Analyzing the Value of Time for a Highway using Discrete Choice Models

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ABSTRACT

Traffic jam and congestion problems are something that is increasingly well known, especially in metropolitan urban areas. It is vital to seek for new alternatives and solutions in order to decrease traffic jams caused by the excessive numbers of cars and the set of variables concerning commuters' quality of life, such as pollution, driving stress and their value of time.

The value of time in urban transport is becoming more and more important due to the necessity of people saving time to use it in other activities.

This study identifies the value of time of commuters in a very important Brazilian highway. The highway is both part of a Brazilian federal highway and an important link between two big cities in Rio de Janeiro state. The main goal is to calculate the value of time based on a discrete choice model with a set of stated preference data.

Keywords: Applications to Logistics and Transportation, Discrete Choice Models, Value of Time, Traffic Jam

1.INTRODUCTION

Over the years, traffic jam in big cities has increased a lot. This growth happens by increasing the fleet of cars, buses and trucks in big cities. Given this situation, each city takes steps in order to adapt and try to reduce the time wasted in traffic for its residents. Some actions were taken:

- Car relay;
- Creation of new routes

Another point that should be noted is the quality of roads and pathways, which mostly present very low conditions for the movement of the cars. Given the inability of the state to take account of new roads and maintaining them, the state is conceding this road to a private concession.

To do this, the companies make use of fare collection. This fact is shown more clearly when we observe that Brazil has overtaken the U.S. in the number of miles controlled by the private sector, according to an article published in the Revista do Conselho Federal de Engenharia, Arquitetura e Agronomia (CONFEA 2002).

Lately, governments have required companies to take, besides the large roads, which are those of greater financial returns, secondary and local roads, minimizing the public costs of maintenance.

According to reports published by the ANTT (Agência Nacional de Transporte Terrestre), companies have done a satisfactory job, because the quality of customer service has undergone improvements.

The companies have some responsibilities that are imposed by the state at the time of grant, which are audited by ANTT, which are:

- Maintenance of the tracks;
- 24 hour Trailer for the user in case of any emergency;
- Signal improvement, in some cases making use of electronic boards;
- Customer service via phone and website;
- Telephones available every kilometer on the highway;
- Other services, paid by the fee charged to the user.

Because of this, the present study aims to quantify the amount of time of the users of a toll road linking two major cities of the State of Rio de Janeiro, to evaluate the financial return of works to be performed in order to decrease the length of stay on the highway.

The main cause of waste of time for users occurs in the rush hour, near the fare collection cabin. Therefore, the greatest beneficiaries from these reductions in waiting time of fare are the people who are traveling during this time to go to work or schools, colleges and other daily activities.

The methodology used is the discrete choice models, due to its ability to capture preferences quite suited to different ways of thinking of the interviewee.

2.OBJECTIVES

The goal of this study is to identify choices for car users commuting between two Brazilian cities which are linked by an important highway in Rio de Janeiro. The goal is to calculate the value of time for car users by using Stated Preference data base for modeling discrete choices.

The study objectives are:

- To identify attributes most relevant to decision makers in the choice of their daily trip (travel time, amount spent, accessibility and so on.);
- To mould users preferences with regard to possible improvements that will be implemented by the company;
- To calculate the amount of time for users of this tool road.

3. CAUSES, CONSEQUENCES AND WORST TRAFFIC JAMS IN THE WORLD

One of the main factors of the major traffic jam is the rapid growth of urban centers without proper monitoring and adjustment of routes and public transportation. This deficiency in public transport means there is an increase in the number of private cars on the roads and, consequently, an increase in congestion due to lack of adaptation to the pathways.

According to Sugiyama et al. (2008), another reason for congestion is the difference between the speeds of drivers, creating a butterfly effect, i.e., when a group of drivers achieve another with lower speed, the second one is required to reduce their speed.

Sugiyama et al. also cites the inefficiency of the transport systems of cities, so that people are forced to use cars to make the shuttle home from work more often.

Another factor that contributes to congestion are accidents, because roads are prepared for a particular traffic flow, but when an accident occurs, the route ends partially reducing its service capacity, which creates congestion on this road and other adjacents. This fact is compounded on rainy days, since a larger proportion of accidents occur due to the increase of vehicles on the streets.

And finally, the quality of the tracks is also a point which generates congestion. Poorly maintained roads end up being underutilized, so there is an increased flow in the major highways.

