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


data = pd.read_csv('/content/drive/MyDrive/AI/Assingment-1/WHR-2024-5CS037.csv')
print(data.head(10))
```

```
  Country name  score  Log GDP per capita  Social support  \
0      Finland  7.741               1.844           1.572
1      Denmark  7.583               1.908           1.520
2      Iceland  7.525               1.881           1.617
3       Sweden  7.344               1.878           1.501
4       Israel  7.341               1.803           1.513
5  Netherlands  7.319               1.901           1.462
6       Norway  7.302               1.952           1.517
7   Luxembourg  7.122               2.141           1.355
8  Switzerland  7.060               1.970           1.425
9    Australia  7.057               1.854           1.461

   Healthy life expectancy  Freedom to make life choices  Generosity  \
0                    0.695                         0.859       0.142
1                    0.699                         0.823       0.204
2                    0.718                         0.819       0.258
3                    0.724                         0.838       0.221
4                    0.740                         0.641       0.153
5                    0.706                         0.725       0.247
6                    0.704                         0.835       0.224
7                    0.708                         0.801       0.146
8                    0.747                         0.759       0.173
9                    0.692                         0.756       0.225

   Perceptions of corruption  Dystopia + residual
0                      0.546                2.082
1                      0.548                1.881
2                      0.182                2.050
3                      0.524                1.658
4                      0.193                2.298
5                      0.372                1.906
6                      0.484                1.586
7                      0.432                1.540
8                      0.498                1.488
9                      0.323                1.745
```

```
rows,columns = data.shape
print(f"The data has {rows} rows and {columns} columns")
```

```
The data has 143 rows and 9 columns
```

```
types = data.dtypes
print(types)
```

```
Country name                     object
score                           float64
Log GDP per capita              float64
Social support                  float64
Healthy life expectancy         float64
Freedom to make life choices    float64
Generosity                      float64
Perceptions of corruption       float64
Dystopia + residual             float64
dtype: object
```

Basic Statistics

```
meann = data['score'].mean()
mediann = data['score'].median()
stdDev = data['score'].std()
print(f"Mean: {meann}")
print(f"Median: {mediann}")
print(f"Standard Deviation: {stdDev}")
```

```
Mean: 5.52758041958042
Median: 5.785
Standard Deviation: 1.1707165099442995
```

```
highest = data['score'].max()
lowest = data['score'].min()
highest_country = data.loc[data['score'].idxmax(),'Country name']
lowest_country = data.loc[data['score'].idxmin(),'Country name']
print(f"Highest score: {highest} Country:{highest_country}")
print(f"Lowest score: {lowest} Country:{lowest_country}")
```

```
Highest score: 7.741 Country:Finland
Lowest score: 1.721 Country:Afghanistan
```

```
missing_values = data.isnull().sum()
print(f"Missing values: \n{missing_values}")
```

```
Missing values:
Country name                    0
score                           0
Log GDP per capita              3
Social support                  3
Healthy life expectancy         3
Freedom to make life choices    3
Generosity                      3
Perceptions of corruption       3
Dystopia + residual             3
dtype: int64
```

```
data = pd.read_csv('/content/drive/MyDrive/AI/Assingment-1/WHR-2024-5CS037.csv')
greater_country  =  data[data['score']>7.5]
print(greater_country)
```

```
  Country name  score  Log GDP per capita  Social support  \
0      Finland  7.741               1.844           1.572
1      Denmark  7.583               1.908           1.520
2      Iceland  7.525               1.881           1.617

   Healthy life expectancy  Freedom to make life choices  Generosity  \
0                    0.695                         0.859       0.142
1                    0.699                         0.823       0.204
2                    0.718                         0.819       0.258

   Perceptions of corruption  Dystopia + residual
0                      0.546                2.082
1                      0.548                1.881
2                      0.182                2.050
```

```
filtered_data = data[data['score'] > 7.5]
sorted_data = filtered_data.sort_values(by='Log GDP per capita', ascending=False)
top_10 = sorted_data.head(10)
print(top_10)
```

```
  Country name  score  Log GDP per capita  Social support  \
1      Denmark  7.583               1.908           1.520
2      Iceland  7.525               1.881           1.617
0      Finland  7.741               1.844           1.572

   Healthy life expectancy  Freedom to make life choices  Generosity  \
1                    0.699                         0.823       0.204
2                    0.718                         0.819       0.258
0                    0.695                         0.859       0.142

   Perceptions of corruption  Dystopia + residual
1                      0.548                1.881
2                      0.182                2.050
0                      0.546                2.082
```

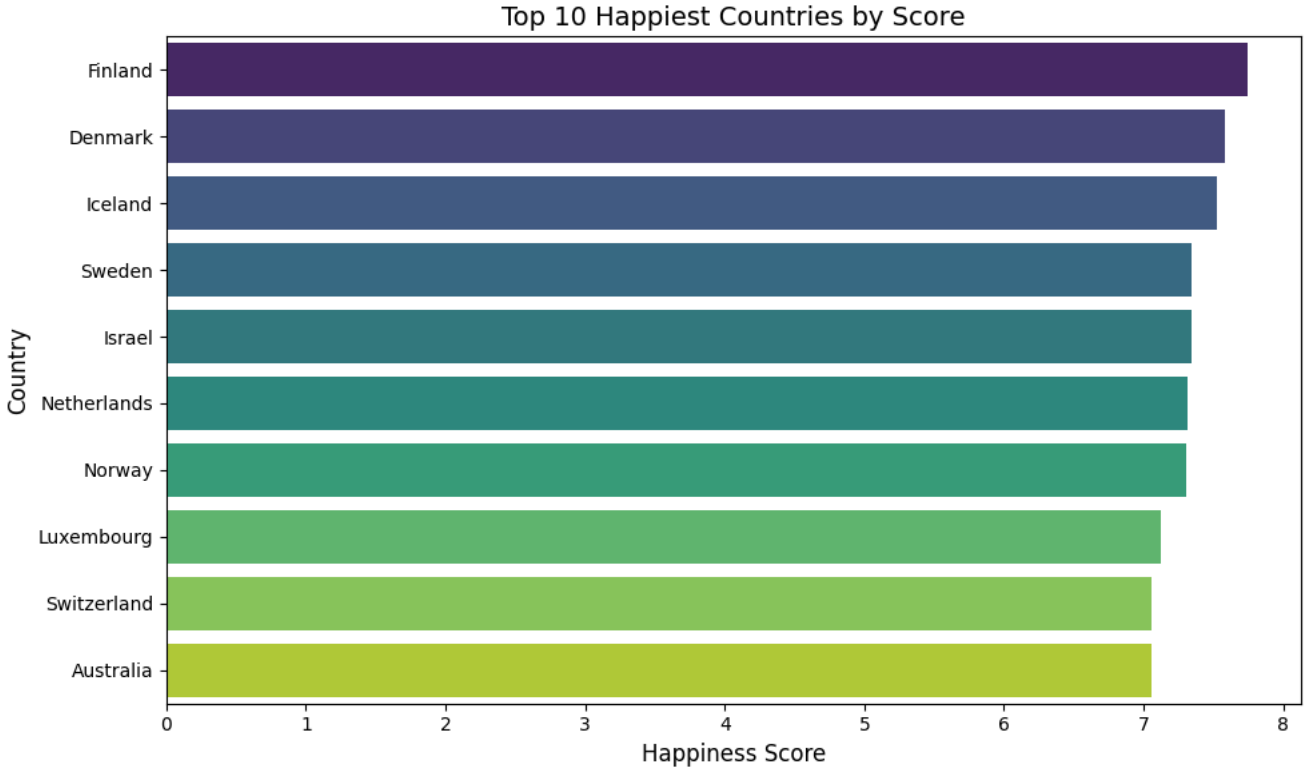
```
def categorize_happiness(score):
    if score < 4:
        return 'Low'
    elif 4 <= score <= 6:
        return 'Medium'
    else:
        return 'High'
data['Happiness Category'] = data['score'].apply(categorize_happiness)
print(data[['Country name', 'score', 'Happiness Category']])
```

