Household Questionnaire:** The home questionnaire was similar to that, which was prepared by Dodeen (2014) taking into consideration some modifications. The questionnaire contains two tables, the first table is for recording household data and its characteristics such as household size, age of each resident, gender of each resident, number of owned vehicles, number of persons who are employed, and number of persons receiving education. The second table is for recording travel data for household residents regarding trip purposes, trip time, no. of trips, origin and destination for each trip. The questionnaire form used in this thesis is shown in Appendix A (Table

A-1 and Table A-2). In general, the questionnaire aims to get required information from the study area as accurately as possible taking into consideration simple and direct questions. The number of questions in the questionnaire was reduced to the least possible. The question related to household income was asked at the end of interview.

5) **Collecting the Required Data (Survey Data):** The questionnaire was distributed and collected by conducting personal face-to-face interviews from the sample of randomly selected households between early October and late November 2016. The data were gathered by visits conducted by the researcher to the home of the respondents. The travel data were gathered along the weekdays taking into consideration activities in a typical day. By referring to Table 3.2, the survey consists of 256 randomly selected households from Salfit City, despite the difficulties in conducting such interviews due to social reasons. The sample size in each zone was selected from the various six internal zones based on the population in each. There was an additional sample for verification purposes, which contains 53 respondents, which represented approximately 20% of the sample size (256). The collected data from these internal zones included investigating destination (even if these were external zones) to help in future studies to investigate trip distribution modeling. This survey method gives a better observation of respondents' behavior and more precise data.

Table 3.2: Number of Households per Traffic Zone for Study Area and Sample Size Required

Traffic Zone No.	No. of Housing Units	% of Housing Units	Sample Size
1	510	20%	51
2	420	16%	42
3	590	23%	59
4	304	12%	30
5	430	17%	43
6	308	12%	31
Total	**2,562**	**100%**	**256**

6) **Analyzing the Collected Data and Building Models**: The analysis of collected data and building required models were performed by using a proper computer program (Excel). This includes the estimation of dependent variables and their coefficients for each category of home-based trips utilizing linear regression method. The simple linear regression is a process for modeling, explaining and summarizing the relationships between a dependent variable and one explanatory variable. The case of two explanatory (independent) variables or more is called multiple linear regression, as shown in Equation (3.1).

$$Y = a + b_1*X_1 + b_2*X_2 + ... + b_n*X_n \quad (3.1)$$

where:

Y = Dependent Variable.

X = Independent Variable.

a = Constant.

b = Coefficient of Independent Variable.

Regression analysis predicts trends and future values and helps to understand how much the change of the dependent variable when independent variables change. To estimate the best regression model, statistical tests such as R^2, Pearson's correlation, Variance Inflation Factor (VIF), F-test and T-test could be conducted to evaluate the goodness of the models.

The goodness-of-fit (GOF) statistics is useful for comparing the results of cross - multiple studies, for comparing competing models within a single study, and for providing feedback on the extent of knowledge about the uncertainty involved with the phenomenon of interest (Washington et al., 2003).

The R^2 measures the ratio of explained variance to total variance, as expressed in Equation 3.2. An adjusted measure for the R^2 is used to account for the number of variables in a data set, which is called $R^2_{adjusted}$. The values of R^2 and $R^2_{adjusted}$ take on values 0 and 1 for regression models with intercept terms. When the intercept is forced through zero, the values of R^2 can exceed the value 1. The value of R^2 from a model shall be judged between models that have been estimated on similar phenomenon. Thus, an $R^2_{adjusted}$ of 0.40 in one study may be considered "good" only if it represents an improvement over similar studies and the model provides new insights into the underlying data-generating process (Washington et al., 2003).

$$R^2 = 1 - \frac{SSE}{SST} \tag{3.2}$$

where:

R^2 = Coefficient of Determination.

SSE = Sum of square errors.

SSR = Regression sum of squares.

SST = Total sum of squares (SSR + SSE).

Before start building models, the impact of multicollinearity on the regression analyses shall be studied. The relation between each explanatory variable and dependent variable and the relation between the explanatory variables shall be checked. When the relation is linear between dependent variable and one of the explanatory variables, this indicates that when one of them increases the other increases and vice versa. The relation between independent variables shall be nonlinearity and this could be checked using Pearson's correlation and VIF. Therefore, multicollinearity is a phenomenon exists in the multiple regression model when two or more of the explanatory variables in the model are highly correlated.

The two variables in the multiple regression model are perfectly collinear if there is an exact linearity relationship between them. This means that Pearson's correlation value is one. To calculate Pearson's correlation, following Equation (3.3) is used:

$$r = \frac{\sum_i (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_i (X_i - \bar{X})^2}\sqrt{\sum_i (Y_i - \bar{Y})^2}} \quad (3.3)$$

where:

r = Pearson's correlation.

X_i and Y_i = Variables.

$\bar{X}$ = The mean for X.

$\bar{Y}$ = The mean for Y.

Hunt and Broadstock (2010) indicated in their study that the strength of relationship is considered strong when Pearson's correlation value is considered small when value is -0.1 to -0.3 or 0.1 to 0.3, the strength is considered medium when the value is -0.3 to -0.5 or 0.3 to 0.5 and the strength of relationship is considered large when Pearson's correlation value is -0.5 to -1.0 or 0.5 to 1.0.

The VIF quantifies how much the variance is inflated and the severity of multicollinearity regression analysis. It provides an indicator that measures the effect of collinearity and how much the variance of an estimated regression coefficient is increased. Belsley et al., (1980) indicated that the VIF should not exceed 10. When Xj is orthogonal to the remaining predictors, its VIF will be one.

To calculate the VIF factor, one of the following formulas is used:

$$VIF_j = \frac{S^2_{x_j}(n\text{-}1)SE^2_{b_j}}{S^2} \quad (3.4)$$

$$VIF_j = \frac{1}{1\text{-}R^2_j} \quad (3.5)$$

where:

S_{xj} = Standard Deviation for Explanatory Variable.

n = Sample Size.

SE_{bj} = Standard Error for Explanatory Variable.

S = Total Standard Error.

R^2_j = R-Squared.

The F-Statistics is used to test the hypothesis that all regression coefficients are jointly equal to zero or not. When the coefficients values are zero, this indicates that all the independent variables have no impact on the dependent variable.

To calculate the F-value factor, the following formula is used

$$F = \frac{\text{Mean of Squares for Model}}{\text{Mean of Squares for Error}} = \frac{SSE_R\text{-}SSE_F/df_R\text{-}df_F}{SSE_F/df_F} \qquad (3.6)$$

where:

SSE_R = Sum of squared errors is estimated for the reduced model.

SSE_F = Sum of square errors for the full model.

df_R = $n - p_R$.

df_F = $df_F = n - p_F$.

n = Number of observations.

p = Number of parameters.

7) **Model Verification:** This step is conducted to check the ability of the model to predict future behavior. This is will be done by comparing the

resulting predicted number of trips with the actual ones for the additional surveyed sample, which contains 53 respondents.

3.3 Transferring Trip Generation Models

This section discusses the general steps of methodology that used in this research to transfer trip generation models from Jericho City to Salfit City. It contains desk and internet research, application of Jericho City models to Salfit City using "Native Transfer" and "Updating Constants" methods, evaluation of transferred models, transferability tests, and assessment of transferability of the models. These are briefly explained hereafter.

1) **Desk and Internet Research:** This is done by reviewing the internet websites and related literature including published researches and studies, which are related to the spatial transferability of trip generation models, mode choice models and activity-based travel forecasting models using different approaches such as native transfer and transfer with updating constants of models among different areas in the world in different periods.
2) **Application of Jericho City Models to Salfit City:** This implies the transfer the trip generation models developed by Dodeen (2014) to Salfit City in order to predict the number of trips in Salfit. The transfer was done using two methods. The first method is "Native Transfer". In this method the models, which were estimated for Jericho City were transferred to Salfit City with same explanatory variables and

coefficients without any modifications. The estimated trips were generated by applying the independent variables values, which were observed in verification sample in Salfit City in the transferred models.

The second method is “Updating Constants” method. In this method, the model, which were estimated for Jericho City were transferred to Salfit City with the same explanatory variables but with updated coefficients. The updating was done with reference to observed data in Salfit City for the original sample size, which included 256 respondents.

3) **Evaluation of the Transferred Models:** The models which were estimated using the first approach “Native Transfer” were verified by measuring the difference between actual and estimated daily trips generated by a household for each of the randomly selected 53 additional observations and by conducting a comparison between the average of actual trips and the average of estimated trips generated by transferred model. The Relative Transfer Error (%RTE) measure was used to evaluate model transferability.

   The models which were estimated by using the second approach “Updating Constants” were verified by measuring the difference between actual and estimated daily trips generated by a household for each of the randomly selected 53 observations and by conducting a comparison between the average of actual trips and the average of estimated trips generated by transferred model. Moreover, the VIF, R-squared, F-test and T-test were used to assess the goodness of the models.

The %RTE measure was used to evaluate model transferability. This measure indicates relative error of prediction between the transferred and original models. The criteria for recommending the models is to have a %RTE less than 25 % giving that the model itself is statistically accepted with respect to R^2 value.

$$\%RTE = \frac{RMSE_t - RMSE_o}{RMSE_o} \tag{3.7}$$

where:

$RMSE_t$ = Root mean square error of the transferred model.

$RMSE_o$ = Root mean square error of the original model.

The Root Mean Square Error (RMSE) measure is an index of the average relative error of prediction weighted by the size of prediction element.

$$RMSE = \sqrt{\frac{\sum(REM)^2}{N_i}} \tag{3.8}$$

where:

N_i = The number of observations, and

$$REM = \frac{(Y_{est} - Y_{obs})}{Y_{est}} \tag{3.9}$$

where:

Y_{est} = Estimated value of the dependent variable, and

Y_{obs} = Observed value of the dependent variable.

REM = Relative Error Measure, which measures the relative error of prediction for the original or transferred models.

4) **Discussion of the transferability assessment results:** The results obtained from the application-based approach and from the estimation-based approach are discussed and consequently proper conclusions are drawn.

Chapter Four

Field Survey and Data Collection

Chapter Four

Field Survey and Data Collection

4.1 Introduction

This chapter describes the procedures for collection of data for developing trip generation models to estimate the number of trips generated in a small geographic area. In general, for collecting data, the zones divisions are needed to start survey work and to determine the distribution of samples on the TAZ's. This is important to facilitate the data collection procedure.

4.2 Study Area and Zoning

The study area was defined using the maps of Salfit City including minor and major roads from Municipality of Salfit (see Appendix B). The Study area was divided into six internal traffic analysis zones after defining the boundary into smaller land use areas, which was considered in data collection and distributing the survey sample. Zoning is a technique used by planners to facilitate urban and land-use planning as mentioned in Section 3.2.2. Moreover, zoning takes into consideration maps of major roads, which defined the zonal boundaries for each zone. Zone number one, two, four and five are considered residential zones, while zone number three is considered a commercial zone and zone number six is considered mix of industrial and residential uses. Moreover, there are five external zones.

4.3 Selecting Sample Size

Before starting data collection and field survey, the sample size was determined as presented in Chapter 3. The number of households in Salfit City in 1997 was 1,321, and the number of households in 2007 were 1,840, the forecasted number of households in 2017 by using linear extrapolation would be approximately = (1,840/1,321)*1,840= 2,562 household. Therefore, the sample size will be 256 (10% of 2,562).

The sample was distributed randomly on the divided zones as per Table 3.2. The sample size for each zone is depending on the number of households in that zone.

4.4 Information Included in the Questionnaire

As mentioned in Chapter 3, the questionnaire was included two parts. The first part of questionnaire, which is related to personal and household characteristics; the household size, type of house (independent home or apartment), household income, age, gender, current work, level of current education such as kindergarten, school, college and university, possession of a driving license and vehicle ownership such as motorcycle, private car, public car, and bicycle. The second part of questionnaire is related to trip data, all trips made by members of household characterized as per the purpose of trip, which is classified to five types of trips: work, educational, shopping, recreational and social trips. The data for each trip contains number of trips for each person, origin of trip, destination of trip, start time, end time and the mode used. The mode used for traveling was classified into

private car drive alone, private car share-ride, bicycle, motorcycle, shared taxi, taxi, bus, walk and others.

Table 4.1 summarizes the independent variables included in modeling trip generation. It is noticed from the table that the age of respondents is divided into five categories. The first age category includes ages up to 16 years, the persons who are assumed to be in kindergartens or basic schools. The second age category includes persons between 17 to 30 years, the youth who are in either high school or continuing higher education, or being part of the labor force. The third age category includes persons between 31 and 50 years, who mainly form the labor force, and the fourth age category includes persons between 51 to 64 years who are assumed as in charge of families and part of the labor force. Finally, the fifth age category of ages 65 and above includes elderly persons who are usually have retired.

Table 4.1: Explanatory Variables for Use in the Models to Predict Number of Trips

X_1	Number of persons in the household
X_2	Number of males in the household
X_3	Number of females in the household
X_4	Number of persons who are employed in the household
X_5	Number of persons who are receiving education in the household
X_6	Number of persons who are under 16 years in the household
X_7	Number of persons who are between 17 and 30 years in the household
X_8	Number of persons who are between 31 and 50 years in the household
X_9	Number of persons who are between 51 and 64 years in the household
X_{10}	Number of persons who are above 65 years in the household
X_{11}	Number of licensed drivers in the household
X_{12}	Number of cars owned by a household
X_{13}	Number of bicycles owned by a household
X_{14}	Number of motorcycles owned by a household
X_{15}	Monthly household income (Thousand New Israeli Shekel)
X_{16}	House type: 1 if Independent Residence, 0 if Apartment

Table 4.2 presents the dependent variables, which are included in part two of the questionnaire. The table shows the number of total daily trips made by household, number of total trips made as per trip purpose (work trips, educational trips, shopping trips, social trips and recreational trips), and the number of trips made according to their period. The time of day period in which the trip took place is divided to five categories. The first category includes generated trips made before 8:00 AM. The second-time category includes generated trips made between 8:00 and 9:00 AM. The third-time category includes generated trips made between 9:00 AM and 12:00 PM. The fourth-time category includes generated trips made between 12:00 – 4:00 PM. The fifth-time category includes generated trips made after 4:00 PM. The number of daily trips made by household also should include the independent trips conducted by children and the trips conducted by non-motorized modes either by walking or biking.

Table 4.2: Dependent Variables Used in the Models

Y	Number of daily trips made by household
Y_1	Number of daily work trips made by household
Y_2	Number of daily educational trips made by household
Y_3	Number of daily shopping trips made by household
Y_4	Number of daily social trips made by household
Y_5	Number of daily recreational trips made by household
Y_6	Number of daily trips made by household before 8:00 AM
Y_7	Number of daily trips made by household between 8:00 – 9:00 AM
Y_8	Number of daily trips made by household between 9:00 AM -12:00 PM
Y_9	Number of daily trips made by household between 12:00 – 4:00 PM
Y_{10}	Number of daily trips made by household after 4:00 PM

4.5 Conducting Field Survey

After defining the study area, the internal and external zones, determining the sample size for each zone, designing the questionnaire, choosing door-to-door interview survey, and get a letter from Faculty of Graduate Studies in coordination with Salfit Municipality to facilitate the mission, the field survey was conducted in Salfit City by determining household addresses randomly for each zone.

Two skilled enumerators who are familiar with respondents and study area are chosen to help in collecting the data. The sample of households was numbered on the questionnaire form and the same numbers on a printed map of household layout. The collected data of trip details is representing typical working day in Palestine, so the respondents are required to answer the questionnaire for a typical working day. The questionnaire was asked to the household members and each member above 12 years of the household gives his/her answers. The answers for questions to the members below 12 years were obtained from their parents. The data was collected from 309 households, the data of 256 households of sample is used to develop new models and the data of 53 households is used to verify estimated models. The field survey was conducted between early October starting at zone 4 and late November 2016 ending at zone 5. Trip generation analysis takes into consideration production home based trips between traffic zones. The divided zones are illustrated in Figure 3.1.

Chapter Five

Model Estimation and Examination of Model Transferability

Chapter Five

Model Estimation and Examination of Model Transferability

5.1 Introduction

In this chapter, the estimated trip generation models for Salfit City are analyzed and discussed. The descriptive statistics for both the dependent and explanatory parameters are presented, then the estimation of each trip generation model is presented and evaluated, considering model statistical or various specific tests, such as Pearson's correlation, P-value, T-test, F-test, the coefficient of determination, and Variable Inflation Factor (VIF). This chapter considers first the general model for all trips generated by a household, and then deals with trip generation models based on trip purpose and trip timing. Five purposes and five periods were considered. Next, the transferability of Jericho City models is tested and compared to trip generation models' outcomes generated for Salfit City. Two approaches to test the transferability of the models are used; native transfer and updating model coefficients.

5.2 Descriptive Analysis

This section discusses and shows the descriptive statistics of variables for both dependent and explanatory parameters and the descriptive statistics analysis to show travel behavior for a sample of Salfit households. Proper comparisons of the descriptive statistics between Salfit City and Jericho City are illustrated in tables.

5.2.1 Descriptive Statistics of Dependent Variables

The descriptive statistical data for total daily trips in Salfit City and in comparison, with the descriptive statistics for total daily trips in Jericho City are shown in Table 5.1. There has been a total of 1,620 trips made by 256 households for Salfit City in comparison with a total of 4,913 trips made by 713 households for Jericho City.

Table 5.1: Descriptive Statistics for the Total Daily Household Trips for Salfit in comparison with Jericho

City	Mean	Standard Deviation	Maximum	Minimum	Range	Sample Size
Salfit	6.33	2.950	17	1	16	253
Jericho	6.89	3.096	16	0	16	713

Table 5.1 shows that the average daily trips generated by a household for Salfit City is around 6.3 trips, which is slightly less than that for Jericho City, which is around 6.9. The maximum number of total trips for Salfit City and Jericho City is 17 and 16, while the minimum number of total trips is 1 and 0, respectively.

The descriptive statistics for the work, education, shopping, social and recreational daily trips generated by a household are shown in Table. 5.2. It is clear from the table that there is high similarity of the descriptive statistics between Salfit City and Jericho City for the work trips, where the average work daily trips generated by a household are almost identical (around 1.6).

Table 5.2: Descriptive Statistics for Daily Household Trips Based on Purpose for Salfit in Comparison with Jericho

Work trips						
City	**Mean**	**Standard Deviation**	**Maximum**	**Minimum**	**Range**	**Sample Size**
Salfit	1.59	1.069	5	0	5	253
Jericho	1.60	0.817	5	0	5	713
Educational trips						
City	**Mean**	**Standard Deviation**	**Maximum**	**Minimum**	**Range**	**Sample Size**
Salfit	1.59	1.519	7	0	7	253
Jericho	1.84	1.575	6	0	6	713
Shopping trips						
City	**Mean**	**Standard Deviation**	**Maximum**	**Minimum**	**Range**	**Sample Size**
Salfit	0.49	0.587	3	0	3	253
Jericho	1.52	0.996	7	0	7	713
Social trips						
City	**Mean**	**Standard Deviation**	**Maximum**	**Minimum**	**Range**	**Sample Size**
Salfit	1.90	1.479	8	0	8	253
Jericho	1.03	1.143	7	0	7	713
Recreational trips						
City	**Mean**	**Standard Deviation**	**Maximum**	**Minimum**	**Range**	**Sample Size**
Salfit	0.76	0.817	4	0	4	253
Jericho	0.92	1.45	6	0	6	713

The table shows that the average educational daily trips generated by a household for Salfit City is around 1.6 trips and for Jericho City is slightly higher (around 1.8). The maximum number of educational trips for Salfit City and Jericho City is 7 and 6, respectively, while the minimum number is zero for the two cities.

For the shopping daily trips, the table shows that the average daily trips for Salfit City is around 0.5 trip per household and for Jericho City is around

1.5. With regard to social daily trips, the average daily trips generated by a household for Salfit City is around 1.9 trips, compared with around 1.0 for Jericho City. On the other hand, the average recreational daily trips generated by a household are almost equal for both cities.

The descriptive statistics for the temporal daily household trips for Salfit City in comparison with Jericho City are shown in Table 5.3. It is clear from the table that there is high similarity of the descriptive statistics between Salfit City and Jericho City for the trips made before 8:00 AM, where the average daily trips generated by a household for Salfit City is around 2.3 trips and for Jericho City is slightly higher, which is around 2.6 trips. The maximum number of daily trips made before 8:00 AM by a household are almost identical for the two cities, which is 7 trips.

The table shows that the average daily trips made between 8:00 and 9:00 AM by a household for Salfit City is around 0.4 trip and for Jericho City is slightly higher (around 0.6).

For the daily trips made between 9:00 AM -12:00 PM, the table shows that the average daily trips for Salfit City is around 0.6 trip and for Jericho City is around 0.2 trip, which is considerably less.

Table 5.3: Descriptive Statistics for Daily Household Trips by Period

Before 8:00 AM						
City	**Mean**	**Standard Deviation**	**Maximum**	**Minimum**	**Range**	**Sample Size**
Salfit	2.34	1.799	7	0	7	253
Jericho	2.58	1.640	7	0	7	713
Between 8:00 AM – 9:00 AM						
City	**Mean**	**Standard Deviation**	**Maximum**	**Minimum**	**Range**	**Sample Size**
Salfit	0.38	0.632	3	0	3	253
Jericho	0.57	0.820	5	0	5	713
Between 9:00 AM -12:00 PM						
City	**Mean**	**Standard Deviation**	**Maximum**	**Minimum**	**Range**	**Sample Size**
Salfit	0.64	0.780	4	0	4	253
Jericho	0.24	0.501	3	0	3	713
Between 12:00 PM – 4:00 PM						
City	**Mean**	**Standard Deviation**	**Maximum**	**Minimum**	**Range**	**Sample Size**
Salfit	0.25	0.573	3	0	3	253
Jericho	0.54	0.653	4	0	4	713
After 4:00 PM						
City	**Mean**	**Standard Deviation**	**Maximum**	**Minimum**	**Range**	**Sample Size**
Salfit	2.73	1.691	9	0	9	253
Jericho	2.95	1.820	10	0	10	713

With regard to the daily trips made between 12:00 PM – 4:00 PM, the average daily trips generated by a household for Salfit City is around 0.3 trips, which is less than that for Jericho City, which is around 0.5. The maximum number of daily trips made between 12:00 PM – 4:00 PM for Salfit City and Jericho City is 3 and 4, respectively, while the minimum number is zero for the two cities.

In reference to Table 5.3, the average daily trips made after 4:00 PM by a household for Salfit City is around 2.7 trips, which is slightly less than that for Jericho City, which is around 3.0.

The distribution of daily household trips by purpose shown in Table 5.4 as a percentage of total. The table also shows the comparison between travel behavior based on purpose between Salfit City and Jericho City. The social trips are about 30% of total trips for Salfit City, while for Jericho City were 15% of total trips.

Table 5.4: Distribution of Daily Household Trips by Purpose for Salfit in Comparison with Jericho

Trip Purpose	Salfit City	Jericho City
Work	25.1%	23.0%
Education	25.1%	27.0%
Shopping	7.7%	22.0%
Social	30.1%	15.0%
Recreational	12.0%	13.0%
Total	**100.0%**	**100.0%**

Table 5.4 shows that the percent of work and education trips are 25.1% for Salfit City, while for Jericho City were 23% and 27%, respectively. The percent of work, education and recreational trips are almost equal for the two cities.

For shopping trips, Table 5.4 shows that there is a high difference between both cities; the percent of shopping trips in Jericho City is more than in Salfit City due to the wide and extended area of Jericho City in comparison with Salfit City, which is smaller than Jericho.

For social trips, Table 5.4 shows that Salfit City has about 30% of social trips where Jericho City has 15%, and mainly that is due to the closer social relations between the people living in Salfit City, where the population is almost homogeneous with high social interaction.

The temporal distribution of trips is important in planning to determine peak periods. The distribution of household's trips is shown in Table 5.5. The table shows two peak periods. A considerable share of the generated trips (43.1%) are made within the afternoon peak period. The percent of daily trips made after 4:00 PM are almost equal for both cities. According to survey data for Salfit City, about 37% of trips are made before 8 AM, during the morning peak period, which is equal to that for Jericho City.

Table 5.5: Distribution of Daily Household Trips by period for Salfit in comparison with Jericho

Trip Purpose	Salfit City	Jericho City
Before 8:00 AM	36.9%	37.0%
8:00 – 9:00 AM	5.9%	8.0%
9:00 AM- 12:00 PM	10.1%	4.0%
12:00 – 4:00 PM	4.0%	8.0%
After 4:00 PM	43.1%	43.0%
Total	**100.0%**	**100.0%**

For the trips made before 8:00 AM, most of people work and study in government institutions and private companies. Therefore, they leave their homes before 8:00 AM, which is the official start time.

The percent of trips conducted at the midday in Jericho City is less than Salfit City due to the high temperature degree and weather conditions. The final

results show that there is a high similarity between Salfit City and Jericho City, such as the mean and distribution of daily trips made before 8:00 AM and daily trips made after 4:00 PM.

5.2.2 Descriptive Statistics of Independent Variables

- **Household Size**

One of the most important independent variables is the household size. This variable has effect on the total number of trips conducted by the household. Table 5.6 lists descriptive statistics data for the size of household.

Table 5.6: Descriptive Statistics for the Size of Household for Salfit in Comparison with Jericho

City	Mean	Standard Deviation	Maximum	Minimum	Range	Sample Size
Salfit	4.01	1.761	9	1	8	253
Jericho	4.66	1.626	9	1	8	713

Table 5.6 shows that the average of household size in Salfit City is around 4.0 and in Jericho is around 4.7. The maximum and minimum number of persons in the two cities are identical.

- **Gender Distribution**

With regard to gender distribution, which is important variable, Table 5.7 shows gender distribution in each city.

Table 5.7: Gender Distribution of the Sample for Salfit in Comparison with Jericho

Gender	Salfit City	Jericho City
Males	50.5%	49.0%
Females	49.5%	51.0%
Total	**100.0%**	**100.0%**

The results from table show that the percent of males and females are approximately equal in Salfit City and in Jericho City, and the values were analogical between two cities.

- **Number of Males**

Table 5.8 shows the statistics, which describe the distribution of males for Salfit City and for Jericho City in the household.

Table 5.8: Descriptive Statistics of Distribution for Males in the Household for Salfit in Comparison with Jericho

City	Mean	Standard Deviation	Maximum	Minimum	Range	Sample Size
Salfit	2.02	1.199	6	0	6	253
Jericho	2.32	1.216	7	0	7	713

In reference to Table 5.8, it is clear that the average number of males in Salfit City is around 2.0. It is slightly less than that to Jericho City, in which the average number of males is 2.3. The maximum number of males in Salfit City is 6 where was found 7 males in Jericho City. The minimum number of males for each city is zero.

- **Number of Females**

The descriptive statistics for females' distribution in the household for Salfit City and for Jericho City are illustrated in Table 5.9.

Table 5.9: Descriptive Statistics of Distribution for Females in the Household for Salfit in Comparison with Jericho

City	Mean	Standard Deviation	Maximum	Minimum	Range	Sample Size
Salfit	1.98	1.068	5	1	4	253
Jericho	2.38	1.206	7	0	7	713

With respect to Table 5.9, the average number of females in Salfit City and in Jericho City is around 2.0 and 2.4, respectively. The maximum number of females in the household is 5 in Salfit City and 7 in the Jericho City. For the minimum number of females, the data shows that is 1 female in Salfit City, and 0 for Jericho City.

