Implementation of fuzzy tsukamoto method in decision support system of journal acceptance

by Umi Kholifah

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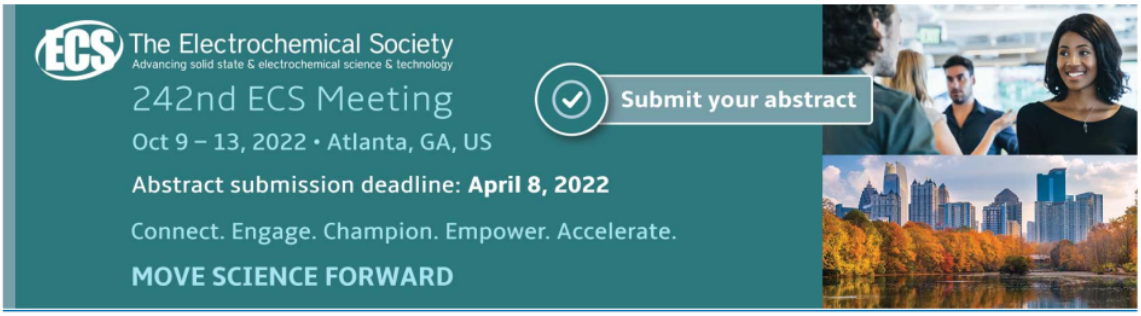

Implementation of fuzzy tsukamoto method in decision support system of journal acceptance

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Abstract. Journal acceptance is a difficult problem to solve since in the practice it involves some reviewers who can produce different decisions from various perspectives. Therefore, a decision support system is needed to assist the reviewers to decide the acceptance of the paper. This study was purposed to develop the decision support system using the Fuzzy Tsukamoto method for journal acceptance. The Fuzzy Tsukamoto method described the relationship between input and output of the system by using a set of fuzzy if-then rules. From the comparison results, It is obtained that the accuracy from the result of comparison of the manual method, expert decision, and DSS of journal acceptance using Fuzzy Tsukamoto Method is 95% with 5% errors. Based on the results of the accuracy and error, it shows that the DSS of journal acceptance using the Fuzzy Tsukamoto Method is accurate and has high precision.

1. Introduction

A scientific journal is one type of scientific works in which the authors publish scientific articles which effectively give contribute to the theory or application of science. To ensure the scientific quality of the published article, the article initially should be reviewed by colleagues which then can be revised by the author of the article. The reviewer read the submitted article, then judged them on every aspect provided in the form and then collected into one in the article manager. Thus, it took longer time.

Therefore, a web-based decision support system that can speed up the review process is necessary. This specific information system intended to help management in making a decision related to semi-structured issues, and does not replace decision-making functions to make decisions [1].

To solve the problems in multi-criteria evaluation, one of Multi-Criteria Decision Making (MCDM) methods was very needed; MCDM consists of : (1) Multi-Attribute Utility Theory (MAUT); (2) Analytic Hierarchy Process (AHP); (3) Fuzzy logic; (4) Case-Based Reasoning (CBR); (5) Data Envelopment Analysis (DEA); (6) Simple Multi-Attribute Rating Technique; (7) Goal Programming; (8) ELECTRE; (9) PROMETHEE; (10) Simple Additive Weighting (SAW), and (11) Technique for Order of Preference by Similarity to Ideal Solution [1, 2].

In this research, the Fuzzy Logic method would be applied. In fuzzy logic, several methods were used to present the results of fuzzy logic namely Tsukamoto, Sugeno and Mamdani ones [3]. Those three methods were used on different issues. Therefore, on the issue of journal acceptance, Fuzzy

Tsukamoto Method was suitable to apply. Fuzzy method has several advantages such as (1) having the ability to solve complex problems; (2) representing knowledge that was easily interpreted by humans; (3) Being flexible for modelling architecture and inference mechanism which can be adapted to the given problem [4]. Another reason is related to the method's excellent accuracy [5-8].

Several studies mentioned above had proved the accuracy of Fuzzy. Thus, those results led the researchers in this study to prove the accuracy of Fuzzy Tsukamoto Method, particularly in providing recommendations related to journal acceptance.

2. Methods

This research was used to know the accuracy of the implementation of Fuzzy Model Tsukamoto Method on decision support system. The Fuzzy Tsukamoto method consisted of three stages of count: fuzzification, inference engine, and defuzzification [9].

2.1. Fuzzification

Fuzzification defines as inputs, whose true value of truth (Crisp input) is converted to fuzzy input, in the form of linguistic values based on membership function [9]. At this stage, the Crips input was the values of each input variable consisting of significance, originality, quality, clarity, and relevance.

