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Exploring Users' Acceptability to Toll Road Fees in Brazil

Alan de Oliveira Lopes[a], Fabiana Serra de Arruda[b]*

[a] *Brazilian Federal Police, SPO, Qd. 07, Lote 23, Asa Sul, Brasília/DF, 70610-200, Brazil*
b University of Brasília (UnB), Department of Civil and Environmental Engineering, Asa Norte, Brasília/DF, 70910-900, Brazil

Abstract

The objective of this research is to identify the factors that influence the acceptance of toll road fees by means of a case study of the route between Brasília and Goiânia in Brazil. The context of the research is to simulate the competition between a toll road and a free road, evaluating the consequences of monopolistic concession models. The data sample is taken from a stated preference survey, and based on utility theory. Using an electronic questionnaire, developed with the Google Forms tool, 241 questionnaires were obtained for the period December 2013 to February 2014. Thus, using an inference statistical model for a multiple linear regression (R-squared = 32%), 13 factors were identified in addition to "Saving Fuel" (input data), which can influence toll road fee acceptance. These factors are related to infrastructure ("Saving Time," "Lower Fatal Crash," "Divided Highway," and "Pavement Smoothness"), personal aspects ("Age," "Residence," "Sex," and "Family Income per Capita"), and behavioral aspects ("Experience in Highways," "Experience on a Specific Highway," "Tourism Travel," "Branding Loyalty," and "Favorable Ideology for Tolls"). The results indicate that the highway monopolistic concession process requires rigid control of construction and operational costs to avoid overpriced toll fees, as compared to the competitive concession process, which offers a free alternative route.

Keywords: Acceptance; Behavioral; Modeling; Road; Toll Road;

1. Introduction

Brazil's road transportation infrastructure is relatively poor. Several factors contribute to this situation, including political issues, budgetary imbalances, tax regulations, and local, cultural, and economic aspects. Thus, a solution to this problem will require significant financial resources. Toll roads are one option in terms of financing the construction and maintenance of the physical infrastructure.

* Corresponding Alan de Oliveira Lopes. Tel.: +55-61-98111-5425. *E-mail address:* alan.aol@dpf.gov.br
* Corresponding Fabiana Serra de Arruda. Tel.: +55-61-99903-8805. *E-mail address:* farruda@unb.br

In the United States, the implementation of toll roads encountered much resistance from the public because users were accustomed to having free access to highways and parking areas (Banister, 2006). For example, the New York City Congestion Pricing Experience was described as a battle when introduced in 2007 (Schaller, 2010). The difficulty is that users do not want to pay tolls, and investors want an investment with a safe financial return. Thus, an ongoing concern in the United States since the beginning of the master plan to implement toll roads was that the toll road should be sufficiently attractive in comparison to the alternative of a free road in order to ensure a minimum volume of traffic (USA, 1939). Indeed, it was known at that time that a driver would be able to choose between a free road and the toll road.

Thus, toll roads should offer advantages (influence factors) that seem greater than the charged toll rate. In the United States, the first studies on toll roads had already departed from this premise of competition with free roads. Initial estimates based on income, given specific traffic conditions (congestion locations) and other considerations, reached rates between 0.167 and 0.40 for the conversion of demand from free roads to toll roads. In fact, the implementation of a toll road is easier and more acceptable when building a new road, where users still have the choice of using an alternative un-tolled road. An example of this was the implementation of the M6 toll road in England (Walker, 2011).

The important of toll road acceptance is because Brazil has one of the most extensive tolling systems on the planet (Theophilo, 2013). This extensive toll-highway system affects millions of Brazilians, particularly because it is increasingly difficult for Brazilians to move between work and home without passing through a number of toll gates.

This study presents a simulation of a concession on the route between the cities of Brasília (Capital of Brazil) and Goiânia (largest city in the central-western region of Brazil). In the online surveys, respondents chose toll road fees for roads with various features and in different scenarios, always with the possibility of using an alternative free road. Then, the results are compared to the toll rates estimated by the government in the actual bidding concession process. This approach may offer an alternative to the estimation of toll rates that according to the laws of Brazil may not be expensive or abusive.

