Thesis for Degree of Master of Engineering

Estimation Method of Optimal Price for CTS(Cloud Transportation System) Vehicle

by

Seong Beom Ryu

Department of Geoinformatic Engineering

The Graduate School

Pukyong National University

February   2012

Estimation Method of Optimal Price for

CTS(Cloud Transportation System) Vehicle

(클라우드 교통시스템 차량의
최적 요금 산정 방법론)

Advisor: Prof. Sang Hoon Bae

by
Seong Beom Ryu

A thesis submitted in partial fulfillment of the requirements
for the degree of

Master of Engineering

in Department of Geoinformatic Engineering,
The Graduate School, Pukyong National University
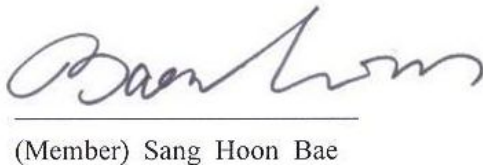
February   2012

Estimation Method of Optimal Price for

CTS(Cloud Transportation System) Vehicle

A dissertation

by

Seong Beom Ryu

Approved by:

(Chairman) Young Sub Kim

(Member) Kyung Soo.Han
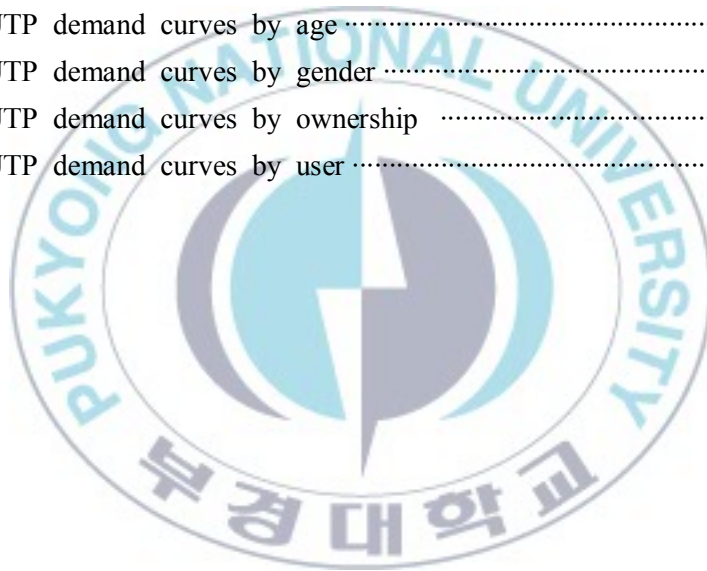
(Member) Sang Hoon Bae

February , 2012

Contents

List of Figs

List of Tables

클라우드 교통시스템 차량의 최적 요금 산정 방법론

유 성 범

부 경 대 학 교   대 학 원   위 성 정 보 과 학 과

요   약

도심부는 교통수요 증가로 인해 극심한 교통 혼잡이 발생하며, 이로 인한 경제적 손실은 매년 증가하고 있다. 교통 혼잡으로 인한 경제적 손실을 감소시킬 수 있는 방법 중 개인차량의 운행 억제를 위해 카 쉐어링, 렌터카 등의 시스템이 첨단 IT 기술들과 접목되어 등장하고 있다. 이러한 차량 공유는 교통 혼잡을 완화하고 차량의 효율성을 증대시켜 차량유지비 절약, 자동차를 소유하려는 인간의 욕구 감소, 차량소유의 번거로움 완화, 비즈니스, 개인용무 활용, 대중교통 수단과의 연계성을 향상시키며, 저탄소, 친환경 교통의 구현을 목적으로 하고 있다. 본 논문에서는 차량공유시스템에 대한 개념, 국내외 차량공유 시스템, 유사교통의 요금 체계를 소개하였다. 아울러 클라우드 교통 시스템에서 가장 중요한 역할을 하는 최적의 이용 요금에 대해 추정하였다. 유사교통 수단 요금 체계 분석을 통해 운영원가와 이용원가가 포함된 대여요금을 산정하는 방법론을 제시하였다. 유사교통수단과의 요금 비교분석을 통해 최대, 최소요금 범위를 설정 하였으며, PSM기법과 UTP기법을 이용해 실제 이용할 수요와, 지불의사금액을 추정하였다. 최소요금은 렌터카 요금과 비교하여 5,333원으로 추정되었으며, 최대요금은 택시요금과 비교하여 17,700원, PSM을 통한 지불의사금액은 6,930원으로 추정되었으며, UTP기법을 통한 50%수요시의 가격은 6,550원으로 추정되었다. 향후연구로 이용자들의 이용시간, 날씨, 수요패턴, 추세 등을 분석하여 동적가격 관리에 대해 연구되어야 할 것이다.

1. Introduction

1.1. Background

  Due to the increasing demand for inner-city traffic causes severe congestion and resulting economic losses have been increasing every year. Economic loss caused by congestion of the ways you can reduce the operation of private vehicles for inhibiting car-sharing, car rental, etc. The system combines state-of-the-art IT technologies and has appeared in many ways is a trend. Sharing these vehicles to reduce traffic congestion increase efficiency and low carbon vehicle, for the purpose of the implementation of environmentally friendly transportation are. In this paper, the concept of car sharing systems, domestic and foreign car-sharing system, introduced a similar system of transportation charges. Was introduced pricing theory, price structure, fee strategic transport system of the vehicle by applying the cloud-rent base rate methodology was developed to estimate. In addition, the most important role in cloud-transport system using the optimal rates were estimated for the quasi-systematic analysis of transportation charges and the operating cost base rate that includes cost of using the proposed methodology to calculate. Rates compared with similar transport through the maximum and minimum rates were set a range, WTP surveys and the actual use and demand by using UTP approach, willing to pay the amount estimated.

1.2. Goal and Objectives

This study estimated the existing traffic-related charges related to a literature review to determine the existing price theory, price structure, fee costing methodology to identify strategies for development will be realized in the future transport vehicle when the cloud can be applied in accordance with the development of a model was intended. In addition, the model estimated by applying the best fare cloud transport system of the vehicle for the purpose of calculating the optimal rates was studied.

1.3. Flow of Study

The research literature on the transport system through the cloud, take a look at the pricing for the theory was investigated. In addition, Zip-car and taxi, rental car fees, and similar systems for transportation were analyzed. In addition to the basic fee calculation methodology was developed, had set a range of rental rates, the estimated model to estimate the optimal rates.

Flow chart of study conducted in this study are shown in Fig 1.1.
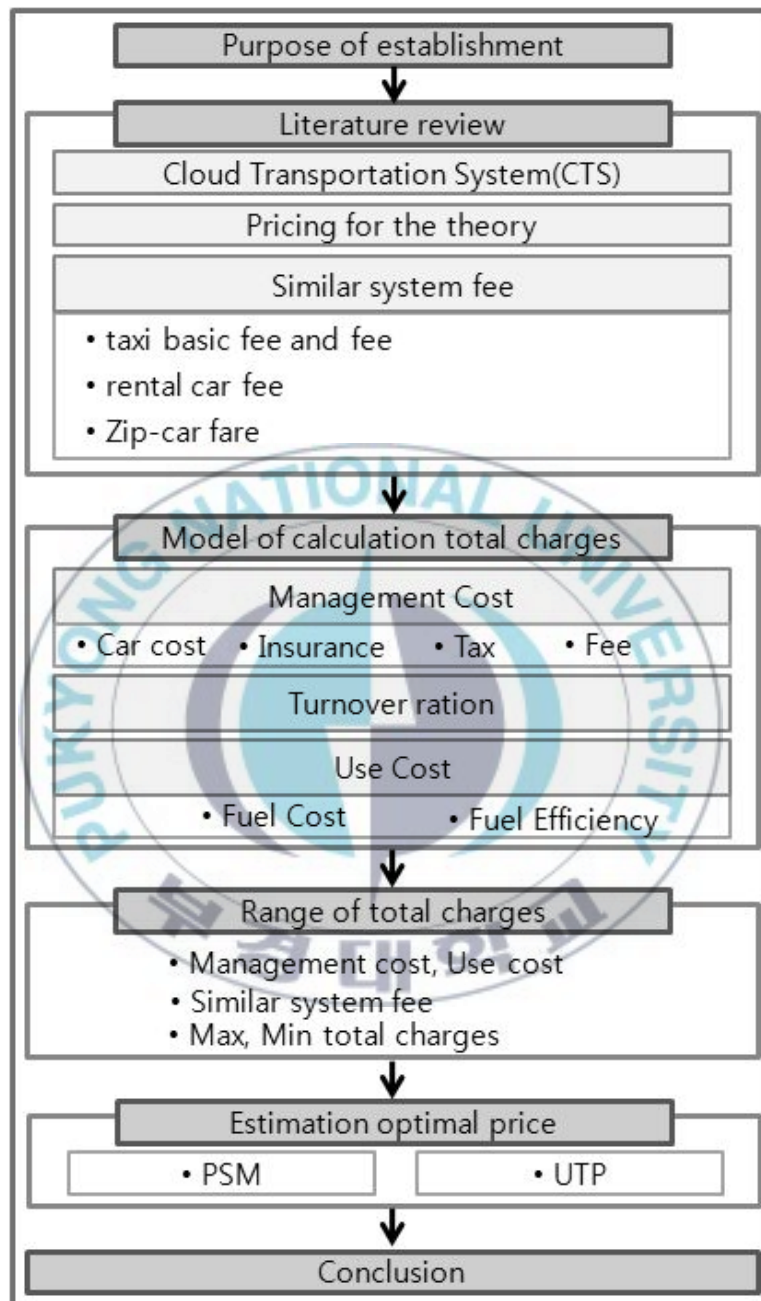
Fig 1.1 Flow chart

