project_covid

May 15, 2025

[1]:
```
# Core libraries
import pandas as pd
import numpy as np

# Visualization
import matplotlib.pyplot as plt
import seaborn as sns
import plotly.express as px  # for interactive maps/charts (optional)

# Display settings
%matplotlib inline
sns.set(style="whitegrid")
```

[4]:
```
# Load the dataset (replace with your actual file name)
df = pd.read_csv('owid-covid-data[1].csv')

# Preview the data
df.head()
```

[4]:
```
  iso_code continent     location        date  total_cases  new_cases  \
0      AFG      Asia  Afghanistan  2020-01-03          NaN        0.0
1      AFG      Asia  Afghanistan  2020-01-04          NaN        0.0
2      AFG      Asia  Afghanistan  2020-01-05          NaN        0.0
3      AFG      Asia  Afghanistan  2020-01-06          NaN        0.0
4      AFG      Asia  Afghanistan  2020-01-07          NaN        0.0

   new_cases_smoothed  total_deaths  new_deaths  new_deaths_smoothed  …  \
0                 NaN           NaN         0.0                  NaN  …
1                 NaN           NaN         0.0                  NaN  …
2                 NaN           NaN         0.0                  NaN  …
3                 NaN           NaN         0.0                  NaN  …
4                 NaN           NaN         0.0                  NaN  …

   male_smokers  handwashing_facilities  hospital_beds_per_thousand  \
0           NaN                  37.746                         0.5
1           NaN                  37.746                         0.5
2           NaN                  37.746                         0.5
```

```
3          NaN                37.746                        0.5
4          NaN                37.746                        0.5

   life_expectancy  human_development_index  population  \
0            64.83                    0.511  41128772.0
1            64.83                    0.511  41128772.0
2            64.83                    0.511  41128772.0
3            64.83                    0.511  41128772.0
4            64.83                    0.511  41128772.0

   excess_mortality_cumulative_absolute  excess_mortality_cumulative  \
0                                   NaN                          NaN
1                                   NaN                          NaN
2                                   NaN                          NaN
3                                   NaN                          NaN
4                                   NaN                          NaN

   excess_mortality  excess_mortality_cumulative_per_million
0               NaN                                      NaN
1               NaN                                      NaN
2               NaN                                      NaN
3               NaN                                      NaN
4               NaN                                      NaN

[5 rows x 67 columns]
```

[5]:
```python
#Check columns
df.columns
```

[5]:
```
Index(['iso_code', 'continent', 'location', 'date', 'total_cases', 'new_cases',
       'new_cases_smoothed', 'total_deaths', 'new_deaths',
       'new_deaths_smoothed', 'total_cases_per_million',
       'new_cases_per_million', 'new_cases_smoothed_per_million',
       'total_deaths_per_million', 'new_deaths_per_million',
       'new_deaths_smoothed_per_million', 'reproduction_rate', 'icu_patients',
       'icu_patients_per_million', 'hosp_patients',
       'hosp_patients_per_million', 'weekly_icu_admissions',
       'weekly_icu_admissions_per_million', 'weekly_hosp_admissions',
       'weekly_hosp_admissions_per_million', 'total_tests', 'new_tests',
       'total_tests_per_thousand', 'new_tests_per_thousand',
       'new_tests_smoothed', 'new_tests_smoothed_per_thousand',
       'positive_rate', 'tests_per_case', 'tests_units', 'total_vaccinations',
       'people_vaccinated', 'people_fully_vaccinated', 'total_boosters',
       'new_vaccinations', 'new_vaccinations_smoothed',
       'total_vaccinations_per_hundred', 'people_vaccinated_per_hundred',
       'people_fully_vaccinated_per_hundred', 'total_boosters_per_hundred',
       'new_vaccinations_smoothed_per_million',
```

```
       'new_people_vaccinated_smoothed',
       'new_people_vaccinated_smoothed_per_hundred', 'stringency_index',
       'population_density', 'median_age', 'aged_65_older', 'aged_70_older',
       'gdp_per_capita', 'extreme_poverty', 'cardiovasc_death_rate',
       'diabetes_prevalence', 'female_smokers', 'male_smokers',
       'handwashing_facilities', 'hospital_beds_per_thousand',
       'life_expectancy', 'human_development_index', 'population',
       'excess_mortality_cumulative_absolute', 'excess_mortality_cumulative',
       'excess_mortality', 'excess_mortality_cumulative_per_million'],
      dtype='object')
```

