World Population Data Analysis and Visualization

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import plotly.express as px
import plotly.graph_objects as go
from sklearn.preprocessing import LabelEncoder

import warnings
warnings.filterwarnings('ignore')


from plotly.offline import init_notebook_mode
init_notebook_mode(connected=True)
```

About Dataset

Rank: Ranked by population

CCA3: Three-digit Country/Territory code

Country: Name of the Country/Territory

Capital: Name of the Capital

Continent: Name of the Continent

2022 Population: Population of the Country/Territory in the year 2022

2020 Population: Population of the Country/Territory in the year 2020

2015 Population: Population of the Country/Territory in the year 2015

2010 Population: Population of the Country/Territory in the year 2010

2000 Population: Population of the Country/Territory in the year 2000

1990 Population: Population of the Country/Territory in the year 1990

1980 Population: Population of the Country/Territory in the year 1980

1970 Population: Population of the Country/Territory in the year 1970

Area (km^2): Land area of the Country/Territory in square kilometers

Density (per km^2): Population density per square kilometer

Growth Rate: Population growth rate for each Country/Territory

World Population Percentage: The population percentage of each Country/Territory

In [2]:
```
data = pd.read_csv("../input/world-population-dataset/world_population.csv")
```

Basic Data Exploration

In [3]:
```
print(f"Shape Of The Dataset : {data.shape}")
print(f"\nGlimpse Of The Dataset :")
data.head().style.set_properties(**{"background-color": "#006837","color":"#e9c46a","border": "1.5px solid black"})
```

```
Shape Of The Dataset : (234, 17)

Glimpse Of The Dataset :
```

Out[3]:

	Rank	CCA3	Country/Territory	Capital	Continent	2022 Population	2020 Population	2015 Population	2010 Population	2000 Population	1990 Population	1980 Population	1970 Population	Area (km²)	Density (per km²)	Growth Rate	World Population Percentage
0	36	AFG	Afghanistan	Kabul	Asia	41128771	38972230	33753499	28189672	19542982	10694796	12486631	10752971	652230	63.058700	1.025700	0.520000
1	138	ALB	Albania	Tirana	Europe	2842321	2866849	2882481	2913399	3182021	3295066	2941651	2324731	28748	98.870200	0.995700	0.040000
2	34	DZA	Algeria	Algiers	Africa	44903225	43451666	39543154	35856344	30774621	25518074	18739378	13795915	2381741	18.853100	1.016400	0.560000
3	213	ASM	American Samoa	Pago Pago	Oceania	44273	46189	51368	54849	58230	47818	32886	27075	199	222.477400	0.983100	0.000000
4	203	AND	Andorra	Andorra la Vella	Europe	79824	77700	71746	71519	66097	53569	35611	19860	468	170.564100	1.010000	0.000000

In [4]:
```
print(f"Informations Of The Dataset :\n")
print(data.info())
```

```
Informations Of The Dataset :

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 234 entries, 0 to 233
Data columns (total 17 columns):
 #   Column                        Non-Null Count  Dtype
---  ------                        --------------  -----
 0   Rank                          234 non-null    int64
 1   CCA3                          234 non-null    object
 2   Country/Territory            234 non-null    object
 3   Capital                       234 non-null    object
 4   Continent                     234 non-null    object
 5   2022 Population               234 non-null    int64
 6   2020 Population               234 non-null    int64
 7   2015 Population               234 non-null    int64
 8   2010 Population               234 non-null    int64
 9   2000 Population               234 non-null    int64
 10  1990 Population               234 non-null    int64
 11  1980 Population               234 non-null    int64
 12  1970 Population               234 non-null    int64
 13  Area (km²)                    234 non-null    int64
 14  Density (per km²)             234 non-null    float64
 15  Growth Rate                   234 non-null    float64
 16  World Population Percentage   234 non-null    float64
dtypes: float64(3), int64(10), object(4)
memory usage: 31.2+ KB
None
```

Dataset Summary

In [5]:
```
print(f"Summary Of The Dataset :")
data.describe().style.set_properties(**{"background-color": "#006837","color":"#e9c46a","border": "1.5px solid black"})
```

```
Summary Of The Dataset :
```

Out[5]:

	Rank	2022 Population	2020 Population	2015 Population	2010 Population	2000 Population	1990 Population	1980 Population	1970 Population	Area (km²)	Density (per km²)	Growth Rate	Po Per
count	234.000000	234.000000	234.000000	234.000000	234.000000	234.000000	234.000000	234.000000	234.000000	234.000000	234.000000	234.000000	234
mean	117.500000	34074414.709402	33501070.952991	31729956.243590	29845235.034188	26269468.816239	22710220.790598	18984616.970085	15786908.807692	581449.384615	452.127044	1.009577	0
std	67.694165	136766424.804763	135589876.924439	130404992.751760	124218487.632998	111698206.719070	97832173.346751	81785186.084201	67795091.643236	1761840.864063	2066.121904	0.013385	1
min	1.000000	510.000000	520.000000	564.000000	596.000000	651.000000	700.000000	733.000000	752.000000	1.000000	0.026100	0.912000	0
25%	59.250000	419738.500000	415284.500000	404676.000000	393149.000000	327242.000000	264115.750000	229614.250000	155997.000000	2650.000000	38.417875	1.001775	0
50%	117.500000	5559944.500000	5493074.500000	5307400.000000	4942770.500000	4292907.000000	3825409.500000	3141145.500000	2604830.000000	81199.500000	95.346750	1.007900	0
75%	175.750000	22476504.750000	21447979.500000	19730853.750000	19159567.500000	15762301.000000	11869231.000000	9826053.750000	8817329.000000	430425.750000	238.933250	1.016950	0
max	234.000000	1425887337.000000	1424929781.000000	1393715448.000000	1348191368.000000	1264099069.000000	1153704252.000000	982372466.000000	822534450.000000	17098242.000000	23172.266700	1.069100	17

In [6]:
```
data.describe(include=object).T.style.set_properties(**{"background-color": "#006837","color":"#e9c46a","border": "1.5px solid black"})
```

Out[6]:

	count	unique	top	freq
CCA3	234	234	AFG	1
Country/Territory	234	234	Afghanistan	1
Capital	234	234	Kabul	1
Continent	234	6	Africa	57

In [7]:
```
print(f"Null values of the Dataset :")
data.isna().sum().to_frame().T.style.set_properties(**{"background-color": "#006837","color":"#e9c46a","border": "1.5px solid black"})
```

```
Null values of the Dataset :
```

Out[7]:

	Rank	CCA3	Country/Territory	Capital	Continent	2022 Population	2020 Population	2015 Population	2010 Population	2000 Population	1990 Population	1980 Population	1970 Population	Area (km²)	Density (per km²)	Growth Rate	World Population Percentage
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Insights:

- There is no missing values in this dataset.
- We will encode the categorical features into numerical form later.

Custom Palette For Visualization

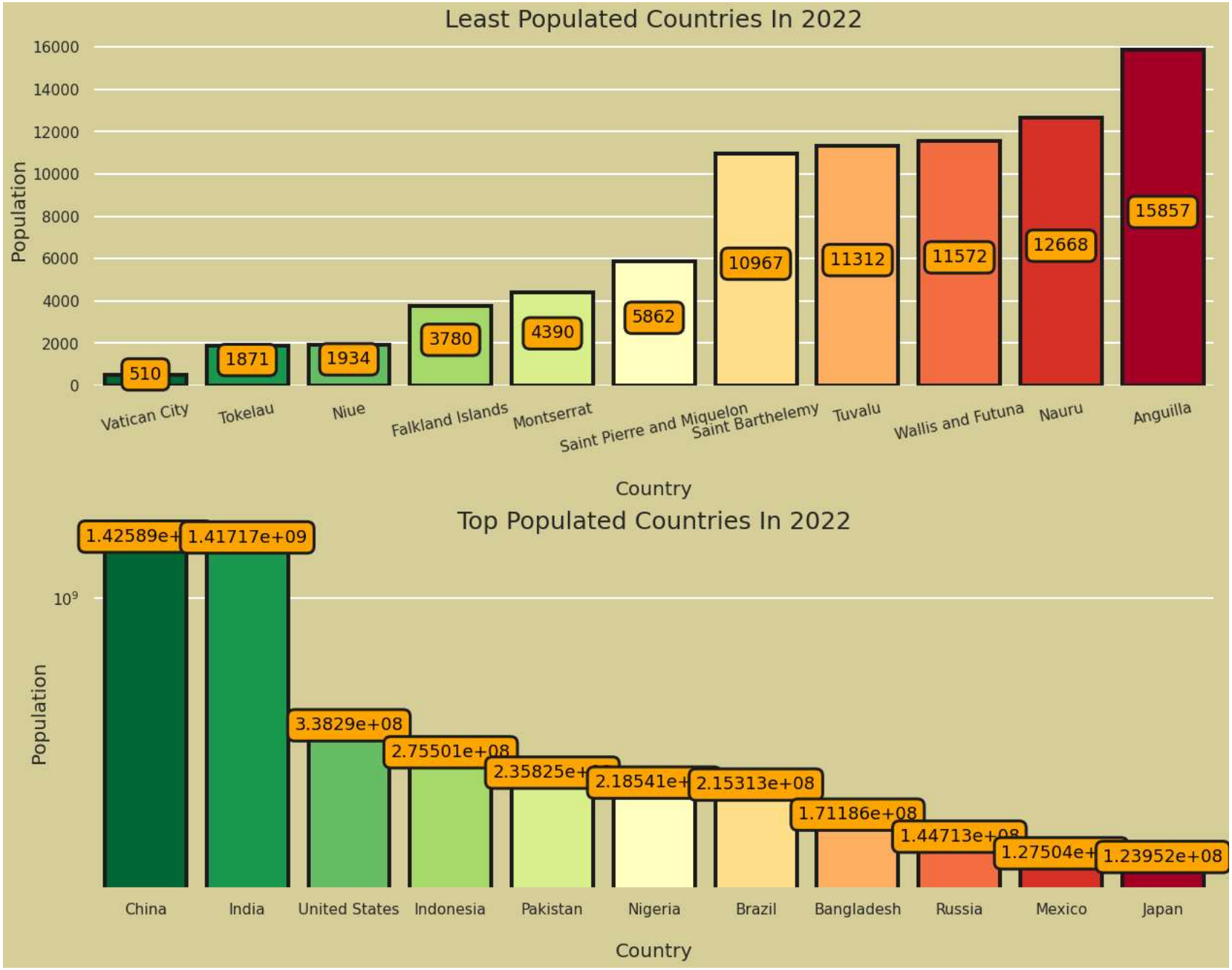
In [8]:
```
sns.set_style("white")
sns.set(rc={"axes.facecolor":"#D5CE98","figure.facecolor":"#D5CE98"})
sns.set_context("poster",font_scale = .7)

palette = ["#006837","#1A9850","#66BD63","#A6D96A","#D9EF8B","#FFFFBF","#FEE08B","#FDAE61","#F46D43","#D73027","#A50026"]
palette_cmap = ["#A50026","#D73027","#F46D43","#FDAE61","#FEE08B","#FFFFBF","#D9EF8B","#A6D96A","#66BD63","#1A9850","#006837"]

# sns.palplot(sns.color_palette(palette))
# sns.palplot(sns.color_palette(palette_cmap))
# plt.show()
```

Population

In [9]:
```
print(f"Let's have a look on the population :")
_, axs = plt.subplots(2,1,figsize=(20,16))
plt.tight_layout(pad=7.0)
```

```
sns.barplot(x=data["Country/Territory"],y=data["2022 Population"],order=data.sort_values("2022 Population",ascending=True)["Country/Territory"][:11],ax=axs[0],palette=palette, saturation=1
axs[0].set_yscale("linear")
axs[0].set_title("Least Populated Countries In 2022",fontsize=25)
axs[0].set_xlabel("\nCountry",fontsize=20)
axs[0].set_ylabel("Population",fontsize=20)
axs[0].set_xticklabels(axs[0].get_xticklabels(),rotation = 12)
for container in axs[0].containers:
    axs[0].bar_label(container,label_type="center",padding=6,size=18,color="black",rotation=0,
    bbox={"boxstyle": "round", "pad": 0.4, "facecolor": "orange", "edgecolor": "#1c1c1c", "linewidth" : 3, "alpha": 1})


sns.barplot(x=data["Country/Territory"],y=data["2022 Population"],order=data.sort_values("2022 Population",ascending=False)["Country/Territory"][:11],ax=axs[1],palette=palette, saturation=
axs[1].set_yscale("log")
axs[1].set_title("Top Populated Countries In 2022",fontsize=25)
axs[1].set_xlabel("\nCountry",fontsize=20)
axs[1].set_ylabel("Population",fontsize=20)
axs[1].set_xticklabels(axs[1].get_xticklabels(),rotation = 0)
for container in axs[1].containers:
    axs[1].bar_label(container,label_type="edge",padding=6,size=18,color="black",rotation=0,
    bbox={"boxstyle": "round", "pad": 0.4, "facecolor": "orange", "edgecolor": "#1c1c1c", "linewidth" : 3, "alpha": 1})


sns.despine(left=True, bottom=True)
plt.show()
```

Let's have a look on the population :

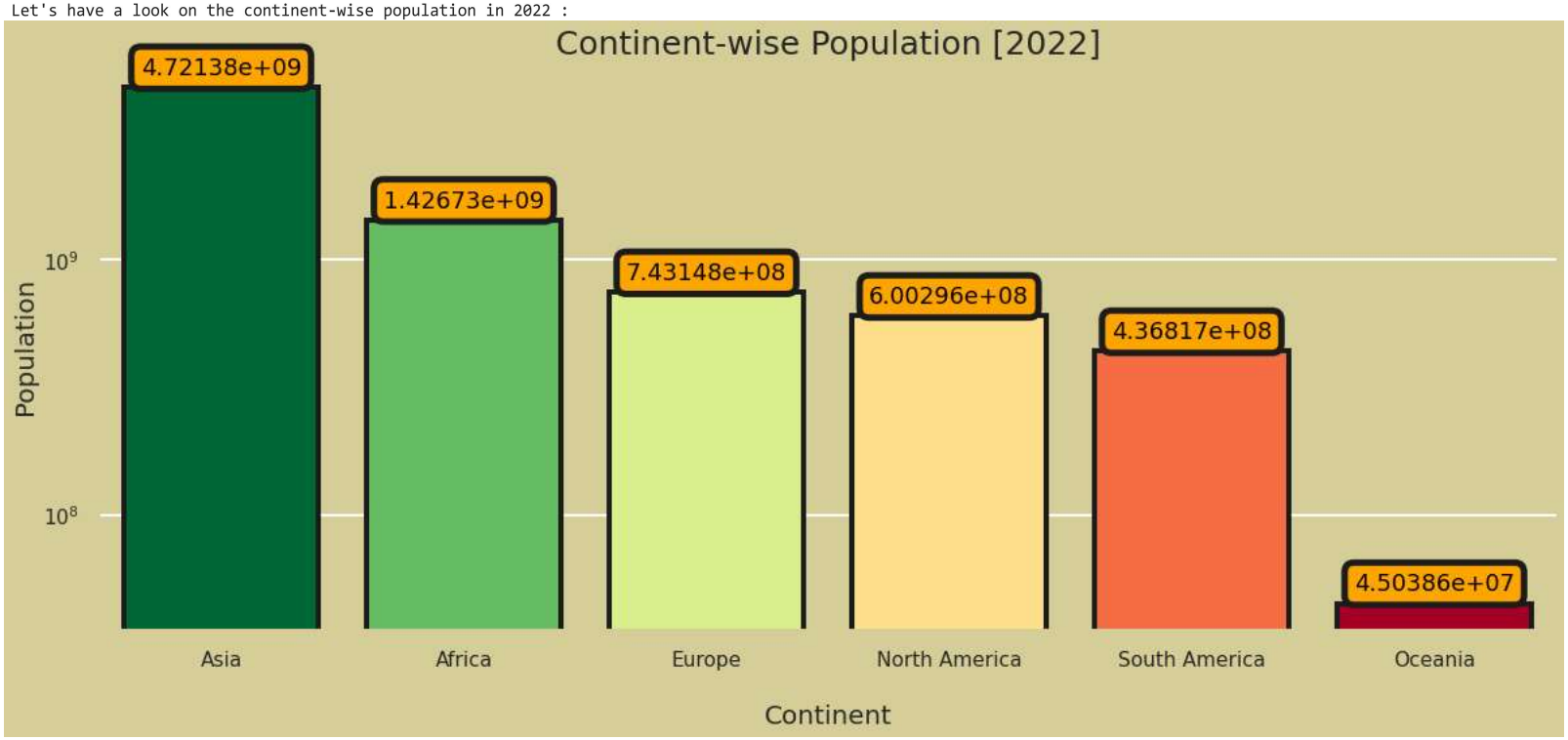


Insights:

- China is the most densely populated country with 1.4B people followed by India, United States and others.
- Vatican City is the least populated country with 510 people followed by Tokelau, Niue and others.

In [10]:
```
data_pop = data.copy()
data_pop = pd.DataFrame(data_pop.groupby(["Continent"])["1970 Population","1980 Population","1990 Population","2000 Population","2010 Population","2015 Population","2020 Population","2022

print("Let's have a look on the continent-wise population in 2022 :")
plt.subplots(figsize=(20,8))
p=sns.barplot(x=data_pop.index, y=data_pop["2022 Population"],order=data_pop.sort_values("2022 Population",ascending=False).index,palette=palette[0:11:2], saturation=1,edgecolor = "#1c1c1c
p.set_yscale("log")
p.set_title("Continent-wise Population [2022]",fontsize=25)
p.set_xlabel("\nContinent",fontsize=20)
p.set_ylabel("Population",fontsize=20)
p.set_xticklabels(p.get_xticklabels(),rotation = 0)
for container in p.containers:
    p.bar_label(container,label_type="edge",padding=6,size=18,color="black",rotation=0,
    bbox={"boxstyle": "round", "pad": 0.4, "facecolor": "orange", "edgecolor": "#1c1c1c", "linewidth" : 5, "alpha": 1})

