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Utilization Of Fuzzy Time Series Method Of Analyzing Changes In Rice Prices Throughout The Year In East Java

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ABSTRACT

The research aims to analyze the vertical transmission of rice selling prices from the producer (miller) level to the consumer and analyze what factors influence the formation of rice prices at the producer (miller) level in East Java province. The main data used is 2023 data from January to September 2023 with a sample of each rice price in the district/city in East Java province, while for the analysis of price formation factors using monthly data on rice prices at the producer (miller) level, rice prices in consumer level, rice consumption, price of imported rice 2. The method used in this research is a descriptive research method with a quantitative approach. The analysis tool used is fuzzy time series. The research results found that the rice price transmission pattern in east java province was symmetrical. In the short term, the rice price transmission pattern is asymmetric, meaning that there is a delay or indirect price transmission mechanism between producers and consumers, and in the long term, this means that consumer prices are transmitted directly to producer prices. (milling). Factors that influence the price of rice at the milling level in East Java province are consumer prices, imported rice prices, rice consumption, and climate..

Keywords: *Rice, Price, Formation, Transmission, Fuzzy Time Series.*

INTRODUCTION

Rice is a basic need for Indonesian people and the main commodity produced by farmers in general. The need for rice in Indonesia has increased by more than 30 million tons per year. According to Dodge (2012), based on 2010 Susenas data, as many as 98.5 percent of Indonesian people consume rice as their staple food. The Indonesian people, which reached 252.17 million people with a growth rate of 1.31 percent, had a rice consumption level in 2020 of 784.8 tons per capita/year. The highest consumption of rice in Indonesia was in 2017 at 868.2 tons per capita/year. In the following year, Indonesia's consumption continued to decline until 2020 (Ministry of Agriculture, 2020). The Central Statistics Agency (BPS) report shows that national rice production will reach 31.54 million tons in 2022. The price of rice can change every month, all of this is due to many reasons, so many traders find it difficult to develop their business. Apart from that, the unpredictable rise and fall of rice prices makes rice traders stop their business because they always don't make a profit and even experience losses. Thus, there is a need for a system that can predict the rise and fall of rice prices every month throughout the year. Research conducted by Vivi Aida Fitria, Rina Dewi Indahsari, and Muhammad Saikhul Masykur. Prices of basic necessities in the market in general are often less stable. This is influenced by many things, one of which is the lack of information obtained regarding applicable standard pricing. Price games will affect the availability of goods, so the price of these basic necessities must always be monitored by the government. This was carried out by the Malang City Department of Agriculture and Food Security. Therefore, the author created a web-based application using the PHP programming language and MySQL database processing. The method used to predict basic food prices for the next day is Single Eksponential Smoothing[4]

The research carried out by A. Sumarudin et al, was the creation of a monitoring and prediction application for market commodity prices in the Indramayu region. The Department of Industry

and Trade Cooperatives (DISKOPERINDAG) needs a monitoring system aimed at providing information on matters related to the policies being implemented, in this case monitoring commodity prices. The author found a solution, namely creating a system using the Software Development Life Cycle method and the Fuzzy Time Series method to predict prices. Based on tests with descriptions and test results, it can be concluded that the price prediction for medium rice commodities can be obtained with almost accurate data using the Fuzzy Time Series Method [5]. In this research, the development of a vegetable price monitoring information system aims to overcome the lack or uncertainty of vegetable price information so that farmers do not experience losses. In previous research, price monitoring information systems were also developed to overcome the problem of lack of price information, such as research conducted by April Lia Hananto, Bayu Priyatna [3] and research conducted by Vivi Aida Fitria, et al. [4]. A price monitoring information system was also created to provide integrated information for further use as needed. To predict the price of goods in this research, the Fuzzy Time Series Chen Model method is used because the calculations are easier to understand, whereas in research conducted by Vivi Aida Fitria, et al [4].
The Single Exponential Smoothing method is used. The system developed in this research is website based, while the system was developed by April Lia Hananto, Bayu Priyatna. The advantage of this research is that it can help rice traders predict buying and selling prices every month so that they will not experience losses. The research carried out in this article is a novelty from previous research that has been carried out, the novelty in question is by applying the fuzzy time series method. and apply the system to a special website. i has a novelty value (or benefit) which is an innovation or gap in previous research. The purpose of conducting this research is to help traders in buying and selling rice and also to prevent groups who want to monopolize the rice market, especially in East Java.

