International Journal of Economics, Business and Accounting Research (IJEBAR)
Peer Reviewed – International Journal
Vol-8, Issue-4, 2024 (IJEBAR)
E-ISSN: 2614-1280 P-ISSN 2622-4771
https://jurnal.stie-aas.ac.id/index.php/IJEBAR

INDONESIAN CONSUMER PRICE INDEX (CPI) FORECASTING USING AN EXPONENNTIAL SMOOTHING-STATE SPACE MODEL

Jauharul Maknunah[1], Mohamad As'ad[2*], Sigit Setyowibowo[3], Eni Farida[4]
Indah Dwi Mumpuni[5]
System of Information, STMIK PPKIA Pradnya-Paramita, Malang[1,4,5]
Technology of Information, STMIK PPKIA Pradnya-Paramita, Malang[2,3]
E-mail: asad@.stimata.ac.id[2]*

Abstract: The Consumer Price Index (CPI) is one of the important economic indicators that can provide information about the development of the price of goods/services paid by consumers. The CPI has a relationship in determining inflation so inflation and CPI are important variables in seeing the development of the economy in a particular country or city. The CPI and inflation are so important that many researchers have studied inflation and CPI. The purpose of this study is to predict the value of Indonesia's monthly CPI with a simple, easy, and highly accurate forecasting model using R package statistics software. The CPI data used was the monthly CPI data from BPS from January 2014 to August 2024. The forecasting model used in this study was the ETS(M,N,N) model. The determination of the best ETS model is based on the minimum value of the Akaike information criteria (AIC) and Bayesian information criteria (BIC). The best model used was the ETS (M,N,N) model with a smoothing parameter (α) of 0.9933, a root mean square error (RMSE) of 3.275868, and a mean absolute percentile error (MAPE) of 0.6595211%. The forecasting results for the next four periods, namely September-December 2024, are around the value of 106,0602.

Keywords: *Price Consumer Index (PCI), Forecasting of Indonesia PCI, Exponential Smoothing-State Space, ETS (M,N,N).*

Submitted: 2024-11-20; Revised: 2024-12-06; Accepted: 2024-12-19

1. Introduction

The consumer price index (CPI) is an important economic indicator that can provide information regarding the development of the price of goods/services consumers pay (BPS, 2024). CPI is related to deciding to swell, whereas swelling is characterized as an increment within the cost of merchandise and administrations in common, where these merchandise and administrations are necessities for the community or can too be said to be a diminish within the offering control of a country's money (BPS, 2024). Inflation can be measured using the consumer price index (CPI) method. Inflation and CPI are important variables in seeing problems or economic developments in a particular country or city (Robbayani et al., 2022). One of the factors that determine inflation is the CPI. Current month inflation depends on previous CPI and current CPI (Utari et al., 2016).

Between CPI and inflation must be stable so that the country's economy can be stable, inflation is so important that the Indonesian government formed a national inflation control

team (TPIN) based on Presidential Decree Number 23 of 2017. This TPIN was also formed at the provincial and city/district levels (Keppres_23, 2017). To control inflation and CPI, we often hear about necessities or staple food market operations in city/district markets that aim to control inflation and CPI. CPI and inflation are so important, that many researchers have studied the CPI value, including a study on consumer price index prediction and inflation in Zambia. This research uses double exponential smoothing (DES) from Holt and the ARIMA model. The final study showed that DES is worse than the ARIMA model, but for software tools, it is easier to use the DES model from Holt (Jere, 2016). Another study is on CPI in Yogyakarta. This research uses a double exponential smoothing (DES) model from Brown's. The forecasting accuracy used the mean absolute percentage error (MAPE) of 0.1308443%. DES model one-parameter from Brown's is simple and accurate in this research (Mukron et al., 2021). The Indonesian CPI study using the backpropagation artificial neural network method produced a MAPE of 0.463% with input neuron value parameters equal 6, hidden neuron value equal 10, initial weight range value in the range of -1 to 1, learning rate value equal 0.1, and epoch value equal 5000 (Madani et al., 2020). Research on forecasting the Indonesian CPI used ARIMA and obtained the best final result of the ARIMA (2,1,3) model with a mean square (MS) value of 0.1744 (Mukron, et al., 2021). A study on forecasting the Indonesian CPI using Seasonal Autoregressive Integrated Moving Average (SARIMA) obtained the best final result of the SARIMA (0,1,1)(0,1,1)12 model with a MAPE value of 0.26% (Yahya, 2022). Research using simple and accurate good forecasting models includes a study on inflation forecasting in Indonesia using the moving average method, SES, and DES. The final result in the conclusion that the best method is SES with an alpha value of 1.316, MAPE of 7.76202, mean absolute deviation (MAD) of 0.27343 and mean square deviation (MSD) of 0.14625 (Sudibyo et al., 2020).