sns.despine(left=True, bottom=True)
plt.show()
```

```
Let's have a look on the continent-wise population in 2022 :
```



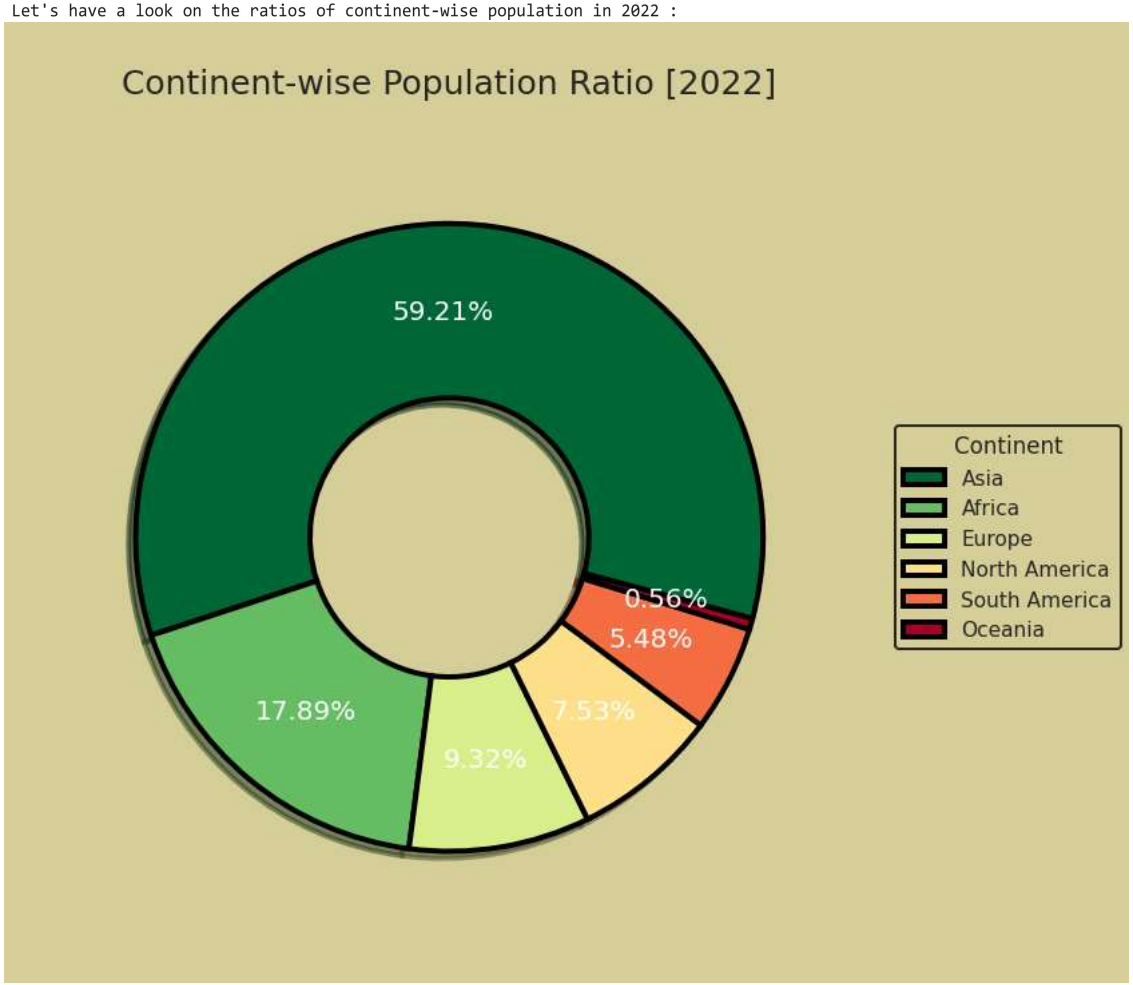
Insights:

- Asia is the most densely populated continent with 4.7B people followed by Africa, Europe and others.

In [11]:
```
print(f"Let's have a look on the ratios of continent-wise population in 2022 :")
plt.subplots(figsize=(12, 12))

labels = "Asia","Africa","Europe","North America","South America","Oceania"
size = 0.5

wedges, texts, autotexts = plt.pie([data_pop.sort_values("2022 Population",ascending=False)["2022 Population"][0],
                                    data_pop.sort_values("2022 Population",ascending=False)["2022 Population"][1],
                                    data_pop.sort_values("2022 Population",ascending=False)["2022 Population"][2],
```

```
                                    data_pop.sort_values("2022 Population",ascending=False)["2022 Population"][3],
                                    data_pop.sort_values("2022 Population",ascending=False)["2022 Population"][4],
                                    data_pop.sort_values("2022 Population",ascending=False)["2022 Population"][5]],
                                    explode = (0,0,0,0,0,0),
                                    textprops=dict(size= 20, color= "white"),
                                    autopct="%.2f%%",
                                    pctdistance = 0.72,
                                    radius=.9,
                                    colors = palette[0:11:2],
                                    shadow = True,
                                    wedgeprops=dict(width = size, edgecolor = "black",
                                    linewidth = 4),
                                    startangle = -15)

plt.legend(wedges, labels, title="Continent",loc="center left",bbox_to_anchor=(1, 0, 0.5, 1), edgecolor = "black")
plt.title("\nContinent-wise Population Ratio [2022]",fontsize=25)
plt.show()
```

Let's have a look on the ratios of continent-wise population in 2022 :

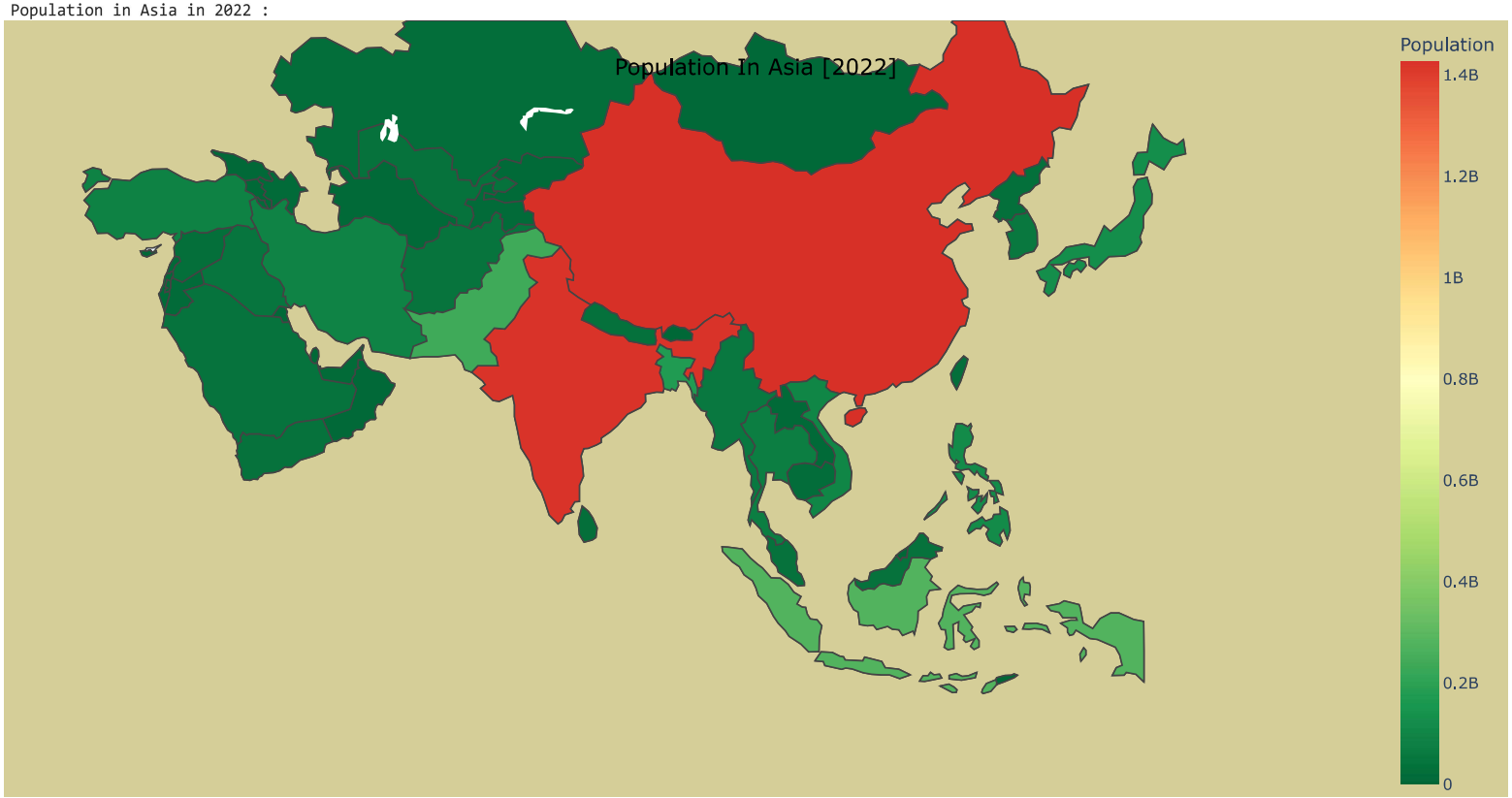


Insights:

- In world population, 59.21% from Asia, 17.89% from Africa, 9.32% from Europe,7.53% from North America, 5.48% from South America and 0.56% from Oceania.

In [12]:
```
print("Population in Asia in 2022 :")

fig = px.choropleth(data_frame = data,
                    locations="Country/Territory",locationmode="country names", color="2022 Population",
                    color_continuous_scale=palette[:10],height= 600,scope="asia",
                    labels={"2022 Population":"Population"})


fig.update_layout(title=dict(text= "Population In Asia [2022]",
                             y=0.95,x=0.5,xanchor= "center",yanchor= "top",font_color="black"),
                  margin=dict(l=0, r=0, b=0, t=0),
                  geo_bgcolor="#D5CE98",
                  paper_bgcolor="#D5CE98")

fig.show()
```

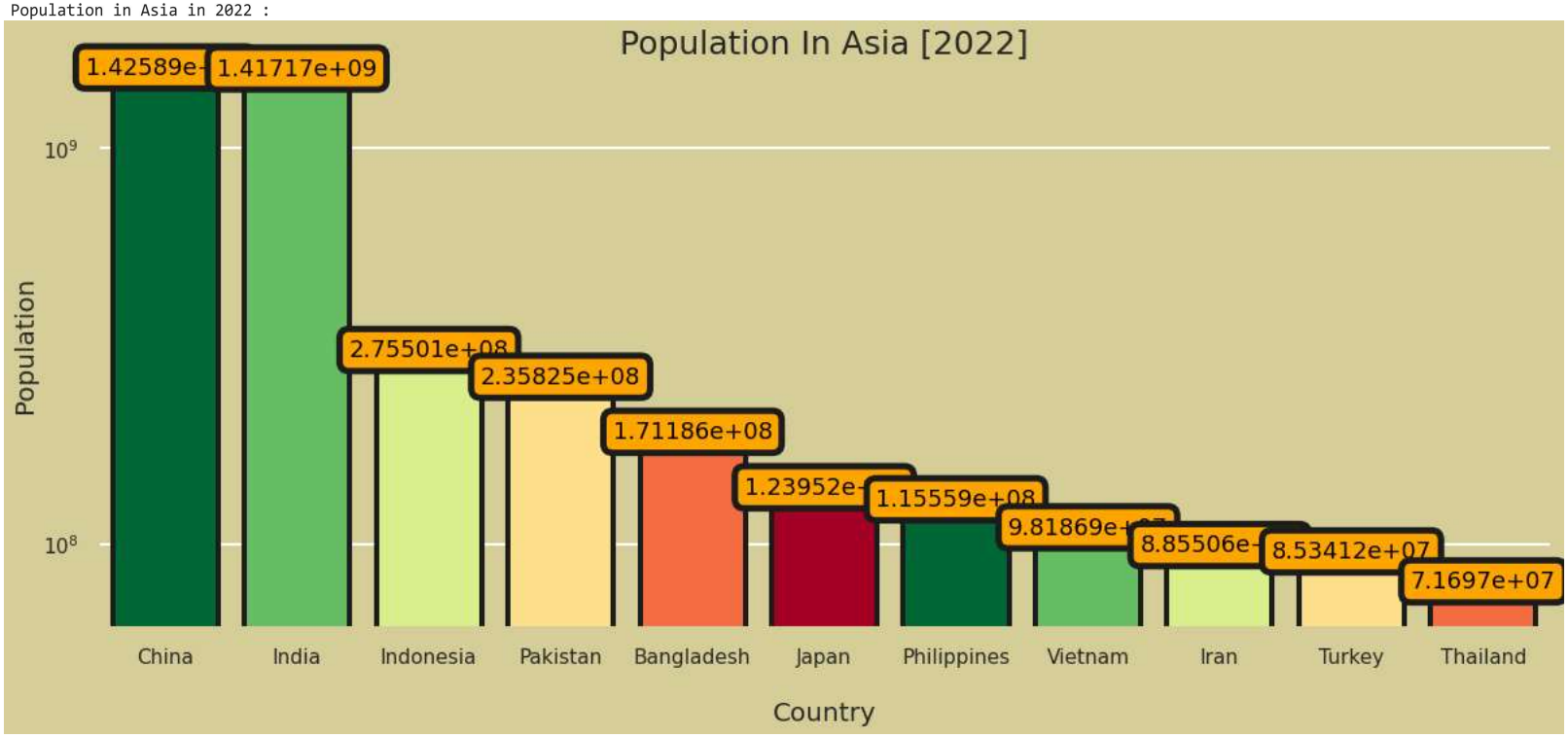
```
Population in Asia in 2022 :
```



In [13]:
```
print("Population in Asia in 2022 :")
plt.subplots(figsize=(20,8))
p=sns.barplot(data=data[data["Continent"]=="Asia"],x="Country/Territory", y="2022 Population",order=data[data["Continent"]=="Asia"].sort_values("2022 Population",ascending=False)["Country/
p.set_yscale("log")
p.set_title("Population In Asia [2022]",fontsize=25)
p.set_xlabel("\nCountry",fontsize=20)
p.set_ylabel("Population",fontsize=20)
p.set_xticklabels(p.get_xticklabels(),rotation = 0)
for container in p.containers:
    p.bar_label(container,label_type="edge",padding=6,size=18,color="black",rotation=0,
    bbox={"boxstyle": "round", "pad": 0.4, "facecolor": "orange", "edgecolor": "#1c1c1c", "linewidth" : 5, "alpha": 1})
```

```
sns.despine(left=True, bottom=True)
plt.show()
```

```
Population in Asia in 2022 :
```

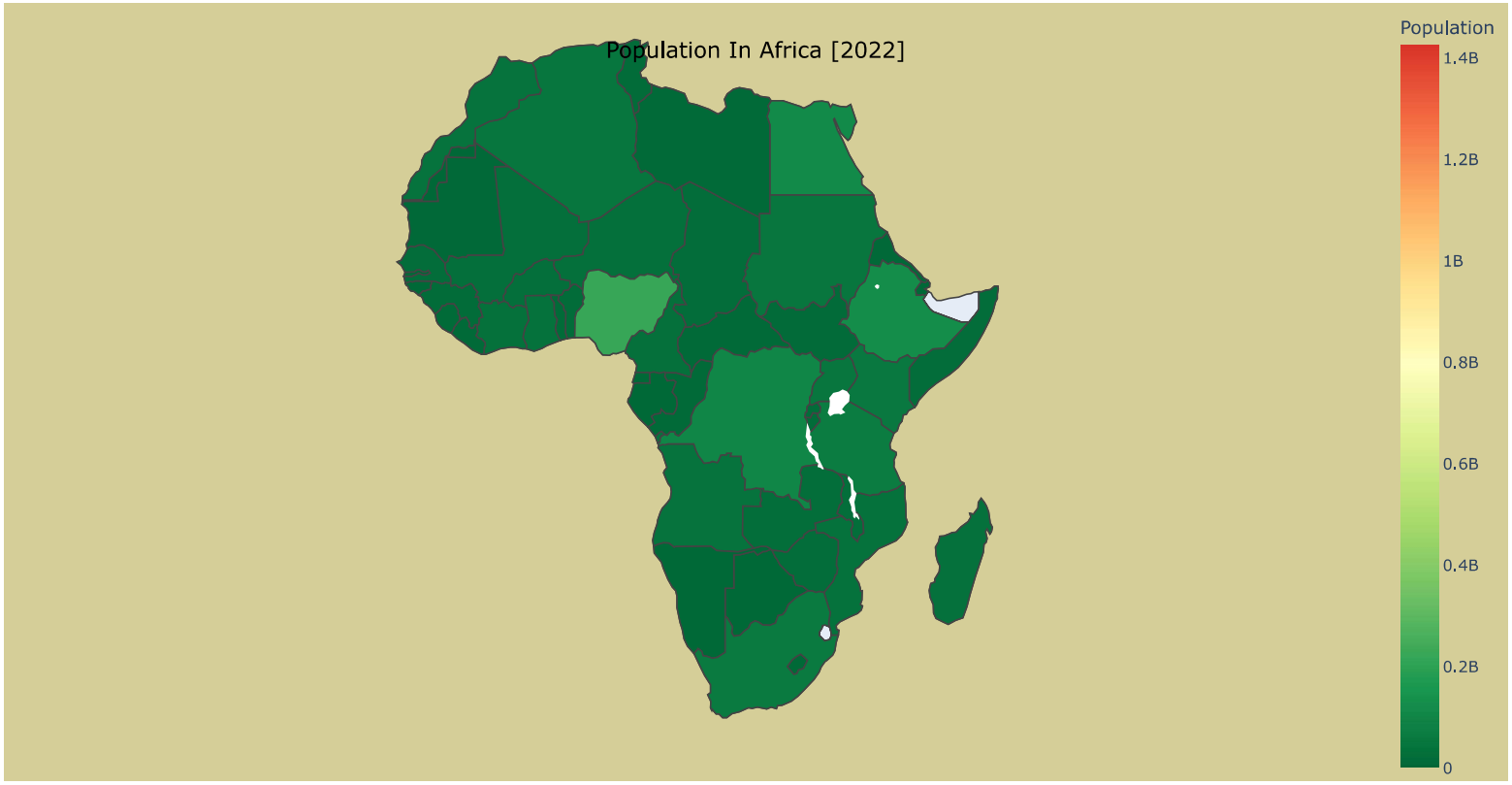


Insights:

- China is leading in Asia with 1.42B people followed by India, Indonesia and other countries.

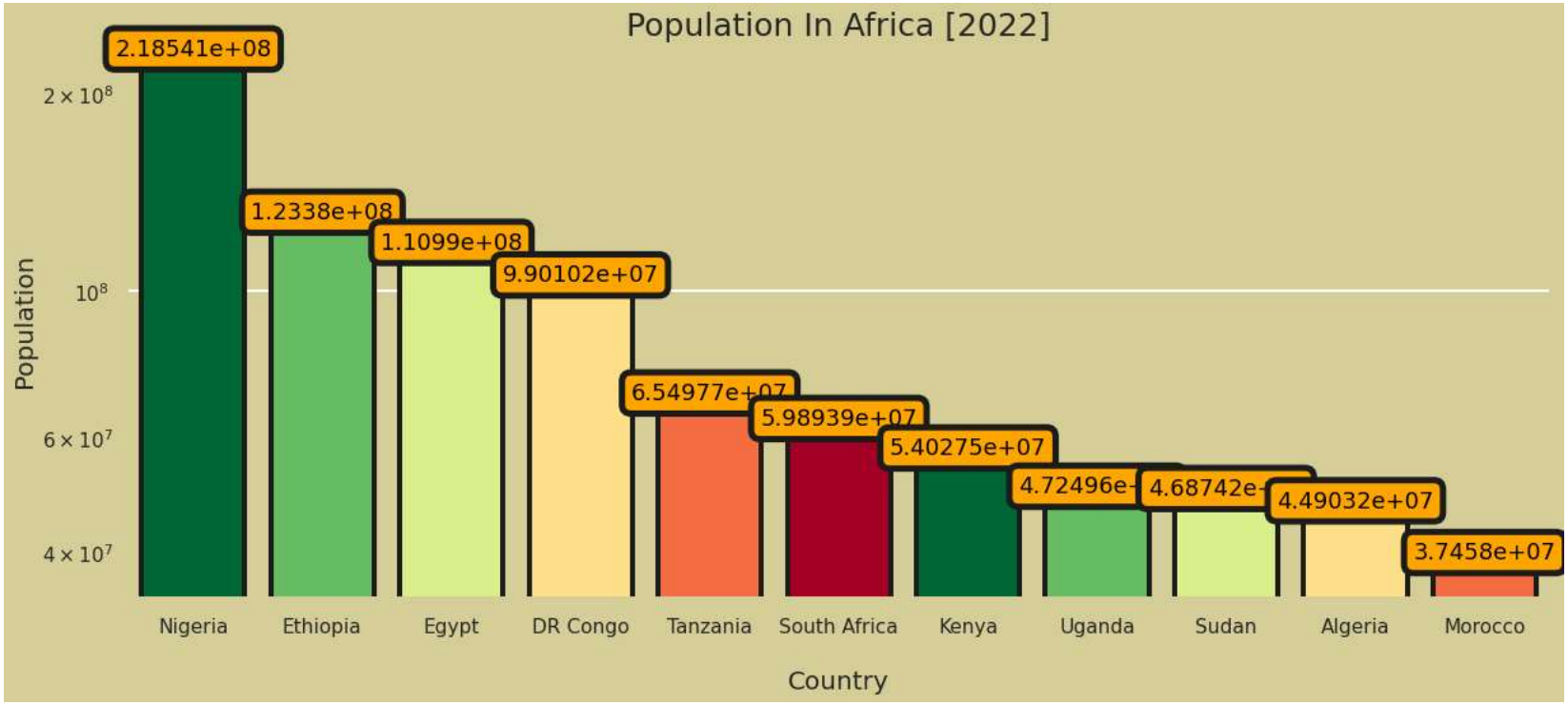
In [14]:
```
print("Population in Africa in 2022 :")

