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APPLICATION OF A LOGIT MODEL IN PUBLIC TRANPSORT MODELLING – CASE STUDY OF CITY VELIKA GORICA

Key Words

Trips
Statistic method
Similar geographic characteristics
Socio-demographic characteristics

Abstract

Transport modelling represent one of tools that help various researchers and engineers in the field of transport planning and engineering. Using transport modelling can help to detect the number and characteristics of trips for specific area or regions. Trips can be separated regarding to transport mode (e.g., car, bicycle, public transport, walking, etc.). Public transport has shown numerous benefits comparing to private cars. Determine real and possible number of trips of every transport mode are achieved by using logit model. Logit model is mostly used statistic method for detecting modal split in transport modelling. Data collected by survey conducted in the City of Velika Gorica will be used to calculate logit model of trips. Trips will be separated between public transport and private cars. Goal of paper is creating a logit model that can be used as an initial model in other cities that have similar geographic and socio-demographic characteristics.

1. INTRODUCTION

Transport planning as general idea of creating future sustainable transport systems today is practically impossible without transport modelling, especially in the cities. Transport modelling represent one of tools that help various researchers and

engineers in the field of transport planning and engineering. Using transport modelling can help to detect the number and characteristics of trips for specific area or regions.

Trips can be separated regarding to transport mode (e.g., car, bicycle, public transport, walking, etc.). Public transport has shown numerous benefits comparing to private cars. Determine real and possible number of trips of every transport mode are achieved by using logit model. Logit model is mostly used statistic method for detecting modal split in transport modelling. Data collected by survey conducted in the City of Velika Gorica will be used to calculate logit model of trips.

Trips will be separated between public transport and private cars. Goal of paper is creating a logit model that can be used as an initial model in other cities that have similar geographic and socio-demographic characteristics. Paper consists of literature overview, methodology and data collection, public transport model and conclusion.

2. LITERATURE OVERVIEW

Literature overviews consist of seven papers that main goal is presenting different segment of public transport modelling. First paper [1] defines that requiring not only a well-functioning assignment method, but also reliable passenger data to create transport models. Reliable passenger data means a time-dependent origin-destination matrix. To solve the problem of the lack of time-dependent passenger data, paper[1] have developed a forecasting method. It consists of three stages. The results were reliable, so authors stated that results of model could be used in the planning process [1].

Paper [2] states limitations of conventional four-stage models that they do not consider subjectivity, imprecision, ambiguity, and vagueness involved in human decisions. In this direction, fuzzy logic is found to be the most suitable technique because it considers linguistic variables and expressions. Keeping this in view, the authors propose to develop a methodology to consider fuzzy logic technique at different stages to develop travel demand models. Further, to demonstrate the suitability of the developed fuzzy logic travel demand model, selected public transport policies are simulated considering appropriate parameters [2].

Authors [3] shows problem with detecting needed size of the sample at a surveying, to be able to produce reliable data for OD matrix estimation. The paper [3] deals with the issue of needed sample size and reliability of results.

Paper [4] present how petrol prices have been increasing and decreasing at a formidable rate. Despite the increases and drops in retail in petrol prices over the last three years, there is a sense of optimism in some camps that prices will rise when the global financial crisis is over, and that finally we will have pricing signals to encourage earlier investment in substitutes that include public transport, more fuel-efficient cars as well as lower polluting vehicles. This note uses TRESIS, an integrated transport, land use and environmental strategy impact simulation program, to assess the influence of higher fuel prices on short run and long run

passenger travel activity in Melbourne. Authors [4] evaluate petrol prices in the range AU$2 to AU$10 over the period 2009-2017, to establish likely impacts on car use, modal share, greenhouse gas emissions, and public transport revenue.

Paper [5] shows that are major concerns that as the total travel demand rises back toward prepandemic levels, the overall transport system capacity with transit constraints will be insufficient for the increasing demand. Paper [5] uses city-level scenario analysis to examine the potential increase in post-COVID-19 car use and the feasibility of shifting to active transportation, based on prepandemic mode shares and varying levels of reduction in transit capacity. Also paper [5] provides a strategic planning tool for policy makers facing challenging transportation system decisions in the aftermath of the COVID-19 pandemic.

Paper [6] shows that studies on the elasticity of demand for urban public transport services have a very high theoretical and application value, proven by the fact that despite the knowledge already possessed new studies in this field are permanently undertaken worldwide. The paper [6] presents the hitherto results of studies in the field of price elasticity of demand for public transport services. Also results of studies on price elasticity of demand have been presented, based on empirical data related to the sales of tickets for public transport services in the Upper Silesian conurbation in Poland. Moreover, the paper identifies the non-price factors that determine changes in demand for urban public transport services. The obtained results became the basis to discuss estimation limitations of demand elasticity in the urban public transport and allowed to determine directions of further studies [6].