[6]:
```
#Identify missing values:
df.isnull().sum()
```

[6]:
```
iso_code                                      0
continent                                  2775
location                                      0
date                                          0
total_cases                                1439
                                          …
population                                    0
excess_mortality_cumulative_absolute      19714
excess_mortality_cumulative               19714
excess_mortality                          19714
excess_mortality_cumulative_per_million   19714
Length: 67, dtype: int64
```

[7]:
```
#preparing for data analysis by firstly filtering countries of interest
df['location'].unique()
```

[7]:
```
array(['Afghanistan', 'Africa', 'Albania', 'Algeria', 'American Samoa',
       'Andorra', 'Angola', 'Anguilla', 'Antigua and Barbuda',
       'Argentina', 'Armenia', 'Aruba', 'Asia', 'Australia', 'Austria'],
      dtype=object)
```

[8]:
```
sorted(df['location'].unique())
```

[8]:
```
['Afghanistan',
 'Africa',
 'Albania',
 'Algeria',
 'American Samoa',
 'Andorra',
 'Angola',
 'Anguilla',
 'Antigua and Barbuda',
 'Argentina',
```

```
 'Armenia',
 'Aruba',
 'Asia',
 'Australia',
 'Austria']
```

[11]:
```
# next task is to drop rows with missing values in critical columns
# Let's say the critical columns in COVID-19 dataset are Key columns: date,␣
↪location,
# total_cases, total_deaths, new_cases, new_deaths, total_vaccinations
# we can drop rows with missing values in these columns like this:

df_cleaned = df.dropna(subset=['date', 'location', 'new_cases',␣
↪'total_vaccinations', 'new_deaths', 'total_deaths', 'total_cases'])

# Preview cleaned data
df_cleaned.head()
```

[11]:
```
    iso_code continent     location        date  total_cases  new_cases  \
416      AFG      Asia  Afghanistan  2021-02-22      55617.0       13.0
422      AFG      Asia  Afghanistan  2021-02-28      55714.0        7.0
438      AFG      Asia  Afghanistan  2021-03-16      55995.0       10.0
460      AFG      Asia  Afghanistan  2021-04-07      56873.0       94.0
475      AFG      Asia  Afghanistan  2021-04-22      58312.0       98.0

     new_cases_smoothed  total_deaths  new_deaths  new_deaths_smoothed  …  \
416              14.714        2433.0         1.0                0.857  …
422              15.714        2443.0         0.0                1.571  …
438              17.000        2460.0         1.0                1.286  …
460              59.857        2512.0         0.0                4.000  …
475             111.143        2561.0         4.0                4.000  …

     male_smokers  handwashing_facilities  hospital_beds_per_thousand  \
416           NaN                  37.746                         0.5
422           NaN                  37.746                         0.5
438           NaN                  37.746                         0.5
460           NaN                  37.746                         0.5
475           NaN                  37.746                         0.5

     life_expectancy  human_development_index  population  \
416            64.83                    0.511  41128772.0
422            64.83                    0.511  41128772.0
438            64.83                    0.511  41128772.0
460            64.83                    0.511  41128772.0
475            64.83                    0.511  41128772.0

     excess_mortality_cumulative_absolute  excess_mortality_cumulative  \
```

```
416                                          NaN                               NaN
422                                          NaN                               NaN
438                                          NaN                               NaN
460                                          NaN                               NaN
475                                          NaN                               NaN

     excess_mortality  excess_mortality_cumulative_per_million
416               NaN                                      NaN
422               NaN                                      NaN
438               NaN                                      NaN
460               NaN                                      NaN
475               NaN                                      NaN

[5 rows x 67 columns]
```