fig = px.choropleth(data_frame = data,
                    locations="Country/Territory",locationmode="country names", color="2022 Population",
                    color_continuous_scale=palette[:10],height= 600,scope="africa",
                    labels={"2022 Population":"Population"})


fig.update_layout(title=dict(text= "Population In Africa [2022]",
                             y=0.95,x=0.5,xanchor= "center",yanchor= "top",font_color="black"),
                  margin=dict(l=0, r=0, b=0, t=0),
                  geo_bgcolor="#D5CE98",
                  paper_bgcolor="#D5CE98")

fig.show()
```

```
Population in Africa in 2022 :
```



In [15]:
```
print("Population in Africa in 2022 :")
plt.subplots(figsize=(20,8))
p=sns.barplot(data=data[data["Continent"]=="Africa"],x="Country/Territory", y="2022 Population",order=data[data["Continent"]=="Africa"].sort_values("2022 Population",ascending=False)["Coun
p.set_yscale("log")
p.set_title("Population In Africa [2022]",fontsize=25)
p.set_xlabel("\nCountry",fontsize=20)
p.set_ylabel("Population",fontsize=20)
p.set_xticklabels(p.get_xticklabels(),rotation = 0)
for container in p.containers:
    p.bar_label(container,label_type="edge",padding=6,size=18,color="black",rotation=0,
    bbox={"boxstyle": "round", "pad": 0.4, "facecolor": "orange", "edgecolor": "#1c1c1c", "linewidth" : 5, "alpha": 1})

sns.despine(left=True, bottom=True)
plt.show()
```

```
Population in Africa in 2022 :
```

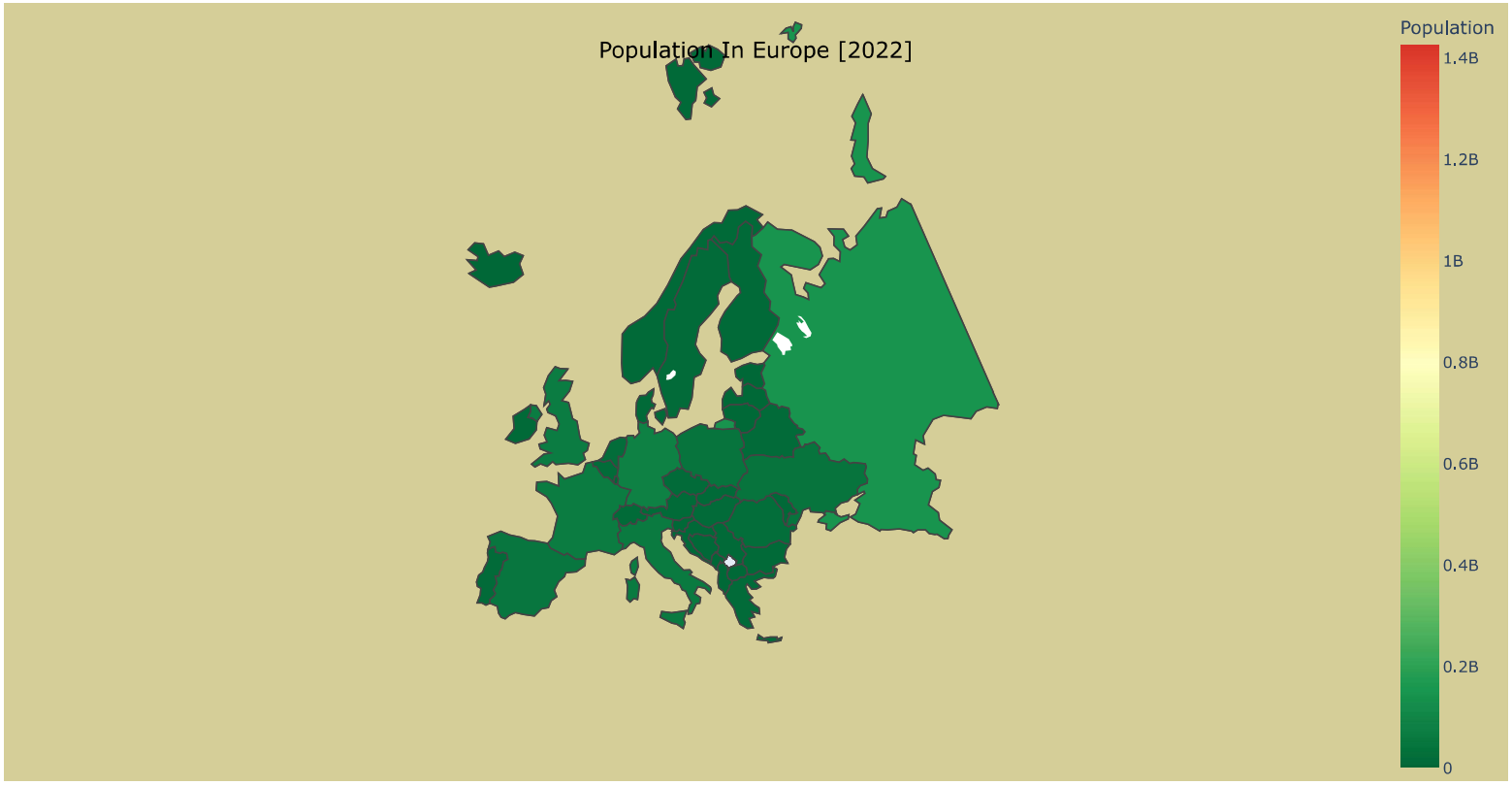


Insights:

- Nigeria is leading in Africa with 218.5M people followed by Ethiopia, Egypt and other countries.

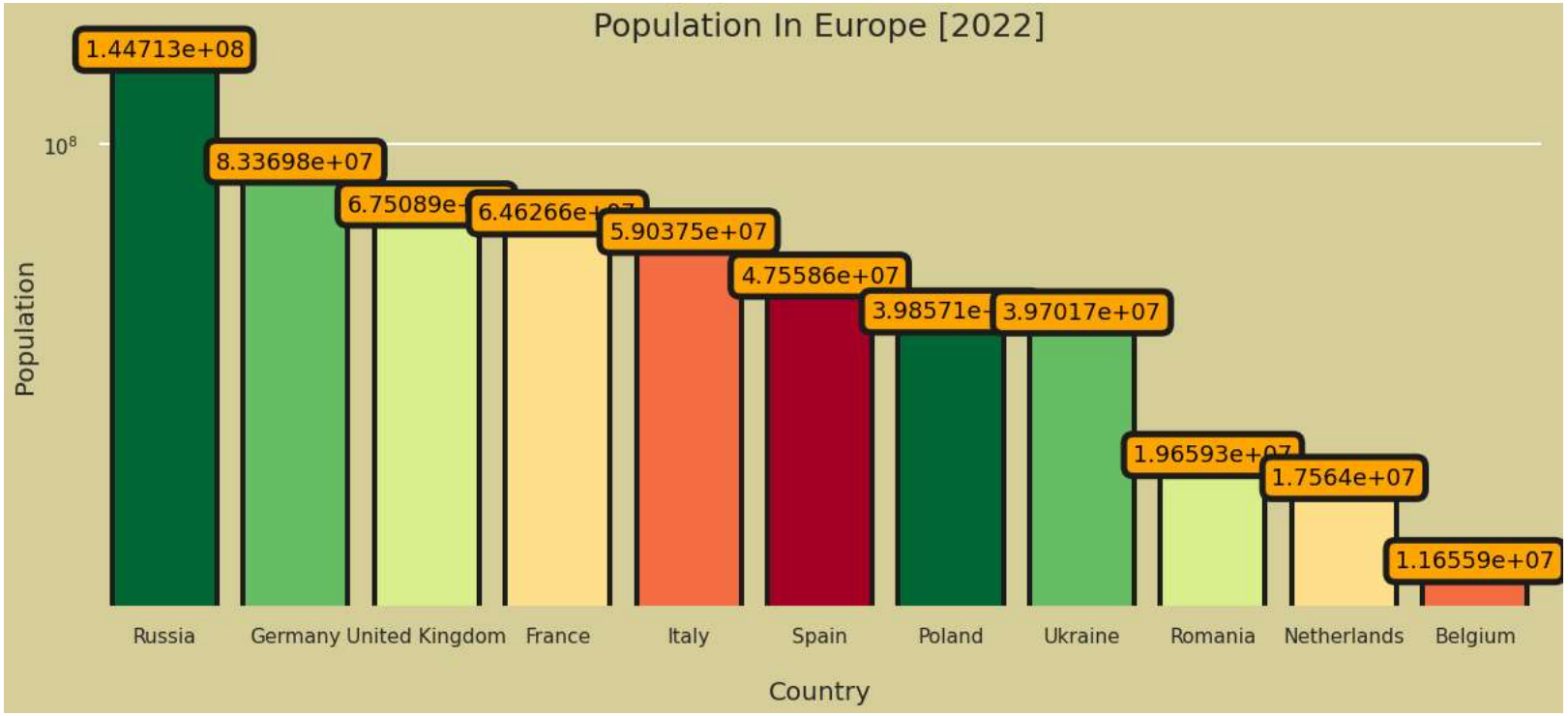
In [16]:
```
print("Population in Europe in 2022 :")

fig = px.choropleth(data_frame = data,
                    locations="Country/Territory",locationmode="country names", color="2022 Population",
                    color_continuous_scale=palette[:10],height= 600,scope="europe",
                    labels={"2022 Population":"Population"})


fig.update_layout(title=dict(text= "Population In Europe [2022]",
                             y=0.95,x=0.5,xanchor= "center",yanchor= "top",font_color="black"),
                  margin=dict(l=0, r=0, b=0, t=0),
                  geo_bgcolor="#D5CE98",
                  paper_bgcolor="#D5CE98")

fig.show()
```

```
Population in Europe in 2022 :
```



In [17]:
```
print("Population in Europe in 2022 :")
plt.subplots(figsize=(20,8))
p=sns.barplot(data=data[data["Continent"]=="Europe"],x="Country/Territory", y="2022 Population",order=data[data["Continent"]=="Europe"].sort_values("2022 Population",ascending=False)["Coun
p.set_yscale("log")
p.set_title("Population In Europe [2022]",fontsize=25)
p.set_xlabel("\nCountry",fontsize=20)
p.set_ylabel("Population",fontsize=20)
p.set_xticklabels(p.get_xticklabels(),rotation = 0)
for container in p.containers:
    p.bar_label(container,label_type="edge",padding=6,size=18,color="black",rotation=0,
    bbox={"boxstyle": "round", "pad": 0.4, "facecolor": "orange", "edgecolor": "#1c1c1c", "linewidth" : 5, "alpha": 1})

sns.despine(left=True, bottom=True)
plt.show()
```

```
Population in Europe in 2022 :
```

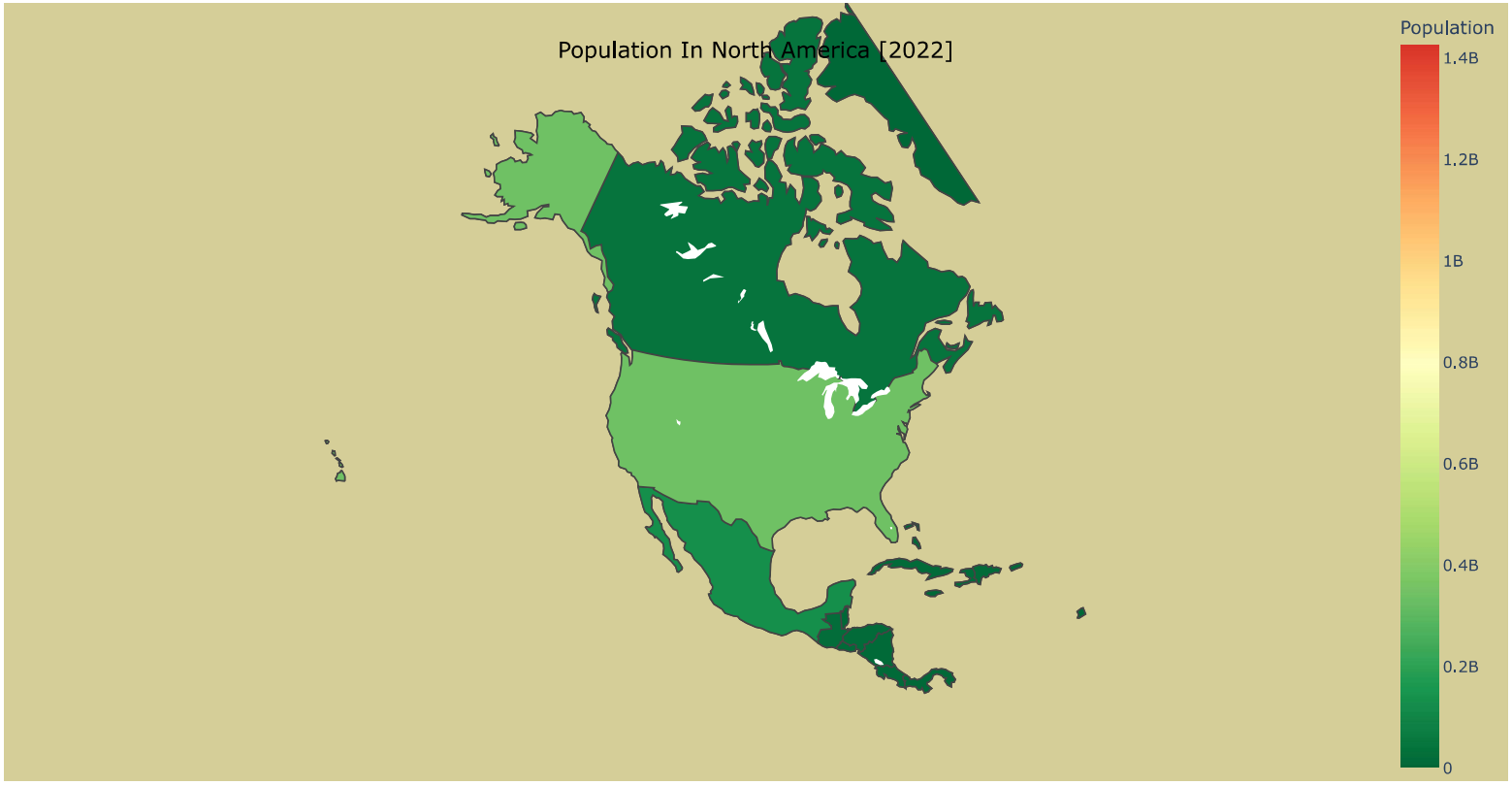


Insights:

- Russia is leading in Europe with 144.7M people followed by Germany, United Kingdom and other countries.

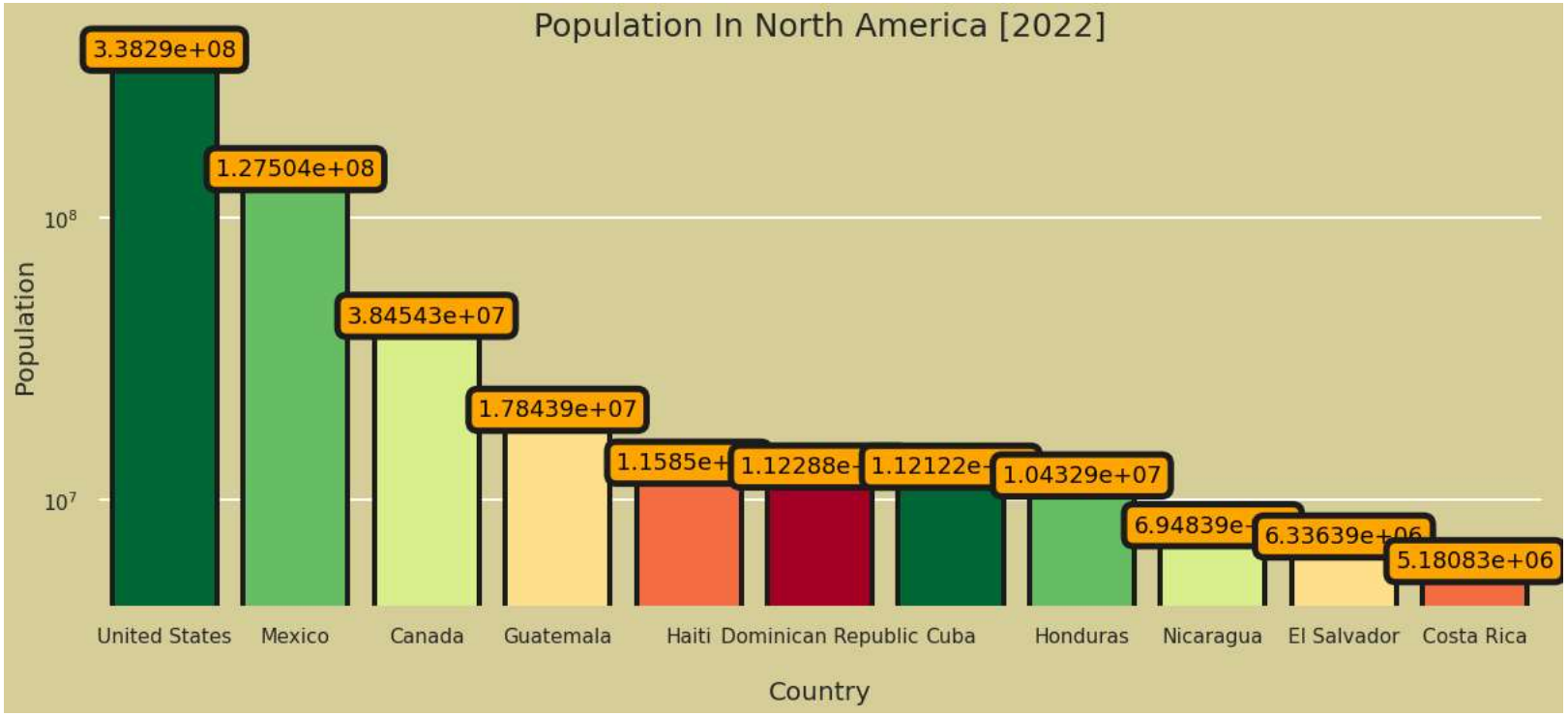
In [18]:
```
print("Population in North America in 2022 :")