```
          Country name  score Happiness Category
0              Finland  7.741               High
1              Denmark  7.583               High
2              Iceland  7.525               High
3               Sweden  7.344               High
4               Israel  7.341               High
..                 ...    ...                ...
138  Congo (Kinshasa)  3.295                Low
139      Sierra Leone  3.245                Low
```

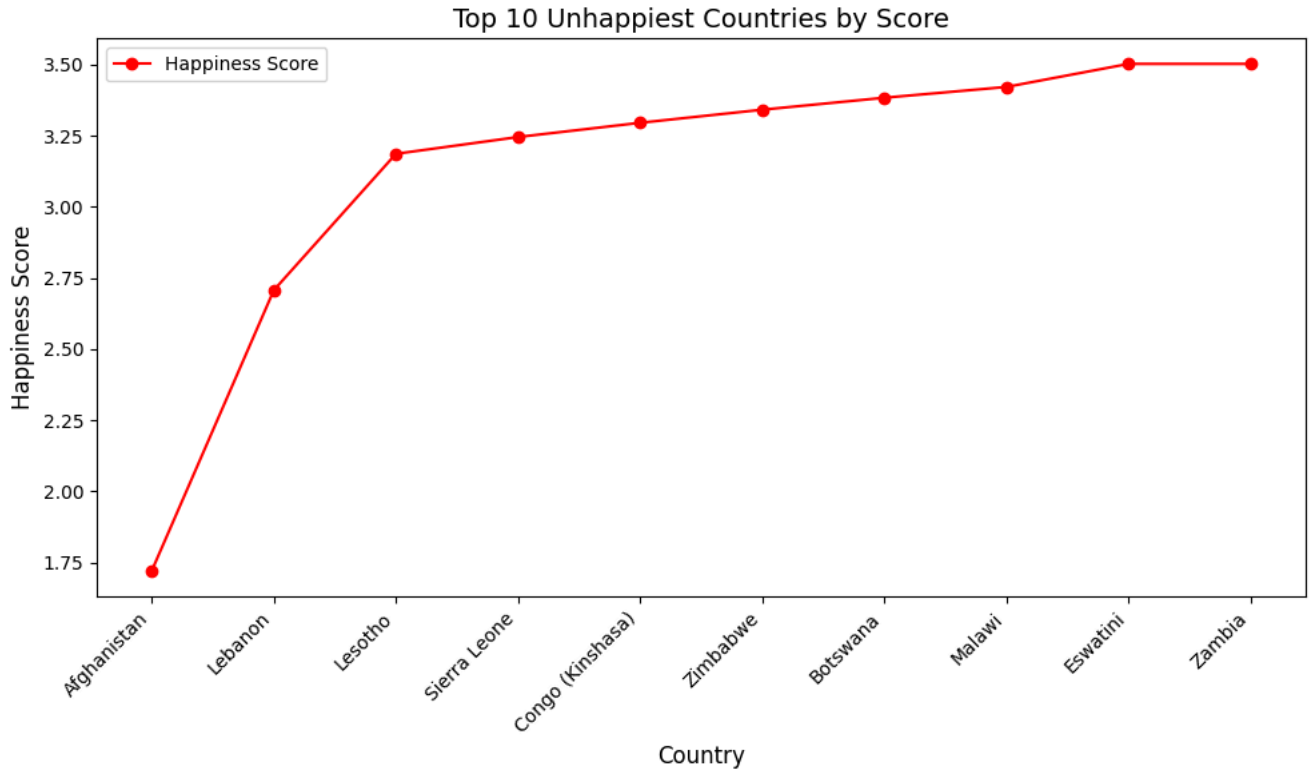
```
140           Lesotho  3.186               Low
141           Lebanon  2.707               Low
142       Afghanistan  1.721               Low

[143 rows x 3 columns]
```

```
top_10_happiest = data.sort_values(by='score', ascending=False).head(10)
plt.figure(figsize=(10, 6))
sns.barplot(x='score', y='Country name', data=top_10_happiest, palette='viridis')
plt.xlabel('Happiness Score', fontsize=12)
plt.ylabel('Country', fontsize=12)
plt.title('Top 10 Happiest Countries by Score', fontsize=14)
plt.tight_layout()
plt.show()
```

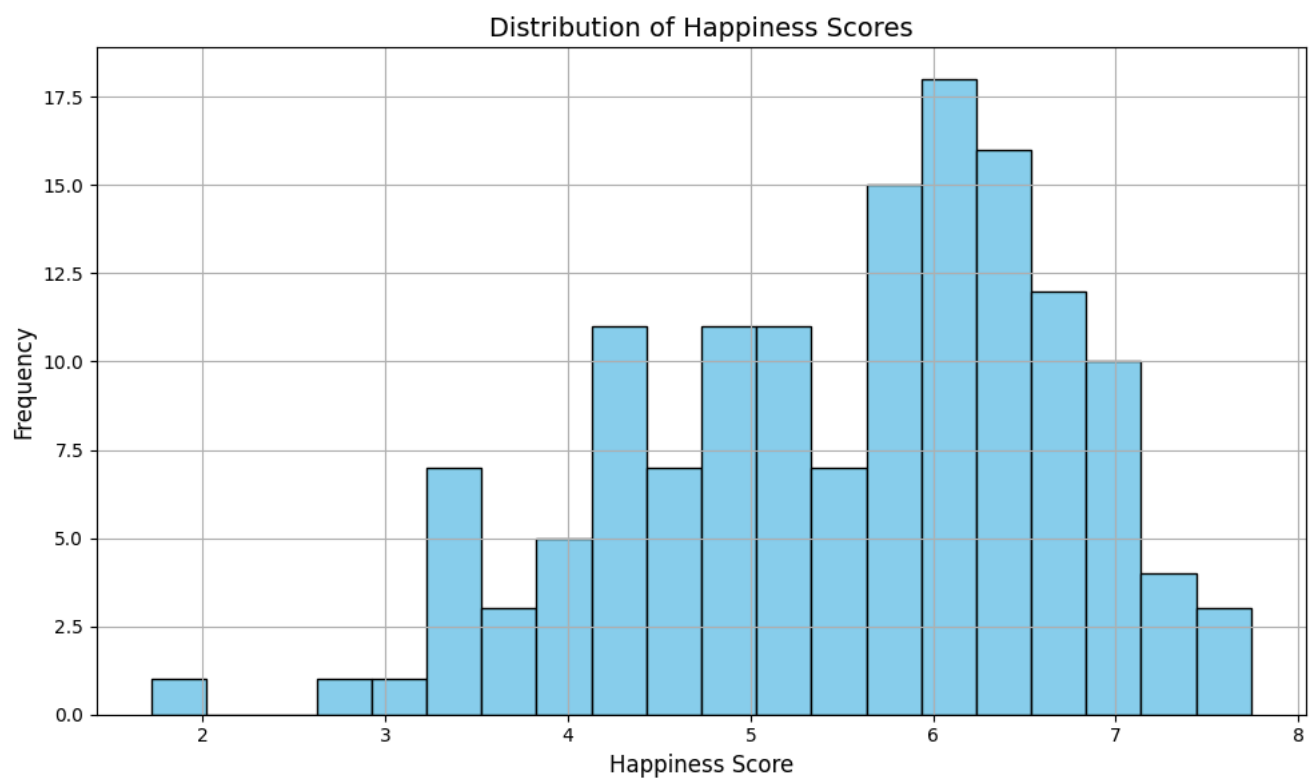
```
<ipython-input-12-11d0ba72e668>:3: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `y` variable to `hue`

  sns.barplot(x='score', y='Country name', data=top_10_happiest, palette='viridis')
```



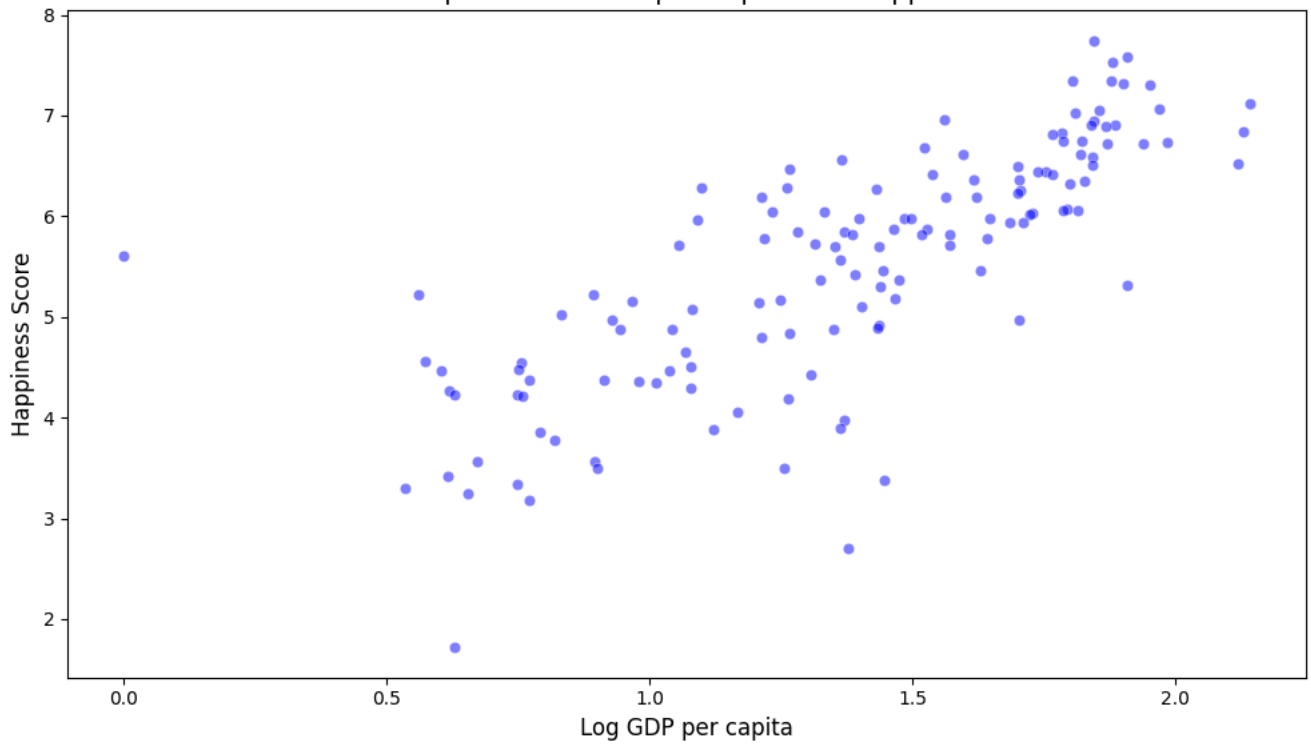

```
top_10_unhappiest = data.sort_values(by='score', ascending=True).head(10)
plt.figure(figsize=(10, 6))
plt.plot(top_10_unhappiest['Country name'], top_10_unhappiest['score'], marker='o', linestyle='-', color='red', label='Happi
plt.xlabel('Country', fontsize=12)
plt.ylabel('Happiness Score', fontsize=12)
plt.title('Top 10 Unhappiest Countries by Score', fontsize=14)
plt.xticks(rotation=45, ha='right')
plt.legend()
plt.tight_layout()
plt.show()
```




```
plt.figure(figsize=(10, 6))
plt.hist(data['score'], bins=20, color='skyblue', edgecolor='black')
plt.xlabel('Happiness Score', fontsize=12)
plt.ylabel('Frequency', fontsize=12)
plt.title('Distribution of Happiness Scores', fontsize=14)
plt.grid(True)
plt.tight_layout()
plt.show()
```




