An-Najah National University

Faculty of Graduate Studies

Assessment of Intercity Public Transportation Demand and Elasticity in the West Bank

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Assessment of Intercity Public Transportation Demand and Elasticity in the West Bank

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الإهـــــداء

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إلى روح أبي الطاهرة الذي رباني صغيرا

إلى والدتي ينبوع الحنان

إلى ابني العزيز "محمد" وزوجتي اللذين شاركاني عناء البحث والدراسة وزادا من عزيمتي

إلى اخوتي وأخواتي الذين احسسوني دوما بالثقة والأمل

إلى كل الشرفاء والأوفياء من أبناء فلسطين والعرب

إليهم جميعا اهدي هذا الجهد المتواضع

شكر وتقدير

****

أتقدم بالشكر والامتنان إلى أستاذي ومشرفي الفاضل د. خالد الساحلي الذي لم يدخر جهدا

و لم يتوانى عن تقديم النصح والإرشاد لإنجاح هذه الدراسة،

كما وأتقدم بالشكر لكل من ساهم في إنجاز هذا البحث سواء اشخاص او مؤسسات

ABSTRACT

The ability to predict and evaluate the intercity public transportation demand has become increasingly important in recent years. In the Palestine Territories, as the country is developing, it needs such a project to determine the relations between travel demand and factors affecting it.

This study concerned with transportation planning in Palestine. It was undertaken to find the relationship between the public transportation demand and both operating and socioeconomic variables that influence demand. Therefore, the results obtained can be used to assess the intercity public transportation as well as for a basis to predict its future ridership demand.

There are two main objectives of this study. The first is to develop the intercity bus ridership demand model. Socioeconomic and operating data in the Northern and Central Governorates were used in developing the model. In total six governorates were studied including Nablus, Ramallah, Jenin, Tulkarm, Qalqilia, and Salfit. A mathematical equation for intercity bus ridership demand was developed using five independent variables. These independent variables were; origin city population, destination city population, bus fare, and the percent of employees and students in both origin and destination cities. The correlation coefficient of the suggested aggregation model, R^2, was 0.84.

The second objective was to collect information about the public transportation ridership behavior using two different questionnaires for bus riders and shared taxi riders. The sampling size was 410 for the intercity bus riders, while the sampling size for the shared taxi riders was 158, which accomplished for five percent of the population of riders. Both questionnaires contain questions about personal characteristics of the riders, about the trip itself, and about changing mode preference for a change in bus fare or waiting time. These questionnaires

were analyzed and the ridership demand elasticity toward the change in bus fare was estimated. As a result of bus ridership questionnaire, the elasticity of the bus riders toward the bus fare change was estimated to be –1.83. This means that for every 1 percent increase in bus fare, there is an expected decrease in bus ridership by 1.83 percent. The shared taxi questionnaire showed that the elasticity of riders towards the bus fare change was estimated to be 1.34.

Cross–tabulations were conducted to examine the relationship between riders' characteristics and mode change based on changing bus fare, bus waiting time, or express bus service. The examined riders' characteristics were riders' job, monthly income, trip purpose, and the number of weekly trips. It was found that employees and students were the most sensitive to mode change based on fare change, reducing the waiting time, and availability of express bus services. They almost make daily trips and they try to save money and time.

It was concluded that the study results could be used in evaluating the existing public transportation, and forecast future demand as a function of the suggested variables.

It is recommended for future research to extend such efforts for the rest of the West Bank governorates and Gaza Strip.

ملخص

إن التخطيط الأمثل لقطاع الطرق والمواصلات يعتبر من أهم الأولويات لبناء دولتنا المستقلة، كونه من اكثر العناصر تأثيرا على تطوير النواحي الاقتصادية والاجتماعية والثقافية والسياسية للمجتمع، وكذلك لدوره في الربط الجغرافي لأوصال مدننا وقرانا ومخيماتنا الفلسطينية مع بعضها البعض. هذا فضلا عن تعزيز المتطلبات الاجتماعية والتوزيع السكاني وحاجات السكن والوظائف والتعليم، والاستعمال الفاعل للموارد الطبيعية، وتطوير الصناعة والزراعة والتجارة.

بالنظر إلى الوضع الحالي لقطاع المواصلات في الضفة الغربية وقطاع غزة، وما يقدمه هذا القطاع وخاصة وسائل النقل العام من خدمات للسكان بين المدن، فهو غير مؤهل بالشكل المطلوب حاليا، كما أن وسائل النقل العام يجب تطويرها لتستوعب المزيد من الركاب في المستقبل والذين سوف يتم استقطابهم من المركبات الخاصة في حال اتباع سياسة تشجيع استخدام المواصلات العامة.

لذا كان من الضروري عمل هذه الدراسة عن وسائل النقل العام بين المدن، وتشمل الباصات بشكل أساسي، وذلك لتقييم وضع المواصلات العامة في الوقت الحاضر وذلك للتعرف على أهم العوامل التي تؤثر سلبا أو إيجابا على عدد الركاب حاليا ومستقبليا. بالإضافة إلى التعرف على طبيعة رواد هذه الوسائل وصفاتهم وكذلك المشاكل التي يواجهونها خلال تنقلهم بين المدن. اقتصرت الدراسة على محافظات وسط وشمال الضفة الغربية والتي تشمل: محافظات نابلس وجنين وطولكرم وقلقيلية وسلفيت ورام الله. وقد تم حصر جميع خطوط الباصات بين هذه المحافظات الست، وهي تتكون من اثنين وعشرين خطا عاملا بانتظام .وكذلك تمت عملية المسح الميداني لعينة عشوائية طبقية تمثل ما يقارب 5% من المجتمع الكلي لرواد الباصات وسيارات

الأجرة بين المدن. حيث شملت هذه العينة 410 من ركاب الباصات، و158 من ركاب سيارات الأجرة.

وقد هدفت هذه الدراسة إلى ما يلي:

- تقييم المواصلات العامة وخاصة الباصات بين المدن الرئيسة في شمال ووسط محافظات الضفة الغربية في الوقت الحالي، والتنبؤ بالإقبال السكاني عليها في المستقبل بالاعتماد على نموذج الركاب.
- استنتاج مرونة (حساسية) الطلب على استخدام الباصات كوسيلة نقل بين المدن نتيجة تغير بعض العوامل الداخلية لصفات الرحلة نفسها مثل سعر تذكرة الباص ،وفترة انتظار الباص في المحطة الرئيسية واعتماد نظام الرحلات المباشرة السريعة بين المدن.

توصلت الدراسة إلى ما يلي:

- صيغة رياضية تصف العوامل التي تلعب دورا هاما في تحديد عدد ركاب الباصات بين المدن هي: عدد السكان ، نسبة الأيدي العاملة والطلاب، سعر التذكرة.
- تم احتساب معامل المرونة لركاب الباص نتيجة تغير سعر تذكرة الباص وكان الناتج = -1.828 في حين كان معامل المرونة لركاب سيارات الأجرة =1.34-.
- كما استخدمت الدراسة التحليل التقاطعي (Cross-Tabulation) إلى إيجاد العلاقة بين بعض خصائص الركاب وتغير نوع وسيلة النقل تبعا لتغير سعر تذكرة الباص، وفترة انتظار الباص في المحطة الرئيسية واعتماد نظام الرحلات المباشرة السريعة بين المدن. وقد أظهرت الدراسة إلى أن الموظفين والطلاب (رحلات العمل و التعليم) هي اكثر حساسية للتغير في سعر الباص أو في زمن الرحلة. وهذا يفسر بان هؤلاء الركاب الذين يعملون رحلات شبة يومية يسعون إلى توفير بعض التكاليف المالية للرحلة، وكذلك للوصول إلى أماكنهم المنشودة بأسرع وقت ممكن ودون تأخر.

وعلى ضوء نتائج هذه الدراسة وتحليلاتها الإحصائية يصبح بالمكان تقييم الوضع الحالي لوسائل النقل العام، وكذلك حل المشاكل التي يعاني منها رواد هذا النوع من المواصلات. ويمكن كذلك توقع عدد الركاب المستقبلي بالاعتماد على المتغيرات المقترحة في الصيغة الرياضية.

ومن التوصيات إلى الأبحاث المستقبلية بان يتم إجراء دراسات مشابهة لتشمل المحافظات الأخرى من الضفة الغربية وقطاع غزة.

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Abbreviations

PLO	Palestinian Liberation Organization
PNA	Palestinian National Authority
PCBS	Palestinian Central Bureau of Statistics
USA	United States of America
UK	United Kingdom
TRRL	Transport and Road Research Laboratory
TDM	Travel Demand Management
TDF	Travel Demand Forecasting
JD	Jordanian Dinar
NIS	New Israeli Sheqel
No.	Number
m	Meter
Km	Kilometer
Min.	Minute
hr	Hour
LOS	Level of service
Employ.	Employment
Expend.	Expenditure
Pop.	Population
Orig.	Origin
Dest.	Destination
Co.	Company

CHAPTER 1

INTRODUCTION

1.1 Background

Public transportation plays an important role in fulfilling the population's transport needs. Advanced public transportation technology is an efficient and effective way to transport large number of riders. Therefore, the analysis of public transportation patronage is one an important issues. Recently, transportation planners around the world directed their research and studies towards the development of public transportation using different technologies. Research efforts were focused on increasing the efficiency of the existing public transportation system using different strategies to achieve the desired objectives.

One such strategy is providing incentives to public transportation patronage by different methods such as the improvement of bus services by enforcing the bus priority system.

Another strategy deals with the analysis of the demand for travel. Some of inquiries related to the purpose of the journey, which affect travel demand are how, when, and where this journey will be generated and then destined, as well as the frequency of these trips. To deal with these inquiries, it is important to

know the socioeconomic characteristics of the trip maker who is, in this research, considered as a public transportation commuter.

The combination of these two strategies is achieved by connecting between the factors affecting public transport patronage and those factors affecting the public transportation demand. Using this approach has been growing steadily in recent years, and as a result, the existing information was efficiently analyzed by the transportation planners and then used in planning, operation, and managing purposes.

Many factors affect public transport demand. These factors are associated with socio-economic developments and are not subject to control. They include income, car ownership, population, employment, and other household characteristics. These factors are sometimes referred to as external or background factors. In contrast, there are internal factors that influence demand including public transport fares, trip length, travel time, and service levels. The internal factors are characteristics of the public transport system and are often themselves subject to policy decisions.

Changes in the geographical distribution of population and economic activities might also be classified as 'background' factors. But, because of the distinctly separate policy implications of land use transportation planning, the impacts of changes in land use and town structure are not considered in this study.

facilities in this period except by private sector. The decision of postponing the public transportation development by the concerned parties in this period may refer to the following reasons:

- Public transportation agencies including buses and shared taxis are privately owned.
- Traffic congestion on intercity roads is not a serious problem.
- PNA focused on infrastructure rather than operation projects.
- PNA institutions are still developing.
- There is no independent Palestinian policy decision to execute regional or intercity transportation facilities in the Palestinian Territories at present or the near future.
- Some of public transportation development projects need public awareness.

The public transportation offered to meet the future needs of riders and the demand for public transportation services were not recognized nor studied. Therefore, there is a need to evaluate the existing public transportation in the Palestinian Territories to meet the expected growth in the automobiles on the Palestinian roads, which is expected to cause more congestion and delays. The public transportation can be easily managed and operated after an evaluation had taken place.

1.3 Research Objectives

This research is intended to develop a model for the existing intercity public transportation and forecasting ridership demand. This can be used to create a framework to assist policy makers in their decisions in managing public transportation.

The particular objectives of this research are:

- Use the ridership demand modeling technique to assess the existing and future intercity public transportation.

- Evaluate and test some factors that have significant impact on elasticities of passenger demand for the patronage of bus services.

1.4 Research Importance

This research deals with the evaluation of the public transportation using the ridership demand modeling and ridership elasticity.

Most studies deal with either ridership demand modeling or the ridership elasticity, separately. But, this research combines these two issues. This research considered the ridership demand and the ridership elasticity to be complementary

to each other so as to have a comprehensive overview of the public transportation.

After having a comprehensive overview of the public transportation, one can evaluate the public transportation subjectively and the related problem would be identified. Therefore, the decision-maker can choose the feasible and logical solutions.

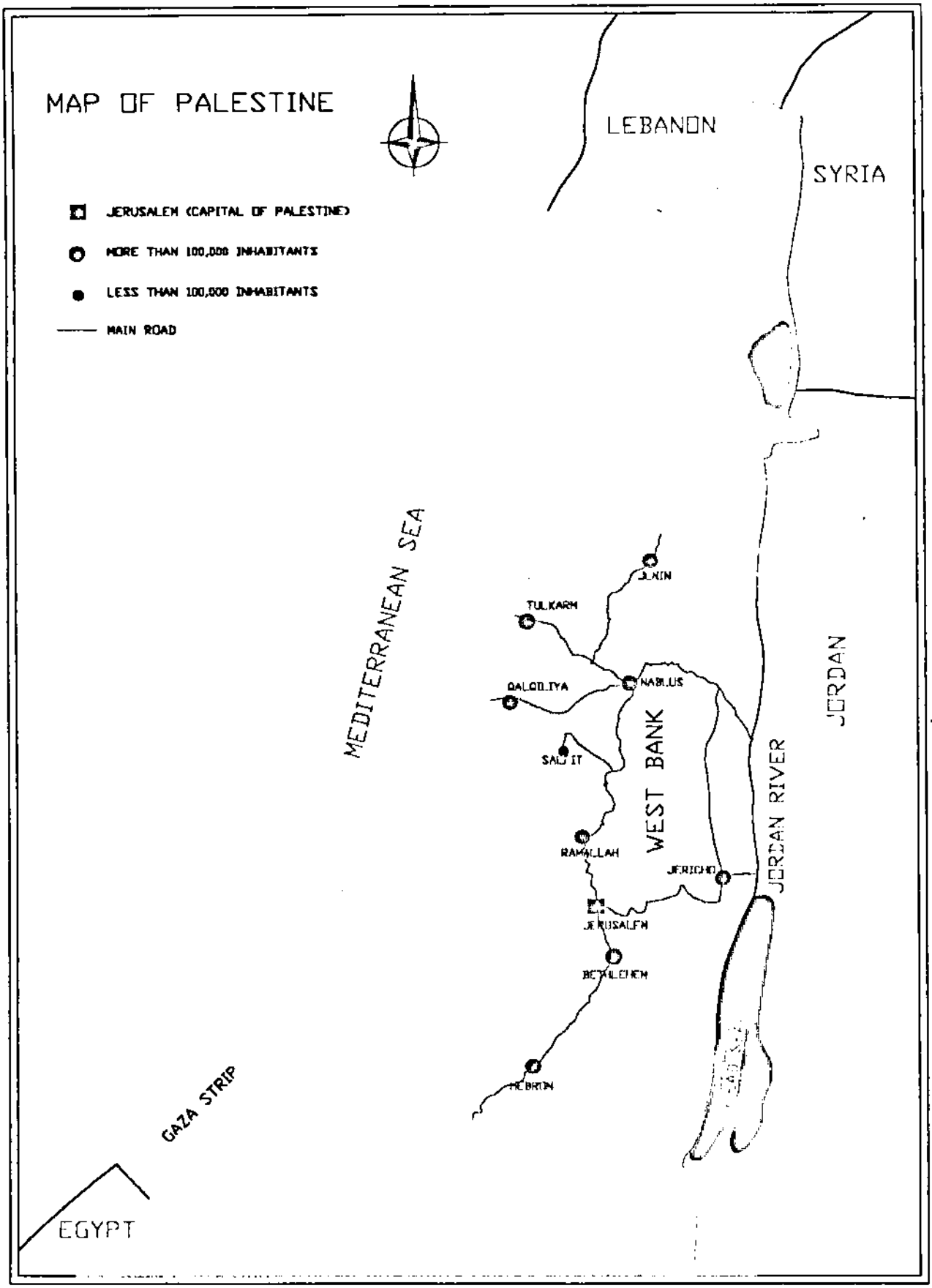
1.5 Study Area

The study area is the Northern and the Central Districts of the West Bank. The case study is Nablus City, which connects the Northern Districts with the Central and Southern Districts of the West Bank. Nablus is the second largest city in the West Bank after Hebron in terms of population. It is also considered the largest commercial center. It has the largest university in Palestine (in terms of number of students), and it is centrally located among other cities in the West Bank. Figure 1.1 illustrates the location of the main cities in the West Bank.

1.6 Study Approach

The first objective of this research focused on developing the ridership intercity bus trip model, which will forecast travel demand. The model should explain bus

Figure 1.1
Map of Palestine



ridership, as a dependent variable, and factors that have significant effect on the dependent variable, as independent variables. The correlation between these independent variables will be examined. Independent variables, which have high correlation, will be either eliminated or joined as one variable.

The regression analysis model can be employed in connection with ridership survey studies. The selection of the most appropriate form in a particular case is usually based on experience and preliminary investigation into the matter. A frequently used regression model is the multiple linear regression model. Each term of the equation can be interpreted as the contribution of the corresponding independent variable to the magnitude of the dependent variable.

The second objective of this research is determining the ridership elasticity towards the change in some variables. The ridership demand reflects the behavior of individuals or the public transport commuters. This behavior of an aggregate group of individuals may be sensitive to any change in one or more of the internal variables. As a result of this change, the behavior of the aggregate group of individuals will change in different amounts with respect to the modal choice.

To achieve this objective under present conditions and the limited historical information, this part of the research was based on the public transportation questionnaire. Thus, the public transportation questionnaire was prepared in a way to obtain the required input data from riders' survey.

1.7 Definitions

Public Transportation

Service provided for the transport of passengers and their incidental baggage on established routes and fixed schedules at published rate of fare, which are available to the general public in urban areas or for short distances in rural areas (Oglesby and Hicks, 1982).

Public Travel (Mass Transit) Demand

Demand for mass transit is estimated as a part of total trip estimation process for the study area between the origin and destination points. It involves some information about those trips through a fixed route and schedule (Morlok, 1978).

Modal Split

Modal split is an estimation of travelers who will use each of the available types of transportation modes between origins and destinations. Mode choice has been hypothesized to depend upon characteristics of the mode, which reflects the continuity of riders to the selected mode between alternatives (Morlok, 1978).

Ridership

It is the traveler who freely chooses a specific mode of transportation on a specific route to achieve his or her trip purpose between the origin and destination.

Shared Taxi Mode

The shared taxi is considered as one of the paratransit services. It is a service providing a transition of passengers and their packages from one place to another. The standard shared taxi seated capacities is seven passengers. Services may deviate from routes and/or fixed schedule, and may pick up and drop off passengers at other than regular stops.

Intercity Bus Service

Intercity bus service is the public transportation mode that connects two cities that have a bus service all week days in a fixed route, fixed schedule, and fixed bus fare. Intercity bus service is provided by a private companies; the most principal two companies for the study area of this research are Al-Tamimi and Al-Taneeb Bus Companies, which operate at a profit, with little or no support from the government.

Regression Analysis

Regression analysis is a statistical method dealing with the formulation of mathematical models that depict relationships among variables, and the use of these modeled relationships for the purpose of predicting and other statistical inferences. The method of least square is the efficient method of estimating the regression parameters to minimize the overall discrepancy (Bhattacharyya and Johnson, 1977).

Travel Demand Elasticity

Travel demand elasticity is a major tool that measures the rider response's sensitivity for any change of one or more variable. That means that the rider may change his or her preferable transportation mode, route, and trip itself because of such changes (Morlok, 1978).

1.8 Research Outline

This research is composed of seven chapters. The first chapter introduces the research, which contains a background on the public transportation conditions in general, the public transportation in the Palestinian Territories, the objectives, the research importance, the study area, and the study approach.

Chapter Two deals with the literature review where a brief discussion of the related studies of the public transportation was presented. This Chapter consists of three groups of studies; the public travel demand studies; elasticity demand, and combination of the travel demand and elasticity.

Chapter Three discusses the methodology of the main two objectives of this study. The approach of data collection, analysis of the public ridership demand modeling, and ridership elasticity were identified in this chapter.

The data collection and input requirements as well as the sources of information were explained in Chapter Four.

Chapter Five presents statistical analysis of the collected data. The implementation of the ridership demand model. The ridership elasticity towards the change of some variables was also determined.

The public transportation assessment in the study year and the discussion of the analyzed data were made in Chapter Six.

Finally, research summary, conclusions, and recommendations were presented in Chapter Seven. In addition, references and appendices were included at the end of this thesis.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Historically, the analysis of factors affecting the demand for public transport goes back about hundred years.

Many researches and studies had been conducted in this field addressing different points of view. Most of these studies can be classified into the two approaches; traffic demand forecasting for the public transportation and the elasticities of the ridership demand towards the internal variables of the public transportation.

These approaches were classified into three groups; ridership demand forecasting and elasticity studies, ridership demand forecasting studies, and elasticity of passenger demand studies. More details about these groups are discussed in this chapter.

2.2 Ridership Demand Forecasting and Elasticity Studies

The United Kingdome (U.K.) Transport and Road Research Laboratory (TRRL) invited transportation research workers in a number of countries to cooperate in a

collaborative study of the factors affecting public transport patronage. Nine countries participated in a joint exercise of this type and the first meeting was held in March 1976 (U.K. Transport and Road Research Laboratory (TRRL), 1980).

Researchers found in this study that in the climate in which public transport found itself more than ever before. Investment decisions and operating policies were geared to giving good value for money. A major component in such planning decisions was a knowledge of how passengers react to changes in transit either imposed by the operator, such as alterations in fares and the level of service offered, or brought about by changing circumstances affecting, for example, income levels, car ownership, and land-use patterns. Similarly, there was a need to know how costs vary with the type of operation and the potential, which existed for reducing overall costs.

In the TRRL meeting, a lot of models were used to establish the empirical relationships between the various factors and demand. The model, which was used to describe and forecast travel by public transport, should ideally reflect the behavior of both the people who might use transit services and the suppliers of those services.

Based on the TRRL meeting (U.K. TRRL, 1980), the demand forms were divided into two basic concepts:

1. The Demand Forecasting Concept

When considering the demand for public transport, the explanatory variables would include the monetary costs of the journey, and the time spent travelling. The time spent travelling might be divided into the various components such as waiting, walking, and in-vehicle time. Similar competing variables, which were considered in demand forecasting were modes of transport and income. A general formulation of a demand function was

$$Y = f(x_1, x_2 \ldots\ldots, x_n)$$

Where Y is the dependent variable (level of demand) and x_i ($i = 1, \ldots, n$) are the explanatory variables.

2. The Elasticity Concept

A measure frequently used to summarize the responsiveness of demand to changes in the factors determining the level of demand is the elasticity. Elasticities are, in practice, measured in several ways, according to the nature of the influence variable and the size of the change. The following equation was set for a price change:

$$e = \{(y - y_0) / y_0\} / \{(x - x_0) / x_0\}$$

Where

e = the elasticity of the ridership demand

$y - y_0$ = the change in ridership demand

y_0 = the original ridership demand

$x - x_0$ = the change in transit fare

x_0 = the original transit fare

Banister and Gwilliam, 1975 & 1976, studied the change of mode choice according to different socioeconomic categories. The authors found that mode choice varied according to the auto ownership and showed that the use of buses in car-owning households was smaller than in non-car owning households.

The authors also found that people who were living alone were more likely to use public transport than people in larger households. The study also found that the married men used their own cars more than public transport. On the other hand, the married women preferred to use the public transport more than their own cars. Finally, the children and the young people were generally less likely to have a car for a particular trip (either drivers or passengers) than old people who have reached relatively high wage levels.

Bermello, Ajamil and Partners (B & A), 1997, discussed transit ridership demand in several statewide and regional studies in the U.S.A. and expressed the demand model in the following format:

Ridership =Constant (Population)^{a} (Service Frequency)^{b} (Distance)^{c} (Fare)^{d} ...

The study also investigated the ridership demand for the Tri-Rail routes connecting the South Florida Region. The researchers explained that the Tri-Rail ridership was a function of the service area demographics, route characteristics, and the station area profile.

The Tri-Rail annual ridership origins and destinations between its stations for 1995 were obtained from Tri-County Commuter Rail Authority. The variables expected to influence ridership demand were examined at every station. These variables were: population at the origin and destination stations, average annual household income, average population age, train fare, distance betw en stations, running time, and average automobile ownership.

A logarithmic transformation of the model was used to convert the model to a linear format. Then the multiple-linear regression analysis was performed. After several trials and testing of both correlation and the causation of the variables, the following model and the corresponding correlation coefficients were reached:

$$R_{ij} = 2.168\,(10^{0.15})\,(Pop_i)^{1.909}\,(Pop_j)^{1.537}\,(Age_i)^{0.446}\,(TT_i)^{2.051}\,(Dist_{ij})^{1.246} \Big/ (Inc_i)^{2.051}\,(Fare_{ij})^{1.246}$$

Where,

R_{ij} : The ridership demand (# of passenger) between station (i) to station (j)

Pop_i : Population (persons) within a 3-mile radius of the origin station

Pop_j : Population (persons) within a 3-mile radius of the destination station

Age_i : Average population age (year) within a 3-mile radius of the origin station

TT_i : Average travel time (minutes) within a 3-mile radius of the origin station

$Dist_{ij}$: Average distance (mile) between station (i) to station (j)

Inc_i : Average annual income (US $) at the origin station

$Fare_{ij}$: Round-trip train fare per mile ($/ mile) between station (i) to station (j)

Although the above model explained only 65 percent of the overall variance in demand ($R^2 = 0.65$), these results were found to be practical and consistent with several studies conducted in the U.S.A.

Kain and Liu, 1999, studied the transit ridership systems of Houston, Texas and San Diego, California. The authors explained that there were large increases in transit ridership achieved by Houston and San Diego transit providers with time.

Based on Kain and Liu's estimated ridership models using cross sections and time series data, the study quantified the relative contributions of policy variables and factors beyond the control of transit operators and ridership growth. It was found that large ridership increases in both areas were caused principally by large service increases and fare reductions, as well as metropolitan employment and population growth. In addition, the study provided careful estimates of total and

operating costs per passenger boarding and per passenger mile for Houston's bus operator and San Diego's bus and light rail operators.

The study developed two models. Model (I) was based on Houston ridership equation and employed a fare elasticity of –0.23. Model (II) replaced the estimated Houston fare elasticity with the industry consensus estimate, which was –0.33.

2.3 Ridership Demand Forecasting Studies

Chen, 1995, developed a simple demand model to predict the intercity bus ridership based on the limited information available at the time of the study. The bus ridership originated at ten Michigan cities in U.S.A. was used to develop the model. The model was a function of the origin city's population and income, as shown below:

$$\text{Ridership Trip} = 4210 + 0.094\ \text{Population} - 0.278\ \text{Income}$$

Although the model's correlation coefficient was relatively high (92.4%), the model was determined to be unsatisfactory because, first the income variable was determined to be insignificant since the annual per capita income value did not significantly vary between cities. Secondly, the model depended only on the characteristics of the origin city regardless of the destination.

Al-Sahili and Taylor, 1996, used the 1977 and 1985 Michigan intercity bus ridership data to develop the demand model between city pairs. These data were used to develop a model that could predict the bus ridership based on the characteristics of both the origin and destination cities. The 1980 and 1990 Census of Population were used to determine the socioeconomic characteristics of each city for the above mentioned years. The following model was tested:

$$T_{ij} = \frac{C\,(P_i)^a\,(P_j)^b}{(D_{ij})^c}$$

Where T_{ij} = annual bus ridership between city i and city j

P_i = population of city i

P_j = population of city j

D_{ij} = distance between city i and city j

C, a, b, c = calibration coefficients

Using the log-linear regression and forcing the line through the origin, the calibration coefficients for the 1977 model were C = 1.0, a = 0.600, b = 0.260, and c = 0.710, with a correlation coefficient $R^2 = 0.768$. The 1977 data was used in this study while the 1985 data was not used.

Moussavi et al, 1996, developed models to predict the future intracounty public transportation ridership demand in rural State of Nebraska, U.S.A. Existing and

historical transit operation and socioeconomic and demographic data were collected for the counties and cities in Nebraska that had rural transportation services. This information was used to develop a series of equations for predicting the future ridership demand in rural areas with or without existing public transportation services.

The overall objective of Moussavi research was to assess the existing and future intercity public transportation needs in rural State of Nebraska. Specific objectives were to estimate the potential yearly intracounty public transportation ridership demand in each county for base year (e.g., 1990) using the existing socioeconomic and demographic data. As well as to forecast the potential intracounty public transportation ridership demand over a 20-year period using the historical trends of changes in socioeconomic and demographer in each county. The results of this research project were expected to enhance the capabilities of decision-makers at the Nebraska Department of Roads in setting priorities for meeting the public transportation needs in rural Nebraska.

The equations developed in this study were in the following forms:

$$\text{Annual passenger boarding} = a_1 \text{ VehMile} + \text{constant} \quad (1)$$

$$\text{Annual passenger boarding} = a_1 \text{ VehMile} - a_2 \text{ AvgFare} + \text{constant} \quad (2)$$

Where a_1 and a_2 = coefficients for annual vehicle miles (VehMile) and the annual average fare (AvgFare), respectively.

