```
! pip install pandas
! pip install numpy
! pip install matplotlib
! pip install tweepy
! pip install pandas tweepy
! pip install textblob
```

```
Requirement already satisfied: pandas in c:\users\g a  computers\
anaconda3\lib\site-packages (2.2.2)
Requirement already satisfied: numpy>=1.26.0 in c:\users\g a
computers\anaconda3\lib\site-packages (from pandas) (1.26.4)
Requirement already satisfied: python-dateutil>=2.8.2 in c:\users\g a
computers\anaconda3\lib\site-packages (from pandas) (2.9.0.post0)
Requirement already satisfied: pytz>=2020.1 in c:\users\g a
computers\anaconda3\lib\site-packages (from pandas) (2024.1)
Requirement already satisfied: tzdata>=2022.7 in c:\users\g a
computers\anaconda3\lib\site-packages (from pandas) (2023.3)
Requirement already satisfied: six>=1.5 in c:\users\g a  computers\
anaconda3\lib\site-packages (from python-dateutil>=2.8.2->pandas)
(1.16.0)
Requirement already satisfied: numpy in c:\users\g a  computers\
anaconda3\lib\site-packages (1.26.4)
Requirement already satisfied: matplotlib in c:\users\g a  computers\
anaconda3\lib\site-packages (3.8.4)
Requirement already satisfied: contourpy>=1.0.1 in c:\users\g a
computers\anaconda3\lib\site-packages (from matplotlib) (1.2.0)
Requirement already satisfied: cycler>=0.10 in c:\users\g a
computers\anaconda3\lib\site-packages (from matplotlib) (0.11.0)
Requirement already satisfied: fonttools>=4.22.0 in c:\users\g a
computers\anaconda3\lib\site-packages (from matplotlib) (4.51.0)
Requirement already satisfied: kiwisolver>=1.3.1 in c:\users\g a
computers\anaconda3\lib\site-packages (from matplotlib) (1.4.4)
Requirement already satisfied: numpy>=1.21 in c:\users\g a  computers\
anaconda3\lib\site-packages (from matplotlib) (1.26.4)
Requirement already satisfied: packaging>=20.0 in c:\users\g a
computers\anaconda3\lib\site-packages (from matplotlib) (23.2)
Requirement already satisfied: pillow>=8 in c:\users\g a  computers\
anaconda3\lib\site-packages (from matplotlib) (10.3.0)
Requirement already satisfied: pyparsing>=2.3.1 in c:\users\g a
computers\anaconda3\lib\site-packages (from matplotlib) (3.0.9)
Requirement already satisfied: python-dateutil>=2.7 in c:\users\g a
computers\anaconda3\lib\site-packages (from matplotlib) (2.9.0.post0)
Requirement already satisfied: six>=1.5 in c:\users\g a  computers\
anaconda3\lib\site-packages (from python-dateutil>=2.7->matplotlib)
(1.16.0)
Requirement already satisfied: tweepy in c:\users\g a  computers\
anaconda3\lib\site-packages (4.14.0)
Requirement already satisfied: oauthlib<4,>=3.2.0 in c:\users\g a
computers\anaconda3\lib\site-packages (from tweepy) (3.2.2)
Requirement already satisfied: requests<3,>=2.27.0 in c:\users\g a
```

```
computers\anaconda3\lib\site-packages (from tweepy) (2.32.2)
Requirement already satisfied: requests-oauthlib<2,>=1.2.0 in c:\
users\g a  computers\anaconda3\lib\site-packages (from tweepy) (1.3.1)
Requirement already satisfied: charset-normalizer<4,>=2 in c:\users\g
a  computers\anaconda3\lib\site-packages (from requests<3,>=2.27.0-
>tweepy) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in c:\users\g a
computers\anaconda3\lib\site-packages (from requests<3,>=2.27.0-
>tweepy) (3.7)
Requirement already satisfied: urllib3<3,>=1.21.1 in c:\users\g a
computers\anaconda3\lib\site-packages (from requests<3,>=2.27.0-
>tweepy) (2.2.2)
Requirement already satisfied: certifi>=2017.4.17 in c:\users\g a
computers\anaconda3\lib\site-packages (from requests<3,>=2.27.0-
>tweepy) (2024.8.30)
Requirement already satisfied: pandas in c:\users\g a  computers\
anaconda3\lib\site-packages (2.2.2)
Requirement already satisfied: tweepy in c:\users\g a  computers\
anaconda3\lib\site-packages (4.14.0)
Requirement already satisfied: numpy>=1.26.0 in c:\users\g a
computers\anaconda3\lib\site-packages (from pandas) (1.26.4)
Requirement already satisfied: python-dateutil>=2.8.2 in c:\users\g a
computers\anaconda3\lib\site-packages (from pandas) (2.9.0.post0)
Requirement already satisfied: pytz>=2020.1 in c:\users\g a
computers\anaconda3\lib\site-packages (from pandas) (2024.1)
Requirement already satisfied: tzdata>=2022.7 in c:\users\g a
computers\anaconda3\lib\site-packages (from pandas) (2023.3)
Requirement already satisfied: oauthlib<4,>=3.2.0 in c:\users\g a
computers\anaconda3\lib\site-packages (from tweepy) (3.2.2)
Requirement already satisfied: requests<3,>=2.27.0 in c:\users\g a
computers\anaconda3\lib\site-packages (from tweepy) (2.32.2)
Requirement already satisfied: requests-oauthlib<2,>=1.2.0 in c:\
users\g a  computers\anaconda3\lib\site-packages (from tweepy) (1.3.1)
Requirement already satisfied: six>=1.5 in c:\users\g a  computers\
anaconda3\lib\site-packages (from python-dateutil>=2.8.2->pandas)
(1.16.0)
Requirement already satisfied: charset-normalizer<4,>=2 in c:\users\g
a  computers\anaconda3\lib\site-packages (from requests<3,>=2.27.0-
>tweepy) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in c:\users\g a
computers\anaconda3\lib\site-packages (from requests<3,>=2.27.0-
>tweepy) (3.7)
Requirement already satisfied: urllib3<3,>=1.21.1 in c:\users\g a
computers\anaconda3\lib\site-packages (from requests<3,>=2.27.0-
>tweepy) (2.2.2)
Requirement already satisfied: certifi>=2017.4.17 in c:\users\g a
computers\anaconda3\lib\site-packages (from requests<3,>=2.27.0-
>tweepy) (2024.8.30)
Requirement already satisfied: textblob in c:\users\g a  computers\
anaconda3\lib\site-packages (0.18.0.post0)
Requirement already satisfied: nltk>=3.8 in c:\users\g a  computers\
anaconda3\lib\site-packages (from textblob) (3.8.1)
Requirement already satisfied: click in c:\users\g a  computers\
anaconda3\lib\site-packages (from nltk>=3.8->textblob) (8.1.7)
Requirement already satisfied: joblib in c:\users\g a  computers\
anaconda3\lib\site-packages (from nltk>=3.8->textblob) (1.4.2)
Requirement already satisfied: regex>=2021.8.3 in c:\users\g a
computers\anaconda3\lib\site-packages (from nltk>=3.8->textblob)
(2023.10.3)
Requirement already satisfied: tqdm in c:\users\g a  computers\
anaconda3\lib\site-packages (from nltk>=3.8->textblob) (4.66.4)
Requirement already satisfied: colorama in c:\users\g a  computers\
anaconda3\lib\site-packages (from click->nltk>=3.8->textblob) (0.4.6)
```

```python
users_df = pd.read_csv(r"D:\Uni Graz Assignments\FCSS\Final
Assignment\Water Quality - Every Drop Matters\Cities1.csv")
print("Dataset Preview:")
display(users_df.head())

print("\nDataset Information:")
users_df.info()

print("\nSummary Statistics:")
display(users_df.describe())
```

```
Dataset Preview:

               City                Region                   Country  \
0     New York City              New York  United States of America   
1  Washington, D.C.  District of Columbia  United States of America   
2     San Francisco            California  United States of America   
3       Los Angeles            California  United States of America   
4        Alexandria              Virginia  United States of America   

  ParentLocation  AirQuality  WaterPollution  
0       Americas   46.816038       49.504950  
1       Americas   66.129032       49.107143  
2       Americas   60.514019       43.000000  
3       Americas   36.621622       61.299435  
4       Americas   89.062500       46.153846  


Dataset Information:
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3082 entries, 0 to 3081
Data columns (total 6 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   City            3082 non-null   object 
 1   Region          2790 non-null   object 
 2   Country         3082 non-null   object 
 3   ParentLocation  3082 non-null   object 
 4   AirQuality      3082 non-null   float64
 5   WaterPollution  3082 non-null   float64
dtypes: float64(2), object(4)
memory usage: 144.6+ KB

Summary Statistics:

        AirQuality  WaterPollution
count  3082.000000     3082.000000
mean     68.336600       41.826076
std      27.446439       25.075062
min       0.000000        0.000000
25%      50.000000       25.000000
50%      75.000000       50.000000
75%      90.748355       51.785714
max     100.000000      100.000000
```

```
users_df = pd.read_csv(r"D:\Uni Graz Assignments\FCSS\Final 
Assignment\Water Quality - Every Drop Matters\Cities1.csv")
print(users_df.columns)
```

```
Index(['City', 'Region', 'Country', 'ParentLocation', 'AirQuality',
       'WaterPollution'],
      dtype='object')
```

