

ACHITS 2019

Proceedings of the 1st Asian Conference on Humanities,
Industry, and Technology for Society

Surabaya, Indonesia

30-31 July 2019



Contents

<u>Establishing Backup Fish Stock Kerapu (Blue-lined seabass) Suspended Situbondo</u>	1
<i>Samsul Huda, Siti Naviah, Yola Berta Calvinanda, Samrotul Fikriyah</i>	
<u>Making Better Indonesia's Thin Capitalization Rules (Lesson Learn from China)</u>	8
<i>Neni Susilawati</i>	
<u>Fantasy Themes in Peasants Movement</u>	24
<i>A. Pratiwi, S. Sarwoprasodjo, E. Soetarto, N. K. Pandjaitan</i>	
<u>The Fullfillment of The Social Rights for Child Client With Parole Status at Correctional Center in South Jakarta-Indonesia</u>	35
<i>Sarinah Sarinah, Fentiny Nugroho, Desi Setiana</i>	
<u>Analysis Of Credit Risk Measurement Using CreditRisk+ Method (Study of PT XYZ (Persero) Tbk SME Loans For 2016-2018)</u>	40
<i>Andrey Carver, Ferdinand D Saragih, Bernardus Yulianto Nugroho</i>	
<u>Implementation of The JKN Programs on The Community Health Center at Level 1 (Descriptive study of the implementation of the JKN program at the Pucang Sewu Health Center, Gubeng District, Surabaya City)</u>	46
<i>Sri Roekminiati, Sapto Pramono, Nihayatus Sholichah, Ika Devy Pramudiana</i>	
<u>The Implementation of Deep Learning for White Blood Cell Subtype Classification from Microscopic Images</u>	53
<i>Yustisia Amalia, Miftahul Khairoh, Arkha Rosyaria B, Budi Santoso</i>	
<u>The Application of Omotenashi in Japanese-Conceptualized Company in East Java</u>	60
<i>Cicilia Tantri Suryawati, Isnin Ainie, Ni Nyoman Sarmi</i>	
<u>The Challenges of Government Public Relations and Abuse of Power over Indonesia</u>	66
<i>Suwandi Sumartias, Nurtyasih Wibawanti Ratna Amina</i>	
<u>The Impact Of Double Role Conflict and Job Satisfaction to Work Performance of The Woman Employees in PT Bio Farma (PERSERO)</u>	79
<i>Sedarmayanti Sedarmayanti, Nitta Aprillianti Ashari, Fedianty Augustinah, Meithiana Indrasari</i>	
<u>Difable Literacy: Analysis of Difable Representation in Indonesian Media</u>	87
<i>Hanna Nurhaqiqi</i>	
<u>Information Technology Strategy in Applying and Developing Knowledge Management Systems (R & D Study to Improve the Quality of Lecturers' Performance in Higher Education)</u>	96
<i>A T R Rosa</i>	
<u>Financial Technology Readiness: Strategic Innovation Management in the Service Industry 4.0</u>	108
<i>J T Purba, H Hery, V N S Lestari</i>	

<u>15 Pillars of Islamic Good Corporate Governance for The Corporate Level</u> <i>Maulidah Narastri</i>	121
<u>The Relationship between Ethical Work Climate and Organizational Innovation</u> <i>Adibah Abdul Kadir, Fadillah Ismail, Asad Khan, Adnan Ali Hassan Humaid AlHosani, Nor Syafiqah Izzati Zaidi</i>	128
<u>The Modified Conceptual Understanding Layer "PKS" Model As An Alternative Assessment Tool On Hots Type Problems</u> <i>Viktor Sagala, Ahmad Hatip, Sucipto Sucipto, Kusmiyati Kusmiyati</i>	150
<u>The Role of Teachers in Utilizing Learning Media as A Learning Source for Millennial Students</u> <i>Talizaro Tafonao, Setinawati Setinawati, Ezra Tari</i>	158
<u>Education Literacy Expectations on Technology Industry Development of Humanities Revolution society 5.0 Era</u> <i>Ade Tutty Rokhayati Rosa</i>	166
<u>The Effect of Compensation and Benefits Towards Employee Performance</u> <i>Adibah Abdul Kadir, Adnan Ali Hassan Humaid AlHosani, Fadillah Ismail, Norseha Sehan</i>	171
<u>Forecasting of Vivo and Advan Handphone Sales Using Cheng Fuzzy Time Series Method</u> <i>Anisah Anisah, Mas'amatuz Zahrah, Qurrotul Aini, Tony Yulianto</i>	187
<u>Determining The Types Of Tiles Based On Building Location And Building Elevation Using Fuzzy Weighted Product (WP) Methods</u> <i>Sayyidah Sayyidah, Nurul Huda Maksun, Sarmiatal Hasanah, Tony Yulianto</i>	205
<u>Forecasting the Number of Tuberculosis (TBC) Using Fuzzy Prey Predator</u> <i>Subaidah Subaidah, Putri Ukrowthi, Achmad Alam, Tony Yulianto</i>	213
<u>Key Determinants of Online Product Purchase Decisions for Students in Surabaya City (Case Study at FEB Students, Dr. Soetomo University)</u> <i>Firdaus Firdaus, Sukesi Sukesi, Windyra Fitriani, Meithiana Indrasari, Sugiyanto Sugiyanto</i>	229
<u>Blusukan and Personal Branding of Regional Head Election Candidates in Solo City</u> <i>Betty Gama, Bani Sudardi, Wakil Abdullah, Mahendra Wijaya</i>	238
<u>The Wage Gap for Women Homeworkers and Their Role in Family Resilience</u> <i>Intan Fatma Dewi, Fentiny Nugroho</i>	250
<u>Implementation of The Democracy Culture for Fulfillment of The Social Economic Rights for The Correctional Clients at Correctional Center in Central Jakarta-Indonesia</u> <i>Dina Setyani, Fentiny Nugroho</i>	247
<u>The Implication of "Ewuh Pakewuh" Cultural in OCB Implementation of Service Employee at Pesantren Sub District of Kediri City</u> <i>Restin Meilina, Dodi Kusuma Hadi</i>	252
<u>Design of Health Telemonitoring System on Vital Sign Patient's Web-Based</u> <i>Mery Subito, Alamsyah Alamsyah, Ardi Amir</i>	258