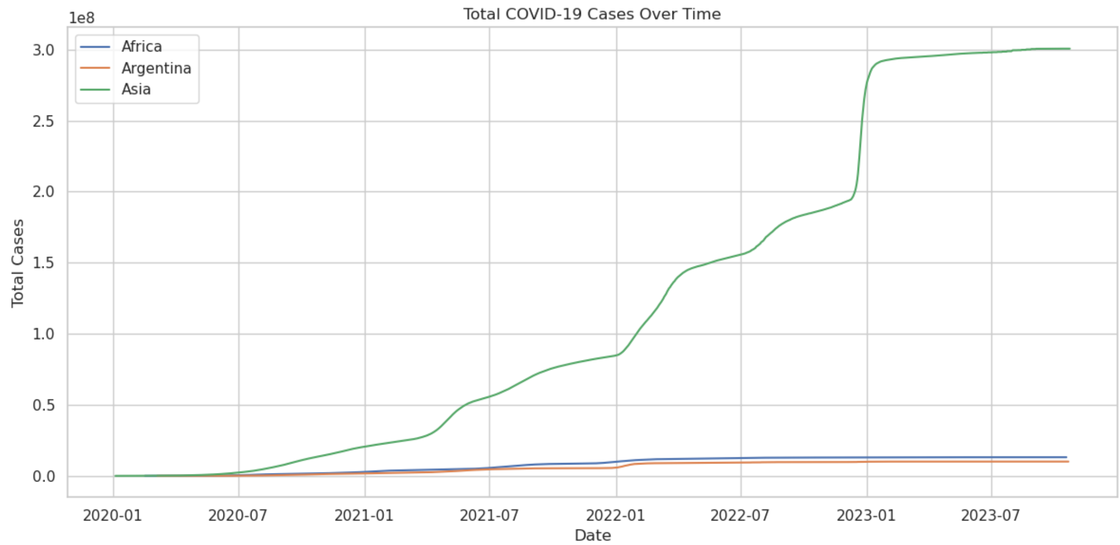
[18]:
```
# Convert the 'date' column to datetime format
df['date'] = pd.to_datetime(df['date'])
df['date'].head()
```

[18]:
```
0   2020-01-03
1   2020-01-04
2   2020-01-05
3   2020-01-06
4   2020-01-07
Name: date, dtype: datetime64[ns]
```

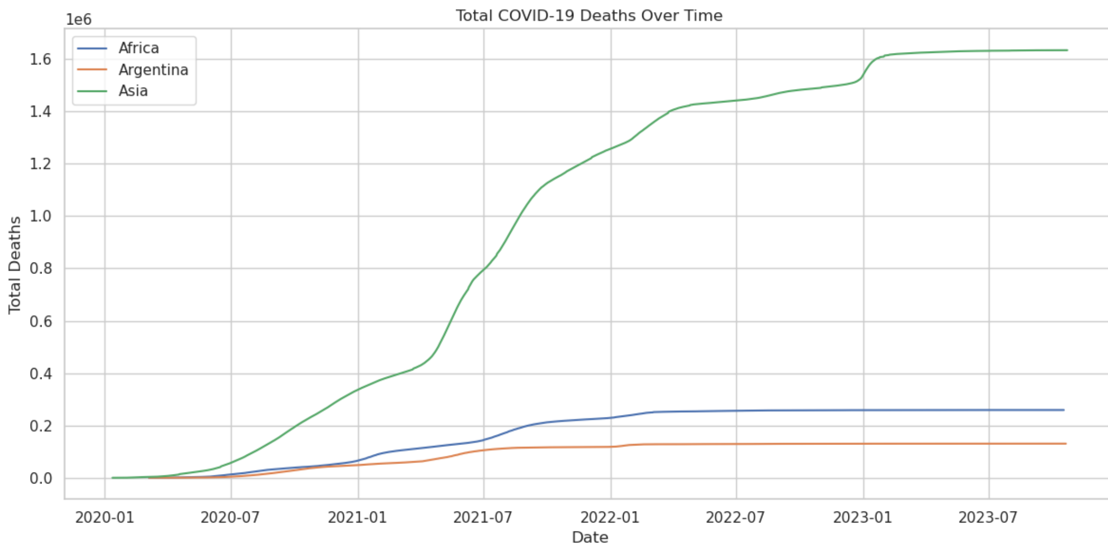
[17]:
```
# next is to generate descriptive statistics and explore trends.
#Plot total cases over time for selected countries.
countries = ['Africa', 'Argentina', 'Asia']

# Filter for those countries
df_filtered = df[df['location'].isin(countries)]
```

