JUSIKOM PRIMA (Jurnal Sistem Informasi dan Ilmu Komputer Prima)
Vol. 6 No. 1, Agustus 2022 E-ISSN : 2580-2879

APPLICATION OF THE FUZZY TIME SERIES MODEL IN CLOTHING MATERIAL STOCK FORECASTING

Mutammimul Ula*[1], Bakhtiar [2] ,Desvina Yulisda[3], Badriana[4],Andik Bintoro[5]
[1,3] Information Systems, [2] Industrial Engineering, [4,5] Electrical Engineering
Information Systems, Department of Electrical Engineering, Faculty of Engineering, Universitas Malikussaleh
E-mail : *mutammimul@unimal.ac.id

ABSTRACT- The application of fuzzy time series is used to view the stock of clothing materials. As for the problem so far, CV Duta Express does not have a model for seeing the stock of complete materials in the warehouse, so the process is not optimal. This will have an impact on orders that come in at the same time and in large quantities. to avoid stock shortages, which resulted in the company experiencing losses. The purpose of this study is to make it easier to predict the stock of clothing materials and to be able to analyze every stock management at CV Duta Express with a fuzzy time series model. The variables used are stock needs, the amount of stock of school clothes, batik clothes, and pants. The research methodology in data collection consists of product type data from 2018–2021 at CV Duta Express Aceh Utara. Data analysis needs consist of school clothes, school pants, and clothes. Next, the fuzzy time series process determines the actual data is the type of school clothes, and what is forecast is sales for January 2018–2021 at the end of December. For a value of 1108 A2 fuzzification value, 172 A4 fuzzification value for batik clothes, and 894 pants with an A1 fuzzification value, then the value of the universe set used is U = [26, 323]. The value of forming a linguistic set is based on the length of the interval U3 = [111,153], U4 = [153,196], and U5 = [196,238]. The result of the fuzzification value from historical data for the value of 172 fuzzification is A4, for data of 133 fuzzification is A3. The formation of Fuzzy Logic Relationship (FLR) values for the period 1/7/2021 to 1/13/2021 is obtained from the data range A4=174 and range A3=125 in each period to be related. The results of forecasting with fuzzy time series testing at the end of December 2021 are 196 stocks of clothes that must be optimized in the following month. The test results in this study are to see if the error value using the AFER model is 0.4511% while the RMSE test value has an error value of 5.0199. After being calculated for the forecast every month, the average obtained for AFER is 0.50154 % and the RMSE is 9.86518..

Keywords : Forecasting, Fuzzy Time Series, stock

1. INTRODUCTION

Computer technology and forecasting models are widely used to see the level of forecasts in the stock of clothing materials in a company. CV Duta Express is engaged in meeting the needs of meeting the stock of clothing materials and selling the clothing products. So far, CV Duta Express is still manual, starting from the system of recording incoming and outgoing goods and not using a model in viewing the stock of raw materials [1]. Along with the development of its business, CV Duta Express has no control over the needs for goods that are often used by employees, and the large number of incoming and outgoing goods is no longer controlled. Therefore, a strategy is needed to see stock and the right sales and stock forecasting models for future stock inventories [2] [3] [4].

Sales is one element in exchanging products with customers and with other people [5]. The existence of a prediction model can help predict future sales and can minimize losses on a product so that management can predict inventory optimally [6]. Inventory control should not be reduced so that demand for spare parts is always available [7]. A program technology is needed to predict the amount of inventory in the warehouse that does not reach capacity, causing losses because many items are not used [8].

Prediction results can be used to see a gold price trend in the future. time series prediction model for data accuracy in the following month to invest [9]. Furthermore, the forecasting model can use machine learning and SVM models that can be used in forecasting [10] [11]. Furthermore, fuzzy time series forecasting can predict in the following month the determination of rainfall with Chen's FTS series [12]. The Fuzzy Time Series method can be used in forecasting the demand for the amount of inventory in the following month with the input variables consisting of demand, inventory, and sales [13]. The fuzzy time series method is used in predicting world oil prices and the interval value in the fuzzy time series is very influential on the subsequent prediction results, so that the results of the formation of fuzzy values in the use of intervals are precise and effective in determining further forecasts [14] [15]. The FTS method can predict the amount of demand for stock for the next month based on historical data and capture patterns from previous data [16] [17]. There is an accuracy value in seeing the quality of test results using the AFFER and MSE equation models in the final test of the application of obesity prediction level testing [18].

