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EVALUATION METHODS FOR MEASURING THE VALUE OF ITS SERVICES AND BENEFITS FROM IMPLEMENTATION: PART X FREEWAY SERVICE PATROLS.

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Introduction

Incident management programs are one of the key elements of Intelligent Transportation Systems (ITS). The goal of such programs is to clear the incidents on the roadways and return traffic flow on the roadway back to normal as soon as possible. Incident management programs have been introduced in many places to help reduce incident detection and duration time. They make use of ITS services and coordinate among the various operating agencies to meet the goals of reduction in the detection and clearance of incidents.

Highway assistance services, also called the freeway service patrols (FSPs), are one of the main approaches used by incident management programs. These patrols use vehicles to patrol the heavily traveled segments and congested sections of the freeways that are prone to incidents (Freeway Operations Section- Highway Helper Summary report 2000).

The main goals of the Freeway Service Patrols are to help identify incident locations, reduce the incident duration time, get the freeway capacity back to the fullest and to reduce the risks of secondary accidents to the motorists (Fenno and Ogden 1998). The role of the patrols is to clear the majority of incidents without any assistance from the other agencies. In case of major incidents, the patrols help assess the equipment and manpower needed to clear the incidents, coordinate with the other agencies involved, provide the needed traffic control and act as a buffer between the workers and traffic. They also help detect and verify incidents like major accidents and pass on the required information to the transportation management centers (TMCs). This helps reduce delay, congestion, wasted fuel, emissions and potential for secondary accidents.

The first service patrol was started in the early 1900s. Early patrols were located at locations where incidents were expected to have a major impact on the traffic flow. The first patrol that was operated on a regular basis was the Chicago Emergency Traffic Patrol (ETP) in 1960.

The patrols are generally sponsored by public agencies but sometimes involve a combination of agencies and private organizations. Most of the funding comes from State Departments of Transportation (DOTs), local and state police, and metropolitan transportation agencies. Private towing companies are contracted to provide the patrols and supply the required vehicles, trained drivers and equipment.

Patrols usually adopt one of the following types of weekday coverage: peak period only, daytime coverage and 24 hours. The most common type of weekday coverage is the however the peak period coverage. The second common type of coverage is the daytime coverage. Few patrols have continuous coverage. The hours of coverage in construction zones are usually increased because the impact of incidents on traffic in these areas is expected to be very high.

The frequency of coverage of the patrols largely depends on the length of the routes, time spent assisting the disabled vehicles and traffic conditions prevailing on the roadway. The frequencies of the patrols range between one vehicle every ten minutes to one vehicle every hour and is usually decided based on a trade-off between the area of coverage and intensity of coverage.

Patrols use a variety of vehicles including pickup trucks, vans, tows, trucks, cars and utility vehicles. Certain patrols have special on-call support vehicles like changeable message signs (CMS) trailers, crash-cushion trailers, dump trucks, and sanders. The

primary goal of these patrols is to remove the vehicles stalled in the freeway routes. Other services include changing flat tires, providing a needed gallon of, moving the vehicle to a safe location away from traffic, jump-starting a battery, or duct taping a hose. The freeway service patrols operating nationally are summarized in Table 1.

In addition to the public highway assistance services like the freeway service patrols there are also private emergency services, often operated by auto clubs, which provide similar services. These offer services to the stranded motorists who are members of their club. The largest auto club is the Automobile Association of America (AAA). AAA is a non-profit, fully taxpaying federation of 90 motor clubs with offices in the United States and Canada. AAA was formed by 9 motor clubs in Chicago in 1902. The services that the AAA provides to its members are given in the appendix.

Previous analyses of the freeway service patrols include the studies conducted by California's PATH (Partners for Advanced Transit and Highways) program at the Institute of Transportation Studies (ITS) University of California Berkeley. The first study evaluated the effectiveness of the freeway service patrol at a San Francisco Bay Area freeway section (Skabardonis, Noeimi, Petty, Rydzweski, Varaiya and Al-Deek 1995). Two hundred and seventy-six hours of "before" and "after" data was collected for the section. The processing of the data into a computerized database was done using software that was developed for this purpose. The study found that, based on the savings in incident delay and fuel consumption, the introduction of the freeway service patrol was cost-effective at the test site.

The second study (Skabardonis, Petty, Varaiya and Bertini 1998) evaluated the effectiveness of the freeway service patrols operating on a 7.8-mile test section of the I-

10 (Beat 8) freeway in Los Angeles. The evaluation methodology estimated the incident delays before and after the freeway service patrols were introduced in that test section. A comprehensive database was developed to describe the traffic conditions on this section over a period of 32 weekdays, for 6 hours per day. The benefit/cost ratio was calculated using the delays and fuel savings due to reductions in incident duration. The study showed that the introduction of the freeway service patrol resulted in significant benefits at the test site. The study found that the introduction of the freeway service patrol in the test section increased the number of incidents assisted and reduced the detection and response time of the incidents.

Another study carried out by the Texas Transportation Institute (David and Ogden 1998) showed that these patrols have a high benefit-to-cost ratio that varied from 2:1 to 36.2:1. The patrols have become highly popular among the motorists and have proved to be very effective in aiding in the removal of congestion causing accidents

This goal of our report is to determine the value that people place on the benefits offered by freeway service patrols in comparison to private assistance services and how much they would be willing to pay to avoid being stranded when their vehicle breaks down on the freeway. The report investigates the factors that contribute to people choosing to rely on the highway assistance services in comparison to the private assistance services. The studies conducted so far have focused on the effectiveness of the freeway service patrol whereas this report analyzes the factors that influence people in choosing to rely on the freeway service patrol.

The first part of the report reviews the literature regarding the value and methods for calculating the economic value of a good. The second and third parts of the report

look at the Revealed Preference analysis and Stated preference analysis respectively. The final part of the report estimates a cost model for the freeway service patrol.

Types of Value

The economic value of a good is made up of two components: Use value and Non-Use value. The total value of a good, from an individual's perspective, is nothing but the summation of both these values and is a function of the psychological, moral, ethical and altruistic satisfaction obtained from the good.

Use value (or active value) is defined as the value an individual obtains from actually using the good or service.

Non-use value (or passive value) is the value that an individual places on something although he does not intend to use it. This is often considered in the valuation of environmental goods.

Non-Use value is comprised of the following categories:

Existence value is the value obtained by an individual from the knowledge that a good exists or is protected as in the case of an important resource.

Vicarious value is the value than an individual obtains from the indirect consumption of a resource.

Option value is the value that an individual obtains from having an option to enjoy the resource at a later time period.

Quasi-option value is the opportunity value that an individual obtains by delaying a decision that may result in irreversible losses otherwise.

Bequest value is the value that an individual in the current generation gets from preserving the environment for the use of future generations.

In addition to the use and non-use values, there is also another value seen in the automobile sector, called the ***insurance value***. The freeway service patrol or an auto club membership can be considered as an insurance for an individual against being stranded on a freeway when his/her breaks down.

Risks are commodities that may be exchanged (Richard 1999). The inter-relationship of risks determines how the risk is handled and priced in an exchange. Economic goods such as risk share the characteristics of being valuable and costly. Under certain conditions, risk sharing, and insurance in particular, are mutually advantageous transactions. The value and the cost of risk shifting to economic agents stem from an aversion to taking risks (Arrow 1996). Individual facing risk thus derives value if they can find others to assume some of the risk; the former is willing to pay something for this. By the same scale, the one who is assuming the risk is worse off and will not do so unless compensated. Risk shifting is in the interests of both parties only if there is a price accepTable to both. Uncertainty gives rise to risk shifting. To have gains from trade it is necessary that the participants be differently situated. However trade in risk bearing does not require that one trade be initially in a risky situation and the other safe. Both might be exposed to risks but in different directions.