<u>Rating of Bottled Drinking Water (AMDK) Sellers in Local and National in Madura Using Fuzzy TOPSIS</u>	267
<i>Tony Yulianto, M. Rofiqi Mudassir, Faisal Faisal</i>	
<u>Can Regional Free-Trade Bring Positive Impact on Local Farmers? (A Study on the Ornamental Fish Farmers in Depok City, West Java, Indonesia)</u>	277
<i>Fentiny Nugroho, Marsudi Marsudi</i>	
<u>Implementation of the Government Credit Card Policy in the Ministry of Foreign Affairs of the Republic of Indonesia</u>	281
<i>Paramita Nur Kurniati, Bernardus Yulianto Nugroho, Ferdinand D. Saragih</i>	
<u>Dimension of Management Control in Entrepreneurial University</u>	287
<i>Wirawan ED Radianto, Oscarius Yudhi Ari Wijaya</i>	
<u>The Influence of Education on The Depressing of Unemployment and The Increasing of The Society Economy in East Java</u>	292
<i>Suyanto Suyanto, Bambang Purnomo, Rahmawati Erma Standsyah</i>	
<u>The Effectiveness of The Use of The "Kartubarpel" Media in Learning Calistung Mentally Disabled Children Based on Learning to Play in "Tunas Kasih" SLB Lidah Kulon Surabaya</u>	299
<i>Wahyu Widayati, Viktor Sagala, Sri Utami, Ardianik Ardianik</i>	
<u>Communicating Environmental Issue: Movie as Medium on Earth Conservation</u>	304
<i>Redi Panuju, Daniel Susilo</i>	
<u>Effect of Organizational Culture on Individual Work Performance and Organizational Performance (Study at PT. Kramayudha Tiga Berlian Motors)</u>	309
<i>Pebri Tuter Srihadi, Ferdinand Dehoutman Saragih, Bernardus Yulianto Nugroho</i>	
<u>Atmospheric Impact Analysis of Work on Employee Performance Through Aspects of Employee Welfare</u>	316
<i>Agustiawan Djoko Baruno, Meithiana Indrasari, Dandy Patrija Wirawan, Jovi Iristian</i>	
<u>Effect of Organizational Commitment and Work Motivation on Job Satisfaction and Individual Performance</u>	327
<i>Sarwani Sarwani, Andry Herawati, Liling Listyawati, Damajanti Sri Lestari</i>	
<u>Da'wah Ethics in Candra Malik's Sufistic Literature</u>	336
<i>Imron Amrullah, Hetty Purnamasari, Ni Nyoman Sarmi, Imayah Imayah</i>	
<u>Determinants of Stock Returns on the Indonesian Stock Exchange</u>	343
<i>Aminullah Assagal, Meithiana Indrasari, Eddy Yunus</i>	
<u>Improvement of Human Resources Performance Through Online Presence Applications Based on Android Using UML - Iconix process</u>	356
<i>Amirul Mustofa, Achmad Muzakki, Slamet Kacung, Eny Haryati</i>	
<u>Orientalism on Malay People in Kipling's Limitation of Pambe Serang</u>	368
<i>Hariyono Hariyono, Putut Handoko, Sanhari Prawiradiredja, Meithiana Indrasari</i>	

<u>Do Technological Innovation Capabilities Contribute to New Product Development Performance? A Conceptual Framework</u>	374
<i>Gogor Arif Handiwibowo</i>	
<u>Islamic Higher Education and Human Capital Development (The Study of Ma'had Aly As Education Training for 'Ulama')</u>	381
<i>Fatah Syukur, Abdul Wahib, Mahfud Junaedi</i>	
<u>Weighted sum model for Spatial Analysis in Classification of Areas Prone to Diphtheria Tetanus</u>	387
<i>Anik Vega Vitianingsih, Achmad Choiron, Dwi Cahyono, Suyanto Suyanto</i>	
<u>The disparity of Economic Development and Social in Coastal Area of East Java</u>	397
<i>Totok Hendarto</i>	
<u>The Importance of Thinking Skills for Islamic Education</u>	406
<i>Meithiana Indrasari, Bambang Raditya, Bambang Purnomo, Iwan Sugianto, Lusiana Prastiwi</i>	
<u>The Effect of Quality of Products and Services on Trust and Decision of Customers to Choose Banks (Study at Sampang Bank Rakyat Indonesia Branch)</u>	414
<i>Bambang Raditya, Meithiana Indrasari, Sri Handini, Susanto Soekiman</i>	
<u>Right of Workers are Guaranteed in the Constitution</u>	425
<i>Siti Marwiyah, M. Syahrul Borman, Bachrul Amiq, Vieta Imelda Cornelis</i>	
<u>Government policy in giving land procurement replacement for development</u>	429
<i>Wahyu Prawesthi, Meithiana Indrasari, Basoeki Nugroho, Nur Syamsudin</i>	
<u>Addition of Foam Agent Using Polyester and Polystyrene Waste for Lightweight Mixed</u>	432
<i>Safrin Z, Bambang S, Budi H, Wisnu A, Riky Sim</i>	
<u>The Implementation of the Street Vendor Arrangement Policy on Jalan Diponegoro, Bandung</u>	445
<i>Rezky Afiatul Barokah, Sedarmayanti Sedarmayanti, Kurhayadi Kurhayadi, Amirul Mustofa</i>	
<u>Identification of Nutrition, Phytochemicals and Antioxidants Taro (Colocasia sp)</u>	459
<i>Arlin, B. D., Fadjar, K. H., Nunuk, H.</i>	
<u>Implementation of the Authority of Financial Services Supervision in Legal Protection of Customers Storing Funds in Sharia Banks</u>	464
<i>Sri Astutik, Irawan Soerodjo, Ach. Rubaie, Bachrul Amiq</i>	
<u>Patterns of Use of Social Media in the Culinary Community "Langsungenak"</u>	472
<i>Zulaikha Zulaikha, Achmad Muzzaki, Jovi Iristian, Meithiana Indrasari</i>	
<u>Opinion Polarisation in Indonesia Politics</u>	478
<i>Senja Yustitia, Muhammad Edy Susilo, Subhan Afifi</i>	
<u>Effect of Corporate Social Responsibility Disclosure, Capital Structure, and Ownership Structure on Value of The Firm with Intervening Variables of Financial Performance and Dividend Policy in Manufacturing Companies Listed in Indonesia Stock Exchange</u>	488
<i>S Rahayuningsih, D R Prihastuty, Hwihanus Hwihanus</i>	

