


## Predicted demand for 3 kg LPG gas in each provinces area in Indonesia

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Article Info	ABSTRACT
<b>Keywords:</b> Trend and Pattern Analysis, Demand Prediction, Exponential Triple Smoothing	Predicted the demand for 3 kilograms of LPG gas in different provinces of Indonesia is crucial for assuring the provision of energy to households. By employing the Exponential Triple Smoothing (ETS) technique, this study examines demand-influencing factors and consumption patterns. By integrating historical data's levels, trends, and seasonality, ETS enables accurate and timely forecasts. The findings illustrate the predicted outcomes for the ten provinces in Indonesia that have the highest demand for 3 kilograms of LPG gas, as well as the ten provinces that have the lowest demand across all regions. All provinces' MAPE forecasting error testing results utilizing the ETS method are incorporated with an exceptionally high degree of precision, given that the error rate is 5.27%.
This is an open access article under the <a href="https://creativecommons.org/licenses/by-nc/4.0/">CC BY-NC</a> license 	<b>Corresponding Author:</b> Rachmawati Novaria Universitas 17 Agustus 1945 Surabaya <a href="mailto:nova@untag-sby.ac.id">nova@untag-sby.ac.id</a>

### INTRODUCTION

3 KG LPG gas is the main energy source which is integral to the daily needs of households in Indonesia. The availability of this gas directly affects daily life and people's welfare. With a large population and geographic diversity, gas demand prediction helps in efficient distribution planning[1]. Accurate predictions of demand will ensure adequate supply for households, especially those dependent on this energy source.

Variations in consumption patterns and demographic and economic factors in each province can influence demand for LPG gas. These factors include population size, economic growth, cooking habits, other energy infrastructure, and population migration patterns between regions. Consistent availability of LPG gas can have a direct impact on social and economic stability[2]–[4]. Price spikes or supply shortages can affect inflation levels and people's welfare.

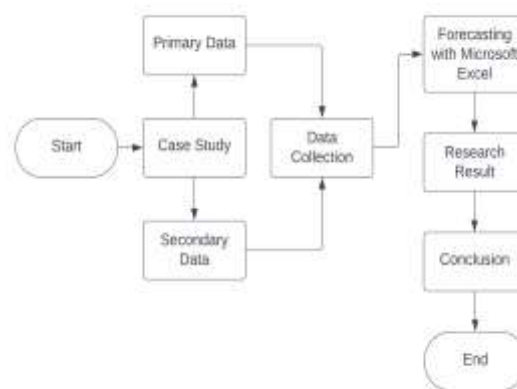
Through analysis of historical data on 3 KG LPG gas consumption, economic growth trends, demographic changes, and other relevant factors, this research can develop an accurate prediction model for LPG gas needs in each provincial region [5]–[7]. The main objective is to assist the government, producers and distributors of LPG gas in planning efficient distribution[8], [9], anticipating spikes in demand, and ensuring the availability of adequate supply to meet community needs[10]–[12].

So the aim and implications of the research are to produce visualizations of trends and patterns of 3 KG LPG gas consumption data in various provincial areas to identify factors that influence demand by forecasting using the Exponential Triple Smoothing (ETS) method [13]–[15]. The advantage of the ETS method in predicting the need for 3 KG LPG gas in each province in Indonesia lies in its ability to simultaneously consider three important aspects of historical data: level, trend and seasonal components [16]–[20]. ETS not only relies on information from the past, but also adaptively calculates the rate of change in trends and seasonal fluctuations that may occur over time[21]–[23]. Its flexibility allows adjustments to changing consumption patterns, seasonal patterns that may vary in different regions, and external factors such as changes in policy or economic conditions. Apart from that, ETS is also able to provide more responsive and accurate predictions, even in situations where the data has high variations or fluctuations. The advantages of adaptability and predictive accuracy of the ETS method make it a strong choice for planning efficient and measurable LPG gas distribution, facing the complexity of energy needs in every region of Indonesia's provinces. So that the research implications can provide data and information for the government and related stakeholders. Predicting LPG gas needs correctly will ensure adequate availability, avoid supply shortages, and meet household energy needs.