The situation is complicated when there are different individuals exposed to different situations more or less independently of each other. Each person is concerned about his condition. Suppose the risks are more or less independent, it will be an opportunity for mutual insurance. In case of complete insurance, the one who assumes the risks may require compensation for complete coverage which is higher than the shifter of risks is willing to pay. Then there may be an agreement to cover part of the loss

at a lower price. The larger the loss, the smaller the proportion that will be met because the marginal cost of insurance will rise due to increasing risk-aversion.

It is generally noticed that the availability of insurance in many cases can lead to increased risk taking and willingness to hold risky assets. It is also seen that the level of risk aversion depends on the asset position of the individual. Empirical studies show that generally the non-wealthy tend to be more risk averse than the wealthy (Bowles and Gintis 1998).

Automobile insurance started as soon as the automobiles first appeared on the roads. This insurance needs special consideration because of the nature of road activity.

The problem generally seen is information problem. Two aspects of this asymmetrical problem are Adverse Selection and Moral Hazard (Pierre1999).

Adverse Selection arises when one party, generally the subscriber has better information than the other party (insurer) about some parameter that is important to the relationship. Most of the time the informational advantage is linked to the level of risk. Generally, the issue is the client knowing his/her own accident probability or the distribution of the losses incurred in case of an accident. An essential point is that the agent's informational advantage is directly related to the insurers' cost of providing the contract. The agent's better knowledge of the risk causes asymmetry. The insured generally know their own preferences and particularly their level of risk aversion.

Moral Hazard occurs when accident probabilities are not exogenous but depend on some decision made by the subscriber (e.g., effort of prevention). When the latter is observable and contractible then the optimal decision will be an explicit part of the contractual agreement. The problem in insurance is that their mere existence tends to

decrease the incentives to reduce risk. In the extreme case of complete insurance, incentives are killed, resulting in maximum accident probabilities.

The difference between adverse selection and moral hazard is that in the former, different levels of risk characterize people and because of these differences they choose different contracts. In the case of moral hazard, they first chose different contracts and then they are faced with different incentives schemes, hence adopt more or less cautious behavior causing heterogeneous accident probabilities. The conclusion however is that controlling for observables, the choice of a contract will be correlated with the accident probability.

Non-use values have caused substantial controversy because of the following reasons. One reason is the difficulty in assessing them. Secondly, the non-use value can represent moral and ethical concerns. The response to surveys indicates more than more than just individual preference, but also include moral and ethical beliefs that can not be treated in the same way. Individual preferences are best resolved within markets whereas ethical concerns may be best resolved in a public forum. Hence, there is substantial disagreement about the usage of non-use values in a reliable manner and their proper roles in public decisions.

Public Goods

Non-rivalrous goods are goods that can be consumed by one person without reducing the availability to others. Non-excludability means that it is not possible or at least very costly to prevent anyone from enjoying the good (Dickson).

Goods are classified under four categories. The four types of goods are:

Private Goods: These are goods that are both rivalrous and excludable.

Congesting goods: These are goods that are rivalrous but non-excludable.

Club goods: These are goods that are excludable but non-rivalrous.

Pubic goods: These are goods that are both non-rivalrous and non-excludable.

A public good is one that is available to everyone free of charge once it is provided because it is difficult to control people from using a public good and to collect money from the users. As profit seeking firms do not provide public goods, governments normally provide them with the help of the tax revenue they get.

The freeway service patrol can be considered a public good or a club good depending on the way the program is run. If the program is run in such a way that the patrol serves one person without affecting another person's quality of service then it is said to be non-rivalrous. If the program is being provided such that everyone gets to enjoy the service then it can be considered non-excludable. The patrol will be considered a club good if everyone does not get to enjoy the services of the patrol but one person is being served without affecting the quality of service of the other.

Measuring value

It is very difficult to determine the value of a public good. Value is obtained from anything that increases an individual's satisfaction as long as the individual is willing to spend scarce resources for the good. Thus, an individual need not use a good or service directly for him/her to obtain a utility from the good. The two broad categories for measuring value are Revealed Preference Methods and Stated Preference Methods.

Revealed Preference Methods

Revealed Preference (RP) Methods have been used widely in the field of travel demand. The traditional models of travel demand use data that have been obtained by direct observation of the choice that individuals make with respect to travel behavior (Kroes and Sheldon 1988). A rational individual makes a choice based on the benefits that he/she expects from that particular choice. Hence the basic principle of RP methods is that, the choices made by rational individuals reveal their preferences (King 2000).

Statistical tools are then used to obtain the implicit utility functions of the individuals. The RP methods are hence very useful tools to obtain utilities and develop models of travel demand. However these methods have some disadvantages.

> *Firstly is difficult to obtain sufficient variation in the RP data to analyze all variables of interest. Strong correlations are often seen between the variables and this makes it difficult to estimate the model parameters. RP methods can not be used for evaluating demand for hypothetical choice situations. It is imperative for the explanatory variables to be expressed in ' objective ' or ' engineering' units in RP methods. Hence the variables are usually restricted to primary variables.* (Kroes and Sheldon 1988).

Further in RP methods the choice set considered by the decision-maker may be ambiguous and the service attributes may be measured with error. (Morikawa, Ben-Akiva and Yamada 1991). Two techniques used in RP methods are Travel Cost Analysis and Hedonic Pricing:

Travel Cost Analysis uses the prices of market goods to evaluate the value of goods that are not traded in the market. Part of the value of a public good, for example a park, is the pleasure that visitors get from being at the park. Measuring this value will prove difficult but what can be obtained is the minimum amount, that is, the amount of money spent by individuals to get there. This measure will also include the value of time

spent travelling to the park, using wage rates to convert the travel time to dollars. The travel time method defines a minimum value for the good in question, which is very important in economic analysis. Unfortunately, it is difficult to apply this method to the problem of freeway service patrols.

Hedonic Pricing uses the market price of a traded good to calculate the value of a public good. The traded good is treated as a collection of characteristics. By focusing on one of the characteristics of the traded good it is sometimes possible to obtain the value of a public good. The hedonic pricing method requires quite a large amount of good data to provide useful results. It is essential to identify the right characteristics. Further it is imperative to have a large number of observations. In addition, some assumptions are needed to apply the statistical techniques. As a result, it can be very expensive to obtain what can be uncertain results. However the method is appealing because it is rooted firmly on market prices and can be used to measure what looks impossible to measure.

Stated Preferences Methods

The term ***"Stated Preference (SP) Methods"*** refers to a group of techniques used to calculate the utility functions of transport options based on the response of an individual decision-maker to certain options, which are given to him/her. The options generally are based on descriptions of the transport scenario or are constructed by the researcher (Kroes and Sheldon 1988).

An individual in a SP experiment is given a choice set of alternatives, for example the various travel modes by which he/she can reach a particular travel destination. The choice of a particular mode is assumed to be dependent on the relative utilities of the various travel options that an individual faces.

These methods use experimental procedures to obtain individuals preferences based on the individual's evaluation of the various options given to him/her. Typically these experiments generally provide hypothetical travel scenarios to obtain an individual's preferences (Fowkes and Wardman 1988)

SP methods are easier to control, are more flexible and are cheaper to apply than RP methods. Further SP methods allow individuals to have more choices than are available in reality. The researcher is able to provide the respondents with trade-off rather than dominated choices. Most applications of stated preferences methods help obtain the relative utility rather than absolute values.

Since the SP methods provide individuals with hypothetical situations, it becomes feasible to analyze situations that are qualitatively different from the actual ones seen in practice (Bradley 1988). Further since the individuals respond to several different hypothetical choice situations given to them, the efficiency of data collection is improved and enough data is hence available to calculate the utility functions of the individuals.

Against this backdrop the disadvantage in SP methods is that people may not always do what they say, that is, the individuals' stated preferences might not be similar to the preferences they actually show (Wardman 1988). This arises because of the systematic bias in survey responses or because of the difficulty in actually carrying out the SP task. A solution to this is to trade-off between RP methods and SP methods and use both the methods in conjunction with each other. Further careful design of the survey is also imperative to help identify the preferences of the individual.