2. Literature Review

2.1. Previous studies

2.1.1. Car-sharing system

Lee jae young, Jeong woo hyeon (2007), the "Car-sharing effect of the introduction of international practice and national estimates," Car-sharing in studies on the concepts, definitions, and taxi or rental car, and were compared with similar measures. Running on the local and overseas examples of Car-sharing programs to introduce, Car-sharing that occurs when the introduction of many kinds of social benefits introduced in Korea say that the city estimates, ally-cost analysis that examined the economic effects .

More Jang won jae et al (2009), "co-Use Vehicles(Business Car-Sharing) analyze the potential effects of introducing the system," Study on the joint use of cars in the Business examined the possibility of a domestic adoption. And through surveys Business estimated potential demand for joint use of car was it based on traffic reduction effects, such as fuel cost savings were analyzed expected social benefits, the introduction outlines the City business day Saints were reviewed.

Park jun seok(2008) "The car measures introduced joint-use system," Study on the joint use of cars in the system, and an introduction to the concepts and the type of survey is based on the possibility of introduction of domestic demand and potential side effects introduced in the estimates for the legal and institutional support measures devised.

2.1.2. Determined rates and structural principles theory

Bae eun seon (2010) "The Evolution of liberation previous studies on railway passenger fares," approximately 60 years of the transition process, take a look at rail fare, including a modern Business public freight railroads in discussing the nature and pricing methods, Learn an overview of previous studies based on introduced.

Kim gyeong cheol (2006), "Integrated Fare System implemented in accordance with Policy Studies, Seoul, public transport fees," charges from the Seoul Metropolitan Government to determine policy, laying the basic principles, basic principles, each separated by means of the services provided by fare policies provide the main direction of was Seoul Metropolitan Government in accordance with basic principles of policy surcharge fee / additional length adjustment of Ophthalmology, Seoul, by reviewing the basic rates compare settlement rates for the basic direction of the proposed settlement.

Song je ryong (2005), "Study on Corporate Governance, Gyeonggi

taxi″ taxi fare in the introduction to the system, and taxis operating in Gyeonggi and Usage survey results and problems of the region based on supply and demand for taxi cab services adequate contrast enhancement various schemes for the proposed improvement measures.

Kim sun ju (2003), ″A Study on the Structural Improvement, Busan, taxi fares,″ the taxi station in Busan, after examining the reality of the current taxi fare structure system learn about the inefficiencies and problems that have the current rate structure to identify and was reasonable to study the direction of improvement.

2.1.3. Theory of optimal pricing

Lee ui eun et al (2003), ″Price sensitivity techniques with highway traffic information, the appropriateness of valuation studies in″ Highway Traffic Information fair value estimate to the survey was conducted, the survey data based on price and sales volume relationship Price obtain the reaction function to calculate the optimal price for the price sensitivity analysis techniques were used for calculating the fair value.

Won yong jang et al (2000), ″high-speed rail freight acceptance of the pricing study on″ in the high-speed rail potential passengers for the precision surveys obtained through the customer′s needs and behavior patterns, the analysis carried out was high-speed rail freight in the appropriate were analyzed for a range of acceptable pricing.

Choi mi gyeong (2006), ″Strategy for the price of a family restaurant price sensitivity analysis, case studies″ to target companies in the dining price sensitivity analysis using PSM techniques, case studies, whether conducted by understanding customers′ price and value reasonable price based on each menu strategy, and the actual applicable price sensitivity suggests ways to use metrics.

Lee chang mu et al (2007), the ″PSM techniques, public rental housing with the crystal structure analysis of willingness to pay rent″ in the PSM technique through research on the potential of public rental housing tenants were willing to pay the rent estimates, based on this technique UTP was drawn through the demand function. In addition, the rent level in accordance with changes in demand and willingness to pay estimates to the factors that affect rent levels were analyzed.

2.2. CTS(Cloud transportation System)

Decision Existing transportation system that combines the concept of cloud computing users as required by the new concept of transport used for renting this is to pay.

CTS is a hybrid mix of a variety of transportation users as a form of transportation did not currently have a virtual ″cloud″ can be likened to.

Tailored to each individual's situation, to provide the best means of transportation you want to use as a service does not need to own all means of transportation. Different owners and a variety of physical locations that exist in the transportation provided by integrating technology, unmanned rental service is a new concept. In addition, the existing means of transportation (private cars, buses, subway, train, etc.) and other means of transportation in developing and delivering new services (Electric Cars / scooter / taxi, electric bicycles, the Segway (Segway), water taxis, etc.) a variety of means, , is the link between complex systems. Users desktop or personal handsets, smart phones, etc. are provided to apply for the service.

2.3. Pricing Theory

2.3.1. Price of market principle

Competition with other means to set the price according to market principles as a way to calculate the price, the price calculated by the basic wage structure then applied to further competitive prices is a way.

2.3.2. Cost of service principle

Business users of the service fees that cover the time spent on production and supply of services is to determine the cost basis. Cost

of all necessary cost of business operations and business expansion to cover additional costs required to include a profit means the whole cost. Compensation on the basis of careful cost allocation or income distribution can be consumed in a way that, for both consumer and producer decisions based on a reasonable price has been recognized. public strong price resistance mechanism that is not appropriate to apply the cost of goods and services prices and can be difficult to accept. Requires a detailed analysis of costs, which at the cost of each individual service are difficult to distinguish disadvantages.

2.3.2.1. Profit maximizing pricing

Marginal cost and marginal revenue is equal to the price at a level determined by the way, the profit-maximizing public benefits, but the evils of monopoly occurs exclusively in the case of public resources hinder the efficient allocation of the burden should result in a plethora of consumer .

2.3.2.2. Average cost pricing

As the most widely used method of determining price, the price to cover the average cost, the price is a way of determining the level. The average cost of capital for operating expenses means the total sum of money.

2.3.3. Value of service principle

Unlike the supply side, the cost of service, care service, the value of the demand side is based on the fee structure. To lower the cost of care and attention as the upper bound value between the fair value by considering the practical conditions to be determined. Semantically as a profit-maximizing rate system that the price elasticity of consumers to justify discrimination on the basis of fee structure will be used to mean two. Depends on the consumer′s subjective, difficult to show quantitative representation has disadvantages.

2.3.4. Social principle of rate making

Social needs or social costs in accordance with the price of goods and services produced by public enterprises to determine the will, according to supply it with input costs and consumers are willing to pay the amount is that there is no direct relationship with.
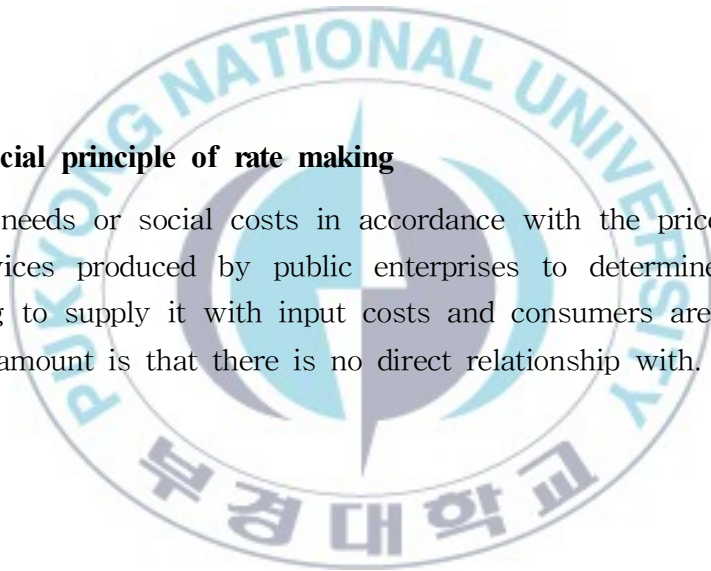
Table 2.1 Pricing theory

	Cost of service principle	Value of service principle	Social principle of rate making
Concept	User's fees expended in production and supply of services is determined by the cost	Nothing to do with production costs, and recognized by users of the service charge is determined by the value	Users' ability to pay a fee in consideration of social policy and economic policy is the consideration, or by maximizing the benefit of society as a whole is to determine the rates
Features	Confirmed the essence of the concept of cost, service levels, higher than the rates of payment occurs when the user, the service there is no prevention for depreciation	Users feel about the transportation services difficult to quantify qualitative concept	Difficulty estimating the social benefits and costs, the market price mechanism is complicated
Application	City bus fares Basic rate of Railway Rates	Rating of taxi fare Rating of railway fare rates	Discounted bus fares Free-riding

2.4. Rates Strategy

Rates strategy are typically separated by a flat fare and differential fare.

