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The Use of ANOVA in Comparative Analysis of Exchange Rates in Indonesia

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ABSTRACT

The aim of research regarding the use of Analysis of Variance (ANOVA) in comparative analysis of exchange rates in Indonesia is to analyze differences in foreign currency exchange rates. This research uses ANOVA analysis to determine differences in exchange rates in Indonesia. The research results show that the calculated F value is less than the F table, showing that the difference between the groups is not statistically significant. In the context of foreign currency at BCA, BI, BNI, and KMK, based on the analysis results, there is no significant difference between the foreign currency exchange rates at these banks. It is hoped that future research can use other methods to measure exchange rate differences more precisely, such as Two Way ANOVA or other statistical methods.

Keywords: ANOVA, Exchange Rate, Indonesia

INTRODUCTION

In recent times, the Indonesian industry has seen significant growth, with companies in the country actively engaging in international trade. One crucial factor that facilitates these import and export activities is the use of currency as a medium of exchange. Among the various currencies involved, the US dollar stands out as a common and widely accepted currency in these transactions. For companies actively participating in import and export, the stability of the dollar's exchange rate relative to the Indonesian rupiah holds immense importance. Exchange rate, in this context, signifies the value of the Indonesian rupiah concerning the United States dollar, Euro, Australian dollar, and Singapore dollar. Fluctuations in these exchange rates can significantly impact a company's competitiveness.

The Indonesian industry has undergone substantial growth in recent times, leading to heightened engagement of local companies in import and export endeavors. A key facilitator of these international transactions is the utilization of currency as a medium of exchange. Among the diverse range of currencies employed in these global trade transactions, the United States dollar (USD) stands out as a prevalent and dependable choice. For businesses actively participating in import and export activities, the steadiness of the dollar's exchange rate in relation to the Indonesian rupiah holds significant importance.

Currency exchange is the price or value of a country's currency when compared with the currency of another country. In the context of this study, the exchange rate that is of concern is the value of the rupiah against several major currencies, including the United States dollar (USD), Euro (EUR), Australian dollar (AUD), and Singapore dollar (SGD). Changes in these currency exchange rates can have a significant impact on a company's competitiveness.

For example, when the value of the rupiah weakens against the US dollar, Indonesian products become cheaper for international buyers, which can increase exports. However, on the other hand, companies that import raw materials or finished goods from abroad will face higher costs. On the other hand, if the rupiah strengthens against the US dollar, this could benefit importing companies but could make it difficult for Indonesian exporters.

Because of this, careful monitoring and analysis of changes in currency rates is very important for companies involved in international trade. They need to manage foreign exchange risk wisely and may use financial instruments such as forward contracts or currency options to protect against adverse exchange rate fluctuations.

The stability of currency exchange rates is also important for overall economic stability because it can affect inflation, the trade balance, and foreign investment. Therefore, careful monitoring and analysis of currency movements is an integral part of the business strategy of companies involved in international trade in Indonesia.

Research has many diverse benefits, for individuals, society, and science as a whole. Here are some of the main benefits of doing research:

1. **Better Understanding:** Research helps us understand the world better. This helps reveal previously unknown phenomena and answer unanswered questions.
2. **Knowledge Development:** Research is one of the main ways to develop and update knowledge. This helps enrich our knowledge base and develop an understanding of various topics.
3. **Solutions to Problems:** Research is often used to identify solutions to real-world problems. This can have a positive impact on society and help overcome various problems, such as health, environmental, or economic problems.
4. **Skills Enhancement:** Conducting research allows individuals to develop analytical, critical thinking, and problem-solving skills. This is an important aspect of personal and professional development.
5. **Innovation and Technological Development:** Research is the engine of innovation. Many of the discoveries and technological developments that we enjoy today come from the results of in-depth research.
6. **Better Decision Making:** Research results can help decision-makers, both at the personal and organizational levels, to make better, evidence-based decisions.
7. **Development of Science and Fields of Study:** Research is an integral part of the development of science and certain fields of study. It helps update scientific theories, methods, and paradigms.
8. **Improved Quality of Life:** Research in health, education, economics, and other fields can have a positive impact on people's quality of life. For example, research in the medical field can help develop more effective treatments.
9. **Better Public Policies:** Research results are often used by governments and policymakers to design more effective and sustainable policies.
10. **Career Development:** For individuals, research can enhance qualifications and career opportunities. Publication of research results can also open doors for collaboration and recognition within the scientific community.
11. **Contribution to Global Knowledge:** Research conducted in one place can contribute to global knowledge and form the basis for further research in different parts of the world.

