DATA VISUALIZATION AND ANALYSIS OF PORTABLE FIRE EXTINGUISHER (PFE) IN GREATER JAKARTA USING THE EXPLORATORY DATA ANALYSIS (EDA) METHOD

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ABSTRACT

Proper placement of portable fire extinguishers (PFE) is critical in supporting the initial response to fire incidents. However, the PFE distribution in urban areas is often uneven. This research aims to analyze and visualize PFE data using the Exploratory Data Analysis (EDA) method to show the PFE distribution pattern in Greater Jakarta year 2023-2024. Previous related research mostly focused on general fire incident, on the other hand this research examines the PFE geographic distribution using an exploratory data approach. EDA is used to trace the PFE spatial distribution and to evaluate the effectiveness of their placement based on the potential fire incident in Greater Jakarta. The statistical analysis showed that the PFE average number per location was 7.11 units, with a variance value of 129.57 and a standard deviation of 11.38. The PFE highest distribution was 2,850 units in South Jakarta and the lowest was 6 units in the Seribu Islands. The data visualization was developed using Google Looker Studio in an interactive dashboard, which includes a PFE distribution map, a bar chart to compare PFE units between regions, a stacked bar chart to show PFEs conditions, and some detailed table based on district and subdistrict areas. This research shows that the integration of EDA and interactive spatial visualization can be used for initial analysis in planning a more equitable and risk-based PFE distribution in urban areas.

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Keywords: *Analysis, Data Visualization, Portable Fire Extinguishers (PFE), Dashboard, Exploratory Data Analysis (EDA), Google Looker Studio.*

1. INTRODUCTION

Greater Jakarta, the capital city of Indonesia, has very dense population. This makes the province vulnerable to various incidents, such as fire incidents [1]. The 2023 data shows that electrical short circuit is the leading cause of fire incident with 1,216 cases, followed by other factors such as gas leaks, trash, and cigarette butts. Geographically, South Jakarta experienced the highest number of fire incidents [2].

Facing the fire risk, portable fire extinguishers (PFEs) play a crucial role as the first tool in handling small-scale fire incidents. However, research studies on the PFE distribution in Greater Jakarta are very limited and have not been systematically analyzed using a data-driven approach. Most previous studies have focused more on the causes and frequency of fire incidents, rather than on the readiness of PFE units. Strategic and easily accessible position of PFEs is crucial for the effectiveness of early response [3], which is conceptually related to the principles of risk management and spatial accessibility, namely the suitability of the distribution of equipments to the level of potential danger in an area.

Therefore, this research aims to evaluate and visualize data on the PFE distribution in Greater Jakarta. The Exploratory Data Analysis (EDA) method is used to identify distribution patterns and various numbers of PFEs across Greater Jakarta. This method is used as the initial stage in compiling a basic overview of PFE distribution. Further more, this research would compare the PFE distribution across Greater Jakarta to identify variations and potential uneven distribution across the region. Data visualization and interactive maps would be performed using Google Looker Studio to present the PFE distribution in a more realistic and understandable manner, thereby supporting efforts to improve community preparedness for fire incidents.

2. BACKGROUND THEORY

2.1. Portable Fire Extinguisher

PFE is a Portable Fire Extinguisher designed to extinguish fires in their early stages. According to the Minister of Manpower and Transmigration Regulation 04 - 1980 (Per.04/Men/1980), PFE is "a device that is light to carry and used by one person to extinguish a fire incident when it first starts." Similarly, Indonesian National Standard SNI 03–3987–1995 defines PFE as "a set of light fire extinguishers, easy to carry/move and use by one person, can be used to extinguish a fire incident when it initially starts, not for fires that have already grown." Meanwhile, the National Fire Protection Association (NFPA 10, 2018) defines PFE as "a light, tube-shaped device with a pressurized solution and gas that can be emitted when extinguishing a fire." In short, PFE is a portable fire extinguisher that is easy to be used by one person [4].