## METHODS

### Research Stages

In this research, the analysis process uses the Exponential Triple Smoothing (ETS) method and is assisted by Microsoft Excel software.



**Figure 1.** Research Stage Flowchart

Research stages are a series of initial processes in a research. This research starts from an initial study, namely understanding the problems that exist in the research. Next, look for the required dataset on the official website of the Central Bureau of Statistics (BPS) and get data on the ratio of household gas use from 2015 to 2022. After the data is collected, the data is then entered into Microsoft Excel and then forecasting is carried out using the Exponential method. Triple Smoothing (ETS) and produces research output in the

form of forecasting values and graphs for the top 10 provinces with the highest and lowest household gas usage ratios. The final stage of this research is drawing conclusions from the research that has been carried out.

### Research Data Source

This research uses main data that researchers obtained from the site [www.bps.go.id](http://www.bps.go.id) in the form of time series data in the form of historical ratio data household gas use from 2015 to 2022.

### Import Data

The initial stage in carrying out data analysis in Microsoft Excel is importing data. Import can be done by entering data into Microsoft Excel software. Because the amount of training data is small, the data can be entered manually into Microsoft Excel.

### Forecasting

The next stage after the data is entered into Microsoft Excel is to carry out the forecasting process using the Exponential Triple Smoothing (ETS) method. This forecasting process can be done by utilizing the Forecast Sheet tool.

### Error Testing

After forecasting, the next stage is to carry out error testing. Error testing is carried out manually using formulas and using the MAPE error testing method [24]–[27]. The MAPE formula is as follows:

$$MAPE = \frac{1}{n} \sum_{i=1}^n \left| \frac{A_i - F_i}{A_i} \right| \times 100\% \quad (1)$$

### Data Output

The final stage in the Exponential Triple Smoothing (ETS) stage is to visualize data from the results of data processing.

## RESULTS AND DISCUSSION

### Forecasting Results

Forecasting is carried out using the Forecast Sheet tool in Microsoft Excel software, where by default the forecasting method used is the Exponential Triple Smoothing (ETS) method. The following are the results of forecasting the ratio of household gas use for 2023 and 2024.

### Forecasting Graph for the 10 Highest Provinces

The following is a forecasting graph for the 10 provinces with the highest ratio of household gas use in Indonesia.

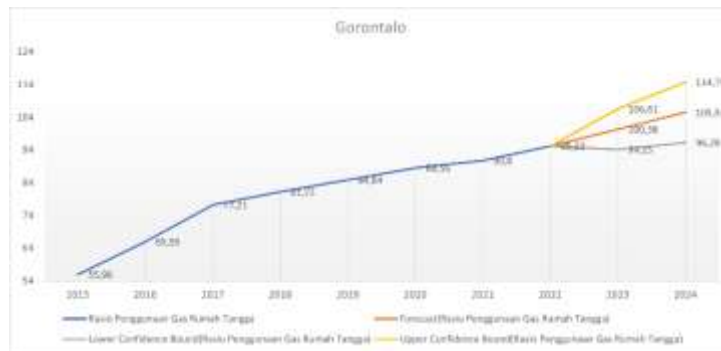


Figure 2. Forecasting for Gorontalo Province

As can be seen in Figure 2, Gorontalo Province has experienced a regular increase in household gas use since 2015 until 2022, so that for the next two periods it is predicted that Gorontalo Province will experience an increase until it reaches a household gas use ratio of 105.54.

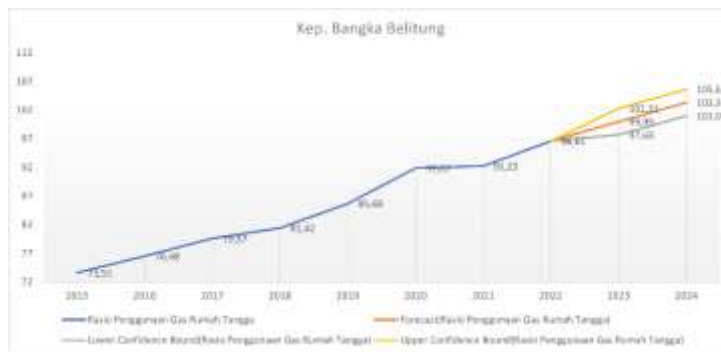


Figure 3. Forecasting for Kep Province. Bangka Belitung

It can be seen in Figure 3, Kep Province. Since 2015, Bangka Belitung has experienced a periodic increase in household gas use until 2022, so that for the next two periods it is predicted that Kep Province. Bangka Belitung will experience an increase to reach the household gas usage ratio of 103.34.

