talenta PUBLISHER

Journal of Research in Mathematics Trends and Technology

Journal homepage: https://talenta.usu.ac.id/jormtt

Implementation of the Doubling Mamdani Fuzzy Method in Comparing the Output Quality of Four-Wheeled Vehicles in 2024

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ARTICLE INFO

Article history:
Received: 07 January 2023
Revised: 08 February 2023
Accepted: 29 March 2023
Available online: 30 March 2023

E-ISSN: 2656-1514
P-ISSN: -

How to cite:
Balqis, M.F., Gultom, A. "Implementation of The Doubling Mamdani Fuzzy Method in Comparing the Output Quality of Four-Wheeled Vehicles in 2024". Journal of Research in Mathematics Trends and Technology, vol. V5, no. 1, Mar. 2023,
doi: 10.32734/jormtt.v5i1.16923

ABSTRACT

Nowadays, a four-wheeled vehicle or a car is already a primary necessity for most people. Various functions and advantages exist in four wheeled vehicles that are the factors that make the existence of four wheels very helpful in transportation and other activities. As a dynamic means of transportation, four-wheeled vehicles from year to year have been increasing in models and are becoming more and more sophisticated. The problem is that as a prospective buyer, one will surely be confused in choosing a four-wheeled vehicle among its various variations and models. In this paper will be given enlightenment in the selection of four-wheeled vehicles of such variation. Fuzzy decision making, or fuzzy decision maker, with the method of scanning, is designed to help the prospective buyer in selecting the four-wheeled vehicle that meets the criteria of the potential buyer. Based on the criterion desired by the prospecting buyer, the data around the four wheeled vehicles will be processed in the fuzzy assembly system until in the end each of the vehicle four wheels produces fire strength.

Keywords: Fuzzy Decision Making, Fuzzy Mamdani, Vehicles

http://doi.org/10.32734/jormtt.v5i1.16923

1. Introduction

A four-wheeled vehicle (car), nowadays, has become one of the important things for every household to have. One of the reasons is that it can facilitate mobility together. Not only does it facilitate mobility together, a car is also an effective and efficient vehicle compared to a motorcycle. Apart from the mobility factor, there are also other factors that make a car an important item that should be owned when you have a family, such as safety, comfort, and freedom. By considering these factors, each buyer should choose a vehicle that best suits the desired criteria.

Vehicle selection is an important decision for many individuals and families. This process involves complex considerations, including factors such as daily use needs, personal preferences, budget, technical features and specifications, as well as environmental and safety factors. However, consumers often face

difficulties in making an informed decision as these factors are subjective and difficult to measure unequivocally. In addition, there is uncertainty in assessing the relative value of each factor and making comparisons between different vehicle options. In this case, the application of fuzzy logic in the selection of four-wheeled vehicles can be the right solution. Fuzzy logic allows the representation and handling of uncertain or fuzzy values, so as to overcome the uncertainty that often occurs in the decision-making process. By using a fuzzy logic approach, decisions can be made based on ambiguous or subjective criteria, and can integrate various relevant factors flexibly. By utilizing fuzzy logic in the selection of four-wheeled vehicles, this research can provide more personalized and accurate recommendations to consumers, and can help them make better and more informative decisions. In addition, this research can also be used as an additional reference.

2. Methods

2.1 Data Collection

The data collection technique in this research used the literature study method. Data was obtained from literature, books, journals, and websites. In this study, the fuzzy mamdani doubling method was used to determine the four-wheeled vehicle that best suits the criteria of each consumer. Then these data would be processed so that the final result was obtained in the form of a fire strength value, and the object with the highest fire strength value is the choice that best meets the criteria of the consumer.

The data that had been obtained through literature studies from various sources was formed into the following table:

Merk	TE	RPM/TE	TR	RPM/TR	SL	TN	HR
Daihatsu All New Xenia 1.3 MMT	98	6000	121.6	4200	1329	43	226.650.000
Daihatsu New Terios R AT Custom	104	6000	136	4200	1496	45	307.750.000
Daihatsu New Sigra 1.2 R MT	88	6000	108	4200	1197	36	164.000.000
Toyota New Kijang Innova Zenix HEV G Hybrid Type	152	6000	187	5200	1987	52	477.600.000
Toyota All New Veloz Q CVT TSS	106	6000	137	4200	1496	43	340.400.000
Toyota	106	6000	137	4200	1496	43	276.700.000

Merk	TE	RPM/TE	TR	RPM/TR	SL	TN	HR
All New Avanza 1.5 G CVT Toyota New Calya G A/T	88	6000	108	4200	1197	36	190.000.000
Toyota All New Kijang Innova Zenixx G Gasoline Type	174	6600	205	4900	1987	52	430.400.000
Toyota All New Voxy 2.0 CVT	170	6600	202	4900	1986	52	615.000.000
Toyota All New Kijang Innova Zenix HEV V Hybrid Type	152	6000	187	5200	1987	52	541.750.000

Source : https://www.toyota.astra.co.id/home & https://daihatsu.co.id/

These datas then will be fuzzified in order to get the degree of membership value.

