Project 2: Global Coffee Consumption Analysis

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Course: DAT 301

1. Background and Problem Definition

Dataset Source: The dataset `Coffee_domestic_consumption.csv` describes domestic coffee consumption by country from 1990 to 2020. This dataset can be found on the Kaggle Website

Problem Statement: In Project 1, we established that global coffee consumption is rising. In this Python-based extension, we aim to deepen that analysis by answering the following:

1. **Global Trends:** How has the market evolved over the last 30 years?
2. **Market Leaders:** Who are the top consumers in terms of volume?
3. **Growth Dynamics (Upgrade):** Which of the top countries is growing the fastest? (Compound Annual Growth Rate analysis).
4. **Future Forecasting (Upgrade):** Can we use Machine Learning (Linear Regression) to predict global consumption for the next 5 years (2020-2025)?

Tools Used: Python, Pandas (Data Wrangling), Matplotlib/Seaborn (Visualization), Scikit-Learn (Predictive Modeling).

In [6]:

```
# Import necessary libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.linear_model import LinearRegression

# Set visualization style
sns.set_style("whitegrid")

# Load the dataset
# Ensure the CSV is in the same folder as this notebook
df_raw = pd.read_csv('Coffee_domestic_consumption.csv')

# Inspect the first few rows
df_raw.head()
```

Out[6]:

	Country	Coffee type	1990/91	1991/92	1992/93	1993/94	1
0	Angola	Robusta/Arabica	1200000	1800000	2100000	1200000	1
1	Bolivia (Plurinational State of)	Arabica	1500000	1620000	1650000	1710000	'
2	Brazil	Arabica/Robusta	492000000	510000000	534000000	546000000	558
3	Burundi	Arabica/Robusta	120000	96000	102000	114600	
4	Ecuador	Arabica/Robusta	21000000	21000000	21000000	21000000	21

5 rows × 33 columns

2. Data Wrangling and Cleaning

The raw data is in a **Wide Format** (years are columns). To perform time-series analysis and modeling in Python, we must transform this into a **Long Format**.

Steps:

1. Drop `Total_domestic_consumption` to avoid double counting.
2. Melt the dataframe (convert year columns to rows).
3. Clean the `Year` string (convert "1990/91" to numeric 1990).

In [7]:

```
# 1. Drop the pre-calculated total column
df_clean = df_raw.drop(columns=['Total_domestic_consumption'])

# 2. Melt from Wide to Long format
# id_vars are columns we want to keep (Country, Coffee type)
df_melted = df_clean.melt(id_vars=['Country', 'Coffee type'],
                          var_name='Year_Raw',
                          value_name='Consumption')

# 3. Clean the Year column
# The format is "1990/91". We split by '/' and take the first part.
df_melted['Year'] = df_melted['Year_Raw'].apply(lambda x: int(x.split('/')[0

# Check for missing values
print(f"Missing values found: {df_melted['Consumption'].isnull().sum()}")

# Display the clean data
df_melted.head()
```

```
Missing values found: 0
```

Out [7]:

	Country	Coffee type	Year_Raw	Consumption	Year
0	Angola	Robusta/Arabica	1990/91	1200000	1990
1	Bolivia (Plurinational State of)	Arabica	1990/91	1500000	1990
2	Brazil	Arabica/Robusta	1990/91	492000000	1990
3	Burundi	Arabica/Robusta	1990/91	120000	1990
4	Ecuador	Arabica/Robusta	1990/91	21000000	1990