2.2. Data Visualization

Data visualization is a method to present information or data in the form of graphs to help understand patterns, relationships, and trends that are difficult to see in tables or figures. This method makes data clearer and more interesting, making it easier to understand for various audiences. This method is very useful in analysis and decision-making process because it simplifies complex data and it is possible to draw conclusion visually. Data visualization can be done using various tools such as Microsoft Excel, Google Looker Studio, Python, and R [5].

2.3. Google Looker Studio

Google Looker Studio is a data visualization application designed as an easy-to-use tool for presenting complex data sets in an interesting way. Google Looker Studio is to help users to create dynamic and visually appealing reports by inputting external data sources into an easy-to-navigate platform. Google Looker Studio can create interactive dashboards, build easy-to-understand data presentations and it can also access various data sources, such as Google Sheets, Google Docs, and others. Hence, reports created with Google Looker Studio are easy to share with other team members and allow real-time editing[6].

2.4. Exploratory Data Analysis (EDA)

The EDA method refers to a critical initial data investigation to seek patterns, to detect anomalies, to test hypotheses, and to verify assumptions by using descriptive statistics and graphical representations (Indra et al., 2025). EDA is a data analysis method that aims to understand the data characteristics in greater depth. In EDA, data analysis uses various visualization techniques, descriptive statistics, and many other methods to seek patterns, relationships, and important information in the dataset [7].

3. RESEARCH METODOLOGY

At this research, data visualization requires some stages that should be followed to obtain valid results, as shown in Figure 1.

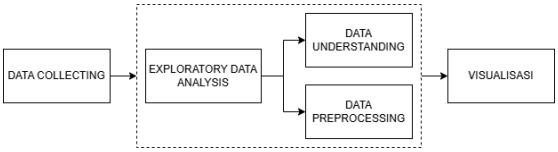


Figure 1. Research stages

4. RESULTS DAN DUSCUSSIONS

4.1. Data Collecting

At this stage, data collection is carried out by downloading the dataset taken from the official website satudata.jakarta.go.id in XLS format.

Figure 2. PFE Data year 2023

Figure 3. PFE Data year 2024

4.2. Import Dataset and Library

Google Collaboratory can be accesed through https://colab.research.google.com/ to import the dataset and run the program through a web browser application such as Chrome. After importing the dataset, the next step is to import the library and to create access to the dataset in Google Collaboratory. A variable named 'df1' is for PFE data year 2023 and another one named 'df2' is for PFE data year 2024. Data verification is carried out to ensure that the data loaded into the variables named 'df1' and 'df2' as the original data, before proceeding to the next step.

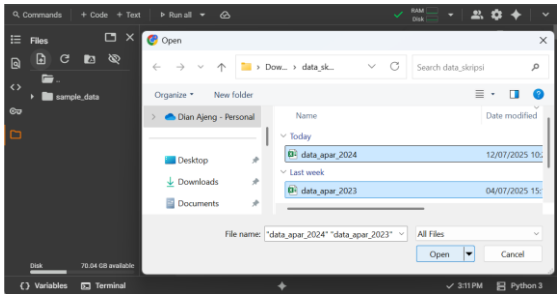


Figure 4. Select the File to Use

```
import pandas as pd
from pandas import read_excel
import numpy as np
```

Figure 5. Import Library

```
df1 = pd.read_excel('/content/data_apar_2023.xlsx')
df2 = pd.read_excel('/content/data_apar_2024.xlsx')
```

Figure 6. Access Dataset

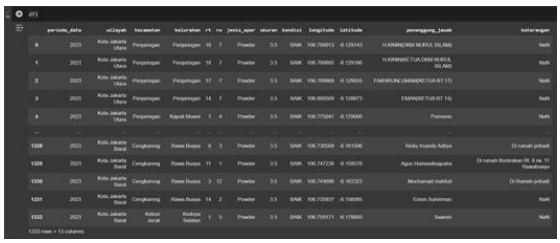


Figure 7. Df1 dataset

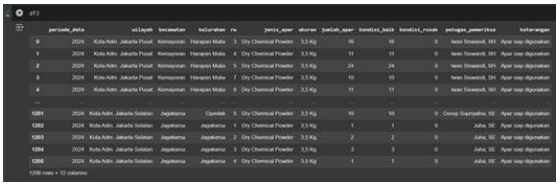


Figure 8. Df2 dataset

4.3. Identification of Data Types and Null Values

This stage is to determine the data type of each column and to find out if there is any null values in the dataset.

