A NATIONAL PASSENGER MODE CHOICE MODEL FOR THE GREEK OBSERVATORY

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Abstract

This paper presents a combined Stated Preference (SP) and Revealed Preference (RP) national passenger mode choice model developed for Greece. The data used for model estimation include RP data collected by different transport organizations and a national customized and computerized SP telephone survey conducted for the purposes of this study. The model includes the following alternative choices: car, bus, traditional train, high speed train, airplane, traditional ship, and high speed ship, as well as combinations of them to account for multimodal trips. Elasticities and Value of Time's (VOT's) calculated using model estimation results for alternate modes are comparable with results of other European National Model Systems and consistent with the passenger decision-making behavior in Greece.

Keywords: Revealed and stated preferences; National mode choice model; Multimodal choices; VOT
Topic Area: D1 Passenger Transport Demand Modelling

1. Introduction

This paper presents a system of national passenger mode choice models developed for the Greek Transport Observatory. European experience in other National Model Systems, such as the Italian and the Dutch ones (Cascetta, et al. 1995; Expedite Report, 2000) was taken into consideration.

The mode choice models that are presented give results which are compatible with international bibliography (Expedite, 2000; Polydoropoulou and Ben-akiva, 2001) and representative of the Greek transport market as they take into consideration the following:

(a) the peculiarity of the transport network and geographic configuration of Greece, consisting by the mainland and more than 100 inhabited islands;
(b) the significant seasonality effects and differentiation of the number and purpose of trips between summer and winter period;
(c) all the possible combinations of existing modes, such as car, bus, traditional train, high speed train, airplane, traditional ship, and high speed ship, thus representing travelers' preferences towards multimodal transportation; and
(d) the competitiveness among traditional ship, high speed ship and airplane as the modes serving the Greek islands and connecting them with the mainland.

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The system of models simulates the behavior of decision makers and constitutes an evaluation (assessment) tool of alternative policies of transport planning, i.e. ticketing policies, improvement of transport services (new transport means, itineraries), combined transport, etc.

2. State of the art

In order to develop the Greek National Mode choice model, econometric mode choice models for passenger trips developed in European countries for transport planning purposes were studied in-depth (Expedite, 2000). These models concern mainly passenger trips of long distances (> 100km) within a country. Particularly useful was the experience acquired by the analysis of (1) the Dutch Model (Dutch National Model System - NMS, 1985- up today); (2) the Norwegian Model (Norwegian National Model, (1988-up today); (3) the Denmark Model (1996- today); (4) the Swedish Model (1998-today); and (5) Italian Model (1993- today). According to the above-mentioned analysis the development of National Model Systems is a continuous process. All national model systems include mode choice models either for individual trips (trip-based models) or for trip chains (tour-based models). Usually different trip purposes are examined such as business, recreation, personal reasons, etc. The estimation of these models is based mainly on revealed preferences data (Revealed preferences data) collected by personal or telephone interviews in households, as well stated preferences data.

Note that revealed preferences data describes the behavior of users with regards to the use of existing transport means (Polydoropoulou et al. 2001). The stated preferences data concern the response of individuals in hypothetical situations (Ben-Akiva et al. 1999, 2000). In this study a specialized research was developed according to the state-of-the-art for the study of mode choice for passenger trips at a national level.

Besides socio-economic information about the respondent, the questionnaire includes information regarding origin-destination, mode choice, residence status, travel time, travel cost, car ownership, as well as mode choices under hypothetical scenarios. In these scenarios the respondents have to select between alternative transport means (modes) for their long distance trips. In each customized scenario the following attributes change:

- mode characteristics
- trip characteristics (time, cost)

and the choices of users are recorded. The collected data allow the estimation of econometric discrete choice models (Ben -Akiva and Lerman, 1985). The stated preferences (SP) methodology and the corresponding econometric models, have been proved internationally as the most reliable method for the simulation of individuals' behavior towards innovative transport services and modes (Polydoropoulou et al. 2001a, 2001b).

3. Data collection methodology

This section presents the sampling methodology, the questionnaire design and the results of the main survey.

3.1Sampling methodology

A telephone survey was conducted in order to collect mode choice data from different origin-destination pairs in the Greece in legitimate time. For this aim, MINT –

a software for electronic data collection (Hague Consulting Group, 1990) - was used and an electronic questionnaire in the Greek language was developed. Note that this was the first CATI (computer aided personal interview) survey conducted in Greece at a national level.