Therefore, a forecasting application is needed to forecast the stock distribution of fuzzy time series clothing models.

Destination

The aims of this research are: 1. To facilitate product forecasting and analysis of the results of incoming and outgoing stock of goods obtained from the implementation of CV Duta Express by using the time series method. 2. With the stock forecasting of product sales using the average best fuzzy time series method on the CV Ambassador Express in Krueng Geukuh, the forecasting process can be done quickly and precisely based on predetermined variables.

2. Research Content

2.1 Research methodology

Research on the application of fuzzy time series models in forecasting the stock of clothing materials and distribution of clothing on CV Ambassador Express Aceh. This research data collection is quantitative. 2.2: Data collection techniques The data needed in the study is forecasting data on product types at CV Duta Express from 2018 to 2021. The data provided includes product type data such as batik clothes, school clothes, and school pants. 2. 3Data Analysis and DesignAnalysis of data sorting at CV Duta Express based on data analysis in the clothing stock section according to research needs, then designing an application/program to complete product sales stock forecasting using the fuzzy time series (FTS) method and making a detailed application of the fuzzy time series model according to system requirements [19]. 2.4 Types and sources of data The following data are required for the application of the fuzzy time series model in forecasting stock distributions for clothing stock at CV Duta Express from January 2019 to December 2021:

Tablel 1. Stock of clothes

Mount	Year	Count
Jan	2019	172
Feb	2019	133
Mar	2019	150
April	2019	303
May	2019	31
Juny	2019	152
Juli	2019	122
August	2019	148
Sep	2019	207
Okt	2019	33
Nov	2019	176
Dec	2020	99
Jan	2020	221
Feb	2020	100
Mar	2020	68
April	2020	26
May	2020	231
Juny	2020	220
July	2020	226
…	…	…
August	2020	104
Septem	2020	172

Mount	Year	Count
Jan	2013	141
Feb	2013	87
Mar	2013	211
April	2013	104
May	2013	250
Juny	2013	202
July	2013	210
Jan	2021	219
Feb	2021	323
Mar	2021	48
April	2021	241
May	2021	199
Juny	2021	209
July	2021	193
August	2021	205
Sept	2021	249
Okt	2021	171
Nov	2021	108
Dec	2021	201

Mount	Year	Count
Oktober	2020	275
Nov	2020	229
Des	2020	70

Mount	Year	Count

Source (Processed Data, 2022)

2.5 Research Flowchart

The research flow chart of the application of the fuzzy time series model in forecasting the stock distribution of clothing on the cv ambassador express [20]

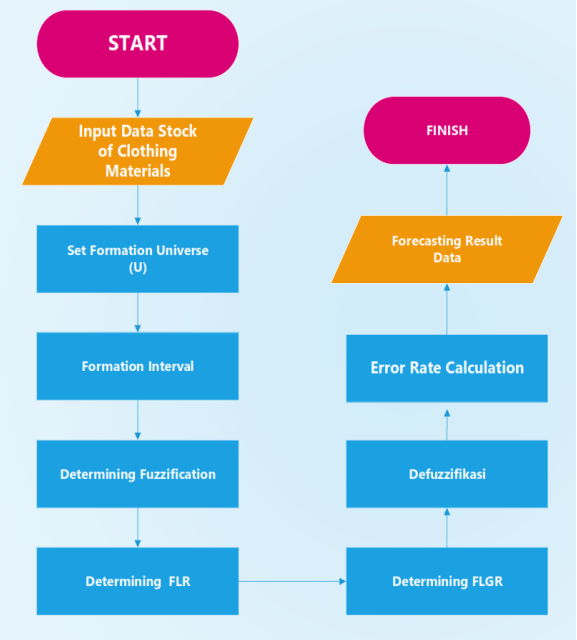

Figure 1. Research Flowchart

The forecasting stages in the fuzzy time series are as follows: the first step is to input data on clothing stock, calculate the formation of the U universe set of clothing stock data in the universe of conversation and then divide it into several intervals with the same distance.

If U is the universal set, U = {u1, u2, ... , un}, then a fuzzy set Ai of U is defined as :

Ai = Ai(u1)/u1 + Ai(u2)/u2 + … + Ai(un)/un ….(1)

Where A is the membership function of the fuzzy set Ai , so that Ai: U → [0,1].

