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Airport terminal choice model

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Abstract
Most studies about air travel have dealt with individual issues such as fares, delays and other variables inherent in this mode of transportation, as well as why travelers chose the air mode against other modes, but little has been done to model how a traveler chooses an airport between two available options in a big city.
Currently a passenger from the city of Medellin - Colombia to some domestic destinations, has the option of traveling by either of the two airports, Jose Maria Cordova (JMC) or Enrique Olaya Herrera (EOH). This research presents the results of a stated preference survey in a discrete choice experiment, and based on this, a model by destination is obtained; for each one of these models multinomial logit and mixed logit were applied, and evaluated, for each model multinomial logit was chosen as the best.

Keywords: Discrete choice model, airports, air transport.

Modelo de elección de una terminal aeroportuaria

Resumen
La mayoría de los estudios del modo aéreo han tratado individualmente los aspectos de tarifas, demoras y demás variables inherentes a este medio de transporte, así como la elección del modo aéreo frente a otros modos, pero poco se ha hecho por modelar cómo un viajero elige un aeropuerto entre dos opciones disponibles en una gran ciudad.
En la actualidad un pasajero que parte de la ciudad de Medellín - Colombia a algunos destinos nacionales, tiene la opción de viajar por alguno de los dos aeropuertos, el José María Córdova (JMC) o el Enrique Olaya Herrera (EOH); esta investigación presenta los resultados de una encuesta de preferencias declaradas en un experimento de elección discreta, y partiendo de esto se obtiene un modelo por destino; para cada uno de estos se hallaron modelos logit multinomial y logit mixto; en cada trayecto evaluado se eligió el logit multinomial como el mejor.

Palabras clave: Modelo de elección discreta, aeropuertos, transporte aéreo.

1. Introduction

During the past few years air passenger transport has experienced a noticeable growth, which indicates the importance of studying the demand for this means of transport.

Many cities in the world have or are serviced by more than one airport (London, Paris, New York, Washington, Medellin, etc.). Even though choice models have been studied between planes and trains, planes and cars, planes and busses, Very few variables are found in the literature which influence the choice of an airport terminal, in the cities which have two airports, given that a user has already decided to use the air mode. In this article the econometric considerations are addressed to estimate the demand that each of the airports would have for different journeys on domestic flights.

This research is illustrated with the particular case of Medellin and its metropolitan area, Since this area has two airports, the Enrique Olaya Herrera located in the city of Medellin and the José Maria Córdoba located 40 kilometers from the metropolitan area, both airports have direct competition since airplanes can depart from both airports to common destinations.

This article shows the different applications of economic principles in choosing an airport. Microeconomic theory applies due to the consumer decision-making to maximize utility, given a series of restrictions. This is how an air travel passenger has the option of travelling to Bogota by any of the two available airports in the city of Medellin, keeping in mind that both terminals offer a variety of rates, besides the time and cost that the user experiences to travel to each one of them.

The article contains 6 sections. In section 2 is a state of

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art review, in which the theory of the discreet choice models is presented and will be used to study the choice between the two closest airports. Among the possible models the Multinomial Logit model and mixed Logit are analyzed; through these models the behavior of individuals faced with the two alternatives can be analyzed. At the same time, the subjective value of the time given by each selected model can be determined. The Biogeme program is used for the survey process and for obtaining the model. Section 3 presents the applied methodology for the study and the application case to the city of Medellin. Section 4 presents the different models developed for several common journeys, which are also discussed. In section 5 the most relevant conclusions are extracted and the recommendations for future research. Finally in the last section, the bibliographic references are presented.

2. State of Art review

According to civil aeronautics, passenger transportation in Colombia over the past decade has duplicated the number of travelers, national passenger mobilization figures went from 7,854,000 to 14,627,000 between 2001 and 2011. For international flights [1], the numbers also duplicated in the same period of time and went from 3,060,000 to 6,960,000. 2010 is considered to be the year of highest growth in aviation market history, over the previous year, the domestic level increased 30.3%, mobilizing a historic peak of 13.2 million passengers annually; the international market has mobilized about 6.2 million passengers, growing 11.5% compared to 2009 [1]. Of the 21 million passengers that Colombia mobilized in 2011, 6 million did so, through the two airports that are in the metropolitan area. [1]