The first step in the design of a SP survey is to specify the variables of interest and levels of the factors that are to be analyzed by the respondents. Secondly the choice

of context and the measurement scale for the dependent variable must be specified. Further the quality of the survey and choice in which the context questions are being asked must be given consideration.

The hypothetical choice situation must be meaningful and realistic. The variations in the attribute levels between the alternatives presented should not be too small so that the respondents ignore it. The whole task should be kept within levels such that the individual is able to handle it. The taste variations between the surveyed individuals is also to be taken into account and the implied trade-off due to these personal variations should be taken care of in these surveys.

Though SP methods have been used in transportation planning for many years, it is only recently that these methods are being used for travel demand forecasting. SP methods are now being used, as there are now a number of situations where revealed preference data is not possible or feasible.

This may be because:

> *Forecasts may be needed for new travel alternatives that do not exist yet.*
> *Forecasts may be needed for existing travel alternatives that change beyond the bounds of current experience.*
> *Forecasts may be needed, which are to be responsive to certain "difficult-to-handle" variables.* (Bradley and Kroes 1988).

Two techniques used in SP analyses are Contingent Valuation and Conjoint Analysis.

The ***Contingent Valuation*** approach is one of the simplest to apply. It is based on the assumption that the best way to find out the value that an individual places on something is known by asking. The simplicity of this approach is appealing and it can be

applied to almost any issue. This approach is a SP method because people are asked to directly state their values.

This method has some disadvantages. There is a basic difference in the way people make hypothetical decisions and the way they take decisions in reality. Respondents may not take the question seriously because they feel that they will not be required to pay the amount that they state and hence may overstate his response. If they feel that they will have to pay for the good then they will invariably understate their response. Another disadvantage is that for some issues, such as those dealing with risk, the phrasing or the wording of the question has an influence on the responses. Despite the above disadvantages, the contingent valuation method has proven to be a very useful method.

The objective of a benefit-cost analysis is to evaluate the relative merits of alternative projects and policies from the perspectives of the society as a whole. It is generally applied to public policy questions where the decision of the individual consumers, producers and investors, that is the market forces, will not lead to optimal outcomes.

Benefits and costs are measured by the compensating and equivalent variations. Compensating and equivalent variations are monetary measures of the gain or loss in a consumer's welfare following an economic change (Shaffer 2000). How a question is phrased in a contingent valuation survey may measure either the compensating variation or equivalent variation.

Compensating Variation is the compensating payment that leaves an individual as well off as before the economic change. The total willingness-to-pay for the benefits

minus the total compensation demanded for the costs (which can be measured as the sum of the compensating variation) measures the overall net benefits.

Equivalent variation for a benefit is the minimum amount of money one would have to be compensated to leave the person as well as they would be after the change. The equivalent variation in acquiring a good is the same as the compensating variation if one had to forego the good. They are measured by the compensation demanded to forego or give it up.

Conjoint Analysis refers to the application of the design of experiments to obtain the preferences of the individual (customer). This market research technique can provide important information about new product development, forecasting market segmentation and pricing decisions (Rice 2000).

Conjoint analysis enables researchers to calculate the value that people place on the attributes or features of products and services. The goal of the conjoint analysis is to assign specific values to the options that buyers look for when making a decision to purchase a good. In reality consumers do not make choices based on a single attribute of the product rather they look for a range of attributes and then make judgements or trade-offs to determine their final selection.

Conjoint analysis looks at this trade-off to determine the combinations of attributes that satisfies the consumer. Conjoint analysis evaluates products/services in a way that is superior to other methods. Contingent valuation approaches ask respondents directly to evaluate the importance they give to each attribute, not a simple task to do. Conjoint analysis, on the other hand, breaks the task into a list of choices or ratings that enable us to compute the relative importance of each of the attributes studied.

Another advantage of conjoint analysis is the ability to use the results obtained. Using conjoint analysis we are able to develop simulation models for the market that could be used for forecasting. With traditional approaches, every time a major change takes place in the market, it becomes essential to conduct new surveys to see how people perceive the change. With conjoint analysis, the new changes can be incorporated into the simulation model to see how buyers will respond to changes.

A conjoint task is valuable because it forces the respondent to look at attributes that are conflicting. People generally try to avoid this by searching for unambiguous solutions. Conjoint requires respondents to trade-off among attributes (Huber 1987). It then simplifies the task for the respondent by selecting a small number of attributes on which they are able to make their judgements.

The basic steps in the conjoint model are:

> *"Determine the attributes that are most essential to the market.*
> *Determine the data collection methodology to be used to recruit the respondents and the data collection procedure.*
> *Determine the conjoint methodology that will best fit the problem.*
> *Create an experimental design that will allow the main effects to be calculated and key interactions between the attributes to be studied.*
> *Collect the data.*
> *Calculate the utilities for each respondent or for each group of respondents.*
> *Create simulation model for the market"* (Paul and Srinivasan 1978)

It is absolutely essential to identify the list of key attributes. Too many attributes can greatly enhance the burden of the respondent and this might reduce the ability of the model to predict. Similarly very few attributes can also severely reduce the capabilities of the model to predict because the necessary information is missing from the model.

In addition to the listing out the attributes, it is also imperative to look at the levels within each attribute. The attribute levels must be able to look at all the products

that exist or are expected to be introduced in the market. The key factor in listing out the attributes and their levels is that the market condition can not be properly simulated otherwise. Suppose an option has not been introduced into the survey, then we do not have any idea about how people will perceive that option.

Three methods of conjoint analysis are Adaptive Conjoint Analysis, Choice-Based Analysis, and Conjoint value Analysis (Orme 1996).

In ***Adaptive Conjoint Analysis*** *(ACA)* the interview has to adapt to the respondents' previous answers. Hence ACA has to be computer administered. The utilities for the attributes are calculated without including the interaction between the attributes. The main advantage is that ACA is able to measure more attributes than is possible using the traditional methodology. In ACA the respondents are not made to analyze all the attributes at the same time. This helps avoid the problem of "information overload" that is seen in many studies. ACA can include about 30 attributes although generally ACA projects involve about 8 to 15 attributes. The disadvantage is that it can only be administered using the computer.

Choice-Based Conjoint (CBC) shows the purchase process as seen in reality. Instead of listing the attributes involved, the respondents are shown a list of products on the screen and are asked to make a decision about which one it would purchase. As seen in reality, respondents can refuse to make a selection in a CBC interview. The data to be used results from the choices that the respondents make. The results are analyzed at the aggregate level. CBC can measure up to six attributes with nine levels in each attribute. A major advantage of the CBC model is that CBC can also be administered both via the paper-and –pencil and by PC. A disadvantage of the CBC model is that the results are

analyzed at the aggregate or average level. Hence this necessitates larger sample sizes to obtain the same precision level as other methods. The other problem in this method is that since individuals have their own unique liking or idiosyncrasies, certain key characteristics may be lost due to the aggregation done in this method.

Conjoint –Value Analysis (CVA) is designed for both paper and pencil studies and can also be administered using the computer. It can handle up to 10 attributes with 15 levels in each attribute. It calculates a set of utilities for each individual and is also able to measure the interaction between the attributes. The compound attributes are created using the levels within the attributes.

If there is a large number of attributes to be studied, ACA is preferred. If there are many attribute interactions in the model, then the use of the CBC method is a good option. If the study has to be administered using the paper and pencil only then the use of the CVA or the CBC method is preferred.

The conjoint analysis uses regression like estimation procedures and hence faces the same problems as the regression model particularly the instability of the estimated parameters in the face of the various sources of error.

