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Analysis Of Consumption Patterns And Prediction Of Subsidized Fuel Availability Based On Dashboard Fusion Data In The Retail Sales Area Of Bengkulu City

1st Iedha Aisyah Wibowo
Information System Study Program
Department of Engineering
University of Bengkulu
Bengkulu, Indonesia
aisyahiedha@gmail.com

2nd Niska Ramadani
Information System Study Program
Department of Engineering
University of Bengkulu
Bengkulu, Indonesia
niskaramadani@unib.ac.id

3rd Fauzan Ramadhanto Susetyo
Sales Area Retail Bengkulu
PT Pertamina Patra Niaga
Bengkulu, Indonesia
fauzan.susetyo@pertamina.com

Abstract*—Subsidized fuel oil (BBM) is an important strategic commodity in supporting transportation activities and ensuring the smooth mobility of the community. Fluctuations in consumption and imbalances in the distribution of subsidized fuel have the potential to cause problems such as shortages at some gas stations, leading to long queues and excess or insufficient stock at other gas station locations. This study aims to analyze the consumption patterns of subsidized fuel (Pertalite and Biosolar), compare the consumption levels between gas stations, and predict the fuel needs for the next period. The data used consists of daily sales data from six gas stations in Bengkulu City during the period from January to March 2026, obtained from the Fusion Sales Area Retail Dashboard. Data processing was carried out using Python with the pandas library for data cleaning and matplotlib for visualization. The prediction method used is a 7-day moving average, with model evaluation using Mean Absolute Percentage Error (MAPE). The research results show that the pattern of fuel consumption is fluctuating, with Pertalite dominating total sales compared to Biosolar. In addition, differences in consumption between gas stations are closely related to geographical location, traffic density, and the dynamics of local economic activities. The prediction results show a relatively stable consumption trend with a gradual increasing tendency, with a MAPE value of 9.20%, indicating a good model accuracy level. This research contributes by providing an analytical approach based on operational data to support the optimization of fuel distribution management and more effective decision-making. However, this research still has limitations in the scope of data and the simple methods used, so future research is recommended to adopt more complex models by including external variables.

Keywords- Pertalite, Biosolar, Fuel Consumption Patterns, Fuel Availability Prediction, Comparison between Gas Stations, Bengkulu City.

I. INTRODUCTION <HEADING 1>

Energy needs, especially subsidized fuels such as Pertalite and Biosolar, are important components in supporting community transportation activities. In practice, the phenomenon of long queues and shortages of subsidized fuel still frequently occurs in various regions, including the city of Bengkulu. Daryono & Amanda (2025) show that the injustice of energy distribution is one of the root causes of the scarcity of subsidized fuel in Bengkulu, where some areas experience supply shortages while others have excess stock [6]. This condition indicates that the main problem is not national availability, but rather the imbalance in distribution at the operational level, triggered by the inaccuracy of stock planning per gas station.

One of the main causes of this imbalance is the inaccuracy in fuel distribution planning, particularly in the mechanism of Purchase Order (PO) preparation by gas stations. Inaccuracy in estimating needs can lead to two extreme conditions: stock shortages that cause long queues or excess stock that reduces distribution efficiency. Each gas station is required to submit a Purchase Order (PO) to Pertamina at least one day before delivery to determine the volume of fuel to be distributed the following day. If the demand forecast submitted by the gas station is inaccurate, two opposing scenarios may occur. Gas stations that underestimate demand will run out of stock more quickly, causing long queues and congestion, while those that overestimate demand will experience excess stock as other stations face shortages, leading people to flock to stations that still have fuel and further worsening the queues. This phenomenon of distribution imbalance is precisely occurring in the city of Bengkulu, as reported by Daryono & Amanda (2025), who stated that the scarcity of fuel in Bengkulu is not uniform but rather concentrated at certain gas station points due to misallocation [6].

Changes in community mobility patterns, traffic conditions, and regional characteristics also affect the level of fuel consumption at each gas station. More systematically, Ishak & Talango (2024) show that fuel consumption is fluctuating and highly influenced by daily activities and regional characteristics [3]. Similarly, Ruma (2025) emphasizes that the estimation of Pertalite demand cannot be generalized across gas stations due to varying factors such as traffic, population density, tank capacity, and economic activity [4]. The inability to accurately predict demand at the gas station level results in purchase orders (PO) that often do not match real needs, which in turn exacerbates distribution imbalances.