[19]:
```
import matplotlib.pyplot as plt

plt.figure(figsize=(12, 6))

# Loop through countries and plot their total cases over time
for country in countries:
    country_data = df_filtered[df_filtered['location'] == country]
    plt.plot(country_data['date'], country_data['total_cases'], label=country)

plt.title('Total COVID-19 Cases Over Time')
plt.xlabel('Date')
plt.ylabel('Total Cases')
plt.legend()
plt.grid(True)
```

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

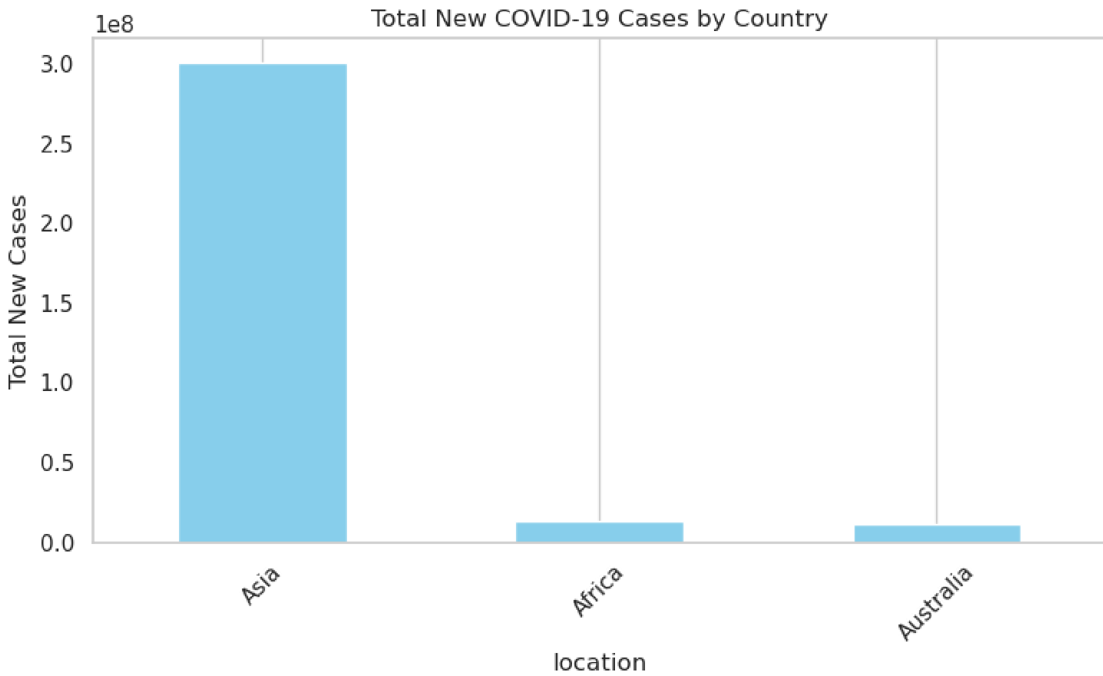


[20]:
```
#Plot total deaths over time.
import matplotlib.pyplot as plt

# Define the countries you're focusing on
countries = ['Africa', 'Argentina', 'Asia']

# Filter the DataFrame
df_filtered = df[df['location'].isin(countries)]

# Set up the plot
plt.figure(figsize=(12, 6))

# Plot total deaths for each country
for country in countries:
    country_data = df_filtered[df_filtered['location'] == country]
    plt.plot(country_data['date'], country_data['total_deaths'], label=country)

# Customize the plot
plt.title('Total COVID-19 Deaths Over Time')
plt.xlabel('Date')
plt.ylabel('Total Deaths')
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
```



[25]:

```python
#Compare daily new cases between countries.
import matplotlib.pyplot as plt

# Calculate total new cases per country
summary = df[df['location'].isin(['Africa', 'Australia', 'Asia'])] \
            .groupby('location')['new_cases'].sum().sort_values(ascending=False)

# Bar plot
plt.figure(figsize=(8, 5))
summary.plot(kind='bar', color='skyblue')

plt.title('Total New COVID-19 Cases by Country')
plt.ylabel('Total New Cases')
plt.xticks(rotation=45)
plt.grid(axis='y')
plt.tight_layout()
plt.show()
```