- **Number of Employed Persons**

In the household, the number of persons who are employed was considered one of the independent parameters. The descriptive statistics for employed persons in the household for Salfit and Jericho cities are illustrated in Table 5.10.

Table 5.10: Descriptive Statistics for Employed Persons in the Household for Salfit in Comparison with Jericho

City	Mean	Standard Deviation	Maximum	Minimum	Range	Sample Size
Salfit	1.39	0.933	4	0	4	253
Jericho	1.46	0.722	4	0	4	713

The descriptive statistics show that the average number of persons who are employed is around 1.4 for Salfit City and 1.5 for Jericho City. The maximum number and minimum number is 4 and 0 for each city, respectively, as presented in Table 5.10.

- **Number of Persons Receiving Education**

The descriptive statistics, which describe the number of persons who are receiving education for Salfit and Jericho cities in the household, are illustrated in Table 5.11.

Table 5.11: Descriptive Statistics for Persons Receiving Education in the Household for Salfit in comparison with Jericho

City	Mean	Standard Deviation	Maximum	Minimum	Range	Sample Size
Salfit	1.61	1.499	7	0	7	253
Jericho	1.88	1.589	7	0	7	713

The average number of persons who are receiving education in the household is around 1.6 in Salfit City and 1.9 in Jericho City. The maximum and minimum values for two cities are identical, which is 7 and 0, respectively.

- **Age Distribution**

The household age was divided into five categories. Table 5.12 shows five age categories for the distribution of household survey respondents for Salfit in comparison with Jericho.

Table 5.12: Distribution of Household Survey Respondents by Age Categories for Salfit in Comparison with Jericho

Age Group	Salfit City	Jericho City
Under 16	29.9%	32.0%
17 - 30	29.6%	33.0%
31 - 50	22.0%	27.0%
51 - 64	13.4%	6.0%
Above 65	5.1%	2.0%
Total	**100.0%**	**100.0%**

The results show that the highest percent was for the combined category of under 16 and between 17-30 years in Salfit City. In comparison with Jericho City, the distribution shows that the highest percent was in the same categories of Salfit.

- **Number of Licensed Drivers**

The descriptive statistics for the number of licensed drivers for Salfit and Jericho cities in the household are illustrated in Table 5.13.

Table 5.13: Descriptive Statistics for the Number of Licensed Drivers by a household for Salfit in Comparison with Jericho

City	Mean	Standard Deviation	Maximum	Minimum	Range	Sample Size
Salfit	1.18	0.988	6	0	6	253
Jericho	1.06	0.892	5	0	5	713

The average number of licensed drivers for Salfit City and Jericho City is around 1.2 and 1.1, respectively. The maximum number for Salfit City and for Jericho City is 6 and 5, respectively, where the minimum number is zero for both.

- **Transportation Vehicles**

The owned transportation vehicles, whether owned motorized or non-motorized, were divided into three categories. The distribution of the vehicles shows that nearly 89.0% of the owned vehicles were cars in Salfit and 76.0% of in Jericho as per shown in Table 5.14. The percent of bicycles was 7.8% in Salfit City, where the percent of bicycles in Jericho City was 23.0%.

Table 5.14: Distribution of Owned Transportation Vehicles for Salfit in Comparison with Jericho within All Households

Transportation Vehicle	% in Salfit City	% in Jericho City
Cars	88.9%	76.0%
Bicycles	7.8%	23.0%
Motorcycles	3.3%	1.0%
Total	**100.0%**	**100.0%**

For the owned transportation vehicles by a household; number of cars, number of bicycles and number of motorcycles, Table 5.15 indicates the descriptive statistics for the Salfit City in comparison with Jericho City.

Table 5.15: Descriptive Statistics of Transportation Vehicles Owned by a Household for Salfit in Comparison with Jericho

Number of Cars						
City	**Mean**	**Standard Deviation**	**Maximum**	**Minimum**	**Range**	**Sample Size**
Salfit	0.53	0.612	3	0	3	253
Jericho	0.59	0.586	3	0	3	713
Number of Bicycles						
City	**Mean**	**Standard Deviation**	**Maximum**	**Minimum**	**Range**	**Sample Size**
Salfit	0.05	0.246	2	0	2	253
Jericho	0.18	0.443	3	0	3	713
Number of Motorcycles						
City	**Mean**	**Standard Deviation**	**Maximum**	**Minimum**	**Range**	**Sample Size**
Salfit	0.02	0.138	1	0	1	253
Jericho	0.01	0.075	1	0	1	713

Table 5.15 shows that the average number of cars is around 0.50 for Salfit City and 0.60 for Jericho City. The maximum number of cars owned by a household in Salfit city was 3, which was equal the maximum number for Jericho.

The results show that the average number of bicycles owned by a household in Salfit City is around 0.1, while for Jericho City is around 0.2. The table shows that the maximum number of bicycles owned by a household in Salfit City is 2 and the minimum is zero.

With reference to Table 5.15, it is noticed that the maximum number of motorcycles owned by household in Salfit City or in Jericho City is 1, where the minimum value is zero.

- **Monthly Household Income**

For the monthly household income, Table 5.16 illustrates the average income, the maximum and minimum values for Salfit City in comparison with Jericho City.

Table 5.16: Descriptive Statistics for the Monthly Income by a household for Salfit in Comparison with Jericho (in NIS)

City	Mean	Standard Deviation	Maximum	Minimum	Range	Sample Size
Salfit	4,750	3.070	30,000	700	29,300	253
Jericho	3,880	2.158	20,000	1,000	19,000	713

With reference to the table, the descriptive statistics show that the average value is 4,750 NIS in Salfit City, while the average value in Jericho city is 3,880 NIS. The maximum income for Salfit City and Jericho City is 30,000 NIS and 20,000 NIS, while the minimum number is 700 NIS and 1,000 NIS, respectively.

5.3 General Trip Generation Model

5.3.1 Estimated Model for Salfit City

The collected data were used to develop the general trip generation model using multiple linear regression analysis. The conducted analysis considered the most suitable variables among the sixteen independent variables. The best estimated general trip generation model is:

$$Y = 2.597+1.249*X_4+1.239*X_5 \quad (5.1)$$

The variables included are the number of persons who are employed (X_4) and the number of persons who are receiving education (X_5). Table 5.17 indicates the regression analysis results for Equation (5.1). Assessment of the model is presented in the following sub-section.

Table 5.17: Regression Results for General Trip Generation Model of Salfit City

	Coefficient	**Stand. Error**	**t-Stat**	**P-value**	**VIF**
Intercept	2.597	0.218	11.906	0.000	
X_4	1.249	0.120	10.422	0.000	1.028
X_5	1.239	0.074	16.650	0.000	1.028
R^2			0.643		
F-value			228.024		
Sample Size			256		

5.3.1.1 Model Assessment

1) Interpretation of Regression Coefficients

The results of regression analysis illustrate that the general trip generation model for Salfit City can be explained considering two variables as per Equation (5.1). The value of coefficient for independent variable (X_4) is 1.249 and the sign is positive. This indicates that as the number of persons who are employed increases in the household, the number of daily generated trips will increase. The variable (X_5) has a coefficient of 1.239, which indicates that the increase in the number of persons who are receiving education, will lead to increase average daily generated trips, with almost the same weight as the number of persons who are employed. This means that the relationship is positive between the number of persons who are receiving education and the number of daily household trips as expected.

2) Testing Coefficients: T-Test Individual

The value of t-statistic test for the coefficient of the explanatory variable X_4 (number of persons who are employed in the household) is 10.422. The value of t- statistic test indicates that the variable is statically significant at 99.99%. This means that the hypothesis that the number of persons who are employed in the selected household has a positive or negative effect on the daily generated trips is accepted.

With reference to Table 5.17, the t-value for the coefficient of the explanatory variable X_5 (number of persons who are receiving education in the household) is 16.650, which is statistically significant at 99.99%.

Thus, the null hypothesis that the number of persons who are receiving education (X_5) does not has an effect on the number of daily trips generated by a household (Y) is rejected, and the alternative hypothesis that number of persons who are receiving education and the number of generated daily trips are positively related is accepted.

The results show that the two variables have an influence on the dependent variable (number of daily trips generated by a household).

3) Testing for Multicollinearity: Pearson's Correlation and (VIF)

The correlation matrix is included in Appendix B (Table B-1), this matrix will be considered in the process of model building. The correlation between X_4 and X_5 is 0.166, the correlation between X_5 and X_6, is 0.865 and so on. The first value of correlation is low and this means there is no multicollinearity problem, but the second value of correlation is very high and there is multicollinearity problem.

For VIF test, Table 5.17 shows the VIF value for each of the independent variables, which included in the general trip generation model. The VIF value for independent variables X_4 and X_5 is 1.028, which is considering less than 10. Regarding check multicollinearity, this value shows that there is no problem in the estimated general model.

4) Testing Goodness of Fit: R-Squared (R^2)

The value of R^2 for the estimated model is 0.643. This implies that the explanatory variables (X_4 and X_5) included in the generated model explained 64.3% of the variation in the total number of daily trips

generated by a household, this indicating that the model shows good explanation of data variability.

Table 5.18: ANOVA Table for General Trip Generation Model of Salfit City

5) Testing Overall Significance of Model: F-Test

	Degrees of Freedom	**Sum of Squares**	**Mean Square**	**F-value**	**Significance**
Regression	2	1407.567	703.783	228.024	$2*10^{-57}$
Residual	253	780.871	3.086		
Total	255	2188.438			

Table 5.18 presents the F-statistics value for the general trip generation model, which is 228.024. Since this is a high value, the null hypothesis that the number of persons who are employed (X_4) and the number of persons who are receiving education (X_5) have no impact on the total number of daily trips generated by a household (Y) is rejected statistically at the 99.99% level and the alternative hypothesis that the explanatory variables X_4 and X_5 are jointly affect the dependent variable is accepted.

Table 5.18 is an ANOVA table that presents the analysis of the total variance in the dependent variable, which is 2188.438. There are two sources for the variance, the first is due to regression, which is 1407.567 and the second is due to errors or residuals, which is 780.871.

Table 5.18 shows the value of mean square for regression variance, which is 703.783 (determined by dividing sum of squares on degrees of freedom) and for residual variance is 3.086 (determined also by dividing the relevant

sum of squares on the respective degrees of freedom). These values are used to determine the F value of 228.024 (using Equation (3.8)). This indicates that the regression coefficients are jointly relevant, therefore, the two related variables (X_4 and X_5) are together significant in the model.

5.3.1.2 Model Verification

The process of determining whether the estimated model and its predicted data accurately represents the actual conditions and ensures that the model does what it is intended to do, is called model verification. The verification is done by forecasting the dependent variable using the estimated model and comparing them to survey observations that were not used in estimating the model. If the forecasts result and the survey observations are in acceptable agreement, the model could be considered verified.

To verify the estimated general trip generation model, Table 5.19 includes the comparison of 53 randomly selected observations of the observed (actual) values of total trips generated by a household with the number of daily trips generated by a household (Y) using the estimated regression model.

Table 5.19: Difference between Actual and Estimated General Trips for Salfit City

Observation	Actual Y	Estimated Y	Difference
Sample (257)	8	6.33	1.67
Sample (258)	8	7.56	0.44
Sample (259)	4	2.60	1.40
Sample (260)	6	3.85	2.15
Sample (261)	3	7.56	-4.56
Sample (262)	9	6.33	2.67
Sample (263)	6	5.09	0.92
Sample (264)	3	5.10	-2.10
Sample (265)	5	3.85	1.15
Sample (266)	10	8.81	1.19
Sample (267)	6	7.56	-1.56
Sample (268)	7	7.57	-0.57
Sample (269)	4	5.09	-1.09
Sample (270)	10	7.56	2.44
Sample (271)	8	5.09	2.92
Sample (272)	7	6.33	0.67
Sample (273)	6	7.57	-1.57
Sample (274)	5	5.09	-0.09
Sample (275)	4	5.09	-1.09
Sample (276)	4	3.85	0.15
Sample (277)	2	2.60	-0.60
Sample (278)	12	8.80	3.20
Sample (279)	11	10.05	0.95
Sample (280)	12	11.29	0.71
Sample (281)	5	3.85	1.15
Sample (282)	8	7.56	0.44
Sample (283)	8	10.05	-2.05
Sample (284)	18	11.29	6.71
Sample (285)	6	5.10	0.90
Sample (286)	10	10.05	-0.05
Sample (287)	11	7.57	3.43
Sample (288)	9	8.82	0.18
Sample (289)	6	5.09	0.92

Sample (290)	5	3.85	1.15
Sample (291)	12	11.28	0.72
Sample (292)	8	7.56	0.44
Sample (293)	1	2.60	-1.60
Sample (294)	9	7.57	1.43
Sample (295)	3	3.85	-0.85
Sample (296)	10	8.81	1.19
Sample (297)	13	10.04	2.96
Sample (298)	10	6.33	3.67
Sample (299)	4	5.09	-1.09
Sample (300)	3	3.85	-0.85
Sample (301)	12	11.30	0.70
Sample (302)	1	3.85	-2.85
Sample (303)	6	6.34	-0.34
Sample (304)	4	3.85	0.15
Sample (305)	1	2.60	-1.60
Sample (306)	7	6.32	0.68
Sample (307)	3	2.60	0.40
Sample (308)	5	6.32	-1.32
Sample (309)	3	6.32	-3.32
Total	**361**	**340.31**	**20.69**

Tables 5.20 shows the descriptive analysis for the actual and estimated daily trips generated by a household for each of the randomly selected observations. Appendix B (Table B-2) shows that there is no significant difference at the 90% level in the comparison between the average estimated trips and of actual trips. This means that the estimated general trip generation model is suitable and is representative for Salfit City.

Table 5.20: Descriptive Analysis for Actual and Estimated Daily Household Trips for Salfit City

	Actual Y	Estimated Y
Mean	6.811	6.420
Standard Error	0.489	0.347
Median	6.000	6.334
Standard Deviation	3.562	2.528
Count	53	53

5.3.2 Transferred General Trip Generation Model from Jericho City

The general trip generation model estimated by Dodeen (2014) used the cross-section data collected from the 713 respondents. The model was:

$$Y = 1.83 + 1.29X_4 + 1.35X_5 + 0.2X_6 + 0.28X_9 + 0.07X_{15} \qquad (5.2)$$

Table 5.21 shows the regression results for Equation (5.2).

Table 5.21: Regression Results for General Trip Generation Model of Jericho City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
Intercept	1.83	0.184	9.92	0.0001	
X_4	1.29	0.098	13.21	0.0001	1.183
X_5	1.35	0.058	23.04	0.004	2.060
X_6	0.20	0.068	2.91	0.038	2.114
X_9	0.28	0.136	2.08	0.038	1.176
X_{15}	0.07	0.034	2.07	0.0001	1.280
R^2			0.691		
F-value			315.590		
Sample Size			713		

The estimated model generated for Jericho City depends on five variables as shown in Equation (5.2). The first variable is the number of persons who are employed (X_4), the second variable is number of persons who are receiving education (X_5), the third variable is the number of persons who are under 16 years (X_6), the fourth variable is number of persons who are between 51 and 64 years (X_9) and the last variable is monthly household income in thousand NIS (X_{15}). It is noticed that all coefficients in the model have a positive sign. The number of daily household trips variable has a positive relationship with each of the independent variables with different effect for each variable as per the coefficient values for each of the parameters. The t-statistics values indicate that all the included variables were significant at 95% level.

Table 5.21 indicates that the R^2 value of the general trip generation model is about 0.69. This shows that the explanatory variables included in the model explains about 69% of the variation in the total number of daily trips made by a household, which is a good value.

5.3.2.1 Transferred General Model by Updating Model Coefficients

As was mentioned previously, the second objective of this research is to check the spatial transferability using two approaches. The second approach is by updating model coefficients for the already estimated trip generation models for Jericho City to Salfit City. This means updating the coefficient for each variable in the model. Thus, the estimated model for Salfit City became:

$$Y = 2.417 + 1.176X_4 + 1.276X_5 - 0.026X_6 + 0.188X_9 + 0.032X_{15} \quad (5.3)$$

Table 5.22 shows the regression results for Equation (5.3).

Table 5.22: Regression Results for Transferred General Trip Generation Model by Updating Model Coefficients

	Coefficient	Stand. Error	t-Stat	P-value	VIF
Intercept	2.417	0.250	9.666	0.000	
X_4	1.176	0.134	8.752	0.000	1.291
X_5	1.276	0.148	8.608	0.000	4.069
X_6	-0.026	0.172	-	0.881	4.264
X_9	0.188	0.159	1.182	0.238	1.159
X_{15}	0.032	0.040	0.796	0.427	1.264
R^2			0.646		
F-value			91.57		
Sample Size			256		

For Equation (5.3), all independent variables are the same for the independent variables in Equation (5.2), but the coefficients differ, while the sign for one of explanatory variable (X_6) is different. For example, the coefficient of X_4 in the Equation (5.3) and Equation (5.2) is 1.176 and 1.29, respectively. The intercept-y value is 2.417 in Equation (5.3), while it is 1.83 in Equation (5.2).

It is noticed that the coefficient of variable X_6 (number of persons who are under 16 years) is very low (0.026) and has a negative sign, which has a minor effect on the model. This indicates that as the number of persons who are under 16 years increases in the household, the average number of daily household trips (Y) will slightly decrease. This is not as expected.

With regard to testing the individual coefficients (T-Test), as per Table 5.22, the coefficient of explanatory variable X_4 (number of persons who are employed in the household) has a t-statistic value of 8.752, which means that the variable is significant at 99.99%. This shows that the number of persons who are employed has a positive effect on the average number of total daily generated trips (Y). Similarly, as the t-value for the coefficient of X_5 (number of persons who are receiving education) is 8.608; the variable is significant at 99.99%.

On the other hand, the t-statistic value for the coefficient of explanatory variable X_6 (number of persons who are under 16 years in the household) is -0.15. The value of t-statistic indicates that the explanatory variable is significant only at the 11.9% level.

Similarly, the coefficient of the variable X_9 (number of persons who are between 51 and 64 years) has a t-statistic value of 1.182, which is less than 2 and statistically significant at 76%. Finally, the t-statistic value for the coefficient of explanatory variable X_{15} (Monthly household income) is 0.796, which is also significant at 57% level. Thus, the null hypothesis that the number of persons who are under 16 years (X_6), number of persons who are between 51 and 64 years (X_9) and monthly household income (X_{15}) have no effect on the total number of daily trips generated by a household (Y) is accepted.

In summary, the regression coefficients for the explanatory variables X_4 and X_5 have t-statistics above two, while the coefficients for the variables X_6, X_9, and X_{15} have t-statistics less than two. Therefore, the variables (X_6, X_9,

and X_{15}) shall be eliminated and the explanatory variables X_4 and X_5 shall be maintained in the transferred model.

With respect to testing multicollinearity; Pearson's Correlation and VIF test are conducted. Table 5.22 summarizes the VIF value for each of the independent variable, which included in the estimated model. The value of the VIF test for each independent variable included in this model is less than 10, this indicates that there is no multicollinearity problem in the related model.

However, the value of Pearson's correlation value between the number of persons who are receiving education (X_5) and the number of persons who are under 16 years (X_6) is very high and equals to 0.865. This means the hypothesis that X_5 and X_6 are positively correlated is true. Therefore, the model shall has one of the two variables (X_5) and the other shall be eliminated (X_6).

The result of testing of goodness of fit shows a relatively good value R^2 of 0.65 as illustrated in Table 5.22.

5.3.2.2 Modified General Trip Generation Model for Jericho City

Based on the previous results for statistical tests and analysis, the general trip generation model with the independent variables X_4 and X_5 was generated for Jericho City using the cross-section data from the 713 respondents. The modified model is presented in Equation (5.4).

$$Y_{modified} = 2.127 + 1.353X_4 + 1.483X_5 \quad (5.4)$$

Table 5.23 indicates the regression analysis results for Equation (5.4).

Table 5.23: Regression Results for the Modified General Trip Generation Model for Jericho City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
Intercept	2.127	0.166	12.856	0.000	
X_4	1.353	0.090	14.962	0.000	1.000
X_5	1.483	0.041	36.125	0.000	1.000
R^2			0.684		
F-value			769.725		
Sample Size			713		

With reference to Table 5.23, the t-statistic values for the coefficients of explanatory variables are considerably more than two. Thus, the independent variables X_4 and X_5 are significant at 99.99%, this indicating that each has an influence on the number of daily trips per a household. Table 5.23 shows a relatively good value R^2 of 0.684.

5.3.2.3 Transferred Modified General Trip Generation Model Using Native Transfer Approach

The modified general trip generation model estimated for Jericho City is:

$$Y_{modified} = 2.127 + 1.353X_4 + 1.483X_5 \quad (5.4)$$

With respect to transferred model using this approach, the model which is applied is the same model estimated for Jericho City. Appendix C (Table C-1) includes the comparison of 53 randomly selected observations of the observed (actual) values of daily trips generated by a household with the total number of daily trips generated by a household (Y) using the modified model in the Jericho City.

Appendix C (Tables C-1 and C-2) shows the difference and the descriptive statistics for the actual daily trips generated by a household and the estimated daily trips generated by a household based on modified model for each of the randomly selected observations. The comparison between the average of estimated trips and the average of actual trips using standard deviation of the difference in means, indicates that there is no significant difference at the 90% level; see Appendix B (Table B-3). The %RTE measure to check the transferability of the general model from Jericho to Salfit City is applied. It is noticed that the value of %RTE is 5.44%, which is less than 25%. This means that the transferred general trip generation model using native transfer approach is suitable and is representative for Salfit City.

5.3.2.4 Transferred Modified General Model by Updating Model Coefficients

With respect to the transferred model using this approach, it will be the same model under Equation (5.1) due to the similarity of model structure between Jericho and Salfit cities (i.e., with the same independent variables). The difference between the actual and estimated general trips and the descriptive analysis data for the model equation is as presented Tables 5.19 and 5.20. The comparison between the average of estimated trips and the average of actual trips using standard deviation of the difference in means, indicates that there is no significant difference at the 90% level; see Appendix B (Table B-4). The %RTE measure to check the transferability of the general

model from Jericho to Salfit City, showed that the value of %RTE is 0.00%, which is less than 25%. This value indicates that the transferred general trip generation model by updating model coefficients is well expressing observed behavior and is suitable and is representative for Salfit City.

5.3.3 Conclusions

The presented results show that the general trip generation model for Salfit City depends on the number of persons who are employed and on the number of persons who are receiving education in the household. The R^2 value for the model is 0.643, which is considered as a good value. The comparison between the average of estimated trips and the average of actual trips indicates that the difference is not significant, and the estimated general trip generation model is suitable and is representative for Salfit City.

The general trip generation model that was generated for Jericho City depends on five explanatory parameters, but due to high value of Pearson's correlation between some of the explanatory parameters, such as X_5 and X_6, and due to low value of t-statistic for some of the explanatory parameters, the explanatory parameters X_6, X_9 and X_{15} were eliminated and a new general trip generation model is estimated using the cross-section data from the 713 respondents of Jericho. The new estimated model depends on the same variables in Salfit City but with different values of coefficients. The R^2 value for the model is 0.684, which shows a good value.

The first method of spatial transferring for the general model from Jericho City to Salfit City is native transfer; without updating the coefficients of

explanatory variables. It is noticed that the results of comparison between the average of the estimated trips with the average of the actual trips are not significantly different at the 90%. The transferability of the general trip generation model was examined using the %RTE measure, which was found to be 5.44%. This result indicates that the transferred general trip generation model using native transfer approach is suitable and thus saves money and time.

The second method of spatial transferring for the general model from Jericho City to Salfit City is with updating the coefficients of the explanatory parameters. In this case, the model which is considered as the transferred model with updating the coefficients is the same model, which was generated in Salfit City, because the explanatory variables are the same. Therefore, there is no relative transfer error. The comparison between the average of the estimated trips and the average of the actual trips are not significantly different at the 90%. This shows that the transferability of the general model from Jericho to Salfit City by updating model coefficients is suitable and is representative for Salfit City and will significantly reduce the cost, effort, and time for planning agencies as compared with estimating new models.

5.4 Trip Generation Models by Purpose

This research deals with trip generation models based on trip purpose. Five purposes were considered; work, educational, shopping, social, and recreational. After developing models for Salfit City, the models of Jericho

City were transferred using the two adopted approaches as presented later in this section.

5.4.1 Work Trip Generation Model

5.4.1.1 Estimated Model for Salfit City

By using the multiple linear regression analysis, the best estimated work trip generation model is:

$$Y_1 = 0.149+0.831*X_4+0.125*X_7+0.25*X_{12} \quad (5.5)$$

Table 5.24 presents the regression analysis results for Equation (5.5). The analysis results of the daily work trip generation model using the Excel program are included in Appendix D.

Table 5.24: Regression Results for Work Trip Generation Model of Salfit City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
Intercept	0.149	0.073	2.045	0.042	
X_4	0.831	0.046	18.194	0.000	1.312
X_7	0.125	0.042	2.983	0.003	1.228
X_{12}	0.25	0.063	3.952	0.000	1.086
R^2			0.695		
F-value			191.048		
Sample Size			256		

Appendix D (Tables D-3 and D-4) shows the difference and the descriptive statistics for the actual and estimated daily work trips by a household for each of the randomly selected observations. The comparison between the average of estimated trips and the average of actual trips indicates that there

is no significant difference at the 90% level; see Appendix B (Table B-2). This means that the estimated work trip generation model is suitable and is representative for Salfit City.

5.4.1.2 Transferred Work Trip Model from Jericho City Using Native Transfer Approach

The work trip generation model estimated for Jericho City used the cross-section data collected from the 713 respondents was:

$$Y_1 = 0.16 + 0.97\ X_4 + 0.04X_8 \qquad (5.6)$$

Table 5.25 shows the regression results for Equation (5.6).

Table 5.25: Regression Results for Work Trip Generation Model of Jericho City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
Intercept	0.16	0.042	3.674	0.000	
X_4	0.97	0.022	44.198	0.000	1.005
X_8	0.04	0.019	2.162	0.031	1.005
R^2			0.737		
F-value			660.797		
Sample Size			713		

To verify the transferred work trip generation model using native transfer approach, Appendix D (Tables D-5 and D-6) shows the difference and the descriptive statistics for the actual and estimated work daily trips generated by a household for each of the randomly selected observations using the transferred Equation (5.6). The result of comparison between the average of actual work trips and the average of estimated work trips indicates that the transferred model is transferable because there is no significant difference

at 90% level. Moreover, the value of %RTE measure to check the transferability of the work model from Jericho to Salfit City is 8.81%, which is less than 25%; see Appendix B (Table B-3). This means that the transferred work trip generation model using native transfer approach is acceptable, and therefore, it saves a lot of money and time for the planning agencies.

5.4.1.3 Transferred Work Trip Model from Jericho City by Updating Model Coefficients

The estimated model for work generation model using Jericho variables and updating the coefficients based on collected data in Salfit City is:

$$Y_1 = 0.32 + 0.947X_4 - 0.058X_8 \quad (5.7)$$

Table 5.26 shows the regression results for Equation (5.7).

