PASSENGER TRAVEL CHOICE PREDICITON BASED ON FUZZY LOGIC

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Abstract: Travelling choice about high-speed rail is very important to improve the level of management. The paper put forward a prediction model based on fuzzy logic to predict the choices of the travelers , after compared several methods. Then , combined with the survey data and the training and testing of the model , we determined a effective model with fuzzy rules. The inspection findings of the model indicate that the choice result predicated by the model based on fuzzy logic and the actual choice very close. Therefore, the prediction method based on fuzzy logic is feasible. In addition, we put forward the concept of improving factor, to provide reasonable proposals about how to improve the services and management quality of the high-speed way.

1 INTRODUCTION

The issue about passenger travel choice is of universal concern, the result of the prediction and its reliability is very significant to improve the level of management and make aid decision. As the most effective way to solve the conveying of a large of passengers quickly, High-speed rail has already become the general development tendency. Nevertheless, the studies on high-speed rail in our country mostly focus on the field of technology, while is lack in the studies on passenger travelling.

The essence of the travel choice decides its result has strong randomness, and its impact factors have obvious ambiguity and uncertainty. Therefore, how to solve the problem caused by the ambiguity and uncertainty is the difficult point of the prediction. Although traditional soft computing methods are strict , certain and accurate, they are not suit to solve the practical problems under uncertain environment in real life, such as the problem about passenger travel choice. For this reason, the paper discussed and put forward the prediction method for the travel choice based on fuzzy logic.

Besides, we put forward how to distinguish the most effective impact factors.

2 LITERATURE REVIEW

Fuzzy logic has been growing attention for engineers since 1965 (Zadeh, 1965). In traffic field, traffic signal control is an important application. However, study on passengers travel is really in shortage. Most study about traffic is about traffic signal control. The first appearance of the fuzzy logic in traffic signal control is due to Pappis and Mamdani(1997).

About passenger travel, scholars' study focused on analyzing passengers' demand. Qiang

Lixia and Yan Ying (2006) put forward the differences in high-speed rail in china and other countries. Go so far as to passenger travel choice, most scholars analyzed it based on behaviouristics. Chen Zhangming (2008) put forward passenger travel choice by researching travelers' action feature .In brief, study on passenger travel choice based on soft computer is such as never previously existed.

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3 THE PREDICTION MODEL BASED ON FUZZY LOGIC

3.1 Prediction System and its Model Structure

In accordance with the expert's suggestion about passenger travel, we choose ticker price(TP), departure time(DT),train environment (TE), train security(TS), train speed(TSS) as the input variable of the prediction system, the choice as the output of the system. The fuzzy inference model structure is shown in Figure 1, the key problem is to confirm effective fuzzy rules.

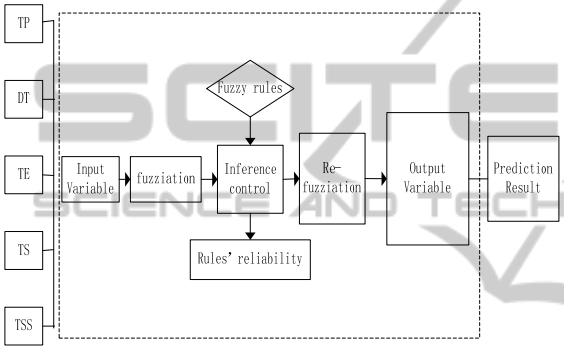

Figure 1: Prediction system structure.

3.2 Fuzzification

Based on the survey data, we determined fuzzy sub-sets and membership function for each parameter. TP is expressed by{VC,C,M,E,VE},
and DT is expressed by{EL,VL,L,M,S,VS,ES},and TE is expressed by {EL,VL,L,M,S,VS,ES}, and TS is expressed by {EL, VL, L,M,S,VS,ES},And TSS is expressed by {EL, VL, L, M, S, VS, ES}. The choice is "yes" or "no". The membership functions of these parameters are determined shown in Figure 2.

3.3 Fuzzy Rules

As for each effective record of the survey data, we set up a relevant fuzzy rule. For example, to a certain passenger, if he thought ticker price(TP) is M, departure time(DT) is VS, train environment(TE) is M, train safety(TS) is VS, train speed (TSS) is VL ,and the choice of his next travel is not choosing high-speed rail, we can describe this rule with fuzzy language as that

If (TP is M)and (DT is VS) and (TE is M) and (TS is VS) and (TSS is VL) , then (choice in not).