The concepts of utility, consumer, and marketing theories are applied to identify potential independent variables that could influence toll road acceptance (dependent variable) in specific scenarios. Utility theory (UT) is the foundation of many urban transport demand studies (Domencich & McFadden, 1975). The basis of UT is the premise that an individual, in a selection process, analyzes the variables involved, and makes decisions considering all information available in order to maximize his/her own benefit (Brito, 2007; Ortúzar & Willumsen, 2001). Consumer theory (CT) is a manifestation of UT. The core assumptions of CT (*Homo economicus*) do not provide all possibilities from which to model individuals' behavior (Van de Kaa, 2010). Thus, it is necessary to broaden the factors involved in this decision-making process. The public acceptance of road pricing is not stable, and can change over time. However, as more information on road tolling becomes available, and people begin to understand the proposed scheme and its advantages, their attitudes should become more positive (Hårsman, 2001; Walker, 2011; Odeck & Kjerkreit, 2010). In its turn, the marketing theory (MT) complements the CT with a different perspective for consumers. MT indicates that behavior is based on the premise that it is influenced by many features: cultural, social, personal, and psychological characteristics. For example, the MT strategy is used to implement road tolls in Stockholm, with politicians' deciding to "re-label" the congestion charges as "environmental charges," and emphasizing their positive effects on air quality in order to increase the acceptability (Eliasson & Jonsson, 2011).

2. Factors Used To Predict Potential Attitudes in the Comparison Between Toll Roads and Free Roads

To explore the factors that affect the acceptance of tolls roads, it was examined aspects of infrastructure, personal features, and behavioral features.

2.1. Influence of Intrinsic Factors

The acceptance of toll road fees is correlated with the quality of the service provided. Thus, it is little surprise that road concession procurement in Brazil set as goals the quality control of the pavement, quantified by measuring the international irregularity index (IRI), monitoring accidents, and the implementation of divided highways (ANTT, 2013).

The initial factors that could potentially influence the acceptance of tolls road were well known and easily monetizable. “Saving Fuel” was estimated at R$ 4.70 (Brazilian currency – Real - base date: December 2013, average fuel consumption tested by the author) for the road passage selected in this case study. Therefore, this factor is included in the survey as input data. Another factor linked to infrastructure is the “Saving Time” generated by a shorter path and better traffic condition (Brito, 2007; Jaensirisak et al., 2005; Cantos-Sánchez et al. 2007). Four infrastructure factors were selected (independent variables) as influencing factors to be tested: “Saving Time”; “Divided Highway”; “Lower Fatal Crash”; and “Pavement Smoothness”.

Accidents are the second largest road transportation externality, and result in personal injuries, fatalities, and damage to vehicles and other property (Anas & Lindsey, 2011). The possibility of having a lower fatality rate stimulates toll schemes. Road safety attributes can determine a user’s choice, especially if such information is easily accessible. It is important to note that fatal road accident rates are one of the largest in the world (Ladeira, et al., 2017). Just as in the case of time and distance, the existence of a divided highway and reduced number of fatal crashes can be correlated. However, a road can be divided and have a higher fatal crash rate than expected owing to other factors, such as lack of supervision, poor signage, pavement conditions, and irresponsible behavior. Pavement smoothness is also important because it affects the cost of maintenance and the replacement of vehicles that travel the road. Therefore, the combination of these three factors provides a derived variable, called “Road Safety”

2.2. Influence of Personal and Behavioral Factors

For predictive modeling in transport systems, it is necessary to analyze the personal and behavioral features of users (Jaensirisak et al., 2005). Behavioral models attempt to relate users’ basic motivations to the attributes of transport systems by addressing issues not achieved in conventional modeling (Carneiro, 2005). One of the premises of the behavioral approach is that the individual establishes, subjectively or objectively, a list of options in order of preference, and chooses the most desirable of these. From this assumption, we have the correlation with CT based on maximizing “Usefulness”.

The acceptance of congestion tolls depends on criteria related to efficiency and equity (Torres, 2007). Measuring efficiency usually uses aspects of infrastructure, but equity is better correlated with the impacts on the different user groups. This reinforces the question of needing to address users from the point of view of their personal and behavioral aspects. The intrinsic aspects of potential users are also relevant to understanding this phenomenon (Brito, 2007), and include the subgroups “Sex,” “Income,” “Tourism Travel,” and experience of driving on highways (“Experience in Highways”).

