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RESEARCH ARTICLE

DECISION SUPPORT SYSTEM TO DETERMINE THE OPTIMAL PRODUCTION QUANTITY USING FUZZY TSUKAMOTO METHOD ON LAMOS GARMENT

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Abstract

Lamos garment is a clothing factory that focuses on producing pants, with anuncertain amount every month. However, in determining the amount of production, there isno calculation or method used so that the number of products produced by garmentssometimes has advantages and disadvantages. This encourages the author to make adecision support system application to make it easier for the owner to determine the optimalamount of production each month. To design a decision support system application theauthor uses the Tsukamoto fuzzy method. Testing the system used in this study using a blackbox. Based on the results of the study, it can be concluded that the designed application canrunand function as expected.

Introduction:-

Lamos garment is a clothing factory that focuses on producing pants. Every day Lamos Garment produces pants with various types of models, and the number is uncertain every month. Under certain conditions, goods produced by Lamos garments sometimes experience shortages and sometimes experience excess because the buying and selling process is relative. Given the high and low consumer demand can not be predicted, then this indirectly requires garments to meet the needs and demands of consumers. To overcome the above problems, a decision support system is needed as a tool in determining the optimal amount of production each month as well as special methods or calculations. The method used by the author in this study is Fuzzy Tsukamoto.

The problem formulation

How to design a decision support system to determine the optimal production quantity using the Fuzzy Tsukamoto method on garment Lamos?

Research Goal

The purpose of this research is to design a decision support system to determine the amount of production using Fuzzy Tsukamoto method on Lamos garments.

Theorical Reference

There was a lot of research on recommendation with the aim helping validation of this research where using the FuzzyTsukamoto method

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The level of production demand that goes up and down so that the company is very difficult to determine the amount of production (Sihotang and Sagala, 2017).The other research was founded is that the inaccuracy of the amount of production greatly affects the level of losses caused by the lack of workers because the amount of production of goods is too low or excessive (Taufiq and Sari, 2019). A decision support system is a system that is able to provide an assessment of alternatives in order to assist managers in making decisions (Syarief and Suwandana, 2018).Fuzzy is linguistically defined as the value of ambiguity or ambiguity, which means that a value can be true or false (Septiani et al, 2022).

According Kusumadewi and Hari Purnomo (2004) there are several things that need to be known in understanding fuzzy systems, namely:
a. Fuzzy Variable
Fuzzy variables are variables that are discussed in the fuzzy system. Example: age, temperature.
b. Fuzzy set
A fuzzy set is a group that represents a certain condition on a fuzzy variable. Example: cold, cool, normal.
c. Universe of talk
Is the overall value that can be used in fuzzy variable operations. Example: universe of temperature variable talk: [0-40].
d. Domain

Domain is the entire value that is allowed in the universe of talk and some are allowed to be operated.
The membership function in fuzzy is a curve that maps data input points into their membership values (degrees of membership) with an interval of 0 to 1. One way that can be used to obtain membership values is through a function approach. One of the functions that can be used is linear representation:

Linear representation goes up
The increase in the value of the degree of fuzzy membership starts at the value of the domain that has a membership degree of zeromoves to the right towards the domain value that has a higher degree of membership.

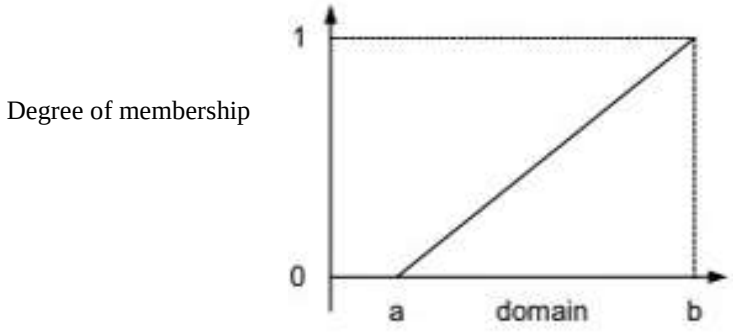

Fig. 1:- Linear representation goes up

Membership Function:

$$\mu(x) = \begin{cases} 0 & x \le a \\ (x-a)/(b-a) & a \le x \le b \\ 1 & x \ge b \end{cases} \quad (1)$$

Descending linear representation
The membership degree value starts from the domain value with the highest membership degree on the left side, then moves down to the domain value with the lower membership degree. Membership Function.

