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Original Research Article

Modelling state preferences among airline travellers in Namibia: a case study at Eros airport and Hosea Kutako international airport

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ABSTRACT

Stated preference experiments are become an increasingly popular survey methodology for investigating air travelers' choices. Analysis of this behaviour, which is an element of the demand prediction, helps for a better future planning and development of competing airlines. In this paper, emphasis is stressed on the stated preferences of passengers in choosing between low cost carriers (LCC) and full service carriers (FSC). A binary logit, probit and latent class models were employed on the primary data collected from departing air passengers at Eros and Hosea Kotako International airport in Windhoek, Namibia, to model passengers' stated preferences and examine the determinants of carrier choice between LCC and FSC in Namibia. Major findings show that airfare, age, income, and purpose of travel are significantly important with respect to passenger choice. Furthermore, it was observed that passengers have different preferences for different destination region be it domestic, regional and international. For domestic and regional flights (short haul) they prefer LCC, while for international flights (long haul) they opted for FSC. In addition, majority of the passengers were travelling for business purposes, hence their tickets were bought by their respective employers. Most passengers indicated that they were willing to fly LCC if it was available in Namibia because of it's low fares. There was an indication that air tickets were not affordable and these are a big concern to passengers. Presumably, if ticket prices can come down or introduce a LCC in Namibia then many will consider flying. This study concluded that, based on the interviewed passengers' profiles, the best and appropriate carrier in Namibia is a low-cost carrier. Introducing a LCC in Namibia might be a viable alternative which may ensure sustainability.

1. Introduction

Discrete choice models, such as the binary logit and multinomial logit, are used to predict the probability a decision-maker (often an individual, group of individuals or corporates) will choose one alternative among a finite set of mutually exclusive and collectively exhaustive alternatives. Currently, there is a growing interest in applying discrete choice models in the airline industry. This interest is driven by the desire to more accurately represent why an individual makes a particular choice and how the individual makes trade-offs among the characteristics of the alternatives.

Integrating discrete choice and other models grounded in behavioural theories with traditional revenue management, scheduling, and other applications is also being driven by several factors, including the increased market penetration of low-cost carriers, wide-spread use of the internet, elimination and/or substantial reduction in travel agency commissions, and introduction of simplified fare structures by network carriers (Garrow, 2010). The presence of low-cost carriers has reduced average market fares and increased the availability of low fares. Moreover, Garrow (2010) indicated that the internet has reduced individuals searching costs and made it easier for individuals to both find these fares and compare fares across multiple carriers without the assistance of a travel agent. In addition, the elimination of commissions has

removed the incentive of travel agencies to concentrate sales only on those carriers offering the highest commissions.

According to Garrow (2010), the introduction of simplified fare structures by network carriers was motivated by the need to offer products competitive with those sold by low-cost carriers. Often, low-cost carrier products do not require Saturday night stays and have few fare-based restrictions. However, these simplified fares have been less effective in segmenting price-sensitive leisure passengers willing to purchase weeks in advance of flight departure from time-sensitive business passengers willing to pay higher prices and needing to make changes to tickets close to flight departure. All of these factors have resulted in the need to better model how passengers make purchasing decisions, and to determine their willingness to pay for different service attributes. Moreover, Garrow (2010) further detailed that unlike traditional models based solely on an airlines internal data, there is now a perceived need to incorporate existing and/or future market conditions of competitors when making pricing, revenue management, and other business decisions.

A wide range of studies have investigated air travel choice behaviour. Mamdoohi et al. (2013) used binary logit to model the origin airport choice of resident and non-resident travellers' from the city of Tehran. Results show that the difference in the two groups is affected by "age", "income", "travel Destination", "trip Purpose" and "marital Status". Further model results show that variables "public access", "flight frequency" and "airport tax" are more important for non-resident air travellers' in choosing their origin airport. Ashford and Bencheman (1987) developed a multinomial logit model to analyze air passengers' choice in central London. This study showed that for business and inclusive tour travel, the most important variables of choice were access time to the airport and frequency to the chosen destination. For domestic and leisure trips, there were three factors: airfare, access time, and frequency of available flights, in that order of importance. Davidson and Ryley (2010) performed a binary logit modelling in airport choice in which the air fare was the most meaningful variable whereas the travel time was the second one. Hess and Polak (2005) extended a mixed multinomial logit model to analysis of the choice of airport, airline and access-mode for travellers' living in the San Francisco Bay area. Results indicated that the most important variables affecting travellers' choices were in-vehicle access time, access-cost and flight frequency.

