PARAMETER
JURNAL MATEMATIKA, STATISTIKA DAN TERAPANNYA

e-ISSN. 2829-6303
Vol. 04 No. 1, April 2025
Page 47-54

ANALYSIS OF THE EFFECT OF GOODS AND SERVICES PRICES ON INFLATION IN NORTH SUMATRA PROVINCE USING A RANDOMIZED BLOCK DESIGN (RBD) APPROACH

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Abstract

Inflation is a significant factor influencing the economy, particularly regarding the prices of goods. This study aims to analyze the impact of inflation on the prices of goods and services using the Randomized Block Design (RBD) method. The methodology includes the collection of price data from various sources during different inflation periods, followed by statistical analysis to identify patterns and relationships. Secondary inflation data from the Central Statistics Agency (BPS) of North Sumatra in 2019 were utilized, covering eight categories of community expenditure across five cities in the province, as well as the national inflation rate. The research findings reveal a significant relationship between inflation and the prices of goods, with greater price variations observed in specific groups of goods. Furthermore, the analysis indicates notable differences among expenditure categories, particularly in the Clothing and Health categories, which recorded the highest expenditures, while the Transportation, Communication, and Financial Services categories exhibited the lowest expenditures. However, no significant differences were found across regions/cities regarding expenditure patterns. These findings provide valuable insights for policymakers and economic stakeholders in understanding price dynamics amid inflation, and are expected to serve as a reference for the government in formulating inflation control policies.

Keywords: *Inflation, Randomized Block Design, Economic Stability..*

: https://doi.org/10.30598/parameterv4i1pp47-54

1. INTRODUCTION

Inflation is an economic phenomenon that is greatly feared by all countries[1]. Inflation is one of the important benchmarks in assessing the stability of a country's economy. Inflation occurs when the price of goods and services experiences a continuous surge in a period of time, which has a direct impact on people's purchasing power[2]. Inflation is a process related to an event, not just a high or low price level. Therefore, prices that are considered high do not necessarily reflect the actual circumstances that indicate inflation[3]. If inflation increases, the price of goods in the country tends to increase. An increase in the price of goods is proportional to a decrease in the value of a currency, so inflation can be defined as a decrease in the purchasing power of a currency that results in an increase in the overall price of goods and services[4]. In this case, the price of goods and services is a very decisive factor for the inflation rate. Inflation occurs due to various factors, such as an increase in the amount of money circulating in society, the detention of goods, and the high demand for goods and services that exceed the supply, which in turn results in higher product prices. In addition, the decline in total supply due to rising production costs also contributes to inflation[5].

In Indonesia, especially in North Sumatra Province, public spending on goods and services is influenced by various factors, including regional differences and the type of goods or services consumed[6]. In North Sumatra Province, inflation is a crucial issue faced every year in economic development efforts, affecting various sectors and the stability of prices of goods and services [7]. In Indonesia, including in North Sumatra, inflation control is a challenge that is difficult to implement optimally. This is mainly due to the condition of the banking sector that has not been fully normalized, thus affecting the transmission of monetary policy to the real sector and causing high uncertainty[8].

The Central Statistics Agency (BPS) divides public expenditure into eight main categories, including foodstuffs, processed foods, housing, clothing, health services, education, transportation, and other categories[9]. Each of these expenditure categories has a varying influence on inflation, where prices in each category tend to differ between regions. Therefore, it is essential to analyze the relationship between this category of expenditure and inflation in various regions in order to gain a deeper understanding of the inflation pattern.

An experiment refers to an action or observation made to corroborate or refute something uncertain, especially the conditions set by the researcher. In addition, experiments can also be understood as an attempt to identify undisclosed principles or impacts, as well as to test or explain existing or suspected views or truths[10]. An experiment design is a series of activities that include carefully and critically prepared thoughts and actions, taking into account various relevant aspects, to ensure the effective implementation of the experiment in an effort to discover new knowledge[11].