In this context, forecasting methods such as the Moving Average are widely used because they can depict data trends simply and effectively for short-term prediction needs [5]. Although more advanced forecasting methods, such as ARIMA and Exponential Smoothing, can capture more complex patterns, they generally require more sophisticated

modeling and parameter tuning. In contrast, the Moving Average method is easier to implement, interpret, and apply to operational daily transaction data. Since this study focuses on identifying short-term fuel consumption trends and supporting practical fuel distribution planning at the gas station level, the Moving Average method was considered an appropriate forecasting approach. Furthermore, Nduru & Kholijah (2025) proved that the Moving Average approach can provide fairly reliable prediction results to support fuel inventory optimization, particularly when applied to historical daily sales data [5].

With the development of information technology, the use of dashboard systems like Dashboard Fusion allows transaction data to be collected in real-time and used as a basis for analysis. The operational data can be processed using the Python programming language, which has the capability for efficient data cleaning, manipulation, and visualization [1], [2]. Chairunnisa & Kahar (2026) demonstrate that Python-based visualization can reveal hidden consumption patterns from daily transaction data [1]. Candra (2025) also added that the pandas and NumPy libraries are very effective for handling time series data on an operational scale [2].

Although various studies have utilized Python for data analysis and forecasting, research specifically addressing the consumption patterns of subsidized fuel at the operational level of several gas stations is still relatively limited. However, analysis at this level is crucial for understanding usage trends, consumption differences between gas stations, and predicting future needs. Based on this, this research was conducted to analyze subsidized fuel consumption at six gas stations in Bengkulu City during the period from January to March 2026 using a Python-based analytical approach. [1], [2], [5].

Based on this background, this research aims to analyze fuel consumption patterns over time, compare consumption levels between gas stations, and predict fuel availability in the next period.

II. RESEARCH METHOD

This research uses a descriptive quantitative approach with time series analysis. A descriptive quantitative approach was selected because the study utilizes numerical transaction data and aims to describe fuel consumption patterns over time. This approach is appropriate for analyzing operational data obtained from Dashboard Fusion, as it enables the identification of consumption trends, comparison of fuel usage across gas stations, and forecasting of future demand. Since the primary objective of this study is to describe and predict fuel consumption behavior rather than examine causal relationships between variables, a descriptive quantitative design is considered the most suitable research approach. The data used are secondary data in the form of daily transactions of subsidized fuel types Pertalite and Biosolar obtained from the Dashboard Fusion Sales Area Retail of Bengkulu City during the period from January to March 2026.

The research variables include transaction date, gas station code, type of fuel, and sales volume (liters). Data was collected from six gas stations in Bengkulu City, namely SPBU 2338207 Kandang, 2438203 Sebakul, 2438204 KM 8, 2438205 Tebeng, 2438216 Betungan, and 2438226 Bumi Ayu. The selection of these gas stations was based on the presence and consistency of subsidized fuel sales (Pertalite and Biosolar), making the obtained data relevant to the research objectives.

A. Research Flow

The research flow in this study is presented in the form of a flowchart in Picture 1. The flowchart illustrates the stages of the r clusion drawing

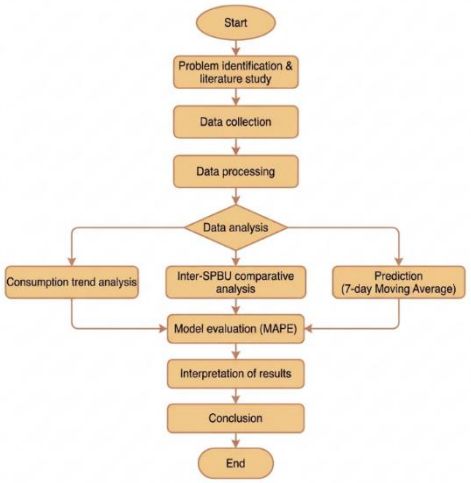


Fig. 1. Research Flowchart

The research begins with the stage of problem identification and literature review aimed at understanding the characteristics of subsidized fuel consumption and distribution. This stage serves as the basis for determining the analytical approach used. Next, data is collected from the Dashboard Fusion system and then processed thru data processing stages using Python, including data cleaning, data transformation, and data merging. This stage aims to ensure data quality before further analysis is conducted. The analysis process is carried out thru three main approaches, namely trend analysis, comparison analysis between gas stations, and prediction using the moving average method. The analysis results are then evaluated using MAPE to measure the model's accuracy level. The final stage of the research is the interpretation of the results, which serves as the basis for formulating conclusions and recommendations.

