Global Smoking Trends Brand (2010-2024)

July 19, 2025

[181]:
```
import pandas as pd
import seaborn as sns
import numpy as np
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression
```

[182]:
```
df = pd.read_csv('../data/smoking_dataset.csv')
print(df.head())
print(df.info())
```

```
       Country  Year  Total Smokers (Millions)  Smoking Prevalence (%)  \
0  South Africa  2010                     279.6                    21.5
1  South Africa  2022                      41.8                    10.2
2  South Africa  2017                     262.0                    30.7
3       Germany  2016                      11.3                    38.2
4        Brazil  2014                     241.9                    27.6

   Male Smokers (%)  Female Smokers (%)  \
0              13.3                 8.2
1               7.5                 2.7
2              22.1                 8.6
3              24.1                14.1
4              18.2                 9.4

   Cigarette Consumption (Billion Units) Top Cigarette Brand in Country  \
0                                 2415.7                Peter Stuyvesant
1                                   97.0                Peter Stuyvesant
2                                  161.5                Peter Stuyvesant
3                                  111.5                        Marlboro
4                                 2151.2                           Derby

   Brand Market Share (%)  Smoking-Related Deaths  Tobacco Tax Rate (%)  \
0                    21.3                  461574                  32.9
1                    46.6                   57945                  42.9
2                    58.5                  407834                  51.4
3                    15.9                   13142                  79.6
4                    59.9                  220450                  56.4
```

```
  Smoking Ban Policy
0            Partial
1      Comprehensive
2            Partial
3            Partial
4                NaN
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150 entries, 0 to 149
Data columns (total 12 columns):
 #   Column                                Non-Null Count  Dtype
---  ------                                --------------  -----
 0   Country                               150 non-null    object
 1   Year                                  150 non-null    int64
 2   Total Smokers (Millions)              150 non-null    float64
 3   Smoking Prevalence (%)                150 non-null    float64
 4   Male Smokers (%)                      150 non-null    float64
 5   Female Smokers (%)                    150 non-null    float64
 6   Cigarette Consumption (Billion Units)  150 non-null    float64
 7   Top Cigarette Brand in Country        150 non-null    object
 8   Brand Market Share (%)                150 non-null    float64
 9   Smoking-Related Deaths                150 non-null    int64
 10  Tobacco Tax Rate (%)                  150 non-null    float64
 11  Smoking Ban Policy                    102 non-null    object
dtypes: float64(7), int64(2), object(3)
memory usage: 14.2+ KB
None
```

[183]:
```
df["Smoking Ban Policy"] = df.groupby("Country")["Smoking Ban Policy"].
 ↪transform(lambda x: x.fillna(x.mode()[0] if not x.mode().empty else "Unknown"))
```

[184]:
```
# Missing values are checked for each column
print("Missing values:\n", df.isna().sum())
```

```
Missing values:
 Country                                0
Year                                    0
Total Smokers (Millions)                0
Smoking Prevalence (%)                  0
Male Smokers (%)                        0
Female Smokers (%)                      0
Cigarette Consumption (Billion Units)   0
Top Cigarette Brand in Country          0
Brand Market Share (%)                  0
Smoking-Related Deaths                  0
Tobacco Tax Rate (%)                    0
Smoking Ban Policy                      0
dtype: int64
```

[185]:
```
#the global total number of smokers in the year 2024.
total_smokers_2024 = df[df["Year"] == 2024]["Total Smokers (Millions)"].sum()
print(f"Total Smokers in 2024: {total_smokers_2024:.1f} million")
```

```
Total Smokers in 2024: 2791.5 million
```

[186]:
```
#the average smoking prevalence percentage for each country.
prevalence_by_country = df.groupby("Country")["Smoking Prevalence (%)"].mean()
print(prevalence_by_country.head())
```

```
Country
Australia    22.787500
Brazil       23.366667
Canada       20.350000
China        22.645455
France       19.525000
Name: Smoking Prevalence (%), dtype: float64
```

[187]:
```
#the average tobacco tax rate by year.
avg_tax_by_year = df.groupby("Year")["Tobacco Tax Rate (%)"].mean()
print(avg_tax_by_year.head())
```

```
Year
2010    38.900000
2011    63.316667
2012    55.290909
2013    54.600000
2014    67.421429
Name: Tobacco Tax Rate (%), dtype: float64
```