From much last research, CPI prediction is important in addition to the inflation that occurs which is interrelated. Some of the forecasting models mentioned above have the smallest MAPE value, namely the CPI forecasting study in Yogyakarta using the double exponential smoothing (DES) model from Brown with a MAPE of 0.1308443% with the amount of data used for modeling as much as 18 data (from March 2020 - August 2021). According to Sugiyono, the minimum number of samples taken from a uniform population to be representative is 30 samples (Sugiyono, 2019). The amount of data used feels less able to reflect the data population because it is only 1.5 years, where since 2014 - 2024 the CPI value has fallen drastically twice, namely in 2020 and 2024. Furthermore, the study with the second smallest MAPE value (0.26%) is the CPI forecast in Indonesia with data from January 2012 - February 2022 with a total of 122 data. This study uses the seasonal autoregressive integrated moving average (SARIMA) model. The SARIMA model is a model that has detected seasonality with statistical assumptions that are sometimes difficult to fulfill. Other studies using the ARIMA model and artificial neural networks to predict monthly CPI values feel that the forecasting model is quite difficult because in ARIMA there are statistical assumptions that must be met which are sometimes difficult to fulfill. Artificial neural network models are indeed quite difficult to model well. From this review, the research gap that emerged was finding a good and easy model with a lot of data, producing accurate forecast values. This research gap was by the purpose of this study, namely to predict CPI values with a simple, easy, and highly accurate forecasting model.

The exponential smoothing (ES) model has the advantage of no statistical assumptions and uses software that is easily available and free to download. The latest development of the exponential smoothing (ES) model, is a model development by looking at the state-space

known as the exponential smoothing-state space model or some call it the ETS model (decomposition of error, trend, and seasonality). The exponential smoothing-state space method is a decomposition model of the exponential smoothing (ES) model, so that it can explore data in more detail and improve forecasting accuracy (Hyndman & Athanasopoulos, 2021).

2. Research Method

This research uses secondary data from the monthly consumer price index (CPI), starting from January 2014 to August 2024 equal to 128 data obtained from the website of the Central Statistics Agency (BPS) Jakarta. To calculate the CPI based on the price of types of goods and consumption value is (modified Laspeyres) (BPS, 2024):

$$IHK_n = \frac{\sum_{i=1}^{k} \frac{P_{ni}}{P_{(n-1)}} P_{(n-i)i}\ Q_{oi}}{\sum_{i=1}^{k} P_{oi}\ Q_{oi}} x100$$

Where:

IHKn	: index of period n
P_{ni}	: the price of a type for goods i, for period n
$P_{(n-1)I}$	: type for price of goods I, for period n-1
$P_{(n-1)i.}\ Q_{Oi}$	: consumption value of the type of goods i, for period n-1
$P_{oi.}\ Q_{Oi}$	: consumption value of a type of goods i, in the base year
K	: number of types of commodity of package goods

There is a relationship between CPI and inflation, where inflation is calculated using CPI. Inflation CPI can be calculated using inflation as below formula (Utari et al., 2016):

$$Inflasi_t = \left(\frac{IHK_t}{IHK_{t-1}} - 1\right) x\ 100\%$$

Where:

t	: the inflation of month/quarter/year t
IHK_t	: the *CPI* of month/quarter/year t
IHK_{t-1}	: the *CPI* of month/quarter/year t-1