2.4.1. Flat fare

The simplest and most common fare structure, the distance of the passenger traffic, time, speed and quality of service, regardless of the charges by the same easy-to-manage, easy to understand the benefits.

Disadvantage relative to the user's short-Louis unfair burden of rates and rate increases at a greater reduction in the number of passengers. To compensate for this prepayment fee is a flat rate of payment policies implemented in conjunction with, and the current wide-area bus and the Seoul city bus and local bus traffic at a single flat rate plan is implemented.

2.4.2. Service based differential

Differentiated rates high-speed service (long distance commuting and peak services) provided to higher operating costs and higher service levels can be used as a means to reflect.

Advantages are relatively easy to understand, high-quality services that charge a high cost in terms of fair.

Disadvantage is you need to use high-cost services to transit users and sophisticated users who have lower response rate.

2.4.3. Distance-based or zonal pricing

Distance-based pricing(zonal pricing), the long-distance toll charges by paying more in fees, advantage, and long-distance traffic by increasing the proceeds to pay a high cost in terms of fairness is that.

Disadvantage to all of the passengers and transportation operating agencies are the most complex fee structures, to make long-distance toll charges apply for low-income and an increase in charge to manage the facilities is that it requires.

2.4.4. Time based differential

Hours Discrimination (peak / off peak) charges for two reasons: The following methods are considered.

Peak is less sensitive to market prices and rates generally increase because it is more for the ability to pay.

Boarding passengers at the peak and the additional cost of providing services is higher than off peak hour.

The advantage of using off peak hour can be increased by increasing the number of passengers, off peak hour demand, demand management programs and move can be helpful.

The disadvantage is not larger shift in demand, in cash and tickets to passengers who use the carrier's complexity increases. However, the use of means of magnetic and smart card systems can reduce the difficulty of operating.

2.4.5. Market based pricing

The most widely used strategy, a form of discrimination charges market or customer base is the base rate, flat rate or differentiated rates are used with.

Pass through and discount tickets, depending on frequency of use and pre-paid doctors to provide differentiated rates. The other passengers (regular vs. occasional users Users) price is used as a way to distinguish. By increasing the cash advance handling fee of constraints can be reduced.

Advantage of low rates and pay-per passage is very convenient. Reduce the carrier's cash handling costs, and increase rates in the market for some fine-grained it is possible to minimize the loss of passengers.

The disadvantage may reduce earnings and rates are at risk of escape. In addition to the introduction of payment rates and the distribution of costs is that costs occur.

2.5. Similar transport fares

2.5.1. Zip-car

Table 2.2 zip-car fare

Charging system
Weekdays : 66,000 won (or per hour 8,000 won)
Weekend : 72,000 won (or per hour 9,000 won)
Fuel cost : 0 won (Day use fee is included in)
Insurance : 0 won (Day use fee is included in)
Parking fee : 0 won

2.5.2. Taxi

Table 2.3 Taxi fare

Charging system	
Seoul	Busan
Basic fare(to 2km) - 2400 won	Basic fare(to 2km) - 2200 won
After 100won per 144m	After 100won per 169m
Speeds less than 15km/h	Speeds less than 15km/h
-100won per 35 seconds	-100won per 41 seconds

2.5.3. Rental car

12 hours average rental fee(compact car) is a 64,000 won (Kumho rent car).

3. Methodology of cost estimation

3.1. Development of methodology to calculate fee

3.1.1. Turnover ratio

$$TO_{ratio} = \Sigma Dmd / 24 / N \times 100 \qquad (1)$$

TO_{ratio} : Turnover ratio (%/hour)

Dmd : Demand of trip generation CTS (vehicle/day)

N : Number of CTS vehicle (vehicle)

The turnover is the percent of rental vehicles per the entire vehicle per one hour. The sum of the demand of trip generation CTS of 24 hours (day) divided by the CTS vehicle number after dividing.

$$TO_{num} = \Sigma Dmd / N \qquad (2)$$

TO_{num} : Number of turnover (number/vehicle)

Number of turnover is the number that the rental one vehicle per day. Number of turnover is the value that is sum of the demand of trip generation CTS divide CTS vehicle.

$$TO_{time} = 24/TO_{num} \qquad (3)$$

TO_{time} : Turnover time (hour/number)

Turnover time is the time interval of one rotation. 24 hours, divided by the turnover number of rotation is obtained.

Turnover time of the one-time rental, return, and parking to the empty car rental, and then including all time. If the turnover ratio is smaller than the rotation time per customer in order to meet the increased cost burden increases.

3.1.2. Operating cost

In order to calculate the operating costs Choi(2998) study analyzed total costs by taking advantage of a taxi transportation was applied.

$$CT_{op} = ((CT_{car} \times 0.45)/5 + Is + Ta + Fe)/365/TO_{num} \qquad (4)$$

$$CT_{op} : Operating\ \text{cost}\,(won/\nu mber)$$

$$CT_{car} : Vehicle\ \text{cost}\,(won)$$

$$Is : Insurance\,(won)$$

$$Ta : Tax\,(won)$$

$$Fe : Fee,\ repairing,\ washing,\ parking\,(won)$$

With a basic requirement for the operation of vehicles used in the cost price (5 years) and insurance premiums, taxes, fee, vehicle repair maintenance, washing, parking, etc. can be represented as the sum.

Cost with a focus on passenger cars arbitrarily storage equipment costs, operating costs, etc. were excluded.

Vehicle when using a 5-year study that can be sold as used cars is the limit of value. After five years the average used car prices will fall 55 percent compared to the cars. (Son, 2008)

In this study, the vehicle was set to 5 years operating period. 45% of new car prices were priced the cost of the vehicle.

3.1.3. Hourly operating rate

$$R_{hourly} = CT_{op}/TO_{time} \tag{5}$$

$R_{hourly} : Hourly\ rate\,(won/hour)$

Hourly operating cost used to average 1 hour is the actual cost. Operating cost is calculated by dividing the rotation time.

3.1.4. Cost of using

$$CT_{use} = CT_{fuel}/E_{fuel} \qquad (6)$$

$CT_{use} : Use\ cost(won/km)$

$CT_{fuel} : Fuel\ cost(won/l)$

$E_{fuel} : Fuel\ Efficient(l/km)$

use cost rates that are available according to the distance. Fuel cost is calculated by dividing the fuel efficient. CTS vehicle is always a full-charge and according to the distance used to charge rental fees are determined by summing the total charge.

3.1.5. Total charges

$$C_{tatal} = (R_{hourly} + P) \times H + CT_{use} \times M_{age} \qquad (7)$$

$C_{tatal} : Total\ cost(won)$

$P : \Pr ofit(won/hour)$

$H : Used hour(hour)$

$M_{age} : Mileage(km)$

Total charges is the total intensity, and an hourly operating rate the sum of the appropriate use profit multiplied by the value of time-time costs and utilization rates and mileage is the sum of the rates multiplied by the distance. Of transportation fee system similar to the aforementioned taxi time-distance cruising speed specified by the infusion of the vehicle speed is above the street when the bus fare to calculate the distance to the charges in conjunction with its cruising speed of the vehicle speed drops below specified Take time when time charges for is a way to calculate the sums. However, CTS developed here over the forearm of a vehicle use fee at the time of the model using the time-distance charges and charges for the distance to be calculated separately by calculating the time-distance charges as may be mixed.

3.2. Apply the methodology

3.2.1. Calculating turnover ratio

Turnover has to apply to the demand and the number of cars Shin min seong(2011) CTS in the study of the passage of the calculated and demand has occurred was calculated using the number of cars.