fig = px.choropleth(data_frame = data,
                    locations="Country/Territory",locationmode="country names", color="2022 Population",
                    color_continuous_scale=palette[:10],height= 600,scope="north america",
                    labels={"2022 Population":"Population"})


fig.update_layout(title=dict(text= "Population In North America [2022]",
                             y=0.95,x=0.5,xanchor= "center",yanchor= "top",font_color="black"),
                  margin=dict(l=0, r=0, b=0, t=0),
                  geo_bgcolor="#D5CE98",
                  paper_bgcolor="#D5CE98")

fig.show()
```

```
Population in North America in 2022 :
```



In [19]:
```
print("Population in North America in 2022 :")
plt.subplots(figsize=(20,8))
p=sns.barplot(data=data[data["Continent"]=="North America"],x="Country/Territory", y="2022 Population",order=data[data["Continent"]=="North America"].sort_values("2022 Population",ascendin
p.set_yscale("log")
p.set_title("Population In North America [2022]",fontsize=25)
p.set_xlabel("\nCountry",fontsize=20)
p.set_ylabel("Population",fontsize=20)
p.set_xticklabels(p.get_xticklabels(),rotation = 0)
for container in p.containers:
    p.bar_label(container,label_type="edge",padding=6,size=18,color="black",rotation=0,
    bbox={"boxstyle": "round", "pad": 0.4, "facecolor": "orange", "edgecolor": "#1c1c1c", "linewidth" : 5, "alpha": 1})

sns.despine(left=True, bottom=True)
plt.show()
```

```
Population in North America in 2022 :
```

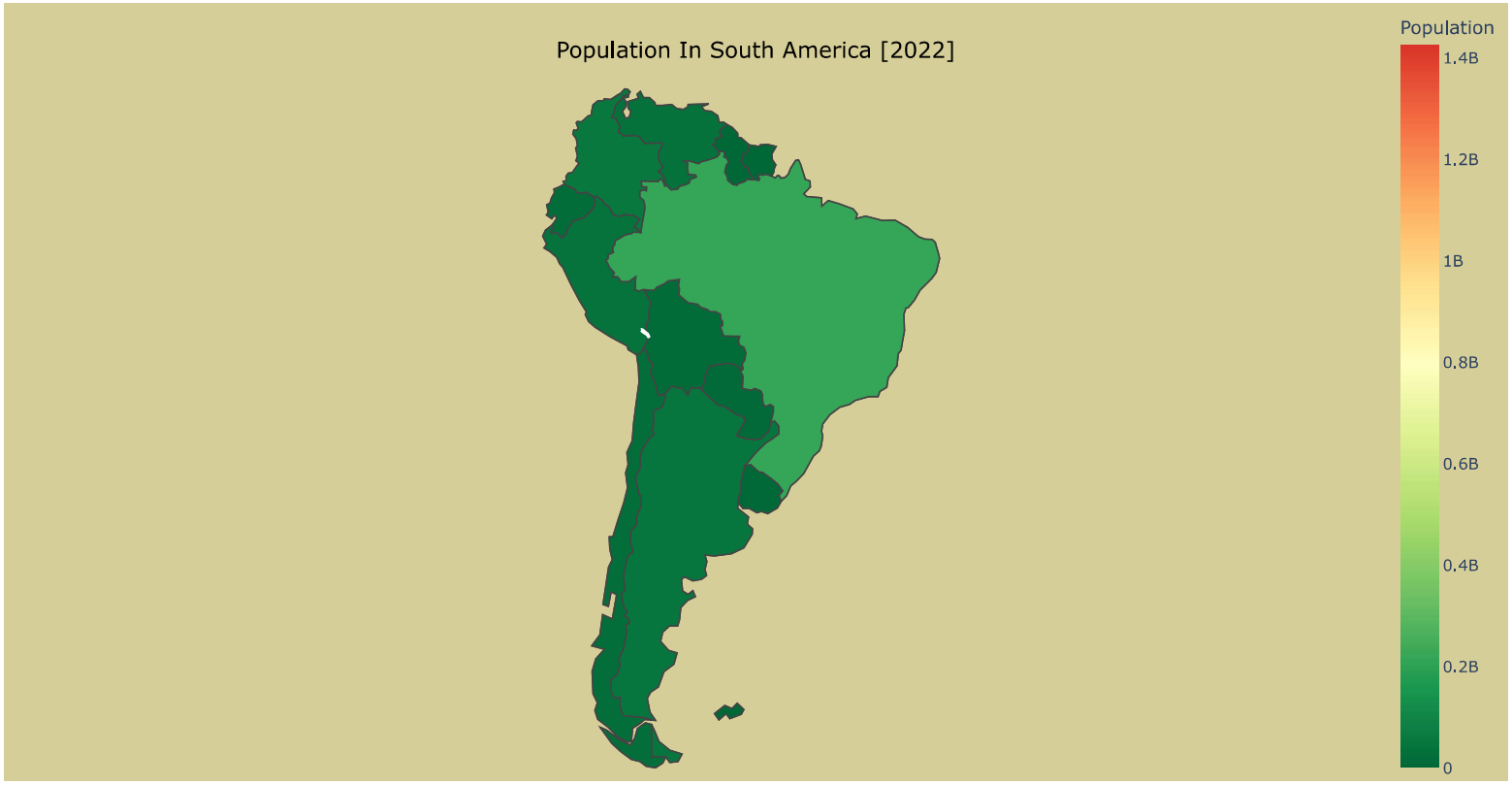


Insights:

- United States is leading in North America with 338.3M people followed by Mexico, Canada and other countries.

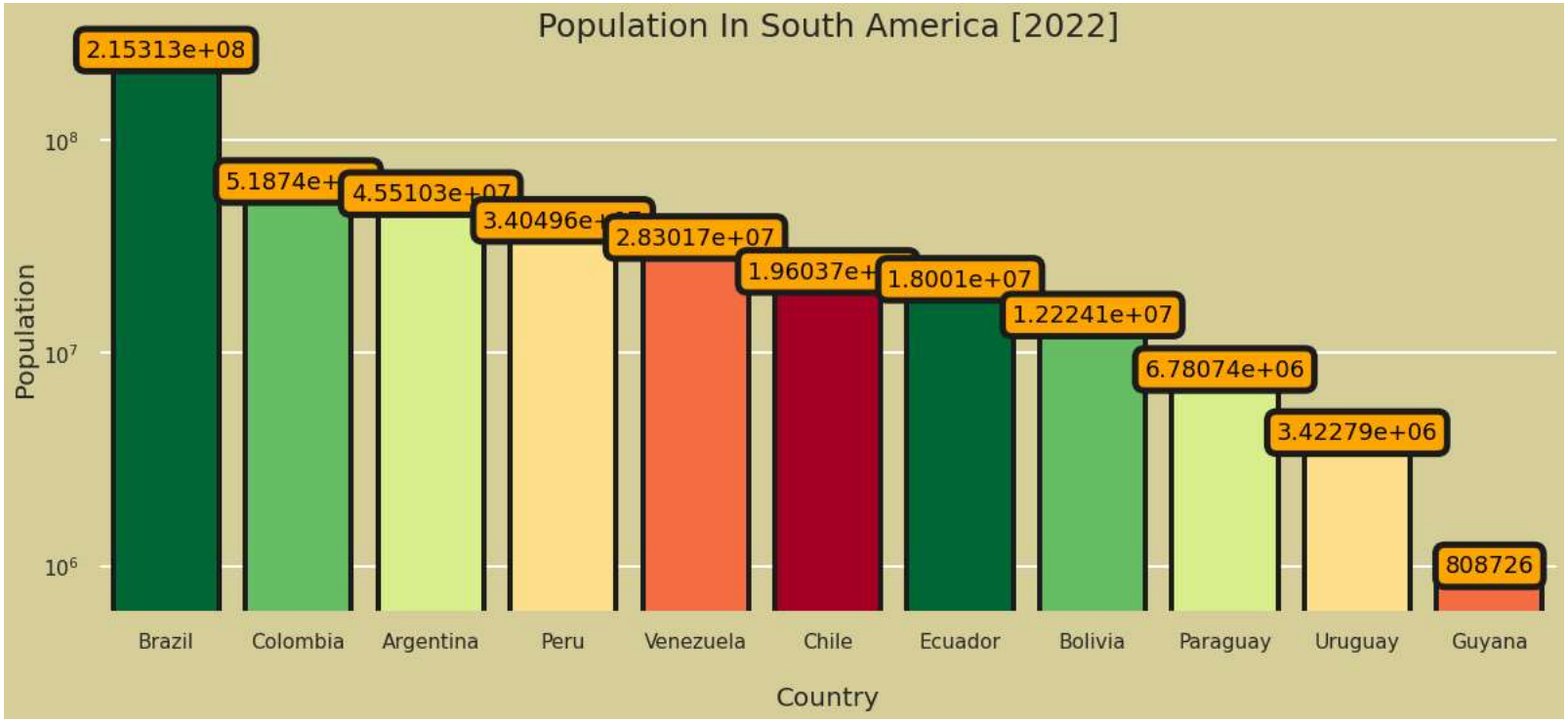
In [20]:
```
print("Population in Souh America in 2022 :")

fig = px.choropleth(data_frame = data,
                    locations="Country/Territory",locationmode="country names", color="2022 Population",
                    color_continuous_scale=palette[:10],height= 600,scope="south america",
                    labels={"2022 Population":"Population"})


fig.update_layout(title=dict(text= "Population In South America [2022]",
                             y=0.95,x=0.5,xanchor= "center",yanchor= "top",font_color="black"),
                  margin=dict(l=0, r=0, b=0, t=0),
                  geo_bgcolor="#D5CE98",
                  paper_bgcolor="#D5CE98")

fig.show()
```

```
Population in Souh America in 2022 :
```



In [21]:
```
print("Population in South America in 2022 :")
plt.subplots(figsize=(20,8))
p=sns.barplot(data=data[data["Continent"]=="South America"],x="Country/Territory", y="2022 Population",order=data[data["Continent"]=="South America"].sort_values("2022 Population",ascendin
p.set_yscale("log")
p.set_title("Population In South America [2022]",fontsize=25)
p.set_xlabel("\nCountry",fontsize=20)
p.set_ylabel("Population",fontsize=20)
p.set_xticklabels(p.get_xticklabels(),rotation = 0)
for container in p.containers:
    p.bar_label(container,label_type="edge",padding=6,size=18,color="black",rotation=0,
    bbox={"boxstyle": "round", "pad": 0.4, "facecolor": "orange", "edgecolor": "#1c1c1c", "linewidth" : 5, "alpha": 1})

sns.despine(left=True, bottom=True)
plt.show()
```

```
Population in South America in 2022 :
```

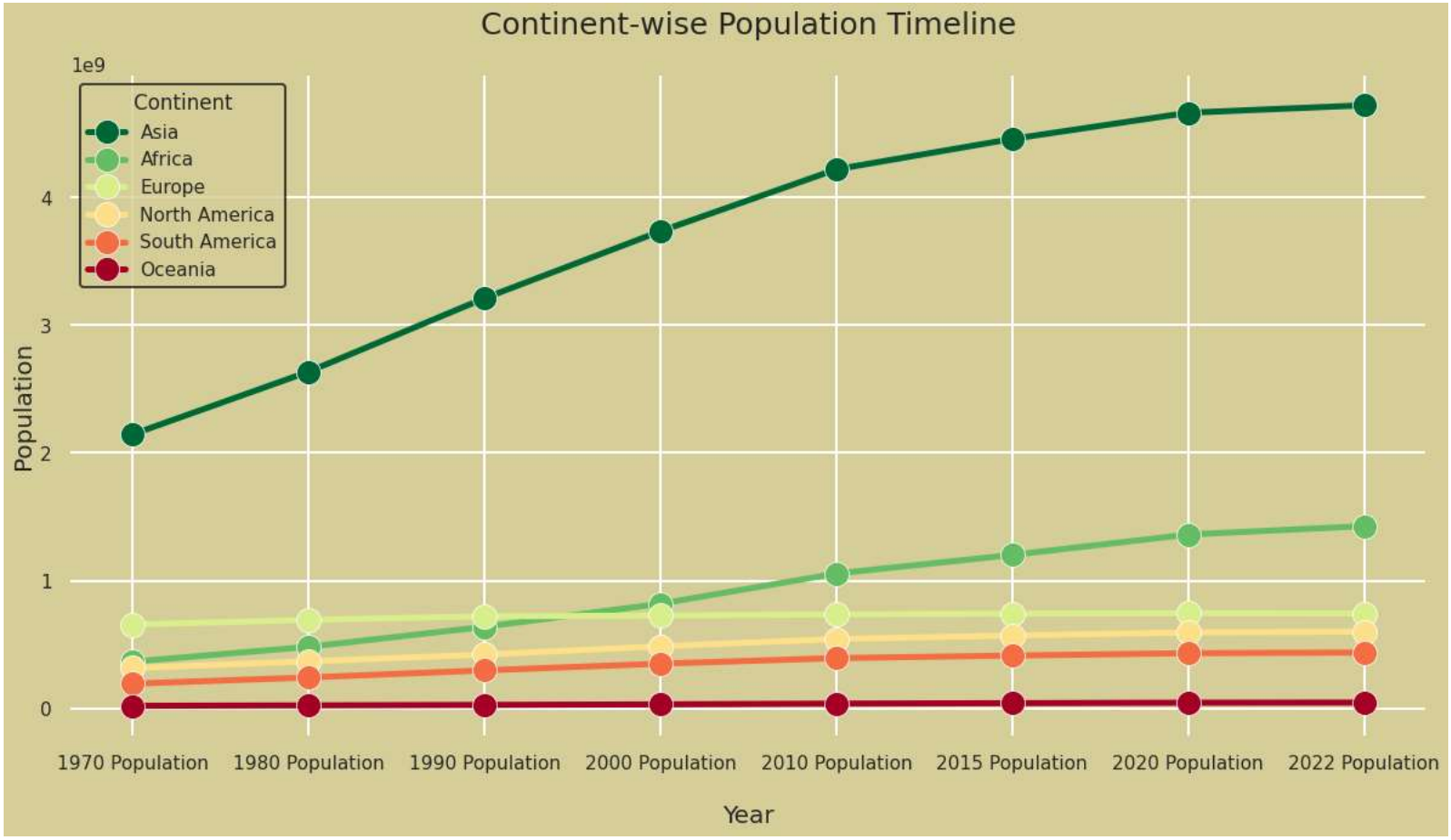


Insights:

- Brazil is leading in South America with 215.3M people followed by Colombia, Argentina and other countries.

In [22]:
```
print(f"Let's have a look on the timeline of continent-wise population :")
_, axs = plt.subplots(figsize=(20,10))

sns.lineplot(x=data_pop.T.index ,y=data_pop.T["Asia"],data=data_pop.T,ax=axs,color="#006837",marker="o",linewidth=5,markersize=20)
sns.lineplot(x=data_pop.T.index ,y=data_pop.T["Africa"],data=data_pop.T,ax=axs,color="#66BD63",marker="o",linewidth=5,markersize=20)
sns.lineplot(x=data_pop.T.index ,y=data_pop.T["Europe"],data=data_pop.T,ax=axs,color="#D9EF8B",marker="o",linewidth=5,markersize=20)
sns.lineplot(x=data_pop.T.index ,y=data_pop.T["North America"],data=data_pop.T,ax=axs,color="#FEE08B",marker="o",linewidth=5,markersize=20)
sns.lineplot(x=data_pop.T.index ,y=data_pop.T["South America"],data=data_pop.T,ax=axs,color="#F46D43",marker="o",linewidth=5,markersize=20)
sns.lineplot(x=data_pop.T.index ,y=data_pop.T["Oceania"],data=data_pop.T,ax=axs,color="#A50026",marker="o",linewidth=5,markersize=20)

axs.set_title("Continent-wise Population Timeline\n",fontsize=25)
axs.set_xlabel("\nYear",fontsize=20)
axs.set_ylabel("Population",fontsize=20)
axs.legend(["Asia","Africa","Europe","North America","South America","Oceania"],title="Continent", edgecolor = "#1c1c1c")
# axs.set_xticks([],minor=False)