```
plt.figure(figsize=(10, 6))
sns.scatterplot(x='Log GDP per capita', y='score', data=data, color='blue', alpha=0.5)
plt.xlabel('Log GDP per capita', fontsize=12)
plt.ylabel('Happiness Score', fontsize=12)
plt.title('Relationship Between GDP per Capita and Happiness Score', fontsize=14)
plt.tight_layout()
plt.show()
```



Problem 2

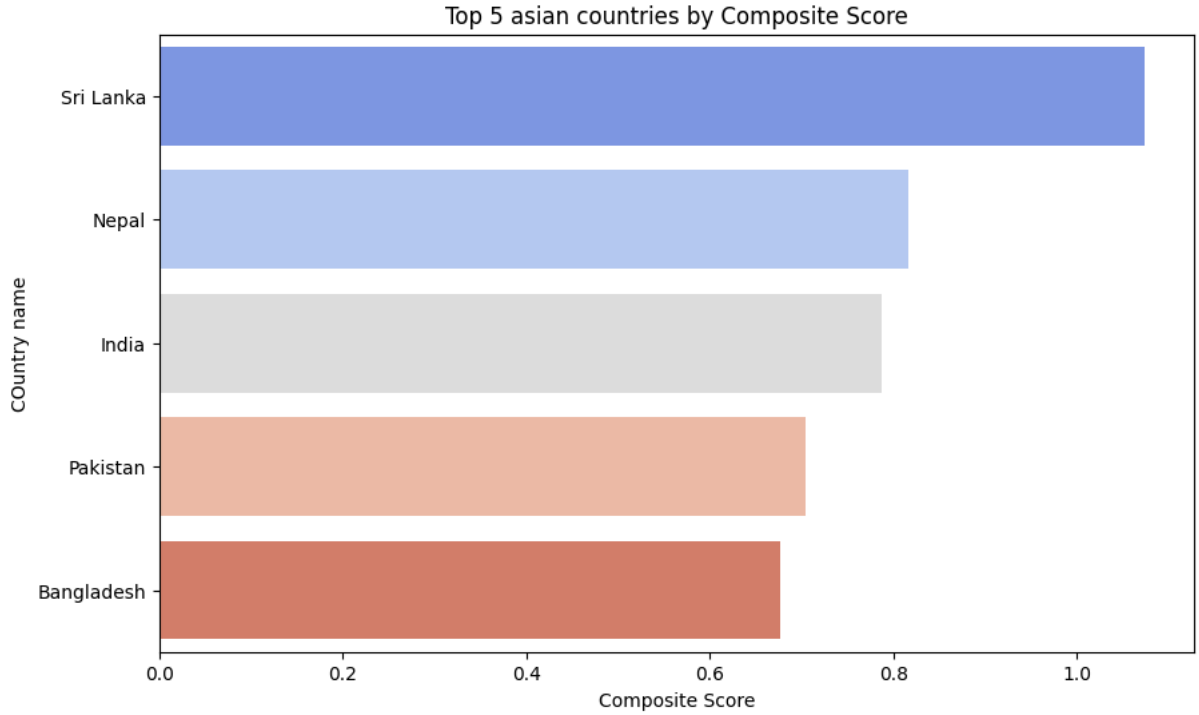
```
# List of South Asian countries
south_asian_countries = [
"Afghanistan", "Bangladesh", "Bhutan", "India", "Maldives",
"Nepal", "Pakistan", "Sri Lanka"
]
# Load the original dataset
happiness_df = pd.read_csv('/content/drive/MyDrive/AI/Assingment-1/WHR-2024-5CS037.csv')
# Step 2: Filter the dataset for South Asian countries
southAsianData = happiness_df[happiness_df['Country name'].isin(south_asian_countries)]

# Step 3: Save the filtered dataframe to a new CSV file
southAsianData.to_csv('/content/drive/MyDrive/AI/Assingment-1/southAsianData.csv', index=False)
#output
print(southAsianData.head())
```

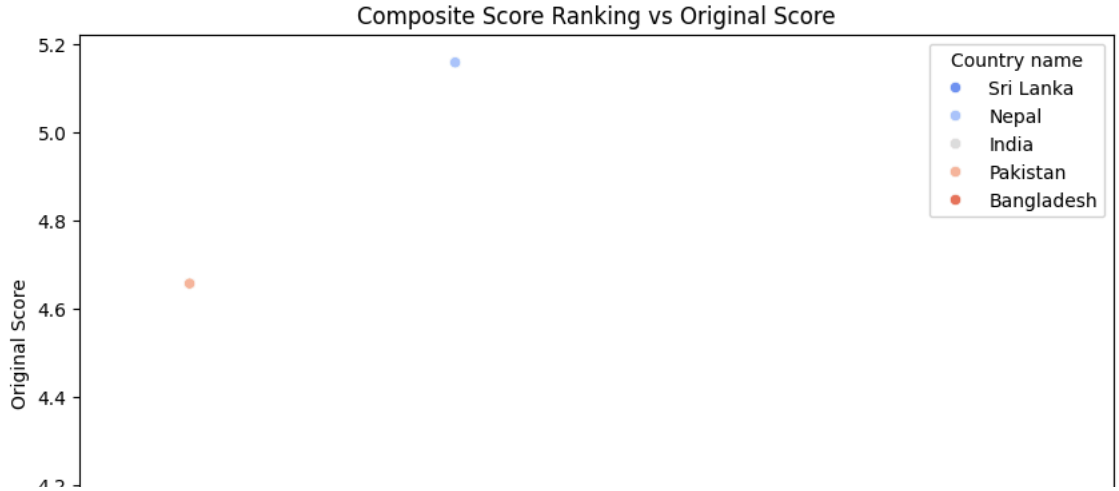
```
  Country name  score  Log GDP per capita  Social support  \
0        Nepal  5.158               0.965           0.990
1     Pakistan  4.657               1.069           0.600
2        India  4.054               1.166           0.653
3    Sri Lanka  3.898               1.361           1.179
4   Bangladesh  3.886               1.122           0.249

   Healthy life expectancy  Freedom to make life choices  Generosity  \
0                    0.443                         0.653       0.209
1                    0.321                         0.542       0.144
2                    0.417                         0.767       0.174
3                    0.586                         0.583       0.144
4                    0.513                         0.775       0.140

   Perceptions of corruption  Dystopia + residual
0                      0.115                1.783
1                      0.074                1.907
2                      0.122                0.756
3                      0.031                0.014
4                      0.167                0.919
```

```
south_asian_data = pd.read_csv('/content/drive/MyDrive/AI/Assingment-1/southAsianData.csv')
# Step 1: Create the Composite Score column
south_asian_data['Composite data']= (
0.40 * south_asian_data['Log GDP per capita'] +
0.30 * south_asian_data['Social support'] +
0.30 * south_asian_data['Healthy life expectancy']
)
south_asian_data['Composite rank'] = south_asian_data['Composite data'].rank(ascending= False)
top_5_countries = south_asian_data.nlargest(5, 'Composite data')
plt.figure(figsize=(10, 6))
sns.barplot(x='Composite data', y='Country name', data=top_5_countries, palette='coolwarm')
```

```
plt.title('Top 5 asian countries by Composite Score')
plt.xlabel('Composite Score')
plt.ylabel('COuntry name')
plt.show()
# Step 4: Compare the Composite Score ranking with the original Score
plt.figure(figsize=(10, 6))
sns.scatterplot(x='Composite data', y='score', data=top_5_countries, hue='Country name', palette = 'coolwarm')
plt.title('Composite Score Ranking vs Original Score')
plt.xlabel('Composite Score')
plt.ylabel('Original Score')
plt.show()
```

```
<ipython-input-30-a659cde85659>:11: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `y` variable to `hue`