<u>Estimation Cost Method Using Cost Significant Model On Channel Work in The Public Work In Sidoarjo</u>	497
<i>W Oetomo, J Rochyantine, K Koespiadi, H T Tjendani</i>	
<u>Conceptual Review of Rethinking Marine Tourism Visit Intention from Word of Mouth, Destination Image dan Destination Branding</u>	510
<i>A Y A Fianto, C Candraningrat</i>	
<u>Radical Detection on Student Knowledge Using Classification Supervised Learning Method</u>	519
<i>Asantoso Asantoso, F Rodli, R N Sari, S Hadayatullah, A Prasnowo, S Sehman</i>	
<u>Natural Vs. Synthetic Food: Which Is Better?</u>	527
<i>A Wangsa, H. Hery, J T Purba</i>	
<u>The Influence of Quality of Services, Innovation of Products, Prices and Trust on Customer Satisfaction Telkomsel In Surabaya</u>	532
<i>F A B K Panjaitan, T Andjarwati, S Sumiati, H Panjaitan</i>	
<u>The Use of The Semanding Tuban Limestone as A Partial Replacement of Coarse Aggregate in Concrete Mixes</u>	542
<i>N Rochmah, G Sarya, F Setiawan</i>	
<u>Reflection: Using Photovoice to Encourage Mastering Vocabularies for Computer Science Students</u>	548
<i>F Nurhidayati, A Cipto, H Hafid, S Mahmudah, M. A. Gunawan</i>	
<u>Language Ideology of Tengger Community in Tukur District</u>	553
<i>H Hariyono, P Handoko, C T Suryawati, C Pujimahanani</i>	
<u>The paradigm of Character Building Between Hope and Challenge</u>	557
<i>H Hendri, R Handoko, A Darmawan, L Y Prakoso, GS Achmad Daengs</i>	
<u>Corruption of Regional Heads in Indonesia: Anatomy, Causative Factors, And Solutions</u>	564
<i>H Agustina, A Sutarih</i>	
<u>Investment Analysis for Replacement Premium Economy Trains into Executive Trains of Argo Parahyangan A Case Study of PT Kereta Api Indonesia (Persero)</u>	573
<i>R Irwanto, A H Anggono</i>	
<u>The Effect of Human Capital, Social Capital, and Competency on Women Entrepreneur Success in Surabaya Indonesia</u>	585
<i>S Mujannah, A Kusmaningtyas, Candraningrat Candraningrat</i>	
<u>Risk Level Analysis Using The Job Safety Analysis Method In Manufacturing System Laboratory</u>	593
<i>S Sastrodiharjo, Q Sholihah, E L Zedniawan</i>	
<u>Design and Control Self Balancing Robot</u>	600
<i>S Santoso, S Yuliananda</i>	
<u>Developing Spatial Intelligence by Utilizing City Park Green Open Space for Educational Functions</u>	606
<i>S Fadjarajani, R As'ari</i>	

<u>Influence of Length Variation in Bamboo Fiber on Tensile Strength and Compressive Strength of Concrete</u>	613
<i>R Trimurtiningrum, Faziz Faziz, Lendah Lendah</i>	
<u>The Spirit of Islam in the Development of Good Governance and Anti-Corruption Concepts</u>	620
<i>Ulul Albab</i>	
<u>An Analysis of The Level of Information Technology (TI) Service Satisfaction (A Case Study of Gojeck Application)</u>	628
<i>Lin Yan Syah, Siti Nurhayati Nafsiah</i>	
<u>Effect of Compensation and Work Environment on Employee Performance (Study at PT Segar Murni Utama, Mojokerto Regency)</u>	636
<i>Bambang Raditya, Meithiana Indrasari, Agus Surya, Maulida Hardianti Bandi</i>	

Forecasting of Vivo and Advan Handphone Sales Using Cheng Fuzzy Time Series Method

Anisah¹, Mas'amatuz Zahrah², Qurrotul Aini³, Tony Yulianto⁴

{anisis119@gmail.com¹, zahraalhopycute@gmail.com², qurrotul188@gmail.com³}

^{1,2,3,4}Mathematics Department, Faculty of Mathematics and Natural Sciences, Madura Islamic University Madura, Indonesia

Abstract. Handphone is one product of technology that has changed the behaviour of human communication by penetrating space and time. Widespread mobile phone product will cause rapid competition between the mobile market, so it is important for cellphone companies to find out how many products will be sold in the future. A company can minimize the risk of unavailability of product stocks and prevent customers from running to other companies by optimizing marketing and sales to get maximum profit. To look for optimal marketing and sales strategies, this study applies the fuzzy time series method which is very useful for the decision making process by combining the analysis of science in the field of computers and statistics that can be used in forecasting sales results. As for the results of the application of fuzzy time series, it is expected that the company can obtain information on sales forecasting of its products to be used as reference material. After matching the simulation results with real in the field, it can be seen that the fuzzy time series cheng method for forecasting the sales of handphones from Indophone Pamekasan uses 60 monthly sales data from January 2014 to December 2018 with the Vivo brand yielding 398.92 and MAPE value = 8.18644%, with the Advan brand give the results of 340.27 and MAPE value = 7.813559%.

Keywords: Handphone, fuzzy time series, sales, forecasting.

1. Introduction

The era of telecommunications technology has hit the joints of human life, where the use of telecommunications technology in helping and alleviating work is needed. One of the telecommunication technology products currently marketed is mobile phones.

Mobile is one product of technology that has changed the behavior of human communication by penetrating space and time. Research firm Gartner recorded an increase in global mobile phone sales in the first quarter of 2018. Mobile phone sales rose 1.3 percent from the same period last year. The total sales volume is 384 million mobile phones, representing 84 percent of the total sales of mobile devices. For sales of all cellphones including feature phones, Gartner recorded 455 million in the first quarter. According to Kevin Restivo, mobile phone sales are increasing because mobile users want computers in their pockets. While this millennial era mobile phones are a daily necessity (primary), Therefore consumers' choice to use mobile phones is currently very high, which causes the rate of increase in mobile phone sales.

Sales is one of the most important indicators in a company. One strategy that can be used in optimizing sales is by analyzing sales forecasting.

Sales forecasting is an activity to predict sales that will occur in the future by using historical data. Forecasting strategies, companies can predict and find out how many products

will be sold in the future so that it can be used as a reference for planning sales targets. In addition to being used as a reference for planning sales targets, this forecasting strategy can also be used in planning the availability of products to be sold to consumers so that companies can minimize the risk of unavailability of product stocks and prevent customers from running to other companies. Sales forecasting can use several forms of mathematical approaches, one of which is Fuzzy. Fuzzy logic was first developed by Lotfi A. Zadeh through his writing in 1965 on fuzzy set theory [1]. Several methods related to Fuzzy have also developed to date, such as the Fuzzy Time Series method. The Fuzzy Time Series (FTS) method is very useful for the decision making process by combining scientific analysis in the field of Computers and Statistics. The author uses the literature method in this study, namely by studying several books, journals, scientific works and the results of previous studies that have similarities with this research.

In its development, many researchers have used Fuzzy Time Series in forecasting in various fields. Tauryawati and Irawan (2014) in their study stated that Fuzzy Time Series Cheng obtained forecasting results more accurately because in their research they had the smallest value of MAE, MSE, MAPE compared to ARIMA when applied to the case of Composite Stock Price Index (CSPI) forecasting [2]. The study has similarities with this research, namely using the fuzzy time series Cheng model to predict sales. The difference in this research with previous research is found in the case study studied, namely in the present study using mobile phone sales.

2. Fuzzy

Fuzzy logic was first made by Lotfi A. Zadeh through his writings in 1965 about fuzzy set theory [3]. Fuzzy logic is a method based on an artificial intelligence system (Artificial Intelligence) that can mimic a human's ability to think into an algorithm that is then run by the engine. This algorithm is used in various data processing applications that cannot be represented in binary form. Fuzzy logic interprets vague statements into a logical understanding [4]. The term fuzzy means vague or unclear, but Fuzzy systems that are built to model this forecasting still have a way of working and clear descriptions based on fuzzy logic theory [3].