sns.despine(left=True, bottom=True)
plt.show()
```

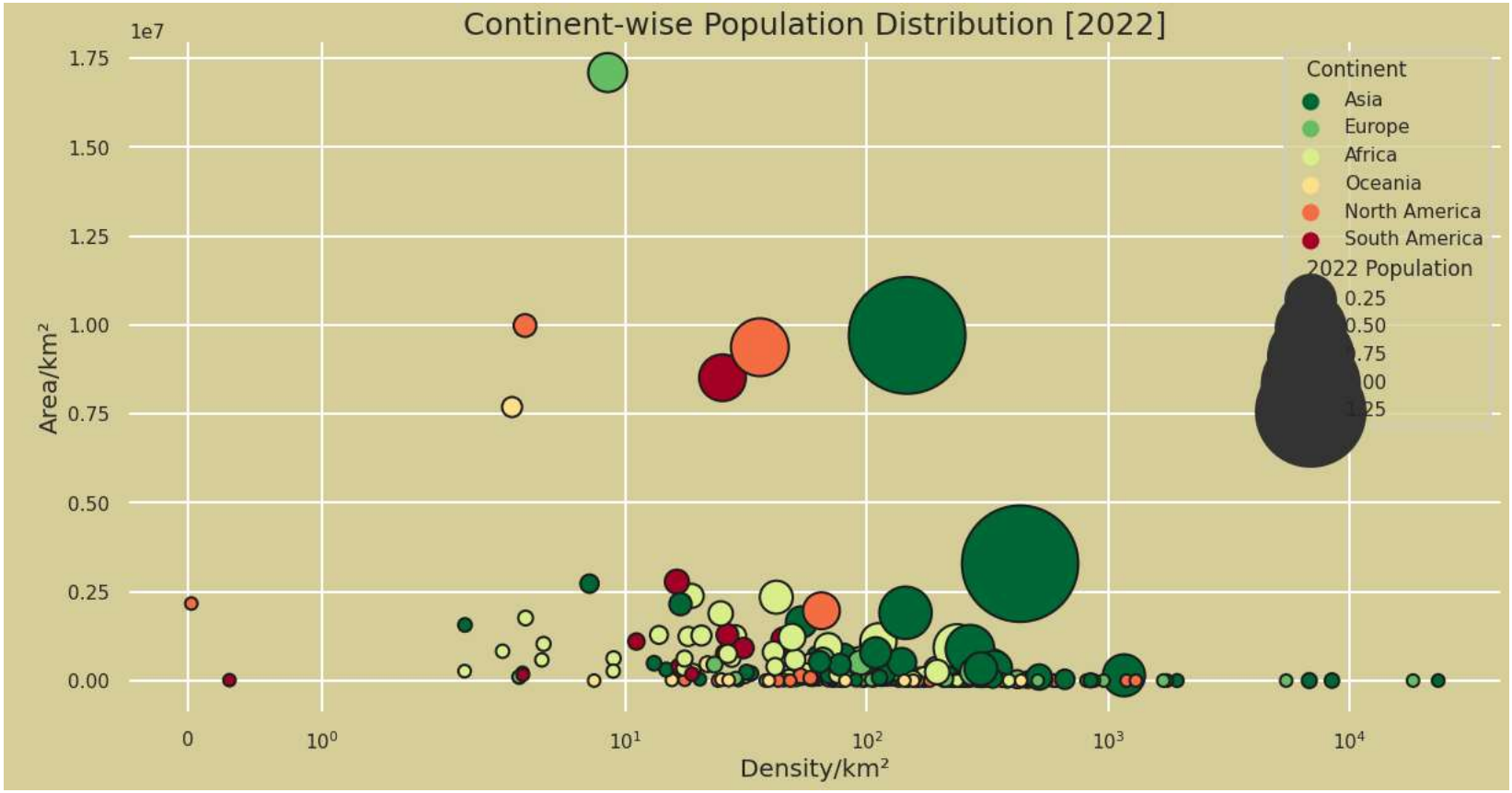
```
Let's have a look on the timeline of continent-wise population :
```



Insights:

- In every continent population is increasing by time.
- Population of Asia is increasing highly followed by Africa.

In [23]:
```
plt.subplots(figsize=(20,10))
p=sns.scatterplot(x=data["Density (per km²)"], y=data["Area (km²)"], hue=data["Continent"],size=data["2022 Population"],palette=palette[0:11:2], edgecolor = "#1c1c1c", linewidth = 2,sizes=
p.set_xscale("symlog")
p.set_yscale("linear")
p.set_title("Continent-wise Population Distribution [2022]",fontsize=25)
p.set_xlabel("Density/km²",fontsize=20)
p.set_ylabel("\nArea/km²",fontsize=20)

sns.despine(left=True, bottom=True)
plt.show()
```



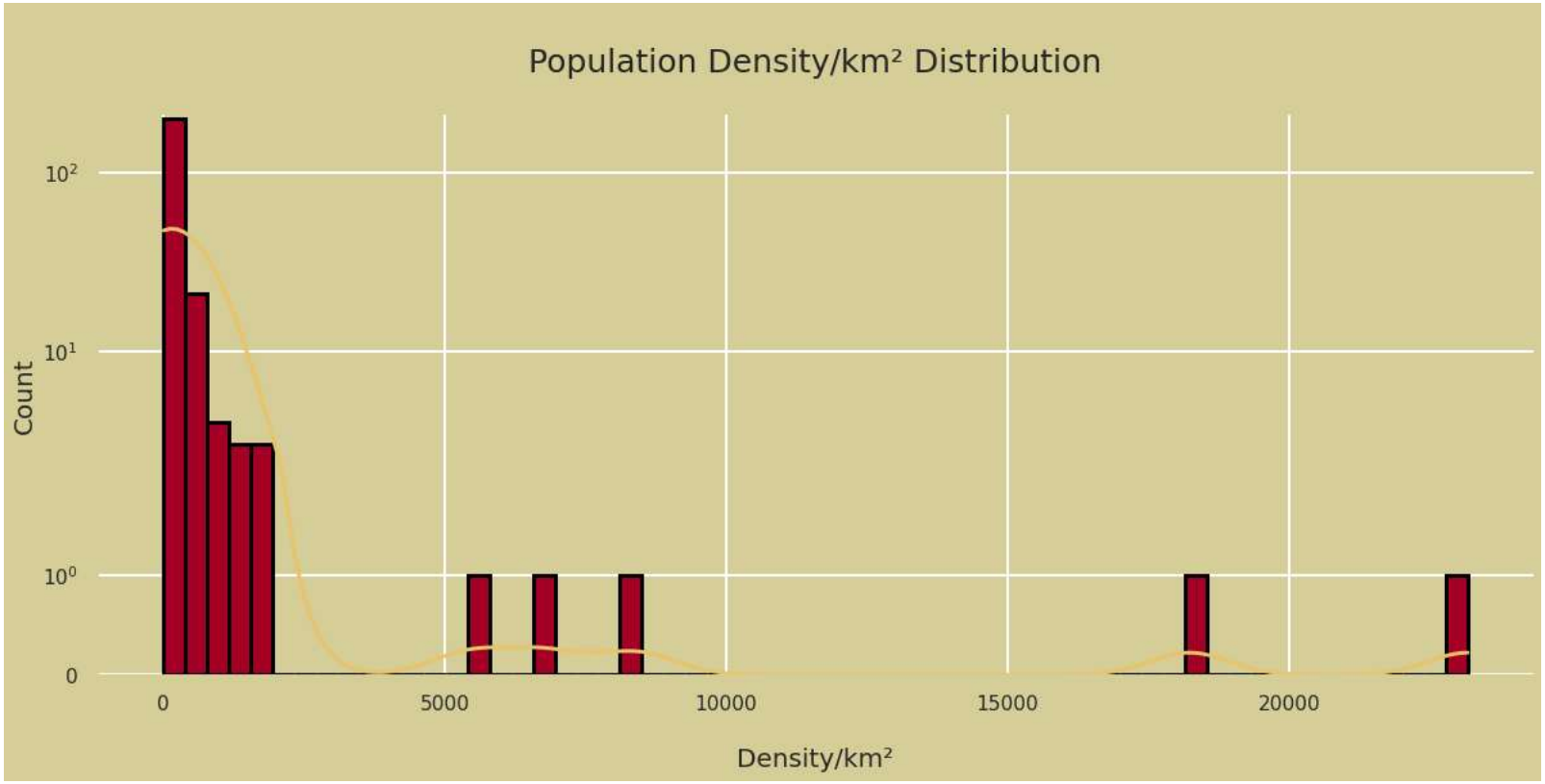
Insights:

- Almost every Asian country has high population with high population density/km².

Population Density

In [24]:
```
print(f"Let's have a look on the distribution of population density :")
plt.subplots(figsize=(20, 8))
p = sns.histplot(data["Density (per km²)"],color=["#A50026"],kde=True,bins=60,alpha=1,fill=True,edgecolor="black",linewidth=3)
p.axes.lines[0].set_color("#e9c46a")
p.axes.set_yscale("symlog")
p.axes.set_title("\nPopulation Density/km² Distribution\n",fontsize=25)
plt.ylabel("Count",fontsize=20)
plt.xlabel("\nDensity/km²",fontsize=20)
sns.despine(left=True, bottom=True)

plt.show()
```

```
Let's have a look on the distribution of population density :
```



Insights:

- Almost all country have population density/km² in between 0 to 2000.

In [25]:
```
print(f"Let's have a look on the population density :")
_, axs = plt.subplots(2,1,figsize=(20,16))
plt.tight_layout(pad=6.0)

sns.barplot(x=data["Country/Territory"],y=data["Density (per km²)"],order=data.sort_values("Density (per km²)",ascending=False)["Country/Territory"][:11],ax=axs[0],palette=palette, saturat
axs[0].set_yscale("linear")
axs[0].set_title("Most Densely Populated Countries",fontsize=25)
axs[0].set_xlabel("\nCountry",fontsize=20)
axs[0].set_ylabel("Density/km²",fontsize=20)
axs[0].set_xticklabels(axs[0].get_xticklabels(),rotation = 0)
for container in axs[0].containers:
    axs[0].bar_label(container,label_type="center",padding=6,size=18,color="black",rotation=0,
    bbox={"boxstyle": "round", "pad": 0.4, "facecolor": "orange", "edgecolor": "#1c1c1c", "linewidth" : 3, "alpha": 1})

sns.barplot(x=data["Country/Territory"],y=data["Density (per km²)"],order=data.sort_values("Density (per km²)",ascending=True)["Country/Territory"][:11],ax=axs[1],palette=palette, saturati
axs[1].set_yscale("linear")
axs[1].set_title("Least Densely Populated Countries",fontsize=25)
axs[1].set_xlabel("\nCountry",fontsize=20)
axs[1].set_ylabel("Density/km²",fontsize=20)
axs[1].set_xticklabels(axs[1].get_xticklabels(),rotation = 15)
for container in axs[1].containers:
    axs[1].bar_label(container,label_type="center",padding=6,size=18,color="black",rotation=0,
    bbox={"boxstyle": "round", "pad": 0.4, "facecolor": "orange", "edgecolor": "#1c1c1c", "linewidth" : 3, "alpha": 1})
```

```
sns.despine(left=True, bottom=True)
plt.show()
```

Let's have a look on the population density :

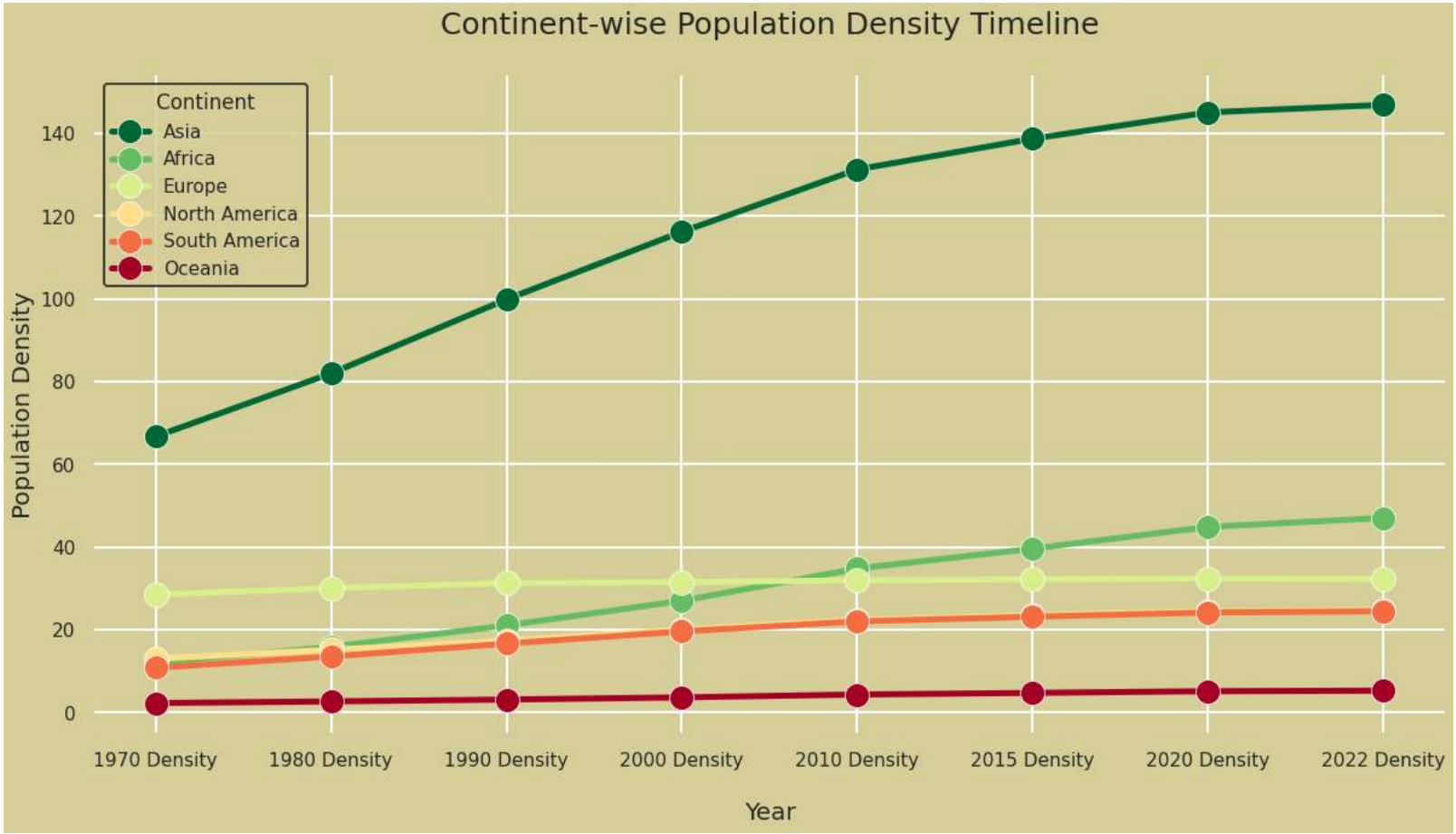

Most Densely Populated Countries
Density/km²
20000
15000
10000
5000
0
23172.3
18234.5
8416.46
6783.39
5441.5
1924.49
1745.96
1687.61
1299.26
1188.59
1160.04
Macau
Monaco
Singapore
Hong Kong
Gibraltar
Bahrain
Maldives
Malta
Sint Maarten
Bermuda
Bangladesh
Country
Least Densely Populated Countries
Density/km²
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0261
0.3105
2.1654
2.1727
3.1092
3.4032
3.6204
3.6459
3.7621
3.7727
3.8513
Greenland
Falkland Islands
Western Sahara
Mongolia
Namibia
Australia
Iceland
French Guiana
Guyana
Suriname
Canada
Country

Insights:

- Macau is the most densely populated country with more than 23172 people in per square kilometer followed by Monaco, Singapore and others.
- Greenland is the least densely populated country with 0.0261 people in per square kilometer followed by Falkland Island, Western Sahara and others.

In [26]:
```
data_den = data.copy()
data_den = pd.DataFrame(data_den.groupby(["Continent"])["1970 Population","1980 Population","1990 Population","2000 Population","2010 Population","2015 Population","2020 Population","2022
col = ["1970 Population","1980 Population","1990 Population","2000 Population","2010 Population","2015 Population","2020 Population","2022 Population"]
for i in col:
    data_den[i] = data_den[i]/data_den["Area (km²)"]
data_den.rename(columns={"1970 Population":"1970 Density","1980 Population":"1980 Density","1990 Population":"1990 Density","2000 Population":"2000 Density","2010 Population":"2010 Density
data_den.drop(columns="Area (km²)",inplace=True)


print(f"Let's have a look on the timeline of continent-wise population density :")
_, axs = plt.subplots(figsize=(20,10))

sns.lineplot(x=data_den.T.index ,y=data_den.T["Asia"],data=data_den.T,ax=axs,color="#006837",marker="o",linewidth=5,markersize=20)
sns.lineplot(x=data_den.T.index ,y=data_den.T["Africa"],data=data_den.T,ax=axs,color="#66BD63",marker="o",linewidth=5,markersize=20)
sns.lineplot(x=data_den.T.index ,y=data_den.T["Europe"],data=data_den.T,ax=axs,color="#D9EF8B",marker="o",linewidth=5,markersize=20)
sns.lineplot(x=data_den.T.index ,y=data_den.T["North America"],data=data_den.T,ax=axs,color="#FEE08B",marker="o",linewidth=5,markersize=20)
sns.lineplot(x=data_den.T.index ,y=data_den.T["South America"],data=data_den.T,ax=axs,color="#F46D43",marker="o",linewidth=5,markersize=20)
sns.lineplot(x=data_den.T.index ,y=data_den.T["Oceania"],data=data_den.T,ax=axs,color="#A50026",marker="o",linewidth=5,markersize=20)

axs.set_title("Continent-wise Population Density Timeline\n",fontsize=25)
axs.set_xlabel("\nYear",fontsize=20)
axs.set_ylabel("Population Density",fontsize=20)
axs.legend(["Asia","Africa","Europe","North America","South America","Oceania"],title="Continent", edgecolor = "#1c1c1c")
# axs.set_xticks([],minor=False)

sns.despine(left=True, bottom=True)
plt.show()
```

```
Let's have a look on the timeline of continent-wise population density :
```



Insights:

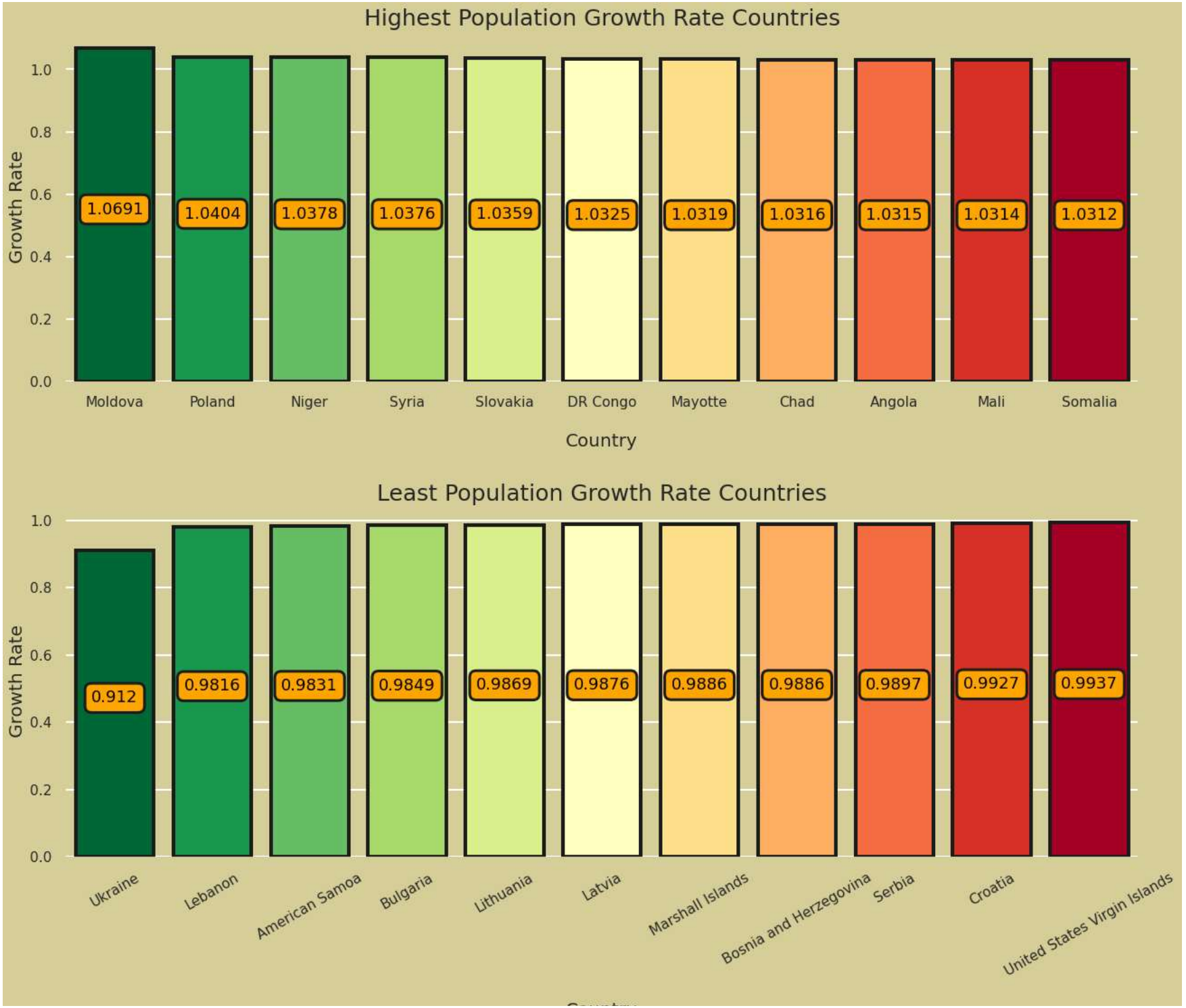
- In every continent population density/km² is increasing by time.
- Population density/km² of Asia is increasing highly followed by Africa.

Population Growth Rate

In [27]:
```
print(f"Let's have a look on the population growth rate :")
_, axs = plt.subplots(2,1,figsize=(20,16))
plt.tight_layout(pad=6.0)

sns.barplot(x=data["Country/Territory"],y=data["Growth Rate"],order=data.sort_values("Growth Rate",ascending=False)["Country/Territory"][:11],ax=axs[0],palette=palette, saturation=1,edgeco
axs[0].set_yscale("linear")
axs[0].set_title("Highest Population Growth Rate Countries",fontsize=25)
axs[0].set_xlabel("\nCountry",fontsize=20)
axs[0].set_ylabel("Growth Rate",fontsize=20)
axs[0].set_xticklabels(axs[0].get_xticklabels(),rotation = 0)
for container in axs[0].containers:
    axs[0].bar_label(container,label_type="center",padding=6,size=18,color="black",rotation=0,
    bbox={"boxstyle": "round", "pad": 0.4, "facecolor": "orange", "edgecolor": "#1c1c1c", "linewidth" : 3, "alpha": 1})

sns.barplot(x=data["Country/Territory"],y=data["Growth Rate"],order=data.sort_values("Growth Rate",ascending=True)["Country/Territory"][:11],ax=axs[1],palette=palette, saturation=1,edgecol
axs[1].set_yscale("linear")
```