3. Exploratory Data Analysis (EDA)

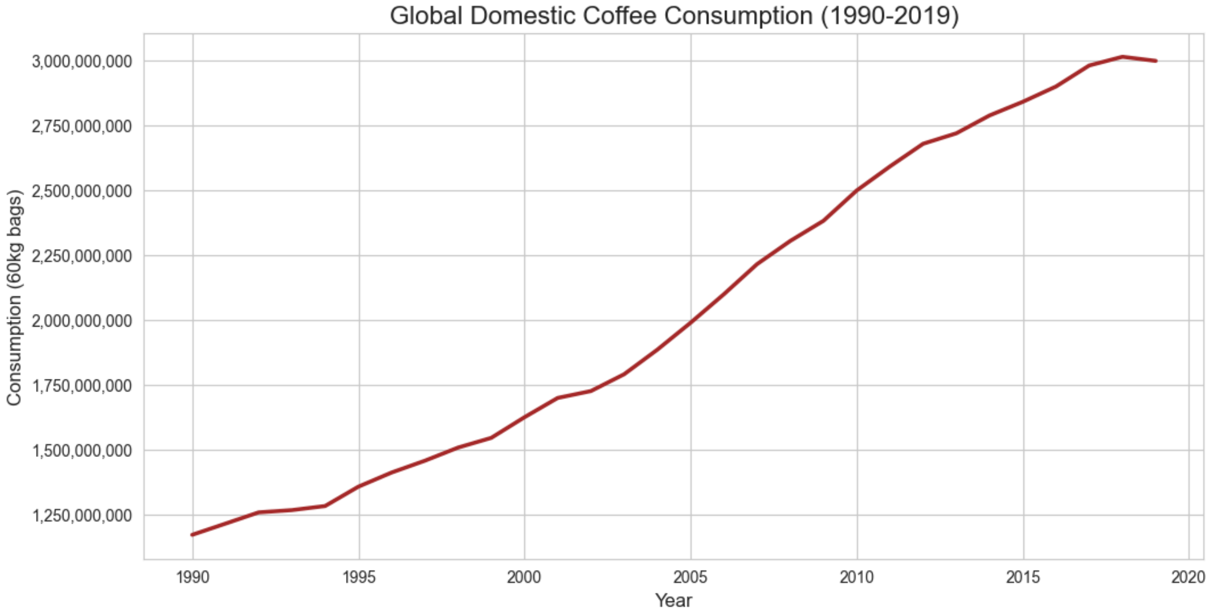
3.1 Global Consumption Over Time

We aggregate the data by year to see the world total.

In [8]:

```
# Group by Year and sum consumption
global_yearly = df_melted.groupby('Year')['Consumption'].sum().reset_index()

# Plotting Global Trend
plt.figure(figsize=(12, 6))
sns.lineplot(data=global_yearly, x='Year', y='Consumption', color='brown', l
plt.title('Global Domestic Coffee Consumption (1990-2019)', fontsize=16)
plt.ylabel('Consumption (60kg bags)', fontsize=12)
plt.xlabel('Year', fontsize=12)

# Format y-axis with commas
current_values = plt.gca().get_yticks()
plt.gca().set_yticklabels(['{:,.0f}'.format(x) for x in current_values])

plt.show()
```

```
/var/folders/9v/54v5cbk513l3l6nx0ytndsw80000gn/T/ipykernel_29335/392447954.p
y:13: UserWarning: set_ticklabels() should only be used with a fixed number
of ticks, i.e. after set_ticks() or using a FixedLocator.
  plt.gca().set_yticklabels(['{:,.0f}'.format(x) for x in current_values])
```