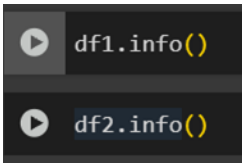


Figure 9. Syntax df.info()

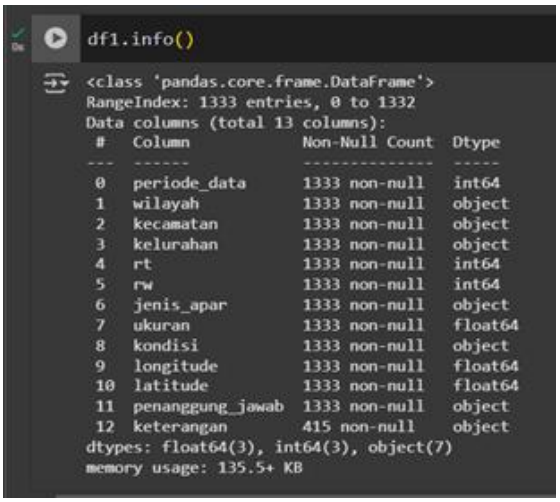


Figure 10. Data on each column in df1

Figure 10 shows the initial inspection results. This figure shows that no null values were found in the first 12 columns, where each column contains 1333 rows of data, the total number of records. However, the "description" column has only 415 rows of data. This indicates 918 rows of data are missing.

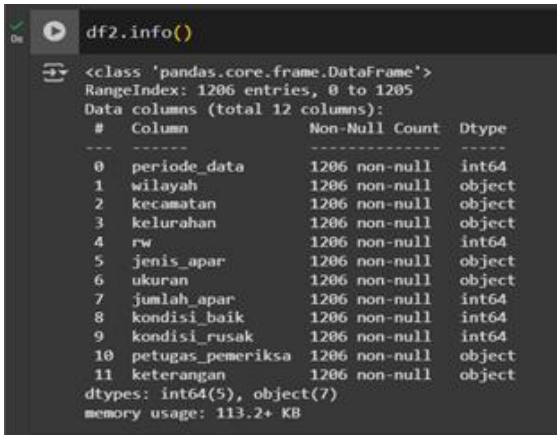


Figure 11. Data on each column in df2

Figure 11 shows that all columns have data without any null values, as indicated by 1206 non-null count in each column.

4.4. Identification of Duplicate Data

To identify duplicate data in a dataset, check for duplicate rows using the *duplicated()* syntax function.

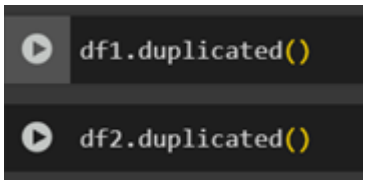


Figure 12. Duplicate Data Checking Syntax

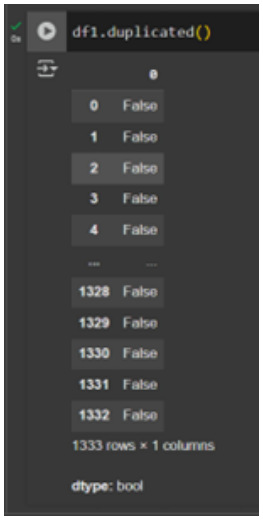


Figure 13. *df1* checking results

Figure 14. *df2* checking results

Figure 13 and 14 show that the check results are false for all rows, which means there are no duplicate rows in the dataset.