In this study, the effect of driving experience on a specific highway was adapted to a binary variable “Experience on a Specific Highway,” which refers to experience of driving on a specific road. The survey evaluated the frequency of travel for the past four years as a possibly important factor (“Frequency of Specific Experience”). In addition, is important to highlight the variable “Income,” which cannot be separated from the variable “Family Size,” which in this case refers to the number of family members. Taken together, we have the derived variable “Family Income per Capita,” which in this case is more representative of the purchasing power of respondents.

In addition, the survey included personal aspects such as “Age,” the respondent's region of origin (“Origin”), living place (“Residence”), sex (man or woman), and level of education (“Education”). Research carried out between the 2000 and 2001 with 830 respondents in London and Leeds indicated that people 55 years-old or more tend not to accept higher toll fees (Jaensirisak et al., 2005). Survey in Spain demonstrated that willingness to pay interurban toll roads vary across regions (Gomez et al., 2017).

The survey on the Stockholm urban toll indicates that more educated the people support the tool charge (Eliasson & Jonsson, 2011). Some studies (Walker, 2011; Eliasson & Jonsson, 2011) indicate that females usually have a more positive attitude to the acceptability of toll schemes. The place of residence was researched as a free field, but in the end, it was treated as a binary variable to indicate whether respondents lived in Brasília, to consider whether the residence could influence the responses.

Some variables come from MT, where it is necessary to evaluate the propensity of non-rational behavioral factors. An important aspect is the propensity to give preferences to a product or a service from famous brands companies that offer loyalty programs, called “Brand Loyalty.” The questionnaire aimed to identify potential users’ propensity for loyalty.

People are influenced in their decision-making by what others around them are doing in social and economic situations. People often decide on which store to buy from, which restaurants to eat at, or which schools to study at based on how popular they are. It is also the way investors in asset markets behave, a phenomenon known in behavioral finance as the “Herd Effect” (Araujo Neto & Freire, 2013). In this survey, questions were introduced that aimed to clarify the degree of susceptibility of respondents to follow the behavior of other potential users of toll roads.

A study developed in Brazil (Brito, 2007) identified that leisure trips (especially tourism) had estimated time values between 24% and 44% above those of traveling for other reasons, such as commuting and business. Therefore, this question was included in this study and converted to a binary type variable, “Tourism Travel,” with values of “yes” or “no.” For traveling times between 91 and 240 minutes, it was estimated that women drivers would have a “Time Value” about 15% higher than that of men.

Ideological factors were also considered in the list of behavioral factors, because many people do not consider the correct cost of using roads. In theory, it would be considered double taxation, because there are already high taxes to ensure the quality of the transport infrastructure, for example, the Economic Domain Intervention Contribution (CIDE) charged on fuel sales in Brazil. This aspect can lead respondents to make irrational decisions, at least from an economic point of view. It was not considered ethical to discard these questionnaires. Thereby to encompass that aspect, we created the variable “Favorable Ideology for Tolls,” where the respondents could indicate whether they are for or against paying tolls to build and maintain roads.

Some studies (Jaensirisak et al., 2005; Anas & Lindsey, 2011; Verhoef et al., 2008) show that drivers believe that toll road fees, beyond being used for the construction and maintenance of the road, should be used for other purposes that benefit communities or groups not directly linked to the infrastructure in question. In this case, resources could be used (or at least part of them) to finance public transport, or to counteract a specific transit tax or general tax bill. Thus, we include the variable “Favorable Ideology for Cross-subsidy,” which measures how much the person favors the expansion of toll revenues.

3. Materials and Methods

The development of models based only on the direct observation of behavioral choices has a number of limitations. Therefore, as an alternative, since the 1980s, discrete choice models incorporated the “stated-preference” (SP) method to collect and estimate data (Ortúzar & Willumsen, 2001).