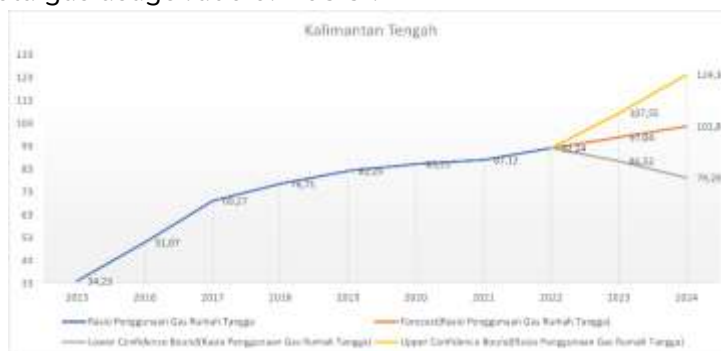


Figure 4. Forecasting for Central Kalimantan Province

As can be seen in Figure 4, Central Kalimantan Province has experienced a regular increase in household gas use since 2015 until 2022, so that for the next two periods it is

predicted that Central Kalimantan Province will experience an increase until it reaches a household gas use ratio of 101.84.

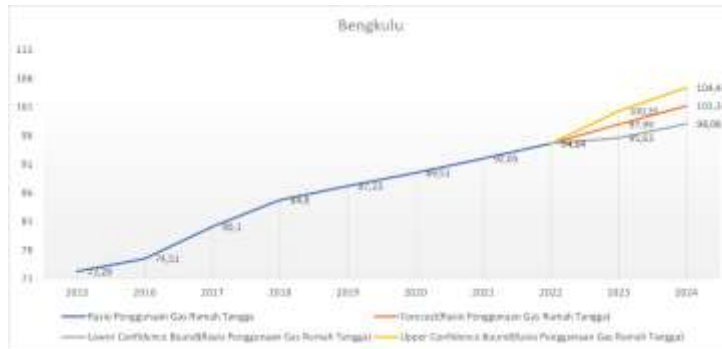


Figure 5. Forecasting for Bengkulu Province

As can be seen in Figure 5, Bengkulu Province has experienced a regular increase in household gas use since 2015 until 2022, so that for the next two periods it is predicted that Bengkulu Province will experience an increase until it reaches a household gas use ratio of 101.26.



Figure 6. Forecasting for West Kalimantan Province

As can be seen in Figure 6, West Kalimantan Province since 2015 has experienced a regular increase in household gas use until 2022, so that for the next two periods it is predicted that West Kalimantan Province will experience an increase until it reaches a household gas use ratio of 101.20.

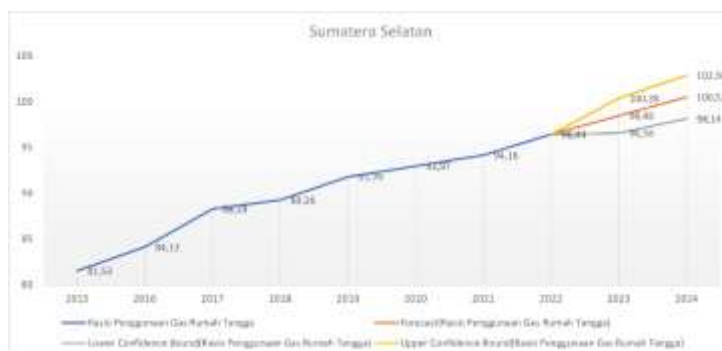


Figure 7. Forecasting for South Sumatra Province

As can be seen in Figure 7, South Sumatra Province since 2015 has experienced a regular increase in household gas use until 2022, so that for the next two periods it is predicted that South Sumatra Province will experience an increase until it reaches a household gas use ratio of 100.52.

