Volcano Activity Analysis and Visualization in Indonesia

This notebook analyzes volcanic activity in Indonesia, using visualizations and predictive modeling to gain insights into volcanic characteristics, intensity, and spatial distribution.

```
!pip install prophet
```

```
Requirement already satisfied: prophet in
/opt/conda/lib/python3.10/site-packages (1.1.5)
Requirement already satisfied: cmdstanpy>=1.0.4 in
/opt/conda/lib/python3.10/site-packages (from prophet) (1.2.4)
Requirement already satisfied: numpy>=1.15.4 in
/opt/conda/lib/python3.10/site-packages (from prophet) (1.26.4)
Requirement already satisfied: matplotlib>=2.0.0 in
/opt/conda/lib/python3.10/site-packages (from prophet) (3.7.5)
Requirement already satisfied: pandas>=1.0.4 in
/opt/conda/lib/python3.10/site-packages (from prophet) (2.2.3)
Requirement already satisfied: holidays>=0.25 in
/opt/conda/lib/python3.10/site-packages (from prophet) (0.57)
Requirement already satisfied: tqdm>=4.36.1 in
/opt/conda/lib/python3.10/site-packages (from prophet) (4.66.4)
Requirement already satisfied: importlib-resources in
/opt/conda/lib/python3.10/site-packages (from prophet) (6.4.0)
Requirement already satisfied: stanio<2.0.0,>=0.4.0 in
/opt/conda/lib/python3.10/site-packages (from cmdstanpy>=1.0.4-
>prophet) (0.5.1)
Requirement already satisfied: python-dateutil in
/opt/conda/lib/python3.10/site-packages (from holidays>=0.25->prophet)
(2.9.0.post0)
Requirement already satisfied: contourpy>=1.0.1 in
/opt/conda/lib/python3.10/site-packages (from matplotlib>=2.0.0-
>prophet) (1.2.1)
Requirement already satisfied: cycler>=0.10 in
/opt/conda/lib/python3.10/site-packages (from matplotlib>=2.0.0-
>prophet) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in
/opt/conda/lib/python3.10/site-packages (from matplotlib>=2.0.0-
>prophet) (4.53.0)
```

```
Requirement already satisfied: kiwisolver>=1.0.1 in
/opt/conda/lib/python3.10/site-packages (from matplotlib>=2.0.0-
>prophet) (1.4.5)
Requirement already satisfied: packaging>=20.0 in
/opt/conda/lib/python3.10/site-packages (from matplotlib>=2.0.0-
>prophet) (21.3)
Requirement already satisfied: pillow>=6.2.0 in
/opt/conda/lib/python3.10/site-packages (from matplotlib>=2.0.0-
>prophet) (10.3.0)
Requirement already satisfied: pyparsing>=2.3.1 in
/opt/conda/lib/python3.10/site-packages (from matplotlib>=2.0.0-
>prophet) (3.1.2)
Requirement already satisfied: pytz>=2020.1 in
/opt/conda/lib/python3.10/site-packages (from pandas>=1.0.4->prophet)
(2024.1)
Requirement already satisfied: tzdata>=2022.7 in
/opt/conda/lib/python3.10/site-packages (from pandas>=1.0.4->prophet)
(2024.1)
Requirement already satisfied: six>=1.5 in
/opt/conda/lib/python3.10/site-packages (from python-dateutil-
>holidays>=0.25->prophet) (1.16.0)
```

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import plotly.express as px
from sklearn.preprocessing import LabelEncoder
import prophet
import geopandas as gpd
from mpl_toolkits.axes_grid1 import make_axes_locatable
```