Table 3.1. Demand of trip generation CTS in Haewoondae-Gu　　　(trip/day)

	CTS Attending	CTS School	CTS Business	CTS Shopping	CTS The others	CTS Homecoming
Woo 1 - Dong	86.3	3.9	46.5	6.9	34.4	122.5
Woo 2 - Dong	53.2	2.4	36.8	4.3	21.2	96.9
Joong 1 - Dong	45.3	2.1	42.9	3.6	18.1	112.8
Joong 2 - Dong	23.7	1.1	6.1	1.9	9.4	16.1
Left 1 - Dong	38.2	1.7	18.5	3.1	15.2	48.8
Left 2 - Dong	72.6	3.3	15.6	5.8	29.0	41.1
Left 3 - Dong	40.4	1.8	6.3	3.2	16.1	16.6
Left 4 - Dong	55.4	2.5	7.4	4.4	22.1	19.4
Song jung Dong	15.6	0.7	9.7	1.2	6.2	25.5
Banyu 1 - Dong	92.9	4.2	33.4	7.4	37.1	87.9
Banyu 2 - Dong	37.2	1.7	6.5	3.0	14.8	17.2
Banyu 3 - Dong	27.2	1.2	4.1	2.2	10.8	10.7
Banyu 4 - Dong	37.6	1.7	4.8	3.0	15.0	12.7
Bansong 1 - Dong	24.6	1.1	7.8	2.0	9.8	20.6
Bansong 2 - Dong	67.2	3.0	11.6	5.4	26.8	30.5
Bansong 3 - Dong	21.1	1.0	4.2	1.7	8.4	11.2
Jaesong 1 - Dong	68.9	3.1	26.9	5.5	27.5	70.8
Jaesong 2 - Dong	67.2	3.0	13.1	5.4	26.8	34.6

Table 3.2. Number of CTS vehicle and turnover ratio

	Total demand of CTS	Demand of CTS at the each time	Number of CTS vehicle	Turnover ratio
Woo 1 - Dong	300.5	12.5	19.0	66.0
Woo 2 - Dong	214.8	8.9	15.0	59.7
Joong 1 - Dong	224.8	9.4	17.5	53.6
Joong 2 - Dong	58.3	2.4	3.8	63.6
Left 1 - Dong	125.6	5.2	7.6	69.3
Left 2 - Dong	167.4	7.0	11.7	59.5
Left 3 - Dong	84.4	3.5	6.5	54.0
Left 4 - Dong	111.3	4.6	9.0	51.8
Song jung Dong	58.9	2.5	4.0	62.1
Banyu 1 - Dong	263.0	11.0	15.0	73.1
Banyu 2 - Dong	80.5	3.4	6.0	55.8
Banyu 3 - Dong	56.2	2.3	4.4	53.3
Banyu 4 - Dong	74.8	3.1	6.1	51.4
Bansong 1 - Dong	65.9	2.7	4.0	69.1
Bansong 2 - Dong	144.5	6.0	10.8	55.5
Bansong 3 - Dong	47.5	2.0	3.4	58.3
Jaesong 1 - Dong	202.8	8.5	11.1	76.0
Jaesong 2 - Dong	150.1	6.3	10.8	57.7
			Average	60.5

When applied to the average turnover ratio at 60%, by the model number of turnover is per day on average 14.4 times and the turnover time is 1.666 hours (100 minutes).

3.2.2. Calculating operating cost

Based on the compact cars CTS cars and car insurance premiums per person average (Non-Life Insurance Association) was applied, The standards of National Tax Service tax was applied. Application of Rates Choi eung yong(1998) analyzed in the study of the price of a taxi and vehicle maintenance costs were the sum of the rates applied.

Table 3.3. Operating cost

Item	Cost(won)
Vehicle cost	10,000,000
Average Insurance(per person per year)	70,000
Car tax(1,000cc , 100won per 1cc)	100,000
Fee, repairing, washing, parking(taxi, per year)	4,000,000

14.4 times the number of turnover calculated by applying to the operating cost is 1,080 won.

3.2.3. Calculating hourly operating rate

1,080 won operating costs per round and turnover time 1.66(100 minutes) when applicable, hourly operating rate is estimated the 648 won.

3.2.4. Estimated range of total charges

You can not calculate a profit. Therefore, range of the first charge is calculated.

In this study, calculated based on estimated range of total charge are as follows:

① 12 hours, including a profit rental fee (excluding cost of use) are more expensive than the rental fee. In other words, inefficient use, and for a long time to reduce parking, rental of more than 12 hours for a smooth rotation users are encouraged to recommend a car rental.

② Zip-Car charges a reasonable fee levels should be compared.

③ To drive to wherever they go and should be excluded because the operation because the service charges are cheaper than taxi fare.

$$C_{tatal} = (R_{hourly} + P) \times H + CT_{use} \times M_{age} \qquad (8)$$

$C_{tatal} : Total\ \mathrm{cost}(won)$

$P : \mathrm{Pr}ofit(won/hour)$

$H : Used hour(hour)$

$M_{age} : Mileage(km)$

3.2.4.1. Minimum charge

Car rental rates using a minimum of 12 hours and fuel costs are not included. Therefore, use and operation costs should be compared, except the product of the distance. Car rental 12 hours mentioned above is the average price is 64,000. And in order to obtain a fee per hour to 12 hours if you divide 64,000 won 5,333 won. Therefore, the total charge should not be less than the 5,333 won. And 5,333won minus 1,080(Hourly operating rate)won is 4,253 won that is minimum profit.

3.2.4.2. Maximum charge

In this study, the maximum charge for calculating the following general assumptions were set up.

①Measured by the compact cars's average fuel efficient (town efficiency) is about 15km per L.

②Seoul metropolitan area average traffic speeds is 24km/h(Seoul,

traffic speed survey 2008).

③Average oil price of about 2,030 won per L (Korea National Oil Corporation Opinet.

The maximum charge that must be cheaper than taxi fare, 1 hour total rental fees should be cheaper than a taxi one time fee.

If using a taxi 1 hour charge is 17,700won (= 2,400 won +22 km/144m * 100 W), and with time can be estimated at 19,000won (Daum map).

If CTS vehicles using 1 hour, hourly operating rate is the 1,080 won, use cost is 135.33won, the total charge is 4,328 won + profit (profit = 1,080 won +135.33won * 24km).

Therefore, the total rental charge will have to be less than 17,700 won, 17,700won minus 4,328 won is 13,372 that is maximum profit.

4. Model of charge estimation

4.1. PSM(Price-Sensitivity Measurement)

Reasonable basis for determining the value for pricing the value of customer service we must understand that you are aware, and more than the cost to produce goods for consumers in the target market for products based on the needs assessment and subsequent price shall be determined. No matter how good the product, even if consumers are hoping to pay the price in case the price level should be determined. To do this, you need to know the price of potential customers can be accommodated, and also of consumers' purchases, price sensitivity to changes, information about the characteristics of target markets through consumer surveys to obtain it must make as a basis for pricing. (Ahn, 2004)

Zeithaml & Bitner (1996) for pricing in the service industry is facing one of the factors consumers consider price, depending on the quality of products or services tend to judge whether that was And to accommodate the budget line at the bottom of the lowest rates, customers doubts on the quality of products or services and the highest price was too expensive and feel on top of the line, because reducing consumption will be replaced by other products or services. Additionally, consumers feel the price is worth considering together. In order to determine the right price in the service industry is the

demand response to price should react to what is detected, it is one of the methods is to evaluate the price sensitivity assay (Price-Sensitivity Measurement, PSM).

4.1.1. Advantage of PSM

PSM to assess the consumer price is set mainly in the price. The valuation of existing products as well as useful for the pricing of new products, and the analysis results can be expressed visually in a small sample can be analyzed.

4.1.2. Disadvantage of PSM

The actual consumers of high quality products have the desire to buy cheaply for the right price has a tendency to under estimate.

PSM purchase basic necessities, such as frequent repetition in case of product is suitable. But do not buy expensive product that is often, consumer electronics and computer products such as 10-20% of the cases tend to under estimate the reliability can degrade not suitable.

4.1.3. Investigation methods

The PSM Model is easy to use, is parsimonious, and requires no special knowledge or skills on the part of either the researcher or the respondents. The survey contains four questions. When consumers′ aggregate responses to those questions are graphed, the model

indicates the price-sensitivity level of the market being tested.

The questions are:

(1)At what price on the scale do you consider the product or service too cheap, so cheap that you would question the quality?

(2)At what price on the scale do you consider the product or service to be cheap?

(3)At what price on the scale do you consider the product or service to be expensive?

(4)At what price on the scale do you consider the product or service to be too expensive, so expensive that you would not consider buying it?

4.1.4. Draw a graph methods

The responses to those questions are analyzed statistically and plotted on a graph, as explained in the accompanying box on PSM. Even though the model is simple to use, it must be carefully applied to ensure accurate results.

When the four cumulative distributions are combined, one can determine whether there is "stress" in price consciousness. The closed the optimum price is to the indifference price, the less price-conscious are the respondents. The more the optimum price falls to the left of the indifference price, the greater is the number of consumers who

feel the "nomal" price is too high-that is, they are more sensitive to price.