Given these causes, some consequences can be observed to congestion in big cities. Among them, we can highlight the wear / stress of drivers and the consequent loss of time from your day in traffic. This great time loss makes people stop producing.

With this decrease in production, various sectors of the economy are affected. Estimates of FHWA (1984), cited in NCHRP (1998), indicate that congestion costs of urban traffic hit in the United States, annual values exceeding two billion dollars. While in Brazil, some studies, such as Indriunas et al. (2007) show that there is a major slowdown in the economy due to the time lost in traffic jams, insomuch there are calculations that indicate annual values of the order of 350 million dollars for the city of São Paulo and 5 million dollars to Porto Alegre.

Another consequence of this transportation problem is the increase in fuel consumption and consequent increase in carbon dioxide emissions in the atmosphere.

There is great concern about the ozone layer, which is losing its efficiency in filtering out ultraviolet rays, over the years, due to the increased consumption of fossil fuels.

Indriunas also cites that problems with high vehicle traffic is not a privilege of large Brazilian cities, other major cities in the world also have chaotic traffic. Some of these cities are: Bangkok, Thailand, Beijing and Shanghai, China; Cairo, Egypt, Kolkata and Chennai, India; Jakarta, Indonesia.

Among the large cities cited, notice the presence of the two most populous countries in the world, China and India.

For these countries, and the factors causing congestion treated this topic, it is worth mentioning the use of alternative means of transport, which are bicycles, as there is a great incentive to use this mean of transport.

4. ROADWAY CONCESSIONS

To try to reduce the costs of road maintenance, the state increasingly grants the rights to administer highways to specialized companies; however, the number of awards far outstrips other countries, which also yield the administration of its highways.

A great example of this is the recent acquisition, auction occurred in October 2007, by a Spanish group, of 5 of the 7 lots auctioned, with their administration spanning more than 2,000 km of national highways, among them two with large traffic involving the cities of Belo Horizonte, Sao Paulo and Curitiba.

This form of exploitation of highways should be overseen by a governing body, but the ANTT cannot perform their function in a competent manner and this is reflected in research published by the Institute of Applied Economic Research (IPEA, 2006), which shows that, between 1995 to 2005, the price of tolls rose 45% above inflation in some stretches of federal roads, which should not happen, since the rate increases need to be authorized.

Besides the fights with public utilities, there is a fight with the state, since many people consider the toll a form of double taxation, due to the existence of taxes that should be used for the preservation of roads and highways of the country, namely: the Property Tax Vehicle (IPVA) for states and Contribution on Intervention in the Economic Domain (CIDE) for the Federal Government.

Another point that is very challenged is, if it's not double taxation, there would be a transfer of population income to the administrators of the highway.

With regard to the above discussion, it is permissible to bring up the doctrinal discussions concerning the subject.

First, it should be explained that the State understands that double taxation does not occur, simply because the toll is not imposed. There is no double impact, because the property taxes are levied on the owner of the vehicle, while the toll is charged on who leads, regardless of their status as owner. Failing these obstacles to collect the toll, he becomes liable to be levied by both the Union and the state or the municipality, that is, that can be charged by who builds or maintains the road or road work to be paid by users that chose it.

In the stream of those that perceive it as double taxation, there is a clear match between tariff and rate, using the precedent of the Supreme Court, therefore, if the toll is a tax that suffers incidence from the same basis of calculation of the tax, there is crystalline injury to the federal constitutional provision.

According to this view, private companies, in practice, could only collect toll in two cases: if they had invested in the construction of the road (the time would be established in the contract) or when the road gets investment from the World Bank or the Inter-American Development Bank, because these entities require that the highway or road be privatized soon, therefore these two cases would not be a form of double taxation.

Once this point is clarified, we should examine how this service - toll - is used in other parts of the planet to observe the differences with how it is used in Brazil.

In some places, the use of toll would have the aim of reducing the use of motor vehicles, or restrict their use in certain areas by charging a certain rate; this use is quite common in London, Singapore, Stockholm and Milan. This practice is quite efficient because ultimately inhibits the constant use of cars and encourages the use of public transport, since this tariff

burdens the use of motor vehicles. New York is another city that wants to implement the system.
It is evident that the collection of the toll and the road concessions to particular groups are very complicated topics and that generate a lot of controversy in the business, legal and economic world.