  sns.barplot(x='Composite data', y='Country name', data=top_5_countries, palette='coolwarm')
```

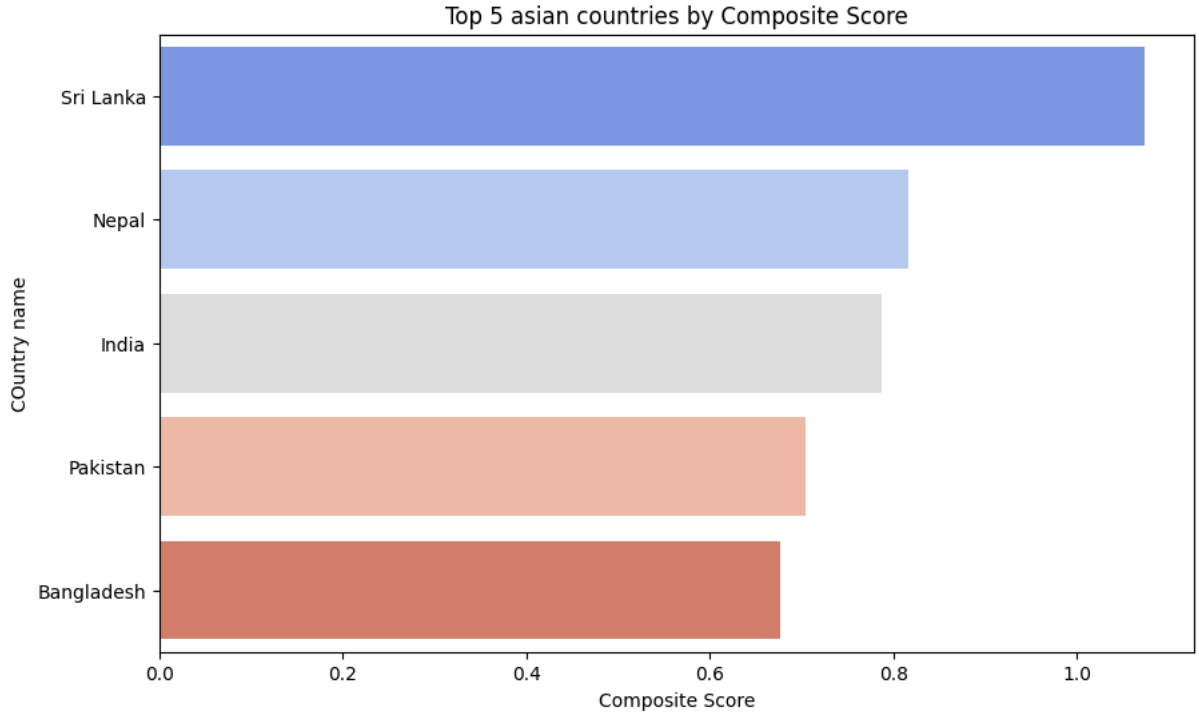


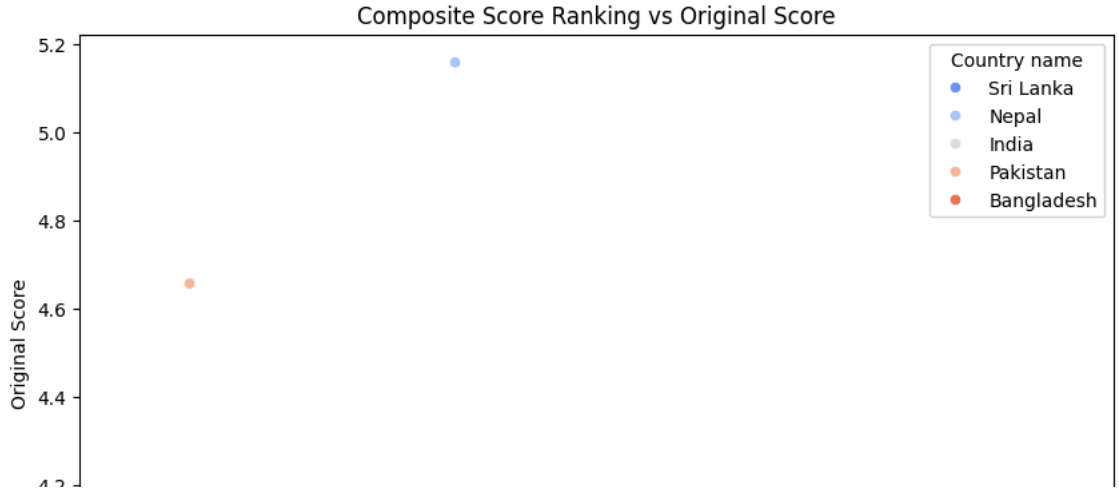



```
southAsianData = pd.read_csv('/content/drive/MyDrive/AI/Assingment-1/southAsianData.csv')
# Step 1: Create the Composite Score column
southAsianData['Composite data']= (
0.40 * southAsianData['Log GDP per capita'] +
0.30 * southAsianData['Social support'] +
0.30 * southAsianData['Healthy life expectancy']
)
southAsianData['Composite rank'] = southAsianData['Composite data'].rank(ascending= False)
top_5_countries = southAsianData.nlargest(5, 'Composite data')
plt.figure(figsize=(10, 6))
sns.barplot(x='Composite data', y='Country name', data=top_5_countries, palette='coolwarm')
plt.title('Top 5 asian countries by Composite Score')
plt.xlabel('Composite Score')
plt.ylabel('COuntry name')
plt.show()
# Step 4: Compare the Composite Score ranking with the original Score
plt.figure(figsize=(10, 6))
```

```
sns.scatterplot(x='Composite data', y='score', data=top_5_countries, hue='Country name', palette = 'coolwarm')
plt.title('Composite Score Ranking vs Original Score')
plt.xlabel('Composite Score')
plt.ylabel('Original Score')
plt.show()
```

```
<ipython-input-31-10aa16ec6553>:11: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `y` variable to `hue`

  sns.barplot(x='Composite data', y='Country name', data=top_5_countries, palette='coolwarm')
```

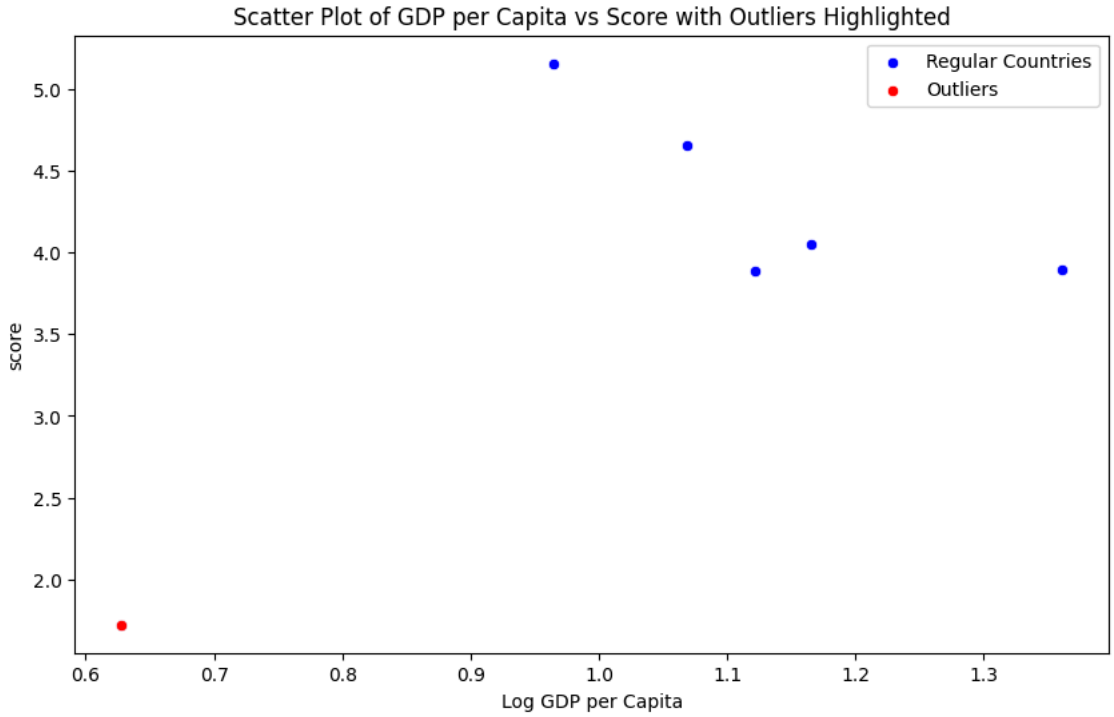





```
#import numpy as np

# Step 1: Calculate IQR for 'Score' and 'Log GDP per capita'
Q1_score = southAsianData['score'].quantile(0.25)
Q3_score = southAsianData['score'].quantile(0.75)
IQR_score = Q3_score - Q1_score

Q1_gdp = southAsianData['Log GDP per capita'].quantile(0.25)
Q3_gdp = southAsianData['Log GDP per capita'].quantile(0.75)
IQR_gdp = Q3_gdp - Q1_gdp

# Step 2: Define outlier thresholds
lower_bound_score = Q1_score - 1.5 * IQR_score
upper_bound_score = Q3_score + 1.5 * IQR_score

lower_bound_gdp = Q1_gdp - 1.5 * IQR_gdp
upper_bound_gdp = Q3_gdp + 1.5 * IQR_gdp

# Step 3: Identify outliers
score_outliers = southAsianData[
    (southAsianData['score'] < lower_bound_score) | (southAsianData['score'] > upper_bound_score)
]
```

```
gdp_outliers = southAsianData[
    (southAsianData['Log GDP per capita'] < lower_bound_gdp) | (southAsianData['Log GDP per capita'] > upper_bound_gdp)
]

# Combine unique outliers
all_outliers = pd.concat([score_outliers, gdp_outliers]).drop_duplicates()
print("Outlier Countries:")
print(all_outliers[['Country name', 'score', 'Log GDP per capita']])
plt.figure(figsize=(10, 6))

# Scatter plot for regular points
sns.scatterplot(
    x='Log GDP per capita',
    y='score',
    data=southAsianData,
    color='blue',
    label='Regular Countries'
)

# Scatter plot for outliers
sns.scatterplot(
    x='Log GDP per capita',
    y='score',
    data=all_outliers,
    color='red',
    label='Outliers'
)

# Add plot details
plt.title('Scatter Plot of GDP per Capita vs Score with Outliers Highlighted')
plt.xlabel('Log GDP per Capita')
plt.ylabel('score')
plt.legend()
plt.show()
# Regional averages with outliers
avg_score_with_outliers = southAsianData['score'].mean()
avg_gdp_with_outliers = southAsianData['Log GDP per capita'].mean()
regular_data = southAsianData[
    ~southAsianData['Country name'].isin(all_outliers['Country name'])
]