The first form was developed for counties and cities that did not charge a fare. The second form was developed for the counties and cities that did charge a fare.

Harrington and Carakatsane, 1984, used a base-case 1985 ridership to develop a transit demand model. The authors used calibrated trip-generation formulae, historical survey data on Needham commuter-rail and express-bus service, and recent employment and population forecasts. The Harrington and Carakatsane study was conducted to examine alternatives for the transit service for the Forest Hills-Needham corridor that will be most appropriate once the relocation of the Orange Line was completed. The Orange Line was being relocated from the elevated structure over Washington Street to the railroad right-of-way adjacent to the tracks used by the South Side Commuter-rail line and Amtrak. Ridership forecasts for three transit-service alternatives were made, based on projected socioeconomic changes and the service alternatives defined through this model. The available study publication was the abstract only. Therefore, very limited information was provided.

Chang, 1988, indicated that over the past three decades, Taiwan and Republic of China, as developing countries, had consistently given priority to the

development of their transportation system. For example, during the 1970s, when the government implemented the highly successful ten major projects.

Chang studied the intercity public transportation in Taiwan. The author discussed Taiwan's economic development, described the existing transportation system, and outlined planned development. The study used the following variables: geographic characteristics, socioeconomic characteristics, and urban centers & metropolitan areas. The study showed that all intercity travel in Taiwan was by highway, airway, or air. It was estimated that in 1985, 1.165 trillion intercity passenger trips were made in Taiwan. Of this total, it was further estimated that 88 percent of these trips were made by highway transportation (including buses and private vehicles), 11 percent by railway transport, and less than 1 percent by air transport.

Nelson and Neil, 1983, presented the major findings of a bus patronage forecasting project to develop a simple short-range planning model for bus transit demand analysis in Albuquerque, New Mexico, U.S.A. The model would typically be applied by an analyst lacking specialized mathematical expertise by using commonly available data to analyze the ridership impacts of proposed transit service changes. Analysis of the information needs of Albuquerque officials and of the ridership patterns of Albuquerque Sun Tran users revealed that a focus on residential service requirements should have the highest analytical priority. In response to this need, a linear home-origin transit generation model

was developed that could be manually applied to predict ridership response to service changes. The model was sensitive to a wide range of service, policy, socioeconomic, and land use factors. Validation studies on the model indicated that the model prediction were quite accurate. The author conducted that this technique should be transferable to other urban areas, especially rapidly growing multi-centered sunbelt cities lacking the radial structure and dominant core of older American cities.

Spear, 1977, indicated that the information on the origins and travel characteristics of individuals who boarded at the Homewood commuter railroad station were obtained from a survey conducted by the Chicago Area Transportation Study (CATS) in 1969. For the purposes of Spear's study, it was assumed that the introduction of feeder bus service would only affect choice of access mode to the station. It would change neither the overall demand for rail service nor the time of day at which the trips were made. The origins of commuter rail passengers identified in the survey were located on a map of the village. The village was then divided into 24 zones, such that commuters within a zone would have similar travel distances to the railroad station.

Spear developed the following model:

$$P_i = \frac{\exp(U_i)}{1 + \exp(U_i)}$$

This model was divided into two categories:

1. Linear utility expression for zones less than one mile from station

$$U_i = -2.5994 - 0.1569\ B_i - 0.0442\ F_i + 0.1315\ S_i$$

2. Linear utility expression for zones over one mile from station

$$U_i = 2.5238 - 0.0721\ B_i - 0.0419\ F_i - 0.0007\ H_i + 0.0032\ S_i$$

Where,

P_i = probability of a commuter in zone i using feeder bus

U_i = linear utility expression for feeder bus in zone i

B_i = average distance to the nearest feeder bus stop for a commuter from zone i (in hundreds of feet)

F_i = bus fare from zone i (in cents)

H_i = bus headway for zone i (in-seconds)

S_i = distance to the train station from zone i (in hundreds of feet)

Sponsor, 1989, determined the types of transit services that had emerged in subcenters and that could provide guidance for future subcenter-based transportation planning. Case study data were gathered from a variety of sources. Informal interviews were conducted with city staff members to identify services

operating conditions within the area. Ridesharing information was gathered from local Transportation System Management (TSM) consultants. Data on private, for-hire services were obtained via telephone interviews with carriers licensed by the California Public Utilities Commission. The collected data were classified into four groups as follows:

1) Population Characteristics of the Case Study Cities

Total population, number of households, number of housing units, percent owner occupied, percent vacant, median family income, and ethnic distribution.

2) Economic Characteristics

Employed workers, jobs/resident workers, percent resident workers employed outside city, and taxable retail sales.

3) Modal Split For Glendale/Pasadena, California Workers

Drive alone, carpool, vanpool/bus-pool, public transit, walk, and others.

4) Commuter Travel Characteristics

Work trip distance, work trip time, travel mode, drive alone, carpool/vanpool, bus, other, employee-paid parking, car available for work trip, and others.

2.4 Elasticities of the Passenger Demand Studies

Urquhart and Buchanan, 1981, discussed the substantial changes in bus fares and service levels which were introduced in Telford, Shropshire, England. The authors provided a suitable context in which to estimate elasticities of bus passenger demand using data collected in special surveys before and after the implementation of the changes.

The study found evidence that shopping trips by bus had been redistributed between the various shopping centers in Telford in response to changes in relative fares and service levels. When a method of estimating elasticities, which eliminated redistribution effects was used, fare elasticities for shopping trips were estimated to fall in the range from -0.58 to -0.80. Shopping trips seemed to be fairly insensitive to changes in service frequency, but elasticities with respect to a weighted combination of walking, waiting, and in-vehicle time were estimated in the range from -0.55 to -0.71. The surveys indicated that trips made for non-shopping purposes (approximately two-thirds of which were work and education trips) were generally less sensitive to fares than shopping trips. For these trips, fare elasticities ranged between -0.32 and -0.46. Elasticities for non-shopping trips with respect to service frequency (buses per hour) were between 0.29 and 0.37.

Hensher, 1998, used yields management techniques in establishing mixtures of ticket types and fare levels through public transportation patronage. The author predicted the response of the market to specific fare classes; knowledge of how various market segments would respond to both the choice of ticket type within a public transport mode, and the choice between modes.

The resulting matrix of direct and cross elasticities reflected the market environment on which concession and non-concession travelers made choice. The researcher stated that the better understanding of market sensitivity to class of tickets was promoted as part of the improvement in management practices designed to improve fare yield.

The elasticities from Hensher's study indicated the level of switching between ticket types and between the car and bus modes for any given change in fare levels or types.

Hughes, 1980, studied the elasticities of demand for suburban rail travel using British Rail's NPAAS (National Passenger Accounting and Analysis System). The data collected were four-weekly time series started in 1971 and giving passenger flows by ticket type. The method of analysis was used to determine the elasticity of rail travel demand with respect to the main types of fare. The model was applied to a sample of sixty-two flows with origins outside Greater London and with destinations at one of the main London terminals.

The analysis covered the period from the setting up of NPAAS to the middle of 1977. Elasticities of about -1.0 for reduced-fare tickets, -0.7 for full-fare tickets, and between -0.2 and -0.4 for season tickets had been obtained. A similar model applied to a small sample of flows where there had been appreciable service changes showed no plausible frequency or journey time elasticities significantly different from zero.

2.5 Conclusion

Most studies in the literature depended on the ridership as an approach to dealing with the travel demand forecasting.

Several models were identified in the literature. Most of these models were analytical models. Analytical models are mathematical formulas, which are developed based on the characteristics of surrounding communities and the transit agencies.

The various factors of these studies, which affected public transport demand, were those factors associated with socio-economic developments and which are not subject to control by the researchers. They include population, income rate, car ownership, and other household characteristics. These variables can be considered as external or background factors, in contrast to the internal factors

such as public transport fares and service levels. The internal factors are characteristics of the public transport system and are often themselves subject to policy decision.

The aggregate data on inter-district travel by public transportation should be used to calibrate a total demand model with influence factors. Thus, it is important to use such influence variables to predict the demand for intercity public transportation in Palestine.

Several studies also emphasized that the ridership demand was very sensitive to the changes in public transit fare and to change in the level of service.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter provides a description of the public transit demand forecasting and the methods of analysis used to establish the empirical relationships and their results. The intention of this research is to provide a comprehensive study on demand modeling and to provide sufficient background to assess the intercity public transportation to appreciate the validity, reliability, and usefulness of the results given in later chapters.

3.2 Intercity Bus Ridership Demand Modeling

3.2.1 Multiple Linear Regression Analysis

The demand function reflects the behavior of an individual, whose preference dictates the particular functional form of the relationship. Then all the individuals in the public transport commuter group (ridership) will be formulated to explain the behavior of an aggregate group of individuals. In this latter case, it is generally assumed that the preferences of the individuals in the group either are

identical or sufficiently similar that the same type of demand function can be used to describe the behavior.

There is no general rule or consensus among researchers in the field as to either the functional form of the demand equation or the variables, which should be used to obtain the best explanation of the demand.

To be consistent with the general form to predict public transport demand, the theories of statistical analysis and least square regression were used. Based on the multiple linear or log-linear regression analysis, the expected model form will be deal with the socioeconomic characteristics and the internal factors of the public transport mode itself such as trip length, travel time, bus fare, and frequency. The expected model took into consideration the living conditions and reflect the willingness and needs of the people who live in the Northern and the Central Districts of the West Bank.

These considerations have to be taken into the empirical analysis, i.e., by testing various forms and specifications against observed behavior using statistical techniques. Many functions used in demand analysis were based on a linear or a log-linear relationship between the dependent and independent variables.

Since multiple regression is a statistical analysis technique, it is important that the various standard tests of validity be considered and that the results be

evaluated by these means. Multiple regression is only as accurate and as useful as the validity of the assumptions that are made and the statistical significance of the results obtained. It is also important that such models be subjected to both the logic of the equation and the statistical evaluations to determine the reasonableness of the results. It is entirely possible to produce equations, which meet all of the various statistical criteria.

The regression analysis programs prepared in this study is reasonable and statistically sound. That is, the analysis method depended on successively adding variables to a regression equation with the objective of obtaining the "best" final equation. In this method one variable is added at each step and statistical tests are conducted to determine the "improvement" in the equation. Variables continue to be added until reaching satisfied results. The chosen variables were added based on their strong correlation with the dependent variable. This type of regression analysis modeling is reasonable and feasible.

The model considers bus ridership demand as a dependent variable and the factors that have significant effect on the dependent variable as independent variables. The correlation between these independent variables will be examined. Some of the independent variables, which have high correlation, will either be eliminated or joined as one variable.

The regression model used in this research was the linear multiple-regression model, which has the following form:

$$Y = a_0 + a_1 X_1 + a_2 X_2 + \ldots\ldots\ldots + a_r X_r$$

Where Y is the dependent variable, herein called the ridership demand. While the X's are the relevant independent or explanatory variables such as population, average monthly family expenditure, percentage of employment, total auto ownership for both origin and destination cities, bus fare, trip length, travel time, ...etc. The a's are the parameters of the model.

3.2.2 Sample Correlation Coefficient

One simple kind of association between the variables X and Y produces pairs of values or, graphically, points that scatter about a straight line. A small amount of scatter about a line indicates strong association; a large amount of scatter is a manifestation of weak association. A numerical measure of this relationship is called a sample correlation coefficient or, sometimes, Pearsons' product moment correlation coefficient (R).

The correlation coefficient, R, is a sample analog of the population correlation that has values between –1.0 and 1.0. The value R = 1.0 occurs only when all the data points lie perfectly on a straight line with a positive slope. The value R =

-1.0 is also a perfect linear relation in which the line has a negative slope. A value of R close to either of these extremes corresponds to a tight clustering of data points around a straight line, constituting a strong linear relation. With lesser amounts of cluster about a straight line, R assumes smaller numerical values, and R = 0 is interpreted as an absence of a linear relation.

3.2.3 Correlation & Causation

Historically, analysts have often jumped to unjustified conclusions by mistaking an observed correlation for a cause-effect relationship. A high sample correlation coefficient does not necessarily signify any causal relation between two variables X and Y. The observation that two variables tend to simultaneously vary in a certain direction does not imply the presence of a direct relationship between them. That is, it may be due to a third unknown causal variable that causes X and Y to vary in the same direction, despite the fact that X and Y may be unrelated or even negatively related, which is referred to as a lurking variable. Sometimes, it becomes more a matter of common sense than of statistical applications to determine if an observed correlation can be practically interpreted or if it is deceptive. That means, the logic and engineering judgement must be used to interpret the given results and their causation.

In this research, the correlation and causation were examined in building the model. More details about these tests are mentioned in the statistical analysis chapter.

3.3 Demand Elasticity and Preparing a Sample Survey

3.3.1 Elasticity Concept

A measure frequently used to summarize the responsiveness of demand to changes in the factors determining the level of demand is the elasticity. Elasticity in practice, is measured in several ways, according to the size of the change. The commonly used elasticity form has the following equation in the linear form:

$$e = \{(y - y_0) / y_0\} / \{(x - x_0) / x_0\}$$

Where

$y - y_0$ = the change in ridership demand

y_0 = the original ridership demand

$x - x_0$ = the change in the tested variable/s

x_0 = the original tested variable value

elasticity of the bus ridership demand depending on existing data cannot be used. The other approach that could be used in such condition. as in this research, was based on a public transportation questionnaire. Thus, the public transportation questionnaire was prepared carefully in a way to obtain the required input data from riders.

3.3.2 Sample Survey

Planning an elaborate survey is usually a more intricate process. It requires careful reflection on the complexities involved in a population structure, on the practical feasibility of the sampling methods, on the coordination and supervision of the field work, and on the processing and analysis of the data. To briefly introduce these issues, the principal steps involved in planning and executing the survey are to be examined first. Because different populations as well as the facilities and personnel available for sampling can present diverse difficulties in conducting a survey, the treatment is intended to be illustrative rather than exhaustive.

In this research, a sample survey was conducted at the bus, at the shared taxi main stations, and on board. The sample survey was done during normal conditions, at different times of the day, and during typical weekdays to get a more accurate and a representative sample for the whole population.

3.3.2.1 Purpose of Survey Study

The necessity for a clear statement of the purpose of the study cannot be overemphasized. Without establishing the goal of an investigation. including what we hope to learn from the data, any deliberation as to choice among alternative sampling methods will be meaningless. Care must be taken in defining the purpose of a survey as specifically as possible, is that vital information is unlikely to be overlooked when the units are sampled.

The main purpose of the questionnaire is to define the ridership elasticity towards the change in bus fare and the reduction of bus waiting time. The other secondary purpose is to make statistical analysis about the commuter personal characteristics.

3.3.2.2 Target Population

The population from which inferences are to be drawn, called the target population, must be defined as clearly as possible. In conducting the survey, care must be taken to ensure that the sampled population does not deviate drastically from the target population.

In this research, the population that was considered was bus and shared taxi commuters. The sample survey was chosen from riders of the bus and the shared

taxi at the main stations and on board to get more accurate results about the trips they make.

3.3.2.3 Data to Be Collected

Guided by the statement of purpose, the nature of the data should be determined, that is to be collected from the sampled units. Care should be taken to include all the essential data and, at the same time, to avoid collecting data that are irrelevant to the purpose of the survey. Frequently, there is a tendency to prepare an overly long questionnaire in the mistaken belief that more questions will provide more information. Conversely, an unusually large number of questions can bore the respondents and may erode the quality of the data gathered on vital issues. The intended manner of conducting the survey should be kept in mind while designing the questionnaire, and the questions should be carefully worded to avoid guiding responses at any particular direction. A question should not indicate the desired answer.

The main data intended from the questionnaire was the impact of bus fare increase on mode choice. Also, the willingness of shared taxi riders to switch for buses when the bus fare decreases or the bus waiting time decreases. The other secondary data to be collected are some information about the trip purpose, employment, income, gender, age, and the auto ownership, which can be used in distinguishing the characteristics of the trip makers.

3.3.2.4 Sampling Method and Sampling Size

The selection of the appropriate sampling method is based on such factors as the structure of the population, the type of information sought, the administrative facilities to conduct the survey, the duration of the survey project, and the survey cost. There are four sampling methods. These are:

1. Completely Random Sampling

   The sample is chosen such that each element of the population has the same chance of being chosen. Choosing any element is independent of choosing any other element. All population numbers are put in a table or in a closed box and the number is chosen randomly up to reach the required sample number.

2. Systematic Random Sampling

   The population numbers are put in a table such as the simple random method. In this method, the numbers are chosen in terms of their orders in a systematic period. In this method, one number is chosen in each period, where the number of periods represents a percent of the sample size of the population.

3. Stratified Random Sampling

The previous two methods do not represent the population adequately. Also, when the population represents some of elements' groups, it is preferable to use the stratified method. In this method, the population is divided into their groups, and the percent of group sample size represents the same percent of this group population, accordingly.

4. Cluster Random Sampling

This method differs from the other sampling methods in choosing the sampling elements. This method is used when the population is too large and distributed in different areas and the sampling of all the area elements is difficult. Some populated areas are chosen to represent the population randomly. All chosen area's elements are considered as the sample size.

The preferable sampling method that was used in this research the stratified random sampling method, because the study population is divided into groups. The main two groups are bus and the shared taxi riders. The subgroups are the city-pair bus routes and the city-pair shared taxi routes.

The sample size needed for such questionnaire should be sufficient, representative of the various sectors, and illustrative of the population. To achieve acceptable results, it is recommended in similar sampling surveys that

From this trial survey, it was concluded that there were two questions in the questionnaire that needed more explaining and; therefore, they were modified accordingly. Otherwise, all other questions were understood and answered properly.

3.4 Data Collection Methodology

Bus Companies

Data collected from bus companies was carried out through scheduled meetings with bus companies' managers. Managers did not provide written documents, and information was given verbally, which are discussed in details in Chapter 4.

PCBS Data

The PCBS data were obtained from PCBS publications, as discussed in the next chapter.

Questionnaire

The questionnaires were distributed from September to November, 2000. The survey was carried out during weekdays and at different times of the day (morning, noon, and afternoon) at bus and taxi stations as well as on-board. The author of this thesis and other engineering students at the university distributed and collected the questionnaire.

This research focussed on the intercity bus services in the Northern and Central Governorates of the West Bank, and considered Nablus Governorate as a core of this study. All city pairs that have bus services in these areas were included. The cities included in this research were; Nablus, Jenin, Ramallah, Tulkarm, Qalqilia, and Salfit. These cities represented the core of commercial, educational, and institutional activities in their respective governorates.

4.2 Sources of Research Data

The data collected in this study can be classified according to their source, nature, and characteristics into three types, as listed below:

1. PCBS (Palestinian Central Bureau of Statistics)
2. Records of various public transportation agencies and bus companies
3. Questionnaire for bus and taxis riders

4.2.1 PCBS (Palestinian Central Bureau of Statistics)

Censuses of population, housing, or establishments are crucial undertakings in the life of any official statistical system. The United Nations recommends the implementation of population censuses every 5 or 10 years to obtain a comprehensive set of data about population size, composition, and characteristics. Such data are essential for economic and social development.

Upon launching of the peace process between the Arab countries and Israel, the Palestine Liberation Organization, PLO, has given highest priority to making the needed data for establishing national plans of actions available. These plans of actions are used for rebuilding the country, especially the economic, social, cultural, and service sectors in the Palestinian Territories. The PLO has recognized that the available gap in the needed statistics for planning will only be filled through the implementation of a population and housing census.

The PCBS was entrusted through that decree to lead the implementation of this strategic exercise. The census covered all of the Palestinian Territories except those parts of Jerusalem, which were annexed by Israel in 1967.

The PCBS published in 1997 the final report which described the population demographics and their activities in Gaza Strip and the West Bank.

Recently, the PCBS published the year 2000 final reports taking into consideration the annual growth and the predicted scenarios of the population growth in the following 20 years. These published reports, which were used in this research, are as follows:

- Transportation and Communication Statistics in the Palestinian Territories, Annual Report, 1999.
- Expenditure and Consumption Levels, Annual Report, 1999.
- Labour Force Survey: Main Finding, 1999 and 2000.
- Final Results, Population Report, West Bank, 1999.

This research considered the year 2000 as the base year. Thus all the collected data were based on year 2000.

The four-external or background variables, which were used in the ridership modeling, were obtained from this source, (PCBS). It consisted of the following information:

- Total population by Governorate (Table 4.1).
- Population by Governorate and activity status (economical activity) (Table 4.2).
- Transportation statistics in the Palestinian Territories (auto ownership) (Table 4.3).
- Expenditure and consumption levels (income levels) (Table 4.4).

Table 4.1

Total Population and Percentage by Governorate

Governorate	Year 1999		Year 2000	
	Population	Percent*	Population	Percent*
Jenin	207,837	6.88	216,126	6.86
Tulkarm	137,381	4.55	142,865	4.54
Qalqilia	74,605	2.47	78,029	2.48
Salfit	49,993	1.66	52,137	1.66
Nablus	267,650	8.86	278,317	8.84
Ramallah	221,436	7.33	231,690	7.36
Palestinian Territories	**3,019,704**		**3,150,056**	

*Percent: The percent of the governorate population out of the total population in the Palestinian Territories

المصدر: فلسطين في القرن العشرين، وقفات احصائية، مارس 2000.

Table 4.2

Percentage Distribution of Employment for People 15 Years or Older by Governorate

Governorate	Inside Employment[1] (%)	Outside Employment[2] (%)	Total (%)	Inside Employment			
				Full Employment[3] (%)	Limited Employment[4] (%)	Unemployment[5] (%)	Total (%)
Jenin	43.3	56.7	100.0	76.8	10.7	12.5	100.0
Tulkarm	42.5	57.5	100.0	69.3	16.3	14.4	100.0
Qalqilia	42.5	57.5	100.0	69.3	16.3	14.4	100.0
Salfit	47.4	52.6	100.0	70.0	19.0	11.0	100.0
Nablus	47.4	52.6	100.0	70.0	19.0	11.0	100.0
Ramallah	41.4	58.6	100.0	92.4	3.0	4.6	100.0

[1]Inside Employment: People 15 years or older who have the ability to be employed.
[2]Outside Employment: People 15 years or older who cannot be employed such as people older than 60 years or ill people.
[3]Full Employment: People 15 years or older who have constant and permanent jobs.
[4]Limited Employment: People 15 years or older who have daily; but not constant jobs such as labors or farmers.
[5]Unemployment: People 15 years or older who do not have a job now.

Source: Labour Force Survey; Main Findings, by PCBS, 1999 and 2000.

Table 4.3

Licensed Auto Ownership By Governorate

Governorate	Private Vehicles in Year 1999	New Private Vehicles	Private Vehicles in Year 2000
Jenin	6100	90	6190
Tulkarm	6956	88	7044
Qalqilia	2301	35	2336
Salfit	2215	44	2259
Nablus	11798	230	12028
Ramallah	11966	749	12715
Total	**41336**	**1236**	**42572**

Source: Transportation and Communication Statistics in the Palestinian Territories, by PCBS, 2000.

Table 4.4

Average Family Expenditure Over a Four-Year Period in Jordanian Dinars

Governorate	Average Expenditure (JD per month)			
	1997	1998	1999	2000
Jenin	580	497	496	440
Tulkarm	543	519	474	443
Qalqilia	543	519	474	443
Salfit	592	551	506	464
Nablus	592	551	506	464
Ramallah	709	744	606	583
Average	**593**	**564**	**510**	**473**

Source: Expenditure and Consumption Levels, 1997, 1998, 1999, and 2000 Reports, by PCBS.

4.2.2 Records of Various Public Transportation Agencies and Bus Companies

Data records of the existing intercity bus trips in the Northern and Central governorates of the West Bank were collected from the transportation agencies and bus companies' operators. These data were obtained through interviews with managers of all bus companies that have intercity bus services. The data included the average trips and riders. More details about the bus companies, intercity bus trip lines, and the number of trips per day are shown in Tables 4.5 through 4.11.

Table 4.5 indicates bus trip lines between study city pairs. From this table, one can see that there were bus services between some city pairs. However, other city pairs were not served by buses. Table 4.5 indicates also the average weekly bus riders for these routes.

Tables 4.6 through 4.11 show the daily bus trips from the origin city to the destination city, in terms of bus companies, number of buses, number of trips, riderships, and other notes. These tables were divided according to the origin city; Nablus, Tulkarm, Ramallah, Jenin, Qalqilia, and Salfit, respectively.

Tables 4.12, 4.13, 4.14 and 4.15 indicate bus trips' attributes between city pairs in terms of the bus trip length, travel time, bus fare, and the average weekly bus trips, respectively. The trip length was measured in kilometer (Km), the travel

Table 4.6
Bus Services Originated at Nablus City

Intercity Bus Route		Bus Company	No. of Buses	No. of Weekday Trips	Average Weekday Riders	Average Bus Occupancy	Notes	Average Weekly Ridership
Origin City	Destination City							
Nablus	Ramallah	Tamimi Co.	20-23	40	1,250	31	Reduces to 950 during winter (4 months)	6,900
	Jenin	Tamimi Co.	2	3	110	37	Reduces to 846 in Summer (3 months)	7,614
		Taneeb Co.	8	18	780	43		
		Arabba Co.	2	2	65	33		
		Abu Farha Co.	2	3	95	32		
		Maithaloon Co.	1	1	40	40		
		Qabatia Co.	2	3	95	32		
		Al Assad Co.	1	2	65	33		
		Others Co.	3	3	90	30		
		Total	**21**	**35**	**1,340**	38		
	Tulkarm	Tamimi Co.	1	2	75	38	Reduces to 800 in Summer (3 months)	6,263
		Taneeb Co.	12	27	1,050	39		
		Total	**13**	**29**	**1,125**	39		
	Qalqilia	Taneeb Co.	6	13	600	46	Reduces to 420 in Summer (3 months)	3,330
	Salfit	Salfit Bus Co.	6	7	160	23	Increases to 192 in Summer (3 months)	1,008

Source: Bus Companies' Operators

Table 4.8

Bus Services Originated at Ramallah City

Intercity Bus Route		Bus Company	No. of Buses	No. of Weekday Trips	Average Weekday Riders	Average Bus Occupancy	Notes	Av Weekly Ridership
Origin City	Destination City							
Ramallah	Nablus	Tamimi Co.	20-23	33	1,025	31	Reduces to 750 in winter (4 months)	5,600
	Jenin	Tamimi Co.	3	4	120	30		720
	Tulkarm	Tamimi Co.	3	3	105	35		630
	Qalqilia	Taneeb Co.	2-3	2	65	33	Increases to 100 on Saturdays	425
	Salfit	Salfit Bus Co.	1	1	40	40		240

Source: Bus Companies' Operators

Table 4.9

Bus Services Originated at Jenin City

Intercity Bus Route		Bus Company	No. of Buses	No. of Weekday Trips	Average Weekday Riders	Average Bus Occupancy	Notes	Average Weekly Ridership
Origin City	Destination City							
Jenin	Ramallah	Tamimi Co.	3	4	120	30		720
	Nablus	Tamimi Co.	2	2-3	110	44	Reduces to 846 in Summer (3 months)	7,614
		Taneeb Co.	9	18	850	47		
		Arabba Co.	2	2	65	33		
		Abu Farha Co.	2	3	95	32		
		Maithaloon Co.	1	1	40	40		
		Qabatia Co.	2	3	95	32		
		Al Assad Co.	1	2	65	33		
		Other Co.	3	3	90	30		
		Total	**22**	**32**	**1,410**	44		
	Tulkarm	Taneeb Co.	1	2	54	27		330

Source: Bus Companies' Operators

Table 4.10

Bus Services Originated at Qalqilia City

Intercity Bus Route		Bus Company	No. of Buses	No. of Weekday Trips	Average Weekday Riders	Average Bus Occupancy	Notes	Average Weekly Ridership
Origin City	Destination City							
Qalqilia	Nablus	Taneeb Co.	7	14	650	46	Reduces to 450 in Summer (3 months)	3,600
	Ramallah	Taneeb Co.	2	2	75	38	Increases to 120 on Saturdays	495
	Tulkarm	Taneeb Co.	3	5	80	16	Mini buses were used	480

* The occupancy of the mini bus =20 riders

Source: Bus Companies' Operators

Table 4.11

Bus Services Originated at Salfit City

Intercity Bus Route		Bus Company	No. of Buses	No. of Weekday Trips	Average Weekday Riders	Average Bus Occupancy	Notes	Average Weekly Ridership
Origin City	Destination City							
Salfit	Nablus	Salfit Bus Co.	6	7	225	32	Increases to 270 in Summer (3 months)	1418
	Ramallah	Salfit Bus Co.	1	1-2	50	33		300

Source: Bus Companies' Operators

Table 4.12

Trip Length in Kilometer (Km) Between the Origin & Destination Cities

From \ To	Nablus	Jenin	Tulkarm	Qalqilia	Ramallah	Salfit
Nablus	x	42	27	40	53	35
Jenin	42	x	60	x	85	x
Tulkarm	27	60	x	50	80	x
Qalqilia	40	x	50	x	68	x
Ramallah	53	85	80	68	x	60
Salfit	35	x	x	x	60	x

x : No intercity bus service
Source: Bus Companies' Operator

Table 4.13

Travel Time in Minutes Between the Origin & Destination Cities

From \ To	Nablus	Jenin	Tulkarm	Qalqilia	Ramallah	Salfit
Nablus	x	50	35	45	55	45
Jenin	50	x	75	x	90	x
Tulkarm	35	75	x	60	80	x
Qalqilia	45	x	60	x	80	x
Ramallah	55	90	80	80	x	55
Salfit	45	x	x	x	55	x

x : No intercity bus service
Source: Bus Companies' Operator

Table 4.14

Bus Fare In New Israeli Sheqel Between the Origin & Destination Cities

From \ To	Nablus	Jenin	Tulkarm	Qalqilia	Ramallah	Salfit
Nablus	x	5	4 to 4.5	5	6	4
Jenin	5	x	6	x	10	x
Tulkarm	4 to 4.5	6	x	6	9	x
Qalqilia	5	x	6	x	7	x
Ramallah	6	10	9	7	x	6
Salfit	4	x	x	x	6	x

x : No intercity bus service
Source: Bus Companies' Operator

Table 4.15

Summary of Average Weekly Intercity Bus Trips for the Study Region

From \ To	Nablus	Jenin	Tulkarm	Qalqilia	Ramallah	Salfit
Nablus	x	198	174	72	203	42
Jenin	198	x	12	x	18	x
Tulkarm	174	12	x	30	18	x
Qalqilia	72	x	30	x	18	x
Ramallah	203	18	18	18	x	9
Salfit	42	x	x	x	9	x

x : No intercity bus service
Source: Bus Companies' Operator

time was measured in minutes (min), bus fare was measured in New Israeli Sheqel (NIS), and the average weekly bus trips were measured in trips.