The state of the art of this research are:

1. **Comparative Analysis of Currency Exchange Rates:** The use of ANOVA in analyzing currency exchange rates in Indonesia will try to compare the average or value of foreign currency exchange rates such as the United States dollar (USD), euro (EUR), Australian dollar (AUD), and others across different time periods or between banks or financial institutions.
2. **Historical Trends:** Previous research may have looked at historical trends in changes in currency exchange rates in Indonesia and tried to explain the factors that influenced these exchange rate fluctuations. This can include economic, political, and global factors.
3. **External Influence:** Analysis using ANOVA may also consider external influences such as monetary policy, global economic events, or geopolitical developments on the currency exchange rate in Indonesia.
4. **Use of Multifactor ANOVA:** In some studies, multifactor ANOVA may be used to identify interactions between several factors that influence currency exchange rates, such as interest rates, inflation, and political stability.
5. **Prediction and Risk Management:** One of the important applications of currency exchange rate analysis is in prediction and risk management for companies involved in exports and imports. Research can focus on developing predictive models or risk management strategies that can help companies deal with exchange rate fluctuations.
6. **Technological Innovation:** In an increasingly connected world, technological innovation, such as the use of big data analysis and machine learning, can contribute to advances in currency exchange rate analysis. This can allow for more in-depth analysis and more accurate predictions.

7. Collaboration with Financial Institutions: Current research may involve collaboration with banks or financial institutions in Indonesia to access more accurate and in-depth currency exchange data.
8. Policy Implications: The results of the research could have important implications for policymakers in Indonesia, especially in managing the country's currency and economic stability.

The research objectives regarding the use of Analysis of Variance (ANOVA) in Comparative Analysis of Exchange Rates in Indonesia are:

1. Analyzing Differences in Currency Exchange Rates: The main objective of this research is perhaps to analyze whether there are significant differences in the exchange rates of currencies traded in Indonesia, especially against major foreign currencies such as the United States dollar (USD), euro (EUR), Australian dollar (AUD), or other currency.
2. Identifying Factors Affecting Exchange Rates: This research may aim to identify economic, political, or other factors that affect currency exchange rate fluctuations in Indonesia. This can include factors such as inflation, interest rates, political stability, etc.
3. Understand the Impact of Changes in Exchange Rates: Another objective might be to understand the impact of changes in exchange rates on the economy, business, and society in Indonesia. This may involve analyzing the impact on exports, imports, inflation, and foreign investment.
4. Assist Decision Making: This research may aim to provide insights that can be used by governments, companies, or individuals in making decisions related to currency, investment, or international trade.
5. Develop Predictive Models: Where relevant, this research can attempt to develop predictive models to understand and forecast future currency rate movements.
6. Contribution to Economic Knowledge: In the context of academic research, the aim may be to contribute to economic knowledge about the behavior of currency exchange rates and the factors that influence it.
7. Identifying Risk Management Strategies: For companies involved in exporting and importing, this research may aim to identify effective risk management strategies related to currency exchange rate fluctuations.
8. Open Room for Further Research: The results of this study may open doors for further research in the field of currency exchange analysis in Indonesia or related topics.
9. Contributing to Monetary Policy: The results of this research can provide insights that can be used by monetary authorities or regulators in formulating better economic policies.

LITERATURE REVIEW

Exchange rate

Exchange rate theory is an economic concept that seeks to explain the factors that affect the exchange rate of a country's currency against another country's currency. Exchange rate theory is used to understand how currency exchange rates can fluctuate and what can affect these fluctuations. Here are some theories of exchange that are important in economics:

Purchasing Power Parity

This theory states that in the long run, the exchange rate between two currencies should reflect the difference in their purchasing power. In other words, if the same goods have different prices in two countries, then their currency exchange rates must move in a direction that cancels out the price differences. PPP theory can be used to predict how currency rates will fluctuate in the long term (Doğanlar et al., 2021).