# Regional averages without outliers
avg_score_without_outliers = regular_data['score'].mean()
avg_gdp_without_outliers = regular_data['Log GDP per capita'].mean()

print(f"Average Score (with outliers): {avg_score_with_outliers:.2f}.")
print(f"Average GDP per Capita (with outliers): {avg_gdp_with_outliers:.2f}.")
print(f"Average Score (without outliers): {avg_score_without_outliers:.2f}.")
print(f"Average GDP per Capita (without outliers): {avg_gdp_without_outliers:.2f}.")
```

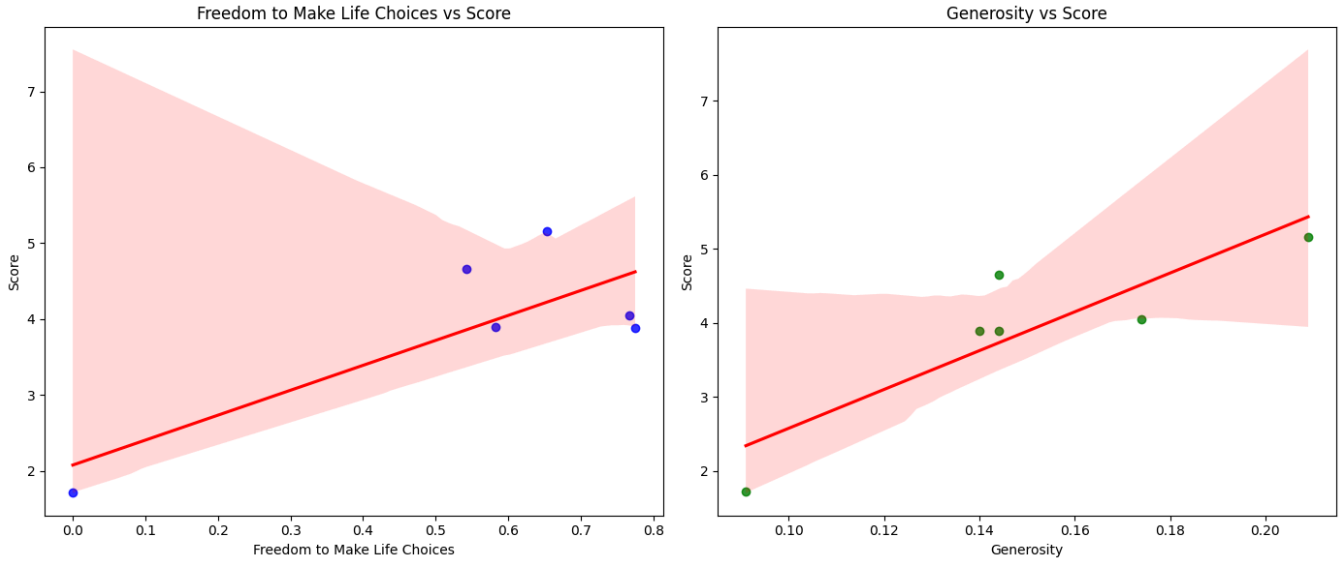
```
Outlier Countries:
  Country name  score  Log GDP per capita
5  Afghanistan  1.721               0.628
```




```
Average Score (with outliers): 3.90.
Average GDP per Capita (with outliers): 1.05.
Average Score (without outliers): 4.33.
Average GDP per Capita (without outliers): 1.14.
```

```
# Step 1: Calculate the Pearson correlation for 'Freedom to Make Life Choices' and 'Generosity' with 'Score'
correlationFreedom = southAsianData['Freedom to make life choices'].corr(southAsianData['score'])
correlationGenerosity = southAsianData['Generosity'].corr(southAsianData['score'])

print(f"Pearson Correlation between Freedom to Make Life Choices and Score: {correlationFreedom:.2f}")
print(f"Pearson Correlation between Generosity and Score: {correlationGenerosity:.2f}")
plt.figure(figsize=(14, 6))

# Scatter plot for Freedom to Make Life Choices vs. Score
plt.subplot(1, 2, 1)
sns.regplot(x='Freedom to make life choices', y='score', data=southAsianData, scatter_kws={'color': 'blue'}, line_kws={'colo
plt.title('Freedom to Make Life Choices vs Score')
plt.xlabel('Freedom to Make Life Choices')
plt.ylabel('Score')

# Scatter plot for Generosity vs. Score
plt.subplot(1, 2, 2)
sns.regplot(x='Generosity', y='score', data=southAsianData, scatter_kws={'color': 'green'}, line_kws={'color': 'red'})
plt.title('Generosity vs Score')
plt.xlabel('Generosity')
plt.ylabel('Score')

plt.tight_layout()
plt.show()
print("\n--- Discussion ---")

print(f"Based on the Pearson correlation, Freedom to Make Life Choices has a correlation of {correlationFreedom:.2f}. This s
print(f"Generosity has a correlation of {correlationGenerosity:.2f}. This indicates a weaker relationship between generosity
```

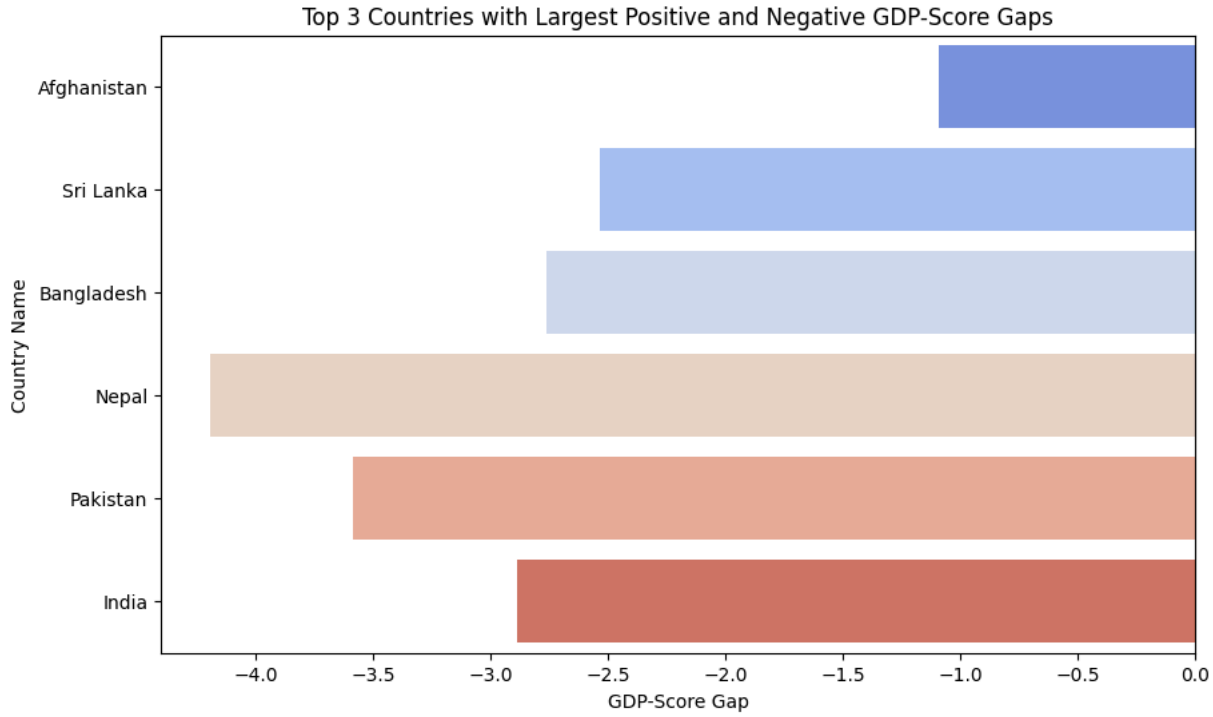
```
Pearson Correlation between Freedom to Make Life Choices and Score: 0.80
Pearson Correlation between Generosity and Score: 0.87
```




```
--- Discussion ---
Based on the Pearson correlation, Freedom to Make Life Choices has a correlation of 0.80. This suggests a strong positiv
Generosity has a correlation of 0.87. This indicates a weaker relationship between generosity and happiness, as the corr
```

```
# Step 1: Add a new column for GDP-Score Gap
southAsianData['GDP-Score Gap'] = southAsianData['Log GDP per capita'] - southAsianData['score']

# Step 2: Rank the South Asian countries by GDP-Score Gap in both ascending and descending order
southAsianData['GDP-Score Gap Ascending Rank'] = southAsianData['GDP-Score Gap'].rank(ascending=True)
southAsianData['GDP-Score Gap Descending Rank'] = southAsianData['GDP-Score Gap'].rank(ascending=False)

# Step 3: Highlight the top 3 countries with the largest positive and negative gaps using a bar chart
top_positive_gap = southAsianData.nlargest(3, 'GDP-Score Gap')
top_negative_gap = southAsianData.nsmallest(3, 'GDP-Score Gap')

# Combine the top positive and negative gaps for plotting
gap_countries = pd.concat([top_positive_gap, top_negative_gap])

# Plotting the bar chart
plt.figure(figsize=(10, 6))
sns.barplot(x='GDP-Score Gap', y='Country name', data=gap_countries, palette='coolwarm')
plt.title('Top 3 Countries with Largest Positive and Negative GDP-Score Gaps')
plt.xlabel('GDP-Score Gap')
plt.ylabel('Country Name')
plt.show()

# Step 4: Analyze the reasons behind these gaps and their implications
print("\n--- Analysis ---")
print("The GDP-Score Gap indicates the difference between the economic prosperity (GDP per capita) and the overall happiness
print("Countries with a large positive gap have high GDP per capita but relatively lower happiness scores, while countries w
print("Possible reasons for a large positive GDP-Score Gap could be income inequality, political instability, or other socio
print("On the other hand, countries with a negative gap might have strong social support systems, healthcare, or cultural fa
```

```
<ipython-input-34-3e735f76dd5d>:17: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `y` variable to `hue`

  sns.barplot(x='GDP-Score Gap', y='Country name', data=gap_countries, palette='coolwarm')
```




```
--- Analysis ---
The GDP-Score Gap indicates the difference between the economic prosperity (GDP per capita) and the overall happiness (S
Countries with a large positive gap have high GDP per capita but relatively lower happiness scores, while countries with
Possible reasons for a large positive GDP-Score Gap could be income inequality, political instability, or other socio-ec
On the other hand, countries with a negative gap might have strong social support systems, healthcare, or cultural facto
```

Problem-3

```
data = pd.read_csv('/content/drive/MyDrive/AI/Assingment-1/Countries.csv')
print(data)
# Step 1: Define the list of Middle Eastern countries
middle_east_countries = [
    "Bahrain", "Iran", "Iraq", "Israel", "Jordan",
    "Kuwait", "Lebanon", "Oman", "Palestine", "Qatar",
    "Saudi Arabia", "Syria", "United Arab Emirates", "Yemen"
]

