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FORECASTING THE USE OF OKE JACK COMPANY'S ONLINE TRANSPORTATION IN MEDAN USING THE CHENG FUZZZY TIME SERIES METHOD

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ABSTRACT

Transportation is an activity to move goods or people from one place to another. At present, transportation is very much needed by all groups to carry out an activity. Along with the development of the times and with the development of the times and with the existence of an internet, now many enterpreneurs are opening a business such as online transportation. This study uses the *Fuzzy Time Series Cheng* method in his research to see how accurate the model is to predict the future period. The results of the research using the *Fuzzy Time Series Cheng* method on the five service features in the Oke Jack, it was found that some of these service features resulted in MAPE *error* values below 10%, which is the best measure.

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1. INTRODUCTION

Online transportation is a transportation that can be used by all Indonesians, especially people in the city of Medan, by using an application located on *a smartphone*. Online transportation provides services between goods and people who will travel anywhere that can be delivered directly to the location without the need to approach the ojek base or no longer have to wait by the roadside to get a taxi or rickshaw. Online transportation also provides food orders that can be delivered directly to the location of the order without having to go to its place directly, because the fare has been determined on the application. Degan this change is widely utilized by entrepreneurs to start business competition in the online transportation business.

Online transportation in Indonesia such as Go-Jek, Grab, Oke Jack, Blue Bird and inDriver and others. This research specifically examines about Oke Jack who is in Medan. Oke Jack is a social enterprise

that led the revolution of the motorcycle taxi industry. Oke Jack himself started his journey in 2015 and still only operates in Malang. And in the next year Oke Jack is growing to several major cities in Indonesia.

Through oke jack app, everyone can access various services ranging from transportation, food delivery, shopping, send delivery, to clean house and vehicle. Because Ok Jack is an application with a variety of solutions for each situation.Oke Jack itself started operating in the city of Medan since mid-2018, from other companies Oke Jack attracted fans by giving about 10% off for drivers and giving a lot of discounts to users of the Oke Jack app. Because of the increasing number of *smartphone*users, there are also increasing users of *online* transportation in the city of Medan. Therefore the author wants to do Online Transportation Usage Forecasting Company Oke Jack in Medan Using *Fuzzy Time Series Cheng* Method**,** in the section Oke Ride, Oke Car, Oke Food, Courier and Oke Shop in a company Oke Jack by using past data from users Oke Jack. Because *online* transportation is growing very rapidly, so it is interesting to research. researchers use *fuzzy time series* method because it will difuzzy the number of users of Oke Jack in Medan. Therefore, researchers used *Cheng's Fuzzy Time Series* method to predict the number of Oke Jack users in Medan for some future periods.

2. RESEARCH METHODE

In performing this research procedure is also assisted by software such as MS. Excel. the following research plans conducted in this study are as follows:

1. Data Retrieval

   Researchers will take secondary data that is data obtained directly from the company Oke Jack.

2. Data Processing

   The data that has been obtained will be processed by the following stages of calculation:

   a. Forming a set of universes (U) that is, a set formed from the historical data available by determining the value of the D_{max}andD_{min}.

   b. Interval formation by determining range values, calculating class intervals, calculating interval widths, and forming *fuzzy* sets by looking at the number of frequencies obtained.

   c. Form a new interval class by looking at the number of frequencies obtained and looking for the middle value of each interval class.

3. Forming FLR (*Fuzzy Logic Relation)*and the formation of FLRG (*Fuzzy Logic Relation Group)* to set the weighting on *fuzzy time series cheng*.
4. Create a weighting matrix from the FLR results obtained then normalize the weighting matrix.
5. Calculate the forecasting value of *cheng fuzzy time series*method.

Calculate the *fuzzy time series chengerror*value, then analyze the accuracy value using mape formula

3. RESULT AND ANALYSIS

The data used by researchers is monthly data in the use of online transportation from okejack company in Oke Ride section from May 2018 to September 2020, therefore there are 29 observation data used by researchers in this study.