For our study the Hedonic Pricing method and the Conjoint Value analysis methods are used. Our Revealed Preference study evaluates the freeway service patrol vis-a-vis the AAA membership. We also conduct a Stated Preference study using the conjoint value analysis since the survey is administered via paper- and-pencil and the number of attributes that were handled was also less than 10. The key attributes of the freeway service patrol like the time of waiting for assistance, cost of assistance, annual fee for the program are used to get the value of the freeway service patrol

Revealed Preference Study

This study was done to determine the revealed preferences of people with respect to auto club (private highway assistance services) membership. The services provided by the auto clubs may be competitive with the public highway assistance services. The aim was to determine how the presence of the highway assistance services affects the Automobile Association of America (AAA) membership. The study was done to see if the presence of the government operated assistance service increases or decreases the number of people opting for the private emergency services. The dependent variable, the ratio of AAA members to the total licensed drivers in a state, was hypothesized to be a function of the presence of the highway assistance services in the state and certain fixed effects namely average income, population and population density of the state.

Data

The data for the government operated highway assistance services was obtained from a previous study conducted by Texas Transportation Institute (David and Ogden 1998). Their study surveyed the various highway emergency services operating in about 22 states (Table 1). The survey provided information about the highway assistance services operating in the various states and the related service features of the programs. The service features included the location of the patrol, name of the program, the year the program was started, the annual budget and sources of funding, the number of routes that the program operated, the number of vehicles in service, hours of operation and the centerline kilometers patrolled by the service.

The membership details for the AAA was obtained for the current year (2000) from the AAA National Office in Heathrow, Florida (Table 2). The state data was

obtained from the Highway Statistics series for the year 1996 published by the Federal Highway Administration. In addition to the above variables the number of licensed drivers in each state, obtained from the Department of Motor Vehicles was also used (Highway statistics 1997).

The number of routes that the highway emergency assistance service operated and the number of vehicles used by the highway emergency assistance service in a state were hypothesized to influence the AAA membership in the state. The presence of the government provided highway assistance services was expected to act as a substitute and have a negative influence on the AAA membership in a state. The state variables that were included in the analysis were the average income of the state, the state population and the population density.

The independent variables were the number of routes that the highway assistance service operated and the number of vehicles used by the service, state income, population and population density. The dependent variable was the ratio of AAA members to the number of licensed drivers in the state.

Models used for analysis

Several models were used for the analysis. Firstly a simple linear regression (OLS) was used to analyze the revealed preferences of people with respect to private auto club membership. The ratio of the AAA members in the state to the total licensed drivers (proportion of the AAA members) was taken to be the dependent variable. So the independent variables also had to be transformed accordingly and hence the ratio of the number of routes that the highway assistance service operated and the number of vehicles used by the service to the total number of licensed drivers in the state was used.

The initial analysis was done to find out which of the variables was significant in influencing the AAA membership in a state. However, none of the variables except population density is significant (Table 3). The variables considered do not seem to contribute to the AAA membership in the state. The population density of the state seems to have a positive influence on the proportion of the AAA members in a state. It is found that for every one percent increase in the population density of the state the AAA membership increased by 0.0027 % (Table 4).

The second model tested on the data set was the Cobb- Douglas model. The dependent and independent variables were transformed using the natural logarithms and regression was carried out on the transformed variables. It is seen that the population density and average income of the state have a positive and significant influence on the AAA membership in the state. The other variables do not seem to influence the AAA membership (Table 3).

The calculation of elasticity shows that for every 1% percent increase in the income of the state the proportion of AAA members in the state increases by 0.1051%. Similarly a 1% percent increase in the population density of the state increases the proportion of AAA members in the state by 0.0035% (Table 4)

The third model to be tested on the data set was the logit model. The transformation of the independent variables using the natural logarithm of the variables was done as above. The logit regression (glogit) for the group data was again carried out using these transformed independent variables. This model seems to provide better results. It is seen that in this model the number of routes that the highway assistance

service operates and the number of vehicles used by the highway assistance service are significant (Table 3).

However contrary to what was expected, the number of routes that the highway assistance service operates seems to have a positive influence on the AAA membership. As expected the number of vehicles used by the highway assistance service seems to have a negative influence on the AAA membership in the state. Because the number of routes and the vehicles are correlated, they may simply be offsetting factors.

The calculation of the elasticity of the dependent variable shows that for every 1% increase in the number of routes that the highway assistance service, the probability of choosing the AAA membership increases by 0.5%. Similarly a 1% increase in the number of vehicles used by the highway assistance service decreases the probability of choosing the AAA membership by 0.311%. (Table 4)

Conclusion

Many of the variables do not seem to contribute to the AAA membership because the public highway assistance services are in service only in certain states. Further even in the states that the public highway assistance services operates, they are still of small scale and are unable to provide the full services than an auto club such as AAA provides. Further, there is another factor to consider. Individuals who are risk averse may both join an auto club and lobby for government provided highway assistance services also, suggesting that they may not be substitutes, but rather complements.

A better data set may help us see more clearly the influence of the private highway assistance services on private emergency services (like AAA) in a state.

Particularly if the AAA data could be obtained for metropolitan areas where the freeway service patrols operate, much of the variance that is seen would be reduced.

Stated Preference Analysis

A pilot survey was done to find out the value people place on the benefits of the highway assistance services. The aim of the survey was to find out how much people are willing to pay to avoid being stranded on the freeway when their vehicle breaks down on the freeway. The goal was in essence to find the stated preferences of people given certain features and services of the highway assistance services.

Survey Description

The pilot survey was done on a sample of sixteen individuals, mostly college students at the University of Minnesota, Minneapolis in spring 2000. Nineteen questions were asked in total. The questions were framed to identify the way people react to avoid being stranded based on the time of breakdown (midnight/morning), cost of assistance, time of waiting for assistance and how much they would be willing to pay for specific services offered by the highway assistance services. A copy of the survey is given in the appendix.

Model Used for Analysis

The logit model was used for the survey analysis. The model was used to estimate the probability of a person choosing a particular alternative given breakdown related characteristics presented to the respondents in the survey and certain individual characteristics obtained from the respondents.

The logit model is a widely used qualitative choice model. Qualitative choice models are used to describe situations where a decision-maker faces a choice among a set of alternatives, which satisfy the following criteria:

The number of alternatives is finite.
The alternatives are mutually exclusive.
The set of alternatives is exhaustive. (Train 1993)

All qualitative choice models calculate the probability that an individual will select a particular alternative given the data observed by the researcher. The difference in the various models arises only due to their functional form. The logit is a very popular qualitative choice model because its formula is easier to interpret and the parameters are inexpensive to estimate relative to the other models.

The basic concept of the logit model is as follows (Train 1993):

Consider a decision-maker **n** facing a set of $\mathbf{J_n}$ alternatives. The utility that the decision- maker receives from a particular alternative **i** in $\mathbf{J}_n$ is given by $\mathbf{U}_{in}$. This can be written as two parts:

A part that is known /observed to the researcher denoted by $\mathbf{V}_{in}$

A part that is unknown, that is, a random variable. This is not observed by the researcher and is denoted by $\mathbf{e}_{in.}$

The probability that a decision-maker will choose alternative i (according to the logit model) is:

$$P_{in} = \frac{e^{V_{in}}}{\sum_{j \in J_n} e^{V_{jn}}} \; \forall i \in J_n \qquad (1)$$

Each random component e_{in} is assumed to be distributed independently and identically in accordance with the extreme value distribution.

The utility function is mathematically given as follows (Fowkes and Wardman 1988):

$$V_{in} = \sum_{j} B_{jn} X_{ijn} \text{ , for all j} \qquad (2)$$

where

V_{in} = modeled value of the utility perceived by the individual i for alternative n

X_{ijn} = Value of the j attribute that is expected to influence the travel behavior

B_{jn} = parameters to be estimated reflecting utility weights.

An individual decision-maker will choose that alternative that he thinks gives him/her the highest utility.

The important properties that are to be noted in choice probabilities are:

Each of the choice probabilities is to be between zero and one.