# Step 2: Filter the dataset to include only Middle Eastern countries
middleEastData = data[data['Country name'].isin(middle_east_countries)]
print(middleEastData)

# Step 3: Save the filtered dataframe as a new CSV file for future use
middleEastData.to_csv('/content/drive/MyDrive/AI/Assingment-1/middleEastData.csv', index=False)

# Step 4: Display the first few rows of the new dataframe
print(middleEastData.head(10))
```

```
          Country name  score  Log GDP per capita  Social support  \
0              Finland  7.741               1.844           1.572
1              Denmark  7.583               1.908           1.520
2              Iceland  7.525               1.881           1.617
3               Sweden  7.344               1.878           1.501
4               Israel  7.341               1.803           1.513
..                 ...    ...                 ...             ...
138  Congo (Kinshasa)  3.295               0.534           0.665
139      Sierra Leone  3.245               0.654           0.566
140           Lesotho  3.186               0.771           0.851
141           Lebanon  2.707               1.377           0.577
142       Afghanistan  1.721               0.628           0.000

     Healthy life expectancy  Freedom to make life choices  Generosity  \
0                      0.695                         0.859       0.142
1                      0.699                         0.823       0.204
2                      0.718                         0.819       0.258
3                      0.724                         0.838       0.221
4                      0.740                         0.641       0.153
```

```
..                    ...                         ...        ...
138                 0.262                       0.473      0.189
139                 0.253                       0.469      0.181
140                 0.000                       0.523      0.082
141                 0.556                       0.173      0.068
142                 0.242                       0.000      0.091

     Perceptions of corruption  Dystopia + residual
0                        0.546                2.082
1                        0.548                1.881
2                        0.182                2.050
3                        0.524                1.658
4                        0.193                2.298
..                         ...                  ...
138                      0.072                1.102
139                      0.053                1.068
140                      0.085                0.875
141                      0.029               -0.073
142                      0.088                0.672

[143 rows x 9 columns]
             Country name  score  Log GDP per capita  Social support  \
4                  Israel  7.341               1.803           1.513
12                 Kuwait  6.951               1.845           1.364
21   United Arab Emirates  6.733               1.983           1.164
27           Saudi Arabia  6.594               1.842           1.361
61                Bahrain  5.959                 NaN             NaN
91                   Iraq  5.166               1.249           0.996
99                   Iran  4.923               1.435           1.136
124                Jordan  4.186               1.262           0.983
132                 Yemen  3.561               0.671           1.281
141               Lebanon  2.707               1.377           0.577

     Healthy life expectancy  Freedom to make life choices  Generosity  \
4                      0.740                         0.641       0.153
12                     0.661                         0.827       0.200
21                     0.563                         0.815       0.209
27                     0.511                         0.787       0.114
61                       NaN                           NaN         NaN
```

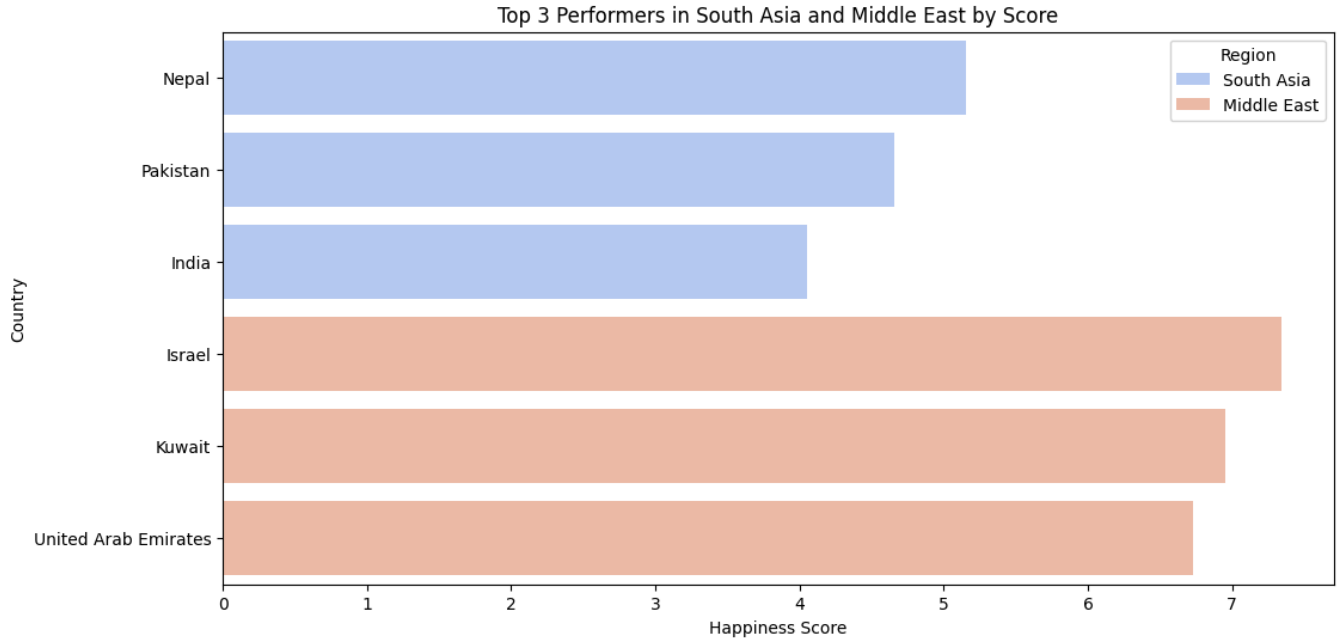
```
# Step 1: Calculate mean and standard deviation for South Asia
south_asia_mean = south_asian_data['score'].mean()
south_asia_std = south_asian_data['score'].std()

# Step 2: Calculate mean and standard deviation for Middle East
middle_east_mean = middleEastData['score'].mean()
middle_east_std = middleEastData['score'].std()

# Step 3: Print results
print("South Asia Statistics:")
print(f"Mean Happiness Score: {south_asia_mean:.2f}")
print(f"Standard Deviation of Happiness Score: {south_asia_std:.2f}")

print("\nMiddle East Statistics:")
print(f"Mean Happiness Score: {middle_east_mean:.2f}")
print(f"Standard Deviation of Happiness Score: {middle_east_std:.2f}")

# Step 4: Compare which region has a higher average happiness score
if south_asia_mean > middle_east_mean:
    print("\nSouth Asia has a higher average happiness score.")
else:
    print("\nMiddle East has a higher average happiness score.")
```

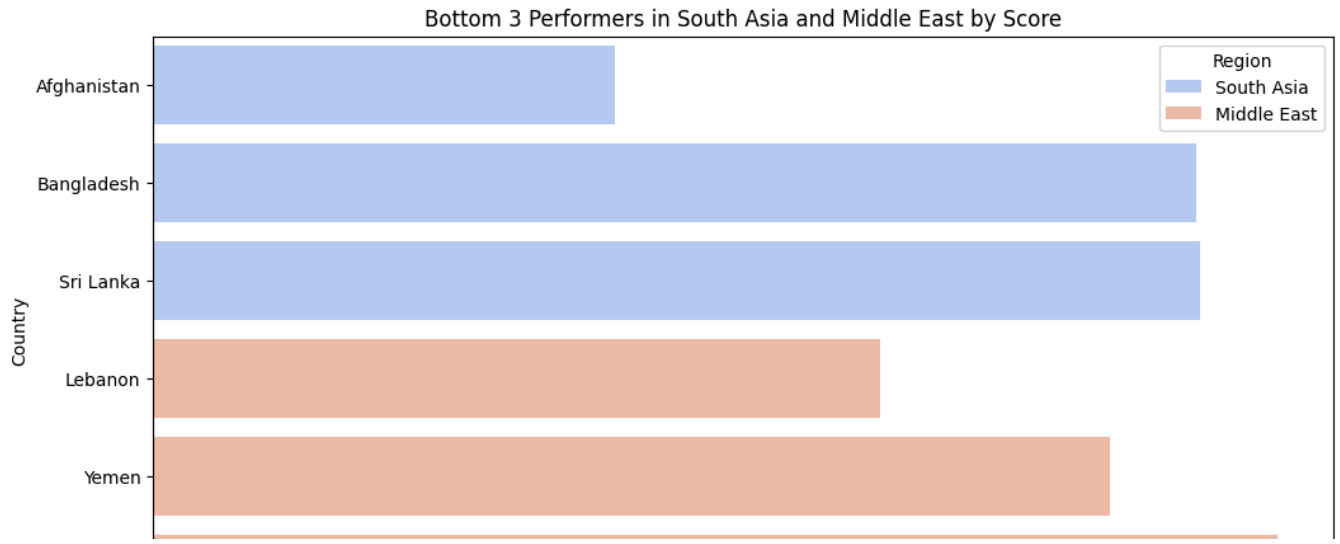
```
South Asia Statistics:
Mean Happiness Score: 3.90
Standard Deviation of Happiness Score: 1.18

Middle East Statistics:
Mean Happiness Score: 5.41
Standard Deviation of Happiness Score: 1.57

Middle East has a higher average happiness score.
```

```
# Add a region column to each dataset
southAsianData['Region'] = 'South Asia'
middleEastData['Region'] = 'Middle East'

# Top 3 and bottom 3 performers in South Asia
south_asia_top3 = southAsianData.nlargest(3, 'score')
south_asia_bottom3 = southAsianData.nsmallest(3, 'score')