```
# Load volcano data
volcano_data = pd.read_csv('/kaggle/input/volcano-
        dataset/database.csv')
volcano_data.head()
```

	Number	Name	Country	Region	Type	Activi Evidenc
0	210010	West Eifel Volcanic	Germany	Mediterranean and Western	Maar(s)	Eruption Dated

	Number	Name	Country	Region	Type	Activi Evidenc
		Field		Asia		
1	210020	Chaine des Puys	France	Mediterranean and Western Asia	Lava dome(s)	Eruption Dated
2	210030	Olot Volcanic Field	Spain	Mediterranean and Western Asia	Pyroclastic cone(s)	Evidence Credible
3	210040	Calatrava Volcanic Field	Spain	Mediterranean and Western Asia	Pyroclastic cone(s)	Eruption Dated
4	211001	Larderello	Italy	Mediterranean and Western Asia	Explosion crater(s)	Eruption Observe

```
# Check for missing values and basic data types
volcano_data.info()
volcano_data.describe(include='all')
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1508 entries, 0 to 1507
Data columns (total 12 columns):
 #   Column               Non-Null Count  Dtype  
---  ------               --------------  -----  
 0   Number               1508 non-null   int64  
 1   Name                 1508 non-null   object 
 2   Country              1508 non-null   object 
 3   Region               1508 non-null   object 
 4   Type                 1508 non-null   object 
 5   Activity Evidence    1507 non-null   object 
 6   Last Known Eruption  1508 non-null   object 
 7   Latitude             1508 non-null   float64
 8   Longitude            1508 non-null   float64
```

```
 9   Elevation (Meters)   1508 non-null   int64
 10  Dominant Rock Type   1455 non-null   object
 11  Tectonic Setting     1501 non-null   object
dtypes: float64(2), int64(2), object(8)
memory usage: 141.5+ KB
```

	Number	Name	Country	Region	Type
count	1508.000000	1508	1508	1508	1508
unique	NaN	1478	100	19	33
top	NaN	Unnamed	United States	South America	Stratovolcano
freq	NaN	23	173	197	597
mean	296656.110743	NaN	NaN	NaN	NaN
std	48861.852600	NaN	NaN	NaN	NaN
min	210010.000000	NaN	NaN	NaN	NaN
25%	261157.500000	NaN	NaN	NaN	NaN
50%	300015.000000	NaN	NaN	NaN	NaN
75%	342123.250000	NaN	NaN	NaN	NaN
max	390847.000000	NaN	NaN	NaN	NaN

```
# Fill missing values for analysis
volcano_data['Activity Evidence'] = volcano_data['Activity
        Evidence'].fillna('Unknown')
volcano_data['Dominant Rock Type'] = volcano_data['Dominant Rock
        Type'].fillna('Unknown')

# Filter for volcanoes in Indonesia
indonesia_volcano_data = volcano_data[volcano_data['Country'] ==
        'Indonesia']


# Plot volcano locations in Indonesia
fig = px.scatter_mapbox(indonesia_volcano_data, lat='Latitude',
        lon='Longitude',
                        hover_name='Name', hover_data=['Country',
        'Region', 'Type'],
```