5. CONSUMER THEORY

Preference is something quite peculiar, as the opinion of a group of individuals is not necessarily able to replicate that of the population or even part of the group of which it is part. This great difficulty in defining and measuring preference is a subject often discussed, because individuals have increasingly more and more options when making their choices.
This diversity of alternatives makes consumer's life more complex, because he becomes uncertain about which product to choose, or he may even know, in a first instance, what is the product he wants, but does not know which specific features it should have, as for example, in choosing cars, cable TV, apartments, etc.
According to the above considerations, there is the difficulty of finding a way to evaluate consumer preference. As a result, utility functions will be created, which will be responsible for capturing consumer preference.
According to the classical theory of the consumer where, with their amount of resources available, they try to make its utility reach the maximum level, it is necessary that this formulation is transformed into an equation for which the calculations are made, this can be seen in equation 5.1.

$MaxU(x)$ sujeito a $p.x <= Y$ (5.1)

where:
U(x) – utility of ;
P – Price vector of each commodity;
X – Number of each commodity;
Y – Available Budget.

In certain situations, which are not mentioned in the study, the utility can be solved using Lagrange's theorem (Equation 5.2).

$$L = U(x) + \lambda(Y - px) \quad (5.2)$$

For the above equation to reach the maximum point, it's required that the first derivative be calculated and equate it to zero, and this is presented in the set of equations 5.3.

$$\partial U / \partial xi = \lambda . p_i \quad (i=1,n)$$

$$Y = p.x \quad (5.3)$$

The utility function U, when viewed as a function of the quantities of commodities chosen, is known as a direct function of utility, and effectively assumes prices and fixed incomes. However, as a result of the maximization process, it is possible to find the value of commodities in terms of price and disposable income. Then, by replacing the values in the original function, we obtain the indirect utility function, seen in terms of prices and income.

This represents the maximum value that can be obtained for a condition price and revenue provided.
In general, the utility function is straightforward when their arguments are commodities and is considered indirect when their arguments are price and income.
To try to reduce the costs of road maintenance, the state increasingly grants the rights to administer highways to specialized companies; however, the number of awards far outstrips other countries, which also yield the administration of its highways.

6. TECHNIQUES OF DATA COLLECTION OF PREFERENCE DATA

There are two ways of collecting consumer preference data. The first way is through stated preference, which explains consumer behavior through their choices, which are made on a set of alternatives, which can´t exist in their daily lives.
The second type of collection is the revealed preference, where the choice is made through options that are part of everyday life.
The stated preference technique is very useful when one wants to observe the reactions of consumers regarding the products and options that do not exist in their daily lives. For this to be done effectively it is necessary to create a number of scenarios and the interviewee will make his choice in each one of them.
As an example, one can cite the inclusion of a new pack of soda on the market, for that you need to know if it will be well accepted. Faced with this kind of situation, you create scenarios with variations in price, packaging or even brand.
Under each scenario, the consumer will choose or even not choose any of the options, if any are to its liking.
To make such a choice, the decision maker will consider some aspects of great relevance:

- Rationale: when the respondent inevitably will consider financial aspects to make its decision;
- Subjective: when consumers take into account aspects that are difficult to measure, such as their personal preferences and psychological aspects.

According to Caldas (1995) the method of binary choice has greater efficiency than ordinations and evaluation through ratings. This technique of data collection has the advantage of being able to capture very well the consumer opinion, especially when changes are made in some subtle issues such as: price, packaging, product size, etc.
The revealed preference technique is characterized by real interviewee´s choice (it represents the real world), because the presented options are those that exist in everyday life. Thus, it is as if consumers come to a market, look at the shelf where the products are exposed, take the product from the shelf, go to the cash register, pay and then go home.
Faced with the real situation, one can observe that the choices are procedural, so it loses a bit of consumer behavior, because, if there is no brand that the consumer likes, he will replace it by another.
In order to be able to reach the preferences, the procedures are:
The decision maker chooses one of the options, if it is his preferred, then other options are presented and he will make his choices according to what suits him best. Furthermore, his