METHOD

This research is a mixed methods research, namely a combination of quantitative and qualitative research carried out and completed through 5 waterfall stages, namely: (1) data collection and analysis of system requirements; (2) system design; (3) implementation of system design; (4) system testing and analysis of test results; and (5) writing research results reports. The stages carried out in this research can be seen in Figure 1.

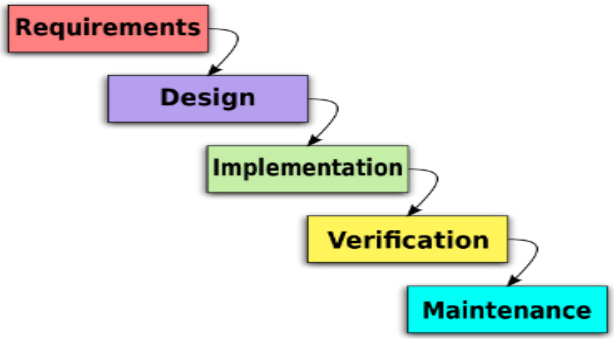

Figure 1. waterfall

1. Requirements
   In this stage, it starts with collecting data in various ways, such as observations, and interviews with one of the Rice traders.
2. Design
   The stage where ideas are expressed and system design is carried out towards solutions to existing problems using the Fuzzy Time series method.
3. Implementation
   The implementation stage begins with the coding process to go through from the beginning to the preparation of the website. In this study, the author used Codeigniter and PHP MySQL to design a website for the task notification system

4. verification
   The final stage is where the new system is tested for its capabilities and effectiveness so that the deficiencies and weaknesses of the system are found and the application is then reviewed and corrected to make it more perfect.
5. Maintenance
   Software that has been completed will change. These changes can be due to errors because the software must adapt to a new environment (peripheral or new operating system), or because customers require functional developments.

RESULT AND DISCUSSION

a. Rice Profile in East Java

Table 1. Paddy and Rice Production by Regency/City in East Java Province, 2021 and 2022*

Regency/Municipality	Paddy1 Production (ton)		Rice Production (ton)	
	2021	2022*	2021	2022*
Regency				
Pacitan	88.116,57	90.955,25	50.880,29	52.519,38
Ponorogo	404.665,04	370.435,11	233.661,75	213.896,69
Trenggalek	116.456,34	117.346,67	67.244,24	67.758,30
Tulungagung	237.916,96	221.637,05	137.378,06	127.977,69
Blitar	247.366,27	217.566,97	142.834,27	125.627,54
Kediri	198.222,01	172.474,88	114.457,39	99.590,48
Malang	273.358,61	283.895,29	157.842,77	163.926,83
Lumajang	295.075,52	303.468,63	170.382,55	175.228,90
Jember	615.697,87	613.237,38	355.516,37	354.095,62
Banyuwangi	513.490,07	462.584,81	296.499,51	267.105,77
Bondowoso	258.951,46	246.388,27	149.523,79	142.269,56
Situbondo	151.157,12	141.914,27	87.281,16	81.944,17
Probolinggo	190.180,14	187.277,08	109.813,84	108.137,55
Pasuruan	264.950,78	254.578,42	152.987,93	146.998,70
Sidoarjo	202.501,40	196.839,63	116.928,41	113.659,17
Mojokerto	297.042,32	287.251,32	171.518,24	165.864,68
Jombang	326.826,64	343.427,84	188.716,29	198.302,15
Nganjuk	429.311,01	387.897,28	247.892,80	223.979,69
Madiun	461.798,12	419.977,93	266.651,51	242.503,71
Magetan	307.279,68	263.822,71	177.429,45	152.336,54
Ngawi	786.475,65	785.037,99	454.126,86	453.296,74
Bojonegoro	674.002,00	715.198,84	389.182,32	412.970,22
Tuban	489.418,62	502.136,24	282.600,18	289.943,58
Lamongan	792.662,09	920.935,59	457.699,04	531.766,76
Gresik	379.666,19	410.323,14	219.226,91	236.928,84
Bangkalan	195.323,29	193.329,37	112.783,60	111.632,27
Sampang	195.600,69	172.558,93	112.943,75	99.639,00
Pamekasan	96.723,97	108.020,20	55.850,36	62.373,05
Sumenep	221.979,41	223.000,46	128.175,38	128.764,96
Municipality				
Kediri	9.534,86	10.449,52	5.505,62	6.033,76
Blitar	5.793,30	5.259,99	3.345,17	3.037,23