There are 3 exponential smoothing models, namely the SES model, the DES model, and triple exponential smoothing (TES). The three models are as follows (Hyndman & Athanasopoulos, 2021). The SES model is suitable for stationary data with data fluctuations. Here is the SES model:

$$F_t = F_{t-1} + \alpha\ (\ A_{\ t-1} - F_{t-1}\ )$$

where:

Ft	: New forecast
F_{t-1}	: Previous forecast
α	: Smoothing constant ($0 \leq \alpha \leq 1$)
A_{t-1}	: Actual demand of the previous period

There are 2 double exponential smoothing (DES) models, namely from Brown for one parameter and from Holt's for double parameters. Both models are suitable for trending data. Here is the double exponential smoothing (DES) model from Holt's:

$$\hat{Y}_{t+p} = A_t + T_t p$$
$$A_t = \alpha Y_t + (1-\alpha)\,(A_{t-1} + T_{t-1})$$
$$A_t = \alpha Y_t + (1-\alpha)\,(A_{t-1} + T_{t-1})$$

Yt : the actual data of period t,
At : the exponential smoothing value,
α : the non-trend smoothing constant,
β : the smoothing constant for trend estimation,
T_t : the trend estimation,
$\hat{Y}$: the forecast value for the next period and
p : the number of periods predicted.

The triple exponential smoothing (TES) model is often referred to as the Winters model. There are 2 types of TES models, namely the additive model and the applicative model. The following is an additive TES model.

$$\hat{y}_{T+p}(T) = \ell_T + pb_T + sn_{T+p-L} \quad (p = 1, 2, 3, \dots)$$
$$\ell_T = \alpha\,(y_T - sn_{T-L}) + (1-\alpha)\;(\ell_{T-1} + b_{T-1})$$
$$b_T = \gamma\,(\ell_T - \ell_{T-1}) + (1-\gamma)\;b_{T-1}$$
$$sn_T = \delta\;(y_T - \ell_T) + (1-\delta)\;sn_{T-L}$$

where:
ℓ_T : exponential smoothing estimate
b_T : trend estimate
sn_T : seasonal estimate

where α is the smoothing coefficient,
γ is the trend coefficient, and
δ is the seasonal coefficient
the values of α, γ and δ are between 0 and 1
L is the seasonal length.

To show the trend pattern in the data, a data stationarity test can be carried out using the "Dicky Fuller test". The "Dicky Fuller test" has Ho and H1 as follows (Farida & As'ad, 2021):

Ho: ϕ = zero (data is not stationary)
H1: $\phi \neq$ zero (data is stationary)

The test of statistics are as follows:

$$ADF_t = \frac{\widehat{\emptyset} - 1}{SE(\emptyset)}$$

Test decision: If the ADFt test value < from the critical point value of the t-student distribution then accept Ho or the p-value (ADFt test probability value) > from alpha (5%, significance level) then accept Ho.

The ETS model is a model that is the result of the development of the exponential smoothing (ES) model through a state space approach also called the ETS model. The ETS model can be built from the SES model, one-parameter and two-parameter DES, and the TES or Winter model for additive and multiplicative models. According to Hyndman & Athanasopoulos, there are 30 models for ETS. In this study, one of the most suitable ETS models was chosen for use in forecasting the Indonesian CPI. ETS itself stands for error (E), trend (T), and (S) for seasonal. An example, the ETS(M, N, N) model has a multiplicative error (M), has a none trend (N) or does not have a trend, and has no seasonal (N) or does not have seasonality. The ETS(M, N, N) model can be said in other words as a Simple Exponential Smoothing (SES) model that has multiplicative errors. The ETS(M, N, N) model has the following equation (Hyndman & Athanasopoulos, 2021):

$$y_t = l_{t-1}\,(1 + \varepsilon_t)$$
$$l_t = l_{t-1}\,(1 + \alpha\varepsilon_t)$$

where :
y_t : the actual data of period t,
l_{t-1} : $y_{\mathbf{t}}|_{t-1}$

As a determinant to determine the best model, the Akaike Information Criteria(AIC) and Bayesian Information Criteria(BIC) values will be used. The AIC value can be calculated using the formula:

$$AIC = -2\left(\frac{L\,L}{T}\right) + \left(\frac{2tp}{T}\right)$$

where,
LL : *loq-likelihood*
tp : total parameters
T : the number of data

BIC value formulated as follow:

$$BIC = -2\,L\,L + k\ln(T)$$

where,
LL : *loq-likelihood*
k : estimation of the parameter model
T : the amount of data

