An-Najah National University

Faculty of Graduate Studies

Fare Estimation for Public Transportation in Palestine: Northern Governorates of the West Bank as Case Study

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This thesis was defended successfully on 29/04 /2018 and approved by:

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Dedication

This research effort is dedicated to my family, friends, and instructors. Without their love and support, I could not have achieved this goal.

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الإقرار

أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

Fare Estimation for Public Transportation in Palestine: Northern Governorates of the West Bank as Case Study

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

Declaration

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

Student’s name: **اسم الطالب : خالد جميل جبر دراوشه**

Signature: **التوقيع :**

Date: **التاريخ: 2018/4/29**

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Fare Estimation for Public Transportation in Palestine: Northern Governorates of the West Bank as Case Study

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Abstract

The aim of this study is to assess public transportation fare estimation practices by the Ministry of Transportation (MOT) and propose more solid, fair and flexible fare estimation procedures considering the current service level and key variables. It also aims to identify the relationship between the fare and the number of public transport units for a public transportation route. The study combines between Identified fare estimation variables with the results of the developed ridership demand model. The model forecasts the average daily number of passengers who are transferred by different public transportation modes (shared taxis and buses) included in this study.

The results provide an estimation of the average monthly profit for the public transportation vehicles for any route, which gives the indication about the route profitability and potential to increase or decrease the public transportation units for any route.

The study had investigated the public transportation operators' and travelers' satisfaction about the current public transportation fare. It shows that about 62% of public transportation operators considered the actual fare as low or very low, and about 38% consider it fair, while 69% of travelers consider it fair, and about 31% consider it high or very high.

Northern Governorates in the West Bank were selected as the case study for this thesis. A sample of external shared-taxi and bus routes which link towns and villages with the centers of the governorates were studied.

The methodology of the study is based mainly on quantitative and analytical methods, using the collected data and the field survey. Proper validation was conducted to ensure applicability of the resulting models.

Data collection on operational and demand aspects and analysis for the studied routes showed that the public transportation fare per one kilometer of travel depends mainly on the fixed cost which is inversely proportional to the average annual traveled distance, and to a less extent on variable cost, which is affected mainly by fuel consumption rate and the fuel price, the average occupancy rate, and on the profit margin which is determined by MOT. Four equations were estimated to express the shared taxi fare for different routes which are classified according to the village/town population and the route length. Three equations were also estimated to express bus fare for different routes. Simple linear regression models were developed to estimate the total number of trips produced per household using public transportation using relevant independent variables which include the shared taxis fare, numbers of employees, enrolled university students, and the number of private cars owned by a household.

The results illustrate that the fuel consumption rate and the fuel price are the main factors affecting the variable cost, but the change in the fuel price should be significant enough, in order to be reflected on the fare values.

The study also illustrates that the public transport system in the study area is economically efficient with 20% profit margin. The study recommends to determine the acceptable minimum and maximum average monthly income for public transport vehicles by the MOT and other stakeholders. In addition, it is recommended to link the fare with the cost of living index.

The study results could be used by the MOT to evaluate the current public transportation fare, and also to estimate the average monthly income for the operators by using the fare equations and the ridership demand model. This will assist them to make decisions about accurate fare estimation of any route and the right number of public transportation vehicles that should be operated on it.

Chapter One

Introduction

1.1. Background

One of the most principal components of the transportation systems is public transportation, which is considered as an important element in the infrastructure for any society, as it provides mobility to a considerable share of the population.

There are several definitions of public transport depending on the type of provided services. Public transport is that mode of transportation which is considered as for-hire to the public. It includes buses, trains, taxis, para-transit, and shared-taxis. If public transport does not satisfy the population needs in a comfortable and suitable way, transportation problem could occur, which must be faced by traffic and transportation engineers and planners (Issa,2006).

A survey of a sample of 385 men and women conducted in the North region of the West Bank in 2008 (World Bank, 2009) found that 97% of them use public transportation. In addition, 73% of females depended on public transportation, while only 61% of males depended on public transportation for most of their trips. Furthermore, 77% of the females who responded (age 16 and above) indicated that they do not have a driving license. Anew study was conducted in 2016 by the Ministry of Transport (MOT) indicated that 66% of the passengers depended on public transportation (large and mini buses, shared taxies) for their travel on external routes between the cities in the West Bank (Rebel, 2016). These results illustrate that public transportation is a very important sector for most of the people in Palestine, so it is necessary to conduct research and develop plans and actions to improve this sector.

1.2. Overview of the Palestinian Public Transportation System

Public transport in Palestine has consisted for decades of three modes; buses, shared-taxis (including intercity vans), and taxis. There is also an illegal operation of private cars that carry part of public transportation demand for fees.

Since the establishment of the Palestinian National Authority (PNA) in 1994, after about 27 years of Israeli occupation of the West Bank and Gaza Strip, there have been no major developments observed in the public transport sector. There were no funds assigned by the PNA from its budget to the development of the public transport facilities or to directly subsidize public transport services. As public transport is owned and operated by the private sector (firms or individuals), the PNA depended on the private sector initiatives to develop the sector. There was one exception, where the PNA arranged with the Dutch government to support the purchase of Dutch buses by Palestinian bus firms (Issa and Abu Eishesh, 2017).

Public transport in certain cities and on long-haul routes is provided by mini-buses (mainly 19 seats) and large buses. This is supplemented by shared-taxis (mainly 7-seat vans), which operate on these routes as well. Shared taxis also operate to provide short-haul services within the larger cities (mainly 4-seat cars), and from cities to the surrounding villages. Private taxis are available for individual point-to-point transport.

Public transport services are regulated by the MOT, which sets relevant policies and keeps records of public transport routes and vehicles, and followed up to the provided services. This implies that every bus and shared-taxi is required to have a permit, which specifies the route on which it must operate. The maximum number of shared-taxis to operate on a line is also regulated by the MOT. The determination of fare is another responsibility of the MOT.

The MOT also has the right to give a certain bus company concession rights to exclusively operate on a certain route. Due to the absence of PNA power on the ground in most of the West Bank, as more than 60% of its area is classified as Area C, which is still controlled by the Israeli occupation, there has been weak monitoring and control of public transport. This has affected the implementation of regulations related to public transport.

The public transportation sector in Palestine is suffering from many problems. According to the MOT officials[1] the main problems are:

- The large number and surplus in public transportation vehicles, which exceed the need.
- The public transportation sector is owned by the private sector, and operators cannot improve the level of service by renewing the fleet,

[1] Interview was held in March 2017 with the Vice General Traffic Controller in the MOT Mr. Yousef Darawshi.

especially bus companies, which are composed from 86 bus companies in the West Bank.

- The large number of private cars that carry passengers for fee.
- The inability to control all public transport routes, especially external routes passing through or operating in area C, and the problems imposed by the Israeli barriers and check points.
- The need to renew the law of the transport.

According to the operators[2] of public transportation sector, the main problems the sector faces are:

- The large number of private cars that illegally and informal carry passengers for a fee, which affects the demand for public transportation and creates a serious problem for the operators. Some gaps in the law and the inability to apply the necessary legal actions make the problem even worse.
- Regulations are issued by the MOT without consulting the representatives of the operators of the public transport sector.
- The public transport fare is not satisfactory and not linked with the cost of living index.
- The more strict enforcement by traffic police concerning public transport, and the inequality in issuing traffic tickets for public and private vehicles drivers.

There are also other problems that affect the public transportation sector, which will be referred to in the following section.

[2] Interview was held in July 2017 with the Head of Public Transport Union Mr. Abdullah Alhelo.

One of the most important determinants in public transport is the cost of service of transportation. For users, the cost of service is the fare which became one of the most important factors that influence public transport demand, and eventually the public transport system as a whole. The fare is that portion paid by users to cover the operators' costs and their margin of profit. It has been influenced effectively by the occupancy rate of public transport vehicle, which is the key link connecting the fare level and operators' costs such fuel, maintenance, labor costs, taxes and licensing fees. These costs influence the development of sustainable public transit fare systems that take into account the dynamic nature of the factors which determine the fare of the provided public transport services.

Transportation planners around the world direct their research and studies toward the development of public transportation using different approaches. Research efforts focus on increasing the efficiency of the existing public transportation system using different strategies to achieve objectives.

In this research, there are two strategies adopted to contribute to improving the public transportation system; the first deals with improving the pricing system for public transportation, and the second deals with analyzing and modeling demand for travel using public transportation. In this thesis, the problems that have to do with the public transportation sector are highlighted. Then appropriate solutions are suggested for some of these problems, especially those related to the public transportation fare estimation, which will be the core of the research. The current study is meant to answer some questions related to public transportation fare policies, structure, estimation, and the prediction of the number of passengers who use public transportation vehicles operating on external shared-taxi and bus routes, which link towns and villages with the centers of the Governorates within the study area. This thesis considers the two indicated strategies, which will also facilitate making proper decisions concerning the number of vehicles on each route.

1.3. Problem Statement

There are several problems and challenges which are related to the public transportation sector in Palestine. Some of these are between the operators of public transportation sector and the Ministry of Transportation, specifically on the fare issue.

Problems and challenges in public transportation associated with the fare include:

1. Problems in the frequency of service, where there are fewer frequent trips and more headway and waiting time.
2. Public transportation is not available in some times during the day, with no enough line capacity during peak hours (some routes have passengers waiting for long times at peak periods without availability of sufficient vehicles) in spite of the high number of public transportation vehicles.
3. Public transportation sectors strikes related to fare issues.

4. Inconsistency in fare from on line to another (e.g., some lines have the same distance but different fares, while others have different distances with the same fare).
5. The frequent requests of public transportation owners to increase the fare due to the increase in fuel cost.

1.4. Study Objectives

The aim of this study is to assess public transportation fare estimation practices by the MOT and propose more solid, fair and flexible fare estimation procedures.

To achieve this aim, the following objectives are to be satisfied:

- Examining the formulas of fare estimation for public transportation in Palestine as set by the MOT.
- Assessing the fare estimation method used in Palestine with respect to those used internationally and regionally.
- Establishing a formula to estimate the public transportation fare, considering the current service level and key variables.
- Identifying the relationship between the fare and the number of public transport units in any public transportation route within the study area, by estimating the total daily average number of passengers per public transportation vehicles using ridership demand modeling.

1.5. Study Approach

The methodology of the study is based mainly on quantitative and analytical methods, using data that were collected and the field surveys that were conducted. Chapter Three shows the detailed methodology to be followed in this research in order to achieve the objective of the study.

1.6. Study Area

The case study area is northern governorates of the West Bank (Nablus, Qalqiliya, Tulkarm, Jenin, and Tubas). A sample of external shared-taxi and bus routes which link towns and villages with the centers of the governorates will be studied. Figure 1.1 shows a map of the study area.

1.7. Thesis Structure

This thesis is composed of seven chapters, Chapter One includes the background, overview of public transportation in Palestine, problem statement, study objectives, study area, and thesis structure. Chapter Two presents a review of similar studies at national, regional and international level. Chapter Three outlines the methodology followed in this thesis, Chapter Four presents in-depth review for public transportation fare estimation methods in Palestine which were mentioned in the studies at national level, and discusses about the actual method followed by the MOT. Chapter Five explores data collection. Chapter Six is provides a presentation of analysis of collected data and presents and discusses the results. Finally, Chapter Seven provides the conclusion and recommendations of this study.

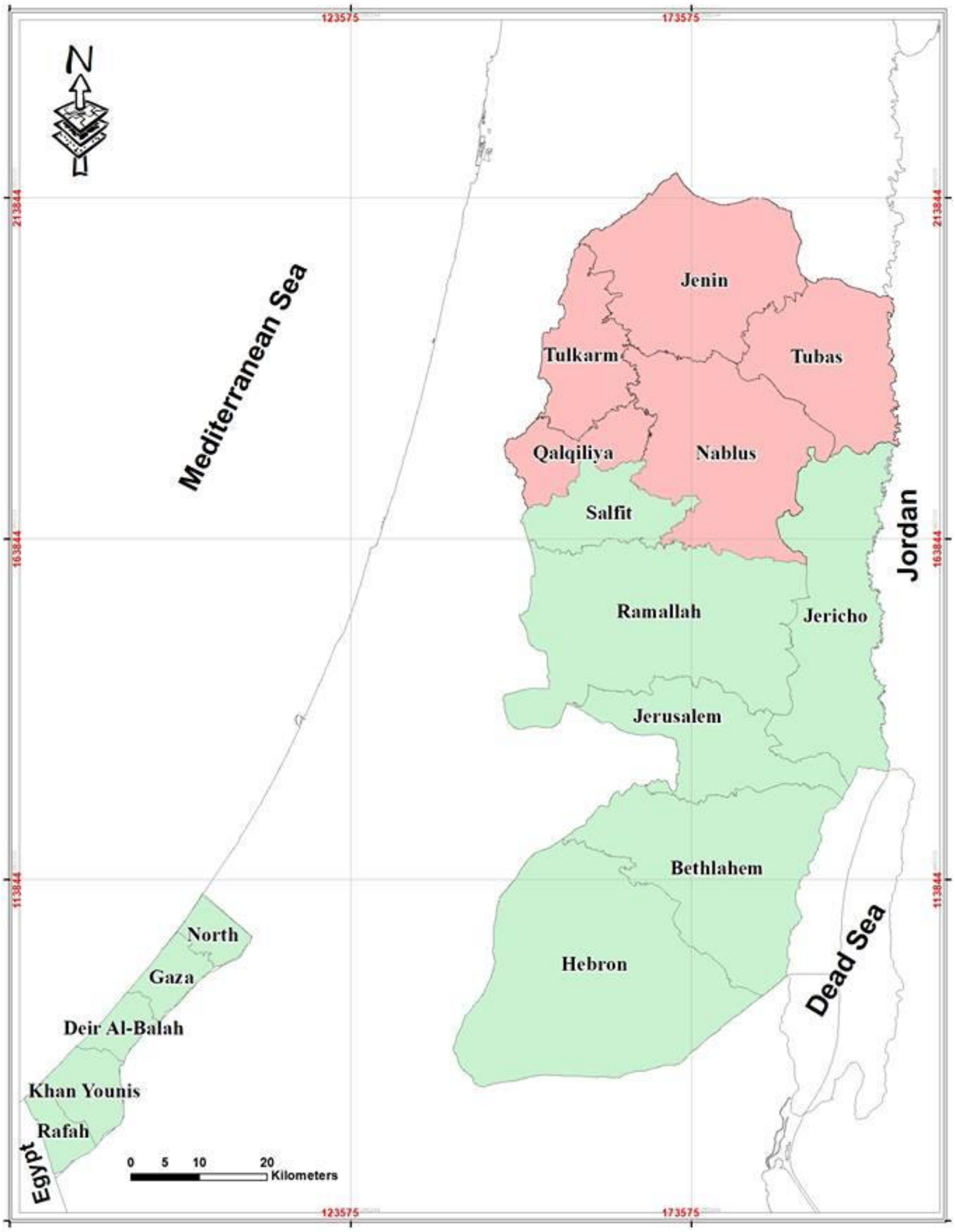

Figure 1.1: A map illustrates the study area

Chapter Two

Literature Review

2.1. Chapter Overview

This chapter presents a review of some key previous studies on public transportation and its operating cost and fare structure, as well as estimation procedures at the international, regional and national levels. It also presents a review of representative studies for public transportation ridership demand modeling.

2.2. Studies at the International and Regional Level

2.2.1. Tariff Integration for Public Transportation in the Metropolitan Area of Bucaramanga(MAB)-Columbia

This paper, prepared by Sepra, et al. (2015) sets forth a proposal to modify the current fare system in the Metropolitan Area of Bucaramanga (MAB) in Colombia, regarding urban public transportation (buses and vans), so as to make this system more attractive for users, because of the lack of fare alternatives and cash use in the current transportation system, which was proven to be ineffective and, on the contrary, provides an adverse and uncomfortable effect on the user.

The study mentioned several problems facing public transportation system including the low coverage of supplementary routes and the frequency irregularities of the service that have forced users to look for alternative ways to transport. In addition, it highlighted Bus Rapid Transit (BRT) deficiencies regarding frequency, coverage, sale and reload points of sale, and service quality.

With reference to above mentioned problems, the study aimed to attract people to use the BRT in the MAB by several measures. One of these measures is to update of the current tariff mode. For the service provider, the tariff has a basic interest since the revenue is the difference between the operation costs and the total income.

Considering the elasticity of demand when varying the tariff, the quantity of travels does not vary the tariff as determined by (Equation 2.1):

$$Tariff = (c(Q) + u)/N \text{..........................} \quad (2.1)$$

where:

c (Q)=the cost that should depend on the service quality

u =the expected income the operator intends to achieve for every transported passenger, normally adopted as a percentage of the cost or invested capital in order to provide service

N = number of passenger transported.

The operator is interested in shaping every cost in order to estimate the total cost for the service provision at different production levels. since based on these values, based on the identified cost elements the minimum income that can be obtained could be established. Total costs can be established by the addition of fixed and variable costs through:

$$CT = CF + N * CV \quad \ldots\ldots(2.2)$$

where:

CT = total cost

CF = fixed cost

CV= variable cost per produced unit

N = units produced (in this case number of passengers)

Also the study indicated for the BRT system, that the cost for the fare collection technology and its distribution need to be included in the budget, because this is an operation and management monthly expense. The duty is performed by a company in charge of collecting MAB's money. In this case, the main income source for the BRT MAB is the daily sale of tickets at the established technical rate. This rate is quantified as the relation of the total BRT's expenditures over the total number of validated tickets of passengers effectively transported- of the system. The licensee's bid tariffs are adjusted every six months according to operative cost increase. Particularly, tariff update per kilometer for every type of vehicle is based on the operation cost increase. This is performed using Equation (2.3):

$$Taju_{j,i} = T_{j,i-1} \cdot \{1 + [(0.67 \cdot VIPC_{i-1}) + (0.13 \cdot VIPP_{i-1}) + (0.2 \cdot VCC_{j,i-1})]\} \ldots\ldots(2.3)$$

where:

Tajuj,i = Licensee's adjusted tariff for the period.

Tj,i-1 = Licensee's tariff for the period immediately preceding.

$VIPC_{i-1}$= Consumer Price Index variation for the period immediately preceding –certified by the National Administrative Department of Statistics (DANE).

$VIPP_{i-1}$= Producer Price Index variation for the period immediately preceding –certified by the National Administrative Department of Statistics (DANE)

$VCC_{j,\ i-1}$: Licensee’s Fuel Cost Index Variation Regarding the licensee’s revenue during the time the license is in force.

2.2.2. Criterion for a Fares Policy and Fares Index for Bus Transport in Sri Lanka

This study was prepared by Kumarage (2002) and is published in the International Journal of Regulation and Governance. It mentioned that most of the problems facing the public transportation sector is the lack of fare policy that makes fare revisions vulnerable to decisions aimed at solving or appeasing a section of the stakeholders rather than the planned growth and development of the sector.

The study made a good review for fare policy and its relation to quality of service, capacity and efficiency of public transportation for several time periods in Sri Lanka. The study investigated the factors considered in criterion of fare policy, which are:

- The passenger profile and affordability
- The efficiency and cost of bus operations
- The fare structure and anomalies

- External benefits and operator subsidy
- Mechanisms for fare revisions and elimination of anomalies

The study indicated that fares policy must recognize the need to have a scientifically determined basis of calculating the operating cost of buses. The cost of bus operations if indexed to costs on inputs (such as price of fuel, wages and spares) can be then used for conveniently calculating the variations to costs at different points in time for different routes at different levels of quality and efficiency. This can be called a Cost Index. The Cost Index should be sensitive to the changes in the operating cost of bus service due to changes in the cost components, so that it can be used as guiding indicator to revise bus fares whenever it is deemed necessary.

The paper sets out the construction of the cost index as a sequential process. The first in this process is to identify the different cost components of operating. The second aspect is that operating cost can also vary according to the different operating conditions. Since there is only a single fare structure procedure implemented in Sri Lanka (i.e., distance based and varying for mountainous terrain), it is necessary to arrive at a single index to calculate a weighted national operating cost. This has been done as a composite index based on averaging the different cost scenarios using a weight according to the number of buses operating on each of the representative route types.

The study mentioned that the fare structure in Sri Lanka is based on fare sections. Each route has its fare sections, and there is anomalies in fare structure between routes quiet similar in nature and the study provided some instance and reasons about that and also mentioned the procedure followed to adjust anomalies by using cost index and a process of trial and error method, whereby the adjustments to the fare structure required to level the cost-benefit return on the different routes at a given level of efficiency.

The study mentioned that bus transport policy introduces the concept of allowable fare “the maximum fares level that an operator is allowed to charge" and if a route requires a higher level of fare then the government may consider a fare subsidy.

The study mentioned the steps that should be included in the mechanism followed for fare revision and eliminations of anomalies, which are the following:

- A cost revision
- A fare revision
- A fare anomaly adjustment plan
- A subsidy plan

For cost revision, the weighted operating cost can be calculated at any point in time by ascertaining the prices of the inputs at that point in time. All cost items may be linked to the Cost Index using unit prices or price levels such as the Consumer Price Index (CPI) or the Exchange Rate for the US$ or market prices. In the fare revision stage, the fare index must ensure that the cost of operating the route is recovered from passengers (unless a subsidy is provided), so that the Benefit Cost Ratio for different routes is around 1.

The paper concluded that lack of fare policy resulted in deterioration of quality of service and stressed the benefits for fare structuring, especially maintaining service quality and providing transparency that would reduce unnecessary bargaining and canvassing among public transit operators with politicians to increase the fares.

2.2.3. Public Transport Fare Structure Review, New Zealand

This report was prepared by Johnson (2013) for the Public Transport Group, Greater Wellington City Council, New Zealand. The report indicated that the objective of the fare review, which is developing a fare structure that is**:**

- equitable for those using the system
- simple and easy to understand
- reflects the policies of the Regional Public Transport Plan, and
- maximizes patronage while achieving the necessary level of fare box recovery.

The report highlighted the criteria for any assessment of an alternative fare structure as follows:

- Simple, easy to understand and use
- Encourage patronage growth
- Affordability for users
- Ease and costs of fare ticketing system implementation and on-going administration
- Support efficient network design, operations and asset utilization
- Deliver sufficient revenue
- Economic efficiency

The report also summaries the strengths and weaknesses for deferent fare structure as in the Table 2.1.

Table2.1: Criteria for Assessment of an Alternative Fare Structure

Fare structure	Strengths	Weaknesses
Flat fare	• Simple and easy to understand • Easy to implement free transfers	• No relationship between fare and distance travelled • Implicit cross subsidization of costs of short and long trips • Transfers within the zone included in fare
Coarse zonal structure	• Relatively simple and easy to understand • Easy to implement free transfers • Broad relationship between distance travelled and fare	• Implicit cross subsidization of costs of short and longer trips within one zone • Issues for short journeys crossing zone boundaries • Transfers within a zone included in fare
Distance based	• Generally perceived as fair by users • Strong relationship between distance travelled and fare	• Users unable to know with certainty what the fare will be prior to boarding for new journey • Difficulty in establishing fares for indirect or circuitous routes (collector routes) • Transfers dealt with through removal of flag fall for second journey.
Time based (duration)	• Simple and easy to understand	• Fare has no relationship with distance

	• Facilitates transfers between services	• Difficulties setting fares when congestion, or for express services vs standard services • Cancelled or late services become more of an issue as may reduce value of the ticket
Time of travel (peak / off peak – can be used with any of above zone, distance or time based structures)	• Relatively simple and easy to understand • Encourage users to shift journey time from peak • Encourages increased usage in off peak period • Increases alignment of fare and cost of service provision	• Potential to increase disputes around fares • Weakens differentiation between fare and distance travelled • Potential to add complexity for transfers from peak to off peak services within one journey

Source: (Johnson, 2013)

2.2.4. Study on Electronic Ticketing in Public Transport

This report was prepared by Mezghani (2008) for the European Metropolitan Transport Authorities (EMTA) and its include some definitions and principles for public transportation pricing, such as the level of fares should be such that the total revenue earned by a public transport service is sufficient to cover the total cost of providing it plus a reasonable profit. This principle would be fine if public transport was operated as a fully commercial service. But this is not the case in the majority of cities/regions where public transport is at the authority's initiative and is implemented pursuing social objectives. Consequently, the study mentioned that public transport price policy should find the right balance between several sometimes contradictory objectives as follows:

For the authority

- Increasing the number of citizens using public transport
- Setting low prices and simple tariffs
- Balancing prices and encouraging social inclusion
- Minimizing public subsidies or financial compensation

For the operator

- Covering costs and maximizing profit
- Building an attractive public transport system (image, loyalty)

For the passenger

- Minimizing transport cost
- Travelling in ‘good’ conditions

2.2.5. Public Transport in Jordan

In 2010, the Land Transport Regulatory Commission (LTRC) became responsible on all land transport facilities instead of Public Transport Regulatory Commission (PTRC). The LTRC aims to regulate, control the land transport services and encourage investment in the land transport sector in line with the objectives of economic and social development (Al-Humood, 2016).

The public transport sector does not receive any significant financial support from the state, which is not surprising considering that public transportation is not among its priorities. The state acts as though this sector should be financially self-sufficient, and therefore should cover its costs. The LTRC determines fares according to a formula it has developed that addresses factors such as the price of fuel and general capital and operating costs, as well as the operator's profit margin, and assumes a certain occupancy rate. Criticism, however, has been made that the formula does not take into consideration the particularities of different routes, specifically as related to issues such as the number of users (reflected in the occupancy rate). As a result, the formula may work well for some operators, but not for the others. Many bus operators accordingly are only able to make a profit by lowering the frequency of bus trips and not initiating trips until their buses are full. This, in turn, results in poor quality of service and lower liability. Subsidies for public transportation are almost nonexistent. The only support currently provided for the sector relates to the routes serving a limited number of universities in the country that are located outside urban centers(CSBE,2017).