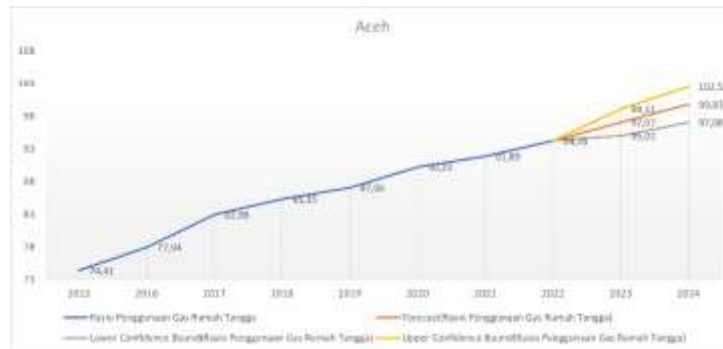


Figure 8. Forecasting for Aceh Province

As can be seen in Figure 8, Aceh Province since 2015 has experienced a regular increase in household gas use until 2022, so that for the next two periods it is predicted that Aceh Province will experience an increase to reach the household gas use ratio of 99.83.



Figure 9. Forecasting for South Kalimantan Province

As can be seen in Figure 9, South Kalimantan Province has experienced a regular increase in household gas use since 2015 until 2022, so that for the next two periods it is predicted that South Kalimantan Province will experience an increase until it reaches a household gas use ratio of 99.79.

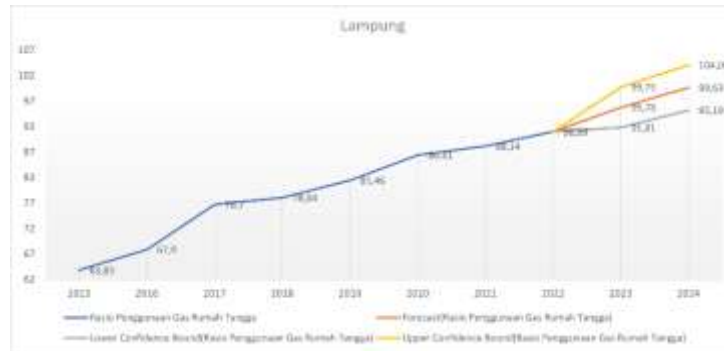


Figure 10. Forecasting for Lampung Province

As can be seen in Figure 10, Lampung Province has experienced a regular increase in household gas use since 2015 until 2022, so that for the next two periods it is predicted that Lampung Province will experience an increase until it reaches a household gas use ratio of 99.63.

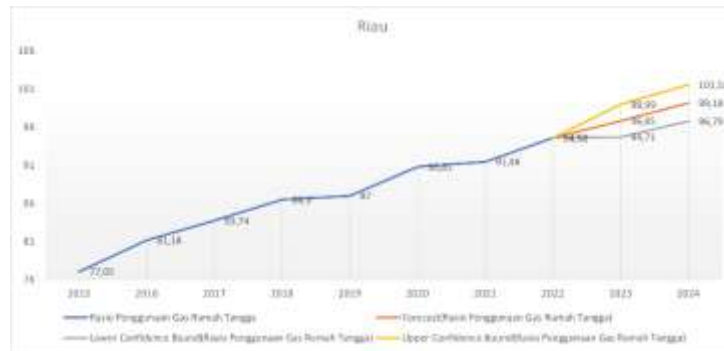


Figure 11. Forecasting for Riau Province

As can be seen in Figure 11, Riau Province has experienced a regular increase in household gas use since 2015 until 2022, so that for the next two periods it is predicted that Riau Province will experience an increase until it reaches a household gas use ratio of 99.18.