The summation of the choice probabilities equals one.

Survey Analysis

The initial analysis focused on finding out if the variables were significant, that is, if they contribute to the probability of an individual choosing a particular alternative and how the variables influence the choice probabilities.

The various hypotheses that were considered are as follows:

Public vs. Private highway emergency services

The respondents were offered series of questions in which they had to choose between the (a) public highway emergency services (freeway service patrols) and (b) private emergency services (AAA).

It was hypothesized that the probability of an individual choosing (a) compared to (b) is a function of the difference in the time of waiting between alternative (a) and (b), difference in the cost of assistance between alternative (a) and (b), time of breakdown on the freeway (midnight/morning) and the socio-demographic characteristics namely age, sex, work status and vehicle ownership.

Individuals choosing the government provided highway emergency services, that is, alternative (a), were coded as 1 and the individuals who chose the alternative (b) were coded as 0. Dummy variables were used for the variables: time of day (1 indicating midnight and 0 indicating morning) and the socio-demographic variables namely sex, work status, vehicle ownership, repair and maintenance.

The results, given in Table 5, show that greater the difference in the time of waiting and the cost of assistance between the alternatives, lesser the probability of an individual choosing the government provided highway assistance service compared to a private emergency assistance service. Socio-demographic characteristics and the time of breakdown do not seem to influence an individual's decision. The difference in the time of waiting between the alternatives (time of waiting for alternative a minus time of waiting for alternative b) and the difference in the cost of assistance between the alternatives (cost for alternative a minus cost for alternative b) alone are significant and seem to influence the choice probabilities.

It is found that a 1% increase in the difference in the time of waiting between the alternatives reduces the probability of people choosing the government provided highway assistance service by 0.0006%. Further a 1% increase in the difference in the cost

between the alternatives reduces the probability of people choosing the government provided highway assistance service by 0.010%. (Table 6).

Annual Fee

The survey also contained a series of questions that looked at the annual fee that people were willing to pay for the highway assistance service. The respondents were provided with 2 alternatives:

(a) To pay an annual fee and not pay a fee at the time of breakdown

(b) Not to pay an annual fee but pay a fee at the time of breakdown

The two fees were varied for the various questions.

It was hypothesized that the probability of an individual choosing (a) was a function of the difference in the annual fees between alternative (a) and (b) (Annual fee for alternative a minus annual fee for alternative b), difference in the fees at the time of assistance between alternative (a) and (b) (assistance fee for alternative a minus assistance fee for alternative b), and the related socio-demographic variables. It was expected that the probability of an individual choosing to pay the annual fee (and no fee at the time of breakdown) would be lower if the difference in the annual fee and the fee of assistance between the alternatives was higher.

The results, given in Table 7, show that the difference in the annual fees and the fees at the time of assistance between the alternatives, age and work status of the individual seem to influence the probability of an individual choosing between alternative (a) or (b). It is seen that as the difference in the annual fees (annual fee for alternative a minus annual fee for alternative b) and fees at the time of assistance (fees for alternative a minus fees for alternative b) between the alternatives increases the probability of an

individual choosing alternative (a) decreases. The results show that as the age of the individual increases, the probability of choosing alternative (a) increased. The work status of the individual also seems to influence the probability of choosing alternative (a). It is seen that a full time worker, part time worker and a full time student/ part time worker is less likely to choose alternative (a). The sex of the individual does not seem to influence the probability of choosing alternative (a).

A 1% increase in the difference in the annual fee between the alternatives reduces the probability of people choosing the public highway assistance service by 0.073%. Further a 1% increase in the difference in the assistance fee between the alternatives reduces the probability of people choosing the public highway assistance service by 0.047%.

Conclusions

The analysis has shown that the factors like time of waiting, cost of assistance, age and work status contribute to the probability of an individual selecting a particular option. The reason that some variables do not contribute to the probability might be the small sample size of the survey. Further, the homogeneity of the sampled group also might be a reason for the socio-economic and demographic variables not being significant and influencing the probabilities.

We anticipate that a larger sample size and a more heterogeneous sample will give better results.

Cost Model

A cost model was developed using the data for the highway assistance services operating in the various states (Fenno and Ogden 1998). The aim was to find out the variables that contribute to the annual cost of the program. The data contained the name and location of the patrol, centerline kilometers, number of routes and vehicles for each patrol, the year the patrol was started, the annual incidents, the weekday hours of operation, sponsorship and funding agencies for the patrols.

A simple OLS regression was done to find out the significant variables. The variables that were considered to affect the cost of the program were the number of vehicles of the patrol, the annual incidents, the weekdays hours of operation, which were considered to be the independent variables. The ratio of the number of vehicles to the number of weekday hours of operation (vehicle per hour) was taken as an indicator of the frequency of the patrol. The independent variable was the annual budget of the patrol.

It was hypothesized that all the independent variables would have a positive influence on the cost of the program. As expected, it is seen from the results (Table 9) that all the variables have a positive influence. However only the vehicle per hour other variable is significant. The cost of the program seems to increase with an increase in the number of vehicles per hour. The calculation of elasticity shows that a 1% increase in the number of vehicles per hour increases the annual cost of the program by 0.006 %. (Table 10).

Conclusions

This report aimed to find the factors that influence the probability of an individual choosing to rely on publicly provided freeway service patrols as opposed to the private assistance services and to determine how much people are willing to pay to avoid being stranded on the freeway.

The findings show that the probability that an individual would choose the highway assistance services depends on the key attributes like the annual fee of the program, the fee at the time of assistance, the time of waiting for assistance and cost of breakdown. The findings also show that the presence of the highway assistance services in a state does have a small influence on the auto club (AAA) membership.

The problem in our case has been that the data set for both the RP and SP analysis has been too small. We anticipate that larger data sets would give us better results and clearly indicate the factors influencing people's choice. We expect that the pilot survey conducted on a larger scale would give us a better idea about the factors influencing people's choices. A larger heterogeneous sample set would give us better indications about the way the socio-demographic variables impact the choice probabilities.

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Appendix 1: SURVEY QUESTIONNAIRE

This survey is being conducted as part of a research project. The aim of this project is to find out how people look at the benefits and services of highway assistance and the value people place on such programs. The primary focus of highway assistance services is to remove stalled vehicles from the Freeways. The services provide include towing the vehicle to a safe location away from traffic, changing tires, providing a gallon of gas, jumpstarting a battery etc. These services operate only at certain times and on certain critical routes.

Your participation in this survey will help identify the value of such services. *All answers are strictly confidential, and no name identification will be recorded.*

Thank you for your participation. Please circle your choices.

1) If your vehicle breaks down on an urban freeway at 7:30 in the morning:

Would you prefer:

a) To be towed by the highway assistance service to a safe location away from the traffic with a **waiting time** of **15 minutes** on the road,

(Or)

b) To be towed to the nearest garage or to a place from where you can make arrangements to get your vehicle repaired with a **waiting time** of **60 minutes** on the road.

Circle **a** or **b**

2) If your vehicle breaks down on an urban freeway at midnight:

Would you prefer:

a) To be towed by the highway assistance service to a safe location away from the traffic with a **waiting time** of **20 minutes** on the road,

(Or)

b) To be towed to the nearest garage or to a place from where you can make arrangements to get your vehicle repaired with a **waiting time** of **40 minutes** on the road.

Circle **a** or **b**

3) **If your vehicle breaks down on an urban freeway at midnight:**

Would you prefer:

a) To wait for **30 minutes** on the freeway with your vehicle, paying **no cost** to get assistance from the highway assistance service,

(Or)

b) To wait for **10 minutes and** pay **$ 10**, for you to get assistance from the highway assistance service.