3.1. Case Study – Route Brasília-Goiânia

From the theoretical framework, this research is based on the dependent variable “Fa” (toll road fee in a given scenario), which is estimated from the answers to a stated questionnaire (“Stated-Preference”) for potential users of the two route roads (link between the cities of Brasília and Goiânia) – an interurban route. The simulation considers a toll road (“Route A;” 160 km – Fig. 1) and a free road (“Route B;” 182 km – Fig. 2). “Route A” is duplicated and exhibits much better traffic conditions compared to “Route B” that is not duplicated, a condition that resembles scenario S4. The objective is to simulate better conditions of Route B to evaluate their competitiveness in the declared opinion of the interviewees.

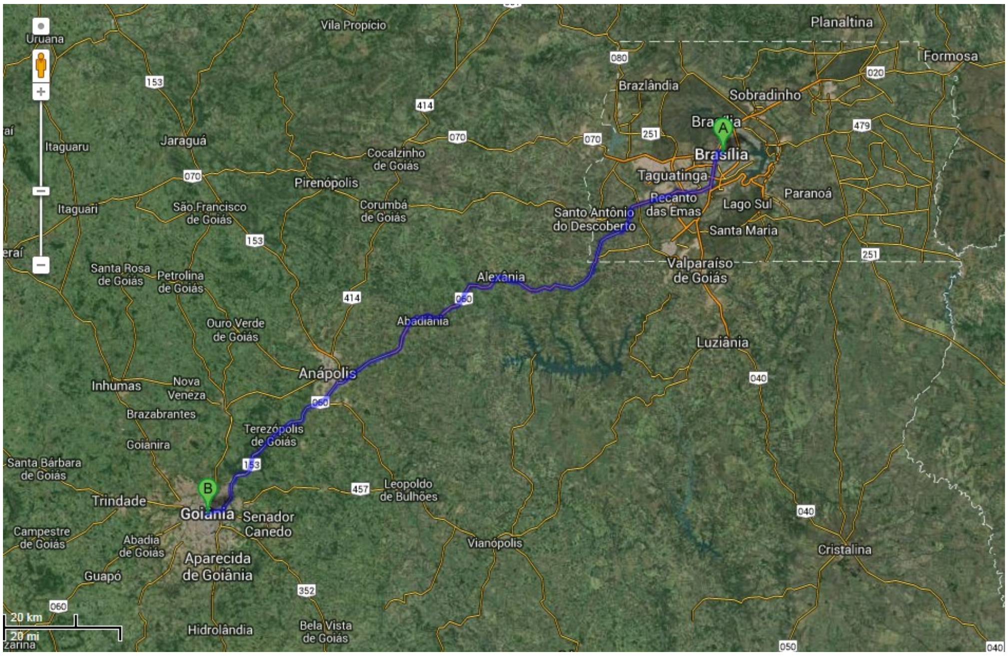

Fig. 1: “Route A” – Toll Road. Source: Google Maps.