2.2.6. Estimation of Transport Buses Operating Cost

This M.Sc. Thesis prepared by Alhasan (2017), has one of its objectives that is related to estimate the operating cost for public transit buses and to evaluate the economic situation for their operators by determining the bus operating ratio (revenue/cost ratio). The study concentrated on buses routes in Irbid city in Jordan.

The study mentioned that transportation costs are the most influential factor on all components of the public transit system. There are many factors influencing the development of sustainable public transit systems that take into account the dynamic nature of the factors influencing the tariff of the provided public transit services. These factors include the variations in fuel costs, labor costs, taxes, licensing fees, demand, and provided subsidies in addition to many other factors. Also, the frequencies of public transit vehicles could affect the costs of public transit, and the level of service for public transit system from users' point of view, which affect the attractiveness of public transit system.

For achieving the previously mentioned objective, the methodology followed to analyze the collected data on different cost variables was dividing the operating cost into two categories, fixed and variable costs.

Fixed costs are paid annually regardless of the traveled distance; while the variable costs depend mainly on the traveled distance. The following equations together forming a deterministic model for determining the total operating cost for a given route using a set of data gathered from the case study area.

$$TC = (FC + VC) \times NB \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2.4)$$

where

TC = Total annual operating cost for a route (JD/yr)

FC = Average fixed operating cost (JD/yr)

VC = Average variable operating cost (JD/yr)

NB = Number of buses per route

Equations 2.5 and 2.6 used to estimate both fixed and variable costs, respectively:

$$F.C = C_d + C_l + C_i + W_w \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2.5)}$$

where

C_d = Average depreciation cost (JD/yr)

C_l = Average license cost (JD/yr)

C_i = Average insurance cost (JD/yr)

W_w = Average staff wages (JD/yr)

The variable cost includes both maintenance and fuel costs:

$$VC = C_m + C_f \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2.6)}$$

where:

C_m = Maintenance cost (JD/yr)

C_f =Fuel cost (JD/yr)

The results of operating cost estimation in the study proved that the wage of labor forms the major proportion of the total operating costs. In general fuel, maintenance and fixed costs almost have the same proportion from the total cost. Noting that, these proportions differ from route to another because of their dissimilarity in the characteristics that affect the operating cost, which are the annual traveled distance, average traveling speed and actual headway (schedule).

The study concluded that the unit of maintenance cost (JD/km) is inversely related to the total traveled distance. The study found that some routes suffer from a significant increase in the number of buses in service more than they actually need, leading to a decline in their revenue cost ratio.

2.3. Studies at the Local Level

2.3.1. The Impact of Ministry of Transport Policies on Public Transportation in Palestine

This M.Sc. thesis, prepared by Issa (2006), studied and evaluated the MOT policies regarding public transportation sector. One of the main issues that were analyzed and discussed in the study is public transportation fares equation and its components. The study indicated that fare structure is regulated by MOT for Palestinian bus companies (not including those registered in Jerusalem). The fare structure for buses is zonal, that is, based on the distance traveled or location of alighting and boarding stations. On the other hand, for shared-taxis the fare is flat. The MOT usually sets the values of public transport fares for both buses and shared-taxis based on one kilometer riding (kilometric tariff). This tariff is reviewed and calculated normally every six months based on the fuel prices (especially diesel).

The MOT generally follows a number of steps in calculating tariff for a certain route of distance in km, average speed in km/hr, and time in hours. Table 2.1 summarizes the fare calculation procedure for the bus mode. The shared-taxi mode fare is also calculated considering a similar procedure. The main differences between the buses and the shared-taxis are the values of average speed, trip time, and the number of riders (passengers). Tables 2.2 and 2.3 present the MOT procedure for calculating the daily operating costs in (NIS) for buses and shared-taxis, respectively.

Table 2.2: General Procedure for Calculating Bus Fares

Route name: ----------
Distance (km): ----------
Average speed (km/hr): ----------
Trip time (one direction) in hours = Distance / Average speed
Total trip time in both directions (hr) = 2* (trip time + waiting time + access time + boarding/alighting time)
Average daily bus work hours (hr): --------
Number of trips per day = average daily hours/ total trip time
Cost of one kilometer(in NIS) = 1.35*(daily cost/((number of trips/day)*distance)), profit percentage is 35%
Rider tariff (in NIS) = (cost of one kilometer*distance)/number of riders), where the average number of riders is usually 25
The cost per kilometer per rider = rider tariff /distance

Source: (Issa, 2006)

Table 2.3: Average Daily Bus Operating Cost

(based on 10 years in Operation)

Item	**Cost (NIS)**
Depreciation	106.0
Insurance	36.12
Fuel	300.0
Maintenance	114.0
Income Tax 1	1.65
Value Added Tax (VAT)	8.27
Drivers wages	83.33
Overheads expenses	30.0
Parking, garage, etc.	40.0
Different registration expenses	1.67
Total Daily cost	**721.04**

Source: (Issa, 2006)

Table 2.4: Average Daily Shared-Taxi Operating Cost

(based on 7 years in Operation)

Item	**Cost (NIS)**
Depreciation	41.1
Insurance	16.4
Fuel	100
Maintenance	31.82
Income Tax	3.36
Value Added Tax (VAT)	6.28
Drivers wages	83.33
Overheads expenses	9.67
Parking, garage, etc.	17.5
Different registration expenses	6.85
Total Daily cost	**318.23**

Source: (Issa, 2006)

The research assessed the public transportation fare formula set by the MOT, as the fare structure for public transportation modes in the Palestinian Territories is regulated by the MOT.

As stated above, the fare structure is zonal for buses, no card system is followed, and no discounts are given for frequent riders except students.

Similar to the operation of buses, the fare structure of shared-taxis is specified by the MOT. On the average, actual public shared-taxi fares are 25% higher than bus fares. Fares are mainly flat, since shared-taxi drivers charge fares regardless of distance.

The study indicated that the MOT established fares for routes of each type of public transport calculated based on cost plus profit for each route depending on components as mentioned in Table 2.2 to calculate average daily operating costs. By referring to the Table 2.1 which illustrates the steps followed in calculating the kilometric fare, it is concluded that the distance variable plays an important role, i.e., the fare value varies mainly based on the length of the route. As a result, the kilometric fare decreases as the distance increases which is logical.

As the results of the research concluded that the MOT fare formula is good and recommended that apart of regulating and monitoring role of the public transport services, the MOT should ensure that the public transport operators charge the governmental tariff. In addition, it also recommended that in order to set the optimal and affordable public transport fare formula, the MOT should subsidize the public transport operators and take into account changes in fuel prices, maintenance costs, and driver wages in its fare formula. The price consumer index and the average national monthly earnings were indicated to be important indicators for consideration.

The study recommended to reduce travel time and to facilitate the fare payment processes, where the MOT was recommended to initiate and encourage the use of new technologies regarding fare collection systems, like electronic or magnetic card systems. Finally, it recommended that the MOT should ensure that the public transport operator's revenues are greater than operating costs with an acceptable percentage of profit (35% based on MOT regulations).

2.3.2 Technical Assistance in Public Transport Performance and Tariff

This study published by the World Bank (2010) had the main objective of the study to develop a formula for calculating public transportation (buses and shared taxis) tariff. The study mentioned that all conclusions and recommendations were developed based on meetings with MOT, other stakeholders, and operators of public transportation. The study mentioned five categories that influence tariff formulation as follows:

1. Cost of operation: This includes fuel costs and fuel consumption rates, vehicle depreciation costs, annual registrations, repairs, insurance, taxes, drivers' salaries, and operation and administration costs.
2. Demand (ridership): This includes number of round trip per day and weighted occupancy rates for each trip.
3. Other sources of revenues: These include field trips for schools and special events, in addition to on-vehicle advertisements (if applicable).
4. Profit margin: All the public transit operators are private companies; thus a minimum profit margin must be expected.
5. Other factors: These other factors that affect tariff estimation are mainly competition, affordability of passengers and uncertainties.

Because of the lack of the existence of methods or formula used for estimating tariffs for the various routes and for each of the two public transportation modes, this study is considered the first attempt to establish procedures for calculating and estimating public transit tariff in the Palestine. It aimed to establish viable tariffs for current service levels, without subsidies at this stage. Viable means that "revenues are sufficient to enable an efficient and diligent operator to cover all costs of service provision, including the financing costs of vehicles, correct maintenance, the statutory obligations to personnel, and adequate regulatory and safety compliance and also aimed at providing information to the MOT to be able to develop a vision and a policy for tariff estimation of public transport.

The calculation of the recommended tariff for the public transport operation in Palestine is based on the abovementioned tariff components. An interactive and user-friendly template was developed with sample routes calculations.

The study concluded that the provided tariff formulation method through a spread sheet template is only as accurate and relevant as the provided data inputs. Thus validation of data from various sources (or conducting of pertinent studies) to obtain such data is of paramount importance.

The study recommended that it is essential to improve the database systems of the MOT, especially in regard to public transit records and data. A component of this study has provided the MOT with technical assistance to store, back-up files, retrieve, and manage databases. It concluded that a continuous process and the system of entering and storing data must be maintained.

2.3.2. Ridership Demand Analysis for Palestinian Intercity Public Transport

This study was prepared by Alsahli and Sadeq (2003). The study presented the results of studied intercity bus ridership demand, and formed a basis to predict future ridership in the Palestinian territories. The Intercity public transport between six governors in the northern and central districts of the West Bank was examined. The relationship between public transportation demand and operating and socio-economic variables that influence demand was established. The study mentioned that there are many factors -external and internal- affect public transport demand. External factors are associated with socio-economic developments which are not subject to control like income, car ownership, population and other household characteristics, and internal factors are characteristics of the public transport system and are subject to policy decision. To achieve the study objective for modeling the ridership demand, statistical analysis and least square regression were used to analyze the data collected by on-board field survey for 410 riders who used intercity buses in the study area.

The study mentioned that different trials and tests were executed which showed that the best relation between the dependent and the independent variables was the linear form. The selected independent variables were chosen based on their correlation and causation(logic) so the initial 14 variables were reduced to 5 which are:

- Origin city population in thousand, D_1
- Destination city population in thousands, D_2
- Bus fare in (NIS), D_3
- Origin city percentage of students who are attending secondary schools or universities, D_4
- Origin city percentage of people older than 15 years who are employed, D_5

By using the multiple linear regression analysis, the obtained relationship was presented in Equation 2.7 with correlation coefficient, $R^2 = 0.82$.

$$Y = 1084.8 + 26.8\ D_1 + 25.7\ D_2 - 813\ D_3 + 80.3\ D_4 + 68.3\ D_5 \text{ …..... } (2.7)$$

2.3.3. Developing Trip Generation Models Utilizing Linear Regression

This M.Sc. thesis was prepared by Dodeen (2014). The aim of the study is to predict current and future traffic trips generated from different traffic zones that comprise a Palestinian city. Thus it studied and modeled trips produced from households according to their characteristics, relying on the principles of the regression analysis technique, considering Jericho City as the case study.

The model establish relationship between the number of trips generated by households and some socioeconomic attributes.

The study mentioned that regression analysis is conducted several times, and in each stage, the regression model is evaluated according to the statistical tests. The iteration is made by reducing the independent variables that have the least t-value. The final estimated general trip generation model was developed as in Equation 2.8 with R^2=0.69.

$$Y = 1.83 + 1.29\ D_1 + 1.35\ D_2 +.20 D_3 + .28\ D_4 + .07\ D_5 \text{ …..... } (2.8)$$

where:

Y = Number of daily trips made by household

D_1 = Number of employed persons in the household

D_2 = Number of persons receiving education in the household

D_3 = Number of persons under 16 years in the household

D_4 = Number of persons between 51 and64 years in the household

D_5 = Monthly household income (Thousand NIS)

The study recommended to build on the resulting models in order to estimate mode choice models that could be used to estimate public transportation riders

2.4. Summary

Review of literature shows that public transportation fare estimation is mainly depending on determine the operating cost, which could be estimated by averaging the different cost variables, which consist of fixed and variable costs. Cost estimation should consider different cost scenarios, operating conditions and the dynamic nature of some cost variables. The fare estimation also depends on other factors, which are the travelled distance, the profit margin, the average occupancy rate and the total ridership demand. Also, the frequencies of public transit vehicles could affect the costs of public transport, and the level of service for public transport system from users' point of view, which affect the attractiveness of the public transport system.

It can also be concluded that the lack of fare policy had resulted in deterioration of quality of service and therefore highlighted the benefits for fare structuring, especially maintaining service quality and providing transparency that would reduce unnecessary bargaining among public transit operators with politicians to increase the fares. The fare should be equitable simple and easy to understand.

The previous studies for public transport fare estimation in Palestine showed that the fare set by the MOT depends on cost plus profit method. The public transport sector operators do not receive any significant financial support from the government. The government acts as if this sector should be financially self-sufficient, and therefore should cover its costs.

Despite the researches and studies carried out in Palestine to find a formula to calculate public transportation fare, the problems that have been mentioned and related to pricing of public transport still exist. These problems are similar to those mentioned in case studies on the international and regional level.

Chapter Three

Methodology

3.1. Chapter Overview

This chapter describes the steps followed to achieve the study objectives. The following highlights the methodology adapted in this study which is composed of:

- Literature review of papers and studies
- Investigate the people's satisfaction and the public transportation sector operators of the current fare of public transportation.
- Review the MOT public transportation fare estimation formula.
- Identify the actual demand.
- Set a new fare estimation formula.
- Examine the fare equation sensitivity.
- Set a model to expect the number of passengers (demand).
- Expect the average monthly or annual profit for public transport operators for each public transport vehicle.
- Identify conclusions and recommendations.

This is presented in more details in the subsequent sections.

3.2. General procedure of the Methodology

The research mainly depends on the following methodological procedure.

- Literature review of papers and studies on the issue at the international regional, and local levels and in depth of review the conducted studies for the Ministry of Transportation (MOT) that tackled public transportation fare (e.g., Public Transportation Performance and Tariff Study Final Report of 2010).

- Investigate the people's and the public transportation sector operators' satisfaction of the current fare for public transportation, and whether the fare has been set after taking into consideration the public and/or the representatives of the public transportation sector operator’s needs, or not. This is done by conducting field surveys and personal interviews of a representative sample of passengers and public transportation operators, and by interviewing MOT officials and operators' representatives.
- Review the MOT public transportation fare equation, and examine whether the fare equation based on the relevant studies is applied or not by collecting data and comparing the estimated fares with actual ones, through a thorough examination of the equation variables of MOT public transportation fare. This is conducted considering collected data concerning all the relevant variables that affect travel cost to figure out the actual travel cost per kilometer through field survey for a representative sample of buses and shared taxis of different routes.
- Identify the actual demand by investigating the actual patronage for a sample of routes to estimate the total number of passengers per day and the number of trips/day for each of these bus and shared taxi routes, by conducting field survey for the indicated representative sample of buses and shared taxis of different routes.

- Set a fare equation considering the travel cost per passenger, the demand, and a suitable profit margin for the current levels of service.
- Examine the fare equation sensitivity, through conducting sensitivity analysis to find the expected changes in fare with changes in some factors like fuel price.
- Set a model to expect the number of passengers (demand) by conducting field survey for representative sample, and to estimate the average monthly income for public transportation operators with integration between the fare equation variables and the expected number of passenger for each vehicle in any route
- Identify conclusions and presenting policy recommendations to the MOT.

3.3. Methodological Outline

3.3.1. Data Collection

Data are obtained from their resources including the available MOT records and studies to determine all required descriptive data about the routes, vehicles, current fare, distances, …etc. In addition, relevant data were collected from the Palestinian Central Bureau of Statistics (PCBS) on the population of the communities in the study area, the average number of household members, household income, …etc. Moreover, field surveys were conducted to obtain all additional information to supplement data collected from the MOT or from the PCBS. The field survey data include personal interviews as well as data obtained from questionnaires distributed to collect the required relevant information from the travelers and public transportation operators on their satisfaction regarding public transportation services and fares, and on travel cost variables, actual demand and average occupancy rates, and the data needed to establish public transportation demand models to represent and forecast the number of passenger produced by different villages and towns in the study area.

3.3.2. Designing Survey Sample.

It's very important to select the proper sample size which reflects the reality with acceptable margin of error. The sample was selected randomly and its size was calculated by using the relevant statistical formula.

The statistical formula used could be found in most statistical text books and it is:

$$n = \frac{(Z\alpha/_2)^2(\pi)(1-\pi)}{E^2 + \frac{(Z\alpha/_2)^2(\pi)(1-\pi)}{N}} \qquad (3.1)$$

where:

n: is the sample size.

Z: is the normal distribution factor from statistical table.

α: is the 1-confidence level.

π: response distribution factor.

E: Acceptable margin of error.

N: size of population.

3.3.3. Designing Survey Questionnaires

Two questionnaires were designed, the first for investigation the satisfaction of public transportation operators on fare and to estimate the different components of cost, average daily number of passengers they carry in their vehicles (actual daily demand), the daily number of trips, and all data required on the routes and vehicles.

The questionnaire was distributed on an average day (not Friday, Saturday or Thursday) during April 2017. It consists of 4 pages, the first illustrates the purpose of the questionnaire, the next two pages contain questions on all data that could be directly obtained from the operators, while the last page requires that the operators should fill it in the next day on the number of passenger on each one way trip during that day.

The second questionnaire was designed to investigate the public transport travelers' satisfaction on the public transportation performance and the fare, and the weekly number of one-way trips made by the household in the average and all the independent variables which could affect that.

The selection of the independent variables depends mainly on the previous results of similar formulated models especially the model that was produced by Sadeq (2001). In his master thesis the assessments of intercity public transportation demand and elasticity in the West Bank, the following independent variables were adopted with some modifications and addition of new variables in this study.

The independent variables are:

- Origin village populations.
- Destination city population.
- The present employee and university students in origin villages household.
- Villages household income and expenses.
- Distance between origin and destination.
- Shared taxi fare.
- Availability of private car for the household.
- Number of household members.

3.3.4. Pilot Questionnaire

The pilot questionnaire is a pre-study survey designed to refine or modify the questionnaire or the research methodology. Ten pilot questionnaires were distributed for the operators' survey and thirty pilot questionnaire for the travelers. Slight modifications were made on the questionnaires depending on the notes that were written during survey and analysis of the pilot questionnaire.

3.3.5. Selecting Survey Method

Face-to-face Survey (Personal Interview Survey) was selected to conduct the field survey for the both previous mentioned questionnaire. Face-to-face surveys, where an interviewer presents the items orally, offer advantages in terms of data quality more than any other survey delivery mode, as it allows researchers a high degree of control over the data collection process and environment (Doyle, 2005). One of the main reasons why researchers achieve good response rates through this method is the face-to-face nature of the personal interview survey(Abdulhaq, 2016).

3.3.6. Data Analysis and Models Formulation

Depending on the data collected from the MOT and PCBS and from field survey an assessment for public transportation fare policy in MOT was conducted. The application of fare equation based on the relevant studies was examined. In addition, investigation was conducted on the travelers' satisfaction regarding public transportation performance and fare, and the public transportation operators on the public transportation fare.

To achieve two of the objectives of this study a model was formulated to estimate the public transportation fare considering the current service level and key variables for any external route between the villages and governorate center. The formulated fare equations are mathematical equations which represent different villages routes according to their population and routes length. The fare equations were formulated depending on cost plus profit procedure by estimating all average fixed and variable cost of travel, average occupancy rate, distance and profit margin, as summarized in Equation 3.1.

$$\text{Fare} = (\sum FC + (FCR * FP)) * L*PM / MOR \quad \ldots\ldots (3.1)$$

where:

FC: Fixed cost per one kilometer, which could be collected as average fixed cost for homogeneous routes circumstances (number of population in the villages or towns and route length)

FCR: Average fuel consumption rate

FP: Fuel price

L: Route length

PM: Profit margin

MOR: Modified average occupancy rate for routes with homogenous circumstances

To achieve the objective related to identifying the relation between the tariff and the number of public transport units in any public transportation route within the study area, the ridership demand model was formulated to estimate the daily number of passengers who use different public transportation modes. In addition, and depending on the fare estimation equation and its component (total cost and occupancy rate), the average monthly income for public transportation operators could be estimated which is mainly affected by the total number of passenger produced by the village and the total number of public transportation vehicles on that route, with the assumption of equal average daily number of passenger transferred by any vehicle within the same transport mode.

The following steps could be used to estimate the expected average monthly profit.

Step 1: Estimate the average daily number of passengers (Y) by using ridership demand model.

Step 2: Estimating the total number of trips in one direction by dividing the total number of daily passengers on the average modified occupancy rate for any village.

Step 3: Estimating total daily cost of travel for the total distance traveled during the total number of one-way trips which is calculated in Step 2 by using the cost part from suitable fare estimation equation.

Step 4: Estimating the daily average profit by subtraction the daily cost from the daily revenue, and by multiplying the daily profit with the average actual working days per month to get the average monthly profit (income).

Step 5: Comparing the average monthly profit with any profit or income level which should be determined by MOT and other stakeholders.

Depending on the previous steps and the average monthly income, it can be easily decided if there is an ability to increase the number of public transport vehicles to improve the level of service by reducing the waiting time, or to reduce the number of shared taxis or buses for weak routes (low demand or low average monthly operator's profit). In addition, the effect of that decision on the operators could be calculated.

Using the theories of statistical analysis and least square regression One model was formulated to forecast public transportation ridership demand. Based on multiple linear regression analysis, the model was formulated considering the field survey data. This model could be used to estimate and forecast the weekly number of two-way household trips using public transportation which mainly depends on socio-economic variables and other variables related to public transportation mode and route characteristics.

3.3.7. Models Calibration

For the fare estimation model, the calibration was made to take into consideration the actual working days and the annual fluctuation in demand, considering the reduction in daily number of passengers traveled by public transportation, due to universities holidays, which was reflected in Equation 3.1 through the modified occupancy rate (MOR).

3.3.8. Models Validation

The validation of the produced models is very important to make sure that models are working well. For the fare estimation model, the validation was made by comparing the estimated fare with the actual one for representative routes for different external routes within the study area which were did not included in the studied samples, and assessing the difference using the absolute percentage of difference between them, and the Root Mean Square Error (RMSE),which is the standard deviation of the residuals (prediction errors).Analysis of residuals presented in equation 3.2 assists to assess how far the data points are from the regression line, measuring the spread out of these residuals. In other words, it tells how concentrated the data are around the line of best fit. RMSE is commonly used in climatology, forecasting, and regression analysis to verify experimental results. (Hyndman and Koehler, 2006).

The RMSE formula is presented in Equation 3.2.

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n} (F - O)^2}{n}} \quad \text{………………... (3.2)}$$

where:

F= forecasts (expected values or unknown results)

O = observed values (known results)

n = Number of sample observations

As for the demand model, the expected public transportation demand (number of passengers per day) was compared with the actual demand, and assessing the difference between the actual values and estimated results.

Chapter Four

Assessment of Public Transportation Current Fare Estimation

4.1. Introduction

During the last years, public transportation fare in the West Bank was modified about three times (2005, 2011, and 2015). The modification includes increase or decrease in the fare which mainly depends on fuel prices, which were the main reason behind of many strikes executed by the operators. The strike was mainly resolved by negotiations with the MOT. The last change in fare was happened in February 2015 with coordination between the MOT and representatives of the public transport operators, which include decrease in fare by (10-15) % for many routes in the West Bank, especially for external routes between the main cities, because of the high reduction in the fuel price which reduced by 1.1 NIS (reduced from 6.41 as an average value for 2014 to 5.31 in February 2015) (Alayam Newspaper). The procedure for calculating public transportation fare by the MOT was discussed in different studies. In this chapter, in depth review and discussion of these studies is presented. The chapter also reviews the actual procedure adopted by the MOT to estimate fare for different public transport modes and routes.

4.2. The Procedure for Calculating Public Transportation Fare by the MOT

General procedure for fare estimation was presented in Table 2.2, which is mentioned in M.Sc. Thesis prepared by Issa (2006). The procedure depends mainly on distance, average speed, total trip time, working hours, total number of trips per day, average number of riders per trip, margin of profit, and average daily operating cost, which are presented in Table 2.3 and Table 2.4 for buses and shared taxies respectively.

According to the MOT Official[3] the above mentioned procedure is not adopted by MOT nowadays. The reasons for not using the previous mentioned procedure include:

- The in availability of the required data on total trip time for different trips during a day (peak and off- peak trips) and for different annual working days.
- The inaccurate number of riders per trip (occupancy rate) which differs from one route to another.
- The actual profit margin determined by MOT is 20% not 35%.
- The average total daily cost contains the average daily fuel cost, which varies from one route to another and depends on the total number of trips, distance and fuel consumption rate.

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[3] Interview was held in May 2017 with the Vice General Traffic Controller in the MOT Mr. Yousef Darawshi.

- The inaccurate average values for some cost variables like depreciation, which means that the annual depreciation for shared taxis, for example equals 12,823 NIS per year which is a large number.

4.3. Procedure for Calculating Public Transportation Fare Set by the World Bank

At the end of 2009, a technical study had been conducted by the World Bank for assisting MOT to develop a formula for calculating public transportation (buses and shared taxis) tariff. A report was produced titled "Technical Assistance in Public Transport Performance and Tariff" (World Bank, 2010). As mentioned in the literature, the study followed the cost plus profit procedure to estimate the tariff. The cost variables were determined using the weighted mean for each variable for all different vehicles in each route for some routes in the West Bank. The total annual cost for different cost variables was determined and divided on the annual travelled distance to find the cost per one km of travel. In addition, the cost of driver wages and fuel per one km was determined. The total number of passengers per one-way trip, which were determined by the weighted mean for occupancy rate (the main factor to estimate the fare per one passenger), by dividing the total one-way trip cost on the number of passengers and by multiplying the fare with fixed profit margin of 20%.