4.5. PFEs 2023 Data per Community Area

This stage processes the '*df1*' dataset after the cleaning, merging, and processing dataset.

Figure 15. Number of PFEs.

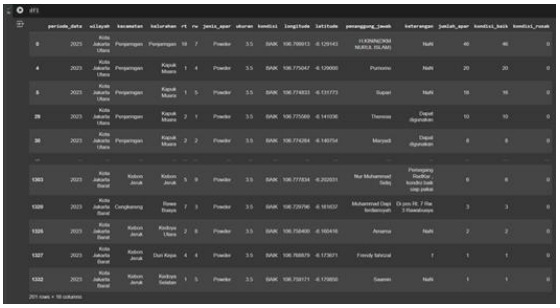
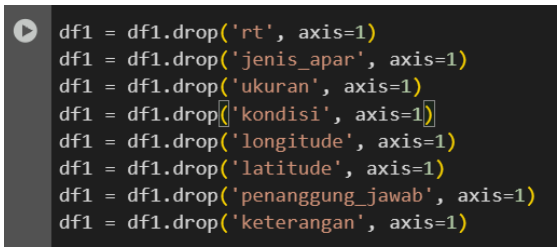


Figure 16. Data df1 processing Results

Figure 16 shows no_of_pfes, good_pfes, and nogood_pfes columns, the data processing result based on the PFE number per area. This figure provides an overview of the number and condition of PFEs in each area. There are 201 data rows on display, representing a unique combination of each area.

4.6. Column Deletion in PFE 2023 Data

At this stage, irrelevant columns in PFE 2023 dataset will be removed as they will not be used in data visualization Google **Looker** Studio.



```
df1 = df1.drop('rt', axis=1)
df1 = df1.drop('jenis_apar', axis=1)
df1 = df1.drop('ukuran', axis=1)
df1 = df1.drop('kondisi', axis=1)
df1 = df1.drop('longitude', axis=1)
df1 = df1.drop('latitude', axis=1)
df1 = df1.drop('penanggung_jawab', axis=1)
df1 = df1.drop('keterangan', axis=1)
```

Figure 17. Delete Column Syntax in PFE 2023 Data

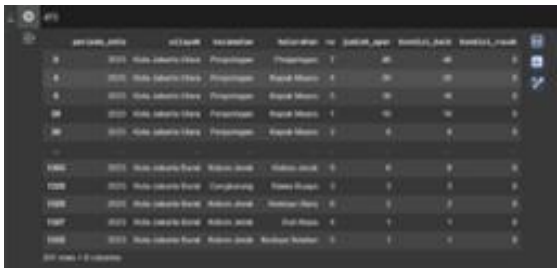


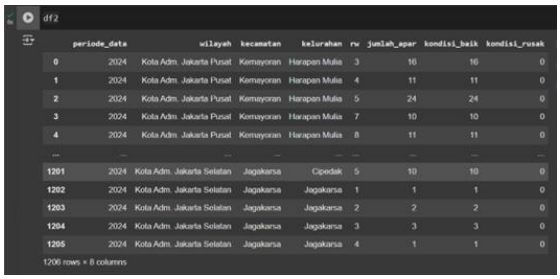
Figure 18. PFE 2023 Data after column deletion

4.7. Column Deletion in PFE 2024 Data

In this stage, irrelevant columns in PFE 2024 dataset will be removed as they will not be used in data visualization Google Looker Studio.

```
df2 = df2.drop('jenis_apar', axis=1)
df2 = df2.drop('ukuran', axis=1)
df2 = df2.drop('petugas_pemeriksa', axis=1)
df2 = df2.drop('keterangan', axis=1)
```