In a related study, a binary logit was used for airport selection in which the most meaningful variables were airfare, access time and frequent flyer benefits (Hess et al. 2007). Another study by Pels et al. (2001) developed a nested logit model to investigate low-cost airline and airport competition in greater London. They analyzed most important factors affecting air travellers' choices such as airfare, surface-access costs and frequency. In a related study, Stefano (2012) used discrete choice random utility models (multinomial logit, mixed multinomial logit and cross-nested logit models) to investigate and model airport choice behaviour in a multi-airport region in Campania, southern Italy. He found that access time, airfare, age, experience and income were the most significant variables.

When passengers choose a carrier, they may base their decision on a combination of factors, including the airline's market presence, schedule convenience, low fares, on time performance, re- liability and the availability of frequent flyer programmes (Proussaloglou and Koppelman, 1999). Hess et al. (2007) studied the airport and airline choice behaviour with the use of stated preference survey data. This paper analyzed factors affecting passenger choice behaviour, including air fare, access time, flight time and airline and airport allegiance using multinomial logit model. Similarly, Pels et al. (2003) used nested logit model and found that passengers are sensitive to fare, frequency, airport access time and airport access cost. Later, same authors studied the competition between full service and low-cost airlines by analyzing the demand structure. They estimated not only the competition for passengers occurring between airports and airlines, but also the own-and cross-price elasticities based on a nested logit model (Pels et al. 2009). There are significant differences in choice behaviour between business travellers' and non-business travellers (Chang and Sun, 2012). Most business travellers have strict requirements regarding travel time and will seldom strive for lower prices because they are restricted by time inflexibility. On the contrary, leisure travellers' will choose the lower price among two acceptable flight choices (Xiao et al 2008). Overall, discrete choice models provide one framework for accomplishing these objectives. In this study we model stated preferences among airline travellers in Namibia.

2. Modelling Travellers' Choices and Preferences

A dichotomous-choice response question is examined, "Why does a traveller choose a particular airline (Low-Cost Carrier [LCC] = 1) over its alternative (Full Service Carrier [FSC] = 0) in his/her travel decision making?" A log-odds model is adopted and estimated using logit analysis of the form (Greene and Hensher, 2010):

$$log[P/(1-P)] = \beta_0 + \beta_1 X_1 + \ldots + \beta_p X_p + \varepsilon \qquad (1)$$

where P is the probability of the respondent to travel by a particular carrier (i.e. LCC); X_i is explanatory

variable hypothesized to influence this probability; while β is coefficients for the explanatory variables; ε is stochastic disturbance term; and $P/(1-P)$ is the ratio of the probability that the respondent travels by LCC to the probability that he/she travels by FSC. It can also be considered as the odds of the respondent to travel by LCC over FSC.

The set of socio-demographic explanatory variables employed are: age groups, ethnic categories, gender, sector of employment, monthly income levels, and educational level. In addition, several behavioural variables are included: concerns for airfare, method of booking, purpose of travel, and destinations of travel Table 1. The predictor variables were identified in line with the objectives of this study. We seek answers to the objectives of the study. These variables will assist us identify what determinants inform the stated preferences based on passengers profiles and when this is assessed, the Namibian airline industry can be informed accordingly given the SP knowledge of their passengers.

In a binary response model, two approaches are available; logit and probit. A logit is obtained if cumulative logistic model is used, whereas a probit applies when ε is assumed to follow a cumulative standard normal distribution.