According to the MOT, the fare formula presented in this study was not actually used by MOT because of the following reasons:

- Illogical results, where the estimated fares for many routes studied to check the formula resulted in fares that differ significantly from the actual fares.
- Large database required for every route which is not commonly available.

The detailed study conducted in the report, and with reference to the related excel template for fare estimation formula, it was found that the results are illogical because of the following reasons that have to do with many components that influence tariff estimation:

- The data collected do not directly come from public transportation operators, but from the sectors' representative, thus, may not reflect the actual situation. In addition, the questionnaire that was distributed on public transportation operators' representatives, not directly on operators or drivers. Representatives were asked to give examples about routes, which may have given an inaccurate data or cost with large margin of error.
- The data collected by field survey questionnaires did not contain detailed questions about the different cost variables. For example, the annual maintenance and repair cost and consumable cost were mentioned in the questionnaire as one package with no details, which increases the margin of error in such data. Moreover, the questionnaire mainly depends on memory not on the actual events that happened with the operators or drivers during working time.

By checking the data used to estimate the fare for some routes in the excel template, it is found that the weighted mean is approximately similar to many variables in all studied routes like idling time per trip, insurance cost, average annual maintenance cost, and other annual cost despite of the difference between the conditions of these routes especially their length. Length, for instance, has a deep impact on the periodic maintenance cost, which should decline when the average annual traveled distance increases (Al-Hasan, 2017).

The study depended mainly on the annual vehicle travel, which included the distance travelled off working times. The weighted average mean for this variable are also illogical in many studied routes. For example, for route BZ2 the mentioned annual vehicle travel was 60,000 Km, while the total number of daily one-way trips equals 22, and the route length is 12 km, which means that the annual vehicle travel should not be less than 76,000 km during 24 working days per month. The same value was used for BT2 route with total number of daily trips that makes 22, while the route length was 6.5 km. This variable should be approximately accurate because of the high effect on the cost per one kilometer travelled (fixed cost for one kilometer = total fixed cost per year/ total kilometers travelled per year). This variable should not include the distance travelled off working times. Furthermore, the working days per year do not exclude the holidays and the number of days that the vehicle is out of service because of repairing. Such data is not available in the MOT records.

- The study depended, on the average number of trips and average occupancy rate, but it didn’t take into account the total number of days that the operators didn’t work during vehicle repairing period and the fluctuation on demand during some periods in the year such as universities vacations. Therefore, the average day demand does not reflect the actual demand during the working period per year. In addition, the demand would vary every year as affected by many independent variables. Therefore, there is a need to combine the outcomes of this study with a demand model to expect the number of ridership. In addition, the average data used for these variables were very high. For example, the average occupancy rate, which is 100%, in route BT2 is not accurate.
- For the profit margin the study mentioned that the profit should be linked to the total profit per year compared to the amount of investment. But this was not reflected in the excel template, and it was not studied.
- The excel template provided by the study includes 28 columns as input data. That data should be collected for each vehicle on every route, and the weighted average mean for each input variable should be determined. This procedure might be very difficult. It is one of the main reasons for not using that template by MOT besides the absence of simple equations that reflect and summarize all those variables.

The excel template was used to estimate the fare for some routes in Nablus Governorate using the same similar variables for the similar studied routes.

By changing the route length, average number of trips, and average occupancy rate, the results for estimated fare were summarized in Table (4.4), which represents illogical results. For example, Awarta-Nablus fare is less than 'Iraq burin –Nablus despite the fact that 'Awarta route length is twice that for 'Iraq Burin, with a high difference between the actual and estimated fare for both routes. Another example is Duma-Nablus route. The estimated fare was less than the fare of Qusra, Jurish-Nablus route, although Duma is a small village (low demand) and its route length is longer than Qusra, Jurish.

Table 4.1: Actual and Estimated Fare Values for Shared Taxi Routes (World Bank Study Fare Formula)

Route	Distance (km)	Actual Fare (NIS)	Estimated Fare(NIS)	Difference	Abs. % Of Differe-nce
Awarta-Nablus	13	5	1.6	-3.4	0.68
'Iraq Burin-Nablus	6	3.5	2.5	-1	0.29
Qusra, Jurish - Nablus	28	8.5	8.9	.4	0.05
Duma-Nablus	30	8.5	8.1	-.4	0.05

4.4. Actual Procedure Followed by MOT to Estimate Public Transportation Fare

To get a clearer idea on the actual procedure adopted by MOT to estimate the transportation fare, an interview was held with the Vice General Traffic Controller in the MOT. The above mentioned procedure was confirmed that it is not applied for fare estimation, and that the actual procedure for fare estimation or fare modification depends on the current fare and the percent of change in fuel prices. It also depends on some average values for the major items of cost of travel per one kilometer such as driver's wage, and the cost for repairing and maintenance, fuel, depreciation, and insurance, as well as license and registration fees, the average value for occupancy rate, and average values for number of trips per day which mainly determined by field observation.

The MOT deals with any complaints from public transportation operators or from public transportation users, especially for fare modification, by conducting in-depth review of different variables that affect the cost of travel and by taking the route circumstances into consideration, mainly the route strength (large number of daily passengers and good average monthly profit for the operators).

An interview was held with the head of public transport union[4] who stated that the public transport operators' representatives were involved in the World Bank study, and they were satisfied from the procedure followed to estimate the fare. They had agreed on the fare modification set in 2015 where

[4] Interview was held in July 2017 with the Head of Public Transport Union Mr. Abdullah Alhelo.

fare was reduced due to drop in the fuel prices. He stated that the actual fare is not satisfactory but because of the economic conditions, especially for public transportation users, they accept the prevailing fares. He complained because of not linking the fare with the cost of living index, and from some regulations issued by the MOT without consulting the representatives of the operators of the public transport sector. The large number of private cars that carry passengers for a fee, which affects the demand for public transportation and creates a serious problem for the operators, is one of the major problems facing the public transportation sector.

Chapter Five

Data Collection

5.1. Introduction

This chapter provide a detailed description of the collected data needed in this study, which was collected from different resources. This database must be reliable to obtain reasonable results.

5.2. Sources of Research Data

The data collected in this study can be classified according to their source, as listed below:

1. Ministry of Transport (MOT)
2. Palestinian Central Bureau of Statistics (PCBS)
3. Palestinian Ministry of Education and Higher Education (MOHE)
4. Field survey data

5.2.1. Data Collected from the MOT

From the MOT records and conducted studies, the collected data include information of descriptive data on the external buses and shared taxi routes which connect the villages and towns with the governorate centers in the northern area of the West Bank, which include the routes names, distance, number of buses and shared taxis and the fare for each mode of public transportation for every route. Such data are presented in the Appendix A. Summary of total numbers of routes in study area is presented in the Table 5.1.

Table 5.1: Summary of External Routes and Number of Public Transportation Vehicles in Study Area

Governorate	No. of external routes	No. of Shared Taxies	No. of Large Buses	No. of Small busses
Nablus	53	402	12	85
Jenin	46	475	0	88
Tulkarm	20	250	0	17
Qalqiliya	8	61	0	1
Tubas	5	21	0	13
Total	**132**	**1197**	**12**	**203**

Source: (MOT, 2017)

5.2.2. Data Collected from PCBS

The population for the communities in the study number of study area was collected from the recently PCBS published reports which are summarized in Table 5.2.

Table 5.2: Summary of Number of Population in Study Area

Governorate	Population of Governorate	City	Refugee Camps	Villages
Nablus	389328	153061	37416	198851
Jenin	318958	48479	12890	257589
Tubas	66854	21487	7958	37409
Tulkarm	185314	60173	20081	105060
Qalqiliya	113574	51969	0	61605
	Total population of villages and towns			**660,514**
Average number of household members = **4.8**				
Total number of households in the study area (Villages) = **137,607**				

Source: (PCBS, 2016)

The number of employees per household in the West Bank equal 1.6 (unpublished data), which was collected from the PCBS, through direct contact with the public relations department.

5.2.3. Data Collected from the MOHE

The total number of students in universities and colleges in Palestine was taken from the published reports on the ministry's website, which indicate that the number of students enrolled in the higher education institutions in the academic year (2016/2017) reached 218,505 students in the west Bank and Gaza Strip, the total number of universities and colleges students in the West Bank only was taken by contacting with the Ministry, the received data about the total number of student is summarized in Table 5.3.

Table 5.3: Enrolled students in West Bank and Gaza 2016/2017

Number of students enrolled in the West Bank in traditional higher education institutions	100,242
Number of students enrolled in Gaza in traditional higher education institutions	62,146
Number of students in the West Bank in open education.	43,575
Number of student in Gaza Strip in open education	12,542
Total in Gaza	74,688
Total in West Bank	143817
Total	**218,505**

Source: (MOHE,2017)

5.2.4. Data Collected from Field Survey

Most of the data used in this study were collected through interviews and field surveys. This was conducted through personal interviews with MOT Officials and public transportation operators and their representatives. In addition, questionnaires were distributed for the public transportation operators and travelers, using face to face method. Two questionnaires were designed, the first directed to the operators for collecting all required data on the public transportation fare and its different components and key variables, while the other was directed to the travelers for investigating the public transportation ridership demand in the studied samples, and to investigate the travelers' satisfaction on public transportation performance fare. The questionnaires are attached in Appendix B.

5.3. Developing the Questionnaires

The first questionnaire was for the public transportation operators constructed from four parts, the first asked on the route, distance actual fare, vehicle model and type. The second part asked on the annual fixed and variable costs of travel for the public transportation mode is operating's and its key variables which could be summarized as follows:

- Driver wage.
- Repairing costs.
- Insurance fees.
- License and dynamometer fees.
- Taxes annual registration fees.

- Parking costs.
- Maintenance costs (tires, oil and filters, brakes, lamps, wind screen wiper, washing and cleaning, etc.).

It contained questions on the vehicles price, salvage value and purchasing year for estimating the depreciation.

The third part of this questionnaire was on the daily number of trips in both directions, total number of passengers per day, average daily consumed fuel and average fuel consumption rate. It also included another question about the actual annually working days.

The forth part was investigated the operator's satisfaction about fare by asking the operator to choose one answer from five possible answers, if that fare is very low, low, fair, high or very high.

The last part is located in a separate page which could be removed and stay with the driver to fill it in the next day and turn it back to the researcher after filling the required data about the number of passengers in each trip per a normal day. It contained a question about the other source of revenue from operating his public transportation vehicle if available and the total annual income from that resources.

The second questionnaire for the travelers consisted from three pages. The first page contained general information about the study, its objectives, and guidelines to answer the questions. The other two pages contained two type of questions, the first one is about the household information which contains address, number of household members, number of workers, number of university students, average number of weekly trips produced by all household members, average monthly income, Average monthly expenses, private car ownership, and the public transportation actual fare.

The second part consisted of two questions to investigate the people satisfaction about the public transportation service and its fare.

5.4. Sampling and Questionnaire Distribution

For the data collected by field survey the sample size was determined by using the following statistical formula:

$$n = \frac{(Z\alpha/_{2})^{2}(\pi)(1-\pi)}{E^{2}+\frac{(Z\alpha/_{2})^{2}(\pi)(1-\pi)}{N}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.1)$$

where:

n = Sample size

Z = Normal distribution factor from statistical tables

A = 1-confidence level

π = Response distribution factor

E = Acceptable margin of error

N= Size of population

5.5. Samples for Fare Estimation Model

Table 5.4 summarized the sample size needed for the operators' questionnaires to represent those operating on the public transportation for external routes in the Northern Area of the West Bank, with 5% margin of error and 98% response distribution factor.

Table 5.4: Sample Size for Fare Estimation Model for External Routes in the Northern Governorates in West Bank

Public transportation mode	Population (N: Number of vehicles)	Min. sample size (n)
Shared Taxes	1197	29.3 (30)
Small Buses	203	26.2 (27)
Large Buses	12	8.5 (9)

For shred taxi mode samples, the procedure followed for samples selection is to cover all different routes circumstances which mainly depend on the distance between the village and the city which affect the occupancy rate and average fixed cost per kilometer, and also depends on the size of population in the village which affect the total number of passengers (demand) per day. Despite the calculated minimum sample size 30, as presented in Table 5.4, 60 questionnaires were distributed directly on shared taxis vehicles operators which represent about 5% of total number of shared taxis in the study area and represent 42 external routes, which represent about 31% of all routes that have the shared taxi mode in the study area. Two or one samples were selected to represent each route in different governorates depending on the total number of shared taxi on that route to answer the questionnaire, according to the total number of shared taxis for that route. The actual number of collected questionnaires is sixty with more concentration in representing the larger governorates (Nablus and Jenin). Table 5.5 represents the selected samples for each governorate in the study area, which include the information was taken from MOT about route name, route distance and information about villages population which was taken from the final updated published report about population in West Bank by PCBS.

Table 5.5: Selected Routes for Shared Taxis Samples.

Governorate	Rout Name	Origin Village population	Route Length (km)
Nablus	'Awarta-Nablus	6,824	13
	Beit Furik- Nablus	12,546	9
	Tell- Nablus	5,271	7
	Qusra, Jurish-Nablus	7,010	28
	Duma- Nablus	2,547	30
	Majdal Bani Fadil-Nablus	2,891	26
	Talfit -Nablus	3,427	22
	Iraq Burin-Nablus	932	6
	Jit-Nablus	2,735	12
	Aqraba-Nablus	9,926	22
	Burqa-Nablus	4,454	18
	Beit Lid-Nablus	5,858	16
	'Asira ash Shamaliya-Nablus	9,169	9
	Qabalan-Nablus	8,652	20
Jenin	Deir Abu Da'if-Jenin	6,926	7
	Jalbun-Jenin	2,971	13
	Faqqu'a-Jenin	4,309	12
	Al Jalama, "Arrana-Jenin	2,560	5
	Beit Qad- Jenin	1,799	6
	Alfandaqumiya-Jenin	4,227	23
	Meithalun, ,Al Judeida, ,Siris, Sanur-Nablus	25,662	32
	Jabba-Nablus	10,555	25
	Kafr Ra'i-Jenin	9,135	21
	Meithalun -Jenin	8,645	22
	Jaba'-Jenin	10,555	23
Tubas	Tammun -Tubas	14,356	6
	'Aqqaba - Tubas	8,710	3
	Tammun - Nablus	14,395	23
	'Attil -Tulkarm	10,611	10.5

Tulkarm	Bal'a -Tulkarm	7,746	12
	'Illar -Tulkarm	7,261	20
	Qaffin -Tulkarm	9,838	20
	Ramin -Tulkarm	2,118	17
	Far'un -Tulkarm	3,636	5
	Zeita -Tulkarm	3,345	13
	Shufa -Tulkarm	2,573	7
	Seida -Tulkarm	3,436	18
Qalqiliya	'Azzun -Qalqiliya	9,738	12
	Beit Amin, Sanniriya, 'Azzun 'Atma -Qalqiliya	6,924	11
	Habla -Qalqiliya	7491	4
	Al Funduq - Qalqiliya	941	18

Source: (MOT, 2016), (PCBS, 2016).

For the second public transportation mode (mini bus), the total number of routes have this mode in the study area are 90 routes with 203 mini buses. The Table 5.6 represents the distribution of these buses per governorates. Twenty-nine randomly selected routes from each governorate are presented in Table 5.7. which represent about 14.3% of the total number of mini buses in the study area, and about 31% of the routs on which have mini bus operate.

Table 5.6: Distribution of Mini Buses in the Study Area

Governorate	Number of routes have mini bus mode.	Number of buses
Nablus	30	87
Jenin	25	88
Tubas	2	11
Tulkarm	10	16
Qalqiliya	1	1
Total	**68**	**203**

For the large buses public transportation mode, the total number of buses is 12, all of them are located on the routes that connect some villages with Nablus city only, seven routes are located in Nablus governorate, and the other five routes are connect some large villages which located on other governorates with Nablus city. However, most of them are completely not working on the ground or irregularly working days with limited number of trips per day (one trip in the morning and sometimes another one in the evening). Comparing the total number of supposed working buses with the total number of public transportation modes, it represents just about .08 %, so this mode was neglected from this study.

5.6. Samples for Ridership Demand Forecasting Model

Eleven Randomly Selected Villages represent different villages circumstances in the study Area regarding to public transportation issues, (Small and Large Villages), which also far or near the governorate city (route length). Table 5.8 presents the selected villages and their population and route length.

Table 5.7: Selected Routes for Mini Buses Samples

Governorate	Rout Name	Route Length(km)
Nablus	Huwwara-'Einabus-'Urif-Nablus	15
	Talfit -Nablus	23
	Majdal Bani Fadel-Nablus	25.5
	Qusra,Jurish-Nablus	28
	Aqraba- Nablus	21
	Burqa-Bizzariya-Nablus	22
	Awarta, Odala -Nablus	14
	Asira Al Qibliya, Madama, Burin-Nablus	15
	Jamma'in -Nablus	19
Jenin	Meithalun, Siris ,Al Judeida, Sir -Jenin	20
	Raba-Jenin	16
	Meithalun, Al Judeida, ,Siris, Sanur-Nablus	32
	Kafr Rai', Fahma -Jenin	21
	Deir Abu Da'if-Jenin	7
	Al Jalama, "Arrana-Jenin	5.5
	Silat al Harithiya -Jenin	9
	Jalqamus-Um at Tut-Jenin	8
	Qabatiya -Jenin	8.5
	Alfandaqumiya -Silat adh Dhahr-Jenin	25
	Alfandaqumiya -Silat adh Dhahr -Nablus	22
	Kafr Dan - Jenin	6
	Jaba' - Nablus	25
Tubas	Tammun -Tubas	6
	Tammun -Nablus	23
Tulkarm	Seida, 'Illar ,'Attil ,Deir Algusun, Al Jarushiy -Tulkarm	20
	Qaffin -Tulkarm	19
	Zeita-Tulkarm	13.7
	Bal'a-Tulkarm	12
Qalqiliya	'Azzun - Qalqiliya	12

Source, (MOT,2017)

By using Equation 5.1 the sample size was estimated which equal 73 with 5% margin of error and 95% response distribution factor. However, 143 Questionnaire were collected (12 questionnaires from each village at least), each one represents one household and as mentioned before, the questionnaire was distributed by using face to face method with different persons were met in their villages.

Table (5.8): Selected Villages for Ridership Demand Model

Village / Governorate	Population	Route Length
'Aqqaba - Tubas	8710	3
'Awarta-Nablus	6824	13
Majdal Bani Fadil-Nablus	2891	26
Iraq Burin-Nablus	932	6
Aqraba-Nablus	9926	22
'Asira ash Shamaliya-Nablus	9169	9
Osarin /Nablus	1956	19
Beita /Nablus	11,017	16
Qabatiya -Jenin	23860	8.5
Silat al Harithiya -Jenin	11711	9
'Azzun -Qalqiliya	9738	12
	Total = 96,734	

Chapter Six

Data Analysis and Results

6.1. Introduction

This chapter presents the results of data collection and analysis. Section 6.2 presents common results which describe the public transportation operator's and travelers' satisfaction and a common result about ridership demand model. While section 6.3 presents the results of data collection and analysis for shared taxis and mini buses fare estimation. Sec 6.4 presents the percentage of public transportation modes users, the public transportation operator's satisfaction and their average monthly income, revenue-cost ratio, The relation between fixed cost and annual distance and fare sensitivity to the change in fuel price. Finally, Section 6.5 presents the public transportation ridership demand model and the analysis the relation between the estimated daily number of passenger and the total average monthly profit for the operators.

6.2. Analysis of Collected Data (Descriptive Analysis)

From the data collected for fare estimation models and ridership demand forecasting model the following results are found.

6.2.1. Public Transportation Operator's Satisfaction

By analyzing data collected using the distributed questionnaire to shared taxi and bus operators, it is found that about 52.3% of shared taxi operators considered the actual fare is low, and about 38.5% consider it fair, and 9.2% consider it very low, as presented in Figure 6.1. For the mini bus operators, it is found that 37% considered the actual fare is fair, and also the same percentage of operators consider the fare is low, and 26% consider it very low, as presented in Figure 6.2.

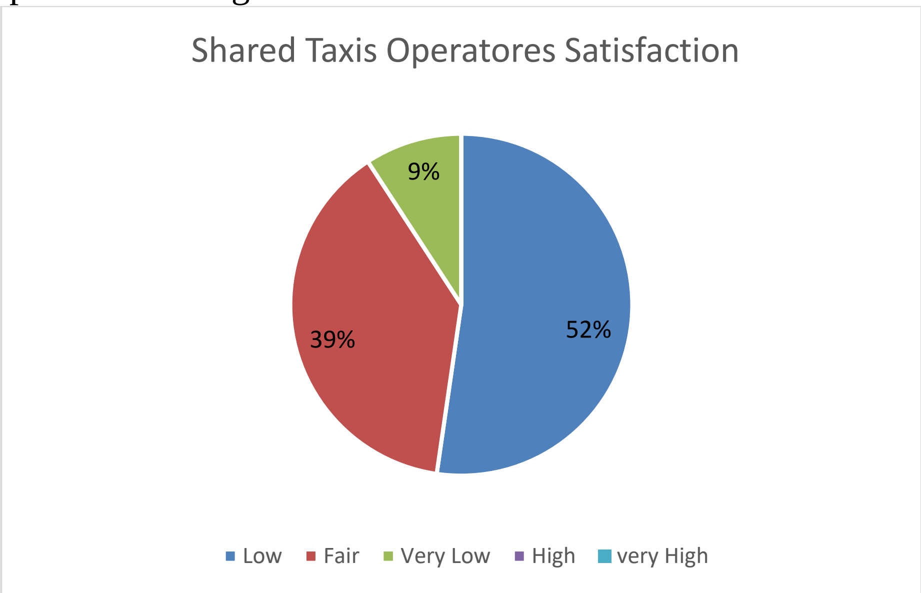

Figure 6.1: Shared Taxis Operators' Satisfaction on the Fare

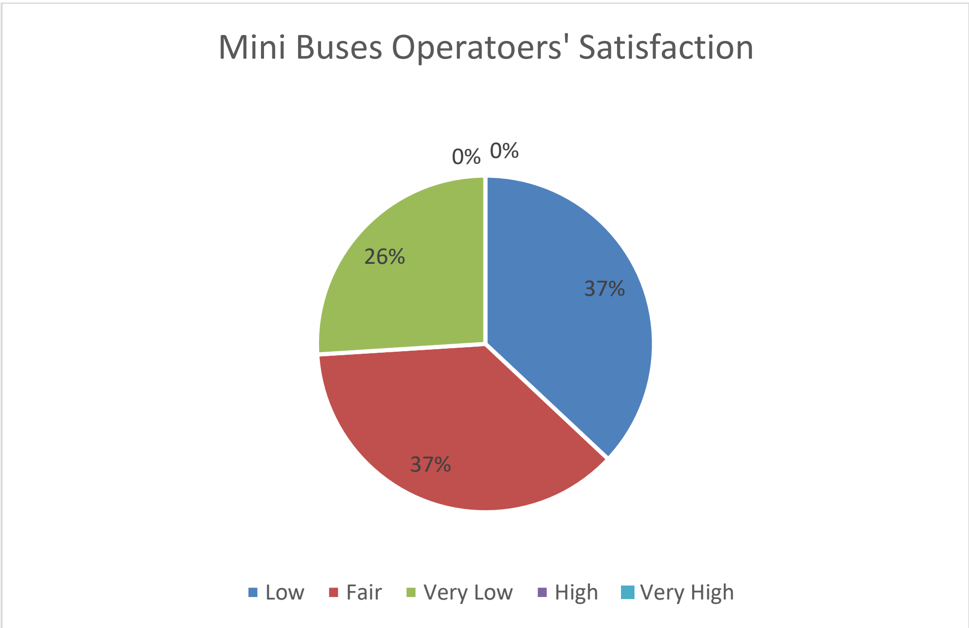

Figure 6.2: Mini Buses Operators' Satisfaction on the Fare

6.2.2. Public Transportation Travelers' Satisfaction

Travelers were asked on the performance of public transportation and its fare. The answers indicate that 11.9 % of population consider it very good, and about37.1% consider it good and 27.3% consider it moderate, 22.4% consider it bad, and 1.4% consider it very bad, as presented in Figure 6.3.

About public transportation fare, 6.8 % consider it very high, 24.3% consider it High, and 68.9 % consider it fair and no one considers it low or very low, as presented in Figure 6.4.