Figure 19. Delete Column Syntax in PFE 2024 Data



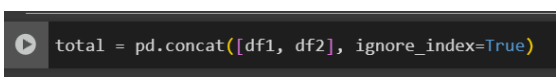
	periode_data	wilayah	kecamatan	kelurahan	rw	jumlah_apar	kondisi_baik	kondisi_rusak
0	2024	Kota Adm. Jakarta Pusat	Kemayoran	Harapan Mulia	3	16	16	0
1	2024	Kota Adm. Jakarta Pusat	Kemayoran	Harapan Mulia	4	11	11	0
2	2024	Kota Adm. Jakarta Pusat	Kemayoran	Harapan Mulia	5	24	24	0
3	2024	Kota Adm. Jakarta Pusat	Kemayoran	Harapan Mulia	7	10	10	0
4	2024	Kota Adm. Jakarta Pusat	Kemayoran	Harapan Mulia	8	11	11	0
...	...	...	...	...	...	...	...	...
1201	2024	Kota Adm. Jakarta Selatan	Jagakarsa	Cipedak	5	10	10	0
1202	2024	Kota Adm. Jakarta Selatan	Jagakarsa	Jagakarsa	1	1	1	0
1203	2024	Kota Adm. Jakarta Selatan	Jagakarsa	Jagakarsa	2	2	2	0
1204	2024	Kota Adm. Jakarta Selatan	Jagakarsa	Jagakarsa	3	3	3	0
1205	2024	Kota Adm. Jakarta Selatan	Jagakarsa	Jagakarsa	4	1	1	0

1206 rows × 8 columns

Figure 20. PFE 2024 Data after column deletion

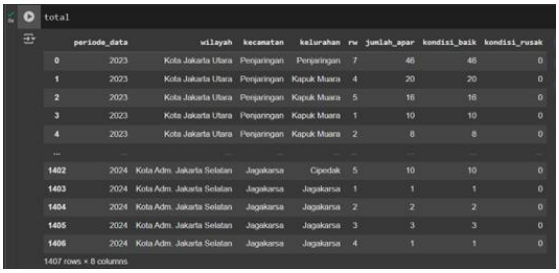
4.8. Merging Two Datasets

The two datasets df1 and df2 will then be merged into a single Dataset named 'total'. The 'total' dataset shows the PFE distribution per area in Greater Jakarta from 2023 to 2024 with a total of 1.407 rows.



```
total = pd.concat([df1, df2], ignore_index=True)
```

Figure 21. Merging Two Datasets Syntax



	periode_data	wilayah	kecamatan	kelurahan	rw	jumlah_apar	kondisi_baik	kondisi_rusak
0	2023	Kota Jakarta Utara	Penjaringan	Penjaringan	7	46	46	0
1	2023	Kota Jakarta Utara	Penjaringan	Kapuk Muara	4	20	20	0
2	2023	Kota Jakarta Utara	Penjaringan	Kapuk Muara	5	16	16	0
3	2023	Kota Jakarta Utara	Penjaringan	Kapuk Muara	1	10	10	0
4	2023	Kota Jakarta Utara	Penjaringan	Kapuk Muara	2	8	8	0
...	...	...	...	...	...	...	...	...
1402	2024	Kota Adm. Jakarta Selatan	Jagakarsa	Cipedak	5	10	10	0
1403	2024	Kota Adm. Jakarta Selatan	Jagakarsa	Jagakarsa	1	1	1	0
1404	2024	Kota Adm. Jakarta Selatan	Jagakarsa	Jagakarsa	2	2	2	0
1405	2024	Kota Adm. Jakarta Selatan	Jagakarsa	Jagakarsa	3	3	3	0
1406	2024	Kota Adm. Jakarta Selatan	Jagakarsa	Jagakarsa	4	1	1	0

1407 rows × 8 columns

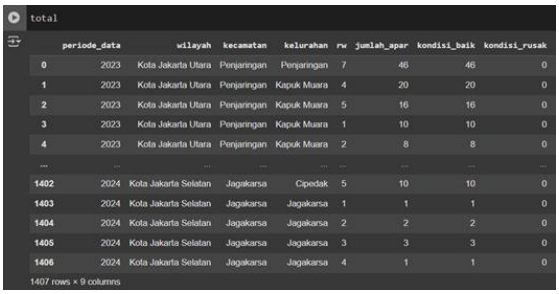
Figure 22. Results of Merging Two Datasets