The next step is the formation of intervals and calculating the number of intervals and the length of each interval from the universal set (U) and in calculating the number of intervals with the conditions k=1+3,3 Log n ……(2)

Next is the determination of fuzzy sets in the universe of conversation and fuzzification of historical data on clothing stock. The next step is to establish a fuzzy logic relation based on historical data on clothing stock and form a sequential fuzzy set Ai(t-1) and Aj(t) can be expressed as:

(FLRG) Ai → Aj1, Aj2 ……(3)

Classifying fuzzy logic relations with all relationships. FLRs that have the same LHS can be grouped into FLR groups. For example, Ai→Aj, Ai→Ak, Ai→Am can be grouped into Ai→Aj, Ak, Am. The next step is to create a group of fuzzy relationships so as to create relational groups from

each of these fuzzy relationships [21]. Calculation results Defuzzification of data to obtain forecasts based on FLRG and probability matrix [22]. Adjustment of the final value of the forecast in viewing the forecast data for the following month.

3. Results and Discussion of Fuzzy Time Series

3.1 Results

Calculation of the results of the application of the fuzzy time series model in forecasting the stock distribution of clothing, there are several steps to be taken

1. Step 1: Input Sales Stock Data

This experiment was carried out on stock data of clothing materials from 1/7/2019 to 5/6/2021. The following is the actual data for the total stock of clothing materials for each sale as shown in the table below:

Table 2. Actual Data Stock of Clothes for the 2019-2021 Period

Mount	Year	Count
Jan	2019	172
Feb	2019	133
Mar	2019	150
April	2019	303
May	2019	31
Juny	2019	152
Juli	2019	122
August	2019	148
Sep	2019	207
Okt	2019	33
Nov	2019	176
Dec	2020	99
Jan	2020	221
Feb	2020	100
Mar	2020	68
April	2020	26
May	2020	231
Juny	2020	220
July	2020	226
…	…	…
August	2020	104
Septem	2020	172
Oktober	2020	275
Nov	2020	229
Des	2020	70

Mount	Year	Count
Jan	2013	141
Feb	2013	87
Mar	2013	211
April	2013	104
May	2013	250
Juny	2013	202
July	2013	210
Jan	2021	219
Feb	2021	323
Mar	2021	48
April	2021	241
May	2021	199
Juny	2021	209
July	2021	193
August	2021	205
Sept	2021	249
Okt	2021	171
Nov	2021	108
Dec	2021	201

Source (Processed Data, 2022)

2. Step 2: Define the universal set of discourse U up to which the fuzzy set is defined. The actual data for the minimum data is 26 and the maximum data is 323. Based on the values obtained, the set of universe talks U can be defined as U = [26, 323].

3. Step 3: Determine the number of intervals and the length of each interval from the universal set (U).

The length of the interval obtained, the class that will be divided into 7 intervals is U1 = [26,68], U2= [68,111], U3=[111,153], U4=[153,196], 5=[196,238], U6=[238,281] ,U7=[281, 323]. Then determined 7 linguistic values that make up 7 fuzzy sets, namely A1 = 26, A2 = 76, A3 = 125, A4 = 175, A5 = 224, A6 = 274, A7 = 323.

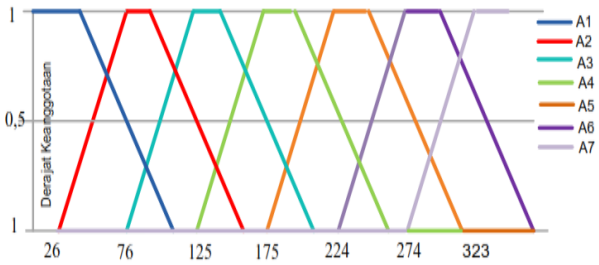

Figure 2. Fuzzy Set of Clothes Stock Data

Caption :

U1 = [26,68] is the length of the interval between the 26,68 that exist in the universe U1

U2=[68,111] is the length of the interval between 68,111 in the universe U2

U3=[111,153], is the length of the interval between 111.153 in the universe U3

U4=[153,196], is the length of the interval between 153,196 in the universe U4

U5=[196.238], is the length of the interval between 196.238 in the universe U5

U6=[238,281], is the length of the interval between 238,281 in the universe U6

U7=[281,323]. is the length of the interval between the 281, 323 that exist in the universe U7