4.2.3 The Public Transportation Questionnaire

4.2.3.1 Developing The Public Transportation Questionnaire

The second objective of this research was to examine the elasticity of intercity bus ridership demand towards the change of some internal variables. There were certain data elements such as the change in bus fare, the service level, and waiting time that are not easy to control.

These variables were very difficult to change during the study period. The variations of these variables required a very high level of coordination with the decision-makers, which may not be feasible for this study. Thus, the public transportation questionnaire was prepared to obtain input data from riders regarding these issues. The questionnaire was carried out in two forms; one for the bus riders and another for the taxi riders, as shown in the Appendix (I)

The first form indicates the questionnaire for the bus riders. The questions were put carefully to examine the riders' willingness to continue riding the bus if the bus fare increases. The other questions were to obtain some information about the commuters' characteristics as a secondary objective of this questionnaire.

The questionnaire consisted of three pages. The first page contained general information about the study, its objective, and guides to answer the questions. The other two pages contained 16 questions, which were sequenced from the general information up to specific questions of this study.

The first set of questions asked about the employment, age, gender, income, auto ownership, and educational attainment. Then several questions asked about the trip purpose, number of similar weekly trips, and the current preference to riding a bus. The last group of questions asked about main reason for riding the bus and the bus rider willingness to continue riding the bus when bus fare increases.

The second form indicates the questionnaire for the shared taxi riders. There were some questions for the shared taxi riders to examine their willingness to divert from riding shared taxi (service) to a bus for a decrease in bus fare, an improvement of bus service level, or a decrease in travel time by eleminateing most stops. The other questions were put to obtain some information about the commuters' personal characteristics, as a secondary objective of this questionnaire.

Similar to the bus riders' questionnaire, the shared taxi questionnaire consisted of three pages; an information page and two pages of 19 questions. The first set of questions asked about the employment, age, sex, income, auto ownership, and

educational attainment. Then several questions asked about the trip purpose, number of similar weekly trips, and the current preference to riding shared taxi. The last group of questions were about the main reason for not riding the bus, and the shared taxi rider willingness to convert to a bus if shared taxi fare increases, bus waiting time at the origin station decreases, or bus stops are eliminated except at the destination station.

4.2.3.2 Sampling and Questionnaire Distribution

Three basic factors were considered in the design of the sampling plan for this study and sampling procedures for drawing sets of samples from the population:

(1) Data points to be included in a sample must be selected so as to exclude bias due to selection processes;

(2) Samples should, insofar as possible, be representative of the study area;

(3) Sampling plan must provide a basis for selection of samples to be modeled which will permit useful conclusions to be drawn from modeling results.

The sample survey of this research was about 5.0 percent of the total population. The average daily intercity bus riders of the study area were about 8,000. The average daily intercity shared taxi riders of the study area was about 3,500.

The total average daily intercity public transportation riders was about 11,500.

The minimum sample size = 11,500 x 0.05 = 575

Bus sample survey = 400

Shared taxi sample survey = 175

A total of 430 and 175 forms were distributed for bus and shared taxi riders, respectively. The distribution of the questionnaires according to each city pair for bus and shared taxi are shown on Tables 4.16 and 4.17, respectively.The number of valid bus riders' sample was 410, while the valid shared taxi riders' sample was 158. The total valid sample survey size was 568. Therefore, the non-valid bus and shared taxi forms represented 4.65 and 9.7 percent of the total distributed forms, respectively.

These non-valid forms were rejected because they were either not completed, there was more than two answers for one question, or some answers were confusing. It was noticed that the non-valid forms of the shared taxi questionnaire were more than that of the bus. This was because the riders had not completed their answers before the taxi took off.

4.2.3.3 Estimation By Confidence Level

To be familiar with some degree of formulation and structure of valid sampling, the use of statistical technique called confidence interval estimation

Table 4.16
Sample Size for Intercity Bus Trip Routes

Trip Route	Sample Size	No. of Non-Valid Cases	Valid Forms	
			No.	Percent of Total (%)
Nablus / Ramallah	91	7	84	20.5
Nablus / Jenin	110	3	107	26.1
Nablus / Tulkarm	120	9	111	27.1
Nablus / Qalqilia	51	1	50	12.2
Nablus / Salfit	17	0	17	4.1
Ramallah / Jenin	10	0	10	2.4
Ramallah / Tulkarm	10	0	10	2.4
Ramallah / Qalqilia	7	0	7	1.7
Ramallah / Salfit	4	0	4	1.0
Tulkarm / Jenin	4	0	4	1.0
Tulkarm / Qalqilia	6	0	6	1.5
Total	**430**	**20**	**410**	100.0

Table 4.17
Sample Size for Intercity Shared Taxi Trip Routes

Trip Route	Sample size	No. of Non-Valid Cases	Valid Forms	
			No.	Percent of Total
Nablus / Ramallah	45	3	42	26.6
Nablus / Jenin	52	6	46	29.1
Nablus / Tulkarm	44	7	37	23.4
Nablus / Qalqilia	24	1	23	14.6
Nablus / Salfit	10	0	10	6.3
Ramallah / Jenin	N/A			
Ramallah / Tulkarm	N/A			
Ramallah / Qalqilia	N/A			
Ramallah / Salfit	N/A			
Tulkarm / Jenin	N/A			
Tulkarm / Qalqilia *				
Total	**175**	**17**	**158**	**100.0**

* = Based on the proportional distribution of trip passengers, the number of questionnaires to be distributed was very low (3) questionnaire. Therefore, no questionnaire was distributed for this route.

N/A : There is no regular intercity shared taxi service

was made. The Bernoulli Theorem (Greenshields and Weida, 1978), as an appropriate tool to determine the survey size, was used in this survey to estimate the degree of confidence interval. The theorem suggests that a certain number of observation (n_0) will give a certain confidence level ($1-\alpha$) that a certain degree of error (e) will not be exceeded. Bernoulli's Theorem is given by the following equation:

$$n_0 = (1+e) / e^2 (\ln (1/\alpha)) + 1/e$$

Where, n_0 = minimum sample size

e = the standard error

$1-\alpha$ = confidence level

By applying the above equation to the sample size of this study, it was found that the 568-sample size represents a 95 percent confidence level and 7.5 percent standard error. Therefore, these results were acceptable.

originated at Salfit City. Figure 5.1 shows the ridership demand between the six cities in the study region. and the 22 bus service routes.

5.2.3 Population

It is expected that the origin and destinated population have some relation with ridership demand. As the origin population increases, the bus ridership demand will increase. Therefore, the origin and destination population variables were studied in this research.

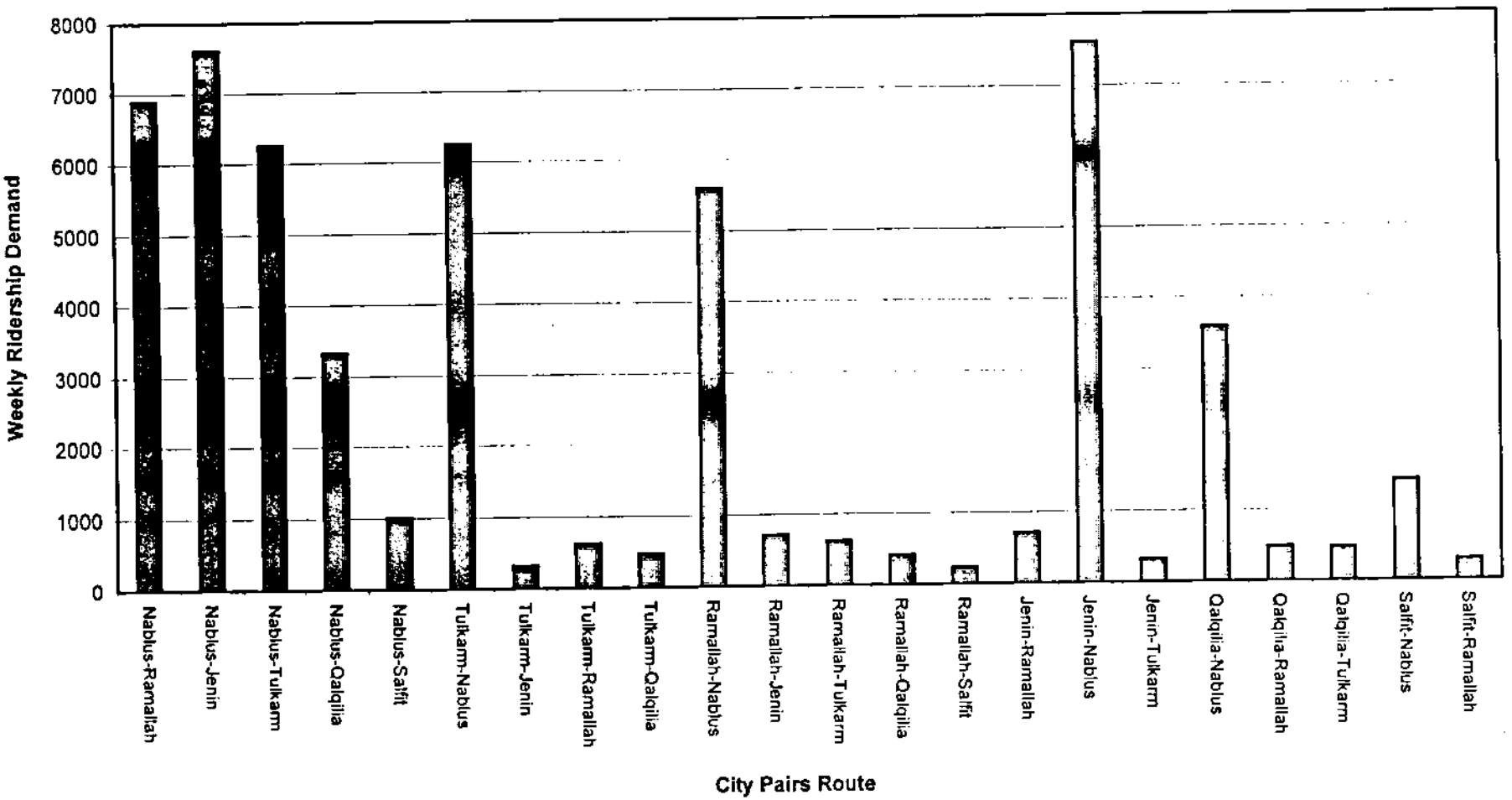
The distribution of population by Governorate of the study area showed that Nablus Governorate has the largest population (278,317) while Salfit Governorate has the smallest population (52,029). Figure 5.2 illustrates the population per Governorate.

5.2.4 Employment

The employment is expected to be one of the important variables affecting the ridership demand. Labors were expected to travel from the city, which has small employment level to the city which has higher employment level.

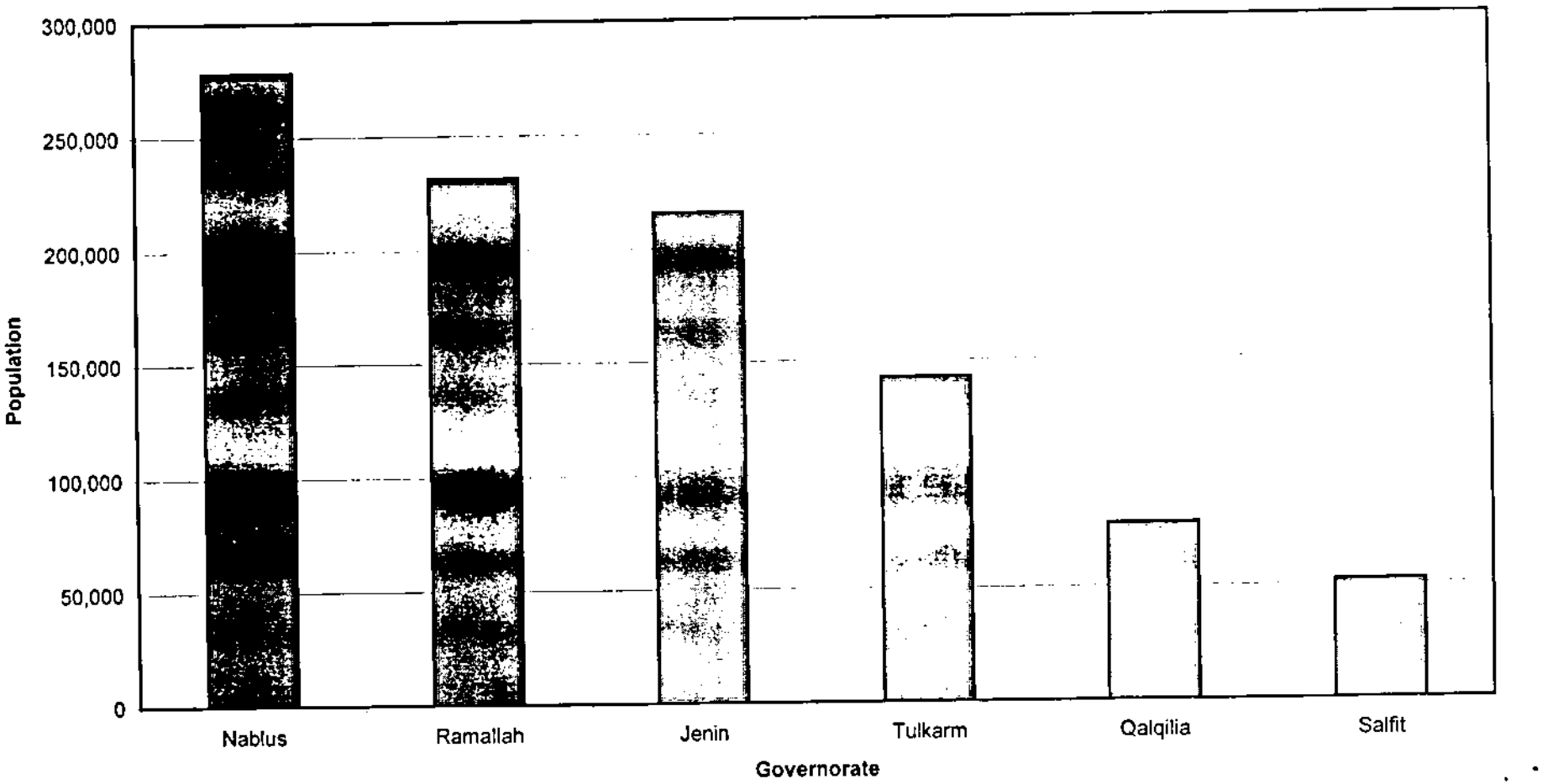
Based on the PCBS reports, the population of 15 years or older were divided into two groups; inside the economically active and outside the economically active.

Figure 5.1
Intercity Bus Ridership



Source: Bus Companies' Operators

Figure 5.2
Population Distribution Per Governorate



Source: Final Results, Population Report, West Bank, by PCBS, 1999.

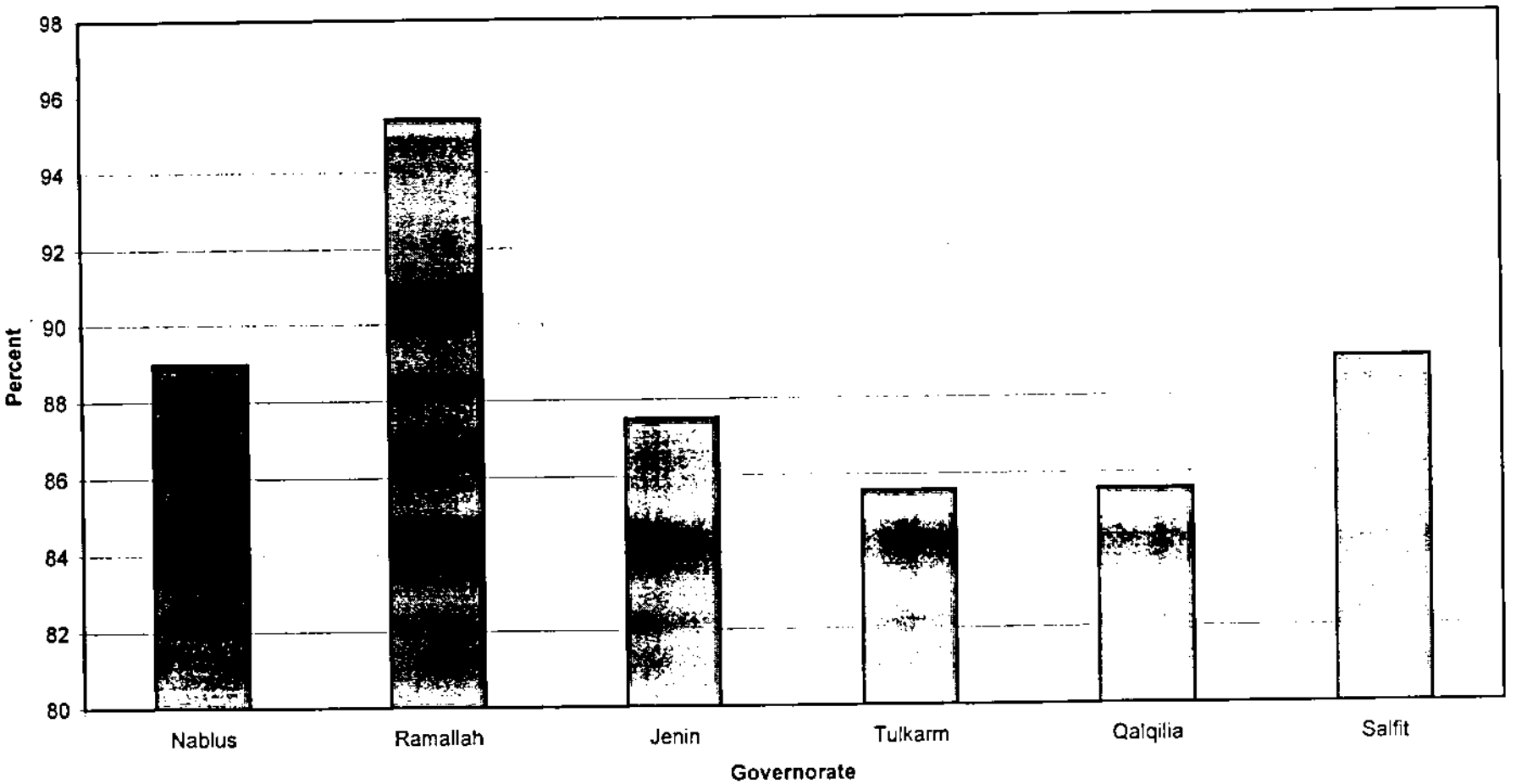
When considering the economically active status group, there were two groups; employed and unemployed. It was noticed that Ramallah Governorate has the largest employment percent (95.4%), while Tulkarm and Qalqilia Governorates have the lowest employment percent (85.6%). Figure 5.3 shows the percent employment per governorate.

5.2.5 Expenditure

The average monthly expenditure of the family is considered one of the variables that may influence ridership demand. Low expenditure communities are expected to use low cost transportation modes, such as buses, more than those of high expenditure who use more expensive transportation modes, such as shared taxis and private automobiles.

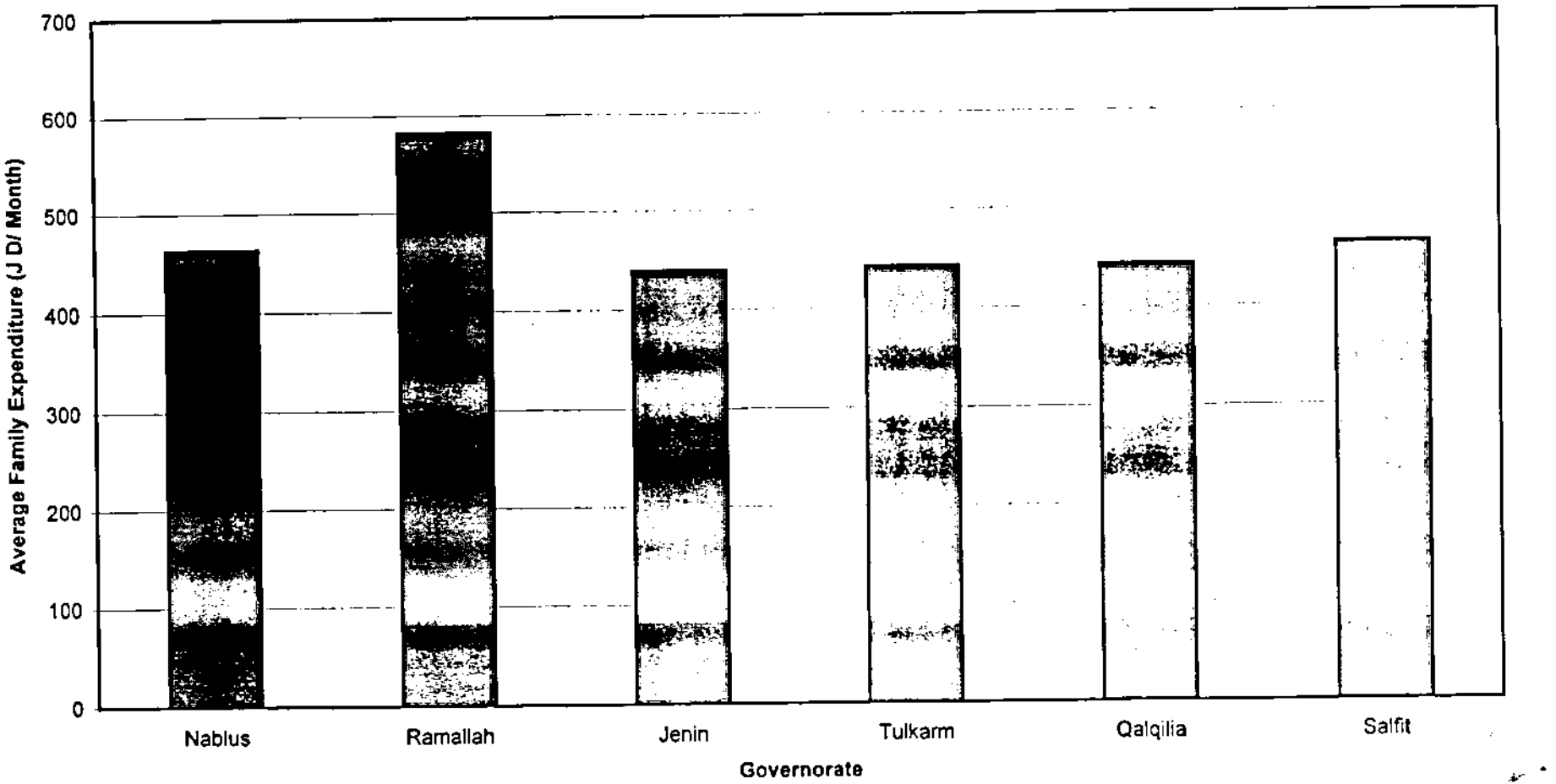
According to PCBS, "The Palestinian Expenditure and Consumption Survey" was considered as the main source for the average family expenditure factor. It was noticed that Ramallah Governorate has largest average family expenditure (583 JD per month) while Jenin Governorate has the lowest family expenditure (440 JD per month). Figure 5.4 shows the average family expenditure in Jordanian Dinars per Governorate.

Figure 5.3
Percent Employment Per Governorate



Source: Labor Force Survey; Main Findings, by PCBS, 1999 and 2000

Figure 5.4
Average Family Expenditure Per Governorate



Source: Expenditure and Consumption Levels, by PCBS, 1999 and 2000.

5.2.6 Auto Ownership

The total number of auto ownership is expected to be one of the important variables affecting the ridership demand. Communities with high auto ownership are expected to make more trips using automobiles than those with low autos.

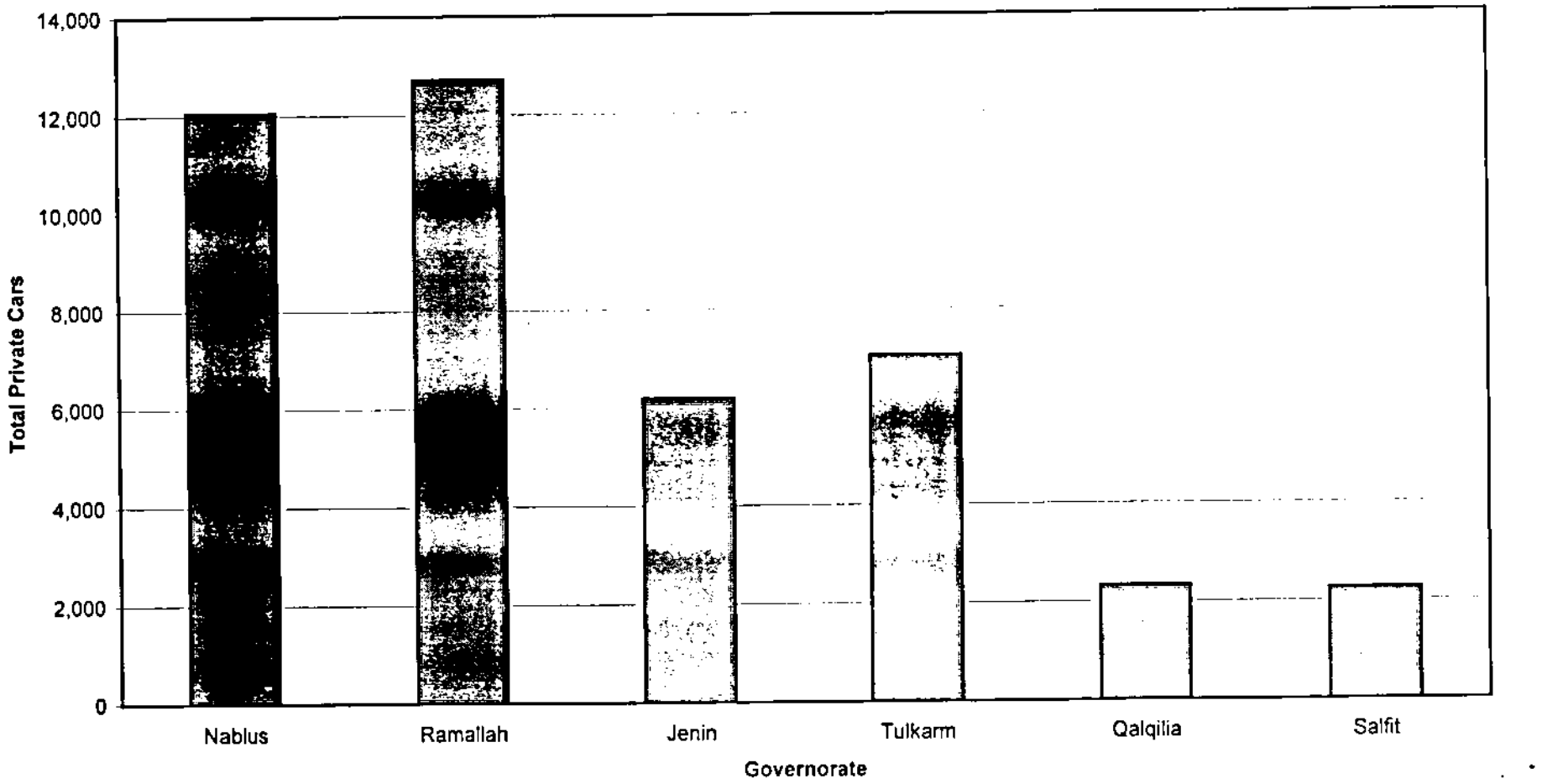
Based on the PCBS source, "Transportation in the Palestinian Territory Report", it was found that Ramallah Governorate has the highest total number of private cars (12,715 cars). Salfit Governorate has the lowest number of private cars (2,259 cars). Figure 5.5 shows the total number of private cars per Governorate.

