Application of determining the price of batik using Fuzzy Tsukamoto

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Abstract. Competition in the world of business is something that is definite and occur in all kinds of business. One of the ways that businesses keep running is to satisfy the customer. Batik business sales in Indonesia continue to grow, this is because one of the non-verbal culture heritage objects is Batik. But not all business people have good luck, this is because they are unable to satisfy customers. Things that make customers upset one of the types of batik is not in accordance with the price. Fuzzy Tsukamoto is one method that there is fuzzy for the determination of the decision. No exception to the price of batik. This study uses Tsukamoto fuzzy to determine the price of batik. The results of the implementation of the Tsukamoto fuzzy method in determining the price of batik in accordance with the price of fabric, the manufacturing process, batik motifs and colours. This system can also help determine the price of batik in accordance with the quality of batik.

Keywords: Fuzzy Logic, Tsukamoto, Price of Batik

1. Introduction
Batik is one of the wealth that is owned by the Nation's. The batik artisans in this country continue to innovate to produce their works. Do not be surprised if UNESCO has also set Batik as heritage culture of oral non-material since 2 October 2009. This is led to an opportunity of business for most people who want to start a business of batik. Not only that, crafters batik also continues to grow motif in various areas.

In North Maluku one of the typical batik embarrassment north is Tubo batik. Especially in determining the price of batik, sometimes not in accordance with the quality of batik. It is making the consumers who buy be disappointed with the quality that is produced. For the necessary existence of a system that can help the process of decision or determination of decision-priced batik, so that the price reached the ideal in accordance with the quality of batik itself.

Fuzzy logic is a way that can be maximized in the price decision making process. It is because dilogika fuzzy very tolerance to uncertainty [1]. There are several methods of fuzzy inference that include fuzzy Tsukamoto, Mamdani and Sugeno [2]. Each method has typical characteristics of each in the process of making the decision. Especially in determining the price of batik by using fuzzy has been implemented by [3] which in the determination using Mamdani methods. This system is considered successful in determining the price of batik.

In addition to the Mamdani method, the Tsukamoto method is also one of the ideal methods in the decision making process. It is as much the domain of cases that have been applying fuzzy Tsukamoto, have been done by [4] in Determining the price of a tutor. In the field of hospitality was ever done [5], [6] in Determining the priority of the fabric. [7] in the field of health, [8] perform implementation for receipt of the article. For it is in the research will be applied to Tsukamoto's fuzzy in determining the price of Tubo batik. In determining the price of batik there are four criteria that are used are variable.
fabrics, the process of manufacture, motifs and colours. Each criterion has a category respectively. The output of the system is in the form of the value or price of batik appropriate criteria for the inputted

2. Method

2.1 Fuzzy Inference System

Fuzzy logic or often referred to as cryptic logic because it is considered able to overcome the problem of uncertainty. Fuzzy Inference System is a method of reasoning which resembles the reasoning of man which allows to estimate the value as well as the conclusion of the data is not complete or the data is ambiguous without just relying on crisp of data, such as that occurred in the data of binary which contains a large selection of yes or no. Meanwhile, according to [9] fuzzy constitute inference system a framework of computing which is based on the theory of sets fuzzy, fuzzy rules which form IF THEN, and fuzzy reasoning. The fuzzy inference system accepts crisp input. The input is then sent to a base of knowledge that contains and rules of fuzzy in the form of IF-THEN. Fire strength (antecedent membership value or α) will be sought for each rule. If there are more than one rule, then all the rules will be aggregated. Furthermore, the results of the aggregation will be de-fuzzy to get the crisp value as the system output. The illustration of the fuzzy inference system is shown in Figure 1.

![Figure 1. Illustrate fuzzy inference system](image)

2.2 Fuzzy Tsukamoto

In the method fuzzy tsukamoto, each consequent on the rules that form the IF-then must be represented by a set of fuzzy, with the function of the membership are monotonic. For the output of each rule is given by firmly based fire strength. The results were obtained from the average weighted [10]. To determine the price of batik with Tsukamoto fuzzy has a stage that is as shown in Figure 2.