Malang	11.311,40	11.524,42	6.531,42	6.654,43
Probolinggo	8.924,08	8.067,16	5.152,96	4.658,14
Pasuruan	8.304,59	7.939,57	4.795,24	4.584,47
Mojokerto	4.414,93	4.324,18	2.549,27	2.496,87
Madiun	13.505,81	11.585,31	7.798,52	6.689,59
Surabaya	9.832,67	8.180,52	5.677,59	4.723,61
Batu	5.750,19	5.912,16	3.320,29	3.413,80
East Java	**9.789.587,67**	**9.686.760,38**	**5.652.705,10**	**5.593.330,44**

b. Rice Price Transmission Analysis in East Java

This analysis was carried out to explain or explain the general state of rice price data clearly and in detail.

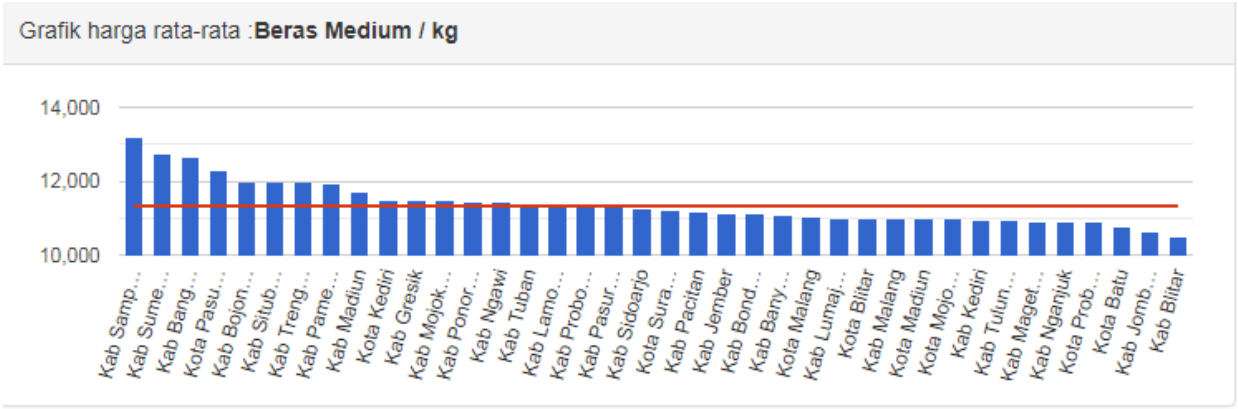

figure 2. Development of rice prices to producers in 2023

In Figure 2 the time series plot shows price movements that continue to increase or rice prices show a certain pattern. In the data in Figure 2 it can also be seen that in 2023 in every region in East Java the lowest rice price will be IDR 10,000 / kg while the highest price will be IDR 14,000 / kg.

C. Implementation of Fuzzy Time Series

The stages carried out to predict rice prices using the fuzzy time series method include the following steps.

Stage 1. Determining the Universe Set and Interval

After the rice producer price data is sorted, the smallest and largest values are obtained. The smallest value obtained is 10,000 (Dmin) and the largest value is 14,000 (Dmax).

