



### Information System for Predicting Warehouse Stock and Utilities (Case Study: PT KERAMIK XYZ)

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#### ABSTRACT

*PT KERAMIK XYZ is one of the companies engaged in the production of ceramics. The company sometimes subjected to declining wall tiles on the market and at warehouses where wall ceramic stocks are sometimes subjected to buildup. Therefore, the research of "Information System Prediction Stock and Warehouse Utility" uses the Fuzzy Time Series Markov Chain method and Fuzzy Mamdani Method. So that the problem of ceramic wall stock and the layout of the placement of ceramic wall stock in the warehouse does not occur again and can be resolved. In the Fuzzy Time Series Markov Chain method, the calculation of prediction results of ceramic stocks of the Base Tile dCaliza Valle type results in forecasting values of (0, 717, 483, 483), then by means of the MAPE (Mean Absolute Percent Error) test method produces an error percentage of 13%. The results of the calculation of the level of accuracy are good and can be used in this case study. So, the results of the calculation of the level of accuracy are good and can be used in this case study. Then for the results of the prediction of the layout of the ceramic stock placement in the warehouse using the Fuzzy Mamdani method get an accurate calculation of 22%.*

**Keywords:** Ceramics, Fuzzy Mamdani, Fuzzy Time Series Markov Chain, MAPE, Information System.

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#### ABSTRAK

PT KERAMIK XYZ merupakan salah satu perusahaan yang bergerak di bidang produksi keramik. Perusahaan ini terkadang mengalami penurunan jenis keramik dinding di pasaran dan pada gudang tempat menyimpan stok keramik dinding terkadang mengalami penumpukan. Maka dari itu dilakukannya penelitian *Sistem Informasi Prediksi Stok dan Utilitas Gudang* menggunakan metode Fuzzy Time Series Markov Chain dan metode Fuzzy Mamdani. Agar permasalahan stok keramik dinding dan tata letak penempatan stok keramik dinding di gudang tidak terjadi lagi dan dapat terselesaikan. Pada metode Fuzzy Time Series Markov Chain perhitungan hasil prediksi stok keramik jenis *Base Tile dCaliza Valle* menghasilkan nilai peramalan sebesar (0, 717, 483, 483), kemudian dengan metode pengujian MAPE (Mean Absolute Percent Error) menghasilkan persentase kesalahan sebesar 13%. Sehingga hasil perhitungan tingkat akurasi tersebut baik dan dapat digunakan pada studi kasus ini. Kemudian untuk hasil dari prediksi tata letak penempatan stok keramik di gudang menggunakan metode Fuzzy Mamdani mendapatkan perhitungan akurasi sebesar 22%.

**Kata kunci:** Keramik, Sistem Informasi, Fuzzy Mamdani, Fuzzy Time Series Markov Chain, MAPE.

## INTRODUCTION

In the era of globalization, technology has advanced at a breakneck pace, resulting in several benefits in a variety of societal areas. Humans' use of technology to assist in the completion of tasks is a need in life. The advancement of technology must be accompanied with advancements in human resources (HR). In all aspects of the business, the usage of information technology is fast increasing. This procedure converts a manual system to a computerized one.

With the large number of housing developments, townhouses, shophouses, and even apartments and others in the city of Malang, the need for materials has also increased. Ceramics are one of the materials needed when construction occurs. Based on field observations and interviews with several bussiness people in the ceramic industry, it is stated that their sales have decreased. According to Triana Elizabeth, the decline in sales of building materials led to stockpiling of unsold goods or other designations that caused the stock to become stuck [1].

PT Keramik XYZ is one of the largest ceramic industry companies in Indonesia. The company was founded in August 1990. This company has a warehouse factory with a land area of approximately 51 hectares. PT This company has a problem that is inaccurate inventory recording. The results of reports are often missed and not recorded when the stock is out. This is due to carelessness from the warehouse that is not careful in recording, especially when the stock is piling up. Therefore, the company feels the need to make layout arrangements in the warehouse so that the warehouse space is more optimal.