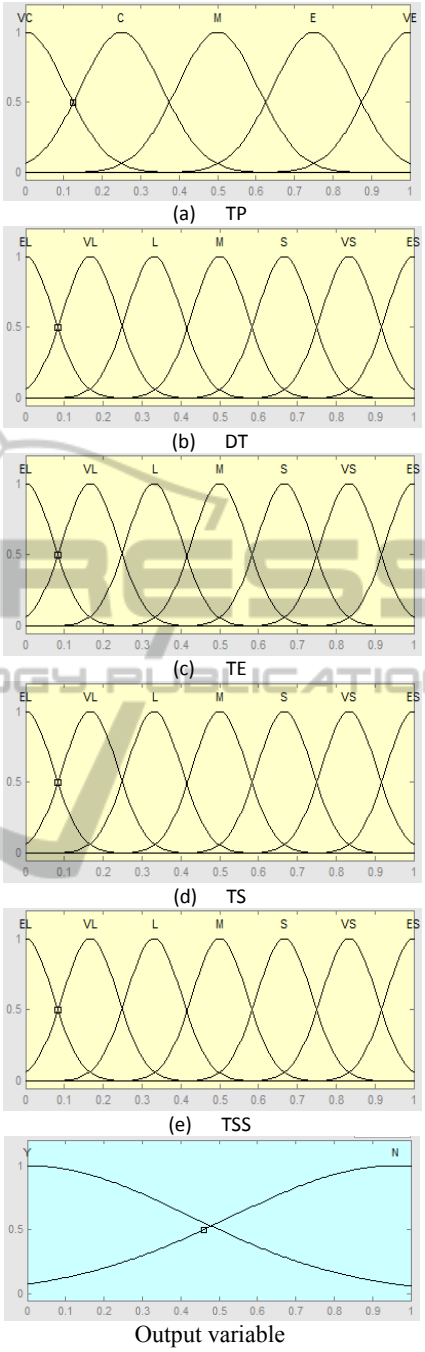

Figure 2: Membership functions.

Accordingly, the weight of this rule is

$$\omega_i = \mu_{TP_i} \wedge u_{TT_i} \wedge u_{TE_i} \wedge u_{TS_i} \wedge u_{TV_i}$$

This paper collected 1270 records about passenger travel choice, then, divided to two parts equally. The first part contained 447 records after deleting reduplicate records, these were for the training of the

fuzzy rules. The second part was used to examine the efficiency of the prediction.

Therefore, we got 447 initial rules, we screened these rules. If some rules' premise were the same, we retained the rule that its weight was biggest, and deleted others. Then, we trained the rules with simulink . In the end, we got 211 rules, as shown in table 1.

3.4 Travel Choice Prediction Model

On the basis of decided input variable, their membership functions, and 211 rules after trained ,we finally built the passenger travel choice prediction model, shown in figure 3.

4 EXAM AND ANALYSIS MODEL

Make the second group data as the input of the fuzzy logic travel choice prediction model, we got the homologous prediction result. To exam the precision of the prediction model, we used two error formula, one was for confirming the prediction precision of a single sample point, the other one was for confirming the prediction precision of the whole sample.

The exam result between the prediction result and the actual passenger travel choice is shown in table 2.With the comparison between the prediction result and the actual choice ,we got the accuracy rate of the prediction model is 87%.

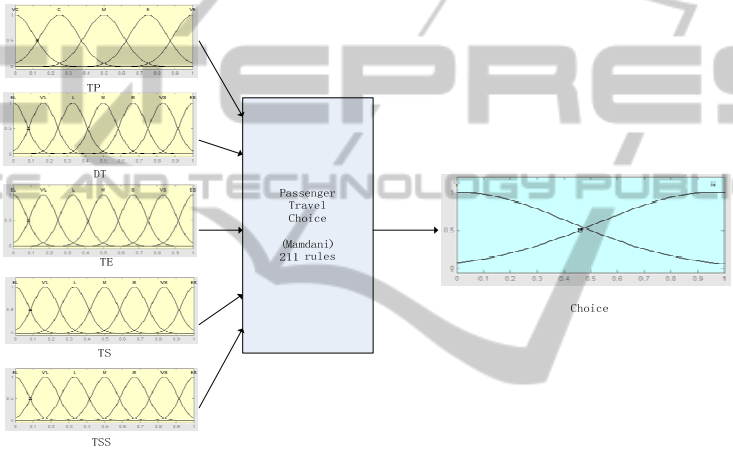

Figure 3: Fuzzy logic travel choice prediction model.

Table1: Fuzzy logic rules.

TP	TT	TE	TS	TSS	CHIOCE
M	S	M	S	VL	N
ES	M	M	M	M	Y
M	L	S	S	VL	N
VS	M	M	S	M	N
……	……	……	……	……	……
M	M	S	S	M	Y

Table 2: comparison result.

Record number	Actual choice	Prediction result	Comparison
1	Y	Y	same
2	Y	Y	same
3	Y	Y	same
4	Y	Y	same
5	Y	N	different
6	Y	Y	same
7	Y	Y	same
…	…	…	…
447	N	N	same

5 DISTINGUISH HIGHEST IMPACT FACTOR

Effective fuzzy control rules not only provided the relationship between input variable ant output variable, they also reflected each impact factors' effect on the final prediction result in a way. Therefore, with this fuzzy logic model, we can exam the most effective impact factor to move forward a single step.

To a certain passenger, change the value of each impact factor one by one. Then, get the homologous prediction result with the model. After that, we can compare the prediction result with the actual passenger travel choice. The principle is that after changing the factor, if the prediction result is in the same with the actual choice, then, we can know the degree of the influence of this factor.

6 CONCLUSIONS

It's very difficult to build an accurate prediction model to predict passengers travel choice. The reason is that passenger's choice about travel is subject to a lot of factors, such as time, weather, individual trait etc. These all factors can have huge influence on passengers' travel. Thus, this paper's ultimate aim is to put forward a feasible model to predict passengers' choices when they is going out. Nevertheless, because of travel choice's randomness, discussing and getting a model to predict passenger travel choice exactly is very unpractical. The demonstration of this paper show that to predict passenger travel choice with fuzzy logic is feasible in a way. Of course, to improve the reliability of this model, there are still a lot of problems needing further study. In addition, a more complete and accurate data base is also indispensable, based on it, we can set up a model with higher quality.

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