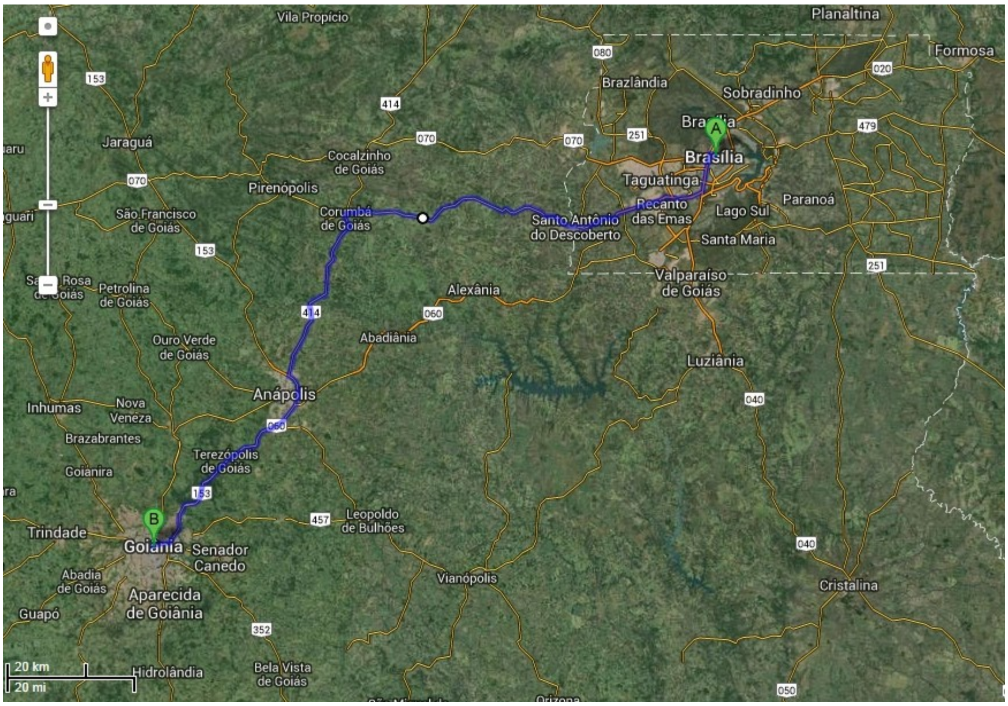

Fig. 2: “Route B” alternative to “Route A”. Source: Google Maps.

3.2. Research Instrument

A questionnaire was used to characterize the personal and behavioral aspects of potential users. Then, confronted with scenarios that gradually increase the “value” of the highway by increments of infrastructure attributes, we test the elasticity of acceptance of the maximum toll road fee (Fa) (Lopes, 2014). The instrument had 21 questions (Tables 1 and 2), with an estimated completion time of 10 minutes, a fact later confirmed by several interviewers. In total 241 questionnaires were obtained, between December 2013 and February 2014, from online respondents (Google Forms Questionnaire), which was sufficient to carry out this case study as exploratory due to some bias issues. The majority of interviewers are male (80%) and middle-class incomes (R$ 16.106,84 per month) was predominant.

Table 1: Questionnaire questions related to personal and behavioral factors.

Factor	Questions
“Age” (Ag)	How old are you?
“Origin” (Or)	What region were you born?
“Residence” (Rs)	Which city do you live in?
“Sex” (Se)	What is your sex?
“Income” (In)	What is the range of your monthly net family income?
“Family Size” (Fs)	How many people make up your family?
“Education” (Ed)	What is your educational graduation?
“Experience in Highways” (Eh)	Over the past four years, have you had any interstate road trips that require an overnight stay outside your home?
“Experience on the Specific Highway” (Es)	Have you travelled by car from Brasília to Goiânia or vice versa?
“Tourism Travel” (Tt)	If you have travelled by car from Brasília to Goiânia, or vice versa, please tell us the main reason for this trip (s)?
“Frequency of Specific Experience” (Fe)	How many car trips have you made between Brasília and Goiânia in the last 12 months?
“Brand Loyalty” (Bl)	Do you give preference to brands/companies products/services that offer loyalty reward programs?
“Herd Effect” (He)	Have you purchased a product? Was this based on other people’s choices?
“Favorable Ideology for Tolls” (Ft)	Do you consider the concession of highways an adequate solution for the improvement of the road infrastructure?
“Favorable Ideology for Cross-subsidy” (Fcs)	Do you consider it is adequate to increase the toll rates to finance other public expenditure?

Table 2: Questionnaire questions related with infrastructure factors (scenarios).

Scenario	Questions
Scenario S1A “16.5 minutes of Saving Time”	The total travel time between Brasília and Goiânia by highway today is greater than two hours. Consider that Route A (toll road) is 22 km shorter than Route B (free road), which causes a saving fuel of R$ 4.70 and travel saving time of 16.5 minutes. Imagine that both Routes A and B have the same maximum speed, with the same quality standard (road safety and pavement conditions). How much would you pay to use Route A?
Scenario S1B “35.7 minutes of Saving Time”	In addition to the previous advantages, Route A has a top speed of 100 km/h and Route B of 80 km/h, which provides a total saving time of 35.7 minutes in comparison to Route B. How much would you pay to use Route A?
Scenario S1C “51.7 minutes of Saving Time”	In addition to the previous advantages, Route B has significant congestion, which reduces its average speed from 80 km/h to 70 km/h, so the use of Route A provides a total saving time of 51.7 minutes. How much would you pay to use Route A?
Scenario S2 “51.7 minutes of Saving Time + Lower Fatal Crash”	In addition to the previous advantages, Route A has about half the number of fatal crashes in comparison to Route B. How much would you pay to use Route A?
Scenario S3 “51.7 minutes of Saving Time + Lower Fatal Crash + Divided Highway”	In addition to the previous advantages, Route A is a divided highway, which provides better safety and comfort conditions in comparison to Route B. How much would you pay to use Route A?
Scenario S4 “51.7 minutes of Saving Time + Lower Fatal Crash + Divided Highway + Pavement Smoothness”	In addition to the previous advantages, Route A has high quality pavements in comparison to Route B, which has poor rolling conditions. How much would you pay to use Route A?