The final manipulation gives the range of acceptable prices. This results in a four-curve graph in which the "too cheap" and "too expensive" curves are graphed with the reversed cumulative distributions of the "cheap" and "expensive" curves, which can then be labeled "not cheap" and "not expensive". The basis for the inversion is that, logically, if something is expensive it is not cheap. Bus asking respondents to state a price that they consider "not cheap" is awkward and prone to error. The intersection of the two reversed curves is the point of marginal cheapness(PMC), or the point where the number of respondents who feel the product or service is too cheap is equal to the number of respondents who feel it is not cheap.

The intersection of the "not expensive: and "too expensive" curves is the point of marginal expensiveness(PME). This is the price point where the number of respondents who feel the product or service is too expensive is equal to the number of respondents who feel it is not expensive.

The range of acceptable prices has the point of marginal cheapness as its lower prive limit and the point of marginal expensiveness as its upper price limit. Operators would e unwise to price outside this range unless there is real change in the perceived value or positioning of the produce or service For example, Taco bell found

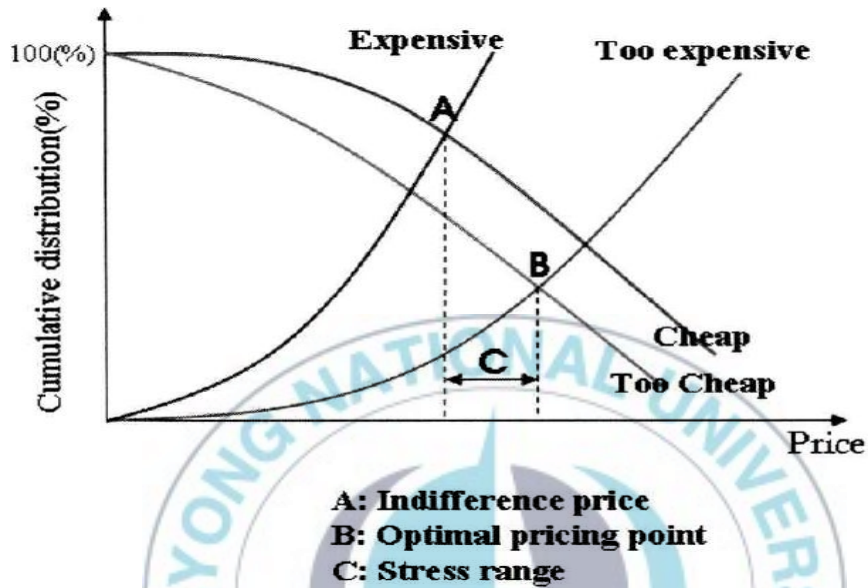that it could move price up by adding sour cream to tacos and
changing the perceived

A: Indifference price
B: Optimal pricing point
C: Stress range

Fig 4.1 Price-Sensitivity Measurement(A)

D: Point of marginal cheapness
E: Point of marginal expensiveness
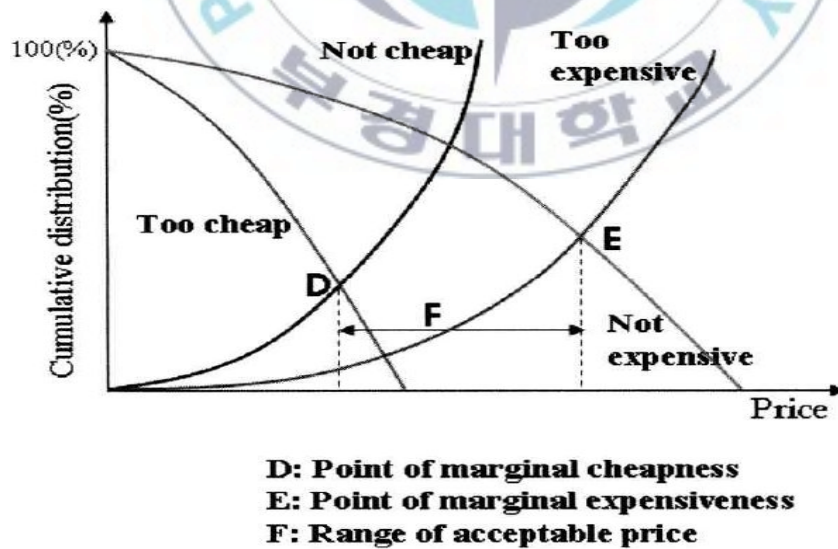F: Range of acceptable price

Fig 4.2 Price-Sensitivity Measurement(B)

Ⓐ**IDP** : Indifference Price

Ⓑ**OPP** : Optimal Pricing Point

Ⓒ**Stress** = IDP-OPP

Ⓓ**PMC** : Point of Marginal Cheapness

Ⓔ**PME** : Point of Marginal Expensiveness

Ⓕ**RAP** : Range of Acceptable Prices(PMC ~ PME)

Positive(-) Stress can be set the more expensive price (possible until PME).

Negative(+) Stress can be set a little cheaper price (possible until PMC).

4.2. UTP(Unique Target Point)

Lee chang mu et al (2007) was introduced UTP by the academic world, mainly in the industry rather than academia, this technique is often used by consulting companies. This technique is very simple and intuitive.

In the proposed four kinds of PSM is created by applying the survey. UTP is individuals responded the halfway point between cheap and expensive (average).

Respondents clearly thinking there is a fair price between the purchase price and the prices are expensive, but considering the

purchase. It means that average of the two prices affordable is considered a representative value.

$$UTP_n = \frac{Expensive_n + Cheap_n}{2} \qquad (9)$$

Also, too-expensive and too-cheap, even among present and reasonably priced, and the other UTP as the average of four kinds of prices you can choose.

$$UTP_n = \frac{Expensive_n + Cheap_n + Too\ expensive_n + Too\ cheap_n}{4}$$

$$(10)$$

Small n means the individual respondent, therefore, n is 1 to 111.

The biggest advantage of UTP is that you can set a fair price about individuals to consider the goods. The cumulative curves of the individual over UTP to derive the demand curve is that possible.

It means that Demand for consumer willingness and ability to use a price is the amount of goods that. Demand and price for two shows a correlation curve is the demand curve. UTP Demand curves of the individual through the accumulation of UTP appears to purchase an affordable price responsive and are able to show a correlation.
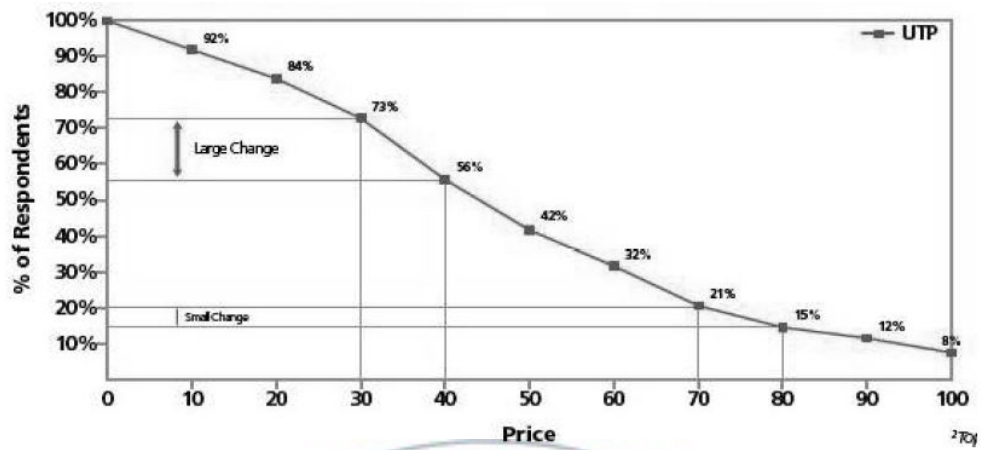
Fig 4.3 UTP demand curves

5. Survey and results

If using a taxi 1 hour the total minimum charge should not be less than the 4,166 won and the total maximum charge will have to be less than 17,700

Therefore, the survey estimated the model using the calculated value and price, minimum, maximum rates to come within range of charges as appropriate will be able to do the best.

5.1. Basic Statistics

Surveys are frequently used as a private means of transportation purposes, such as average hours were about the basics. If the CTS car rental costs, the level of intent to appropriate, available on whether there were about the survey.