Circle **a** or **b**

4) **If your vehicle breaks down on an urban freeway at 7:30 in the morning:**

Would you prefer:

a) To wait for **20 minutes** on the freeway with your vehicle, paying **no cost**, for you to get assistance by the highway assistance service,

(Or)

b) To wait for **10 minutes** and pay **$ 5**, for you to get assistance by the highway assistance service.
Circle **a** or **b**

5) **If your vehicle breaks down on an urban freeway at 7:30 in the morning:**
Would you prefer:
a) A highway assistance service that helps to tow the vehicle to a safe location away from traffic, at **no cost** with a **waiting time of 15 minutes**,
(Or)
b) A highway assistance service that tows the vehicle to the nearest garage or to a place from where you can make arrangements to get your vehicle repaired, with a **waiting time of 20 minute**s and a cost of **$50**.
Circle **a** or **b**

6) **If your vehicle breaks down on an urban freeway at midnight:**
Would you prefer:
a) A highway assistance service that helps to tow the vehicle to a safe location away from traffic, at **no cost** with a **waiting time of 15 minutes,**
(Or)
b) A highway assistance service that tows the vehicle to the nearest garage or to a place from where you can make arrangements to get your vehicle repaired, with a **waiting time of 25 minute**s and a cost of **$30**.
Circle **a** or **b**

7) **If your vehicle breaks down on an urban freeway at 7:30 in the morning:**
Would you prefer:
a) A highway assistance service that helps to tow the vehicle to a safe location away from traffic, at **no cost**, away from the traffic, with a **waiting time of 30 minutes**,
(Or)
b) A highway assistance service that tows the vehicle to the nearest garage or to a place from where you can make arrangements to get your vehicle repaired, with a **waiting time of 15 minute**s and a cost of **$15**
Circle **a** or **b**

8) If your vehicle gets a flat tire on an urban freeway at midnight:
Would you prefer:
a) To pay a **$50** fee and be **assisted** in **changing the tire**,
(Or)
b) To pay **no fee** but to be towed just to a safe location away from the traffic after which you make the necessary arrangements to fix the tire.
Circle **a** or **b**

9) If your vehicle gets a flat tire on an urban freeway at 7:30 in the morning:
Would you prefer:
a) To pay a $50 fee and be assisted in changing the tire,

(Or)
b) To pay no fee but to be towed just to a safe location away from the traffic after which you make the necessary arrangements to fix the tire.
Circle a or b

10) If your vehicle gets a flat tire on an urban freeway at midnight:
Would you prefer:
a) To pay a **$30** fee and be **assisted** in **changing the tire**,
(Or)
b) To be towed just to a safe location away from the traffic after which you make the necessary arrangements to fix the tire, at **no cost**.
Circle **a** or **b**

11) If your vehicle gets a flat tire on an urban freeway at 7:30 in the morning:
Would you prefer:
a) To pay a **$30** fee and be **assisted** in **changing the tire**,
(Or)
b) To be towed just to a safe location away from the traffic after which you make the necessary arrangements to fix the tire, at no cost.
Circle **a** or **b**

As a general user of the roadway:
12) Would you prefer:
a) That you pay an **annual fee** of **$50** for highway assistance services and not pay a fee if the vehicle actually breaks down on the freeway,
(Or)
b) That you pay **no annual fee** but **$ 25** for assistance, when your vehicle actually breaks down.
Circle **a** or **b**

13) Would you prefer:
a) That you pay an **annual fee** of **$75** for highway assistance services and not pay a fee if the vehicle actually breaks down on the freeway,
(Or)
b) That you pay **no annual fee** but **$ 50** for assistance, when your vehicle actually breaks down.
Circle **a** or **b**

14) Would you prefer:
a) That you pay an **annual fee** of **$100** for highway assistance services and not pay a fee if the vehicle actually breaks down on the freeway,
(Or)
b) That you pay **no annual fee** but **$150** for assistance, when your vehicle actually breaks down.
Circle **a** or **b**

15) Would you prefer:
a) That you pay an **annual fee** of say **$25** for highway assistance services and not pay a fee when the vehicle actually breaks down on the freeway,
(Or)
b) That you pay no annual fee but **$ 100** for assistance, when your vehicle actually breaks down.
Circle **a** or **b**

16) Suppose the highway assistance service being provided now operates only on interstate highways.
Would you prefer:
a) That everyone pays an **annual fee** of **$75** so that the highway assistance service operates on all major highways, not just interstates,
(Or)
b) That everyone pays an **annual fee** of **$50** but that the highway assistance service operates only on interstate freeways.
Circle **a** or **b**

17) Suppose the highway assistance service being provided now operates only on interstate highways.
Would you prefer:
a) That everyone pays an **annual fee** of **$50** so that the highway assistance service operates on all major highways, not just interstates,
(Or)
b) That everyone pays an **annual fee** of **$30** but that the highway assistance service operates only on interstate freeways.
Circle **a** or **b**

18) Suppose the highway assistance service being provided now operates only during morning and evening rush hours.
Would you prefer:
a) That everyone pays an **annual fee** of **$75** so that the highway assistance service operates at all times,
(Or)
b) That everyone pays an **annual fee** of **$50** but that the highway assistance service operates only at certain fixed times.
Circle **a** or **b**

19) Suppose the highway assistance service being provided operates only during morning and evening rush hours.
Would you prefer:
a) That everyone pays an **annual fee** of **$50** so that the highway assistance service operates at all times,
(Or)
b) That everyone pays an **annual fee** of **$30** but that the highway assistance service operates only at certain fixed times.

Circle **a** or **b**

Please answer the following questions

1) Your age:
2) Sex: Male Female
3) Occupation (Check all which apply):

- Full time Student
- Part time Student
- Working

Part time working .

4) What is your annual income (Check all which apply)

- Less than $ 5000
- $ 5000-$10,000
- $ 10,001-$ 20,000
- $ 20,001-$ 30,000
- $ 30,001-$ 40,000
- $ 40,001-$ 50,000
- $ 50,001-$ 60,000
- $ 60,001-$ 70,000
- $ 70,001-$ 80,000
- Over $ 80,001.

5) Do you own or lease a vehicle?

- Yes
- No

6) If you do have an automobile, what is the make, model and year of the automobile?

YEAR _____
MAKE _____
MODEL _____

7) Is the automobile in a good repair?

- Yes
- No

8) Is the recommended maintenance for the automobile being done regularly?

- Yes
- No

Appendix 2: Other Hypotheses Tested (Stated Preference)

Service

The survey consisted of a series of questions that concentrated on the service features of the highway assistance services. The respondents were offered two choices:

(a) To pay a fee and to get services like tire changing and

(b) Not to pay a fee and not to get any service.

The fee was varied for the various questions.

It was hypothesized that the probability of choosing alternative (a) was a function of the difference in the fees between the alternative (a) and (b), time of breakdown on the freeway and the socio-demographic characteristics.

The results however indicate that the variables considered are not significant. None of the variables seem to contribute to the choice probabilities. The results show that contrary to what was expected greater the difference in the fee between the alternatives (fees for alternative a minus fees for alternative b) higher was the probability of choosing alternative (a).

Service

Pr (choice=1) = F (Difference in service fee, time of day, Sex, Full time Student, Full time Worker)

Logit estimates — Number of obs = 35

LR chi2(5) = 0.64

Prob. > chi2 = 0.986

Log likelihood = -23.234 — Pseudo R2 = 0.014

Variables	Coefficient	Std. Error	z	P>|z|
Difference in service fee	.0027	.0352	0.077	0.939
time of day	.352	.700	0.502	0.615
Sex	.446	.943	0.473	0.636
Full time Student	-.446	.943	-0.473	0.636
Full time Worker	-.551	1.269	-0.435	0.664
constant	-.581	1.635	-0.356	0.722

Table A1: Results of logit model-Stated Preference analysis: Service

Area of Coverage

This part of the survey looked at the individual preferences about the area of coverage of the highway assistance services and how much an individual would be willing to pay in terms of fees for a particular area of coverage. Here the respondents had two options:

a) Everyone pays a higher annual fee and have higher area of coverage of the highway assistance service.

b) Everyone pays a lower annual fee and have lesser area of coverage of the highway assistance service.