2.1. Modeling demand at airports

Within the framework of an air transport company, marketing must perform certain functions designed to analyze and understand the market where the company is moving, identify customer needs and promote and develop a demand for the company's products. The knowledge of the markets, which is consistent with strategic marketing, will allow firms to tailor their offerings to the market. [2]

The aviation industry's strategic planning is based on the demand of the routes. The prediction of passengers expected to travel is important and it make necessary the use of models. The discret choice model development applied in airports, gives airlines and airport operators an important understanding in the different factors concerning service. Improving the service is possible to increase the participation in the air transportation market [3].

The model for choosing airport terminal represent a support in making decisions, for example, they can help to analyze new routes, in reducing connection times, in price analyzing, in flight programming and profitability efficiency. An airport terminal choice model is an effective tool for planning and decision making for both tactical and strategic levels.

Previews studies have helped greatly in understanding the connection between the attributes of the flight and air mode choice. A multinomial logit model was developed by Algers and Beser [4] for flights and class reservations, while Proussaloglou and Koppelman [5] modeled the simultaneous choice of airline, flight, type of ticket taking out the balance between market presence, quality service, frequent flight membership programs, rate categories, flight restrictions and flight programming. Logit models were obtained in previous works; the costs for passengers who were willing to pay for a higher class ticket or to travel on a membership airline in the frequent flyer program were estimated.

Coldren and Koppeman estimated that route choice models were measured by the exceptional service impact provided by airlines of each route using an added logit model (MNL); these MNL are suitable to describe the attribute service impact in the chosen airport terminal. However, the implied competition between airport terminals is assumed to be consistent when its function is with MNL, this is shown by a well-known property of the MNL model, the independence of irrelevant alternatives, establishes that the probability of choosing any airport is an independent indication. Proussaglou and Koppelman [5], and Parker and Walker [6], formed and evaluated schedule delay impact, which indicates the difference between the passengers preferred flight time and the flight hours offered. These schedule delay studies indicate a negative impact probability in choosing a particular flight. Proussaglou and Koppelman [5] also showed that delays affect business travelers more than pleasure travelers, just like affect passengers who take flights that take off before and after their preferred flight time. Parker and Walker [6] use a non-linear function to evaluate the increasing delay effect between take off time and route usage.

The studies mentioned above are due to two general categories: studies based on official information with a high geographic gathering level or limited to few Origin—Destination pairs, or survey studies implementing both with revealed preferences and stated preferences and information covering a very limited Origin—Destination pair number. In both cases, studies consider that for on Origin—Destination pair, is from one airport and the Origin choice problem is not studied. The only work found, is from Mendieta and Cantillo [7] who determine an airport terminal choice model, but using shown preferences.

2.2. Discreet choice models

Discrete election models are based on the random utility theory, which is based on the principle that the probability of a given option being chosen by an individual is dependent on socio-economic characteristics and the relative attraction of the option [8]. The utility is formed considering the deterministic component observed by the analyst, and an unknown random component. In each alternative, the utility function of the deterministic component is represented according to its attributes, such as flight time and cost of the trip, and also the characteristics of the passengers (age, gender, income, occupation, etc.).

The transportation models were initially developed based on added approaches, but the use of disaggregated discreet choice models was to calibrate them. The test shows that the indirect use of alternative *j* for an individual *q, Ujq*, is represented by the sum of a known term known by the modeler and a random term [9], as shown in equation 1:

$$U_{iq} = V_{iq} + \varepsilon_{iq} \tag{1}$$

Viq belongs to a measurable utility part, which is the alternative attribute function and the individual characteristics and *εiq* a random error which includes all unknown factors or were not taken into account by the modeler.