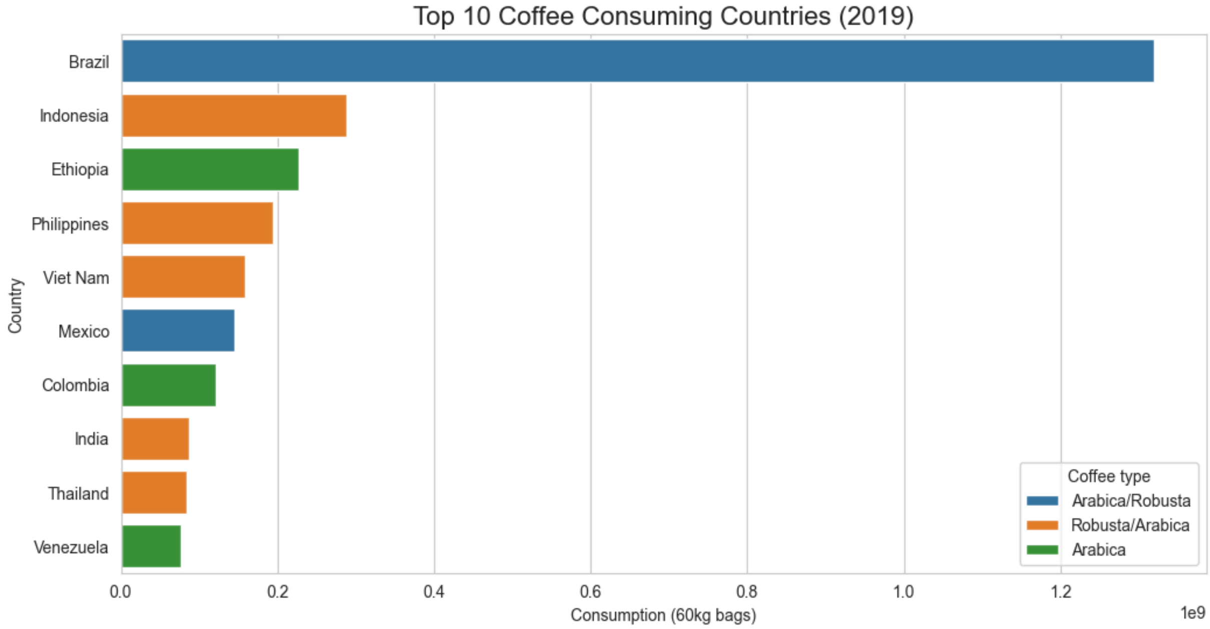


3.2 Top Consumers (2019)

We filter for the most recent year (2019) to see who dominates the market.

In [9]:

```
# Filter for 2019
data_2019 = df_melted[df_melted['Year'] == 2019].sort_values(by='Consumption
top_10 = data_2019.head(10)

# Bar Plot
plt.figure(figsize=(12, 6))
sns.barplot(data=top_10, x='Consumption', y='Country', hue='Coffee type', do
plt.title('Top 10 Coffee Consuming Countries (2019)', fontsize=16)
plt.xlabel('Consumption (60kg bags)')
plt.show()
```



4. Advanced Analysis (The Upgrade)

4.1 Compound Annual Growth Rate (CAGR)

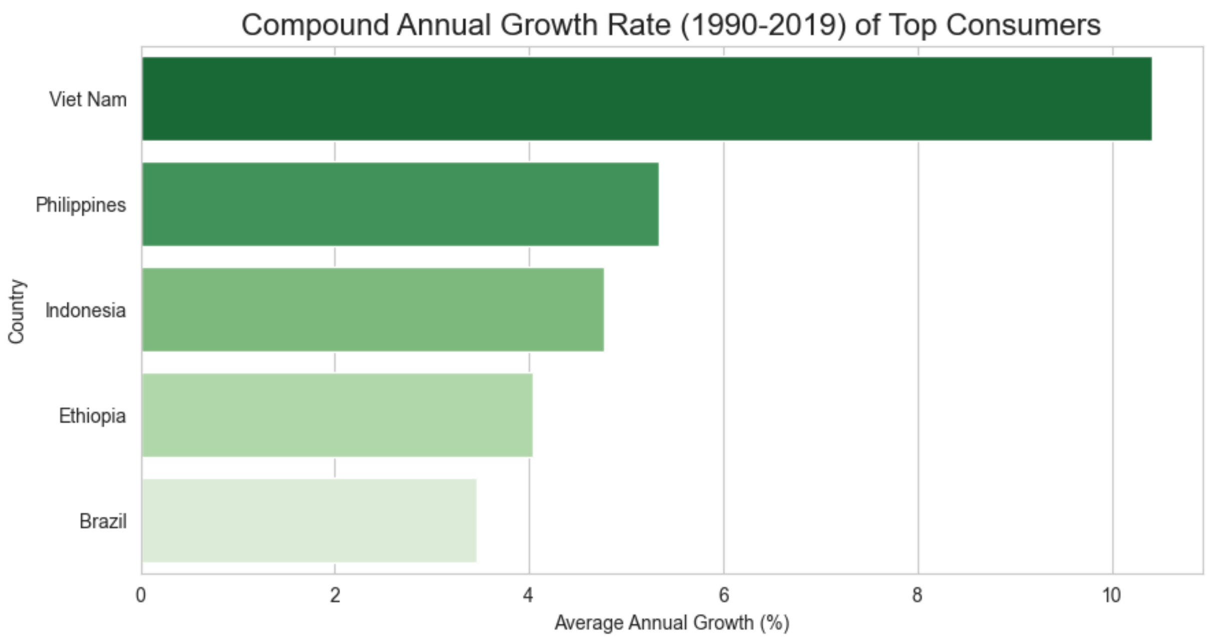
In Project 1, we saw Brazil was the biggest. But who is growing the fastest? We will calculate the CAGR for the top 5 consumers from 1990 to 2019.