3. Fuzzy Time Series

Fuzzy Time Series is one of the soft computing methods that has been applied in Invalid source specified time series data analysis. The Fuzzy Time Series concept introduced by Chen in 1996, the difference between conventional Fuzzy Time Series (FTS) time series lies in the data used in divination. In FTS, the value used is a fuzzy set of real numbers over a predetermined set of universes. So it can be defined that FTS is a method that uses data in the form of fuzzy sets derived from real numbers over the set of universes in the actual data.

3.1 Fuzzy logical relationship on fuzzy time series

According to Fitriyah [5] Relationship is identified based on a fuzzification value from historical data. If the time series $F(t-1)$ variable is clarified as A_i and $F(t)$ as A_j , then A_i berelation A_j can be expressed by $A_i \rightarrow A_j$. This can be interpreted as A_i which is located on the left side of the relationship called the current state and A_j which is on the right side of the relationship is called next state and if there is a repeat relationship, it is counted only once. The description of FLR shown in Table 1

Fuzzy Relationship
$A_1 \rightarrow A_1$
$A_1 \rightarrow A_2$
$A_2 \rightarrow A_3$
$A_3 \rightarrow A_3$
$A_3 \rightarrow A_4$
$A_4 \rightarrow A_4$
$A_4 \rightarrow A_3$
$A_4 \rightarrow A_6$
$A_6 \rightarrow A_6$
$A_6 \rightarrow A_7$
$A_7 \rightarrow A_7$
$A_7 \rightarrow A_8$

Fuzzy logical relation group, defuzzification of forecasting value by assuming from prospective data has 3 rules as follows:

- If the fuzzification result in year- n is A_i dan A_j there is one FLR relation on FLRG, that is, with condition $A_i \rightarrow A_j$ where the highest degree of membership is at U_j , then the forecast value for $n + 1$ is the middle value of U_j atau defined by m_j .
- If the fuzzification result in year- n is A_i dan A_i has more than one FLR on FLRG, that is $A_i \rightarrow A_{j1}, A_{j2}, \dots, A_{jp}$, with the middle values for $A_{j1}, A_{j2}, \dots, A_{jp}$ $m_{j1}, m_{j2}, \dots, m_{jp}$ then the forecasting value for $n + 1$ is $m_{j1}, m_{j2}, \dots, m_{jp}/p$.
- If the fuzzification result in year- n is A_i dan A_i does not have FLR value in FLRG where the maximum value in the membership function is at U_j , then the forecasting value for $n + 1$ is the middle value of U_j or can be defined as m_j .

3.2 Cheng Fuzzy Time Series Algorithm

Cheng's method has a slightly different way of determining intervals, using Fuzzy Logical Relations (FLR) by entering all relationships and giving weights based on the order and looping of the same FLR. The following are the forecasting stages in time series data using FTS Cheng [3]:

- Determine the universal set (U) of actual data, namely:

$$U = [d_{min}, d_{max}] \quad (1)$$

- Determination of interval width using frequency distribution, with the following steps:

- Determine the range with the following formula:

$$R = d_{max} - d_{min} \quad (2)$$

where R is the range: d_{max} is the largest data, d_{min} is the smallest data

- b. Determine the number of class intervals using Equation Sturges. The formula is as follows:

$$K = 1 + 3,322 \times \log n \quad (3)$$

- c. Determine the width of the interval. The formula is as follows:

$$l = (\text{Data range } (R)) / (\text{Number of class intervals } (K)) \quad (4)$$

- d. Search for middle values. The formula is as follows:

$$m_i = ((\text{lower limit} + \text{upper limit})) / 2 \quad (5)$$

with l this is the number of fuzzy sets.

3. Fuzzy sets are formed by looking at the number of different frequencies, so the first most frequencies are divided into h equal intervals. Next, the second most frequency is divided into $h-1$ same interval, the interval at the third most frequency is divided into $h-2$ equal intervals. This is done at intervals with frequencies that cannot be divided again.
4. Defines the fuzzy A_i set and fuzzifies the actual data observed. For example A_1, A_2, \dots, A_p is a fuzzy set that has the linguistic value of a linguistic variable, defining the set of fuzzy A_1, A_2, \dots, A_p on U is as follows:

$$\begin{aligned} A_1 &= 1/u_1 + 0,5/u_2 + 0/u_3 + \dots + 0/u_p \\ A_2 &= 0,5/u_1 + 1/u_2 + 0,5/u_3 + \dots + 0/u_p \\ A_3 &= 0/u_1 + 0,5/u_2 + 1/u_3 + \dots + 0/u_p \\ &\vdots \\ A_p &= 0/u_1 + 0/u_2 + 0/u_3 + \dots + 0,5/u_{p-1} + 1/u_p \end{aligned} \quad (6)$$

With u_i ($i = 1, 2, \dots, p$) is an element of the universe (U) and a number that is given the symbol "/" denotes the membership degree $\mu_{A_i}(u_i)$ against A_i ($i = 1, 2, \dots, p$) where the value is 0; 0.5 or 1.

5. Create FLR tables based on actual data. FLR can be represented by $A_i \rightarrow A_j$, where A_i is called the current state and A_j is called the next state.
6. Determine the weight of the FLR relation to be a Fuzzy Logical Relationship Group (FLRG) by entering all relationships and giving weights based on the same sequence and repetition. FLR which has the same current state (A_i) is combined into one group into the weighting matrix. Then the weight obtained in the FLR relation is entered into the weighting matrix ($W(t)$) whose equation is written as follows:

$$W(t) = \begin{bmatrix} w_{11} & w_{12} & \dots & w_{1p} \\ w_{21} & w_{22} & \dots & w_{2p} \\ \vdots & \vdots & w_{ij} & \vdots \\ w_{p1} & w_{p2} & \dots & w_{pp} \end{bmatrix} \quad (7)$$

with W is a weighting matrix; w_{ij} is the weight of the matrix in the first row and the j th column with $i = 1, 2, \dots, p$; $j = 1, 2, \dots, p$. with i is the interval class of Left Hand Slides (LHS) and j is the interval class of Right Hand Slides (RHS).

7. Then transfer the weight of FLRG into a standardized weighting matrix ($W_n(t)$) whose equation is written as follows:

$$W_n(t) = \begin{bmatrix} w_{11}^* & w_{12}^* & \dots & w_{1p}^* \\ w_{21}^* & w_{22}^* & \dots & w_{2p}^* \\ \vdots & \vdots & \dots & \vdots \\ w_{p1}^* & w_{p2}^* & \dots & w_{pp}^* \end{bmatrix} \quad (8)$$

with $W_n(t)$ is a standardized weighting matrix with $w_{ij}^* = \frac{w_{ij}}{\sum_{j=1}^p w_{ij}}$

8. Calculate forecasting values. To produce a forecasting value, the standardized weighting matrix $W_n(t)$ is multiplied by the defuzzification matrix, namely matrix L_{df} . Where $L_{df} = \vec{f}[m_1, m_2, \dots, m_p]^T$ with m_i is the middle value of each interval. So that the forecasting calculation becomes:

$$F_t = w_{11}^*(m_1) + w_{12}^*(m_2) + \dots + w_{ip}^*(m_p) \quad (9)$$

3.3 Accuracy of the Forecasting Method

In many forecasting situations, accuracy is seen as a refusal criterion for choosing a forecasting method. In many ways, the word accuracy refers to the goodness of fit, which in turn indicates how far the forecasting model is capable of producing known data [5]. The level of accuracy on the results of the recommendation system is done by looking at the error value in the results. In this study using the MAPE equation (Mean Absolute Percentage Error). In the MAPE calculation, the smaller the MAPE results obtained, the fewer errors in the system [6]. The following formula calculates MAPE:

$$MAPE = \frac{\sum_{i=1}^n \frac{|q_i - p_i|}{q_i}}{n} \times 100\% \quad (10)$$

With information:

MAPE = average value of error counting

N = number of observations

p_i = value of forecasting data in the i period

q_i = value of actual data in the i period

4. Results and Discussion

In this chapter, we will discuss the problem solving on how to apply Cheng Fuzzy Time Series in forecasting the sale of mobile phones in Pamekasan to Indophone companies in order to increase sales results in the following years which are simulated in the Matlab R2015a programming language.