The model is the best if the *AIC* value and *BIC* values are the minimum (Jofipasi et al., 2017). This research uses the R package statistics, by activating the smooth library with ETS command. When run, the program will display the best ETS model on the minimum AIC value and BIC values. The minimum AIC value and BIC values are used to determine the best model in the same model class, while to determine the accuracy of the forecasting results, the Root Mean Square Error(RMSE) value and Mean Absolute Percentage Error(MAPE) values are

used. The RMSE value and MAPE values can be calculated with the following formula (As'ad et al., 2020):

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n} e_i^2}{n}}$$

The *MAPE* value formulated as follow :

$$MAPE = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{e_i}{y_i}\right|$$

where,
e_i : the i error
y_i : the i data
n : the number of data

To find out whether the forecasting results are very good, good, sufficient, or bad, it can be seen with the MAPE value, which is the average percentage error value of the actual data. The following is Table 1. forecasting result criteria (Hajjah & Marlim, 2021):

Table 1. The Criteria *of MAPE* Value

Value of MAPE (X)	Description
X < 10 %	Verry Good
10 % ≤ X < 20 %	Good
20 % ≤ X < 50 %	Sufficient
X ≥ 50 %	Bad

In Table 1, it can be seen on the basis of the MAPE value, whether the results of forecasting are very good, good, sufficient, or bad.

The steps in conducting ETS modeling are as follows:

1. Read data with the R package and plot the data.
   - ❖ After being plotted, the data can be identified whether the data has a trend pattern (T), seasonal (S), or stationary (data does not have a trend or seasonal pattern).
   - ❖ To find out whether the data pattern is stationary or trending, a data stationarity test must be carried out using the Dicky Fuller test (DF-test). DF-test test criteria as explained above.
   - ❖ If the DF-test data results are trending, then the T option in ETS can be additive (A) or multiplicative (M).
   - ❖ If the data pattern is seasonal, characterized by a sinusoidal pattern or a pattern of repeated data ups and downs within the same time span, then the S option in ETS can be additive (A) or multiplicative (M).
   - ❖ The E option in ETS, can be additive (A) or multiplicative (M) in stationary conditions, T conditions, or S conditions in the ETS model.
   - ❖ From this identification, the ETS model that might be chosen is modeled.
2. Modeling with the ETS model that might be chosen and calculating the AIC and BIC as in the equation above.
3. Choosing the ETS model with the minimum AIC and BIC values.

4. Calculating RMSE and MAPE values.
5. Determining the forecasting result criteria using MAPE.
6. Using the ETS model to predict for the next period.

3. Results and Discussion

3.1. Results

This research uses secondary data on the Indonesian monthly CPI from January 2014 to August 2024 (128 data). The data was sourced from the Central Bureau of Statistics (BPS) (BPS, 2024). The first step in this research is to prepare the data and plot the data which can be presented in Figure 1 below: Citation is strongly recommended using reference managers such as Mendeley Add citations from journal articles

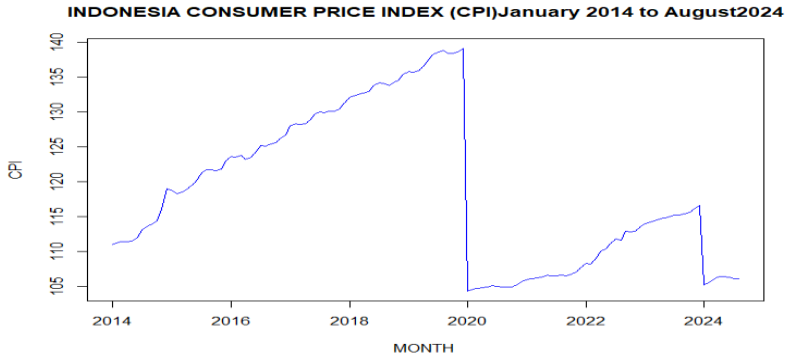

Figure 1. The graphic of monthly CPI of Indonesia (January 2014 – Agustus 2024, *BPS*)

