Programming Project:
COVID-19 Vaccinations

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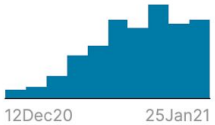
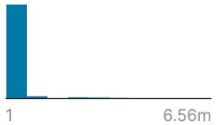
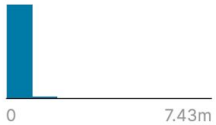
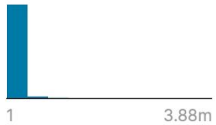
Problems Addressed

1. **Which countries are projected to reach herd immunity from COVID-19 earliest as a result of vaccinating their populations?**
    - *Herd immunity*: about *80%* of a general population of individuals over the age of 16 have been vaccinated
    - Gathered data on individual country populations focusing on age & vaccination distributions across the countries
2. **Which countries are efficiently distributing COVID-19 vaccinations to their populations and which are not?**
    - Based on the number of *days* & the number of *weeks* it will take a country to vaccinate *80%* & *100%* of its population at the current rate of vaccine distribution in that country

Datasets Used

- **COVID Vaccination Dataset - 2021 (Kaggle)**
  - **Important columns:**
    - location: 90 countries, from Albania through Wales
    - date: from December 12th, 2020 through January 25th, 2021
    - total_vaccinations, people_fully_vaccinated, daily_vaccinations, people_fully_vaccinated_per_hundred, etc.
- **COVID-19 Worldometer Dataset (Kaggle)**
  - **Important columns:**
    - Country
    - Total Cases, New Cases
    - Total Deaths, New Deaths
    - Total Recovered, Active Cases, etc.
- **Combined the .csv files in Excel & in Python**

COVID Vaccination Dataset

location	iso_code	date	total_vaccinations	people_vaccinated	people_fully_vacci...	daily_vaccinations...	daily_vaccinations
Canada 3% Northern Ireland 3% Other (1574) 95%	[null] 13% CAN 3% Other (1409) 85%	 12Dec20 25Jan21	 0 71.1m	 0 64.4m	 1 6.56m	 0 7.43m	 1 3.88m
Northern Ireland		2020-12-13	3623	3623			
Scotland		2020-12-13	18858	18858			
Wales		2020-12-13	8181	8181			
Canada	CAN	2020-12-14	297	297			
Northern Ireland		2020-12-14					1778
Scotland		2020-12-14					5821
Wales		2020-12-14					2198
World	OWID_WRL	2020-12-14	297	297			
Canada	CAN	2020-12-15	1163	1163		866	866
China	CHN	2020-12-15	1500000	1500000			
Northern Ireland		2020-12-15					1778
Russia	RUS	2020-12-15	28500	28500			

Worldometer Dataset

Country	Total Cases	New Cases	Total Deaths	New Deaths	Total Recovered	Active Cases
List of countries affected by covid-19	Cumulative number of confirmed cases till date	New confirmed cases each day	Cumulative number of deaths till date	New death cases each day	Cumulative number of recovered cases till date	Cumulative number of recovered cases till date
212 unique values	 1 503k	 1 33.8k	 1 18.8k	 1 2.04k	 1 77.5k	 0 457k
USA	5,02,876	33,752	18,747	2,035	27,314	4,56,815
Spain	1,58,273	5,051	16,081	634	55,668	86,524
Italy	1,47,577	3,951	18,849	570	30,455	98,273
France	1,24,869	7,120	13,197	987	24,932	86,740
Germany	1,22,171	3,936	2,736	129	53,913	65,522
China	81,907	42	3,336	1	77,455	1,116
UK	73,758	8,681	8,958	980	344	64,456
Iran	68,192	1,972	4,232	122	35,465	28,495
Turkey	47,029	4,747	1,006	98	2,423	43,600

Python Packages Used for Analysis

1. **Pandas**
   - Provides easy-to-use data structures & tools to analyze & filter through data
   - Key functionality offered: data visualization, cleaning, accessibility, etc.
2. **NumPy**
   - Enables numerical computing within Python
   - Key functionality: mathematical operations, sorting, selecting, basic linear algebra, basic statistical operations, random simulation, etc.
3. **Matplotlib**
   - Provides tools for creating static, animated, & interactive visualizations in Python
4. **Scikit-Learn**
   - Provides simple & efficient tools for predictive data analysis
   - Built on NumPy, SciPy, & matplotlib