4.1 Application of Cheng Fuzzy Time Series

Step 1. Data input

Data on handphone sales in Pamekasan in Indophone company will be predicted by using Cheng Fuzzy Time Series method. Actual sales data are shown in Table 2.

Table 2. Actual sales data for Vivo brand mobile phones

Year	Month	Vivo	Year	Month	Vivo	
2014	January	258		July	361	
	February	276		August	382	
	March	254		September	232	
	April	301		Oktober	329	
	Mei	277		November	330	
	June	356		Desember	495	
	July	301		2017	January	466
	August	398			February	321
	September	354			March	267
	Oktober	308			April	276
	November	325			Mei	298
	Desember	489			June	308
2015	January	499	July		388	
	February	387	August		405	
	March	346	September		374	
	April	358	Oktober		345	
	Mei	367	November		379	
	June	353	Desember		475	
	July	378	2018	January	498	
	August	405		February	456	
	September	378		March	395	
	Oktober	389		April	356	
	November	352		Mei	345	
	Desember	388		June	358	
2016	January	379		July	367	
	February	384		August	379	
	March	345		September	364	
	April	322		Oktober	356	
	Mei	316		November	321	
	June	315		Desember	453	

Step 2. Define universe of discourse

After sorting the actual data on the sale of Vivo brand mobile phones, the smallest value and the largest value of the data are obtained ($d_{min} = 232, d_{max} = 499$). Based on equation (1), the universe can be seen as follows: $U = [232, 499]$

Step 3. Calculate the interval using a frequency distribution.

From the 60 data in Table 1, the average difference from equation (2) is 267. Then the number of intervals obtained from equation (3) is 7. Determining the interval width of equation (4) is 38.14

Step 4. Fuzzy sets are formed by looking at the number of different frequencies

Based on Step 3 with a number of intervals of 7, the frequency of density of sales data for Vivo brand mobile phones can be seen in Table 2.

Table 3. Data Density Frequency Sales of Vivo brand mobile phones

u_i	Lower Limit	Limit On	Amount of data	Number of SubInterval	Wide SubInterval
u_1	232	270,14	4	2	19,07
u_2	270,14	308,28	8	4	9,54
u_3	308,28	346,42	12	5	7,63
u_4	346,42	384,56	20	6	6,36
u_5	384,56	422,7	8	4	9,54
u_6	422,7	460,84	2	1	38,14
u_7	460,84	498,98	6	3	12,71

From Table 2, it can be seen that there are 25 subintervals that will be the domain of the fuzzy set formed, so that there are 25 fuzzy sets presented in Table 3.

Step 5. Linguistic Values and Fuzzy Sets

The following are defined fuzzy sets based on Equation (6), for A_1 and A_2 :

$$A_1 = \frac{1}{u_1} + \frac{0,5}{u_2} + \frac{0}{u_3} + \frac{0}{u_4} + \frac{0}{u_5} + \frac{0}{u_6} + \frac{0}{u_7} + \frac{0}{u_8} + \frac{0}{u_9} + \frac{0}{u_{10}} + \frac{0}{u_{11}} + \frac{0}{u_{12}} + \frac{0}{u_{13}} + \frac{0}{u_{14}} + \frac{0}{u_{15}} + \frac{0}{u_{16}} + \frac{0}{u_{17}} + \frac{0}{u_{18}} + \frac{0}{u_{19}} + \frac{0}{u_{20}} + \frac{0}{u_{21}} + \frac{0}{u_{22}} + \frac{0}{u_{23}} + \frac{0}{u_{24}} + \frac{0}{u_{25}}$$

$$A_{25} = \frac{0}{u_1} + \frac{0}{u_2} + \frac{0}{u_3} + \frac{0}{u_4} + \frac{0}{u_5} + \frac{0}{u_6} + \frac{0}{u_7} + \frac{0}{u_8} + \frac{0}{u_9} + \frac{0}{u_{10}} + \frac{0}{u_{11}} + \frac{0}{u_{12}} + \frac{0}{u_{13}} + \frac{0}{u_{14}} + \frac{0}{u_{15}} + \frac{0}{u_{16}} + \frac{0}{u_{17}} + \frac{0}{u_{18}} + \frac{0}{u_{19}} + \frac{0}{u_{20}} + \frac{0}{u_{21}} + \frac{0}{u_{22}} + \frac{0}{u_{23}} + \frac{0,5}{u_{24}} + \frac{1}{u_{25}}$$

The linguistic values of many fuzzifications obtained from fuzzy sets can be seen in Table 3.

Table 4. Linguistic Values

Fuzzification	Linguistic Values
A_1	Very, very dramatically down
A_2	Very down dramatically
A_3	Very down drastically
A_4	Get down drastically
A_5	Very down once
A_6	Very down once

Fuzzification	Linguistic Values
A ₇	Down once
A ₈	A little down once
A ₉	Simply go down
A ₁₀	Down
A ₁₁	A little down
A ₁₂	A little down
A ₁₃	Moderate
A ₁₄	Rather up
A ₁₅	Slightly up
A ₁₆	Go up
A ₁₇	Just go up
A ₁₈	A little up once
A ₁₉	Go up once
A ₂₀	Very up once
A ₂₁	Very much go up once
A ₂₂	Drastic
A ₂₃	Very drastic increase
A ₂₄	Very dramatically up
A ₂₅	Very, very dramatically up

Step 6. Fuzzification and FLR.