5. Fuzzification of values from historical data.

as for historical data on the application of the fuzzy time series model in forecasting the stock distribution of clothing in aceh. The following fuzzified historical values are as follows:

Tabel 2. Data Historis Stok Baju

Tanggal	Count	Fuzzified
1/7/2019	172	A4
1/13/2019	133	A3
2/16/2019	150	A4
2/18/2019	303	A7
2/26/2019	31	A1
3/5/2019	152	A4
3/11/2019	122	A3
3/17/2019	148	A3
11/21/2019	87	A2
11/23/2019	211	A5
11/24/2020	104	A3
12/11/2020	250	A6
12/18/2020	202	A5
12/19/2020	210	A5
12/21/2020	219	A5
12/31/2020	323	A7
1/7/2021	48	A1
1/8/2021	241	A5
1/9/2021	199	A4
1/27/2021	209	A5
2/3/2021	93	A2
4/5/2021	129	A3
4/8/2021	312	A7
4/9/2021	205	A5
4/10/2021	249	A6
4/28/2021	171	A4
5/5/2021	108	A3
5/6/2021	201	A5

Source (Processed Data, 2022)

Table Description:

- A total of 172 is included in the historical data fuzzification of group A4, between the range of A4 values, namely 153-196
- The number of 221 is included in the historical data fuzzification of group A5, between the range of A5 values, namely 196-238
- The number of 93 is included in the historical data fuzzification of group A2, between the range of A2 values, namely 26-68
- The number of 104 is included in the historical data fuzzification of group A3, between the range of A3 values, namely 111-153
- The number of 277 is included in the historical data fuzzification of the A6 group, between the A6 value range, which is 238-281

6. Fuzzy Logic Relationship Group (FLRG)
The formation of Fuzzy Logic Relationship Group (FLRG) values is as follows:

Table 3. FLR (Fuzzy Logical Relatinship))

Current State	Next State
A1 →	A4,A3, A5,A7
A2 →	A5, A2, A1,A3
A3 →	A5, A3, A4, A6, A7,A2
A4 →	A1,A2,A3,A5,A6, A7
A5 →	A1, A2,A3, A4,A5,A6, A7
A6 →	A1, A4, A7, A5, A3
A7 →	A1, A6, A4, A3, A5

Table Description:
- First: Formation of Fuzzy Logic Relationship Group (FLRG) by eliminating identical or repeated FLRs, then FLRs that have the same LHS (left hand side) or current state, are combined into one group such as: A1 A4,A3, A5,A7
- Second : Formation of Fuzzy Logic Relationship Group (FLRG): A2 A5, A2, A1,A3
- Third: Formation of Fuzzy Logic Relationship Group (FLRG) into one group such as: A3 A5, A3, A4, A6, A7, A2
- Fourth: Formation of Fuzzy Logic Relationship Group (FLRG) A4 A1, A2, A3, A5, A6, A7

8. Forecasting and defuzzification based on FLRG
Fuzzification results for each group. For groups with current state A1 1128.42, A2 1135.51 and so on for other groups as can be seen in table 4.8 below:

Table 4. FLRG (Fuzzy Logical Relatinship Group)

Current State	Forecasted
A1 →	206.37
A2 →	121.42
A3 →	195.75
A4 →	174.53
A5 →	174.53
A6 →	174.54
A7 →	166.04

- Table Description
- - The value of A1 206.37 is obtained from (A4 + A3 + A5 + A7) / 4 = (174.5 + 132 + 217+ 302) / 4 = 825.5/4 = 206.37
- - The value of A2 121 is obtained from (A5 + A2 + A1 +A3) / 4 = (217 + 89.5 + 47.21 + 132) / 4 = 485.71/4 = 121.42
- - The value of A3 195.75 is obtained from (A5 + A3 + A4 + A6 + A7 + A2) / 6 = (217 + 132 + 174.5 + 259.5 + 302 + 89.5) / 6 = 1174.5/6=195.75