5.2.7 Trip Length

The trip length is considered as a variable that may influence ridership demand. Communities are expected to make more trips of different purposes to the neighboring communities than to the far away communities.

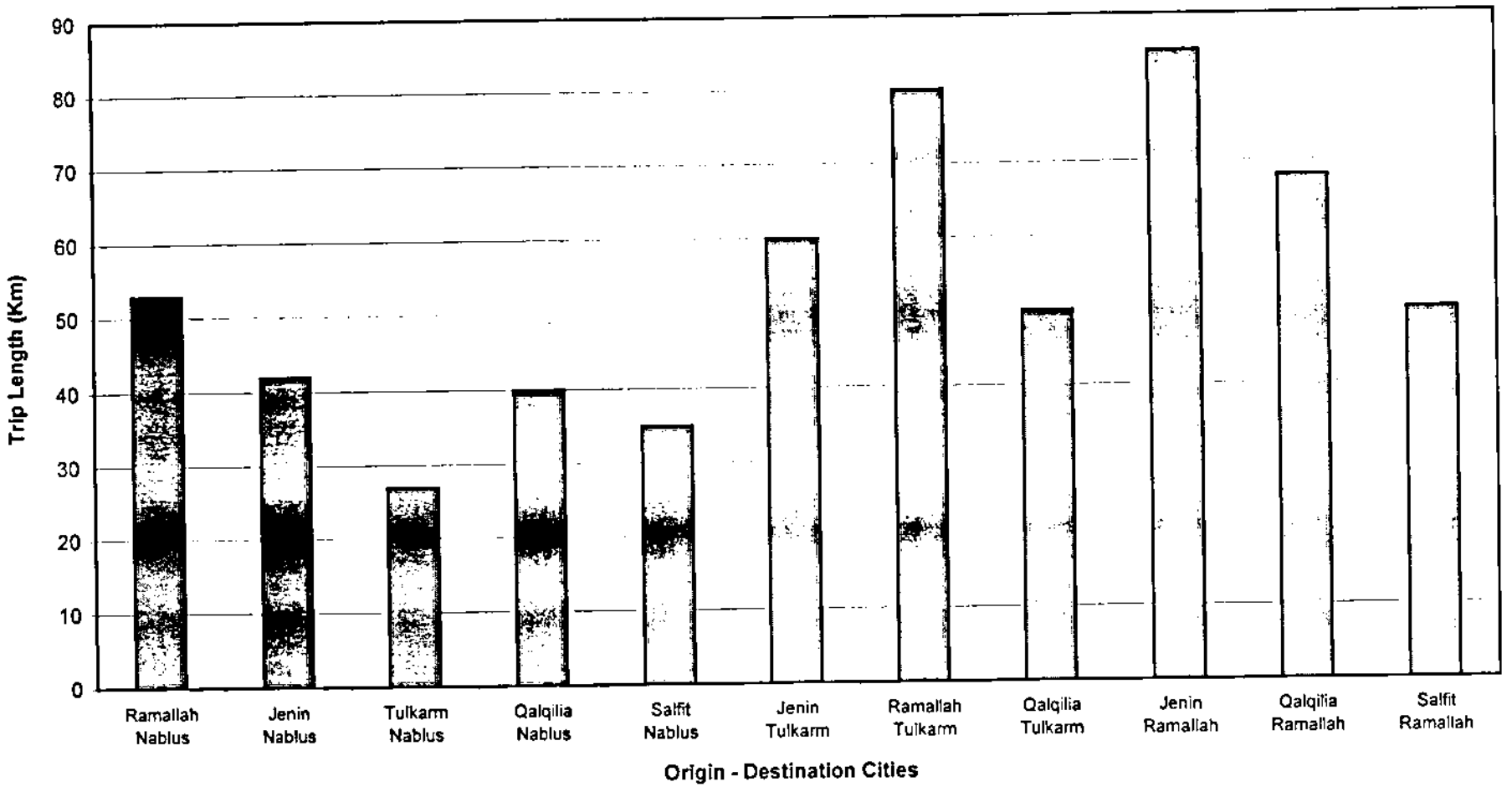
According to the West Bank map and the bus companies' operators, the longest bus trip length was between Jenin and Ramallah Cities (80 Km). The shortest bus trip length was between Nablus and Tulkarm Cities (27 Km). Figure 5.6 shows the trip length between all origin and destination cities within this study.

Figure 5.5
Total Private Cars Per Governorate



Source: Transportation and Communication Statistics in the Palestinian Territories, by PCBS, 1999

Figure 5.6
Intercity Bus Routes Trip Length



Source: Bus Companies' Operators

5.2.8 Travel Time

Similar to trip length, travel time is expected to affect the ridership demand. Riders are expected to make more short time trips to the neighboring communities than long travel time trips.

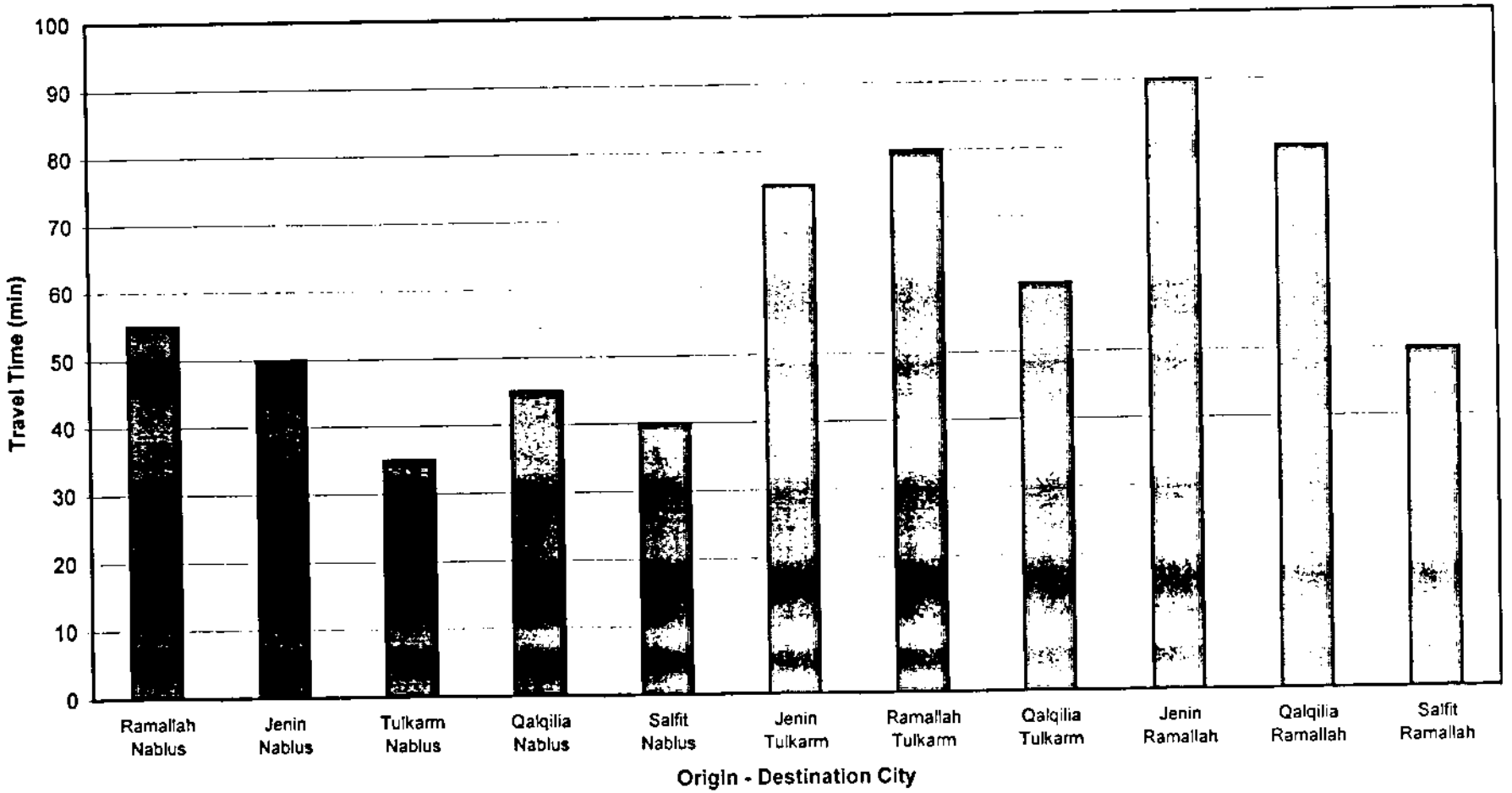
Based on the bus companies' operators, the longest travel time was between Jenin and Ramallah Cities (about 90 minutes). Also, the shortest bus trip was between Nablus and Tulkarm Cities (35 minutes). Figure 5.7 shows the travel time between the origin and destination cities in this study.

5.2.9 Bus Fare

The bus fare is expected to be one of the most influential factors that affect ridership demand. Riders are expected to make more low fare trips. On the other hand, they are expected to make a limited number of trips to the far places with higher fare.

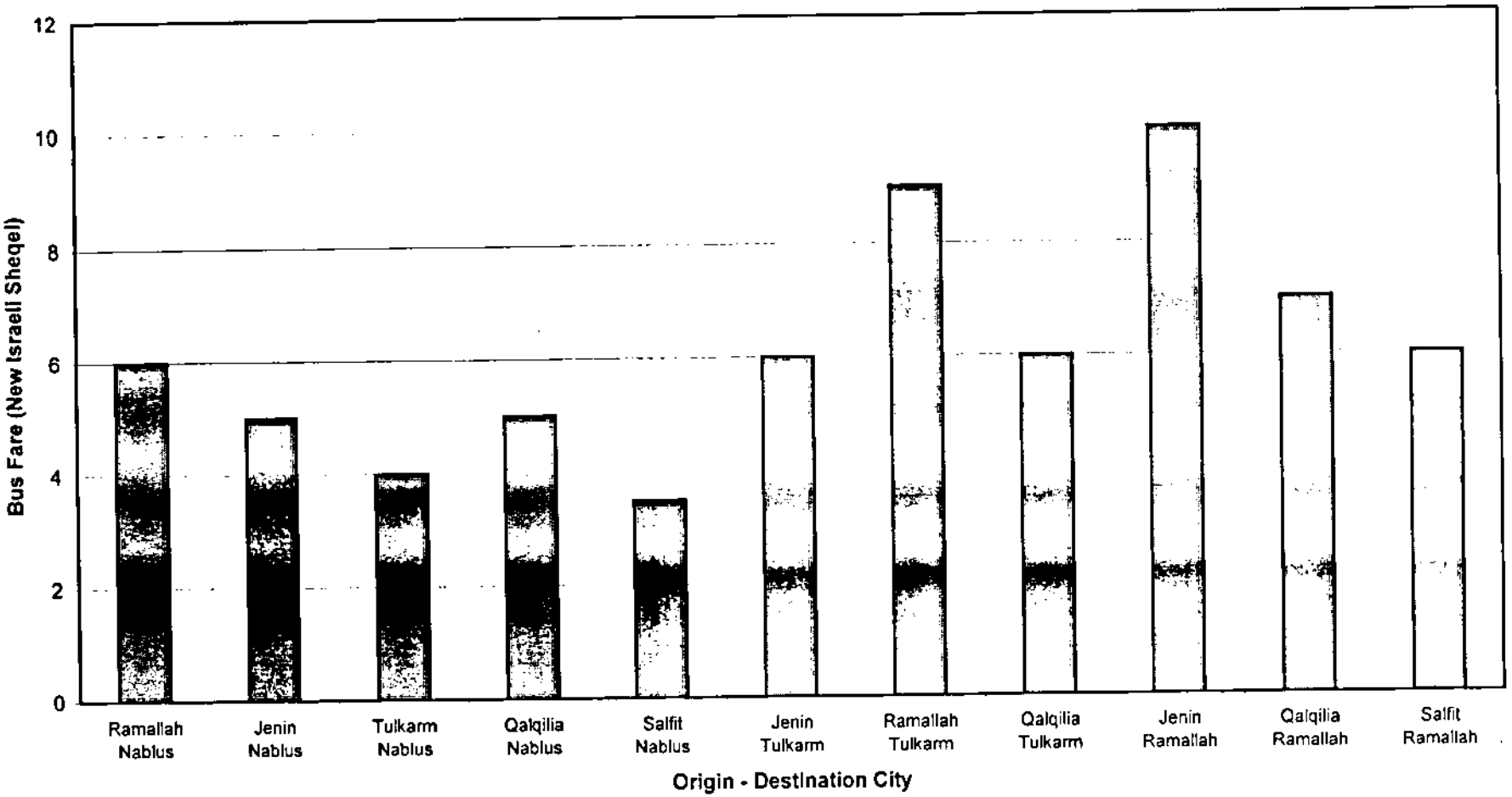
Based on the bus companies' operators, the highest bus fare was between Jenin and Ramallah Cities (10.0 New Israeli Sheqel). Also, the cheapest bus fare was between Nablus and both Tulkarm and Salfit Cities (4.0 New Israeli Sheqel). Figure 5.8 shows the bus fare between all origin and destination cities in this study.

Figure 5.7
Intercity Bus Routes Travel Time



Source: Bus Companies' Operators

Figure 5.8
Intercity Bus Fare



Source: Bus Companies' Operators

5.2.10 Average Weekly Bus Trips (Frequency)

The frequency of bus trips is expected to influence the ridership demand. Riders are expected to make more trips when the trip frequency is high. Conversely, they are expected to make a limited number of trips when trip frequency is low.

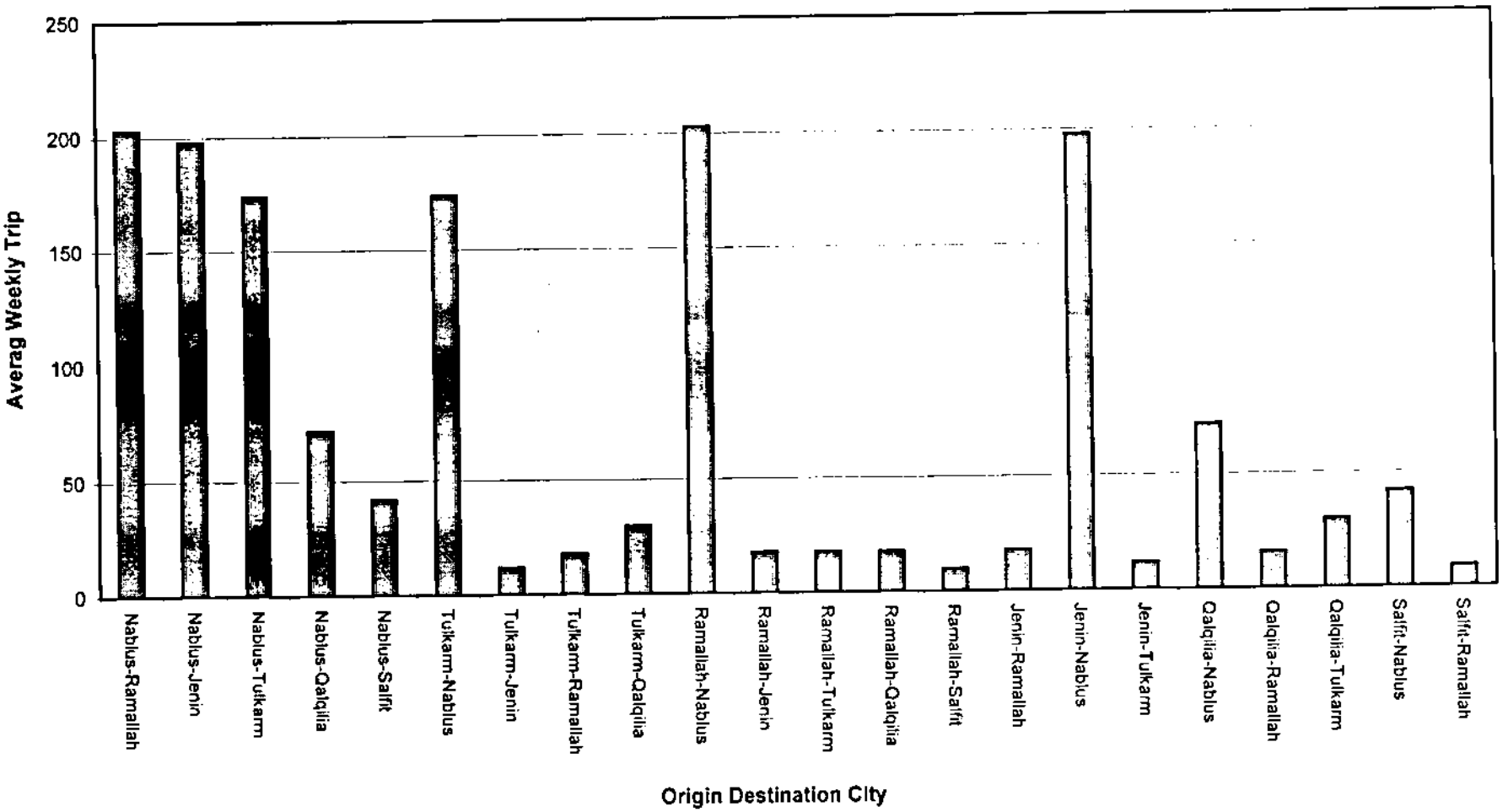
Based on the bus companies' operators, the highest average weekly bus trips were between Nablus and Ramallah Cities (203 bus trip). The least average weekly bus trips were between Ramallah and Salfit Cities (9 bus trips). Figure 5.9 shows the average weekly bus trips between all origin and destination cities in this study.

5.3 Intercity Bus Ridership Demand Modeling

5.3.1 Correlation Coefficient Matrix

The main purpose of intercity bus ridership demand modeling is to develop useful relationships between the intercity bus ridership demand and a set of both external (socioeconomic) and internal bus variables. The first step in modeling is the establishment of a statistical correlation matrix among the different variables included in the study. This step is helpful in selecting the independent variables that are highly correlated with the dependent variable and also in checking the possible correlation between any pair of independent variables.

Figure 5.9
Intercity Average Weekly Bus Trips



Source: Bus Companies' Operators

Table 5.2 illustrates the correlation coefficients between each pair of the dependent and the independent variables and between independent variables themselves. As a result of this correlation, one can see the contrast of the strong relations between the dependent and independent variables.

The next step of regression modeling is to find the type of function between the dependent and independent variables such as linear, or non-linear, such as logarithmic, and exponential functions. Trials and testing the types of functions in this study showed that the best relation between the dependent and the independent variables was the linear format.

Based on Table 5.2, the following statistical issues were observed:

1. The highest correlation coefficients between the independent variables and the ridership demand (dependent variable) were for ravel time followed by trip length, bus fare, destination city population, and origin city population, in this order. Also, the least correlation coefficients were observed for the destination city employment percent preceded by origin city employment, student percent in origin and destination cities, and destination city expenditure. On the other hand, the correlation coefficients for origin and destination city auto ownership, and origin city expenditure with bus ridership were moderate to low.

Table 5.2
Correlation Coefficients for 13 Variables

	Ridership Demand	Origin City Pop.	Dest. City Pop.	Origin City Employ.	Dest. City Employ.	Origin City Expend.	Dest. City Expend.	Origin City Private Cars	Dest. City Auto Ownership	City Pairs Trip Length	City Pairs Travel Time	City Pairs Trip Fare	Origin City Student Percent	Dest. City Student Percent
	Y	*X1*	*X2*	*X3*	*X4*	*X5*	*X6*	*X7*	*X8*	*X9*	*X10*	*X11*	*X12*	*X13*
Y	1.00													
X1	0.39	1.00												
X2	0.41	-0.41	1.00											
X3	-0.07	0.48	-0.27	1.00										
X4	-0.02	-0.27	0.48	-0.25	1.00									
X5	-0.15	0.37	-0.26	0.97	-0.27	1.00								
X6	-0.10	-0.26	0.37	-0.27	0.97	-0.29	1.00							
X7	0.26	0.90	-0.45	0.70	-0.33	0.65	-0.33	1.00						
X8	0.29	-0.45	0.90	-0.33	0.70	-0.33	0.65	-0.54	1.00					
X9	-0.55	0.00	0.00	0.29	0.29	0.35	0.35	0.07	0.07	1.00				
X10	-0.56	-0.01	-0.01	0.18	0.18	0.25	0.25	0.02	0.02	0.97	1.00			
X11	-0.45	0.05	0.05	0.29	0.29	0.35	0.35	0.11	0.11	0.95	0.90	1.00		
X12	-0.09	0.04	-0.06	0.02	-0.09	0.12	-0.12	0.27	-0.18	0.08	0.09	0.12	1.00	
X13	-0.07	-0.06	0.04	-0.09	0.02	-0.12	0.12	-0.18	0.27	0.08	0.09	0.12	-0.36	1.00

2. The independent variables' correlation coefficients with each other had contrasting values. The high correlation coefficients (above 89%) between the independent variables were as follow. It was clear that there is a strong and obvious correlation between these variables.

- Between the destination city population and the destination city auto ownership.
- Between the origin city percent of employment and the origin city average monthly family expenditure.
- Between the destination city percent of employment and the destination city average monthly family expenditure.
- Between the travel time the trip length; between travel time and the bus fare; and between trip length and bus fare.
- Finally, it was found that origin city population and origin city auto ownership were also highly correlated.

Referring to the previous two points, the selected independent variables were chosen according to the following two criteria:

- Have a strong correlation coefficient with the dependent variable
- Independent variables with high correlation between themselves were either joined together as one variable such that the chosen variable has a stronger correlation coefficient with the dependent variable, or eliminated.

Based on these two criteria, the 13 variables were shorthanded into five variables as follows:

- The first variable was the origin city population in thousands.
- Destination city population in thousands was the second variable.
- The third variable was the bus fare in (NIS).
- The fourth variable is the percentage of student who are attending secondary school or university in the origin city
- The fifth variable is the percentage of people older than 15 years who are employed in the origin city.

The fourth and the fifth variables indicate groups with trip purposes, education or work, which were the highest trip purposes as depicted from the questionnaire results, as will be discussed later. Therefore, these two variables reflect the main two bus riders groups (employees and students).

The correlation coefficient matrix of these new variables is shown in Table 5.3

The following model was tested for the 22 intercity bus routes using multiple linear regression analysis :

Table 5.3
Correlation Coeficients for the Five Model Variables

	Y	*D1 = (X1/1000)*	*D2 = (X2/1000)*	*D3 = (X11)*	*D4 = (X12)*	*D5 = (X3)*
Y	1.00					
X1/1000	0.39	1.00				
X2/1000	0.41	-0.41	1.00			
X11	-0.45	0.05	0.05	1.00		
X12	0.25	0.46	-0.25	-0.17	1.00	
X3	0.28	0.47	-0.20	-0.32	0.25	1.00

$$Y = a_0 + a_1 D_1 - a_2 D_2 + a_3 D_3 + a_4 D_4 + a_5 D_5$$

Where, Y = The weekly bus ridership between the origin and destination cities

D_1 = Origin city population (in thousand)

D_2 = Destination city population (in thousand)

D_3 = Bus fare (in NIS)

D_4 = Percentage of student in the origin city

D_5 = Percentage of employees in the origin city

The multiple linear regression analysis was applied to the above equation, to determine the calibration coefficients. The calibration coefficients a_0, a_1, a_2, a_3, a_4, and a_5 were 1084.8, 26.8, 25.7, -813, 80.3, and 68.3, respectively. The correlation coefficient, R^2, for the above equation was 0.82.

The analysis of t-test and significance level indicated that variables D_1, D_2, and D_3 had a good significance with t-statistics of 5.32, 6.32, and –4.73, respectively. Furthermore, the significance of D_4 and D_5 was not as high, with a t-test values of 1.58 and 1.12, respectively as shown in Appendix (II).

Table 5.4 shows the comparison between the observed and the predicted ridership demand using the above model. Also, Figure 5.10 shows the comparison between the predicted and observed intercity bus ridership demand.

It was noticed from Table 5.4 that the expected ridership demand for most city pairs were generally accepted, except those routes from or to Tulkarm and Salfit. The model underestimated ridership from/ to Tulkarm (except Tulkarm – Jenin). This might be explained by a combination of factors such as the moderate population, low employment, and the observed demand originated from Tulkarm to the other cities (except Nablus) was relatively small compared to other cities in the study.

The other estimated ridership from Salfit to Nablus and vice versa might be explained by the fact that Salfit is the smallest Governorate in terms of population. Also, difference between bus fare and taxi fare for Nablus – Salfit trips (3.5 and 4.5 NIS, respectively) was marginal. Therefore, the incentive to use buses is low compared to other trip routes. Furthermore, the employment percentage for this Governorate, which was reported by PCBS publication was taken to be the same as employment for Nablus Governorate. This obviously over states for Salfit employment level. As a result of all these factors, the model overestimated bus ridership to and from Salfit.

Table 5.4
Comparison Between the Observed and Predicted Weekly Ridership Demand

Origin City	Destin. City	D_1	D_2	D_3	D_4	D_5	Y_0	Y_P	Percent Differ.
Nablus	Ramallah	278.32	231.69	6.00	36.0	42.20	6,900	5,871	-14.9
	Jenin	278.32	216.13	5.00	36.0	42.20	7,614	6,284	-17.5
	Tulkarm	278.32	142.87	4.00	36.0	42.20	6,263	5,213	-16.8
	Qalqilia	278.32	78.03	5.00	36.0	42.20	3,330	2,734	-17.9
	Salfit	278.32	52.03	3.50	36.0	42.20	1,008	3,285	225.9
Tulkarm	Nablus	142.87	278.32	4.00	36.3	36.40	6,263	5,875	-6.2
	Jenin	142.87	216.13	6.00	36.3	36.40	330	2,650	703.0
	Ramallah	142.87	231.69	9.00	36.3	36.40	630	611	-3.0
	Qalqilia	142.87	78.03	6.00	36.3	36.40	480	250	-47.9
Ramallah	Nablus	231.69	278.32	6.00	35.0	39.50	5,600	6,133	9.5
	Jenin	231.69	216.13	10.00	35.0	39.50	720	850	18.1
	Tulkarm	231.69	142.87	9.00	35.0	39.50	630	212	-66.3
	Qalqilia	231.69	78.03	7.00	35.0	39.50	425	171	-59.8
	Salfit	231.69	52.03	6.00	35.0	39.50	240	316	31.7
Jenin	Ramallah	216.13	231.69	10.00	34.2	37.90	720	930	29.2
	Nablus	216.13	278.32	5.00	34.2	37.90	7,614	6,702	-12.0
	Tulkarm	216.13	142.87	6.00	34.2	37.90	330	2,408	629.7
Qalqilia	Nablus	78.03	278.32	5.00	33.6	36.40	3,600	3,177	-11.8
	Ramallah	78.03	231.69	7.00	33.6	36.40	495	352	-28.9
	Tulkarm	78.03	142.87	6.00	33.6	36.40	480	120	-75.0
Salfit	Nablus	52.03	278.32	3.50	34.5	42.20	1,418	2,962	108.9
	Ramallah	52.03	231.69	6.00	34.5	42.20	300	202	-32.7

Y_0 = Observed Weekly Ridership Demand

Y_P = Predicted Weekly Ridership Demand

Percent Differ. = (Predicted demand - Observed demand) / Observed demand X 100

D_1 = Origin city population in thousands

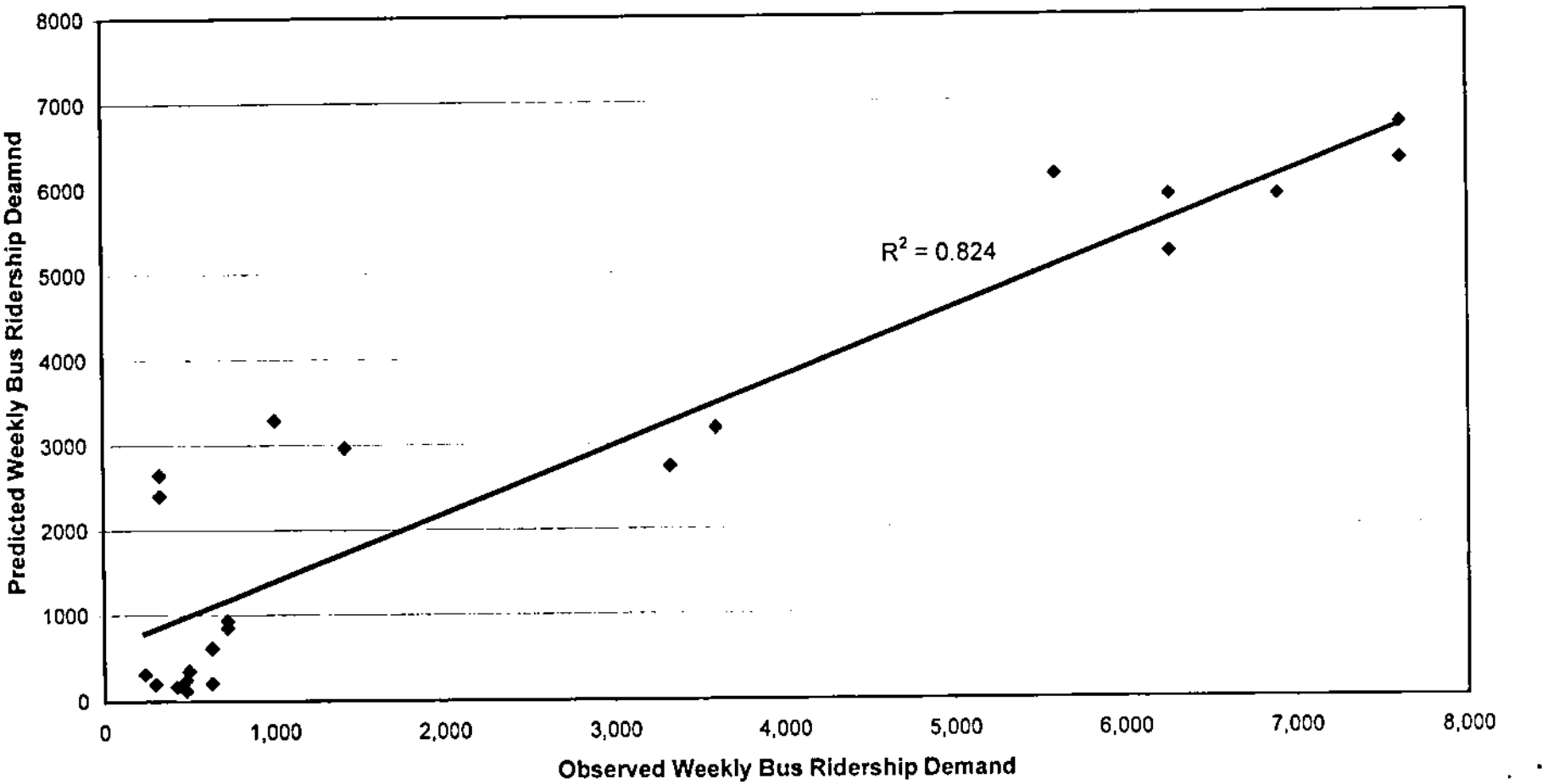
D_2 = Destination city population in thousands

D_3 = Intercity Bus Fare (in Sheqel)

D_4 = Percentage of students in origin city

D_5 = Percentage of employees in origin city

Figure 5.10
Estimated Demand Versus Actual (Observed) Demand



5.4 Statistical Analysis of Ridership Questionnaire

The sample survey size of this research was about 568, such that there were 410 samples for intercity bud riders and 158 samples for intercity shared taxi riders, as mentioned in the previous chapter.

