International Journal of Information System & Technology
Akreditasi No. 158/E/KPT/2021 | Vol. 6, No. 1, (2022), pp. 78-86

Artificial Intelligence In Cooking Oil Price Prediction Using the Fuzzy Inference System Concept

Dedi Mahrizon

Informatics Management Study Program, AMIK KOSGORO, Indonesia

dedimahrizon@gmail.com

Abstract

At the end of 2021 in October the price of cooking oil increased very sharply in packaged cooking oil and bulk cooking oil. Cooking oil had recorded a deflation in February 2022 of 0.11%, then increased again with a deflation of 0.04%. The causes of the increase in oil consist of 4 types including very sharp international oil prices, reduced oil production caused by disruptions in the distribution chain, increase in demand and the last one. Logistical disruptions during the Covid-19 pandemic, such as the reduced number of containers in the cooking oil delivery process. The problem that will be discussed in this study is to see the cause of the increase in cooking oil in the market. The purpose of this study is to examine the causes of the increase in cooking oil prices and the development of market prices for cooking oil circulating in the market. The basic concept of this research uses the concept of Marketing Management and Artificial Intelligence using Sugeno's Fuzzy Logic Method. The criterion variable consists of 4 input variables 1. Oil Price, 2 Cooking Oil Production, 3 Demand and the fourth is Logistics Disorder while the output variable produces a Normal Decision with a value of 0, Expensive with a value of 1. The final result of this study obtains an Output value of 0, 85 which is in the Expensive range. To find out the other x values, it is enough to enter the x value into each search to find out the next output value which can be used as a reference in predicting the current cooking oil price.

Keywords: *Prediction, Cooking Oil Price, Market Price, Ekpert System, Fuzzy Sugeno*

1. Introduction

Based on data from the Central Statistics Agency (BPS) as of October 29, 2021, it is known that in Indonesia, the most widely used cooking oil is cooking oil from palm oil. The development of the average consumption of palm cooking oil at the household level in Indonesia for the 2015-2020 period showed an increase of 2.32% per year. Even though there was an increase in consumption of cooking oil, cooking oil production was still able to meet the consumption needs. one of the basic ingredients needed almost every day, especially for mothers for cooking purposes. In early January 2022, there was an increase in the price of cooking oil, which ranged from Rp. 19,000 to Rp. 24,000, - per liter depending on the type of packaging used. The latest prices that have been in effect since February 1, 2022 are as follows. Bulk cooking oil Rp.11,500,- per liter, simple packaged cooking oil Rp.13,500 per liter and premium packaged cooking oil Rp.14,000,- per liter[1].

The cause of the increase in cooking oil is the cause of the increase in oil consisting of 4 types including very sharp international oil prices, reduced oil production caused by disruptions in the distribution chain, increase in demand and the last one. Logistical disruptions during the Covid-19 Pandemic such as the reduced number of containers and the number of Containers. According to Aris Marwanto (2015:172), price is not something that is not important because this price is closely related to a person's decision to buy a product. when they hear a product that is sold at a low price, consumers will surely run and scramble to get the product. that is why price plays a very important role in

ISSN : 2580-7250

determining someone's decision to buy a product [2]. Revealed that product attributes are product elements that are considered important by consumers and serve as the basis for decision making [3]. One of the product attributes is the pricing policy, where the price becomes a consumer's consideration in making a purchase. The level of consumption of cooking oil has increased in the last 10 years by 83% and every year in the future the consumption of cooking oil will continue to increase with a growth rate of 3.31% per year [4]. According to the results of Exposure [5] the importance of consumer research is to find out the extent of consumer needs and also how they respond to price increases and the scarcity of cooking oil, resulting in a buying panic for the people of Medan Denai. The scarcity of cooking oil is exacerbated by the emergence of hoarding cases. The scarcity that occurs can certainly change the price of the cooking oil product [6]. There are at least 6 (six) channels that can transmit the impact of oil price shocks on economic activity.

a) Supply side effect (supply side effect).
b) Wealth transfer effect (wealth transfer effect), which emphasizes the shift in purchasing power from oil-importing countries to oil-exporting countries.
c) Real balance effect.
d) Inflation effect.
e) Effects of consumption, investment and stock prices.
f) Sectoral adjustment effect [7].