Table 3.1User Data Ok Jack in Medan

Year	Month	Oke Ride	Oke Courier	Oke Shop	Oke Food	Oke Car
2018	May	30	0	0	2	61
	June	90	1	1	3	49
	July	185	5	3	3	112
	August	80	12	1	3	61
	September	72	0	0	3	32
	October	38	10	1	4	20
	November	29	2	0	2	5
	December	15	0	0	0	0
2019	January	2	0	0	0	1
	February	64	1	0	2	2
	March	13	0	0	7	4
	April	18	1	0	0	2
	May	31	1	2	1	5
	June	31	1	2	1	5
	July	10	0	0	0	0
	August	116	7	1	6	0
	September	101	1	0	7	0
	October	71	1	0	4	1
	November	115	3	0	7	0
	Desember	87	3	1	4	0
2020	January	8590	25	5	38	6
	February	8.219	226	23	117	52
	March	16.571	654	86	96	50
	April	5.675	339	56	50	17
	May	3.081	131	42	33	10
	June	12.023	570	54	76	114
	July	24.084	1.299	79	154	238
	August	31.183	1.463	141	207	409
	September	48.019	1.766	125	256	392

Source: Oke Jack Medan Company

Formation of the Universe Set

The first step in the *fuzzy time series* method is to form a set of universes in which there are several partitions of the same interval length. The set of universes is formed from the available historical data, namely by defining the D_{max} and D_{min} or the highest data and lowest data. Here's how to define the set of universes.

$$U = D_{min} \; ; \; D_{max}$$

With D_{max} is the highest data and D_{min} is the lowest data. On Oke Jack data especially in Oke Ride users, researchers get a value of D_{max} = 48.019 users and D_{min} = 2 users. This the universe set U=(2;48.019).

Interval Length Formation

The second step is to form a long interval, researchers use frequency distribution that has the following steps:

a. Calculating *the Range*

$$R = 48.019 - 2$$

$$R = 48.017$$

The range value is obtained from the highest Oke Ride user data then subtracted with the lowest Oke Ride user data.

b. Calculating Class Intervals

In determining the number of class intervals, researchers used the Struges formula as follows:

$$K = 1 + 3{,}322 \log n$$

where the value K is the number of intervals and n is the number of time series data used, here is the result of the calculation of the number of intervals.

$$K = 1 + 3{,}322 \log 29$$

$$K = 5{,}858086149$$

From the above results obtained a value of K of 5.86, the researcher rounded the result to 6. So the number of intervals that researchers use is as much as 6 intervals.

c. Calculating Interval Width

$$I = \frac{R}{K}$$

$$I = \frac{48.017}{6}$$

$$I = 8.002{,}833$$

For the width of the interval can be obtained from the value of the range above then shared with the following class intervals then obtained the interval width value of 8,002,833.

d. *Fuzzy* sets are formed by looking at different number of frequencies.

Table 3.2 Frequency Density of User Data Okay Ride

u_i	Lower Limit	Upper Limit	Frequency	Number of Sub Intervals	Sub Interval Width
u_1	2	8.004,833	2 3	4	2000,70825
u_2	8.004,833	16.007,666	2	3	2667,611
u_3	16.007,666	24.010,499	1	2	4001,4165
u_4	24.010,499	32.013,332	2	3	2667,611
u_5	32.013,332	40.016,165	0	1	8002,833

u_6	40.016,165	48.019	1	2	4001,4175

From table 4.2 above, it can be seen that there are a number of different frequencies. When viewed from theresults of the frequency at all intervals, there are 4 different frequencies, namely 23, 2, 1, and 0. So the first highest data frequency, which is 23, is divided into 4 equal intervals. Next, the second highest frequency of data is at frequency 2 divided into h-1, which is 3 equal intervals, the interval at the third highest frequency is at frequency 1 divided into h-2, which is 2 equal intervals. This is done up to an interval with a frequency of one.

Based on the results of the frequency distribution, there are 15 sub-intervals that will be the domain of the fuzzy set that is formed, so there are 15 fuzzy sets that will be formed in table 4.3.

The following is the result of determining linguistic values with new boundaries.

Table 3.3Fuzzy Intervals Using Frequency Density

A_i	Lower Limit	Upper Limit	Lbr Sub Interval	Middle Value(m_i)
A_1	2	2002,70825	2000,70825	1002,354125
A_2	2002,70825	4003,4165	2000,70825	3003,062375
⋮	⋮	⋮	⋮	⋮
A_{14}	40016,165	44017,5825	4001,4175	42017
A_{15}	44017,5825	48019	4001,4175	46018

Fuzzification User OkRide

In the following stages of fuzzification based on the intervals that have been obtained before, the fuzzification can be seen from the limitations of the interval values that have been formed before.