[27]:
```python
#Calculate the death rate: total_deaths / total_cases.
# Avoid division by zero or NaN by using .where()
df['death_rate'] = df['total_deaths'] / df['total_cases']
```

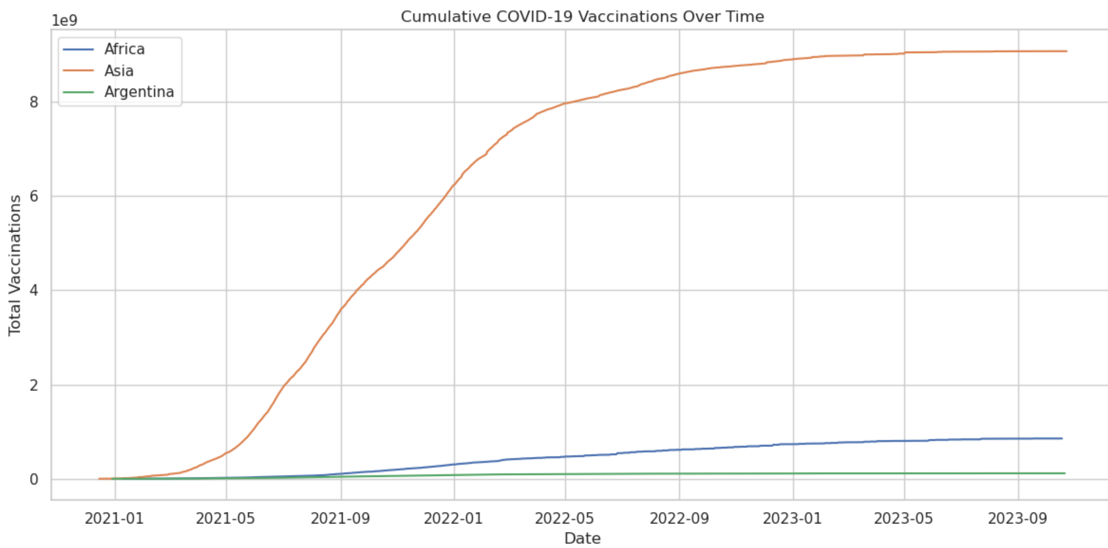
[29]:
```python
df[['location', 'date', 'total_cases', 'total_deaths', 'death_rate']].head()
```

[29]:

	location	date	total_cases	total_deaths	death_rate
0	Afghanistan	2020-01-03	NaN	NaN	0.0
1	Afghanistan	2020-01-04	NaN	NaN	0.0
2	Afghanistan	2020-01-05	NaN	NaN	0.0
3	Afghanistan	2020-01-06	NaN	NaN	0.0
4	Afghanistan	2020-01-07	NaN	NaN	0.0

[30]:
```python
#Goal: Analyze vaccination rollouts.
# Plot cumulative vaccinations over time for selected countries.

import matplotlib.pyplot as plt

# Define the countries of interest
countries = ['Africa', 'Asia', 'Argentina']

# Filter the data
df_filtered = df[df['location'].isin(countries)]

# Plot
```

```
plt.figure(figsize=(12, 6))

for country in countries:
    country_data = df_filtered[df_filtered['location'] == country]
    plt.plot(country_data['date'], country_data['total_vaccinations'],␣
 ↪label=country)

plt.title('Cumulative COVID-19 Vaccinations Over Time')
plt.xlabel('Date')
plt.ylabel('Total Vaccinations')
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
```