2.1. Estimation: Maximum Likelihood Estimation of Binary Response Models

Estimation and inference for probit and logit models for binary choices are usually based on maximum likelihood estimation. Because the dependent variable is discrete, the likelihood function cannot be defined as a joint density function as with a continuously-distributed dependent variables. Each observation is a draw from a Bernoulli distribution (binomial with one trial). The model with success probability $F(\gamma' x_i)$ and independent observations leads to the joint probability, or likelihood function (Greene and Hensher, 2010),

$$\begin{aligned} Prob(Y_1 = y_1, Y_2 = y_2, \ldots, Y_n &= y_n | x_1, x_2, \ldots, x_n) \\ &= \prod_{y_i=0} [-F(\gamma' x_i)] \prod_{y_i=1} F(\gamma' x_i). \end{aligned}$$

Let *X* denote the sample of *n* observations, where the *i*th row of *X* is the *i*th observation on x_i (transposed, since x_i is a column) and let *y* denote the column vector that is the *n* observations on y_i. Then, the likelihood function for the parameters may be written

$$L(\gamma|X,y) = \prod_{i=1}^{n} [1 - F(\gamma' x_i)]^{1-y_i} [F(\gamma' x_i)]^{y_i}$$

Taking logs, we obtain the log likelihood function,

$$lnL(\gamma|X,y) = \sum_{i=1}^{n} (1-y_i) ln[1 - F(\gamma' x_i)] + y_i lnF(\gamma' x_i)$$

By limiting our attention to the normal and logistic, as symmetric distributions, this permits a useful simplification if we let $q_i = 2y_i - 1$. Thus, q_i equals −1 when y_i equals zero and +1 when y_i equals one. Because symmetric distributions have the property that $F(t) = 1 - F(-t)$, we can combine the preceding into:

$$lnL(\gamma|X,y) = \sum_{i=1}^{n} lnF[q_i(\gamma' x_i)]$$

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he maximum likelihood estimator (MLE) of γ is the vector of values that maximizes this function. The MLE is the solution to the likelihood equations, The elasticities are simple to obtain from the estimated partial effects. However, since it is a ratio of percentage changes, the elasticity is not likely to be useful for dummy variables such as marital status, or for discrete variables such as age and education level. Like a partial effect, an elasticity for a dummy variable or an integer valued variable will not necessarily produce a reasonable result. The computation for a dummy variable or an integer variable would be a semi-elasticity, [%ΔProb]/Δx, where Δx would equal one. Whether a percentage change in an integer valued x would make sense would depend on the context.

3. Application: Analysis and Results

Primary data from 285 departing passengers at the two Windhoek airports were analyzed to model four binary logit models. The data set include aspects that affect choice of carrier; behavioural aspects and socio-demographic factors. The dependent variable is defined as passenger's stated preference for k flights = 1 if LCC otherwise 0 if FSC, where k is either domestic, regional, international or general flights. The following variable were used in the regression part of the model, x_i = *(constant, gender, income, education level, maritalstatus, age, nationality).*

The predictor variables were identified in line with the objectives of this study. We seek answers to the objectives of the study. These variables will assist us identify what determinants inform the stated preferences based on passengers' profiles and when this is assessed, the Namibian airline industry can be informed accordingly given the SP knowledge of their passengers.

In the original data set, income is divided into three parts as INCOM1, INCOM2, INCOM3 representing low, mid and high income respectively. Education level is the analysis are shown in Table 1 and 2. Estimates of the parameters of the logit models are shown in Tables 3 and 4.

The assumptions of binary response model are that the outcome must be discrete, otherwise explained as, the dependent variable should be dichotomous in nature (e.g., LCC vs. FSC); There should be no outliers in the data, which can be assessed by converting the continuous predictors to standardized, or z scores, and remove values below -3.29 or greater than 3.29; There should be no high intercorrelations (multicollinearity) measured by TERTIARY which is a binary variable, indicating whether or not the respondent has attended tertiary level. Descriptive statistics for the data used in among the predictors. This can be assessed by a correlation matrix among the predictors. Tabachnick and Fidell (2012) suggest that as long correlation coefficients among independent variables are less than 0.90 the assumption is met. Hence the binary logit assumptions are met and analysis proceeds.

The analysis are presented according to regions of destinations, which are domestic, regional and international plus the passengers general flying preference. All analysis were carried out in R (3.1.0) statistical package.