Interest Rate Parity

This theory focuses on the relationship between interest rates and currency exchange rates. According to this theory, the difference in interest rates between two countries will affect the direction of currency exchange rate movements. If interest rates are higher in one country than another, the country's currency will appreciate (increase in value) because investment in that country becomes more profitable (Alimi & Chakroun, 2022).

Market Capitalization Theory

This theory emphasizes that currency exchange rates can be affected by the total amount of money circulating in the market. When the amount of money in a currency increases, its exchange rate tends to fall, and vice versa (Fadhilah et al., 2021).

Expectations Theory

This theory argues that the current currency exchange rate reflects market participants' expectations of future exchange rates. If investors believe that a country's currency will appreciate in the future, they are more likely to buy the currency now, which can lift its exchange rate.

Equilibrium Theory

This theory says that currency exchange rates will reach an equilibrium level where the supply and demand for these currencies meet. Factors such as macroeconomics, monetary policy, and geopolitics can affect this balance.

Pegged Exchange Rate Theory

Some countries choose to tie their currency's exchange rate to a specific foreign currency or a group of currencies. This theory includes the concept of a fixed exchange rate or managed exchange rate, in which the government actively intervenes to maintain a targeted exchange rate.

Currency Union Theory

This theory focuses on the formation of currency zones where several countries use the same currency. A clear example is the European Union which uses the euro as a common currency. This theory identifies the benefits and challenges of using a common currency in relation to exchange rates.

METHODOLOGY

Research design

The approach to this study is a quantitative approach (Sekaran & Bougie, 2016). The quantitative approach is a research method based on the philosophy of positivism (Hjørland, 2005; Sousa, 2010), used to examine certain populations or samples, sampling techniques are generally carried out randomly, data collection uses research instruments, data analysis is quantitative or statistical with the aim to test the hypothesis has been set. Using a quantitative approach, the data is in the form of numbers and analyzed based on statistical analysis in order to show whether there are differences in exchange rates or not.

Data

Data is raw material that needs to be processed, so as to produce information or information, both qualitative and quantitative, which shows facts. Data is also a collection of facts, figures, or anything that can be trusted to be true so that it can be used as a basis for drawing a conclusion. The data used is taken from the websites <https://www.seputarforex.com> and <https://www.fiskal.kemenkeu.go.id/dw-kurs-db.asp>. In this study, the middle rate is used.

Data analysis technique

The research technique used is the ANOVA test (Arendacká, 2012; LaMotte, 2017; Mathew et al., 2010).

The ANOVA test, as outlined by Lind et al. (2018), represents a specialized statistical analysis widely employed in experimental research. This analytical approach was originally formulated by R.A. Fisher. ANOVA serves as a statistical hypothesis testing technique that makes inferences based on data from multiple groups or categories. The null hypothesis in ANOVA posits that the data stem from the same population and, as a result, exhibit equivalent expected means and variances. The fundamental principle behind the ANOVA test is to assess and compare the variations present in three or more sample groups. Beyond merely examining the mean (average) values, ANOVA takes into account the variability within the data, which is evident in the variance measurements.

The core idea behind the ANOVA test is to evaluate the differences in variances among three or more sample groups. Instead of solely focusing on comparing the mean (average) values, ANOVA also takes into consideration the variability within the data, which is reflected in the variance measurements. The assumptions that must be fulfilled in the ANOVA test as a form of a linear model, include the following:

1. Independence of observation, each observation in the ANOVA analysis must be independent.
2. Normality, residual, or error must follow a normal distribution.
3. Homogeneity of variance, the variance between the groups being compared must be homogeneous.

Considering that the ANOVA test is widely used in experimental research, the ANOVA test can be divided based on its design.

1. One-way ANOVA, is used to test differences between two or more groups where only one factor is considered.
2. Factorial ANOVA, is a development of one-way ANOVA where more than one factor and its interactions are considered.
3. ANOVA repeated measures, used when the experimental design allows research subjects to be included in different treatments.
4. Multivariate ANOVA, unlike the ANOVA test which only measures one response, the Manova measures more than one response in one experiment.