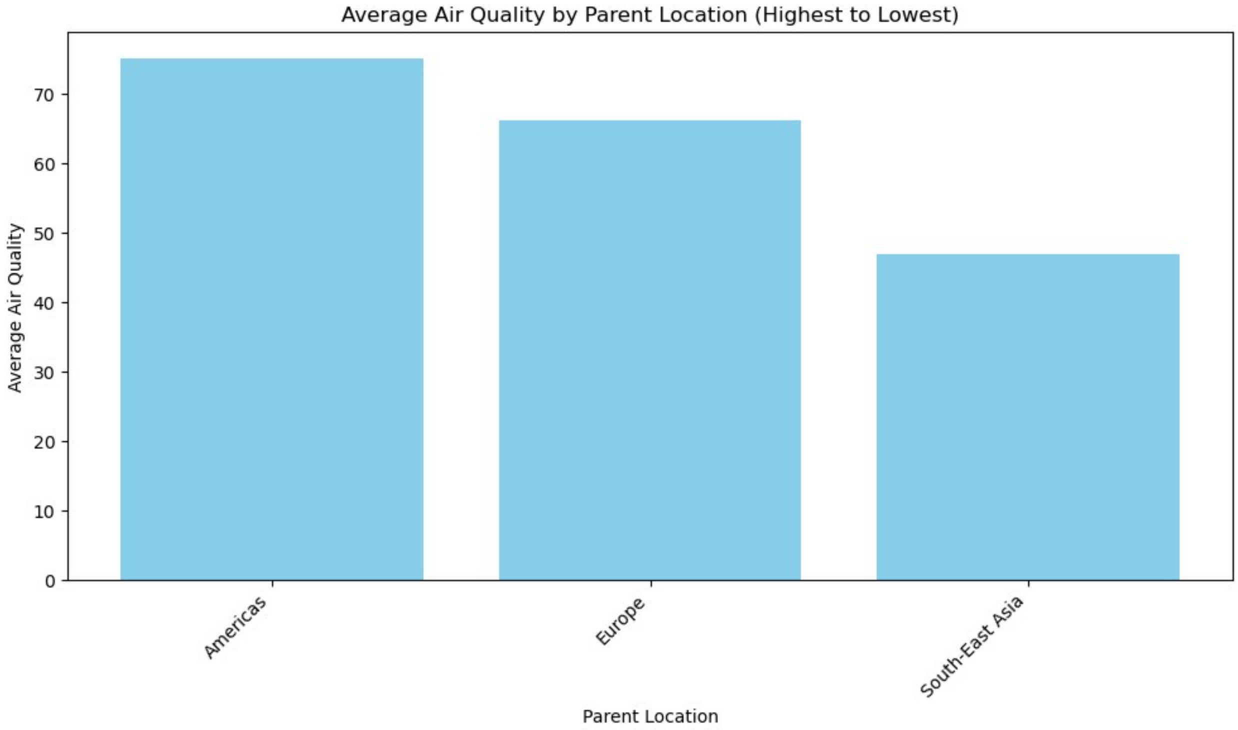
```
users_df = pd.read_csv(r"D:\Uni Graz Assignments\FCSS\Final 
Assignment\Water Quality - Every Drop Matters\Cities1.csv")
users_df = users_df[['City', 'Region', 'Country', 'ParentLocation', 
'AirQuality', 'WaterPollution']]
print(users_df.head())
```

```
               City                Region                   Country  \
0     New York City              New York  United States of America   
1  Washington, D.C.  District of Columbia  United States of America   
2     San Francisco            California  United States of America   
3       Los Angeles            California  United States of America   
4        Alexandria              Virginia  United States of America   

  ParentLocation  AirQuality  WaterPollution  
0       Americas   46.816038       49.504950  
1       Americas   66.129032       49.107143  
2       Americas   60.514019       43.000000  
3       Americas   36.621622       61.299435  
4       Americas   89.062500       46.153846  
```

Highest Airquality of continents

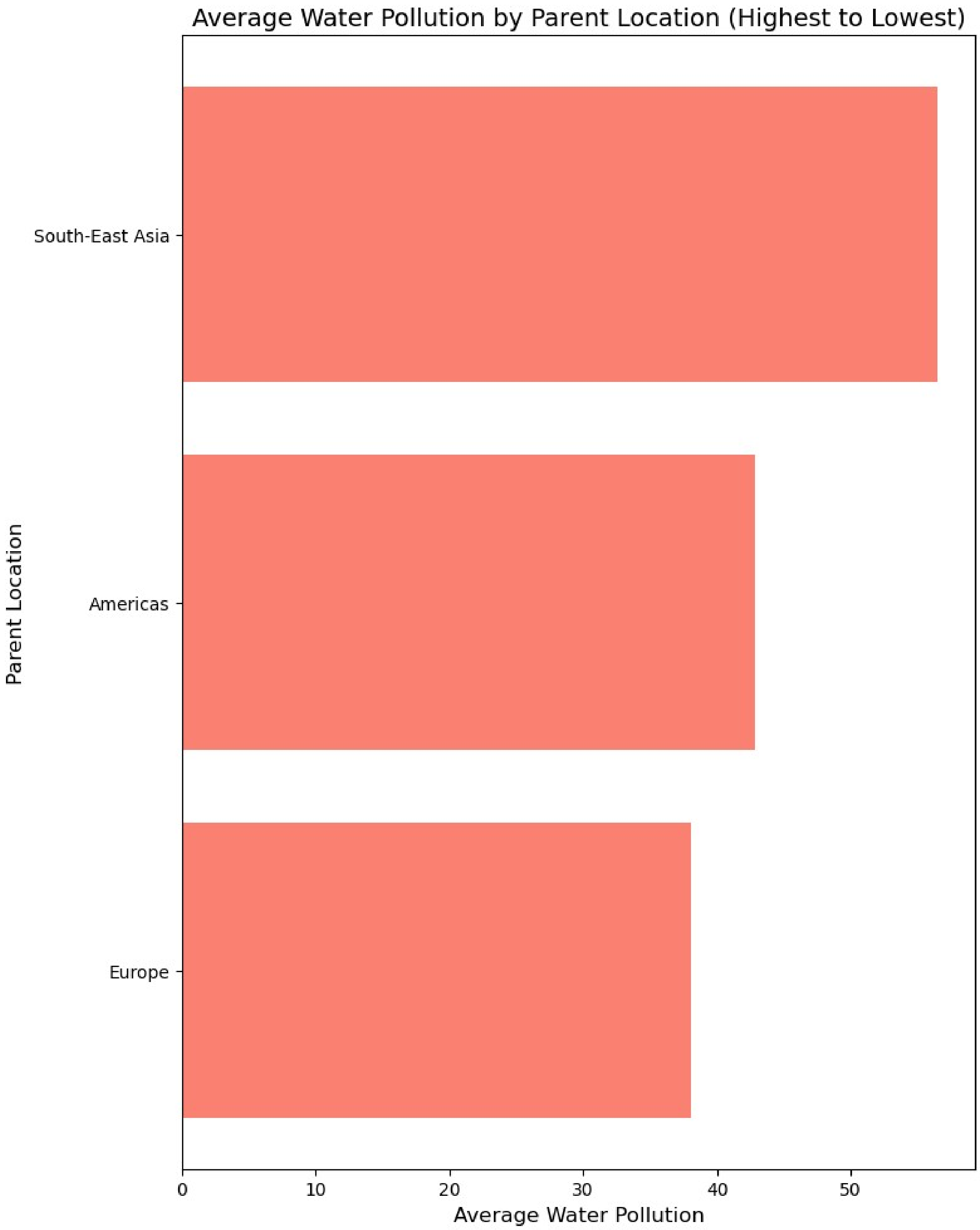
```
import pandas as pd
import matplotlib.pyplot as plt
```

```
users_df = pd.read_csv(r"D:\Uni Graz Assignments\FCSS\Final
Assignment\Water Quality - Every Drop Matters\Cities1.csv")
users_df = users_df[['ParentLocation', 'AirQuality']]
avg_air_quality = users_df.groupby('ParentLocation', as_index=False)
['AirQuality'].mean()
avg_air_quality = avg_air_quality.sort_values(by='AirQuality',
ascending=False)
plt.figure(figsize=(10, 6))
plt.bar(avg_air_quality['ParentLocation'],
avg_air_quality['AirQuality'], color='skyblue')
plt.xticks(rotation=45, ha='right')
plt.title('Average Air Quality by Parent Location (Highest to
Lowest)')
plt.xlabel('Parent Location')
plt.ylabel('Average Air Quality')
plt.tight_layout()
plt.show()
```



```
Water pollution

import pandas as pd
import matplotlib.pyplot as plt
users_df = pd.read_csv(r"D:\Uni Graz Assignments\FCSS\Final
Assignment\Water Quality - Every Drop Matters\Cities1.csv")
users_df = users_df[['ParentLocation', 'WaterPollution']]
```

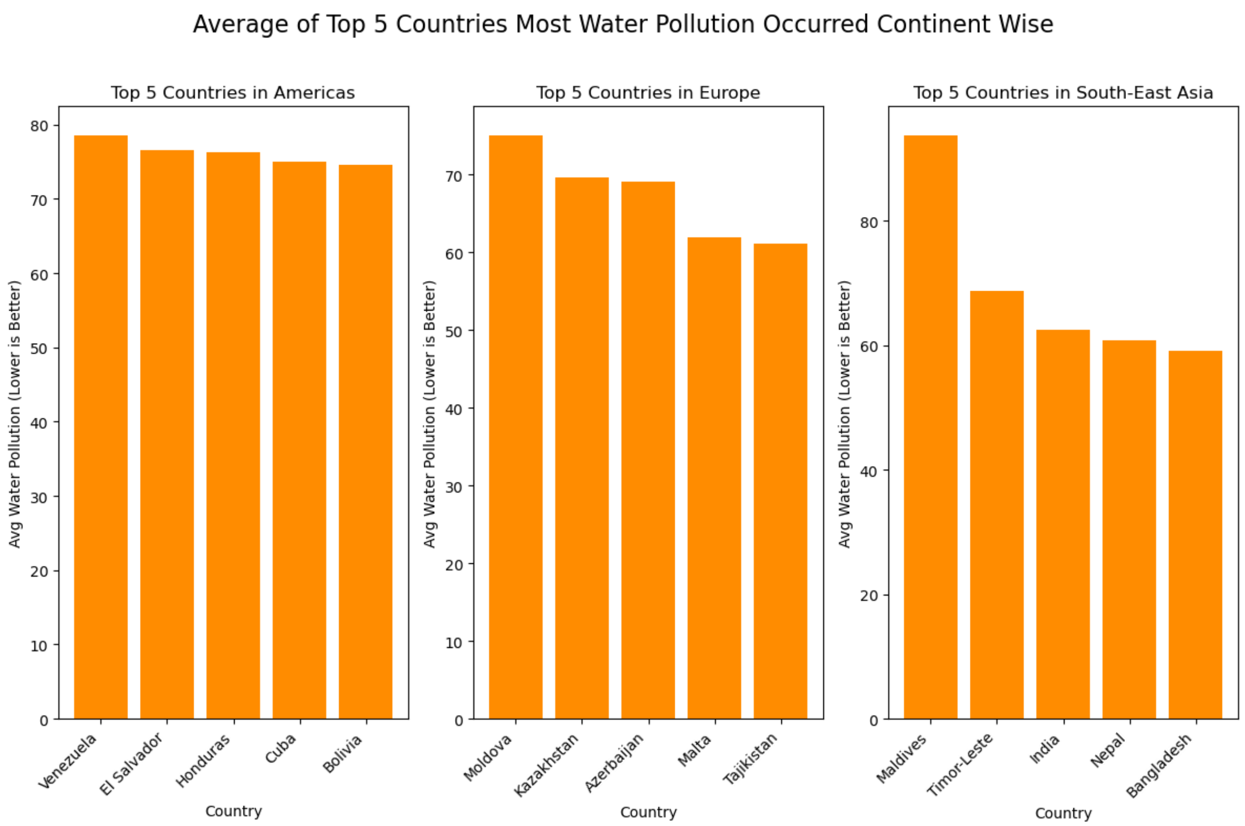
```
avg_water_pollution = users_df.groupby('ParentLocation',
as_index=False)['WaterPollution'].mean()
avg_water_pollution =
avg_water_pollution.sort_values(by='WaterPollution', ascending=False)
plt.figure(figsize=(8, 10))
plt.barh(avg_water_pollution['ParentLocation'],
avg_water_pollution['WaterPollution'], color='salmon')
plt.title('Average Water Pollution by Parent Location (Highest to
Lowest)', fontsize=14)
plt.xlabel('Average Water Pollution', fontsize=12)
plt.ylabel('Parent Location', fontsize=12)
plt.gca().invert_yaxis()  # Invert y-axis for better readability
plt.tight_layout()
plt.show()
```



```
Top 5 countries of most water pollution continent wise
```