2.2.1. Multinomial logit model

The random utility theory considers that the individual chooses the maximum utility alternative, which is choosing option *i* (see equation 2):

$$U_{iq} \geq U_{jq} \tag{2}$$

The probability of the alternative is *Piq*, of mode *i*; being chosen by individual *q*; among all *j* alternatives, is given by equation 3: [10]

$$Piq = \frac{e^{\beta \sum_k \theta_k X_{ikq}}}{\sum_j e^{\beta \sum_k \theta_k Xjkq}} \tag{3}$$

The model estimation is to find the coefficients *θk* that more often generate the watched sample; which are most likely to maximize the possibility of an observed event. The parameter *β* is invaluable and that is why it is incorporated with the coefficient *θk* in one parameter. *Xikq* is the vector of *k* socioeconomic characteristics of the *q* individual (gender, age, income, etc.) and the alternative attributes *i* (time, fare, etc.).[10]

2.2.2. Mixed logit model

The mixed logit is presumably a *Uin* utility function, formed from different components such as; deterministic *Vin*, a random component *εin* independently and identically distributed, and one or more additional random terms *ηin*.Therefore, the utility function is defined in equation 4

$$\mathrm{U}_{\mathrm{in}} = V_{in} + \eta_{in} + \varepsilon_{in} \tag{4}$$

The most interesting characteristic of this model is that, under certain conditions, any random utility model is likely to chosen to be approximately as close as wanted by a mixed logit [10].

3. Case study

3.1. Methodology

The methodology consist in five steps. In the first step it was necessary to define a region with two airports in a metropolitan area of a city, with some common destination journeys.

In the second step, a survey was designed with basic information revealed (RP) about the socioeconomic characteristics of the traveler, and another Stated Preferences (SP) survey that permits to capture the sensibility and different variables in a customer's hypothetical case was also design.

In the third step, the pilot test was performed and the survey is corrected with changes to be considered.

In a fourth step, a revealed preference (RP) and stated preference surveys were carried out. The (SP) consists of questions about decisions (airport chosen) that the individuals eventually make under a series of fictitious aspects, proposed by the investigator according to his objectives. In this case, different situations were investigated to make a trip through any of the two airports considered; such situations are caused from the different values of attributes that are investigated; such as the ticket cost (CT); the trip to the airport cost (CD), and the traveling time to the airport (TV), which is a new variable in this type of studies, as shown in previous studies above, studies focus on comparing routes that are related to different airlines that serve an airport, discreet choice models are obtained through the development of this investigation, which permits customers to know the differences between costs and travel times to two airports competing from the origin of the trip.[11]

Each of the three variables mentioned (CT, CD and TV) is divided in three levels; high, medium and low. The SP survey design details are in Muñoz [11]. See Table 1 and Table 2

Table 1.
Levels of the attributes in Medellin – Bogota Journey

Level / Aiport	Ticket cost (CT) USD			The trip to the airport cost (CD) USD			Traveling time to the airport (TV)		
	0	1	2	0	1	2	0	1	2
JMC	67	83	100	6	14	33	00:40	00:50	01:00
EOH	40	106	122	6	8	12	00:15	00:20	00:30

Source: Adapted from [11]

Table 2.
Levels of the attributes in Medellin – Cali Journey

Level / Airport	Ticket cost (CT) USD			The trip to the airport cost (CD) USD			Traveling time to the airport (TV)		
	0	1	2	0	1	2	0	1	2
JMC	62	78	94	6	14	33	00:40	00:50	01:00
EOH	72	103	133	6	8	12	00:15	00:20	00:30

Source: Adapted from [11]

Table 3
Variables contained in the survey

Variable	Description
CT	Ticket cost
CD	Trip cost to each airport
TV	Travel time to get to the airport
SEX	Gender: 0 (man), 1 (woman)
ED	Age: 0 (<= 50), 1 (> 50)
VI	One way trips made per year : 1 (0-5 trips), 2 (6-10 trips) and 3(>11 trips)
TR	Reservation time: 1 (0-5 days), 2 (6-10 days), 3 (> 11 days)
MOTAG	Reason for the trip: 1 (Employment or Business), 0 (otherwise)
NAVAG	Type of airplane preferred for the travel: 1 (<= 100 pax), 0 (> 100 pax)
VPAG	Who pays the ticket: 1 (respondent), 0 (Company or other person)
DVAG	Who chooses the airport: 1 (respondent), 0 (Company or other person)
MTAG	Type of transportation used to get to the airport: 1 (Private), 0 (Public)
ACAG	Number of companions: 1 (alone), 0 (Accompanied)
EQAG	Luggage: 1 (without luggage), 0 (with Luggage)
ESAG	Socioeconomic level: 1 (low level (1-2-3)), 0 (high level (4-5-6))