favorite product may not appear in the alternatives, which will cause the interviewee to replace it by another product.
An advantage of this type of data collection is that it can capture, quite efficiently, aggregate behaviors to overall preference, i.e., given the lack of product, manages to capture the kind of substitution that the decision maker will do.
For this to be well founded, it is necessary to respect the three axioms of revealed preference (Richter, 1966).
WARP (weak axiom of Revealed preference) or weak axiom of revealed preference, which is a necessary but not sufficient condition for the individual choice to be consistent with the utility theory; for that to happen, you must use the strong axiom of revealed preference - SARP (strong axiom of revealed preference).
The SARP states: - If the allocation X is revealed preference with respect to Y, then Y will never be revealed preference with respect to X. The robustness of this axiom follows from a definition that implies the transitivity of preference relations, redefining PR (Revealed Preference) as follows: if an allocation A is directly revealed preferred to B, B is the direct revealed preference regarding C: C is the preferred disclosed in relation to Z, and A and Z don't have the same value, then A is preferably disclosed with respect to Z.
The SARP is an important tool in econometrics, in confirming that the individual who performs the decision has a rational behavior, making it consistent with the neoclassical utility theory. However SARP is a bit restrictive because it requires that preferences are strictly convex. Afriat (1967) and Varian (1982 apud Andreoni and Miller, 1998) propose a general axiom that presents the necessary and sufficient conditions for a structure revealed preference conducive to the existence of a utility function, it is the general axiom of revealed preference or GARP (generalized axiom of revealed preference)
If X is revealed preference with respect to Y, then Y is not strictly a revealed preference in direct relation to X, i.e. X never belongs to a set of choice to which belongs Y, where Y is chosen as revealed preference.

7. THE VALUE OF TIME

The value of time is a matter of paramount importance in this study because some scenarios will be developed to assess respondents' day-to-day choices according to it. According to Kruesi (1997), the amount of time that is saved in an activity can be used in bringing some other personal gain for the individual as doing paid work, do something that can provide improvement in their health or generating pleasure to them.
Another perspective would be that spending excessive time on a path is intrinsically linked to inadequate conditions, such as:

- Lack of tracks maintenance;
- Too much congestion;
- Lower operating speed of public transport over private transport;
- Exposure to increased noise and air pollution.

Kruesi (1997) said that any decrease in travel time causes the individual's quality of life to improve.

Schmitz (2001) condone with the idea that saving time causes people to develop more activities for their own benefit and perform their job better, thus generating more economic value.
According to Cury (2004), time is an unrecoverable attribute; therefore any improvement aimed at reducing the travel time should be put into practice by the rulers of primordial form. The changes would mean more time for workers to stay with their families and more time for leisure and idleness.
According to Cury (2006), the travel time savings resulting from improvements in public transport are extremely important, because every hour reduced in congestion through investment in public transport corresponds to 1 year and 2 months of longer life for the people.
In addition to personal effects, which include leisure and health, there is a monetary aspect, as a great loss of time during the day will affect, in a very decisive way, financial gains.
The definition of the monetary value of time is quite complex, there are so many authors expounding on the subject, and each one takes a position with respect thereto.
Shaw (1992) concludes that the value of a person's time in any activity will vary between zero and its hourly wage market.
Small (1992), however, mentions several studies that have established value of travel time and market hourly wage (gross) for travel commuting to work, which contradict the assertion of Shaw (1992). Small suggests that the relationship "time value / hourly wage (gross)" ranges from 20% to 100% in industrialized cities and even more than 100% among population groups. Another point raised is that 50% of the gross hourly wage would be an acceptable value of travel time to be used as a yardstick in evaluating transportation projects.
Given the range of options presented, this study will address the theme using another analysis of captivating the value of time. The technique will capture the preference of respondents providing some real or fictional scenarios in which the respondent will choose. This way of estimating the value of time has been widely used, as can be seen below, where they were applied stated preference techniques (Stated Preference - SP) and revealed preference (Revealed Preference - RP).

8. VARIABLE DEFINITION AND VARIABLE LEVEL DEFINITION

Were taken into account some important factors for controlling body (ANTT) and other factors that are important to the dealership, namely as: toll, monthly toll automatic timeout.
The selected variables were:

- Toll paid for passage;
- Monthly fees paid by users of automatic toll;
- Standby time to overcome the barrier;

After the variable selection, another major step was to define the levels of each attribute.
The variables "toll" and "monthly" for users of automatic toll were defined according to the rules of ANTT, because it limits the increase to a certain percentage.
In relation to the "wait time", the De Paula (2006) study was used to define the levels of this attribute.
Given the above, the levels for each attribute were as follows:

- Toll: $ 3.50 per ticket and $ 4.20 per ticket;

- Amounts of tuition: No monthly fee, $ 5.00 per month and $ 10.00 per month;
- Waiting time to pass through the toll: 1 Minute, 3 Minutes and 5 Minutes;

After setting the levels, we can calculate the number of possible combinations for mounting the set of choices. A total of 18 combinations have been calculated, however, some techniques are applied for that number of choices is adequate and without loss in the analysis. After this analysis, 3 combinations were eliminated because they had dominated alternatives and due to this, they were unnecessary for the analysis.