# Top 3 and bottom 3 performers in the Middle East
middle_east_top3 = middleEastData.nlargest(3, 'score')
middle_east_bottom3 = middleEastData.nsmallest(3, 'score')
```

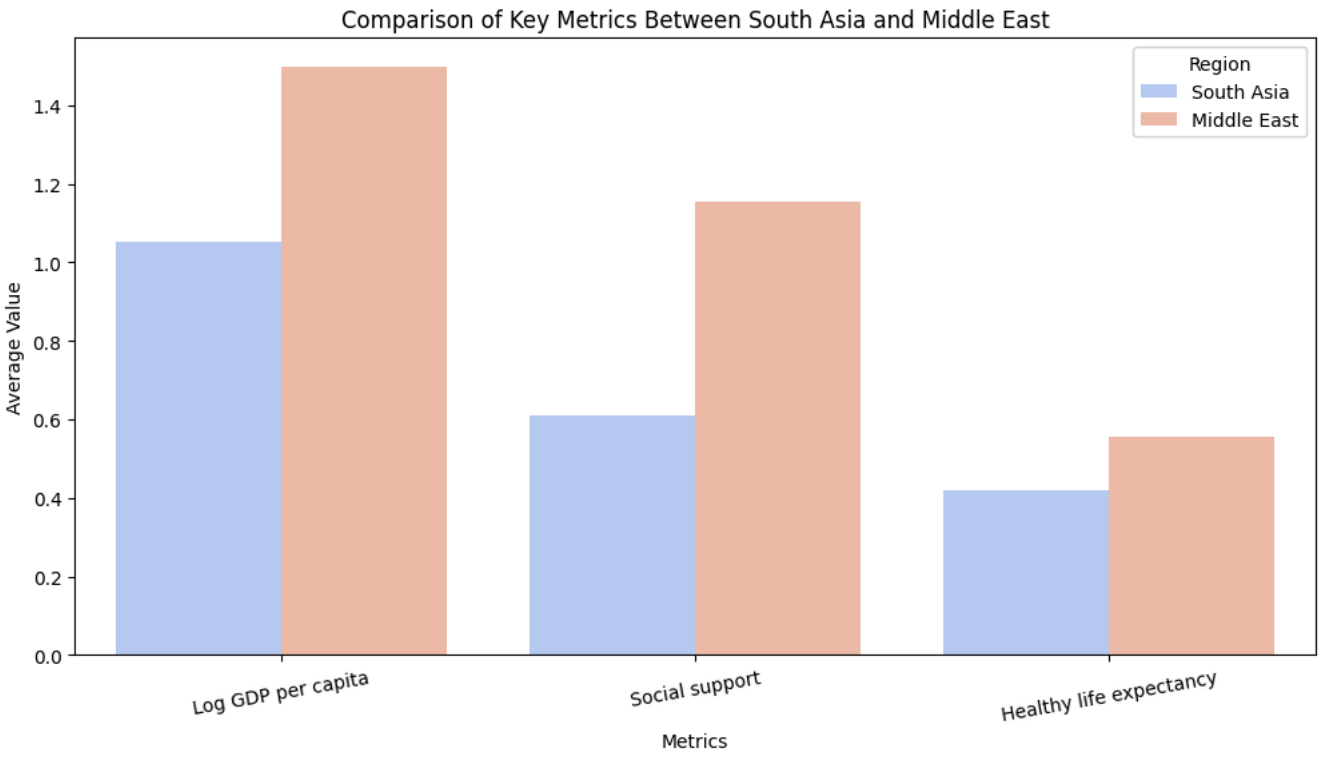
```
# Combine datasets for plotting
top_performers = pd.concat([south_asia_top3, middle_east_top3])
bottom_performers = pd.concat([south_asia_bottom3, middle_east_bottom3])

# Plotting Top Performers
plt.figure(figsize=(12, 6))
sns.barplot(
    x='score', y='Country name', data=top_performers,
    hue='Region', palette='coolwarm'
)
plt.title("Top 3 Performers in South Asia and Middle East by Score")
plt.xlabel("Happiness Score")
plt.ylabel("Country")
plt.legend(title="Region")
plt.show()

# Plotting Bottom Performers
plt.figure(figsize=(12, 6))
sns.barplot(
    x='score', y='Country name', data=bottom_performers,
    hue='Region', palette='coolwarm'
)
plt.title("Bottom 3 Performers in South Asia and Middle East by Score")
plt.xlabel("Happiness Score")
plt.ylabel("Country")
plt.legend(title="Region")
plt.show()
```

```
<ipython-input-59-2c54a0ca556f>:3: 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-
  middleEastData['Region'] = 'Middle East'
```





```
# Step 1: Calculate mean values for each metric by region
metrics = ['Log GDP per capita', 'Social support', 'Healthy life expectancy']

south_asian_means = southAsianData[metrics].mean()
middle_east_means = middleEastData[metrics].mean()

# Combine the mean values into a DataFrame
comparison_df = pd.DataFrame({
    'Metric': metrics,
    'South Asia': south_asian_means.values,
    'Middle East': middle_east_means.values
})

# Melt the DataFrame for plotting
comparison_melted = comparison_df.melt(id_vars='Metric', var_name='Region', value_name='Value')

# Step 2: Create grouped bar chart
plt.figure(figsize=(12, 6))
sns.barplot(x='Metric', y='Value', hue='Region', data=comparison_melted, palette='coolwarm')
plt.title('Comparison of Key Metrics Between South Asia and Middle East')
plt.ylabel('Average Value')
plt.xlabel('Metrics')
plt.xticks(rotation=10)
plt.legend(title='Region')
plt.show()

# Step 3: Identify largest disparity
disparities = abs(south_asian_means - middle_east_means)
largest_disparity_metric = disparities.idxmax()
print(f"The metric with the largest disparity is: {largest_disparity_metric} with a difference of {disparities[largest_dispa
```




```
The metric with the largest disparity is: Social support with a difference of 0.54
```

```
# Step 1: Calculate the range and CV for both regions
def calculate_variability(region_data, region_name):
    score_range = region_data['score'].max() - region_data['score'].min()
    score_mean = region_data['score'].mean()
    score_std = region_data['score'].std()
    cv = (score_std / score_mean) * 100  # Coefficient of Variation in percentage
    return {
        "Region": region_name,
        "Range": score_range,
        "Coefficient of Variation (%)": cv
    }

# Calculate for South Asia
south_asia_variability = calculate_variability(southAsianData, "South Asia")

# Calculate for Middle East
middle_east_variability = calculate_variability(middleEastData, "Middle East")
```

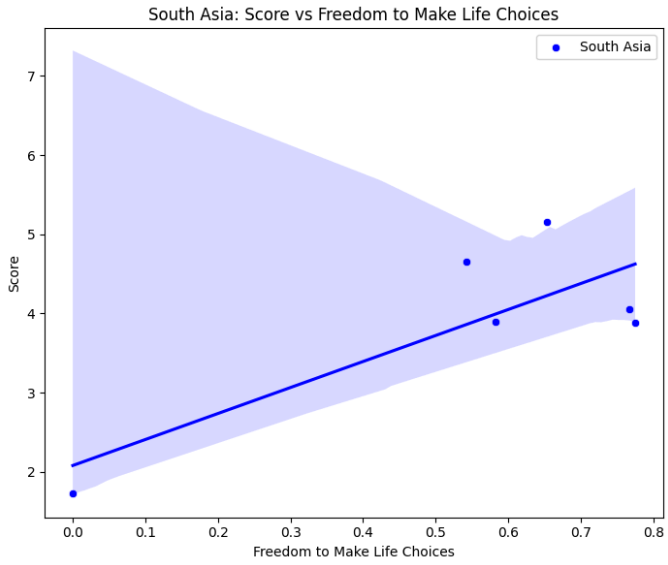
```
# Combine results into a DataFrame for comparison
variability_df = pd.DataFrame([south_asia_variability, middle_east_variability])

# Step 2: Display results
print(variability_df)

# Step 3: Identify which region has greater variability
greater_variability_region = (
    "South Asia" if south_asia_variability['Coefficient of Variation (%)'] > middle_east_variability['Coefficient of Variati
    else "Middle East"
)
print(f"\nThe region with greater variability in happiness is: {greater_variability_region}")
```

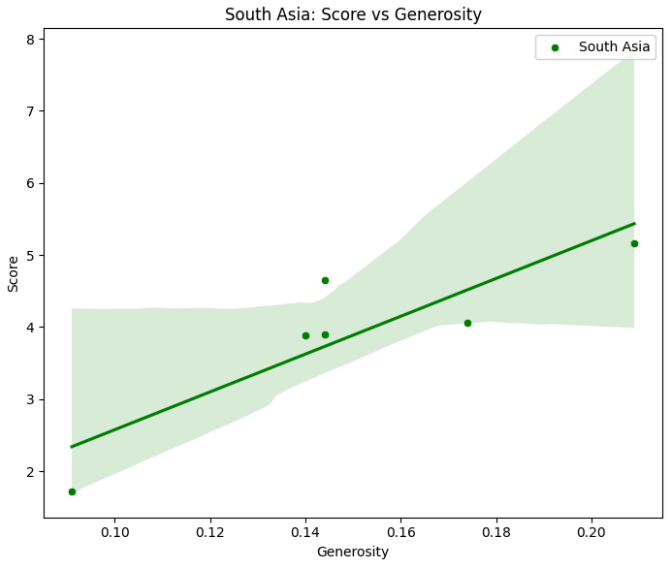
```
         Region  Range  Coefficient of Variation (%)
0   South Asia  3.437                     30.214829
1  Middle East  4.634                     28.938881

The region with greater variability in happiness is: South Asia
```

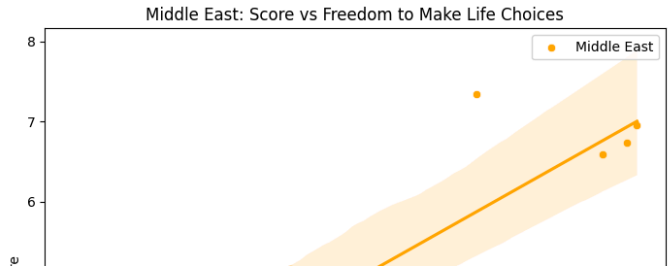
```
# Step 1: Calculate correlations for South Asia
south_asian_corr = southAsianData[['score', 'Freedom to make life choices', 'Generosity']].corr()
print("Correlation Matrix for South Asia:")
print(south_asian_corr)