Table 3.4Fuzzification of Actual Data

Year	Month	Oke Ride	Fuzzification	Tahun	Bulan	Oke Ride	Fuzzification
2018	May	30	A_1	2019	August	116	A_1
	June	90	A_1		September	101	A_1
	July	185	A_1		October	71	A_1
	August	80	A_1		November	115	A_1
	September	72	A_1		Desember	87	A_1
	October	38	A_1	2020	January	859	A_1
	November	29	A_1		February	8.219	A_5
	Desember	15	A_1		March	16.571	A_8
2019	January	2	A_1		April	5.675	A_3
	February	64	A_1		May	3.081	A_2
	March	13	A_1		June	12.023	A_6
	April	18	A_1		July	24.084	A_{10}
	May	31	A_1		August	31.183	A_{12}
	June	31	A_1		September	48.019	A_{15}
	July	10	A_1				

Fuzzy Logic Relationship **(FLR) and** ***Fuzzy Logical Relationship Group*****(FLRG)**

The next step is to establish *Fuzzy Logic Relationship* (FLR) by identifying the differences based on historical data that has been difuzzifikasikan before. FLR is formed based on user data at*the current state*with user data at a later time than the current time (*next state*).

Table 3.5F*uzzy Logic Relationship* (FLR) Results

Year	Month	Fuzzification	FLR	Year	Month	Fuzzification	FLR
2018	May	A_1	-	2019	August	A_1	$A_1 \rightarrow A_1$
	June	A_1	$A_1 \rightarrow A_1$		September	A_1	$A_1 \rightarrow A_1$
	July	A_1	$A_1 \rightarrow A_1$		October	A_1	$A_1 \rightarrow A_1$
	Augusts	A_1	$A_1 \rightarrow A_1$		November	A_1	$A_1 \rightarrow A_1$
	September	A_1	$A_1 \rightarrow A_1$		Desember	A_1	$A_1 \rightarrow A_1$
	October	A_1	$A_1 \rightarrow A_1$	2020	January	A_1	$A_1 \rightarrow A_1$
	November	A_1	$A_1 \rightarrow A_1$		February	A_5	$A_1 \rightarrow A_5$
	Desember	A_1	$A_1 \rightarrow A_1$		March	A_8	$A_5 \rightarrow A_8$
``2019	January	A_1	$A_1 \rightarrow A_1$		April	A_3	$A_8 \rightarrow A_3$
	February	A_1	$A_1 \rightarrow A_1$		May	A_2	$A_3 \rightarrow A_2$
	March	A_1	$A_1 \rightarrow A_1$		June	A_6	$A_2 \rightarrow A_6$
	April	A_1	$A_1 \rightarrow A_1$		July	A_{10}	$A_6 \rightarrow A_{10}$
	May	A_1	$A_1 \rightarrow A_1$		August	A_{12}	$A_{10} \rightarrow A_{12}$
	June	A_1	$A_1 \rightarrow A_1$		September	A_{15}	$A_{12} \rightarrow A_{15}$
	July	A_1	$A_1 \rightarrow A_1$				

After getting the FLR results, the next researcher will form a Fuzzy Logic Relationship Group (FLRG) based on the previous FLR results. If there is a fuzzy set that has a relationship or can predict more than one set, then the right side can be combined. Here are the results from FLRG on Oke Ride.

Tabel 3.6 FLRG Results From Oke Ride

Grup	*Current State*	*Next State*
Grup 1	A_1	A_1,A_5
Grup 2	A_2	A_6
Grup 3	A_3	A_2
Grup 4	A_5	A_8
Grup 5	A_6	A_{10}
Grup 6	A_8	A_3
Grup 7	A_{10}	A_{12}
Grup 8	A_{12}	A_{15}

Weighting

The difference between the method defined by *Chen* and the method defined by *Cheng* is the weighting of each *fuzzy*relationship. The next step after flrg creation is complete is to see how many of the same relationships

in flrg are then created into a transition matrix form and then normalized. For example, in Group 1 that contains fuzzyrelationship$A_1 \rightarrow A_1, A_5$. Therefore, from the fuzzy relationship it can be known that the value of$A_1 \rightarrow A_1$there are as many as 20, while the fuzzyrelationship$A_1 \rightarrow A_5$there is as many as one. Therefore, based onthe FLRG, weighting can be seen in Table 3.7 which is flrg weighting and Table 3.8 is a normalized weighting.

Table 3.7 *Weighting Fuzzy* For Okay Ride Users

W^*	A_1	A_2	A_3	⋮ ⋮	A_{14}	A_{15}
A_1	2 0	0	0	⋮	0	0
A_2	0	0	0	⋮	0	0
A_3	0	1	0	⋮	0	0
⋮	⋮	⋮	⋮	⋮	⋮	⋮
A_{14}	0	0	0	⋮	0	0
A_{15}	0	0	0	⋮	0	0

Table 3.8Normalized Weighting

W^*	A_1	A_2	A_3	⋮ ⋮	A_{14}	A_{15}
A_1	$20/21$	0	0	⋮	0	0
A_2	0	0	0	⋮	0	0
A_3	0	1	0	⋮	0	0
⋮	⋮	⋮	⋮	⋮	⋮	⋮
A_{14}	0	0	0	⋮	0	0
A_{15}	0	0	0	⋮	0	0

After getting the normalized weight from the two data above, then calculate the forecasting value in the next sub-chapte.

