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ANALYSIS OF THE EFFECT OF POPULATION ON THE AMOUNT OF WASTE IN JAKARTA

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ABSTRACT

The waste crisis in DKI Jakarta has reached alarming proportions, marked by a drastic increase in waste volume from 2017 to 2021. This surge has led to the overflow of the Final Disposal Site (TPA), raising concerns about the city's waste management capacity. Despite the city's continuous growth and advancements in community activities, the waste dilemma remains a persistent challenge. Addressing this concern, the study aims to investigate the correlation between the population and waste generation, evaluating the efficiency of government-provided waste management infrastructure at a significance level (□) of 0.05. This research seeks to identify the impact of population growth on waste production and assess the government's waste management facilities to develop effective strategies for sustainable waste control in DKI Jakarta.

Keywords: *Waste, Jakarta, Enviroment, Condition*

INTRODUCTION

The increasing waste quandary in DKI Jakarta presents an alarming scenario, as depicted by the DKI Jakarta Central Statistics Agency (BPS). Over the four-year period from 2017 to 2021, the daily waste production rose dramatically. Commencing at 7,164 tons in 2017, the situation worsened considerably, peaking at an alarming 8,448 tons by 2021. To tackle this escalating crisis, the DKI Jakarta administration implemented an expansion of the Bantargebang TPST area by an additional 7.5 hectares. This measured step was initiated to alleviate the strain on the Bantargebang TPST, which was initially designed to manage 21,879,000 cubic meters of waste. Regrettably, the expansion failed to resolve the issue at hand. By the year 2020, the quantity of waste had far exceeded the TPST's threshold, amassing a staggering volume of 22,387,370 cubic meters.

This escalation of waste volume despite attempts to expand the TPST area indicates the persistent and concerning challenge faced by waste management in Jakarta. As of 2021, the daily waste generation skyrocketed to a significant 8,448 tons. Jakarta, being the capital city of Indonesia, is densely populated, comprising an estimated 10.6 million individuals in 2,758,000 households. This high population density significantly

contributes to the burgeoning waste dilemma. The marked upsurge in waste production, compounded by the limitations in managing the overflow, points towards an urgent necessity for more comprehensive waste management strategies in the region. The existing infrastructure is evidently inadequate in handling the burgeoning waste production and presents a grave concern for the sustainable management of waste in the city. This underscores the immediate need for robust, all-encompassing waste management measures that incorporate reduction, recycling, and efficient management protocols in Jakarta.

This trend marks a worrying pattern in DKI Jakarta. Despite the expansion of the Bantargebang TPST, the waste management challenges within the city continue to intensify. By 2021, Jakarta faces a staggering daily waste output of 8,448 tons. As Indonesia's capital, Jakarta accommodates around 10.6 million people in approximately 2,758,000 households, contributing significantly to the burgeoning waste problem. The relentless increase in waste generation, coupled with the limitations of the current waste management infrastructure, raises significant concerns about the city's ability to sustainably manage its waste. The urgency for more efficient waste reduction, recycling initiatives, and a comprehensive waste management strategy is evident to combat this alarming waste crisis in the region.

DATA SOURCE

The study sourced its data from diverse institutions and agencies, including the Central Statistics Agency (BPS) DKI Jakarta and the National Waste Management Information System (SISPN). Additionally, data was extracted from a variety of sources available on the website walhijakarta.org, notably from an article titled "Overview of Waste Management in Jakarta Today" and "Care for National Waste 2022". The primary focus of data collection encompassed two main categories: population statistics and environmental data. The data retrieved from these sources is designated for a more extensive and in-depth analysis in subsequent phases of the study.

These datasets from different sources served as the foundation for a comprehensive understanding of waste management and its relationship to the population and the environment within the DKI Jakarta region. The statistical data collected from the BPS DKI Jakarta holds significant importance in providing an empirical understanding of the population trends and their correlations to the waste generated in the area. Additionally, the National Waste Management Information System (SISPN) offers detailed insights into the environmental aspects and waste management policies, enabling a more holistic perspective in the study's examination of waste-related issues.

The comprehensive scope of data acquisition, encompassing varied sources, intends to provide a multifaceted understanding of the intricate relationship between the growing population, its environmental impact, and the escalating waste situation in Jakarta. The amalgamation of datasets from multiple reputable sources is essential for deriving reliable and multifaceted conclusions. This approach emphasizes the need for an all-encompassing analysis that can address the complexities surrounding waste management and the surrounding environmental dynamics in DKI Jakarta.