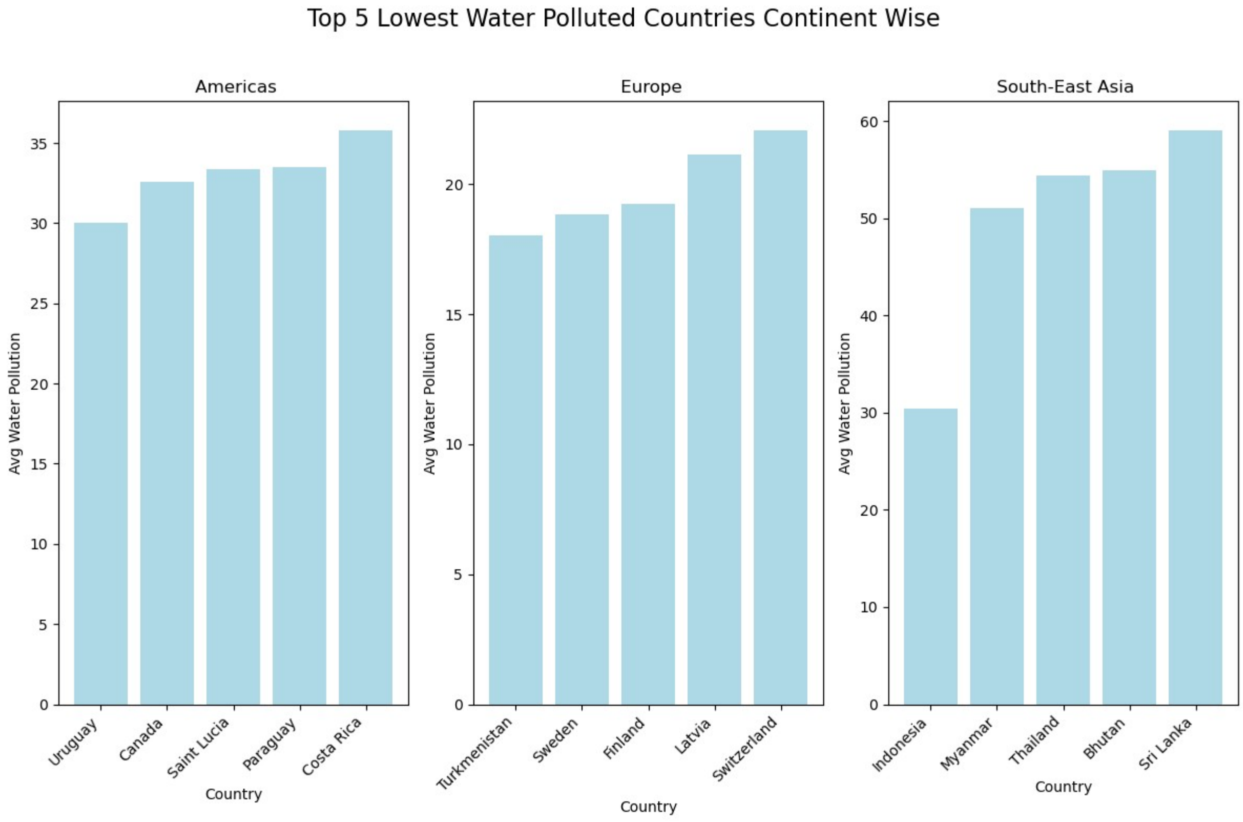
```python
import pandas as pd
import matplotlib.pyplot as plt
users_df = pd.read_csv(r"D:\Uni Graz Assignments\FCSS\Final
Assignment\Water Quality - Every Drop Matters\Cities1.csv")
grouped_data = users_df.groupby(['ParentLocation', 'Country'],
as_index=False)['WaterPollution'].mean()
top_5_countries_by_location =
grouped_data.groupby('ParentLocation').apply(
    lambda x: x.nlargest(5, 'WaterPollution')
).reset_index(drop=True)
parent_locations =
top_5_countries_by_location['ParentLocation'].unique()

plt.figure(figsize=(12, 8))
for i, location in enumerate(parent_locations):
    plt.subplot(1, len(parent_locations), i + 1)
    location_data =
top_5_countries_by_location[top_5_countries_by_location['ParentLocatio
n'] == location]
    plt.bar(location_data['Country'], location_data['WaterPollution'],
color='darkorange')
    plt.title(f'Top 5 Countries in {location}')
    plt.xlabel('Country')
    plt.ylabel('Avg Water Pollution (Lower is Better)')
    plt.xticks(rotation=45, ha='right')
plt.suptitle("Average of Top 5 Countries Most Water Pollution Occurred
Continent Wise", fontsize=16)

plt.tight_layout(rect=[0, 0, 1, 0.96])
plt.show()
```

```
C:\Users\G A  COMPUTERS\AppData\Local\Temp\
ipykernel_16596\1202523147.py:11: DeprecationWarning:
DataFrameGroupBy.apply operated on the grouping columns. This behavior
is deprecated, and in a future version of pandas the grouping columns
will be excluded from the operation. Either pass
`include_groups=False` to exclude the groupings or explicitly select
the grouping columns after groupby to silence this warning.
  top_5_countries_by_location =
grouped_data.groupby('ParentLocation').apply(
```



```
Top 5 Lowest Water Polluted Countries in Europe

import pandas as pd
import matplotlib.pyplot as plt
users_df = pd.read_csv(r"D:\Uni Graz Assignments\FCSS\Final
Assignment\Water Quality - Every Drop Matters\Cities1.csv")
grouped_data = users_df.groupby(['ParentLocation', 'Country'],
as_index=False)['WaterPollution'].mean()
top_5_lowest_polluted_countries =
grouped_data.groupby('ParentLocation').apply(
    lambda x: x.nsmallest(5, 'WaterPollution')
).reset_index(drop=True)
parent_locations =
top_5_lowest_polluted_countries['ParentLocation'].unique()

plt.figure(figsize=(12, 8))
for i, location in enumerate(parent_locations):
    plt.subplot(1, len(parent_locations), i + 1)
    location_data =
top_5_lowest_polluted_countries[top_5_lowest_polluted_countries['Paren
tLocation'] == location]
    plt.bar(location_data['Country'], location_data['WaterPollution'],
color='lightblue')
    plt.title(f' {location}')
    plt.xlabel('Country')
    plt.ylabel('Avg Water Pollution')
    plt.xticks(rotation=45, ha='right')
plt.suptitle("Top 5 Lowest Water Polluted Countries Continent Wise",
fontsize=16)
plt.tight_layout(rect=[0, 0, 1, 0.96])
plt.show()
```

```
C:\Users\G A  COMPUTERS\AppData\Local\Temp\
ipykernel_16596\3293521140.py:11: DeprecationWarning:
DataFrameGroupBy.apply operated on the grouping columns. This behavior
is deprecated, and in a future version of pandas the grouping columns
will be excluded from the operation. Either pass
`include_groups=False` to exclude the groupings or explicitly select
the grouping columns after groupby to silence this warning.
  top_5_lowest_polluted_countries =
grouped_data.groupby('ParentLocation').apply(
```



```
import pandas as pd
from plotnine import ggplot, aes, geom_bar, facet_wrap, labs, theme,
element_text
import matplotlib.pyplot as plt
users_df = pd.read_csv(r"D:\Uni Graz Assignments\FCSS\Final
Assignment\Water Quality - Every Drop Matters\Cities1.csv")
grouped_data = users_df.groupby(['ParentLocation', 'Country'],
as_index=False)['WaterPollution'].mean()
top_5_lowest_polluted_countries =
grouped_data.groupby('ParentLocation').apply(
    lambda x: x.nsmallest(5, 'WaterPollution')
).reset_index(drop=True)
plot = (ggplot(top_5_lowest_polluted_countries, aes(x='Country',
y='WaterPollution', fill='ParentLocation')) +
        geom_bar(stat='identity', position='dodge') +
        facet_wrap('~ParentLocation') +
        labs(title='Top 5 Lowest Water Polluted Countries Continent
Wise',
             x='Country',
             y='Average Water Pollution') +
        theme(axis_text_x=element_text(rotation=45, hjust=1),
              figure_size=(14, 8)))
print(plot)
plt.show()
```

```
<ggplot: (1400 x 800)>
```

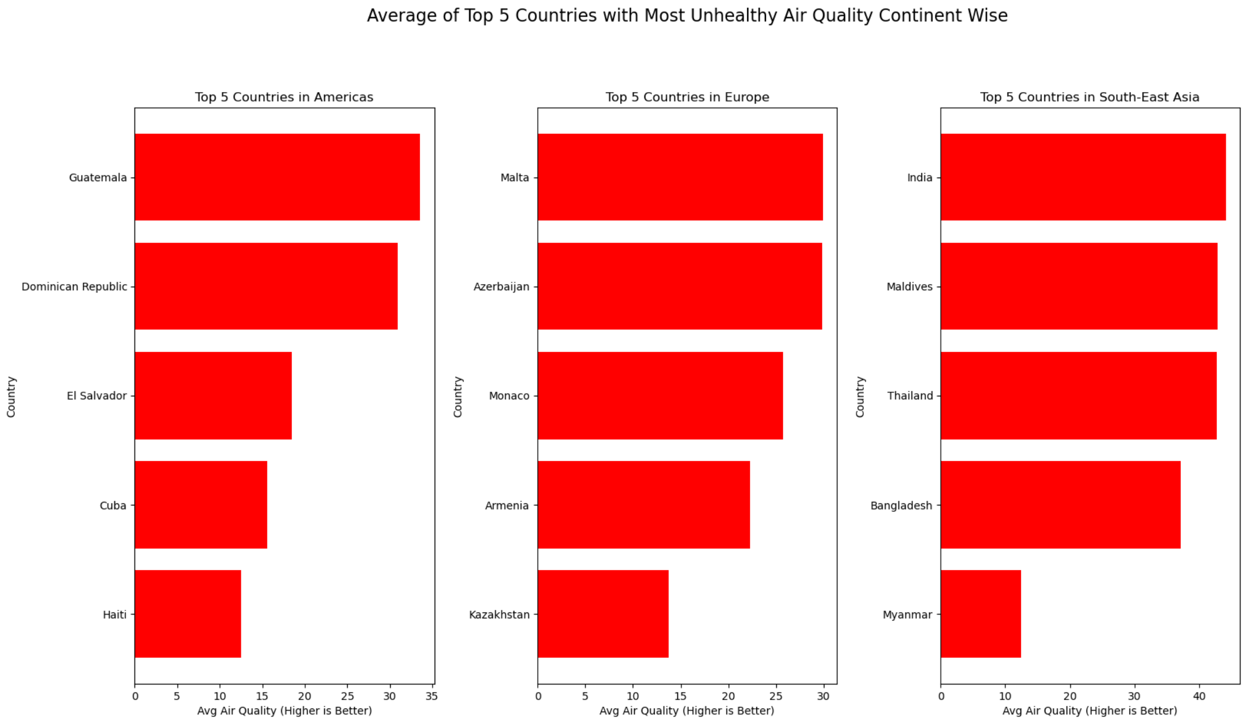
```
C:\Users\G A  COMPUTERS\AppData\Local\Temp\
ipykernel_16596\1899266560.py:12: DeprecationWarning:
DataFrameGroupBy.apply operated on the grouping columns. This behavior
is deprecated, and in a future version of pandas the grouping columns
will be excluded from the operation. Either pass
`include_groups=False` to exclude the groupings or explicitly select
the grouping columns after groupby to silence this warning.
```