Code: Part 1

- Imports **pandas** package for data analysis
- **Reads** the .csv file
- **Displays** dataframe to user
- Converts **date** column into format Python can recognize using **.to_datetime()** function
- Makes it easier to get **most recent** vaccination data for each country

```
import pandas as pd
vaccineData = pd.read_csv('country_vaccinations.csv')
```

```
vaccineData
```

	country	iso_code	date	total_vaccinations	people_vaccinated	people_fully_vaccinated	daily_vaccinations_raw	daily_vaccinations
0	Albania	ALB	1/10/2021	0	0	0	0	0
1	Albania	ALB	1/11/2021	0	0	0	0	64
2	Albania	ALB	1/12/2021	128	128	0	0	64
3	Albania	ALB	1/13/2021	188	188	0	60	63
4	Albania	ALB	1/14/2021	266	266	0	78	66

```
vaccineData['date'] = pd.to_datetime(vaccineData['date'])
vaccineData
```

	country	iso_code	date	total_vaccinations	people_vaccinated	people_fully_vaccinated
0	Albania	ALB	2021-01-10	0	0	0
1	Albania	ALB	2021-01-11	0	0	0
2	Albania	ALB	2021-01-12	128	128	0
3	Albania	ALB	2021-01-13	188	188	0
4	Albania	ALB	2021-01-14	266	266	0
...	...	...	...	...	...	...
3203	Wales	NaN	2021-02-10	687892	684097	3795

Code: Part 1

- Creates dataframe (groupedData) with only most recent data for each country
  - **.groupby() function:** groups data by country
  - **.idxmax() function:** gets most recent date from the data
  - **.loc() function:** gets 1 row of data with most recent date for each country
- Uses groupedData to create final data frame to **project future COVID-19 vaccinations**
  - Puts data used in calculations into **lists** (people fully vaccinated, daily vaccinations, population by country)
  - Determines how many people in each country are left to be vaccinated by using a **for loop** to subtract people vaccinated from total population of each country; appends to list

```
groupedData =vaccineData.loc[vaccineData.groupby(["country"])["date"].idxmax()]
groupedData
```

	country	iso_code	date	total_vaccinations	people_vaccinated	people_fully_vaccinated	daily_vaccinations_raw
30	Albania	ALB	2021-02-09	1127	689	438	0
32	Algeria	DZA	2021-01-30	30	0	0	30
49	Andorra	AND	2021-02-10	1291	1291	0	0
59	Anguilla	AIA	2021-02-13	1341	1341	0	0
108	Argentina	ARG	2021-02-15	609791	372181	237610	186
...	...	...	...	...	...	...	...

```
finalData = groupedData[['country','date','people_fully_vaccinated','daily_vaccinations','population']].copy()
```

```
peopleVacc= finalData['people_fully_vaccinated'].tolist()
dailyVacc = finalData['daily_vaccinations'].tolist()
pop = finalData['population'].tolist()
```

```
leftToVacc=[]
for i in range(len(pop)):
    leftToVacc.append((pop[i]-peopleVacc[i]))
leftToVacc
```

```
[2877032.0,
 43926079.0,
 77278.0,
 32956300.0,
 44999274.0,
```

Code: Part 1

- Calculates # of days until each country reaches **80%** vaccination **(herd immunity)**:
  - Calculates 80% of population left to vaccinate in each country, appends to list
  - Loops through list & calculates # of days it would take for 80% of the population to be vaccinated, appends to new list
  - Checks to see if the country has started daily vaccinations to avoid errors from dividing by zero
- Similar calculation to determine # of days until each country reaches **100%** vaccination

```
daysTo80PercentVac=[]
pop80Percent=[]
for i in range(len(pop)):
    pop80Percent.append(round(((leftToVacc[i])*.8),0))
for i in range(len(pop80Percent)):
    if dailyVacc[i]==0.0:
        daysTo80PercentVac.append(0.0)
    else:
        daysTo80PercentVac.append(round((pop80Percent[i]/dailyVacc[i]),0))
```

```
[28069.0,
 1171362.0,
 2208.0,
 176947.0,
 2566.0,
```

```
daysTillFullVacc=[]
for i in range(len(pop)):
    if dailyVacc[i]==0.0:
        daysTillFullVacc.append(0.0)
    else:
        daysTillFullVacc.append(round((leftToVacc[i]/dailyVacc[i]),0))
daysTillFullVacc
```

```
[35086.0,
 1464203.0,
 2760.0,
 221183.0,
 3207.0,
```