Research results related to predictions, namely [8] calculations for forecasting have been carried out previously. In 2017 Fredericus Awan Gemilang has conducted research on predicting stock closing prices using fuzzy time series. The calculation results obtain the smallest AFER value is 0.5187%. In 2018 Frans Agum Gumelar also conducted a study entitled the implementation of fuzzy time series to predict meat prices in the Malang Regency market. The test uses 21 ivory price data in 2016 and 2017, the accuracy value of forecasting is 57%. The smallest error value is in June 2017 of 16, 129 and the largest error value is in March 2016 of 65, 610,000.

Fuzzy logic can be thought of as a black box that connects the input space to the output space. The black box contains a method or method that can be used to process input data into output in the form of good information. There are several Fuzzy Logic methods including Fuzzy Logic Mamdani, Sugeno and Tsukamoto. The membership function is a graph that represents the degree of membership of each input variable which is in the interval between 0 and 1). The degree of membership of a variable x is denoted by the symbol (x). The rule uses the membership function as a weighting factor to determine its effect when making inferences to draw conclusions [9]. Ascending Linear Representation[10]

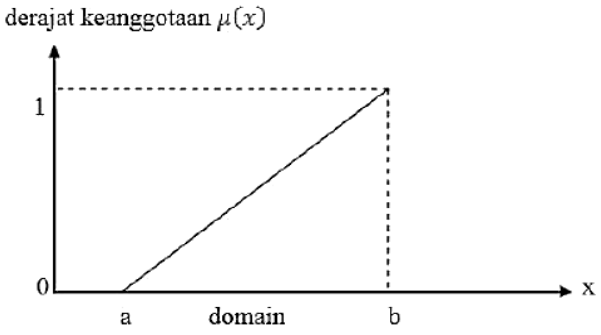


Figure 1. Representation of an Upward Linear Curve

The linear ascending membership function formula is expressed by:

$$\mu(x) = \begin{cases} 0 & ; x < a \\ \frac{x-a}{b-a} & ; a \le x \le b \\ 1 & ; x > b \end{cases} \quad (1)$$

Descending Linear Representation

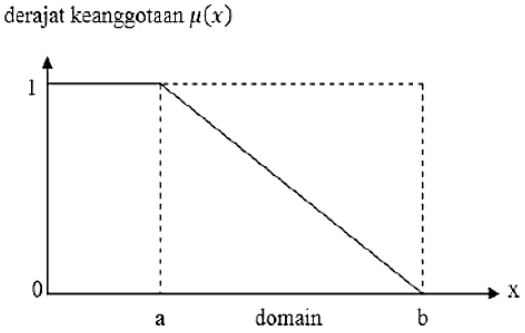


Figure 2. Representation of Descending Linear Curve

The descending linear membership function formula is expressed by:

$$\mu(x) = \begin{cases} 1 ; x < a \\ \frac{b-x}{b-a} ; a \le x \le b \\ 0 ; x > b \end{cases} \quad (2)$$

According to Render and Heizer (2004), the types of forecasting can be divided into several types:type. Judging from the planning of future operations, forecasting is divided into 3 types, namely:

a) Economic forecasts explain the business cycle by predicting the inflation rate, availability of money, funds needed to build housing and other planning indicators.
b) Technological forecasts pay attention to the level of technological progress that can launch attractive new products, which require new plants and equipment.
c) Forecasting demand (demand forecast) is a projection of demand for the product or service of a company.

2. Research Methodology

The stages of completing this research using the Fuzzy Sugeno method used are as follows [10]:

a) The formation of this fuzzy variable consists of variables that will be used as input variables and output variables. The variable has a notation and each universe of speech with a sum from the smallest and the largest.
b) Formation of fuzzy sets. In this stage, the input variables from the fuzzy system are made into fuzzy sets to be used in calculations. At this stage determine the degree of membership of each fuzzy set.
c) The implication function used in the Fuzzy Sugeno method is min. Making fuzzy sets can be made based on input and output variables that have been made previously.
d) Defuzzification is a crisp output calculation stage where the output is a number from the fuzzy set domain.