Table 1. Linguistics Variables

Linguistics Variables			
Input	Significance	Poor	Value <= 40
		Fair	41 >= Value <=70
		Good	Value >= 71
	Originality	Poor	40 >= Value <=60
		Good	50 >= Value <=70
	Quality	Poor	Value <= 40
		Fair	41 >= Value <=70
		Good	Value >= 71
	Clarity	Poor	Value <= 40
		Fair	41 >= Value <=70
		Good	Value >= 71
	Relevance	Poor	40 >= Value <=60
		Good	50 >= Value <=70
Output	Decision	Rejected	∑ Value <= 205
		Accepted with major revision	∑ 205 >= Value <=350
		Accepted with minor revision	∑ 351 >= Value <=499
		Accepted without revision	∑ Value = 500

The significance variables were categorized in the fuzzy set of *poor, fair,* and *good* by using the *membership function* of the trapezoidal function as seen in Figure 1.

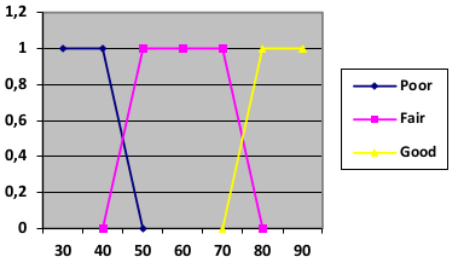

Figure 1. Membership Function Significance

Originality variables categorized in fuzzy *poor* and *good* set course because the journal requirement can be said original if it does not contain plagiarism element more than 20%. This means that there are only two possibilities, when plagiarism is less than 20%, the originality is good, whereas if plagiarism is more than 20% is ensured the originality is low (poor). The accepted journals are only high-quality credible journals evidenced by low plagiarism levels [10]. The set of fuzzy poor and good by using the membership function of the trapezoidal function as seen in Figure 2.

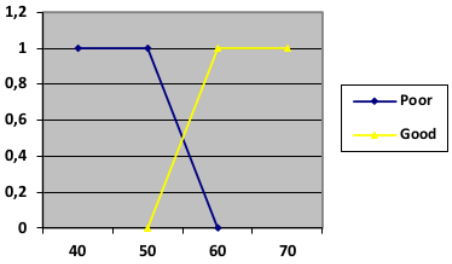

Figure 2. Membership Function Originality

The quality variables were categorized in fuzzy set of *poor*, *fair*, and *good* by using membership function of the trapezoidal function as seen in Figure 3. On the other hands, the clarity variables were categorized in fuzzy set of *poor, fair,* and *good* by using membership function of the trapezoidal function as seen in Figure 4.

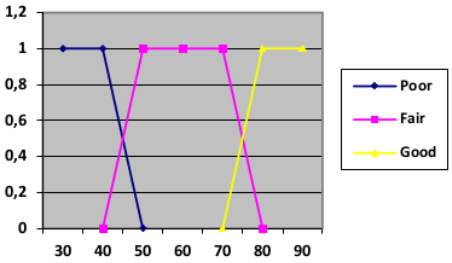

Figure 3. Membership Function Quality

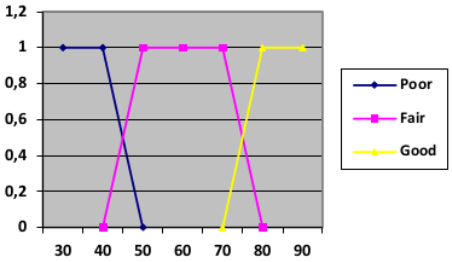

Figure 4. Membership Function Clarity

Relevance variables categorized in the fuzzy *poor* and *good* set because in the relevance assessment only see the suitability of the theme and scope of the journal. The set of fuzzy poor and good by using the membership function trapezoidal function as seen in Figure 5.

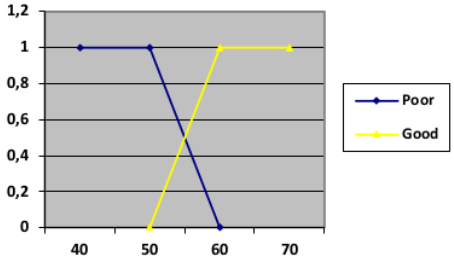

Figure 5. Membership Function Relevance

The decision variables were categorized in fuzzy set of *rejected, accepted with major revision, accepted with minor revision*, and *accepted without revision* by using membership function of trapezoidal function as seen in Figure 6.