Table 1: Description and summary statistic of variables in the statistical model

VARIABLE	DESCRIPTION	MEAN	STD.DEV
WHYTHEAIRLINEGEN	1= THEY CHOOSE AN AIRLINE DEPENDING ON THE FARE, 0=OTHERWISE	1.51	1.143
FLYMOSTLCCFSC	1= LCC, 0=FSC	0.91	0.288
WHYAIRLINESPC	1= FARE, 0=OTHERWISE	2.57	1.484
TICKETPAYER	1= MYSELF, 0=OTHERWISE	0.41	0.584
RESERVATIONSPOINT	1= RESERVATION MADE ONLINE, 0=OTHERWISE	2.18	1.138
ONLINESVCS	1= ONLINE SERVICES IS CONVINIENT, 0 OTHERWISE	0.32	0.727
LONGHAULS	1= PREFER LCC ON LONGHAULS, 0= PREFER FSC ON LONGHAULS	0.31	0.463
DOMESTIC	1= PREFER LCC ON DOMESTIC, 0= PREFER FSC ON DOMESTIC	0.81	0.395
REGIONAL	1= PREFER LCC ON REGIONAL, 0= PREFER FSC ON REGIONAL	0.66	0.475
GENERALFLIGHT	1= PREFER LCC IN GENERAL, 0= PREFER FSC IN GENERAL	0.6	0.491
NATIONALITY	1= NAMIBIAN, 0= NON-NAMIBIAN	0.61	0.488
GOVERNMENT	1= GOVERNMENT EMPLOYEE, 0= OTHERWISE	0.13	0.333
TERTIARYEDU	1= TERTIARY EDUCATED, 0= OTHERWISE	0.6	0.491
INCOM1	1= 0 -9999 (LOW INCOME), 0= OTHERWISE	0.16	0.369
INCOM2	1= 10 000 -29 999 (MID INCOME), 0= OTHERWISE	0.51	0.501
INCOM3	1= 30 000 - 40 000+ (HIGH INCOME), 0= OTHERWISE	0.31	0.461
MARITAL STATUS	1= SINGLE, 0= EVERMARRIED	0.41	0.492
GENDER	1= MALE, 0= FEMALE	0.59	0.493
YOUTH	1= 15-34 YOUTH, 0= OTHERWISE	0.38	0.485
ADULT	1= 35-54 ADULT, 0= OTHERWISE	0.51	0.501
SENIORCITIZV	1= SENIOR CITIZEN, 0= OTHERWISE	0.1	0.303
FAREMATTERS	1= CHOICE BASED ON FARE, 0= OTHERWISE	0.36	0.48
ONLINECONVINIENT	1= CONVINIENT, 0= OTHERWISE	0.18	0.384
FLYREASON	1= BUSINESS, 0= OTHERWISE	0.89	0.316

3.1 Passenger Stated Preferences for Domestic flights

Table 2 shows the frequencies of passenger stated preferences for all destination regions. On average, about 81% of respondents stated that they prefer LCC on domestic routes. Table 3 shows the results of the logit analysis for Domestic preferences. Only one socio demographic variables (TERTIARYEDU) and two behavioral factors (FARE MATTERS AND FLY- REASON) were statistically significant in affecting the choice of carriers (Table 3). The odds of flying domestic with LCC is 0.391 times less for passengers with tertiary education as opposed to passengers with other level of education other than tertiary level. Further, tertiary

educated respondents were less likely to fly LCC on domestic routes as compared to other passengers with non-tertiary educated respondent. This implies that higher educated individuals had a higher tendency of traveling by FSC on domestic routes. Being concerned over fares is also a statistically significant factor on the probability of carrier choice as those who value airfares have a 2.493 more in the log-odds of flying LCC, holding all other independent variables constant. This result is consistent with the findings of O'Connell and Williams (2005) and Ong and Tan (2010), whereby fare is the principle reason for carrier selection among low-cost airline passengers.

Table 2: Frequency table for passengers SP for all regions of destinations and in general.