Table 1. Data on Population and Daily Waste Generation in DKI Jakarta from 2017-2021

Year	Total Population	Waste Generation (tons/day)
2017	10374235	7164
2018	10467629	7722
2019	10557810	8291
2020	10562088	8369
2021	10609681	8448

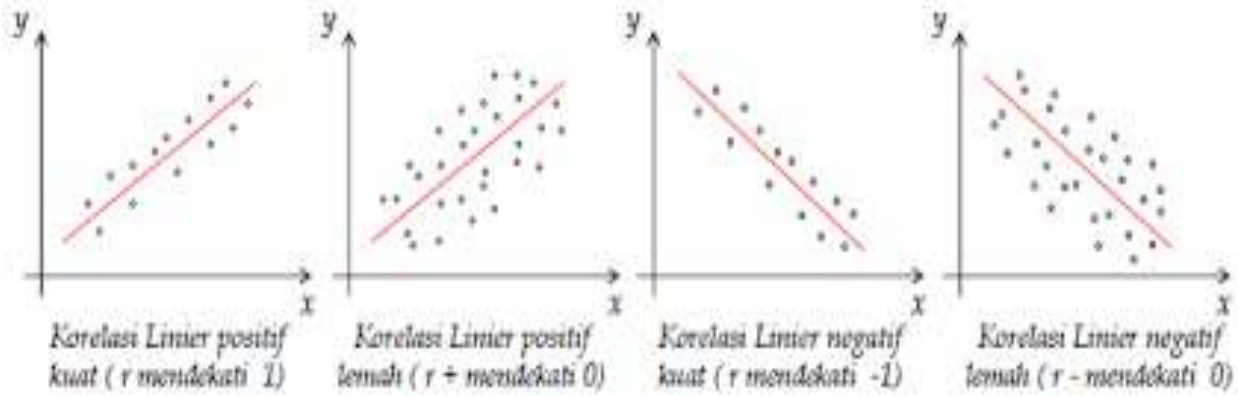
DATA ANALYSIS

In this study aimed at assessing the relationship between DKI Jakarta's population and its waste production, a correlation analysis was employed utilizing computer-aided support through the Python program. Correlation analysis serves as a method to ascertain the presence and nature of a linear relationship between variables. This analytical tool enables researchers to determine whether changes in one variable correspond to changes in another variable.

The primary focus of this correlation analysis involves exploring the statistical relationship between the population statistics in DKI Jakarta and the quantity of waste generated. Correlation analysis evaluates the strength and nature of the association between two variables. The resulting output from this statistical examination provides numerical outcomes that are further categorized into several distinct types. These categories include positive correlation, indicating that an increase in one variable corresponds to an increase in the other. Conversely, negative correlation demonstrates that an increase in one variable corresponds to a decrease in the other. An uncorrelated relationship is depicted when the variables do not exhibit any discernible relationship.

It's crucial to note that the results derived from correlation analysis are denoted in numerical values, with a range from -1 to 1. A value of -1 signifies a strong negative correlation, while a value of 1 indicates a strong positive correlation. In the instance that both variables exhibit no apparent relationship, the value represented is 0. This analysis

is pivotal in understanding the interdependency between the population density and the waste generated in DKI Jakarta, providing insights into how fluctuations in population figures could potentially impact waste production and management strategies. The statistical data derived from this correlation analysis serves as a foundation for drawing conclusive observations about the relationship between population dynamics and waste generation in the region.



To find out the closeness of the relationship between the two variables, namely by looking at the number of correlation coefficients with the following criteria:

A. 0 – 0.05 : No correlation
B. 0.05 – 0.25 : Very weak correlation
C. 0.25 – 0.5 : The correlation is quite strong
D. 0.5 – 0.75 : Strong correlation
E. 0.75 – 0.99 : Very strong correlation
F. 1 : Perfect correlation

The correlation between the two variables is considered statistically significant if the p-value is lower than 0.05 and the correlation between the two variables is considered insignificant if the p-value is greater than 0.05.

RESULTS AND DISCUSSION

A. Hypotesis

H0: There is no relationship between the population of DKI Jakarta and the waste generation in DKI Jakarta

H1: There is a relationship between the population of DKI Jakarta and the generation of waste in DKI Jakarta

The proposed hypotheses are statements that affirm or refute the correlation or relationship between two investigated variables. In this case, two hypotheses are proposed: the null hypothesis (H0) stating that there is no relationship between the population of DKI Jakarta and its waste generation, and the alternative hypothesis (H1) stating that there is a relationship between the population of DKI Jakarta and the amount of waste produced. To test these hypotheses, statistical correlation analysis or a correlation test can be used. In this case, the Pearson correlation might be one suitable technique. The Pearson correlation test is used to measure the extent of the linear relationship between two variables. If the data shows a significant relationship between the population of DKI Jakarta and the amount of waste produced, the alternative hypothesis (H1) will be accepted. Conversely, if the data does not provide sufficient statistical evidence to support the relationship between these variables, the null hypothesis (H0) will be accepted.