Basics of the human characteristics of respondents and the basis of statistics are as follows:

Table 5.1 General characteristics of respondents

Category	Group	Percent
Gender	Male	63.4%
	Female	36.6%
Age	20's	48.8%
	30's	34.1%
	40's	0.0%
	50's	4.9%
	over 50's	12.2%
Vehicle ownership	own	75.6%
	non	24.4%
Frequently used as private transportation	Taxi	36.6%
	Private car	61.0%
	Rental car	2.4%

5.2. Analysis by PSM

CTS vehicle's base rate would be difficult to determine whether the degree was about. So, who estimated car rental (12 hours) and the taxi fare (one hour) rates, U.S. Zip-car rates for the present was to write and direct the appropriate amount.
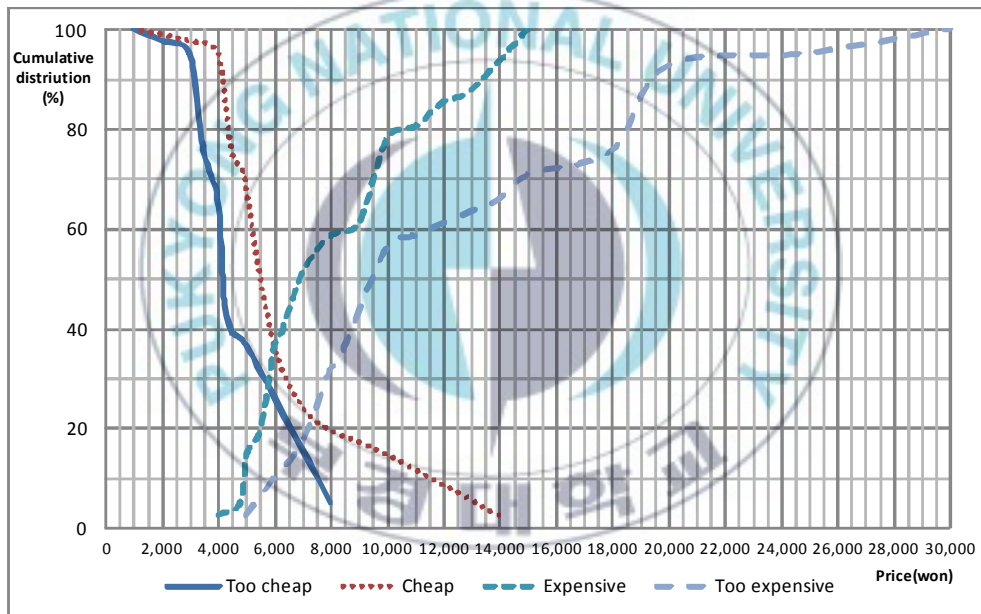

Fig 5.1 PSM result

PSM survey results to accommodate the range of prices for CTS vehicles 7,360 won and 5,780 won, Best price corresponding to the OPP won is 6,930. Taxis are available for a one time fee 19,000 won substantially lower levels when compared with the amount, but rental

rates are higher than a little expensive than Zip-car in the United States showed a tendency.

Table 5.2 PSM result

	PMC	OPP	IPP	PME
CTS vehicle charge	5,780 won	6,930 won	6,000 won	7,360 won

If you doubt the quality is lower than the price of the 5,780 won. 6,930 won the right price point, OPP. Also, cheaper does not think highly expensive, highly price of 6,000 won. And the price is higher than the use (purchase) price to give up is the 7360 won.

When you minus from the OPP and IPP represents a negative value. So a little bit more expensive, it is possible to set the rental rates were analyzed.

5.3. Analysis by UTP

PSM rates in the proposed four kinds of questionnaires were applied to create graphs and UTP. In addition, individuals responded too-cheap, cheap, expensive, too-expensive price between the reasonable (four prices average) was calculated.
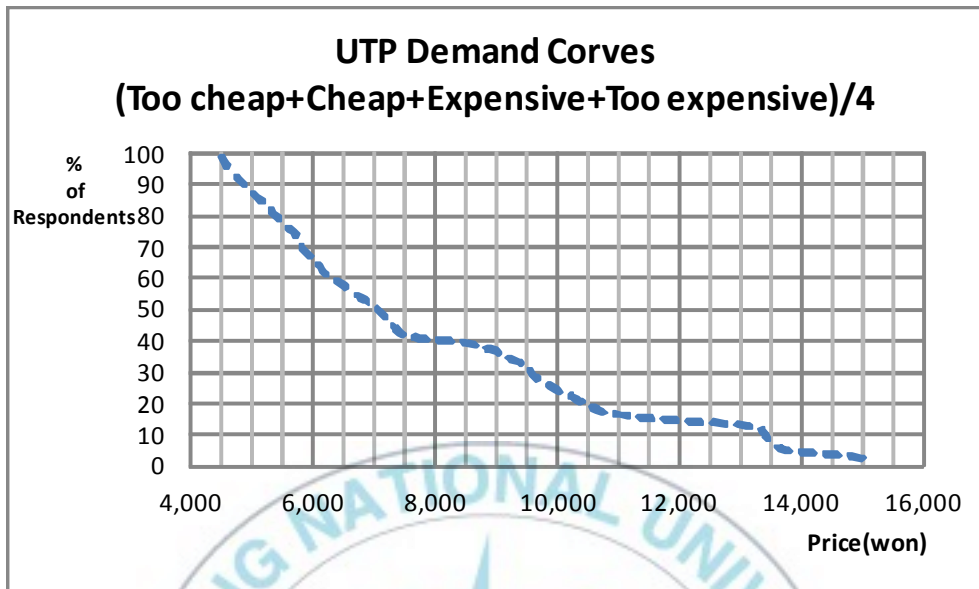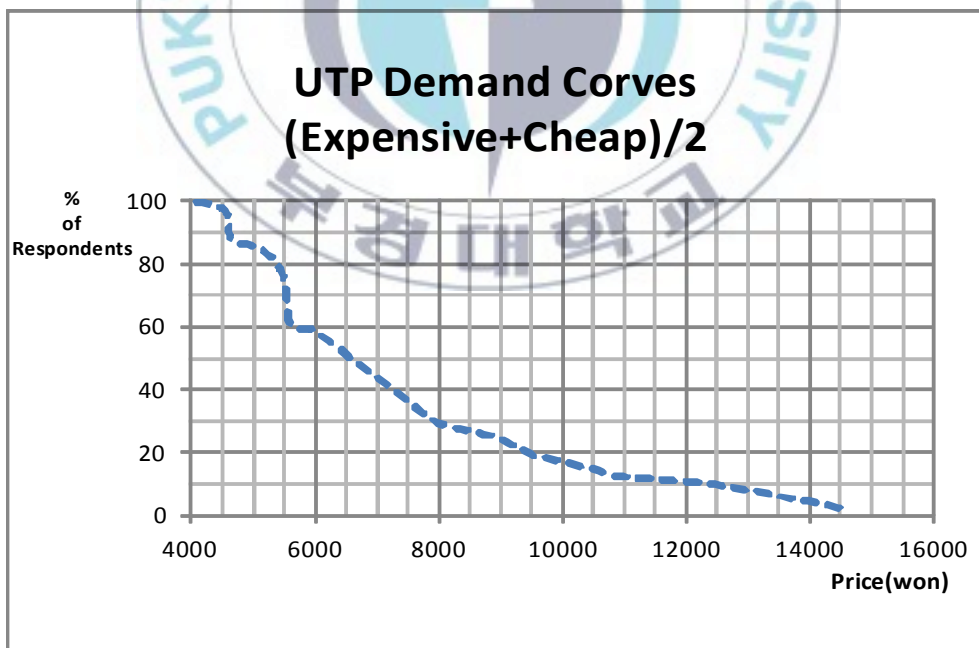
Fig 5.2 UTP demand curves(a)

Fig 5.3 UTP demand curves(b)

Too-expensive, and Too-cheap price between the average UTP 7,100 won about entire data. Another UTP 6,550 won an average of four kinds of prices.

This difference in the too-expensive price range would appear broadly distributed.