The fee was varied for the various questions. It was hypothesized that the probability of an individual choosing (a) or (b) depended on the difference in the annual fees between alternative (a) and (b) (annual fees for alternative (a) minus annual fee for alternative (b)) and socio-demographic characteristics. The results for the hypothesis however indicate that the variables considered are not significant. The signs of the coefficients of the variables obtained are contrary to what was expected.

Pr (choice=1) = F (Difference in annual fee, age, Sex, Full time Worker, Part time Worker, Full Time Student/Part time Worker, Vehicle ownership)

Logit estimates — Number of obs = 28

LR chi2(7) = 2.96

Prob > chi2 = 0.888

Log likelihood = -16.768 — Pseudo R2 = 0.081

Variables	Coefficient	Std. Error	z	P>|z|
Difference in annual fee	1.16e-17	.1664	0.000	1.000
age	.0996	.232	0.430	0.667
Sex	-1.278	1.12	-1.140	0.254
Full time Worker	1.417	1.549	0.915	0.360
Part time Worker	-2.508	6.425	-0.390	0.696
Full Time Student/Part time Worker	-.483	1.043	-0.464	0.643
Vehicle ownership	-.741	1.117	-0.664	0.507
Constant	-.455	6.397	-0.071	0.943

Table A2: Results of logit model-Stated Preference analysis: Area of Coverage

Time of Coverage

This part of the survey concentrated on individual preference about the time of coverage of the highway assistance services and how much they would be willing to pay in terms of fees for this. The respondents were offered two options:

(a) Everyone pays a higher annual fee and have longer hours of operation of the highway assistance service

(b) Everyone pays a lower annual fee and have lesser hours of operation of the highway assistance service.

The fee was varied for the various questions.

It was hypothesized that the probability of an individual choosing (a) or (b) depended on the difference in the annual fees between alternative (a) and (b) (annual fee for alternative (a) minus annual fee for alternative (b)) and socio-demographic characteristics.

The results for the hypothesis however indicate that the variables considered are not significant. Further the signs of the coefficients of the variables obtained are opposite to what was expected.

Pr (choice=1) = F (difference in annual fee, sex, Full time Student, Full time Worker, Vehicle ownership)
Logit estimates Number of obs = 25
LR chi2(5) = 3.22
Prob > chi2 = 0.666
Log likelihood = -13.213 Pseudo R2 = 0.109

Variables	Coefficient	Std. Error	z	P>|z|
Difference in annual fee	.0580	.193	0.300	0.764
sex	.160	1.292	0.124	0.901
Full time Student	-.160	1.292	-0.124	0.901
Full time Worker	-1.986	1.701	-1.167	0.243
Vehicle ownership	1.422	1.263	1.126	0.260
constant	-.901	4.427	-0.204	0.839

Table A3: Results of logit model-Stated Preference analysis: Time of Converage

Appendix 3: Services provided by the AAA:

General

- Road side assistance during emergencies
- Free towing of vehicle up to 100 miles per incident.
- Free maintenance, inspections for the members at AAA approved Auto repair facilities in USA and Canada.

Insurance

- Assistance for medical and legal problems during travel.
- Coverage for trip cancellation and trip interruption.
- Insurance for home and automobiles.
- Bail bond protection.
- Life and health insurance products.

Financial

- Low rates credit cards for members.
- Vehicle leases and loans.
- Personal and student loans, home equity loans for members.

Travel

- Tour guides, travel books, maps and other travel related materials for the use of members.
- Free Travelers Cheques from certain banks.
- Discounts and benefits at certain retail location.

(Source: AAA Minneapolis)

TABLES

Patrol Location	Patrol Name	Hours	Annual Incidents	Annual Budgets	Year Started	Centerline Kilometers	Number routes	Number Vehicles
Albany ,NY	Samaritan	6	8200	NA	1983	NA	2	12
Atlanta,GA	Highway Emergency Response	16.5	16900	400000	1995	105	5	12
Austin,TX	Courtesy Patrol	16	NA	350000	1996	48	2	3
Boston,MA	Motorist Assistance Patrol Samaritan	6	72000	NA	1994	NA	16	16
Charlotte,NC	Incident Management Assistance Patrol	16	12000	410000	1990	26	1	6
Chicago,IL	Emergency Traffic Patrol	24	100000	3500000	1960	127	12	56
Cincinnati,OH	Samaritan	6	18200	NA	1992	NA	3	3
Columbia,SC	State Highway Emergency Patrol	4	4200	200000	1996	32	2	3
Dallas,TX	Courtesy Patrol	16	20000	750000	1987	564	7	17
Denver ,CO	Mile High Courtesy Patrol	5.5	18000	700000	1992	61	5	10
Detroit,MI	Freeway Courtesy Patrol	10	7080	NA	1994	68	4	5
El Paso,TX	Courtesy Patrol	15	18000	186000	1993	31	2	6
Fresno,CA	Freeway Service Patrol	4	1650	241600	1993	35	2	2
Ft.Lauderdale,FL	I-95 Service Patrol	13	24000	1000000	1995	81	6	7
FT.Worth,TX	Courtesy Patrol	24	10200	400000	1973	338	3	7
Greeley,CO	State Patrol Coutesy Patrol	7	NA	30000	1996	19	1	2
Greensboro,NC	Incident Management Assistance Patrol	16	3800	283000	1993	39	3	4
Greenville,SC	State Highway Emergency Patrol	4	NA	165000	1996	48	2	3
Haywod Co.,NC	Incident Management Assistance Patrol	24	4500	180000	1969	32	1	2
Houston,TX	Motorist Assistance Program	16	33500	1400000	1986	270	9	16
Indianapolis,IN	Samaritan	6	3800	NA	1991	NA	1	1
Kansas City.,MO	Motorist Assist.	13	40000	20000	1992	97	2	4
LosAngeles,CA	Metro Freeway Service Patrol	8	250000	20000000	1991	650	41	150
Miami,FL	I-95 Service Patrol	13	NA	400000	1997	27	4	4
Minneapolis,MN	Highway Helper	16	11000	610000	1987	145	7	8
New Jersey,NJ	Courtesy Patrol	8	3580	115000	1989	81	3	5
NeW York,NY	Highway Emergency Local Patrol	8	23570	2905000	1990	217	7	21
Norfolk,VA	Safety Service Patrol	24	12000	700000	1992	31	2	6
Northwestern Indiana	Hoosier Helper	24	13375	NA	1991	26	1	3
Oakland,CA	Freeway Service Patrol	7	97000	6000000	1991	354	20	51

Orange Co., CA	Freeway Service Patrol	7.5	80000	2000000	1992	145	10	30
Philadelphia,PA	Incident Management team	24	NA	NA	1989	815	20	15
Pittsburg,PA	Penn Licoln Parkaway Patrol	6	6000	245000	1996	42	3	4
Providence,RI	Samaritan	6	4400	NA	1978	NA	1	1
Raleigh,NC	Incident Management Assistance Patrol	14	8500	237000	1993	48	2	4
Richmond ,VA	Motorist Assistance Program	15	64500	1075000	1989	NA	NA	7
Riverside Co.,CA	Freeway Service Patrol	6	16000	700000	1993	40	4	8
Sacremento,CA	Freeway Service Patrol	6.5	11700	NA	1992	82	4	8
San Antonio,TX	Courtesy Patrol	24	6250	475000	1978	229	6	4
San Diego,CA	Freeway Service Patrol	6.5	18500	2000000	1993	250	7	7
Southern Connecticut	Samaritan	6.5	4800	NA	1985	NA	1	1
Springfield,MA	Motorist Assistance Patrol Samaritan	6	72000	NA	1995	NA	1	1
St.Louis,MO	Motorist Assistance Patrol	16	NA	NA	1993	161	10	14
Tampa,FL	I-4 Service Patrol	14	NA	NA	1996	32	4	7
Viriginia Beach,VA	Motorist Assistance Program	15	64500	NA	1989	NA	NA	12
Washington,D.C./MD	CHART	24	30000	NA	1989	604	8	22
Washington,D.C./VA	Motorist Assistance Program	15	64500	NA	1989	NA	NA	18
Washington,D.C./VA	Safety Service Patrol	24	39100	3000000	1978	140	10	60
Washington,D.C./VA	Samaritan	6	5200	NA	1990	NA	2	2
Westchester,NY	Samaritan	6	3400	NA	1988	NA	1	1
Westchester Co.,NY	Highway Emergency Local Patrol	8	8600	700000	1994	71	2	9
Winston-Salem,NC	Motorist Assistance Patrol	14	13200	225000	1991	143	4	6
Worcester,MA	Motorist Assistance Patrol Samaritan	6	72000	NA	1978	NA	4	4