9. SAMPLE SIZE

The sample selection is of paramount importance in any study, and for this study the subject of interest are people who travel to work during the week, making use of the highway.

Travel to work, as defined above, are those made during the week with the intention of getting to work, college or school.

For the study to be developed and the data collection to be complete, it took a series of adaptations. Initially, it was necessary to calculate the optimal number of questions that should be answered for the discrete choice models to have a statistically consistent formulation.

For discrete choice models, it's necessary something around 1000 choice questions to be answered by respondents. As the questionnaire developed in this study has 15 choice tasks, it would require fewer than 80 respondents.

However, it was discovered that an on-site research could not be done, because, due to an ANTT regulation, for someone to be able to work moving at a toll plaza, it's necessary at least 3 months of training time, and this would be incompatible with the study timeline. Thus, we chose the Internet data collection. As this form of research is something that has been adopted by major market research companies such as Ipsos, TNS, Millward Brown, it was a good solution for the data to be collected on time.

After defining and hosting the questionnaire on the World Wide Web, there were sent nearly a thousand emails to people so that they could participate in the study. However, at first, the filter designed for the research turned out to be quite strict and few respondents ended up completing the questionnaire. Therefore, the filter changed from a frequency of execution path by car at least 3 times a week to at least 1 time a week. Besides the problem in the filter during the research, it was found that the profile of respondents was deviating a little from the profile of users of the highway, as most questionnaires were from people possessing automatic toll.

After 2 months of collection, 124 questionnaires were filled by different people, which creates 1860 tasks answered, which is more than satisfactory for the development of the model and to calculate the amount of time the user of the highway. However, it is noteworthy that the licensee does not disclose the profile of users of the highway and therefore we could not control that part of the sample.

9. ANALYSIS OF RESULTS

We will present below the analysis of discrete choice models for the sample, i.e., the coefficients, the statistical model validation and other forms of aid in decision making.

Table 10.1 – Anova for total sample

	Estimate	Std. Error	z value	Pr(>|z|)	Test
(Intercept)	310.418	0,36012	8.620	< 2e-16	Sig
TOLL	-0,39182	0,09151	-4.282	1,86E-05	Sig
MONTHLY	-0,32322	0,06633	-4.873	1,10E-06	Sig
TIME	-0,92131	0,0747	-12.333	< 2e-16	Sig

In Table 10.1, it can be seen that all coefficients are significant. People give more importance to the time than the other variables in the model because its coefficient is what has the bigger value. This was somewhat expected, since nowadays the less time is spent on commuting to work or college, you will have more time to devote to other tasks.

Besides the analysis of coefficients, it requires some analysis based on statistical testing, to validate the model, which are:

The first is the significance of the test for observing the table 9.1, we see that all variables of the model are significant, i.e., are nonzero, therefore, they are required to model.

A second test that can be used as a validator is AIC (Akaike, 1974 apud Liew & Mahendran, 2003) where the higher the value of the statistic, the model is more appropriate.

Now we have a third way of validating the model is that the likelihood ratio test, which is jointly verified if all parameters are valid as using one statistic chi-square with k degrees of freedom. This statistic is calculated as follows:

$$\xi(0) = 2(\xi(\beta) - \xi(0))$$

Other statistic test that could be used is the pseudo-coefficient of determination (McFadden, 1974), which calculates the relationship information that is lost when any model variable is withdrawn. For this calculation, the below equation is used:

$$\rho^2 = 1 - \frac{\xi(\beta)}{\xi(0)}$$

For the adjusted model by reducing the degrees of freedom, the model is:

$$\bar{\rho}^2 = 1 - \frac{\xi(\beta) - K}{\xi(0)}$$

After brief explanation of the tests that validate the model, one can show the values obtained for testing the total data. The data found for the tests listed above are:

AIC = 4876.7, then the model can be used, for how its value is quite high right is well suited;

Likelihood ratio, where $\xi(0)$ =5087.7 and $\xi(\beta)$ =4868.7, hence the value of the likelihood ratio is equal to 438, which means that the model also goes by the likelihood ratio test.

ρ^2 (using deviances presented above). Thus the value found is 0.043045 and it is observed that for a model to be considered adequate ρ^2 may be between 0.1 and 0.2. since this value was below that, the model is quite adequate.