4.9. Modifying the Code Area Column Value

The next stage is to modify the code area column value by removing the word "Adm."

```
total['wilayah'] = total['wilayah'].str.replace(r'Adm\.?\s*', '', regex=True)
```

Figure 23. Modifying Column Value Syntax



	periode_data	wilayah	kecamatan	kelurahan	rw	jumlah_apar	kondisi_baik	kondisi_rusak
0	2023	Kota Jakarta Utara	Penjaringan	Penjaringan	7	46	46	0
1	2023	Kota Jakarta Utara	Penjaringan	Kapuk Muara	4	20	20	0
2	2023	Kota Jakarta Utara	Penjaringan	Kapuk Muara	5	16	16	0
3	2023	Kota Jakarta Utara	Penjaringan	Kapuk Muara	1	10	10	0
4	2023	Kota Jakarta Utara	Penjaringan	Kapuk Muara	2	8	8	0
...	...	...	...	...	...	...	...	...
1402	2024	Kota Jakarta Selatan	Jagakarsa	Cipedak	5	10	10	0
1403	2024	Kota Jakarta Selatan	Jagakarsa	Jagakarsa	1	1	1	0
1404	2024	Kota Jakarta Selatan	Jagakarsa	Jagakarsa	2	2	2	0
1405	2024	Kota Jakarta Selatan	Jagakarsa	Jagakarsa	3	3	3	0
1406	2024	Kota Jakarta Selatan	Jagakarsa	Jagakarsa	4	1	1	0

1407 rows × 9 columns

Figure 24. Results of modifying the code area column value.

4.10. Creating a Combined Column

This stage aims to combine location representation in a consistent and concise format.

```
total['lokasi'] = (
    total['wilayah'] + ', ' +
    total['kecamatan'] + ', ' +
    total['kelurahan'] + ', RW ' +
    total['rw'].astype(str)
)
```

Figure 25. Creating a Combined Column Syntax

Figure 26. Results of Creating a Combined Column

4.11. Descriptive Statistics

Descriptive statistic is to provide a general overview of the 'total' DataFrame.

```
# kelompokkan berdasarkan lokasi dan jumlahkan unit APAR-nya
apar_per_lokasi = total.groupby('lokasi')['jumlah_apar'].sum()

# statistik deskriptif berdasarkan jumlah unit APAR per lokasi
mean = apar_per_lokasi.mean()
variance = apar_per_lokasi.var(ddof=1)
std_dev = apar_per_lokasi.std(ddof=1)

# cetak hasil
print("Rata-rata unit APAR per lokasi:", mean)
print(f"Variance: {variance}")
print(f"Standar Deviasi: {std_dev}")
```

Figure 27. Descriptive Statistics Syntax

```
Rata-rata unit APAR per lokasi: 7.115196078431373
Variance: 129.56725866961722
Standar Deviasi: 11.382761469415811
```

Figure 28. Descriptive Statistics

Figure 28 shows that the PFE average number is 7.12 unis per location. This means that, in general, each recorded location has approximately 7 units PFE. However, the variance value of 129.57 and standard deviation of 11.38 indicate that there is significant variation in the number of PFE units between locations.