B. Data Collection and Processing

The research data was obtained from the Fusion Dashboard system, which is used to monitor fuel sales transactions in real-time. The data collection process is carried out by exporting the data into CSV or Excel format to be further processed using Python.

Data processing is carried out using the pandas library for data manipulation and NumPy for numerical computation [2]. The stages of data processing include:

1. Merging data from several files into one dataset
2. Cleaning data by removing missing values and duplicate data
3. Transforming data into a format suitable for analysis.

C. Analysis Data

Data analysis is conducted to identify fuel consumption patterns and support decision-making in fuel distribution.

The analysis process is carried out using Python thru data visualization and time series analysis approaches.

Fuel Consumption Trend Analysis

Trend analysis is conducted to identify consumption patterns over time during the research period. Data is grouped by date and type of fuel to obtain daily consumption totals. The aggregated results are visualized in the form of a line chart to show the movement of Pertalite and Biosolar consumption over time, allowing for the identification of fluctuation patterns and trend tendencies.

Comparison of Consumption Between Gas Stations

This analysis aims to determine the distribution of fuel consumption at each gas station. Data is grouped by gas station code and the total consumption during the study period is calculated.

The results are visualized using a bar chart to compare the consumption levels between gas stations and to identify the gas stations with the highest and lowest consumption.

Fuel Consumption Prediction

Fuel consumption prediction is carried out using the 7-day moving average method. This method is used to smooth out daily data fluctuations by calculating the average consumption over a specific period, resulting in a more stable trend. The data is first accumulated into total daily consumption, and then the moving average value is calculated with a 7-day time window. The calculation results are visualized to compare the actual data with the prediction results.

To measure the model's performance, an evaluation is conducted using the Mean Absolute Percentage Error (MAPE). The moving average method is chosen because it can capture short-term trends in fluctuating data and is simple to implement on daily historical data. The model evaluation is carried out using the Mean Absolute Percentage Error (MAPE) to measure the prediction accuracy, where a smaller MAPE value indicates better model performance.

The MAPE calculation in this study was performed using the Python programming language with the help of the NumPy library to obtain accurate and efficient calculation results. The MAPE value is used as an indicator to assess the accuracy level of the prediction model, where a smaller MAPE value indicates that the model has better predictive capability.

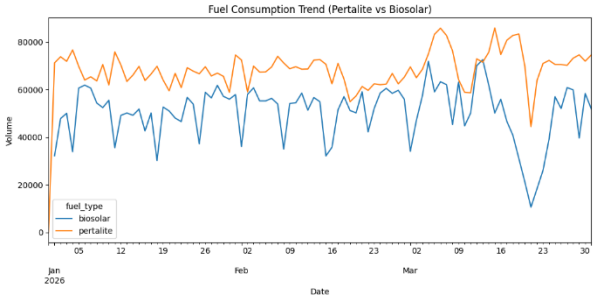
III. Result And Discussions

Analysis of subsidized fuel consumption data sourced from the Fusion Dashboard in the Retail Sales Area of Bengkulu City during the period from January to March 2026 shows a dynamic and fluctuating consumption pattern. Data visualization approaches and time series methods were used to identify consumption characteristics and project fuel needs for the following period.

The discussion is focused on three main aspects, namely the trend of fuel consumption over time, the comparison of consumption levels between gas stations, and the prediction of fuel needs. These three aspects are analyzed integratively to provide a more comprehensive picture of fuel demand patterns and their implications for distribution management in the research area.

A. Analysis of Fuel Consumption Trends

The analysis of fuel consumption trends is conducted to understand the pattern of fuel usage over time during the period from January to March 2026. The processed data is then grouped by date and type of fuel to obtain the total daily consumption. This process aims to simplify the data so that day-to-day consumption changes can be observed more clearly. The results of the grouping were visualized in the form of a line chart to compare the consumption of Pertalite and Biosolar over time.