Table Description
- The value of A1 206.37 is obtained from (A4 + A3 + A5 + A7) / 4 = (174.5 + 132 + 217+ 302) / 4 = 825.5/4 = 206.37
- The value of A2 121 is obtained from (A5 + A2 + A1 +A3) / 4 = (217 + 89.5 + 47.21 + 132) / 4 = 485.71/4 = 121.42
- The value of A3 195.75 is obtained from (A5 + A3 + A4 + A6 + A7 + A2) / 6 = (217 + 132 + 174.5 + 259.5 + 302 + 89.5) / 6 = 1174.5/6=195.75 :

$$AFER = \frac{|A_i - F_i|/A_i}{n} * 100\ \% \quad \text{.....(4)}$$

= 0,44211%

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(A_i - F_i)^2}{n}} \quad \text{.....(5)}$$

= 0.30741

After being calculated for the forecast every month, the average obtained for AFER is 0.44211 % and RMSE is 3.323%.

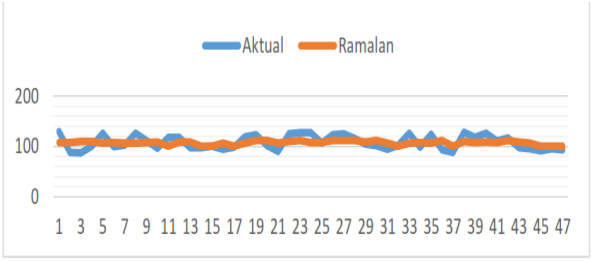

Figure 3. Clothing Stock Chart

5. Conclusion

5.1 Conclusion

The conclusions of the application of the fuzzy time series model in forecasting the stock distribution of clothing in Aceh are as follows:

1. The application of the fuzzy time series model can predict the demand for stock of clothing materials consisting of school clothes, batik clothes and pants and each of these data shows a low number of errors and the predicted data will be better for the prediction results of future plans for better results. optimal.

2. The results for each process of forecasting stock data for pants have an error value for AFER of 0.22927 % and RMSE of 26.10036. Furthermore, for the process of forecasting school clothes stock data, the AFER error value is 0.23640% and the RMSE is

29.09439. Therefore, a comparison chart of the actual stock of school clothes can be seen, which is marked by a blue line with data from the forecasting of clothes stock, which is an orange line that shows the data each month there is a Time Series on each of these data.

5.2 Suggestions

There is a need for more time series data for more data so that the test forecasting results are more accurate. Then there is a comparison with the fuzzy time series method with other forecasting methods such as moving average, least square, ANFIS and so on to determine the level of accuracy by adding other variables, besides batik clothes, school clothes, and pants.

Reference

[1] A. Salam and M. Mujiburrahman, "Pengendalian Persediaan Bahan Baku Menggunakan Metode Min-Max Stock Pada Perusahaan Konveksi Gober Indo," *J. EMT KITA*, vol. 2, no. 1, pp. 47–54, 2018.

[2] R. D. Pramesti, *Implementation Of The Make To Stock Strategy In Metal Casting SME*. Diss. Untag 1945 Surabaya, 2019.

[3] T. A. Jilani, S. M. A. Burney, and C. Ardil, "Fuzzy Metric Approach for Fuzzy Time Series Forecasting Based on Frequency Density Based Partioning. Proceedings of world journal academy of science, engineering and technology," vol. 23, pp. 333–338, 2007.

[4] Isnayati and M. A. Saptari, "Sistem peramalan penjualan sepeda motor menggunakan metode Trend Projection pada PT. UD Prima Nusantara," *J. Sist. Inf.*, vol. 1, no. 2, 2017.

[5] I. Krisna and D. Arifianto, "Implementasi Metode Trend Moment pada Toko Delima Jaya untuk Menentukan Jumlah Kebutuhan Stok Barang," *Dr. Diss. Univ. Muhammadiyah Jember*, 2020, [Online]. Available: http://repository.unmuhjember.ac.id/id/eprint/5466

[6] F. M. Putri, "Tingkat Peramalan Penjualan Produk Bordir dan Sulaman Menggunakan Metode Trend Moment," *J. Inform. Ekon. Bisnis*, pp. 34–38, 2022.

[7] A. Prasetia, S. Suriati, and A. Usman, "Implementasi Metode Trend Moment Untuk Prediksi Data Penjualan Sparepart Sepeda Motor," *JUSIKOM PRIMA*, vol. 5, no. 2, pp. 73–79, 2022.

