Research Paper

Research on the application of fuzzy analytic hierarchy process in the selection mode of intercity vehicles

Chu Fang
College of Economics and Management, Zhaoqing University, Zhaoqing City, Guangdong, China

Abstract: *The method of allocating transportation volume based on past predictions requires a significant amount of manpower, time, money, and technical costs .The quantity and predictive ability of resources are usually not ideal, so this study attempts to develop another simple method ,reducing the required amount of data, has a behavioral theoretical foundation, and can clearly check comfort, convenience, and safety.The Analytic Hierarchy Process (A.H.P.) can solve complex problems in the following ways Layering and simplification, capable of handling both measurable and unmeasurable variables simultaneously, with the ability to handle complexity. The loss is subjective as this study aims to explore the impact of factors such as safety, comfort, and convenience on vehicle selection.Due to the imprecision of psychological assessment, fuzzy theory concepts should be added to consider the uncertainty of preferences and behaviors.IThe content mainly includes analyzing the characteristics of individual vehicle selection behavior and the results of fuzzy analytic hierarchy process for traffic volume allocation.The analysis results indicate that the prediction error is not significant and will not change with different starting and ending markets, which will help alleviate future riskssurvey work on traffic volume prediction in transportation planning.*

I. Introduction

In the early stages of urban transportation planning, Diversion Curves were used to predict traffic distribution. The method is very simple, considering relative travel indicators, and the ratio of transportation vehicles can be directly found through graphics.However, its disadvantage is the need for a large amount of quantitative survey data and the lack of a behavioral theoretical foundation.The direct demand model also requires a considerable amount of data, and the model is usually a nonlinear function, making calibration difficult. The substitution and complementary relationships between various modes of transportation are also not easy to obtain consistent calibration results.After that, there was the development of individual choice models. Individual choice models are mainly based on the behavior of individuals in choosing transportation modes.This type of model starts from the utility function, which assumes that consumers will choose the transportation mode with the highest utility in the face of various possible alternatives, and predicts the distribution of transportation mode usage in the form of probabilities.The most widely used model in this category is the Logit Model, which is currently the most commonly used method in practical planning.The estimation of the Logit Model requires a significantly reduced amount of data collection compared to previous methods, and is based on behavioral theory, but the estimation of the model is still quite difficult.

II. Research model

Establishment of Fuzzy Analytic Hierarchy Process for Traffic Volume Allocation Model: Before establishing the transportation volume allocation model, a thorough exploration of the theoretical foundations of A.H.P method, fuzzy theory, and fuzzy analytic hierarchy process is conducted. Through a review of relevant literature, a comprehensive organization is conducted to propose the key issues to be explored and addressed in this study, and a fuzzy analytic hierarchy process transportation volume allocation model is established using its theoretical calculation program. Regarding the characteristics of the issues raised. The capacity allocation model established based on individual behavior generally has three mathematical forms of representation: Discriminant analysis, Probit model, and Logit model. These mathematical analysis methods are based on the utility or comprehensive cost of transportation, combined with the socio-economic variables of decision-makers, to

analyze the probability of transportation being used, and then calculate the number of trips using various types of transportation. The most widely used among them is the Rogit mode.

III. Empirical Research

In terms of empirical research, several origin and destination transportation markets will be selected as the objects, with aviation, railways, buses, cars, and other transportation options for individuals to travel between cities. The distribution of transportation volume in each transportation market will be analyzed, as well as the factors that affect individual transportation selection and their importance. On the other hand, explore the feasibility of regional transfer of transportation volume allocation.

The purpose of the development of AHP method is to systematize complex problems. Through group discussions, professionals with expertise or accumulated considerable experience gather opinions from all parties, decompose the problem into different levels, quantify the pairwise comparison of elements at the name scale, establish a pairwise comparison matrix, and then obtain the priority order of the feature vectors representing the elements within the hierarchy, Then, the degree of consistency of each paired comparison matrix is evaluated using eigenvalues. Finally, by concatenating the connected layers, the priority level of the lowest level elements for the entire system can be calculated. This priority level can provide decision-makers with overall judgment, thereby achieving more reasonable and correct decisions.

Evaluation scale	Relative scale of names	Explanation
1	Equal Importance	The contribution level of the two comparison schemes is equal importance
3	Weak Importance	Experience and judgment have a slight inclination towards liking certain things
5	Essential Importance	Strong preference for experience and judgment
7	Demonstrated Importance	Experience and judgment are strongly inclined towards preferences
9	Absolute Importance	There is sufficient evidence to confirm an absolute preference for one
2,4,6,8	The importance of intermediate degree	When a compromise value is required

Mode	Is there a market segmentation	Integrating group opinions	Paired comparison matrix form of quantifiable evaluation criteria
Mode1	None	Geometric mean	Relative Paired Comparison Matrix
Mode2	Have	Geometric mean	Relative Paired Comparison Matrix
Mode3	Have	Triangular fuzzy number	Relative Paired Comparison Matrix
Mode4	None	Geometric mean	Absolute paired comparison matrix
Mode5	Have	Geometric mean	Absolute paired comparison matrix
Mode6	Have	Triangular fuzzy number	Absolute paired comparison matrix

IV. Result

Overall, the predictive ability of the fuzzy analytic hierarchy process's transportation volume allocation model is not as good as expected. There is a difference in the proportion of current traffic volume allocation, and the possible reasons for this situation may be: The method used in this model belongs to the analysis method of psychological subjective judgment, and the obtained transportation volume allocation result should be the potential needs of travelers. Their actual transportation vehicle selection behavior may not meet their preferences due to some uncontrollable factors. The accuracy of the estimated bus and minibus series from the current travel frequency data used in this study may affect the comparison results of traffic volume allocation. The preference of the public for choosing transportation vehicles is in good agreement with their actual behavior, with a compliance rate of over 60%.The two most important factors for travelers in various length transportation markets to choose transportation vehicles are safety and time. Short and medium distance travelers believe that comfort and convenience are more important than cost considerations, which can reflect unquantifiable safety factors as a crucial factor in the choice of transportation for the public. According to the analysis results, except for the cost of buses that makes travelers feel satisfied, the general preference of travelers for buses is lower than that of other vehicles.

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