Table 5.26: Regression Results for Transferred Work Trip Model by Updating Model Coefficients

	Coefficient	Stand. Error	t-Stat	P-value	VIF
Intercept	0.320	0.075	4.254	0.000	
X_4	0.947	0.043	22.007	0.000	1.070
X_8	-0.058	0.050	-1.165	0.245	1.070
R^2			0.666		
F-value			252.78		
Sample Size			256		

For Equation (5.7), the coefficient of independent variable X_4 is 0.947 and the sign is positive but it is noticed that the coefficient of variable X_8 (number of persons who are between 31 and 50 years in the household) has

a negative sign. This indicates that as the number of persons who are between 31 and 50 years increases in the household, the average number of daily work household trips (Y_1) will decrease. Moreover, the coefficient of X_8 has a t-statistic value of -1.165, which is less than two and statistically significant at 75.5%. The minimum value of t-test shall be two at the level of significance 95%. Therefore, the explanatory variable X_8 shall be eliminated and the explanatory variable X_4 shall be maintained in the transferred model. This means that the transferred work trip generation model using updating model coefficients approach is unsuitable and not recommended.

5.4.1.4 Conclusions

The presented results show that the R^2 value for the work model is good. The comparison between the average of estimated work trips and the average of actual work trips indicates that the difference is not significant at 90% level, and the estimated work trip generation model is suitable and expresses the observed behavior in Salfit City.

The transferred model of daily work trips using native transfer method from Jericho City to Salfit City is evaluated considering statistical tests. It is noticed that the results of comparison between the average of the estimated work trips and the average of the actual work trips are not significantly different. With reference to the %RTE measure to check transferability, the value shows that the transferred model by native transfer method expresses

the observed behavior. The final results of analysis and tests show that the model is considered as a transferable model.

The transferred model of daily work trips with updating models' coefficients from Jericho city to Salfit city is evaluated considering statistical tests. The final results of analysis and tests show that the transferred model is not recommended.

5.4.2 Education Trip Generation Model

5.4.2.1 Estimated Model for Salfit City

By using the multiple linear regression analysis, the best estimated education trip generation model is:

$$Y_2 = 0.982 * X_5 \quad (5.8)$$

Table 5.27 presents the regression analysis results for Equation (5.8). It is to be stated that the intercept is deleted from the model because its presence in a previous version of the model was not significant. The analysis results of the daily education trip generation model using the Excel program are included in Appendix E.

Table 5.27: Regression Results for Education Trip Generation Model of Salfit City

	Coefficient	**Stand. Error**	**t-Stat**	**P-value**	**VIF**
X_5	0.982	0.012	84.476	0.000	0.464
R^2			0.965		
F-value			7136.146		
Sample Size			256		

Appendix E (Tables E-3 and E-4) shows the difference and the descriptive statistics for the actual and estimated daily education trips generated by a household for each of the randomly selected observations. The comparison between the average of estimated trips and the average of actual trips indicates that the difference is not significant at 90% level; see Appendix B (Table B-2). This means that the estimated education trip generation model is suitable and is representative for Salfit City.

5.4.2.2 Transferred Education Trip Generation Model from Jericho City

The education trip generation model estimated for Jericho City was:

$$Y_2 = 0.007 + 0.975X_5 \qquad (5.9)$$

Table 5.28 shows the regression results for Equation (5.9).

Table 5.28: Regression Results for Education Trip Generation Model of Jericho City

	Coefficient	**Stand. Error**	**t-Stat**	**P-value**
Intercept	0.007	0.016	0.418	0.676
X_5	0.975	0.007	146.432	0.0001
R^2			0.968	
F-value			21,442.257	
Sample Size			713	

The estimated education model generated for Jericho City depends on one variable as per Equation (5.9). The independent variables are the number of persons who are receiving education in the household. The t-statistic value for the intercept is 0.418. The value indicates that the intercept is significant

at 32.4% level. This value is very low and the minimum value of t-test shall be two at the level of significance 95%.Therefore, the intercept shall be eliminated from the transferred model.

5.4.2.3 Modified Education Trip Generation Model for Jericho City

Based on the previous results for statistical tests and analysis, the education trip generation model with the independent variable X_5 was generated for Jericho City using the cross-section data from the 713 respondents. The modified model is presented in Equation (5.10):

$$Y_{2\ \text{modified}} = 0.977X_5 \qquad (5.10)$$

Table 5.29 shows the regression results for Equation (5.10).

Table 5.29: Regression Results for Modified Education Trip Generation Model of Jericho City

	Coefficient	**Stand. Error**	**t-Stat**	**P-value**
X_5	0.977	0.004	227.576	0.000
R^2			0.986	
F-value			51790.82	
Sample Size			713	

5.4.2.3 Transferred Modified Education Trip Generation Model Using Native Transfer Approach

With respect to transferred model using this approach, the model, which is applied, is the same model estimated for Jericho City (Equation (5.10)).

To verify the transferred education trip generation model using native transfer approach, Appendix E (Tables E-5 and E-6) shows the difference

and the descriptive statistics for the actual and estimated education trips generated by a household for each of the randomly selected observations using the transferred Equation (5.10). The result of comparison indicates that the transferred model is transferable because there is no significant difference at 90% level. Moreover, the value of %RTE measure to check the transferability of the education model from Jericho to Salfit City is 0.298%, which is less than 25%; see Appendix B (Table B-3). This means that the transferred education trip generation model using native transfer approach is acceptable.

5.4.2.3 Transferred Education Trip Model from Jericho City by Updating Model Coefficients

With respect to the transferred model using this approach, the transferred model will be the same model under Equation (5.8) due to the similarity of model structure between Jericho and Salfit Cities (i.e., with the same independent variable). The difference between the actual and estimated education trips and the descriptive analysis data for the model equation is as presented in Appendix E (Tables E-3 and E-4). The comparison between the average of estimated education trips and the average of actual education trips using standard deviation of the difference in means, indicates that the difference is not significant at 90% level see Appendix B (Table B-4).

5.4.2.4 Conclusions

The presented results show that the R^2 value for the education model is excellent and the results of statistical tests for comparison between the average of estimated and average of actual values of daily education household trips show that the estimated model is good and there is no significant difference. The estimated education trip generation model is suitable for Salfit City.

The education trip generation model that was generated for Jericho City depends on one explanatory parameter, but due to low value of t-statistic for intercept, the intercept was eliminated and a new education trip generation model was estimated using the cross-section data from the 713 respondents of Jericho. The new estimated model depends on the same variable in Salfit City but with different value of coefficient. The R^2 value for the model is 0.986, which shows a good value.

The transferred model of daily education trips using native transfer method from Jericho City to Salfit City is evaluated considering statistical tests. The results of comparison between the average of the estimated trips and the average of the actual trips are not significantly different at the 90% level. The transferability of the education trip generation model was examined using the %RTE measure, which was found to be 0.298%. This result indicates that the transferred model of daily education household trips using native transfer approach is suitable.

The model of daily education trips, which is considered as the transferred model with updating the coefficients is the same model, which was

generated in Salfit City, because the explanatory variable is the same. This results in no relative transfer error. The comparison between the average of the estimated education trips and the average of the actual education trips are not significantly different at the 90% level. This indicates that the transferability of the education model from Jericho to Salfit City by updating model coefficients is suitable and is representative for Salfit Cit.

5.4.3 Shopping Trip Generation Model

5.4.3.1 Estimated Model for Salfit City

By using the multiple linear regression analysis, the estimated shopping trip generation model is:

$$Y_3 = 0.061*X_3+0.169*X_{12}+0.294*X_{16} \quad (5.11)$$

Table 5.30 presents the regression analysis results for Equation (5.11). The analysis of the daily shopping trip generation model using the Excel program are included in Appendix F.

Table 5.30: Regression Results for Shopping Trip Generation Model of Salfit City

	Coefficient	**Stand. Error**	**t-Stat**	**P-value**	**VIF**
X_3	0.061	0.030	2.032	0.043	1.005
X_{12}	0.169	0.059	2.883	0.004	1.006
X_{16}	0.294	0.076	3.890	0.000	1.011
R^2			0.421		
F-value			61.431		
Sample Size			256		

Appendix F (Tables F-3 and F-4) show the difference and the descriptive statistics for the actual and estimated daily shopping trips generated by a household for each of the randomly selected observations. The comparison between the average of estimated trips and the average of actual trips indicates that the difference is not significant at 90% level; see Appendix B (Table B-2). This means that the estimated shopping trip generation model is unsuitable and is not representative for Salfit City.

5.4.3.2 Transferred Shopping Trip Model from Jericho City Using Native Transfer Approach

The shopping trip generation model estimated for Jericho was:

$$Y_3 = 0.282X_1 + 0.035X_{15} \qquad (5.12)$$

Table 5.31 shows the regression results for Equation (5.12).

Table 5.31: Regression Results for Shopping Trip Generation Model of Jericho City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_1	0.282	0.016	18.016	0.0001	4.363
X_{15}	0.035	0.017	2.010	0.045	4.363
R^2			0.706		
F-value			855.615		
Sample Size			713		

To verify the transferred shopping trip generation model using native transfer approach, Appendix F (Tables F-5 and F-6) shows the difference and the descriptive statistics for the actual and estimated shopping trips generated by a household for each of the randomly selected observations using the

transferred Equation (5.12). The result of comparison between the average of actual shopping trips and the average of estimated shopping trips indicates that the transferred model from Jericho is not recommended because there is a significant difference at 90% level. Moreover, the value of %RTE measure to check the transferability of the shopping model from Jericho to Salfit City is 79.43%, which is considerably more than 25%; see Appendix B (Table B-3). This means that the transferred shopping trip generation model using native transfer approach is unsuitable.

5.4.3.3 Transferred Shopping Trip Model from Jericho City by Updating Model Coefficients

The estimated model for shopping generation model using Jericho model variables and updating the coefficients based on collected data in Salfit City is:

$$Y_3 = 0.068X_1 + 0.034X_{15} \quad (5.13)$$

Table 5.32 shows the regression results for Equation (5.13).

Table 5.32: Regression Results for Transferred Shopping Trip Model by Updating Model Coefficients

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_1	0.068	0.015	4.452	0.000	1.058
X_{15}	0.034	0.012	2.841	0.005	1.058
R^2			0.371		
F-value			75.02		
Sample Size			256		

To verify the transferred shopping trip generation model using updating model coefficients approach, Appendix F (Tables F-7 and F-8) shows the

difference and the descriptive statistics for the actual and estimated shopping daily trips generated by a household for each of the randomly selected observations using the transferred Equation (5.13). The result of comparison between the average of actual trips and the average of estimated trips indicates that the transfer for the model from Jericho is not recommended because there is a significant difference at 90% level. Moreover, the %RTE measure to check the transferability of the shopping model, showed that the value of %RTE is 47.34%, which is more than 25%; see Appendix B (Table B-4). This means that the transferred shopping trip generation model using updating model coefficients approach is unsuitable and not recommended.

5.3.3.4 Conclusions

The above analysis shows that the R^2 value for the model is low and the comparison between the average of estimated shopping trips and the average of actual shopping trips indicates that there is a significant difference at the 90% level. The estimated shopping trip generation model is unsuitable and is not capable of expressing the observed behavior in Salfit City.

The transferred model of daily shopping trips using native transfer method from Jericho City to Salfit City is evaluated considering statistical tests. It is noticed that the results of comparison between the average of the estimated shopping trips and the average of the actual shopping trips are significantly different. With reference to the %RTE measure to check transferability, the value shows that the transferred model by native transfer method is not

capable of expressing the observed behavior. The final results show that the model is considered not good and unsuitable to transfer.

The transferred model of daily shopping trips with updating models' coefficients from Jericho city to Salfit city is evaluated considering statistical tests. The R^2 value for the transferred model is 0.371, which is low. The results of comparison between the average of the estimated shopping trips and the average of the actual shopping trips showed that there are significantly different. The value of %RTE measure indicates that the transferred model by updating models' coefficients method is not capable of expressing the observed behavior. The final results of analysis and tests show that the transferred model is not recommended and it is unsuitable to transfer this model from Jericho City to Salfit City.

5.4.4 Social Trip Generation Model

5.4.4.1 Estimated Model for Salfit City

By using the multiple linear regression analysis, the best estimated social trip generation model is:

$$Y_4 = 0.441*X_1 \qquad (5.14)$$

Table 5.33 presents the regression analysis results for Equation (5.14). The analysis results of the daily social trip generation model using the Excel program are included in Appendix G.

Table 5.33: Regression Results for Social Trip Generation Model of Salfit City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_1	0.441	0.020	21.364	0.000	1.039
R^2			0.641		
F-value			456.45		
Sample Size			256		

Appendix G (Tables G-3 and G-4) shows the difference and the descriptive statistics for the actual and estimated daily social trips generated by a household for each of the randomly selected observations. The comparison between the average of estimated trips and the average of actual trips indicates that there is a significant difference at the 90% level; see Appendix B (Table B-2). This means that the estimated social trip generation model is unsuitable and is not representative for Salfit City.

5.4.4.2 Transferred Social Trip Model from Jericho City Using Native Transfer Approach

The social trip generation model estimated for Jericho was:

$$Y_4 = 0.29X_3 + 0.29X_4 - 0.11X_7 \quad (5.15)$$

Table 5.34 shows the regression results for Equation (5.15).

Table 5.34: Regression Results for Social Trip Generation

Model of Jericho City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_3	0.29	0.028	10.188	0.001	2.971
X_4	0.29	0.053	5.409	0.001	4.022
X_7	-0.11	0.037	-2.857	0.004	2.944
R^2			0.435		
F-value			182.453		
Sample Size			713		

To verify the transferred social trip generation model using native transfer approach, Appendix G (Tables G-5 and G-6) shows the difference and the descriptive statistics for the actual and estimated social trips generated by a household for each of the randomly selected observations using the transferred Equation (5.15). The result of comparison between the average of actual social trips and the average of estimated social trips indicates that the transferred model from Jericho is not recommended because there is a significant difference at 90% level. Moreover, the value of %RTE measure to check the transferability of the social model from Jericho to Salfit City is 232.8%, which is more than 25%; see Appendix B (Table B-3). This means that the transferred social trip generation model using native transfer approach is unsuitable.

5.4.4.3 Transferred Social Trip Model from Jericho City by Updating Model Coefficients

The estimated model for social generation model using Jericho model variables and updating the coefficients based on collected data in Salfit City is:

$$Y_4 = 0.667X_3 + 0.102X_4 - 0.206X_7 \quad (5.16)$$

Table 5.35 shows the regression results for Equation (5.16).

Table 5.35: Regression Results for Transferred Social Trip Model by Updating Model Coefficients

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_3	0.667	0.073	9.173	0.000	1.087
X_4	0.102	0.107	0.957	0.340	1.271
X_7	-0.206	0.105	1.966	0.050	1.247
R^2			0.619		
F-value			136.99		
Sample Size			256		

For Equation (5.16), the coefficient of variable X_4 (number of persons who are employed in the household) is 0.102 and has a positive sign. The t-statistic value for the coefficient of explanatory variable X_4 is 0.957. The value indicates that the variable is significant at 66 % level. This value is very low and the minimum value of t-test shall be two at the level of significance 95%. Therefore, the explanatory variable X_4 shall be eliminated from the transferred model. This means that the transferred social trip generation model using updating model coefficients approach is unsuitable and not recommended.

5.4.4.4 Conclusions

The presented results show that the R^2 value for the model is good but the comparison between the average of estimated social trips and the average of actual social trips indicates that there is a significant difference at the 90% level. The estimated social trip generation model is unsuitable and is not capable of expressing the observed behavior in Salfit City.

The transferred model of daily social trips using native transfer method from Jericho City to Salfit City is evaluated considering statistical tests. It is noticed that the results of comparison between the average of the estimated social trips and the average of the actual social trips are significantly different. With reference to the %RTE measure to check transferability, the value shows that the transferred model by native transfer method is not capable of expressing the observed behavior. The final results show that the model is considered not good and unsuitable to transfer.

The transferred model of daily social trips with updating models' coefficients from Jericho city to Salfit city is evaluated considering statistical tests. The final results of analysis and tests show that the transferred model is not recommended, it is unsuitable to transfer this model from Jericho City to Salfit City. This result might be because the original model for Jericho was considered not well explaining the number of social trips.

5.4.5 Recreational Trip Generation Model

5.4.5.1 Estimated Model for Salfit City

By using the multiple linear regression analysis, the best estimated recreational trip generation model is:

$$Y_5 = 0.231*X_2 + 0.189*X_7 + 0.853*X_{14} \quad (5.17)$$

Table 5.36 presents the regression analysis results for Equation (5.17). The analysis results of the daily recreational trip generation model using the Excel program are included in Appendix H.

Table 5.36: Regression Results for Recreational Trip Generation Model of Salfit City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_2	0.231	0.032	7.195	0.000	1.142
X_7	0.189	0.049	3.832	0.000	1.162
X_{14}	0.853	0.348	2.452	0.015	1.035
R^2			0.543		
F-value			100.32		
Sample Size			256		

Appendix H (Tables H-3 and H-4) shows the difference and the descriptive statistics for the actual and estimated daily recreational trips generated by a household for each of the randomly selected observations. The comparison between the average of estimated trips and the average of actual trips indicates that the difference is significant at the 90% level, see Appendix B (Table B-2). This means that the estimated recreational trip generation model is unsuitable and is not representative for Salfit City.

5.4.5.2 Transferred Recreational Trip Model from Jericho City Using Native Transfer Approach

The recreational trip generation model estimated by for Jericho was:

$$Y_5 = 0.18X_5 + 0.22X_9 + 0.14X_{15} \quad (5.18)$$

Table 5.37 shows the descriptive analysis data for Equation (5.18).

Table 5.37: Regression Results for Recreational Trip Generation Model of Jericho City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_5	0.18	0.032	5.436	0.0001	2.356
X_9	0.22	0.100	2.172	0.030	1.301
X_{15}	0.14	0.019	7.038	0.0001	2.738
R^2			0.36		
F-value			133.12		
Sample Size			713		

To verify the transferred recreational trip generation model using native transfer approach, Appendix H (Tables H-5 and H-6) show the difference and the descriptive statistics for the actual and estimated recreational trips generated by a household for each of the randomly selected observations using the transferred Equation (5.18). The result of comparison between the average of actual recreational trips and the average of estimated recreational trips shows that the difference is not significant at 90% level. On the other hand, the value of %RTE measure to check the transferability of the recreational model from Jericho to Salfit City is 63.5%, which is more than 25%; see Appendix B (Table B-3). This means that the transferred recreational trip generation model using native transfer approach is not recommended.

5.4.5.3 Transferred Recreational Trip Model from Jericho City by Updating Model Coefficients

The estimated model for recreational generation model using Jericho model variables and updating the coefficients based on collected data in Salfit City is:

$$Y_5 = 0.072X_5 + 0.195X_9 + 0.091X_{15} \quad (5.19)$$

Table 5.38 shows the regression results for Equation 5.19:

Table 5.38: Regression Results for Transferred Recreational Trip Model by Updating Model Coefficients

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_5	0.072	0.032	2.264	0.024	1.067
X_9	0.195	0.070	2.801	0.005	1.085
X_{15}	0.091	0.014	6.368	0.000	1.064
R^2			0.445		
F-value			67.56		
Sample Size			256		

To verify the transferred recreational trip generation model using updating model coefficients approach, Appendix H (Tables H-7 and H-8) shows the difference and the descriptive statistics for the actual and estimated recreational daily trips generated by a household for each of the randomly selected observations using the transferred Equation (5.19). The result of comparison between the average of actual trips and the average of estimated trips indicates that the transfer for the model from Jericho is not recommended because there is a significant difference at 90% level. Moreover, the %RTE measure to examine the transferability of the

recreational model showed that the value of %RTE is 38.3%, which is more than 25%; see Appendix B (Table B-4). This means that the transferred social trip generation model using updating model coefficients approach is unsuitable and is not recommended.

5.4.5.4 Conclusions

This study shows that the value of R^2 for the model is moderate but the comparison between the average of estimated recreational trips and the average of actual recreational trips indicates that the difference between averages is significant at the 90%. The estimated recreational trip generation model is unsuitable and is not capable of expressing the observed behavior in Salfit City.

The transferred model of daily recreational trips using native transfer method from Jericho City to Salfit City is evaluated considering statistical tests. It is noticed that the results of comparison between the average of the estimated recreational trips and the average of the actual recreational trips are significantly different. With reference to the %RTE measure to check transferability, the value shows that the transferred model by native transfer method is not capable of expressing the observed behavior. The final results show that the model is considered not good and unsuitable to transfer.

The transferred model of daily recreational trips with updating models' coefficients from Jericho city to Salfit city is evaluated considering statistical tests. The R^2 value for the transferred model is about 0.445, which is not good value. The results of comparison between the average of the estimated

recreational trips and the average of the actual recreational trips showed that there are significantly different. The value of %RTE measure indicated that the transferred model by updating models' coefficients method is not capable of expressing the observed behavior. The final results of analysis and tests show that the transferred model is not recommended, it is unsuitable to transfer this model from Jericho City to Salfit City.

5.5 Temporal Trip Generation Models

This study developed five trip generation models according to time periods. This is important to decide the number of trips in the peak periods and off-peak periods and after that to do a suitable planning for selected area.

5.5.1 Trip Generation Model for Trips Made before 8:00 AM

5.5.1.1 Estimated Model for Salfit City

By using the multiple linear regression analysis, the best estimated trip generation model for trips made before 8:00 AM is:

$$Y_6 = 0.667*X_4 + 0.879*X_5 \quad (5.20)$$

Table 5.39 presents the regression analysis results for Equation (5.20). The total results of the daily trip generation model for trips made before 8:00 AM using the Excel program are included in Appendix I.

Table 5.39: Regression Results for Trip Generation Model of Trips Made Before 8:00 AM of Salfit City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_4	0.667	0.045	14.69	0.000	0.562
X_5	0.879	0.035	25.45	0.000	0.845
R^2			0.907		
F-value			1244.88		
Sample Size			256		

With reference to Appendix I (Tables I-3 and I-4) shows the difference and the descriptive statistics for the actual and estimated daily trips generated by a household for each of the randomly selected observations. The comparison between the average of estimated trips and the average of actual trips indicates that the difference is not significant at 90% level. This means that the estimated trip generation model for trips made before 8:00 AM is suitable and is representative for Salfit City.

5.5.1.2 Transferred Trip Generation Model for Trips Made Before 8:00 AM from Jericho City

The trip generation model for trips made before 8:00 AM estimated for Jericho was:

$$Y_6 = 0.11+0.08X_1 + 0.42X_4 + 0.79X_5 \quad (5.21)$$

Table 5.40 presents the regression analysis results for Equation (5.21).

Table 5.40: Regression Results for Trip Generation Model for Trips Made Before 8:00 AM of Jericho City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
Intercept	0.11	0.113	0.933	0.351	
X_1	0.08	0.032	2.48	0.0013	2.633
X_4	0.42	0.047	9.025	0.0001	1.131
X_5	0.79	0.032	25.128	0.0001	2.494
R^2			0.73		
F-value			649.9		
Sample Size			713		

The estimated model generated for Jericho City depends on three variables as per Equation (5.21). The independent variables are the number of persons in the household, the number of persons who are employed and the number of persons who are receiving education in the household. The coefficients for all independent variables are positive.

5.5.1.3 Transferred Trip Generation Model for Trips Made Before 8:00 AM by Updating Model Coefficients

The estimated trip generation model for trips made before 8:00 AM using Jericho model variables and updating the coefficients based on collected data in Salfit City is:

$$Y_6 = -0.351 + 0.207X_1 + 0.532X_4 + 0.696X_5 \quad (5.22)$$

Table 5.41 presents the regression analysis results for Equation (5.22).

Table 5.41: Regression Results for Transferred Trip Generation Model for Trips Made Before 8:00 AM by Updating Model Coefficients

	Coefficient	Stand. Error	t-Stat	P-value	VIF
Intercept	-0.351	0.167	-2.103	0.036	
X_1	0.207	0.079	2.614	0.009	6.125
X_4	0.532	0.082	6.487	0.000	1.871
X_5	0.696	0.081	8.596	0.000	4.725
R^2			0.756		
F-value			261.61		
Sample Size			256		

For Equation (5.22), the coefficient of independent variable X_1 (number of persons in the household) is 0.207 and the sign is positive. It is noticed that the coefficient of variable X_4 (number of persons who are employed in the household) is 0.532 and has a positive sign. Also, the coefficient of independent variable X_5 (number of persons who are receiving education in the household) is 0.696 and has a positive sign too. This means that the increase value for any of these independent parameters will increase the number of trips made before 8:00 AM.

However, the value of Pearson's correlation value between first explanatory variable X_1 (number of persons in the household) and the third explanatory variable X_5 (number of persons who are receiving education in the household) is equal 0.838, this value is very high and this value indicates that there is a high correlation between these explanatory parameters. This means the hypothesis that X_1 and X_5 are positively correlated is true. Therefore, the model shall have one of the two variables and the other shall be eliminated,

so the first independent variable shall be eliminated from the model. Thus, the model will be the same in Equation (5.20).

5.5.1.4 Modified Trip Generation Model for Trips Made Before 8:00 AM for Jericho City

Based on previous analysis and the results for statistical tests, especially Pearson's correlation, the trip generation model for trips made before 8:00 AM with the independent variables X_4 and X_5 was generated for Jericho City used the cross-section data from the 713 respondents. The modified model is presented in Equation (5.23):

$$Y_{6\ modified} = 0.30 + 0.462\ X_4 + 0.854\ X_5 \qquad (5.23)$$

Table 5.42 presents the regression analysis results for Equation (5.23).

Table 5.42: Regression Results for Modified Trip Generation Model for Trip Made Before 8:00 AM

	Coefficient	Stand. Error	t-Stat	P-value	VIF
Intercept	0.300	0.080	3.710	0.000	
X_4	0.462	0.044	10.454	0.000	1.000
X_5	0.854	0.020	42.561	0.000	1.000
R^2			0.731		
F-value			964.77		
Sample Size			713		

The null hypothesis that the number of persons who are employed (X_4) and the number of persons who are receiving education (X_5) have no impact on the number of daily trips made before 8:00 AM by a household (Y_6) is significantly rejected at the 99.99% level.

5.5.1.5 Transferred Modified Trip Generation Model for Trips Made Before 8:00 AM Using Native Transfer Approach

The modified trip generation model for Trips Made before 8:00 AM estimated for Jericho City is:

$$Y_{6\ modified} = 0.30 + 0.462\ X_4 + 0.854\ X_5 \qquad (5.23)$$

With respect to transferred model using this approach, the model which is applied is the same model estimated for Jericho City.

With respect to model verification, Appendix I (Tables I-5 and I-6) shows the difference and the descriptive statistics for the actual daily trips made before 8:00 AM by a household and the estimated daily trips made before 8:00 AM by a household based on transferred modified model for each of the randomly selected observations. The comparison between the average of estimated trips and the average of actual trips using standard deviation of the difference in means, indicates that the difference is not significant at the 90% level, see Appendix B (Table B-3). The %RTE measure to check the transferability of the model from Jericho to Salfit City is applied. It is noticed that the value of RTE is 0.7%, which is less than 25%. This means that the transferred modified trip generation model for trips made before 8:00 AM using native transfer approach is suitable and is representative for Salfit City.

5.5.1.6 Transferred Modified Trip Generation Model for Trips Made Before 8:00 AM by Updating Model Coefficients

With respect to the transferred model using this approach, the transferred model will be the same model under Equation (5.20) due to the similarity of model structure between Jericho and Salfit Cities (i.e., with the same independent variables). The difference between the actual and estimated trips made before 8:00 AM and the descriptive analysis data for the model equation is as presented Tables I-3 and I-4. The comparison between the average of estimated trips and the average of actual trips using standard deviation of the difference in means, indicates that the difference is not significant at the 90% level, see Appendix B (Table B-4).

5.5.1.7 Conclusions

This study shows that the R^2 value for the model is very good. The comparison between the average of estimated trips and the average of actual trips indicates that the difference is not significant and the estimated trip generation model for trips made before 8:00 AM is suitable and is representative for Salfit City.