With the use of MINT the market research results are automatically registered in the SPSS program- a statistical tool- in which data processing is carried out. With that way time save and elimination of data entry errors is accomplished.

A random population sample was selected via telephone lists that are available for each prefecture by GREEK TELECOM internet services. In order to be possible the estimation of different models per trip purpose , the collection of 300 questionnaires per trip purpose was considered essential. Thus the reliability of results is ensured. The questionnaires were distributed proportionally per prefecture according to the prefecture's population.

A pilot survey was conducted in order to test the questionnaire's efficiency. In total, the pilot survey included 30 telephone interviews. Based on the results of these interviews the questionnaire was modified and finalized. Furthermore, the pilot survey helped in the training of the researchers.

3.2 Development of level of service databases

For the development of the national model system, the geographical area of Greece was subdivided to 51 zones corresponding to the number of prefectures. A major data collection effort ware undertaken to develop the level-of-service (travel time and travel cost) and mode availability datasets per O/D pair for the alternative modes. These statistics were not available in the necessary detail, format, or reliability level required for the design of the customization of the SP surveys and the estimation of the mode choice models. Since the development of such databases required the collaboration of various transport organizations and institutions, this effort was very time-consuming, and represents a major product of this study.

The passengers' choice set included seven mail alternative modes:

1. car
2. bus
3. high speed train
4. slow train
5. airplane
6. high speed ship
7. conventional ship

The level -of -service datasets include in vehicle travel time and travel cost for every O/D pair for each alternative mode.

3.3 Main survey

The main survey was conducted at a national level during the period of September to December 2002, using the MINT software. A total of 900 surveys were collected for three trip purposes: (1) Business, (2) Recreation/ tourism, and (3) Personal (education, social, military, etc.)

3.3.1 Questionnaire Structure

The questionnaire comprises four sections:

Section A: Introduction

Initially the respondent receives a short briefing with regards to the scope of the research and the institution that carries out the survey. Then certain questions are being made, in order to check whether the respondent is suitable to be included in the sample, i.e. if he/she has made a trip in Greece the past 3 months outside the prefecture of his/her residence.

Section B: Trip Characteristics – RP data

In this part of questionnaire a recent trip is randomly selected to be described by the respondent. The collected data concern: (1) Origin –Destination pair, (2) Mode used, (3) Total travel time (door-to-door). This time includes the access time from the initial origin to the departure terminal station (harbor, airport, bus station, train station), the travel time between arrival terminal and final destination, waiting time, as well as the in-vehicle time (in the case of private car this time coincides with the total travel time), (4) Total travel cost, etc.

Section C: Stated Preference Experiments

The transport means that constitute the alternative choices in the Stated preference experiments are: (1) Private car, (2) Bus, (3) Conventional train, (4) Fast train (Intercity), (5) Conventional ship, (6) High speed ship and (7) Airplane.

Depending on the O/D pair that the respondent traveled, the choice set of alternative modes was limited according to mode availability. The attributes used in the stated preference experiments were travel cost and in-vehicle time. In each questionnaire one or two experiments were displayed. The scenarios presented to each respondent were randomly selected by MINT. The attribute levels were fixed in + 20% or -20% of the initial values. The initial values of the attributes, as well as the mode availability per O/D pair of were registered at the Level of Service (LOS) databases.

Section D: Respondent's Characteristics

These particular questions provide information about the socio-economic profile of the respondent.

3.3.2 Survey Implementation

The duration of the telephone interview was 5-10 minutes per respondent . The response rate was 10%. Note that 40% of refusals declared indifference for attendance, while 60% declared that had not traveled in the last 3 months.

3.3.3 Survey Results

A total of 900 questionnaires were collected. As it results from the statistical analysis of the sample, 48% were men and 52% women. The random sampling of the research corresponds to the general demographic data according to the most recent census.

The highest percentage of the respondents belongs to the active population: 49% of the respondents are from 26 up to 40 years old. An important factor affecting the mode choice is the private car ownership. It was found that 54% of the respondents own one car in their household, 24% two cars, while 22% does not own a private car.