[188]:
```
#total cigarette consumption in billions per country.
total_consumption_by_country = df.groupby("Country")["Cigarette Consumption␣
↪(Billion Units)"].sum()
print(total_consumption_by_country.head())
```

```
Country
Australia    7044.2
Brazil       7607.0
Canada       5123.0
China        9590.6
France       2686.1
Name: Cigarette Consumption (Billion Units), dtype: float64
```

[189]:
```
#the top 5 countries with the highest number of deaths linked to smoking.
top_deaths = df.groupby("Country")["Smoking-Related Deaths"].sum().nlargest(10)
print(top_deaths)
```

```
Country
India           3122988
South Africa    2693035
```

```
Indonesia       2506181
Turkey          2343073
China           2290169
Russia          1998464
Brazil          1977591
Australia       1723915
Italy           1697894
Spain           1645229
Name: Smoking-Related Deaths, dtype: int64
```

[190]:
```
#how smoking bans correlate with average prevalence rates.
ban_vs_prevalence = df.groupby("Smoking Ban Policy")["Smoking Prevalence (%)"].
 ↪mean()
print(ban_vs_prevalence)
```

```
Smoking Ban Policy
Comprehensive    24.216667
Partial          22.735714
Name: Smoking Prevalence (%), dtype: float64
```

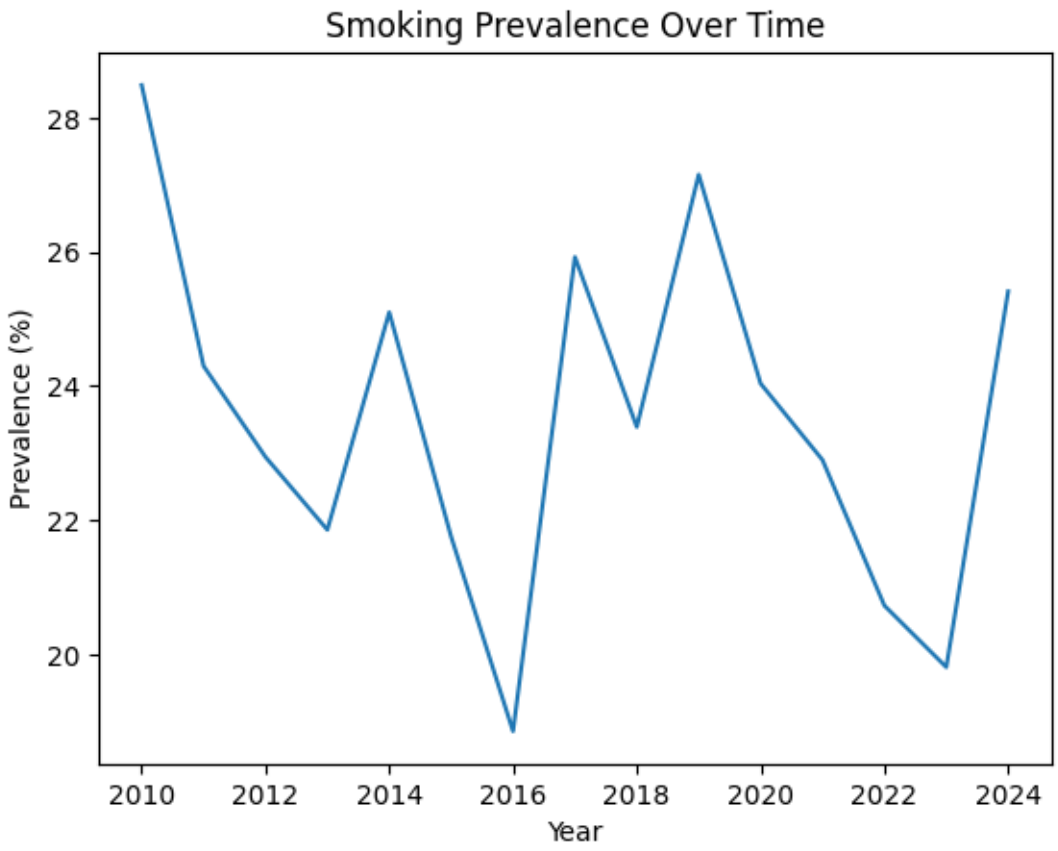
[191]:
```
#how many countries have adopted a 'Comprehensive' smoking ban.
comprehensive_ban = len(df[df["Smoking Ban Policy"] == "Comprehensive"])
print(f"Countries with Comprehensive Ban: {comprehensive_ban}")
```

```
Countries with Comprehensive Ban: 66
```