The results of the two questionnaires for bus riders and shared taxi riders are shown in Appendix (III).

5.4.1 The Rider's Job

Based on the statistical analysis of the two questionnaires, it was found that for both the intercity bus service and the shared taxi, most bus commuters were students (254 out of 410 (61.95%) and 104 out of 158 (65.82%), respectively), as shown in Figure 5.11.

5.4.2 The Rider's Age

It was found that the largest riders age group was between 21 to 30 years (217 out of 410 (52.93%) and 86 out of 158 (54.43%), respectively), as shown in Figure 5.12.

5.4.3 The Rider's Gender

The statistical analysis of the two questionnaires showed that men rode both the intercity bus service and the shared taxi more than women. Figure 5.13 shows that there were 270 men (65.85%) rode bus compared to 140 women out of 410 (34.15%). On the other hand 108 men (68.35%) rode the shared taxi compared to 50 women out of 158 (31.65%), as shown also in Figure 5.13.

5.4.4 Educational Background

It was also found that most riders have a bachelor degree or study in the university (330 out of 410 (80.49%) and 121 out of 158 (76.85%) for bus and shared taxi, respectively), as shown in Figure 5.14.

5.4.5 Monthly Income

Sampling survey analysis showed that the largest riders' average monthly family income group was between 200 to 400 Jordanian Dinars (146 out of 410 (35.61%) and 65 out of 158 (41.14%) for bus and shared taxi, respectively), as shown in Figure 5.15. The figure showed also that the smallest number of riders average monthly family income group was less than 200 Jordanian Dinars (42 out of 410 (10.24%) and 19 out of 158 (12.03%) for bus and shared taxi, respectively).

Figure 5.13
Intercity Bus and Shared Taxi Riders Gender

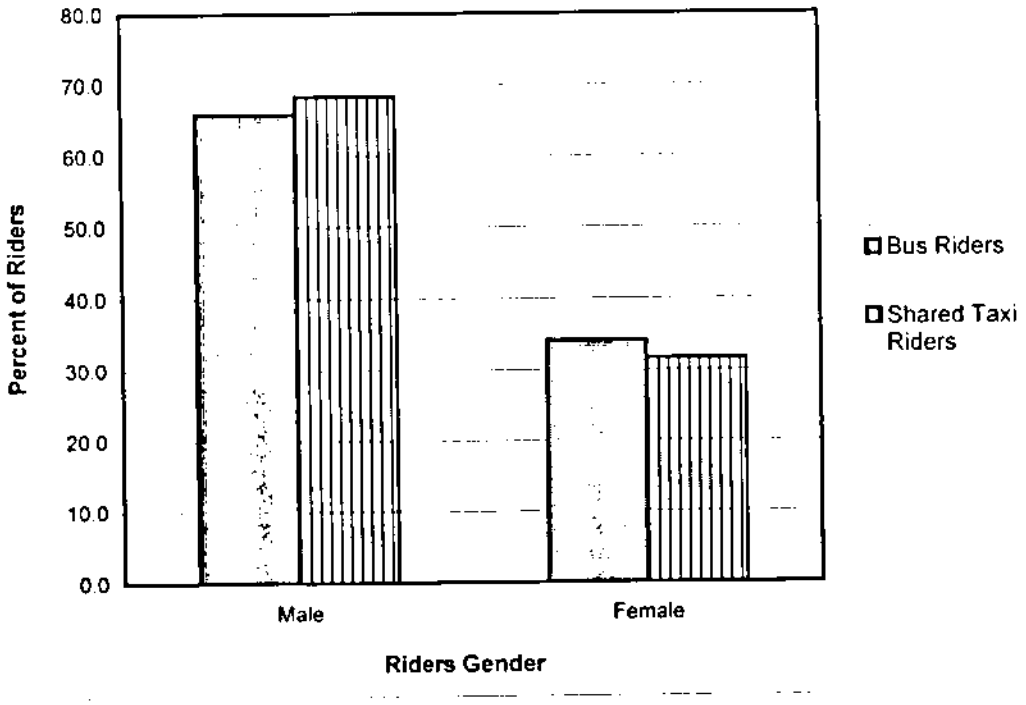
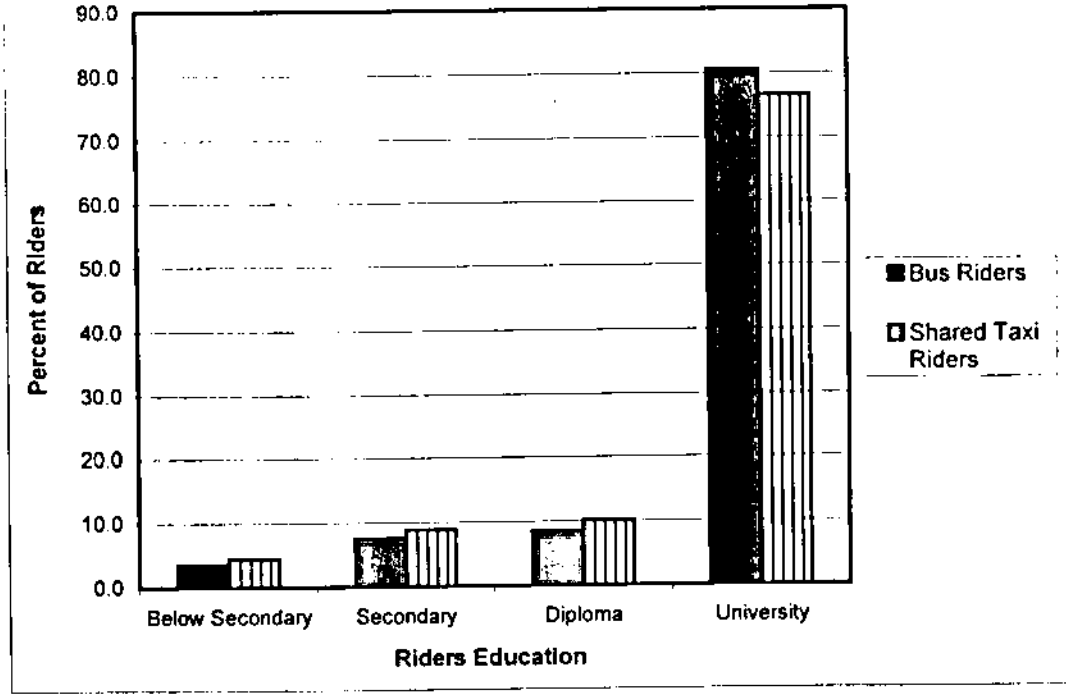


Figure 5.14
Intercity Bus and Shared Taxi Riders Educational Attainment



5.4.6 Trip Purpose

Sampling survey statistical analysis for both bus and shared taxi riders showed that most trip purposes were for school or university (245 out of 410 (59.76%) and 98 out of 158 (62.03%), respectively), as shown in Figure 5.16. The figure showed also that least number of trip purposes were for shopping (12 out of 410 (2.93%) and 5 out of 158 (3.16%), respectively).

5.4.7 Auto Ownership

It was found that riders of intercity buses who have private cars were less than those who do not have any (52 out of 410 (12.68%) and 358 out of 410 (87.32%), respectively), as shown in Figure 5.17. For shared taxi service, the riders who have private car were also less than those who do not have (33 out of 158 (20.89%) and 125 out of 158 (79.11%), respectively), as shown also in Figure 5.17

5.4.8 Current Preference

As a result of statistical analysis for the sampling survey of intercity bus passengers, the riders preferred to use the bus more than other modes. Their preferences for bus, shared taxi, and their private cars were 307, 78, and 25 out of 410 (74.88%, 19.02%, and 6.10%), respectively, as shown in Figure 5.18.

Figure 5.15
Intercity Bus and Shared Taxi Family Income

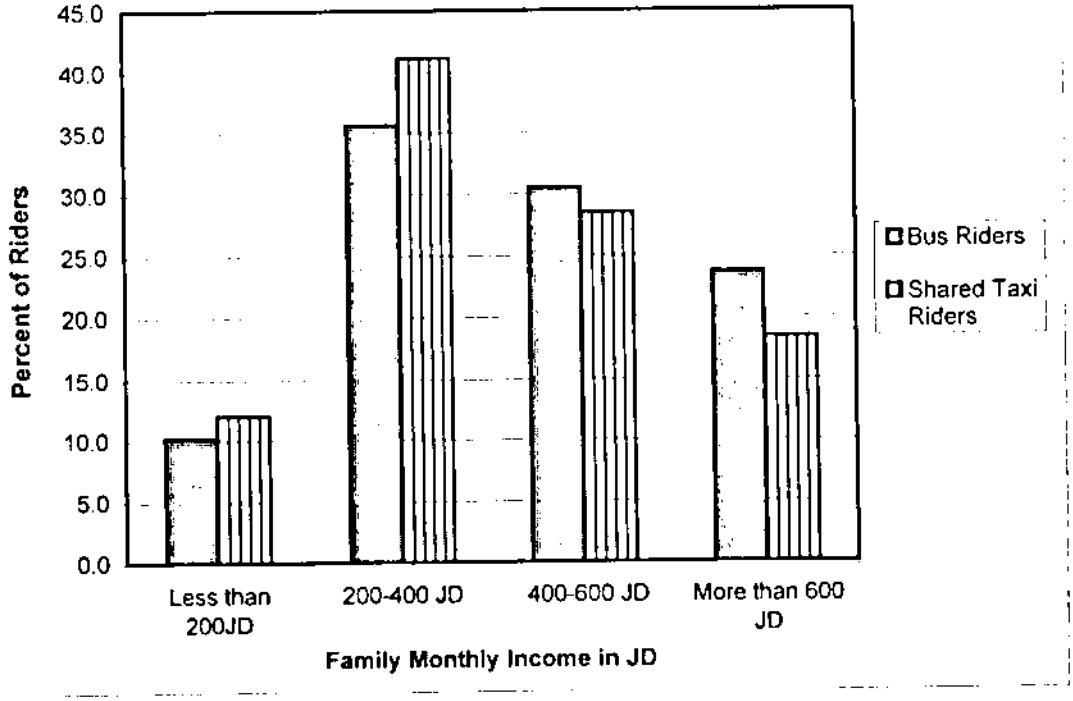


Figure5.16
Intercty Bus and Shared Taxi Riders Trip Purpose

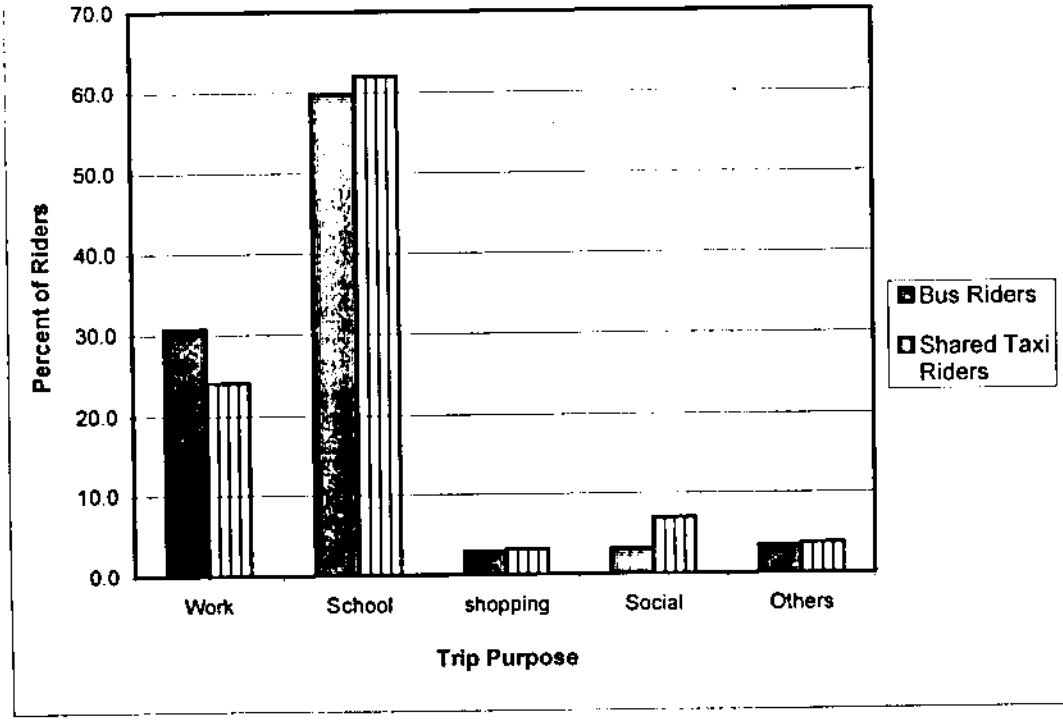


Figure 5.17
Bus and Shared Taxi Riders in Terms of Auto Ownership

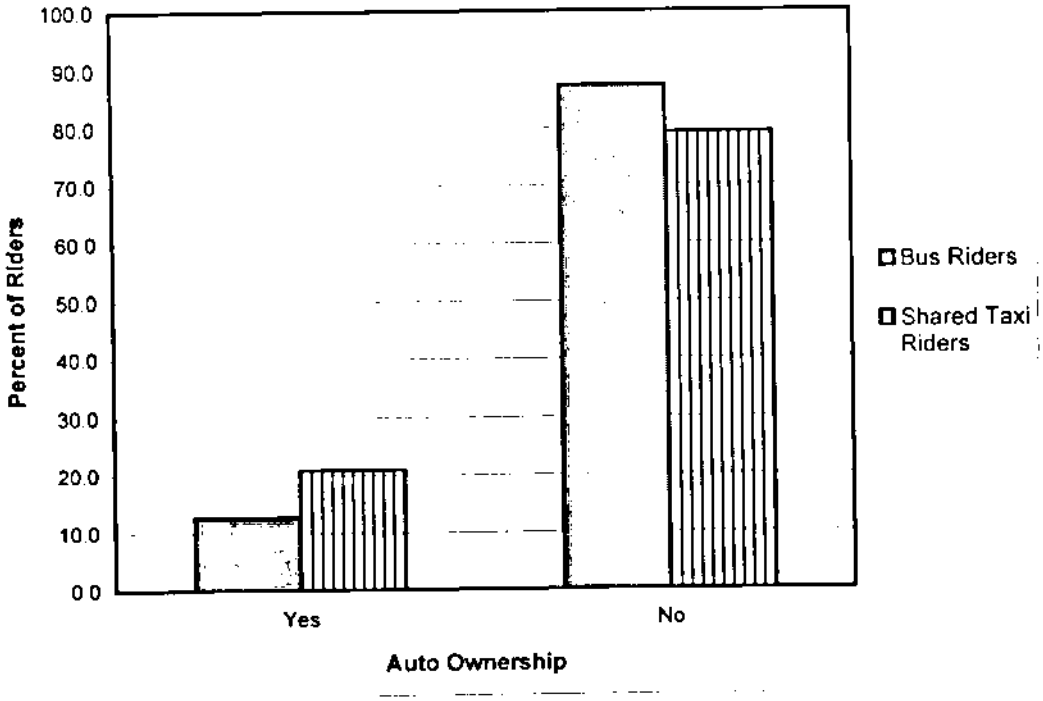


Figure 5.18
Bus and Shared Taxi Riders Current Mode Preference

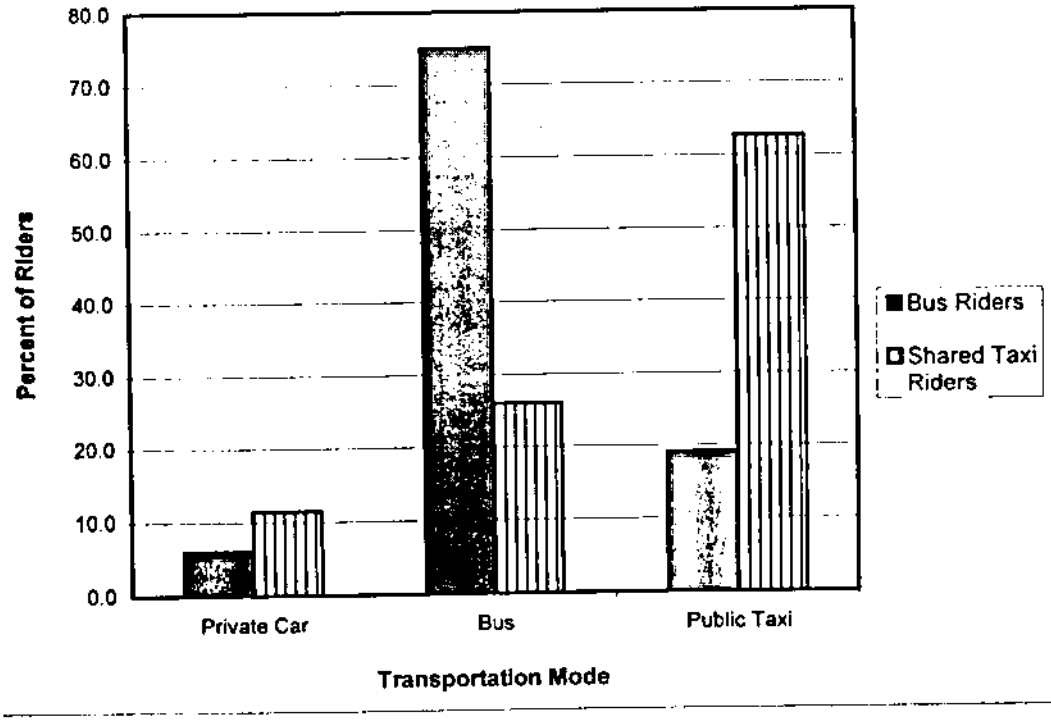


Figure 5.19
Bus Riders Trip Modes

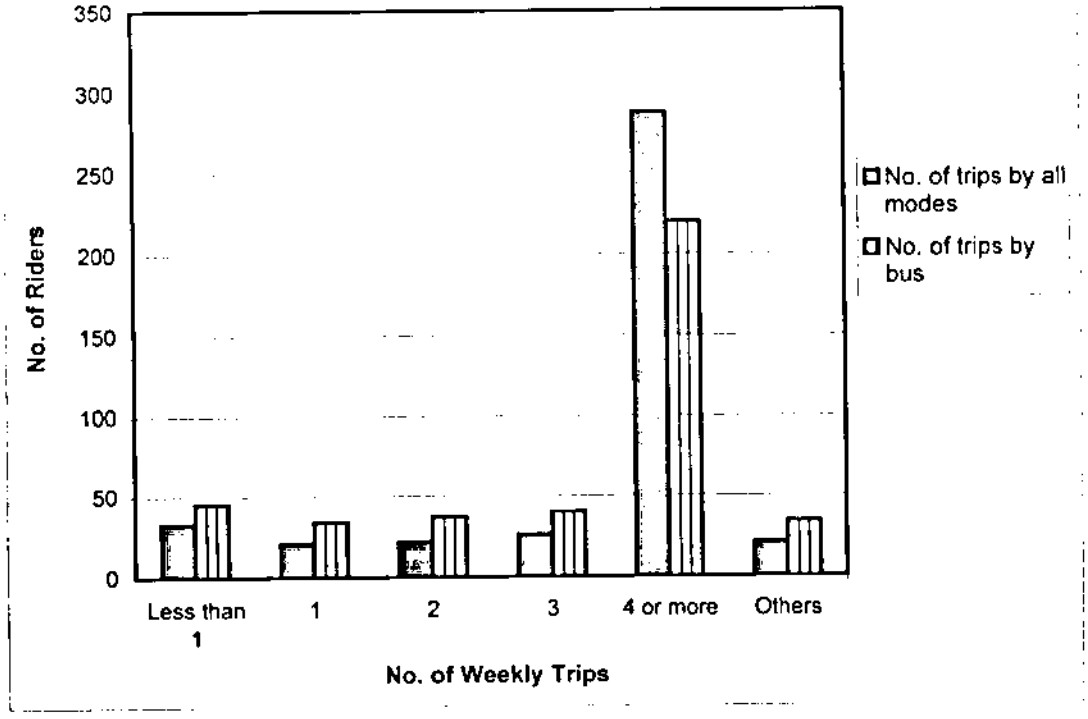
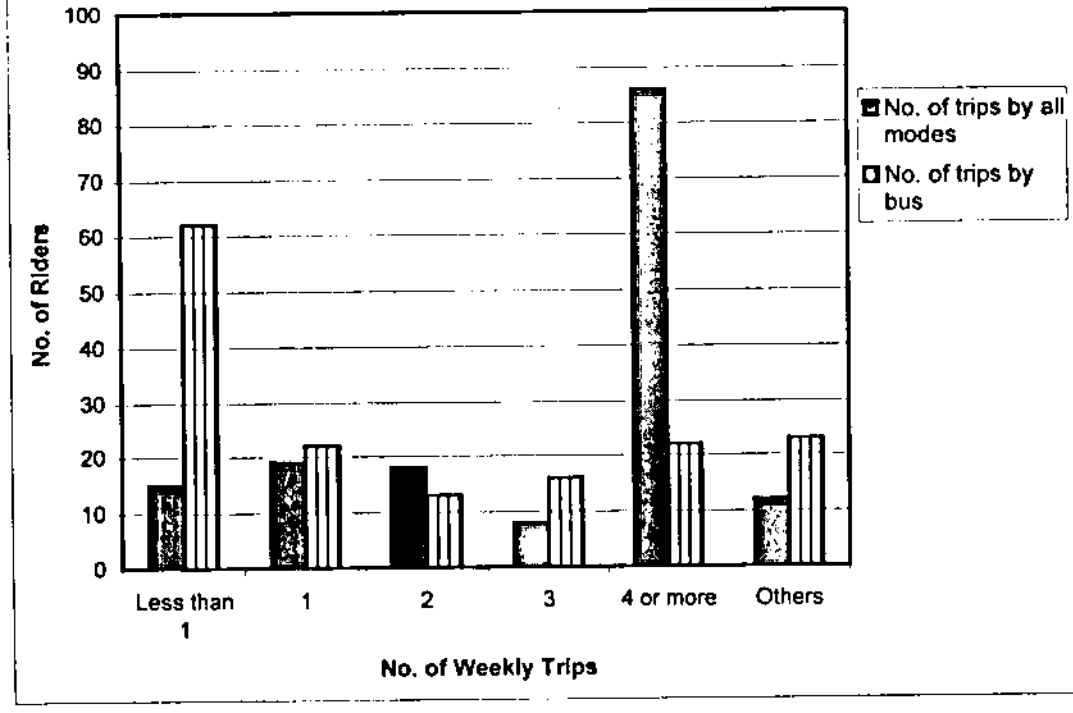


Figure 5.20
Shared Taxi Riders Trips Modes



the same number of weekly trips were 13.29, 10.13, 8.23, 13.92, 39.24, and 14.56, respectively, as shown in Figure 5.20

5.4.10 The Rider's Problems Considering Bus Preference

The statistical analysis for intercity bus service showed that the problems that riders faced while riding the bus were number of bus stops, waiting time, slowness, walking distance to/from the bus station, discomfort, and others (29.78, 28.68, 14.15, 9.68, 8.09, and 9.56 percent, respectively), as shown in Figure 5.21. On the other hand, it was found that for the shared taxi service, the main causes for not riding the bus were waiting time, slowness, number of bus stops, walking distance to/from the bus station, discomfort, and others (28.57, 25.71, 22.29, 5.14, 4.57, and 13.71 percent, respectively), as shown in Figure 5.22.

5.4.11 Reasons for Switching Transportation Modes

Statistical analysis of the intercity bus service questionnaire showed that the main causes that riders preferred to use the bus service were the cost, the safety and comfort, the only mode in their area, the bus route, and others causes (188, 119, 39, 37, and 27 out of 410 riders, respectively), as shown in Figure 5.23.

On the other hand, it was found that for the shared taxi service, the main causes that the riders preferred riding the shared taxi service were speed, comfort, the

Figure 5.21
Bus Riders' Problem for Using a Bus

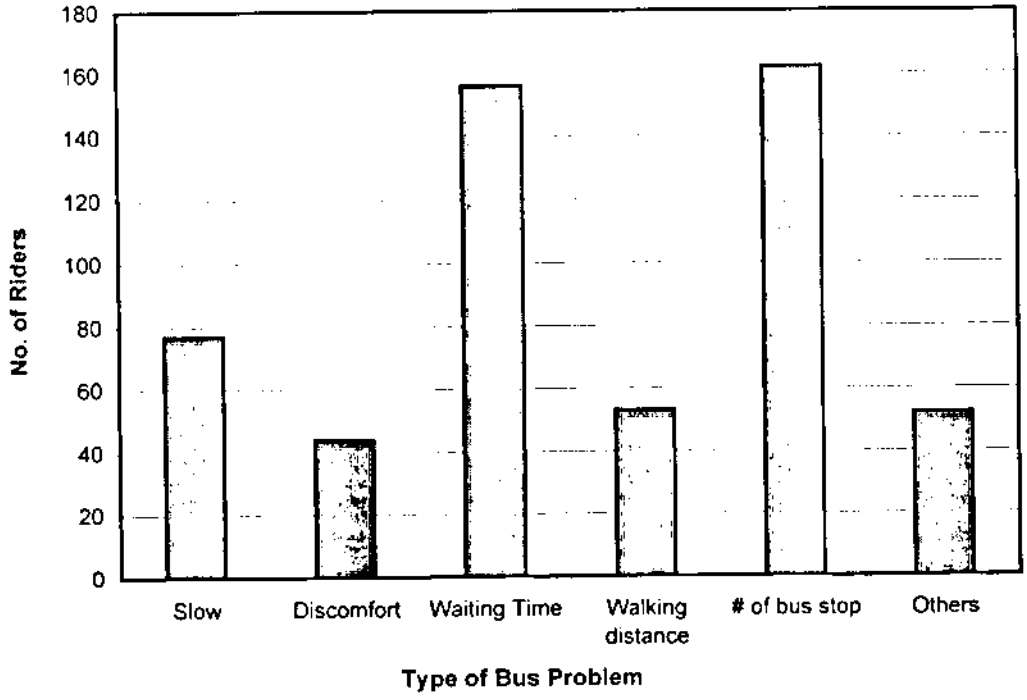
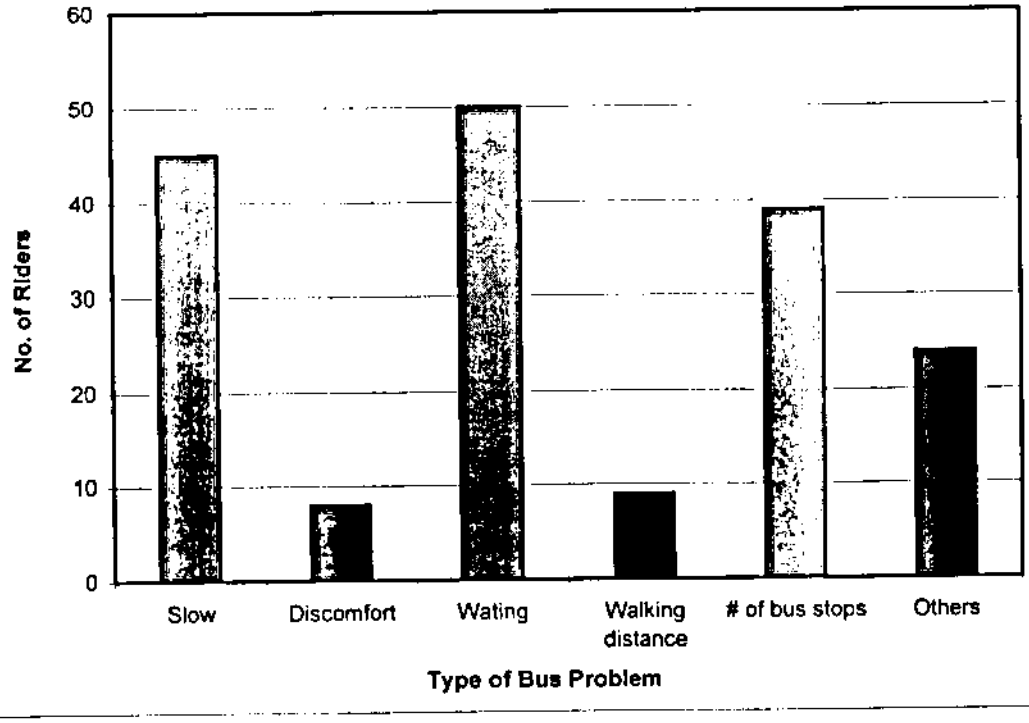


Figure 5.22
Shared Taxi Riders' Reasons for Not Riding a Bus



only mode in their area, others, and trip route (59, 38, 27, 23, and 11 out of 158 riders, respectively), as shown in Figure 5.24.