Based on Picture 2, it can be seen that the pattern of fuel consumption during the observation period is fluctuating with a tendency to stabilize within a certain range. The consumption of Pertalite is consistently higher than that of Biosolar, indicating that the demand for gasoline-type fuel is more dominant in transportation activities in the research area. This indicates that the majority of community mobility relies on gasoline-powered vehicles, so the highest demand pressure is on this type of fuel.

In addition, there were several periods of significant consumption spikes, particularly from early to mid-March. These spikes indicate a short-term increase in demand that cannot be predicted solely based on average consumption. On the other hand, on several other days, there was a decrease in consumption, emphasizing that the demand for fuel is dynamic and highly influenced by daily community activities.

From this analysis, it can be concluded that the pattern of fuel consumption is not constant, but rather fluctuating with a fairly high daily variation. This condition has a direct impact on the distribution planning process, particularly in the preparation of Purchase Orders (PO) by gas stations. If planning only refers to the average consumption without considering fluctuations, gas stations risk experiencing stock shortages during demand spikes.

The implication is that a more adaptive planning approach is needed, taking into account trend patterns and daily consumption variations. The results of this analysis show that historical data not only serves as descriptive information but also as a foundation for building a more accurate prediction system. Thus, the risk of long queues due to running out of fuel can be minimized, and distribution can be carried out more responsively to changes in demand in the field. The fluctuating pattern is in line with previous research that states energy consumption tends to be influenced by community activities and is dynamic in nature [3]. Additionally, the use of historical data in trend analysis also serves as an important basis in the process of forecasting future fuel needs [5].

B. Comparison Analysis of Fuel Consumption Between Gas Stations

A comparative analysis of fuel consumption between gas stations is conducted to determine the distribution of fuel usage at each location during the research period. The processed data is then grouped based on SPBU codes to obtain the total consumption volume at each SPBU. The aggregation results are visualized in the form of a bar chart to

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facilitate comparisons between SPBUs and identify consumption distribution patterns.

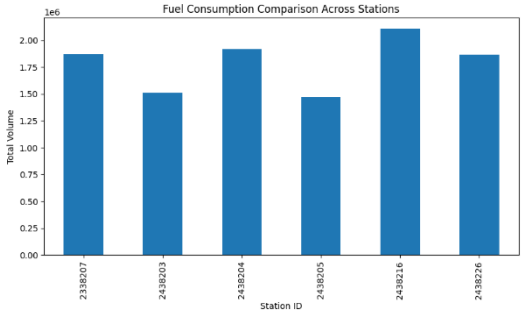


Fig. 3. Fuel Consumption Comparison Across Gas Stations

Based on Picture 3, there is a significant difference in consumption volume among the six analyzed gas stations. SPBU 2438216 (Betungan) shows the highest consumption level, while SPBU 2438205 (Tebeng) and 2438203 (Sebakul) have relatively lower consumption levels. Meanwhile, the other gas stations fall into the medium category with consumption volumes that are not too far apart.

This difference indicates that fuel consumption is not evenly distributed among gas stations. The variation is likely influenced by factors such as strategic location, traffic density, economic activity, and the characteristics of the area surrounding the gas stations. Gas stations with high consumption tend to be located on main routes or in areas with high mobility, while gas stations with low consumption are situated in areas with more limited activity intensity.

These findings have significant implications for the effectiveness of subsidized fuel distribution, particularly in the context of the distribution imbalance explained in the introduction. If all gas stations receive fuel supplies in relatively equal amounts without considering actual consumption levels, stock imbalances will occur. Gas stations with high demand are likely to experience shortages more quickly, while gas stations with low demand will end up with excess stock.

The implication is that the results of this analysis confirm that fuel distribution planning cannot be done uniformly. A data-based approach is needed that considers the consumption characteristics of each gas station in determining supply allocation. By adjusting the distribution volume based on historical consumption patterns, the PO preparation process can become more accurate and targeted. This can ultimately reduce distribution imbalances, minimize queues at certain gas stations, and improve the overall efficiency of subsidized fuel management. These findings are also supported by research stating that fuel demand estimation is influenced by economic activity factors and regional characteristics [4], as well as the importance of using data-based methods to support distribution optimization and demand planning [5].