4.12. Exporting Data

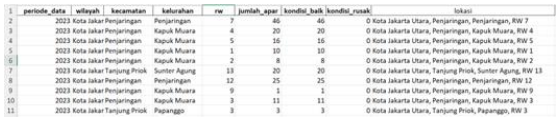
After data understanding and data preprocessing, the next stage is to export data into Excel format, and then followed by creating a visualization dashboard using Google Lookup Studio.

```
from google.colab import files

total.to_excel('/content/Data_APAR_di_Masyarakat.xlsx', index=False)

files.download('Data_APAR_di_Masyarakat.xlsx')
```

Figure 29. Exporting Data Syntax



	periode_data	wilayah	kecamatan	kelurahan	rw	jumlah_apar	kondisi_baik	kondisi_rusak	lokasi
2	2023	Kota Jakar Penjaringan	Penjaringan	Penjaringan	7	46	46	0	Kota Jakarta Utara, Penjaringan, Penjaringan, RW 7
3	2023	Kota Jakar Penjaringan	Kapuk Muara	Kapuk Muara	4	20	20	0	Kota Jakarta Utara, Penjaringan, Kapuk Muara, RW 4
4	2023	Kota Jakar Penjaringan	Kapuk Muara	Kapuk Muara	5	16	16	0	Kota Jakarta Utara, Penjaringan, Kapuk Muara, RW 5
5	2023	Kota Jakar Penjaringan	Kapuk Muara	Kapuk Muara	1	10	10	0	Kota Jakarta Utara, Penjaringan, Kapuk Muara, RW 1
6	2023	Kota Jakar Penjaringan	Kapuk Muara	Kapuk Muara	2	8	8	0	Kota Jakarta Utara, Penjaringan, Kapuk Muara, RW 2
7	2023	Kota Jakar Tanjung Priok	Sunter Agung	Sunter Agung	13	20	20	0	Kota Jakarta Utara, Tanjung Priok, Sunter Agung, RW 13
8	2023	Kota Jakar Penjaringan	Penjaringan	Penjaringan	12	25	25	0	Kota Jakarta Utara, Penjaringan, Penjaringan, RW 12
9	2023	Kota Jakar Penjaringan	Kapuk Muara	Kapuk Muara	9	1	1	0	Kota Jakarta Utara, Penjaringan, Kapuk Muara, RW 9
10	2023	Kota Jakar Penjaringan	Kapuk Muara	Kapuk Muara	3	11	11	0	Kota Jakarta Utara, Penjaringan, Kapuk Muara, RW 3
11	2023	Kota Jakar Tanjung Priok	Papanggo	Papanggo	3	3	3	0	Kota Jakarta Utara, Tanjung Priok, Papanggo, RW 3

Figure 30. EDA Results

4.13. Data Visualization Results

After exploratory data analysis (EDA) stage, an interactive dashboard was created and it can be accessed through the following link: https://lookerstudio.google.com/reporting/14af7037-4610-4c3d-8291-f2b07e830a11.

Figure 31 shows an interactive Portable Fire Extinguisher (PFE) dashboard. This dashboard presents the PFE distribution in Greater Jakarta year 2023–2024, along with the PFE condition. The interactive map displays the PFE location per area, while the bar chart shows the comparison number of PFE units between areas.

South Jakarta was recorded as the area with the highest number (2,088 PFEs), and the Seribu Islands with the lowest number (6 PFEs). The stacked bar chart shows the PFE condition by region. The statistical summary shows 8,674 PFEs

in good condition and 35 PFEs damaged, out of 8,709 recorded PFEs. The horizontal table displays a breakdown of PFE conditions by region, while the more detail table at the bottom presents information by district and sub-district area. The dashboard features an interactive filter feature to customize the data display by sub-district, district and year.