```
                        color='Type', zoom=4, height=600,
        title="Volcano Locations in Indonesia")
fig.update_layout(mapbox_style="carto-positron")
fig.show()
```

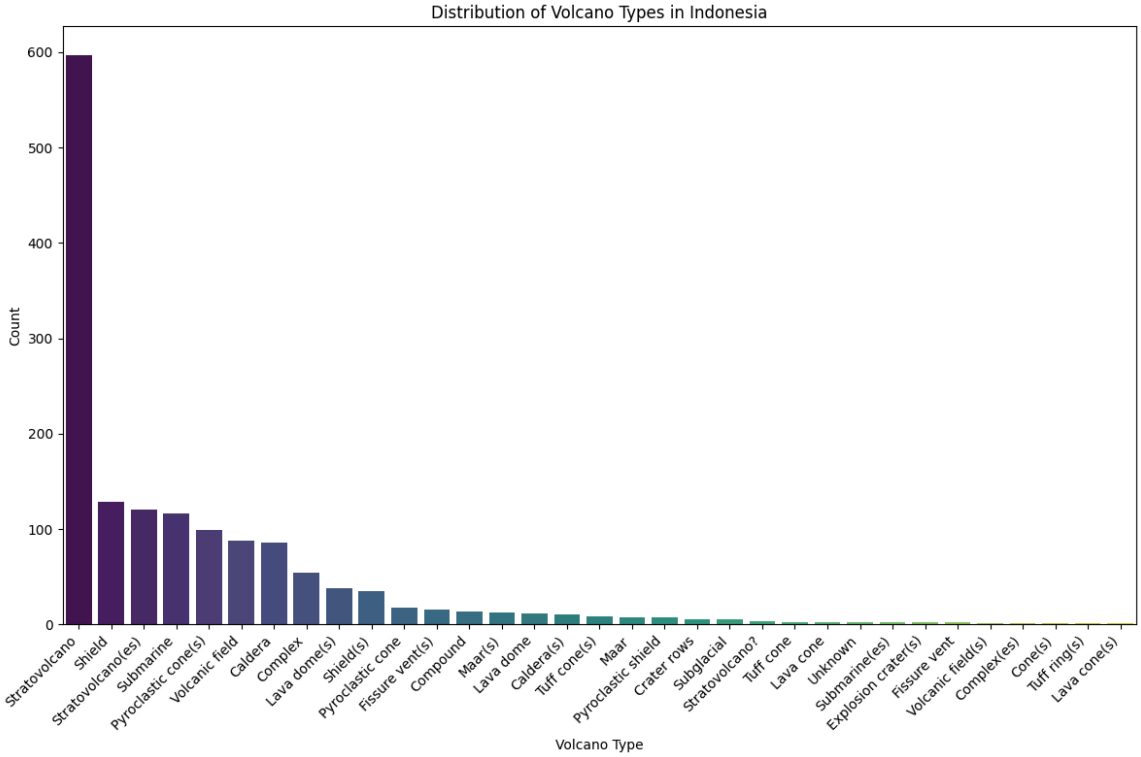
```
import plotly.express as px

# Filter volcano data for Indonesia
indonesia_volcano_data = volcano_data[volcano_data['Country'] ==
        'Indonesia']

# Ensure Latitude and Longitude columns are numeric
indonesia_volcano_data['Latitude'] =
        pd.to_numeric(indonesia_volcano_data['Latitude'],
        errors='coerce')
indonesia_volcano_data['Longitude'] =
        pd.to_numeric(indonesia_volcano_data['Longitude'],
        errors='coerce')

# Remove rows with missing coordinates or elevation
```

```
indonesia_volcano_data = indonesia_volcano_data.dropna(subset=
        ['Latitude', 'Longitude', 'Elevation (Meters)'])


# Get the elevation range for the volcanoes
elevation_range = (indonesia_volcano_data['Elevation (Meters)'].min(),
        indonesia_volcano_data['Elevation (Meters)'].max())


# Create a density heatmap of volcanoes on the map of Indonesia
fig = px.density_mapbox(indonesia_volcano_data, lat='Latitude',
        lon='Longitude',
                        hover_name='Name', hover_data=['Country',
        'Region', 'Type', 'Elevation (Meters)'],
                        color_continuous_scale='Reds',
                        title=f"Density Heatmap of Volcanoes in
        Indonesia (Elevation Range: {elevation_range[0]}m to
        {elevation_range[1]}m)",
                        zoom=4, height=600)


# Update the map style (using a Mapbox style that doesn't require an
        access token)
fig.update_layout(mapbox_style="open-street-map")