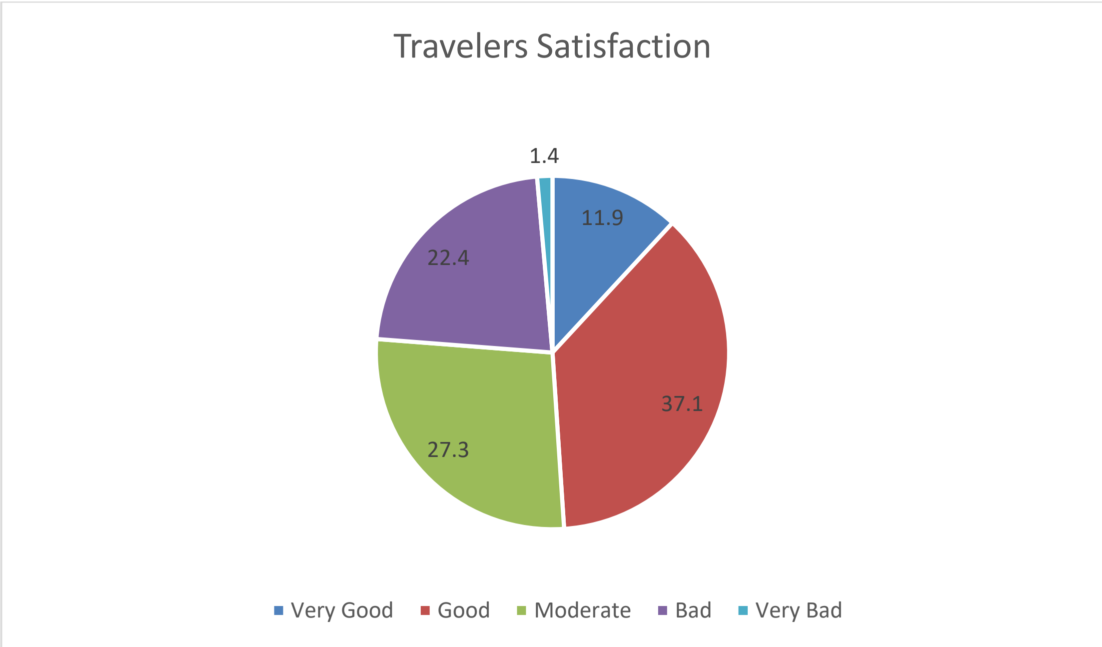

Figure 6.3: Travelers Satisfaction on Public Transportation Performance

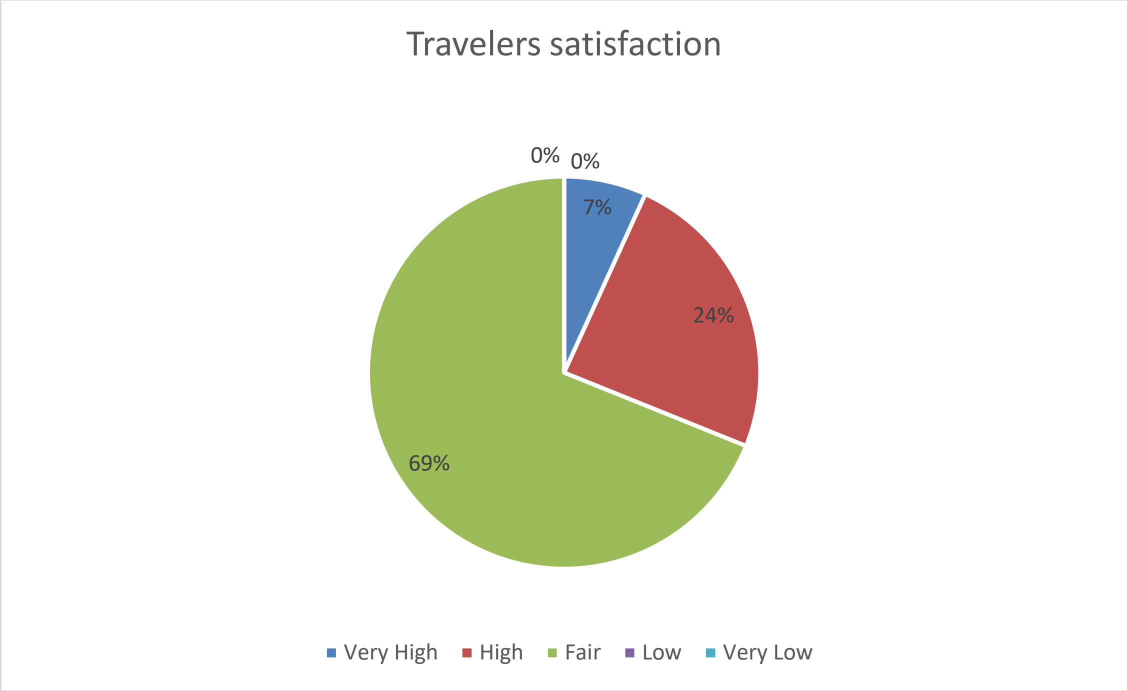

Figure 6.4: Travelers Satisfaction on Public Transportation Fare

6.2.3. Average Values for Socioeconomic Independent Variables

Table 6.1 summarizes the average values for the studied socio economic independent variables, which were believed to affect public transportation ridership demand.

Table 6.1: Average Values for Independent Socio Economic Variables

Variable	**Average Value**	**St. dev.**
Household members	5.30	2.21
Number of employees per household	1.72	0.80
Number of enrolled university students per household	0.38	0.62
Number of private cars per household	0.43	0.51
Average monthly income (NIS)	4991	2229
Average monthly expense (NIS)	3887	1365

6.3. Analysis Procedure

6.3.1. Public Transport Fare Estimation

The public transport sector operators in Palestine do not receive any significant financial support from the government. The government acts as if this sector should be financially self-sufficient, and therefore should cover its costs. The process followed for analyzing the collected data to estimate the suitable fare depends on cost plus profit method, considering the average values for different required cost elements variables to estimate the cost of one-way travel per one passenger. A user friendly Excel template as attached in Appendix C. was structured to estimate the required fare equation variables which are summarized in the Equation 6.1.

$$Fare = \left(FC + (FCR * FP)\right) * L * PM / \,(OR * F) \ldots\ldots (6.1)$$

where:

FC = Average fixed cost per one kilometer.

FCR = Average fuel consumption rate.

FP = Fuel price.

L = Route Length.

PM = Profit Margin.

OR = Average occupancy rate.

F = Fluctuation in demand factor.

The total average fixed cost per one kilometer consists of the annual cost divided on the total annual travelled distance during the actual working days. The fixed cost includes the driver's wages, maintenance and repair cost, insurance, license fee, registration fee, taxes, washing and cleaning cost, parking fees, management and services cost, and the cost of vehicles depreciation. All the data collected for daily or monthly cost were converted to annual cost, and the annual depreciation cost was estimated from Equation 6.2.

$$D = (PC - SC) / N \quad \ldots\ldots (6.2)$$

where:

D = Depreciation.

PC = Purchase cost.

SC = Salvage value.

N = Remaining service years for the vehicles from the date of purchase.

It is to be noted that to determine N, the total allowed working years for public transportation vehicles were taken into consideration. These set by the MOT to be 18 years for shared taxi and 20 years for buses, starting from the vehicle manufacturing year.

6.3.2. Shared Taxi Fare Estimation

To estimate the required variables, the average values for all collected vehicles and routes data are calculated first. The data was collected from 48 samples represent different routes and different vehicle types and models. The results are illustrated in Tables 6.2 and 6.3.

Fluctuation in demand in the West Bank is mainly determined based on fluctuation in demand for travel by students. On the average universities are closed for 10 weeks during the year, Where about 30% of passengers using public transportation are students, the overall ridership demand during 10 weeks holidays is dropped by 24% (Rebel,2016) .In June 2017, the previous data were checked by asking the same operators for six shared taxis and buses about the daily number of passengers during that period (universities vacation), It is found that on the average overall total passengers demand dropped by 25.30% per day as presented in Table 6.4 . This mean that the overall annual passenger demand dropped by 4.6 %, so the fluctuation in demand factor equal 95.4 %.

Table 6.2: Average Annual Values for Shared Taxis Fixed Cost Variables

Fixed cost variable	Average annual cost	Range (Min, Max)	Standard Deviation	% of total fixed cost
Driver wages	29,937 NIS	(15600,31200)	3,418.19	51.54
Maintenance and repairing	11317 NIS	(4950,18350)	3,093.00	19.48
Insurance	4245 NIS	(2400,7500)	1,523.00	7.31
license	740 NIS		51.96	1.27
Taxes and Registration	2977 NIS	(2400,6400)	1,199	5.12
Washing and cleaning	832 NIS	(300,1260)	202.28	1.43
Parking fees	1679 NIS	(1200,3600)	647.15	2.89
Management and services	420 NIS	(420,420)	0.0	0.72
Depreciation	5942 NIS	(1583,8666)	1450.8	10.23
Total	**58,089 NIS**			**100%**

Table 6.3: Average Values for Shared Taxi Fare Equation Variables

Variable, (unit)	Value	Max, Min Values	Standard Deviation
Fixed cost (FC) ,(NIS/km)	0.91	(.43,1.68)	0.33
Fuel Consumption Rate (FCR), (Liter/km)	0.11	(.08,.14)	.01
Fuel Price (FP), (NIS/km)	5.38*	-	-
Profit Margin (PM), (%)	20**	-	-
Occupancy Rate (OR), (passenger/trip)	4.67***	(3.13,7)	.81
F (%)	95.4	-	-

*: The fuel price was determined as the average value for 2017

**: The profit margin was determined by the MOT.

***: The total number of shared taxi seats = 7.

Table 6.4: Fluctuation in Demand During Universities Holiday

Route Name	Number of passenger in Normal day	Number of passenger in In university holiday	Percent of difference
'Awarta Nablus	97	78	19.59
'Iraq Burin-Nablus	111	90	18.9 %
Qusra, Jurish-Nablus	56	42	25%
Qabalah-Nablus	56	35	37.5%
Shufa-Tulkarem	78	72	20.5%
Huwwara, 'Einabous, 'Urif- Nablus (Bus)	115	80	30.4%
'Awarta –Nablus (Bus)	123	92	25.2 %
			Average =25.3%

Based on the values of the indicated data, the fare equation becomes as presented in Equation 6.3 and 6.4.

$$Fare = \left(0.91 + (0.11 * 5.38\,)\right) * 1.2 * L/\ 4.45 \quad \ldots\ldots (6.3)$$

$$Fare = 0.405\,D \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6.4)$$

6.3.3. Validation of Shared Taxi Fare Estimation Equation

To validate fare estimation equation, the procedure followed was to compare the estimated values with the actual fare determined by the MOT, calculate the total average absolute percentage of difference between the actual and estimated values, and estimate the total (RMSE).

The previous fare formula as presented in Equation 6.3 and 6.4 was tested on 51 routes which represent most of Nablus Governorate routes and other routes form the other governorates which were not included in the study samples as presented in Table 6.5, which represents about 35% of the total routes in the study area.

Table 6.5: Actual and Estimated Value for Overall Average Equation

NO.	Route	Distance (km)	Estimated Fare (F)	MOT Fare (O)	Difference (F-O)	Abs. % of (F-O)	$(F\text{-}O)^2$
1	Silat al Harthyia-Jenin	9.5	3.85	4	0.15	3.81	0.02
2	Zububa,Rummana-Jenin	12.5	5.06	5	-0.06	1.25	0.00
3	Asira ash Shamaliya - Nablus	9	3.65	4	0.36	8.87	0.13
4	Anabta-Tulkarim	9.4	3.81	4.5	0.69	15.40	0.48
5	Huwwara-Nablus	9	3.65	4	0.36	8.87	0.13
6	Einabus-Nablus	11	4.46	4	-0.46	11.38	0.21
7	Al Yamun-Jenin	9	3.65	4	0.36	8.87	0.13
8	Kafr al Labad-Tulkarim	10.5	4.25	5	0.75	14.95	0.56
9	Aqqaba-Tubas	3	1.22	3	1.79	59.5	3.19
9	Salim -Nablus	9	3.65	4	0.36	8.87	0.13
10	Burin-Nablus	9.2	3.73	4	0.27	6.85	0.08
11	Madama-Nablus	12	4.86	4.5	-0.36	8.00	0.13
12	Rujeib-Nablus	6	2.43	3	0.57	19.00	0.32
13	Beit Lid-Nablus	16	6.48	6	-0.48	8.00	0.23
14	Ya'bad-Jenin	17.5	7.09	6	-1.09	18.13	1.18

15	Ajja-Jenin	19.5	7.90	6.5	-1.40	21.50	1.95
16	Ajja-Nablus	30	12.15	10	-2.15	21.50	4.62
17	Azzon-Nablus	23	9.32	7	-2.32	33.07	5.36
18	Al Lubban,As Sawiya-Nablus	24	9.72	8	-1.72	21.50	2.96
19	Jamma'in-Nablus	19	7.70	6.5	-1.20	18.38	1.43
20	Aqraba-Nablus	23	9.32	7	-2.32	33.07	5.36
21	Qabalan-Nablus	20	8.10	7	-1.10	15.71	1.21
22	Anabta-Nablus	18	7.29	6.5	-0.79	12.15	0.62
23	Asira al Qibliya-Nablus	15	6.08	5.5	-0.58	10.45	0.33
24	Baita-Nablus	16	6.48	5	-1.48	29.60	2.19
25	Urif-Nablus	15	6.08	5	-1.08	21.50	1.16
27	Beit Iba-Nablus	6.5	2.63	3.5	0.87	24.79	0.75
28	Deir sharf-Nablus	9	3.65	4	0.36	8.87	0.13
29	Sarra-Nablus	11	4.46	4.5	0.04	1.00	0.00
30	Arabbuna-Jenin	10.3	4.17	4.5	0.33	7.30	0.11
31	Deir Ghazala-Jenin	8	3.24	4	0.76	19.00	0.58
32	Jit-Nablus	12	4.86	5	0.14	2.80	0.02
33	Deir al Hatab-Nablus	7	2.84	4	1.17	29.13	1.36
34	Kafr Sur-Tulkarim	10.2	4.13	5.5	1.37	24.89	1.87
35	Kafr Jammal-Tulkarim	13.8	5.59	6	0.41	6.85	0.17
36	Kafr Zibad-Tulkarim	12.8	5.18	6	0.82	13.60	0.67
37	Kafr 'Abbushbush-tulkarim	14.1	5.71	6.5	0.79	12.15	0.62
38	Azmut -Nablus	8	3.24	4	0.76	19.00	0.58
39	Yatma - Nablus	19	7.70	6.5	-1.20	18.38	1.43
40	Talluza-Albathan-Nablus	15	6.08	6	-0.08	1.25	0.01
41	Beit Imrin-Nablus	17	6.89	6	-0.89	14.75	0.78
42	An Naqura-Nablus	13	5.27	5.5	0.23	4.27	0.06
43	Sabatyia-Ijnisiniya-Nablus	14	5.67	5	-0.67	13.40	0.45
44	Yasid-Nablus	19	7.70	7	-0.70	9.93	0.48
45	Al 'Aqrabanyia-al Far'a-Nablus	17	6.89	5.5	-1.39	25.18	1.92
46	Osarin-Nablus	19	7.70	6.5	-1.20	18.38	1.43
47	Beit Dajan-Nablus	13	5.27	5	-0.27	5.30	0.07
48	Burqa-Nablus	20	8.10	6	-2.10	35.00	4.41
49	Alsawya-aleban-Nablus	24	9.72	8	-1.72	21.50	2.96
50	Alnasarya-Nablus	17	6.89	6.5	-0.39	5.92	0.15
51	Qaryout-Jalod-Nablus	27	10.94	9	-1.94	21.50	3.74
						Average= 15.77 %	Sum = 58.83

For the previous tested routes for validation, the RMSE = 1.07 NIS, and the total absolute percentage of error = 15.77%. The results show that the previously mentioned Equation 6.3 is suitable for some routes which connect the villages are relatively large with short route length with the cities like (Silat al Harthyia, Asira ash Shamaliya, Huwwara, Al Yamun, Salim), because a small difference is noticed between estimated and actual fares, where the equation indicated that the average absolute difference for these routes is less than 10%. However, the indicated equation is not suitable for many routes and villages especially for those with long routes (more than 15 km) which connect the large and small villages with governorate centers where the average absolute difference between the actual and estimated fare reached 20% and the RMSE reached 1.36 NIS.

By referring to the Equation 6.3, the main factors affecting the fare estimation are:

1. Fixed cost, which is approximately similar for most vehicles, but the difference occurs when calculating the fixed cost per one kilometer travel, because of dividing the total annual fixed cost on the total annually distance travelled which are longer for far villages from the governorate center.
2. Average fuel consumption rate, which is approximately equal for different vehicles in different routes.
3. Average occupancy rate, which is different from one village to another, because of differences in waiting time and demand.
4. Fuel price, which is equal for all routes.

Therefore, other analysis procedures are followed to estimate shared taxi fare, which depend on dividing the different routes into groups with similar circumstances (route length and origin village population). To conduct this, threshold values should be determined. The first which is related to route length threshold, is determined by analyzing all routes in the study area which connect the villages with the respective governorate center. The longest distance is 30 km for Duma-Nablus route, therefore the threshold is considered that all routes lengths which are less than 15 km are short routes, and all routes length are equal or more than 15 km are long routes.

The second threshold is determined based on the population for origin villages, which mainly depend on the classification of the PCBS for the localities whose population is less than 4,000 persons or whose population varies from 4,000 to 9,999 persons (but lacking four element of public electricity network, public water network, post office, health center with a full – time physician and a school offering a general secondary education certificate). (PCBS, 2010). Therefore, localities in rural areas are classified with reference to their population are divided into small villages, with less than 4000 inhabitants, and large villages with more than 4000 inhabitants.

Based on the above, four groups of shard taxi routes are identified based on the route length and on the village population as presented here after.

Group A: Large villages with short route length

This group includes eight routes, with data taken from 14 vehicles operators, to represent these routes in different governorates. The average required input data for fare estimation are presented in the Table 6.6.

For this group, fare is estimated as in Equation 6.6.

$$Fare = \big(1.06 + (0.11 * 5.38\,)\big) * 1.2 * L/\ 4.426 \quad \ldots (6.6)$$

$$Fare = 0.447\ L \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6.7)$$

Table 6.6: Average Values for Shared Taxi Fare Equation Variables,

(Group A)

Variable	Value	Unit
Fixed cost (FC)	1.06	NIS/km
Fuel Consumption Rate (FCR)	0.11	Liter/km
Fuel Price (FP)	5.38	NIS/km
Profit Margin (PM)	20	%
Occupancy Rate (OR)	4.64	Passengers/Trip
F	95.4	%

For testing and validation of the fare equation, it was applied on the same routes it was used to validate the overall general equation (Equation 6.4) which was mentioned in Table 6.3 after classifying them into four groups. The previous fare formula was tested on 13 routes, which included in Table 6.7.

For the indicated tested routes, the total absolute percentage of error = 11.06% and the RMSE = 0.62 NIS, as was estimated using Equation 3.2.

Table 6.7: Actual and Estimated Value for Shared Taxi Selected Routes for group A

NO.	Route	Distance Km)(	Estimated Fare (F)	MOT Fare (O)	Difference (F-O)	Abs. % of (F-O)	$(F-O)^2$
1	Silat al Harthyia -Jenin	9.5	4.25	4	-0.25	6.16	0.06
2	Zububa, Rummana-Jenin	12.5	5.59	5	-0.59	11.75	0.35
3	Asira ash Shamaliya - Nablus	9	4.02	4	-0.02	0.57	0.00
4	Anabta-Tulkarim	9.4	4.20	4.5	0.30	6.63	0.09
5	Huwwara-Nablus	9	4.02	4	-0.02	0.57	0.00
6	Einabus-Nablus	11	4.92	4	-0.92	22.93	0.84
7	Al Yamun-Jenin	9	4.02	4	-0.02	0.57	0.00
8	Kafr al Labad -Tulkarim	10.5	4.69	5	0.31	6.13	0.09
9	Salim -Nablus	9	4.02	4	-0.02	0.57	0.00
10	Burin-Nablus	9.2	4.11	4	-0.11	2.81	0.01
11	Madama-Nablus	12	5.36	4.5	-0.86	19.20	0.75
12	Rujeib-Nablus	6	2.68	3	0.32	10.60	0.10
13	Aqqaba-Tubas	3	1.34	3	1.66	55.30	2.75
						Average= 11.06%	**Total =5.04**

Group B: Large villages with long route length

This group includes eight routes, with data taken from 14 vehicles operators represent these routes in different governorates. The average required input data for fare estimation are presented in the Table 6.8.

Table 6.8: Average Values for Shared Taxi Fare Equation Variables

(Group B)

Variable	Value	Unit
Fixed cost (FC)	0.71	NIS/km
Fuel Consumption Rate(FCR)	0.11	Liter/km
Fuel Price (FP)	5.38	NIS/km
Profit Margin (PM)	20	%
Occupancy Rate (OR)	5.09	Passengers/Trip
F	95.4	%

For this group, fare is estimated as in Equation 6.8.

$Fare = \left(0.71 + (0.11 * 5.38\,)\right) * 1.2 * L/\ 4.856$ …………… (6.8)

$Fare = 0.319\,L$ .. ……………………………………………. (6.9)

The previous fare formula was tested on 13 routes which included in Table 6.9.

Table 6.9: Actual and Estimated Value for Shared Taxi Selected Routes for group B

NO.	Route	Distance (Km)	Estimated Fare (F)	MOT Fare (O)	Difference (F-O)	Abs. % of (F-O)	$(F\text{-}O)^2$
1	Beit Lid-Nablus	16	5.14	6	0.86	0.14	0.75
2	Ya'bad-Jenin	17.5	5.62	6	0.38	0.06	0.15
3	Ajja-Jenin	19.5	6.26	6.5	0.24	0.04	0.06
4	Ajja-Nablus	30	9.63	10	0.37	0.04	0.14
5	Azzon-Nablus	23	7.38	7	-0.38	0.05	0.15
6	Al Lubban,As Sawiya-Nablus	24	7.70	8	0.30	0.04	0.09
7	Jamma'in-Nablus	19	6.10	6.5	0.40	0.06	0.16
8	Aqraba-Nablus	23	7.38	7	-0.38	0.05	0.15
9	Qabalan-Nablus	20	6.42	7	0.58	0.08	0.34
10	Anabta-Nablus	18	5.78	6.5	0.72	0.11	0.52
11	Asira al Qibliya-Nablus	15	4.82	5.5	0.69	0.12	0.47
12	Beita-Nablus	16	5.14	5	-0.14	0.03	0.02
13	Urif-Nablus	15	4.82	5	0.19	0.04	0.03
						Average = 6.71%	**Sum =3.01**

For the indicated tested routes, the total absolute percentage of error = 6.71% and the RMSE = 0.48 NIS, as was estimated by using Equation 3.2.

Group C: Small villages with Short route length.

This group includes eight routes, with data taken from 12 vehicles operators, to represent these routes in different governorates. The average required input data for fare estimation are presented in the Table 6.10. For this group, fare is estimated as in Equation 6.9.

$$Fare = \left(1.07 + (.11 * 5.38\,)\right) * 1.2 * L/\ 4.254 \quad \ldots \text{(6.9)}$$

$$Fare = 0.468\,L \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(6.10)}$$

The previous fare formula was tested on 12 routes which included in Table 6.111. For the indicated tested routes, the total absolute percentage of error = 8.82% and the RMSE = 0.46 NIS, as was estimated by using Equation 3.2

Table 6.10: Average Values for Shared Taxi Fare Equation Variables, (Group C)

Variable	Value	Unit
Fixed cost (FC)	1.07	NIS/km
Fuel Consumption Rate(FCR)	0.11	Liter/km
Fuel Price (FP)	5.38	NIS/km
Profit Margin (PM)	20	%
Occupancy Rate (OR)	4.46	Passengers/Trip
F	95.4	%

Table 6.11: Actual and Estimated Value for Shared Taxi Selected Routes for Group C

NO.	Route	Distance Km)(	Estimated Fare (F)	MOT Fare (O)	Difference (F-O)	Abs. % of (F-O)	$(F\text{-}O)^2$
1	Beit Iba-Nablus	6.5	3.05	3.5	0.45	12.96	0.21
2	Deir sharf-Nablus	9	4.22	4	-0.22	5.46	0.05
3	Sarra-Nablus	11	5.16	4.5	-0.66	14.57	0.43
4	Arabbuna-Jenin	10.3	4.83	4.5	-0.33	7.28	0.11
5	Deir Ghazala-Jenin	8	3.75	4	0.25	6.26	0.06
6	Jit-Nablus	12	5.62	5	-0.62	12.49	0.39
7	Deir al Hatab-Nablus	7	3.28	4	0.72	17.98	0.52
8	Kafr Sur-Tulkarim	10.2	4.78	5.5	0.72	13.08	0.52
9	Kafr Jammal-Tulkarim	13.8	6.47	6	-0.47	7.80	0.22
10	Kafr Zibad-Tulkarim	12.8	6.00	6	0.00	0.01	0.00
11	Kafr 'Abbushbush-Tulkarim	14.1	6.61	6.5	-0.11	1.67	0.01
12	Azmut - Nablus	8	3.75	4	0.25	6.26	0.06
						Average = 8.82	**Sum = 2.57**

Group D: Small villages with Long route length

This group includes six routes, with data taken from 9 vehicles operators, to represent these routes in different governorates. The average required input data for fare estimation are presented in the table 6.12.

Table 6.12: Average Values for Shared Taxi Fare Equation Variables, (Group D)

Variable	Value	Unit
Fixed cost (FC)	0.62	NIS/KM
Fuel Consumption Rate(FCR)	0.11	Liter/KM
Fuel Price (FP)	5.38	NIS/KM
Profit Margin (PM)	20	%
Occupancy Rate (OR)	4.33	Passengers/Trip
F	95.4	%

For this group, fare is estimated as in Equation 6.11.

$$Fare = \left(0.62 + (0.11 * 5.38\,)\right) * 1.2 * L/\ 4.161 \quad \ldots\ldots (6.11)$$

$$Fare = 0.352\,L \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. (6.12)$$

The previous fare formula was tested on 13 routes in, which included in Table 6.13. For the indicated tested routes, the total absolute percentage of error = 7.27% and the RMSE = 0.54 NIS, as was estimated by using Equation 6.3.