In addition, the demand curve, the graph above, the amount of rent to be a member of the 4500, when the graph below the 3,500 member, 100% indicates that demand.
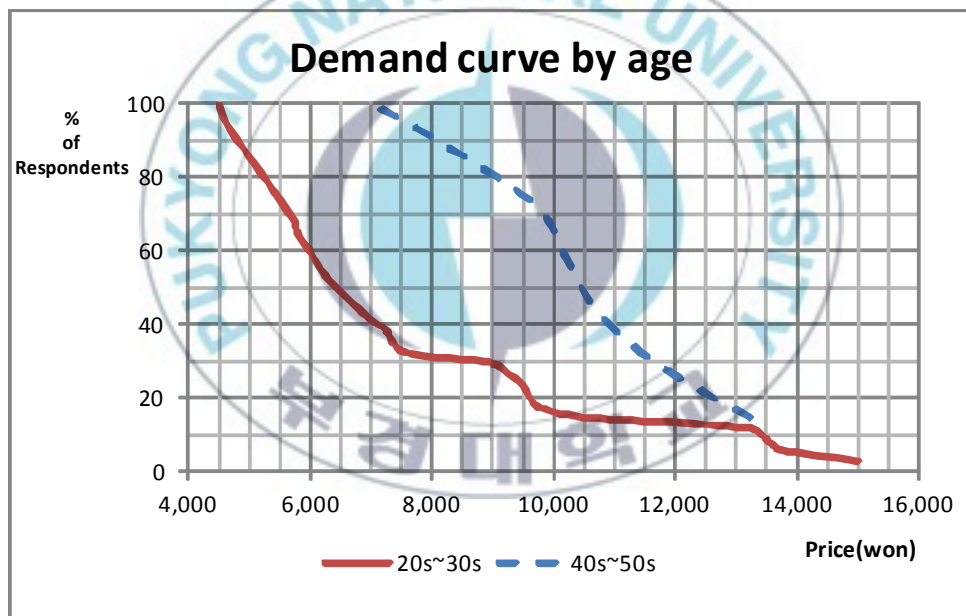

Fig 5.4 UTP demand curves by age

The demand curve by age 20~30's showed a wide distribution, but also know the average price is lower than 40~50's. The median age is stable and economic concepts of cost and price is estimated to be due has been settled sufficiently.
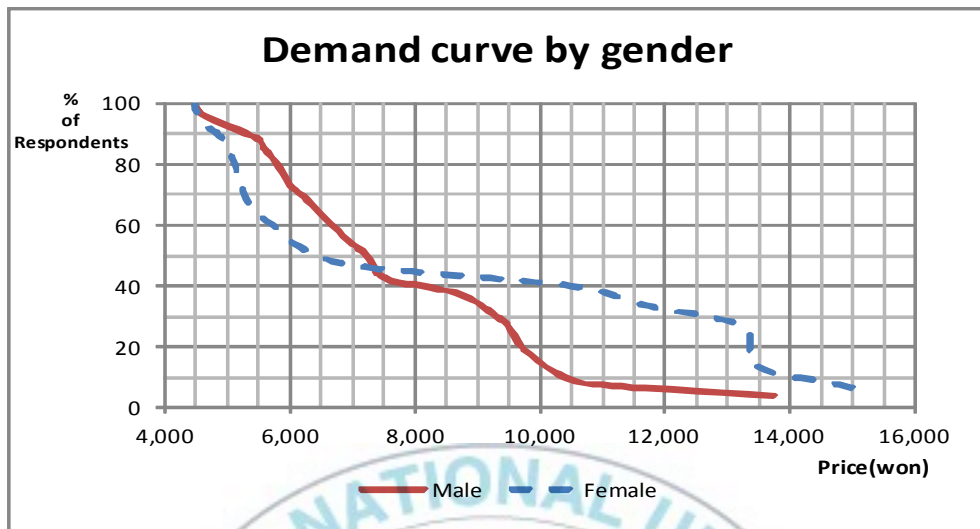
Fig 5.5 UTP demand curves by gender

Demand curve by gender to an average of 6,500 won ~ 7,300 won, showed a similar trend, more women than men, showed that demand is far higher price.
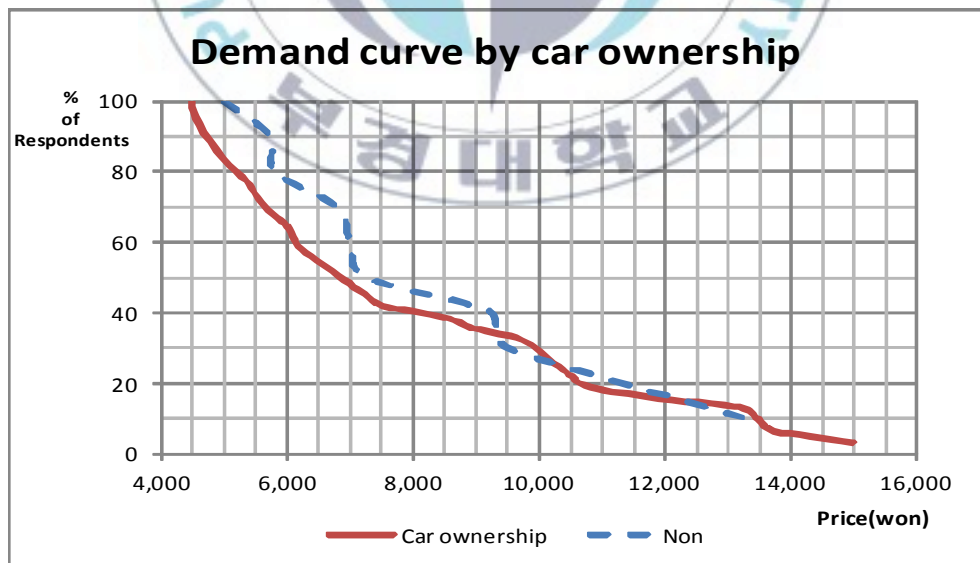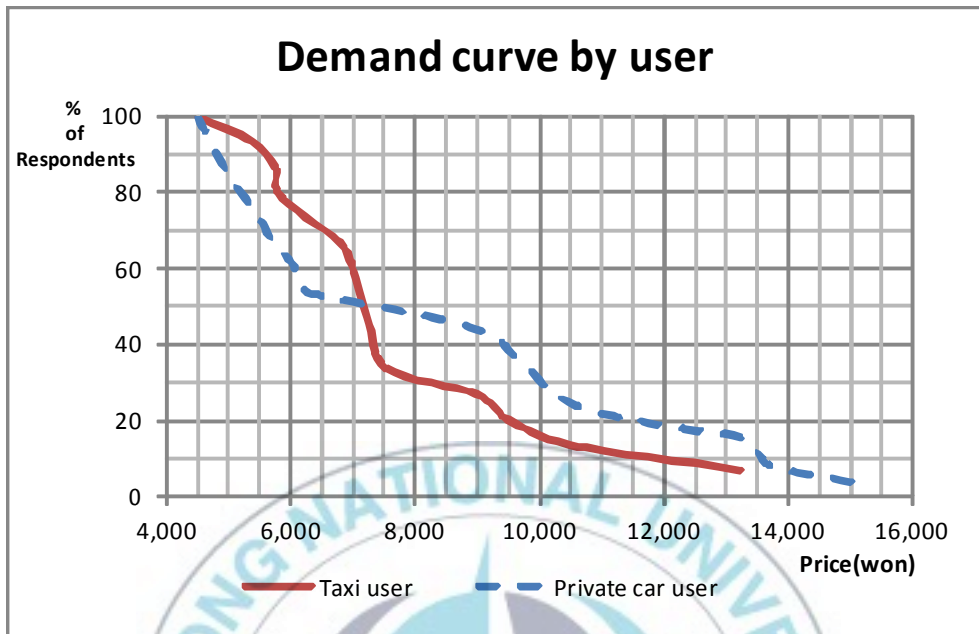

Fig 5.6 UTP demand curves by ownership

Fig 5.7 UTP demand curves by user

The distribution of demand curves by ownership and demand curves by user represent a very similar value could not find greater difference.

6. Conclusion

This study estimated the existing traffic-related charges related to a literature review to determine the existing price theory, price structure, fee strategies were identified. Costing methodology development, the best model by applying the estimated charge cloud of the vehicle transportation system for the purpose of calculating the optimal rates was studied. CTS system is applied in this study are currently under investigation, Turnover ratio has to apply to the demand and the number of cars in the research paper are obtained by applying demand of trip generation CTS and number of CTS vehicle in Haewoondae-Gu.

Costing methodology, the results of applying the rental charge a minimal fee compared to the total rental fee should not be less than 5,333 won. So minimum profits was estimated Hourly operating rate at 5,333 won minus value of 1,080 won to 4,253 won.

In addition, the maximum rates should be cheaper than taxi vehicles an hour use CTS if the total rental fee is 17,700 won. So maximum profit was estimated Hourly operating rate from 17,700 won minus value of 1,080 won to 13,372 won.

PSM model applied to survey results to estimate the optimal price corresponding to the OPP had 6,930 won. Similar transport, taxi one time fee that corresponds to the significantly lower levels when

compared to 17,700 won, but rental rates are higher than a little expensive than Zip-car in the United States showed a tendency. In addition, an average of four kinds UTP price was 6,550 won.

Therefore, the survey estimates and prices are calculated using the model UTP and PSM value, minimum, maximum rates due to come within range of charges as appropriate will be able to do the best.

The consumer, or directly to consumers, asking how reasonable or how conceptually difficult to respond accurately to consumers and does not match the actual behavior, there is likely to respond. In practice, consumers high quality products at lower prices have a desire to purchase the best price has a tendency to under estimate. This trend is a price for a replacement or a competing product lines, and can occur even if the information provided, and this has been pointed out as shortcomings when applied PSM. However, on the part of consumers that can be recognized for any product you can estimate the amount of willingness to pay has the advantage.