**Overall Prediction Graph for Each Region in Indonesia**

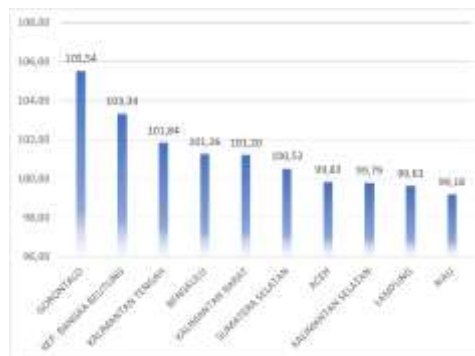
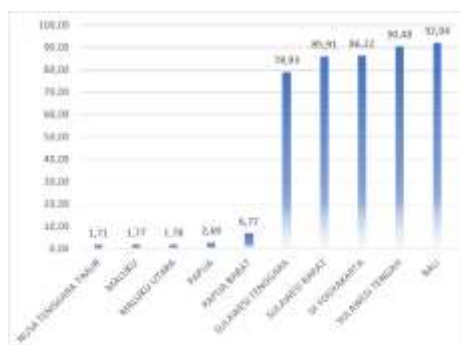


Figure 12. Prediction of the Top 10 Provinces with the Highest Gas Use Ratio in 2024

As can be seen in Figure 12, Gorontalo Province is estimated to be the province with the highest household gas usage ratio in Indonesia with a usage ratio value of 105.54, followed by Kep Province. Bangka Belitung with a usage ratio value of 103.34, Central Kalimantan Province with a usage ratio value of 101.84, Bengkulu Province with a usage ratio value of 101.26, West Kalimantan Province with a usage ratio value of 101.20, South Sumatra Province with a usage ratio value of 100.52, Aceh Province with a usage ratio value of 99.83, South Kalimantan Province with a usage ratio value of 99.79, Lampung Province with a usage ratio value of 99.63, and Riau Province with a usage ratio value of 99.18.



**Figure 13.** Prediction of the Top 10 Provinces with the Lowest Gas Use Ratio in 2024

As can be seen in Figure 13, East Nusa Tenggara Province is estimated to be the province with the lowest household gas usage ratio in Indonesia with a usage ratio value of 1.71, followed by Maluku Province with a usage ratio value of 1.77, North Maluku Province with a usage ratio value of 1.78, Papua Province with a usage ratio value of 2.69, West Papua Province with a usage ratio value of 6.77, Southeast Sulawesi Province with a usage ratio value of 78.93, West Sulawesi Province with a usage ratio value of 85.91, DI Yogyakarta Province with the usage ratio value is 86.22, Central Sulawesi Province with a usage ratio value of 90.48, and Bali Province with a usage ratio value of 92.04.

### Error Testing

At this error testing stage, the error value in the forecasting results will be checked. The error checking method used in this research is the MAPE method.

**Table 1.** MAPE Error Test Results

Provinsi	Rasio Penggunaan Gas Rumah Tangga										MAPE
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	
Aceh	74,41	77,94	82,96	85,35	87,06	90,23	91,89	94,25	97,07	99,83	1,22%
Sumatera Utara	72,09	75,43	78,17	80,42	83,73	85,37	88,12	91,20	93,69	96,34	0,39%
Sumatera Barat	41,58	54,73	61,99	66,36	72,48	75,21	79,71	85,55	91,25	96,95	4,57%
Riau	77,05	81,18	83,74	86,50	87,00	90,81	91,48	94,58	96,85	99,18	0,92%
Jambi	63,69	69,42	75,69	77,29	81,22	84,35	87,11	91,05	94,73	98,42	1,40%
Sumatera	81,53	84,12	88,29	89,26	91,79	92,97	94,16	96,44	98,48	100,52	0,85%