```
axs[1].set_title("Least Population Growth Rate Countries",fontsize=25)
axs[1].set_xlabel("\nCountry",fontsize=20)
axs[1].set_ylabel("Growth Rate",fontsize=20)
axs[1].set_xticklabels(axs[1].get_xticklabels(),rotation = 30)
for container in axs[1].containers:
    axs[1].bar_label(container,label_type="center",padding=6,size=18,color="black",rotation=0,
    bbox={"boxstyle": "round", "pad": 0.4, "facecolor": "orange", "edgecolor": "#1c1c1c", "linewidth" : 3, "alpha": 1})

sns.despine(left=True, bottom=True)
plt.show()
```

Let's have a look on the population growth rate :


Highest Population Growth Rate Countries
Growth Rate
1.0
0.8
0.6
0.4
0.2
0.0
1.0691
1.0404
1.0378
1.0376
1.0359
1.0325
1.0319
1.0316
1.0315
1.0314
1.0312
Moldova
Poland
Niger
Syria
Slovakia
DR Congo
Mayotte
Chad
Angola
Mali
Somalia
Country
Least Population Growth Rate Countries
Growth Rate
1.0
0.8
0.6
0.4
0.2
0.0
0.912
0.9816
0.9831
0.9849
0.9869
0.9876
0.9886
0.9886
0.9897
0.9927
0.9937
Ukraine
Lebanon
American Samoa
Bulgaria
Lithuania
Latvia
Marshall Islands
Bosnia and Herzegovina
Serbia
Croatia
United States Virgin Islands

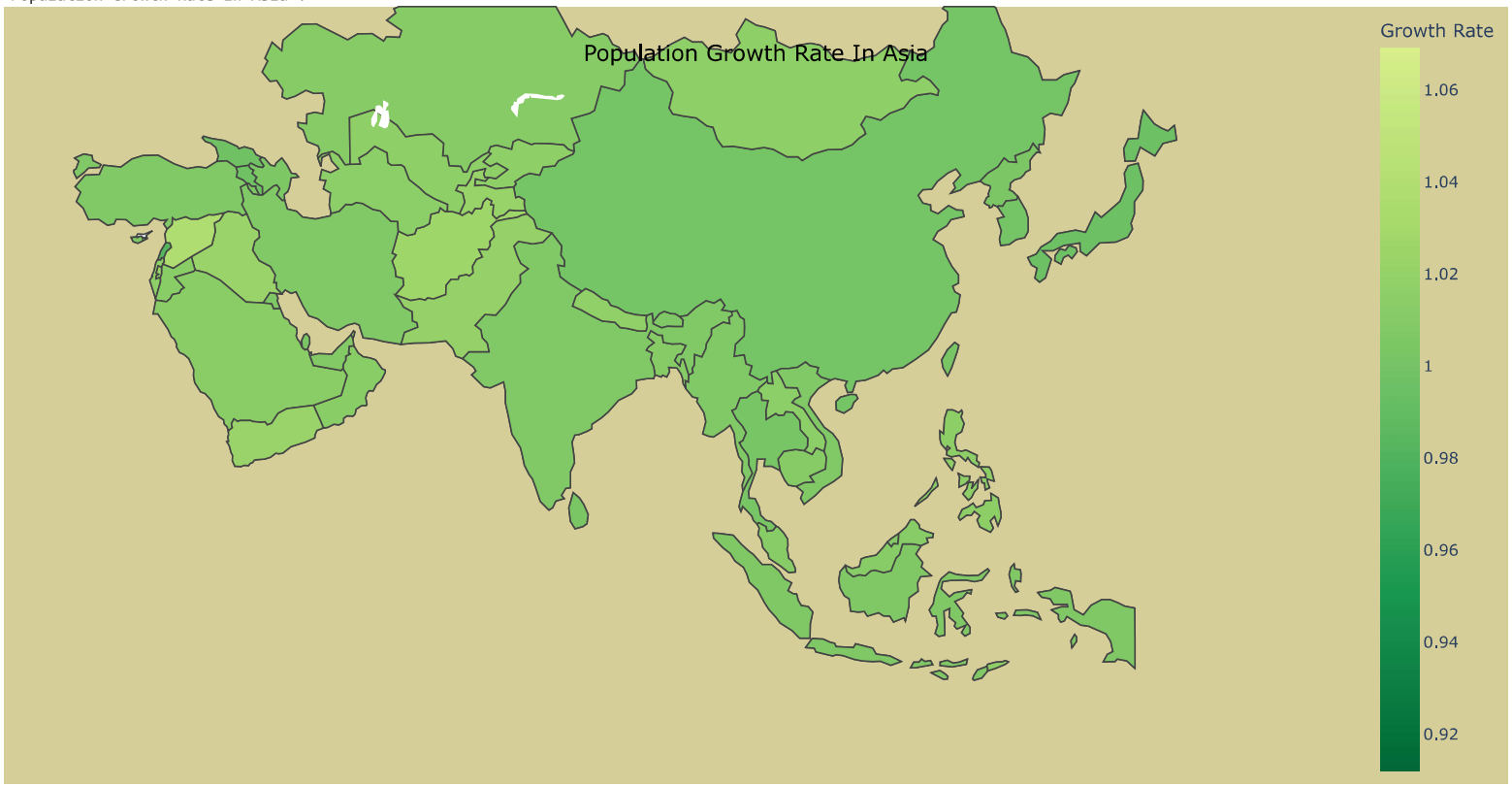
Country

Insights:

- Moldova is leading in population growth rate with a growth rate of 1.0691 followed by Poland, Niger and others.
- Ukraine has the lowest population growth rate of 0.912 followed by Lebanon, American Samoa and others.

In [28]:
```
print("Population Growth Rate in Asia :")

fig = px.choropleth(data_frame = data,
                    locations="Country/Territory",locationmode="country names", color="Growth Rate",
                    color_continuous_scale=palette[0:5],height= 600,scope="asia",
                    labels={"Growth Rate":"Growth Rate"})


fig.update_layout(title=dict(text= "Population Growth Rate In Asia",
                             y=0.95,x=0.5,xanchor= "center",yanchor= "top",font_color="black"),
                  margin=dict(l=0, r=0, b=0, t=0),
                  geo_bgcolor="#D5CE98",
                  paper_bgcolor="#D5CE98")

fig.show()
```

```
Population Growth Rate in Asia :
```



Insights:

- Syria is leading in Asia with a population growth rate of 1.0376 followed by Afghanistan, Palestine and other countries.

In [29]:
```
print("Population Growth Rate in Africa :")

fig = px.choropleth(data_frame = data,
                    locations="Country/Territory",locationmode="country names", color="Growth Rate",
                    color_continuous_scale=palette[0:5],height= 600,scope="africa",
                    labels={"Growth Rate":"Growth Rate"})


fig.update_layout(title=dict(text= "Population Growth Rate In Africa",
                             y=0.95,x=0.5,xanchor= "center",yanchor= "top",font_color="black"),
                  margin=dict(l=0, r=0, b=0, t=0),
                  geo_bgcolor="#D5CE98",
                  paper_bgcolor="#D5CE98")

fig.show()
```

```
Population Growth Rate in Africa :
```

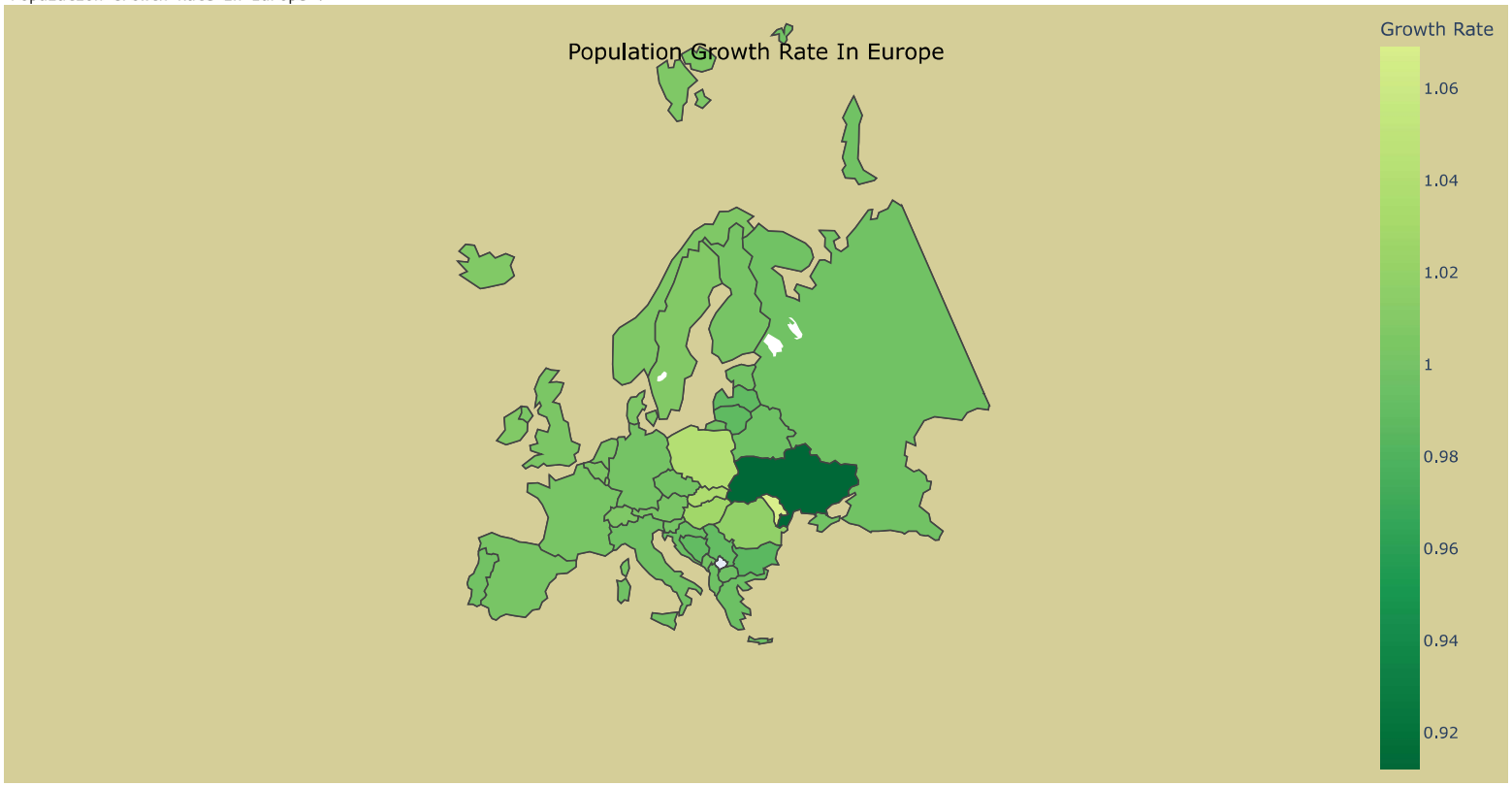
Insights:

- Niger is leading in Africa with a population growth rate of 1.0378 followed by DR Congo, Mayotte and other countries.

In [30]:
```
print("Population Growth Rate in Europe :")

fig = px.choropleth(data_frame = data,
                    locations="Country/Territory",locationmode="country names", color="Growth Rate",
                    color_continuous_scale=palette[0:5],height= 600,scope="europe",
                    labels={"Growth Rate":"Growth Rate"})
```

```
fig.update_layout(title=dict(text= "Population Growth Rate In Europe",
                             y=0.95,x=0.5,xanchor= "center",yanchor= "top",font_color="black"),
                  margin=dict(l=0, r=0, b=0, t=0),
                  geo_bgcolor="#D5CE98",
                  paper_bgcolor="#D5CE98")

fig.show()
```

Population Growth Rate in Europe :



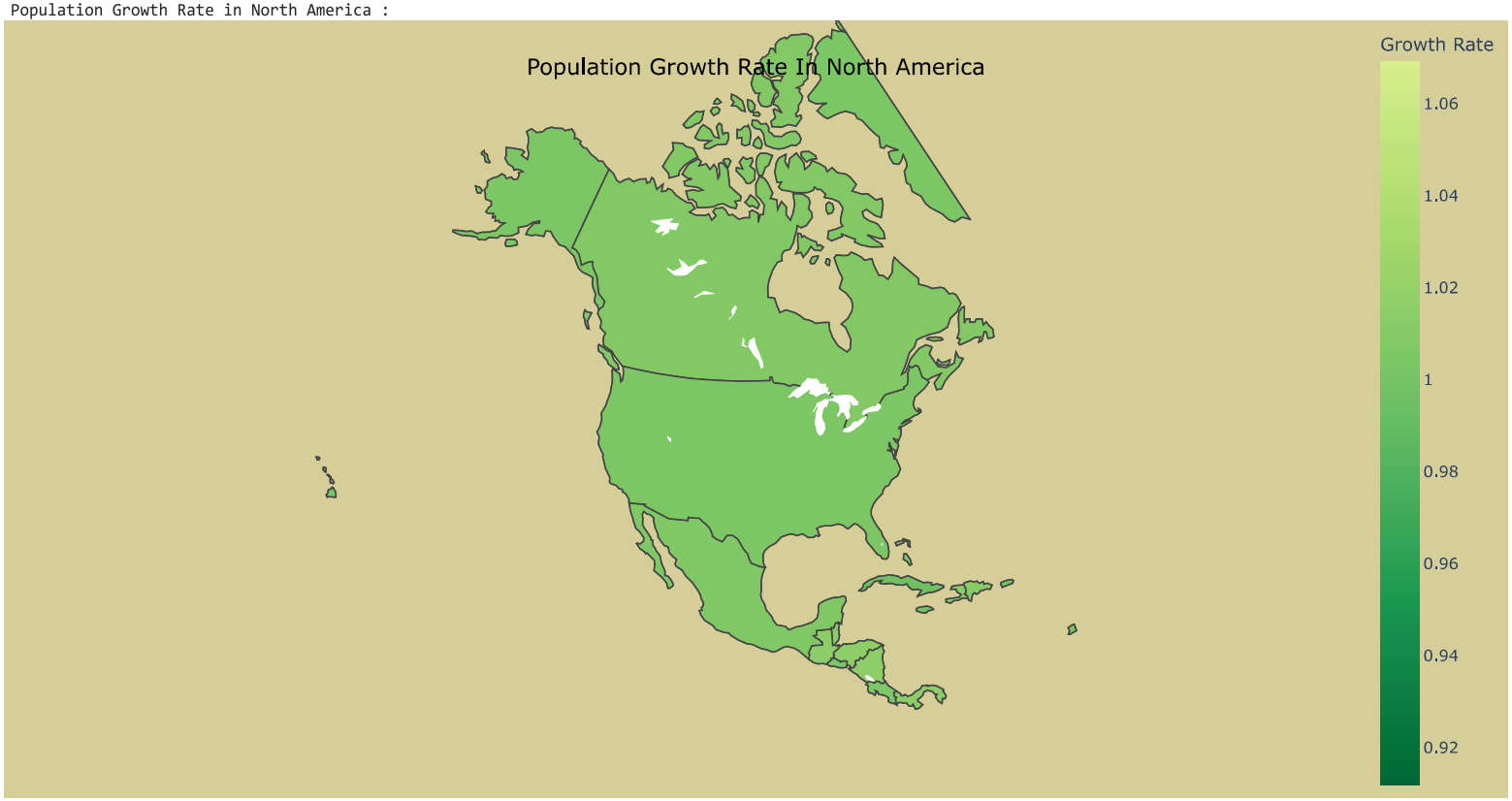
Insights:

- Moldova is leading in Europe with a population growth rate of 1.0691 followed by Poland, Slovakia and other countries.

In [31]:

```
print("Population Growth Rate in North America :")

fig = px.choropleth(data_frame = data,
                    locations="Country/Territory",locationmode="country names", color="Growth Rate",
                    color_continuous_scale=palette[0:5],height= 600,scope="north america",
                    labels={"Growth Rate":"Growth Rate"})


fig.update_layout(title=dict(text= "Population Growth Rate In North America",
                             y=0.95,x=0.5,xanchor= "center",yanchor= "top",font_color="black"),
                  margin=dict(l=0, r=0, b=0, t=0),
                  geo_bgcolor="#D5CE98",
                  paper_bgcolor="#D5CE98")

fig.show()
```

Population Growth Rate in North America :



Insights:

- Honduras is leading in North America with a population growth rate of 1.015 followed by Nicaragua, Guatemala and other countries.

In [32]:
```
print("Population Growth Rate in South America :")

fig = px.choropleth(data_frame = data,
                    locations="Country/Territory",locationmode="country names", color="Growth Rate",
                    color_continuous_scale=palette[0:5],height= 600,scope="south america",
                    labels={"Growth Rate":"Growth Rate"})


fig.update_layout(title=dict(text= "Population Growth Rate In South America",
                             y=0.95,x=0.5,xanchor= "center",yanchor= "top",font_color="black"),
                  margin=dict(l=0, r=0, b=0, t=0),
                  geo_bgcolor="#D5CE98",
                  paper_bgcolor="#D5CE98")

fig.show()
```

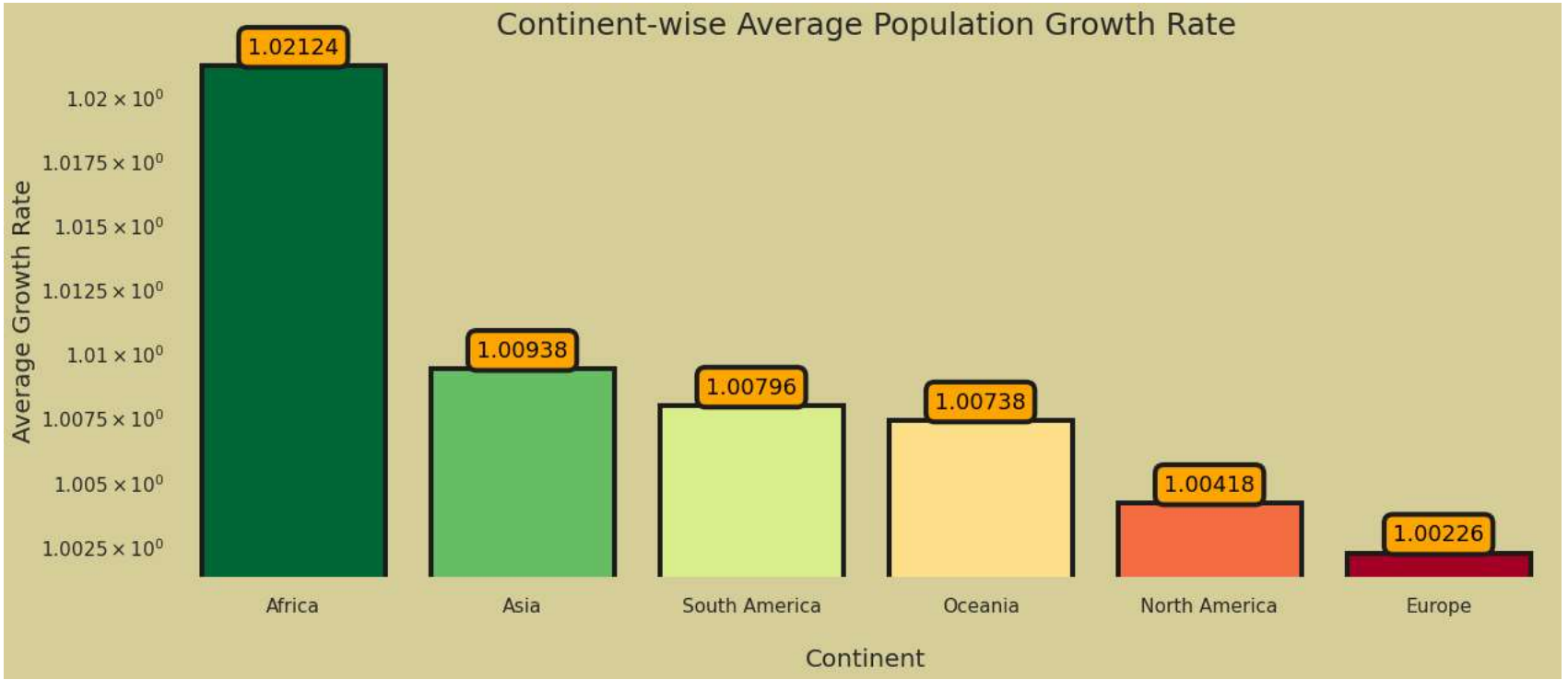
Population Growth Rate in South America :

Insights:

- French Guiana is leading in South America with a population growth rate of 1.0239 followed by Bolivia, Paraguay and other countries.

In [33]:
```
data_gr = data.copy()
data_gr = pd.DataFrame(data_gr.groupby(["Continent"])["Growth Rate"].mean())

print("Let's have a look on the continent-wise average population growth rate :")
plt.subplots(figsize=(20,8))
p=sns.barplot(x=data_gr.index, y=data_gr["Growth Rate"],order=data_gr.sort_values("Growth Rate",ascending=False).index,palette=palette[0:11:2], saturation=1,edgecolor = "#1c1c1c", linewidt
p.set_yscale("log")
p.set_title("Continent-wise Average Population Growth Rate",fontsize=25)
p.set_xlabel("\nContinent",fontsize=20)
p.set_ylabel("Average Growth Rate",fontsize=20)
p.set_xticklabels(p.get_xticklabels(),rotation = 0)
for container in p.containers:
    p.bar_label(container,label_type="edge",padding=6,size=18,color="black",rotation=0,
    bbox={"boxstyle": "round", "pad": 0.4, "facecolor": "orange", "edgecolor": "#1c1c1c", "linewidth" : 4, "alpha": 1})

sns.despine(left=True, bottom=True)
plt.show()
```

```
Let's have a look on the continent-wise average population growth rate :
```



Insights:

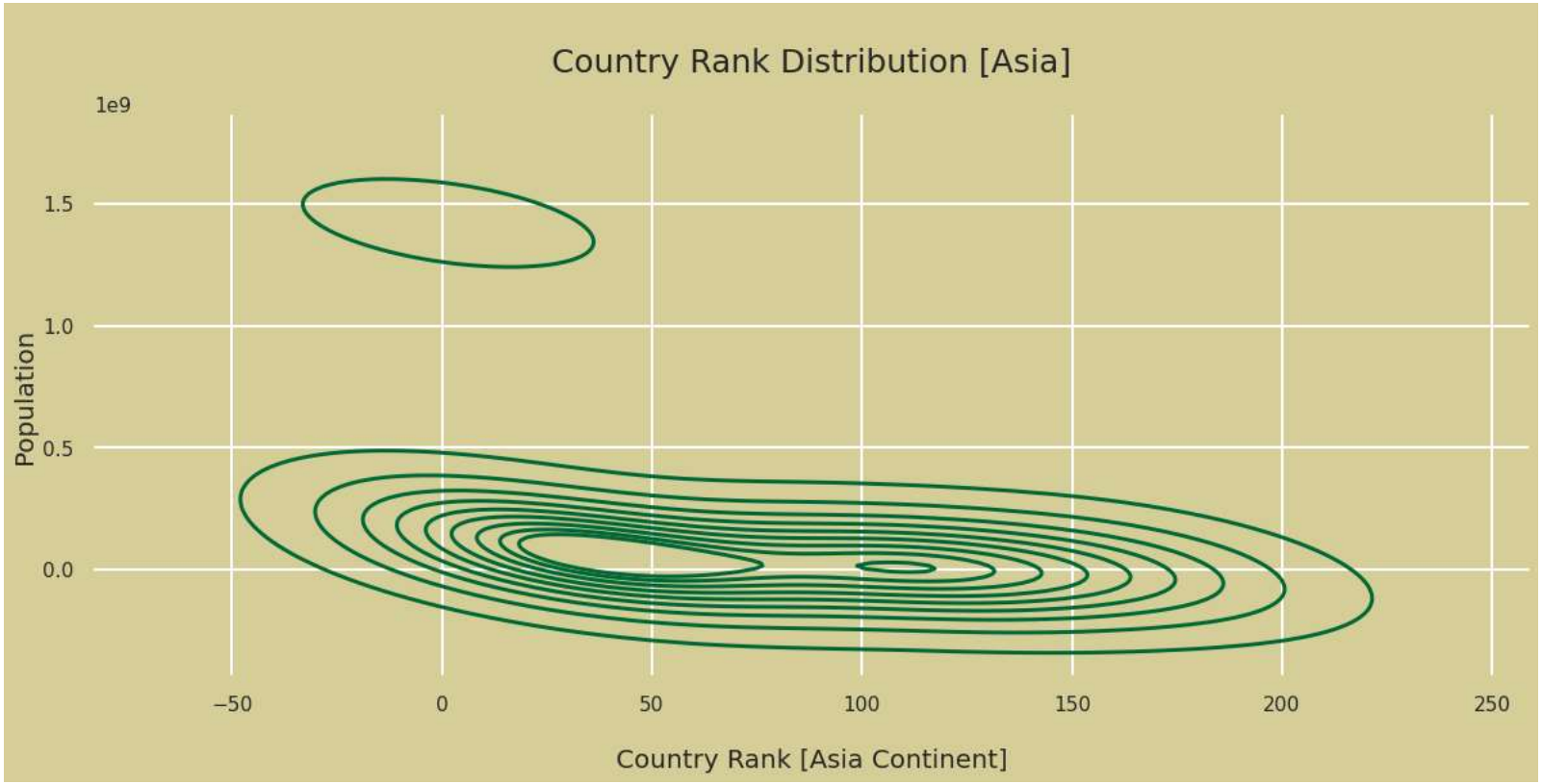
- Africa is leading in average population growth rate with a growth rate of 1.02124 followed by Asia, South America and others.
- Europe has the lowest average population growth rate of 1.00226

Country Rank

In [34]:
```
def rank(feature,color):

    _, axes = plt.subplots(figsize=(20,8))
    sns.kdeplot(x=data[data["Continent"]==feature]["Rank"], y=data["2022 Population"],edgecolor="#1c1c1c",fill=True, kind="kde",shade=False,height=10,color=color)
    axes.set_title(f"\nCountry Rank Distribution [{feature}]\n",fontsize=25)
    axes.set_ylabel("Population",fontsize=20)
    axes.set_xlabel(f"\nCountry Rank [{feature} Continent]",fontsize=20)

    sns.despine(left=True, bottom=True)
    plt.show()
```

In [35]:
```
print("Let's have a look on the distribution of asian country rank :")
rank("Asia",palette[0])
```

```
Let's have a look on the distribution of asian country rank :
```

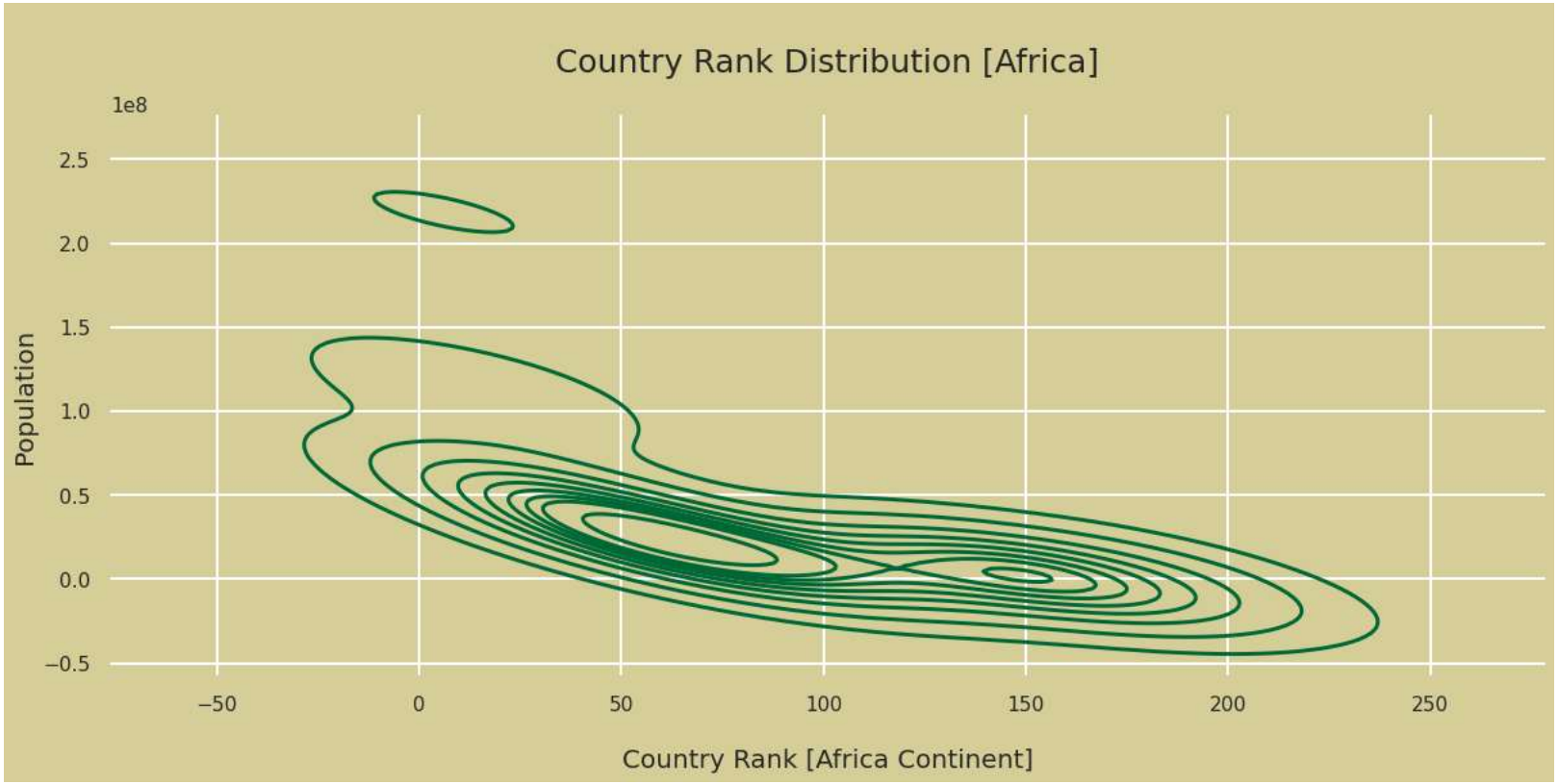


Insights:

- Most countries rank in Asia fall in between 0 to 75 and in between 100 to 130.

In [36]:
```
print("Let's have a look on the distribution of african country rank :")
rank("Africa",palette[0])
```

```
Let's have a look on the distribution of african country rank :
```

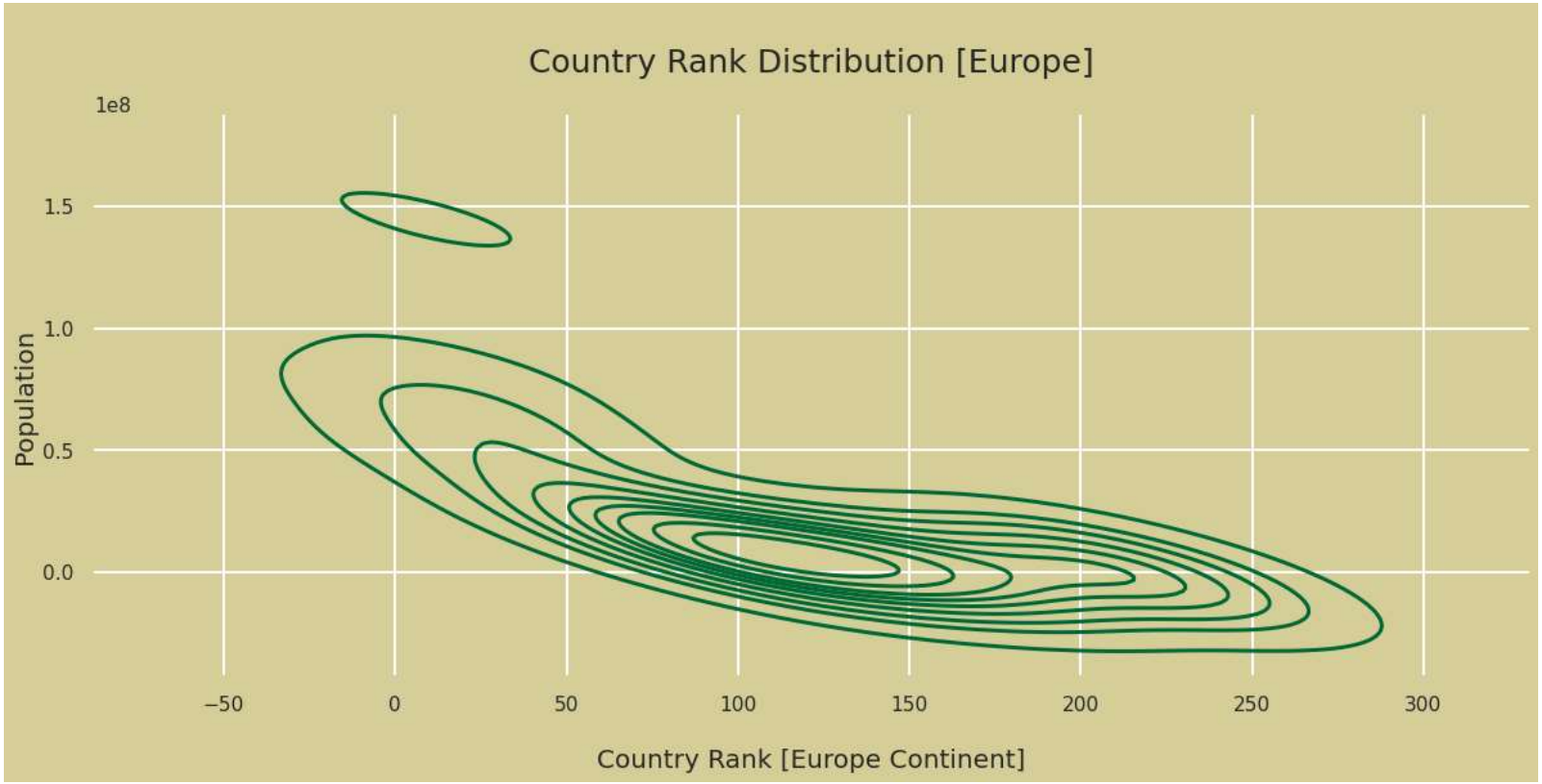


Insights:

- Most countries rank in Africa fall in between 6 to 85 and others are scattered.

In [37]:
```
print("Let's have a look on the distribution of european country rank :")
rank("Europe",palette[0])
```