2.2 Degree of Membership Value

Merk	HR	Affordable	Moderate	Expensive
Daihatsu All New Xenia 1.3 MMT	226.650.000	0.9	0.1	0
Daihatsu New Terios R AT Custom	307.750.000	0.46	0.54	0
Daihatsu New Sigra 1.2 R MT	164.000.000	1	0	0
Toyota New Kijang Innova Zenix HEV G Hybrid Type	477.600.000	0	0.6	0.4
Toyota All New Veloz Q CVT TSS	340.400.000	0.3	0.7	0
Toyota All New Avanza 1.5 G CVT	276.700.000	0.6	0.4	0
Toyota	190.000.000	1	0	0

Merk	HR	Affordable	Moderate	Expensive
New Calya G A/T Toyota All New Kijang Innova Zenixx G Gasoline Type	430.400.000	0	0.9	0.1
Toyota All New Voxy 2.0 CVT	615.000.000	0	0	1
Toyota All New Kijang Innova Zenix HEV V Hybrid Type	541.750.000	0	0.3	0.7

The same steps are performed on other variables.

After the membership degree of each variable is obtained, the next step is to apply the AND multiplication operator to get a four-wheeled vehicle recommendation that is closest to the criteria or wishes of the buyer. In this case, suppose someone wants to buy a four-wheeled vehicle with the following criteria:

Power : Moderate
RPM at Max Power : Moderate
Torque : Moderate
RPM at Max Torque : Moderate
Cubic Capacity : Moderate
Tank Capacity : Large
Price : Affordable

So, to get the choice of four-wheeled vehicles that are closest to the criteria to be sought, namely by looking for the value of fire strength in each vehicle. The fire strength value can be found using the AND multiplication operator formula:

$$\alpha = (\mu_{TE}) * (\mu_{RPM/TE}) * (\mu_{TR}) * (\mu_{RPM/TR}) * (\mu_{SL}) * (\mu_{TN}) * (\mu_{HR})$$

Merk	μ_{TE} Moderate	$\mu_{RPM/TE}$ Moderate	μ_{TR} Moderate	$\mu_{RPM/TR}$ Moderate	μ_{SL} Moderate	μ_{TN} Large	μ_{HR} Affordable
Daihatsu All New Xenia 1.3 MMT	0.04	1	0.22	0.4	0.66	0.15	0.9
Daihatsu New Terios R AT Custom	0.48	1	0.36	0.4	0.9	0.25	0.46
Daihatsu New Sigra 1.2 R MT	0.16	1	0.08	0.4	0.4	0	1

Toyota New Kijang Innova Zenix HEV G Hybrid Type	0.56	1	0.87	0	0.03	0.6	0
Toyota All New Veloz Q CVT TSS	0.52	1	0.37	0.4	0.9	0.15	0.3
Toyota All New Avanza 1.5 G CVT	0.52	1	0.37	0.4	0.9	0.15	0.6
Toyota New Calya G A/T	0.16	1	0.08	0.4	0.4	0	1
Toyota All New Kijang Innova Zenixx G Gasoline Type	0.12	0	0.9	0.2	0.03	0.6	0
Toyota All New Voxy 2.0 CVT	0.2	0	0.96	0.2	0.03	0.6	0
Toyota All New Kijang Innova Zenix HEV V Hybrid Type	0.56	1	0.87	0	0.03	0.6	0

3. Result and Discussions

After the membership degree of each variable in accordance with the criteria is obtained, the next step is to enter the membership degree value into the AND multiplication operator formula to get the fire strength value of each vehicle:

Daihatsu All New Xenia 1.3 MMT

$$\alpha = (\mu_{TE}Moderate) * (\mu_{RPM/TE}Moderate) * (\mu_{TR}Moderate) * (\mu_{RPM/TR}Moderate) * (\mu_{SL}Moderate) * (\mu_{TN}Large) * (\mu_{HR}Affordable)$$

$$\alpha = 0.04 * 1 * 0.22 * 0.4 * 0.66 * 0.15 * 0.9$$

$$\alpha = 0.000313632$$

With the same steps, the α of each vehicle is obtained as shown in the following table:

No	Merk	Fire Strength (α)

1	Daihatsu All New Xenia 1.3 MMT	0.000313632
2	Daihatsu New Terios R AT Custom	0.00715392
3	Daihatsu New Sigra 1.2 R MT	0
4	Toyota New Kijang Innova Zenix HEV G Hybrid Type	0
5	Toyota All New Veloz Q CVT TSS	0.00311688
6	Toyota All New Avanza 1.5 G CVT	0.00623376
7	Toyota New Calya G A/T	0
8	Toyota All New Kijang Innova Zenixx G Gasoline Type	0
9	Toyota All New Voxy 2.0 CVT	0
10	Toyota All New Kijang Innova Zenix HEV V Hybrid Type	0

So, it can be seen from the table that the one with the largest fire strength value is Daihatsu New Terios R AT Custom, which is 0.00715392. So based on the table, the order of four-wheeled vehicles that best suits the criteria desired by buyers is Daihatsu New Terios R AT Custom, Toyota All New Avanza 1.5 G CVT, Toyota All New Veloz Q CVT TSS, to Daihatsu All New Xenia 1.3 MMT.

4. Conclusions

Based on the results of the study, it can be concluded that the application of the Mamdani doubling method can assist users in obtaining recommendations for the best four-wheeled vehicles and closest to the criteria desired by users by comparing the quality of each vehicle based on the fire resistance value of each vehicle.

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