Top 5 countries of most healthy airquality continent wise

```
import pandas as pd
import matplotlib.pyplot as plt
users_df = pd.read_csv(r"D:\Uni Graz Assignments\FCSS\Final
Assignment\Water Quality - Every Drop Matters\Cities1.csv")
grouped_data_airquality = users_df.groupby(['ParentLocation',
'Country'], as_index=False)['AirQuality'].mean()
top_5_countries_by_airquality =
grouped_data_airquality.groupby('ParentLocation').apply(
    lambda x: x.nsmallest(5, 'AirQuality')
).reset_index(drop=True)
parent_locations =
top_5_countries_by_airquality['ParentLocation'].unique()
plt.figure(figsize=(16, 10))
for i, location in enumerate(parent_locations):
    plt.subplot(1, len(parent_locations), i + 1)
    location_data =
top_5_countries_by_airquality[top_5_countries_by_airquality['ParentLoc
ation'] == location]
    plt.barh(location_data['Country'], location_data['AirQuality'],
color='red')
```

```
    plt.title(f'Top 5 Countries in {location}')
    plt.xlabel('Avg Air Quality (Higher is Better)')
    plt.ylabel('Country')
    plt.tight_layout()
plt.suptitle("Average of Top 5 Countries with Most Unhealthy Air 
Quality Continent Wise", fontsize=16)
plt.subplots_adjust(left=0.05, right=0.95, top=0.85, bottom=0.1)
plt.show()
```

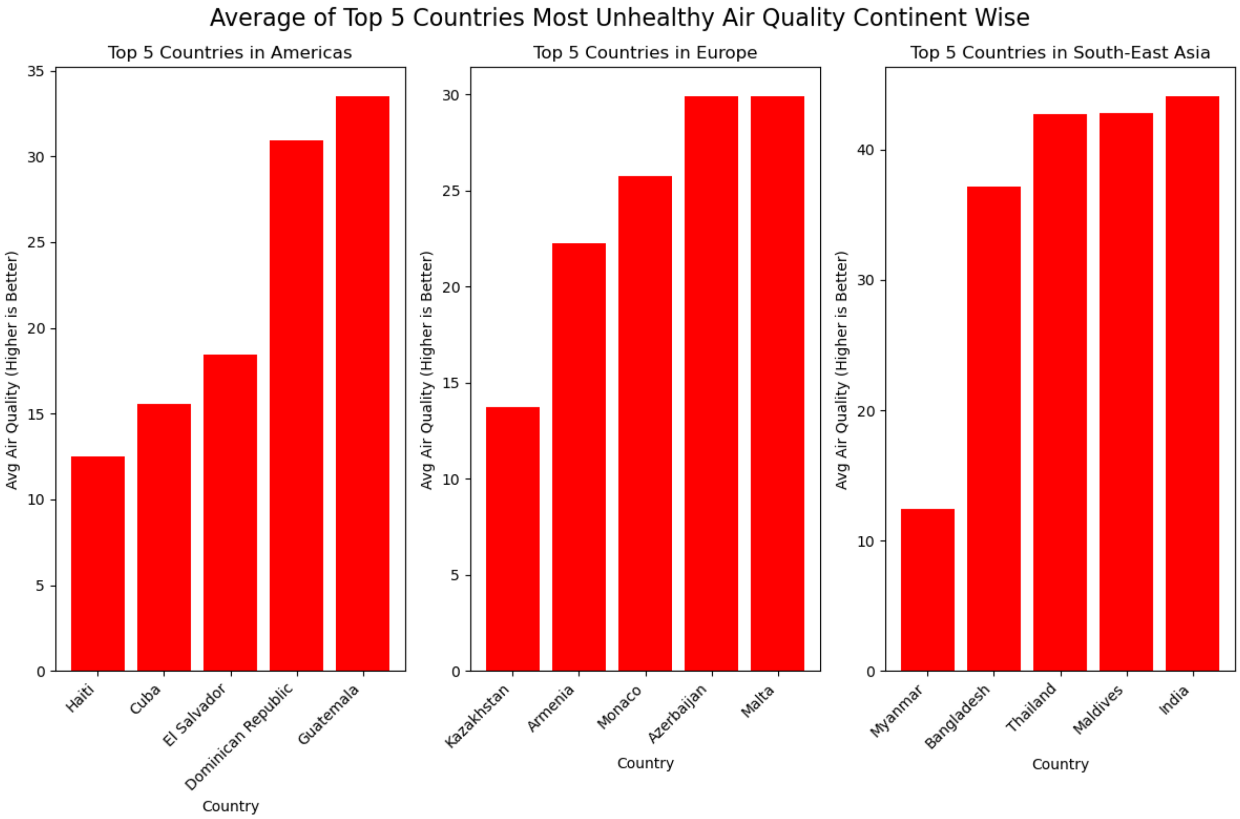
```
C:\Users\G A  COMPUTERS\AppData\Local\Temp\
ipykernel_16596\650378492.py:11: DeprecationWarning: 
DataFrameGroupBy.apply operated on the grouping columns. This behavior
is deprecated, and in a future version of pandas the grouping columns
will be excluded from the operation. Either pass 
`include_groups=False` to exclude the groupings or explicitly select
the grouping columns after groupby to silence this warning.
```



```
grouped_data_airquality = users_df.groupby(['ParentLocation', 
'Country'], as_index=False)['AirQuality'].mean()
top_5_countries_by_airquality = 
grouped_data_airquality.groupby('ParentLocation').apply(
    lambda x: x.nsmallest(5, 'AirQuality')
).reset_index(drop=True)
parent_locations = 
top_5_countries_by_airquality['ParentLocation'].unique()
```

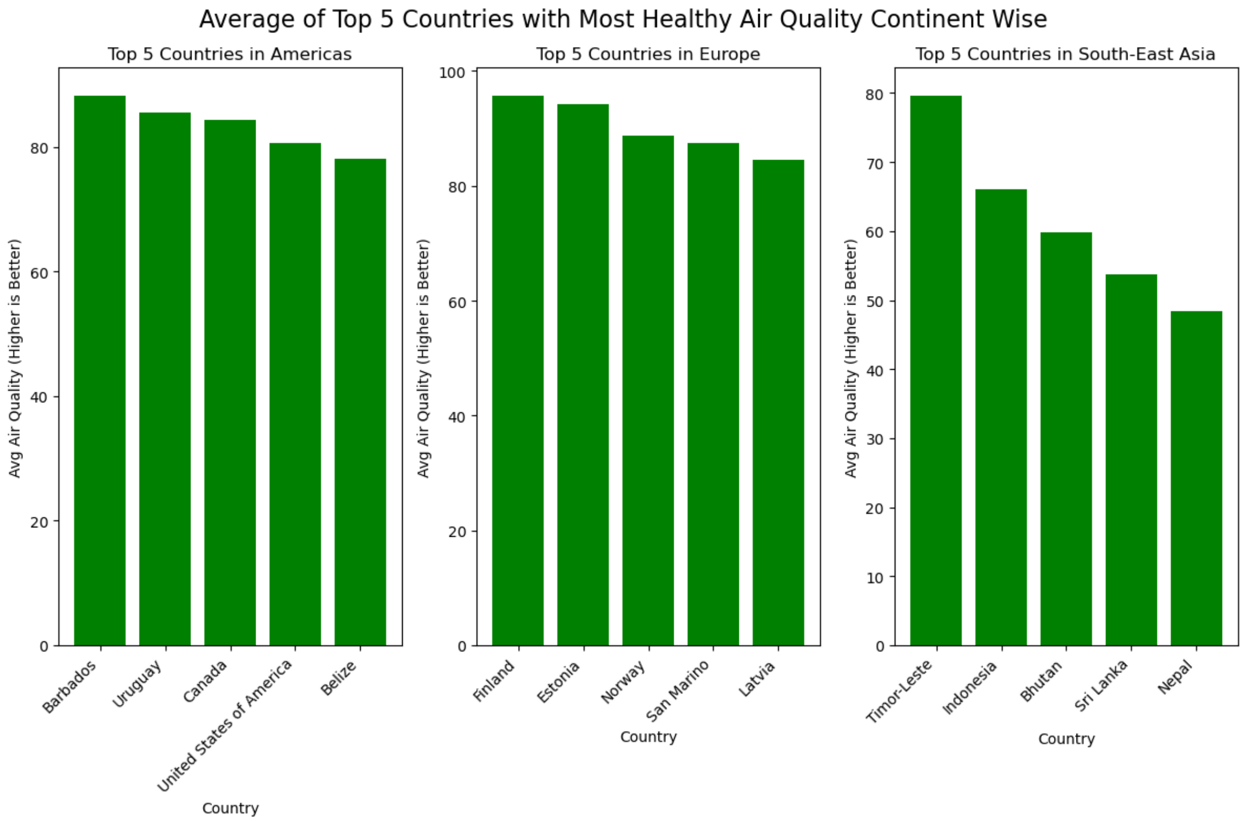
```python
plt.figure(figsize=(12, 8))
for i, location in enumerate(parent_locations):
    plt.subplot(1, len(parent_locations), i + 1)
    location_data = top_5_countries_by_airquality[top_5_countries_by_airquality['ParentLocation'] == location]
    plt.bar(location_data['Country'], location_data['AirQuality'], color='red')
    plt.title(f'Top 5 Countries in {location}')
    plt.xlabel('Country')
    plt.ylabel('Avg Air Quality (Higher is Better)')
    plt.xticks(rotation=45, ha='right')
plt.suptitle("Average of Top 5 Countries Most Unhealthy Air Quality Continent Wise", fontsize=16)

plt.tight_layout()
plt.show()
```

```
C:\Users\G A  COMPUTERS\AppData\Local\Temp\
ipykernel_16596\3356742019.py:11: DeprecationWarning:
DataFrameGroupBy.apply operated on the grouping columns. This behavior
is deprecated, and in a future version of pandas the grouping columns
will be excluded from the operation. Either pass
`include_groups=False` to exclude the groupings or explicitly select
the grouping columns after groupby to silence this warning.
```



```
Average of Top 5 Countries with Most Healthy Air Quality Continent
Wise


grouped_data_airquality = users_df.groupby(['ParentLocation',
'Country'], as_index=False)['AirQuality'].mean()
top_5_countries_by_airquality =
grouped_data_airquality.groupby('ParentLocation').apply(
    lambda x: x.nlargest(5, 'AirQuality')
).reset_index(drop=True)
parent_locations =
top_5_countries_by_airquality['ParentLocation'].unique()

plt.figure(figsize=(12, 8))
for i, location in enumerate(parent_locations):
    plt.subplot(1, len(parent_locations), i + 1)
    location_data =
top_5_countries_by_airquality[top_5_countries_by_airquality['ParentLoc
ation'] == location]
    plt.bar(location_data['Country'], location_data['AirQuality'],
color='green')
    plt.title(f'Top 5 Countries in {location}')
    plt.xlabel('Country')
    plt.ylabel('Avg Air Quality (Higher is Better)')
    plt.xticks(rotation=45, ha='right')
plt.suptitle("Average of Top 5 Countries with Most Healthy Air Quality
Continent Wise", fontsize=16)

plt.tight_layout()
plt.show()
```

```
C:\Users\G A  COMPUTERS\AppData\Local\Temp\
ipykernel_16596\3390998174.py:11: DeprecationWarning:
DataFrameGroupBy.apply operated on the grouping columns. This behavior
is deprecated, and in a future version of pandas the grouping columns
will be excluded from the operation. Either pass
`include_groups=False` to exclude the groupings or explicitly select
the grouping columns after groupby to silence this warning.
```