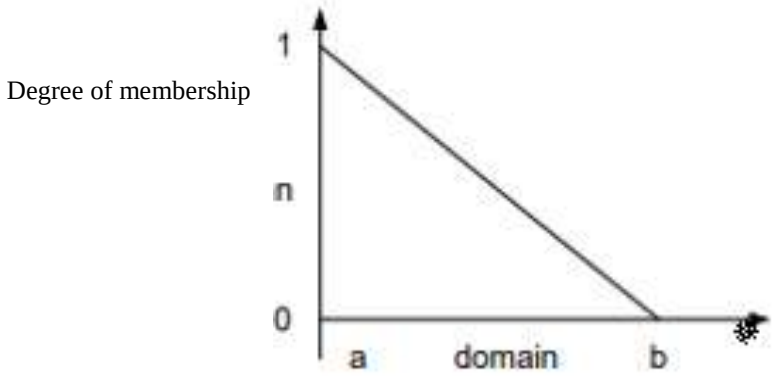

Fig.2:- Descending linear representation.

Membership Function

$$\mu(x) = \begin{cases} (b-x)/(b-a) & a \le x \le b \\ 0 & x \ge b \end{cases} \quad (2)$$

There are 3 basic operators created by Zadeh, which are as follows:
a. AND operator
This operator deals with the intersection operation on the set, A∩B = min (μA[x], B[y])
b. OR . operator
This operator deals with the union operation on the set,
AUB = max(μA[x], B[y])
c. NOT operator
This operator deals with the complement operation on the set,
A' = 1-μA[x]
According to (Hermawanto, 2006), "The processes in fuzzy logic fuzzification, inference and deffuzification"
The following is the process in fuzzy logic:
• Fuzzification: is a process to get the degree of membership of an input numeric value (crisp).
• Inference: the process of getting the output action of an input condition by following the rules (IF-THEN Rules) that have been set which is called inference.
• Defuzzification: the process of changing the results of reasoning in the form of output membership degrees into a numeric variable again.

Fuzzy Tsukamoto
According to (Mariko &Yaqin, 2019), the Tsukamoto method is an extension of monotonous reasoning, where every rule in the form of IF-THEN must be represented by a fuzzy set with a monotonic membership function. As a result, the inference output of each rule is given in a crisp (crisp) based on the predicate.

Unified Modelling Language (UML)
Unified Modeling Language (UML) is a family of graphical notations that help research and design software, especially systems built using object-oriented programming. Unified Modeling Language (UML) is a tool, a modeling language that can be used for object-oriented design. UML can be used for specification, visualization and system documentation during the development phase. Although there are many other object-oriented modeling tools, UML is arguably the standard tool in modeling languages. This is proven by the acceptance of UML as a standard by the Object Management Group (OMG), the largest consortium in the field of business objects, so that UML is widely adopted and used by many software manufacturers.

This Use Case diagram explains admin access (production staff) in this system, admins can manage product data, manage training data, manage rules, predictions, and results.

System Implementation
a. Login page view
The login page is the first page that will appear, to be able to access this application, the admin is required to login first by entering the username and password. Here's what the login page looks like:

b. Main page view
The main page is the page that will appear after the admin has successfully logged in.
c. Product data page display
This page serves to display various types of productswhich is produced by Lamos garment.
d. Prediction page view
This page serves to implement calculationsusing the Tsukamoto fuzzy method.
e. Results page view
This page serves to display all data that has been calculated using the Tsukamoto method on the calculation page.

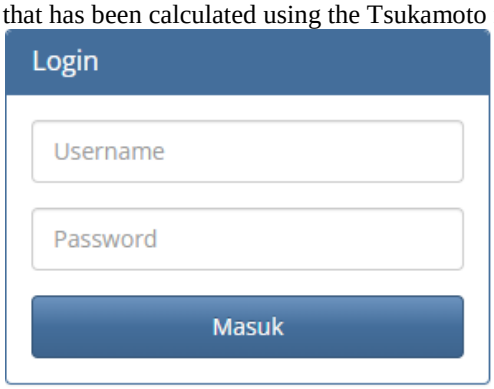

Fig. 3:- Page to Login vew.