Source: Adapted from [11]

Nine (9) different situations were put in the survey and each airport was represented in terms of ticket cost (CT), the trip cost to each airport (CD) and the travel time to get to the airport (TV). In the survey development several variables were taken into account; such as gender (SEX), age (ED), one way trips made per year (VI), reason for the trip (MOTAG), socioeconomic level (ESAG), type of transportation used to get to the airport (MTAG), Luggage

(EQAG), reservation time (TR), type of airplane preferred for to travel (NAVAG), who pays the ticket (VPAG), who chooses the airport (DVAG) and number of companions (ACAG).[11]

The variables contained in the survey are explained in Table 3 with their classification parameters

Finally all information is gathered and the model is generated, and different structures are tested, then results are compared between them to get the best model for each Origin—Destination.

3.2. Application case

The airport passenger transportation market research was developed for passengers on routes from the Medellin metropolitan area to the main populated Colombian cities: Bogotá (IATA: BOG) and Cali (IATA: CLO), for the choices of the passengers in the Medellin metropolitan area, leaving from the airport terminals: Airport Jose Maria Cordoba (IATA: MDE) and the Enrique Olaya Herrera (IATA: EOH) from Medellin, which is the only Colombian state capital that has two airports.

In 2012 the Medellin metropolitan area had 3.5 million inhabitants, Bogota more than 7 million inhabitants and Cali more than 2 million inhabitants, these being the three biggest urban areas in Colombia. These three urban areas combined cover over a third part of the county's population. [1]

Surveys were conducted in the waiting rooms of each airport (JMC and EOH). From 9 presented cases to 120 people with a destination to Bogota, 1,080 observations were obtained for the Bogota destination and 80 people with a destination to Cali, 720 observations were obtained for Cali, with this information two databases were built for each destination, in order to feed the BIOGEME program [12], and to begin modeling.

4. Results and discussion

4.1. Model estimation for each journey.

Several models with different specifications were tested; these models vary in the number of estimated variables; the model is initially adjusted from the information obtained in the SP surveys for both journeys Medellin—Bogota and

Table 4.
Value of the parameters in each Journey

Variable	Parameter	Medellin-Bogota Journey MNL Value	Medellin-Bogota Journey MNL Test-T	Medellin-Bogota Journey ML Value	Medellin-Bogota Journey ML Test-T	Medellin-Cali Journey MNL Value	Medellin-Cali Journey MNL Test-T	Medellin-Cali Journey ML Value	Medellin-Cali Journey ML Test-T
	β1	-0.369/	0.97	-0.153	(-0.50)	0.994	(-2.04)	1.09	(-2.1)
	β2	Fixed		Fixed		Fixed		Fixed	
CT	Θct	-0.0000141	(-8.03)	-0.000013	(-7.60)	-0.000012	(-6.85)	-0.0000127	(-6.32)
CD	θcd	-0.0000157	(-4.68)	-0.0000164	(-4.72)	-0.0000186	(-3.98)	-0.000025	(-2.88)
TV	θtv	-0.0167	(-2.32)	-0.021	(-2.97)	-0.0205	(-2.03)	-0.0227	(-2.11)
SEX	θsex	0.514	3.31	0.507	3.34				
ED	θed	0.871	4.62	0.365	2.1				
MOTAG	θmotag	0.458	2.72	0.582	3.6	0.888	(-4.08)	0.939	(-4.02)
NAVAG	θnavag	0.485	2.37			1.26	(-5.13)	1.33	(-4.98)
MTAG	θmtag	1.05	6.5	0.681	4.42				
TR	θtr	0.256	2.7			0.437	(-2.73)	0.446	(-2.64)
ESAG	θesag					0.709	(-3.25)	0.727	(-3.15)
Sigma				0.00000263	0.12			-0.0000247	(-1.67)
Likelihood ratio	**Lθ**	-597.962		-608.903		-327.42		-326.843	
Rho square	**ρ^2**	0.201		0.187		0.344		0.345	

Source: Adapted from [11]

Medellin—Cali, different aspects were tested for the utility function, where many of the variables were statistically important at 95% confidence. The Multinomial Logit (MNL) and the Mixed Logit (ML) models were used for both journeys, of which the best two can be seen in Table 4.