[192]:
```
#average market share of top cigarette brands per country.
brand_share_dist = df.groupby("Top Cigarette Brand in Country")["Brand Market␣
 ↪Share (%)"].mean()
print(brand_share_dist.head())
```

```
Top Cigarette Brand in Country
China National Tobacco Corp.    30.345455
Derby                           32.066667
Du Maurier                      39.233333
Esse                            34.444444
Fortuna                         42.528571
Name: Brand Market Share (%), dtype: float64
```

[193]:
```
df.groupby("Year")["Smoking Prevalence (%)"].mean().plot(kind="line")
plt.title("Smoking Prevalence Over Time")
plt.ylabel("Prevalence (%)")
plt.show()
```



[194]:
```
#the average percentage of male and female smokers in each country.
gender_smokers_by_country = df.groupby("Country")[["Male Smokers (%)", "Female␣
↪Smokers (%)"]].mean()
print(gender_smokers_by_country.head())
```

```
           Male Smokers (%)  Female Smokers (%)
Country
Australia         18.162500            4.625000
Brazil            18.944444            4.422222
Canada            16.416667            3.933333
China             17.245455            5.400000
France            15.650000            3.875000
```

[195]:
```
#Percentage of Countries with Tobacco Tax Over 50%
high_tax = len(df[df["Tobacco Tax Rate (%)"] > 50]) / len(df) * 100
print(f"Percentage with Tax > 50%: {high_tax:.2f}%")
```

```
Percentage with Tax > 50%: 54.00%
```

[196]:
```
#how brand market share correlates with average cigarette consumption.
share_vs_consumption = df.groupby("Brand Market Share (%)")["Cigarette␣
↪Consumption (Billion Units)"].mean()
print(share_vs_consumption.head())
```

```
Brand Market Share (%)
10.1     171.6
10.7     719.4
10.9     677.9
11.2     517.0
11.3    1213.3
Name: Cigarette Consumption (Billion Units), dtype: float64
```

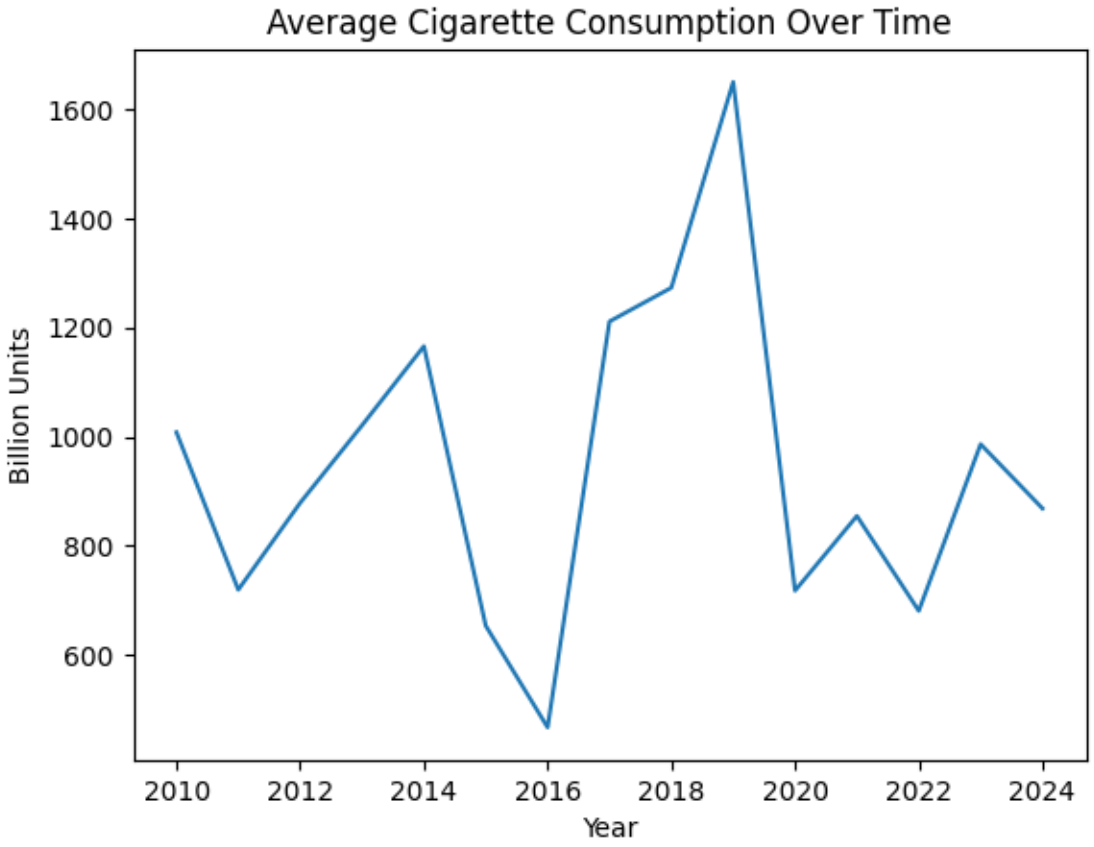
[197]:
```
#average deaths related to smoking for each ban policy type.
deaths_by_ban = df.groupby("Smoking Ban Policy")["Smoking-Related Deaths"].mean()
print(deaths_by_ban)
```

```
Smoking Ban Policy
Comprehensive    254125.909091
Partial          201079.511905
Name: Smoking-Related Deaths, dtype: float64
```