From Figure 1, there was a continuous increase in CPI from early January 2014 to 2020, it decreased drastically, this may be inflation, and CPI that occurred was controlled by TPIN which was formed in 2017. After 2020 it rose again and decreased in 2024. The first step has been done by preparing data and plotting the data in Figure 1.

Next, an analysis was carried out with the ETS model, namely conducting a stationarity test (Dicky Fuller test) of the data to determine the presence of a trend pattern (As'ad et al., 2020), and the results are presented as follows:

Tabel 2. Results Test of the Dickey--Fuller

Augmented Test for Dickey--Fuller
Data : ihk
Dickey--Fuller : -2.2733, Lag order : 5, p--value : 0.4629
alternative hypothesis : stationary

In table 2, the DFT-test value is -2.2733, p-value is 0.4629. If the p-value (0.4629) is greater than 0.05 then Ho is accepted which means the data is not stationary. The ETS model might be suitable for this is T or trend containing A (A: additive) or M (M: multiplicative) because it is not stationary / there is a trend (As'ad et al., 2020). Possible ETS models are ETS(N, A, N), ETS(N, M, N), ETS(A, A, N), ETS(M, A, N), ETS(M, M, N) and one more ETS(M, N, N) recommended by the R package (Hyndman R. et al., 2024). The first selection is by looking at the minimum AIC value and BIC values because they are still in the same ETS model class. Here are the results in Table 3:

Table 3. Results of *AIC* and *BIC* values for several ETS models

Model	*AIC*	*BIC*	Description
(N, A, N)	-	-	Invalid error type
(N, M, N),	-	-	Invalid error type
(A, A, N)	934.8227	949.0828	
(M, A, N)	899.7787	914.0388	
(M, M, N)	899.8053	914.0655	
(M, N, N) from ***R*** package	895.7580	904.3141	The smallest *AIC* and *BIC* values

From Table 2 it appears that the ETS model that has the minimum AIC value and BIC values is the ETS (M, N, N) model, namely: 895.7580 (AIC) and 904.3441 (BIC). Furthermore, the selected ETS(M, N, N) model is used for forecasting in this study. The complete results of the ETS (M, N, N) model are presented in the following table 4:

Table 4. Results of the Model for *ETS (M, N, N)*

ETS(M,N,N)					
Parameter of smoothing :					
alpha : 0.9933					
Initial states :					
l : 110.9299					
sigma : 0.0243					
AIC	AICc	BIC			
895.7580	895.9515	904.3141			
Training set error measures :					
	ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
Training set	-0.03829907	3.275868	0.7381049	-0.07645856	0.6595211	0.09765854	-0.005346714

From Table 3, the ETS(M, N, N) model has a smoothing parameter (α) of 0.9933, a forecasting accuracy value for RMSE of 3.275868, and an accuracy value for MAPE of 0.6595211%. The MAPE value of 0.659511% is less than 10%, which means the forecasting is very good (Hajjah & Marlim, 2021).

After obtaining the best forecasting model, it is used to forecast the next 4 months, namely September, October, November, and December. The forecasting results with a significance level of 5% (alpha: α) are presented in the following table 5:

Table 5. Forecast Results for the Next 4 Months of the ETS (M,N,N) Model

Month	September	October	November	December
Lower Forecast Limit	101.0026	98.93033	97.33637	95.99093
Forecast Value	106.0602	106.0602	106.0602	106.0602
Upper Forecast Limit	111.1178	113.1901	114.7840	116.1295

From table 5, it shows that the flat forecast value is 106.0602 from September to December with the lower limits and upper limits of the forecast widening. Its model is almost similar to the Single Exponential Smoothing (SES) model which has a flat forecast value, which means the ETS(M, N, N) model can be used for short-term forecasting (one or two periods ahead).