The estimated trip generation model for trips made before 8:00 AM that was generated for Jericho City depends on the number of persons in the household (X_1), the number of persons who are employed (X_4) and the number of persons who are receiving education (X_5), but due to high value of Pearson's correlation between some of the explanatory parameters, such as X_1 and X_5, the independent variable X_1 was eliminated and a new trip generation model

for trips made before 8:00 AM is estimated used the cross-section data collected from the 713 respondents of Jericho. The new estimated model depends on the same variables in Salfit City but with different values of coefficients. The R^2 value for the model is 0.731, which shows a good value. The transferred model of daily trips made before 8:00 AM using native transfer method from Jericho City to Salfit City is evaluated considering statistical tests. It is noticed that the results of comparison show that there is no significant difference between the average of the estimated trips and the average of the actual trips at the 90% level. The transferability of the trip generation model for trips made before 8:00 AM was examined using the RTE measure, which was found to be 0.7%. This result indicates that the transferred trip generation model for trips made before 8:00 AM using native transfer approach is suitable and so this means saving money and time.

The transferred model of daily trips made before 8:00 AM with updating models' coefficients from Jericho City to Salfit City is evaluated considering statistical tests. In this case, the model which is considered as the transferred model with updating the coefficients is the same model, which was generated in Salfit City, because the explanatory variables are the same, this is resulting is no relative transfer error. The comparison between the average of the estimated trips and the average of the actual trips shows that there is no significant difference at the 90% level. This indicates that the transferability of the model of daily trips made before 8:00 AM from Jericho to Salfit City by updating model coefficients is suitable and is representative for Salfit City.

5.5.2 Trip Generation Model for Trips Made between 8:00 - 9:00 AM

5.5.2.1 Estimated Model for Salfit City

By using the multiple linear regression analysis, the best estimated trip generation model for trips made between 8:00 - 9:00 AM is:

$$Y_7 = 0.201*X_4 + 0.136*X_{12} \quad (5.24)$$

Table 5.43 presents the regression analysis results for Equation (5.24). The analysis results of the daily trip generation model for trips made between 8:00 - 9:00 AM using the Excel program are included in Appendix J.

Table 5.43: Regression Results for Trip Generation Model for Trips Made between 8:00 - 9:00 AM of Salfit City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_4	0.201	0.030	6.628	0.000	1.086
X_{12}	0.136	0.063	2.172	0.031	1.086
R^2			0.322		
F-value			60.46		
Sample Size			256		

Appendix J (Tables J-3 and J-4) shows the difference and the descriptive statistics for the actual and estimated daily trips generated by a household for each of the randomly selected observations. The comparison between the average of estimated trips and the average of actual trips indicates that the difference is not significant at 90% level; see Appendix B (Table B-2). This means that the estimated trip generation model for trips made before between 8:00 AM - 9:00 AM suitable and is representative for Salfit City.

5.5.2.2 Transferred Trip Generation Model for Trips Made Between 8:00 – 9:00 AM from Jericho City Using Native Transfer Approach

The trip generation model for trips made between 8:00 - 9:00 AM estimated by was:

$$Y_7 = 0.24X_4 + 0.069X_5 + 0.092X_{11} + 0.154X_{13} \quad (5.25)$$

Table 5.44 presents the regression analysis results for Equation (5.25).

Table 5.44: Regression Results for Trip Generation Model for Trips Made between 8:00 - 9:00 AM of Jericho City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_4	0.240	0.031	7.789	0.0001	3.184
X_5	0.069	0.017	4.172	0.0001	2.124
X_{11}	0.092	0.035	2.662	0.0080	2.914
X_{13}	0.154	0.065	2.388	0.0170	1.207
R^2			0.44		
F-value			137.65		
Sample Size			713		

To verify the transferred trip generation model for trips made between 8:00-9:00 AM using native transfer approach, Appendix J (Tables J-5 and J-6) shows the difference and the descriptive statistics for the actual and estimated trips made between 8:00 - 9:00 AM by a household for each of the randomly selected observations using the transferred Equation (5.25). The result of comparison between the average of actual trips made between 8:00 AM - 9:00 AM and the average of estimated trips made between 8:00 - 9:00 AM indicates that the transferred model from Jericho is not recommended because there is a difference at 90% level. On the other hand, the value of

%RTE measure to check the transferability of the trip generation model for trips made between 8:00 - 9:00 AM from Jericho to Salfit City is 12.7%, which is less than 25%; see Appendix B (Table B-3). This means that the transferred trip generation model for trips made between 8:00 - 9:00 AM using native transfer approach is not recommended.

5.5.2.3 Transferred Trip Generation Model for Trips Made Between 8:00 – 9:00 AM from Jericho City by Updating Coefficients

The estimated trip generation model for trips made between 8:00 - 9:00 AM using Jericho model variables and updating the coefficients based on collected data in Salfit City is:

$$Y_7 = 0.2X_4 + 0.003X_5 + 0.053X_{11} + 0.11X_{13} \quad (5.26)$$

Table 5.45 presents the regression analysis results for Equation (5.26).

Table 5.45: Regression Results for Transferred Trip Generation Model for Trips Made between 8:00 - 9:00 AM by Updating Model Coefficients

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_4	0.200	0.042	4.799	0.000	1.288
X_5	0.003	0.024	0.111	0.912	1.053
X_{11}	0.053	0.042	1.263	0.208	1.257
X_{13}	0.110	0.158	0.695	0.488	1.032
R^2			0.316		
F-value			29.12		
Sample Size			256		

With reference to Table 5.45, the t-value for the coefficient of X_5 (number of persons who are receiving education in the household) is 0.111. This

indicates that the variable at the 8.8% level of significance is statically significant.

Similarly, the t-statistic value for the coefficient of explanatory variable X_{11} (number of licensed drivers in the household) is 1.263. The value indicates that the variable is significant at the 79.2% level. This value is very low and the minimum value of t-test shall be two at the level of significance 95%.

Finally, the coefficient of the variable X_{13} (number of bicycles owned by a household) has a t-statistic value of 0.695, which is less than 2 and significant at the 51.2% level.

In summary, the regression coefficients for explanatory variables X_5, X_{11}, and X_{13} have t-statistic under two. Therefore, the explanatory variables X_5, X_{11}, and X_{13} shall be eliminated from the transferred model.

This means that the transferred trip generation model of daily trips made between 8:00 - 9:00 AM using updating model coefficients approach is unsuitable and is not representative.

5.5.2.4 Conclusions

This research indicates that the R^2 value for the model is very low and unsatisfactory, but the comparison between the average of estimated trips made between 8:00 AM - 9:00 AM and the average of actual trips made between 8:00 - 9:00 AM indicates that that the difference is not significant at 90% level. On the other hand, the estimated trip generation model for trips made between 8:00 - 9:00 AM is unsuitable and is not capable of expressing the observed behavior in Salfit City well.

The transferred model of daily trips made between 8:00 - 9:00 AM using native transfer method from Jericho City to Salfit City is evaluated considering statistical tests. It is noticed that the results of comparison between the average of the estimated daily trips made between 8:00 AM - 9:00 AM and the average of the actual daily trips made between 8:00 AM - 9:00 AM are significantly different but With reference to the %RTE measure to check transferability, the value shows that the transferred model by native transfer method expresses the observed behavior. The final results show that the model is considered not good and unsuitable for transfer.

The transferred model of daily trips made between 8:00 AM - 9:00 AM with updating models' coefficients from Jericho city to Salfit city is evaluated considering statistical tests. The final results of analysis and tests show that the transferred model is not recommended, it is unsuitable to transfer this model from Jericho City to Salfit City.

5.5.3 Trip Generation Model for Trips Made by Household between 9:00 AM - 12:00 PM

5.5.3.1 Estimated Model for Salfit City

By using the multiple linear regression analysis, the best estimated trip generation model for trips made between 9:00 AM - 12:00 PM is:

$$Y_8 = 0.139*X_3 + 0.154*X_7 + 0.195*X_{16} \quad (5.27)$$

Table 5.46 presents the regression analysis results for Equation (5.27). The analysis results of the daily trip generation model for trips made between 9:00 AM - 12:00 PM using the Excel program are included in Appendix K.

Table 5.46: Regression Results for the Trip Generation Model for Trips Made between 9:00 AM - 12:00 PM of Salfit City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_3	0.139	0.041	3.414	0.001	1.054
X_7	0.154	0.048	3.225	0.001	1.051
X_{16}	0.195	0.096	2.034	0.043	1.006
R^2			0.451		
F-value			69.47		
Sample Size			256		

Appendix K (Tables K-3 and K-4) shows the difference and the descriptive statistics for the actual and estimated daily trips generated by a household for each of the randomly selected observations. The comparison between the average of estimated trips and the average of actual trips indicates that approximately there is difference at the 90% level of significance; see Appendix B (Table B-2). This means that the estimated trip generation model for trips made before 8:00 AM is unsuitable and is not representative for Salfit City.

5.5.3.2 Transferred Trip Generation Model for Trips Made Between 9:00 AM – 12:00 PM from Jericho City Using Native Transfer Approach

The trip generation model for trips made between 9:00 AM - 12:00 PM estimated for Jericho was:

$$Y_8 = 0.09X_7 + 0.01X_8 + 0.04X_9 \qquad (5.28)$$

Table 5.47 presents the regression analysis results for Equation (5.28).

Table 5.47: Regression Results for Trip Generation Model for Trips Made between 9:00 AM - 12:00 PM of Jericho City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_7	0.09	0.013	6.929	0.0001	1.978
X_8	0.01	0.015	2.656	0.008	1.446
X_9	0.04	0.038	3.474	0.001	1.453
R^2			0.23		
F-value			68.91		
Sample Size			713		

To verify the transferred trip generation model for trips made between 9:00 AM - 12:00 PM using native transfer approach, Appendix K (Tables K-5 and K-6) shows the difference and the descriptive statistics for the actual and estimated trips made between 9:00 AM - 12:00 PM by a household for each of the randomly selected observations using the transferred Equation (5.28). The result of comparison between the average of actual trips made between 9:00 AM - 12:00 PM and the average of estimated trips made between 9:00 AM - 12:00 PM indicates that the transferred model from Jericho is not recommended because there is a significant difference at 90% level. The value of %RTE measure to check the transferability of the recreational model from Jericho City to Salfit City is 667.7%, which is more than 25%; see Appendix B (Table B-3). This means that the transferred trip generation model for trips made between 9:00 AM - 12:00 PM using native transfer approach not recommended.

5.5.3.3 Transferred Trip Generation Model for Trips Made Between 9:00 AM – 12:00 PM from Jericho City by Updating Coefficients

The estimated trip generation model for trips made between 9:00 AM - 12:00 PM using Jericho model variables and updating the coefficients based on collected data in Salfit City is:

$$Y_8 = 0.245X_7 + 0.254X_8 + 0.166X_9 \quad (5.29)$$

Table 5.48 presents the regression analysis results for Equation (5.29).

Table 5.48: Regression Results for Transferred Trip Generation Model for Trips Made between 9:00 AM - 12:00 PM by Updating Model Coefficients

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_7	0.245	0.041	5.912	0.000	1.048
X_8	0.254	0.046	5.537	0.000	1.323
X_9	0.166	0.062	2.688	0.008	1.304
R^2			0.438		
F-value			65.78		
Sample Size			256		

To verify the transferred trip generation model of daily trips made between 9:00 AM - 12:00 PM using updating model coefficients approach, Appendix K (Tables K-7 and K-8) shows the difference and the descriptive statistics for the actual and estimated trip generation model of daily trips made between 9:00 AM - 12:00 PM by a household for each of the randomly selected observations using the transferred Equation (5.29). The result of comparison between the average of actual trips and the average of estimated trips indicates that there is significant difference at 90% level. The %RTE measure to check the transferability of the trip generation model of daily trips made between 9:00 AM - 12:00 PM, showed that the value of %RTE

is 39.1%, which is more than 25%; see Appendix B (Table B-4). This means that the transferred trip generation model of daily trips made between 9:00 AM - 12:00 PM using updating model coefficients approach is unsuitable and not recommended.

5.5.3.4 Conclusions

This above analysis shows that the R^2 value for the model is low and unsatisfactory. The comparison between the average of estimated trips made between 9:00 AM - 12:00 PM and the average of actual trips made between 9:00 AM - 12:00 PM indicates that there is a little difference between two means at the 90% level of significance. Therefore, the estimated trip generation model for trips made between 9:00 AM - 12:00 PM is unsuitable and is not capable of expressing the observed behavior in Salfit City.

The transferred model of daily trips made between 9:00 AM - 12:00 PM using native transfer method from Jericho City to Salfit City is evaluated considering statistical tests. It is noticed that the results of comparison between the average of the estimated daily trips made between 9:00 AM - 12:00 PM and the average of the actual daily trips made between 9:00 AM - 12:00 PM are significantly different. Moreover, with reference to the %RTE measure to check transferability, the value shows that the transferred model by native transfer method is not capable of expressing the observed behavior. Final results show that the transferred model is not recommended.

The transferred model of daily trips made between 9:00 AM - 12:00 PM with updating models' coefficients from Jericho city to Salfit city is evaluated considering statistical tests. The R^2 value for the transferred model is about 0.438, which is not good value. The results of comparison between the average of the estimated daily trips made between 9:00 AM - 12:00 PM and the average of the actual daily trips made between 9:00 AM - 12:00 PM showed that there are significantly different. Moreover, the value of %RTE measure indicated that the transferred model by updating models' coefficients method is not capable of expressing the observed behavior. The final results of analysis and tests show that the transferred model is not recommended, it is unsuitable to transfer this model from Jericho City to Salfit City.

5.5.4 Trip Generation Model for Trips Made by Household between 12:00 PM - 4:00 PM

5.5.4.1 Salfit City

By using the multiple linear regression analysis, the best estimated trip generation model for trips made between 12:00 - 4:00 PM is:

$$Y_9 = 0.108*X_7 + 0.163*X_{12} \quad (5.30)$$

Table 5.49 presents the regression analysis results for Equation (5.30). The analysis results of the daily trip generation model for trips made between 12:00 - 4:00 PM using the Excel program are included in Appendix L.

Table 5.49: Regression Results for the Trip Generation Model for Trips Made between 12:00 - 4:00 PM of Salfit City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_7	0.108	0.028	3.850	0.000	1.016
X_{12}	0.163	0.053	3.070	0.002	1.016
R^2			0.179		
F-value			27.76		
Sample Size			256		

Appendix L (Tables L-3 and L-4) shows the difference and the descriptive statistics for the actual and estimated daily trips generated by a household for each of the randomly selected observations. The comparison between the average of estimated trips and the average of actual trips indicates that the difference is not significant at 90% level; see Appendix B (Table B-2), but with reference to the R^2 value for the model, which is unsatisfactory and very low; the estimated trip generation model for trips made between 12:00 - 4:00 PM is unsuitable and is not representative for Salfit City.

5.5.4.2 Transferred Trip Generation Model for Trips Made by Household between 12:00 - 4:00 PM from Jericho City Using Native Transfer Approach

The trip generation model for trips made between 12:00 - 4:00 PM estimated for Jericho was:

$$Y_9 = 0.17X_4 + 0.10X_6 + 0.08X_{11} \quad (5.31)$$

Table 5.50 presents the regression analysis results for Equation (5.31).

Table 5.50: Regression Results for Trip Generation Model for Trips Made between 12:00 - 4:00 PM of Jericho City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_4	0.17	0.026	6.578	0.0001	2.950
X_6	0.10	0.016	6.397	0.0001	1.698
X_{11}	0.08	0.029	2.874	0.004	2.618
R^2			0.40		
F-value			154.42		
Sample Size			713		

To verify the transferred trip generation model for trips made between 12:00 - 4:00 PM using native transfer approach, Appendix L (Tables L-5 and L-6) shows the difference and the descriptive statistics for the actual and estimated trips made between 12:00 - 4:00 PM by a household for each of the randomly selected observations using the transferred Equation (5.31). The result of comparison between the average of actual trips made between 12:00 PM - 4:00 PM and the average of estimated trips made between 12:00 - 4:00 PM indicates that the transferred model from Jericho is not recommended because there is a significant difference at 90% level. On the other hand, the value of %RTE measure to check the transferability of the trip generation model for trips made between 12:00 - 4:00 PM from Jericho to Salfit City is 1.2%, which is less than 25%, see Appendix B (Table B-3). This final results show that the transferred trip generation model for trips made between 12:00 - 4:00 PM using native transfer approach is not recommended.

5.5.4.3 Transferred Trip Generation Model for Trips Made by Household between 12:00 - 4:00 PM from Jericho City by Updating Coefficients

The estimated trip generation model for trips made between 12:00 - 4:00 PM using Jericho model variables and updating the coefficients based on collected data in Salfit City is:

$$Y_9 = 0.099X_4 - 0.030X_6 + 0.086X_{11} \quad (5.32)$$

Table 5.51 presents the regression analysis results for Equation (5.32).

Table 5.51: Regression Results for Transferred Trip Generation Model for Trips Made between 12:00 PM - 4:00 PM by Updating Model Coefficients

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_4	0.099	0.0401	2.482	0.013	1.326
X_6	-0.030	0.0260	-1.152	0.250	1.052
X_{11}	0.086	0.0389	2.203	0.028	1.283
R^2			0.165		
F-value			16.77		
Sample Size			256		

For Equation (5.32), it is noticed that the coefficient of variable X_6 (the number of persons who are under 16 years in the household) is -0.030 and has a negative sign.

The coefficient of the variable X_6 (the number of persons who are under 16 years in the household) has a t-statistic value of -1.152, which is less than 2 and statistically significant at 76%. Therefore, the explanatory variable X_6 shall be eliminated from the transferred model. This means that the

transferred trip generation model of daily trips made between 12:00 - 4:00 PM using updating model coefficients approach is unsuitable and not recommended.

5.5.4.4 Conclusions

This research indicates that the R^2 value for the model is unsatisfactory and very low. The comparison between the average of estimated trips made between 12:00 PM - 4:00 PM and the average of actual trips made between 12:00 - 4:00 PM indicates that the difference is not significant at 90% level. The final results show that the estimated trip generation model for trips made between 12:00 - 4:00 PM is unsuitable and not recommended due to low value of R^2.

The transferred model of daily trips made between 12:00 - 4:00 PM using native transfer method from Jericho City to Salfit City is evaluated considering statistical tests. It is noticed that the results of comparison between the average of the estimated daily trips made between 12:00 PM - 4:00 PM and the average of the actual daily trips made between 12:00 PM - 4:00 PM are significantly different. However, with reference to the %RTE measure to check transferability, the value shows that the transferred model by native transfer method expresses the observed behavior. The final results show that the model is considered not good and it is not recommended to transfer.

The transferred model of daily trips made between 12:00 PM - 4:00 PM with updating models' coefficients from Jericho City to Salfit City is evaluated

considering statistical tests. The R^2 value for the transferred model is about 0.165, which is not good value and very low. With reference to t-statistic value, the second independent variable shall be eliminated from the model. The final results of analysis and tests show that the transferred model is not recommended, it is unsuitable to transfer this model from Jericho City to Salfit City.

5.5.5 Trip Generation Model for Trips Made by Household after 4:00 PM

5.5.5.1 Estimated Model for Salfit City

By using the multiple linear regression analysis, the best estimated trip generation model for trips made after 4:00 PM is:

$$Y_{10} = 0.416*X_1 + 0.227*X_{11} + 0.779*X_{16} \quad (5.33)$$

Table 5.52 presents the regression analysis results for Equation (5.33). The analysis results of the daily trip generation model for trips made after PM using the Excel program are included in Appendix M.

Table 5.52: Regression Results for the Trip Generation Model for Trips Made after 4:00 PM of Salfit City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_1	0.416	0.048	8.633	0.000	1.072
X_{11}	0.227	0.099	2.785	0.006	1.069
X_{16}	0.779	0.214	3.647	0.000	1.013
R^2			0.775		
F-value			290.49		
Sample Size			256		

Appendix M (Tables M-3 and M-4) shows the difference and the descriptive statistics for the actual and estimated daily trips generated by a household for each of the randomly selected observations. The comparison between the average of estimated trips and the average of actual trips indicates there is a difference at the 90% level of significance; see Appendix B (Table B-2).

5.5.5.2 Transferred Trip Generation Model for Trips Made by Household after 4:00 PM from Jericho City Using Native Transfer Approach

The trip generation model for trips made after 4:00 PM estimated by for Jericho was:

$$Y_{10} = 0.788X_4 + 0.555X_5 + 0.148X_{15} \quad (5.34)$$

Table 5.53 presents the descriptive analysis data for Equation (5.34).

Table 5.53: Regression Results for Trip Generation Model for Trips Made after 4:00 PM of Jericho City

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_4	0.788	0.077	10.260	0.0001	3.875
X_5	0.555	0.040	13.987	0.0001	2.373
X_{15}	0.148	0.031	4.740	0.0001	4.791
R^2			0.762		
F-value			758.914		
Sample Size			713		

To verify the transferred trip generation model for trips made after 4:00 PM using native transfer approach, Appendix M (Tables M-5 and M-6) shows the difference and the descriptive statistics for the actual and estimated trips

made after 4:00 PM by a household for each of the randomly selected observations using the transferred Equation (5.34). The result of comparison between the average of actual trips made after 4:00 PM and the average of estimated trips made after 4:00 PM indicates that the transferred model from Jericho is recommended because the difference is not significant at 90% level. But on the other hand, the value of %RTE measure to check the transferability of the trip generation model for trips made after 4:00 PM from Jericho to Salfit City is 44.2%, which is more than 25%; see Appendix B (Table B-3). This means that the transferred trip generation model for trips made after 4:00 PM using native transfer approach is not recommended.

5.5.5.3 Transferred Trip Generation Model for Trips Made by Household after 4:00 PM from Jericho City by Updating Coefficients

The estimated trip generation model for trips made after 4:00 PM using Jericho model variables and updating the coefficients based on collected data in Salfit City is:

$$Y_{10} = 0.674X_4 + 0.509X_5 + 0.136X_{15} \quad (5.35)$$

Table 5.54 presents the descriptive analysis data for Equation (5.35).

Table 5.54: Regression Results for Transferred Trip Generation Model for Trips Made after 4:00 PM by Updating Model Coefficients

	Coefficient	Stand. Error	t-Stat	P-value	VIF
X_4	0.674	0.120	5.636	0.000	3.486
X_5	0.509	0.068	7.475	0.000	1.951
X_{15}	0.136	0.035	3.891	0.000	3.416
R^2			0.718		
F-value			214.64		
Sample Size			256		

To verify the transferred trip generation model of daily trips made after 4:00 PM using updating model coefficients approach, Appendix M (Tables M-7 and M-8) shows the difference and the descriptive statistics for the actual and estimated trip generation model of daily trips made after 4:00 PM by a household for each of the randomly selected observations using the transferred Equation (5.35). The result of comparison between the average of actual trips and the average of estimated trips indicates that there is a significant difference at 90% level. Moreover, the %RTE measure to check the transferability of the trip generation model of daily trips made after 4:00 PM, showed that the value of %RTE is 65.1%, which is more than 25%; see Appendix B (Table B-4). This means that the transferred trip generation model of daily trips made after 4:00 PM using updating model coefficients approach is unsuitable and not recommended.

5.5.5.4 Conclusions

This study shows that the R^2 value for the model is very good. The comparison between the average of estimated trips after 4:00 PM and the

average of actual trips made after 4:00 PM indicates that there is difference at the 90% level of significance. The final results with reference to the conducted tests show that the estimated trip generation model for trips made after 4:00 PM is suitable and recommended.

The transferred model of daily trips made after 4:00 PM using native transfer method from Jericho City to Salfit City is evaluated considering statistical tests. It is noticed that the results of comparison between the average of the estimated daily trips made before 4:00 PM and the average of the actual daily trips made before 4:00 PM are not different. However, with2 ʳeference to the %RTE measure to check transferability, the value shows that the transferred model by native transfer method is not capable of expressing the observed behavior. The final results show that in general the model is considered not good and not recommended to transfer.

The transferred model of daily trips made after 4:00 PM with updating models' coefficients from Jericho City to Salfit City is evaluated considering statistical tests. The results of comparison between the average of the estimated daily trips made after 4:00 PM and the average of the actual daily trips made after 4:00 PM showed that there is significant difference. Moreover, the value of %RTE measure indicated that the transferred model by updating models' coefficients method is not capable of expressing the observed behavior. The final results of analysis and tests show that the transferred model is not recommended, it is unsuitable to transfer this model from Jericho City to Salfit City.

5.6 Chapter Summary

This chapter shows the estimated trip generation models for Salfit City taking into consideration various statistic tests. The analysis shows that there is a high similarity of the descriptive statistics between Salfit City and Jericho City for the general, work, educational and recreational trips. The distribution of daily household trips by purpose indicates that the percent of work, educational and recreational trips are approximately equal for both. On the other hand, the distribution and percent of daily household trips by period, shows that the percent of trips made before 8:00 AM and after 4:00 PM are approximately equal between two cities.

With reference to the explanatory variables such as the average number of males, the average number of females, the average number of persons who are employed, the average number of persons who are receiving education, the number of licensed drivers, the average number of cars, and the average number of motorcycles, the values for all these variables are close between two cities.

The results show that there is slight difference between the two cities for the household size, gender distribution, and the percent of males and females. Moreover, the percent of males equal approximately to the percent of females for each city.

This chapter presents the overall number of trips made in Salfit City and the results of transferring different models of daily trips made by households whether for different purposes or for different time periods along the day from Jericho City to Salfit City.

Table 5.55 shows all the estimated models as well as the resulting transferred model, whether using “Native Transfer” and “Updating Constants” method. Based on the outcome of the study, Table 5.56 summarizes the final findings of tests and analysis illustrating whether model transferability by either method is suitable or not.