Future willingness to pay a little more obvious how to derive the amount of research on the diet that is too much to be done. In addition, rental cars, taxis and similar means of transportation used in calculating the actual cost data obtained through companies or verification methodology for calculating the cost to demonstrate the feasibility study will be needed.

References

Won Je-Mu , 1989, Transport Engineering theory

Korea Transport Institute, 1996, Fare structure of passenger and cargo rail system improvement

Choi eung yong, 1998, A Study on Cost Analysis and Fare Determination in the Taxi Industry, Chonnam National University, Vol.30, No.1, pp.97-124

Kwon yong Jang, 2000, A Study of developing fare structure on the high speed rail, Korean Railroad Research Institute

Jo sang in, 2002, A study on improvement of Railroad Fare System, Inha University

Kim sun ju, 2003, Improvement of Fare Structure for Busan Taxi Services, Department of urban Engineering, Dong-Eui University

Lee eui eun, 2003, Estimation of optimal price of freeway traffic information using a price-sensitivity analysis, journal of intelligent transport Systems society, Vol.2, No.1, pp.85-92

Song je ryong, 2005, A Stusy on Improving the Taxi System in Gyenggi-Do, Gyeonggi Research Institute

Kim gyeong cheol, 2006, Study of seoul public Transportation Fare policy in operating the integral Fare policy, Seoul Development Institute

Lee, Chang-moo, 2007, Determining Factors of Potential Applicants Willingness To Pay for National Rental Housing, Journal of Korea Planners Association, Vol.42, No.4, pp.149-159

Lee jae young, 2007, Car-sharing in Overseas and Introduction to Korea, Journal of Korea Society of Transportation Nov.09,pp.180-187

Lee jung so, 2008, Value of Environment-Friendly Characteristics in Apartment

Complexes, Korea Planners Association, Vol.42, No.1, pp.101-110

Son won il, 2008, Toyota and GM comparative study of the corporate culture, Kwandong University

Lee sang yeon, 2009, A study on the Demand for Green Condominium Using PSM and UTP Methods, Housing study review Vol.18, No.1, pp.89-103

Jang won-jae, 2009, An Analysis of Potential Impacts of business Car-Sharing in Korea, Journal of transport research, Vol.16, No.1, pp.45-60

Bae eun sun, 2010, A study on the Changes of Railway Passenger's Fares before the Liberation of Korea, Department of Railroad Techno Management, Woosong University

Shin min seong, 2011, Study of cloud transportation system architecture, Korean society of Transportation

Van westendorp, p.,1976, Nss-Price Sensitivity Meter(PSM) - A New Approach to Study Consumer perception of price., Proceedings of the ESOMAR Congress.

Lewis, r. and S. Shoemaker, 1997, Price-Sensitivity Measurement, Cornell Hotel and Restaurant Administration Quarterly, Vol. 38, No.2, pp.44-54.

Socratic Technologies, 2008, Price Sensitivity in Configurator Analysis TM Models : Modified van Westendorp Procedure

감사의 글

처음 대학원에 진학하고 연구실에 들어올 생각을 가졌을 때 늦었다고 생각했지만 꿈과 목표가 많았습니다. 돌이켜 보면 아쉬운 점도 많지만 뿌듯하며 기쁜 일들도 많았던 것 같습니다. 대학원 생활을 잘 마칠 수 있도록 인도해 주시고 도와주신 모든 분들에게 감사의 마음을 전합니다.

먼저 무엇보다 언제나 저를 믿고 격려와 독려를 해주신 존경하는 나의 영원한 멘토 아버지께 진심으로 감사하며, 늘 곁에서 따뜻하게 보살펴 주시고 때론 친구처럼 터놓을 수 있는 어머니, 말없이 언제나 저의 앞날을 걱정해주시고 밥 걱정 해주시는 할머니께도 감사하며 사랑합니다.

언제나 같은 맘으로 따뜻하게 이끌어 주시고 저희 연구원생들이 잘되기를 가족 같은 마음으로 바라시는 저희 지도교수님이자 선배, 연구실의 아버지이신 배상훈 교수님께 존경하고 감사하는 마음을 표합니다.

바쁜 업무중에도 저희를 챙겨주시고 학문적으로, 때론 인간적으로 따뜻하게 6년간을 채워주신 김영섭 교수님, 윤홍주 교수님, 최철웅 교수님, 서용철 교수님, 한경수 교수님, 이양원 교수님께도 진심으로 감사드립니다.

처음부터 저를 믿고 격려해 주시고 때론 쓴 소리도 주저 없이 해주신 연구실의 어머니 병용이 행님, 제가 행님이 원하시는 반도 못 채운거 같아 미안한 마음이 앞서며 여러 가지로 감사드립니다. 그리고 연구실 생활에서 나의 반쪽인 친구 같은 형님 같은 동생 민성이, 마이너스 쏭만 좀 덜하면 넌 퍼펙트 맨이야. 조금은 삐걱거렸지만 같이 대학원 생활 잘 마무리한 학부 때 친했던 우리 동기 오지, 앞으로도 잘 지내자^^ 우리 연구실 동기들과 함께한 미국 해외탐방은 두 번 다시 오지 않을 힘들면서 뿌듯했던 추억이네. 연구실의 현재이자 미래인 태욱이, 아직은 좀 모자라 실세임을 실감 못하고 있지만 크게 성장 할꺼라 믿는다. 행님 마음 알지? 언제라도 어깨개그 준비해 놓도록! 태욱이를 추종중인 너무 큰 승현이, 이제 마음과 머리를 크게 자라도록 해. 너 때문에 요즘 많이 웃어서 정말 고맙다. 끝까지 함께 하지 못했지만 언제나 연구실을 생각했던 이쁜

이 선민이, 성실한 너의 모습이 떠오른다.

졸업한 연구실 선배들께도 정말 감사드립니다. 전형적인 미국인 같은 희진선배, 꼭 같이 한번 미국을 누벼봐요. 아직도 조교쌤의 흔적이 남아 희종쌤이라고 부르곤 하는 희종선배, 쭉 하시는 일 잘 되시길 바랍니다. 주니어도 쑥쑥~! 왠지 스키장에서 친해진 거 같은 따뜻한 살인미소 태동이 행님, 행복한 결혼생활 유지하시고 앞으로도 계속 잘 부탁드립니다. 나이는 같은데 학부때는 1년 선배, 대학원은 보이지도 않는 능력자 선배 희제, 넌 이쁘니깐 이쁠 때 시집가자^^ 항상 동네 형 같은 학교앞에 사는 탁영이 행님, 밥이고 술이고 더 얻어먹어야 하는데... 행님은 웃을 때 너무 순수해 보입니다. 졸업했지만 나름 친하다 생각하는 유진이, 항상 심적으로 따뜻하게 격려와 위로해주고 나 덕분에 일도 많이 했던 거 같아 미안하고 정말 고마워요. 꼭 기억할게. 언제나 너와 편하게 커피 마시는 게 참 좋아. 약해보이지만 마음은 강한 여린 최지, 앞으로 다시 연구실에 잘 녹아들꺼라 믿어. 사회에서 쓴맛을 본만큼 더욱 강력한 병기로 다시 태어날태야^^

각자의 연구실에서 하루종일(?) 연구와 과제를 열심히 했던 우리 동기들과 행님들께도 너무 감사하며 앞으로도 좋은 인연 계속 유지하고 싶습니다. 그리고 다 같이 좋은 결과 내기를 기원합니다. 또한 학사에서 항상 저의 졸업을 도와주시는 수미 조교쌤, 민서 조교쌤, 말 잘 안듣는 저를 케어하시느라 수고많으셨습니다.

이제 반평생을 함께한 다대포 7인방 친구들, 엄수 현수, 양 세진, 절 현철, 생돔 성우, 앤디 지훈, 잠수 진효, 간지 돌돌 민석이 다들 일찍이 사회에 나가서 잘하고 있다고 믿고 앞으로도 모두 잘되길 빈다. 화이링~! 매번 나를 연구하겠다는 진혁이도 고맙고 술 좀 자제하고 성공하자. 대학 친구들은 좀 그렇다는 편견을 깨준 10년지기 같은 하지, 민재, 정허니, 중허니, 학준이, 기진이, 기순이, 동환이도 정말 고맙고 앞으로도 함께하자. 현재 정신적으로 가장 나를 지탱해주고 있는 귀염둥이 하늬, 내가 부족한게 너무너무 많지만 믿고 응원해주고, 손잡아줘서 고맙고 사랑한다.

21살에 부경대학교에 재수를 해서 들어와 군대, 휴학, 어학연수, 대학원까지 정말 10년이 됐네요. 다 언급하지 못했지만 그동안 도와주시고 챙겨주셨던 모든 인연들에게 정말 고개 숙여 감사의 마음을 전합니다.