C. Prediction of Fuel Demand

Fuel demand prediction is carried out to estimate consumption patterns in the following period based on historical daily consumption data. The consumption data is first grouped by date to obtain the total daily consumption, then a seven-day moving average is calculated as the basis for the prediction.

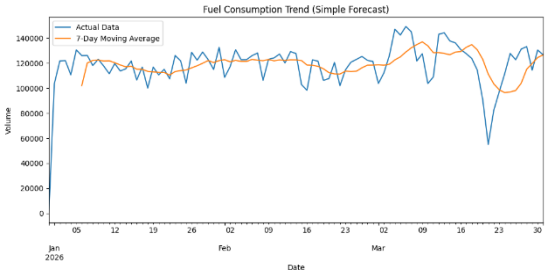


Fig. 4. Prediction of Fuel Consumption Using Moving Average

Based on Picture 4, it can be seen that the actual consumption data experiences quite high daily fluctuations, while the moving average line forms a smoother and more stable pattern. At the beginning to the middle of the observation period, fuel consumption remained relatively constant, then showed an increase at the beginning of March before declining again from the middle to the end of the period. This pattern indicates that fuel consumption is dynamic and does not always move linearly over time.

Analytically, the moving average results show that this method is quite good at depicting the general trend of short-term fuel consumption. However, the prediction line appears to be slower in responding to sudden spikes or drops in the actual data. This means that the model is able to capture the general direction of the trend, but is less sensitive to extreme changes in a short period of time. This condition is important to note because, in the context of fuel distribution, a delay in capturing demand spikes can directly impact the accuracy of stock planning.

The results of this prediction have a quite significant operational impact. If used as the main basis in the preparation of Purchase Orders (PO), then the moving average can help gas stations estimate daily fuel needs more stably under normal conditions. However, when there is a sudden increase in demand, this model has the potential to produce predictions that are lower than the actual needs. In practice, this can trigger stock shortages faster than anticipated, prolong vehicle queues, and exacerbate the imbalance in fuel distribution among gas stations. Conversely, during periods of declining demand, the model can also produce estimates that are still higher than actual needs, risking excess stock.

Additionally, to measure the model's accuracy, an evaluation was conducted using the Mean Absolute Percentage Error (MAPE). The MAPE calculation was performed by comparing the actual consumption values with the predicted values from the moving average, then calculating the average absolute percentage error. After that, the absolute difference between the actual and predicted values was calculated, divided by the actual value, and then averaged to obtain the MAPE value. The calculation results showed a MAPE value of 9.20%. Based on this value, the 7-day moving average model can be categorized as having very good accuracy for short-term predictions. This shows that, in general, the model is able to follow the daily fuel consumption pattern quite well. However, the daily error visualization results in Figure 5 show that although most errors are at a low level, there are several spikes in errors that are quite high during certain periods, especially from mid to late March. This indicates that the model is still less responsive to sudden changes in consumption. Analytically,

these error spikes indicate that the moving average method has limitations when used on highly volatile data. This model tends to perform well on stable consumption patterns but is less optimal in capturing sudden extreme changes. Thus, although the overall MAPE value is relatively low, the daily error results still indicate that the model's accuracy is not yet evenly distributed throughout the entire observation period. In other words, the assessment of the model should not only look at the average MAPE value, but also consider the distribution of errors at specific times.

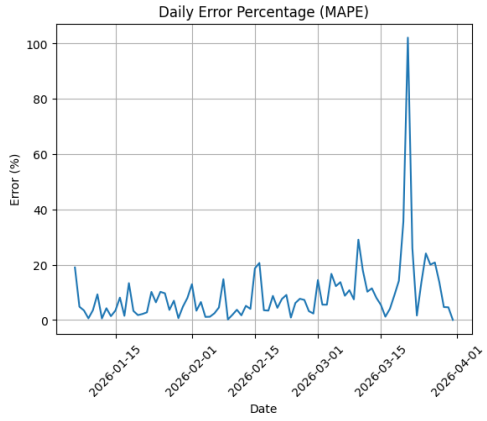


Fig. 5. Daily Error Percentage (MAPE)

These findings have important implications for the process of planning fuel distribution and preparing SPBU purchase orders. The moving average model can be used as an initial approach to estimate fuel needs under normal conditions, but it is not fully adequate if used as the sole basis for decision-making during periods of high demand fluctuations. In an operational context, gas stations still need to consider additional information such as consumption patterns from the past few days, traffic conditions, holidays, or community activities around the gas station location so that the proposed purchase orders are closer to actual needs.