Perbandingan Dollar Australia (AUD)

Bank	Kurs			
	Jual	Beli	Tengah	
BCA	10,013	9,749	9,881	06 Jun
BI	9,996	9,895	9,945	06 Jun
BNI	9,915	9,843	9,879	06 Jun

Perbandingan Dollar Singapura (SGD)

Bank	Kurs			
	Jual	Beli	Tengah	
BCA	10,405	10,325	10,365	06 Jun
BI	10,478	10,372	10,425	06 Jun
BNI	10,395	10,336	10,366	06 Jun

The F test is used to compare variance between several groups or treatments in statistics, such as in the analysis of variance (ANOVA). The calculated F value is a statistic that is calculated based on existing data, while the F table is a critical value that is used to decide whether the differences between groups are statistically significant.

This research design, using a one-way ANOVA test, aims to find out whether there are differences in the exchange rates of several foreign currencies at Bank Central Asia (BCA), Bank Indonesia (BI), Bank Negara Indonesia (BNI), and the Minister of Finance's Exchange Rate (KMK).

RESULTS AND DISCUSSION

Descriptive statistics

Perbandingan Dollar Amerika (USD)

Bank	Kurs			
	Jual	Beli	Tengah	
BCA	14,425	14,125	14,275	06 Jun
BI	14,457	14,313	14,385	06 Jun
BNI	14,306	14,251	14,279	06 Jun

Perbandingan Euro (EUR)

Bank	Kurs			
	Jual	Beli	Tengah	
BCA	16,114	15,736	15,925	06 Jun
BI	16,098	15,936	16,017	06 Jun
BNI	15,963	15,876	15,920	06 Jun

Effective Date: 29 May 2019 - 11 June 2019

No	Mata Uang	Nilai
1	Dolar Amerika Serikat (USD)	14,455.00
2	Dolar Australia (AUD)	9,980.75
3	Dolar Kanada (CAD)	10,755.54
4	Kroner Denmark (DKK)	2,164.14
5	Dolar Hongkong (HKD)	1,841.53
6	Ringgit Malaysia (MYR)	3,450.97
7	Dolar Selandia Baru (NZD)	9,432.62
8	Kroner Norwegia (NOK)	1,655.40
9	Poundsterling Inggris (GBP)	18,349.50
10	Dolar Singapura (SGD)	10,496.86
11	Kroner Swedia (SEK)	1,506.22
12	Franc Swiss (CHF)	14,372.02
13	Yen Jepang (JPY)	13,158.67
14	Kyat Myanmar (MMK)	9.46
15	Rupiah India (INR)	207.29
16	Dinar Kuwait (KWD)	47,487.37
17	Rupiah Pakistan (PKR)	95.19
18	Peso Philipina (PHP)	275.92
19	Riyal Saudi Arabia (SAR)	3,854.43
20	Rupiah Sri Lanka (LKR)	81.93
21	Bath Thailand (THB)	453.30
22	Dolar Brunei Darussalam (BND)	10,481.90
23	Euro Euro (EUR)	16,162.49
24	Yuan Renminbi Tiongkok (CNY)	2,087.73
25	Won Korea (KRW)	12.15

ANOVA test

Hypothesis = there is a difference in foreign currency exchange rates at BCA, BI, BNI, and KMK. Enter the middle value of the bank and KMK exchange rates. Find the average of each sample taken.

	BCA	BI	BNI	KMK	
USD	14.275,00	14.385,00	14.279,00	14.455,00	
EUR	15.925,00	16.017,00	15.920,00	16.162,49	
AUD	9.881,00	9.945,00	9.879,00	9.980,75	
SGD	10.365,00	10.425,00	10.366,00	10.496,86	Rata-rata
Rata-rata	12.611,50	12.693,00	12.611,00	12.773,78	Rp12.672,32

Finding the sum of squares (SS)

$$SS \text{ total} = (14.275-12.672,32)^2 + (15.925-12.672,32)^2 + (9.881-12.672,32)^2 + (10.365-12.672,32)^2 + (14.385-12.672,32)^2 + (16.017-12.672,32)^2 + (9.945-12.672,32)^2 + (10.425-12.672,32)^2 + (14.279-12.672,32)^2 + (15.920-12.672,32)^2 + (9.879-12.672,32)^2 + (10.366-12.672,32)^2 + (14.455-12.672,32)^2 + (16.162,49-12.672,32)^2 + (9.980,75-12.672,32)^2 + (10.496,86-12.672,32)^2 = 106.459.586,40$$