# Show the plot
fig.show()
```

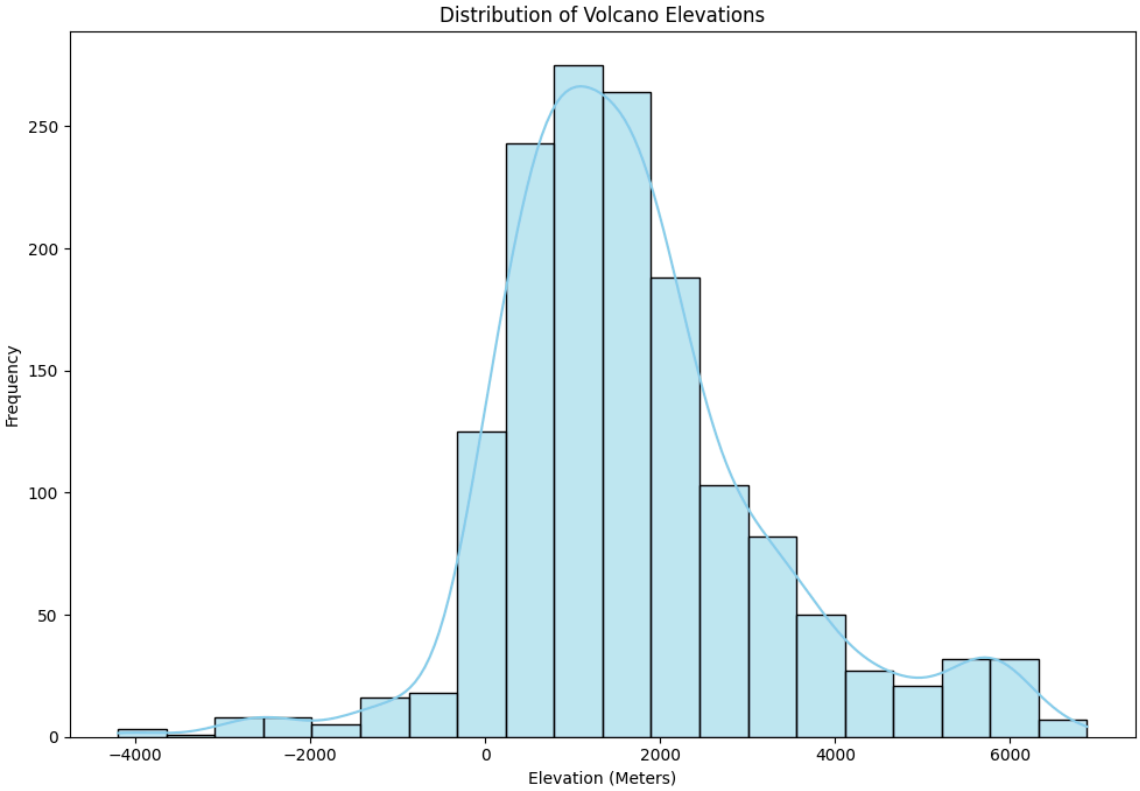
```
/tmp/ipykernel_30/976909514.py:7: SettingWithCopyWarning:



A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation:
https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy

/tmp/ipykernel_30/976909514.py:8: SettingWithCopyWarning:



A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation:
https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
```

```
import matplotlib.pyplot as plt
import seaborn as sns

# Plot volcano types with adjusted figure size and rotation
plt.figure(figsize=(12, 8))  # Increase figure size for clarity
sns.countplot(data=volcano_data, x='Type',
        order=volcano_data['Type'].value_counts().index,
        palette='viridis')
plt.xticks(rotation=45, ha='right')  # Rotate labels and align them to
        the right
plt.title("Distribution of Volcano Types in Indonesia")
plt.xlabel("Volcano Type")
plt.ylabel("Count")
plt.tight_layout()  # Adjust layout to ensure everything fits
plt.show()

# Plot elevation distribution
plt.figure(figsize=(10, 7))
sns.histplot(volcano_data['Elevation (Meters)'], bins=20, kde=True,
        color='skyblue')
plt.title("Distribution of Volcano Elevations")
```

```
plt.xlabel("Elevation (Meters)")
plt.ylabel("Frequency")
plt.tight_layout()
plt.show()
```




```
/opt/conda/lib/python3.10/site-packages/seaborn/_oldcore.py:1119:
FutureWarning:

use_inf_as_na option is deprecated and will be removed in a future
version. Convert inf values to NaN before operating instead.
```


Distribution of Volcano Elevations
Frequency
Elevation (Meters)
0
50
100
150
200
250
−4000
−2000
0
2000
4000
6000