For the Medellin—Bogota trip, in all cases is that the signs are as expected; applying the t-student test, $T>|1.96|$, it can be noted that all the parameters are important, except for the mixed-logit model sigma, besides, the MNL has a better value for the statistics test ρ^2, that is why the MNL model was chosen as it has the highest significant variable level within 95% of confidence and for the likelihood ratio test.

The MNL production model, which is better for the Bogota destination is shown in equations 5 to 8. The specific constant of EOH airport in the model becomes zero to initialize the model.

$$U_{JMC} = \beta_{JMC} + \theta_{CT}CT_{JMC} + \theta_{CD}CD_{JMC} + \theta_{TV}TV_{JMC} + \theta_{SEX}SEX + \theta_{ED}ED + \theta_{NAVAG}NAVAG \quad (5)$$

$$U_{EOH} = \beta_{EOH} + \theta_{CT}CT_{EOH} + \theta_{CD}CD_{EOH} + \theta_{TV}TV_{EOH} + \theta_{MTAG}MTAG + \theta_{TR}TR + \theta_{MOTAG}MOTAG \quad (6)$$

$$U_{JMC} = -0.369 - 0.0000141CT_{JMC} - 0.0000157CD_{JMC} - 0.0167TV_{JMC} + 0.514SEX + 0.871ED + 0.485NAVAG \quad (7)$$

$$U_{EOH} = -0.0000141CT_{EOH} - 0.0000157CD_{EOH} - 0.0167TV_{EOH} + 1.05MTAG + 0.256TR + 0.458MOTAG \quad (8)$$

The subjective time value is the effort that each person has to expend to reduce their travel time or the compensation that they are prepared to receive for loosing time. The subjective time value is estimated (STV) using the $\theta TV/\theta CD$ equation.

The subjective time value for the Medellin—Bogota journey is calculated in Equation 9.

Taking the representative market rate 1USD=2,000COP

$$STV_{Bogotá} = \frac{-0.0167}{-0.0000157} = 1{,}063COP/\min \quad (9)$$

This cost is close to 0.53 USD/min or 32 USD/hours.

For the Medellin—Cali journey the MNL and ML [8] models were calculated. The MNL model is the only one that satisfies the condition that its variables are statistically important at a 95% confidence level; all models have consistency with the principal variable signs, as shown in Table 4.

The best model is the MNL model, which shows the best rho-square (ρ^2) and the L *(θ)* value test and for a likelihood ratio test.

The MNL model production, according to the above is the best for the Cali destination, as it is described in equations 10 to 13.

$$U_{JMC} = \beta_{JMC} + \theta_{CT}CT_{JMC} + \theta_{CD}CD_{JMC} + \theta_{TV}TV_{JMC} + \theta_{ESAG}ESAG \quad (10)$$

$$U_{EOH} = \beta_{EOH} + \theta_{CT}CT_{EOH} + \theta_{CD}CD_{EOH} + \theta_{TV}TV_{EOH} + \theta_{TR}TR + \theta_{MOTAG}MOTAG + \theta_{NAVAG}NAVAG \quad (11)$$

$$U_{JMC} = 0.994 - 0.0000120CT_{JMC} - 0.0000186CD_{JMC} - 0.0205TV_{JMC} + 0.705ESAG \quad (12)$$

$$U_{EOH} = -0.0000120CT_{EOH} - 0.0000186CD_{EOH} - 0.0205TV_{EOH} + 0.437TR + 0.888MOTAG + 1.26NAVAG \quad (13)$$

The estimated time value for the Medellin—Cali journey is indicated in equation 14. This cost is close to 0.55 USD per minute or 33 USD/ hour.

$$\mathrm{STV_{Cali}} = \frac{-0.0205}{-0.0000186} = 1{,}102COP/\,min \quad (14)$$

4.2. Predictive Analysis.

Airport terminal market fees can be calculated with the best chosen and estimated model, which means, the probability that each analyzed airport is chosen to perform each selected route.

Yearly average information has been taken from the accomplished flights in order to improve the model. In all the survey aspects, costs and time were generally taken into account; In addition the statistical analyzes were taken into account as described in Muñoz, [11], which were basis for analyzing the respondents behavior and were used to assign the variable values in the utility function.