```
Let's have a look on the distribution of european country rank :
```

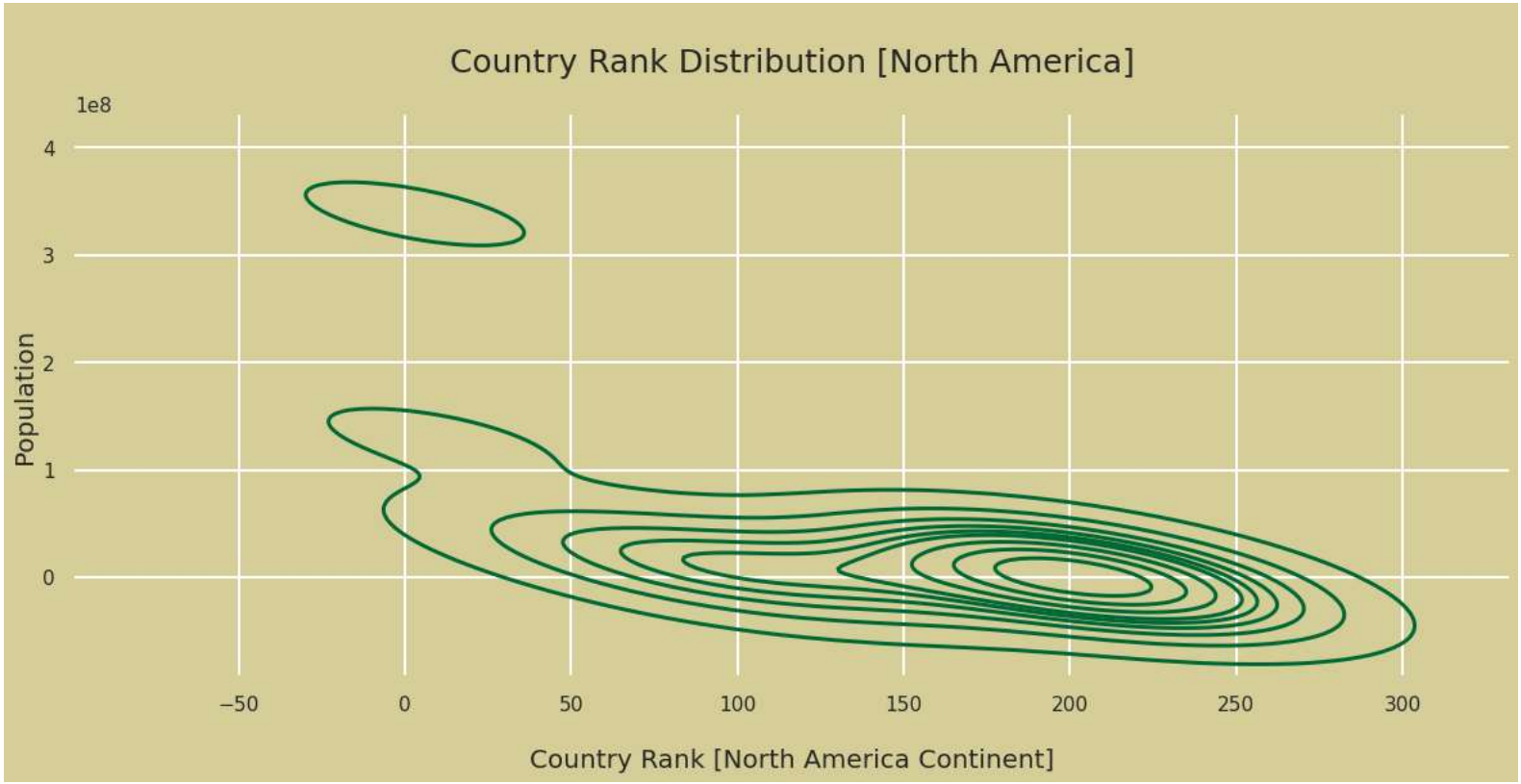


Insights:

- Most countries rank in Europe fall in between 60 to 160 and others are scattered.

In [38]:
```
print("Let's have a look on the distribution of north american country rank :")
rank("North America",palette[0])
```

```
Let's have a look on the distribution of north american country rank :
```

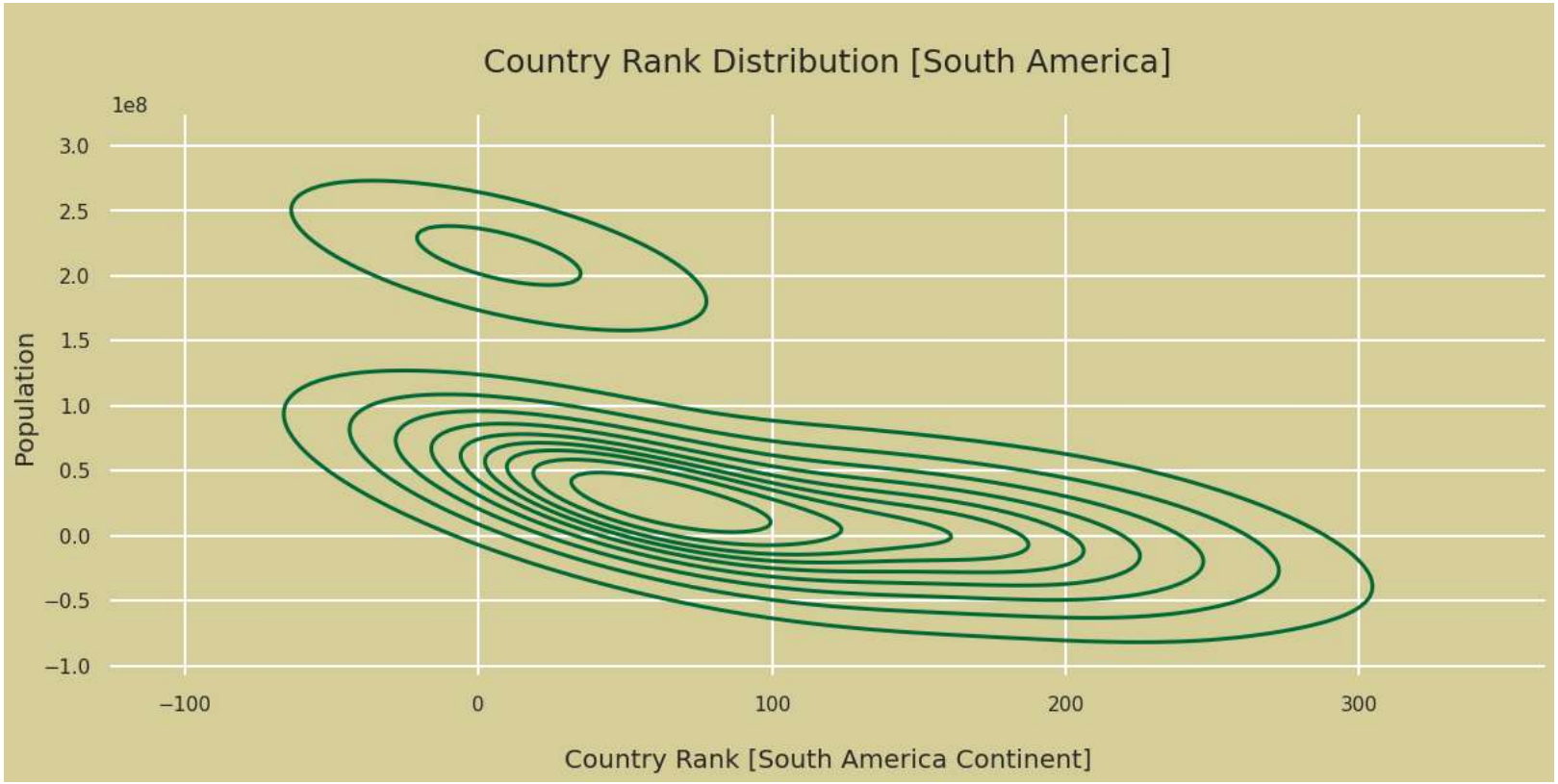


Insights:

- Most countries rank in North America fall in between 170 to 230 and others are scattered.

In [39]:
```
print("Let's have a look on the distribution of south american country rank :")
rank("South America",palette[0])
```

```
Let's have a look on the distribution of south american country rank :
```

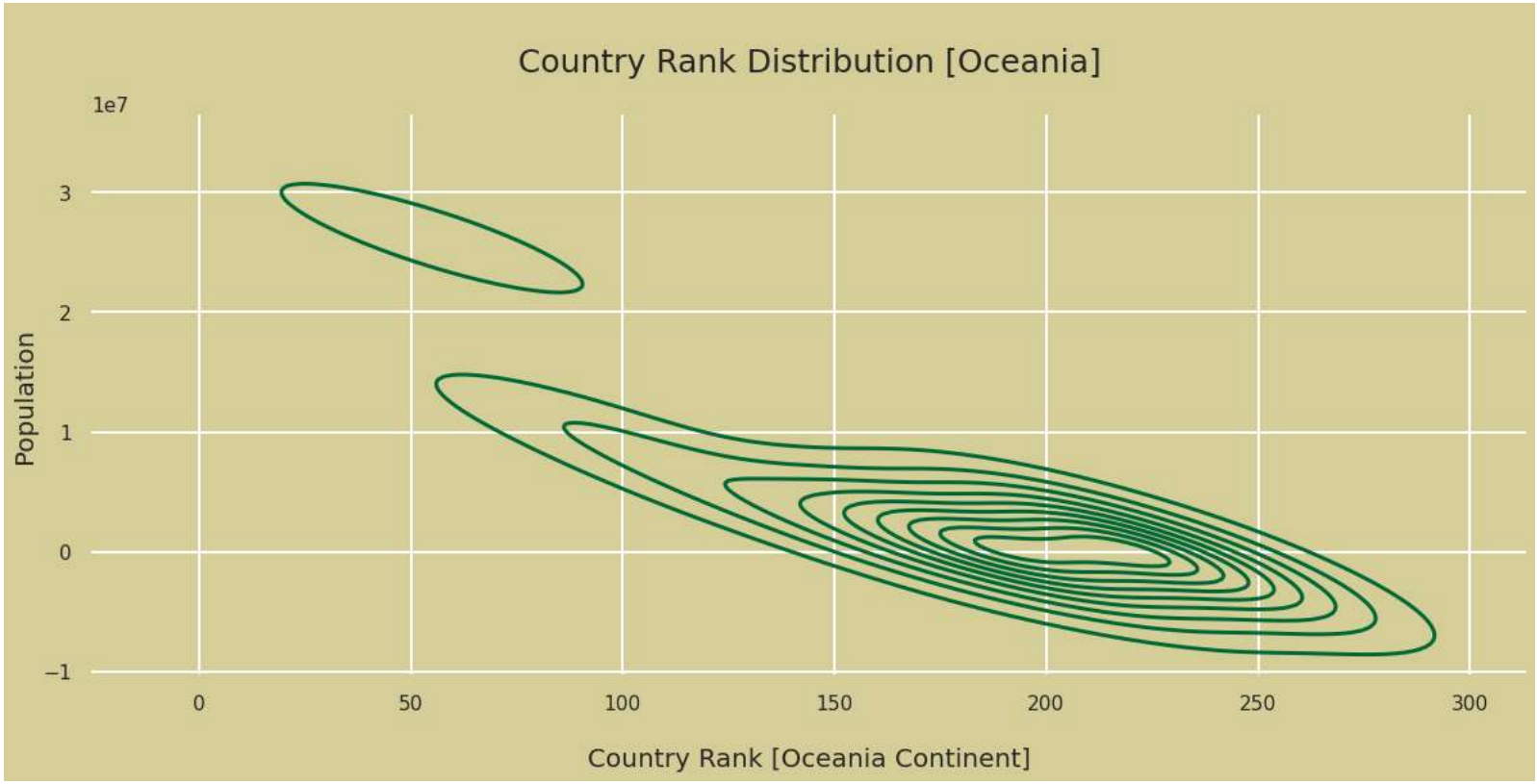


Insights:

- Most countries rank in South America fall in between 20 to 110 and others are scattered.

In [40]:
```
print("Let's have a look on the distribution of oceanian country rank :")
rank("Oceania",palette[0])
```

```
Let's have a look on the distribution of oceanian country rank :
```

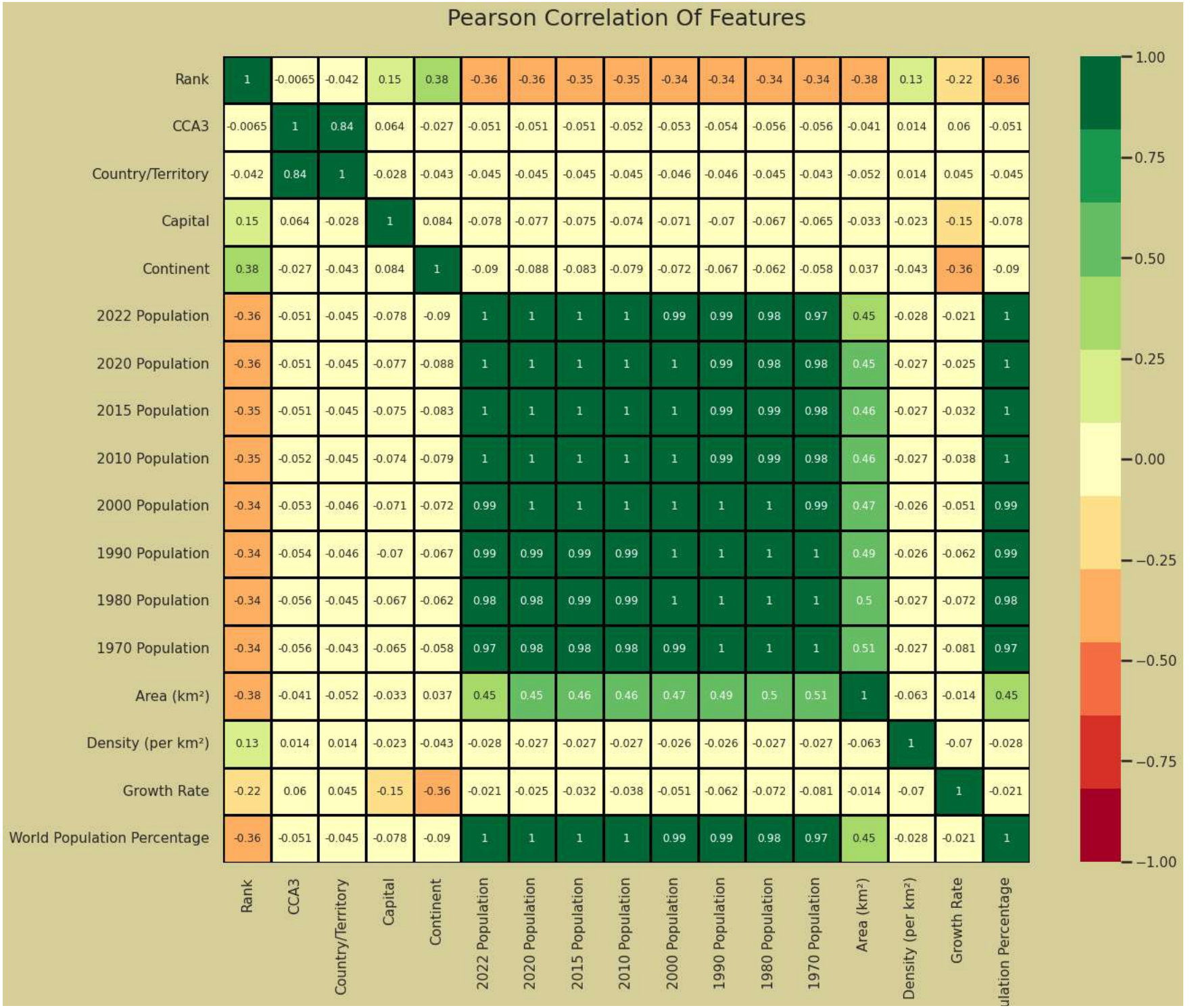


Insights:

- Most countries rank in Oceania fall in between 180 to 230 and others are scattered.

Correlation Map

In [41]:
```
catcol = ["CCA3","Country/Territory","Capital","Continent"]
le = LabelEncoder()
for col in catcol:
        data[col] = le.fit_transform(data[col])


plt.subplots(figsize =(20, 20))

sns.heatmap(data.corr(), cmap = palette_cmap, square=True, cbar_kws=dict(shrink =.82),
            annot=True, vmin=-1, vmax=1, linewidths=3,linecolor='black',annot_kws=dict(fontsize =12))
plt.title("Pearson Correlation Of Features\n", fontsize=25)
plt.xticks(rotation=90)
plt.show()
```


Pearson Correlation Of Features
Rank 1 -0.0065 -0.042 0.15 0.38 -0.36 -0.36 -0.35 -0.35 -0.34 -0.34 -0.34 -0.34 -0.38 0.13 -0.22 -0.36
CCA3 -0.0065 1 0.84 0.064 -0.027 -0.051 -0.051 -0.051 -0.052 -0.053 -0.054 -0.056 -0.056 -0.041 0.014 0.06 -0.051
Country/Territory -0.042 0.84 1 -0.028 -0.043 -0.045 -0.045 -0.045 -0.045 -0.046 -0.046 -0.045 -0.043 -0.052 0.014 0.045 -0.045
Capital 0.15 0.064 -0.028 1 0.084 -0.078 -0.077 -0.075 -0.074 -0.071 -0.07 -0.067 -0.065 -0.033 -0.023 -0.15 -0.078
Continent 0.38 -0.027 -0.043 0.084 1 -0.09 -0.088 -0.083 -0.079 -0.072 -0.067 -0.062 -0.058 0.037 -0.043 -0.36 -0.09
2022 Population -0.36 -0.051 -0.045 -0.078 -0.09 1 1 1 1 0.99 0.99 0.98 0.97 0.45 -0.028 -0.021 1
2020 Population -0.36 -0.051 -0.045 -0.077 -0.088 1 1 1 1 1 0.99 0.98 0.98 0.45 -0.027 -0.025 1
2015 Population -0.35 -0.051 -0.045 -0.075 -0.083 1 1 1 1 1 0.99 0.99 0.98 0.46 -0.027 -0.032 1
2010 Population -0.35 -0.052 -0.045 -0.074 -0.079 1 1 1 1 1 0.99 0.99 0.98 0.46 -0.027 -0.038 1
2000 Population -0.34 -0.053 -0.046 -0.071 -0.072 0.99 1 1 1 1 1 1 0.99 0.47 -0.026 -0.051 0.99
1990 Population -0.34 -0.054 -0.046 -0.07 -0.067 0.99 0.99 0.99 0.99 1 1 1 1 0.49 -0.026 -0.062 0.99
1980 Population -0.34 -0.056 -0.045 -0.067 -0.062 0.98 0.98 0.99 0.99 1 1 1 1 0.5 -0.027 -0.072 0.98
1970 Population -0.34 -0.056 -0.043 -0.065 -0.058 0.97 0.98 0.98 0.98 0.99 1 1 1 0.51 -0.027 -0.081 0.97
Area (km²) -0.38 -0.041 -0.052 -0.033 0.037 0.45 0.45 0.46 0.46 0.47 0.49 0.5 0.51 1 -0.063 -0.014 0.45
Density (per km²) 0.13 0.014 0.014 -0.023 -0.043 -0.028 -0.027 -0.027 -0.027 -0.026 -0.026 -0.027 -0.027 -0.063 1 -0.07 -0.028
Growth Rate -0.22 0.06 0.045 -0.15 -0.36 -0.021 -0.025 -0.032 -0.038 -0.051 -0.062 -0.072 -0.081 -0.014 -0.07 1 -0.021
World Population Percentage -0.36 -0.051 -0.045 -0.078 -0.09 1 1 1 1 0.99 0.99 0.98 0.97 0.45 -0.028 -0.021 1
Rank
CCA3
Country/Territory
Capital
Continent
2022 Population
2020 Population
2015 Population
2010 Population
2000 Population
1990 Population
1980 Population
1970 Population
Area (km²)
Density (per km²)
Growth Rate
ulation Percentage
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00

Insights:

There is a high correlation between population and the world population percentage. There is also a high correlation between the country and its CCA3 code, as expected.

A medium correlation exists between area and population, as well as between area and the world population percentage.

A medium inverse correlation can be observed between growth rate and continent, rank and the world population percentage, rank and area, and rank and population.