3. Results and Discussion

Analysis and Design In this study using the Sugeno Method. The process of completing the Sugeno method consists of 4 parts. The variables used consist of 4 input variables:

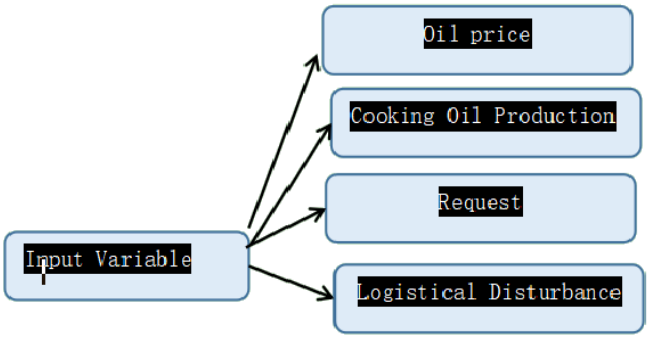
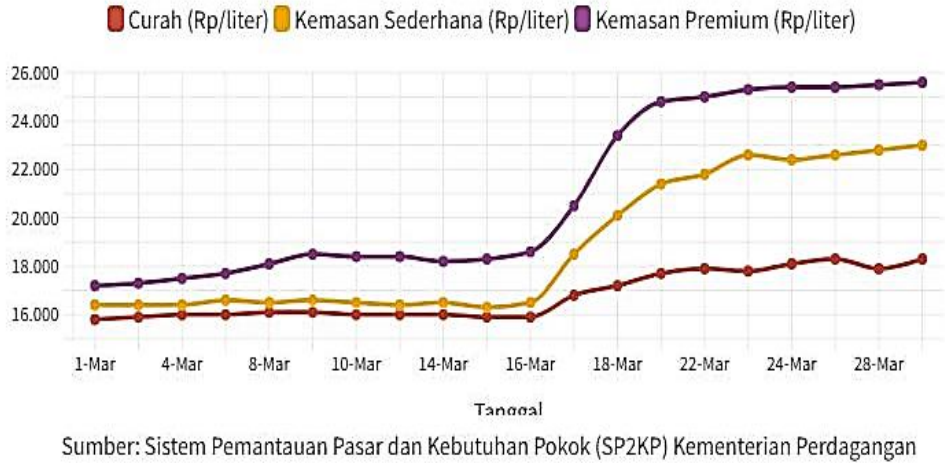


Figura 3. Variabel Input

The data obtained calmly The increase in cooking oil prices can be seen in the image below



Sumber: Sistem Pemantauan Pasar dan Kebutuhan Pokok (SP2KP) Kementerian Perdagangan

Figure 4. Oil Price Data

Table 1. Domain of the Fuzzy Set

Variable Name	Set	Universe of Conversation	Domain
Oil price	Inexpensive Standard Expensive	[0 70]	[0 0 20 40] [35 40 45] [40 45 70 70]
Cooking Oil Production	Down Currently Go on	[0 90]	[0 0 30 50] [30 50 70] [50 70 100 100]
Request	A little Currently Lots	[0 100]	[0 0 10 40] [20 45 55] [40 70 100 100]
Logistical Disturbance	Not smooth Normal Fluent	[0 100]	[0 0 10 50] [30 50 70] [50 70 100 100]

The process of completing this research can be described with each division of the Mambership Function and Linear Equation can be seen below.

Solution:

A. Stage 1 Fuzification

Fuzzy Variable Modeling

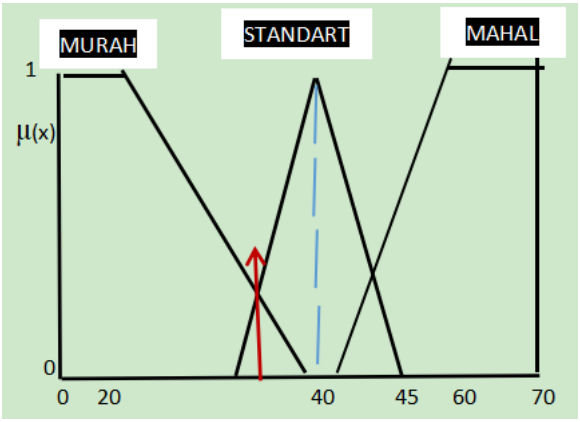
a) Oil prices are divided into 3 fuzzy sets, namely EXPENSIVE, STANDART and CHEAP using the right shoulder-left shoulder membership function
b) The production of cooking oil is divided into 3 fuzzy sets, namely UP, MEDIUM and DOWN using the right shoulder-left shoulder membership function
c) Demand, divided into 3 fuzzy sets, namely MANY, MEDIUM and LITTLE using the right-hand-left-shoulder membership function
d) Logistic disorders, divided into 3 fuzzy sets, namely CURRENT, NORMAL and NOT CURRENT using the right shoulder-left shoulder membership function
e) Output Variable Table. Output variables are divided into 2 parts, namely Expensive and Normal, Expensive is assumed to be with a value of 1, and Normal with a value of 0.