In an experiment, it is often difficult to obtain a relatively homogeneous unit of experiment [10]. In general, the design of an experiment consists of a series of structured steps, where each step is clearly designed and implemented to get a solution to the problem being analyzed through hypothesis testing[12]. Group Random Design (RAK) is applied in research that uses experimental media with heterogeneous properties. Randomization is done separately in each group, which creates additional diversity in the form of diversity between groups or blocks. Thus, the function of the group or block in the RAK is equivalent to the function of the repeat in the study[13]. The condition for grouping is that the diversity (variation) within the group must be smaller compared to

the diversity between groups. If the grouping is not done properly, then the experiment is done using a Complete Random Design[1]

Previous research used the Complete Group Random Design (RAKL) with variable prices of goods and services to analyze inflation in general in Indonesia, in RAKL each combination of treatment is given to all existing groups or blocs. With so many treatment combinations, RAKL requires a more complicated experimental setup. Errors in placement or treatment arrangements can affect the validity of the research results. Meanwhile, this study applies the Group Random Design (RAK) method to analyze the impact of the price of goods and services on inflation. This method was chosen because it can accommodate variability between regions (groups) as well as the influence of treatment (expenditure category) on inflation. RAK is effective in reducing variation due to differences in characteristics between groups because research objects are grouped based on certain factors or characteristics that are considered homogeneous in the group (e.g., environmental conditions or sample characteristics), so that the results of the analysis become more accurate. Thus, this study is expected to be able to present deeper insights related to the role of goods and services prices in influencing inflation, as well as provide input for the government and policymakers in designing inflation control strategies, especially in North Sumatra Province.

2. RESEARCH METHODS

This analysis is a study that applies statistical methods in the analysis process. The information applied in this study was obtained from the official website of the Central Statistics Agency. The type of data used is secondary data, namely inflation data from 8 groups of goods and services in 2019. The variables analyzed in this study are the inflation rates of eight groups of goods and services that have been categorized by the Central Statistics Agency of North Sumatra. This analysis is classified as a type of quantitative research, in which the researcher processes the information needed to solve the problem in accordance with the purpose of the research. Descriptive analysis is a process that includes collecting, processing, presenting, and interpreting data in quantitative or percentage form, which can be presented through tables or graphs[14]. The technique applied in this study is RAK, with a focus on the inflation rate in 5 cities in North Sumatra Province as well as the national inflation rate.

The Central Statistics Agency (BPS) of North Sumatra classifies the available goods and services into 8 categories. categories of various goods and services related to food raw materials. The categories of processed foods, beverages, cigarettes, and tobacco consist of goods and services produced from processed food products. housing, water, electricity, gas, and fuel categories include services used by the Indonesian population. The clothing group consists of goods and services that meet the clothing needs of the community. The health group is related to goods and services in the health sector. The Education, recreation, and sports group is a crucial service to meet the needs of the community. Transportation, communication, and financial services are services provided by the government and private parties in the transportation, communication, and financial sectors. Meanwhile, the general group covers the needs of the community at large both in North Sumatra and nationally. The researcher used all categories formed by BPS North Sumatra. In this study, the goal is to identify the influence of each group of goods and services on the inflation rate. The assumption used is that the price or value of each group

of goods and services is different in each city, so the researcher analyzed data from 5 cities in North Sumatra Province and national data

3. RESULTS AND DISCUSSION

3.1 Data Description

The data in this study uses inflation data from 5 cities in North Sumatra Province and the national level according to the expenditure category (percent). This study used 8 treatments, we can see in **Table 1**.

The researcher performs manual calculations first before applying the MATLAB software, which will then be verified on both results **[15]** In the initial stage, the researcher grouped the data based on the treatment applied. Table 1 shows the initial steps in this study. Furthermore, the calculation is carried out based on the analysis techniques applied.**Table 1** shows the initial steps in this study. Furthermore, the calculation is carried out based on the analysis techniques applied.