[198]:
```
#Groups countries based on smoking prevalence bins and counts how many fall into␣
↪each range.
prevalence_bins = pd.cut(df["Smoking Prevalence (%)"], bins=[0, 20, 40, 60],␣
↪include_lowest=True)
prev_dist = df.groupby(prevalence_bins, observed=True)["Country"].count()
print("Distribution of Countries by Smoking Prevalence Bins:")
print(prev_dist)
```

```
Distribution of Countries by Smoking Prevalence Bins:
Smoking Prevalence (%)
(-0.001, 20.0]    57
(20.0, 40.0]      93
Name: Country, dtype: int64
```

[199]:
```
df.groupby("Year")["Cigarette Consumption (Billion Units)"].mean().
 ↪plot(kind="line")
plt.title("Average Cigarette Consumption Over Time")
plt.ylabel("Billion Units")
plt.show()
```



[200]:
```
#how smoking prevalence changes with varying tax rates.
tax_vs_prevalence = df.groupby("Tobacco Tax Rate (%)")["Smoking Prevalence (%)"].
 ↪mean()
print(tax_vs_prevalence.head())
```

```
Tobacco Tax Rate (%)
30.1     8.6
30.4    38.2
30.7    28.6
31.5    10.5
32.3    22.3
Name: Smoking Prevalence (%), dtype: float64
```

[201]:
```
#the total number of smokers per leading cigarette brand in each country.
total_smokers_by_brand = df.groupby("Top Cigarette Brand in Country")["Total␣
↪Smokers (Millions)"].sum()
print(total_smokers_by_brand.head())
```

```
Top Cigarette Brand in Country
China National Tobacco Corp.    1710.9
Derby                           1511.8
Du Maurier                       883.5
Esse                            1317.2
Fortuna                         1319.2
Name: Total Smokers (Millions), dtype: float64
```

[202]:
```
#the 10 countries with the lowest recorded smoking prevalence rates.
top_decline = (df.loc[df.groupby("Country")["Smoking Prevalence (%)"].idxmin()]
                .set_index("Country")["Smoking Prevalence (%)"]
                .nlargest(10))
print(top_decline)
```

```
Country
Germany        23.9
Japan          22.1
Russia         19.4
Italy          17.2
France         12.6
Australia      12.3
South Korea    11.9
Mexico         11.1
Brazil         10.8
Turkey         10.6
Name: Smoking Prevalence (%), dtype: float64
```

[203]:
```
#how many times each country implemented each type of smoking ban policy.
ban_by_country = df.groupby("Country")["Smoking Ban Policy"].value_counts()
print(ban_by_country.head())
```

```
Country    Smoking Ban Policy
Australia  Partial               7
           Comprehensive         1
Brazil     Comprehensive         7
           Partial               2
Canada     Partial               6
Name: count, dtype: int64
```