Universe Set U

$$U = [Dmin, Dmax]$$
$$= [9.000, 14.000]$$

Determining the range (R) is obtained from the results Range

$$(R) = Dmax - Dmin$$
$$= 14.000 - 9.000$$
$$= 5.000$$

Calculating multiple intervals $K = 1 + 3{,}332 \times \log(n)$

$$= 1+3{,}332 \times \log 36$$
$$= 4{,}332 \times 1{,}556$$
$$= 9$$

Calculating the length of an interval, $I = R/K$

$$= 2000/9$$
$$= 333{,}3$$

Table 2. Forming a subset of the universe

Low limit	Upper limit	Middle value	Month
9.000	9.500	9.250	January
9.500	10.000	10.000	February
9.000	10.000	10.000	Maret
10.000	12.000	11.000	April
10.000	12.000	11.000	Mei
12.000	12.000	11.000	Juni
12.000	14.000	13.000	July
12.000	14.000	13.000	Agustus
12.000	14.000	13.000	September

Stage 2. Performing Fuzzification

The fuzzification stage is done by dividing the data into 9 intervals and the results of the price fuzzification are denoted into linguistic values as shown in table 3.

Table 3. Performing Fuzzification.

Fuzzification	Linguistic Value
A 1	up
A2	slightly up
A3	a little down
A4	very up
A5	stable
A6	very up
A7	very up
A8	very up
A9	very up

Table 4. Calculation using Mean Absolute Percentage Error (MAPE)

Tahun 2023			
	Value HJB/ Xt	**Prediction/Ft**	MAP E/Et/Xt*100
January	9.500	9.250	0,5
February	10.000	10.000	0,
Maret	10.000	10.000	0,
April	12.000	11.000	1,33
Mei	12.000	11.000	1,33
Juni	12.000	11.000	1,33
July	14.000	13.000	2,33
Agustus	14.000	13.000	2,33
September	14.000	13.000	2,33

From the test, based on the results of the MAPE calculation, it can be concluded that the smallest difference value is 0.5% while the largest difference value is 2.33%. The result of the calculation process using the Mean Absolute Percentage Error (MAPE) is 3.41%.

Result

Resulting System Display

In the resulting system, there is a main feature to detect the price of rice in the past or the previous day and then the price of rice today and is equipped with information on whether the price of rice has experienced a price decrease, price increase, or is stable. As shown in figure 3.

NAMA BAHAN POKOK	SATUAN	HARGA KEMARIN	HARGA SEKARANG	PERUBAHAN (Rp)	PERUBAHAN (%)
BERAS					
- Beras Premium	kg	13.524	13.488	-36	-0,27%
- Beras Medium	kg	11.379	11.330	-48	-0,42%

Figure 3.fitur consument prediction

The next feature is equipped with price predictions, namely for predicting the price of rice in the future based on calculations and analysis of existing data or rules that are stored and then processed using the Fuzzy Time Series method as shown in Figure 4.

Nama bahan pokok	Satuan	Harga kemarin	Harga sekarang	Prediksi harga	Keterangan
Beras premium	Kg	13.524	13.488	13. 00	Turun
Beras medium	Kg	11.379	11.330	11.330	Stabil

Figure 4. Price prediction fitur

Discussion

After the system has been created, the next step is to test the system. Testing was carried out using the black box method. The black box method is a software quality testing method that aims to find interface errors, data structures, and performance errors. The test results using the black box method show that the system works well without any feature errors.

CONCLUSIONS

Based on the research results, it can be concluded that:

1. The data used in this research is secondary data obtained from the BPS (Central Statistics Agency) of East Java Province. In this research, the population used is the price
2. From this test, based on the MAPE calculation results, it can be concluded that the smallest difference value occurred in January 2023 at 0.5%, while the largest difference value occurred in September 2023 at 2.33%.
3. The results of the calculation process using the Mean Absolute Percentage Error (MAPE) are 7%.
4. Fact 1: Rice price volatility can be caused by fluctuating rice production following the planting season.
5. Fact 2. Rice consumption tends to be stable over time.
6. Fact 3: low rice prices will reduce the level of welfare of farmers
7. Fact 4: The development of consumer rice prices in each district moves randomly.
8. Fact 5: For the period 2020 to 2022, rice price movements fluctuated first, until February-July 2021 when prices fell
9. Fact 6: For the period 2022 to 2023, rice price movements in February-July 2021 are stable
10. Fact 6: the period 2022 to 2023 is seasonal movements so that the price of rice from August to September increases.
11. Fact 7: Rice production fluctuates following the planting season, while rice consumption tends to be stable over time

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