4. Data Analysis

Users were told that when using the toll road, in addition to “Saving Time” they would gain R$ 4.70 on the trip by saving fuel (“Saving Fuel”). Thus, it is possible to create derived variables from the answers, the difference between the value given by the respondent in each scenario (acceptable toll road fee), less the value that would be gained by the fuel saving. The resulting value of this operation tends to be closer to the real monetarization of “Time Value” stated by respondents.

In conducting this procedure, we define the average “Time Value” of the S1C scenario (51.7 minutes of “Saving Time”) as an average value of R$ 3.43 (Table 3) which, converting the rate to 60 minutes (1 hour) results in R$ 3.98/h. Even if this is adopted as a parameter, the relative difference between Scenario S1A (16.5 min) and Scenario S1C (51.7 min), the estimated average time value of this comparison, would be R$ 3.74, for a “Saving Time” of 35.2 minutes, which converted to a rate of 60 minutes (1 hour) results in R$ 6.38/h.

The first hypothesis to be tested is whether the average responses in the scenario is different from the average responses in the previous scenario or in relation to the “Saving Fuel” value of R$ 4.70.

4.1. Critical Analysis of Sample Data

Before performing the statistical comparisons, it was verified the reliability of the research responses. It was used Cronbach’s Alpha Coefficient (CAC). The CAC is a data reliability model that analyzes the measurement scales and the extent to which the items are related to others. It measures the internal consistency, which means having reliability. The CAC should be 0.7 for a preliminary research, 0.8 for a basic research, and 0.9 for an applied research. A CAC of 0.7 is an ideal minimum, but we can accept 0.6 for exploratory research (Hair, 2009). The CAC of the variables regression modeling is 0.67, representing a satisfactory reliability.

After the CAC verification, normality tests were performed, which are used to determine whether a data set of a given random variable is well modeled by a normal distribution. The Kolmogorov–Smirnov, Anderson–Darling, and Shapiro–Wilk tests are performed for all scenarios. For analyzing the distribution curve, is recommend using the Kolmogorov–Smirnov test to compare populations of the paired samples (Barbetta et al., 2010).

For independent samples, is recommend the Signal Test of Mann–Whitney. The Anderson–Darling normality test compares the cumulative probability distribution. The Shapiro-Wilk normality test compares the posts ordered, not the cumulative distribution function, as in the previous two. The tests results did not meet the requirements of the normal distribution. Therefore, the average comparison had to be done by non-parametric tests.

4.2. Averages of Original Variables and Derived Variables

Non-parametric tests are chosen when the variables do not have a normal distribution. The necessary assumptions for the application of these tests are less severe than those of parametric tests, allowing for a broader application. Obviously, these more relaxed assumptions imply that the statistical power of a nonparametric test is less than the equivalent parametric test, but in many cases, they are the only alternative available for data analysis.

The present study uses the test for populations two, named signal tests. A signal test is when the observed variable has at least one ordinal a measure (Barbetta et al., 2010). The sign test is used to compare the center position of two population distributions. Thus, the test statistics were calculated from the average of the original scenarios, the derived scenarios, and scenarios by subgroups.

In Table 3, we show the value and the derived scenarios (variables) “Time Value Dif. S1C - R$4.70” (ST1), “Time Value Dif. S1C - S1A” (ST2), and “Dif. S4 - S1C” (ST3). The first two assess the relevance of the “Time Value” (monetary value of “Saving Time” in the toll road trip), compared with the “Saving Fuel” value of R$ 4.70 and the scenario with more “Saving Time” (S1C) with the lower S1A. Both the average measured values were statistically different for confidence levels of 95%. In the third derived scenario “Time Value Dif. S4 - S1C,” we analyze all scenarios if the infrastructure attributes (derived variable “Road Safety”) are statistically significant in the scenario with the greatest saving time, which we confirmed in Table 3.