Provinsi	Rasio Penggunaan Gas Rumah Tangga										MAPE	
Selatan												
Bengkulu	72,28	74,51	80,10	84,80	87,23	89,51	92,05	94,64	97,99	101,26		1,53%
Lampung	63,83	67,90	76,70	78,04	81,46	86,41	88,14	90,99	95,78	99,63		1,91%
Kep. Bangka Belitung	73,55	76,48	79,57	81,42	85,68	91,87	92,23	96,61	99,99	103,34		0,95%
Kep. Riau	70,72	76,26	75,27	74,66	82,23	86,09	87,89	88,42	91,88	94,53		2,02%
DKI Jakarta	89,24	89,38	87,53	91,78	89,14	89,52	92,15	95,59	94,13	94,86		1,66%
Jawa Barat	81,45	83,89	85,63	86,17	88,41	89,05	89,39	92,89	93,48	94,92		0,68%
Jawa Tengah	70,83	73,30	79,24	80,13	82,54	85,63	85,82	90,01	92,47	95,07		1,23%
DI Yogyakarta	62,91	65,12	71,66	73,16	72,33	76,25	76,65	83,85	83,63	86,22		2,06%
Jawa Timur	70,51	73,77	76,58	78,21	80,46	83,35	83,97	88,37	89,98	92,35		0,67%
Banten	81,47	83,50	84,80	86,57	88,66	88,88	88,12	91,93	92,45	93,77		0,87%
Bali	67,47	69,53	72,38	74,95	78,08	81,05	82,10	87,55	89,27	92,04		0,69%
Nusa Tenggara Barat	43,20	49,40	54,85	58,87	58,23	61,65	79,52	87,17	88,66	94,34		5,11%
Nusa Tenggara Timur	0,27	0,57	0,51	1,04	1,20	1,01	1,41	1,26	1,56	1,71		17,58%
Kalimantan Barat	74,22	79,52	85,97	87,01	88,87	90,55	91,91	95,85	98,47	101,20		1,69%
Kalimantan Tengah	34,23	51,07	69,27	76,71	82,29	85,25	87,12	92,24	97,04	101,84		13,83%
Kalimantan Selatan	52,09	64,63	74,17	75,09	80,08	82,68	85,63	90,16	95,00	99,79		4,73%
Kalimantan Timur	91,55	93,71	94,90	94,11	95,27	95,07	96,28	98,23	98,13	98,86		0,67%
Kalimantan Utara	53,91	62,71	68,20	75,33	78,57	82,09	82,12	86,59	91,04	95,46		4,16%
Sulawesi Utara	56,68	64,22	68,59	72,61	75,31	78,87	80,94	84,65	88,40	92,12		2,32%
Sulawesi Tengah	13,09	29,45	47,88	52,61	49,57	59,55	68,96	74,55	82,62	90,48		13,50%
Sulawesi Selatan	78,85	82,55	85,13	86,89	88,47	89,98	91,53	93,38	95,33	97,29		0,90%
Sulawesi Tenggara	32,54	43,80	50,55	56,92	59,01	62,38	64,49	69,41	74,18	78,93		6,20%
Gorontalo	55,96	65,95	77,21	81,22	84,84	88,56	90,80	95,22	100,38	105,54		4,67%
Sulawesi Barat	53,08	63,32	69,07	74,47	78,37	80,39	81,86	83,13	84,52	85,91		8,98%
Maluku	0,77	0,65	0,44	0,75	0,89	0,80	1,76	1,45	1,63	1,77		30,84%
Maluku Utara	0,51	0,65	0,89	1,70	1,23	0,97	1,48	1,52	1,64	1,78		14,77%
Papua Barat	3,34	1,59	3,42	4,50	4,32	4,35	5,21	6,01	6,30	6,77		18,71%
Papua	0,61	0,80	0,88	1,13	1,39	1,73	1,92	2,23	2,46	2,69		6,72%
Total												5,27%

Based on the MAPE error test results in table 1, it can be seen that the forecast error test results using the Exponential Triple Smoothing (ETS) method from all provinces have a very good level of accuracy because the error rate is 5.27%.

## CONCLUSION

The research draws the following conclusions from the analysis of household gas usage ratio forecasting using the Exponential Triple Smoothing (ETS) model: 1) By 2024, the ratio of household gas use is projected to increase in a total of 33 provinces, while it is anticipated that it will decrease in DKI Jakarta Province. 2) It is projected that in 2024, Gorontalo Province will have the highest household gas consumption ratio among all provinces in Indonesia. 3) It is anticipated that in 2024, East Nusa Tenggara Province will have the lowest household gas consumption ratio in Indonesia. 4) The accuracy of the implemented Exponential Triple Smoothing (ETS) method is exceptionally high, as evidenced by the MAPE value (less than 10%) derived from all forecasting data.