Presented papers show a great possibility of public transport modelling use in creating future traffic solutions, not just infrastructure segments, but also in policies and other soft measures.

3. METHODOLOGY AND DATA COLLECTION

Methodology and data collection for this paper have been created and used from project titled “Analysis of public transport system in the City of Velika Gorica”. During project, data have been collected at main bus terminal in the City of Velika Gorica and in all schools at city are (both elementary and high) as survey with numerous questions. Survey consisted of socio-economic parameters and transport parameters.

Data used in this paper will consist of three transport parameters collected:

- Travel time of public transport system between various zones centroids,
- Travel time of private cars between various zones centroids and
- Selected mode of travel.

This sets of data were prepared by using programming tools MS excel and analyzed by statistical programming language R.

Table 1. Data preparation for programming tool R

Number	Public transport	Private car	Mode of travel
1	43.13	32.06	2
2	163.54	49.93	2
3	163.54	49.93	2
4	117.92	30.41	2
5	90.38	25.73	2
6	90.38	25.73	2
7	86.62	31.65	2
8	86.62	31.65	2
9	86.62	31.65	2
10	86.62	31.65	2
11	86.62	31.65	2
12	86.62	31.65	2
13	125.47	21.94	2
14	125.47	21.94	2
15	86.62	31.65	2
16	86.62	31.65	2
17	2.45	13.20	2

4. PUBLIC TRANSPORT MODEL

Public transport model for City of Velika Gorica is developed during project “Analysis of public transport system in the City of Velika Gorica”. One part of that model was creating logit binomial model to check possible effect of different measure that could be implemented in future. Public transport model consists of routes and timetables based on working day for administrative area of City of Velika Gorica and submodel of origin-destination trips that have been determined from survey (approximately 2.000 completed surveys which have been increased according to the number of passengers counted. Final step was assigning trips to public transport routes.

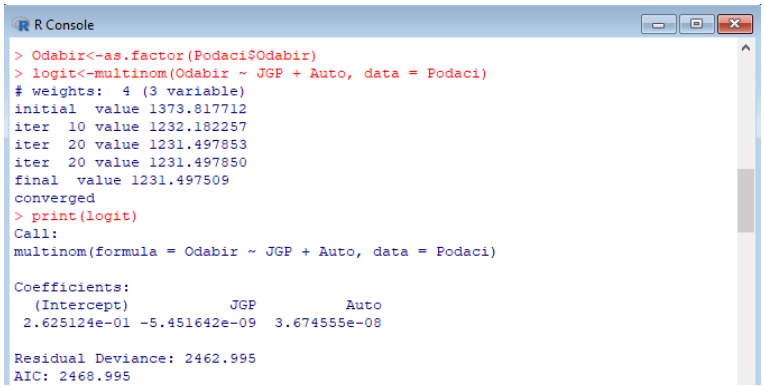

Figure 1. Codes from programming tool R

Figure 1 shows programming interface of programming language R with syntax for creating logit models based on data about travel times for public transport and private cars with selected options between available modes. Red text in the figure 1 present commands and blue text are result of conducted commands.

Table 2 shows coefficients of created logit model. Intercept represent first (single) coefficient, while others two coefficient (JGP and Auto) represent influence on dependent variable of the model.

The dependent variable of this model is one of two possible modes of travel that respondents have selected (public transport – JGP and private car – Auto). Independent variables are time travels of both modes. Values in the Table 2 present coefficients which have various level of influence on possibility for selected specific mode of travel.

Table 2. Coefficients values after creating of logit model in programming tool R

Coefficients		
(Intercept)	**JGP**	**Auto**
2.625124e-01	-5.451642e-09	3.674555e-08

Coefficient from table shows (except coefficient Intercept) very small values. That number can be argued with structure of responders from conducted survey. Most of the responders were passenger that can only use public transport to conduct their travel to their activity location. Although data show that travel time of private car are in almost all cases smaller than travel time of public transport, results of logit model and real data show that very larger number responders in such situation is forced to use and choose public transport.

5. CONCLUSION

Paper presented how public transport modelling can contribute during transport planning before phase of implementation. Literature overviews show various segments that have benefit from public transport modelling. Using logit model must satisfy several conditions to be useful as part of modelling. First is real and reliable data. Second is detecting parameters that have significant influence on passenger decision which travel of mode to use when travelling. Third is data to use as comparison to model results. There is more conditions but this three is minimum to develop logit model that can be used for public transport modelling of future solutions.

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