Table 5.55: Final Results of Analysis for Estimated Models

	Estimated Models for Salfit City	Transferred Models - Native Transfer Approach	Transferred Models - Updating Model Coefficients Approach
General	$Y = 2.597+1.249*X_4+1.239*X_5$	$Y_{modified} = 2.127 + 1.353X_4 + 1.483X_5$	$Y = 2.597+1.249*X_4+1.239*X_5$
Work	$Y_1 =0.149+0.841*X_4+0.125*X_7+0.25*X_{12}$	$Y_1 = 0.16 + 0.97\ X_4 + 0.04X_8$	$Y_1 = 0.32 + 0.947X_4 – 0.058X_8$
Education	$Y_2 = 0.982*X_5$	$Y_{2\ modified} = 0.977X_5$	$Y_2 = 0.982*X_5$
Shopping	$Y_3 = 0.061*X_3+0.169*X_{12}+0.294*X_{16}$	$Y_3 = 0.282X_1 + 0.035X_{15}$	$Y_3 = 0.068X_1 + 0.034X_{15}$
Social	$Y_4 = 0.441*X_1$	$Y_4 = 0.29X_3 + 0.29X_4 - 0.11X_7$	$Y_4 = 0.667X_3 + 0.102X_4 - 0.206X_7$
Recreational	$Y_5 = 0.231*X_2 + 0.189*X_7 + 0.853*X_{14}$	$Y_5 = 0.18X_5 + 0.22X_9 + 0.14X_{15}$	$Y_5 = 0.072X_5 + 0.195X_9 + 0.091X_{15}$
Trips Made before 8:00	$Y_6 = 0.667*X_4 + 0.879*X_5$	$Y_{6\ modified} = 0.30 + 0.462\ X_4 + 0.854\ X_5$	$Y_6 = 0.667*X_4 + 0.879*X_5$
Trips Made between 8:00 - 9:00 AM	$Y_7 = 0.201*X_4 + 0.136*X_{12}$	$Y_7 = 0.24X_4 +0.069X_5 + 0.092X_{11} + 0.154X_{13}$	$Y_7 = 0.2X_4+ 0.003X_5 + 0.053X_{11} + 0.11X_{13}$
Trips Made between 9:00 AM - 12:00	$Y_8 = 0.139*X_3 + 0.154*X_7+ 0.195*X_{16}$	$Y_8 = 0.09X_7 +0.01X_8 + 0.04X_9$	$Y_8 = 0.245X_7 + 0.254X_8 + 0.166X_9$
Trips Made between 12:00 PM - 4:00 PM	$Y_9 = 0.108*X_7 + 0.163*X_{12}$	$Y_9 = 0.17X_4 +0.10X_6 + 0.08X_{11}$	$Y_9 = 0.099X_4 - 0.030X_6 + 0.086X_{11}$
Trips Made after 4:00 PM	$Y_{10} = 0.416*X_1 + 0.227*X_{11}+ 0.779*X_{16}$	$Y_{10} = 0.788X_4 +0.555X_5 + 0.148X_{15}$	$Y_{10} = 0.674X_4 + 0.509X_5 + 0.136X_{15}$

Table 5.56: Final Results of Analysis for Transferability

Model Structure	Method of Transfer	
	Native Transfer	**Updating Constants**
Number of daily trips made by household (Y)	Suitable	Suitable
Number of daily work trips made by household (Y_1)	Suitable	Unsuitable
Number of daily educational trips made by household (Y_2)	Suitable	Suitable
Number of daily shopping trips made by household (Y_3)	Unsuitable	Unsuitable
Number of daily social trips made by household (Y_4)	Unsuitable	Unsuitable
Number of daily recreational trips made by household (Y_5)	Unsuitable	Unsuitable
Number of daily trips made by household before 8:00 AM (Y_6)	Suitable	Suitable
Number of daily trips made by household between 8:00 - 9:00 AM (Y_7)	Unsuitable	Unsuitable
Number of daily trips made by household between 9:00 AM-12:00 PM (Y_8)	Unsuitable	Unsuitable
Number of daily trips made by household between 12:00 – 4:00 PM (Y_9)	Unsuitable	Unsuitable
Number of daily trips made by household after 4:00 PM (Y10)	Unsuitable	Unsuitable

Chapter Six

Conclusions and Recommendations

Chapter Six

Summary and Conclusions

6.1 Summary

Trip generation modeling to predict the number of trips, which explains the travel behavior as related to producing or attracting trips, is important in the transportation forecasting process. The transferability of trip generation models from the estimation context to the application context is needed to achieve appropriate transportation infrastructure planning for future developments to save effort, time, and cost.

Salfit City and Jericho City are selected to be studies for the purpose of examining trip generation model transferability. Trip generation models were recently developed for Jericho City. Salfit City is a similar medium-sized city. Salfit City was divided into six internal traffic analysis zones, and a sample size of 256 households was selected. Gathering required data was done by conducting personal face-to-face interviews. The collected data were analyzed and trips generation models were generated considering multiple linear regression method.

The study developed three types of trip generation models; the general trip generation model, the trip generation models based on trip purpose (which include work, educational, shopping, social, and recreational) and trip making period (including before 8:00 AM, between 8:00 – 9:00 AM, between 9:00 AM – 12:00 PM, between 12:00 – 4:00 PM, and after 4:00 PM).

After developing the trip generation models for Salfit City, research on examination of transferring trip generation models from Jericho City to Salfit City was conducted. The transfer process was done using two approaches; the first is “Native Transfer” and the second is “Updating Constants”. The evaluation of the transferred model was conducted by the Relative Transfer Error Measure and comparing the average of actual trips with the average of estimated trips generated by the transferred model.

6.2 Conclusions

The results of this study deal with eleven trip generation models, which were classified under three categories, the general trip generation model, the trip generation models by trip purpose and trip generation models for different trip periods. The following conclusions can be drawn from the results of this study:

- The general trip generation model, and the models of work, educational, trips made before 8:00 AM, and trips made after 4:00 PM for Salfit City have relevant statistical significance, and therefore are proposed to be considered for the future transportation planning for Salfit City.
- The results show that the gender distribution, the number of persons who are employed, the number of persons who are receiving education, the number of licensed drivers, and the number of owned cars per household are similar for the two studied cities. It was noticed that the transfer effectiveness improves when the variables, which

have similarity in socioeconomic characteristics between the cities exist in the relevant model.

- The results of data analysis show that there is a high similarity between Salfit City and Jericho City, such as the mean and distribution of total daily trips, work trips, educational, daily trips made before 8:00 AM and daily trips made after 4:00 PM.
- The general model, work model, educational model and the model for trips made before 8:00 AM are transferable. Therefore, transferability of trip generation models between cities is generally feasible for the general trips and key purposes and the trips generated during the period including the AM peak.
- The results show that the R^2 values were good in estimation context for all transferable models.
- The capability of the generated and transferred models of expressing the observed behavior can be well verified by measuring the difference between actual and estimated daily trips generated by a household for each of the randomly additional observations, and by conducting a comparison between the average of actual trips and the average of estimated trips generated by transferred model using standard deviation of the difference in means.
- The independent variables that mostly affect the total number of daily trips generated by a household are the number of persons who are employed in the household, the number of persons who are receiving education in the household, the number of persons who are between

17 and 30 years in the household and the number of cars owned by a household.

- Model transfer is more accurate when the estimation context models are well defined and the data quality is good. The general trip generation model and the trip generation model for trips made before 8:00 AM that were generated for Jericho City were not accurate due to high value of Pearson's correlation between some independent variables, therefore the transfer was not suitable. A new model was estimated by using the cross-section data from the 713 respondents, where the new model depends on the same variables in Salfit City and the transfer of this model was more efficient than the model developed in Jericho City study.
- The models based on time for off-peak periods were not accurate, hence, a reconsideration of the start and end of the periods may be needed.

In summary, the study found that, in general, the transferability tests of the trip generation models indicated that key models could be transferred. Therefore, the findings of this study are important. It is clear that such trip generation models could be transferred from context to another context where the dataset is not available, taking into consideration the two methods of transfer model examined in this study.

6.3 Recommendations

The following recommendations can be summarized from the results of this study:

1. Researchers are encouraged to study transferability of models estimated in this study for Salfit City and for Jericho City study to other Palestinians cities with different sizes to determine the suitability of using trip generation models for future transportation planning by other cities planners.
2. Salfit Municipality, and so the other municipalities for which models are developed or transferred, are encouraged to use the results of trip generation models in future transportation planning.
3. It is recommended to use the results of estimated trip generation models in this study in further studies in modeling trip distribution, mode choice, and route assignment for Salfit City.
4. Researchers are encouraged to use other analysis techniques to develop a trip generation models such as cross classification approach for Salfit and Jericho cities to decide the most appropriate analysis technique.
5. It is recommended to use other transfer methods such as Bayesian approach and joint context estimation. This is to conduct a comparison between the results of these methods to arrive at the most appropriate transfer method.

6. Researchers are encouraged to study temporal transferability (i.e., after a specific number of years) in the future for the same studied areas.
7. Researchers are encouraged to develop models for non-home-based trips.

References

1. Abdel-Aal, M. M. (2004). **Cross Classification Trip Production Model for the City of Alexandria**, *Alexandria Engineering Journal*, *43*(2), 177-189.
2. Abdel-Latif, H. M., Abo-Taleb, A. S., & Abdel-Fattah, A. H. (2015). **Spatial Transferability of Trip Generation Models for Intercity Transport in Egypt**. Retrieved from https://www.researchgate.net/publication/274886632.
3. Al-Sahili, K., Abu-Eisheh, S., & Kobari, F. (2017). **Estimation of New Development Trip Impacts through Trip Generation Rates for Major Land Uses in Palestine**. Presented at the Seventh Jordanian International Civil Engineering Conference, Engineers Association, Amman. Retrieved from http://www.jeaconf.org/UploadedFiles/Document/3e35e863-ce33-463d-a388-0fc6f484ee88.pdf.
4. Al-Taei, A., & Taher, A.M. (2006). **Prediction Analysis of Trip Production**, *Al-Rafidain Engineering*, *14*(4), 51-63.
5. Arabani, M., & Amani, B. (2007). **Evaluating the Parameters Affecting Urban Trip-Generation**, *Iranian Journal of Science & Technology*, *31*(B5), 547-560.
6. Best, H., & Lanzendorf, M. (2005). **Division of Labor and Gender Differences in Metropolitan Car Use: An Empirical Study in Cologne,** Germany, *Journal of Transport Geography*, *13*(2), 109-121.

7. Caldwell, L. C., & Demetsky, M. J. (1980). **Transferability of Trip Generation Models**, *Transportation Research Record 751*, 56-62.
8. Cambridge Systematics, Inc. & AECOM Consult (2007). **A Recommended Approach to Delineating Traffic Analysis Zones in Florida**. **Florida**, USA.
9. Chatterjee, A., Martinson, D., & Sinha, K. (1977). **Trip Generation Analysis for Regional Studies**, *ASCE Transportation Engineering*, 103(6), 825-841.
10. Cotrus, A. V. (2003). **Analysis of Trip Generation Characteristics in Israel for the Years 1984, 1996/7 and Spatial & Temporal Transferability of Trip Generation Demand Models** (Master thesis, Transportation Research Institute, Haifa).
11. Cubukcu, K. M. (2001). **Factors Affecting Shopping Trip Generation Rates in Metropolitan Areas**, Studies in Regional and Urban Planning, 9, 51-67.
12. Dodeen, A. (2014). **Developing Trip Generating Models Utilizing Linear Regression Analysis: Jericho City as a Case Study** (Master thesis, An-Najah National University, Nablus, Palestine).
13. Everett, J. (2009). **An Investigation of the Transferability of Trip Generation Models and the Utilization of a Spatial Context Variable (**Doctoral dissertation, University of Tennessee, Knoxville).
14. Giuliano, G., & Dargay, J. (2006). **Car Ownership, Travel and Land Use: A Comparison of the US and Great Britain**, *Transportation Research Part A: Policy and Practice*, *40*(2), 106-124.

15. Giuliano, G., & Narayan, D. (2003). **Another Look at Travel Patterns and Urban Form: the US and Great Britain**. *Urban Studies, 11*(40), 2295-2312.

16. Golob, T. (1989). **The Causal Influences of Income and Car Ownership on Trip Generation by Mode**, *Journal of Transport Economics and Policy*, *11*(2), 141-162.

17. Hunt, L., & Broadstock, D. (2010). **Modeling Car Trip Generations for UK Residential Developments Using Data from TRICS,** *Transportation Planning and Technology*, *33* (8), 671-678.

18. Joeph, O.O., & Opeyemi, M.O. (2009). **Regression Model of Household Trip Generation of Ado-Ekiti Township in Nigeria,** *European Journal of Scientific Research, 28*(1), 132-140.

19. Karasmaa, N. (2003). **The Transferability of Travel Demand Models** (Doctoral thesis, Helsinki University of Technology Transportation Engineering, Finland).

20. Karasmaa, N. & Pursula, M. (1997). **Empirical Studies on the Transferability of the Helsinki Metropolitan Area Travel Forecasting Models**, *Transportation Research Record 1607*, 38-44.

21. Kawamoto, E. (2003) **Transferability of Standardized Regression Model Applied to Person Based Trip Generation**, *Transportation Planning and Technology*, *26*(4), 331-359.

22. Kleinbaum, D. G., Kupper, L. L., Nizam. A., & Muller, K. E. (1988). **Applied Regression Analysis and other Multivariate Methods** (2nd Ed.). Boston, Mass: Cengage.

23. Koppelman, F. S., & Rose, G. (1985). **Geographic Transfer of Travel Choice Models: Evaluation and Procedures,** Lecture Notes in Economics and Mathematical Systems, 247.

24. Koppelman, F. S., & Wilmot, C. G. (1985). **Transferability Analysis of Disaggregate Choice Models**, Transportation Research Record 895, 18-24.

25. Laerd Statistics (2017). Retrieved from https://statistics.laerd.com/statistical-guides/pearson-correlation coefficient-statistical-guide.php.

26. Lawrence, C. C., & Michael, J. C. (1978). **An Evaluation of the Transferability of Cross-Classification Trip Generation Models (VHTRC 78-R39).** Charlottesville, United States: Federal Highway Administration, Virginia Highway and Transportation Research Council.

27. Mahmassani, H. S., & Sinha, K. C. (1978). **Framework for the Transferability of Trip Generation Parameters for Small Urban Areas in Indiana (FHUA/ISHC/JHRP-78/13).** West Lafayette, Indiana: Purdue University, Joint Highway Research Project.

28. Mansfield N. W. (1969). **Recreational Trip Generation: A Cross Section Analysis of Weekend Pleasure Trips to the Lake District National Park**, *Journal of Transport Economics and Policy,* 3(2), 152-164.

29. Martinson, D. R. (1974). **A Practical Approach to Trip Generation Analysis for a Multi-County Region**, Marquette University, Milwaukee, Wisconsin, 33-34.

30. Meyer, M.D., & Miller, J.M. (2001). **Urban Transportation Planning**. New York: McGraw-Hill Book Company.

31. Moriarty, P., & Honnery, D. (2005). **Determinants of Urban Travel in Australia,** *28th Australasian Transport Research Forum, 28*, 1-13.

32. Moussa, H. (2013), **Development of a Trip Generation Model for Gaza City** (Master thesis, The Islamic University, Gaza, Palestine).

33. Newbold, K., Scott, D., & Spinney, J. (2005). **Travel Behavior within Canada's Older Population: A Cohort Analysis,** *Journal of Transport Geography, 13*(4), 340-351.

34. Palestinian Central Bureau of Statistics (2016). **Localities in Salfit Governorate by Type of Locality and Population Estimates.** Retrieved from http://www.pcbs.gov.ps/Portals/_Rainbow/Documents/salft.htm

35. Palestinian Central Bureau of Statistics (2012). **Census Final Results in the Palestinian Territory**. Ramallah, Palestine.

36. Priyanto, S. & Friandi, E.P. (2010). **Analyzing of Public Transport Trip Generation in Developing Countries; A Case Study in Yogyakarta, Indonesia**, *International Journal of Civil and Environmental Engineering*, *4*(6), 167-171.

37. Rahman, R.B. (2009). **Modeling of Trip Generation Based on School Attraction** (Master thesis, University of Technology Malaysia, Malaysia).

38. Said, G. (1990). **A General Linear Model Framework for Estimating Work Trip Rates for Households in Kuwait**, *Transportation Research, 24*(3), 187-200.

39. Sikder, S. (2013). **Spatial Transferability of Activity-Based Travel Forecasting Models** (Doctoral thesis, University of South Florida, Florida).

40. Sikder, S., Augustin, B., Pinjari, A. R., and Eluru, N. (2013). **Spatial Transferability of Tour-Based Time-of-Day Choice Models: An Empirical Assessment**, Procedia – Social and Behavioral Sciences, 104, 640-649.

41. Sofia, G., Abel Ali, H., and Al-Zubaidy, A. (2012). **Trip Generation Modeling for Selected Zone in Al-Diwaniyah City,** *Journal of Engineering and Development*, *16*(4), 167-180.

42. Stopher, P. R., & Mcdonald, K. G. (1983). **Some Contrary Indications for the Use of Household Structure in Trip Generation Analysis,** *Transportation Research Record 944*, 92-100.

43. Tom, V. M. and Krishna Rao, K. V. (2006). **Introduction to Transportation Engineering**. Powai, Indian: Institute of Technology Bombay.

44. United States. Bureau of Public Roads (1967). **Guidelines for Trip Generation Analysis** Washington D.C, USA.

45. Wilmot, C. G. (1995). **Evidence on Transferability of Trip-Generation Models**, *Journal of Transportation Engineering*, (9), 405-410.

46. Yasmin, F., Morency, C., & Roorda, M. (2013, July). **Spatial Transferability of Activity Based Models: Moving Tasha from Toronto to Montreal**. Paper presented at the 13th World Conference on Transportation Research, Rio de Janeiro, Brazil. Retrieved from

https://www.researchgate.net/258405633_Spatial_transferability_of_activitybased_models_Moving_TASHA_from_Toronto_to_Montreal.

Appendices

Appendix A:

Table A-1: Questionnaire Form

Sample No. ( )						
Table One						
TAZ No.						
Household No.						
Household Size						
Type of House	Independent House ☐		Apartment ☐			
Average Monthly Household Income (NIS)						
Person No.	Age	Gender (M/F)	Current Work	Current Education *	Driving License	Vehicle Ownership
1		M/F			Yes / No	
2		M/F			Yes / No	
3		M/F			Yes / No	
4		M/F			Yes / No	
5		M/F			Yes / No	
6		M/F			Yes / No	
7		M/F			Yes / No	
8		M/F			Yes / No	
9		M/F			Yes / No	
10		M/F			Yes / No	
* Education: Kindergarten (K), School (S), College (C), University (U), Other (O), or None (N).						
**Vehicle Ownership: Private car (C), Bicycle(B), Motorcycle (M) and Public car (P)						

Table A-2: Questionnaire Form

Table Two																						
Trip Purpose	Work											Education										
Person No.	No. of Trips/ Day	Origin**	Destination ***	Time Start (Trip #01)	Time End (Trip #01)	Time Start (Trip #02)	Time End (Trip #02)	Time Start (Trip #03)	Time End (Trip #03)	Day	Mode*	No. of Trips/ Day	Origin**	Destination ***	Time Start (Trip #01)	Time End (Trip #01)	Time Start (Trip #02)	Time End (Trip #02)	Time Start (Trip #03)	Time End (Trip #03)	Day	Mode*
1																						
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						
Trip Purpose	Shopping											Recreational										
Person No.	No. of Trips/ Day	Origin**	Destination ***	Time Start (Trip #01)	Time End (Trip #01)	Time Start (Trip #02)	Time End (Trip #02)	Time Start (Trip #03)	Time End (Trip #03)	Day	Mode*	No. of Trips/ Day	Origin**	Destination ***	Time Start (Trip #01)	Time End (Trip #01)	Time Start (Trip #02)	Time End (Trip #02)	Time Start (Trip #03)	Time End (Trip #03)	Day	Mode*
1																						
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						
Trip Purpose	Social																					
Person No.	No. of Trips/ Day	Origin**	Destination ***	Time Start (Trip #01)	Time End (Trip #01)	Time Start (Trip #02)	Time End (Trip #02)	Time Start (Trip #03)	Time End (Trip #03)	Day	Mode*											
1																						
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						

* Mode: Private Car Drive alone (D), Private Car Share-ride (Sh), Bicycle (B), Motorcycle (M), Shared Taxi (ST), Taxi (T), Bus (B), Walk (W), or Other (O).

** Origin: TAZ No. Where the Trip Starts.

*** Destination: TAZ No. Where the Trip Ends.

Appendix B:

Table B-1: Correlation Matrix

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}
X_1	1.000	0.802	0.742	0.500	0.838	0.763	0.370	0.501	0.066	-0.182	0.247	0.146	0.173	0.113	0.235	0.097
X_2	0.802	1.000	0.195	0.503	0.642	0.597	0.348	0.408	0.043	-0.179	0.352	0.208	0.170	0.116	0.268	0.077
X_3	0.742	0.195	1.000	0.256	0.656	0.582	0.217	0.365	0.060	-0.098	0.010	0.007	0.093	0.055	0.085	0.072
X_4	0.500	0.503	0.256	1.000	0.166	0.182	0.431	0.256	0.161	-0.239	0.455	0.281	0.074	0.214	0.430	0.095
X_5	0.838	0.642	0.656	0.166	1.000	0.865	0.119	0.564	0.188	-0.266	0.088	0.047	0.167	-0.020	0.128	0.028
X_6	0.763	0.597	0.582	0.182	0.865	1.000	0.144	0.579	0.267	-0.263	-0.031	0.009	0.176	-0.021	0.080	0.012
X_7	0.370	0.348	0.217	0.431	0.119	0.144	1.000	0.201	0.163	-0.191	0.345	0.127	0.028	0.175	0.138	0.048
X_8	0.501	0.408	0.365	0.256	0.564	0.579	0.201	1.000	0.478	-0.293	0.032	0.000	0.107	-0.015	0.087	0.033
X_9	0.066	0.043	0.060	0.161	0.188	0.267	0.163	0.478	1.000	-0.009	0.212	0.174	-0.009	0.126	0.181	0.034
X_{10}	0.182	0.179	0.098	0.239	0.266	0.263	0.191	0.293	0.009	1.000	-0.092	0.005	-0.078	-0.058	-0.093	0.131
X_{11}	0.247	0.352	0.010	0.455	0.088	0.031	0.345	0.032	0.212	-0.092	1.000	0.597	0.061	0.174	0.419	0.082
X_{12}	0.146	0.208	0.007	0.281	0.047	0.009	0.127	0.000	0.174	0.005	0.597	1.000	0.068	0.108	0.448	0.077
X_{13}	0.173	0.170	0.093	0.074	0.167	0.176	0.028	0.107	0.009	-0.078	0.061	0.068	1.000	0.088	-0.009	0.024
X_{14}	0.113	0.116	0.055	0.214	0.020	0.021	0.175	0.015	0.126	-0.058	0.174	0.108	0.088	1.000	0.067	0.053
X_{15}	0.235	0.268	0.085	0.430	0.128	0.080	0.138	0.087	0.181	-0.093	0.419	0.448	-0.009	0.067	1.000	0.110
X_{16}	0.097	0.077	0.072	0.095	0.028	0.012	0.048	0.033	0.034	0.131	0.082	0.077	0.024	0.053	0.110	1.000

Table B-2: The Result of Statistical Tests Used to Verify the Estimated Models for Salfit City

Salfit Models		Model Calibration and Statistics
		If $\left\|\overline{U}_1 - \overline{U}_2\right\| > ZS$d (Significant Difference at 90% Confidence Level)
Number of daily trips made by household	Y	0.390 < 3.211
Number of daily work trips made by household	Y_1	0.062 < 0.227
Number of daily educational trips made by household	Y_2	0.120 < 0.891
Number of daily shopping trips made by household	Y_3	0.100 > 0.090
Number of daily social trips made by household	Y_4	0.628 > 0.549
Number of daily recreational trips made by household	Y_5	0.285 > 0.273
Number of daily trips made by household before 8 AM	Y_6	0.131 < 1.025
Number of daily trips made by household between 8-9 AM	Y_7	0.050 < 0.116
Number of daily trips made by household between 9 AM-12 PM	Y_8	0.104 < 0.109
Number of daily trips made by household between 12 PM - 4 PM	Y_9	0.001 < 0.035
Number of daily trips made by household after 4 PM	Y_{10}	1.033 > 0.926

Table B-3: The Result of Statistical Tests Used to Verify the Transferred Models without Updating Coefficients

Models Transferred without Updating Coefficients		Model Calibration and Statistics	
		%RTE	If $\left\|\overline{U}_1 - \overline{U}_2\right\| > ZS\mathrm{d}$ (Significant Difference at 90% Confidence Level)
Number of daily trips made by household	Y	5.444	0.298 < 0.405
Number of daily work trips made by household	Y_1	8.81	0.050 < 0.228
Number of daily educational trips made by household	Y_2	0.298	0.111 < 0.887
Number of daily shopping trips made by household	Y_3	-79.435	0.761 > 0.100
Number of daily social trips made by household	Y_4	232.8	1.498 > 0.533
Number of daily recreational trips made by household	Y_5	-63.5	0.143 < 0.279
Number of daily trips made by household before 8 AM	Y_6	-0.7	0.118 < 0.965
Number of daily trips made by household between 8-9 AM	Y_7	-12.7	0.160 > 0.118
Number of daily trips made by household between 9 AM-12 PM	Y_8	667.7	0.328 > 0.109
Number of daily trips made by household between 12 PM - 4 PM	Y_9	1.2	0.283 > 0.039
Number of daily trips made by household after 4 PM	Y_{10}	44.2	0.800 < 1.027

Table B-4: The Result of Statistical Tests Used to Verify the Transferred Models with Updating Coefficients

Models Transferred with Updating Coefficients		Model Calibration and Statistics	
		%RTE	If $\left\|\overline{U}_1 - \overline{U}_2\right\| > ZS$d (Significant Difference at 90% Confidence Level)
Number of daily trips made by household	Y	0.000	0.390 < 3.211
Number of daily educational trips made by household	Y_2	0.000	0.120 < 0.891
Number of daily shopping trips made by household	Y_3	-47.338	0.084 > 0.075
Number of daily recreational trips made by household	Y_5	-38.3	0.282 > 0.273
Number of daily trips made by household before 8 AM	Y_6	0.0	0.131 < 1.025
Number of daily trips made by household between 9 AM-12 PM	Y_8	-39.1	0.119 > 0.109
Number of daily trips made by household after 4 PM	Y_{10}	65.1	1.088 > 0.988

Appendix C:

Table C-1: Difference between Actual and Estimated General Trips Based on Modified Model Using Native Transfer

Observation No.	Actual Y	Estimated $Y_{modified}$	Difference
Sample (257)	8	6.32	1.68
Sample (258)	8	7.93	0.07
Sample (259)	4	2.13	1.87
Sample (260)	6	3.48	2.52
Sample (261)	3	7.93	-4.93
Sample (262)	9	6.32	2.68
Sample (263)	6	4.96	1.04
Sample (264)	3	4.83	-1.83
Sample (265)	5	3.48	1.52
Sample (266)	10	9.28	0.72
Sample (267)	6	7.93	-1.93
Sample (268)	7	7.80	-0.80
Sample (269)	4	4.96	-0.96
Sample (270)	10	7.93	2.07
Sample (271)	8	4.96	3.04
Sample (272)	7	6.32	0.68
Sample (273)	6	7.80	-1.80
Sample (274)	5	4.96	0.04
Sample (275)	4	4.96	-0.96
Sample (276)	4	3.48	0.52
Sample (277)	2	2.13	-0.13
Sample (278)	12	9.41	2.59
Sample (279)	11	10.77	0.23
Sample (280)	12	12.25	-0.25
Sample (281)	5	3.48	1.52
Sample (282)	8	7.93	0.07
Sample (283)	8	10.77	-2.77
Sample (284)	18	12.25	5.75
Sample (285)	6	4.83	1.17
Sample (286)	10	10.77	-0.77
Sample (287)	11	7.80	3.20
Sample (288)	9	9.15	-0.15
Sample (289)	6	4.96	1.04
Sample (290)	5	3.48	1.52
Sample (291)	12	12.38	-0.38
Sample (292)	8	7.93	0.07
Sample (293)	1	2.13	-1.13
Sample (294)	9	7.80	1.20
Sample (295)	3	3.48	-0.48

Sample (296)	10	9.28	0.72
Sample (297)	13	10.90	2.11
Sample (298)	10	6.32	3.68
Sample (299)	4	4.96	-0.96
Sample (300)	3	3.48	-0.48
Sample (301)	12	12.12	-0.12
Sample (302)	1	3.48	-2.48
Sample (303)	6	6.19	-0.19
Sample (304)	4	3.48	0.52
Sample (305)	1	2.13	-1.13
Sample (306)	7	6.45	0.55
Sample (307)	3	2.13	0.87
Sample (308)	5	6.45	-1.45
Sample (309)	3	6.45	-3.45
Total	**361**	**345.23**	**15.77**