Table 1. Observation Data

Treatment (Expenses)	Exams/Groups(City/Region						Total (Y_{ij})
	1 (Nasional)	2 (Sumut)	3 (Sibolga)	4 (P.Sidempuan)	5 (P.Siantar)	6 (Medan)	
General	2.72	2.33	2.58	2.15	1.54	2.43	**13.75**
Foodstuffs	4.27	3.19	2.48	-0.68	0.23	3.79	**13.28**
Finished Food, Beverages, Cigarettes and Tobacco	3.97	2.47	2.69	2.1	1.92	2.55	**15.7**
Housing, Water, Electricity, Gas and Fuel	1.75	1.38	1.77	1.99	0.14	1.47	**8.5**
Clothing	4.93	5.49	6.72	5.51	5.16	5.47	**33.28**
Health	3.46	3.37	2.41	8.77	7.18	2.62	**27.81**
Education, Recreation, and Sports	3.25	2.23	3.43	9.73	5.8	1.43	**25.87**
Transport, Communication and Financial Services	0.17	1.12	0.91	0.28	0.05	1.29	**3.82**
Total	**24.52**	**21.58**	**22.99**	**29.85**	**22.02**	**21.05**	**142.01**

The table illustrates the average expenditure of various categories of household expenditure in six regions/cities (National, North Sumatra, Sibolga, Sidempuan District, Siantar District, and Medan) with expenditure categories including: General, Foodstuffs, Finished Food, Housing, Clothing, Health, Education, and Transportation. The value of expenditure is presented in the form of an index for each category in each region, and is also calculated in total at the end.

Expense Category Details :

1. General :

   The average expenditure of this category in various regions ranges from 1.54 (P. Siantar) to 2.72 (National), for a total of 13.75.

2. Foodstuffs :
   The highest in the National (4.27) and the lowest in P. Sidempuan (-0.68), with an overall total of 13.28.
3. Finished Food, Beverages, Cigarettes and Tobacco :
   Range between 1.92 (P. Siantar) and 3.97 (National), for a total of 15.70.
4. Housing, Water, Electricity, Gas and Fuel :
   The lowest expenditure value was in P. Siantar (0.14) and the highest in P. Sidempuan (1.99), with a total of 8.50.
5. Clothing :
   The expenditure of this category is quite high in all regions, ranging from 4.93 (National) to 6.72 (Sibolga), with a total of 33.28, being the highest among other categories.
6. Health :
   Health expenditure recorded the highest figure in P. Sidempuan (8.77), with a total expenditure of 27.81..
7. Education, Recreation, and Sports :
   The highest expenditure in this category was found in P. Sidempuan (9.73) and the overall total was 25.87.
8. Transportation, Communication and Financial Services :
   The lowest expenditure in this category, ranging from 0.05 (P. Siantar) to 1.29 (Medan), for a total of 3.82

Total Expenditure per region:

- Nasional: 24.52
- Sumut: 21.58
- Sibolga: 22.99
- P. Sidempuan: 29.85
- P. Siantar: 22.02
- Medan: 21.05

The overall total of all expenditure categories across the region was 142.01. This table provides an overview of the variation in expenditure in important categories in different regions/cities and shows that categories such as Apparel and Healthcare have higher total expenditures than other categories, while Transportation, Communications, and Financial Services are the categories with the lowest total expenditure.

3.2 Variety Fingerprint Analysis (Calculating the results of the anova table)

Manual calculations are performed with the support of Excel software. After completing all calculations manually, the ANOVA table will be obtained as shown in **Table 2**. The researcher deliberately carried out manual calculations to make it easier for readers to better understand and understand the Group Random Design (RAK) process. After that, the researcher performed calculations with the help of MATLAB. **Tabel 3** shows the results of data processing performed with MATLAB software.

- Correction factors (FK) = $\frac{y^2}{u.p} = \frac{(\sum\sum y_{ij})^2}{u.p}$

  $FK = \frac{(142.01)^2}{6X8} = 420.1425021$

- Total sum of squares (JKT) = $\sum\sum y_{ij}^2 - FK$

  $JKt\ (corrected) = \{(2{,}72)^2 + (2{,}33)^2 + \cdots + (1{,}29)^2\} - FK = 232.1069979$

- Number of squares of treatment (JKP) = $(\sum y_i^2)/u - FK$

$$JKp = \frac{\{(13{,}75)^2 + (13{,}28)^2 + \cdots + (3{,}82)^2\}}{6} - FK = 121.3516146$$