[204]:
```
#the average market share for each cigarette brand across countries.
brand_share_by_brand = df.groupby("Top Cigarette Brand in Country")["Brand␣
↪Market Share (%)"].mean()
print(brand_share_by_brand.head())
```

```
Top Cigarette Brand in Country
China National Tobacco Corp.    30.345455
Derby                           32.066667
Du Maurier                      39.233333
Esse                            34.444444
Fortuna                         42.528571
Name: Brand Market Share (%), dtype: float64
```

[205]:
```
#average smoking rates between males and females in the year 2024.
gender_vs_prev_2024 = df[df["Year"] == 2024][["Male Smokers (%)", "Female␣
↪Smokers (%)"]].mean()
print(gender_vs_prev_2024)
```

```
Male Smokers (%)      19.600000
Female Smokers (%)     5.811765
dtype: float64
```

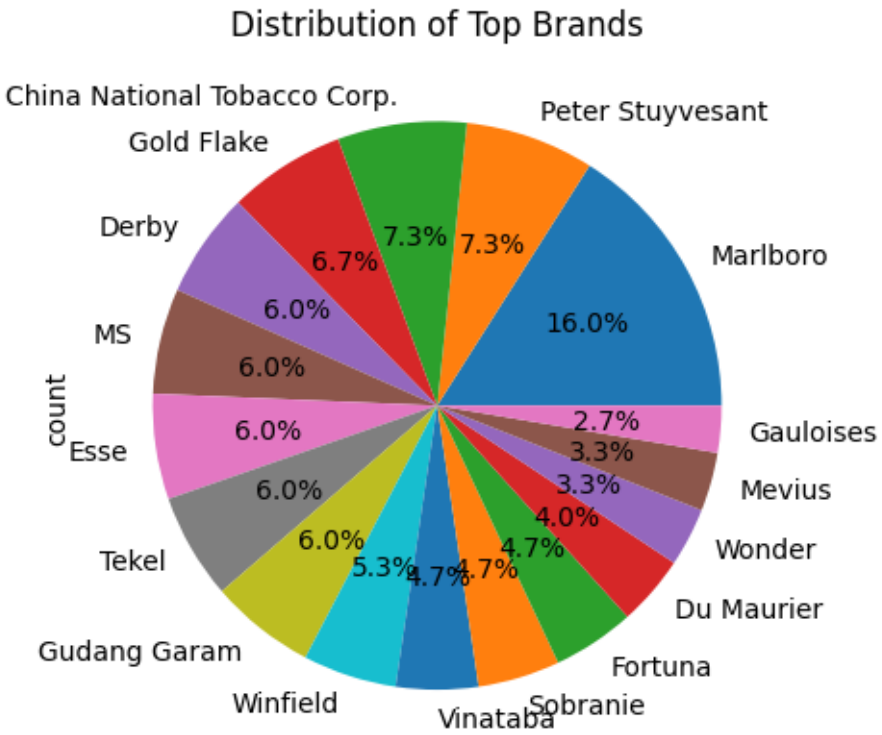
[206]:
```
#the number of countries where smoking-related deaths exceed 100,000.
high_deaths = len(df[df["Smoking-Related Deaths"] > 100000])
print(f"Countries with >100,000 Deaths: {high_deaths}")
```

```
Countries with >100,000 Deaths: 105
```

[207]:
```
#the percentage of countries that have both high taxes (>50%) and a␣
↪comprehensive smoking ban.
high_tax_ban = len(df[(df["Smoking Ban Policy"] == "Comprehensive") &␣
↪(df["Tobacco Tax Rate (%)"] > 50)]) / len(df) * 100
print(f"Percentage with High Tax & Comprehensive Ban: {high_tax_ban:.2f}%")
```

```
Percentage with High Tax & Comprehensive Ban: 19.33%
```

[208]:
```
df["Top Cigarette Brand in Country"].value_counts().plot(kind="pie", autopct='%1.
↪1f%%')
plt.title("Distribution of Top Brands")
plt.show()
```



[209]:
```
#Displays the average cigarette consumption in each country.
consumption_by_country = df.groupby("Country")["Cigarette Consumption (Billion␣
↪Units)"].mean()
print(consumption_by_country.head())
```

```
Country
Australia    880.525000
Brazil       845.222222
Canada       853.833333
China        871.872727
France       671.525000
Name: Cigarette Consumption (Billion Units), dtype: float64
```