Table 2. Output Variables

Variabel Output	Range	Value
Normal	0- 0,6	Value 0
Expensive	0,7- 1	Value 1

Process of Completion Stages of Each Input Variable

a) Oil Price Variable



Degree of Membership 0 20 35n Function For the price of Minayk as much as 35000 packs per day is

Cheap Fuzzy Set

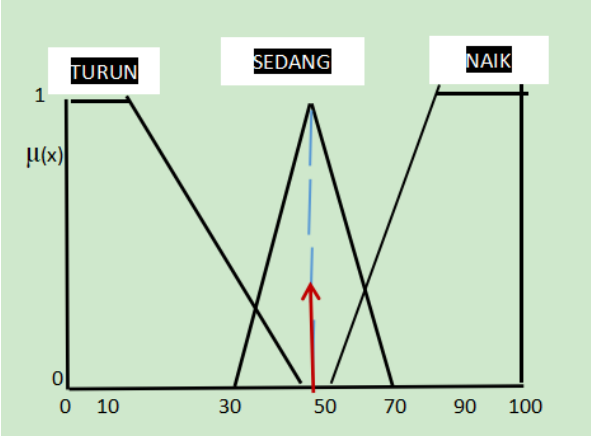
μCheap Oil Prices[35] = (40-35)/(40-20)
= (5/20)
= 0.25

μStandard Cooking Oil Price [35] = (45-35)/(40-30)
= 10/10
= 1

μThe Price of Cooking Oil is Expensive

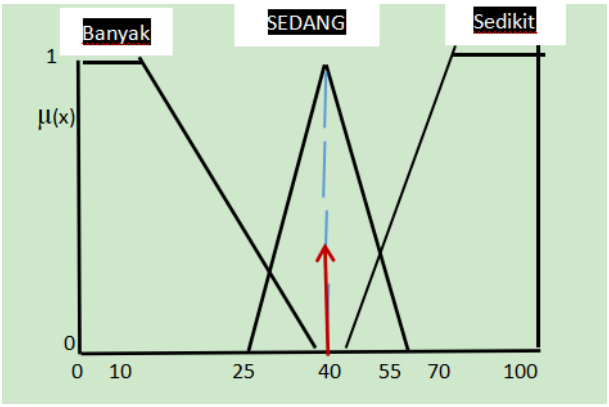
Production of Cooking Oil Expensive [35] =0

b) Cooking Oil Production Variable



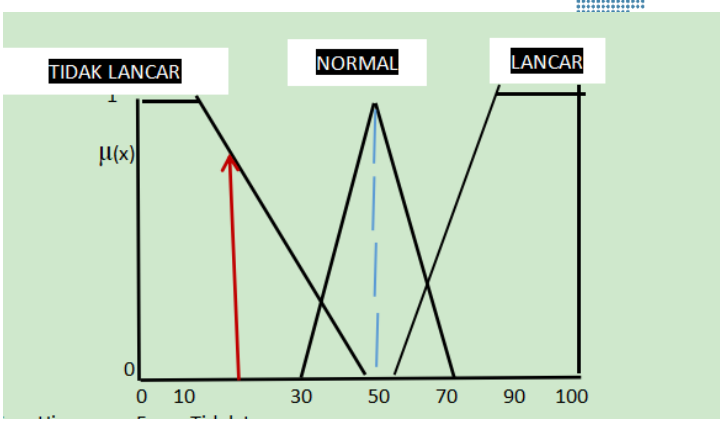
The value of the membership function in each set is formulated as follows:
Fuzzy Set DOWN
μFuzzy Set Down
Oil Production Down [30] = (50-30)/(50-10)
= (20/40)
= 0.2
Medium Oil Production
μMedium Oil Production [30] = 0
Many Oil Production
μ Many Oil Production [30] =0

c) Demand Variable



Slightly Fuzzy Set
μLittle Demand[25] = (40-25)/(40-10)
= (15/30)
= 0.2
moderate k demand
μMedium Demand [25] = 0
MANY Request
μlots of Demand [25] = 0

d) Logistical Disturbance Variable



Fluzy Set Not Current
μNon-Current Logistics Interference[30] = (50-30)/(50-10)
= (20/40)
= 0.2