Table C-2: Descriptive Analysis for Actual and Estimated General Trips Based on Modified Model Using Native Transfer

	Actual Y	**Estimated $Y_{modified}$**
Mean	6.811	6.514
Standard Error	0.489	0.407
Median	6.000	6.316
Standard Deviation	3.563	2.962
Count	53	53

Appendix D:

Table D-1: ANOVA Table for the Work Trip Generation Model of Salfit City

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	3	201.509	67.169	191.048	1.32E-64
Residual	252	88.599	0.351		
Total	255	290.109			

Table D-2 ANOVA Table for the Transferred Work Trip Model Using Updating Model Coefficients Method

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	2	193.350	96.675	252.78	4.74E-61
Residual	253	96.759	0.382		
Total	255	290.109			

Table D-3: Difference between Actual and Estimated Work Trips for Salfit City

Observation No.	Actual Y_1	Estimated Y_1	Difference
Sample (257)	2.00	2.06	-0.06
Sample (258)	1.00	1.48	-0.48
Sample (259)	0.00	0.15	-0.15
Sample (260)	3.00	1.23	1.77
Sample (261)	1.00	1.36	-0.36
Sample (262)	2.00	1.94	0.06
Sample (263)	1.00	1.23	-0.23
Sample (264)	2.00	1.81	0.19
Sample (265)	1.00	1.36	-0.36
Sample (266)	2.00	2.19	-0.19
Sample (267)	2.00	1.36	0.65
Sample (268)	2.00	2.19	-0.19
Sample (269)	1.00	1.11	-0.11

Sample (270)	1.00	1.36	-0.36
Sample (271)	1.00	1.23	-0.23
Sample (272)	2.00	2.19	-0.19
Sample (273)	2.00	2.06	-0.06
Sample (274)	0.00	1.11	-1.11
Sample (275)	1.00	1.11	-0.11
Sample (276)	1.00	1.11	-0.11
Sample (277)	0.00	0.15	-0.15
Sample (278)	1.00	1.48	-0.48
Sample (279)	2.00	2.31	-0.31
Sample (280)	2.00	2.06	-0.06
Sample (281)	1.00	1.23	-0.23
Sample (282)	1.00	1.36	-0.36
Sample (283)	2.00	1.81	0.19
Sample (284)	3.00	2.06	0.94
Sample (285)	2.00	2.19	-0.19
Sample (286)	2.00	2.06	-0.06
Sample (287)	2.00	2.19	-0.19
Sample (288)	4.00	3.39	0.61
Sample (289)	3.00	1.48	1.52
Sample (290)	3.00	1.36	1.65
Sample (291)	1.00	0.98	0.02
Sample (292)	1.00	1.23	-0.23
Sample (293)	0.00	0.15	-0.15
Sample (294)	2.00	2.19	-0.19
Sample (295)	1.00	1.11	-0.11
Sample (296)	2.00	2.06	-0.06
Sample (297)	1.00	1.23	-0.23
Sample (298)	2.00	2.06	-0.06
Sample (299)	1.00	1.23	-0.23
Sample (300)	2.00	1.11	0.90
Sample (301)	2.00	3.39	-1.39
Sample (302)	0.00	0.98	-0.98
Sample (303)	3.00	2.89	0.11
Sample (304)	1.00	1.23	-0.23
Sample (305)	0.00	0.15	-0.15
Sample (306)	1.00	1.23	-0.23
Sample (307)	0.00	0.40	-0.40
Sample (308)	1.00	0.98	0.02
Sample (309)	0.00	0.98	-0.98
Total	**77**	**80.27**	**-3.27**

Table D-4: Descriptive Analysis for Actual and Estimated Daily Work Trips for Salfit City

	Actual Y_1	Estimated Y_1
Mean	1.453	1.515
Standard Error	0.128	0.098
Median	1.000	1.355
Standard Deviation	0.932	0.713
Count	53	53

Table D-5: Difference between Actual and Estimated Work Trips Using Native Transfer Method

Observation No.	Actual Y_1	Transferred Y_1	Difference
Sample (257)	2.00	2.18	-0.18
Sample (258)	1.00	1.21	-0.21
Sample (259)	0.00	0.16	-0.16
Sample (260)	3.00	1.17	1.83
Sample (261)	1.00	1.17	-0.17
Sample (262)	2.00	2.14	-0.14
Sample (263)	1.00	1.13	-0.13
Sample (264)	2.00	2.18	-0.18
Sample (265)	1.00	1.17	-0.17
Sample (266)	2.00	2.18	-0.18
Sample (267)	2.00	1.17	0.83
Sample (268)	2.00	2.18	-0.18
Sample (269)	1.00	1.17	-0.17
Sample (270)	1.00	1.21	-0.21
Sample (271)	1.00	1.21	-0.21
Sample (272)	2.00	2.14	-0.14
Sample (273)	2.00	2.18	-0.18
Sample (274)	0.00	1.17	-1.17
Sample (275)	1.00	1.17	-0.17
Sample (276)	1.00	1.17	-0.17
Sample (277)	0.00	0.16	-0.16
Sample (278)	1.00	1.17	-0.17
Sample (279)	2.00	2.18	-0.18
Sample (280)	2.00	2.18	-0.18
Sample (281)	1.00	1.13	-0.13
Sample (282)	1.00	1.17	-0.17
Sample (283)	2.00	2.18	-0.18
Sample (284)	3.00	2.18	0.82
Sample (285)	2.00	2.10	-0.10

Sample (286)	2.00	2.18	-0.18
Sample (287)	2.00	2.10	-0.10
Sample (288)	4.00	3.11	0.89
Sample (289)	3.00	1.13	1.87
Sample (290)	3.00	1.17	1.83
Sample (291)	1.00	1.21	-0.21
Sample (292)	1.00	1.21	-0.21
Sample (293)	0.00	0.20	-0.20
Sample (294)	2.00	2.14	-0.14
Sample (295)	1.00	1.13	-0.13
Sample (296)	2.00	2.18	-0.18
Sample (297)	1.00	1.21	-0.21
Sample (298)	2.00	2.18	-0.18
Sample (299)	1.00	1.13	-0.13
Sample (300)	2.00	1.17	0.83
Sample (301)	2.00	3.07	-1.07
Sample (302)	0.00	1.17	-1.17
Sample (303)	3.00	3.07	-0.07
Sample (304)	1.00	1.13	-0.13
Sample (305)	0.00	0.16	-0.16
Sample (306)	1.00	1.13	-0.13
Sample (307)	0.00	0.16	-0.16
Sample (308)	1.00	1.17	-0.17
Sample (309)	0.00	1.21	-1.21
Total	**77**	**79.63**	**-2.63**

Table D-6: Descriptive Analysis for Actual and Estimated Work Trips Using Native Transfer Method

	Actual Y_1	**Transferred Y_1**
Mean	1.453	1.502
Standard Error	0.128	0.099
Median	1.000	1.210
Standard Deviation	0.932	0.720
Count	53	53

Appendix E:

Table E-1: ANOVA Table for the Education Trip Generation Model of Salfit City

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	1	1192.392	1192.392	7136.146	6.333E-188
Residual	255	42.608	0.167		
Total	256	1235			

Table E-2: ANOVA Table for the Modified Education Trip Model of Jericho City

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	1	4123.31	4123.314	51790.82	0
Residual	712	56.686	0.08		
Total	713	4180			

Table E-3: Difference between Actual and Estimated Education Trips for Salfit City

Observation No.	Actual Y_2	Estimated Y_2	Difference
Sample (257)	2	0.98	1.02
Sample (258)	3	2.95	0.05
Sample (259)	0	0.00	0.00
Sample (260)	0	0.00	0.00
Sample (261)	0	2.95	-2.95
Sample (262)	1	0.98	0.02
Sample (263)	1	0.98	0.02
Sample (264)	0	0.00	0.00
Sample (265)	0	0.00	0.00
Sample (266)	3	2.95	0.05
Sample (267)	0	2.95	-2.95
Sample (268)	2	1.96	0.04
Sample (269)	1	0.98	0.02
Sample (270)	3	2.95	0.05

Sample (271)	1	0.98	0.02
Sample (272)	1	0.98	0.02
Sample (273)	2	1.96	0.04
Sample (274)	1	0.98	0.02
Sample (275)	1	0.98	0.02
Sample (276)	0	0.00	0.00
Sample (277)	0	0.00	0.00
Sample (278)	4	3.93	0.07
Sample (279)	4	3.93	0.07
Sample (280)	5	4.91	0.09
Sample (281)	0	0.00	0.00
Sample (282)	3	2.95	0.05
Sample (283)	4	3.93	0.07
Sample (284)	4	4.91	-0.91
Sample (285)	0	0.00	0.00
Sample (286)	2	3.93	-1.93
Sample (287)	2	1.96	0.04
Sample (288)	2	1.96	0.04
Sample (289)	1	0.98	0.02
Sample (290)	0	0.00	0.00
Sample (291)	7	5.89	1.11
Sample (292)	3	2.95	0.05
Sample (293)	0	0.00	0.00
Sample (294)	2	1.96	0.04
Sample (295)	0	0.00	0.00
Sample (296)	3	2.95	0.05
Sample (297)	5	4.91	0.09
Sample (298)	1	0.98	0.02
Sample (299)	0	0.98	-0.98
Sample (300)	0	0.00	0.00
Sample (301)	4	3.93	0.07
Sample (302)	0	0.00	0.00
Sample (303)	0	0.00	0.00
Sample (304)	0	0.00	0.00
Sample (305)	0	0.00	0.00
Sample (306)	2	1.96	0.04
Sample (307)	0	0.00	0.00
Sample (308)	2	1.96	0.04
Sample (309)	2	1.96	0.04
Total	**84**	**90.34**	**-6.34**

Table E-4: Descriptive Analysis for Actual and Estimated Education Trips for Salfit City

	Actual Y_2	Estimated Y_2
Mean	1.585	1.705
Standard Error	0.232	0.226
Median	1.000	0.982
Standard Deviation	1.692	1.647
Count	53	53

Table E-5: Difference between Actual and Estimated Education Trips Using Native Transfer Method

Observation No.	Actual Y_2	Transferred Y_2	Difference
Sample (257)	2	0.98	1.02
Sample (258)	3	2.93	0.07
Sample (259)	0	0.00	0.00
Sample (260)	0	0.00	0.00
Sample (261)	0	2.93	-2.93
Sample (262)	1	0.98	0.02
Sample (263)	1	0.98	0.02
Sample (264)	0	0.00	0.00
Sample (265)	0	0.00	0.00
Sample (266)	3	2.93	0.07
Sample (267)	0	2.93	-2.93
Sample (268)	2	1.95	0.05
Sample (269)	1	0.98	0.02
Sample (270)	3	2.93	0.07
Sample (271)	1	0.98	0.02
Sample (272)	1	0.98	0.02
Sample (273)	2	1.95	0.05
Sample (274)	1	0.98	0.02
Sample (275)	1	0.98	0.02
Sample (276)	0	0.00	0.00
Sample (277)	0	0.00	0.00
Sample (278)	4	3.91	0.09
Sample (279)	4	3.91	0.09
Sample (280)	5	4.89	0.12
Sample (281)	0	0.00	0.00

Sample (282)	3	2.93	0.07
Sample (283)	4	3.91	0.09
Sample (284)	4	4.89	-0.89
Sample (285)	0	0.00	0.00
Sample (286)	2	3.91	-1.91
Sample (287)	2	1.95	0.05
Sample (288)	2	1.95	0.05
Sample (289)	1	0.98	0.02
Sample (290)	0	0.00	0.00
Sample (291)	7	5.86	1.14
Sample (292)	3	2.93	0.07
Sample (293)	0	0.00	0.00
Sample (294)	2	1.95	0.05
Sample (295)	0	0.00	0.00
Sample (296)	3	2.93	0.07
Sample (297)	5	4.89	0.12
Sample (298)	1	0.98	0.02
Sample (299)	0	0.98	-0.98
Sample (300)	0	0.00	0.00
Sample (301)	4	3.91	0.09
Sample (302)	0	0.00	0.00
Sample (303)	0	0.00	0.00
Sample (304)	0	0.00	0.00
Sample (305)	0	0.00	0.00
Sample (306)	2	1.95	0.05
Sample (307)	0	0.00	0.00
Sample (308)	2	1.95	0.05
Sample (309)	2	1.95	0.05
Total	**84**	**89.88**	**-5.88**

Table E-6: Descriptive Analysis for Actual and Estimated Education Trips Using Native Transfer Method

	Actual Y_2	**Transferred Y_2**
Mean	1.585	1.696
Standard Error	0.232	0.225
Median	1.000	0.977
Standard Deviation	1.692	1.639
Count	53	53

Appendix F:

Table F-1: ANOVA Table for the Shopping Trip Generation Model of Salfit City

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	3	62.795	20.932	61.432	7.64E-30
Residual	253	86.205	0.341		
Total	256	149			

Table F-2: ANOVA Table for the Transferred Shopping Trip Generation Model with Updating Coefficients

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	2	55.335	27.667	75.028	2.61E-26
Residual	254	93.665	0.369		
Total	256	149			

Table F-3: Difference between Actual and Estimated Shopping Trip for Salfit City

Observation No.	Actual Y_3	Estimated Y_3	Difference
Sample (257)	0.00	0.23	-0.23
Sample (258)	0.00	0.29	-0.29
Sample (259)	1.00	0.06	0.94
Sample (260)	0.00	0.23	-0.23
Sample (261)	1.00	0.23	0.77
Sample (262)	1.00	0.42	0.58
Sample (263)	0.00	0.42	-0.42
Sample (264)	0.00	0.06	-0.06
Sample (265)	1.00	0.23	0.77
Sample (266)	0.00	0.59	-0.59
Sample (267)	0.00	0.65	-0.65
Sample (268)	0.00	0.71	-0.71
Sample (269)	0.00	0.36	-0.36
Sample (270)	2.00	0.23	1.77

Sample (271)	1.00	0.59	0.42
Sample (272)	0.00	0.35	-0.35
Sample (273)	1.00	0.35	0.65
Sample (274)	0.00	0.36	-0.36
Sample (275)	1.00	0.36	0.65
Sample (276)	0.00	0.36	-0.36
Sample (277)	1.00	0.36	0.65
Sample (278)	1.00	0.35	0.65
Sample (279)	1.00	0.46	0.54
Sample (280)	0.00	0.47	-0.47
Sample (281)	1.00	0.06	0.94
Sample (282)	0.00	0.52	-0.52
Sample (283)	1.00	0.31	0.70
Sample (284)	0.00	0.59	-0.59
Sample (285)	1.00	0.52	0.48
Sample (286)	0.00	0.71	-0.71
Sample (287)	0.00	0.48	-0.48
Sample (288)	0.00	0.75	-0.75
Sample (289)	1.00	0.52	0.48
Sample (290)	0.00	0.52	-0.52
Sample (291)	1.00	0.24	0.76
Sample (292)	0.00	0.52	-0.52
Sample (293)	0.00	0.48	-0.48
Sample (294)	1.00	0.29	0.71
Sample (295)	0.00	0.36	-0.36
Sample (296)	0.00	0.65	-0.65
Sample (297)	2.00	0.83	1.17
Sample (298)	1.00	0.42	0.58
Sample (299)	1.00	0.06	0.94
Sample (300)	0.00	0.36	-0.36
Sample (301)	1.00	0.65	0.35
Sample (302)	1.00	0.36	0.65
Sample (303)	0.00	0.36	-0.36
Sample (304)	1.00	0.36	0.65
Sample (305)	0.00	0.36	-0.36
Sample (306)	1.00	0.48	0.52
Sample (307)	0.00	0.52	-0.52
Sample (308)	1.00	0.42	0.58
Sample (309)	0.00	0.36	-0.36
Total	**27**	**21.70**	**5.30**

Table F-4: Descriptive Analysis for Actual and Estimated Daily Shopping Trips for Salfit City

	Actual Y_3	Estimated Y_3
Mean	0.509	0.410
Standard Error	0.079	0.024
Median	0.000	0.355
Standard Deviation	0.576	0.175
Count	53	53

Table F-5: Difference between Actual and Estimated Shopping Trips Using Native Transfer Method

Observation No.	Actual Y_3	Transferred Y_3	Difference
Sample (257)	0.00	1.27	-1.27
Sample (258)	0.00	1.50	-1.50
Sample (259)	1.00	0.67	0.33
Sample (260)	0.00	0.93	-0.93
Sample (261)	1.00	0.99	0.01
Sample (262)	1.00	1.23	-0.23
Sample (263)	0.00	0.93	-0.93
Sample (264)	0.00	0.88	-0.88
Sample (265)	1.00	0.69	0.31
Sample (266)	0.00	1.60	-1.60
Sample (267)	0.00	1.55	-1.55
Sample (268)	0.00	1.60	-1.60
Sample (269)	0.00	0.93	-0.93
Sample (270)	2.00	1.59	0.42
Sample (271)	1.00	1.27	-0.27
Sample (272)	0.00	1.30	-1.30
Sample (273)	1.00	1.62	-0.62
Sample (274)	0.00	0.93	-0.93
Sample (275)	1.00	0.74	0.26
Sample (276)	0.00	1.23	-1.23
Sample (277)	1.00	0.70	0.30
Sample (278)	1.00	1.94	-0.94
Sample (279)	1.00	1.87	-0.87
Sample (280)	0.00	2.18	-2.18
Sample (281)	1.00	0.70	0.30
Sample (282)	0.00	1.76	-1.76
Sample (283)	1.00	1.90	-0.90
Sample (284)	0.00	1.90	-1.90
Sample (285)	1.00	1.02	-0.02
Sample (286)	0.00	1.87	-1.87
Sample (287)	0.00	2.01	-2.01

Sample (288)	0.00	1.87	-1.87
Sample (289)	1.00	0.70	0.30
Sample (290)	0.00	0.67	-0.67
Sample (291)	1.00	2.40	-1.40
Sample (292)	0.00	1.50	-1.50
Sample (293)	0.00	0.88	-0.88
Sample (294)	1.00	1.29	-0.29
Sample (295)	0.00	0.67	-0.67
Sample (296)	0.00	1.69	-1.69
Sample (297)	2.00	2.43	-0.43
Sample (298)	1.00	1.80	-0.80
Sample (299)	1.00	0.65	0.35
Sample (300)	0.00	0.70	-0.70
Sample (301)	1.00	2.15	-1.15
Sample (302)	1.00	0.30	0.70
Sample (303)	0.00	0.99	-0.99
Sample (304)	1.00	0.70	0.30
Sample (305)	0.00	0.35	-0.35
Sample (306)	1.00	1.20	-0.20
Sample (307)	0.00	0.67	-0.67
Sample (308)	1.00	1.20	-0.20
Sample (309)	0.00	1.22	-1.22
Total	**27**	**67.32**	**-40.32**

Table F-6: Descriptive Analysis for Actual and Estimated Shopping Trips Using Native Transfer Method

	Actual Y_3	**Transferred Y_3**
Mean	0.509	1.270
Standard Error	0.079	0.074
Median	0.000	1.233
Standard Deviation	0.576	0.541
Count	53	53

Table F-7: Difference between Actual and Estimated Shopping Trips Using Updating Model Coefficients Method

Observation No.	**Actual Y_3**	**Transferred Y_3**	**Difference**
Sample (257)	0.00	0.41	-0.41
Sample (258)	0.00	0.43	-0.43
Sample (259)	1.00	0.24	0.76
Sample (260)	0.00	0.29	-0.29

Sample (261)	1.00	0.34	0.66
Sample (262)	1.00	0.37	0.63
Sample (263)	0.00	0.29	-0.29
Sample (264)	0.00	0.44	-0.44
Sample (265)	1.00	0.26	0.75
Sample (266)	0.00	0.53	-0.53
Sample (267)	0.00	0.48	-0.48
Sample (268)	0.00	0.53	-0.53
Sample (269)	0.00	0.29	-0.29
Sample (270)	2.00	0.51	1.49
Sample (271)	1.00	0.61	0.39
Sample (272)	0.00	0.44	-0.44
Sample (273)	1.00	0.54	0.46
Sample (274)	0.00	0.29	-0.29
Sample (275)	1.00	0.31	0.69
Sample (276)	0.00	0.37	-0.37
Sample (277)	1.00	0.27	0.73
Sample (278)	1.00	0.65	0.35
Sample (279)	1.00	0.58	0.42
Sample (280)	0.00	0.68	-0.68
Sample (281)	1.00	0.27	0.73
Sample (282)	0.00	0.68	-0.68
Sample (283)	1.00	0.61	0.39
Sample (284)	0.00	0.61	-0.61
Sample (285)	1.00	0.37	0.63
Sample (286)	0.00	0.58	-0.58
Sample (287)	0.00	0.71	-0.71
Sample (288)	0.00	0.78	-0.78
Sample (289)	1.00	0.27	0.73
Sample (290)	0.00	0.24	-0.24
Sample (291)	1.00	0.68	0.32
Sample (292)	0.00	0.43	-0.43
Sample (293)	0.00	0.23	-0.23
Sample (294)	1.00	0.43	0.58
Sample (295)	0.00	0.24	-0.24
Sample (296)	0.00	0.61	-0.61
Sample (297)	2.00	0.71	1.29
Sample (298)	1.00	0.71	0.29
Sample (299)	1.00	0.22	0.78
Sample (300)	0.00	0.27	-0.27
Sample (301)	1.00	0.65	0.35
Sample (302)	1.00	0.09	0.92
Sample (303)	0.00	0.34	-0.34
Sample (304)	1.00	0.27	0.73
Sample (305)	0.00	0.14	-0.14
Sample (306)	1.00	0.34	0.66
Sample (307)	0.00	0.24	-0.24

Sample (308)	1.00	0.34	0.66
Sample (309)	0.00	0.36	-0.36
Total	**27**	**22.56**	**4.44**

Table F-8: Descriptive Analysis for Actual and Estimated Shopping Trips Using Updating Model Coefficients Method

	Actual Y_3	**Transferred Y_3**
Mean	0.509	0.426
Standard Error	0.079	0.024
Median	0.000	0.374
Standard Deviation	0.576	0.175
Count	53	53

Appendix G:

Table G-1: ANOVA Table for the Social Trip Generation Model

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	1	951.462	951.462	456.454	1.16E-58
Residual	255	531.538	2.084		
Total	256	1483			

Table G-2: ANOVA Table for the Transferred Social Trip Generation Model with Updating Coefficients

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	3	917.920	305.973	136.992	1.17E-52
Residual	253	565.080	2.234		
Total	256	1483			

Table G-3: Difference between Actual and Estimated Social Trip for Salfit City

Observation No.	Actual Y_4	Estimated Y_4	Difference
Sample (257)	3.00	1.76	1.24
Sample (258)	3.00	2.21	0.80
Sample (259)	1.00	0.88	0.12
Sample (260)	2.00	1.32	0.68
Sample (261)	1.00	1.32	-0.32
Sample (262)	5.00	1.76	3.24
Sample (263)	4.00	1.32	2.68
Sample (264)	0.00	0.88	-0.88
Sample (265)	3.00	0.88	2.12
Sample (266)	5.00	2.21	2.80
Sample (267)	4.00	2.21	1.80
Sample (268)	2.00	2.21	-0.21
Sample (269)	2.00	1.32	0.68
Sample (270)	3.00	2.21	0.80
Sample (271)	2.00	1.32	0.68

Sample (272)	2.00	1.76	0.24
Sample (273)	0.00	2.21	-2.21
Sample (274)	2.00	1.32	0.68
Sample (275)	1.00	0.88	0.12
Sample (276)	2.00	1.76	0.24
Sample (277)	1.00	0.88	0.12
Sample (278)	3.00	2.65	0.35
Sample (279)	4.00	2.65	1.35
Sample (280)	5.00	3.09	1.91
Sample (281)	2.00	0.88	1.12
Sample (282)	3.00	2.21	0.80
Sample (283)	0.00	2.65	-2.65
Sample (284)	6.00	2.65	3.35
Sample (285)	2.00	1.32	0.68
Sample (286)	5.00	2.65	2.35
Sample (287)	5.00	2.65	2.35
Sample (288)	1.00	2.21	-1.21
Sample (289)	1.00	0.88	0.12
Sample (290)	2.00	0.88	1.12
Sample (291)	3.00	3.53	-0.53
Sample (292)	3.00	2.21	0.80
Sample (293)	1.00	1.32	-0.32
Sample (294)	3.00	1.76	1.24
Sample (295)	2.00	0.88	1.12
Sample (296)	4.00	2.21	1.80
Sample (297)	1.00	3.53	-2.53
Sample (298)	5.00	2.21	2.80
Sample (299)	1.00	0.88	0.12
Sample (300)	1.00	0.88	0.12
Sample (301)	3.00	3.09	-0.09
Sample (302)	0.00	0.44	-0.44
Sample (303)	1.00	1.32	-0.32
Sample (304)	1.00	0.88	0.12
Sample (305)	1.00	0.44	0.56
Sample (306)	3.00	1.76	1.24
Sample (307)	3.00	0.88	2.12
Sample (308)	1.00	1.76	-0.76
Sample (309)	1.00	1.76	-0.76
Total	**125**	**91.73**	**33.27**

Table G-4: Descriptive Analysis for Actual and Estimated Daily Social Trips for Salfit City

	Actual Y_4	Estimated Y_4
Mean	2.36	1.73
Standard Error	0.21	0.11
Median	2.00	1.76
Standard Deviation	1.53	0.78
Count	53	53

Table G-5: Difference between Actual and Estimated Social Trips Using Native Transfer Method

Observation No.	Actual Y_4	Transferred Y_4	Difference
Sample (257)	3.00	0.87	2.13
Sample (258)	3.00	0.65	2.35
Sample (259)	1.00	0.29	0.71
Sample (260)	2.00	0.58	1.42
Sample (261)	1.00	0.47	0.53
Sample (262)	5.00	1.05	3.95
Sample (263)	4.00	0.65	3.35
Sample (264)	0.00	0.87	-0.87
Sample (265)	3.00	0.47	2.53
Sample (266)	5.00	1.05	3.95
Sample (267)	4.00	1.05	2.95
Sample (268)	2.00	1.63	0.37
Sample (269)	2.00	0.47	1.53
Sample (270)	3.00	0.47	2.53
Sample (271)	2.00	0.87	1.13
Sample (272)	2.00	1.34	0.66
Sample (273)	0.00	1.45	-1.45
Sample (274)	2.00	0.47	1.53
Sample (275)	1.00	0.47	0.53
Sample (276)	2.00	0.47	1.53
Sample (277)	1.00	0.29	0.71
Sample (278)	3.00	0.94	2.06
Sample (279)	4.00	1.16	2.84
Sample (280)	5.00	2.03	2.97
Sample (281)	2.00	0.36	1.64

Sample (282)	3.00	0.47	2.53
Sample (283)	0.00	2.03	-2.03
Sample (284)	6.00	1.16	4.84
Sample (285)	2.00	0.76	1.24
Sample (286)	5.00	1.74	3.26
Sample (287)	5.00	1.12	3.88
Sample (288)	1.00	1.23	-0.23
Sample (289)	1.00	0.36	0.64
Sample (290)	2.00	0.47	1.53
Sample (291)	3.00	1.45	1.55
Sample (292)	3.00	0.58	2.42
Sample (293)	1.00	0.87	0.13
Sample (294)	3.00	1.05	1.95
Sample (295)	2.00	0.47	1.53
Sample (296)	4.00	1.45	2.55
Sample (297)	1.00	2.03	-1.03
Sample (298)	5.00	0.94	4.06
Sample (299)	1.00	0.36	0.64
Sample (300)	1.00	0.47	0.53
Sample (301)	3.00	1.30	1.70
Sample (302)	0.00	0.58	-0.58
Sample (303)	1.00	0.94	0.06
Sample (304)	1.00	0.36	0.64
Sample (305)	1.00	0.29	0.71
Sample (306)	3.00	0.94	2.06
Sample (307)	3.00	0.29	2.71
Sample (308)	1.00	0.87	0.13
Sample (309)	1.00	0.58	0.42
Total	**125**	**45.58**	**79.42**