[210]:
```
#the average number of smoking-related deaths in 2022 by type of smoking ban.
ban_vs_deaths_2022 = df[df["Year"] == 2022].groupby("Smoking Ban␣
 ↪Policy")["Smoking-Related Deaths"].mean()
print(ban_vs_deaths_2022)
```

```
Smoking Ban Policy
Comprehensive    227635.875
Partial          256407.875
Name: Smoking-Related Deaths, dtype: float64
```

[211]:
```
#the top 10 countries that experienced the largest drop in the number of smokers.
top_smoker_decline = (
    df.loc[df.groupby("Country")["Total Smokers (Millions)"].idxmin()]
    .sort_values("Total Smokers (Millions)").head(10))

print("Top 10 Countries by Lowest Number of Smokers Recorded:")
print(top_smoker_decline[["Country", "Total Smokers (Millions)", "Year"]].
 ↪to_string(index=False))
```

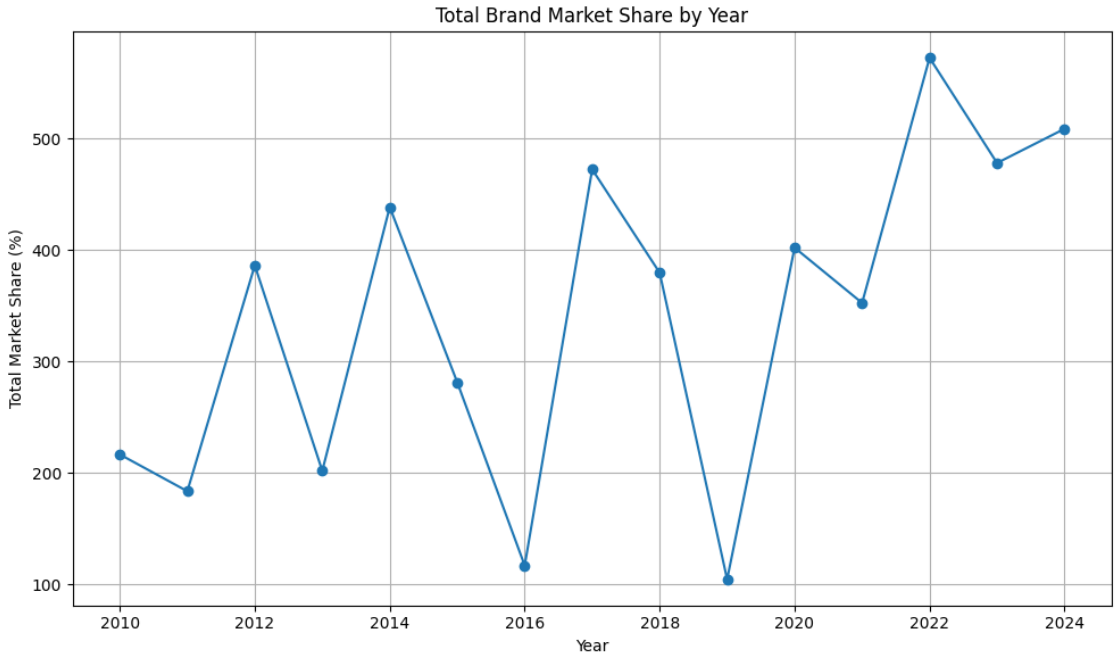
```
Top 10 Countries by Lowest Number of Smokers Recorded:
    Country  Total Smokers (Millions)  Year
     Canada                       2.7  2015
South Korea                       4.1  2024
    Vietnam                       4.8  2020
     France                       5.0  2020
  Australia                       7.9  2018
    Germany                      11.3  2016
      Italy                      11.5  2012
      China                      13.2  2010
     Turkey                      14.8  2020
        USA                      21.7  2022
```

[212]:
```
#Total Market Share per Year
total_share_by_year = df.groupby("Year")["Brand Market Share (%)"].sum()
print(total_share_by_year)
```