Thus, the prediction results and MAPE evaluation affirm that the use of historical data thru moving averages can help improve the accuracy of fuel distribution planning, but still require adjustments to be more adaptive to field conditions. This approach is important because the main objective of this research is not only to produce predictions but also to support the preparation of more accurate Purchase Orders (PO), reduce the risk of stock shortages at certain gas stations, and help create a more balanced and efficient distribution of subsidized fuel.

D. Recommendations for Oil Fuel Distribution

Based on the analysis of consumption trends, comparisons between gas stations, and predictions of fuel needs, the distribution recommendations in this study focus on optimizing supply management thru the purchase order (PO) mechanism conducted by each gas station. This approach places consumption data as the basis for determining the volume, timing, and composition of the types of fuel requested, allowing for more targeted and efficient distribution.

From a spatial aspect, the analysis results show significant differences in consumption levels between gas stations. SPBU 2438216 (Betungan) has the highest consumption level, so it is recommended to submit larger purchase order (PO) volumes or increase the frequency of submissions to maintain stock availability. Conversely, gas stations with lower consumption levels, such as 2438205 (Tebeng) and 2438203 (Sebakul), can submit PO volumes more proportionally to avoid excess stock and ensure efficient distribution.

From a temporal aspect, the fluctuating consumption pattern indicates that PO submissions and distribution scheduling should not be done uniformly every day. Adjustments need to be made by considering periods with potential consumption spikes, such as weekends or times with high community activity. Thus, the supply of fuel can be more responsive to the occurring demand dynamics.

In addition, the analysis results show that Pertalite consumption is more dominant compared to Biosolar. Therefore, the composition of the PO submission needs to be adjusted to this need, by allocating a larger portion to Pertalite without neglecting the distribution of Biosolar, especially in areas with a high activity of diesel-fueled vehicles.

The storage capacity of fuel at each gas station is also an important factor in determining the distribution strategy. Differences in tank capacity cause each gas station to have a maximum supply reception limit, so increasing the PO volume cannot always be done in a single delivery. Therefore, for gas stations with high consumption, a more appropriate strategy is to increase the frequency of purchase orders (PO) rather than just adding volume at one time. This approach aims to maintain a balance between stock availability and storage capacity limitations. Overall, the fuel distribution recommendations in this study emphasize the integration of spatial dimensions (location and consumption levels of gas stations), temporal dimensions (consumption time patterns), fuel type dimensions (composition of needs), and operational aspects (PO mechanisms and storage capacity). By considering these four aspects, it is expected that fuel distribution management can be conducted in a more adaptive, efficient manner, and in accordance with field demand conditions.

IV. CONCLUSION

This study shows that the pattern of subsidized fuel consumption at six gas stations in Bengkulu City during the period from January to March 2026 is dynamic and fluctuating. The consumption of Pertalite dominates compared to Biosolar, reflecting the high use of gasoline-powered vehicles. In addition, there are significant differences in consumption between gas stations, influenced by factors such as location and mobility levels.

The results of this analysis confirm that fuel consumption is not evenly distributed, both in terms of time and location. This condition has the potential to cause distribution imbalances if planning is carried out without considering the actual consumption characteristics of each gas station. The prediction using the 7-day moving average method shows that fuel consumption in the next period tends to be stable with a gradual increasing trend. This model has a good level of accuracy with a MAPE value of 9.20%, making it suitable as an initial estimate for short-term fuel needs. However, the model still has limitations in capturing sudden spikes in demand.

The implication of this research is the need for a more adaptive and data-driven management of fuel distribution, particularly in the preparation of Purchase Orders (PO) at the gas station level. The determination of quantity, timing, type of fuel, and frequency of requests needs to be adjusted according to actual consumption patterns to make distribution more targeted and efficient.

This research contributes by providing data-based operational analysis at the gas station level as a basis for fuel distribution decision-making. However, this study still has limitations in the scope of data and methods used. Therefore, future research is recommended to use more complex predictive models and integrate external variables to improve the accuracy and quality of the analysis.

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