The following shows the ETS forecast value (M, N, N) and the original CPI data from January 2014 to August 2024:

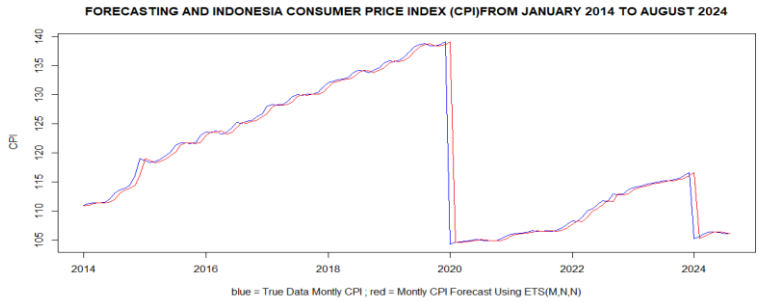

Figure 2. The graphic of monthly *CPI* of Indonesia and forecasting (January 2014 – Agustus 2024, *BPS*)

From Figure 2, it shows that the monthly CPI data coincides with the forecast value. From 2014 to 2019, there was a drastic uptrend and a downtrend in 2020. Then it continued to rise again until it fell again in 2024, this was followed by the forecast value which seemed to overlap.

3.2. Discussion

The model of ETS (M, N, N) is a model with multiplicative errors without trends and seasonality, this is similar to the SES model. It is a model for forecasting data without trends and seasonality. The model of ETS(M, N, N) can be used to make short-term forecasts (1 or 2 periods ahead) because the forecast results will be the same. The addition of the latest data each period can update the model so that it can get very good forecast results. Previous research by Yahya (2020) examined the prediction of the Indonesian CPI using the SARIMA (0,1,1) (0,1,1)12 model, obtaining a MAPE result of 0.26% (very good), while this study obtained a MAPE of 0.6595211% (very good). The SARIMA model is more difficult than the ETS model which gets equally very good forecast results with CPI data for different periods. This study starts from 2014 to 2024 with a graph showing a drastic decline in data twice, namely in 2020 and 2024, while the data used by Yahya (2020) from the graph shows a trend and may be seasonal (Yahya, 2022). The seasonality can be seen from the SARIMA model with a seasonal length of 12 months. It should be noted that the period from 2014 to 2024 occurred 2 times (2020 and 2024) a drastic decline in the CPI index, is this because of the existence of a national inflation control team (TPIN) that controls inflation and has an effect on the decline in the CPI index, this certainly requires separate research.

Forecasting accuracy (MAPE) on Brown's double exponential smoothing (DES) model with MAPE of 0.1308443% (very good criteria) with the amount of data used for modeling as much as 18 data (March 2020 - August 2021) (Febriyanti et al., 2021). The results of this study are the ETS (M,N,N) model which produces MAPE of 0.6595211% (very good criteria) with the amount of data as much as 128, the results obtained with the same criteria are very good with the forecasting model which is also equally easy. For Brown's double exponential smoothing (DES) model, the number of samples is small, even though the population is quite large, can it be representative of the population taken. Of the three forecasting models (very good criteria) used to forecast monthly CPI, namely the double exponential smoothing (DES) model from Brown, the SARIMA model, and in this study using the representative ETS (M, N, N) model can represent the population and an easy model with good forecasting accuracy

(MAPE) namely the ETS model (M, N, N). It is worth recommending for further research, namely the DES model from Brown to be made a model for Indonesian monthly CPI data from January 2014 to August 2024, whether it still has a smaller MAPE forecasting accuracy value than the MAPE model ETS (M, N, N) in this study.

4. Conclusion

From the results of this study, it can be concluded that the best model for forecasting Indonesia's monthly consumer price index (CPI) is to use the ETS (M, N, N) model, with a smoothing parameter (α) of 0.9933, having a forecast accuracy value for RMSE of 3.275868 and an accuracy value for MAPE of 0.6595211% (very good). The ETS (M, N, N) model is suitable for short-term forecasting. The forecast results for the next four periods (September-December 2024) with the ETS (M, N, N) model appear stable around the value of 106.0602. To obtain forecast results that still have high accuracy, it is expected to update the model by adding the latest data in the model update.