Source: (David and Ogden 1998)

Table 1: Highway assistance service data

USA membership By state

State	12-Month Membership As of 2/292000
Alabama	247,805
Alaska	17,721
Arizona	509,032
Arkansas	64,606
California	8,503,950
Colorado	425,810
Connecticut	785,072
Delaware	105,761
District of Columbia	77,705
Florida	2,606,230
Georgia	423,219
Hawaii	73,401
Idaho	84,171
Illinois	722,651
Indiana	504,561
Iowa	320,586
Kansas	190,064
Kentucky	485,304
Louisiana	181,740
Maine	297,936
Maryland	753,765
Massachusetts	1,657,046
Michigan	1,736,443
Minnesota	566,833
Mississippi	32,987
Missouri	562,785
Montana	98,922
Nebraska	201,358
Nevada	268,174
New Hampshire	262,154
New Jersey	1,807,342
New Mexico	120,429
New York	2,421,365
North Carolina	820,325
North Dakota	63,175
Ohio	2,572,052
Oklahoma	272,870
Oregon	532,269
Pennsylvania	2,817,094
Rhode Island	419,519
South Carolina	266,573
South Dakota	84,947
Tennessee	333,417
Texas	880,569
Utah	112,912
Vermont	84,888

Virginia	1,048,584
Washington	725,172
West Virginia	154,188
Wisconsin	569,471
Wyoming	29,056
USA TOTAL	38,904,009

Source: AAA National Office, Heathrow, Florida

Table 2: AAA membership Data

Results of Revealed Preference analysis

Variable	OLS		Cobb-Douglas		Logit	
aaadri	Coefficient	t	Coefficient	t	Coefficient	t
Routes	4060.856	0.247	.496	1.740	.655	3.045
Vehicles	-136.088	-0.029	-.348	-1.576	-.414	-2.457
Income	3.21e-06	0.570	1.985	3.048 *	1.730	1.862
Population	2.13e-09	0.797	.006	0.059	.000	0.005
Populationdensity	.0003	3.914 *	.153	2.051*	.134	1.085
Constant	.0533	0.487	-20.257	-2.914	-19.508	-2.040

Variable	OLS Model	Cobb-Douglas Model	Logit Model
Number of observations	50	50	50
F statistics	8.49	6.86	8.31
Prob. >F	0.000	0.000	0.000
R-squared	0.491	0.438	0.486

(*) Indicates significant variable at 95 % confidence level

Table 3: Results of AAA Membership Analysis

Variables	OLS Model	Cobb-Douglas Model	Logit Model
Routes	0.0003	0.0364	0.499 *
Vehicles	-1.78E-05	-0.0250	-0.311*
Income	0.0037	0.1051 *	0.952
Population	0.0006	0.0005	0.001
Population density *	0.0027*	0.0035 *	0.032

(*) Indicates significant variable at 95 % confidence level

Table 4: Elasticity of AAA membership

Results of Stated Preference Analysis:

Public vs. Private highway assistance services

Pr (choice=1) = F (difference in time of waiting, difference in cost, time of day, age, Full time Student, Full time Worker, Full time Student/ Full time Worker, Full time Student /Part time worker, Vehicle ownership, Vehicle repair)

Logit estimates — Number of obs = 112; LR chi2(12) = 43.65; Prob. > chi2 = 0.000; Log likelihood = -55.361; Pseudo R2 = 0.283

Variable	Coefficient	Std. Error	z	P>|z|
difference in time of waiting *	-.0674	.0135	-5.003	0.000
Difference in cost *	-.0331	.0144	-2.300	0.021
age	-.115	.114	-1.003	0.316
time of day	.145	.484	0.299	0.765
sex	-1.312	.803	-1.633	0.102
Full time Student	-.440	1.616	-0.272	0.786
Full time Worker	.198	1.494	0.133	0.894
Full time Student/ Full time Worker	.853	1.655	0.515	0.606
Full time Student /Part time worker	-.657	1.560	-0.421	0.674
Vehicle ownership	1.238	1.185	1.045	0.296
Vehicle repair	-1.166	1.365	-0.854	0.393
constant	3.102	3.930	0.789	0.430

* Indicates significance at 95% confidence level

Table 5: Highway Assistance Choice

Tabulation of Elasticity

Variables	Elasticity of choice probabilities
Difference in Time of waiting	-0.006
Difference in Cost	-0.010

Table 6: Elasticity of Assistance Choice

Annual Fee

Pr (choice=1) = F (difference in annual fee, difference in fee of assistance, Age, Sex, Full time Worker, Part time worker, Full time Student /Part time worker, Vehicle ownership)

Logit estimates — Number of obs = 55
LR chi2(8) = 30.81
Prob > chi2 = 0.000
Log likelihood = -20.049 — Pseudo R2 = 0.435

Variable	Coefficient	Std. Error	z	P>|z|
Difference in annual fee *	-.0561	.0185	-3.025	0.002
Difference in fee of assistance *	-.0283	.0104	-2.729	0.006
Age*	.549	.208	2.640	0.008
Sex	-.137	.992	-0.138	0.890
Full time Worker *	-3.201	1.601	-1.999	0.046
Part time worker *	-16.600	6.0003	-2.766	0.006
Full time Student /Part time worker *	-3.515	1.306	-2.692	0.007
Vehicle ownership	-.878	1.093	-0.803	0.422
constant	-10.242	4.637	-2.209	0.027

* Indicates significance at 95% confidence level

Table 7: Highway Assistance Choice: Annual vs. Per Use Payment

Tabulation of Elasticity

Variables	Elasticity of choice probabilities
Difference in a annual fee	-0.073
Difference in fee of assistance	-0.047

Table 8: Elasticity of Assistance Choice Payment Type

Variables	Coefficient	Standard error	t	P > |t|
Vehicles/hours*	878342.1	96401.39	9.111	0.000
incident	11.73755	6.932999	1.693	0.102
constant	-226558.4	152011.4	-1.490	0.148

Note: (*) indicates significance at 95 % confidence

Table 10: Results of Cost Model

Variable	Elasticity of Budget
Vehicles/hours	0.006

Table 11: Tabulation of Elasticity (Cost Model)

Hypothesis No	Dependent variable	Independent variables	Number of observations	Results as expected Yes/No
Public vs. Private Highway Assistance Services	Choice Probabilities	Difference in time of waiting(*), Difference in cost of assistance (*), Time of day, socio-demographic variables.	112	Yes
Annual Fee	Choice Probabilities	Difference in fee(*), difference in cost of assistance(*), socio-demographic variables (age (*))	55	Yes
Service	Choice Probabilities	Difference in fee, Time of day, Socio-demographic variables.	35	No
Area of Coverage	Choice Probabilities	Difference in annual fee, socio-demographic variables	28	No
Time of Coverage	Choice Probabilities	Difference in annual fee, socio-demographic variables	25	No

Note: (*) indicates significance at 95 % confidence

Table 9: Summary of results of Stated Preference Analysis