For the previous 4 groups, it is noticed that the absolute percentage of difference and the RMSE are approximately equal, except that values for the Group A which is relatively high. By analyzing the results for that group, it is found that the high values of validation parameters refer to the high difference for Aqqaba–Tubas route between the estimated and the actual fare; the reason refers to the route length which is relatively very small (3 km) which mean small value for the annual travelled distance for the vehicles in that route, and consequently the fixed cost per one kilometer of travel will be greater than that for longer routes.

Table 6.13: Actual and Estimated Value for Shared Taxi Selected Routes for Group D

NO.	**Route**	**Distance**	**Estimated Fare (EF)**	**MOT Fare**	**Difference**	**Abs. % Of Difference**	**Deference2**
1	Yatma - Nablus	19	6.69	6.5	-0.19	2.89	0.04
2	Talluza-Albathan-Nablus	15	5.28	6	0.72	12.00	0.52
3	Beit Imrin-Nablus	17	5.98	6	0.02	0.27	0.00
4	An Naqura-Nablus	13	4.58	5.5	0.92	16.80	0.85
5	Sabatyia-Ijnisiniya-Nablus	14	4.93	5	0.07	1.44	0.01
6	Yasid-Nablus	19	6.69	7	0.31	4.46	0.10
7	Al 'Aqrabanyia-al Far'a-Nablus	17	5.98	5.5	-0.48	8.80	0.23
8	Osarin-Nablus	19	6.69	6.5	-0.19	2.89	0.04
9	Beit Dajan-Nablus	13	4.58	5	0.42	8.48	0.18
10	Burqa-Nablus	20	7.04	6	-1.04	17.33	1.08
11	Alsawya-aleban-Nablus	24	8.45	8	-0.45	5.60	0.20
12	Alnasarya-Nablus	17	5.98	6.5	0.52	7.94	0.27
13	Qaryout-Jalod-Nablus	27	9.50	9	-0.50	5.60	0.25
						Average = 7.27	**Sum = 3.76**

The previous result led to construct a new formula for the routes which length is less than 5 km by changing the average fixed cost variable in fare estimation equation.

As mentioned in Chapter Five, three questionnaires were collected from Habla, Ras at Tira, Ras 'Atiya, Ad Dab'a–Qalqiliya Route and from 'Aqqaba –Tubas Route which was not used in previous fare equations formulation to keep them for validation stage because of limited number of routes in those two governorates.

By analyzing the collected data from that two mentioned routes it is found that the average fixed cost = 2.17 NIS / km and the average occupancy rate =4.71 Passenger/Trip which is approximately equal to the average value for occupancy rate for Group A. Therefore, the modified fare formula for the routes which length is less than 5 km is then as presented in Equation 6.13.

Fare = (2.17+(0.11*5.38)) *1.2*L/ 4.426 ……………….………… (6.13)

Fare = 0.75 L ………………...…………………...………... (6.14)

The previous fare formula was tested on 3 routes, which are included in Table 6.14.

Table 6.14: Actual and Estimated Value for Shared Taxi Selected Routes for Routs length less than 5 km.

NO.	**Route**	**Distance Km)(**	**Estimated Fare (F)**	**MOT Fare (O)**	**Difference (F-O)**	**Abs. % of (F-O)**	**$(F-O)^2$**
1	Birqin -Jenin	4.	3.52	3	-0.52	17.33	0.27
2	Kafa-Tulkarm	3.7	2.77	2.5	-0.27	10.80	0.072
3	Tayasir -Tubas	3	2.25	3	-0.75	0.25	0.562
						Average =17.71 %	**Sum= 0.9**

For the indicated tested routes, the total absolute percentage of error = 17.71% and the RMSE = 0.54 NIS.

6.3.4. Conclusion

For the previous 4 groups fare estimation equations the absolute percentage of difference between the actual and estimated fare ranges from 6.71% to 11.06%, and the overall average for all routes in the groups = 8.46%, while the RMSE ranges from 0.46 to 0.62 NIS and the overall average RMSE = 0.53 NIS. These values are judged to be acceptable due to their relatively small values. It is noticed that groups classification method has reduced the absolute percentage of difference and the RMSE by approximately 50%.

6.3.5. Mini Buses Fare Estimation Equation

Randomly 28 questionnaires were distributed on the public transportation operators which represent 28 routes in the study area as mentioned in Chapter Five. All data related to the fare equation key variables were entered in the Excel template to conduct the required analysis as in the procedure followed in the shared taxi fare estimation analysis, but the difference between the two mentioned modes is the allowed vehicle service life which is 20 years for mini buses compared with 18 years for shared taxis. In addition, there is another additional fixed cost for mini buses that can be identified as "companies' operation and management cost”.

The average values for all collected data about buses and routes were determined, the results are illustrated in Tables 6.15 and 6.16.

Table 6.15: Average Annual Values for Minibuses Fixed Cost variables

Fixed cost variable	Average annual cost	(Min - Max)	Standard deviation	% of total fixed cost
Driver wages	30,666 NIS	(24,000-36000)	279.82	45.11
Maintenance and repairing	16,962 NIS	(10,270-24,970)	4,039.57	24.95
Insurance	4.464 NIS	(3,000-6,000)	833.31	6.57
license	800 NIS	(711-850)	51.51	1.18
Taxes and Registration	3,006 NIS	(1,320-6,500)	968	4.42
Washing and cleaning	1,154 NIS	(500-2400)	475.24	1.70
Parking fees	1,908 NIS	(1,200-3240)	775.62	2.81
Management and services	2,572 NIS	(670-6,420)	1,759	3.78
Depreciation	6,454 NIS	(2,666-11,000)	2,007	9.49
Total	**67,986 NIS**			**100%**

There is an allowance for mini buses to change their routes and transfer passengers for special event like schools Trips, wedding parties…etc., so there is another income resource for the operators which is estimated to be 7,777 NIS per year, and this amount was deducted from the annual fixed cost.

Table 6.16: Average values for Mini Buses Fare Equation Variables

Variable	Value	unit
Fixed cost (FC)	1.43	NIS/km
Fuel Consumption Rate(FCR)	0.17	Liter/km
Fuel Price (FP)	5.38*	NIS/km
Profit Margin (PM)	20**	%
Occupancy Rate (OR)	10.95***	Passengers/Trip
Fluctuation in demand factor (F)	95.4	%

*: The fuel price was determined as the average value for 2017.

**: The profit margin was determined by the MOT.

***: The total number of bus's seats = 19.

Based on the indicated data, the fare equation becomes as presented in Equation 6.3 and 6.4.

$$Fare = \left(1.44 + (.17 * 5.38)\right) * 1.2 * L / \ 10.446 \quad \text{...... (6.15)}$$

$$Fare = 0.270\, L \quad \text{... (6.16)}$$

The previous formula was tested on randomly selected 33 routes were not included in the study, which represent about 36.6 % of total routes, which have mini bus mode in the study area, as illustrated in Table 6.17.

Table 6.17: Actual and Estimated Fare Values for Mini Buses Routes (Overall Average Equation)

NO.	Route	Distance (Km)	Estimated Fare (F)	MOT Fare (O)	Difference (F-O)	Abs. % of (F-O)	$(F\text{-}O)^2$
1	Al Yamun-Jenin	8.8	2.38	3	0.62	20.80	0.39
2	Anabta-Tulkarim	9.4	2.54	3.5	0.96	27.49	0.93
3	Deir Abu Da'if-Jenin	7	1.89	2.5	0.61	24.40	0.37
4	Asira ash Shamaliya - Nablus	9	2.43	3	0.57	19.00	0.32
5	Beit Furik-Nablus	9	2.43	3	0.57	19.00	0.32
6	Deir al Hatab-Nablus	7	1.89	3	1.11	37.00	1.23
7	Salim -Nablus	9	2.43	3	0.57	19.00	0.32
8	Rujeib-Nablus	6	1.62	2	0.38	19.00	0.14
9	Far'un - Tulkarm	6.5	1.76	2.5	0.75	29.80	0.56
10	Anin-Jenin	15	4.05	4	-0.05	1.25	0.00
11	Ti'innik Jenin	17	4.59	5	0.41	8.20	0.17
12	Ya'bad-Jenin	17.5	4.73	5	0.27	5.50	0.08

13	Kufeirit-Jeinin	13.1	3.54	3.5	-0.04	1.06	0.00
14	Arraba-Jenin	12.7	3.43	3.5	0.07	2.03	0.01
15	Baqa as Sharqiya, Nazlat 'Iisa-Tulkarim	17.5	4.73	5	0.27	5.50	0.08
16	An Nazlaat-Tulkarim	18.6	5.02	5	-0.02	0.44	0.00
17	Kafr al Labad-Tulkarim	10.5	2.84	3.5	0.67	19.00	0.44
18	Ramin-Tulkarm	17	4.59	4	-0.59	14.75	0.35
19	Beit lid, Safarin - Tulkarim	17.5	4.73	5	0.27	5.50	0.08
20	Azzun-Qalqiliya	12	3.24	3	-0.24	8.00	0.06
21	Jamma'in-Nablus	19	5.13	5	-0.13	2.60	0.02
22	Yasid-Nablus	18	4.86	5	0.14	2.80	0.02
23	Al 'Aqrabanyia-al Far'a-Nablus	17	4.59	4.5	-0.09	2.00	0.01
24	Osarin-Nablus	19	5.13	5	-0.13	2.60	0.02
25	Beit Dajan-Nablus	13	3.51	3.5	-0.01	0.29	0.00
26	Beita-Nablus	16	4.32	4	-0.32	8.00	0.10
27	Qusin-Nablus	11	2.97	3	0.03	1.00	0.00
28	Alaguar-Tubas	25	6.75	6	-0.75	12.50	0.56
29	Jaba'-Jenin	21.3	5.75	5	-0.75	15.02	0.56
30	Silat adh Dhaher, alatara, Jeinin	25	6.75	6	-0.75	12.50	0.56
31	Ya'bad-Nablus	43	11.61	10	-1.61	16.10	2.59
32	Qaryout-Jalod-Nablus	27	7.29	6	-1.29	21.50	1.66
33	Qabalan-Nablus	20	5.40	5	-0.40	8.00	0.16
						Average = 12.15	**Sum =12.12**

For the indicated tested routes, it is found that the total absolute average for all tested routes is 12.15 % and the RMSE is 0.61NIS, this formula is suitable for some routes with route length more than 10 km and less than 20 km with a 5.03 % average absolute difference between the actual and estimated fare, and the RMSE = 0.28.NIS. However, this formula was not suitable for those routes which their lengths are less than or equal 10 km or more than 20 km, because of the average absolute percentage of difference between the actual and estimated fare is 23.94 % and 14.34 %, and the RMSE for that routes is 0 .71 and 0.96 NIS respectively.

Therefore, another procedure for analysis was followed, which depends on dividing the collected data into groups, in the similar way that followed to estimate shared taxies fare estimation, but the population of the origin was excluded because of most of small villages are shared in the same bus's route which is considered as one large village. This is in addition to the none existence of buses mode for many small villages in the study area, so the groups formulation was only dependent on the route length.

The collected data about mini buses were classified into three groups as presented below.

Group A: Routes length less than 10 KM

This group includes seven routes, with data taken from seven vehicles operators represent these routes in different governorates. The average required input data for fare estimation are presented in the Table 6.18.

Table 6.18: Average Values for Mini Buses Fare Equation Variables

(Group A)

Variable	**Value**	**Unit**
Fixed cost (FC)	1.79	NIS/km
Fuel Consumption Rate(FCR)	0.17	Liter/km
Fuel Price (FP)	5.38	NIS/km
Profit Margin (PM)	20	%
Occupancy Rate (OR)	9.97	Passengers/Trip
F	95.4	%

For this group, fare is estimated as in Equation 6.17.

$$Fare = \left(1.76 + (0.17 * 5.38\ )\right) * 1.2 * L/\ 9.58 \quad \ldots\ldots\ldots\ldots\ldots (6.17)$$

$$Fare = 0.353\ L \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6.18)$$

For testing and validation of the fare equations it was applied on the same routes previously selected to test the overall average fare estimation equation after classifying them into three groups.

The previous fare formula was tested on nine routes from different Governorates in the study area which included in Table 6.19.

Table 6.19: Actual and Estimated Fare Values for Mini Buses Routes (Group A)

NO.	Route	Distance Km)(	Estimated Fare (F)	MOT Fare (O)	Difference (F-O)	Abs. % of (F-O)	$(F\text{-}O)^2$
1	Al Yamun-Jenin	8.8	2.99	3	0.01	0.27	0.00
2	Anabta-Tulkarim	9.4	3.17	3.5	0.33	9.49	0.11
3	Deir Abu Da'if-Jenin	7	2.37	2.5	0.13	5.36	0.02
4	Asira ash Shamaliya - Nablus	9	3.04	3	-0.04	1.40	0.00
5	Beit Furik-Nablus	9	3.04	3	-0.04	1.40	0.00
6	Deir al Hatab-Nablus	7	2.37	3	0.63	21.13	0.40
7	Salim -Nablus	9	3.04	3	-0.04	1.40	0.00
8	Rujeib-Nablus	6	2.03	2	-0.03	1.40	0.00
9	Far'un - Tulkarm	6.5	2.20	2.5	0.30	12.12	0.09
						Average = 5.20	**Sum = 0.63**

For the indicated tested routes, the total absolute percentage of error =5.20 % and the RMSE = 0.26 NIS, as was estimated by using Equation 2.3.

Group B: Routes length equal or more than 10 km and less than 20 km

This group includes eight routes, with data taken from eight busses operators represent these routes in different governorates. The average required input data for fare estimation are presented in the Table 6.20.

Table 6.20: Average Values for Mini Buses Fare Equation Variables

(Group B)

Variable	Value	Unit
Fixed cost (FC)	1.58	NIS/km
Fuel Consumption Rate(FCR)	0.17	Liter/km
Fuel Price (FP)	5.38	NIS/km
Profit Margin (PM)	20	%
Occupancy Rate (OR)	11.69	Passengers/Trip
F	95.4	%

For this group, fare is estimated as in Equation 6.19.

$$Fare = \left(1.58 + (0.17 * 5.38\,)\right) * 1.2 * L/\ 11.15 \quad \ldots\ldots\ldots (6.19)$$

$$Fare = 0.268\,L \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6.20)$$

The previous fare formula was tested on 18 Villages from different Governorates in the study area which included in Table 6.21.

For the indicated tested routes, the total absolute percentage of error =4.99 % and the RMSE = 0.28 NIS.

Table 6.21: Actual and Estimated Fare Values for Mini Buses routes (group B)

NO.	Route	Distance Km)(	Estimated Fare (F)	MOT Fare (O)	Difference (F-O)	Abs. % of (F-O)	$(F-O)^2$
1	Anin-Jenin	15	4.02	4	-0.02	0.50	0.00
2	Ti'innik Jenin	17	4.56	5	0.44	8.88	0.20
3	Ya'bad-Jenin	17.5	4.69	5	0.31	6.20	0.10
4	Kufeirit-Jeinin	13.1	3.51	3.5	-0.01	0.31	0.00
5	Arraba-Jenin	12.7	3.40	3.5	0.10	2.75	0.01
6	Baqa as Sharqiya, Nazlat 'Iisa-Tulkarim	17.5	4.69	5	0.31	6.20	0.10
7	An Nazlaat-Tulkarim	18.6	4.98	5	0.02	0.30	0.00
8	Kafr al Labad-Tulkarim	10.5	2.81	3.5	0.69	19.60	0.47
9	Ramin-Tulkarm	17	4.56	4	-0.56	13.90	0.31
10	Beit lid, Safarin - Tulkarim	17.5	4.69	5	0.31	6.20	0.10
11	Azzun-Qalqiliya	12	3.22	3	-0.22	7.20	0.05
12	Jamma'in-Nablus	19	5.09	5	-0.09	1.84	0.01
13	Yasid-Nablus	18	4.82	5	0.18	3.52	0.03
14	Al 'Aqrabanyia-al Far'a-Nablus	17	4.56	4.5	-0.06	1.24	0.00
15	Osarin-Nablus	19	5.09	5	-0.09	1.84	0.01
16	Beit Dajan-Nablus	13	3.48	3.5	0.02	0.46	0.00
17	Beita-Nablus	16	4.29	4	-0.29	7.20	0.08
18	Qusin-Nablus	11	2.95	3	0.05	1.73	0.00
						Average = 4.99	**Sum = 1.46**

Group C: Routes length equal or more than 20 KM.

This group includes 12 routes, with data taken from 12 busses operators represent these routes in different Governorates. The average required input data for fare estimation are presented in the Table 6.22.

Table 6.22: Average Values for Mini Buses Fare Equation Variables (Group C)

Variable	**Value**	**Unit**
Fixed cost (FC)	1.14	NIS/km
Fuel Consumption Rate(FCR)	0.17	Liter/km
Fuel Price (FP)	5.38	NIS/km
Profit Margin (PM)	20	%
Occupancy Rate (OR)	11.04	Passengers/Trip
F	95.4	%

For this group, fare is estimated as in equation 6.19.

$$Fare = \left(1.14 + (.17 * 5.38\ )\right) * 1.2 * D/\ 10.53 \quad \text{……………} (6.19)$$

$$Fare = 0.234D \quad \text{………………..……………………………..} (6.20)$$

The previous fare formula was tested on 6 Villages from different Governorates in the study area which are the total number of villages included in this group were not included in the study, which presented in Table 6.23.

For the indicated tested routes, the total absolute percentage of error =2.94% and the RMSE = 0.21NIS.

Table 6.23: Actual and Estimated Fare Values for Mini Buses routes (Group C)

NO.	Route	Distance Km)(	Estimated Fare (F)	MOT Fare (O)	Difference (F-O)	Abs. % of (F-O)	$(F-O)^2$
1	Alaguar-Tubas	25	5.85	6	0.15	2.50	0.02
2	Jaba'-Jenin	21.3	4.98	5	0.02	0.32	0.00
3	Silat adh Dhaher, alatara, Jeinin	25	5.85	6	0.15	2.50	0.02
4	Ya'bad-Nablus	43	10.06	10	-0.06	0.62	0.00
5	Qaryout-Jalod-Nablus	27	6.32	6	-0.32	5.30	0.10
6	Qabalan-Nablus	20	4.68	5	0.32	6.40	0.10
						Average = 2.94	**Sum = .24**

6.3.6. Conclusion

For the previous 3 mini buses groups Equations the absolute percentage of difference between the actual and estimated fare ranges from 2.94% to 5.2%, and the overall average for all routes in the groups = 4.89%, and the RMSE is ranged from 0.21 to 0.34 NIS and the overall average RMSE = 0.26 NIS. These values are judged to be acceptable due to their relatively small values. It is noticed that groups classification method is reduced the absolute percentage of difference and the RMSE by approximately 57%.

6.4. Common Results: (Analysis of Collected Data)

6.4.1. Percentage of Public Transport Users

By comparing the total number of passengers who travelled by shared taxis and the total number of passengers who travelled by buses for the same routes, it is found that 74% of passengers were using the shared taxi mode and 26% of passengers were using the bus mode. This result was formed based on the data collected from 13 routes distributed in different governorate, which are the average actual collected number of daily passengers per one vehicle multiplied by the total number of the shared taxies or buses on that route, which are presented in the Table 6.24

Table 6.24: Percentage of Public Transport Users

Route Name	Total Number of passengers	Shared taxi passengers	Buses Passengers	% of shared taxis Passengers	% of buses Passengers
'Awarta-Udala-Nablus	1209	1455	246	83	17
Deir Abu Da'if-Jenin	70	846.5	140	83	17
Bal'a-Tulkarim	1040	1340	300	78	22
Tammun-Tubas	952	1352	400	70	30
Qusra-Jurish-Nablus	440	556	116	79	21
Tammun-Nablus	405	675	270	60	40
Jaba'-Nablus	245	351	106	70	30
Kafr Rai'-Jenin	960	1288	328	75	25
Qaffin-Tulkarm	1098	1268	170	87	13
Al Jalama, "Arrana-Jenin	1008	2138	1130	47	53
Zeita-Tulkarim	581	791	210	73	27
Majdal Bani Fadel-Nablus	196	254	58	77	23
Talfit -Nablus	295	384	89	77	23
Average				**74%**	**26%**

6.4.2. Analysis of Average Monthly Income

After calculating all the cost variables for all shared taxis and buses that were included in the selected samples and by using the same Excel template was used to estimate fare equation, the total cost per one kilometer of travel for each route was calculated and divided on the actual occupancy rate, considering the following equations:

$$Cost\ of\ 1km\ travell\ \ = \frac{TC}{AD} \ldots\ldots\ldots\ldots\ldots\ldots \text{(6.21)}$$

where:

TC = Total cost

AD = Annual Distance (actual working days × Daily distance of travel)

The actual one way cost of travel per passenger was calculated by using Equation 6.22.

$$cost\ per\ passenger = L\ (\frac{cost\ per\ 1\ km}{OR}) \ldots\ldots\ldots \text{(6.22)}$$

where:

L = One-way trip distance (Route length)

OR = Occupancy rate.

The actual monthly profit for each vehicle was calculated by using Equation 6.23.

$$MP = (AF - CP) \times P \times WD \ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(6.23)}$$

Where:

MP = Monthly Profit

AF = Actual Fare

CP = Cost per passenger per one-way trip

P = total number of passengers per day

WD = Average monthly working days

The average monthly profit (income) for shared taxi and Mini Bus operators are presented in Table 6.25.

Table 6.25: Average Monthly Profit for shard Taxi and Bus Operators

Public Transport Mode	Average monthly profit (NIS)	Range (Min-Max) NIS	Standard deviation
Shared Taxi	2,219	(208.55-4,649)	843
Mini Bus	2,554	(670-6,420)	1,759

These estimated monthly income as presented in Table 6.25 is consistence with the roughly average estimated income calculated by most public transportation operators. They divide the total daily or monthly vehicle revenue, after deducting fuel cost, into 3 approximately equal shares; one third for the driver's wage, another third for travel fixed cost (not including the drivers' wage), and the remaining third for the operator as a profit. Based on the collected data, the calculated average monthly shared taxi driver wage is about 2,000 NIS, and the mini bus driver wage is about 2,555 NIS. The average monthly profit for public transportation operator will be as a reference for estimating the number of shred taxis and buses required for any route, and this will be discussed and analyzed in the public transportation demand section.

By referring to the actual calculated monthly income for some routes, where the related income is less than the average, and by applying the previously mentioned fare estimation equation it is found that most of the routes fare should be raised as presented in the Table 6.26.

Table 6.26: Actual and Estimated Monthly Income for Shared Taxis

Route	Distance (KM)	Actual fare (NIS)	Actual monthly income (NIS)	Estimated fare (NIS)	Estimated monthly income (NIS)
Jalbon-Jeinin	12.5	5	1596	6	2379
Ramin-Tulkarim	17	6	1246	6	1246
'Azzun -Qalqiliya	12	5	1682	5.38 (5.5)*	2379
Alfandaqumiya-Jenin	22.5	7	1682	7.5	2452
Duma-Nablus	30	8.5	1062	10.5	3683
Majdal Bani Fadel - Nablus	25.5	8	758	9	2287
Tammun- Nablus	23	7.5	758	8	1337

* Rounded Fare to nearest 0.5 NIS

6.4.3. Revenue-Cost Ratio

The revenue-cost ratio (RC) is an economical measure that describes the economic efficiency for a given system (Alhasan, 2017). This ratio is used to measure the economic efficiency of public transport system in the study area.

Firstly, results from the previous sections include the total annual costs paid by the operator. On the other hand, Equations 6.24 described the calculation procedures to estimate the annual revenue for each selected routes separately.

$$R = NP \times FL \quad \text{.................................} \quad (6.24)$$

where:

R = Annual revenue (NIS/yr)

NP = Annual number of passengers

FL = Fare level (NIS/Passenger)

$$NP = WD \times Fr \times NS \times OR \times F \quad \text{................} \quad (6.25)$$

where:

WD = Average annual working days

Fr = Average route daily one-way trips (trip/day)

NS = Number of seat (seat/bus)

OR = vehicle occupancy rate

F = Fluctuation in demand factor

Finally, the RC will be simply determined using Equation 6.26. If the ratio is more than one then the system is economically efficient otherwise it is not efficient, (Alhasan,2017).

$$R.C. = R / TC \quad \text{................................} \quad (6.26)$$

Where:

R = Annual revenue (NIS/yr)

TC = Total operating cost

For the studied shared taxis and mini buses routes the RC was calculated as in the procedure mentioned above and the results are illustrated in Table 6.27.

In general, the results illustrate that the public transport system in the study area is economically efficient with 20% profit margin.