Calculating Forecasting Values

Here are the forecasting results from Oke Ride users using *cheng fuzzy time series* method.

$$F(1) = W_1^*(m_1) + W_5^*(m_5)$$

$$= \frac{20}{21}(1002{,}354125) + \frac{1}{21}(9338{,}6385)$$

$$= \frac{20047{,}0825}{21} + \frac{9338{,}6385}{21}$$

$$= \frac{29385,721}{21}$$

$$= 1399,32$$

The following is the result of the calculation of forecasting on FLRG from Oke Ride using *Cheng's* weighting method and can be seen the results in table 3.9.

Table 3.9Forecast results on FLRG

Fuzzification	Fuzzification Relationships	Forecasting Results
$A_1 \rightarrow$	A_1, A_5	1399,32
$A_2 \rightarrow$	A_6	12006,24
⋮	⋮	⋮
$A_{14} \rightarrow$	$\emptyset$	42.017
$A_{15} \rightarrow$	$\emptyset$	46.018

The forecast results from Oke Ride users from May 2018 to September 2020 can be seen in the next table, as follows:

Table 3.10Okay Ride Forecasting Results

Month	Oke Ride	Fuzzification	Forecasting Results
Mei 2018	30	A_1	-
Juni 2018	90	A_1	1399,32
⋮	⋮	⋮	⋮
Agustus 2020	31.183	A_{12}	30.680
September 2020	48.019	A_{15}	46.018

The forecasting on *Cheng's Fuzzy Time Series* method is seen from the previous fuzzification and put the forecasting results in the following month.

Calculating Cheng's Fuzzy Time Series Error Value

The next step is to calculate the *error* value to see how small the *error* value is to produce the best model of each type in Oke Jack. Because, if the model has a value to a small*error*or has a small error, then the model can be used to predict the user Okay Jack of each type for a period to come. Here's the result of the error value.

Tabel 3.11 Error Value On Data Okay Ride

Month	Oke Ride	Forecasting Results	$\left\lvert\frac{X_t - F_t}{X_t}\right\rvert$
Mei 2018	30	-	-
Juni 2018	90	1399,32	14,54788889
Juli 2018	185	1399,32	6,563891892
⋮	⋮	⋮	⋮
Agustus 2020	31.183	30.680	0,016130584
September 2020	48.019	46.018	0,041671005
Jumlah			1430,13227

$$\text{MAPE} = \frac{\sum_{t=1}^{n}\left|\frac{X_t - F_t}{X_t}\right|}{n} \times 100\%$$

$$= \frac{14{,}54788889 + 6{,}563837838 + 16{,}491375 + \cdots + 0{,}041671005}{29} \times 100\%$$

$$= \frac{1430{,}12191}{29} \times 100\%$$

$$= 49{,}31490586 \times 100\%$$

$$= 49{,}31\%$$

Based on the results above, the error value for Oke Ride users is 49.31%. Forecasting using the Fuzzy Time Series Cheng method has a pretty good forecasting value to predict Oke Ride service users on the Oke Jack application, because it has a MAPE value below 50%.

Furthermore, to get forecasts for Oke Ride users using Fuzzy Time Series Cheng for the next few months, it can be reprocessed by entering the data that has been obtained to predict the next months, it can be reprocessed by entering the data that has been obtained to predict the next month. Here are the forecast results for the next 20 months:

Table 3.12 Next Forecasting Result For Oke Ride

Month	**Forecasting Results**
Oktober 2020	18159,203225
November 2020	18994,199964
⋮	⋮
April 2022	33189,13813
Mei 2022	34024,13451

4. CONCLUSION

Conclusion Based on the results of the analysis and discussion that has been done about the forecasting about the use of online transportation on Oke Jack who is in Medan using the Fuzzy Time Series Cheng method, then the researchers came to the conclusion that, the results of forecasting by using Fuzzy Time Series Cheng on Oke Jack that is for some service features the method is very accurately used as in the oke shop service feature , Oke Food and Oke Car because it has a MAPE value below 10%, for courier service features are also still accurate because it has a MAPE value still below 20%, while for Oke Ride service is not accurately used because it has a MAPE value close to 50%. Here is a table of error values in the service feature OK Jack:

5. **Table 3.13** Error Value On Service Feature OK Jack

Cheng	MAPE
Oke Ride	49,31%
Oke Courier	13,69%
Oke Shop	0,7%
Oke Food	1,25%
Oke Car	2,24%

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