In this context, the conclusion of the analysis will provide a deeper understanding of whether the increase in population in DKI Jakarta truly contributes to the increase in waste production. If the null hypothesis (H0) is accepted, then the population of DKI Jakarta does not have a significant correlation with an increase in waste production. Conversely, if the alternative hypothesis (H1) is accepted, it will affirm that population growth plays a role in the increase in the amount of waste.

B. Significance Level

The level of significance (α) signifies the probability of observing a relationship between variables due to random chance. It is a threshold that is set to evaluate the statistical significance of the observed relationship. In this context, α is defined as 0.05, which indicates that there is a 5% chance that the observed relationship between variables could be due to random variability rather than an actual relationship.

Considering the given information with the value of r at df = 3 and p-value = 0.05 being 0.8783, this result can be interpreted as follows: The calculated r value at the given degrees of freedom (df) and p-value suggests a correlation of 0.8783 between the variables under consideration. As the p-value is the probability of obtaining results as extreme as the observed results if the null hypothesis were true, a p-value of 0.05 indicates that there is a 5% chance that the observed correlation is due to random chance rather than a true relationship between the variables.

Given the level of significance (α) set at 0.05, the observed correlation (r = 0.8783) surpasses the threshold of statistical significance. As the calculated r value exceeds the critical value, it implies that there is strong evidence to reject the null hypothesis, indicating a significant relationship between the variables, with the possibility of this

correlation being a genuine relationship rather than a chance occurrence. It can be seen at the level of significance (α) is 0.05. Based on table r, the value of r at df = 5-2 = 3 and p-value = 0.05 is 0.8783.

C. Test Criteria

The test criteria outline the decision-making process based on the p-value or the calculated correlation coefficient (r) concerning the null hypothesis (H0) and the significance of the relationship between the population of DKI Jakarta and waste generation in DKI Jakarta:

1. If the p-value (or r compared to rtable) is 0.05 or more.
   In this case, the instruction is to accept the null hypothesis (H0). The conclusion drawn is that there is no significant relationship between the population of DKI Jakarta and the waste generation in DKI Jakarta. A p-value or an r value not meeting the significance level (0.05 or less) implies that there is insufficient evidence to reject the null hypothesis. Thus, it is deemed that no meaningful relationship exists between the variables.
2. If the p-value (or r compared to rtable) is less than 0.05.
   It is inferred that the correlation coefficient between the population of DKI Jakarta and waste generation is considered statistically significant. A p-value less than 0.05 signifies that the likelihood of observing such results due to random chance is below 5%. Therefore, the conclusion is that there exists a significant relationship between the population of DKI Jakarta and the waste generation in DKI Jakarta.

In summary, the test criteria provide a guideline for the decision-making process regarding the null hypothesis based on the significance of the calculated p-value or correlation coefficient (r). If the p-value is less than 0.05, it indicates statistical significance and leads to the rejection of the null hypothesis, affirming a significant relationship between the variables. Conversely, if the p-value is 0.05 or higher, it suggests the acceptance of the null hypothesis, indicating no substantial relationship between the population of DKI Jakarta and waste generation. It can be seen at it.

1. If r count rtable or p-value 0.05 then accept H0, the conclusion is that there is no relationship between the population of DKI Jakarta and the waste generation in DKI Jakarta.
2. If r count rtable or p-value 0.05, it can be concluded that the correlation coefficient between the two variables is significant.

D. Test Statistics

In the following analysis, correlation testing results obtained using the Python program with computer assistance will be presented.

Table 2. Correlation Result of Population and Total Waste Generated in DKI Jakarta

		Total Population	Trash Amount
Total Population	**pearson correlation**	1.000000	0.990943
	p-value		0.001033
Trash Amount	**pearson correlation**	0.990943	1.000000
	p-value	0.001033	

The robust positive correlation coefficient of 0.990943, representing 99.0943%, points to a remarkably strong and direct relationship between the population variable and waste generation in DKI Jakarta throughout the studied period from 2017 to 2021. This high correlation value indicates that the waste generation in the region tends to increase in proportion to the population growth. The significance value of 0.001033, falling well below the commonly used significance level of 0.05, strengthens the validity of this correlation, affirming the relationship's statistical significance. The small p-value suggests strong evidence against the null hypothesis (H0), favoring the alternative hypothesis (H1), which states there is indeed a relationship between the population of DKI Jakarta and the volume of waste produced.

Moreover, in scholarly papers, figures and tables play an integral role in presenting data and findings clearly. Placing these visual aids close to the text they reference enhances the reader's understanding by offering immediate visual context. Therefore, it is highly recommended to position figures and tables in proximity to the relevant text sections. This ensures readers can easily navigate between textual explanations and supporting visual data, facilitating a more comprehensive comprehension of the analysis and its outcomes.