Table 3: Average values and standard deviations of scenarios (in R$ - Brazilian Currency - December 2013).

Measure	S1A (R$)	S1B (R$)	S1C (R$)	S2 (R$)	S3 (R$)	S4 (R$)	ST1 (R$)	ST2 (R$)	ST3 (R$)
Average	4.38	6.20	8.13	9.36	10.54	11.69	3.43	3.74	3.56
Standard deviation	3.37	4.80	6.75	8.35	9.72	11.71	6.75	4.66	6.28

In the first scenario, the “Saving Fuel” value was larger than the average value of Scenario S1A, influenced by the high number of respondents who attributed value 0 (zero), even with a “Saving Fuel” value, one effect of the ideology against the toll road system. However, even with this group of respondents, starting from the Scenario S1B, the factor “Saving Time” was identified as one of the variables that can influence the value of the toll road acceptance.

4.3. Subgroup Average Comparison

To identify other factors influencing the acceptance of the toll road, it is necessary to study the personal and behavioral variables raised from the literature review. The procedure adopted was to determine whether the averages of the scenarios are larger or smaller, or the same, based on the different subgroups. To this end, because the test is for subgroups of the same variable, we use non-parametric tests for unpaired samples: the median of k samples and the Mann–Whitney U, in this case, with a 95% confidence level. Adopting this procedure, four variables (“Origin,” “Frequency of Specific Experience,” “Herd Effect,” and “Favorable Ideology for Cross-subsidy”) were discarded, because their median comparisons were shown to be null, and we could not conclude that it would influence the toll road fee acceptance.

In summary, the 11 influencing factors statistically identified for toll road fee acceptance are presented in Table 4, in addition to “Saving Fuel” which is input data in this simulation.

Table 4: Factors influencing the toll road fee acceptance statistically identified in the case study of the route between Brasília and Goiânia.

Aspects	Factors
Personals Aspects	“Residence;” “Sex;” and “Family Income per Capita.”
Behavioral Aspects	“Experience in Highways” “Experience on the Specific Highway,” “Brand Loyalty” (Test with confidence level of 80% instead of 95%); and “Favorable Ideology for Tolls.”
Infrastructure Aspects	“Saving Time” “Lower Fatal Crash” “Divided Highway” and “Pavement Smoothness.”

In addition to the variables identified in the statistical tests (Table 4), the variables “Age” and “Tourism Travel” were considered in the modeling, owing to their large average difference in the subgroups comparisons.

5. Linear Statistic Inference Modeling

The establishment of toll fees at fair prices is one of the factors that most facilitates the acceptability (Walker, 2011). A predictive model was developed using linear statistic inference modeling, using “SISREN” (PELLI SISTEMAS, 2017). The predictive modeling is summarized in eqn (1). The overall R-squared (R^2) = 32% (squared multiple correlation), and the goodness of fit is satisfactory, particularly for such an unfamiliar choice questionnaire. The most decisive variables were “Favorable Ideology for Tolls,” “Brand Loyalty,” “Family Income per Capita,” “Experience in Highways” and “Saving Time,” noting that the latter is influenced by the “Saving Fuel” which was given in the survey as an input.

$$
\begin{aligned}
&\text{Fa} = 34{,}10 - 0{,}08\ \text{"Ag"} + 0{,}06\ \text{"Rs"} - 0{,}32\ \text{"Se"} \\
&+0{,}05\sqrt{\text{"Fc"}} - 8{,}00\sqrt{\text{"Eh"}} - 1{,}96\sqrt{\text{"Es"}} \\
&-\frac{1{,}37}{\text{"Tt"}^2} - 7{,}46\sqrt{\text{"Bl"}} - \frac{5{,}12}{\text{"Ft"}^2} + 0{,}10\ \text{"St"} \\
&-\frac{1{,}74}{\text{"}Lc\text{"}^2} - \frac{1{,}59}{\text{"}Dh\text{"}^2} - \frac{1{,}53}{\text{"}Ps\text{"}^2}.
\end{aligned}
\tag{1}
$$