Normal Logistics Disruption
μNormal Logistics Disruption [30] = 0
Current Logistical Disturbance
μCurrent Demand[30] = 0

B. 2nd Stage of Rule Establishment

1) Oil inventory, divided into 3 fuzzy sets, namely A LOT, MEDIUM and LITTLE using the right shoulder-left shoulder membership function.
2) Cooking Oil Production is divided into 3 fuzzy sets, namely UP, MEDIUM and DOWN using the right shoulder-left shoulder membership function.
3) Demand, divided into 3 fuzzy sets, namely MANY, MEDIUM and LITTLE using the right-shoulder-left-shoulder membership function.
4) Logistic disturbances are divided into 3 fuzzy sets, namely CURRENT, NORMAL and NOT CURRENT using the right shoulder-left shoulder membership function.

a) [R1] IF Oil Supply is High AND Production of Cooking Oil is Rising AND Demand is Slight AND Current Logistics Disruption THEN Normal Price
b) [R2] IF Oil Supply is Medium AND Cooking Oil Production is Rising AND Demand is Slight AND Logistical Disruption is Current THEN Price is Normal
c) [R3] IF Low Oil Inventory AND Increased Cooking Oil Production AND Slight Demand AND Current Logistics Disruption THEN Normal Price
d) [R4] IF Large Oil Supply AND Medium Cooking Oil Production AND Low Demand AND Current Logistics Disruption THEN Normal Price
e) [R5] IF Oil Supply is High AND Cooking Oil Production is Down AND Demand is Slight AND Logistical Disruption is Current THEN Normal Price
f) [R6] IF Oil Supply is High AND Production of Cooking Oil is Rising AND Demand is Little AND Logistical Disruption THEN Normal Price
g) [R7] IF There is a lot of Oil Supply AND Cooking Oil Production is Rising AND Demand is Little AND Logistics Disruption is Current THEN Prices are Normal
h) [R8] IF Oil Supply is High AND Production of Cooking Oil is Rising AND Demand is Slight AND Logistical Disruption is not smooth THEN Normal Price
i) [R9] IF Low Oil Supply AND Low Oil Production AND Large Demand AND Sluggish Logistics Disruption THEN High Prices

j) [R10] IF Low Oil Supply AND Low Oil Production AND Large Demand AND Sluggish Logistics Disruption THEN High Prices
k) [R11] IF Low Oil Supply AND Medium Oil Production AND High Demand AND Non-current Logistics Disruption THEN High Prices
l) [R12] IF Oil Supply is Low AND Oil Production is Down AND Demand is Moderate AND Logistics Disruption is not smooth THEN Prices are High
m) [R13] IF Low Oil Supply AND Low Oil Production AND Large Demand AND Normalr Logistics Disruption THEN High Prices

C. 3rd Stage Inference Engine

a) [R10] IF Low Oil Supply AND Low Oil Production AND Large Demand AND Sluggish Logistics Disruption THEN High Prices
b) [R11] IF Low Oil Supply AND Medium Oil Production AND High Demand AND Non-current Logistics Disruption THEN High Prices
c) [R12] IF Oil Supply is Low AND Oil Production is Down AND Demand is Moderate AND Logistical Disruption is not smooth THEN Prices are High
d) [R13] IF Low Oil Supply AND Low Oil Production AND Large Demand AND Normal Logistics Disruption THEN High Prices

α1 = min(μLow Oil Inventory[35], Cooking Oil ProductionDecreased[30], Large Demand[25], Non-Smooth Logistical Disruption[20]
= min(0,25;0,2;0,2;0,2) = (0.25)