- Number of repetition squares (JKU) = $(\sum y_j^2)/p - FK$

$$JKu = \frac{\{(24{,}52)^2 + \cdots + (21{,}05)^2\}}{8} - FK = 6.666535417$$

- Number of squares of error (JKG) = JKT + JKP + JKK

$$JKg = JKt - JKp - JKu = 104.0888479$$

- Free Degree
  Repeat/group = u-1 = 6-1 =5
  Treatment = p -1 = 8-1 = 7
  Error = (u-1)(p-1) = 5. 7 = 35
  Total = pu-1 = 6.8 -1 = 47
- Middle Square = Number of squares/degrees of freedom
  KTu = JKu /db = 6.666535/5 =1.333307
  KTp = JKp/db = 121.3516/7 = 17.33594
  KTg = JKg/db = 104.0888/35 = 2.9739671
- F calculate = Median square/Median square of error
  Repeat/group = KTu/KTg = 1.333307/2.9739671 = 0.448326
  Treatment = KTp/KTg = 17.33594/2.9739671 = 5.8292306

Table 2. Anova Calculation Results

Sources of Diversity	Free Degree	JK	KT	$F_{calculate}$	F_{table}
Repeat/group	5	6.666535417	1.333307	0.448326	2,49
Treatment	7	121.3516146	17.33594	5.8292306	2,29
Error	35	104.0888479	2.9739671		
Total	47	232.107			

Below are the results obtained from MATLAB.

Table 3. Calculation Results Using Matlab

Sources of Diversity	JK	df	KT	F
Treatment	6.6975	5	1.3395	0.45104
Block	121.32	7	17.332	5.836
Error	103.94	35	2.9698	NaN
Total	231.96	47	NaN	NaN

Manual calculations and MATLAB calculations are not much different, because the use of MATLAB produces more accurate and meticulous values, Thus, MATLAB becomes a very useful tool to ensure reliability and accuracy in data analysis. However, in testing, manual calculations are used.

3.3 Hypothesis Testing

1. Group Influence

In the group influence test, the null hypothesis (H0) states that there is no significant mean difference between the groups (regions/cities), while the alternative hypothesis (H1) states that there is at least one average pair between different groups.

Based on the results of the ANOVA calculation, the F value for the block is 0.44833. This value was then compared to the Ftable at a significance level of 5% (α = 0.05), with the degree of freedom for the group of 5 and the degree of freedom for error of 35, which resulted in a table F value of 2.49. Since the F calculation (0.44833) is smaller than the F table (2.49), then we accept H0. This means that there are no significant differences between groups (regions/cities) in terms of average spending. Thus, it can be concluded that expenditure in different regions tends to be similar and does not show significant variation.

2. Effect of Treatment

Furthermore, in the treatment influence test, the null hypothesis (H0) states that there is no significant mean difference between treatments (expense category), while the alternative hypothesis (H1) states that there is at least one average pair between different treatments.

From the results of the ANOVA calculation, the F value for the treatment was obtained as 5.8292. This value was compared to the F table at a significance level of 5% (α = 0.05) with a treatment-free degree of 7 and an error-free degree of 35, which resulted in a table F value of 2.29. Since the F count (5.8292) is greater than the F table (2.29), we reject H0 and accept H1. This shows that there are significant differences between expenditure categories. At the very least, there is one category of expenditure that differs significantly from the others. This study found a significant influence between expenditure categories on inflation in five cities in North Sumatra, with the Clothing and Health categories being the highest, while Transportation, Communication, and Financial Services were the lowest. These results show the priority of basic needs in the expenditure structure. This finding is in line with the research of Murniati[2], which used the Complete Group Random Design (RAKL) to analyze the effect of the price of goods and services on inflation in general in Indonesia. Meanwhile, the study uses a Group Random Design (RAK) to analyze differences between cities, providing guidance for inflation policy in North Sumatra..

4. CONCLUSION

From the results of the analysis that has been carried out in this study, the following can be concluded :

1. Influence Between Expenditure Categories Diversity analysis (ANOVA) revealed that there were significant differences between household expenditure categories in five cities in North Sumatra Province as well as nationally. Expenditure categories such as Clothing and Healthcare have a higher spending value compared to other categories, while the Transportation, Communication, and Financial Services categories have the lowest expenditure. This difference shows that household spending patterns in the regions studied are more concentrated on basic needs such as clothing and health.
2. Effect Between Regions/Cities The test on the difference in expenditure between regions/cities stated that no average difference was found between the groups between them. This means that, in general, household spending patterns in the regions studied are relatively similar, although there are small differences in some expenditure categories

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