5.5 Ridership Demand Elasticity

5.5.1 Bus Services Ridership Demand Elasticity

The rider's response towards any change of prices (trip fare) was considered as an indication of the demand elasticity based on fare change. About 188 riders out of 410 riders (45.85 percent) expressed their preference for the bus because of its cost, while the others preferred the bus because of different reasons. These 188 riders were asked for continuing preference to ride the bus if the bus fare increases by 25 percent of the original fare. The riders who were willing to ride the bus, shared taxi, private cars, and other modes were 80, 96, 5, and 7 out of 188 riders, respectively. Also, it was found that if the bus fare increases by 50 percent, the riders who were willing to continue riding the bus, shared taxi, private cars, and other modes were 25, 149, 3, and 11 out of 188 riders, respectively. The unexpected decrease in preference for private cars from 7 to 3 could not be explained except that riders did not understand the question fully. Figure 5.25 shows the possible shift in bus mode because of bus fare increases by 25 percent and 50 percent. Figure 5.26 presents the bus ridership continuing preference for using the bus if bus fare increases. The best fit line of this equation was:

Figure 5.23
Bus Riders Main Reason for Riding Bus

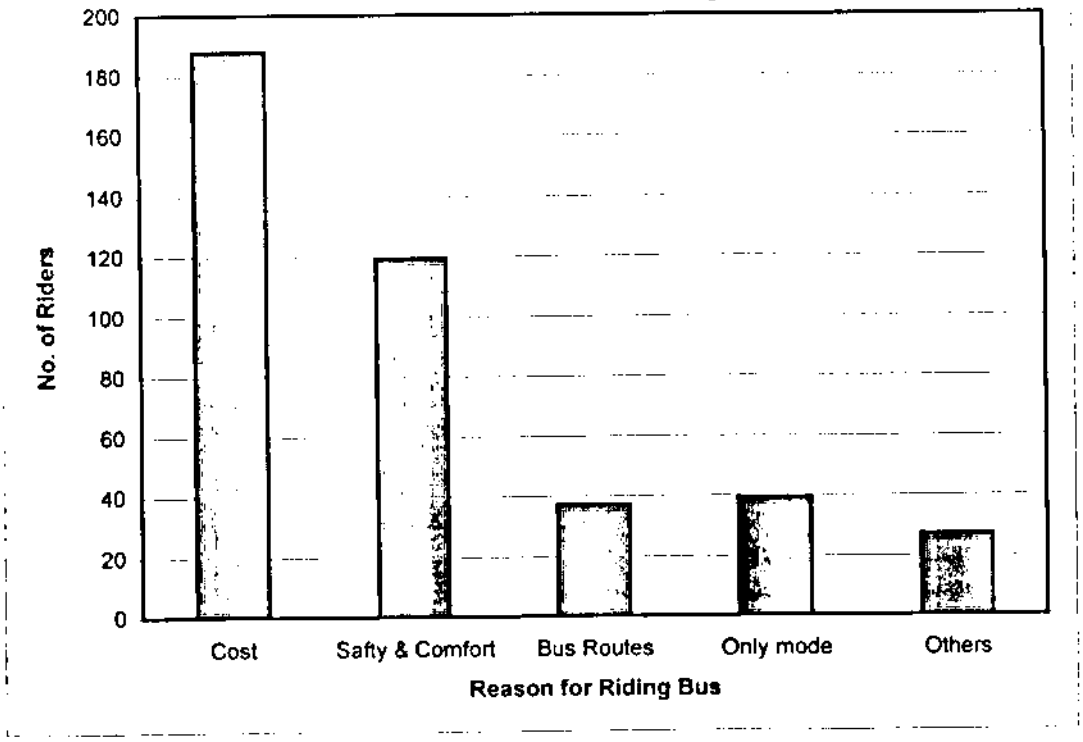


Figure 5.24
Shared Taxi Main Reason for Riding Shared Taxi

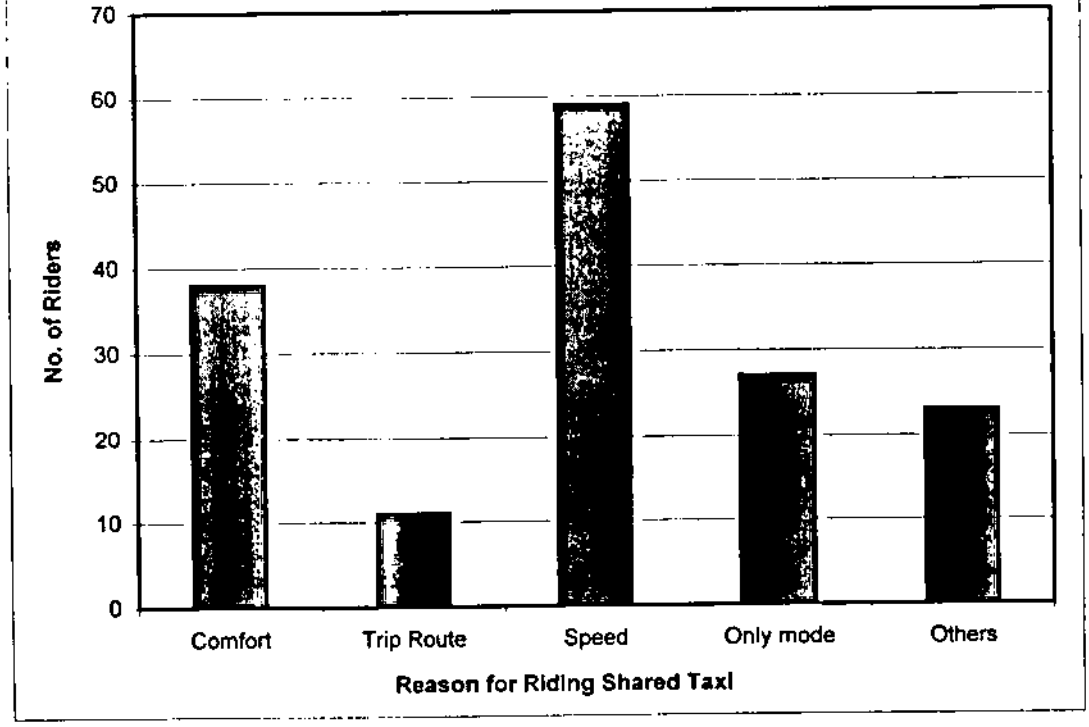


Figure 5.25
Bus Riders Preference for Transportation Mode for Bus Fare Increase

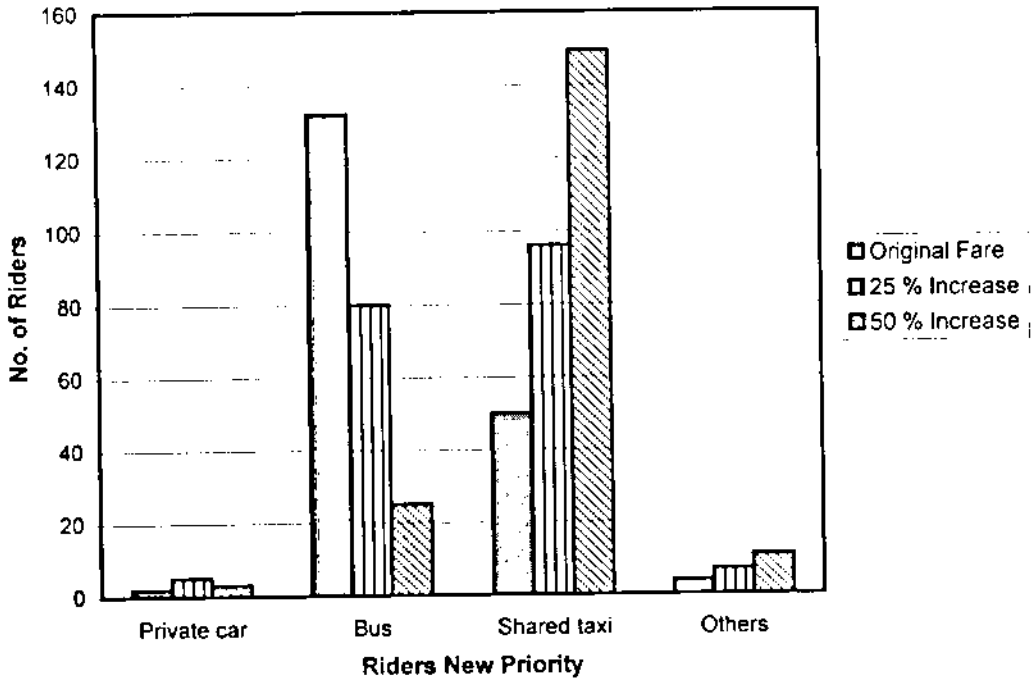
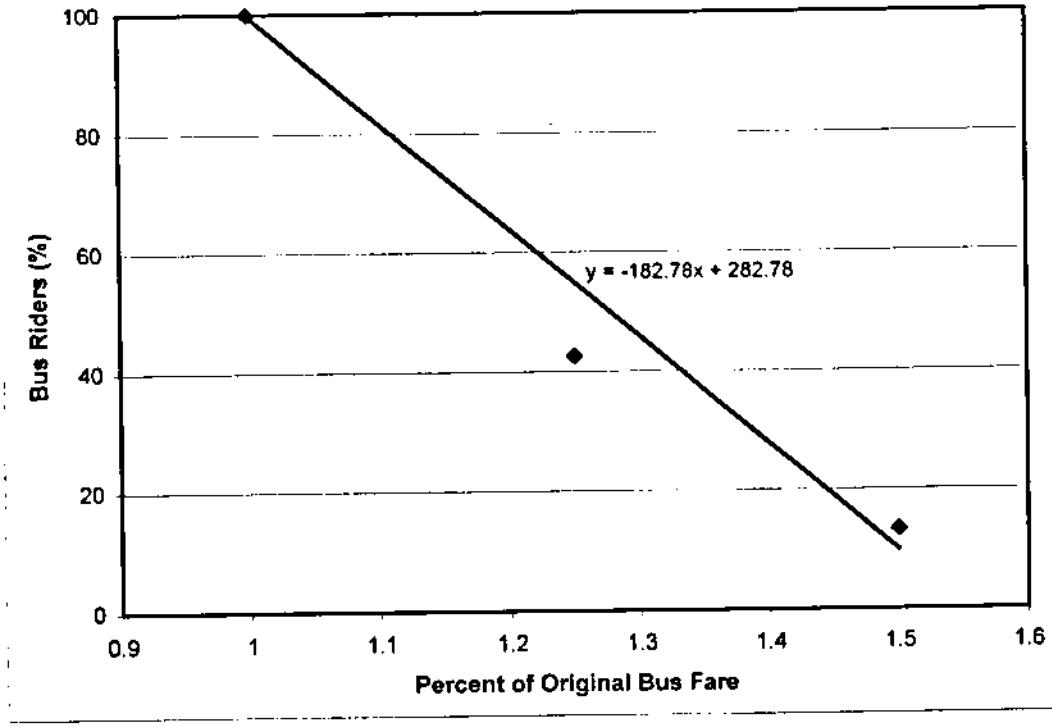


Figure 5.26
Bus Riders Elasticity to Fare Change



$$Y = -182.78X + 282.78$$

Where, Y = Ridership demand

X = Bus fare (in NIS)

The demand elasticity equation is:

$$E = (\Delta Y / Y_0) / (\Delta X / X_0)$$

This equation can be rewritten in the following form:

$$E = (\Delta Y / \Delta X) * (X_0 / Y_0)$$

Where, E = Demand elasticity

ΔY = The change in demand $(Y_1 - Y_0)$

Y_0 = The original demand

ΔX = The change in fare $(X_1 - X_0)$

X_0 = The original fare

$\Delta Y / \Delta X$ = Line slope

Applying the above equation for the intercity bus sampling survey results in

$$E = -182.78 * (1.0 / 100) = -1.828$$

It means that the intercity bus commuter riders demand elasticity was –1.828 for the bus fare change (see Figure 5.26). This means that, for example, for a 25 percent increase in bus fare, the expected decrease in ridership demand is 45.7 percent (-1.828 x 0.25 = -0.457).

5.5.2 Shared Taxi Services Ridership Demand Elasticity

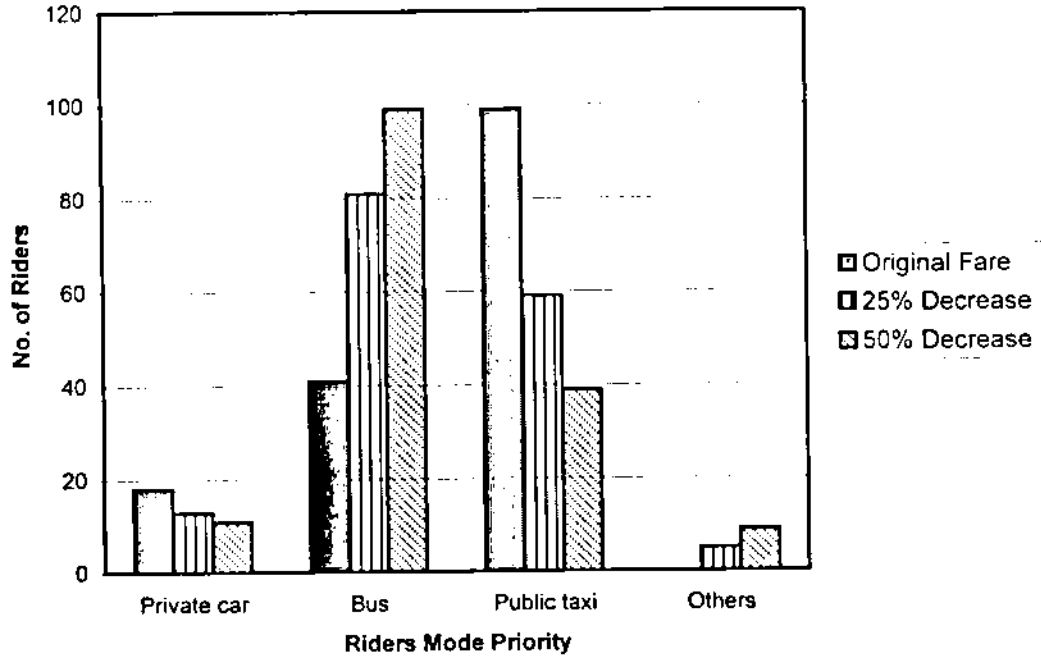
Similar to the demand elasticity of the bus riders, it was found that 99 out of 158 shared taxi riders preferred to use the shared taxi under the current situation. These 158 shared taxi riders were asked about their willingness to continue using the shared taxi when the bus fare decreases by 25 percent compared to the original fare. The riders who were willing to ride the bus, shared taxi, private cars, and other modes were 81, 59, 13, and 5 riders, respectively. Also, it was found that when the bus fare decreases by 50 percent, the riders who were willing to ride the bus, shared taxi, private cars, and other modes were 99, 39, 11, and 9 riders, respectively. Figure 5.27 shows the change of shared taxi riders because of decreasing the bus fare by 25 percent and 50 percent.

Figure 5.28 shows a graphical presentation of this relationship. The best fit line (trend line), can be written as:

$$y = 134 X - 34$$

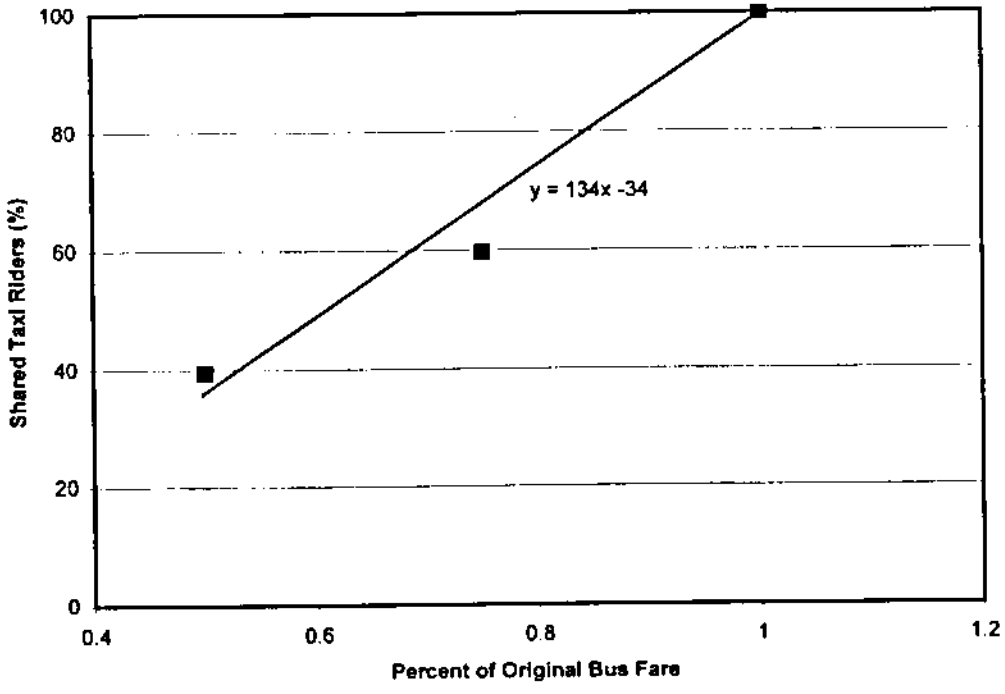
Similar to the bus riders demand elasticity, the equation for determining the shared taxi rider elasticity can be calculated from the following equation:

Figure 5.27
Shared Taxi Riders Preference for Transportation Mode for Bus Fare Decrease



* Original riders for other modes was zero.

Figure 5.28
Shared Taxi Riders Elasticity to Bus Fare Change



$$E = (\Delta Y / \Delta X) * (X_0 / Y_0)$$

Applying the above equation in the shared taxi sampling survey results in:

$$E = 134 * (1.0 / 100) = 1.34$$

The above results showed that the intercity shared taxi riders demand elasticity was about 1.34 for the bus fare change (see Figure 5.28). This means that, for example, for a 25 percent decrease in bus fare, the expected shared taxi riders who will switch to riding a bus is 33.5 percent (1.34 x 0.25 = 0.335) out of the taxi riders.

The shared taxi riders demand elasticity for the change of bus waiting time at the origin station was also studied in this research. It was found that for a waiting time of up to ten minutes, the switch in shared taxi riders to a bus, shared taxi (no change), private cars, and other modes were 75, 65, 14, 4 out of 158 riders, respectively.

However, for the waiting time of up to 20 minutes, the change of shared taxi riders' willingness to use the bus, shared taxi, private cars, and other modes was 96, 46, 11, 4 out of 158 riders, respectively. Figure 5.29 shows the change of shared taxi riders because of reducing the waiting time to 10 minutes and 20 minutes. It was noticed that number of bus riders who will switch to using their cars for a change in bus waiting time to 10 and 20 minutes were 14 and 11 riders,

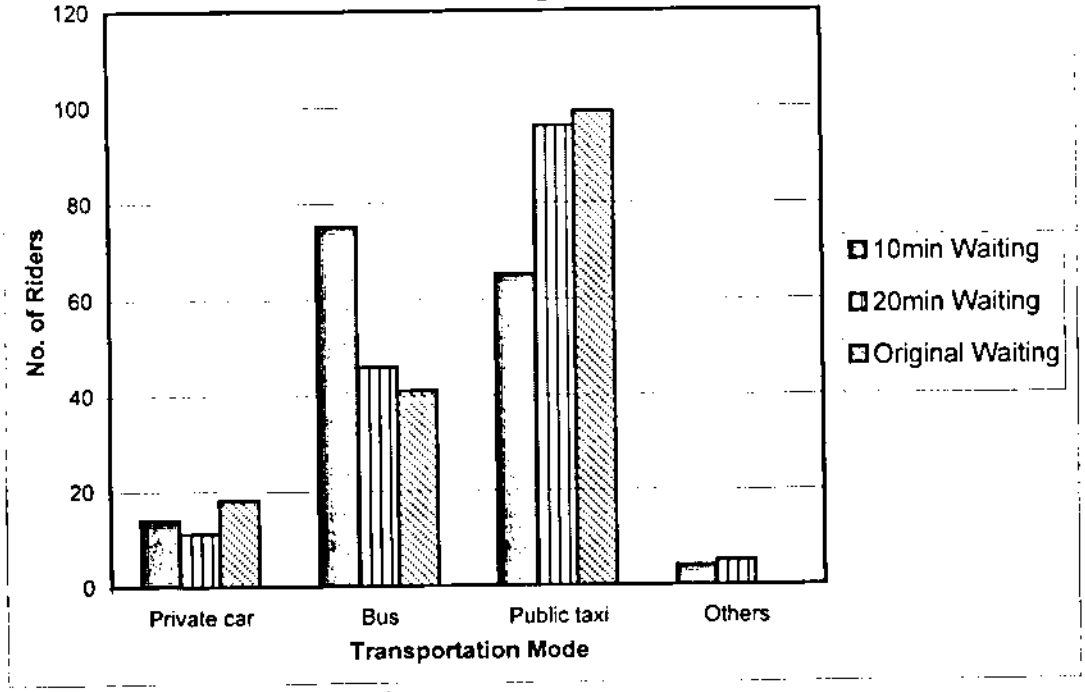
respectively. It is expected that when bus waiting time increases, its demand decreases, and the share of other modes increases. However, the riders' response for switching to private cars could not be explained except that this question was not clearly understood.

The equation for determining the shared taxi riders' elasticity for bus waiting time change was determined and the elasticity was calculated to be 0.646.The above elasticity of shared taxi riders demand for change in bus waiting time can not give a good estimation of true elasticity because it was based on a two-point data only (the original waiting time was not obtained). The best fit line should always be for the three points as a minimum.

The shared taxi riders demand elasticity because of elimina ing bus stops except at the original and the destination stations (express bus) was also studied in this research. It was found that the change of shared taxi riders' preference to choose the bus, shared taxi, private cars, and other modes was 68, 70, 13, 7 out of 158 riders, respectively, as shown in Figure 5.30.

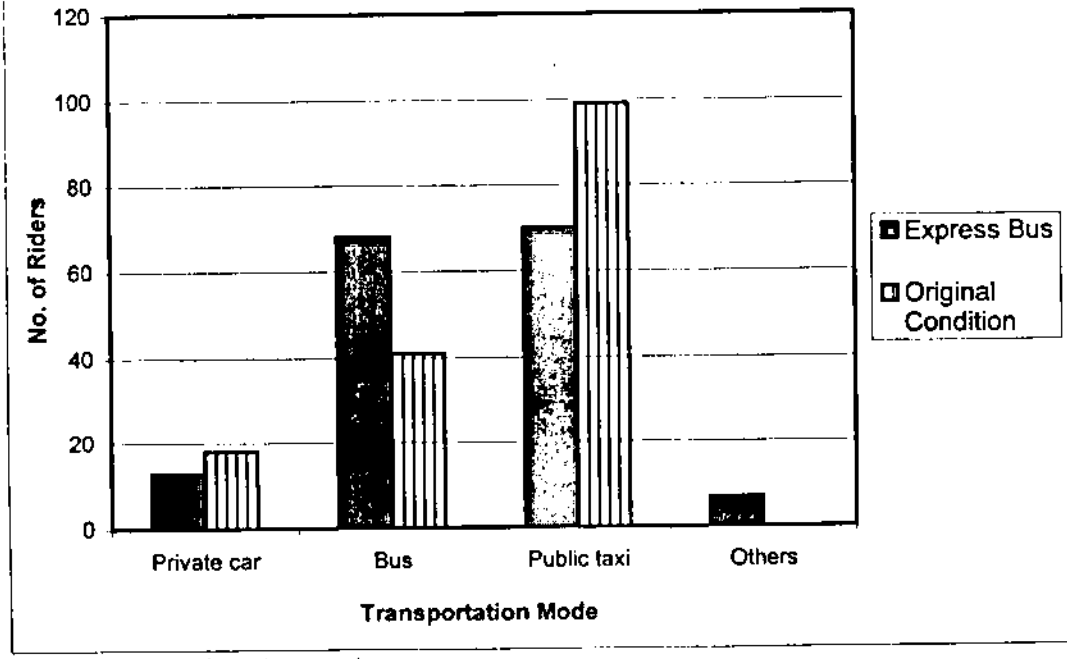
The above results showed that there were also good number of shared taxi riders who will shift to a bus mode for eliminating the intermediate stops (express trip). However, elasticity for this phenomenon could not be obtained because it is a one-point data.

Figure 5.29
Shared Taxi Ridership Mode Change for a Reduction in Bus Waiting Time



* Riders for the original waiting time was zero.

Figure 5.30
Shared Taxi Ridership Mode Change for Eliminating Bus Stops



* Original riders for other modes was zero.

5.6 Cross-Statistical Analysis

In addition to the previous analysis of the questionnaire results, the following cross-tabs relations were investigated.

5.6.1 Bus Riders' Job and Mode Change

Based on questionnaire results, there were 188 bus riders (out of 410) who rode bus for cost. Cross-statistical for these riders with other variables were examined.

The relationship between bus riders' job and mode change for a fare increase by 25 percent and 50 percent is shown in Table 5.5. Regular employees were the highest group among other employments who would switch mode if a bus fare increases by 25 and 50 percent (64% and 91%, respectively). It seems that this group was highly sensitive to price change because they make daily trips.

Table 5.5

Cross Tabulation Between Bus Riders' Job and Mode Change

				Mode Change For			
				25% Fare Increase		50% Fare Increase	
Variable	**Groups**	**Original Percent**	**Original No.**	**Percent**	**Riders No.**	**Percent**	**Riders No.**
Job	Student	59	110	55	60	85	94
	Employee	30	56	64	36	91	51
	Labor	5.5	11	55	6	82	9
	Others	5.5	11	55	6	82	9
	Overall	**100**	**188**	**57**	**108**	**87**	**163**

5.6.2 Bus Riders' Income Rate and Mode Change

To measure the relationship between bus riders' income rate and mode change for a fare change by 25 percent and 50 percent, the cross-tab relation was investigated, as shown in Table 5.6. Based on questionnaire results, the income group of 400 – 600 JD per month was the highest among other income groups who would switch mode for a bus fare increase by 25 percent and 50 percent (63% and 96%, respectively). It was expected the lower income groups would be more sensitive to price increases. However, the unexpected data showed the middle income group (400 - 600 JD) was the most sensitive.