The fuzzification stage is based on the number of intervals formed. Fuzzification results of sales data for Vivo brand mobile phones can be seen in Table 4

Table 5 Fuzzy intervals use frequency density

A _i	Lower Limit	Lower On	Wide Sub-interval	Middle value (m)
A ₁	232	251.07	19.07	241.535
A ₂	251.07	270.14	19.07	260.605
A ₃	270.14	279.68	9.54	274.91
A ₄	279.68	289.22	9.54	284.45
A ₅	289.22	298.76	9.54	293.99
A ₆	298.76	308.3	9.54	303.53
A ₇	308.3	315.93	7.63	312.115
A ₈	315.93	323.56	7.63	319.745
A ₉	323.56	331.19	7.63	327.375
A ₁₀	331.19	338.82	7.63	335.005
A ₁₁	338.82	346.45	7.63	342.635
A ₁₂	346.45	352.81	6.36	349.63
A ₁₃	352.81	359.17	6.36	355.99
A ₁₄	359.17	365.53	6.36	362.35
A ₁₅	365.53	371.89	6.36	368.71
A ₁₆	371.89	378.25	6.36	375.07
A ₁₇	378.25	384.61	6.36	381.43
A ₁₈	384.61	394.15	9.54	389.38
A ₁₉	394.15	403.69	9.54	398.92
A ₂₀	403.69	413.23	9.54	408.46
A ₂₁	413.23	422.7	9.54	417.97
A ₂₂	422.7	460.91	38.14	441.81
A ₂₃	460.91	473.62	12.71	467.27

A_i	Lower Limit	Lower On	Wide Sub-interval	Middle value (m)
A_{24}	473.62	486.33	12.71	479.98
A_{25}	486.33	499.04	12.71	492.69

Relationship is identified based on a fuzzification value from historical data. If the time series variable $F(t-1)$ is clarified as A_i and $F(t)$ as A_j , then A_i is related to A_j which can be expressed by A_i notation $\rightarrow A_j$. Based on the fuzzy set, the actual data fuzzification and FLR are obtained as in Table 5.

Table 6 Fuzzification and FLR

Year	Month	Vivo	Fuzzification	FLR
2014	January	258	A_2	-
	February	276	A_3	$A_2 \rightarrow A_3$
	March	254	A_2	$A_3 \rightarrow A_2$
	April	301	A_6	$A_2 \rightarrow A_6$
	Mei	277	A_3	$A_6 \rightarrow A_3$
	June	356	A_{13}	$A_3 \rightarrow A_{13}$
	July	301	A_6	$A_{13} \rightarrow A_6$
	August	398	A_{19}	$A_6 \rightarrow A_{19}$
	September	354	A_{13}	$A_{19} \rightarrow A_{13}$
	Oktober	308	A_6	$A_{13} \rightarrow A_6$
	November	325	A_9	$A_6 \rightarrow A_9$
	December	489	A_{25}	$A_9 \rightarrow A_{25}$
2015	January	499	A_{25}	$A_{25} \rightarrow A_{25}$
	February	387	A_{18}	$A_{25} \rightarrow A_{18}$
	March	346	A_{11}	$A_{18} \rightarrow A_{11}$
	April	358	A_{13}	$A_{11} \rightarrow A_{13}$
	Mei	367	A_{15}	$A_{13} \rightarrow A_{15}$
	June	353	A_{13}	$A_{15} \rightarrow A_{13}$
	July	378	A_{16}	$A_{13} \rightarrow A_{16}$
	August	405	A_{20}	$A_{16} \rightarrow A_{20}$
	September	378	A_{16}	$A_{20} \rightarrow A_{16}$
	Oktober	389	A_{18}	$A_{16} \rightarrow A_{18}$
	November	352	A_{12}	$A_{18} \rightarrow A_{12}$
	December	388	A_{18}	$A_{12} \rightarrow A_{18}$
2016	January	379	A_{17}	$A_{18} \rightarrow A_{17}$
	February	384	A_{17}	$A_{17} \rightarrow A_{17}$
	March	345	A_{11}	$A_{17} \rightarrow A_{11}$
	April	322	A_8	$A_{11} \rightarrow A_8$
	Mei	316	A_8	$A_8 \rightarrow A_8$
	June	315	A_7	$A_8 \rightarrow A_7$
	July	361	A_{14}	$A_7 \rightarrow A_{14}$
	August	382	A_{17}	$A_{14} \rightarrow A_{17}$
	September	232	A_1	$A_{17} \rightarrow A_1$
	Oktober	329	A_9	$A_1 \rightarrow A_9$
	November	330	A_9	$A_9 \rightarrow A_9$
	December	495	A_{25}	$A_9 \rightarrow A_{25}$
2017	January	466	A_{23}	$A_{25} \rightarrow A_{23}$

Year	Month	Vivo	Fuzzification	FLR
2018	February	321	A ₈	A ₂₃ → A ₈
	March	267	A ₂	A ₈ → A ₂
	April	276	A ₃	A ₂ → A ₃
	Mei	298	A ₅	A ₃ → A ₅
	June	308	A ₆	A ₅ → A ₆
	July	388	A ₁₈	A ₆ → A ₁₈
	August	405	A ₂₀	A ₁₈ → A ₂₀
	September	374	A ₁₆	A ₂₀ → A ₁₆
	Oktober	345	A ₁₁	A ₁₆ → A ₁₁
	November	379	A ₁₇	A ₁₁ → A ₁₇
	Desember	475	A ₂₄	A ₁₇ → A ₂₄
	January	498	A ₂₅	A ₂₄ → A ₂₅
	February	456	A ₂₂	A ₂₅ → A ₂₂
	March	395	A ₁₉	A ₂₂ → A ₁₉
	April	356	A ₁₃	A ₁₉ → A ₁₃
	Mei	345	A ₁₁	A ₁₃ → A ₁₁
	June	358	A ₁₂	A ₁₁ → A ₁₂
	July	367	A ₁₅	A ₁₂ → A ₁₅
	August	379	A ₁₇	A ₁₅ → A ₁₇
	September	364	A ₁₄	A ₁₇ → A ₁₄
	Oktober	356	A ₁₃	A ₁₄ → A ₁₃
	November	321	A ₈	A ₁₃ → A ₈
	Desember	453	A ₂₂	A ₈ → A ₂₂

Step 7. Weight of FLRG

Based on equation (7), the FLRG weight matrix can be obtained as follows:

There are two stages in the defuzzification process namely the first, looking for the middle value in each interval based on equation (5) and the second, calculating the forecasting value based on equation (9). If the first period fuzzification result is A_i , and A does not have FLR in FLRG with condition $A_i \rightarrow \emptyset$, then the forecast value is the middle value of A_i . Thus the defuzzification of FLRG in table 6 is obtained as follows:

Table 7. Weight of FLRG and Defuzzification

Current State (A_i)	Next State (A_j)	Forecasting
$A_1 \rightarrow$	A_9	327,38
$A_2 \rightarrow$	A_2, A_6	284,45
$A_3 \rightarrow$	A_2, A_5, A_{13}	303,53
$A_4 \rightarrow$	\emptyset	284,45
$A_5 \rightarrow$	A_6	303,53
$A_6 \rightarrow$	A_3, A_4, A_{18}, A_{19}	347,65
$A_7 \rightarrow$	A_{14}	362,35
$A_8 \rightarrow$	A_2, A_7, A_8, A_{22}	333,57
$A_9 \rightarrow$	A_9, A_{25}	437,58
$A_{10} \rightarrow$	\emptyset	335,01
$A_{11} \rightarrow$	A_8, A_{13}, A_{17}	353,29
$A_{12} \rightarrow$	A_{18}	389,38
$A_{13} \rightarrow$	$A_6, A_8, A_{11}, A_{15}, A_{16}$	340,28
$A_{14} \rightarrow$	A_{13}, A_{17}	368,71
$A_{15} \rightarrow$	A_{13}, A_{17}	368,71
$A_{16} \rightarrow$	A_{11}, A_{18}, A_{20}	380,16
$A_{17} \rightarrow$	$A_7, A_{11}, A_{14}, A_{17}, A_{24}$	361,39
$A_{18} \rightarrow$	$A_{11}, A_{12}, A_{17}, A_{20}$	370,54
$A_{19} \rightarrow$	A_{15}	355,99
$A_{20} \rightarrow$	A_{16}	375,07
$A_{21} \rightarrow$	\emptyset	417,97
$A_{22} \rightarrow$	A_{19}	398,92
$A_{23} \rightarrow$	A_8	319,75
$A_{24} \rightarrow$	A_{25}	492,69
$A_{25} \rightarrow$	$A_{18}, A_{22}, A_{23}, A_{25}$	447,78

The results of forecasting sales of Vivo brand mobile phones from January 2014 to December 2018 can be seen in Table 7 as follows:

Table 8 Results of forecasting sales of Vivo brand mobile phones

Year	Month	Vivo	Fuzzifikasi	Forecasting
2014	January	258	A_2	-
	February	276	A_3	284,45
	March	254	A_2	303,53
	April	301	A_6	284,45
	Mei	277	A_7	347,65
	June	356	A_{13}	303,53
	July	301	A_6	340,28
	August	398	A_{19}	347,65
	September	354	A_{13}	355,99
	Oktober	308	A_6	340,28
	November	325	A_9	347,65
	Desember	489	A_{25}	437,58

Year	Month	Vivo	Fuzzifikasi	Forecasting
2015	January	499	A ₂₁	447,78
	February	387	A ₁₈	447,78
	March	346	A ₁₁	370,54
	April	358	A ₁₇	353,29
	Mei	367	A ₁₈	340,28
	June	353	A ₁₃	368,71
	July	378	A ₁₆	340,28
	August	405	A ₂₀	380,16
	September	378	A ₁₆	375,07
	Oktober	389	A ₁₈	380,16
	November	352	A ₁₂	370,54
	Desember	388	A ₁₈	389,38
2016	January	379	A ₁₇	370,54
	February	384	A ₁₇	361,39
	March	345	A ₁₁	361,39
	April	322	A ₆	353,29
	Mei	316	A ₆	333,57
	June	315	A ₇	333,57
	July	361	A ₁₄	362,35
	August	382	A ₁₇	368,71
	September	232	A ₁	361,39
	Oktober	329	A ₉	327,38
	November	330	A ₈	437,58
	Desember	495	A ₂₅	437,58
2017	January	466	A ₂₁	447,78
	February	321	A ₈	319,75
	March	267	A ₂	333,57
	April	276	A ₃	284,45
	Mei	298	A ₅	303,53
	June	308	A ₆	303,53
	July	388	A ₁₈	347,65
	August	405	A ₂₀	370,54
	September	374	A ₁₆	375,07
	Oktober	345	A ₁₁	380,16
	November	379	A ₁₇	353,29
	Desember	475	A ₂₄	361,39
2018	January	498	A ₂₁	492,69
	February	456	A ₂₁	447,78
	March	395	A ₁₉	398,92
	April	356	A ₁₅	355,99
	Mei	345	A ₁₁	340,28
	June	358	A ₁₃	353,29
	July	367	A ₁₅	340,28
	August	379	A ₁₇	368,71
	September	364	A ₁₄	375,71

Year	Mounth	Vivo	Fuzzifikasi	Forecasting
	Oktober	356	A_{13}	368,71
	November	321	A_8	340,28
	Desember	453	A_{23}	333,57
2019	January	-		398,92

Forecasting on this FTS Cheng method looks at the fuzzification of previous data, forecasting the sale of Vivo brand mobile phones for January 2019 using fuzzification in December 2018, namely A_{25} with forecasting results of 398.92 points.

4.2. Cheng Fuzzy Time Series simulation results

In this step, the data that has been applied using the Cheng Fuzzy Time Series method is solved by using Matlab R2015a. The results of the simulation of 60 sales data on Vivo brand mobile phones using the Matlab R2015a software can be seen in Table 8.

Table 9 Data from the sales simulation of the Vivo brand mobile phone

Year	Mounth	Vivo	Forecasting	Error
2014	January	258	-	
	February	276	284.4464	8.4464
	March	254	303.5179	49.5179
	April	301	284.45464	16.5536
	Mei	277	347.6205	70.6205
	June	356	303.5179	52.4821
	July	301	340.2531	39.2531
	August	398	347.6205	50.3795
	September	354	355.9643	1.9643
	Oktober	308	340.2531	32.2531
	November	325	347.6205	22.6205
	Desemher	489	437.5476	51.4524
2015	January	499	447.7455	51.2545
	February	387	370.5062	16.4938
	March	346	370.5062	24.5062
	April	358	353.2625	4.7375
	Mei	367	340.2531	26.7496
	June	353	368.6786	15.6786
	July	378	340.2531	37.7469
	August	405	380.1214	24.8786
	September	378	375.0357	2.9643
	Oktober	389	380.1214	8.8786
	November	352	370.5062	18.5062
	Desember	388	389.3393	1.3393
2016	January	379	370.5062	8.4938
	February	384	361.5586	22.4414
	March	345	361.5586	16.5586
	April	322	353.2625	31.2625
	Mei	316	333.5554	17.5554
	June	315	333.5554	18.5554
	July	361	362.3214	1.3214

	August	382	368.6786	13.3214
	September	232	361.5586	129.5586
	Oktober	329	327.3571	1.6429
	November	330	437.5476	107.5476
	Desember	495	437.5476	57.4524
2017	January	466	447.7455	18.2545
	February	321	319.7286	1.2714
	March	267	333.5554	66.5554
	April	276	284.4464	8.4464
	Mei	298	303.5179	5.5179
	June	308	303.5179	4.4821
	July	388	347.6205	40.3795
	August	405	370.5062	34.4938
	September	374	375.0357	1.0357
	Oktober	345	380.1214	35.1214
	November	379	353.2625	25.7375
	Desember	475	361.5586	113.4414
2018	January	498	492.6429	5.3571
	February	456	447.7455	8.2545
	March	395	398.875	3.875
	April	356	355.9643	0.035714
	Mei	345	340.2531	4.7469
	June	358	353.2625	4.7375
	July	367	340.2531	26.7469
	August	379	368.6786	10.3214
	September	364	361.5586	2.4414
	Oktober	356	368.6786	12.6786
	November	321	340.2531	19.2531
	Desember	453	333.5554	119.4446
2019	January		398.875	

Based on manual calculations and the results of Matlab software shows the same results, the following graph displayed from the results of Matlab software can be seen in Figure 1.