Where Fa: Acceptable Toll Road Fee (R$ - Brazilian Real - Currency);
Age (“Ag”): Respondents age (years);
Residence (“Rs”): If residence is Brasília (2) if not (1);
Sex (“Se”): If man (2) or if woman (1);
Family Income per Capita (“Fc”): Family Income per Capita (R$ per Month);
Experience in Highways (“Eh”): Recent car trip experience, yes (2) not (1);
Experience on the Specific Highway (“Es”): Car trip experience between the Brasília-Goiânia route, if yes (2) or if not (1);
Tourism Travel (“Tt”): If trip’s motivation is tourism (2), if not (1);
Brand Loyalty (“Bl”): If in favor of brands products or services (2), if not (1);
Favorable Ideology for Tolls (“Ft”): If in favor of toll road financing (2), if not (1);
Saving Time (“St”): Saving Time (minutes);
Lower Fatal Crash (“Lc”): If road with reduction of fatal accident (2), if not (1);
Divided Highway (“Dh”): If road with double lines (2), if not (1); and
Pavement Smoothness (“Ps”): If road with pavement smoothness (2), if not (1).

6. Comparison Between Simulation and Real Bid Data

The comparison between the statistical modeling with real values for the bidding concession process of this specific road segment showed that if there is a free alternative road, in good condition, competing with the toll road, the maximum toll fee accepted by users tends to be equal to the fee obtained in a competitive bidding process. However, if the free alternative road is not in good condition, then the maximum accepted toll fee can be much higher. The Brazilian National Land Transportation Agency (ANTT), Brazil's national regulator for the ground transportation sector, and awards infrastructure construction concessions for highways and railways did a toll road cost estimative of R$ 11.00 (sum tolls of the segment). Fortunately, during the bidding process there was a lot of competition and the winner bid toll road price was R$ 5.20.

A similar situation was obtained from the modeling of scenarios where the toll road offers only few advantages over the free road, for example Scenario S1B. The toll road value is R$ 6.20, very close to the real value after the competition. On the other hand, in Scenario S4, where the difference between the toll road and the free road alternative is larger, mainly because of road safety factors (Lower Fatal Crash, Divided Highway, and Pavement Smoothness). Then, the toll road value is R$ 11.69, which approaches the ceiling value estimated by the ANTT.

7. Conclusions

The results obtained in this exploratory study served to identify factors that may influence the acceptability of road toll fees. Considering the scenarios of the case study of the route between the Cities of Brasília and Goiânia. These factors were classified in aspects of road infrastructure (strongly related to “Road Safety”), personal and behavioral aspects, as demonstrated in the statistical comparisons made. This demonstrates that it is possible to estimate toll roads fee with different approaches, in addition to the financial value of an enterprise's expenses and revenues.

It was concluded that “Saving Time” is one of the factors influencing toll road fee, regardless of the value of “Saving Fuel”, thus overcoming this type of questioning faced in the study of Brito (2007). However, the monetary values of the “Saving Time” were much lower than those presented by Brito (2007), there was an expectation that these values would be of the order of R$ 16.30/hour, but the possible estimates with the collected data indicated values between

R$ 3.98/hour and R$ 6.38/hour in the different scenarios. Possibly due to overlapping effects of other factors of influence, such as “Saving Fuel” and infrastructure factors related to “Road Safety”.

One of the major insights learned is that in real bid competition situations, if an alternative highway exists with minimum standards of quality and location (free road), a strict price control by the government regulatory agencies is not so necessary, especially the evaluation of the construction and operational costs to ensure a fair fee. With a free road available, the balance between market forces tends to keep prices at reasonable levels. However, when the government agencies have to face schemes of cartelized companies, the precision of the cost estimate needs to be improved through the better detailing of projects (financial and engineering aspects), professional market research, reduction of restrictions, to new players’ participation in bids.

In the future, with the expansion of the study in other road scenarios with the proposed method, it will be feasible a better evaluation of the correlation effects between the independent variables.

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