Table:6.27: Average Values for Revenue Cost Ratio

Mode	Number of studied routes	Number of studied Vehicles	Average R.C	St. Dev.	Rang (Min ,Max)	Number of vehicle with RC<1
Shared taxi	29	48	1.2	0.14	(0.83-1.74)	5
Mini bus	27	27	1.17	0.22	(0.83-1.85)	4

6.4.4. Fixed Cost and Annual Distance Relationship

The relationship between the one kilometer fixed cost and the annual travelled distance is studied for all available data in the study. This reveals that the fixed cost depends on average annual traveled distance of shared taxies and mini buses. Figure 6.5 and 6.6 indicates that the fixed costs per kilometer decline with the increase in the average annual traveled distance. This result is consistent with California Air Resources Board (2016), where they found a strong correlation between brake repair costs (part of total maintenance costs) and average miles traveled per month for conventional buses and confirmed that brake costs per mile decline for duty cycles that have higher average monthly mileage

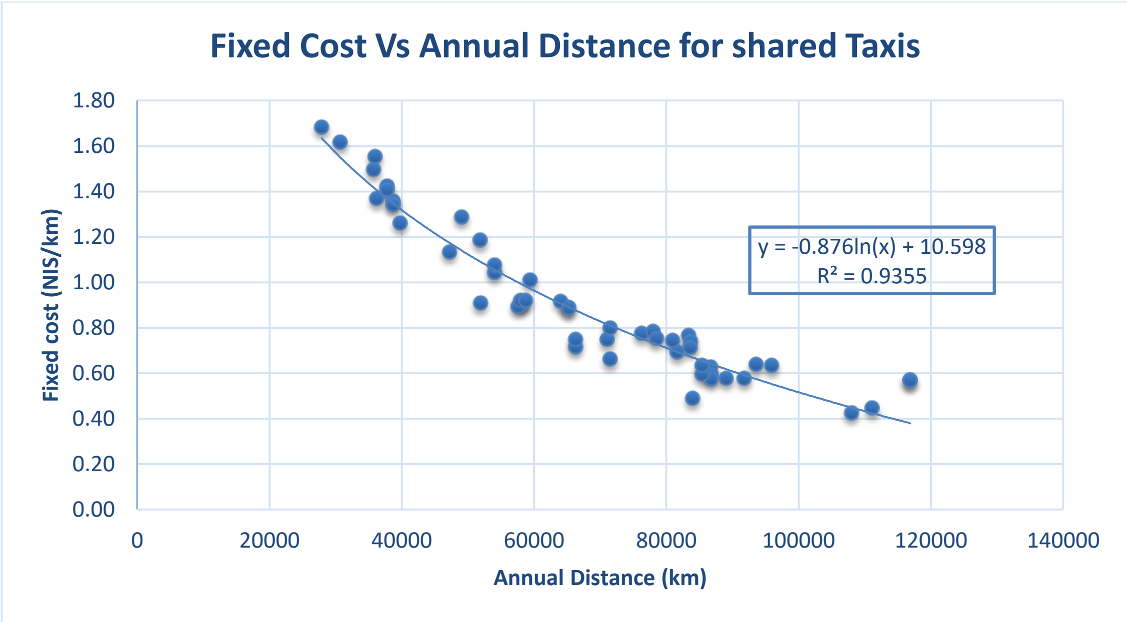

Figure 6.5: Fixed Coast and Annual Distance Relationship for Shared Taxis

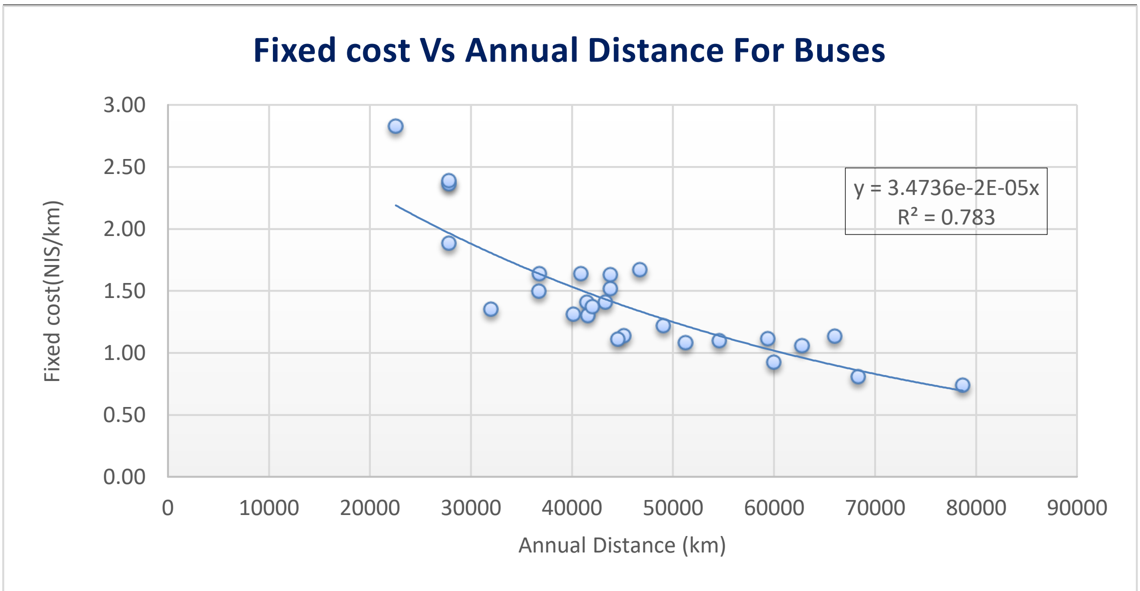

Figure 6.6: Fixed Coast and Annual Distance Relationship for Mini Buses

6.4.5. Fare Sensitivity for Fuel Price Change

The fuel price and the consumption rate are two of major components which affect the estimated fare as presented previously in fare estimation equations. To estimate the sensitivity of fare to changes in the fuel price, the change in fare is calculated based in Equation 6.6, which is formulated for shared taxi (Group A) as an example. For a 10 km route length, the estimated fare is 4.5 NIS. Table 6.28 presents the estimated changes in fuel price, which corresponds with the increase or decrease in fuel price by 0.5 NIS increment.

Table 6.28: Fare Sensitivity for Changes in Fuel Price for Shared Taxi

Route Classification	Changes in Fuel Price (NIS)	Changes in Fare (NIS)
Group A (Route Length 10 km)	±1.74	± 0.5
	±3.42	±1.0
	±5.10	±1.5
	±6.77	±2.0

As presented in Table 6.28, for ±1.74 NIS in fuel price, the result will be ±0.5 NIS change in fare, which is the minimum amount of increment that could be applied on the fare, with the absence of use of any currency smaller than half shekel (0.5 NIS) in Palestine despite the use of such fraction of currency in "Israel". For any other route length, the same procedure could be done to estimate the required change in the fuel price to get 0.5 NIS in fare. This can also be applied for mini buss groups.

Table 6.29 summaries the changes in fuel price which met with 0.5 NIS changes in Fare for the other shared taxis and mini buses routes which located with 10 km route length groups.

Table 6.29: Fare Sensitivity to Fuel Price Change for 10 km Routes Length

Group	Changes in Fuel Price (NIS)	Changes in Fare (NIS)
Shared Taxi Mode		
A	± 1.74	±0.5
C	± 1.61	±0.5
Mini Bus Mode		
B	±2.72	±0.5

6.5. Public Transportation Ridership Demand

It is very important to forecast the ridership for public transportation modes for any route in order to forecast the daily or monthly profit or income for the operators, and to make a balance between the estimated fare and the total monthly profit. This is mainly affected by the daily public transportation demand (number of passengers per day), and the percentage of the total passengers for each public transport mode operating on the route.

In this study, as mentioned in Chapter Five, the data collected from 143 sample which represent 143 households from different villages size and location with respect to the governorate center, the demand model equations were produced by using multiple regression analysis.

6.5.1. Dependent and Independent Variables

The first step in developing the mathematical relationship was the establishment of a statistical matrix among the different variables included in the study. The next step of regression modeling was to find the type of function between the dependent and independent variables such as a linear or log linear functions. Depending on the previous studies implemented to model ridership demand in Palestine and through different trials and tests, the type of function in this study showed that the best relation between the dependent and the independent variables for the collected data is the linear format.

As previously mentioned in Chapter three, the dependent variable is the Number of trips produced per one household per one week, and the probably independent variables are selected to be studied which may affect the independent variables are:

- Origin village populations.
- Destination city (governorate center) population.
- The number of employee and university students in origin villages household.
- Village household income and expense.
- Distance between origin and destination.
- Shared taxi fare.
- Availability of private car for the household.
- Number of household members.

6.5.2. Development of Demand Model

By using the SPSS software with 95% confidence level, the correlation matrix was determined, Table 6.30 present the correlation between the independent and dependent variables and also the correlation between the independent variables themselves. As mentioned in the literature, the selected independent variables were chosen according to the following criteria:

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

Based on these two criteria the ten variables were reduced into four variables as follow:

- The first variable was the shared taxi fare in (NIS).
- The second variable is the percent of employees per household.
- The third variable is the percent of university students per household who are attending universities or Colleges.
- The fourth variable is the average number of private cars per household.

  The correlation matrix of these new variables is shown in Table 6.31

Table 6.30: Correlations Coefficients for 10 Variables

	Trips Per Week	Shared Taxi Fare	Number of employees	Number of University Students	Population of Origin	population of Destination	Distance	Private Car Ownership	Number of Household Members	Household Income	Household Expenses
	Y	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**X7**	**X8**	**X9**	**X10**
Y	1										
X1	.270	1									
X2	.345	0.059	1								
X3	.530	0.076	0.130	1							
X4	0.065	.470	0.101	0.013	1						
X5	0.061	.548	0.008	0.070	.589	1					
X6	0.272	.941	0.074	0.086	.282	.541	1				
X7	.351	0.085	0.074	0.041	0.006	0.077	0.076	1			
X8	.189	0.041	.232	.311	0.043	0.103	0.060	0.039	1		
X9	0.106	0.139	.418	0.119	0.077	0.033	0.089	.284	.259	1	
X10	.221	.224	.384	.275	0.061	0.084	.217	0.148	.325	.698	1

Table 6.31: Correlation Matrix for the Four Model Variables

	Trips Per Week	Shared Taxi Fare	Number of employee	Number of University Students	Private Car Owner Ship
	Y	**D1 = (X1)**	**D2 = (X2)**	**D3 = (x3)**	**D4 =(X7)**
Y	1				
X1	0.270	1			
X2	0.345	0.059	1		
X3	0.530	0.076	0.130	1	
X4	0.351	0.085	0.074	0.041	1

Using multiple linear regression analysis, final estimated ridership demand model is:

$$Y = 3.446 - .46\, D_1 + 1.174\, D_2 + 2.317\, D_3 - 2.336\, D_4 \ldots\ldots\ldots\ldots\ldots \quad (6.27)$$

Where:

Y = Number of one way produced trips per household

D_1 = Shared taxi fare in (NIS) for any external route.

D_2 = Percent of employs per household.

D_3 = Percent of enrolled university students per household

D_4 = average number of private cars per household.

The correlation coefficient (Adjusted R^2) for the above equation is 0.53. The analysis of t-test and significance level indicated that all variables had a good significance with t-statistics of -4.118, 5.398, 7.607 and -6.276 respectively as presented in Table 6.32.

Table 6.32: Regression Results for Public Transportation Ridership Demand Model

Intercept and Variables	Coefficients	Standard Error	t-Value	Significance
Intercept	3.446	0.741	4.651	0.000
D_1	-0.460	0.107	-4.305	0.000
D_2	1.174	0.229	5.125	0.000
D_3	2.317	0.295	7.849	0.000
D_4	-2.336	0.360	-6.485	0.000
Adjusted R^2			0.53	
F-Value			41.17	
Sample Size			143	

The signs of the independent variables are logical, indicate that when D_1 (shared taxi fare) and D_4 (number of private car per household) increase, the expected number of trips will be decreased and when D_2 and D_3 (percent of employees and university students, respectively) increase, the expected number of produced trips per household will be increased.

6.5.3. Demand Model Validation

The previous ridership demand model was tested on 15 routes from different governorates which represent about 12% of the total routes in the study area and about 50% from the studied shared taxi routes. Eight of these routes have bus mode which represent about 29% of the studied routes. Table 6.33

Table 6.33: Observed and Estimated Daily Number of Passengers Per Vehicle

	Shared Taxis				Mini Buses			
Route Name	**Estimated**	**Observed**	**Difference**	**% of Difference**	**Estimated**	**Observed**	**Difference**	**% of Difference**
Bal'a-Tulkarm	96	80	16	20.23	176	150	26	17.56
Far'un-Tulkarm	123	99	24	24.34				
Duma-Nablus	43	48	-5	-9.86				
Talfit-Nablus	62	59	3	4.55	92	89	3	3.51
Faqu'a-Jenin	83	76	7	9.01				
Jalbun-Jenin	79	71	8	10.63				
Qusra,Jurish-Nablus	48	55	-7	-13.20	51	58	-7	-12.48
Qaffiin-Tulkarm	68	61	7	11.53	91	85	6	7.63
Beit Fourik-Nablus	123	99	24	24.20	96	120	-24	-20.30
Ramin-Tulkarm	62	57	5	8.39				
Saida-Tulkarm	65	65	0	-0.56	57	50	7	13.55
Awarta,Udal-Nablus	103	93	10	10.77	137	123	14	11.50
Majdal Bani Fadil-Nablus	56	49	7	14.60	67	58	9	15.68
Beit Qad-Jenin	117	91	26	28.21				
'Asira ash Shamaliya - Nablus	116	120	-4	-2.93				
Average Absolute Percent of Difference				**12.87 %**				**10.22 %**

presents a comparison between the observed number of passengers which was collected directly from the public transportation operators, and the estimated number of passengers using ridership demand model for almost the same routes were studied for fare estimation equations. The needed input data for the validation process to determine the daily number of passenger per one public transportation vehicle are:

- The total number of village households which equal to the total population divided by the average number of household members, which equal 4.8 for the West Bank (PCBS,2016).
- The total number of shared taxis vehicles and buses on the route.
- The shared taxi fare.
- The percent of enrolled university students per household which equal 0.235 for West Bank for 2016/2017, (MOHE,2017).
- The percent of employees per household which equal 1.6 from (PCBS,2016), as mentioned in Chapter Five.
- The number of private car per household which was taken from the MOT, which differ from one governorate to other, which equal to the total number of private vehicles divide on the total number of households for each governorate.
- The percent of passenger for each mode (shared taxi or bus) which was determined from the field survey data for the studied routes.

To determine the total daily ridership demand (passengers in both directions) for any vehicle, the following procedure should be followed:

- Estimate the total number of two way trip per household per week by multiply the result of Equation 6.27 by 2.
- Determine the total number of passengers per day by dividing the previous result on 6 (working days per week).

- Determine the total number of passenger per village by multiplying the previous result by the total number of village households.
- The total number of passenger estimated for each routes is divided between public transportation modes according to the determined mode split, and the total number of passenger for every mode is divided by the total number of the vehicles for that mode.

The previously predicted values are very important to evaluate the route strength and to know if there is an ability to increase or decrease the number of shared taxis for any route by applying some simple mathematical equations, depending on the estimated fare equation and the demand model result.

By taking 'Asira ash Shamaliya -Nablus route as an example, the following calculations will present the method to calculate the average monthly income for shared taxi operator:

Step 1: Estimate the average daily number of passengers (Y) by using Equation (6.23).

From Table 6.32, Y = 116 passenger per day.

Step 2: Estimate the total number of trips in one direction by using the average modified occupancy rate for the village using the suitable equations. (Group A, Equation 6.5), for 'Asira ash Shamaliya -Nablus route, the MOR=4.459.

Total Number of trips per day = 116 / 4.459

= 26 Trips.

Step 3: Estimate the total daily cost of travel by using the cost part from the previous Equation 6.5 used in Step 2.

Cost of travel = 1.06 +(.11 * 5.38) *26 * (route length = 9).

= 386.5 NIS/Day.

Step 4: Estimate the daily and monthly average profit.

Total Daily revenue = Y* Actual Fare

= 116 * 4

= 464 NIS/Day

Total Profit =Total Revenue – Total cost

= 77.5 NIS.

Average Monthly income = 77.5 *(Actual average annual working days per month = 24.58)

Average Monthly income = 1,905 NIS.

For the example of 'Asira ash Shamaliya -Nablus route, there are 18 shared taxi vehicles. If an additional one increased, it is mean that the total number of daily passengers will be divided on 19 on stead of 18.

Total estimated number of daily shared taxis passengers in 'Asira ash Shamaliya = 2088

➔ 2088/19 = 110

By repeating the previous calculation, the total monthly profit will be 1,681 NIS.

6.5.4. Conclusion

There is a necessity to determine the lowest and highest average monthly profit amount for shared taxis operators by MOT officials and stakeholders. This values will provide an assistance to know if there is an ability to increase the number of shared taxis to improve the level of service by reducing the waiting time, or to reduce the number of shared taxis for weak routes (low demand or low average monthly operator's profit), or to take a decision for the required fare increment to improve the level of service or to increase the average monthly profit for the operators up to certain level, to be consistence with the national average income .

Chapter Seven

Conclusions and Recommendations

7.1. Conclusion

Most of the citizens in the West Bank depend on public transportation in their travel, but this sector is suffering from many problems, including problems and challenges associated with the service provided and the fare, such as protests on changes in the fare and public transportation sectors strikes. This thesis is considered as a contribution for solving some of these problems especially those related to fare and demand related.

Operators of the public transport sector in Palestine do not receive any significant financial support from the government. The government acts as if this sector should be financially self-sufficient, and therefore should cover its costs. Therefore, the procedure followed for fare estimation depends on cost plus profit which is the same procedure followed for fare estimation in many developing countries.

Public transportation is studied in this thesis for a sample of external routes in the northern West Bank that connect villages and towns to governorate centers. These consist of two modes; shared taxis and mini bus. Some large buses operate on a very limited number of routes with irregular working times, so this mode is not considered in this study.

All potential variables that affect the cost of travel using public transport were studied, and the collected data were classified into homogeneous groups. The average values were used to estimate the fare equation parameters.

Based on data collection and analysis the following conclusions can be drawn:

- The actual procedure followed by the MOT, which is responsible for regulating public transportation, to estimate the new fare for any route mainly depends on change in fuel prices, while results provided by studies carried out by institutions such as the World Bank are not taken into consideration, because of their illogical results and the shortage of required input data.
- The representatives of public transportation operators are involved in the fare modification process. The process is mostly a result of negotiations between the representatives and the MOT officials, where consequently routes are identified whether to be subjected to fare modification and the percentage of that.
- About 62% of the operators consider the actual fair as low or very low, and about 38% see it as fair. On the other hand, most of passengers (about 69 %) consider the actual fare as fair, and about 31 % consider it as high or very high. About 24% of passengers consider the public transportation performance as bad or very bad, 27% consider it as moderate, 37% consider it as good, and about 12% consider it as very good. These results indicate that this sector needs a special attention and a well-studied improvement process to increase people's

satisfaction on the performance of public transportation, including fare estimation procedure.

- Four equations were estimated to express the fare for shared taxis in the light of the two main variables for each route: the served village/town population and the route length. Routes were classified into four groups, and the fare for any routes is determined by multiplying the cost per one kilometer of travel per one passenger by the route length and by fixed profit margin (set by the MOT as 20%). The cost per one kilometer results from the total fixed cost plus the variable cost, where the later depends on fuel consumption rate and fuel price.
- It is found that the average fixed cost is inversely proportional to the average annual traveled distance, and the average fuel consumption rate is almost the same for all shared taxis or mini buses. The average occupancy rate differs from one group of routes to another. The results show that when the route length increases, the average occupancy rate also increases per trip for the large villages due to the need for more fuel. This difference in cost increases the waiting time on the part of the driver to increase the number of passengers. It is also found that the average occupancy rate for the small villages is less than that for the large ones.
- Three Equations were estimated to express the fare for mini buses in the light of route's length. Routes were classified into three groups,

and the fare is made out similar to that for the shared taxis as mentioned above.

- The fare estimation equations were tested for many different routes, and the results were compared with the actual fares. The average absolute difference between the estimated and the actual fares and the RMSE were assessed. The absolute percentage of difference of the overall average of all routes in the groups = 8.46% for shared taxis and 4.89% for mini buses, and the overall average RMSE = 0.53 NIS for shared taxis groups and 0.26 NIS for mini buses routes. These values are judged to be acceptable due to their relatively small values.
- The results illustrate that the fuel consumption rate and the fuel price are the main factors affecting the variable cost, but the change in the fuel price should be significant enough, in order to be reflected on the fares values.
- It is found that distance is not the only factor that influences the fare. As such, one may find approximately an equal fare for different route lengths, or different fares for approximately equal route length.
- The average difference between buses and shared taxis fare is about 24% for all the different classified groups, which ranged from 16% up to 40%.
- The average monthly income for each public transport vehicle was estimated as 2,219 NIS for a shared taxi and 2,554 NIS for a mini bus. These average monthly incomes are consistent with the approximate average income as calculated by most public transportation operators

They divide the total daily or monthly vehicle revenue, after deducting fuel cost, into 3 approximately equal shares; one third for the driver's wage, another third for travel fixed cost (not including the drivers' wage), and the remaining third for the operator as a profit. The average of the monthly calculated shared taxi driver wage is about 2,000 NIS, and the mini bus driver wage is about 2,555 NIS. These results indicate that the input data used is trustworthy and reflects the actual situation.

- The average monthly income is used in this study to investigate the route strength (the average daily number of passengers and the average monthly income). It is also used as a parameter to make a judgment about the potential to increase or reduce the number of public transport vehicles and to determine the effect of this on the operators.
- To estimate the average monthly income, there is a need to forecast the average daily number of passengers per vehicle (ridership) on any route, which was determined by using multiple linear regression method based on the collected data from different households in the study area.
- The developed ridership demand model to estimate the total number of trips produced per household using public transportation considered independent variables that include the shared taxis fare, numbers of employees, enrolled university students, and the number of private cars owned by the household.

- The model has acceptable explanatory power with R^2 value of 0.53, indicating that the explanatory model variables explain 53% of the variation in the daily trips per household.
- The general trip ridership demand model is successfully verified by comparing the estimated number of passengers with the actual observed number of the different shared taxis and mini buses which have been studied for fare estimation.

7.2. Recommendations

The following recommendations are identified based on the outcome results of this research:

- MOT officials and planners are encouraged to use the results of fare estimation procedure and to validate these results for the other governorates by comparing the results of estimated equations with the actual ones. Accordingly, it is recommended to make revisions to the actual fare.
- It is very important to determine the acceptable minimum and maximum monthly average income for public transport vehicles by the MOT and other stakeholders and to compare the actual income with the estimated limits. This will help in determining the required number of public transport vehicles and the suitable fare for a given level of service, which may solve the problem of the decline in the revenue cost ratios caused by the unjustified increase in the number of public transport vehicles.

- Because of not using fraction of NIS in the West Bank, and the minimum currency used is 0.5 NIS, it is recommended to follow one of the following suggestions to determine the applied fare.
    1. Reuse the fraction of NIS in cash transaction in the West Bank.
    2. Use rounding process up to 0.25 NIS, which means applying a different fare for each direction of the two-way trip; one fare will be more than the other by 0.5 NIS.
    3. Use rounding process up to 0.5 NIS.
    4. Use of new technologies regarding fare collection system, such as electronic or magnetic card system, especially for buses, which will allow using any value of fare. This will also decrease the fare payment and processing time.
- It is essential to improve the database systems of the MOT, especially in regard to public transit records and data with a continuous process for entering and storing data especially which is related to fixed cost variables for proper fare estimation.
- The MOT should cooperate with the PCBS to estimate the price index for the different cost variables, which formulate the total cost of travel. The cost of public transport operations if indexed to costs on inputs (such as price of fuel, wages, and spare parts) could be used to conveniently calculate the variations to costs at different points in time for different routes at different levels of quality.
- It is essential to link the fare with the cost of living index, which could be part of further studies in the future.

- MOT officials and planners are encouraged to use the results of rider ship demand model that are estimated in this research in the modeling of share of each public transport mode (i.e., mode choice between the shared taxi and bus modes).
- The PCBS should conduct household travel surveys that include detailed data on trips made by households. These surveys can be used by researchers to estimate trip generation models.
- Researchers are encouraged to validate this model in the future (e.g., after 5 years) through collecting proper data in the future and to use such data in the models developed in this research in order to ensure that the models are still valid then by comparing the estimated trips from the developed models with the observed trips.
- Researchers are encouraged to conduct similar studies to establish fare equations and ridership models for other types of routes and for other public transport modes, such as for the internal urban routes considering the shared taxi and the standard bus modes.
- Researchers are recommended to study mode split and establish mode choice models, especially on the disaggregate level, so as to determine the percentage of the travelers who would use public transportation modes more accurately.