References

As'ad, M., Sujito, & Setyowibowo, S. (2020). Prediction of Daily Gold Prices Using an Autoregressive Neural Network. *Inform : Jurnal Ilmiah Bidang Teknologi Informasi dan Komunikasi*, 69-73.

BPS. (2024). *IHK 90 Kota di Indonesia 2023.*

Farida, E., & As'ad, M. (2021). The Forecasting Of Monthly Inflation In Malang City Using An Autoregressive Integrated Moving Average. *International Journal of Economics, Business and Accounting Research (IJEBAR)*, 73-83.

Febriyanti, S., Pradana, W. A., Saputra, M. J., & Widodo, E. (2021). Forecasting The Consumer Price Index In Yogyakarta By Using The Double Exponential Smoothing Method. *Parameter: Journal of Statistics*, 1 - 7 .

Hajjah, A., & Marlim, Y. N. (2021). Analisis Error Terhadap Peramalan Data Penjualan. *Techno.COM*, 1-9.

Hyndman, R. J., & Athanasopoulos, G. (2021). F*orecasting: Principles and Practice.* Melbourne: OTexts: Melbourne, Australia.

Hyndman, R., Athanasopoulos , G., Bergmeir , C., Caceres , G., Chhay , L., Kuroptev , K., . . . Zhou , Z. (2024). *Package 'forecast' in R package.* https://cran.r-project.org/web/packages/forecast/forecast.pdf. Accessed on 2024-12-05.

Jere, S. a. (2016). Forecasting Inflation Rate of Zambia Using Holt's Exponential Smoothing. *Open Journal of Statistics*, 363-372.

Jofipasi, C. A., Miftahuddin, & Hizir. (2017). Selection for the best ETS (error, trend, seasonal) model to forecast weather in the Aceh Besar District. *IOP Conference Series: Materials Science and Engineering* (pp. 1-9). Banda Aceh: IOP Publishing.

Keppres_23. (2017). *Keppres no 23 thn 2017.* Jakarta: Pemerintah RI.

Madani, E. P., Furqon, M. T., & Hidayat, N. (2020). Peramalan Indeks Harga Konsumen Indonesia menggunakan Metode Jaringan Saraf Tiruan Backpropagation. *Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer* , 2801-2809.

Mukron, M. H., Susianti, I., Azzahra, F., Kumala, Y. N., Widiyana, F. R., & Haris, M. A. (2021). Peramalan Indeks Harga Konsumen Indonesia Menggunakan Autoregressive Integrated Moving Avarage. *Jurnal Statistika Industri dan Komputasi*, 20-25.

Robbayani, A., Riaman, & Subbarini, B. (2022). Analisis Hubungan Inflasi, Indeks Harga Konsumen dan Jumlah Uang Beredar di Indonesia Menggunakan Model Vector Autoregressive Integrated (VARI). *Jurnal Matematika Integratif*, 179-189.

Sudibyo, N. A., Iswardani, A., Septyanto, A. W., & Wicaksono, T. G. (2020). Prediksi Inflasi Di Indonesia Menggunakan Metode Moving Average, Single Exponential Smoothing Dan Double Exponential Smoothing. *Lebesgue : Jurnal Ilmiah Pendidikan Matematika, Matematika dan Statistika* , 123-129.

Sugiyono. (2019). *Metodelogi Penelitian Kuantitatif dan Kualitatif Dan R&D.* Bandung:. https://doi.org/ISBN : 979-8433-64-0

Utari, G. D., Kristina S, R., & Pambudi, S. (2016). *Inflasi di Indonesia : Karakteristik dan Pengendaliannya.* Jakarta: BI Institute.

Yahya, A. (2022). Peramalan Indeks Harga Konsumen Indonesia Menggunakan Metode Seasonal-Arima (Sarima). *Jurnal Gaussian*, 313 - 322.