4. Model estimation results

Different structures of discrete choice models were tested. The final model that fitted the data best was an MNL (multinomial logit model). The dependent variable takes the following values: (1) car, (2) bus, (3) train, (4)ship, and (5) airplane. As an outcome of model estimations, some mode choices were lumped together (high speed with traditional means). The models developed in this study are trip-based. The basic assumption of these models is that individuals select the transport mode that provides the highest utility. The choices depend on: (1) the mode's characteristics (travel cost and travel time), and (2) the factors acting as restrictions of choices (i.e mode availability, car ownership, etc.).

ALOGIT (Hague Consulting Group, 1985) was used for the model estimations. Different models were estimated for two trip purposes, professional and personal. These two trip purposes have distinct characteristics and were the outcome of the modeling process as the only trip purposes with significantly different estimated coefficients.

Table 1 presents some selective results of the estimated models. It only includes the estimation of level of service parameters, travel time (TT) and travel cost (Level-of-Service). Column 2 presents the names of parameters. Column 3, 4, and 5 presents the parameters that were estimated and the t-statistics in parenthesis for all the data, for the two trip purposes (business and personal) respectively.

Table 1: Selective Estimation Results

No (1)	**Variable Name** (2)	**Total Coef (t-stat)** (3)	**Purpose Professional Coef (t-stat)** (4)	**Purpose Personal Coef (t-stat)** (5)
1	Car TT	-0.0067 (-7.2)	-0.010 (-6.4)	-0.0042 (-3.5)
2	Bus TT	-0.0050 (-6.3)	-0.0075 (-5.7)	-0.0033 (-2.6)
3	Train TT	-0.0044 (-4.8)	-0.0044 (-3.0)	-0.0029 (-3.1)
4	Ship TT	-0.0057 (-6.3)	-0.0074 (-5.5)	-0.0037 (-3.5)
5	Airplane TT	-0.021 (-4.3)	-0.032 (-4.3)	-0.014 (-1.9)
6	Travel Cost	-0.0012 (-3.1)	-0.0017(-3.6)	-0.00075 (-1.6)
Summary Statistics:				
Number of observations		1456	875	581
Initial Log Likelihood		-1472.71	-520.23	-954.68
Final Log Likelihood		-1392.73	-474.01	-899.37

Based on the above mode specification the cost parameter is generic for all the alternative means, has a negative sign and is statistically significant as expected. The time parameters are different for each alternative (alternative specific), have negative sign and are statistically significant.

Table 2 presents the values of time for the different trip purposes.

Table 2: Values of Time

No	Transport Mode	Total VOT (Euros/hr)	VOT Purpose Professional (Euros/hr)	VOT Purspose Personal (Euros/hr)
1	Car	5.5	5.6	6.1
2	Bus	4.1	4.5	4.4
3	Train	3.6	3.9	2.6
4	Ship	4.7	4.9	4.3
5	Airplane	17.3	20.8	18.8

Based on the results, the VOT for the professional trip purpose is higher than that computed for the personal reasons (vacations and entertainment) for the car and the airplane alternatives. As expected the VOT of the airplane is higher than all the transport means, since the airplane is significantly faster than any of the other means and it services travelers with high incomes or emergency situations. The VOT of train is the lowest, since there are very few ODs that are served by high speed rail.

The ship's VOT is relatively high which is expected due to the availability of high speed ferries the last 5 years that service most of the major islands with decreased travel times compared to conventional ferries. Therefore these ships compete with the airline industry and service also high income passengers.

In summary, the mode choice models presented above give results that are comparable with the state-of-the-art, especially with the Italian National Model (Casceta et al., 1995), and are representative of the Greek reality.

5. Conclusions

The national mode choice model developed for passenger trips is functional and maybe exploited within the Greek Observatory for the transport analysis and transport planning process in Greece. The model application gives the possibility of forecasting the demand for alternative modes, transport services and evaluation of the user's willingness to pay for improved services.

The estimated models were trip-based and involved the choice of the main mode of the trip conducted. Future modeling efforts may involve the development of combined transport mode choice models and modeling of destination choices for a better representation of the travelers behavior.

Note that the existing models include the effect of cost and in-vehicle time in the mode choice, as basic level of service variables. More advanced simulation models may include also other explanatory variables as: waiting time , average access time, average access cost, frequency of itineraries, and departure hour. Also other socio-economic characteristics, that can be included in models are: income, age, and gender. Such models are under estimation.

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