E. Satterplot

It appears that a straightforward relationship exists between the population and daily waste generation in DKI Jakarta. The scatterplot graph illustrates a distinctive pattern showing a diagonal trend from the lower-left to the upper-right section. This pattern signifies a visible and positive linear correlation between the population count and the amount of daily waste generated. As the population of DKI Jakarta rises, there is a noticeable concurrent rise in the volume of waste generated each day. This relationship

is portrayed graphically and supports the conclusion of a direct, positive correlation between the two variables. The scatterplot distinctly demonstrates how the increase in population directly corresponds to an increase in the generation of daily waste in DKI Jakarta. This significant association is visually represented in the scatterplot graph below, further solidifying the notion of a strong linear relationship between these two crucial variables.

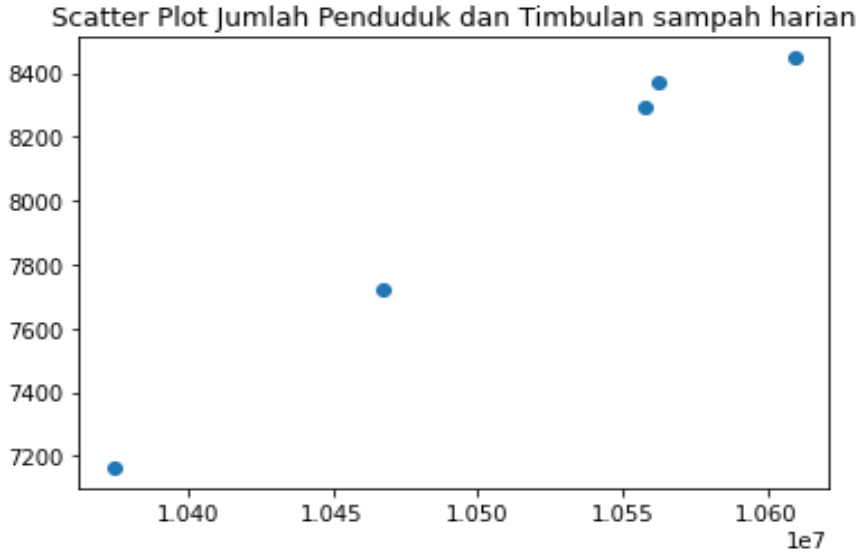


Figure 1 ScatterPlot

It's critical to emphasize that the linear trend observed in the scatterplot graph visually represents the interconnected relationship between population and daily waste generation in DKI Jakarta. The noticeable pattern, as depicted by the diagonal trend from the lower-left to the upper-right section, clearly implies a substantial positive correlation between the population count and the volume of daily waste produced. This evident alignment in the scatterplot graph underscores how the upsurge in DKI Jakarta's population invariably leads to a parallel increase in the daily waste generation. Consequently, this observation substantiates the conclusion that the two variables share a direct and positive association. The visually illustrative scatterplot underlines how population growth significantly influences the amplification of daily waste generation within the region. This distinct linkage is crucially emphasized by the scatterplot representation, reaffirming the strong linear relationship between population and daily waste production in DKI Jakarta.

F. Decision

The analysis of the correlation coefficient (r = 0.990943) shows that it is notably greater than the threshold for rejection (0.8783). Simultaneously, the p-value of 0.001033

is less than the set significance level of 0.05. This substantiates that there exists a statistically significant relationship between the population variable and daily waste generation in DKI Jakarta. The correlation coefficient exceeding the critical value and the p-value falling below the defined significance level confirm the strong and meaningful connection between these variables. Therefore, it can be confidently established that there is a substantial and meaningful association between population changes and the generation of daily waste in DKI Jakarta.

CONCLUSION

Based on the conducted analysis, the findings unequivocally suggest a correlation between the population and the quantity of waste generated in DKI Jakarta. It is evident that an increase in population is directly linked to a surge in waste production. Consequently, addressing this issue requires a comprehensive waste management system, both at the governmental and community levels. Individuals within communities can contribute to this effort by implementing waste management practices at home, such as segregation of organic and inorganic waste, substituting plastic waste materials with biodegradable alternatives like cardboard, and reusing items to minimize unnecessary waste production.

Concurrently, the DKI Jakarta Provincial Government must spearhead the initiative by introducing programs aimed at waste reduction. This includes establishing efficient waste management infrastructure and facilities, such as strategically positioned and well-maintained garbage bins. These measures are pivotal in encouraging residents to actively participate in waste segregation and management. By creating a conducive environment and offering practical waste management solutions, it's feasible to minimize the volume of generated waste in DKI Jakarta. Hence, the collaboration between the government's initiatives and community-based waste management practices is essential for an effective waste reduction strategy.

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