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Appendix

Appendix A (External Routes in the Study Area)

Rout Name	of No. Shared Taxi	No. of Buses		Fare (NIS)		Distance (km)
		Large	Mini	Shared taxi	Bus	
Tubas Governorate Routes						
Tammun-Tubas	7	-	2	3	2	6
Tyasir-Tubas	5	-	-	3	-	3
Alaguar-Tubas	5	-	9	5	6	25
Aqqaba-Tubas	4	-	-	3	-	3
Al far'a-Nablus	7	-	3	5.5	4	17
Jenin Governorate Routes						
Zububa,Rummana-Jenin	16	-	2	5	-	12.5
Al Tayba-Jenin	6	-	2	6	-	15.5
Arabbuna-Jenin	2	-	-	4.5	-	10.3
Deir Ghazala-Jenin	3	-	-	4	-	8
Silat alHarthyia-Jenin	21	-	4	4	2.5	9.5
Al jalama , 'Arrana-Jenin	8	-	5	3.5	3	7.5
Anin-Jenin	9	-	3	5.5	4	10.3
Ti'innik Jenin				6	5	16.7
Faqqu'a-Jeinin	11	-	-	5	-	10.5
Al Yamun-Jenin	26	-	2	4	3	8.8
Kafr Dan - Nablus	9	-	2	3.5	-	6.2
Jaba'-Jenin	12	-	3	6.5	5	21.3
Alfandaqumiya-Jenin	7	-	1	7	-	21.5
Silat adh Dhaher, alatara, Jeinin	6	-		7.5	6	25.3
Anza-Jenin	5	-	-	6	-	17.5
Kharuba-Jenin	5	-	-	2.5	2	6.5
Aba , Alalmanya-Jenin	5	-	1	3,2	1.5	2.5
Beit Qad- Jenin	4	-	-	3.5	-	6
Barta'a ash Sharqiya-Jenin	15	-	3	10	8	30
Al 'Araqa-Jenin	6	-	-	5	-	13.3
Tura,Nazlat zaid , At Tarem-Jenin	6	-	-	7.5	-	25
Al Hashimiya-Jenin	3	-	1	5	4	8

Kafr Qud-Jenin	3	-	1	4.5	3.5	7.1
Deir Abu Da'if-Jenin	9	-	1	3.5	2.5	7
Berqin-Jenin	14	-	-	3	-	4.7
Um Dar, Zabda-Jenin	2	-	-	7.5	-	25/23.5
Siris ,Al Judeida, Sir -Jenin	13	-	7	7	6	21.6
Jalbun-Jenin	8	-	-	5	-	12.5
Almarah-Jenin	-	-	5	-	1.5	2
Aljaberyat-Jenin	2	-	-	2	-	2
Ya'bad-Jenin	29	-	4	6	5	17.5
Kufeirit-Jeinin	6	-	2	5	3.5	13.1
Al Mughayyir, Al Mutilla-Jenin	5	-	2	5	4.5/	11.7
Jalqamus-Um at tut-Jenin	7	-	2	4.5	/3/3	6.3/8
Qabatiya -Jeinin	19	-	17	3.5	2.5	8.3
Arraba-Jenin	27	-	4	5	5	12.7
Mirka-Jenin	2	-	-	5	-	11.9
Raba-Jenin	4	-	4	6	5	18
Misliya- Jenin	4	-	-	5	-	11.4
Az Zababda, Alamrikiya-Jenin	21	-	-	5	-	12.5/9.1
Kafr Ra'i-Jenin	16	-	4	6.5	6	21
Ajja-Jenin	12	-	-	6.5/7	-	19.5/21.2
Sanur-Jenin	7	-	1	6	5	15.2
maythalon-Jenin	13	-	1	6.5	5	17
Tubas, 'Aqqaba, Az Zababda-Jenin	49	-	6	7.5	6	24
Tulkarm Governorate Routes						
Deir Algusun-Tulkarm	22	-		4.5		8
Attil-Tulkarm	23	-	4	5.5	4	10.3
Zeita-Tulkarm	7	-	2	6	4.5	13
Illar-Tulkarm	13			7	5	17.5
Seida-Tulkarm	5			7.5	5.5	18
Baqa as Sharqiya, Nazlat 'Iisa-Tulkarim	18	-	-	7	5	17.5
Qaffin-Tulkarm	18	-	2	7	5.5	18.5
An Nazlaat-Tulkarim	6	-	1	7	5	18.6
Bal'a-Tulkarim	17	-	2	5	3.5	9.8
Anabta-Tulkarim	18	-	1	4.5	3.5	9.4
Kafr al Labad-Tulkarim	11	-	1	5	3.5	10.5
Ramin-Tulkarm	6	-	1	6	4	17
Beit lid, Safarin -Tulkarim	16	-	1	7	5	17.5
Far'un -Tulkarm	8	-	1	3.5	2.5	14.5

Kafr Sur-Tulkarim	23	-	-	5.5		10.2
Kafr Jammal-Tulkarim		-	-	6		13.8
Falamya-Tulkarm		-	-	7		15.7
Kafr Zibad-Tulkarim		-	-	6		12.8
Kafr 'Abbushbush-tulkarim		-	-	6.5		14.1
Jayyus-Tulkarm		-	-	7		18
Thinaba-tulkarim	13	-	-	2.5		2
Al'ezab-Tulkarm	8	-	-	2		2.3
Kafa-Tulkarm	5	-	-	2.5		3.1
Bizzariya-Tulkarm	3	-	-	6.5	-	13
Qalqiliya Governorate Routes						
Azzun-Qalqiliyia	17	-	1	4.5	3	12
Kafr Thulth-Qalqiliya	6	-	-	6	-	16
Hablah	11	-	-	3		4
Ras 'Atiya-				3.5		4.5
Ad Dab'a				4.5		4.5
Ras at Tira- Qalqiliya				4.5		5
Izbit Jal'ud, Izbit Salman, A lMudawar,Izbit al Ashqar-Qalqiliya	2	-	-	4./5.5/5.5 4.5/5		7/7/08/07
Beit Amin, Sanniriya, 'Azzun 'Atma -Qalqiliya	9	-	-	6.5/6/7		9/9.5/11
Sir-Qalqiliya	4	-	-	6		14.5
Kafr Laqif, Jinsafut, Alfunduq, Hajja, Baqat al Hatab, Kafr Qaddum -Qalqiliya	12	-	-	5./7/7.5/8 6.5/6.5/5		1/17/18/20 25/22/6
Nablus Govrnorate Routes						
Tammun-Nablus	9	1	5	7.5	6	23
Azzon-Nablus	12	-	-	7		23
Jamma'in-Nablus	6	-	6	08/6.5	5	19
Yatma - Nablus	6	-	-	6.5	4.5	19
Beit Imrin-Nablus	8	-	2	5.5	4	21
Beit Iba-Nablus	14	-	-	3.5	-	6.4
Beit Lid-Nablus	7	-	-	6	-	16
An Naqura-Nablus	4	-	1	5.5	4	13
Tell- Nabluse	13	-	-	4	-	6.5
Deir sharf-Nablus	5	-	-	4	-	9.3
Anabta-Nablus	7	-	-	6.5	-	18
Sabatyia-Ijnisiniya-Nablus	10	-	-	5	-	15
Siris	9	-	2	10	7	30

Meithalun				10	**7**	28
Sanur-				10	**7**	24
Al Judeida-Nablus				10	7	32
Alfandaqumiya - Silat adh Dhahr -Nablus	3	-	1	8	6	23
Burqa-Nablus	4	-	4	6	4.5	20
Ajja-Nablus	2	-	1	12	8	3
Sarra-Nablus	8	-	-	4.5	-	11
Yasid-Nablus	6	-	1	7	5	18
Iraq Burin-Nablus	3	-	-	3.5	-	7
Jit-Nablus	4	-	-	5	-	15
Jaba'-Nablus	5	-	2	8	6	23
Azzun-Nablus	12	-	-	10	-	23
Asira ash Shamaliya - Nablus	18	-	2	4	3	9
Ya'bad-Nablus	-	1	5	-	10	43
Alnasarya-Nablus	13	-	5	6.5	5	17
Aljeftlek-Nablus				12.5	10.5	25
Al 'Aqrabanyia-al Far'a-Nablus	7	-	3	5.5	04/4.5	17
Al Lubban,As Sawiya-Nablus	12	-	-	8	-	24
Osarin-Nablus	3	-	2	6.5	5	19
Jinsafut-Nablus	12	3	-	7.5		18
Hajja-nablus				7.5		18
Al funduq -Nablus.				6.5		16
Imatin-Nablus				6		18
Kafrr Qaddum-Nablus				9	-	21
Burin-Nablus				4	**3**	12
Madama-Nablus				4.5	**3.5**	13
Asira al Qibliya-Nablus	9	1	3	5.5	4.5	15
Beit Furik- Nablus	21	-	4	4	3	9
Beit Dajan-Nablus	11	-	-	5	3.5	13
Baita-Nablus	5	-	11	4.5	3.5	16
Talfit -Nablus	5	-	2	8	5.5	23
Qaryout-Jalod-Nablus	4			9	6	27
Qusra-Jurish-Nablus	8	1	-	18.5	6.5	28
Huwwara-Nablus	8	-	4	3	3	12
Einabus-Nablus					4	15
Urif-Nablus				4	4	15
Duma- Nablus	5	-	-	8.5	-	30
Deir al Hatab-Nablus	5	1	1	4	3	7
Salim -Nablus	13	1	1	4	3	9

Talluza-Albathan-Nablus	10	-	-	6	-	15
Azmut -Nablus	6	-	-	4	-	8
Aqraba-Nablus	10	-	4	7	5.5	21
Awarta,Udala-Nablus	13	-	2	5	3.5	14
Qabalan-Nablus	17	1	-	7	5	20
Majdal Bani Fadil-Nablus	4	-	-	7.5	-	25.5
Rujeib-Nablus	7	1	4	2.5	1.5	6
Osarin-Nablus	-	1	2	-	3	11
Al 'attara-Nablus	-	-	1	-	8	26

Appendix (B): Questionnaires

بسم الله الرحمن الرحيم

جامعة النجاح الوطنية .

كلية الدراسات العليا

قسم هندسة الطرق والمواصلات:

استبيان تكاليف النقل العام ومعدل الرحلات وعدد الركاب اليومي

اخي السائق الكريم:

ان هذه الاستبانة جزء من رسالة الماجستير تحت عنوان (احتساب تعرفة المواصلات العامة في فلسطين – محافظات شمال الضفة الغربية - حالة دراسية)

يرجى التكرم بالإجابة عن الاسئلة في هذه الاستبانة اجابة واضحة ودقيقة وذلك بهدف التعرف على آرائكم والاستفادة منها في اطار البحث العلمي والتخطيط الامثل لقطاع النقل العام في فلسطين وبما يعود بمنفعة كبيرة على المجتمع بشكل عام .

حيث نؤكد على ان بيانات هذه الاستبانة لن تستخدم الا في اغراض البحث العلمي والتحليل الاحصائي فقط .

الباحث : م. خالد دراوشة

الجزء الاول :

التاريخ : / / 2017 **اليوم ....**

الخط .... نوع السيارة ....
الموديل......................... الاجرة ذهابا ....شيكل , الاجرة ايابا .... شيكل.

المسافة من البلدة الى المدينة ....

الجزء الثاني :

سعر المركبة عند الشراء ....شيكل/ السعر المتوقع عند انتهاء فترة الخدمة للمركبة......... شيكل. سنة الشراء:.......................

هل تم شراء السيارة من خلال قرض من البنك ؟ نعم لا

عنصر التكلفة	التكلفة بالشيكل	المدة الزمنية
اجرة سائق + الامتيازات (اكل ..)		شهر
اجور وتكاليف تصليح اعطال		سنة
تامين		سنة
ترخيص		سنة
الضريبة / الرسوم السنوية		سنة
دينامومتر		سنة
تغيير اطارات		عدد المرات في السنة ....
اجرة مجمع		شهر
غيار زيت+ فلاتر		عدد المرات السنوية..................
غيار بريكات		عدد المرات السنوية..................
غبار درمات		عدد المرات السنوية..................
اجرة غسيل		عدد المرات الشهرية..................
تغيير لمبات		عدد المرات السنوية..................
تغيير مساحات زجاج		عدد المرات السنوية..................

تكاليف اخرى اضافية

1. .....مصاريف ادارية لشركة الباصات......... التكلفة .... شيكل
2. .... التكلفة .... شيكل
3. .... التكلفة .... شيكل

الجزء الثالث :

- عدد الرحلات اليومية .... (ذهابا من البلدة الى المدينة وايابا الى البلدة)
- معدل عدد الركاب الاجمالي اليومي ....
- المسافة المقطوعة يوميا لإجمالي الرحلات ....كم .
- استهلاك الوقود اليومي .... بالشيكل , تاريخ التعبئة ....
- ما هو معدل استهلاك السيارة للوقود (كم كيلو متر تسير السيارة باستخدام 1 لتر وقود (.......كم).
- عدد الايام التي تتوقف فيها عن العمل سنويا بسبب الاعطال والاعياد..............

الجزء الرابع :

ما هو تقيمك لتسعيرة المواصلات العامة :

قليلة جدا 2- قليلة 3- عادلة 4- مرتفعة 5- مرتفعة جدا

الجزء الخامس :

عدد المسافرين اليومي – التعبئة كما في الجدول . يرجى التعبئة خلال احد الايام التالية فقط :

(الاحد , الاثنين , الثلاثاء , الاربعاء)

الرحلة	عدد الركاب ذهابا	عدد الركاب ايابا
1		
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هل يوجد مصادر دخل اخرى غير النقل على الخط / مثال حفلات ,مناسبات,اعراس ..... الخ

نعم لا

اذا كانت الاجابة نعم كم يبلغ الدخل السنوي من المصادر الاخرى ؟ : .... شيكل .

يرجى كتابة رقم الهاتف ان امكن للاستفسارات : ....

شكرا لكم

بسم الله الرحمن الرحيم

جامعة النجاح الوطنية

كلية الدراسات العليا

قسم هندسة الطرق والمواصلات:

استبيان معدل الرحلات الاسبوعية ورضى الركاب عن المواصلات العامة

اخي المواطن الكريم:

ان هذه الاستبانة جزء من رسالة الماجستير تحت عنوان (احتساب تعرفة المواصلات العامة في فلسطين – محافظات شمال الضفة الغربية - حالة دراسية)

يرجى التكرم بالإجابة عن الاسئلة في هذه الاستبانة اجابة واضحة ودقيقة وذلك بهدف التعرف على آرائكم والاستفادة منها في اطار البحث العلمي والتخطيط الامثل لقطاع النقل العام في فلسطين وبما يعود بمنفعة كبيرة على المجتمع بشكل عام .

حيث نؤكد على ان بيانات هذه الاستبانة لن تستخدم الا في اغراض البحث العلمي والتحليل الاحصائي فقط .

الباحث : م. خالد دراوشة

الجزء الأول :

معلومات عامة :

- مكان السكن :....................................
- عدد افراد الاسرة :..............................
- عدد الافراد العاملين في الاسرة ....
- عدد طلبة الجامعات من افراد الاسرة الذين يستخدمون المواصلات العامة للوصول الى الكلية او الجامعة ....
- عدد الرحلات **الاسبوعية** باستخدام المواصلات العامة لكافة افراد الاسرة ....
- ما هو سعر تكلفة الرحلة :

1. ذهابا (باستخدام الباص) : .... شيكل
2. ذهابا (باستخدام سيارة السبع ركاب) : .... شيكل
3. ايابا (باستخدام الباص): ....شيكل
4. ايابا (باستخدام سيارة السبع ركاب) : .... شيكل

- ما هو معدل الدخل الشهري لكافة افراد الاسرة .... شيكل .
- ما هو معدل الانفاق الشهري للأسرة .... شيكل .
- عدد السيارات التي يمتلكها افراد الاسرة ....

الجزء الثاني :

ما هو تقيمك لأداء المواصلات العامة .

1- جيد جدا   2- جيد   3- متوسط   4- سيء   5- سيئ جدا

ما هو تقيمك لأجرة المواصلات العامة .

1- مرتفعة جدا   2- مرتفعة   3- عادلة   4- منخفضة   5- منخفضة جدا

Appendix (C): Fare Estimation Templates

Shared Taxis Fare estimation Template														
Route Name		Route Length km	Vehicle Type	Model	Driver's wage	Reappearing/Yr	Insurance	License	Taxes & Registration	Dynamometer	Tires	Parking	Oils & Filters
Large Villages-Short distance (Group A)													
1	Awarta-Nablus	12.5	Caravell	2008	30000	7000	4600	600	2500	120	1200	1200	3000
2	Awarta-Nablus	12.5	Caravell	2013	24000	5000	6500	600	2800	110	2000	1200	2500
3	Beit Furik- Nablus	9.0	Caravell	2010	31200	5000	5000	600	2160	112	1400	1200	2080
4	Beit Furik- Nablus	9.0	Caravell	1998	31200	5000	2400	600	3000	232	1800	1200	4500
5	Tell- Nabluse	7.0	Mercedes	2008	31200	7000	4850	600	6400	142	1700	1200	2500
6	Deir Abu Da'if-Jeinin	7.0	Caravell	2005	24000	10000	2500	600	1900	112	1400	2500	1300
7	Deir Abu Da'if-Jeinin	7.0	Caravell	2002	30000	6000	2450	600	2400	150	1200	2500	1200
8	Attil-Tulkarm	10.5	Caravell	2000	26400	3000	2400	600	3000	220	1400	1200	1900
9	Attil-Tulkarm	10.5	Caravell	2015	26400	1000	4100	600	5800	110	2000	1200	3600
10	Bal'a-Tulkarim	12.0	Caravell	2013	24000	1000	5000	600	2600	108	2200	1560	3000
11	Bal'a-Tulkarim	12.0	Transporter	2005	24000	5000	2400	600	5000	216	900	1560	2000

12	Azzun-Qalqiliya	12.0	Caravell	2009	28080	5000	2400	600	2600	112	800	2160	3000
13	Azzun-Qalqiliya	12.0	Transporter	2011	30000	4000	2400	600	5800	112	2200	2160	2760
14	Tammun-Tubas	6.0	Caravell	2008	26400	12000	2400	600	4700	112	1400	1440	4200
Large Villages- Far distance(Group B)													
1	Qusra-Jurish-Nablus	30.0	Mercedes	1999	27600	10000	2400	600	5100	224	1500	1200	4000
2	Qusra-Jurish-Nablus	30.0	caravell	2011	28800	1500	3900	600	2600	112	1500	1200	4000
3	Tammun-Nablus	23.0	Mercedes	2014	24000	2000	7000	600	2400	112	2000	1200	3600
4	Jabba-Nablus	25.0	Caravell	2014	31200	10000	5000	600	2640	112	1600	1200	2750
5	Jabba-Nablus	25.0	Caravell	2013	31200	2000	5000	600	3600	112	1400	1400	1560
6	Kafr Ra'i-Jenin	21.0	Caravell	2014	31200	12000	6000	600	2500	112	1400	2400	1400
7	Kafr Ra'i-Jenin	21.0	Caravell	2008	27600	10000	5000	600	4600	112	2000	2300	2500
8	maythalon-Jenin	22.0	Caravell	2014	24000	5000	6000	600	2600	112	1800	3600	2500
9	maythalon-Jenin	22.0	Mercedes	2015	24000	3000	6000	600	2600	112	3000	3600	3600
10	Jaba'-Jenin	23.0	Caravell	2009	24000	6000	2500	600	2600	111	3000	2300	3500
11	Illar-Tulkarm	19.5	Caravell	2008	26400	7000	4500	600	6290	110	1000	1200	2100
12	Illar-Tulkarm	19.5	Caravell	2011	26400	1700	4200	600	2200	112	2400	1200	3600
13	Qaffin-Tulkarm	20.0	Caravell	2013	25200	2000	5000	600	3800	112	1800	1200	2500
14	Qaffin-Tulkarm	20.0	Caravell	2004	26400	5000	2500	600	2160	224	1800	1200	2250
Small Villages-Short distance (Group C)													
1	Iraq Burin-Nablus	5.5	Mercedes	2015	22800	2000	6000	600	2500	108	1500	1200	3000
2	Jit-nablus	12.0	Caravell	2011	21600	3600	5000	600	2600	111	1500	1200	3600

3	Jalbun-Jenin	12.5	Caravell	2000	24000	8000	2500	600	2000	220	1400	2200	1700
4	Jalbun-Jenin	12.5	Caravell	2001	24000	10000	2600	600	2500	220	1400	2600	3200
5	Faqqu'a-Jeinin	12.0	Caravell	2009	30000	5000	2600	600	2400	300	1600	2200	1800
6	Faqqu'a-Jeinin	12.0	Mercedes	2016	30000	3000	2800	600	2200	300	2000	2200	1200
7	Al jalama , 'Arrana-Jenin	5.5	Caravell	2010	30000	10000	2500	600	1800	170	1200	2200	800
8	Beit Qad- Jenin	6.0	Caravell	2013	26400	6000	2600	600	1200	200	1000	2200	1800
9	Far'un-Tulkarm	4.5	Caravell	2015	24000	1000	6800	600	3100	112	1000	1200	2500
10	Zeita-Tulkarm	13.0	Caravell	2013	30000	10000	5000	600	2600	112	1600	1200	3000
11	Zeita-Tulkarm	13.0	Caravell	2014	30000	7000	5500	600	2600	112	1500	1200	2750
12	Far'un-Tulkarm	4.5	Caravell	2014	24000	1000	5000	600	3100	112	1100	1200	2400
Small Villages-Far distance (Group D)													
1	Duma- Nablus	30.0	Caravell	2011	15600	5000	5000	600	3000	112	2000	1200	4200
2	Majdal Bani Fadil-Nablus	25.5	Caravell	2010	21480	5000	5000	600	3000	112	2000	1200	4800
3	Talfit -Nablus	22.0	Caravell	2016	31200	1000	7500	600	2300	112	2000	1200	4800
4	Telfeet -Nablus	22.0	Caravell	2012	30000	6000	4500	600	2300	112	1800	1200	3600
5	Alfandaqumiya-Jenin	23.0	Caravell	2014	30000	6000	5400	600	2640	112	1500	2200	2250
6	Alfandaqumiya-Jenin	23.0	Mercedes	2011	31200	4000	5600	600	2640	111	1600	2220	3000
7	Ramin-Tulkarm	17.0	Hunday	2011	26400	5000	5000	600	2200	112	2000	1200	3600
8	Ramin-Tulkarm	17.0	Caravell	2002	24000	1000	2500	600	1500	200	1500	1200	1500

Brakes	Drums	Washing	Lamps	Windscreen	ID Card	Parking Services	Secondary Income	Purchasing Price	Salvage Value	Purchasing Year	Remaining Vehicle life period	Depreciation	Total Annual fixed Cost
480	250	960	50	65	120	300	0	75000	25000	2014	12	4166.67	56611.67
300	300	720	140	50	120	300	0	170000	30000	2013	18	7777.78	54417.78
900	250	800	50	50	120	300	0	165000	50000	2011	17	6764.71	57986.71
1100	300	800	40	60	120	300	0	164000	30000	1998	18	7444.44	60096.44
690	400	400	50	45	120	300	0	102000	30000	2013	13	5538.46	63135.46
400	400	1000	100	100	120	300	0	150000	45000	2005	18	5833.33	52565.33
800	200	1000	100	100	120	300	0	100000	30000	2005	15	4666.67	53786.67
800	100	600	100	100	120	300	0	40000	30000	2016	2	5000.00	47240.00
900	400	800	100	50	120	300	0	178000	90000	2016	17	5176.47	52656.47
600	300	960	50	60	120	300	0	120000	45000	2016	15	5000.00	47458.00
800	250	960	50	50	120	300	0	100000	30000	2010	13	5384.62	49590.62
450	250	960	100	50	120	300	0	150000	45000	2011	16	6562.50	53544.50
280	180	720	15	20	120	300	0	100000	40000	2015	14	4285.71	55952.71
400	250	720	50	50	120	300	0	110000	40000	2015	11	6363.64	61505.64

200	180	720	120	30	120	300	0	75000	30000	2007	10	4500.00	58794.00
200	200	840	50	50	120	300	0	160000	60000	2011	18	5555.56	51527.56
1200	0	720	0	100	120	300	0	170000	30000	2014	18	7777.78	53129.78
800	600	800	20	40	120	300	0	170000	60000	2014	18	6111.11	63893.11
2880	300	960	50	60	120	300	0	160000	30000	2014	17	7647.06	59189.06
310	350	1200	400	200	120	300	1000	170000	40000	2014	18	7222.22	66714.22
800	600	960	120	50	120	300	0	160000	30000	2011	15	8666.67	66328.67
1200	240	720	10	60	120	300	0	180000	45000	2014	18	7500.00	56362.00
2400	300	1260	10	50	120	300	0	200000	70000	2015	18	7222.22	58174.22
1800	220	1000	20	60	120	300		84000	65000	2015	12	1583.33	49714.33
900	300	1200	100	10	120	300	0	165000	35000	2009	17	7647.06	59777.06
1500	200	800	50	50	120	300	0	165000	60000	2012	17	6176.47	51608.47
1000	400	900	50	50	120	300	0	110000	40000	2017	14	5000.00	50032.00
1680	150	960	150	50	120	300	0	120000	30000	2005	17	5294.12	50838.12
1300	500	720	50	40	120	300	0	189000	40000	2015	20	7450.00	50188.00
960	300	720	50	60	120	300	0	100000	30000	2017	14	5000.00	47321.00
500	250	1000	150	150	120	300	0	160000	45000	2002	18	6388.89	51478.89
1120	220	1000	100	100	120	300	0	80000	30000	2006	15	3333.33	53413.33
1000	500	1200	100	150	120	300	0	165000	4500	2009	20	8025.00	57895.00
800	220	1200	100	100	120	300	0	200000	60000	2016	20	7000.00	54140.00
300	300	300	100	100	120	300	2600	120000	30000	2013	17	5294.12	53484.12

500	400	300	150	100	120	300	0	160000	45000	2013	20	5750.00	49620.00
900	400	720	60	50	120	300	0	176000	40000	2015	20	6800.00	49662.00
1680	400	960	40	100	120	300	0	100000	50000	2016	15	3333.33	61045.33
1500	500	960	50	50	120	300	0	120000	50000	2016	16	4375.00	59117.00
800	350	720	20	50	120	300	0	150000	40000	2016	18	6111.11	46983.11
1200	700	720	100	30	120	300	0	150000	40000	2011	18	6111.11	45993.11
800	700	960	100	50	120	300	0	160000	45000	2011	17	6764.71	52986.71
800	250	960	50	60	120	300	0	195000	40000	2016	18	8611.11	61863.11
700	250	800	50	50	120	300	0	155000	30000	2014	16	7812.50	60194.50
720	700	960	40	50	120	300	0	170000	60000	2014	18	6111.11	59703.11
2000	600	960	20	50	120	300	0	120000	45000	2016	13	5769.23	60790.23
1500	350	800	50	30	120	300	0	120000	45000	2014	15	5000.00	54262.00
400	400	720	50	100	120	300	0	60000	30000	2014	6	5000.00	41090.00