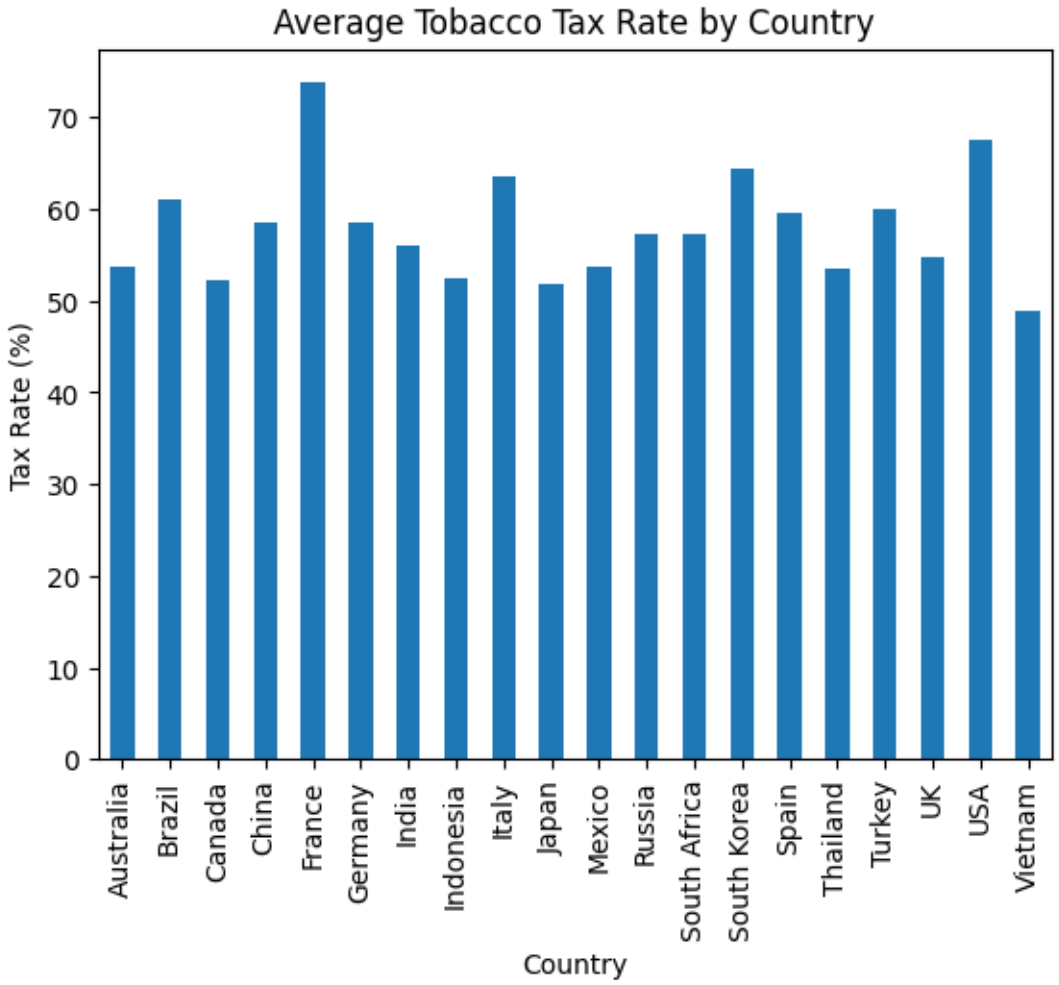
```
Year
2010    216.4
2011    183.4
2012    386.1
2013    201.7
2014    438.4
2015    281.2
2016    116.7
2017    472.3
2018    379.5
2019    104.3
2020    402.0
2021    352.4
```

```
2022    572.4
2023    478.0
2024    508.7
Name: Brand Market Share (%), dtype: float64
```