A new analysis that can be made is the probability of selection of an option and usefulness thereof for this will be presented Table 10.2.

Table 10.2 – Utilities and choice probabilities of each option

Option	Constant	Toll	Monthly	Time	Utility	Probability
1	1	1	1	3	**-0,375**	**0,407**
2	1	1	2	2	**0,223**	**0,556**
3	1	1	2	1	**1,145**	**0,759**
4	1	1	3	1	**0,822**	**0,695**
5	1	1	3	2	**-0,100**	**0,475**
6	1	2	1	2	**0,155**	**0,539**
7	1	2	2	2	**-0,168**	**0,458**
8	1	2	3	1	**0,430**	**0,606**

By observing the table 10.2, it is clear that option 3 is the most likely one, especially for having the lowest price range and less waiting time. Another point that can be noticed is that the most likely choice is tied directly to time because when time is the lowest, it has more chance of being chosen. That's because the weather has a weight greater than the amount paid by users, both in terms of monthly toll, as in the toll for passage.

Based on the outcome of the model, it becomes possible to calculate the time value to the user of the toll road linking two major cities of the State of Rio de Janeiro.

As the selected sample was small, it will not be possible to repeat the analyzes in the previous chapter for the value of time, since by observing the bases of each income segment, and possession of automatic toll are small and end up not producing significant coefficients, precluding its analysis in this part of the job. Therefore, only an analysis by total will be done, so that the sample won't be reduced even more.

The calculation of the value of time is something widely used and studied, especially nowadays, and quite a formulation is used to calculate the equation (Lam and Small, 2001):

$$VT = \frac{\partial(Função) \big/ \partial(preço)}{\partial(Função) \big/ \partial(tempo)}$$

Where:

$\frac{\partial(Função)}{\partial(Tempo)}$ is the derivative of the function with respect to time;

$\frac{\partial(Função)}{\partial(\mathrm{Pr}eço)}$ is the derivative of the function with respect to the price of a product;

In this study, there are only two important variables in the model. Therefore, it is necessary to adapt the method of calculation. It will be inserted one more term in the equation, which aims to capture the importance of the monthly payment of a device used to not having to face the queues manual toll. Thus, the formulation to be used is as follows:

$$VT = \frac{\partial(Função) \big/ \partial(preço) + \partial(Função) \big/ \partial(mensalidade)}{\partial(Função) \big/ \partial(tempo)}$$

Where:

$\frac{\partial(Função)}{\partial(Tempo)}$ is the derivative of the function with respect to time;
$\frac{\partial(Função)}{\partial(\mathrm{Pr}eço)}$ is the derivative of the function with respect to the toll;
$\frac{\partial(Função)}{\partial(mensalidade)}$ is the derivative of the function with respect to the price of the monthly automatic device
N is the number of times the user goes through the automatic toll gate;
After the explanation of how the calculation is done for the value of time for non-users and automatic toll to the user toll pass, and presented in Table 10.3.

Table 10.2 – Value of time for possession of the device's automatic toll Table 10.2 – Utilities and choice probabilities of each option

Device possession	Value of time (R$)
It does not have	0,43
It has	0,78

It can be seen from Table 10.3 that the user automatic toll has a value almost doubled. And that's something relevant, since the time that this user can gain from the automatic toll is significant, and the amount he pays per month ends up being valid.

9. CONCLUSION

This study aimed to present the concepts of discrete choice models to calculate the value of time. This type of study is very appropriate because it manages to capture so well the characteristics of effective choice among alternatives of the interviewee, thus enabling modeling choices in sets with hypothetical alternatives. This study also envisioned at multi question, which were used to calculate the value of time and discrete choice models.
The study achieved its primary goals, to satisfactorily define a questionnaire to be applied, as well as defining attributes and levels that are required to make a good assessment of the views of users of the highway.
In the discrete choice model, one can see that the overall model was quite adequate, since it managed to pass all the statistical tests used to validate the model.
The conclusion is that the first criterion for users to choose an attribute is time, therefore, to observe the probabilities of choosing each option, we see that the first 3 are more likely to be chosen are those with the time of 1 minute expected to overcome the barrier.
Regarding the amount of time, you realize that only the possession of automatic toll system nearly doubles the amount of time of the individual, since those are concerned about not getting in the queue waiting to be served in the manual toll.
For future work, an increase in the database is important, so that there could be made deeper analysis, for example, to identify segments of users, or even filter data for any demographic information.

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