Total Daily Distance	Average Annual Working Days	Annual Distance	Fixed Cost / 1Km	Fuel Consumption Rate(Liter/Km)	Fuel Price	1 Km Fuel cost	One-Way Distance	One Way Total Cost	Daily No. of Passengers	Total No. of one-way trips	No. of Seats	Occupancy Rate	Cost per pass.	Cost +20% profit	Actual Fare	Average monthly income
275.00	297.00	81675.00	0.69	0.10	5.38	0.54	13.00	16.00	88	22	7	4.00	4.00	4.80	5.00	2175.42
300.00	289.00	86700.00	0.63	0.11	5.38	0.59	13.00	15.85	97	24	7	4.04	3.92	4.71	5.00	2517.42
216.00	302.00	65232.00	0.89	0.11	5.38	0.59	9.00	13.33	102	24	7	4.25	3.14	3.76	4.00	2218.75
200.00	297.00	59400.00	1.01	0.13	5.38	0.67	9.00	15.16	94	20	7	4.70	3.23	3.87	4.00	1802.78
168.00	292.00	49056.00	1.29	0.13	5.38	0.67	7.00	13.72	103	24	7	4.29	3.20	3.84	4.00	2014.86
126.00	307.00	38682.00	1.36	0.13	5.38	0.67	7.00	14.22	77	18	7	4.28	3.32	3.99	4.00	1331.42
126.00	300.00	37800.00	1.42	0.11	5.38	0.59	7.00	14.10	80	18	7	4.44	3.17	3.81	4.00	1653.61
168.00	309.00	51912.00	0.91	0.11	5.38	0.59	10.50	15.77	66	16	7	4.13	3.82	4.59	5.50	2850.46
189.00	308.00	58212.00	0.90	0.11	5.38	0.59	10.50	15.71	70	16	7	4.38	3.59	4.31	5.50	3429.35
216.00	307.00	66312.00	0.72	0.12	5.38	0.63	12.00	16.14	80	18	7	4.44	3.63	4.36	5.00	2800.10

216.00	307.00	66312.00	0.75	0.11	5.38	0.60	12.00	16.14	79	18	7	4.39	3.68	4.41	5.00	2672.85
120.00	298.00	35760.00	1.50	0.11	5.38	0.59	12.00	25.07	63	10	7	6.30	3.98	4.78	5.00	1596.89
120.00	300.00	36000.00	1.55	0.11	5.38	0.59	12.00	25.75	64	10	7	6.40	4.02	4.83	5.00	1561.87
170.00	305.00	51850.00	1.19	0.13	5.38	0.67	6.00	11.15	136	28	7	4.86	2.30	2.76	3.00	2433.25
240.00	267.00	64080.00	0.92	0.11	5.38	0.59	28.00	42.26	56	8	7	7.00	6.04	7.24	9.00	3691.60
300.00	297.00	89100.00	0.58	0.10	5.38	0.54	28.00	31.26	53	10	7	5.30	5.90	7.08	9.00	4069.71
230.00	309.00	71070.00	0.75	0.11	5.38	0.59	23.00	30.81	45	10	7	4.50	6.85	8.21	7.50	758.21
276.00	302.00	83352.00	0.77	0.11	5.38	0.59	25.00	33.96	49	10	7	4.90	6.93	8.32	9.00	2552.24
250.00	305.00	76250.00	0.78	0.13	5.38	0.67	25.00	36.22	49	10	7	4.90	7.39	8.87	9.00	2003.15
387.00	302.00	116874.00	0.57	0.11	5.38	0.59	21.00	24.42	56	12	7	4.67	5.23	6.28	7.00	2491.99
387.00	302.00	116874.00	0.57	0.11	5.38	0.59	21.00	24.35	63	14	7	4.50	5.41	6.49	7.00	2520.67
176.00	307.00	54032.00	1.04	0.11	5.38	0.59	22.00	35.97	56	8	7	7.00	5.14	6.17	7.00	2667.16

176.00	307.00	54032.00	1.08	0.14	5.38	0.76	22.00	40.49	56	8	7	7.00	5.78	6.94	7.00	1740.96
368.00	302.00	111136.0 0	0.45	0.11	5.38	0.59	23.00	23.90	72	16	7	4.50	5.31	6.37	6.50	2154.28
312.00	300.00	93600.00	0.64	0.11	5.38	0.59	19.50	23.99	65	16	7	4.06	5.91	7.09	7.50	2590.04
280.00	310.00	86800.00	0.59	0.10	5.38	0.54	19.50	22.09	77	18	7	4.28	5.16	6.20	7.50	4649.19
280.00	310.00	86800.00	0.58	0.11	5.38	0.59	20.00	23.36	60	14	7	4.29	5.45	6.54	7.00	2399.98
280.00	305.00	85400.00	0.60	0.13	5.38	0.67	20.00	25.36	61	14	7	4.36	5.82	6.98	7.00	1830.45
141.00	282.00	39762.00	1.26	0.13	5.38	0.67	5.50	10.64	111	26	7	4.27	2.49	2.99	3.50	2628.16
240.00	298.00	71520.00	0.66	0.10	5.38	0.54	12.00	14.40	70	20	7	3.50	4.11	4.94	5.50	2410.94
192.00	300.00	57600.00	0.89	0.12	5.38	0.63	12.50	19.04	70	16	7	4.38	4.35	5.22	5.00	1134.05
192.00	302.00	57984.00	0.92	0.11	5.38	0.59	12.50	18.91	72	16	7	4.50	4.20	5.04	5.00	1444.70
216.00	302.00	65232.00	0.89	0.13	5.38	0.67	12.00	18.72	82	18	7	4.56	4.11	4.93	5.00	1838.04
192.00	306.00	58752.00	0.92	0.10	5.38	0.53	12.00	17.45	69	16	7	4.31	4.05	4.86	5.00	1678.13
160.00	295.00	47200.00	1.13	0.12	5.38	0.63	5.5	12.87	126	24	7	5.25	2.45	2.94	3.50	3249.74

120.00	302.00	36240.00	1.37	0.10	5.38	0.54	6.00	11.44	91	20	7	4.55	2.51	3.02	3.50	2255.82
100.00	307.00	30700.00	1.62	0.13	5.38	0.67	4.50	10.31	100	20	7	5.00	2.06	2.47	3.00	2401.92
260.00	300.00	78000.00	0.78	0.11	5.38	0.59	13.00	17.87	84	20	7	4.20	4.25	5.11	6.00	3666.19
260.00	302.00	78520.00	0.75	0.11	5.38	0.59	13.00	17.48	82	20	7	4.10	4.26	5.12	6.00	3583.24
90.00	310.00	27900.00	1.68	0.13	5.38	0.67	4.50	10.60	98	20	7	4.90	2.16	2.60	3.00	2116.18
360.00	300.00	108000.0	0.43	0.11	5.38	0.56	30.00	29.72	48	12	7	4.00	7.43	8.92	8.50	1283.14
306.00	300.00	91800.00	0.58	0.11	5.38	0.56	25.50	29.12	49	12	7	4.08	7.13	8.56	8.00	1062.96
270.00	310.00	83700.00	0.74	0.11	5.38	0.59	22.00	29.28	58	12	7	4.83	6.06	7.27	7.50	2160.73
270.00	300.00	81000.00	0.74	0.11	5.38	0.59	22.00	29.37	59	12	7	4.92	5.97	7.17	7.50	2251.88
276.00	303.00	83628.00	0.71	0.11	5.38	0.59	23.00	30.03	61	12	7	5.08	5.91	7.09	7.00	1682.24
322.00	298.00	95956.00	0.63	0.12	5.38	0.63	23.00	29.05	60	12	7	5.00	5.81	6.97	7.00	1773.52
280.00	305.00	85400.00	0.64	0.11	5.38	0.59	17.00	20.86	57	16	7	3.56	5.86	7.03	6.00	208.55
280.00	300.00	84000.00	0.49	0.08	5.38	0.43	17.00	15.63	50	16	7	3.13	5.00	6.00	6.00	1246.95

Mini Buses Fare estimation Template

No.	Rote name	Distance Km	Vehicle Type	Model	Driver's wage	Repairing/Yr	Insurance	License	Taxes & Registration	Dynamometer	Tires	Parking	Oils & Filters
	Route length(L) <10Km												
1	Deir Abu Da'if-Jeinin	7.0	Mercedes	2002	30000	10000	3800	600	2600	200	1200	2200	1200
2	Al jalama , 'Arrana-Jenin	5.5	Mercedes	2004	30000	7000	3800	600	2600	200	1400	2400	1200
3	Silat al Harthiya - Jenin	9.0	Mercedes	2004	30000	12000	3800	600	1320	220	1800	3240	1500
4	Kafr Dan - Nablus	6.0	Mercedes	2009	24000	10000	5000	600	3000	111	2000	3240	4800
5	Tammun-Tubas	6.0	Volkswagen	2001	36000	5000	4000	600	3000	240	1500	1440	3600
6	Jalqamus-Um at tut-Jenin	8.0	Mercedes	2000	31200	8000	4000	600	2040	240	4000	2500	1800
7	Qabatiya -Jeinin	8.5	Mercedes	2000	31200	13000	4000	600	1800	240	3000	3240	3000
	10 Km< L <20 Km												
1	Bal'a-Tulkarim	12.0	Mercedes	2009	30000	8000	5000	600	3000	250	3000	2000	600
2	Awarta,Udala-Nablus	14.0	Mercedes	2008	30000	10000	5500	600	2800	200	4200	1200	3000
3	Asira Al Qibliya, Madama, Burin-Nablus	15.0	Mercedes	2004	36000	9000	4000	600	3600	200	2400	1200	3000
4	Zeita-Tulkarm	13.7	Mercedes	2007	30000	10000	3800	600	3600	200	1500	1800	1000
5	Meithalun, Siris ,Al Judeida, Sir - Jenin	20.0	Volkswagen	2007	31200	15000	3600	700	3600	120	3600	3600	1500
6	Raba-Jenin	16.0	Mercedes	2010	33600	15000	4000	600	4800	117	3200	3000	3600
7	Qaffin-Tulkarm	19.0	Mercedes	2006	31200	10000	6000	600	2600	200	6000	1800	3000
8	Huwwara-'Einabus-'Urif-Nablus	15.0	Mercedes	2005	32400	15000	4200	600	3000	220	3600	1200	2000
	L > 20 Km												
1	Talfit -Nablus	23.0	Mercedes	2010	26400	5000	4000	530	3600	112	3000	1200	4800
2	Majdal Bani Fadil-Nablus	25.5	Mercedes	2009	30000	7000	5000	600	3000	112	2700	1200	4800
3	Qusra, Jurish - Nablus	28.0	Mercedes	2001	24000	12500	3900	600	1700	240	3200	1200	1320

4	Meithalun, Al Judeida, ,Siris, Sanur-Nablus	32.0	Mercedes	2005	31200	8000	3600	600	3600	200	3600	1200	1500
5	Tammun -Nablus	23.0	Volkswagen	2005	36000	7000	6000	600	3000	120	1500	1440	3600
6	Kafr Rai', Fahma -Jeinin	21.0	Volkswagen	2000	31200	8500	4000	600	2500	120	4800	2220	1800
7	Alfandaqumiya -Silat adh Dhahr-Jenin	25.0	Mercedes	2006	30000	6000	4750	600	2640	165	1800	2220	1200
8	Alfandaqumiya - Silat adh Dhahr -Nablus	22.0	Volkswagen	2014	31200	7000	5800	600	2640	112	1200	1200	2400
9	Aqraba- Nablus	21.0	Volkswagen	2000	30000	15000	3000	600	3000	118	5100	1200	3000
10	Burqa-Bazaryia-Nablus	22.0	Volkswagen	2001	31200	10000	6000	600	6500	120	2000	1200	2400
11	Seida, 'Illar ,'Attil ,Deir Algusun, Al Jarushiy -Tulkarm	20.0	Mercedes	2007	30000	5000	5000	600	3000	250	3000	2000	600
12	Jaba'-Nablus	25.0	Mercedes	2006	30000	10000	5000	600	2640	200	5600	1200	1400

Brakes	Drums	Washing	Lamps	Windscreen	ID Card	Services	Management fees	Vehicle Purchasing Price	Salvage Value	Purchasing Year	Remaining Vehicle life period	Depreciation	Total Annual fixed Cost	Secondary income	Total Annual fixed Cost
800	400	2400	200	100	120	300	2000	130000	40000	2007	15	6000.00	64120.00	10000.00	54120.00
1200	500	2400	100	100	120	300	2000	160000	70000	2005	19	4736.84	60656.84	8000.00	52656.84
1200	500	1200	150	30	120	300	1500	163000	30000	2009	15	8866.67	68346.67	8000.00	60346.67
400	500	960	150	50	120	300	1500	70000	30000	2014	15	2666.67	59397.67	7000.00	52397.67
1200	300	720	250	250	120	300	2775	130000	25000	2010	11	9545.45	70840.45	5000.00	65840.45
1800	400	1440	50	100	120	300	2235	160000	30000	2005	15	8666.67	69491.67	3000.00	66491.67
1200	300	1920	100	100	120	300	2235	125000	40000	2005	15	5666.67	72021.67	5000.00	67021.67
1200	500	500	50	50	120	300	6000	125000	25000	2016	13	7692.31	68862.31	9000.00	59862.31
2400	1200	1200	60	240	120	300	500	95000	25000	2017	11	6363.64	69883.64	10000.00	59883.64
2400	400	1440	50	60	120	300	2000	80000	20000	2010	14	4285.71	71055.71	10000.00	61055.71
1200	500	960	50	60	120	300	6000	100000	25000	2015	12	6250.00	67940.00	12000.00	55940.00
2400	1000	1200	20	40	120	300	250	90000	30000	2014	13	4615.38	72865.38	9000.00	63865.38
1200	600	1440	100	120	120	300	2235	150000	10000	2010	20	7000.00	81032.00	3000.00	78032.00
720	200	960	50	50	120	300	6000	120000	30000	2014	12	7500.00	77300.00	11000.00	66300.00
1000	400	1200	100	100	120	300	2000	75000	20000	2014	11	5000.00	72440.00	6000.00	66440.00

2000	250	1500	100	60	120	300	1200	120000	30000	2015	15	6000.00	60172.00	5000.00	55172.00
480	250	1200	50	50	120	300	1200	90000	20000	2016	13	5384.62	63446.62	12000.00	51446.62
2500	500	960	100	60	120	300	1200	80000	25000	2016	5	11000.00	65400.00	10000.00	55400.00
2400	1000	1200	20	40	120	300	250	120000	45000	2013	12	6250.00	65080.00	10000.00	55080.00
2500	900	720	250	250	120	300	2775	180000	20000	2008	17	9411.76	76486.76	5000.00	71486.76
1680	450	960	50	50	120	300	1350	150000	15000	2006	14	9642.86	70342.86	4000.00	66342.86
700	470	600	50	50	120	300	250	90000	40000	2015	11	4545.45	56460.45	7000.00	49460.45
800	400	960	20	50	120	300	250	160000	50000	2016	18	6111.11	61163.11	3000.00	58163.11
1280	500	720	30	60	120	300	2000	100000	30000	2005	15	4666.67	70694.67	10000.00	60694.67
1200	600	960	50	50	120	300	900	130000	50000	2006	15	5333.33	69533.33	11000.00	58533.33
1200	500	500	50	50	120	300	6000	120000	25000	2014	13	7307.69	65477.69	10000.00	55477.69
800	440	960	150	60	120	300	1500	95000	35000	2010	16	3750.00	64720.00	7000.00	57720.00

Daily Distance	Average Annual Working Days	Annual Distance	Fixed Cost / 1Km	Fuel Consumption Rate(Liter/Km)	Fuel Price	1 Km Fuel cost	One-Way Distance	One Way Total Cost	Daily No. of Passengers	Total No. of one-way trips	No. of Seats	Occupancy Rate	Cost per pass.	Cost +20% profit	Actual Fare	Average monthly income
140.00	297.00	41580.00	1.30	0.17	5.38	0.89	7.00	15.36	140	20	19	7.00	2.19	2.63	3.00	2790.48
132.00	304.00	40128.00	1.31	0.17	5.38	0.89	5.50	12.13	226	24	19	9.42	1.29	1.55	2.50	6938.80
126.00	292.00	36792.00	1.64	0.17	5.38	0.89	9.00	22.80	140	14	19	10.00	2.28	2.74	2.50	749.59
96.00	290.00	27840.00	1.88	0.17	5.38	0.89	6.00	16.65	130	16	19	8.13	2.05	2.46	2.50	1415.75
96.00	290.00	27840.00	2.36	0.17	5.38	0.89	6.00	19.55	200	16	19	12.50	1.56	1.88	2.00	2108.02
96.00	290.00	27840.00	2.39	0.18	5.38	0.97	8.00	26.90	102	8	19	12.75	2.11	2.53	3.00	2194.91
140.00	292.00	40880.00	1.64	0.17	5.38	0.89	8.50	21.53	160	16	19	10.00	2.15	2.58	2.50	1352.27
168.00	292.00	49056.00	1.22	0.18	5.38	0.97	12.00	26.26	150	14	19	10.71	2.45	2.94	3.50	3827.66
182.00	300.00	54600.00	1.10	0.19	5.38	1.02	14.00	29.67	123	14	19	8.79	3.38	4.05	4.00	1917.05
150.00	289.00	43350.00	1.41	0.17	5.38	0.89	15.00	34.52	90	8	19	11.25	3.07	3.68	4.00	2018.62
110.00	291.00	32010.00	1.75	0.18	5.38	0.97	13.70	44.25	105	8	19	13.13	3.22	3.86	4.50	2790.48
80.00	282.00	22560.00	2.83	0.14	5.38	0.76	20.00	71.90	65	4	19	16.25	4.42	5.31	6.00	2406.64
160.00	292.00	46720.00	1.67	0.17	5.38	0.90	16.00	41.07	90	8	19	11.25	3.65	4.38	5.00	2954.49
200.00	297.00	59400.00	1.12	0.17	5.38	0.89	19.00	38.18	85	8	19	10.63	3.59	4.31	5.00	2959.98
150.00	292.00	43800.00	1.52	0.17	5.38	0.89	15.00	36.15	115	10	19	11.50	3.14	3.77	4.00	2396.92

230.00	297.00	68310.00	0.81	0.20	5.38	1.08	23.00	43.32	89	10	19	8.90	4.87	5.84	5.50	1392.33
153.00	295.00	45135.00	1.14	0.17	5.38	0.89	25.50	51.84	58	6	19	9.67	5.36	6.44	6.00	908.68
168.00	305.00	51240.00	1.08	0.17	5.38	0.89	28.00	55.28	58	6	19	9.67	5.72	6.86	6.50	1151.97
128.00	287.00	36736.00	1.50	0.14	5.38	0.75	32.00	72.08	62	4	19	15.50	4.65	5.58	7.00	3484.04
150.00	292.00	43800.00	1.63	0.16	5.38	0.86	23.00	57.34	54	4	19	13.50	4.25	5.10	6.00	2303.19
210.00	299.00	62790.00	1.06	0.20	5.38	1.08	21.00	44.78	82	10	19	8.20	5.46	6.55	6.00	1100.26
150.00	297.00	44550.00	1.11	0.17	5.38	0.89	25.00	50.08	78	6	19	13.00	3.85	4.62	6.00	4145.74
264.00	298.00	78672.00	0.74	0.17	5.38	0.89	22.00	35.91	69	8	19	8.63	4.16	5.00	6.00	3146.36
220.00	300.00	66000.00	0.92	0.17	5.38	0.90	22.00	39.96	95	10	19	9.50	4.21	5.05	6.00	4259.46
144.00	288.00	41472.00	1.41	0.17	5.38	0.90	22.00	50.78	65	6	19	10.83	4.69	5.63	6.00	2047.50
200.00	300.00	60000.00	0.92	0.19	5.38	1.02	20.00	38.94	95	8	19	11.88	3.28	3.93	5.00	4087.69
140.00	300.00	42000.00	1.37	0.18	5.38	0.97	23.00	54.01	53	4	19	13.25	4.08	4.89	6.00	2549.45

جامعة النجاح الوطنية
كلية الدارسات العليا

احتساب تعرفة المواصلات العامة في فلسطين، محافظات شمال الضفة الغربية
(حالة دراسية)

إعداد
خالد جميل جبر دراوشة

إشراف
أ.د. سمير أبو عيشة

قدمت هذه الأطروحة استكمالا لمتطلبات الحصول على درجة الماجستير في هندسة الطرق والمواصلات بكلية الدارسات العليا في جامعة النجاح الوطنية في نابلس، فلسطين.

2018

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إعداد

خالد جميل جبر دراوشة

إشراف

أ.د. سمير أبو عيشة

الملخص

تهدف هذه الدراسة الى مراجعة وتقييم الآلية المتبعة لدى وزارة النقل والمواصلات الفلسطينية لتحديد تعرفة المواصلات العامة، ولايجاد صيغة رياضية عادلة ومرنة لاحتساب التعرفة، مع الاخذ بعين الاعتبار كافة المتغيرات والعوامل التي تؤثر في تكلفة نقل الركاب وفقا لظروف الخدمة الراهنة. كما تهدف الدراسة الى توقع عدد الركاب اليومي لكل مركبة من خلال نموذج رياضي باستخدام طريقة الانحدار الخطي والتي تربط بين عدد الرحلات الاسبوعية المتولدة للأسرة وعدد من الخصائص الاجتماعية والاقتصادية ذات الصلة لهذه الأسر، وخصائص القرى والبلدات وخطوط النقل العام التي تربطها مع مراكز المحافظات، وقد تم اعتماد الخطوط الخارجية والتي تربط القرى والبلدات الفلسطينية مع مراكز المحافظات في شمال الضفة الغربية كحالة دراسية.

من خلال ربط نتائج نموذج احتساب اعداد الركاب الذين يستخدمون وسائل النقل العام في رحلاتهم الخارجية نحو مراكز المحافظات مع المعدلات التي تم ايجادها لاحتساب التعرفة، فانه يمكن احتساب معدّل الدخل الشهري لمشغلي مركبات النقل العام على هذه الخطوط، وبالتالي يصبح من الممكن معرفة تأثير زيادة او نقصان عدد المركبات العمومية على المشغلين.

وقد تم من خلال هذه الدراسة استطلاع رأي المشغلين حول التسعيرة الحالية، وكذلك رأي مستخدمي وسائل النقل العام حول التسعيرة الحالية واداء هذا القطاع بشكل عام، حيث اظهرت النتائج ان نسبة 62% من مشغلي وسائل النقل العام يعتبرون التعرفة الحالية قليلة أو قليلة جدا، ونسبة 38% منهم يعتبرونهاعادلة، في حين أن 69% من مستخدمي وسائل النقل العام يعتبرون التعرفة الحالية عادلة و31% منهم يعتبرونها مرتفعة أو مرتفعة جدا.

تم اعتماد منهجية التحليل الكمي للبيانات والمعلومات التي تم جمعها والتأكد من مدى صلاحية نتائج تحليل هذه البيانات، والتي اشارت بان التعرفة تعتمد بشكل اساسي على التكلفة الثابتة، والتي تتناسب

عكسيا مع المسافة السنوية التي تقطعها المركبات, وكذلك تعتمد على التكلفة المتغيرة والتي تتاثر بشكل اساسي بأسعارالوقود, كما تعتمد التعرفة على معدل الامتلاء للرحلات ونسبة الربح التي يتم تحديدها من قبل وزارة النقل والمواصلات.

وقد تم ايجاد اربعة معادلات لاحتساب التعرفة لمركبات النقل المشترك والتي تتسع لسبعة ركاب، وذلك لكافة الخطوط في منطقة الدراسة والتي تم تصنيفها الى اربعة اصناف وفقا لعدد سكان للقرى والبلدات التي تم دراستها، وكذلك المسافة الواصلة بينها وبين مراكز المحافظات. كما تم ايجاد ثلاثة معادلات لاحتساب تعرفة نقل الركاب باستخدام الحافلات الصغيرة والتي تتسع لتسعة عشر راكبا، حيث تم تصنيف هذه الخطوط الى ثلاثة اصناف وفقا لطول الخطوط التي تربط هذه البلدات مع مراكز المحافظات. وكذلك تم ايجاد نموذج لاحتساب عدد الرحلات المتولد من الاسرة الواحدة اسبوعيا باستخدام وسائل النقل العام، وذلك باستخدام المتغيرات التي تؤثر بشكل ملحوظ في هذه القيمة وهي تسعيرة المواصلات العامة باستخدام سيارات النقل المشترك، وعدد العاملين في الاسرة ، وعدد الطلبة الملتحقين بالجامعات والكليات الفلسطينية، وكذلك عدد المركبات الشخصية التي تمتلكها الاسرة.

أظهرت النتائج أن معدل استهلاك الوقود واسعاره هما العاملان الرئيسيان المؤثران في التكلفة المتغيرة، ولكن لا بد من ان يكون هنالك تغير ملموس بشكل كاف ليؤدي الى تغير في تعرفة المواصلات العامة. وكما اظهرت النتائج بان نظام المواصلات العامة في منطقة الدراسة هو فعال اقتصاديا بنسبة ربح 20%، وقد أوصت الدراسة بضرورة تحديد الحد الادنى والاعلى المقبول لمعدل الدخل الشهري للمركبات العمومية من قبل وزارة النقل و المواصلات وبالتعاون مع بقية الشركاء، كما اوصت بضرورة ربط التعرفة مع مؤشر غلاء المعيشة.

يمكن استخدام نتائج هذه الدراسة لتقييم التسعيرة الحالية للمواصلات العامة، واحتساب معدل الدخل الشهري لمشغلي هذاالمركبات، وذلك باستخدام معادلات احتساب التعرفة ونتائج نموذج تولد الرحلات والتي ستساعد في اتخاذ القرار المناسب بخصوص عدد المركبات اللازم تشغيلها على هذه الخطوط.