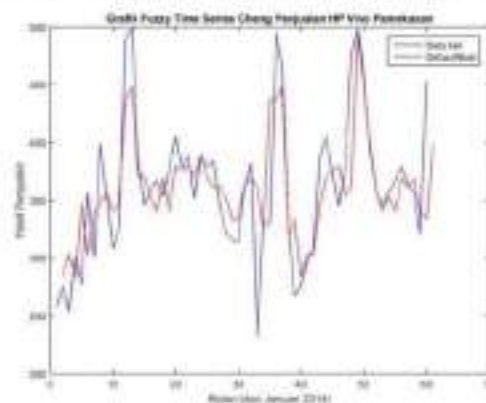


Fig. 1. Forecasting Graphs for Sales of Vivo Mobile Phones

Based on Figure 1, graphs in blue are graphs of actual data on sales of Vivo brand mobile phones, while graphs in red are graphs of forecasted data using Cheng Fuzzy Time Series method. Forecasting the sale of the Vivo brand mobile phone from Indophone Pamekasan using 60 monthly sales data from January 2014 to December 2018 using the fuzzy time series Cheng method, the MAPE value = 8,18644%.

While the results of the Advan brand forecasting use the same steps based on Table 9.

Table 10 Data on the results of sales forecasting for Advan brand mobile phones

Year	Month	Advan	Forecasting	Error
2014	January	256	-	
	February	287	316.8679	29.8679
	March	263	292.8286	29.8286
	April	298	293	5.3986
	Mei	343	354.3631	11.3631
	June	295	316.7771	21.7771
	July	364	354.631	9.6369
	August	376	330.2482	45.7518
	September	365	302.2024	62.7976
	Oktober	342	330.2482	11.7518
	November	358	316.7771	41.2229
	Desember	467	340.7257	126.2743
2015	January	431	388	42.619
	February	342	345	2.5357
	March	332	316.7771	15.2229
	April	309	291.0143	17.9857
	Mei	366	347.7863	18.2137
	June	288	330.2482	42.2482
	July	315	292.8286	22.1714
	August	351	325.1229	25.8771
	September	280	340.7257	60.7257
	Oktober	275	287.8393	12.8393
	November	261	258.0548	2.9452
	Desember	305	292.6018	12.3982
2016	January	288	334.3304	46.3304
	February	255	292.8286	37.8286
	March	340	316.8679	23.1321
	April	260	316.7771	56.7771
	Mei	285	292.6018	7.6018
	June	269	287.8393	18.8393
	July	213	258.0548	45.0548
	August	398	413	14.5714
	September	337	335	1.5357
	Oktober	281	291.0143	10.0143
	November	306	287.8393	18.1607
	Desember	378	334.3304	43.6696
2017	January	239	302.2024	63.2024
	February	261	262.8929	1.8929
	March	291	292.6018	1.6018
	April	270	292.8286	22.8286
	Mei	287	258.0548	28.9452

Year	Month	Advan	Forecasting	Error	
2018	June	303	292.8286	10.1714	
	July	354	334.3304	19.6696	
	August	321	340.7257	19.7257	
	September	313	325.1229	12.1229	
	Oktober	315	325.1229	32.7863	
	November	317	340.7257	8.1229	
	Desember	358	347.7863	32.8771	
	January	312	330.2482	28.7257	
	February	366	347.7863	18.2137	
	March	312	316.7771	18.2482	
	April	340	291.0143	7.7863	
	Mei	334	287.8393	17.2229	
2019	June	281	291.0143	10.0143	
	July	306	287.8393	18.1607	
	August	315	334.3304	19.3304	
	September	289	325.1229	36.1229	
	Oktober	286	291.8286	6.8286	
	November	290	291.8286	2.8286	
	Desember	354	291.8286	61.1714	
	2019	January		340.7257	

Based on manual calculations and the results of Matlab software shows the same results, the following graph displayed from the results of Matlab software can be seen in Figure 2.

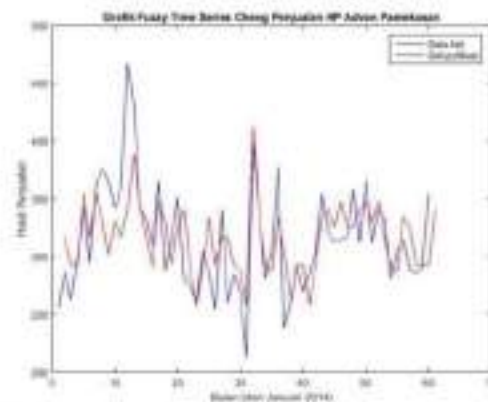


Fig. 2. Forecasting Graphs for Sales Results of Advan brands

Based on Figure 2, graphs in blue are graphs of actual data on sales of Advan brand mobile phones, while graphs in red are graphs of forecasted data using Cheng Fuzzy Time Series method. Forecasting the sale of Samsung brand mobile phones from Indophone Pamekasan using 60 monthly sales data from January 2014 to December 2018 using the fuzzy time series Cheng method, the MAPE value = 7.237288%.

5. CONCLUSION

The conclusions from this study are:

After matching the simulation results with real in the field it can be seen that the Cheng Fuzzy Time Series method for forecasting the sale of Samsung brand mobile phones from Indophone Pamekasan uses 60 monthly sales data from January 2014 to December 2018 to provide results with the Vivo brand 398.92 and MAPE value = 8.18644 %, with the Advan brand giving the results of 340.27 and the MAPE value = 7.813559%.

Acknowledgements

The author thanks: Ristekdikti who have provided funding assistance related to PKM-PE, Dean, Chair of the UIM MIPA Study Program and Supervisor who have helped in the completion of PKM-PE. The Indophone Pamekasaan company has been willing in this research

References

- [1] T. Yulianto, S. Komariyah, and N. Ulfaniyah, "Application of fuzzy inference system by Sugeno method on estimating of salt production," in *AIP Conference Proceedings*, 2017, pp. 020039-1.
- [2] M. L. Tauryawati and I. M. Irawan, "Perbandingan metode fuzzy time series cheng dan metode Box-jenkins untuk memprediksi IHSB," *Sains dan seni Pomits*, vol. 3, p. 34, 2014.
- [3] M. N. Sumartini, Hayati and S. Wahyuningsih, "Peramalan Menggunakan Metode," *J. EKSPONENSIAL*, vol. 8, p. 51.
- [4] A. B. Elfajar, B. D. Setiawan, and C. Dewi, "Peramalan Jumlah Kunjungan Wisatawan Kota Batu Menggunakan Metode Time Invariant Fuzzy Time Series," *J. Pengemb. Teknol. Inf. Dan Ilmu Komput.*, p. 86, 2017.
- [5] N. Fitriyah, "Peramalan Penjualan Batik menggunakan metode fuzzy time series markov chain," 2017.
- [6] R. I. Aprilia and M. Fachurrozi, "Sistem Rekomendasi Bacaan Tugas Akhir Jurusan Teknik Informatika Universitas Sriwijaya Menggunakan Metode Collaborative Filtering dan Naive Bayes," in *Prosiding Annual Research Seminar*, 2016, vol. 2, no. 1, p. 346.