		DOMESTIC		REGIONAL		INTERNATIONAL		GENERAL	
VARIABLE	CATEGORY	FSC % (n)	LCC % (n)	FSC % (n)	LCC % (n)	FSC % (n)	LCC % (n)	FSC % (n)	LCC % (n)
GENDER	FEMALE	15% (18)	85% *100)	26% (31)	74% (87)	61% (72)	39% (46)	35% (41)	65% (77)
	MALE	22% (37)	79% (130)	40% (66)	61% (101)	75% (125)	25% (42)	44% (73)	56% (94)
NATIONALITY	NAMIBIAN	20% (34)	80% (140)	29% (50)	31% (124)	66% (114)	34% (60)	35% (61)	65% (113)
	NON-NAMIBIAN	19% (21)	81% (90)	42% (47)	58% (64)	75% (83)	25% (28)	48% (53)	52% (58)
MARITAL STATUS	EVER MARRIED	18% (30)	82% (139)	34% (58)	66% (111)	68% (115)	32% (54)	36% (60)	64% (109)
	SINGLE	22% (25)	78% (91)	34% (39)	66% (77)	71% (82)	29% (29)	47% (54)	53% (62)
EDULEVEL	LOWER	17% (1)	83% (5)	17% (1)	83% (5)	50% (3)	50% (3)	17% (1)	83% (5)
	HIGHER TERTIARY	25% (27)	75% (82)	29% (32)	71% (77)	66% (72)	34% (37)	33% (36)	67% (73)
		16% (27)	84% (143)	38% (64)	62% (106)	72% (122)	28% (48)	45% (77)	54% (93)
AGE	0-34 (YOUTHS)	16% (23)	84% (83)	25% (32)	75% (74)	86% (80)	14% (26)	39% (51)	61% (55)
	35-54 (ADULTS)	28% (27)	72% (123)	35% (52)	65% (98)	65% (97)	35% (53)	32% (49)	68% (101)
	55+	17% (5)	83% (24)	45% (13)	55% (16)	75% (52)	25% (17)	48% (14)	52% (15)

The reason why respondents fly is significantly related to carrier choice as those that fly for business are less likely to use LCC as opposed to respondents that fly for non-business purposes. The odds of business travelers to fly domestic with LCC is 0.233 times less than for respondents traveling for other reasons other than business.

Table 3: Domestic and regional flights results of logit analysis

	DOMESTIC			REGIONAL		
VARIABLE	**COEF.**	**SIG**	**OR**	**COEF.**	**SIG**	**OR**
CONSTANT	4.215	0.141	67.667	1.695	0.539	5.447
NATIONALITY	0.195	0.615	1.215	-0.212	0.499	0.809
GOVERNMENT	-0.117	0.841	0.890	-1.622	0.014 (*)	0.197
TERTIARYEDU	-0.939	0.009 (*)	0.391	0.023	0.939	1.023
INCOM1	1.331	0.188	3.785	0.701	0.446	2.016
INCOM2	-0.583	0.533	0.558	-0.064	0.939	0.938
INCOM3	0.674	0.475	1.962	0.985	0.240	2.678
MARITAL STATUS	0.145	0.714	1.156	-0.098	0.760	0.907
GENDER	0.179	0.635	1.196	0.173	0.574	1.189
YOUTH	-1.140	0.278	0.320	-0.413	0.698	0.662
ADULT	-1.428	0.158	0.240	-0.414	0.690	0.661
SENIORCITIZV	-1.768	0.119	0.171	-0.14	0.899	0.87
FARESMATTERS	0.914	0.01 (*)	2.493	0.345	0.229	1.412
ONLINECONVINIENT	0.499	0.402	1.648	1.034	0.043 (*)	2.812
FLYREASON	-1.459	0.01 (*)	0.233	-0.492	0.243	0.611

3.2. Passenger Stated Preferences for Regional flights

Passengers stated different preferences for different fleets. In this paragraph we are examining the stated preferences for passengers on regional fleet. The model explains 19.9% of the variability of the response data around its mean. Among the interviewed passengers, 66% indicated that their stated preference on regional fleet is LCC and only 34% stated to prefer FSC (see Table 2). Table 3 shows the results of the logit analysis for regional flights. Results in Table 3 indicate that government employee's respondents were less likely to fly LCC on Regional routes as compared to respondents from any other sector. Therefore the odds of flying Regional with LCC was 0.197 less times more for respondents who were worked for the Government opposed to respondents who are non-government employees. This is supported by the fact that the most tickets are company/government paid and companies/government usually just pay for full paid tickets for their employees' business trips. This is tied to business travelers being less likely to fly LCC on domestic routes.

The use of online services in making airline reservations is significantly related to carrier choice as those who fly LCC on Regional are more likely to use Information Communication Technology (ICT) booking channels. Moreover, for every one-unit increase in online services, we expect a 1.034 increase in the log-odds of flying LCC on Regional routes, holding all other independent variables constant. Research show that many that fly LCC use ICT booking channels (Hess et al. 2007).