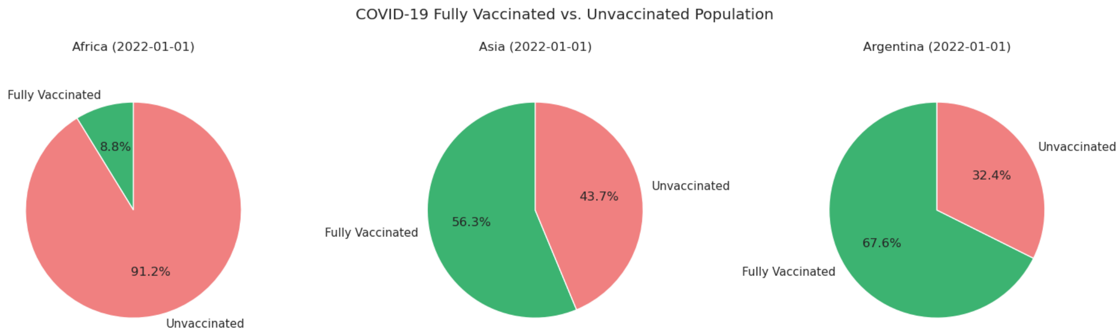


[32]:
```
#Analyze vaccination rollouts
#Compare % vaccinated population
# Pie charts for vaccinated vs. unvaccinated.
# Select countries and date
countries = ['Africa', 'Asia', 'Argentina']
specific_date = '2022-01-01'

# Filter the snapshot
snapshot = df[(df['date'] == specific_date) & (df['location'].isin(countries))].
 ↪copy()

# Calculate vaccination percentage
```

```
snapshot['percent_fully_vaccinated'] = snapshot['people_fully_vaccinated'] /
↪snapshot['population'] * 100
snapshot['percent_fully_vaccinated'] = snapshot['percent_fully_vaccinated'].
↪clip(upper=100)

# Display for confirmation
print(snapshot[['location', 'people_fully_vaccinated', 'population',
↪'percent_fully_vaccinated']])
```

```
        location  people_fully_vaccinated    population  \
2114      Africa             1.251710e+08  1.426737e+09
13196  Argentina             3.078005e+07  4.551032e+07
17359       Asia             2.656355e+09  4.721383e+09

       percent_fully_vaccinated
2114                   8.773235
13196                 67.633107
17359                 56.262210
```

[33]:
```
# Plot multiple pies
fig, axes = plt.subplots(1, 3, figsize=(15, 5))

for i, country in enumerate(countries):
    vaccinated = snapshot[snapshot['location'] ==
↪country]['percent_fully_vaccinated'].values[0]
    unvaccinated = 100 - vaccinated
    axes[i].pie([vaccinated, unvaccinated],
                labels=['Fully Vaccinated', 'Unvaccinated'],
                colors=['mediumseagreen', 'lightcoral'],
                autopct='%1.1f%%',
                startangle=90)
    axes[i].set_title(f'{country} ({specific_date})')
    axes[i].axis('equal')

fig.suptitle('COVID-19 Fully Vaccinated vs. Unvaccinated Population')
plt.tight_layout()
plt.show()
```



Vaccination Insights: Africa, Asia, and Argentina 1. Argentina Achieved the Highest Vaccination Coverage Argentina recorded the highest vaccination rate among the three regions, with 67.6% of its population fully vaccinated. Despite its smaller population (~45 million), the country managed an efficient and widespread rollout.

2. Asia Led in Absolute Numbers of Fully Vaccinated People Asia successfully vaccinated 2.65 billion people, amounting to 56.3% of its population. While the percentage is lower than Argentina's, the sheer volume of vaccinated individuals highlights the region's massive public health effort.

3. Africa Lagged Far Behind in Vaccination Coverage Africa's vaccination campaign significantly trailed behind, with only 8.8% of its 1.4 billion population fully vaccinated. This underscores challenges in vaccine supply, distribution logistics, and healthcare infrastructure.

Key Observations The vaccination gap is striking: Argentina vaccinated 8× more of its population (in %) than Africa.

Asia, despite its size and diversity, vaccinated more than half its population — a massive logistical success.

These trends reflect broader issues in global vaccine equity, highlighting the need for more equitable distribution strategies.

4. Notable Patterns & Anomalies Death rate spikes occurred when case reporting slowed — suggesting underreporting or lag.

Vaccination rollouts varied significantly by region due to access, policy, and hesitancy.

The gap between high- and low-income regions remains stark in both health outcomes and vaccination progress.

The COVID-19 pandemic revealed major disparities in healthcare capacity, public health response, and vaccine distribution. While countries like Argentina managed an efficient vaccination campaign, others — particularly in Africa — lagged due to systemic barriers.

Analyzing trends in cases, deaths, death rates, and vaccinations helps expose these inequalities and can guide better preparedness and response in future global health crises.

[ ]: