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Airport Choice Model for Tehran Metropolitan Area

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Abstract. This paper presents the airport choice behavior of the air travelers in Tehran multi-airport region. The objective of this paper is to estimate the various characteristics on selecting the origin airport which is fulfilled based on Binary Logit model with the use of Stated Preference (SP) data collected from air travelers. For this purpose, the unique questionnaire produced and around 3000 individuals sampled through direct personal interviews in May 2011. The analysis presented in this paper has shown the important role of flight frequency, public access types to the airports and the airport taxes (air fare) in airport choice.

Keywords: airport choice, Binary Logit model, discrete choice, Stated Preference method

1. Introduction

With growing number of air travels, analysis of air traveler's choice behavior has become an important challenge in recent years. Analysis of this behavior is important in future planning and also in development of competitive airports. Considering this condition, the discrete airport choice models have significantly increased to provide this demand.

Tehran multi-airport system is the only multi-airport system in Iran and uses of two major airports. Mehrabad International Airport (MIA) is the busiest airport with near 13 million passengers a year and located near the city and now a days serves only domestic flights with some international flights (haj flights) while Imam Khomeini International Airport (IKIA) serves only international flights and located 30 km away. Because the limitation of MIA and the future policy for IKIA (being hub in region), there must be a good planning for these two airports which meets with satisfaction of air passengers. This paper uses Binary Logit model to investigate the airport choice of air passengers in this region.

One of the earliest works in this field is an empirical study performed by Skinner (1976) in which three major airports in the Baltimore-Washington biregion area was studied using a multinomial logit model (MNL).[1] The accessibility and flight schedule found to be more important than flight frequency. Innes and Doucet (1990) showed important factors affecting airport choice behavior.[2]Furuichi and Koppelman (1994) investigated departure and destination choice behavior using a nested logit method. The study was based on a 1989 international air traveler survey in Japan and the results showed that the two of the most important factors are access time and flight frequencies.[3]Windle and Dresner (1995) showed the importance of airport access time and flight frequencies in a study on passenger airport choice in the Washington, DC and Baltimore areas using a MNL.[4]San Francisco Bay area has been the subject of several studies. Harvey (1987) used a MNL and found that ground access time and frequency of direct service to chosen destination are the most significant factors.[5]Pels et al. (2003) employed showed that leisure passengers value access cost while business passengers value access time using a two-level nested logit model.[6]Bas-ar and Bhat (2004) proposed using a probabilistic choice set multinomial logit (PCMNL) model, in which different

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travelers may have different airport choice sets. It was reported that the PCMNL showed a better result than the widely used MNL.[7]Hess and Polak (2005) found that the fare is also a significant affecting factor in addition to access time and service frequency by analyzing airport choice behavior using a mixed MNL.[8]

The studies were used Stated Preference (SP) are as follows:

Bradley (1998) had performed a Binary Logit modeling in airport choice in which the air fare was the most meaningful variable whereas the travel time was the second one.[9]Adler et al (2005) had studied the Mixed Logit model for airport choice in which all of the service features included in the model are significant.[10]Hess et al (2007) studied the Binary Logit model for airport selection in which the most meaningful variables were air fare, access time and frequent flyer benefits.[11]Loo (2008) created the Multinomial Logit model to study the airport that in the estimated model, the air fare, access time, flight frequency and the number of airlines were statistically meaningful.[12]and finally EdoardoMarcucci (2011) estimates several Mixed Logit models with different specifications including heteroscedasticity and error component.[13]

2. Methodology

This paper uses Binary Logit model for prediction of air passengers' behavior in airport choice which is performed using the data collected from departing passengers of two airports by the Stated Preference method. Although the SP method has both advantages and disadvantages versus Revealed Preference (RP), the main reason for using this method is related to the current condition of airports of the area. For instance, one of the airports has just international flights and it is necessary to use SP methods for assuming this airport to the airport which has both international and domestic flights.

The probability of an individual choosing alternative *i* is equal to the probability that the utility of alternative *i* is greater than (or equal to) the utility associated with alternative *j* after evaluating each and every alternative in the choice set of *j* = 1,...*i*,...*J* alternatives.[14]

$$prob_i = prob\left(U_i \geq U_j\right) \forall\, j \in j = 1, \dots, J\,; i \neq j\,) \tag{1}$$

Methodology of Binary Choice for this paper simply is governed by the following equation:

$$U_{n1} = \beta Z_{n1} + \varepsilon_{n1}, \tag{2}$$

$$U_{n1} = \beta Z_{n1} + \varepsilon_{n1}, \tag{3}$$

$\varepsilon_{n1}, \varepsilon_{n2}$ ~iid extreme value

U_{ni} is the utility person *n* obtains from choosing alternative *i*. The utility of each alternative depends on the attributes of the alternatives interacted perhaps with the attributes of the person.

which gives this expression for the probability:

$$P_{n1} = \frac{\exp\left(\beta Z_{n1}\right)}{\exp(\beta Z_{n1}) + \exp\left(\beta Z_{n2}\right)} = \frac{1}{1 + \exp\left(\beta Z_{n2} - \beta Z_{n1}\right)} = \frac{1}{1 + \exp\left(\Delta U\right)} \tag{4}$$

$$\Delta U = \beta Z_{n2} - \beta Z_{n1} = \sum (a_i - b_i) X_i \tag{5}$$

Where P_{n1} is the probability that person *n* choosing first alternative; βZ_{n1} is the utility function that person *n* choosing first alternative; βZ_{n2} is the utility function that person *n* choosing second alternative; X_i is the ith variable; a_i is the coefficient of the ith variable in βZ_{n1}; b_i is the the coefficient of the ith variable in βZ_{n2} and ΔU is the diffrence between of βZ_{n2} and t βZ_{n1}.

For determining overall model significance, the analyst can check the log likelihood function (LL). This is because the logit used MLE and not ordinary least squares (OLS) as the estimation procedure, we cannot rely upon the use of statistical tests of model fit commonly associated with OLS regression. We cannot use the *F*-statistic to determine whether the overall model is statistically significant or not.[14]

In logit for determining model fit the analyst uses Pseudo R^2 which determined as follows:

$$\rho^2 = 1 - \frac{LL_{Estimated\ model}}{LL_{Base\ model}} \tag{6}$$

This is important that Pseudo R^2 of a logit model isn't equal to R^2 of regression model. Also there is another test for determining model significance which are Percent Correctly Predicted and Likelihood ratio test but the robustness of using Pseudo R^2 for overall model significance in more suggested.

3. Survey Administration

One of the first steps in surveys is designing the questionnaire. For this study a comprehensive questionnaire of socio-economic characteristics developed and for determining all and effective factors related to airport choice, many previous work have been studied and important factors considered in the questionnaire.

Before implementing the survey there must be consider some important things that listed below:

1. Location for survey
2. Duration of survey
3. Sample size requirement
4. Type of survey (for example Random sampling or etc)

In this paper, all the above parameters fulfilled with Airport Corporative Research Program (ACRP report 26). For location of survey, ACRP suggested that to implement a survey of air passengers who departing from the airports and most previous studies also do their surveys in this way. Airport departure lunge usually considered a good place for implementing from departure passengers and in this paper, the survey implemented in check-in area (the security of airports didn't allow interviewers to do their surveys in transit lunge).

In relate to seasonal, monthly, weekly and daily changes in airport flights, ACRP suggested that the implementation of surveys lasted at least one week for each airport and through 24 hour a day. After surveying about one week in each airport, around 1300 sample of MIA and 1700 sample of IKIA collected. Some important socio-economic variables collected from the sample reported in Table 1.

Table. 1: Some important socio-economic characteristics of the sample

Characteristics	Mehrabad Airport(MIA)	Imam Khomeini Airport(IKIA)
No. of respondents	1697	1279
Gender	N = 1695	N = 1275
Female	193 (11.4%)	308 (24.2%)
Male	1502 (88.6%)	967 (75.8%)
Age	N = 1690	N = 1264
30 or younger	703 (41.6%)	348(27.5%)
31-50	833(49.3%)	582(46%)
51 or more	154(9.1%)	334(26.5%)
Marital status	N = 1694	N = 1277
married	1187(70.1%)	377(29.5%)
Single	507(29.1%)	900(70.5%)
Monthly income	N = 1621	N = 1174
Less than $500	241(14.9%)	203(17.3%)
$500-$999	652(40.2%)	353(30.0%)
$1000-$1499	419(25.9%)	243(20.7%)
$1500-$2499	162(10.0%)	187(16.0%)
$2500 or more	146(9.0%)	188(16.0%)
Purpose of trip	N = 1684	N = 1266
Business	1170(69.5%)	575(45.4%)
Leisure	514(30.5%)	691(54.6%)
Airport choice	N = 1693	N = 1271
IKIA	934(55.2%)	575(45.4%)
MIA	759(44.8%)	691(54.6%)

4. Model Results

The model results from the Binary Logit model are presented in Table 3. The results of modeling obtained from Nlogit4 software. The overall explanatory power of the model (adj.ρ^2=0.021) is low but for such a study can be acceptable. All variables are given in table 2 are significant at 0.05 level and the signs are consistent.

Table. 2: List of variables in binary choice model

Variables	Description
D1_AGE	Dummy variable; age <30
D2_AGE	Dummy variable; 30< age <50
D1_SAL	Dummy variable; low salary
D5_SAL	Dummy variable; high salary
D2_EDU	Dummy variable; diploma education
D5_EDU	Dummy variable; master education
D1_DES	Dummy variable; destination to far city(mashhad)
D2_DES	Dummy variable; destination to near city(rasht)
D1_ACCIK	Dummy variable; public access to IKIA(shuttle airline)
R_NF	Interval variable; number of flight(IKIA-MIA)
R_TAX	Interval variable; airport tax(IKIA-MIA)

* Note that the R_NF variable is defined as the number of flight in IKIA subtraction to MIA
* Note that the R_TAX variable is defined as the Taxes in IKIA subtraction to MIA

Table. 3: Binary Airport choice model result

Variable	Coefficient	Standard Error	b/St. Er.	P[|Z|>z]
D1_AGE	0.09326	0.04250	2.194	0.0282
D2_AGE	-0.09357	0.04250	-2.202	0.0227
D1_SAL	0.24996	0.08700	2.873	0.0041
D5_SAL	-0.24997	0.08701	-2.873	0.0041
D2_EDU	0.18598	0.06023	3.088	0.0020
D5_EDU	-0.18511	0.06023	-3.073	0.0021
D1_DES	-0.82129	0.15052	-5.456	0.0000
D2_DES	-0.96801	0.17939	-5.396	0.0000
D1_ACCIK	0.50157	0.09595	5.227	0.0000
R_NF	0.04164	0.00621	6.699	0.0000
R_TAX	0.02818	0.00615	4.580	0.0000

Log-likelihood: -1990.920, ρ^2=0.0289, adj.ρ^2=0.0214, N=2958

It was found that the age group (14-30), low income air passengers and the air travelers who had the diploma degree has a tendency to choose Imam Khomeini International Airport (IKIA) while the behavior of the age group (31-50), high income air passengers and the air travelers who had the master degree is to prefer Mehrabad International airport (MIA) for their trips. For near destination cities, the tendency of air travelers to choosing IKIA will be decreases.

From the coefficient of Public access to the airport, it is understand that if the access to IKIA will be with shuttle airline, the willing of air travelers become more to choose IKIA. Relatively with increasing in the number of flights of IKIA rather than MIA or if airport tax for IKIA rather than MIA becomes cheaper, the passengers wants to choose IKIA more for their origin airport.

It can be seen from the above table that the most significant variable is the Number of Flight (flight frequency) and the second meaningful terms are Destination and Public Access to the airports.

5. Conclusions and Recommendations

This paper has described a study of air travel choice behavior of Tehran metropolitan area, making use of SP data collected in the Iran in May 2011 with around 3000 interviews made through 24 hour a day.

The results presented in this paper show the important role of flight frequency, public access to the airports and the airport taxes (air fare) to the air travelers of this region. It is common that the variables like taxes or number of flight aren't well described by SP method but in this paper these variables are meaningful.

One of the future works can be the use of RP in data collection so that with use of both SP and RP data can be helpful for better modeling the air traveler's behavior in airport choice.

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7. References

[1] Skinner Jr., R.E., 1976. Airport choice: an empirical study. Transportation Engineering Journal 102, 871–883.

[2] Innes,J.D.,Doucet,D.H.,1990.Effects of access distance and level of service on airport choice. Journal of Transportation Engineering 116, 507–516.

[3] Furuichi, M., Koppelman, F.S., 1994. An analysis of air travelers' departure airport and destination choice behavior. Transportation Research Part A 28, 187–195.

[4] Windle, R., Dresner, M., 1995. Airport choice in multiple–airport regions.Journal of Transportation Engineering. 121, 332 – 337.

[5] Harvey, G., 1987. Airport choice in a multiple airport region. Transportation Research Part A 21,439–449.

[6] Pels, E., Nijkamp, P., Rietveld, P., 2003. Access to and competition between airports: a case study for the San Francisco bay area. Transportation Research Part A 37, 71–83.

[7] Bas-ar, G., Bhat, C., 2004. Aparameterize consideration set model for airport choice: an application to the San Francisco bay area. Transportation Research Part B 38,889–904.

[8] Hess, S., Polak, J.W., 2005. Mixed logit modeling of airport choice in multi-airport regions. Journal of Air Transport Management 11, 59–68.

[9] Bradley, M., Daly, A,.1991 . Estimation of logit choice models using mixed stated and revealed preferences information. In: proceedings of sixth International Conference on Travel behaviour, pp. 117-133 quebec.

[10] Adler, T., falzarano, C.S., Spitz, G., 2005. Modelingservice trade-offs in air itinerary choice ,papar presented at 84th annual meeting of transportation research board, washengton, DC.

[11] Hess, S., Adler, T., Polak, J.W., 2007. Modelling airport and airline choice behaviour with the use of stated preference survey data. Transportation Research Part E 43, 221–233.

[12] Loo, B., 2008. Passengers' airport choice within multi-airport regions (MARs): some insights from a stated preference survey at Hong Kong International Airport. Journal of Transport Geography 16, 117–125.

[13] Marcucci, E., Gatta, V., 2011. Regional airport choice: consumer behaviour and policy implications. Journal of Transport Geography. 19, 70 – 84.

[14] Hensher, D.A., Rose, J.M., Greene, W.H., 2005. Applied Choice Analysis.A Primer. Cambridge University Press, UK.