Fuzzy Tsukamoto Method Analysis

Table 1:- Actual Production Data.

Date	Suply	Demand	Production
01/06/2020	900	1600	2500
01/07/2020	140	1560	1700
01/08/2020	310	675	985
01/09/2020	387	1468	1855
01/10/2020	650	1250	870
01/11/2020	215	1255	1470
01/12/2020	90	2580	2670
01/01/2021	164	1376	1540
01/02/2021	475	1390	1865

Table 2:- Data Analysis.

	variable	Fuzzy Set	interval	Domain(pcs)
Input	Demand	descending	[0-2580]	[0-675]
		Ascending		[676-2560]
	Stock	Small	[0-900]	[0-90]
		More		[91-900]
Output	Production	reduce	[0-2670]	[0-870]
		increase		[871-2670]

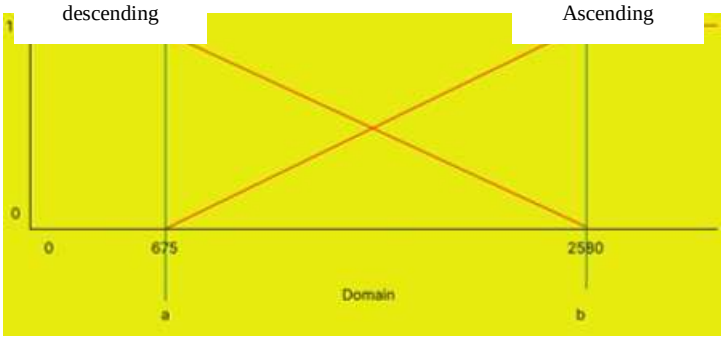

Fig. 4:- Demand Variable Membership Function.

The demand variable consists of 2 sets, down and up. Where the lowest demand in the last year is 675 and the highest is 2580.

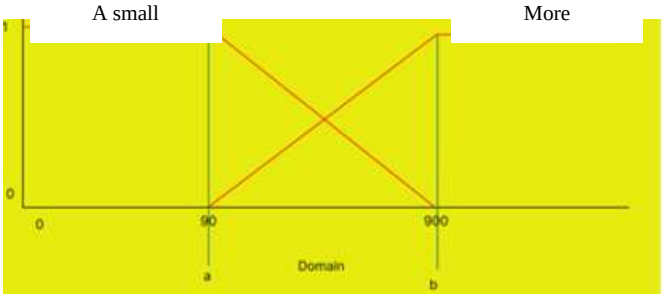

Fig. 5:- StockVariable Membership Function.

Inventory variable consists of 2 sets, many and few. Where the inventory of goods in the last year was the lowest at 90 and the highest at 900.

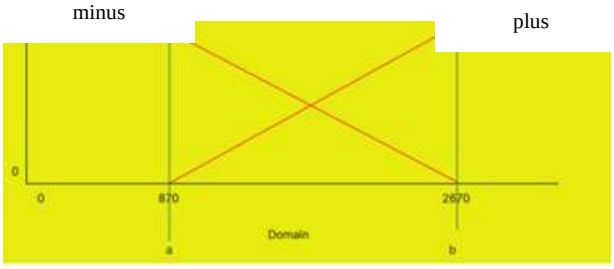

Fig.6:- Production Variable Membership Function.

The production variable consists of 2 sets, decreasing and increasing. Where production in the last year was the lowest at 870 and the highest at 2670

Inferensi
[R1] If demand descending and stock more then production minus
[R2] If demand descending and stock a little then production minus
[R3] If demand ascending and stock more then production plus
[R4] If demand ascending and stock aliitle then production plus

Defuzzyfication
Z=($\alpha 1 * z1 + \alpha 2 * z2 + \alpha 3 * z3 + \alpha 4 * z4$)/($\alpha 1 + \alpha 2 + \alpha 3$)
Z=(0.06∗2562+0,65∗1500+0,06∗978+0,33∗1464)/(0.06+0.65+0.33)
Z=1671,52/1.1=1.519

Conclution:-

Based on the research that has been done on the lamos garment, after testing the design of the decision support system application using the black box. it can be concluded that this system can run and function as expected. With this system, it can make it easier for leaders to determine the optimal amount of production so as to minimize the occurrence of overstock and stockout.

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