Table G-6: Descriptive Analysis for Actual and Estimated Social Trips Using Native Transfer Method

	Actual Y_4	**Transferred Y_4**
Mean	2.358	0.860
Standard Error	0.211	0.066
Median	2.000	0.870
Standard Deviation	1.533	0.478
Count	53	53

Appendix H:

Table H-1: ANOVA Table for the Recreational Trip Generation Model

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	3	173.315	57.772	100.328	9.29E-43
Residual	253	145.685	0.576		
Total	256	319			

Table H-2: ANOVA Table for the Transferred Recreational Trip Generation Model with Updating Coefficients

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	3	141.892	47.297	67.564	4.31E-32
Residual	253	177.108	0.700		
Total	256	319			

Table H-3: Difference between Actual and Estimated Recreational Trip for Salfit City

Observation No.	Actual Y_5	Estimated Y_5	Difference
Sample (257)	1.00	0.69	0.31
Sample (258)	1.00	0.84	0.16
Sample (259)	2.00	0.23	1.77
Sample (260)	1.00	0.46	0.54
Sample (261)	0.00	0.65	-0.65
Sample (262)	0.00	0.65	-0.65
Sample (263)	0.00	0.61	-0.61
Sample (264)	1.00	0.23	0.77
Sample (265)	0.00	0.42	-0.42
Sample (266)	0.00	0.88	-0.88

Sample (267)	0.00	0.65	-0.65
Sample (268)	1.00	0.42	0.58
Sample (269)	0.00	0.65	-0.65
Sample (270)	1.00	1.11	-0.11
Sample (271)	3.00	0.23	2.77
Sample (272)	2.00	0.65	1.35
Sample (273)	1.00	0.46	0.54
Sample (274)	2.00	0.65	1.35
Sample (275)	0.00	0.42	-0.42
Sample (276)	1.00	0.88	0.12
Sample (277)	0.00	0.23	-0.23
Sample (278)	3.00	1.07	1.93
Sample (279)	0.00	0.92	-0.92
Sample (280)	0.00	0.46	-0.46
Sample (281)	1.00	0.61	0.39
Sample (282)	1.00	1.11	-0.11
Sample (283)	1.00	0.23	0.77
Sample (284)	5.00	0.92	4.08
Sample (285)	1.00	0.65	0.35
Sample (286)	1.00	0.46	0.54
Sample (287)	2.00	1.26	0.74
Sample (288)	2.00	1.07	0.93
Sample (289)	0.00	0.61	-0.61
Sample (290)	0.00	0.42	-0.42
Sample (291)	0.00	0.92	-0.92
Sample (292)	1.00	0.92	0.08
Sample (293)	0.00	0.00	0.00
Sample (294)	1.00	0.65	0.35
Sample (295)	0.00	0.42	-0.42
Sample (296)	1.00	0.46	0.54
Sample (297)	4.00	0.46	3.54
Sample (298)	1.00	1.07	-0.07
Sample (299)	1.00	0.61	0.39
Sample (300)	0.00	0.42	-0.42
Sample (301)	2.00	1.68	0.32
Sample (302)	0.00	0.00	0.00
Sample (303)	2.00	0.84	1.16
Sample (304)	1.00	0.61	0.39
Sample (305)	0.00	0.00	0.00

Sample (306)	0.00	0.61	-0.61
Sample (307)	0.00	0.23	-0.23
Sample (308)	0.00	0.46	-0.46
Sample (309)	0.00	0.69	-0.69
Total	**48**	**32.91**	**15.09**

Table H-4: Descriptive Analysis for Actual and Estimated Daily Recreational Trips for Salfit City

	Actual Y_5	**Estimated Y_5**
Mean	0.906	0.621
Standard Error	0.151	0.046
Median	1.000	0.609
Standard Deviation	1.097	0.332
Count	53	53

Table H-5: Difference between Actual and Estimated Recreational Trips Using Native Transfer Method

Observation No.	**Actual Y_5**	**Transferred Y_5**	**Difference**
Sample (257)	1.00	0.74	0.26
Sample (258)	1.00	0.89	0.11
Sample (259)	2.00	0.86	1.14
Sample (260)	1.00	0.57	0.43
Sample (261)	0.00	1.10	-1.10
Sample (262)	0.00	0.82	-0.82
Sample (263)	0.00	0.53	-0.53
Sample (264)	1.00	1.26	-0.26
Sample (265)	0.00	0.49	-0.49
Sample (266)	0.00	1.31	-1.31
Sample (267)	0.00	1.10	-1.10
Sample (268)	1.00	1.35	-0.35
Sample (269)	0.00	0.53	-0.53
Sample (270)	1.00	1.24	-0.24
Sample (271)	3.00	1.86	1.14
Sample (272)	2.00	1.10	0.90
Sample (273)	1.00	1.20	-0.20
Sample (274)	2.00	0.53	1.47

Sample (275)	0.00	0.88	-0.88
Sample (276)	1.00	0.64	0.36
Sample (277)	0.00	0.78	-0.78
Sample (278)	3.00	1.92	1.08
Sample (279)	0.00	1.42	-1.42
Sample (280)	0.00	1.74	-1.74
Sample (281)	1.00	0.56	0.44
Sample (282)	1.00	1.94	-0.94
Sample (283)	1.00	1.56	-0.56
Sample (284)	5.00	1.74	3.26
Sample (285)	1.00	1.14	-0.14
Sample (286)	1.00	1.42	-0.42
Sample (287)	2.00	1.84	0.16
Sample (288)	2.00	2.40	-0.40
Sample (289)	0.00	0.74	-0.74
Sample (290)	0.00	0.42	-0.42
Sample (291)	0.00	1.64	-1.64
Sample (292)	1.00	0.89	0.11
Sample (293)	0.00	0.35	-0.35
Sample (294)	1.00	0.99	0.01
Sample (295)	0.00	0.42	-0.42
Sample (296)	1.00	1.66	-0.66
Sample (297)	4.00	1.60	2.40
Sample (298)	1.00	1.72	-0.72
Sample (299)	1.00	0.53	0.47
Sample (300)	0.00	0.56	-0.56
Sample (301)	2.00	1.86	0.14
Sample (302)	0.00	0.07	-0.07
Sample (303)	2.00	0.78	1.22
Sample (304)	1.00	0.56	0.44
Sample (305)	0.00	0.28	-0.28
Sample (306)	0.00	1.08	-1.08
Sample (307)	0.00	0.42	-0.42
Sample (308)	0.00	0.86	-0.86
Sample (309)	0.00	0.71	-0.71
Total	**48**	**55.60**	**-7.60**

Table H-6: Descriptive Analysis for Actual and Estimated Recreational Trips Using Native Transfer Method

	Actual Y_5	Transferred Y_5
Mean	0.906	1.049
Standard Error	0.151	0.074
Median	1.000	0.890
Standard Deviation	1.097	0.536
Count	53	53

Table H-7: Difference between Actual and Estimated Recreational Trips Using Updating Model Coefficients Method

Observation No.	Actual Y_5	Transferred Y_5	Difference
Sample (257)	1.00	0.44	0.56
Sample (258)	1.00	0.44	0.56
Sample (259)	2.00	0.66	1.34
Sample (260)	1.00	0.42	0.58
Sample (261)	0.00	0.58	-0.58
Sample (262)	0.00	0.54	-0.54
Sample (263)	0.00	0.30	-0.30
Sample (264)	1.00	0.82	0.18
Sample (265)	0.00	0.32	-0.32
Sample (266)	0.00	0.72	-0.72
Sample (267)	0.00	0.58	-0.58
Sample (268)	1.00	0.84	0.16
Sample (269)	0.00	0.30	-0.30
Sample (270)	1.00	0.67	0.33
Sample (271)	3.00	1.16	1.84
Sample (272)	2.00	0.72	1.28
Sample (273)	1.00	0.69	0.31
Sample (274)	2.00	0.30	1.70
Sample (275)	0.00	0.53	-0.53
Sample (276)	1.00	0.47	0.53
Sample (277)	0.00	0.56	-0.56
Sample (278)	3.00	1.12	1.88
Sample (279)	0.00	0.74	-0.74
Sample (280)	0.00	0.91	-0.91
Sample (281)	1.00	0.36	0.64

Sample (282)	1.00	1.13	-0.13
Sample (283)	1.00	0.83	0.17
Sample (284)	5.00	0.91	4.09
Sample (285)	1.00	0.85	0.16
Sample (286)	1.00	0.74	0.26
Sample (287)	2.00	1.16	0.84
Sample (288)	2.00	1.52	0.48
Sample (289)	0.00	0.44	-0.44
Sample (290)	0.00	0.27	-0.27
Sample (291)	0.00	0.80	-0.80
Sample (292)	1.00	0.44	0.56
Sample (293)	0.00	0.28	-0.28
Sample (294)	1.00	0.55	0.45
Sample (295)	0.00	0.27	-0.27
Sample (296)	1.00	0.94	0.06
Sample (297)	4.00	0.82	3.19
Sample (298)	1.00	1.07	-0.07
Sample (299)	1.00	0.30	0.70
Sample (300)	0.00	0.36	-0.36
Sample (301)	2.00	1.13	0.87
Sample (302)	0.00	0.05	-0.05
Sample (303)	2.00	0.56	1.44
Sample (304)	1.00	0.36	0.64
Sample (305)	0.00	0.18	-0.18
Sample (306)	0.00	0.72	-0.72
Sample (307)	0.00	0.27	-0.27
Sample (308)	0.00	0.52	-0.52
Sample (309)	0.00	0.37	-0.37
Total	**48**	**33.04**	**14.96**

Table H-8: Descriptive Analysis for Actual and Estimated Recreational Trips Using Updating Model Coefficients Method

	Actual Y_5	**Transferred Y_5**
Mean	0.906	0.623
Standard Error	0.151	0.042
Median	1.000	0.559
Standard Deviation	1.097	0.309
Count	53	53

Appendix I:

Table I-1: ANOVA Table for the Trip Generation Model for Trips Made Before 8:00 AM of Salfit City

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	2	2014.487	1007.243	1244.883	1.2E-131
Residual	254	205.513	0.809		
Total	256	2220			

Table I-2: ANOVA Table for the Modified Trip Generation Model for Trips Made Before 8:00 AM of Jericho City

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	2	1400.221	700.110	964.771	3.6E-203
Residual	710	515.229	0.725		
Total	712	1915.45			

Table I-3: Difference between Actual and Estimated Trip Generation Model for Trips Made Before 8:00 AM for Salfit City

Observation No.	Actual Y_6	Estimated Y_6	Difference
Sample (257)	4.00	2.21	1.79
Sample (258)	4.00	3.30	0.70
Sample (259)	0.00	0.00	0.00
Sample (260)	1.00	0.67	0.33
Sample (261)	0.00	3.30	-3.30
Sample (262)	3.00	2.21	0.79
Sample (263)	1.00	1.55	-0.55
Sample (264)	2.00	1.33	0.67
Sample (265)	1.00	0.67	0.33
Sample (266)	4.00	3.97	0.03
Sample (267)	1.00	3.30	-2.30
Sample (268)	2.00	3.09	-1.09
Sample (269)	1.00	1.55	-0.55

Sample (270)	3.00	3.30	-0.30
Sample (271)	2.00	1.55	0.45
Sample (272)	2.00	2.21	-0.21
Sample (273)	4.00	3.09	0.91
Sample (274)	0.00	1.55	-1.55
Sample (275)	0.00	1.55	-1.55
Sample (276)	1.00	0.67	0.33
Sample (277)	0.00	0.00	0.00
Sample (278)	4.00	4.18	-0.18
Sample (279)	6.00	4.85	1.15
Sample (280)	6.00	5.73	0.27
Sample (281)	1.00	0.67	0.33
Sample (282)	4.00	3.30	0.70
Sample (283)	2.00	4.85	-2.85
Sample (284)	6.00	5.73	0.27
Sample (285)	2.00	1.33	0.67
Sample (286)	4.00	4.85	-0.85
Sample (287)	4.00	3.09	0.91
Sample (288)	4.00	3.76	0.24
Sample (289)	1.00	1.55	-0.55
Sample (290)	1.00	0.67	0.33
Sample (291)	7.00	5.94	1.06
Sample (292)	4.00	3.30	0.70
Sample (293)	0.00	0.00	0.00
Sample (294)	2.00	3.09	-1.09
Sample (295)	1.00	0.67	0.33
Sample (296)	4.00	3.97	0.03
Sample (297)	5.00	5.06	-0.06
Sample (298)	3.00	2.21	0.79
Sample (299)	1.00	1.55	-0.55
Sample (300)	0.00	0.67	-0.67
Sample (301)	3.00	5.52	-2.52
Sample (302)	0.00	0.67	-0.67
Sample (303)	3.00	2.00	1.00
Sample (304)	1.00	0.67	0.33
Sample (305)	0.00	0.00	0.00
Sample (306)	1.00	2.43	-1.43
Sample (307)	0.00	0.00	0.00
Sample (308)	3.00	2.43	0.58
Sample (309)	2.00	2.43	-0.43
Total	**121**	**128.23**	**-7.23**

Table I-4: Descriptive Analysis for Actual and Estimated Daily Household Trips Made before 8:00 AM for Salfit City

	Actual Y_6	Estimated Y_6
Mean	2.283	2.419
Standard Error	0.256	0.233
Median	2.000	2.213
Standard Deviation	1.864	1.697
Count	53.0	53.0

Table I-5: Difference between Actual and Estimated Modified Trip Generation Model for Trips Made Before 8:00 AM for Salfit City

Observation No.	Actual Y_6	Estimated Y_6 modified	Difference
Sample (257)	4.00	2.08	1.92
Sample (258)	4.00	3.32	0.68
Sample (259)	0.00	0.30	-0.30
Sample (260)	1.00	0.76	0.24
Sample (261)	0.00	3.32	-3.32
Sample (262)	3.00	2.08	0.92
Sample (263)	1.00	1.62	-0.62
Sample (264)	2.00	1.22	0.78
Sample (265)	1.00	0.76	0.24
Sample (266)	4.00	3.79	0.21
Sample (267)	1.00	3.32	-2.32
Sample (268)	2.00	2.93	-0.93
Sample (269)	1.00	1.62	-0.62
Sample (270)	3.00	3.32	-0.32
Sample (271)	2.00	1.62	0.38
Sample (272)	2.00	2.08	-0.08
Sample (273)	4.00	2.93	1.07
Sample (274)	0.00	1.62	-1.62
Sample (275)	0.00	1.62	-1.62
Sample (276)	1.00	0.76	0.24
Sample (277)	0.00	0.30	-0.30
Sample (278)	4.00	4.18	-0.18
Sample (279)	6.00	4.64	1.36
Sample (280)	6.00	5.49	0.51
Sample (281)	1.00	0.76	0.24
Sample (282)	4.00	3.32	0.68
Sample (283)	2.00	4.64	-2.64
Sample (284)	6.00	5.49	0.51

Sample (285)	2.00	1.22	0.78
Sample (286)	4.00	4.64	-0.64
Sample (287)	4.00	2.93	1.07
Sample (288)	4.00	3.39	0.61
Sample (289)	1.00	1.62	-0.62
Sample (290)	1.00	0.76	0.24
Sample (291)	7.00	5.89	1.11
Sample (292)	4.00	3.32	0.68
Sample (293)	0.00	0.30	-0.30
Sample (294)	2.00	2.93	-0.93
Sample (295)	1.00	0.76	0.24
Sample (296)	4.00	3.79	0.21
Sample (297)	5.00	5.03	-0.03
Sample (298)	3.00	2.08	0.92
Sample (299)	1.00	1.62	-0.62
Sample (300)	0.00	0.76	-0.76
Sample (301)	3.00	5.10	-2.10
Sample (302)	0.00	0.76	-0.76
Sample (303)	3.00	1.69	1.31
Sample (304)	1.00	0.76	0.24
Sample (305)	0.00	0.30	-0.30
Sample (306)	1.00	2.47	-1.47
Sample (307)	0.00	0.30	-0.30
Sample (308)	3.00	2.47	0.53
Sample (309)	2.00	2.47	-0.47
Total	**121**	**127.27**	**-6.27**

Table I-6: Descriptive Analysis for Actual and Estimated Modified Trip Generation Model for Trips Made Before 8:00 AM for Salfit City

	Actual Y_6	**Estimated $Y_{6\ modified}$**
Mean	2.283	2.401
Standard Error	0.256	0.216
Median	2.000	2.078
Standard Deviation	1.864	1.575
Count	**53**	**53**

Appendix J:

Table J-1: ANOVA Table for the Trip Generation Model for Trips Made between 8:00 - 9:00 AM of Salfit City

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	2	44.509	22.254	60.462	3.45E-22
Residual	254	93.490	0.368		
Total	256	138			

Table J-2: ANOVA Table for the Transferred Trip Generation Model for Trips Made between 8:00 – 9:00 AM of Salfit City with Updating Coefficients

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	4	43.627	10.906	29.124	6.76E-20
Residual	252	94.372	0.374		
Total	256	138			

Table J-3: Difference between Actual and Estimated Trip Generation Model for Trips Made between 8:00 AM - 9:00 AM for Salfit City

Observation No.	Actual Y_7	Estimated Y_7	Difference
Sample (257)	0.00	0.54	-0.54
Sample (258)	0.00	0.34	-0.34
Sample (259)	1.00	0.00	1.00
Sample (260)	0.00	0.34	-0.34
Sample (261)	0.00	0.34	-0.34
Sample (262)	0.00	0.40	-0.40
Sample (263)	1.00	0.20	0.80
Sample (264)	0.00	0.40	-0.40
Sample (265)	1.00	0.34	0.66
Sample (266)	0.00	0.54	-0.54

Sample (267)	0.00	0.34	-0.34
Sample (268)	1.00	0.54	0.46
Sample (269)	1.00	0.20	0.80
Sample (270)	1.00	0.34	0.66
Sample (271)	0.00	0.34	-0.34
Sample (272)	1.00	0.54	0.46
Sample (273)	0.00	0.54	-0.54
Sample (274)	1.00	0.20	0.80
Sample (275)	0.00	0.20	-0.20
Sample (276)	0.00	0.20	-0.20
Sample (277)	0.00	0.00	0.00
Sample (278)	0.00	0.34	-0.34
Sample (279)	0.00	0.67	-0.67
Sample (280)	1.00	0.54	0.46
Sample (281)	0.00	0.20	-0.20
Sample (282)	0.00	0.34	-0.34
Sample (283)	4.00	0.40	3.60
Sample (284)	0.00	0.54	-0.54
Sample (285)	0.00	0.54	-0.54
Sample (286)	0.00	0.54	-0.54
Sample (287)	0.00	0.40	-0.40
Sample (288)	1.00	0.88	0.13
Sample (289)	0.00	0.34	-0.34
Sample (290)	0.00	0.34	-0.34
Sample (291)	0.00	0.20	-0.20
Sample (292)	0.00	0.34	-0.34
Sample (293)	0.00	0.00	0.00
Sample (294)	2.00	0.54	1.46
Sample (295)	0.00	0.20	-0.20
Sample (296)	1.00	0.54	0.46
Sample (297)	1.00	0.34	0.66
Sample (298)	0.00	0.40	-0.40
Sample (299)	0.00	0.20	-0.20
Sample (300)	1.00	0.20	0.80
Sample (301)	1.00	0.74	0.26
Sample (302)	0.00	0.20	-0.20
Sample (303)	0.00	0.60	-0.60
Sample (304)	0.00	0.20	-0.20
Sample (305)	0.00	0.00	0.00
Sample (306)	1.00	0.20	0.80
Sample (307)	0.00	0.14	-0.14

Sample (308)	0.00	0.20	-0.20
Sample (309)	0.00	0.20	-0.20
Total	**21**	**18.35**	**2.65**

Table J-4: Descriptive Analysis for Actual and Estimated Daily Household Trips Made between 8:00 AM - 9:00 AM for Salfit City

	Actual Y_7	**Estimated Y_7**
Mean	0.396	0.346
Standard Error	0.098	0.026
Median	0.000	0.337
Standard Deviation	0.716	0.190
Count	53	53

Table J-5: Difference between Actual Values and Trip Generation Model for Trips Made between 8:00 - 9:00 AM Using Native Transfer Approach

Observation No.	**Actual Y_7**	**Transferred Y_7**	**Difference**
Sample (257)	0.00	0.73	-0.73
Sample (258)	0.00	0.54	-0.54
Sample (259)	1.00	0.09	0.91
Sample (260)	0.00	0.33	-0.33
Sample (261)	0.00	0.63	-0.63
Sample (262)	0.00	0.73	-0.73
Sample (263)	1.00	0.31	0.69
Sample (264)	0.00	0.66	-0.66
Sample (265)	1.00	0.33	0.67
Sample (266)	0.00	0.87	-0.87
Sample (267)	0.00	0.54	-0.54
Sample (268)	1.00	0.80	0.20
Sample (269)	1.00	0.40	0.60
Sample (270)	1.00	0.54	0.46
Sample (271)	0.00	0.49	-0.49
Sample (272)	1.00	0.64	0.36
Sample (273)	0.00	0.71	-0.71
Sample (274)	1.00	0.40	0.60

Sample (275)	0.00	0.49	-0.49
Sample (276)	0.00	0.24	-0.24
Sample (277)	0.00	0.00	0.00
Sample (278)	0.00	0.70	-0.70
Sample (279)	0.00	0.94	-0.94
Sample (280)	1.00	1.01	-0.01
Sample (281)	0.00	0.24	-0.24
Sample (282)	0.00	0.63	-0.63
Sample (283)	4.00	0.94	3.06
Sample (284)	0.00	1.01	-1.01
Sample (285)	0.00	0.66	-0.66
Sample (286)	0.00	0.94	-0.94
Sample (287)	0.00	0.62	-0.62
Sample (288)	1.00	1.13	-0.13
Sample (289)	0.00	0.49	-0.49
Sample (290)	0.00	0.33	-0.33
Sample (291)	0.00	0.81	-0.81
Sample (292)	0.00	0.63	-0.63
Sample (293)	0.00	0.00	0.00
Sample (294)	2.00	0.80	1.20
Sample (295)	0.00	0.33	-0.33
Sample (296)	1.00	1.03	-0.02
Sample (297)	1.00	0.77	0.23
Sample (298)	0.00	0.55	-0.55
Sample (299)	0.00	0.31	-0.31
Sample (300)	1.00	0.33	0.67
Sample (301)	1.00	1.18	-0.18
Sample (302)	0.00	0.24	-0.24
Sample (303)	0.00	0.72	-0.72
Sample (304)	0.00	0.24	-0.24
Sample (305)	0.00	0.00	0.00
Sample (306)	1.00	0.47	0.53
Sample (307)	0.00	0.09	-0.09
Sample (308)	0.00	0.38	-0.38
Sample (309)	0.00	0.47	-0.47
Total	**21**	**29.49**	**-8.49**

Table J-6: Descriptive Analysis for Actual and Estimated Trip Generation Model for Trips Made between 8:00 - 9:00 AM Using Native Transfer Method

	Actual Y_7	Transferred Y_7
Mean	0.396	0.556
Standard Error	0.098	0.041
Median	0.000	0.539
Standard Deviation	0.716	0.296
Count	53	53

Appendix K:

Table K-1: ANOVA Table for the Trip Generation Model for Trips Made between 9:00 AM - 12:00 PM of Salfit City

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	3	116.990	38.996	69.476	8.95E-33
Residual	253	142.009	0.561		
Total	256	259			

Table K-2: ANOVA Table for the Trip Generation Model of Daily Trips Made between 9:00 AM - 12:00 PM Using Updating Model Coefficients Method

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	3	113.501	37.833	65.787	1.89E-31
Residual	253	145.498	0.575		
Total	256	259			

Table K-3: Difference between Actual and Estimated Trip Generation Model for Trips Made between 9:00 AM - 12:00 PM for Salfit City

Observation No.	Actual Y_8	Estimated Y_8	Difference
Sample (257)	0.00	0.14	-0.14
Sample (258)	0.00	0.59	-0.59
Sample (259)	2.00	0.14	1.86
Sample (260)	1.00	0.14	0.86
Sample (261)	1.00	0.29	0.71
Sample (262)	0.00	0.63	-0.63
Sample (263)	0.00	0.78	-0.78
Sample (264)	0.00	0.14	-0.14
Sample (265)	0.00	0.29	-0.29
Sample (266)	1.00	0.63	0.37
Sample (267)	0.00	0.77	-0.77
Sample (268)	1.00	0.91	0.10

Sample (269)	0.00	0.49	-0.49
Sample (270)	0.00	0.29	-0.29
Sample (271)	1.00	0.47	0.53
Sample (272)	0.00	0.57	-0.57
Sample (273)	0.00	0.42	-0.42
Sample (274)	1.00	0.49	0.51
Sample (275)	1.00	0.49	0.51
Sample (276)	0.00	0.49	-0.49
Sample (277)	1.00	0.33	0.67
Sample (278)	2.00	0.73	1.28
Sample (279)	0.00	0.28	-0.28
Sample (280)	0.00	0.70	-0.70
Sample (281)	1.00	0.45	0.55
Sample (282)	0.00	0.49	-0.49
Sample (283)	0.00	0.70	-0.70
Sample (284)	0.00	0.47	-0.47
Sample (285)	0.00	0.49	-0.49
Sample (286)	0.00	0.75	-0.75
Sample (287)	1.00	1.07	-0.07
Sample (288)	0.00	0.78	-0.78
Sample (289)	1.00	0.64	0.36
Sample (290)	0.00	0.49	-0.49
Sample (291)	0.00	0.56	-0.56
Sample (292)	1.00	0.33	0.67
Sample (293)	0.00	0.61	-0.61
Sample (294)	0.00	0.43	-0.43
Sample (295)	0.00	0.49	-0.49
Sample (296)	0.00	0.61	-0.61
Sample (297)	0.00	1.03	-1.03
Sample (298)	2.00	0.78	1.22
Sample (299)	0.00	0.45	-0.45
Sample (300)	0.00	0.49	-0.49
Sample (301)	3.00	1.23	1.77
Sample (302)	1.00	0.33	0.67
Sample (303)	0.00	0.64	-0.64
Sample (304)	0.00	0.64	-0.64
Sample (305)	0.00	0.33	-0.33
Sample (306)	1.00	0.92	0.08
Sample (307)	0.00	0.33	-0.33
Sample (308)	0.00	0.47	-0.47
Sample (309)	0.00	0.33	-0.33
Total	**23**	**28.52**	**-5.52**

Table K-4: Descriptive Analysis for Actual and Estimated Daily Household Trips Made between 9:00 AM - 12:00 PM for Salfit City

	Actual Y8	Estimated Y8
Mean	0.434	0.538
Standard Error	0.095	0.033
Median	0.000	0.488
Standard Deviation	0.694	0.237
Count	53	53

Table K-5: Difference between Actual Values and Trip Generation Model for Trips Made between 9:00 AM - 12:00 PM Using Native Transfer Approach