$$SS \text{ Error} = (14.275-12.611,50)^2 + (15.925-12.611,50)^2 + (9.881-12.611,50)^2 + (10.365-12.611,50)^2 + (14.385-12.693)^2 + (16.017-12.693)^2 + (9.945-12.693)^2 + (10.425-12.693)^2 + (14.279-12.611)^2 + (15.920-12.611)^2 + (9.879-$$

$$12.611)^2 + (10.366-12.611)^2 + (14.455-12.773,78)^2 + (16.162,49-12.773,78)^2 + (9.980,75-12.773,78)^2 + (10.496,86-12.773,78)^2 = 106.386.866,42$$

$$SS \text{ Treatment} = SS \text{ total} - SS \text{ error} = 106.459.586,40 - 106.386.866,42 = 72.719,98$$

$$df_1 = k-1 = 4-1 = 3$$

$$df_2 = n-k = 16-4 = 12$$

F		$\alpha = 0.05$					
df1	1	2	3	4	5	6	
1	161.447639	199.500000	215.707345	224.583241	230.161878	233.986000	
2	18.512821	19.000000	19.164292	19.246794	19.296410	19.329534	
3	10.127964	9.552094	9.276628	9.117182	9.013455	8.940645	
4	7.708647	6.944272	6.591382	6.388233	6.256057	6.163132	
5	6.607891	5.786135	5.409451	5.192168	5.050329	4.950288	
6	5.987378	5.143253	4.757063	4.533677	4.387374	4.283866	
7	5.591448	4.737414	4.346831	4.120312	3.971523	3.865969	
8	5.317655	4.458970	4.066181	3.837853	3.687499	3.580580	
9	5.117355	4.256495	3.862548	3.633089	3.481659	3.373754	
10	4.964603	4.102821	3.708265	3.478050	3.325835	3.217175	
11	4.844336	3.982298	3.587434	3.356690	3.203874	3.094613	
12	4.747225	3.885294	3.490295	3.259167	3.105875	2.996120	
13	4.667193	3.805565	3.410534	3.179117	3.025438	2.915269	
14	4.600110	3.738892	3.343889	3.112250	2.958249	2.847726	
15	4.543077	3.682320	3.287382	3.055568	2.901295	2.790465	
16	4.493998	3.633723	3.238872	3.006917	2.852409	2.741311	
17	4.451322	3.591531	3.196777	2.964708	2.809996	2.698660	
18	4.413873	3.554557	3.159908	2.927744	2.772853	2.661305	
19	4.380750	3.521893	3.127350	2.895107	2.740058	2.628318	
20	4.351244	3.492828	3.098391	2.866081	2.710890	2.598978	

Then enter it into the table as follows.

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F HITUNG	F TABEL
TREATMENT	72.719,98	3	24.239,99	0,00273	3,49029
ERROR	106.386.866,42	12	8.865.572,20		
TOTAL	106.459.586,40	15			

$$\text{Mean square treatment} = 72,719,98 : 3 = 24,239,99$$

$$\text{Mean square error} = 106,386,866,42 : 12 = 8,865,572,20$$

$$F \text{ count} = \text{Mean square treatment} : \text{Mean square error} = 24,239,99 : 8,865,572,20 = 0,00273$$

Judging from the results in the table, it can be concluded that the calculated F value < F table, which means the hypothesis is rejected. It is not true that there are significant differences between foreign currency exchange rates at BCA, BI, BNI, and KMK.

CONCLUSION

Conclusion

The calculated F value is less than the F table, so this indicates that the difference between the groups is not statistically significant. In the context of foreign currency at BCA, BI, BNI, and KMK, based on the analysis results, there is no significant difference between the foreign currency exchange rates at these banks.

Implication

Interpretation of statistical test results should be based on several factors, including sample size, predetermined level of significance, and study design. If these results are part of a larger study or statistical analysis, it is necessary to consider the context and interpret the results with caution.

Recommendation

It is hoped that future research can use other methods to measure exchange rate differences more precisely, such as Two Way ANOVA (Renaldo et al., 2023; Suhardjo et al., 2023) or other statistical methods.

Future researchers can also use other topics such as tax (Estu et al., 2023), dividend (Saitri et al., 2023), farmer's exchange rate (Eddy et al., 2023), and any other topics.

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