## REFERENCES

- [1] R. Sianipar, "Optimalisasi Ketahanan Energi Melalui Kebijakan Pengurangan Konsumsi Gas Elpiji di Indonesia," *JDKPJ. Desentralisasi dan Kebijakan. Publik*, vol. 4, no. 1, pp. 62–72, 2023.
- [2] K. Thoday, P. Benjamin, M. Gan, and E. Puzzolo, "The Mega Conversion Program from kerosene to LPG in Indonesia: Lessons learned and recommendations for future clean cooking energy expansion," *Energy Sustain. Dev.*, vol. 46, pp. 71–81, 2018.
- [3] W. Wahyuddin, M. Marzuki, M. Khaddafi, R. N. Ilham, and I. Sinta, "A Study of Micro, Small and Medium Enterprises (MSMEs) during Covid-19 Pandemic: An Evidence using Economic Value-Added Method," *J. Madani Soc.*, vol. 1, no. 1, pp. 1–7, 2022.
- [4] I. G. I. Sudipa, R. Riana, I. N. T. A. Putra, C. P. Yanti, and M. D. W. Aristana, "Trend Forecasting of the Top 3 Indonesian Bank Stocks Using the ARIMA Method," *Sink. J. dan Penelit. Tek. Inform.*, vol. 8, no. 3, pp. 1883–1893, 2023.
- [5] I. G. I. Sudipa, I. B. G. Sarasvananda, H. Prayitno, I. N. T. A. Putra, R. Darmawan, and D. A. WP, *Teknik Visualisasi Data*. PT. Sonpedia Publishing Indonesia, 2023.
- [6] A. Arifin, I. Djumat, D. G. Nicolas, A. S. M. Syam, and N. Saputra, "Metaverse in Education; Innovation Strategy, Learning Acceleration, and Optimization," *J. Namibian Stud. Hist. Polit. Cult.*, vol. 34, pp. 1470–1485, 2023.
- [7] R. Dewantara and J. Giovanni, "Analisis Peramalan Item Penjualan dalam Optimalisasi Stok Menggunakan Metode Least Square," *J. Krisnadana*, vol. 3, no. 1, pp. 59–66, 2023.
- [8] D. F. Hakam, H. Nugraha, A. Wicaksono, R. A. Rahadi, and S. P. Kanugrahan, "Mega conversion from LPG to induction stove to achieve Indonesia's clean energy transition," *Energy Strateg. Rev.*, vol. 41, p. 100856, 2022.
- [9] A. Prahendratno *et al.*, *BUSINESS INTELEAGENT: Pengantar Business Intelligence dalam Bisnis*. PT. Sonpedia Publishing Indonesia, 2023.
- [10] J. N. A. Aziza, "Perbandingan Metode Moving Average, Single Exponential Smoothing,