Table 5 indicates the market share in the Medellin—Bogotá journey and, for the values of the variable presented, the probability of JMC could be chosen is 40% and for EOH is 60%. Even though even though the probabilities presented are the result of predictive analysis based on user choices actually JMC daily frequencies are 6 times more than EOH, and current demands hold the relation 80/20 between both (JMC/EOH) airports. This fact shows that many users look for or request a flight initially in EOH, but because of the flight necessity they are forced to travel from JMC. This is due to the fact that EOH, being within the city, has schedule limitations from 6pm to 6am, and restrictions on types of planes; additionally the fares to Bogota and Cali are limited and their availability decrease rapidly on the time

Table 5.
Market fees for the Medellin—Bogotá trips

AIRPORT	VARIABLE	COST	β	UTILITY	PROB.	No. PAX/Year potencial
JMC	Ticket Cost (**CT**) USD	75	-0.369	-3.27	40%	374,878
	Travel Cost (**CD**) USD	25				
	Travel time to the Airport. Min (**TV**)	60				
	Sex (**SEX**)	1				
	Age (**ED**)	0				
	Types of planes (**NAVAG**)	1				
EOH	Ticket Cost (**CT**) USD	110	0	-2.88	60%	555,350
	Travel Cost (**CD**) USD	5				
	Travel time to the Airport. Min (**TV**)	20				
	Transport means to get to the Airport (**MTAG**)	0				
	Reservation time (**TR**)	1				
	Purpose of the trip (**MOTAG**)	1				

Source: Adapted from [11]

Table 6
Market fees for the Medellin—Cali trips

AIRPORT	VARIABLE	VALUE	β	UTILITY	PROB.	No. PAX/Year potencial
JMC	Ticket cost COP (**CT**) USD	80	0.994	-3.65	7%	7,657
	Travel cost COP (**CD**) USD	25				
	Travel time to the Airport. Min (**TV**)	60				
	Level (**ESAG**)	0				
EOH	Ticket cost COP (**CT**) USD	115	0	-1.04	93%	104,135
	Travel cost COP (**CD**) USD	5				
	Travel time to the Airport. Min (**TV**)	20				
	Reservation time (**TR**)	1				
	Purpose of the trip (**MOTAG**)	1				
	Types of planes (**NAVAG**)	1				

Source: Adapted from [11]

The airport terminal market fees in the Medellin—Cali journey, present a notable change between one and other, the probability to choose JMC is of 7% and for EOH is 93% as shown in Table 6, this situation is due to the fact that users indirectly know that both airports offer almost the same services, that´s why EOH is preferred, but in reality both demands are similar, showing again a transfer to JMC for the travel necessity and the insufficient flights in EOH to meet the demand

4.3. Result Analysis

Given the differences in frequency for different services and different rates a destination model was achieved that shows why it was necessary to separate each model by destinations. This is how two new models appeared which will be presented next.

4.3.1. Utility function for the Medellin—Bogotá journey

Based on the described models in equations 7 and 8, in which the gender (SEX) variable is included, for women this represents a utility increase value travelling by JMC, this may be because for them the terminal represents comfort, better schedule options, having the possibility of taking another flight in case they lose the reserved one, fewer airport closures due to bad weather factors, etc., elements which were not evaluated in the investigation. The age (ED) variable shows a utility increase in the JMC for older users in the age of 50, this situation shows that travelling by this airport represents better convenience for users, also more comfort in the waiting areas, a favorable situation for people of that age.

Making a trip from JMC airport represents a bigger utility factor for people who don´t mind in what type of plane they travel in. Since JMC has all types of aircrafts, while the EOH is restricted for having aircrafts for certain passengers, this due to NAVAG (type of aircraft) variable, indicating when users are indifferent as to which type of plane they prefer to travel in. There may be some relation between this and the previous sex and age aspects, but this interaction was not investigated, there is generally a perception that big aircraft at JMC are safer and more comfortable than the small and medium aircraft that operate in the EOH airport.