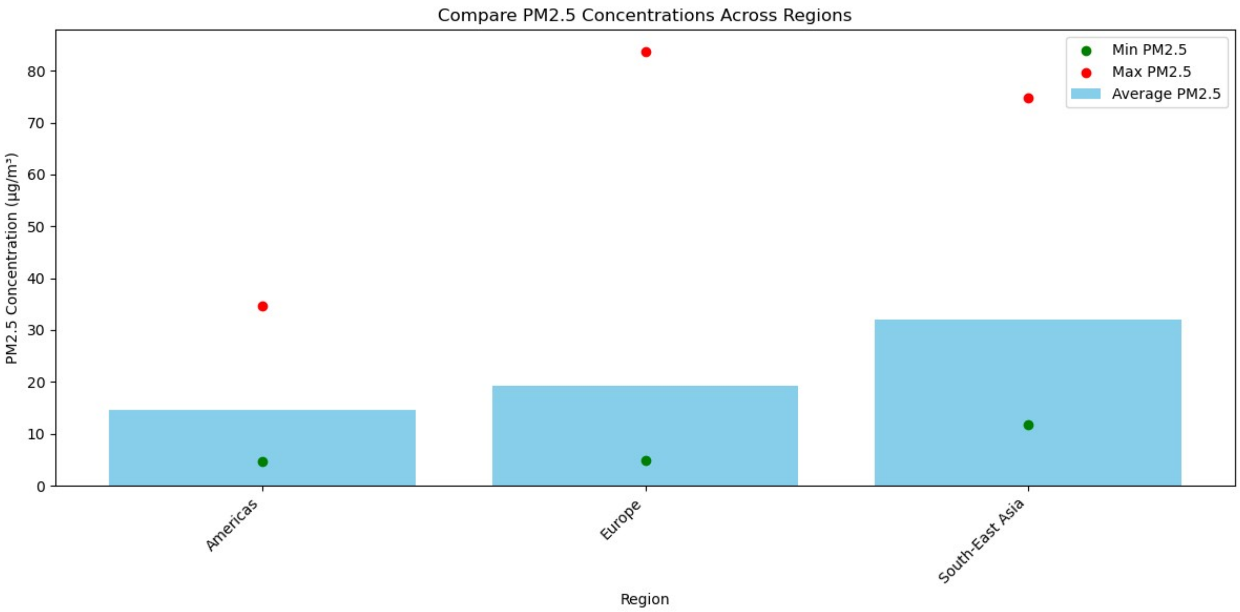
```
import pandas as pd

users_df = pd.read_csv(r"D:\Uni Graz Assignments\FCSS\Final
Assignment\Water Quality - Every Drop Matters\WHO_PM_Filtered.csv")
print("Dataset Preview:")
display(users_df.head())

print("\nDataset Information:")
users_df.info()

print("\nSummary Statistics:")
display(users_df.describe())
```

```
Dataset Preview:

  IndicatorCode                                                  Indicator
ValueType  \
0       SDGPM25  Concentrations of fine particulate matter (PM2.5)
text
1       SDGPM25  Concentrations of fine particulate matter (PM2.5)
text
2       SDGPM25  Concentrations of fine particulate matter (PM2.5)
text
3       SDGPM25  Concentrations of fine particulate matter (PM2.5)
text
```

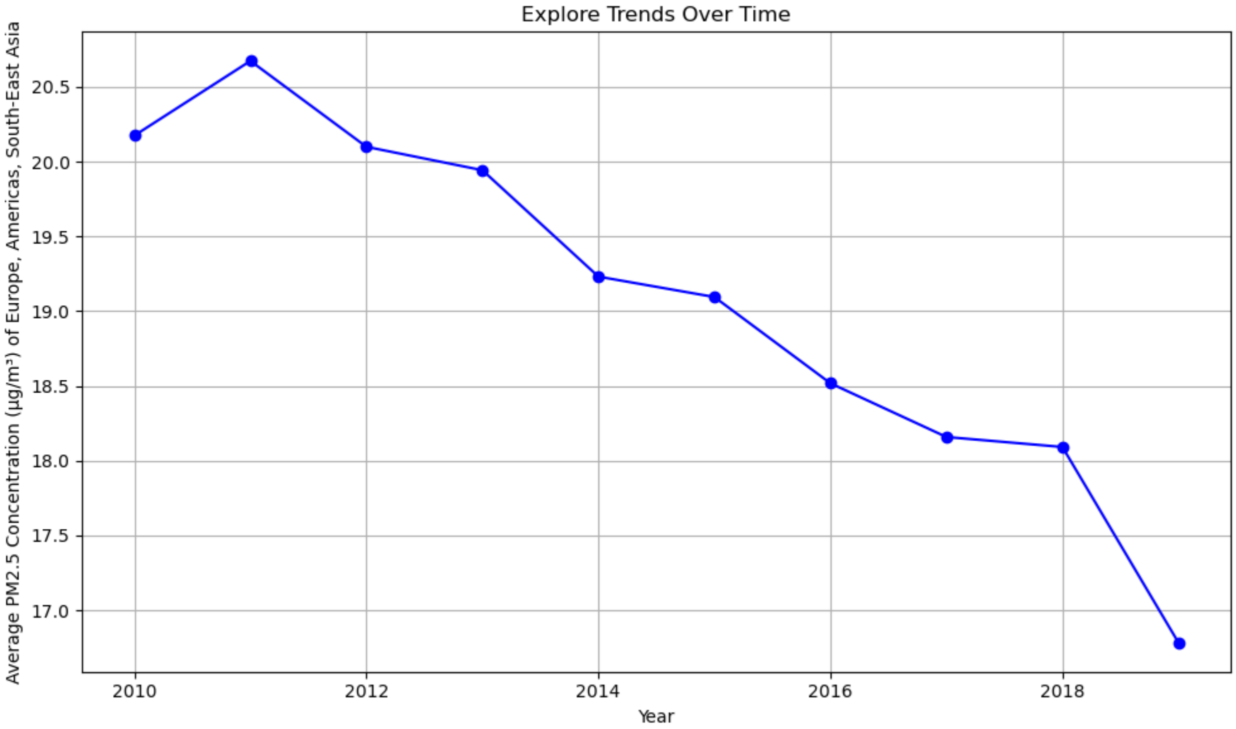
```
4       SDGPM25  Concentrations of fine particulate matter (PM2.5)
text

  ParentLocationCode ParentLocation Location type SpatialDimValueCode
\
0                AMR       Americas       Country                 TTO

1                EUR         Europe       Country                 GBR

2                AMR       Americas       Country                 BRA

3                EUR         Europe       Country                 RUS

4                EUR         Europe       Country                 ESP


                                            Location Period type
Period  ...  \
0                                Trinidad and Tobago        Year
2019  ...
1  United Kingdom of Great Britain and Northern I...        Year
2019  ...
2                                             Brazil        Year
2019  ...
3                                 Russian Federation        Year
2019  ...
4                                              Spain        Year
2019  ...

   FactValueUoM FactValueNumericLowPrefix FactValueNumericLow  \
0           NaN                       NaN                7.44
1           NaN                       NaN                9.73
2           NaN                       NaN                8.23
3           NaN                       NaN                8.58
4           NaN                       NaN                9.94

  FactValueNumericHighPrefix  FactValueNumericHigh              Value
\
0                        NaN                 12.55  10.02 [7.44-12.55]

1                        NaN                 10.39  10.06 [9.73-10.39]

2                        NaN                 12.46  10.09 [8.23-12.46]

3                        NaN                 12.57  10.19 [8.58-12.57]

4                        NaN                 10.38  10.19 [9.94-10.38]


   FactValueTranslationID  FactComments  Language
DateModified
```

```
0                      NaN        NaN        EN  2022-08-
11T23:00:00.000Z
1                      NaN        NaN        EN  2022-08-
11T23:00:00.000Z
2                      NaN        NaN        EN  2022-08-
11T23:00:00.000Z
3                      NaN        NaN        EN  2022-08-
11T23:00:00.000Z
4                      NaN        NaN        EN  2022-08-
11T23:00:00.000Z

[5 rows x 34 columns]


Dataset Information:
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2850 entries, 0 to 2849
Data columns (total 34 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   IndicatorCode               2850 non-null   object
 1   Indicator                   2850 non-null   object
 2   ValueType                   2850 non-null   object
 3   ParentLocationCode          2850 non-null   object
 4   ParentLocation              2850 non-null   object
 5   Location type               2850 non-null   object
 6   SpatialDimValueCode         2850 non-null   object
 7   Location                    2850 non-null   object
 8   Period type                 2850 non-null   object
 9   Period                      2850 non-null   int64
 10  IsLatestYear                2850 non-null   bool
 11  Dim1 type                   2850 non-null   object
 12  Dim1                        2850 non-null   object
 13  Dim1ValueCode               2850 non-null   object
 14  Dim2 type                   0 non-null      float64
 15  Dim2                        0 non-null      float64
 16  Dim2ValueCode               0 non-null      float64
 17  Dim3 type                   0 non-null      float64
 18  Dim3                        0 non-null      float64
 19  Dim3ValueCode               0 non-null      float64
 20  DataSourceDimValueCode      0 non-null      float64
 21  DataSource                  0 non-null      float64
 22  FactValueNumericPrefix      0 non-null      float64
 23  FactValueNumeric            2850 non-null   float64
 24  FactValueUoM                0 non-null      float64
 25  FactValueNumericLowPrefix   0 non-null      float64
 26  FactValueNumericLow         2850 non-null   float64
 27  FactValueNumericHighPrefix  0 non-null      float64
 28  FactValueNumericHigh        2850 non-null   float64
 29  Value                       2850 non-null   object
 30  FactValueTranslationID      0 non-null      float64
 31  FactComments                0 non-null      float64
 32  Language                    2850 non-null   object 
 33  DateModified                2850 non-null   object 
dtypes: bool(1), float64(17), int64(1), object(15)
memory usage: 737.7+ KB

Summary Statistics:

            Period  Dim2 type  Dim2  Dim2ValueCode  Dim3 type  Dim3  \
count  2850.000000        0.0   0.0            0.0        0.0   0.0   
mean   2014.500000        NaN   NaN            NaN        NaN   NaN   
std       2.872785        NaN   NaN            NaN        NaN   NaN   
min    2010.000000        NaN   NaN            NaN        NaN   NaN   
25%    2012.000000        NaN   NaN            NaN        NaN   NaN   
50%    2014.500000        NaN   NaN            NaN        NaN   NaN   
75%    2017.000000        NaN   NaN            NaN        NaN   NaN   
max    2019.000000        NaN   NaN            NaN        NaN   NaN   

       Dim3ValueCode  DataSourceDimValueCode  DataSource  \
count            0.0                     0.0         0.0   
mean             NaN                     NaN         NaN   
std              NaN                     NaN         NaN   
min              NaN                     NaN         NaN   
25%              NaN                     NaN         NaN   
50%              NaN                     NaN         NaN   
75%              NaN                     NaN         NaN   
max              NaN                     NaN         NaN   

       FactValueNumericPrefix  FactValueNumeric  FactValueUoM  \
count                     0.0       2850.000000           0.0   
mean                      NaN         19.076944           NaN   
std                       NaN         12.116808           NaN   
min                       NaN          4.590000           NaN   
25%                       NaN         10.530000           NaN   
50%                       NaN         15.970000           NaN   
75%                       NaN         23.150000           NaN   
max                       NaN         83.680000           NaN   

       FactValueNumericLowPrefix  FactValueNumericLow  \
count                        0.0          2850.000000   
mean                         NaN            15.452467   
std                          NaN             9.603646   
min                          NaN             2.950000   
25%                          NaN             8.490000   
50%                          NaN            13.540000   
75%                          NaN            19.017500   
max                          NaN            61.830000   

       FactValueNumericHighPrefix  FactValueNumericHigh  \
count                         0.0           2850.000000
mean                          NaN             23.851361
std                           NaN             16.574223
min                           NaN              5.260000
25%                           NaN             12.855000
50%                           NaN             19.260000
75%                           NaN             28.115000
max                           NaN            114.700000

       FactValueTranslationID  FactComments
count                     0.0           0.0
mean                      NaN           NaN
std                       NaN           NaN
min                       NaN           NaN
25%                       NaN           NaN
50%                       NaN           NaN
75%                       NaN           NaN
max                       NaN           NaN
```