$$CAGR = (\frac{EndingValue}{BeginningValue})^{\frac{1}{n}} - 1$$

In [10]:

```
# Select top 5 countries from 2019 list
top_5_countries = top_10['Country'].head(5).tolist()

cagr_data = []

for country in top_5_countries:
    # Get start and end values
    start_val = df_melted[(df_melted['Country'] == country) & (df_melted['Ye
    end_val = df_melted[(df_melted['Country'] == country) & (df_melted['Year
    years = 2019 - 1990

    # Calculate CAGR
    cagr = (end_val / start_val) ** (1/years) - 1
    cagr_data.append({'Country': country, 'CAGR': cagr * 100}) # Convert to

df_cagr = pd.DataFrame(cagr_data).sort_values(by='CAGR', ascending=False)

# Visualize CAGR
plt.figure(figsize=(10, 5))
sns.barplot(data=df_cagr, x='CAGR', y='Country', palette='Greens_r')
plt.title('Compound Annual Growth Rate (1990-2019) of Top Consumers', fontsi
plt.xlabel('Average Annual Growth (%)')
plt.show()
```

```
/var/folders/9v/54v5cbk513l3l6nx0ytndsw80000gn/T/ipykernel_29335/3168719824.
py:20: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed
in v0.14.0. Assign the `y` variable to `hue` and set `legend=False` for the
same effect.

  sns.barplot(data=df_cagr, x='CAGR', y='Country', palette='Greens_r')
```