The MTAG variable (transportation means for arriving to the airport) represents better utility for people who travel in their own car to arrive at the EOH airport. This situation is because that airport terminal is within the city, so travelling there is easier by car, while getting to the JMC airport by car is more expensive, since this airport is more distant from the city (50 minutes) and represents a bigger fuel, toll and parking expenses (only the toll is 16,000 COP or 8 USD round-trip).

For the TR (reservation time) variable, the utility is better for the EOH airport if reservation time is done with enough time in a ticket towards Bogotá, in this way is possible to get better air fares, which generally are higher than the JMC fares. According to air fare terms it is clear that travelling by the EOH airport is more expensive as shown in the MOTAG (reason for the trip) evaluation, because a great percentage of work or business trips are done by employees whose companies pay for their air tickets.

4.3.2. Utility function for the Medellin—Cali journey

Analyzing Equations 12 and 13 for Medellin-Cali journey, the ESAG (level of earn) variable, people with lower income have better utility travelling by the JMC airport because they can find several airlines traveling to Cali, which indicates a possible price war that is reflected in the users benefit, since lower rates can be found at the EOH airport.

For the NAVAG (aircraft type), travelling by the EOH airport represents better utility for people who prefer to travel in planes with less than 100 passengers, a related situation is that only small aircrafts land in this airport. According to the TR (reservation time) variable behavior within the utility function, indicates that if the ticket is booked with enough advanced time, this represents a better utility if it´s done by the EOH airport, since with this measure it is possible to get better air fares. The same as for the Bogotá destination with the MOTAG (reason for the trip) variable, in air fare terms is more expensive travelling by the EOH airport, but if it´s a work trip, the EOH airport represents better utility for the user, this is due to the fact that most work or business trips are reserved though companies who also pay the air ticket.

4.4. Subjective time value

The subjective time value for the evaluated journeys presents a high value, this shows that, in general, people who use air transportation have high incomes, and can afford this means of transportation, which is expensive compared to other means. In addition to this analysis, when companies pay for the employee´s ticket, they also pay for transportation to arrive to the airport, this also adds a high time value, since the user does not matter the high ticket cost or the transportation means to the airport, this way behaving as a high income level user.

It can be observed that for the Medellin—Cali journey and for the Medellin—Bogotá journey the subjective time value is similar, which is very consistent with the type of users who use the air mode, this means high value time travelers, with 1,100 COP per minute value, or 66,000 COP per hour (33USD per hour), when medium urban class travelers range between 30 COP and 300 COP per minute (0.9 to 9 USD per hour).

5. Conclusions

Air travel choice generally depends on time and cost, as well as the transportation means characteristics, such as land transportation, the poor roads condition, road safety, inconvenience and travel time, makes air travelling consuming increase.

The approach in this article has been to use discreet choice models for the air transportation topic of passengers that contribute to this field of research; which also opens doors to future applications, not only in air transportation area, but for other fields of interest.

When deciding which alternative airport to select, users evaluate ticket cost, airport travel cost and time. The multinomial logit and the mixed logit models were made from all the information collected from the chosen survey, after evaluating and comparing all models, it was noticed that the best model for both destinations was the multinomial logit model; these models show the main factors that impact the user when deciding by which airport they should travel from. Choice models were found for the Medellin-Bogota and Medellin-Cali journeys, which both have relevant common variables; such as ticket cost, the arrival cost to each terminal, travel time to each airport, type of aircraft, backup time and the purpose of trip. In addition, there were also some particular variables which were significant in each model, like for the Medellin—Bogotá journey the gender and age of the traveler is important, as is the means of transportation used to get to the airport. The socioeconomic level also influences in the Medellin—Cali journey.

As a result in the subjective time value calculations which were performed for both destinations, finding costs over 1,100COP/min (0.55 USD/ min), which shows that most air travelers have high incomes and can access this means of transportation, which is expensive comparing to other transportation systems.

It is recommended in future studies, to use the revealed preference results, and the stated preference models in order to obtain stronger models which take advantage of each type of models strengths. Models could also be estimated with users resident in destination cities, to determine how they choose from their cities to which terminal they should travel to or from and which terminal they should return to if the city that has two terminals, even though many non-local travelers don´t have the complete information about the location of both terminals.

In future projects should include latent variables perceived as customer satisfaction and personality variables in order to obtain more powerful models.

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