3.3 Passenger Stated Preferences for International flights

On international fleet, which are usually long hauls, passengers stated preferences are quite different from those of domestic and regional fleet. Table 2 displays that about 69% of interviewed passenger stated that they will prefer FSC on International routes because they are quite comfortable than LCC and on a long haul one needs to travel in comfort.

Factors related to being a government employee and online services convenience were statistically significant in affecting the choice of airlines (Table 4). Specifically, government employees respondents were less likely to fly LCC on regional routes as compared to respondents from any other sector. Therefore, the odds of flying regional with LCC was 0.359 less times more for respondents who were worked for the government opposed to respondents who are non-government employees. This is supported by the fact that the most tickets are company/government paid and companies/government usually just pay for full paid tickets for their employees' business trips. Similar to Regional the use of online services in making airline reservations is significantly related to carrier choice as those who fly LCC on International are more likely to use information communication technology (ICT) booking channels. This implies that for International or long haul flights respondent prefer FSC over LCC due to the comfort found in FSC.

Table 4: International and general flights results of logit analysis

		INTERNATIONAL			GENERAL	
VARIABLE	**COEF.**	**SIG**	**OR**	**COEF.**	**SIG**	**OR**
CONSTANT	-1.739	0.506	0.176	3.753	0.179	42.648
NATIONALITY	-0.222	0.519	0.801	-0.800	0.014 (*)	0.449
GOVERNMENT	-1.024	0.02 (*)	0.359	-0.963	0.088	0.382
TERTIARYEDU	-0.061	0.845	0.941	0.076	0.801	1.078
INCOM1	0.584	0.501	1.792	1.027	0.278	2.792
INCOM2	0.803	0.301	2.232	-0.203	0.812	0.816
INCOM3	1.364	0.089	3.913	0.688	0.425	1.989
MARITAL STATUS	-0.127	0.709	0.881	0.201	0.531	1.222
GENDER	0.419	0.180	1.521	-0.316	0.311	0.729
YOUTH	0.555	0.593	1.742	-0.806	0.441	0.446
ADULT	-0.065	0.949	0.937	-1.702	0.097	0.182
SENIORCITIZV	-0.100	0.927	0.905	-1.305	0.234	0.271
FARESMATTERS	0.580	0.069	1.785	0.936	0.002 (*)	2.549
ONLINECONVINIENT	-2.099	0.006 (*)	0.123	0.587	0.209	1.798
FLYREASON	-0.653	0.109	0.520	-1.793	0.0 *)	0.166

3.4. Passenger Stated Preferences for General flights

Now turning to preferences flights in general, results show that more than half (60%) (see Table 2) of the interviewed group stated that they prefer LCC. Table 4 shows the results of the logit analysis for general lights. Both NATIONALITY and two behavioural factors (FAREMATTERS AND FLYREASON) were statistically significant in affecting the choice of airlines.

Namibians were less likely to prefer LCC more than non-Namibians. This is because the non-Namibians were possibly exposed to LCC in their respective countries, unlike in Namibia where there is not a single LCC. The odds of flying domestic with LCC is 0.449 times less for Namibian respondents as opposed to non-Namibian respondents. Further, even though over all majority preferred LCC, for a Namibia it was less likely compared to non-Namibians. Overall, both Namibians and Non- Namibians respondents had a higher tendency of traveling by LCC than FSC in general- regardless of the route. Being concerned over fares is also a statistically significant factor on the probability of carrier choice as those who value airfares have a 2.551 increase in the log-odds of flying LCC, holding all other independent variables constant. The reason why respondents fly is significantly related to carrier choice as those that fly for business are less likely to use LCC as opposed to respondents that fly for non-business purposes. The odds of business travellers to fly domestic with LCC is 0.166 times less than for respondents traveling for other reasons other than business.

4. Conclusion

This study aims to inspect the likelihood of passengers to choose between two air carriers with dissimilar operating structures: low cost and full-service carrier. The findings provide additional support to the concept that passengers' socio-demographics (occupation, education level) and behavioural choices (concerns about ticket prices, fares, online services, and purpose journey) are main determinants of air- line choice. The model results show that the difference in the four groups is affected by age, income, purpose of travel, fares, and occupation. Furthermore, passengers indicated that for domestic, regional and in general flights they prefer LCC while for international flights they prefer FSC.

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