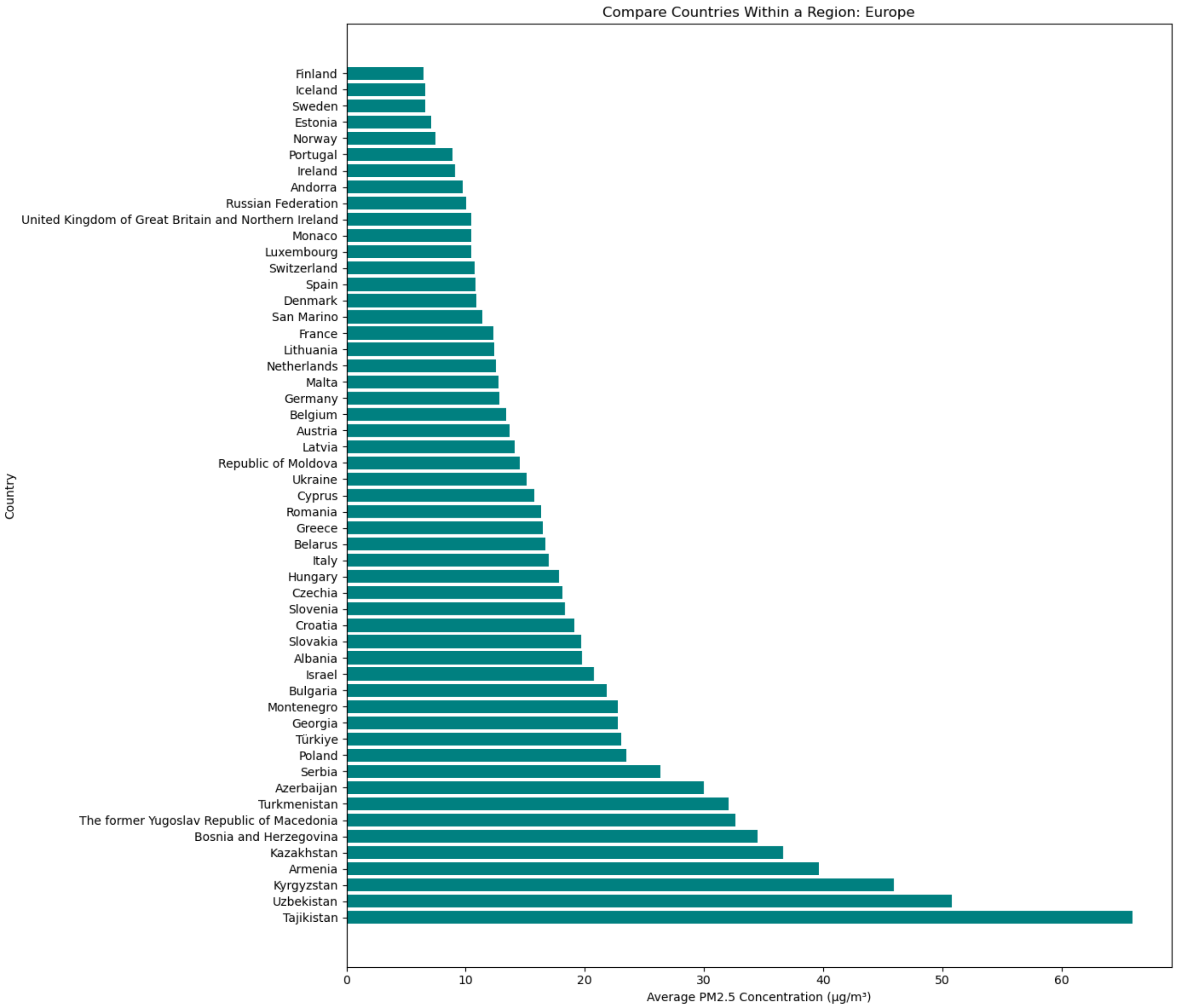
```
Compare PM2.5 Concentrations Across Regions (Analysis: Group data by
ParentLocation (e.g., Africa, Americas, Europe) and calculate the
average, minimum, and maximum PM2.5 concentrations (FactValueNumeric)
for each region.)

import matplotlib.pyplot as plt
import pandas as pd
file_path = r"D:\Uni Graz Assignments\FCSS\Final Assignment\Water
Quality - Every Drop Matters\WHO_PM_Filtered.csv"
users_df = pd.read_csv(file_path)
regional_stats = users_df.groupby('ParentLocation')
['FactValueNumeric'].agg(['mean', 'min', 'max']).reset_index()
regional_stats.columns = ['Region', 'Average_PM2.5', 'Min_PM2.5',
'Max_PM2.5']
plt.figure(figsize=(12, 6))
x = range(len(regional_stats))

plt.bar(x, regional_stats['Average_PM2.5'], color='skyblue',
label='Average PM2.5')
plt.scatter(x, regional_stats['Min_PM2.5'], color='green', label='Min
PM2.5')
plt.scatter(x, regional_stats['Max_PM2.5'], color='red', label='Max
PM2.5')
plt.xticks(x, regional_stats['Region'], rotation=45, ha='right')
plt.xlabel('Region')
plt.ylabel('PM2.5 Concentration (µg/m³)')
plt.title('Compare PM2.5 Concentrations Across Regions')
plt.legend()
plt.tight_layout()
plt.show()
```



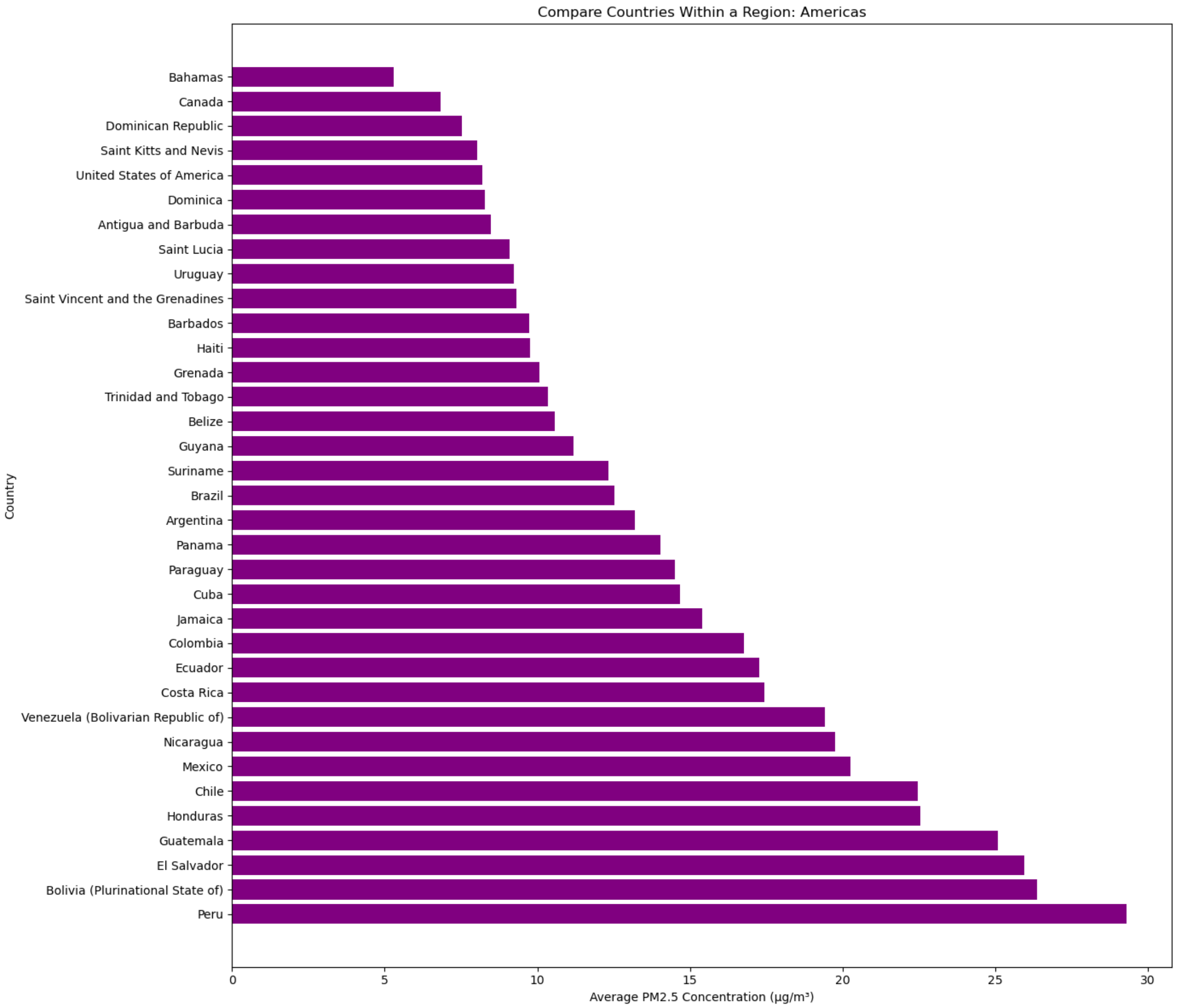
```
Explore Trends Over Time (Analysis: If the dataset contains multiple
years (Period column), analyze how PM2.5 concentrations have changed
over time for a specific region or globally)


file_path = r"D:\Uni Graz Assignments\FCSS\Final Assignment\Water
Quality - Every Drop Matters\WHO_PM_Filtered.csv"
users_df = pd.read_csv(file_path)
users_df['Period'] = pd.to_numeric(users_df['Period'],
errors='coerce')
time_trends = users_df.groupby('Period')
['FactValueNumeric'].mean().reset_index()
plt.figure(figsize=(10, 6))
plt.plot(time_trends['Period'], time_trends['FactValueNumeric'],
marker='o', linestyle='-', color='blue')
plt.xlabel('Year')
plt.ylabel('Average PM2.5 Concentration (µg/m³) of Europe, Americas,
South-East Asia')
plt.title('Explore Trends Over Time')
plt.grid(True)
plt.tight_layout()
plt.show()
```