# Step 2: Calculate correlations for Middle East
middle_east_corr = middleEastData[['score', 'Freedom to make life choices', 'Generosity']].corr()
print("\nCorrelation Matrix for Middle East:")
print(middle_east_corr)

# Step 3: Create scatter plots for South Asia
plt.figure(figsize=(14, 6))
plt.subplot(1, 2, 1)
sns.scatterplot(
    x='Freedom to make life choices', y='score', data=southAsianData,
    color='blue', label='South Asia'
)
sns.regplot(
    x='Freedom to make life choices', y='score', data=southAsianData,
    scatter=False, color='blue'
)
plt.title('South Asia: Score vs Freedom to Make Life Choices')
plt.xlabel('Freedom to Make Life Choices')
plt.ylabel('Score')

plt.subplot(1, 2, 2)
sns.scatterplot(
    x='Generosity', y='score', data=southAsianData,
    color='green', label='South Asia'
)
sns.regplot(
    x='Generosity', y='score', data=southAsianData,
    scatter=False, color='green'
)
plt.title('South Asia: Score vs Generosity')
plt.xlabel('Generosity')
plt.ylabel('Score')
plt.tight_layout()
plt.show()

# Step 4: Create scatter plots for Middle East
plt.figure(figsize=(14, 6))
plt.subplot(1, 2, 1)
sns.scatterplot(
    x='Freedom to make life choices', y='score', data=middleEastData,
    color='orange', label='Middle East'
)
sns.regplot(
    x='Freedom to make life choices', y='score', data=middleEastData,
    scatter=False, color='orange'
)
plt.title('Middle East: Score vs Freedom to Make Life Choices')
plt.xlabel('Freedom to Make Life Choices')
plt.ylabel('Score')

plt.subplot(1, 2, 2)
sns.scatterplot(
    x='Generosity', y='score', data=middleEastData,
    color='purple', label='Middle East'
)
sns.regplot(
    x='Generosity', y='score', data=middleEastData,
```

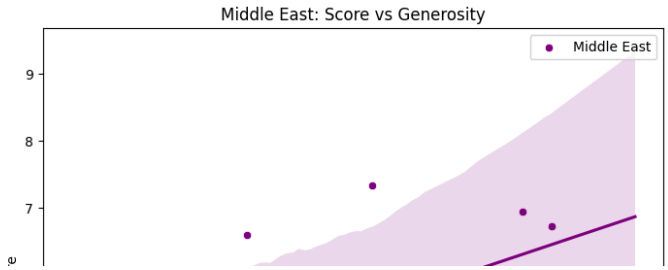
```
    scatter=False, color='purple'
)
plt.title('Middle East: Score vs Generosity')
plt.xlabel('Generosity')
plt.ylabel('Score')
plt.tight_layout()
plt.show()
```

```
Correlation Matrix for South Asia:
                                score  Freedom to make life choices  \
score                        1.000000                      0.800519
Freedom to make life choices 0.800519                      1.000000
Generosity                   0.874512                      0.733396

                             Generosity
score                          0.874512
Freedom to make life choices   0.733396
Generosity                     1.000000

Correlation Matrix for Middle East:
                                score  Freedom to make life choices  \
score                        1.000000                      0.863220
Freedom to make life choices 0.863220                      1.000000
Generosity                   0.627524                      0.388854

                             Generosity
score                          0.627524
Freedom to make life choices   0.388854
Generosity                     1.000000
```





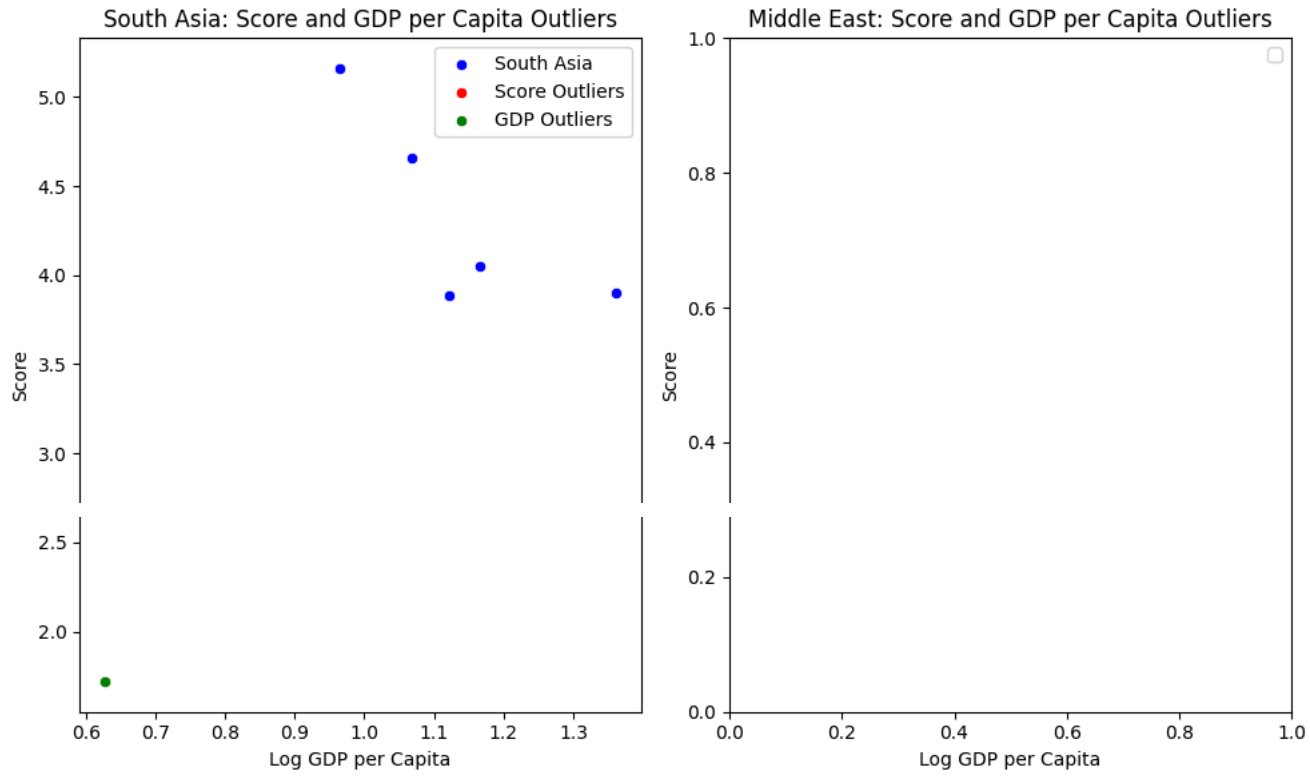





```
import numpy as np

# Step 1: Function to detect outliers using IQR
def detect_outliers(df, column):
    Q1 = df[column].quantile(0.25)
    Q3 = df[column].quantile(0.75)
    IQR = Q3 - Q1
    lower_bound = Q1 - 1.5 * IQR
    upper_bound = Q3 + 1.5 * IQR
    outliers = df[(df[column] < lower_bound) | (df[column] > upper_bound)]
    return outliers, lower_bound, upper_bound

# Step 2: Detect outliers for both regions (South Asia and Middle East)
south_asian_score_outliers, _, _ = detect_outliers(south_asian_data, 'score')
south_asian_gdp_outliers, _, _ = detect_outliers(south_asian_data, 'Log GDP per capita')

middle_east_score_outliers, _, _ = detect_outliers(middle_east_data, 'score')
middle_east_gdp_outliers, _, _ = detect_outliers(middle_east_data, 'Log GDP per capita')

# Step 3: Plot outliers for South Asia
plt.figure(figsize=(10, 6))
```

```
plt.subplot(1, 2, 1)
sns.scatterplot(x='Log GDP per capita', y='score', data=south_asian_data, label='South Asia', color='blue')
sns.scatterplot(x=south_asian_score_outliers['Log GDP per capita'], y=south_asian_score_outliers['score'], color='red', labe
sns.scatterplot(x=south_asian_gdp_outliers['Log GDP per capita'], y=south_asian_gdp_outliers['score'], color='green', label=
plt.title('South Asia: Score and GDP per Capita Outliers')
plt.xlabel('Log GDP per Capita')
plt.ylabel('Score')
plt.legend()

# Step 4: Plot outliers for Middle East
plt.subplot(1, 2, 2)
sns.scatterplot(x='Log GDP per capita', y='score', data=middle_east_data, label='Middle East', color='orange')
sns.scatterplot(x=middle_east_score_outliers['Log GDP per capita'], y=middle_east_score_outliers['score'], color='red', labe
sns.scatterplot(x=middle_east_gdp_outliers['Log GDP per capita'], y=middle_east_gdp_outliers['score'], color='green', label=
plt.title('Middle East: Score and GDP per Capita Outliers')
plt.xlabel('Log GDP per Capita')
plt.ylabel('Score')
plt.legend()

plt.tight_layout()
plt.show()

# Step 5: Print outlier countries for both regions
print("South Asia Score Outliers:")
print(south_asian_score_outliers[['Country name', 'score', 'Log GDP per capita']])

print("\nSouth Asia GDP Outliers:")
print(south_asian_gdp_outliers[['Country name', 'score', 'Log GDP per capita']])

print("\nMiddle East Score Outliers:")
print(middle_east_score_outliers[['Country name', 'score', 'Log GDP per capita']])

print("\nMiddle East GDP Outliers:")
print(middle_east_gdp_outliers[['Country name', 'score', 'Log GDP per capita']])
```

```
WARNING:matplotlib.legend:No artists with labels found to put in legend.  Note that artists whose label start with an un
```




```
South Asia Score Outliers:
  Country name  score  Log GDP per capita
5  Afghanistan  1.721               0.628
```