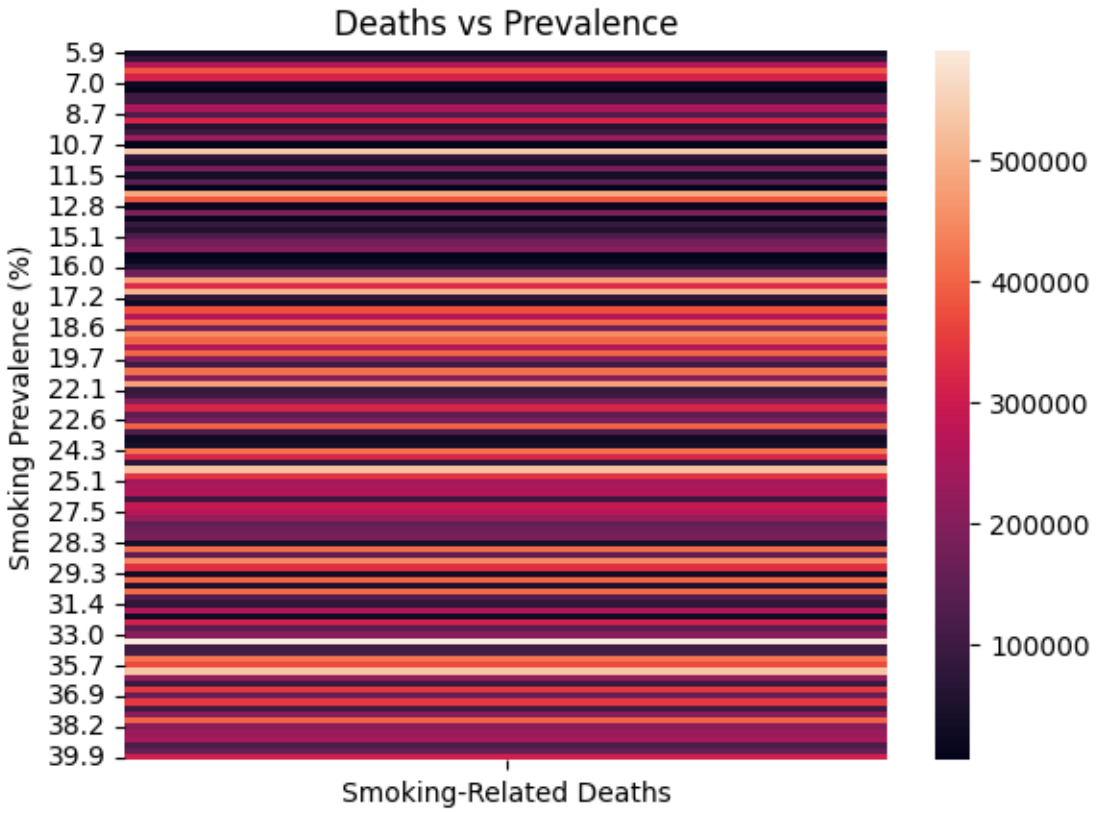
[213]:
```
plt.figure(figsize=(10, 6))
plt.plot(total_share_by_year.index, total_share_by_year.values, marker='o',␣
 ↪linestyle='-')
plt.title("Total Brand Market Share by Year")
plt.xlabel("Year")
plt.ylabel("Total Market Share (%)")
plt.grid(True)
plt.tight_layout()
plt.show()
```



[214]:
```
df.groupby("Country")["Tobacco Tax Rate (%)"].mean().plot(kind="bar")
plt.title("Average Tobacco Tax Rate by Country")
plt.ylabel("Tax Rate (%)")
plt.show()
```



[215]:
```
pivot = df.pivot_table(values="Smoking-Related Deaths", index="Smoking␣
↪Prevalence (%)", aggfunc="mean")
sns.heatmap(pivot)
plt.title("Deaths vs Prevalence")
plt.show()
```



[216]:
```
# Predict the smoking prevalence for the year 2025

df_yearly = df.groupby("Year")["Smoking Prevalence (%)"].mean().reset_index()

#Prepare the feature (year) and target (prevalence) variables
X = df_yearly["Year"].values.reshape(-1, 1)
y = df_yearly["Smoking Prevalence (%)"].values

#
model = LinearRegression()
model.fit(X, y)
```

```
#Predict the smoking prevalence for the year 2025
year_2025 = np.array([[2025]])
prediction_2025 = model.predict(year_2025)[0]
print(f"Predicted Smoking Prevalence in 2025: {prediction_2025:.2f}%")
```

```
Predicted Smoking Prevalence in 2025: 22.28%
```

[217]:
```
plt.figure(figsize=(8, 5))
plt.scatter(X, y, label="Actual Data")
plt.plot(X, model.predict(X), color="green", label="Trend Line")
plt.scatter(2025, prediction_2025, color="red", label="2025 Prediction")
plt.title("Smoking Prevalence Over Time with 2025 Prediction")
plt.xlabel("Year")
plt.ylabel("Smoking Prevalence (%)")
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
```