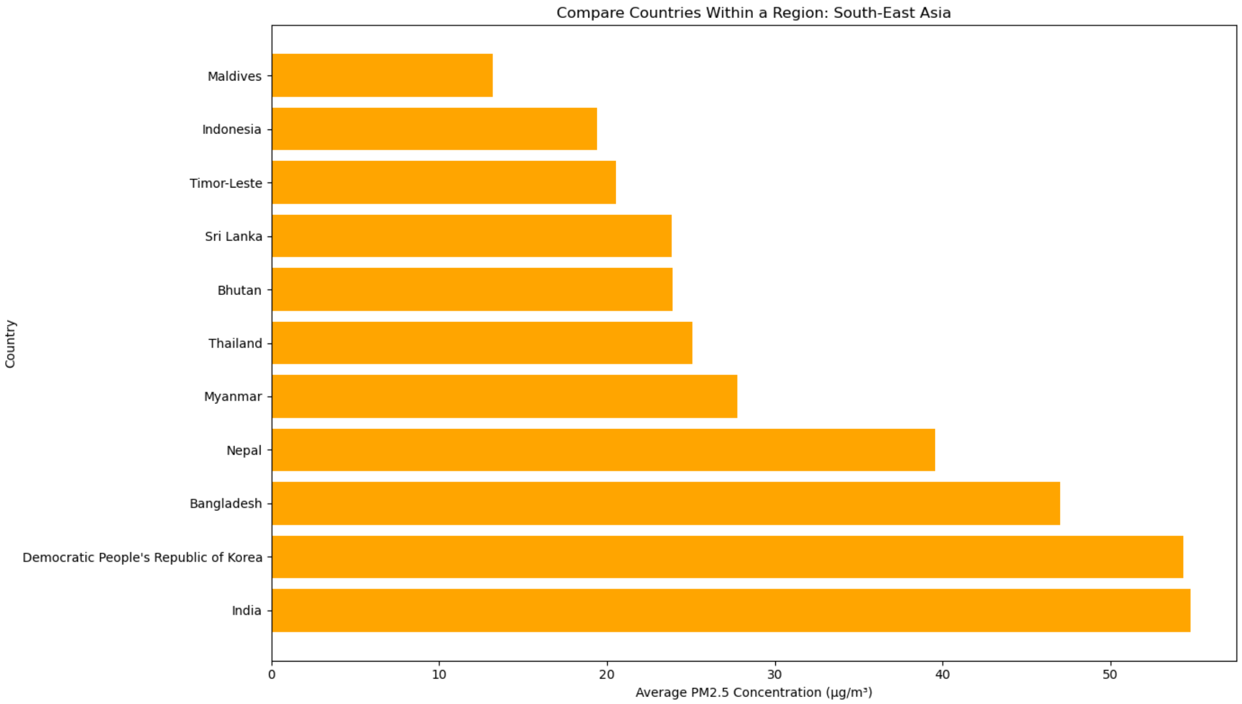
```
Compare Countries Within a Region (Analysis: Select a specific region
(e.g., Africa) and compare PM2.5 levels among countries in that region
using FactValueNumeric.)


region_of_interest = 'Europe'
region_data = users_df[users_df['ParentLocation'] ==
region_of_interest]
country_comparison = region_data.groupby('Location')
['FactValueNumeric'].mean().reset_index()
country_comparison =
country_comparison.sort_values(by='FactValueNumeric', ascending=False)
plt.figure(figsize=(14, 12))
plt.barh(country_comparison['Location'],
country_comparison['FactValueNumeric'], color='teal')
plt.xlabel('Average PM2.5 Concentration (µg/m³)')
plt.ylabel('Country')
plt.title('Compare Countries Within a Region: Europe')
plt.tight_layout()
plt.show()
```



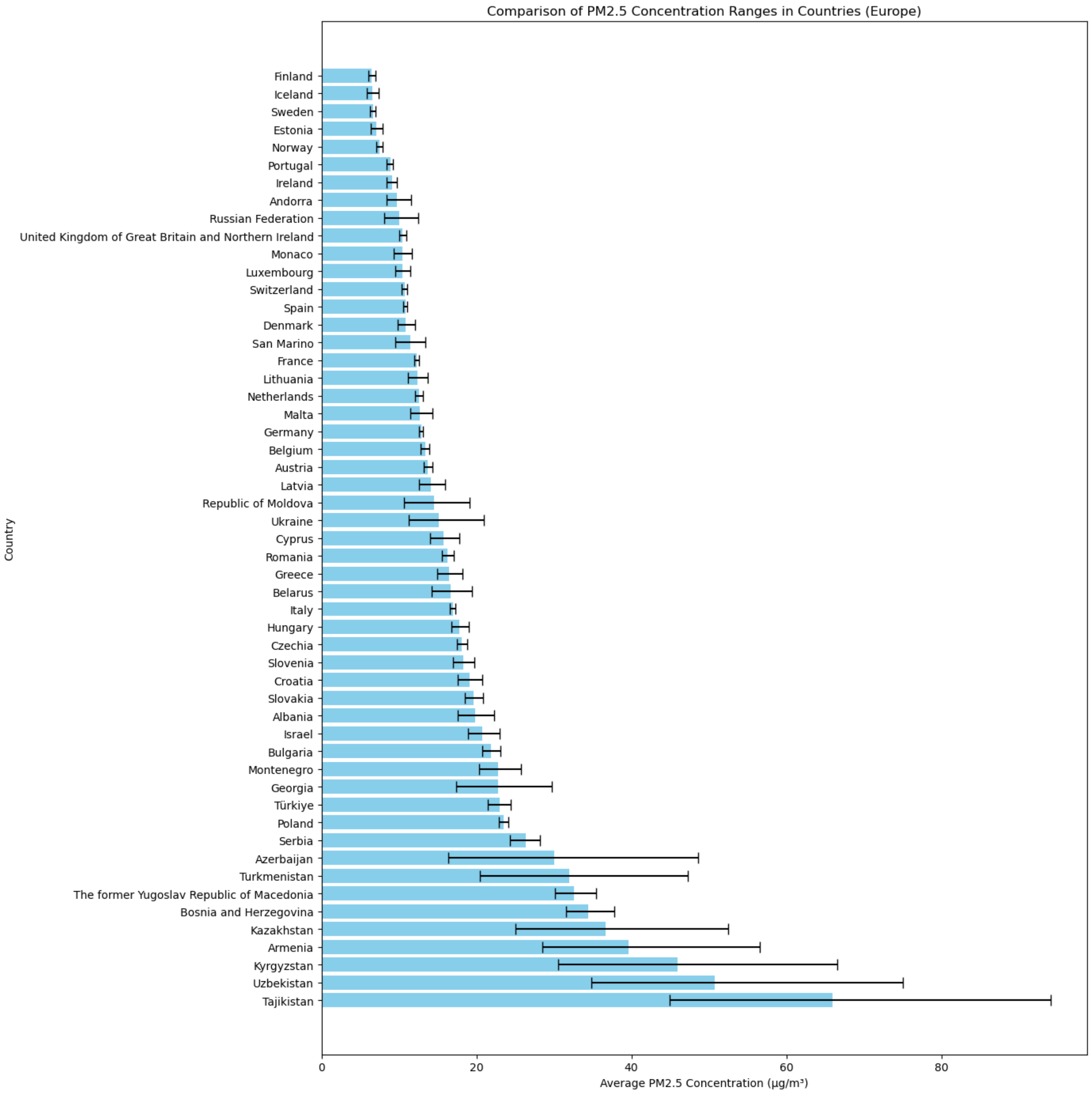
```
region_of_interest = 'Americas'
region_data = users_df[users_df['ParentLocation'] ==
region_of_interest]
country_comparison = region_data.groupby('Location')
['FactValueNumeric'].mean().reset_index()
country_comparison =
country_comparison.sort_values(by='FactValueNumeric', ascending=False)
plt.figure(figsize=(14, 12))
plt.barh(country_comparison['Location'],
country_comparison['FactValueNumeric'], color='purple')
plt.xlabel('Average PM2.5 Concentration (µg/m³)')
plt.ylabel('Country')
plt.title('Compare Countries Within a Region: Americas')
plt.tight_layout()
plt.show()
```



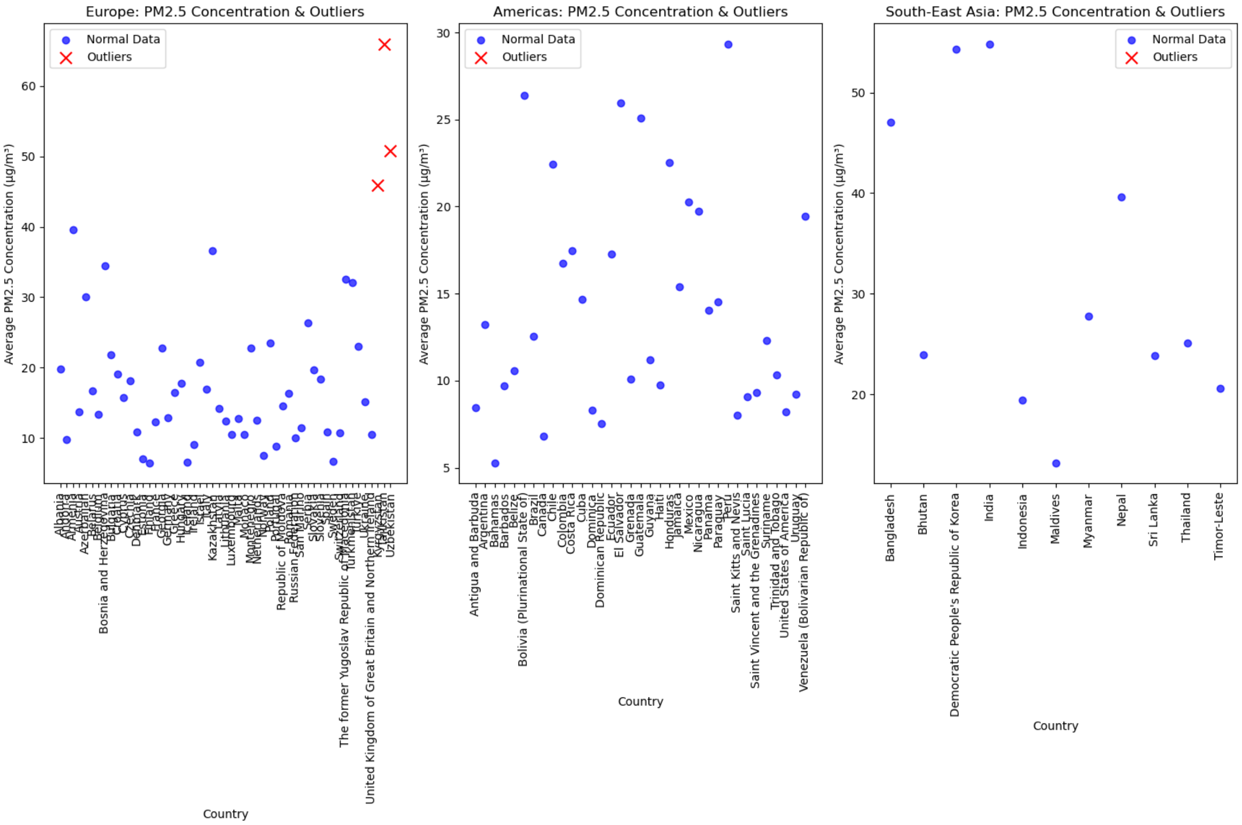
```
region_of_interest = 'South-East Asia'
region_data = users_df[users_df['ParentLocation'] ==
region_of_interest]
country_comparison = region_data.groupby('Location')
['FactValueNumeric'].mean().reset_index()
country_comparison =
country_comparison.sort_values(by='FactValueNumeric', ascending=False)
plt.figure(figsize=(14, 8))
plt.barh(country_comparison['Location'],
country_comparison['FactValueNumeric'], color='orange')

plt.xlabel('Average PM2.5 Concentration (μg/m³)')
plt.ylabel('Country')
plt.title('Compare Countries Within a Region: South-East Asia')

plt.tight_layout()
plt.show()
```