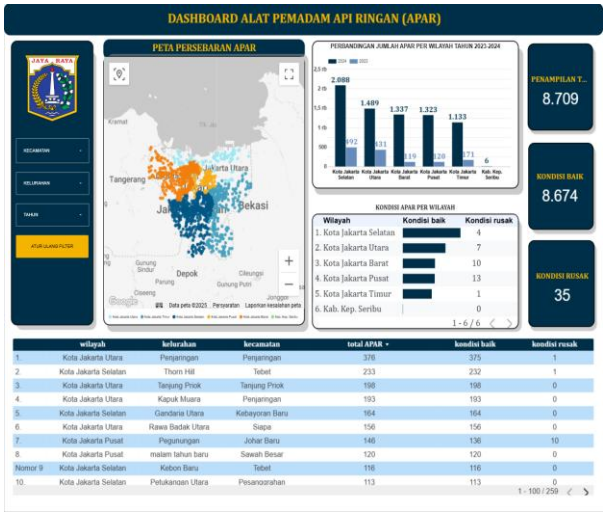


Figure 31. Portable Fire Extinguisher (PFE) Dashboard

5. CONCLUSIONS & SUGGESTIONS

Analysis of Portable Fire Extinguisher (PFE) data in Greater Jakarta shows that the distribution of PFEs is not evenly distributed. This is reflected in descriptive statistical analysis, which shows significant variation in the number of PFEs per area, on average 7.11 units per area; but with a relatively high standard deviation of 11.38. South Jakarta has the highest number PFEs, while the Seribu Islands region has the lowest. To visualize this data, an interactive dashboard was created using Google Lookup Studio, which presents a distribution map, a comparison of the number between regions, the PFE conditions (good or damaged), and detailed tables per district and sub-district area. This dashboard is expected to serve as a more optimal evaluation tool.

To follow-up, it is recommended that local governments reevaluate the PFE distribution by considering the level of fire risk in each region. It is also crucial to ensure that PFE data is always well-managed and integrated to support effective policy making. Furthermore, educating the public about PFE use is also essential to improve readyness. For future research, it is recommended that analysis [8] should not focus on the number and location only, but it should also consider the various factors causing the fire incident and the type of fire as additional variables. This aims to give better recommendations for PFE location based on the actual potential risk in the area.

REFERENCES

[1] Anonim, "Tentang Jakarta," *JAKARTA.GO.ID*, diakses 1 Mei, 2024, https://www.jakarta.go.id/tentang-jakarta.

[2] Anonim, "Pengantar APAR (Alat Pemadam Api Ringan)." *Damkar Kota Banda Aceh*, diakses 1 Mei, 2021, https://damkar.bandaacehkota.go.id/2021/03/25/pengantar-apar-alat-pemadam-api-ringan/.

[3] Mukhamad Kurniawan, Rhama Purna Jati, "Kebakaran Hampir Tiap Hari Terjadi di Jakarta, Apa Penyebabnya?," *KOMPAS.ID*, diakses 1 Mei, 2024, https://www.kompas.id/baca/metro/2024/08/15/kebakaran-hampir-setiap-hari-terjadi-di-jakarta-apa-penyebabnya.

[4] Budi Sulistiyo Nugroho, Silvya Yusnica Agnesty, Farid Alfalaki Hamid, Suyanto, Wiyanto, Taman, Abdul Malik, "MODUL PRAKTIKUM LABORATORIUM FIRE & SAFETY," Penerbit Adab, 2022, https://books.google.co.id/books?id=AjJkEAAAQBAJ.

[5] I Gede Iwan Sudipa, Ida Bagus Gede Sarasvananda, Hartatik, Heri Prayitno, I Nyoman Tri Anindia Putra, Risanto Darmawan, Dwi Atmodjo WP, Efitra, "Teknik Visualisasi Data," PT. Sonpedia Publishing Indonesia, 2023, https://books.google.co.id/books?id=LjC4EAAAQBAJ.

[6] Hadrianti H. D. Lasari, Samahuddin, Pandji Winata Nurikhwan, Wahyuni, Nur Amalia Muslimah, Ikrima Medyna, Amalia Juwita Hasri, Dewi Firani, Verinda Ghea Ayu Astuti, "Pendampingan Pembuatan Dashboard Status Gizi," Penerbit NEM, 2024, https://books.google.co.id/books?id=kzcVEQAAQBAJ.

[7] Fatwa Ramdani, Ika Qutsiati Utami, "Pengantar Data Science," Bumi Aksara, 2024, https://books.google.co.id/books?id=l8rsEAAAQBAJ.