- dan Double Exponential Smoothing Pada Peramalan Permintaan Tabung Gas LPG PT Petrogas Prima Services,” *J. Teknol. dan Manaj. Ind. Terap.*, vol. 1, no. 1, pp. 35–41, 2022.
- [11] T. Saputra, S. Zuhdi, F. Kusumawardhani, and R. Novaria, “The Effect of Economic Development on Illegal Gold Mining in Kuantan Singingi, Indonesia,” *J. Gov.*, vol. 8, no. 1, pp. 31–42, 2023.
- [12] M. Heikal, R. N. Ilham, and M. Khaddafi, “Accelerate Economic Growth of Lhokseumawe City with Application of Supply Chain and Main Strategic Commodity Model Based on Sharia During the Covid-19 Pandemic.,” *Qual. to Success*, vol. 23, no. 191, 2022.
- [13] A. Pujianto, A. Mulyati, and R. Novaria, “Pemanfaatan Big Data Dan Perlindungan Privasi Konsumen Di Era Ekonomi Digital,” *Maj. Ilm. BIJAK*, vol. 15, no. 2, pp. 127–137, 2018.
- [14] M. N. R. Fitriani, B. Priyatna, B. Huda, A. L. Hananto, and T. Tukino, “Implementasi Metode K-Means Untuk Memprediksi Status Kredit Macet,” *J. Sist. Komput. dan Inform.*, vol. 4, no. 3, pp. 554–561, 2023.
- [15] T. Widyanti, S. S. Hilabi, A. Hananto, and E. Novalia, “Implementasi K-Means dan K-Nearest Neighbors pada Kategori Siswa Berprestasi,” *J. Inf. dan Teknol.*, pp. 75–82, 2023.
- [16] I. M. D. Susila, Y. P. Atmojo, N. L. P. Srinadi, I. B. Suradarma, L. Yuningsih, and E. S. Rini, “Performance Analysis of the Triple Exponential Smoothing Method During the Covid19 Pandemic on Tourist Visit Data,” in *2022 1st International Conference on Information System & Information Technology (ICISIT)*, 2022, pp. 358–363.
- [17] R. Sesario, T. Duha, A. Alfiah, S. A. Pramono, and P. A. Cakranegara, “SINGLE EXPONENTIAL SMOOTHING IN FORECASTING TOOLS AND MEDICINE STOCKS,” *INFOKUM*, vol. 10, no. 4, pp. 27–32, 2022.
- [18] I. H. Kusnadi, T. B. Sembiring, M. Khaddafi, W. Nurhayati, and S. Sahrul, “Demographic trends in average wages of workers in Indonesian provinces,” *J. Mantik*, vol. 7, no. 2, pp. 1264–1272, 2023.
- [19] A. Arifin, E. Prajayanti, M. Hasby, M. Taufik, and D. T. Anggarini, “The Unex Application as An English Interactive Learning Media: A Feasibility Study,” *J. Kependidikan J. Has. Penelit. dan Kaji. Kepustakaan di Bid. Pendidikan, Pengajaran dan Pembelajaran*, vol. 9, no. 2, 2023.
- [20] I. K. D. A. Saputra, I. P. Satwika, and N. W. Utami, “Analisis Transaksi Penjualan Barang Menggunakan Metode Apriori pada UD. Ayu Tirta Manis,” *J. Krisnadana*, vol. 1, no. 2, pp. 11–20, 2022.
- [21] I. M. D. P. Asana, I. M. D. Kurniadi, S. A. Dwipayani, and K. J. Atmaja, “Sales Forecasting Applications For Retail Companies Using Double Exponential Smoothing And Golden Section Methods,” *J. Mantik*, vol. 6, no. 2, pp. 1603–1611, 2022.
- [22] I. K. A. G. Wiguna, N. L. P. A. C. Utami, W. G. S. Parwita, I. P. A. E. D. Udayana, and I. G. I. Sudipa, “Rainfall Forecasting Using the Holt-Winters Exponential Smoothing Method,” *J. Info Sains Inform. dan Sains*, vol. 13, no. 01, pp. 15–23, 2023.

- [23] D. S. M. Simanjuntak, I. Gunawan, S. Sumarno, P. Poningsih, and I. P. Sari, “Penerapan Algoritma K-Medoids Untuk Pengelompokan Pengangguran Umur 25 tahun Keatas Di Sumatera Utara,” *J. Krisnadana*, vol. 2, no. 2, pp. 289–309, 2023.
- [24] K. D. Hartomo, S. Yulianto, and A. Valentina, “A New Model of Poverty Index Prediction Using Triple Exponential Smoothing Method,” in *2020 7th International Conference on Information Technology, Computer, and Electrical Engineering (ICITACEE)*, 2020, pp. 76–79.
- [25] I. G. I. Sudipa *et al.*, *METODE PENELITIAN BIDANG ILMU INFORMATIKA (Teori & Referensi Berbasis Studi Kasus)*. PT. Sonpedia Publishing Indonesia, 2023.
- [26] S. T. Muhammad Wali *et al.*, *Penerapan & Implementasi Big Data di Berbagai Sektor (Pembangunan Berkelanjutan Era Industri 4.0 dan Society 5.0)*. PT. Sonpedia Publishing Indonesia, 2023.
- [27] B. H. Hayadi, I. G. I. Sudipa, and A. P. Windarto, “Model Peramalan Artificial Neural Network pada Peserta KB Aktif Jalur Pemerintahan menggunakan Artificial Neural Network Back-Propagation,” *MATRIK J. Manajemen, Tek. Inform. Dan Rekayasa Komput.*, vol. 21, no. 1, pp. 11–20, 2021.