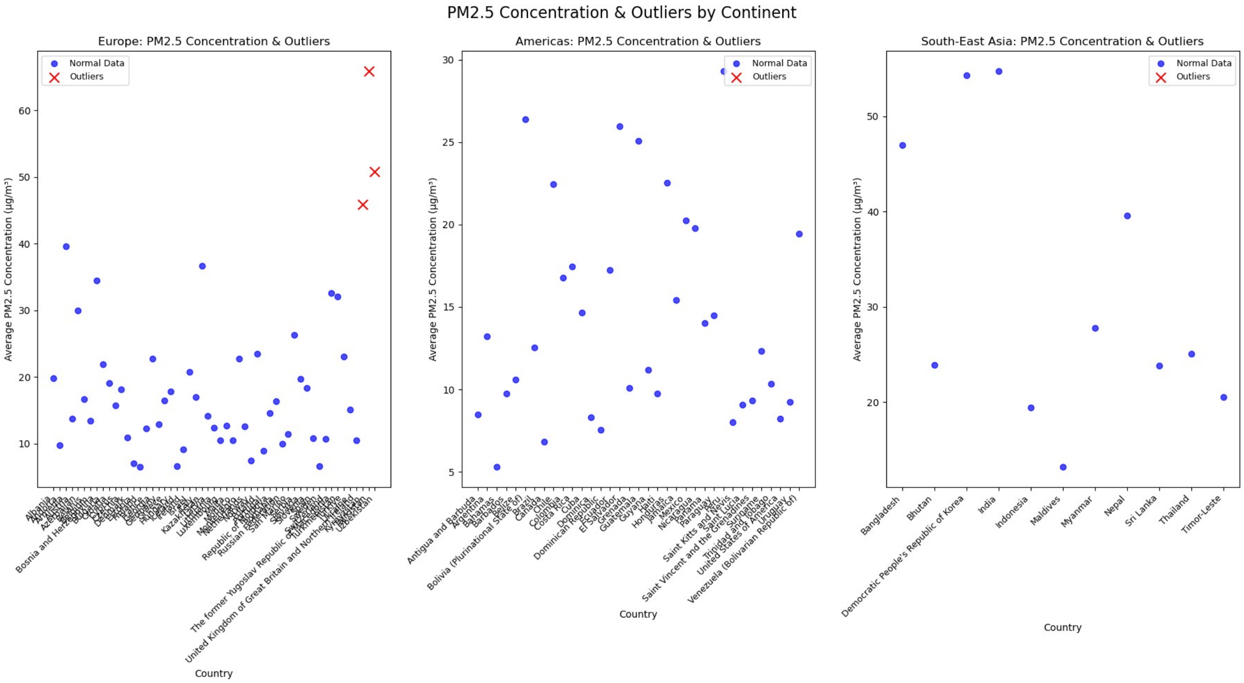
```
Compare Ranges of PM2.5 Concentrations (Analysis: Use
FactValueNumericLow and FactValueNumericHigh to show variability in
PM2.5 measurements across countries or regions.)


region_of_interest = 'Europe'
region_data = users_df[users_df['ParentLocation'] ==
region_of_interest]
country_comparison = region_data.groupby('Location').agg(
    mean_pm25=('FactValueNumeric', 'mean'),
    low_pm25=('FactValueNumericLow', 'mean'),
    high_pm25=('FactValueNumericHigh', 'mean')
).reset_index()
country_comparison = country_comparison.sort_values(by='mean_pm25',
ascending=False)
plt.figure(figsize=(14, 14))
plt.barh(country_comparison['Location'],
country_comparison['mean_pm25'], color='skyblue',
xerr=[country_comparison['mean_pm25'] -
country_comparison['low_pm25'], country_comparison['high_pm25'] -
country_comparison['mean_pm25']], capsize=5)

plt.xlabel('Average PM2.5 Concentration (µg/m³)')
plt.ylabel('Country')
plt.title('Comparison of PM2.5 Concentration Ranges in Countries
(Europe)')
plt.tight_layout()
plt.show()
```



```
continents_of_interest = ['Europe', 'Americas', 'South-East Asia']
plt.figure(figsize=(15, 10))
for i, continent in enumerate(continents_of_interest):
    continent_data = users_df[users_df['ParentLocation'] == continent]
    country_comparison = continent_data.groupby('Location')
['FactValueNumeric'].mean().reset_index()
    Q1 = country_comparison['FactValueNumeric'].quantile(0.25)
    Q3 = country_comparison['FactValueNumeric'].quantile(0.75)
    IQR = Q3 - Q1
    lower_bound = Q1 - 1.5 * IQR
    upper_bound = Q3 + 1.5 * IQR

    outliers = 
country_comparison[(country_comparison['FactValueNumeric'] < 
lower_bound) | 

(country_comparison['FactValueNumeric'] > upper_bound)]

    non_outliers = 
country_comparison[(country_comparison['FactValueNumeric'] >= 
lower_bound) & 

(country_comparison['FactValueNumeric'] <= upper_bound)]

    plt.subplot(1, 3, i + 1)
    plt.scatter(non_outliers['Location'], 
non_outliers['FactValueNumeric'], label='Normal Data', color='blue', 
alpha=0.7)
    plt.scatter(outliers['Location'], outliers['FactValueNumeric'], 
label='Outliers', color='red', marker='x', s=100)
    plt.xlabel('Country')
    plt.ylabel('Average PM2.5 Concentration (µg/m³)')
    plt.title(f'{continent}: PM2.5 Concentration & Outliers')
    plt.xticks(rotation=90)
    plt.legend()
plt.tight_layout()
plt.show()
```

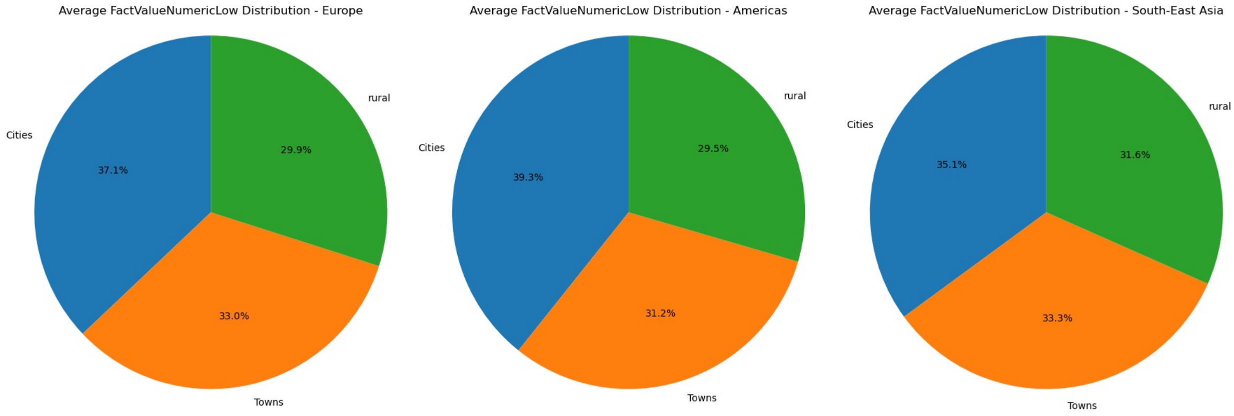


```
continents_of_interest = ['Europe', 'Americas', 'South-East Asia']
plt.figure(figsize=(18, 10))
for i, continent in enumerate(continents_of_interest):
    continent_data = users_df[users_df['ParentLocation'] == continent]
    country_comparison = continent_data.groupby('Location')
['FactValueNumeric'].mean().reset_index()
    Q1 = country_comparison['FactValueNumeric'].quantile(0.25)
    Q3 = country_comparison['FactValueNumeric'].quantile(0.75)
    IQR = Q3 - Q1
    lower_bound = Q1 - 1.5 * IQR
    upper_bound = Q3 + 1.5 * IQR
    outliers =
country_comparison[(country_comparison['FactValueNumeric'] <
lower_bound) |

(country_comparison['FactValueNumeric'] > upper_bound)]
    non_outliers =
country_comparison[(country_comparison['FactValueNumeric'] >=
lower_bound) &

(country_comparison['FactValueNumeric'] <= upper_bound)]
    plt.subplot(1, 3, i + 1)
    plt.scatter(non_outliers['Location'],
non_outliers['FactValueNumeric'], label='Normal Data', color='blue',
alpha=0.7)
    plt.scatter(outliers['Location'], outliers['FactValueNumeric'],
label='Outliers', color='red', marker='x', s=100)
    plt.xlabel('Country', fontsize=10)
    plt.ylabel('Average PM2.5 Concentration (µg/m³)', fontsize=10)
    plt.title(f'{continent}: PM2.5 Concentration & Outliers',
fontsize=12)
    plt.xticks(rotation=45, ha='right', fontsize=9)
    plt.legend(fontsize=9)
plt.tight_layout(rect=[0, 0, 1, 0.95])
plt.suptitle("PM2.5 Concentration & Outliers by Continent",
fontsize=16)
plt.show()
```



```
filtered_data = data[['ParentLocation', 'Dim1',
'FactValueNumericLow']]
continents = ['Europe', 'Americas', 'South-East Asia']
fig, axes = plt.subplots(1, 3, figsize=(18, 6))
for i, continent in enumerate(continents):
    print(f"Processing {continent}...")
    continent_data = filtered_data[filtered_data['ParentLocation'] ==
continent]
    avg_fact_value_low = continent_data.groupby('Dim1')
['FactValueNumericLow'].mean()
    axes[i].pie(avg_fact_value_low, labels=avg_fact_value_low.index,
autopct='%1.1f%%', startangle=90)
    axes[i].set_title(f"Average FactValueNumericLow Distribution -
{continent}")
    axes[i].axis('equal')
plt.show()
```

```
Processing Europe...
Processing Americas...
Processing South-East Asia...
```


Average FactValueNumericLow Distribution - Europe
Cities
rural
Towns
Average FactValueNumericLow Distribution - Americas
Cities
rural
Towns
Average FactValueNumericLow Distribution - South-East Asia
Cities
rural
Towns