2.3 Fuzzification

The first step in fuzzy calculation is after the input criteria are Fuzzification. Fuzzification is to change the firm value (crisp) to fuzzy value. To get the value of a fuzzy by seeking the value of membership in accordance with the categories that exist on the criteria Mentioned by using representation linear. Figure 3 below Reviews These are a few examples of the representation of linear can is used to obtain the value of membership fuzzy.
Figure 2. process determine price of batik using fuzzy tsukamoto

Figure 3. Representasi linear [10]
2.4 Fire Strength
Next look for the value of a-predicate or fire strength of each rule that is on the knowledge base. For a-predicate values use the Min function, as shown in Equation 1.
\[ a\text{-predikat } i = \min (\mu \text{ membership } x [\text{value}], \mu \text{ membership } y[\text{value}]) \] (1)

2.5 Output Inference
Before the defuzzification process that is looking for the value of inference output from batik price membership for all if then. For the equation is adjusted by a linear representation on the price of batik.

2.6 Defuzzification
Defuzzification is the process of changing the output fuzzy into the value of firm (crisp) in accordance with the functions of membership are determined. In a study this using a Weighted Average method, the process of defuzzification is different from that before. Where this process can only be used if the membership function outputs from several fuzzy processes have the same form. The method is represented in the formula at Equation 2 [11]
\[ z = \frac{\sum a\text{-predikat } z_i}{\sum a\text{-predikat }} \] (2)

2.7 System design
Designing an advance of this, has been in the design as simple as possible in order to be able to easily understand how it works. Because the operation is simply to insert the prices of variable-variables into criteria in determining the price of the sale of batik, which will be marketed. The results of the system design are shown in Figure 4.

![System design](image)

**Figure 4.** System design

3. Result And Discussion

3.1 Fuzzy Association
Step first in the implementation of fuzzy Tsukamoto for the determination of the price of batik is to determine the variables fuzzy along with a set of fuzzy of each variable fuzzy it. In this study, fuzzy variables are used based on data from batik seller reports. Following is the formation of the set and membership function of each fuzzy variable used:
(1) Fabric variable

![Fabric Variable Membership Function](image1)

**Figure 5.** Fabric Variable Membership Function

(2) Manufacturing Process variables

![Process Variable Membership Function](image2)

**Figure 6.** Process Variable Membership Function

(3) Motive variable

![Motif Variable Membership Function](image3)

**Figure 7.** Motif Variable Membership Function
(4) Calor variable

![Figure 8. Color Variable Membership Function](image)

3.2 Knowledge base
Base of knowledge that exist in the system is in the form of fuzzy rules that have been made to the inference that menghasil right value crisp than the price of batik. The number of the rule that there is research that 36 rule. The rules that have been formed as shown in Table 1.

| Table 1. Fuzzy rule in knowledge base |
|--------------------------------------|
| Fuzzy rule                           |                                           |
| R1 IF Low Fabric AND Easy Process AND Simple Motifs AND Synthesis Color THEN Cheap Batik Prices |
| R1 IF Low Fabric AND Easy Process AND Simple Motifs AND Natural Colors THEN Cheap Batik Prices |
| R1 IF Low Fabric AND Easy Process AND Intricate Motives AND Color Synthesis THEN Cheap Batik Prices |
| R1 IF Low Fabric AND Easy Process AND Intricate Motives AND Natural Colors THEN Cheap Batik Prices |
| R1 IF Low Fabric AND Rather Complicated Process AND Simple Motifs AND Synthesis Color THEN Cheap Batik Prices |
| R1 IF Low Fabric AND Rather Complicated Process AND Simple Motifs AND Natural Colors THEN Cheap Batik Prices |
| R36 IF High fabric AND very complicated process AND complicated motifs and natural colors THEN Expensive Batik Prices |

3.3 System implementation
System is constructed with language programming Java. This system is only used by users, namely batik sellers. The results of the system implementation as shown in Figure 9.

3.4 System Testing
To get the price of batik then the user must enter the value of crisp that exist on the types of batik. Furthermore, the system will process according to the rules that have been stored in the knowledge base. the process of determining the price of batik as shown in Figure 2. The value of each variable that is inputted is the price of cloth Rp . 25 . 000, the manufacturing process costs Rp . 27,000 , variable motives Rp . 30,000 and color variables Rp . 55,000. the results of determining the price of batik as shown in Figure 10.
4. Conclusion

Based on the results were obtained from the research it can disimpulakn that the system can determine the price of selling batik ideal to take into account the criteria that is fundamental in determining the price of the sale of batik with consideration of batik with prices low and high, in addition to that, the price of batik is also in accordance with its quality when applied to fuzzy tsukamoto. This system can also accommodate the value of uncertainty. Besides that, the system 's need to be developed so variables created by the dynamic, so even with the addition of fuzzy rules on the basis of knowledge so that users can be helped when there is a change of variables that need to be done in determining the price of selling batik.

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