Observation No.	Actual Y_8	Transferred Y_8	Difference
Sample (257)	0.00	0.02	-0.02
Sample (258)	0.00	0.20	-0.20
Sample (259)	2.00	0.08	1.92
Sample (260)	1.00	0.05	0.95
Sample (261)	1.00	0.10	0.90
Sample (262)	0.00	0.14	-0.14
Sample (263)	0.00	0.18	-0.18
Sample (264)	0.00	0.02	-0.02
Sample (265)	0.00	0.10	-0.10
Sample (266)	1.00	0.11	0.89
Sample (267)	0.00	0.10	-0.10
Sample (268)	1.00	0.15	0.85
Sample (269)	0.00	0.10	-0.10
Sample (270)	0.00	0.11	-0.11
Sample (271)	1.00	0.02	0.98
Sample (272)	0.00	0.14	-0.14
Sample (273)	0.00	0.02	-0.02
Sample (274)	1.00	0.10	0.90
Sample (275)	1.00	0.10	0.90
Sample (276)	0.00	0.14	-0.14
Sample (277)	1.00	0.04	0.96
Sample (278)	2.00	0.23	1.77
Sample (279)	0.00	0.02	-0.02

Sample (280)	0.00	0.02	-0.02
Sample (281)	1.00	0.18	0.82
Sample (282)	0.00	0.10	-0.10
Sample (283)	0.00	0.02	-0.02
Sample (284)	0.00	0.02	-0.02
Sample (285)	0.00	0.17	-0.17
Sample (286)	0.00	0.02	-0.02
Sample (287)	1.00	0.31	0.69
Sample (288)	0.00	0.23	-0.23
Sample (289)	1.00	0.18	0.82
Sample (290)	0.00	0.10	-0.10
Sample (291)	0.00	0.02	-0.02
Sample (292)	1.00	0.02	0.98
Sample (293)	0.00	0.05	-0.05
Sample (294)	0.00	0.10	-0.10
Sample (295)	0.00	0.09	-0.09
Sample (296)	0.00	0.02	-0.02
Sample (297)	0.00	0.02	-0.02
Sample (298)	2.00	0.20	1.80
Sample (299)	0.00	0.18	-0.18
Sample (300)	0.00	0.10	-0.10
Sample (301)	3.00	0.44	2.56
Sample (302)	1.00	0.01	0.99
Sample (303)	0.00	0.22	-0.22
Sample (304)	0.00	0.18	-0.18
Sample (305)	0.00	0.00	0.00
Sample (306)	1.00	0.26	0.74
Sample (307)	0.00	0.00	0.00
Sample (308)	0.00	0.05	-0.05
Sample (309)	0.00	0.02	-0.02
Total	**23**	**5.60**	**17.40**

Table K-6: Difference between Actual Values and Trip Generation Model for Trips Made between 9:00 AM - 12:00 PM Using Native Transfer Approach

	Actual Y_8	Transferred Y_8
Mean	0.434	0.106
Standard Error	0.095	0.012
Median	0.000	0.100
Standard Deviation	0.694	0.090
Sample Variance	0.481	0.008
Sum	23	5.6
Count	53	53

Table K-7: Difference between Actual and Estimated Trip Generation Model of Daily Trips Made between 9:00 AM - 12:00 PM Using Updating Model Coefficients Method

Observation No.	Actual Y_8	Transferred Y_8	Difference
Sample (257)	0.00	0.51	-0.51
Sample (258)	0.00	1.00	-1.00
Sample (259)	2.00	0.33	1.67
Sample (260)	1.00	0.42	0.58
Sample (261)	1.00	0.50	0.50
Sample (262)	0.00	0.67	-0.67
Sample (263)	0.00	0.49	-0.49
Sample (264)	0.00	0.51	-0.51
Sample (265)	0.00	0.50	-0.50
Sample (266)	1.00	0.75	0.25
Sample (267)	0.00	0.50	-0.50
Sample (268)	1.00	0.92	0.08
Sample (269)	0.00	0.50	-0.50
Sample (270)	0.00	0.75	-0.75
Sample (271)	1.00	0.51	0.49
Sample (272)	0.00	0.67	-0.67
Sample (273)	0.00	0.51	-0.51
Sample (274)	1.00	0.50	0.50
Sample (275)	1.00	0.50	0.50

Sample (276)	0.00	0.67	-0.67
Sample (277)	1.00	0.17	0.83
Sample (278)	2.00	0.91	1.09
Sample (279)	0.00	0.51	-0.51
Sample (280)	0.00	0.51	-0.51
Sample (281)	1.00	0.49	0.51
Sample (282)	0.00	0.50	-0.50
Sample (283)	0.00	0.51	-0.51
Sample (284)	0.00	0.51	-0.51
Sample (285)	0.00	0.58	-0.58
Sample (286)	0.00	0.51	-0.51
Sample (287)	1.00	0.90	0.10
Sample (288)	0.00	0.91	-0.91
Sample (289)	1.00	0.49	0.51
Sample (290)	0.00	0.50	-0.50
Sample (291)	0.00	0.51	-0.51
Sample (292)	1.00	0.51	0.49
Sample (293)	0.00	0.42	-0.42
Sample (294)	0.00	0.50	-0.50
Sample (295)	0.00	0.25	-0.25
Sample (296)	0.00	0.51	-0.51
Sample (297)	0.00	0.51	-0.51
Sample (298)	2.00	1.00	1.00
Sample (299)	0.00	0.49	-0.49
Sample (300)	0.00	0.50	-0.50
Sample (301)	3.00	1.31	1.69
Sample (302)	1.00	0.25	0.75
Sample (303)	0.00	0.66	-0.66
Sample (304)	0.00	0.49	-0.49
Sample (305)	0.00	0.00	0.00
Sample (306)	1.00	0.82	0.18
Sample (307)	0.00	0.00	0.00
Sample (308)	0.00	0.42	-0.42
Sample (309)	0.00	0.51	-0.51
Total	**23**	**29.31**	**-6.31**

Table K-8: Descriptive Analysis for Actual and Estimated Trip Generation Model of Daily Trips Made between 9:00 AM - 12:00 PM Using Updating Model Coefficients Method

	Actual Y_8	**Transferred Y_8**
Mean	0.434	0.553
Standard Error	0.095	0.032
Median	0.000	0.508
Standard Deviation	0.694	0.232
Count	53	53

Appendix L:

Table L-1: ANOVA Table for the Trip Generation Model for Trips Made between 12:00 – 4:00 PM of Salfit City

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	2	17.937	8.968	27.759	1.26019E-11
Residual	254	82.062	0.323		
Total	256	100			

Table L-2: ANOVA Table for the Transferred Trip Generation Model of Daily Trips Made between 12:00 – 4:00 PM Using Updating Model Coefficients Method

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	3	16.589	5.530	16.773	5.76E-10
Residual	253	83.411	0.330		
Total	256	100			

Table L-3: Difference between Actual and Estimated Trip Generation Model for Trips Made between 12:00 PM - 4:00 PM for Salfit City

Observation No.	Actual Y_9	Estimated Y_9	Difference
Sample (257)	0.00	0.16	-0.16
Sample (258)	0.00	0.38	-0.38
Sample (259)	0.00	0.00	0.00
Sample (260)	1.00	0.16	0.84
Sample (261)	0.00	0.27	-0.27
Sample (262)	0.00	0.11	-0.11
Sample (263)	0.00	0.22	-0.22
Sample (264)	0.00	0.00	0.00
Sample (265)	0.00	0.27	-0.27
Sample (266)	0.00	0.27	-0.27
Sample (267)	0.00	0.27	-0.27
Sample (268)	0.00	0.27	-0.27
Sample (269)	0.00	0.11	-0.11

Sample (270)	0.00	0.27	-0.27
Sample (271)	0.00	0.16	-0.16
Sample (272)	0.00	0.27	-0.27
Sample (273)	0.00	0.16	-0.16
Sample (274)	0.00	0.11	-0.11
Sample (275)	1.00	0.11	0.89
Sample (276)	0.00	0.11	-0.11
Sample (277)	0.00	0.00	0.00
Sample (278)	0.00	0.38	-0.38
Sample (279)	1.00	0.33	0.67
Sample (280)	0.00	0.16	-0.16
Sample (281)	0.00	0.22	-0.22
Sample (282)	0.00	0.27	-0.27
Sample (283)	1.00	0.00	1.00
Sample (284)	1.00	0.16	0.84
Sample (285)	0.00	0.27	-0.27
Sample (286)	0.00	0.16	-0.16
Sample (287)	0.00	0.32	-0.32
Sample (288)	0.00	0.54	-0.54
Sample (289)	1.00	0.38	0.62
Sample (290)	1.00	0.27	0.73
Sample (291)	0.00	0.00	0.00
Sample (292)	0.00	0.16	-0.16
Sample (293)	0.00	0.00	0.00
Sample (294)	0.00	0.27	-0.27
Sample (295)	0.00	0.11	-0.11
Sample (296)	0.00	0.16	-0.16
Sample (297)	0.00	0.16	-0.16
Sample (298)	0.00	0.22	-0.22
Sample (299)	0.00	0.22	-0.22
Sample (300)	0.00	0.11	-0.11
Sample (301)	0.00	0.60	-0.60
Sample (302)	0.00	0.00	0.00
Sample (303)	0.00	0.22	-0.22
Sample (304)	0.00	0.22	-0.22
Sample (305)	1.00	0.00	1.00
Sample (306)	0.00	0.22	-0.22
Sample (307)	1.00	0.16	0.84
Sample (308)	1.00	0.00	1.00
Sample (309)	0.00	0.00	0.00
Total	**10**	**9.97**	**0.03**

Table L-4: Descriptive Analysis for Estimated and Actual Values of Daily Household Trips Made between 12:00 - 4:00 PM

	Actual Y_9	Estimated Y_9
Mean	0.189	0.188
Standard Error	0.054	0.018
Median	0.000	0.163
Standard Deviation	0.395	0.133
Sample Variance	0.156	0.018
Sum	10.00	9.97
Count	53	53

Table L-5: Difference between Actual Values and Trip Generation Model for Trips Made between 12:00 - 4:00 PM Using Native Transfer Approach

Observation No.	Actual Y_9	Transferred Y_9	Difference
Sample (257)	0.00	0.70	-0.70
Sample (258)	0.00	0.35	-0.35
Sample (259)	0.00	0.08	-0.08
Sample (260)	1.00	0.25	0.75
Sample (261)	0.00	0.43	-0.43
Sample (262)	0.00	0.60	-0.60
Sample (263)	0.00	0.27	-0.27
Sample (264)	0.00	0.50	-0.50
Sample (265)	0.00	0.25	-0.25
Sample (266)	0.00	0.70	-0.70
Sample (267)	0.00	0.55	-0.55
Sample (268)	0.00	0.60	-0.60
Sample (269)	0.00	0.35	-0.35
Sample (270)	0.00	0.45	-0.45
Sample (271)	0.00	0.43	-0.43
Sample (272)	0.00	0.52	-0.52
Sample (273)	0.00	0.72	-0.72
Sample (274)	0.00	0.35	-0.35
Sample (275)	1.00	0.33	0.67
Sample (276)	0.00	0.17	-0.17
Sample (277)	0.00	0.00	0.00

Sample (278)	0.00	0.53	-0.53
Sample (279)	1.00	0.90	0.10
Sample (280)	0.00	1.00	-1.00
Sample (281)	0.00	0.17	-0.17
Sample (282)	0.00	0.63	-0.63
Sample (283)	1.00	0.90	0.10
Sample (284)	1.00	0.90	0.10
Sample (285)	0.00	0.50	-0.50
Sample (286)	0.00	0.90	-0.90
Sample (287)	0.00	0.54	-0.54
Sample (288)	0.00	0.85	-0.85
Sample (289)	1.00	0.33	0.67
Sample (290)	1.00	0.25	0.75
Sample (291)	0.00	0.77	-0.77
Sample (292)	0.00	0.63	-0.63
Sample (293)	0.00	0.00	0.00
Sample (294)	0.00	0.70	-0.70
Sample (295)	0.00	0.35	-0.35
Sample (296)	0.00	0.80	-0.80
Sample (297)	0.00	0.83	-0.83
Sample (298)	0.00	0.44	-0.44
Sample (299)	0.00	0.17	-0.17
Sample (300)	0.00	0.25	-0.25
Sample (301)	0.00	0.77	-0.77
Sample (302)	0.00	0.37	-0.37
Sample (303)	0.00	0.51	-0.51
Sample (304)	0.00	0.17	-0.17
Sample (305)	1.00	0.00	1.00
Sample (306)	0.00	0.35	-0.35
Sample (307)	1.00	0.08	0.92
Sample (308)	1.00	0.37	0.63
Sample (309)	0.00	0.45	-0.45
Total	**10**	**25.01**	**-15.01**

Table L-6: Descriptive Analysis for Actual and Estimated Trip Generation Model for Trips Made between 12:00 - 4:00 PM Using Native Transfer Method

	Actual Y_9	Transferred Y_9
Mean	0.189	0.472
Standard Error	0.054	0.036
Median	0.000	0.450
Standard Deviation	0.395	0.263
Count	53	53

Appendix M:

Table M-1: ANOVA Table for the Trip Generation Model for Trips Made after 4:00 PM of Salfit City

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	3	2040.589	680.1963	290.4903	1.8E-81
Residual	253	592.411	2.341545		
Total	256	2633			

Table M-2: ANOVA Table for the Transferred Trip Generation Model of Daily Trips Made after 4:00 PM with Updating Coefficients

	Degrees of Freedom	Sum of Squares	Mean Square	F-value	Significance
Regression	3	1890.3	630.1	214.6429	4.2E-69
Residual	253	742.7001	2.935574		
Total	256	2633			

Table M-3: Difference between Actual and Estimated Trip Generation Model for Trips Made after 4:00 PM for Salfit City

Observation No.	Actual Y_{10}	Estimated Y_{10}	Difference
Sample (257)	4.00	2.22	1.78
Sample (258)	4.00	2.36	1.64
Sample (259)	1.00	1.11	-0.11
Sample (260)	3.00	1.53	1.48
Sample (261)	2.00	1.80	0.20
Sample (262)	6.00	3.00	3.00
Sample (263)	4.00	2.03	1.97
Sample (264)	1.00	1.39	-0.39
Sample (265)	3.00	1.11	1.89
Sample (266)	5.00	3.41	1.59
Sample (267)	5.00	3.14	1.86
Sample (268)	3.00	3.41	-0.41
Sample (269)	2.00	2.30	-0.30

Sample (270)	6.00	2.36	3.64
Sample (271)	5.00	2.58	2.42
Sample (272)	4.00	1.94	2.06
Sample (273)	2.00	2.36	-0.36
Sample (274)	3.00	2.30	0.70
Sample (275)	2.00	2.17	-0.17
Sample (276)	3.00	2.44	0.56
Sample (277)	1.00	1.61	-0.61
Sample (278)	6.00	3.05	2.95
Sample (279)	4.00	3.05	0.95
Sample (280)	5.00	3.47	1.53
Sample (281)	3.00	0.83	2.17
Sample (282)	4.00	3.41	0.59
Sample (283)	1.00	3.05	-2.05
Sample (284)	11.00	3.83	7.17
Sample (285)	4.00	2.58	1.42
Sample (286)	6.00	3.83	2.17
Sample (287)	6.00	3.28	2.73
Sample (288)	4.00	3.69	0.31
Sample (289)	3.00	2.17	0.84
Sample (290)	3.00	1.89	1.11
Sample (291)	5.00	3.33	1.67
Sample (292)	3.00	3.41	-0.41
Sample (293)	1.00	2.03	-1.03
Sample (294)	5.00	2.22	2.78
Sample (295)	2.00	1.89	0.11
Sample (296)	5.00	3.41	1.59
Sample (297)	7.00	4.66	2.34
Sample (298)	5.00	2.86	2.14
Sample (299)	3.00	0.83	2.17
Sample (300)	2.00	1.89	0.11
Sample (301)	5.00	4.25	0.76
Sample (302)	0.00	1.20	-1.20
Sample (303)	3.00	2.03	0.97
Sample (304)	3.00	1.61	1.39
Sample (305)	0.00	1.20	-1.20
Sample (306)	4.00	2.72	1.28
Sample (307)	2.00	1.89	0.11
Sample (308)	1.00	2.44	-1.44
Sample (309)	1.00	2.72	-1.72
Total	**186**	**131.24**	**54.76**

Table M-4: Descriptive Analysis for Estimated and Actual Values of Daily Household Trips Made after 4:00 PM

	Actual Y_{10}	Estimated Y_{10}
Mean	3.51	2.48
Standard Error	0.28	0.12
Median	3.00	2.36
Standard Deviation	2.01	0.89
Sample Variance	4.02	0.79
Sum	186	131.2
Count	53	53

Table M-5: Difference between Actual Values and Trip Generation Model for Trips Made after 4:00 PM Using Native Transfer Approach

Observation No.	Actual Y_{10}	Transferred Y_{10}	Difference
Sample (257)	4.00	2.72	1.28
Sample (258)	4.00	2.82	1.18
Sample (259)	1.00	0.44	0.56
Sample (260)	3.00	1.16	1.84
Sample (261)	2.00	3.05	-1.05
Sample (262)	6.00	2.58	3.43
Sample (263)	4.00	1.71	2.29
Sample (264)	1.00	2.91	-1.91
Sample (265)	3.00	1.31	1.69
Sample (266)	5.00	4.06	0.95
Sample (267)	5.00	3.05	1.96
Sample (268)	3.00	3.50	-0.50
Sample (269)	2.00	1.71	0.29
Sample (270)	6.00	3.19	2.81
Sample (271)	5.00	3.12	1.88
Sample (272)	4.00	2.87	1.13
Sample (273)	2.00	3.57	-1.57
Sample (274)	3.00	1.71	1.29
Sample (275)	2.00	2.08	-0.08
Sample (276)	3.00	1.23	1.77
Sample (277)	1.00	0.59	0.41
Sample (278)	6.00	4.04	1.96
Sample (279)	4.00	4.54	-0.54

Sample (280)	5.00	5.24	-0.24
Sample (281)	3.00	1.38	1.62
Sample (282)	4.00	3.93	0.07
Sample (283)	1.00	4.68	-3.68
Sample (284)	11.00	5.24	5.76
Sample (285)	4.00	2.32	1.68
Sample (286)	6.00	4.54	1.46
Sample (287)	6.00	4.02	1.98
Sample (288)	4.00	5.40	-1.40
Sample (289)	3.00	1.94	1.07
Sample (290)	3.00	1.23	1.77
Sample (291)	5.00	4.71	0.29
Sample (292)	3.00	2.82	0.18
Sample (293)	1.00	0.13	0.87
Sample (294)	5.00	3.35	1.65
Sample (295)	2.00	1.23	0.77
Sample (296)	5.00	4.43	0.58
Sample (297)	7.00	4.30	2.70
Sample (298)	5.00	3.76	1.24
Sample (299)	3.00	1.71	1.29
Sample (300)	2.00	1.38	0.62
Sample (301)	5.00	5.32	-0.32
Sample (302)	0.00	0.86	-0.86
Sample (303)	3.00	2.96	0.04
Sample (304)	3.00	1.38	1.62
Sample (305)	0.00	0.30	-0.30
Sample (306)	4.00	2.19	1.81
Sample (307)	2.00	0.44	1.56
Sample (308)	1.00	2.19	-1.19
Sample (309)	1.00	2.27	-1.27
Total	**186**	**143.62**	**42.38**

Table M-6: Descriptive Analysis for Actual Values and Transferred Trip Generation Model for Trips Made after 4:00 PM Values

	Actual Y_{10}	Transferred Y_{10}
Mean	3.509	2.710
Standard Error	0.276	0.200
Median	3.000	2.823
Standard Deviation	2.006	1.455
Count	53	53

Table M-7: Difference between Actual and Estimated Trip Generation Model of Daily Trips Made after 4:00 PM Using Updating Model Coefficients Method

Observation No.	Actual Y_{10}	Transferred Y_{10}	Difference
Sample (257)	4.00	2.40	1.60
Sample (258)	4.00	2.54	1.46
Sample (259)	1.00	0.41	0.59
Sample (260)	3.00	1.01	1.99
Sample (261)	2.00	2.75	-0.75
Sample (262)	6.00	2.27	3.74
Sample (263)	4.00	1.52	2.48
Sample (264)	1.00	2.57	-1.57
Sample (265)	3.00	1.15	1.85
Sample (266)	5.00	3.62	1.38
Sample (267)	5.00	2.75	2.26
Sample (268)	3.00	3.11	-0.11
Sample (269)	2.00	1.52	0.48
Sample (270)	6.00	2.88	3.12
Sample (271)	5.00	2.82	2.19
Sample (272)	4.00	2.54	1.46
Sample (273)	2.00	3.18	-1.18
Sample (274)	3.00	1.52	1.48
Sample (275)	2.00	1.86	0.14
Sample (276)	3.00	1.08	1.92
Sample (277)	1.00	0.54	0.46
Sample (278)	6.00	3.66	2.34
Sample (279)	4.00	4.06	-0.06

Sample (280)	5.00	4.71	0.29
Sample (281)	3.00	1.22	1.78
Sample (282)	4.00	3.56	0.44
Sample (283)	1.00	4.20	-3.20
Sample (284)	11.00	4.71	6.29
Sample (285)	4.00	2.03	1.97
Sample (286)	6.00	4.06	1.94
Sample (287)	6.00	3.59	2.41
Sample (288)	4.00	4.81	-0.81
Sample (289)	3.00	1.73	1.27
Sample (290)	3.00	1.08	1.92
Sample (291)	5.00	4.27	0.73
Sample (292)	3.00	2.54	0.46
Sample (293)	1.00	0.12	0.88
Sample (294)	5.00	2.98	2.02
Sample (295)	2.00	1.08	0.92
Sample (296)	5.00	3.96	1.04
Sample (297)	7.00	3.90	3.10
Sample (298)	5.00	3.35	1.65
Sample (299)	3.00	1.52	1.48
Sample (300)	2.00	1.22	0.78
Sample (301)	5.00	4.74	0.26
Sample (302)	0.00	0.74	-0.74
Sample (303)	3.00	2.57	0.43
Sample (304)	3.00	1.22	1.78
Sample (305)	0.00	0.27	-0.27
Sample (306)	4.00	1.96	2.04
Sample (307)	2.00	0.41	1.59
Sample (308)	1.00	1.96	-0.96
Sample (309)	1.00	2.03	-1.03
Total	**186**	**128.33**	**57.67**

Table M-8: Descriptive Analysis for Actual and Estimated Trip Generation Model of Daily Trips Made after 4:00 PM Using Updating Model Coefficients Method

	Actual Y_{10}	Transferred Y_{10}
Mean	3.509	2.421
Standard Error	0.276	0.180
Median	3.000	2.537
Standard Deviation	2.006	1.309
Count	53	53

جامعة النجاح الوطنية

كلية الدراسات العليا

النقل البيني لنماذج تولد الرحلات للمدن الفلسطينية: أريحا وسلفيت

إعداد

أحمد عامر عبد اللطيف عامر

إشراف

أ.د. سمير أبو عيشة

قدمت هذه الأطروحة استكمالا لمتطلبات الحصول على درجة الماجستير في هندسة الطرق والمواصلات بكلية الدراسات العليا في جامعة النجاح الوطنية في نابلس، فلسطين.

2017

النقل البيني لنماذج تولد الرحلات للمدن الفلسطينية:
أريحا وسلفيت

إعداد
أحمد عامر عبد اللطيف عامر
إشراف
أ.د. سمير أبو عيشة

الملخص

تعتمد عملية التخطيط للمواصلات على أربع خطوات رئيسية، حيث تعتبر نمذجة توليد الرحلات الخطوة الأولى والأساسية لعملية التخطيط هذه. ويتطلب التحضير لهذه الخطوات دراسات استقصائية واسعة النطاق وتحليلاً معمقاً، ويستلزم الكثير من الوقت والجهد والتكلفة لتطوير هذه النماذج. إن البحث المختص بهذا المجال محدود جدا في فلسطين، لذا فإن هذه الدراسة تدرس إمكانية النقل البيني لنماذج تولد الرحلات بين المدن. وتهدف هذه الدراسة إلى التنبؤ بعدد الرحلات المتولدة من مناطق حركة المرور المختلفة في مدينة سلفيت، وإلى دراسة النقل البيني لنماذج تولد الرحلات المتولدة والمعدة مؤخراً لمدينة أريحا إلى مدينة سلفيت.

ويأخذ هذا البحث بعين الاعتبار النموذج العام لكل الرحلات المتولدة على مستوى الأسرة، وكذلك يتعامل مع نماذج تولد الرحلات وذلك بالاعتماد على غرض الرحلة وتوقيتها. وهناك خمسة أغراض للرحلات تم أخذها بعين الاعتبار؛ العمل والتعلم والتسوق والرحلات الاجتماعية والترفيهية. أما نماذج الرحلات المعتمدة على توقيت الرحلة فإنها تتمثل بنموذج الرحلات التي تتم قبل الساعة الثامنة صباحا، والتي تتم ما بين الساعة الثامنة والتاسعة صباحا، والتي تتم ما بين الساعة التاسعة صباحا والثانية عشرة ظهراً، والتي تتم ما بين الساعة الثانية عشرة ظهرا والرابعة مساءً، والتي تتم بعد الساعة الرابعة مساءً.

وقد تم تصميم واستخدام استبانة خاصة لغرض الدراسة لجمع المعلومات من عينة مختارة بشكل عشوائي مكونة من حوالي 256 أسرة في مدينة سلفيت، ثم تم تحليل هذه المعلومات وإعداد النماذج. وقد تمت دراسة الأثر المحتمل لستة عشر متغيرا مستقلا على نماذج الرحلات، حيث تم تحليل المعلومات التي تم جمعها باستخدام معادلات الانحدار. ولقد تم تقييم كل متغير مستقل في كل نموذج بالاعتماد على فحوصات إحصائية مثل معامل تصحيح بيرسون.

وتوصي نتائج هذا البحث باستخدام النموذج العام لتولد الرحلات على مستوى الأسرة ونماذج تولد رحلات العمل والتعلم ونموذج الرحلات التي تتم قبل الساعة الثامنة صباحا ونموذج الرحلات التي تتم بعد الساعة الرابعة مساءً للتخطيط المستقبلي لمدينة سلفيت، حيث كانت النماذج المعدة مقبولة وجيدة إحصائيا.

وبعد استنباط نماذج تولد الرحلات لمدينة سلفيت، تمت مقارنة وتحليل ودراسة النتائج بين النماذج المتولدة لمدينة سلفيت والنماذج المنقولة بينيا والتي تم استنباطها من مدينة أريحا في عام 2014. وقد تم استخدام طريقتين في النقل البيني للنماذج من مدينة أريحا الى مدينة سلفيت؛ الأولى تتصل بنقل النموذج كما هو بمعاملات المتغيرات والثانية تتصل بنقل النموذج بمتغيراته مع تحديث معاملات المتغيرات.

وقد أظهرت نتائج فحوصات النقل البيني لنماذج تولد الرحلات أن النموذج العام لتولد الرحلات ونماذج تولد رحلات العمل والتعلم ونموذج تولد الرحلات ما قبل الساعة الثامنة صباحا من الممكن نقلها من مدينة أريحا إلى مدينة سلفيت باستخدام أي طريقة من الطريقتين المذكورتين سابقا، بينما تبين أنه من غير الممكن نقل باقي النماذج. وقد أشارت هذه الدراسة الى أن التشابه بين الخصائص الاجتماعية والاقتصادية بين المدن يزيد من فعالية النقل البيني لنماذج تولد الرحلات، مما يؤدي إلى توفير الجهد والوقت والتكلفة.