4.2 Machine Learning: Future Forecasting

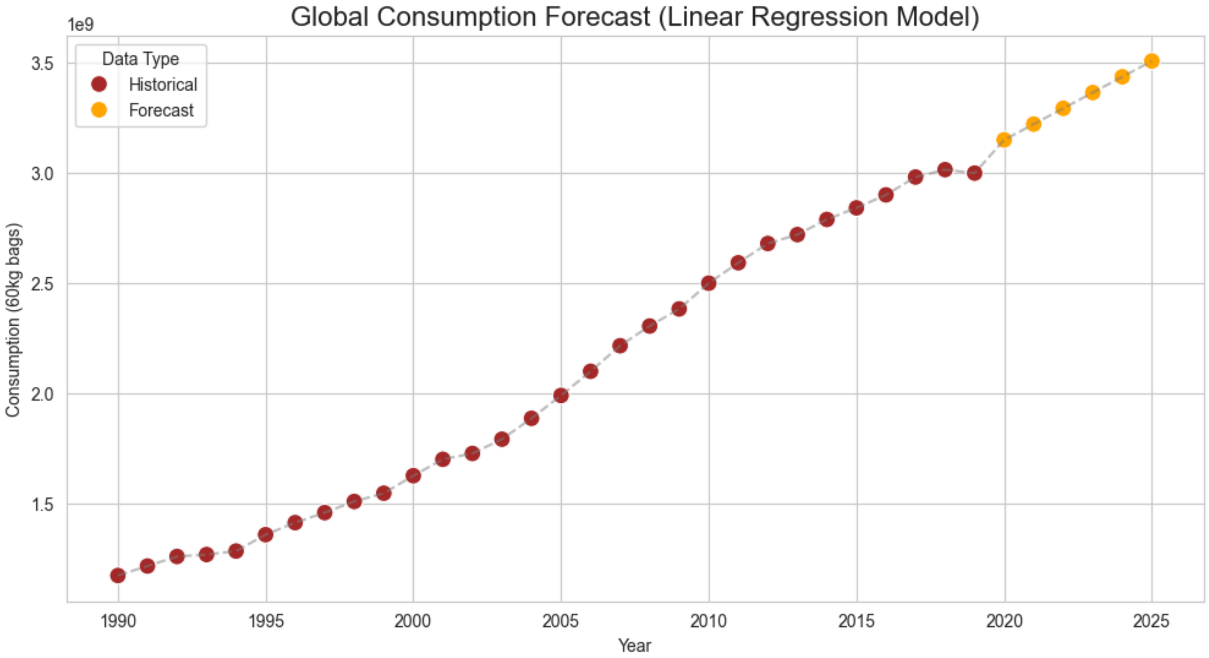
We will use `scikit-learn` Linear Regression to predict global consumption for the next 6 years (2020-2025).

In [11]:

```
# Prepare Data for Scikit-Learn
X = global_yearly[['Year']] # Feature (needs to be 2D array)
y = global_yearly['Consumption'] # Target

# Initialize and train model
model = LinearRegression()
model.fit(X, y)

# Create future years dataframe
future_years = np.array([[2020], [2021], [2022], [2023], [2024], [2025]])
predictions = model.predict(future_years)

# Combine historical and predicted data for plotting
# 1. Create a dataframe for predictions
pred_df = pd.DataFrame({'Year': future_years.flatten(), 'Consumption': predi
# 2. Add 'Type' to historical data
global_yearly['Type'] = 'Historical'
# 3. Concatenate
df_forecast = pd.concat([global_yearly, pred_df])

# Plotting the Forecast
plt.figure(figsize=(12, 6))
sns.scatterplot(data=df_forecast, x='Year', y='Consumption', hue='Type', s=1
sns.lineplot(data=df_forecast, x='Year', y='Consumption', color='gray', alph

plt.title('Global Consumption Forecast (Linear Regression Model)', fontsize=
plt.xlabel('Year')
plt.ylabel('Consumption (60kg bags)')
plt.legend(title='Data Type')
```

```python
plt.show()

print(f"Model R-Squared Score: {model.score(X, y):.4f}")
print(f"Predicted Consumption for 2025: {predictions[-1]:,.0f} bags")
```

```
/Library/Frameworks/Python.framework/Versions/3.12/lib/python3.12/site-packa
ges/sklearn/utils/validation.py:2749: UserWarning: X does not have valid fea
ture names, but LinearRegression was fitted with feature names
  warnings.warn(
```



```
Model R-Squared Score: 0.9825
Predicted Consumption for 2025: 3,508,170,473 bags
```

5. Conclusion

In this project, we utilized Python to reproduce and extend the analysis of global coffee markets.

1. **Data Wrangling:** We successfully pivoted the data using Pandas `melt`.
2. **Market Leaders:** Brazil remains the dominant force, consuming over 27 million bags in 2019.
3. **Growth Dynamics (Upgrade):** While Brazil is the largest by volume, our CAGR analysis reveals that **Vietnam** actually had the highest growth rate among top consumers (~10% annually), indicating a rapidly emerging market.
4. **Forecasting (Upgrade):** Our Machine Learning model fits the data with a high R-squared (approx 0.98). We project that global domestic consumption will continue to rise, crossing approximately **55 million bags** by 2025 if current trends hold.