Table 5.6

Cross Tabulation Between Bus Riders' Income Rate and Mode Change

				Mode Change For			
				25% Fare Increase		50% Fare Increase	
Variable	**Groups**	**Original Percent**	**Original No.**	**Percent**	**Riders No.**	**Percent**	**Riders No.**
Monthly Income Rate	Less than 200JD	12	22	59	13	86	19
	200-400 JD	40	75	59	44	88	66
	400-600 JD	26	49	63	31	96	47
	More than 600 JD	22	42	48	20	74	31
	Overall	**100**	**188**	**57**	**108**	**87**	**163**

5.6.3 Bus Riders' Trip Purpose and Mode Change

The cross-tab relation between bus riders' trip purpose and mode change is shown in Table 5.7. The percent of riders who would change mode (for 25

percent fare increase) out of the work, school, shopping, social, and other trips were 64. 55, 25, 50, and 50, respectively. However, these percentages were 91, 86, 50, 100, and 67, respectively for 50 percent fare increase. Based on questionnaire results, work trips were the most sensitive for fare increase because these employees make daily trips; therefore, they will be highly impacted by additional cost.

Table 5.7

Cross Tabulation Between Bus Riders' Trip Purpose and Mode Change

				Mode Change For			
				25% Fare Increase		50% Fare Increase	
Variable	**Groups**	**Original Percent**	**Original No.**	**Percent**	**Riders No.**	**Percent**	**Riders No.**
Trip Purpose	Work	36	67	64	43	91	61
	School	56	105	55	58	86	90
	Shopping	2	4	25	1	50	2
	Social	3	6	50	3	100	6
	Others	3	6	50	3	67	4
	Overall	**100**	**188**	**57**	**108**	**87**	**163**

5.6.4 Bus Riders' Number of Weekly Trips and Mode Change

The relation between bus riders' number of weekly trips and mode change for fare increase by 25 percent and 50 percent is shown in Table 5.8. Based on questionnaire results, the group with less than one weekly trip was the highest among others who would change mode for a bus fare increase by 25 percent and 50 percent (92%, 100%, respectively). However, this group was the smallest in number (13 out of 188); therefore, it might not be reliable.

Table 5.8

Cross Tabulation Between Riders' Number of Trips and Change Mode

				Mode Change For			
				25% Fare Increase		50% Fare Increase	
Variable	Groups	Original Percent	Original No.	Percent	Riders No.	Percent	Riders No.
No. of trips per week	Less than 1	7	13	92	12	100	13
	1	7	14	43	6	71	10
	2	7	13	62	8	85	11
	3	10	19	53	10	95	18
	4 or more	60	113	56	63	85	96
	Others	9	16	56	9	94	15
	Overall	**100**	**188**	**57**	**108**	**87**	**163**

5.6.5 Shared Taxi Riders' Job and Mode Change

The relation between shared taxi riders' job and switching for a bus for fare change by 25 percent and 50 percent is shown in Table 5.9. It was noticed that there were no major differences between riders' job and mode change based on bus fare increase.

Table 5.9

Cross Tabulation Between Shared Taxi Riders' Job and Mode Change

				Mode Change For			
				25% Fare Decrease		50% Fare Decrease	
Variable	Groups	Original Percent	Original No.	Percent	Riders No.	Percent	Riders No.
Job	Student	66	104	51	53	61	63
	Employee	22	35	51	18	66	23
	Labor	9	14	50	7	64	9
	Others	3	5	60	3	80	4
	Overall	**100**	158	**51**	**81**	**63**	**99**

5.6.6 Bus Riders' Income Rate and Mode Change

To measure the correlation between shared taxi riders' income rate and the mode change for bus fare decrease by 25 percent and 50 percent, the cross-tab relation was investigated, as shown in Table 5.10. Based on questionnaire results, the riders' income group of less than 200 JD per month was the highest among other income groups who would switch mode for bus fare increase by 25 percent and 50 percent (63% and 74%, respectively). This low income family riders are expected to be highly sensitive to price change.

Table 5.10

Cross Tabulation Between Shared Taxi Riders Income Rate and Mode Change

				Mode Change For			
				25% Fare Decrease		50% Fare Decrease	
Variable	Groups	Original Percent	Original No.	Percent	Riders No.	Percent	Riders No.
Monthly Income Rate	Less than 200JD	12	19	63	12	74	14
	200-400 JD	41	65	51	33	63	41
	400-600 JD	28	45	49	22	60	27
	More than 600 JD	18	29	48	14	59	17
	Overall	**100**	158	**51**	**81**	**63**	**99**

5.6.7 Shared Taxi Riders' Trip Purpose and Mode Change

The cross-tab relation between bus riders' trip purpose and mode change is shown in Table 5.11. The percent of riders who would change mode for 25

percent bus fare decrease, out of the work, school, shopping, social, and other trips were 50, 52, 60, 45, and 50 percent, respectively. However, these percentages were 66, 61, 80, 55, and 67 percent, respectively for 50 percent bus fare decrease. Based on questionnaire results, shopping trips were the most sensitive among other trip purposes for mode change because of bus fare decrease. However, this group was the smallest in number (5 out of 158) and, therefore, not reliable. Other than shopping trips, the percentages of other trip purposes where not much different.

Table 5.11

Cross Tabulation Between Shared Taxi Riders' Trip Purpose and Mode Change

				Mode Change For			
				25% Fare Decrease		50% Fare Decrease	
Variable	**Groups**	**Original Percent**	**Original No.**	**Percent**	**Riders No.**	**Percent**	**Riders No.**
Trip Purpose	Work	24	38	50	19	66	25
	School	62	98	52	51	61	60
	Shopping	3	5	60	3	80	4
	Social	7	11	45	5	55	6
	Others	4	6	50	3	67	4
	Overall	**100**	158	**51**	**81**	**63**	**99**

5.6.8 Shared Taxi Riders Number of Weekly Trip and Change Fare

The relation between bus riders' number of weekly trips and mode change for bus fare decrease by 25 percent and 50 percent is shown in Table 5.12. Based on questionnaire results, the group with three or more weekly trips was the highest

among others who would change mode for a bus fare decrease by 25 and 50 percent. As expected, the riders who make frequent trips were the most sensitive for fare change.

Table 5.12

Cross Tabulation Between Shared Taxi Riders Number of Trips & Mode Change

				Mode Change For			
				25% Fare Decrease		50% Fare Decrease	
Variable	**Groups**	**Original Percent**	**Original No.**	**Percent**	**Riders No.**	**Percent**	**Riders No.**
No. of trips per week	Less than 1	39	62	48	30	56	35
	1	14	22	50	11	64	14
	2	8	13	46	6	69	9
	3	10	16	56	9	75	12
	4 or more	14	22	64	14	73	16
	Others	15	23	48	11	57	13
	Overall	**100**	158	**51**	**81**	**63**	**99**

5.6.9 Shared Taxi Riders' Job and Mode Change Based on Bus Waiting Time

The relation between shared taxi riders' job and mode change for a decrease in waiting time up to 10 and 20 minutes is shown in Table 5.13. It was noticed that there were no major differences between riders' job and change mode, based on bus waiting time.

Table 5.13

Cross Tabulation Between Shared Taxi Riders Job and Mode Change Based on Bus Waiting Time

				Mode Change For			
				20 Minutes Waiting Time		10 Minutes Waiting Time	
Variable	**Groups**	**Original Percent**	**Original No.**	**Percent**	**Riders No.**	**Percent**	**Riders No.**
Job	Student	66	104	30	31	46	48
	Employee	22	35	26	9	46	16
	Labor	9	14	29	4	57	8
	Others	3	5	40	2	60	3
	Overall	**100**	158	**29**	**46**	**47**	**75**

5.6.10 Shared Taxi Riders' Income and Mode Change for Bus Waiting Time

It was found that there was also no major differences between shared taxi riders' income level and mode change for decreasing waiting time up to 10 and 20 minutes, as shown in Table 5.14. However, as expected, low income group (less than 200 JD/month) were slightly higher than other groups.

Table 5.14

Cross Tabulation Between Shared Taxi Riders' Income Rate and Mode Change Based on Bus Waiting Time

				Mode Change For			
				20 Minutes Waiting Time		10 Minutes Waiting Time	
Variable	**Groups**	**Original Percent**	**Original No.**	**Percent**	**Riders No.**	**Percent**	**Riders No.**
Monthly Income Rate	Less than 200JD	12	19	32	6	53	10
	200-400 JD	41	65	29	19	48	31
	400-600 JD	28	45	29	13	47	21
	More than 600 JD	18	29	28	8	45	13
	Overall	**100**	158	**29**	**46**	**47**	**75**

5.6.11 Shared Taxi Riders' Trip Purpose and Mode Change Based on Bus Waiting Time

The relationship between shared taxi riders' trip purpose and mode change, for a bus waiting time decrease is shown in Table 5.15. The percent of shared taxi riders who would change mode for reducing waiting time to 20 minutes out of work, school, shopping, social, and other trips were 32, 30, 20, 27, 17 percent, respectively. However these percentages were 53, 48, 40, 36, and 33, respectively for reducing waiting time to 10 minutes. Work trips, followed by school trips, were slightly more sensitive for reducing bus waiting time because those groups of riders want to arrive at their work or schools without delay.

Table 5.15

Cross Tabulation Between Shared Taxi Riders Trip Purpose and Mode Change Based on Bus Waiting Time

				Mode Change For			
				20 Minutes Waiting Time		10 Minutes Waiting Time	
Variable	**Groups**	**Original Percent**	**Original No.**	**Percent**	**Riders No.**	**Percent**	**Riders No.**
Trip Purpose	Work	24	38	32	12	53	20
	School	62	98	30	29	48	47
	Shopping	3	5	20	1	40	2
	Social	7	11	27	3	36	4
	Others	4	6	17	1	33	2
	Overall	**100**	158	**29**	**46**	**47**	**75**

5.6.12 Number of Shared Taxi Weekly Trips and Mode Change Based on Bus Waiting Time

The relation between shared taxi riders' number of weekly trips and mode change for reducing the waiting time is shown in Table 5.16. The group with three weekly trips was slightly higher than the others groups who would change mode for reducing waiting time for 20 and 10 minutes (38% and 63%, respectively). The relation between mode change and number of weekly trips based on reducing the waiting time is not clear in the sampling data.

Table 5.16

Cross Tabulation Between Shared Taxi Riders Number of Trips & Mode Change for Bus Waiting Time

				Mode Change For			
				20 Minutes Waiting Time		10 Minutes Waiting Time	
Variable	**Groups**	**Original Percent**	**Original No.**	**Percent**	**Riders No.**	**Percent**	**Riders No.**
No. of trips per week	Less than 1	39	62	26	16	44	27
	1	14	22	27	6	55	12
	2	8	13	31	4	46	6
	3	10	16	38	6	63	10
	4 or more	14	22	27	6	50	11
	Others	15	23	30	7	39	9
	Overall	**100**	158	**29**	**45**	**47**	**75**

5.6.13 Shared Taxi Riders' Job and Express Bus Service

The relation between shared taxi riders' job and mode change for express bus service is shown in Table 5.17. Based on questionnaire results, it was noticed that all job groups would be almost equally willing to switch to express bus service, with employees being the highest (49%). Employees always want to arrive at their work early, thus are highly sensitive for reducing trip time.

Table 5.17

Cross Tabulation Between Shared Taxi Riders' Job and Mode Change for Express Bus Service

Variable	Groups	Original Percent	Original No.	Mode Change Because of Express Bus Service	
				Percent	Riders No.
Job	Student	66	104	41	43
	Employee	22	35	49	17
	Labor & Technician	9	14	43	6
	Others	3	5	40	2
	Overall	**100**	158	**43**	**68**

5.6.14 Shared Taxi Riders' Income Rate and Mode Change for Express Bus Service

It was found that there were no major differences for different income level groups and mode change for express bus, as shown in Table 5.18. However, the monthly income group of more than 600 JD were the highest (48%), which was not consistent with bus riders.

Table 5.18

Cross Tabulation Between Shared Taxi Riders' Income Rate and Mode Change for Express Bus Service

				Mode Change Because of Express Bus Service	
Variable	**Groups**	**Original Percent**	**Original No.**	**Percent**	**Riders No.**
Income Rate	Less than 200JD	12	19	37	7
	200-400 JD	41	65	43	28
	400-600 JD	28	45	42	19
	More than 600 JD	18	29	48	14
	Overall	**100**	158	**43**	**68**

5.6.15 Shared Taxi Riders' Trip Purpose and Mode Change for Express Bus Service

Based on questionnaire results, it was found that work and school trips were the highest among other trip purposes who would switch mode based on the express bus service (47 and 44 percent, respectively), as shown in Table 5.19. Similar to the effect of reducing bus waiting time, work trips, followed by school trips, were slightly more sensitive for eliminating bus stops because those groups of riders want to arrive at their work or schools without delay.

Table 5.19

Cross Tabulation Between Shared Taxi Riders Trip Purpose and Express Bus Service

Variable	Groups	Original Percent	Original No.	Mode Change Because of Express Bus Service	
				Percent	Riders No.
Trip Purpose	Work	24	38	47	18
	School	62	98	44	43
	Shopping	3	5	40	2
	Social	7	11	27	3
	Others	4	6	33	2
	Overall	**100**	158	**43**	**68**

5.6.16 Shared Taxi Riders' Number of Trips and Mode Change Based on Express Bus Service

It was found that there were no major differences among number of trips groups for willingness to switch for an express bus service, as shown in Table 5.20.

Table 5.20

Cross Tabulation Between Shared Taxi Riders' Number of Trips and Mode Change Based on Express Bus Service

Variable	Groups	Original Percent	Original No.	Mode Change Because of Express Bus Service	
				Percent	Riders No.
No. of trips per week	Less than 1	39	62	42	26
	1	14	22	45	10
	2	8	13	46	6
	3	10	16	44	7
	4 or more	14	22	41	9
	Others	15	23	43	10
	Total	**100**	158	**43**	**68**

CHAPTER 6

PUBLIC TRANSPORTATION EVALUATION

6.1 Introduction

This chapter discusses the public transportation evaluation, especially the intercity bus routes based on both ridership demand modeling and the public transportation questionnaires. Statistical analysis for the ridership demand and the elasticities of riders related to different variables bring a comprehensive overview of the assessment of the intercity bus routes in the West Bank. Also, this chapter explains the interpretation of some public transportation issues. Finally, this chapter deals with the future public transportation demand and supply.

6.2 Overview of Evaluation Background

The evaluation can be thought of conceptually as a link between the operational measures and developing the public transportation policies in the future. That is, it serves as a bridge between the conduct of operational measures (surveys) at the particular location and understanding of its actual performance at that location as well as its potential effectiveness in other locations. The evaluation process, strategy, and decision making are directly influenced by the nature of such

variables that were well studied during the operational surveys especially those variables, which deals with the human behaviors. The evaluation process also depends on the interpretation of each variable individually, in addition to the influence of each variable on the other variables

6.3 Evaluation the Existing Intercity Public Transportation

Evaluating the existing intercity public transportation in this research was based on the collected and analyzed data. There were two kinds of evaluation processes; using the ridership demand modeling and the public transportation questionnaire.

6.3.1 Using the Ridership Demand Modeling

Results of the ridership demand modeling suggested that population for both origin and destination cities, the income level expressed in terms of an employment ratio of origin to destination city, bus fare, and the weekly number of trip Kilometers influence ridership demand.

The modeling results showed that when the population of the origin city increases, the bus ridership demand increases, and vice versa. This direct proportional relation is feasible and logical. The interpretation of this strong relation is while the population increases, the number of passengers' increases in

all transportation modes. The bus ridership demand will also increase. The highly populated cities will generate more intercity trips than less populated cities.

It was also found that the destination city population has direct proportional relationship to the intercity ridership demand. The interpretation of this relation is that, the highly populated cities will attract more trips than the less population cities. This is logical and expected.

The results of the ridership demand modeling showed that the number of intercity bus riders increases as the percent of employees and students in the origin city increases. The interpretation is that generation of work and school trips at the city of high percentage of students and employees is more than that generated at low percentage cities.

It was also found from the ridership demand modeling that the bus trip fare between the city pairs was inversely proportional to the ridership demand. The interpretation of this is that cheeper bus trips will attract more riders than other more expensive non-bus trips.

6.3.2 Using the Public Transportation Questionnaire

6.3.2.1 Intercity Bus Riders

From the intercity bus routes questionnaire, some issues were noticed, which can be interpreted as follows:

Bus Riders Mode Change Based on Bus Fare Increase

Regular employees represented 30 percent of the total bus riders compared with students who represented 59 percent of the total bus riders. Regular employees were the highest group among other job groups who would switch mode if a bus fare increases because this group is expected to be highly sensitive to price change because they make daily trips.

Work trips were the most sensitive to mode change for fare increase among other trip purposes because of the same reason mentioned above.

According to the questionnaire analysis, the ridership demand elasticity towards the fare change was expressed by a linear relationship with a negative slope. The down slope is quite common in most demand curves. The reason is that as the bus fare price drops, additional persons will be able to afford it (will be attracted). Also, it is possible that some who had perhaps purchased a certain

amount of the higher cost commodity (non-bus trips) may now afford to consume more (make more trips). Based on the sample data obtained, the elasticity of the ridership demand was –1.828

Pricing management must be done to deal with the riders' elasticity towards change mode if bus fare increases; however, it is unlikely to happen since transportation costs go up to all modes together. Those riders may change to other low occupancy vehicles and will be lost as bus commuters.

Problems in Riding Bus Mode

It was found that the number one problem, which bus riders' face during their bus trips, was the number of bus stops, which is considered as a negative point for 29.78 percent of the bus riders. This was followed by waiting time with 28.68 percent. Therefore, if these problems are improved by reducing the number of bus stops and providing more frequent bus service, the number of people who would shift to riding the bus might increase.

6.3.2.2 Intercity Shared Taxi Riders

From the intercity shared taxi routes questionnaires, the following were some of the noted issues:

Shared Taxi Problems When Riding Bus Mode

As discussed before, the bus waiting time and long travel time were the main reasons that shared taxi riders did not ride the bus. Therefore, it is expected that for reducing bus waiting time and stops especially during the beak hour, some shared taxi riders would shift to riding a bus. This will also encourage riders of other modes to switch to the bus.

Shared Taxi Riders Mode Change Based on Bus Fare Decrease

The riders' income group of less than 200 JD per month was the highest among other shared taxi riders income groups who would switch for riding a bus if bus fare decreases. The low-income riders are typically sensitive to price change.

Shared taxi riders who make four or more weekly trips were the most sensitive to fare change because they make daily trips. Therefore, they will be highly impacted by this price change.

It was also found that the shared taxi ridership demand was sensitive towards the fare change by a linear relationship with a positive slope. The reason for upward slope of this curve is that, as the bus fare decreases, shared taxi riders may be attracted to riding the bus. Therefore, shared taxi demand decreases. Based on the

sample data. the elasticity of the shared taxi ridership demand was calculated to be 1.34.

Shared Taxi Riders Mode Change Based on Bus Waiting Time Decrease

Work trips was highly sensitive than other trip purposes for reducing the bus waiting time because riders want to arrive at their work without delay.

Also, questionnaire analysis showed that the shared taxi ridership demand was sensitive towards decreasing bus-waiting time at the origin station. The main reason that some people did not ride the bus mode because of the long waiting time, as discussed before. Therefore when reducing the bus waiting time, some shared taxi riders would divert .o riding the bus mode. The elasticity of the shared taxi riders based on reducing bus-waiting time was 0.646.

Shared Taxi Riders Mode Change Based on Eliminating Bus Stops

Employees were the highest among other riders who would switch mode for the express bus service. Employees always want to arrive at their work early and, thus are expected to be highly sensitive for express bus service.

As discussed before, many shared taxi riders (22.29%) did not prefer riding a bus because of the frequent number of bus stops. Therefore, some of these riders

would switch for a bus if the total trip time is reduced by providing the express bus service.

6.3.3 Combination of Ridership Demand Modeling & Elasticity

A. Ridership Demand

The suggested bus ridership demand model was expressed in the following equation:

$$Y = a_0 + a_1 D_1 + a_2 D_2 + a_3 D_3 + a_4 D_4 + a_5 D_5$$

Where, Y, D_1, D_2, D_3, D_4, and D_5 are as defined before.

The calibration coefficients a_0, a_1, a_2, a_3, a_4, and a_5 were 24983, 27.6, 28.6, -901.5, -170.6, and –200.2, respectively.

Fixing all variables except D_3, the equation can be written in the following form:

$$Y = C + a_3 D_3$$

$$Y = C - 813.04 D_3$$

B. Demand Elasticity

The suggested bus ridership demand elasticity was determined using the following equation:

$$E = (\Delta Y / Y_0) * / (\Delta X / X_0)$$

The best-fit line for the sample data was expressed by:

$$Y = -182.8X + 282.8$$

Where, Y = Ridership demand

X = Bus fare

The elasticity (E) of the bus riders was −1.828

C. Combination of Demand and Elasticity

From the above two forms, one can conclude that both equations have the form of:

$$Y = a F + b$$

Where, Y = Ridership demand

F = Bus fare

a = straight line slope (negative value)

b = coefficient, which represents the Y-intercept

The expected bus ridership demand for trips originated at Nablus City, for example, as a result of 25 percent bus fare increase, can be calculated using the developed demand model as well as elasticity results. Table 6.1 shows the examples of observed and the predicted ridership demand based on the model and elasticity. It was noticed that there was a difference between the two results, such that the reduction in ridership demand based on ridership demand model was less than reduction based on riders' elasticity to all destination cities (except for Salfit).

Table 6.1

Comparison Between Bus Ridership Modeling and Elasticity Forms

Origin	Destination	Actual Ridership	Original Fare	25% Fare Increase	Ridership Reduction Using Demand Model	Ridership Reduction Using Elasticity
Nablus	Ramallah	6900	6	7.5	1220	3153
	Jenin	7614	5	6.25	1016	3480
	Tulkarm	6263	4	5	813	2862
	Qalqilia	3330	5	6.25	1016	1522
	Salfit	1008	3.5	4.375	711	461

These differences can be attributed to the difference in sample size of the two. In addition, the ridership model was derived based on the aggregate characteristics of riders and cities. However, the elasticity was derived based on riders' willingness to switch mode for a price change.

Based on the results from Table 6.1, the two models can be used as a measure to determine riders mode change for bus fare increase (or decrease). The nature of the available data would sometimes necessitate applying one of the two models.

The elasticity result was constant for all routes in contrast with the changed elasticity for each route using the demand model, which reflect the characteristic of the city pairs nature. Based on the results obtained, the demand model produced somewhat logical and reasonable results in predicting the mode change based on fare increase.

For example, bus fare for Nablus – Tulkarm trips is 4.0 NIS and shared taxi fare is 6.0 NIS. If bus fare increases by 25 percent (become 5.0 NIS), then it becomes closer to the shared taxi fare. The number of weekly riders who would stop using the bus (most probably, would shift to a shared taxi) would be:

a) 902 (13%) based on the demand model.

b) 2862 (46%) based on the elasticity formula.

The mode shift is expected to be closer to the results obtained from ridership demand calculations.

On the other hand, the elasticity results based on reducing bus waiting time or eliminating bus stops could not be compared with results of the demand model, because travel time was not used as a separate variable in the model.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

Based on the results of the intercity bus and shared taxi service analysis in this study, the following conclusions were made:

1. The ridership demand can be modeled based on the socioeconomic data and internal intercity service data using the multiple linear regression analysis.

2. Ridership demand model factors that most influence intercity ridership demand for the West Bank were origin and destination city population, percent of employees and students, and bus fare.

3. The suggested ridership demand model had the following form:

$$\text{Demand} = a_0 + a_1 \text{Pop}_{(\text{orig.})} + a_2 \text{Pop}_{(\text{dest.})} + a_3 \text{Fare} + a_4 (\%\text{Student})_{(\text{orig.})} + a_5 (\%\text{Employ.})_{(\text{orig.})}$$

Where the correlation coefficient of the suggested demand model, R^2, was 0.84.

4. The sampling size of the public transportation riders questionnaire was 568, which represents a 95 percent confidence level and 7.5 percent standard error. The sample size for bus riders was 410 while for shared taxi, it was 175.

5. It was found that bus-waiting time was the number one reason for not riding the bus.

6. This study demonstrated that the bus ridership demand decreases as the travel time increases due to number of stops. The questionnaire analysis showed that many people did not prefer riding the bus because of the frequent stops along the route.

7. This study showed also that there was a share of riders who did not ride a bus because they found it uncomfortable. Some of them commented that they try to avoid the old and poor air-conditioned buses.

8. Improving the current bus service and its operation will achieve passengers' satisfaction and will attract more riders. This can be accomplished in the following ways:

- Reduce waiting time (headway) or operate on schedule.
- Reduce the number of bus stops.

- Provide express bus routes.

However, the economic feasibility of the improvements should first be investigated.

9. Students represented the highest percentage among other riders of intercity bus and shared taxi.

10. Employees and students as well as work and school trips were the most sensitive among other bus and shared taxi riders to mode change based on reducing travel time or fare.

11. Elasticity of bus riders for fare change was calculated to be -1.828, while the elasticity for shared taxi riders was calculated to be 1.34.

12. The ridership demand model and elasticity forms could be written in a linear form as:

$$Y = a\,(Fare) + b$$

Therefore, both methods could be used to determine the change in ridership demand based on a bus fare change.

7.2 Recommendations

This type of researches can not be feasible nor worthy as itself without the coordination with the relevant authorities and the decision-makers in considering the results and dealing with the recommendations of this research. The following are recommendations for relevant parties and future research in the field of intercity bus demand.

For Bus Companies

1. Improve the frequency of intercity bus services by providing more frequent travel service on existing routes. This is expected to attract more riders.

2. Explore providing an intercity express bus service during the peak period to attract more riders such as employees who would like to arrive at their work on time.

For Planner, and Bus Companies

As general recommendations, the following issues should be investigated:

1. Pricing policies to increase the public transportation riders, especially daily commuters. Therefore, one of the following policies could be used:
   - Offer weekly, monthly, or seasonal fare card.
   - Offer a special fare for specific groups such as students and elderly.

2. It is natural that population and, thus trips will increase in the future. Therefore, in the transportation planning process, there should be serious efforts to direct trips to public transportation.

3. To accommodate the future passengers demand, increasing trip frequency (reducing the headway) and number of buses for congested routes should be investigated.

4. The economic feasibility for all the pervious recommendations should be investigated.

5. Advertisement and publications can be used to describe the good image of the public transportation services.

Considerations for Future Research

1. This study was conducted with limited data and financial resources. For similar studies in future, it is recommended that database with more detailed information about trips of other transportation modes (shared taxi and private cars) be included.

2. The study questionnaires were carried out for buses and shared taxis only. It is recommended that private car riders be included in future studies.

3. It is believed that interviews with the general public in the study area (household survey) and their expectations regarding the need for public transportation services would enhance the quality of such studies.

4. It is recommended that future research should include Gaza Strip and the Southern Districts of West Bank.

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المراجـــع العربيـــة

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Appendix (I)

Questionnaire Forms

خط رحلة الباص:
رقم الاستبانة:
التاريخ:

بسم الله الرحمن الرحيم

الأخ المواطن/ الأخت المواطنة .....

إن هذا الاستبيان هو جزء من دراسة ضمن رسالة ماجستير بعنوان (تقييم حالة المواصلات العامة في الضفة الغربية بالاعتماد على نموذج الركاب).

فيرجى الإجابة على الأسئلة في هذه الاستبانة إجابة واضحة ودقيقة ودون أي حرج، حتى تعكس هذه الإجابة حقيقة الوضع، وبالتالي يمكن الاستفادة من محتويات هذه الاستبانة في التخطيط الأمثل للنقل العام، وعلى العكس فان أي لبس أو عدم جدية في الإجابات قد لا يثمر في تحقيق الفائدة المرجوة منها.

وأود أن اذكر بان الهدف من هذه الاستبانة هو الدراسة العلمية والتحليل الإحصائي فقط ولا يوجد لها أي أهداف أخرى.

شاكرا لكم جهودكم في إنجاح هذه الدراسة العلمية،،،

أخوكم الباحث

م. عبد المجيد صادق

برنامج الدراسات العليا/

هندسة الطرق والمواصلات

جامعة النجاح الوطنية – 2000

استبيـــــــــــان

1. المهنة: .....

2. العمر:.....

3. الجنس: ا.ذكر ب. أنثى

4. مستوى التعليم: ا. دون الثانوية ب. ثانوي ج. دبلوم د. جامعة

5. متوسط دخل الأسرة الشهري :-
ا. اقل من 200 دينار ب. من 200-400 دينار ج. من 400-600 د. اكثر من 600 دينار

6. مكان بداية رحلة الباص (اسم المدينة أو القرية): .....

7. مكان نهاية رحلة الباص (اسم المدينة أو القرية): .....