α2 = min(μLow Oil Inventory[35], Medium Cooking Oil Production[30], Large Demand[25],Non-Current Logistics Disorder[20]
= min(0,25;0;0,2;0,2) = (0)

α3 = min(μLow Oil Inventory[35], Cooking Oil ProductionDown[30], Moderate Demand[25],Non-Current Logistics Disruption[20]
= min(0,25;0,2;0;0,2) = (0)

α4 = min(μLow Oil Inventory[35], Cooking Oil ProductionDown[30], Large Demand[25],Normal Logistics Disruption[20]
= min(0,25;0,2;0,2;0) = (0)

D. 4th Stage of Defuzification

The value of x is searched with the following equation:

$$X = \frac{0,25*35+0,2*30+25*0,2+20*0,2}{0,25+0,2+0,2+0,2}$$

$$X = \frac{23,75}{0,85} =$$

$$X = 0,85$$

4. Conclusion

Based on the process of completing this research, the following conclusions are obtained, this research produces 4 input variables and 1 output variable. Input variables consist of 1. Oil Prices, 2. Oil Production, 3. Demand, 4. Logistics Disorders and the output variables are Standard and Expensive. The results of the search for the output value obtained are 0.85 which is in the expensive range with the input value of Oil Prices [35]. Oil Production, [30]. Request[25], . Logistical Disturbance[20]. Fuzzy Inference System Sugeno method is able to predict the price of cooking oil in the market based on the input value to be processed at the final value of Defuzification. This method uses input values between the range 0 to 1. The Sugeno method can be used in the case of price predictions on other objects, it is hoped that this research will be developed more deeply.

References

[1] Nani Rochani Rahayu. (2022). Kenaikan Harga Minyak Goreng Kelapa Sawit Di Indonesia Sebuah Analisis Berita Kompas *On Line*. *Jurnal Intelektual. 3(8).26-37.*

[2] Felicia Ruth Dkk, *(2019).* Pengaruh Harga Dan Promosi Terhadap Keputusan Pembelian Minyak Goreng Bimoli Pada Pt. Salim Ivomas Pratama, Tbk Lubuk Pakam . *Jurnal Ilmiah Socio Secretum.. 9(1).1-12.*

[3] Sulistyowati Ayu. Pengaruh Kualitas Produk Dan Harga Terhadap Keputusan Pembelian Minyak Goreng Kemasan Bimoli Di Kecamatan Sumbersari Kabupaten Jember. *Jurnal Universitas Jamber*.Basuki Agus Dkk. Strategi Pemasaran Minyak Goreng Berdasarkan Analisi Indeks Sikap Konsumen Dan Analisis Swot Di Yogjakarta. *Jurnal Agritech 23-28.*

[4] Yuli Siska Anita. *(2022),* Pengaruh *Panic Buying* Terhadap Minat Beli Konsumen Secara *Impulse Buying* Pada Produk Minyak Goreng. Jurnal Manajemen. 16(1).72-84.

[5] Tato Wahyu Prio. (2017). Penerapan Logika *Fuzzy* Dalam Optimasi Produksi Barang Menggunakan Metode Mamdani. Jurnal Ilmiah. 5(1).14 21.

[6] Nizar, M. A. (2012). The Impact Of World Oil Prices Fluctuation On Indonesia's Economy. Buletin Ilmiah Litbang Perdagangan, 6(2), 189–209. Https://Ideas.Repec.Org/p/Pra/Mprapa/65770.Html.

[7] Ella, A. P., & Arifianto, D. (2020). *Penerapan Fuzzy Time Series Dalam Peramalan Harga Minyak Serai Pada Cv Agam Jaya Atsiri*. 1–8.

[8] Hartayo Sri.(2011). Dampak Kenaikan Harga Minya Bumi Terhadap Ketersediaan Minyak Goreng Kelapa Sawit Domestik. Jurnal Pembangunan Ekonomi Indonesia. 169-179.

[9] Khaerudin, M., Noeman, A., Komputer, F. I., Bhayangkara, U., Raya, J., & Bekasi, K. (2021). *Penggunaan Metoda Fuzzy Logic Tsukamoto Untuk Memprediksi Jumlah Penerimaan Peserta Didik Baru (Studi Kasus Tk . Bina Mulia). 2*(2), 269–280.