[8] A. Meizar, A. Fahrozi, E. Indra, and M. Saputra, "Analisis Trend Moment Pada Datamining Forecasting Dalam Memprediksi Jumlah Persediaan Obat Herbal," *JUSIKOM PRIMA*, vol. 5, no. 2, pp. 103–106, 2022.

[9] Sugumonrong, D. Purba, A. Handinata, and A. Tehja, "Prediksi Harga Emas Menggunakan Metode Fuzzy Time Series Model Algoritma Chen," *J. Informatics Eng. Res. Technol.*, vol. 1, no. 1, 2019.

[10] and R. A. R. Yennimar, Yennimar, "jurnal dan penelitian teknik informatika," *Comp. Mach. Learn. Classif. Algorithms Sentim. Anal. Prod. Rev. North Padang Lawas Regency*, vol. 4, no. 1, 2019.

[11] & A. Rizal, R. A., Purba, N. O., Siregar, L. A., Sinaga, K., "Analysis of Tuberculosis (TB) on X-ray Image Using SURF Feature Extraction and the K-Nearest Neighbor (KNN) Classification Method," *JAICT*, vol. 5, no. 2, pp. 9–12, 2020.

[12] N. Fauziah, S. Wahyuningsih, and Y. N. Nasution, "Peramalan Mengunakan Fuzzy Time Series Chen (Studi Kasus: Curah Hujan Kota Samarinda)," *J. Stat.*, vol. 4, no. 2, pp. 52–61, 2016.

[13] D. A. Fyanda, M. Ula, and Asrianda, "Implementasi Fuzzy Time Series Pada Peramalan Penjualan Tabung Gas Lpg Di Ud. Samudera Lpg Lhokseumawe," *J. Sist. Inf.*, vol. 1, no. 1, 2017.

[14] L. Handayani and D. Anggriani, "Perbandingan Model Chen Dan Model Lee Pada Metode Fuzzy Time Series Untuk Prediksi Harga Emas," *J. Pseudocode*, vol. 2, no. 1, pp. 28–36, 2015.

[15] D. R. Syahputra and R. Arifudin, "Forecasting World Crude Oil Prices using the Fuzzy Time Series Method with a Comparison of the Chen and Lee Model," *J. Adv. Inf. Syst. Technol.*, vol. 2, no. 1, pp. 1–12, 2020.

[16] L. A. Nurkhasanah, Suparti, and Sudarno, "Perbandingan Metode Runtun Waktu Fuzzy Chen dan Fuzzy Markov Chain untuk Meramalkan Data Inflasi di Indonesia," *J. Gaussian*, vol. 4, no. 4, 2012.

[17] S. C. Sihombing and A. Dahlia, "Prediction Of Stock Close Price On The Five Best Issuers Forbes Global 2000 Version Using Chen's Fuzzy Time Series Method," *Int. Conf. Bus. Soc. Sci.*, pp. 1163–1171, 2022.

[18] D. Sitanggang and S. Sherly, "Model Prediksi Obesitas dengan Menggunakan Support Vector Machine," *JUSIKOM PRIMA*, vol. 5, no. 2, pp. 172–175, 2022.

[19] and F. R. Nasution, Pauziah, Nurul Huda Prasetya, "FORECASTING THE NUMBER OF PASSENGERS FOR THE MEDAN-KUALANAMU TRAIN WITH TIME INVARIANT FUZZY TIME SERIES METHOD," *Math. Sci. Comput. With Appl.*, vol. 2, no. 2, pp. 125–135, 2021, doi: https://doi.org/10.38035/dijefa.v2i3.858.

[20] M. Ulinnuha, F. M Afendi, and I. M.

Sumertajaya, "Study of Clustering Time Series Forecasting Model for Provincial Grouping in Indonesia Based on Rice Price," *Indones. J. Stat. Its Appl.*, vol. 6, no. 1, pp. 50–62, May 2022, doi: 10.29244/ijsa.v6i1p50-62.

[21] and M. K. Montgomery, Douglas C., Cheryl L. Jennings, *Introduction to time series analysis and forecasting*. John Wiley & Sons, 2015.

[22] M. Heriyadi, "Pemanfaatan Metode Promethee Untuk Sistem Pendukung Keputusan Dalam Penentuan Target Promosi Kampus Stmik Indonesia …," *J. Ilm. Teknol. Inf. dan Komput. …*, pp. 59–66, 2020, [Online]. Available: https://journal.stmik.id/index.php/pranala/article/view/42