8. الغرض من الرحلة:- ا. رحلة عمل ب. رحلة تعليمية ج. رحلة للتسوق
د. رحلة اجتماعية هـ. غير ذلك

9. هل لديك سيارة خاصة: ا. نعم ب. لا

10. معدل عدد الرحلات المشابهة لنفس المكان في الأسبوع باستخدام جميع وسائل المواصلات:-
ا. اقل من مرة ب. مرة واحدة ج. مرتين د. 3 مرات هـ. 4 مرات أو اكثر
و. غير ذلك

11. معدل عدد الرحلات المشابهة لنفس المكان في الأسبوع باستخدام الباصات:
ا. اقل من مرة ب. مرة واحدة ج. مرتين د. 3 مرات هـ. 4 مرات أو اكثر
و. غير ذلك

12. إذا كان لديك خيار في الوضع الحالي هل تفضل ركوب:-

ا. سيارتك الخاصة التي تمتلكها حاليا ب. الباص ج. سيارة الأجرة

13. أهم المشاكل التي تتعرض لها باستخدام هذه الوسيلة:-

ا. بطيئة ب. غير مريحة ج. انتظار أطول د. مسافة المشي إلى /من محطة الباصات

هـ. عدد مرات توقف الباص و. غير ذلك

14. سبب اختيارك لهذه الوسيلة:-

ا. التكلفة ب. الراحة و الأمان ج. خط سير الرحلة د. كونها الوسيلة الوحيدة المتوفرة

هـ. غير ذلك

إذا كانت الإجابة على سؤال رقم (14) هي التكلفة، فاجب عن الأسئلة من (15 – 16)

15. في حال ازدياد سعر تذكرة الباص بمقدار الربع وعدم ارتفاع أسعار النقل بالوسائط الأخرى فهل تفضل ركوب:-

ا. سيارتك الخاصة التي تمتلكها حاليا ب. الباص ج. سيارة الأجرة د. غير ذلك

16. في حال ازدياد سعر تذكرة الباص بمقدار النصف وعدم ارتفاع أسعار النقل بالوسائط الأخرى فهل تفضل ركوب:-

ا. سيارتك الخاصة التي تمتلكها حاليا ب. الباص ج. سيارة الأجرة د. غير ذلك

خط رحلة السيارة:
رقم الاستبانة:
التاريخ:

بسم الله الرحمن الرحيم

الأخ المواطن/ الأخت المواطنة .....

إن هذا الاستبيان هو جزء من دراسة ضمن رسالة ماجستير بعنوان (تقييم حالة المواصلات العامة في الضفة الغربية بالاعتماد على نموذج الركاب).

فيرجى الإجابة على الأسئلة في هذه الاستبانة إجابة واضحة ودقيقة ودون أي حرج، حتى تعكس هذه الإجابة حقيقة الوضع، وبالتالي يمكن الاستفادة من محتويات هذه الاستبانة في التخطيط الأمثل للنقل العام، وعلى العكس فان أي لبس أو عدم جدية في الإجابات قد لا يثمر في تحقيق الفائدة المرجوة منها.

وأود أن اذكر بان الهدف من هذه الاستبانة هو الدراسة العلمية والتحليل الإحصائي فقط ولا يوجد لها أي أهداف أخرى.

شاكرا لكم جهودكم في إنجاح هذه الدراسة العلمية ،،،

أخوكم الباحث

م. عبد المجيد صادق

برنامج الدراسات العليا/

هندسة الطرق والمواصلات

جامعة النجاح الوطنية – 2000

استبيـــــــــــان

1. المهنة: .....

2. العمر:.....

3. الجنس: ا. ذكر ب. أنثى

4. مستوى التعليم: ا. دون الثانوية ب. ثانوي ج. دبلوم د. جامعة

5. متوسط دخل الأسرة:-

ا. اقل من 200 دينار ب. من 200-400 دينار ج. من 400-600 د. اكثر من 600 دينار

6. مكان بداية رحلة التاكسي العمومي (اسم المدينة أو القرية): .....

7. مكان نهاية رحلة التاكسي الـ مومي (اسم المدينة أو القرية): .....

8. الغرض من الرحلة:- ا. رحلة عمل ب. رحلة تعليمية ج. رحلة للتسوق
د. رحلة اجتماعية هـ. غير ذلك

9. هل لديك سيارة خاصة: ا. نعم ب. لا

10. معدل عدد الرحلات المشابهة لنفس المكان في الأسبوع باستخدام جميع وسائل المواصلات:-

ا. اقل من مرة ب. مرة واحدة ج. مرتين د. 3 مرات هـ. 4 مرات أو اكثر
و. غير ذلك

11. معدل عدد الرحلات المشابهة لنفس المكان في الأسبوع باستخدام الباصات إذا كنت تستخدمها:-

ا. اقل من مرة ب. مرة واحدة ج. مرتين د. 3 مرات هـ. 4 مرات أو اكثر
و. غير ذلك

12. إذا كان لديك خيار في الوضع الحالي هل تفضل ركوب:-

ا. سيارتك الخاصة التي تمتلكها حاليا ب. الباص ج. سيارة الأجرة

13. سبب اختيارك لهذه الوسيلة (التاكسي العمومي):-

ا. الراحة و الأمان ب. خط سير الرحلة ج. السرعة د. كونها الوسيلة الوحيدة المتوفرة

هـ. غير ذلك

14. في حال انخفاض سعر تذكرة الباص بمقدار الربع وعدم انخفاض أسعار النقل بالوسائط الأخرى فهل تفضل ركوب:-

ا. سيارتك الخاصة التي تمتلكها حاليا ب. الباص ج. سيارة الأجرة د. غير ذلك

15. في حال انخفاض سعر تذكرة الباص بمقدار النصف وعدم انخفاض أسعار النقل بالوسائط الأخرى فهل تفضل ركوب:-

ا. سيارتك الخاصة التي تمتلكها حاليا ب. الباص ج. سيارة الأجرة د. غير ذلك

16. أهم الأسباب في عدم استخدامك الباصات كوسيلة نقل:-

ا. بطيئة ب. غير مريحة ج. انتظار أطول د. مسافة المشي إلى /من محطة الباصات

هـ. عدد مرات توقف الباص و. غير ذلك

17. في حال قصر فترة انتظار الباص في المحطة الرئيسية وأصبحت 10 دقائق كحد أقصى فهل تفضل ركوب:-

ا. سيارتك الخاصة التي تمتلكها حاليا ب. الباص ج. سيارة الأجرة د. غير ذلك

18. في حال قصر فترة انتظار الباص في المحطة الرئيسية وأصبحت 20 دقيقة كحد أقصى فهل تفضل ركوب:-

ا. سيارتك الخاصة التي تمتلكها حاليا ب. الباص ج. سيارة الأجرة د. غير ذلك

19. في حال عدم وجود محطات توقف الباص إلا في نهاية الرحلة فهل تفضل ركوب:-

ا. سيارتك الخاصة التي تمتلكها حاليا ب. الباص ج. سيارة الأجرة د. غير ذلك

Appendix (II)

Regression Analysis Results

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.908
R Square	0.824
Adjusted	0.769
Standard	1343.463
Observatio	22

ANOVA

	df	*SS*	*MS*	*F*	*gnificance F*
Regressio	5	1.35E+08	27037852	14.98031	1.51E-05
Residual	16	28878292	1804893		
Total	21	1.64E+08			

	Coefficient	*andard Err*	*t Stat*	*P-value*
Intercept	1084.83	13837.67	0.08	0.938484
X1/1000	26.77	5.03	5.32	6.9E-05
X2/1000	25.71	4.05	6.35	9.56E-06
X11	-813.04	171.89	-4.73	0.000227
X12	80.31	350.20	1.58	0.11
X3	68.32	149.26	1.12	0.225841

RESIDUAL OUTPUT

bservatio	*redicted*	*Residuals*
1	5871	1029
2	6284	1330
3	5213	1050
4	2734	596
5	3285	-2277
6	5875	388
7	2650	-2320
8	611	19
9	250	1380
10	6133	-533
11	1282	-562
12	212	418
13	171	254
14	316	-76
15	1439	-719
16	6702	912
17	2408	-2078
18	3177	423
19	352	143
20	120	1598
21	2962	-1544
22	202	569

Appendix (III)

Questionnaire Results

Bus Riders Statistical Analysis

Question	Category	Jenin Nablus	Jenin Ramallah	Qalqilia Nablus	Qalqilia Ramallah
Job	Student	33	3	24	2
	Employee	8	2	1	2
	Labor	7	0	0	2
	Others	4	0	0	1
	Total	52	5	25	7
Age	10-20	12	0	13	2
	21-30	32	4	12	2
	31-40	4	1	0	3
	41-50	1	0	0	0
	>50	3	0	0	0
	Total	52	5	25	7
Gender	Male	33	5	10	4
	Female	19	0	15	3
	Total	52	5	25	7
Education	Below Secondary	3	0	0	2
	Secondary	8	0	1	1
	Diploma	5	0	1	2
	University	36	5	23	2
	Total	52	5	25	7
Monthly Income Rate	Less than 200JD	4	0	3	0
	200-400 JD	13	2	10	4
	400-600 JD	17	2	5	2
	More than 600 JD	18	1	7	1
	Total	52	5	25	7
Trip Purpose	Work	15	3	1	4
	School	31	2	24	2
	Shopping	1	0	0	1
	Social	1	0	0	0
	Others	4	0	0	0
	Total	52	5	25	7
Auto Ownership	Yes	10	0	3	1
	No	42	5	22	6
	Total	52	5	25	7
# of Trips by All Modes	>1	8	1	1	2
	1	1	2	0	0
	2	7	0	0	1
	3	6	0	2	0
	4 or more	28	2	22	4
	Others	2	0	0	0
	Total	52	5	25	7

Bus Riders Statistical Analysis

Question	Category	Jenin Nablus	Jenin Ramallah	Qalqilia Nablus	Qalqilia Ramallah
# of Trips by Bus	>1	7	1	1	1
	1	8	2	1	0
	2	6	1	2	1
	3	4	0	4	1
	4 or more	25	1	16	3
	Others	2	0	1	1
	Total	52	5	25	7
Mode Current Preference	Private Car	8	0	2	1
	Bus	35	4	19	2
	Shared Taxi	9	1	4	4
	Total	52	5	25	7
Problem Using Bus Mode	Slow	15	0	3	2
	Discomfort	7	0	1	1
	Waiting Time	20	4	10	2
	Walking Distance	6	0	4	1
	# of Bus Stops	35	0	5	0
	Others	4	1	4	1
	Total	87	5	27	7
First Reason for Riding Bus	Cost	17	4	13	5
	Safety & Comfort	16	1	8	1
	Bus Routes	5	0	2	1
	The Only Mode	9	0	0	0
	Others	5	0	2	0
	Total	52	5	25	7
Increasing Bus Fare by 25%	Private Car	1	0	1	0
	Bus	6	1	6	2
	Shared Taxi	10	2	6	3
	Others	0	1	0	0
	Total	17	4	13	5
Increasing Bus Fare by 50%	Private Car	0	0	0	0
	Bus	1	0	2	1
	Shared Taxi	16	4	11	4
	Others	0	0	0	0
	Total	17	4	13	5

Bus Riders Statistical Analysis

Question	Category	Ramallah Salfit	Tulkarm Jenin	Tulkarm Nablus	Tulkarm Qalqilia
Job	Student	0	1	37	6
	Employee	1	0	16	0
	Labor	1	0	3	0
	Others	0	3	2	0
	Total	2	4	58	6
Age	10-20	0	0	21	2
	21-30	2	3	25	4
	31-40	0	1	6	0
	41-50	0	0	3	0
	>50	0	0	3	0
	Total	2	4	58	6
Gender	Male	2	1	43	2
	Female	0	3	15	4
	Total	2	4	58	6
Education	Below Secondary	0	0	2	0
	Secondary	0	1	2	2
	Diploma	0	1	3	0
	University	2	2	51	4
	Total	2	4	58	6
Monthly Income Rate	Less than 200JD	1	0	8	0
	200-400 JD	0	2	23	3
	400-600 JD	1	1	18	2
	More than 600 JD	0	1	9	1
	Total	2	4	58	6
Trip Purpose	Work	1	0	15	0
	School	0	0	39	2
	Shopping	1	1	2	0
	Social	0	2	1	2
	Others	0	1	1	2
	Total	2	4	58	6
Auto Ownership	Yes	0	0	6	0
	No	2	4	52	6
	Total	2	4	58	6
# of Trips by All Modes	>1	0	4	3	2
	1	0	0	2	0
	2	0	0	2	0
	3	0	0	4	1
	4 or more	2	0	43	2
	Others	0	0	4	1
	Total	2	4	58	6

Bus Riders Statistical Analysis

Question	Category	Ramallah Salfit	Tulkarm Jenin	Tulkarm Nablus	Tulkarm Qalqilia
# of Trips by Bus	>1	0	4	3	3
	1	0	0	6	0
	2	0	0	4	0
	3	1	0	5	0
	4 or more	1	0	33	3
	Others	0	0	7	0
	Total	2	4	58	6
Mode Current Preference	Private Car	0	0	0	0
	Bus	2	3	49	4
	Shared Taxi	0	1	9	2
	Total	2	4	58	6
Problem Using Bus Mode	Slow	1	0	8	0
	Discomfort	0	0	5	0
	Waiting Time	0	0	19	3
	Walking Distance	0	0	10	0
	# of Bus Stops	0	2	25	2
	Others	1	2	5	1
	Total	2	4	72	6
First Reason for Riding Bus	Cost	1	1	25	0
	Safety & Comfort	0	0	23	4
	Bus Routes	1	1	5	1
	The Only Mode	0	2	3	1
	Others	0	0	2	0
	Total	2	4	58	6
Increasing Bus Fare by 25%	Private Car	0	0	0	0
	Bus	0	1	9	0
	Shared Taxi	1	0	16	0
	Others	0	0	0	0
	Total	1	1	25	0
Increasing Bus Fare by 50%	Private Car	0	0	0	0
	Bus	0	0	2	0
	Shared Taxi	1	1	23	0
	Others	0	0	0	0
	Total	1	1	25	0

Bus Riders Statistical Analysis

Question	Category	Nablus Salfit	Ramallah Nablus	Ramallah Jenin	Ramallah Tulkarm
Job	Student	4	6	0	10
	Employee	2	28	4	0
	Labor	1	5	1	0
	Others	0	0	0	0
	Total	7	39	5	10
Age	10-20	3	5	0	4
	21-30	1	20	2	6
	31-40	1	10	1	0
	41-50	2	3	2	0
	>50	0	1	0	0
	Total	7	39	5	10
Gender	Male	6	25	3	2
	Female	1	14	2	8
	Total	7	39	5	10
Education	Below Secondary		1	1	0
	Secondary	0	1	0	0
	Diploma	0	9	0	0
	University	7	28	4	10
	Total	7	39	5	10
Monthly Income Rate	Less than 200JD	0	5	0	1
	200-400 JD	4	19	1	4
	400-600 JD	1	8	2	4
	More than 600 JD	2	7	2	1
	Total	7	39	5	10
Trip Purpose	Work	3	31	5	1
	School	4	7	0	7
	Shopping	0	0	0	0
	Social	0	1	0	2
	Others	0	0	0	0
	Total	7	39	5	10
Auto Ownership	Yes	1	6	3	1
	No	6	33	2	9
	Total	7	39	5	10
# of Trips by All Modes	>1	0	1	0	2
	1	1	3	0	2
	2	0	1	1	0
	3	1	2	0	1
	4 or more	5	29	3	5
	Others	0	3	1	0
	Total	7	39	5	10

Bus Riders Statistical Analysis

Question	Category	Nablus Salfit	Ramallah Nablus	Ramallah Jenin	Ramallah Tulkarm
# of Trips by Bus	>1	0	4	1	2
	1	1	2	0	2
	2	1	3	0	1
	3	1	3	0	2
	4 or more	2	22	3	3
	Others	2	5	1	0
	Total	7	39	5	10
Mode Current Preference	Private Car	0	0	0	1
	Bus	2	32	3	7
	Shared Taxi	5	7	2	2
	Total	7	39	5	10
Problem Using Bus Mode	Slow	1	9	4	1
	Discomfort	0	6	2	0
	Waiting Time	3	14	2	2
	Walking Distance	2	5	2	1
	# of Bus Stops	0	12	3	4
	Others	1	6	1	2
	Total	7	52	14	10
First Reason for Riding Bus	Cost	4	22	3	1
	Safety & Comfort	2	10	0	7
	Bus Routes	0	3	0	0
	The Only Mode	1	4	0	2
	Others	0	0	2	0
	Total	7	39	5	10
Increasing Bus Fare by 25%	Private Car	1	0	0	0
	Bus	1	10	0	1
	Shared Taxi	2	11	3	0
	Others	0	1	0	0
	Total	4	22	3	1
Increasing Bus Fare by 50%	Private Car	1	0	0	0
	Bus	1	4	0	0
	Shared Taxi	2	17	3	1
	Others	0	1	0	0
	Total	4	22	3	1

Bus Riders Statistical Analysis

Question	Category	Nablus Jenin	Nablus Ramallah	Nablus Tulkarm	Nablus Qalqilia
Job	Student	46	11	45	19
	Employee	4	24	6	2
	Labor	4	9	2	3
	Others	1	1	0	1
	Total	55	45	53	25
Age	10-20	18	7	18	11
	21-30	31	23	34	10
	31-40	5	8	0	2
	41-50	0	6	1	1
	>50	1	1	0	1
	Total	55	45	53	25
Gender	Male	34	35	38	18
	Female	21	10	15	7
	Total	55	45	53	25
Education	Below Secondary	2	2	0	1
	Secondary	4	6	2	2
	Diploma	1	7	1	4
	University	48	30	50	18
	Total	55	45	53	25
Monthly Income Rate	Less than 200JD	3	3	9	5
	200-400 JD	19	12	15	9
	400-600 JD	16	17	15	9
	More than 600 JD	17	13	14	2
	Total	55	45	53	25
Trip Purpose	Work	6	27	7	3
	School	45	11	43	20
	Shopping	0	2	2	2
	Social	1	2	1	0
	Others	3	3	0	0
	Total	55	45	53	25
Auto Ownership	Yes	5	12	3	0
	No	50	33	50	25
	Total	55	45	53	25
# of Trips by All Modes	>1	0	5	2	1
	1	1	3	2	4
	2	2	5	1	1
	3	4	2	2	1
	4 or more	45	27	45	17
	Others	3	3	1	1
	Total	55	45	53	25

Bus Riders Statistical Analysis

Question	Category	Nablus Jenin	Nablus Ramallah	Nablus Tulkarm	Nablus Qalqilia
# of Trips by Bus	>1	0	9	5	1
	1	2	3	3	4
	2	3	5	5	4
	3	6	4	6	3
	4 or more	38	18	32	12
	Others	6	6	2	1
	Total	55	45	53	25
Mode Current Preference	Private Car	4	6	2	0
	Bus	47	34	39	20
	Shared Taxi	4	5	12	5
	Total	55	45	53	25
Problem Using Bus Mode	Slow	11	8	6	7
	Discomfort	4	7	6	5
	Waiting Time	27	12	18	15
	Walking Distance	4	9	5	4
	# of Bus Stops	27	12	25	4
	Others	7	8	5	3
	Total	80	56	65	38
First Reason for Riding Bus	Cost	25	23	25	13
	Safety & Comfort	12	14	15	4
	Bus Routes	3	1	8	4
	The Only Mode	10	1	2	4
	Others	5	6	3	0
	Total	55	45	53	25
Increasing Bus Fare by 25%	Private Car	0	0	2	0
	Bus	13	12	10	5
	Shared Taxi	11	8	13	7
	Others	1	3	0	1
	Total	25	23	25	13
Increasing Bus Fare by 50%	Private Car	0	0	2	0
	Bus	4	2	4	3
	Shared Taxi	19	17	16	9
	Others	2	4	3	1
	Total	25	23	25	13

Bus Riders Statistical Analysis

Question	Category	Salfit Ramallah	Salfit Nablus
Job	Student	0	7
	Employee	2	3
	Labor	0	0
	Others	0	0
	Total	2	10
Age	10-20	0	4
	21-30	2	4
	31-40	0	2
	41-50	0	0
	>50	0	0
	Total	2	10
Gender	Male	1	8
	Female	1	2
	Total	2	10
Education	Below Secondary	0	0
	Secondary	0	1
	Diploma	1	0
	University	1	9
	Total	2	10
Monthly Income Rate	Less than 200JD	0	0
	200-400 JD	1	5
	400-600 JD	0	5
	More than 600 JD	1	0
	Total	2	10
Trip Purpose	Work	2	2
	School	0	8
	Shopping	0	0
	Social	0	0
	Others	0	0
	Total	2	10
Auto Ownership	Yes	1	0
	No	1	10
	Total	2	10
# of Trips by All Modes	>1	1	0
	1	0	0
	2	0	1
	3	0	0
	4 or more	0	8
	Others	1	1
	Total	2	10

Bus Riders Statistical Analysis

Question	Category	Salfit Ramallah	Salfit Nablus
# of Trips by Bus	>1	2	1
	1	0	0
	2	0	1
	3	0	0
	4 or more	0	8
	Others	0	0
	Total	2	10
Mode Current Preference	Private Car	1	0
	Bus	1	4
	Shared Taxi	0	6
	Total	2	10
Problem Using Bus Mode	Slow	0	1
	Discomfort	0	0
	Waiting Time	0	5
	Walking Distance	0	0
	# of Bus Stops	2	4
	Others	0	0
	Total	2	10
First Reason for Riding Bus	Cost	1	5
	Safety & Comfort	0	2
	Bus Routes	0	2
	The Only Mode	0	0
	Others	1	1
	Total	2	10
Increasing Bus Fare by 25%	Private Car	0	0
	Bus	0	3
	Shared Taxi	1	2
	Others	0	0
	Total	1	5
Increasing Bus Fare by 50%	Private Car	0	0
	Bus	0	1
	Shared Taxi	1	4
	Others	0	0
	Total	1	5

Shared Taxi Riders Statistical Analysis

Question	Catigory	Nablus Jenin	Nablus Ramallah	Nablus Tulkarm
Job	Student	21	10	10
	Employee	2	8	5
	Labour	1	4	4
	Others	0	2	0
	Total	24	24	19
Age	10-20	8	7	4
	21-30	14	11	12
	31-40	1	5	1
	41-50	1	1	2
	Less than 50	0	0	0
	Total	24	24	19
Gender	Male	20	20	13
	Female	4	4	6
	Total	24	24	19
Education	Below Secondary	0	2	1
	Secandary	0	3	4
	Diploma	2	2	1
	University	22	17	13
	Total	24	24	19
Monthly Income Rate	Less than 200JD	5	1	2
	200-400 JD	10	9	7
	400-600 JD	6	4	6
	More than 600 JD	3	10	4
	Total	24	24	19
Trip Purpose	Work	3	9	8
	School	21	6	11
	Shopping	0	2	0
	Social	0	5	0
	Others	0	2	0
	Total	24	24	19
Auto Ownership	Yes	5	11	7
	No	19	13	12
	Total	24	24	19
# of Trips by All Modes	Less than One	3	3	1
	1	0	4	1
	2	3	5	2
	3	0	3	1
	4 or more	18	6	13
	Others	0	3	1
	Total	24	24	19
# of Trips by Bus	>1	9	12	8
	1	0	4	1
	2	2	3	1
	3	2	1	2
	4 or more	8	0	3
	Others	3	4	4
	Total	24	24	19
Mode Current Preferencee	Private Car	4	7	1
	Bus	8	6	3
	Shared Taxi	12	11	15
	Total	24	24	19

Shared Taxi Riders Statistical Analysis

Question	Catigory	Nablus Jenin	Nablus Ramallah	Nablus Tulkarm
Reason for Riding Shared Taxi	Comfort	10	5	6
	Trip Route	4	1	0
	Speed	5	6	6
	The Only Mode	4	1	5
	Others	1	11	2
	Total	24	24	19
Decreasing Bus Fare by 25%	Private Car	2	5	2
	Bus	19	8	5
	Shared Taxi	3	8	11
	Others	0	3	1
	Totai	24	24	19
Decreasing Bus Fare by 50%	Private Car	2	5	0
	Bus	20	11	10
	Shared Taxi	2	4	8
	Others	0	4	1
	Total	24	24	19
Cause for Not Riding Bus	Slow	5	11	2
	Discomfort	1	1	1
	Wating	7	5	9
	Walking Distance	0	2	1
	# of Bus Stops	8	5	3
	Others	3	8	3
	Total	24	32	19
Bus Waiting Time 10min Only	Private Car	3	6	0
	Bus	14	9	3
	Shared Taxi	7	6	15
	Others	0	3	1
	Total	24	24	19
Bus Waiting Time 20min Only	Private Car	3	6	0
	Bus	9	8	4
	Shared Taxi	11	8	15
	Others	1	2	0
	Total	24	24	19
Express Bus Service	Private Car	3	6	1
	Bus	10	10	7
	Shared Taxi	8	5	11
	Others	3	3	0
	Total	24	24	19

Shared Taxi Riders Statistical Analysis

Question	Catigory	Nablus Qalqilia	Nablus Salfit	Ramallah Nablus
Reason for Riding Shared Taxi	Comfort	0	2	7
	Trip Route	0	1	0
	Speed	9	2	7
	The Only Mode	0	5	1
	Others	2	0	3
	Total	11	10	18
Decreasing Bus Fare by 25%	Private Car	1	0	2
	Bus	4	7	6
	Shared Taxi	5	3	10
	Others	1	0	0
	Total	11	10	18
Decreasing Bus Fare by 50%	Private Car	1	0	2
	Bus	4	7	9
	Shared Taxi	5	2	6
	Others	1	1	1
	Total	11	10	18
Cause for Not Riding Bus	Slow	3	6	11
	Discomfort	0	1	1
	Wating	5	1	3
	Walking Distance	1	1	1
	# of Bus Stops	2	1	3
	Others	1	0	4
	Total	12	10	23
Bus Waiting Time 10min Only	Private Car	1	0	3
	Bus	6	7	7
	Shared Taxi	4	3	8
	Others	0	0	0
	Total	11	10	18
Bus Waiting Time 20min Only	Private Car	1	0	1
	Bus	2	2	4
	Shared Taxi	8	8	12
	Others	0	0	1
	Total	11	10	18
Express Bus Service	Private Car	1	0	2
	Bus	5	5	5
	Shared Taxi	5	5	10
	Others	0	0	1
	Total	11	10	18

Shared Taxi Riders Statistical Analysis

Question	Catigory	Tulkarm Nablus	Jenin Nablus	Qalqilia Nablus
Job	Student	9	19	8
	Employee	5	1	2
	Labour	3	0	2
	Others	1	2	0
	Total	18	22	12
Age	10-20	3	9	3
	21-30	10	11	7
	31-40	2	2	0
	41-50	3	0	2
	Less than 50	0	0	0
	Total	18	22	12
Gender	Male	9	7	10
	Female	9	15	2
	Total	18	22	12
Education	Below Secondary	1	0	2
	Secandary	2	3	0
	Diploma	5	1	3
	University	10	18	7
	Total	18	22	12
Monthly Income Rate	Less than 200JD	0	6	2
	200-400 JD	10	10	4
	400-600 JD	6	6	4
	More than 600 JD	2	0	2
	Total	18	22	12
Trip Purpose	Work	6	1	2
	School	11	18	8
	Shopping	1	1	0
	Social	0	1	1
	Others	0	1	1
	Total	18	22	12
Auto Ownership	Yes	0	1	2
	No	18	21	10
	Total	18	22	12
# of Trips by All Modes	Less than One	2	2	0
	1	2	4	2
	2	2	1	1
	3	2	0	0
	4 or more	9	11	9
	Others	1	4	0
	Total	18	22	12
# of Trips by Bus	>1	7	4	4
	1	2	3	4
	2	2	0	1
	3	2	2	1
	4 or more	1	6	1
	Others	4	7	1
	Total	18	22	12
Mode Current Preferencee	Private Car	0	0	2
	Bus	5	7	5
	Shared Taxi	13	15	5
	Total	18	22	12

Shared Taxi Riders Statistical Analysis

Question	Catigory	Tulkarm Nablus	Jenin Nablus	Qalqilia Nablus
Reason for Riding Shared Taxi	Comfort	4	3	1
	Trip Route	1	2	2
	Speed	8	9	7
	The Only Mode	5	5	1
	Others	0	3	1
	Total	18	22	12
Decreasing Bus Fare by 25%	Private Car	0	1	0
	Bus	10	16	6
	Shared Taxi	8	5	6
	Others	0	0	0
	Total	18	22	12
Decreasing Bus Fare by 50%	Private Car	0	1	0
	Bus	16	16	6
	Shared Taxi	2	4	6
	Others	0	1	0
	Total	18	22	12
Cause for Not Riding Bus	Slow	1	5	1
	Discomfort	0	1	2
	Wating	9	7	4
	Walking Distance	1	2	0
	# of Bus Stops	6	5	6
	Others	1	3	1
	Total	18	23	14
Bus Waiting Time 10min Only	Private Car	0	1	0
	Bus	10	12	7
	Shared Taxi	8	9	5
	Others	0	0	0
	Total	18	22	12
Bus Waiting Time 20min Only	Private Car	0	0	0
	Bus	5	8	4
	Shared Taxi	13	13	8
	Others	0	1	0
	Total	18	22	12
Express Bus Service	Private Car	0	0	0
	Bus	10	10	6
	Shared Taxi	8	12	6
	Others	0	0	0
	Total	18	22	12