In this paper, the propose an information system to predict how many stock items are in the warehouse so that PT XYZ can satisfy the number of demands of its customers. The intended customers are direct consumers and distributors involved in ceramics. In the research method, we were using *fuzzy times series* to predict sales for the next month and we will calculate the utility of the warehouse space so that the remaining warehouse space can be used to optimize the placement of ceramics. We apply Fuzzy Mamdani to predict the placement of ceramics in the warehouse according to the number of stock items.

## LITERATURE STUDY

### Forecasting

According to Jatipaningrum et.al., forecasting is estimating something that will happen in the future based on empirical data [2]. Thus by making a prediction, we can prepare ourselves for the next period [3]. The fuzzy times series approach is an example of a forecasting method.

### *Fuzzy Time Series Markov Chain*

The basic concept of fuzzy logic and fuzzy set theory was introduced to cope with the ambiguity and uncertainty of most real-world problems. Thus a time series introduced with fuzziness is termed a *fuzzy time series*. Song and Chissom introduced the basic concept of fuzzy time series, and since then, a number of variants were published by many authors [4,5]. According to Rukhansah and friends, *fuzzy time series* using the time invariant method which is used to forecast the number of applicants in a university[6]. Safitri and friends used *Fuzzy Times Series Markov Chain* to to analyze the accuracy of the Taiwan dollar exchange rate prediction [7].

According to [7], the steps to forecast ceramic stock data using the Fuzzy Time Series Markov Chain method as follow:

**Step 1:** Determine the Universal set U, where D1 and D2 are positive numbers determined by the researcher. The formula is as follows:

$$U = [D_{min} - D_1, D_{max} + D_2], \quad (1)$$

where  $D_{min}$  is minimum value,  $D_{max}$  is maximum value, and  $D_1, D_2$  is positive value.

**Step 2:** Define the Interval

- a. Define the number of class intervals. The formula used to determine the number of class intervals denoted as:

$$k = 1 + (3,322 \times \log(\text{amount of data})) \quad (2)$$

- b. Determine the length of the class interval

$$l = \frac{[(D_{max} + D_2) - (D_{min} - D_1)]}{k} \quad (3)$$

- c. Find the median for each U-universal set by adding the lower limit to the upper limit and dividing it by two.

**Step 3:** Determining the Fuzzy Set for the Universal set U

**Step 4:** Determining the *Fuzzy Logical Relationship* (FLR)

**Step 5:** Determining the *Fuzzy Logical Relationship Group* (FLRG)

**Step 6:** Determine the Markov Transition Probability Matrix

The formula for the transition probability for the state can be written:

$$P_{ij} = \frac{M_{ij}}{M_i}, i, j = 1, 2, \dots, n \quad (4)$$

where  $P_{ij}$  is probability of transition from state  $A_i$  to  $A_j$  (one-step),  $M_{ij}$  is the number of transitions from state  $A_i$  to  $A_j$  (one-step), and  $M_i$  is the amount of data included in state  $A_i$ .

**Step 7:** Determine the defuzzification of the forecast value

**Step 8:** Calculate the calibration value

**Step 9:** Calculating the Adjusted Forecasting Value

### Fuzzy Mamdani

The process of mapping given input variables to an output space using a fuzzy logic-based deducing mechanism that includes If-Then rules, membership functions, and fuzzy logical operations is known as fuzzy inference [8]. In general, the literature proposes three types of fuzzy inference methods: Mamdani fuzzy inference, Sugeno fuzzy inference, and Tsukamoto fuzzy inference [9]. The consequence of the If-Then rule is defined as a fuzzy set in Mamdani inference. Each rule's output fuzzy set will be molded by a matching number, and after aggregating all of these reshaped fuzzy sets, defuzzification will be necessary [10]. There are five steps in the Mamdani-type fuzzy inference process:

**Step 1 :** Fuzzify Input Variables.

**Step 2:** Apply fuzzy operator

**Step 3:** Apply implication method

**Step 4:** Apply aggregation method

**Step 5:** Defuzzification

### RESEARCH METHODS

This study was carried out using the following method: The step of problem identification and research objective determination aids in clarifying the research's context and the objectives that must be reached. At this step, data is collected and processed, and the information needed for the research process is gathered. In order to accomplish the objectives set forth at the previous level, the data acquired will be examined using appropriate procedures. Results Analysis and Interpretation: At this point, the collected results will be analyzed and discussed. Following data collection and processing, a data review is performed to assess the research's findings and administrative consequences. Conclusion and Suggestion: The results of the data processing and analysis will be

used to come up with solutions to the problem formulation and goals that must be achieved. The method is shown in the diagram below.

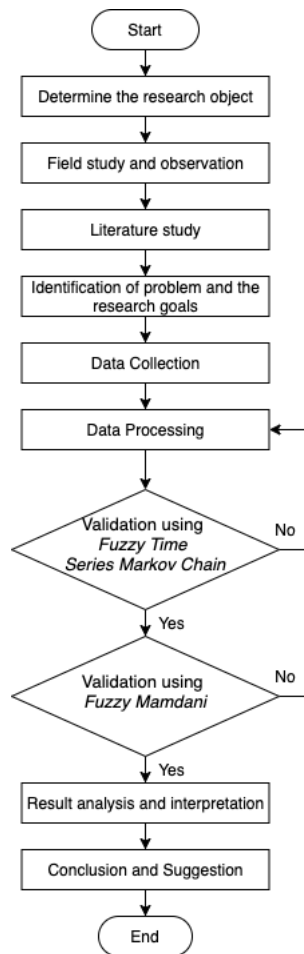


Figure 1. Research Methodology

## RESULT AND DISCUSSION

This paper, we show the performance of *Fuzzy Time Series Markov Chain* to predict the stock of goods in the warehouse. In particular, we applied three years of data to be processed, then we consider the MAPE calculation to calculate the ceramic stock forecasting error. For example, we take sample data of one type of ceramic.

Table 1. MAPE Criteria

Criteria (MAPE)	Interpretation
<10%	High Accurate Prediction
10% - 20%	Good Prediction
20% - 50%	Reasonable Prediction
> 50%	Weak and Inaccurate Prediction

Table 2. MAPE of Predictions for Ceramic (Base Tile dCaliza Valle) Stock

Period	Actual Data	Prediction	MAPE (%)
2016	500	0	0
2017	750	717	4
2018	543	483	11
2019	350	483	38
Total			53
MAPE			13

Based on the calculation of errors in table 2 using MAPE, it can see that the MAPE value is 13%. So it can conclude that the analysis of prediction of ceramic stock using the Fuzzy Time Series Markov Chain method has a good level of accuracy. Furthermore, we will present the results of the accuracy test for the layout of the prediction placement of ceramic stocks in 2017 using the Fuzzy Mamdani method.

Table 3. The result of accuracy to prediction placement/location of ceramic stock base on amount of stock

No.	Type of Ceramic	Amount of Stock	Prediction Location	Accuracy (%)
1	A	717	3	80
2	B	833	3	80
3	C	570	2	70
4	D	65	1	50
5	E	100	1	50
6	F	652	3	80
7	G	269	1	50
8	H	248	1	50
9	I	933	4	90
10	J	891	3	80
Average value				68

## CONCLUSION

This paper proposes an information system for predicting how much stock is in the warehouse and where these products will be placed. The *Fuzzy Time Series Markov Chain* method produces a MAPE value of 13% in predicting ceramic stock. However, predicting the location for the placement of ceramic stock using the fuzzy mamdani method produces an accuracy value of 68%. In the future, it can develop using other methods to produce even better accuracy values.

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