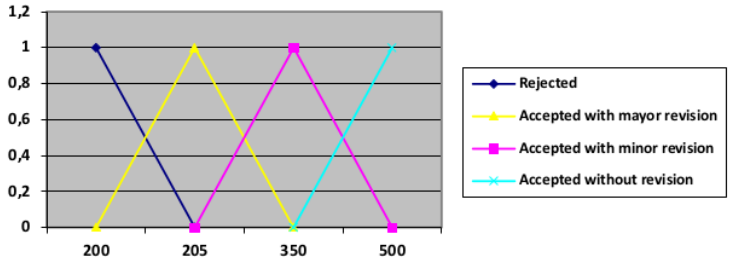

Figure 6. Membership Function Decision

2.2. Inference Engine

Inference engine in determining the decision of journal acceptance using input variable of *significance, originality, quality, clarity,* and *relevance*. Inference engine in this system consisted of 108 rules. Then, the rule formation based on this rule: IF antecedent THEN consequent [11].

2.3. Defuzzification

The defuzzification process of a fuzzy set was derived from the composition of fuzzy rules, while the resulting output was a number in the fuzzy set domain in the form of a decision of journal acceptance. In fuzzy, there are 5 methods of defuzzification: *centroid method, height method, first (or last) of Maxima, Mean-Max Method, Weighted Average* [12]. This system used a centre average defuzzied. Equation formula for centre average defuzzied method is as follows:

$$z = \frac{a1z1+a2z2+a3z3+a4z4+a5z5}{a1+a2+a3+a4+a5} \quad (1)$$

3. Result and Discussions

This study was purposed to determine the accuracy of the Fuzzy Tsukamoto Method in providing recommendations related to the journal acceptance. This method was applied to a web-based decision support system.

Moreover, the pseudocode of Fuzzy Tsukamoto method applied to DSS of the paper acceptance was shown in Figure 7.

STEP 1: Analysing the data collection of values of the journal
STEP 2: Creating and determining the value of the linguistic variable of the max and min values
STEP 3: Calculating the value of *fuzzification* of each variable
STEP 4: Initializing variables and calculating each alpha predicate
STEP 5: Filling alpha predicate columns by eliminating some unrelated / or zero (0) rules
STEP 6: Finding the Min value of the rule in alpha predicate included in the category
STEP 7: Initializing variables and output values of the accepted, accepted with revision, and rejected journals
STEP 8: Calculating Z value of each alpha predicate result
STEP 9: Calculating Z value of overall calculation of Z alpha predicate
STEP 10: Displaying the decision of journal acceptance based on the final Z value'

Figure 7. Pseudocode of Fuzzy Tsukamoto Method

Eighteen articles were used as the data samples on the DSS paper acceptance. The selected articles in this study were only those which had potential chances to be submitted to the journal. Before the selection was done by the system, the researchers had done manual assessment on each article, exactly assessed by 4 reviewers. The criteria assessed by the reviewers covered *significance, originality, quality, clarity, and relevance*. Journal data menu was beneficial to add and edit data of the journal or value. The menu of setting membership can be used to edit the membership values / fuzzy set values. While the menu of fuzzification and defuzzification was to display the calculation process and decision/ summary results. After getting the decision of the review results, it will be compared by the system using the Fuzzy Tsukamoto method and manual calculation. The comparisons of those three methods were shown in Table 2.

Table 2. Comparison of the Calculation Results

Article	Expert		System		error
	score	judgment	score	judgment	
1	358,78	minor	358,79	minor	0,01
2	365,98	minor	365,99	minor	0,01
17	354,27	minor	354,29	minor	0,02
18	352,94	minor	351,94	minor	0
Total					0,05

From the results of the comparison, it was obtained an accuracy of 95%. The accuracy of the calculation indicated that the decision support system of the journal acceptance was accurate as the result of the expert's decision was not different from the results of both manual and program calculations. The errors were 5% obtained from the results of the comparison of the system and the expert, and 0% obtained from the results of the comparison of the system and manual calculation. The errors of low calculation indicated that the DSS of journal acceptance had high precision.

Fuzzy can be said to be the most effective MCDM method and can be implemented in different cases [2-13]. The results were proven by the results obtained based on the comparison of manual calculation and DSS of journal acceptance and reviewers' decision. Thus, the use of Fuzzy Tsukamoto Method was accurate and precise.

4. Conclusion

The use of fuzzy logic using the Fuzzy Tsukamoto Method can be implemented to the DSS of journal acceptance. In addition, there are five input variables and one output variable in which the input variables

are *significance, originality, quality, clarity*, and *relevance*, while the output variable is the decision category. It is obtained that the accuracy from the result of comparison of the manual method, expert decision, and DSS of journal acceptance using Fuzzy Tsukamoto Method is 95% with 5% errors. Based on the results of the accuracy and error, it shows that the DSS of journal acceptance using the Fuzzy Tsukamoto Method is accurate and has high precision.

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