Code: Part 1

- Calculates # of **weeks** until each country reaches **100%** vaccination & **80%** vaccination
  - Loops through lists
  - Divides # of days left by 7
  - Adds results to new list
- Adds created lists to **dataframe** so all data & projections are in 1 place
- **Saves** final dataframe as a **.csv file** for easier data analysis & visualization

```
weeksTillFullVacc=[]
weeksTill80PercentVacc=[]
for i in range(len(pop)):
    weeksTillFullVacc.append(round(((daysTillFullVacc[i])/7),2))
    weeksTill80PercentVacc.append(round(((daysTo80PercentVac[i])/7),2))
```

```
finalData["people left to vaccinate"]=leftToVacc
finalData["days till full vaccination"]= daysTillFullVacc
finalData["weeks till full vacccination"]= weeksTillFullVacc
finalData["Days till 80 percent vaccination"]= daysTo80PercentVac
finalData["weeks till 80 percent Vaccination"]= weeksTill80PercentVacc
finalData
```

	country	date	people_fully_vaccinated	daily_vaccinations	population	people left to vaccinate	days till full vaccination	Days till 80 percent vaccination	weeks till full vacccination	weeks till 80 percent Vaccination
30	Albania	2021-02-09	438	82	2877470.0	2877032.0	35086.0	28069.0	5012.29	4009.86
32	Algeria	2021-01-30	0	30	43926079.0	43926079.0	1464203.0	1171362.0	209171.86	167337.43
49	Andorra	2021-02-10	0	28	77278.0	77278.0	2760.0	2208.0	394.29	315.43
59	Anguilla	2021-02-13	0	149	32956300.0	32956300.0	221183.0	176947.0	31597.57	25278.14
108	Argentina	2021-02-15	237610	14030	45236884.0	44999274.0	3207.0	2566.0	458.14	366.57
...	...	...	...	...	...	...	...	...	...	...
2980	Turks and Caicos Islands	2021-02-08	0	222	38768.0	38768.0	175.0	140.0	25.00	20.00
3022	United Arab Emirates	2021-02-15	0	96169	43705858.0	43705858.0	454.0	364.0	64.86	52.00
3086	United Kingdom	2021-02-14	539630	433313	67922029.0	67382399.0	156.0	124.0	22.29	17.71
3143	United States	2021-02-14	14077440	1667631	331198130.0	317120690.0	190.0	152.0	27.14	21.71

90 rows × 10 columns

```
finalData.to_csv("GroupProjectData.csv")
```

Code: Part 2

- To determine the overall % of population that could be vaccinated per country based on the total vaccines available
    - Opens country vaccination & world cases/population datasets obtained from Kaggle in Jupyter Notebook
    - Creates **dataframes** for each file, renames columns, merges 2 files into 1 dataset, & fills in null values with 0
    - Converts file into a **dictionary** of dictionaries called “my_dict” so each column & data value are recorded as **keys & values** in a list with other data from that country

```
import pandas as pd
```

```
vaccination_file = pd.read_csv('country_vaccinations.csv')
```

```
vaccination_file
```

```
frame1 = pd.DataFrame(vaccination_file)
```

```
frame2 = pd.DataFrame(worldmeter)
```

```
frame1.columns
```

```
Index(['Country', 'Sum of total_vaccinations',
       'Sum of people_vaccinated_per_hundred'],
      dtype='object')
```

```
frame2.columns
```

```
Index(['country', ' Population', 'Sum of TotalCases', 'Sum of TotalDeaths',
       'Sum of ActiveCases'],
      dtype='object')
```

```
frame2 = frame2.rename(columns = {'country' : 'Country'})
```

```
frame2.columns
```

```
Index(['Country', ' Population', 'Sum of TotalCases', 'Sum of TotalDeaths',
       'Sum of ActiveCases'],
      dtype='object')
```

```
dataset = pd.merge(left = frame2, right = frame1, left_on='Country', right_on='Country')
```

```
my_dict = dataset.to_dict('records')
my_dict
```

Code: Part 2

- To determine the overall % of population that could be vaccinated per country based on total vaccines available
    - Uses **for loop** to determine data type for each key in dictionary using **if statements** that match keys with respective fields
    - Calculates % of population vaccinated:
        - ((total vaccines ⁄ 2) ⁄ population for each country) ✕ 100
    - Values added to dictionary called “percentage_country” with respective keys (countries)
    - Uses dataframe that displays output as a table with countries & corresponding percentages
    - Sorts % values in descending order by using **.sort_values()** function
      Uses **.head() & .tail()** functions to display top & bottom 10 results

```
percentage_country = {}

for i in my_dict:
    population = 0
    country = ''
    total_vaccines = 0
    percentage = 0
    for k, v in i.items():
        if(k == 'Country'):
            country = v
    for k, v in i.items():
        if(k == ' Population'):
            population = int(v)
    for k, v in i.items():
        if(k == 'Sum of total_vaccinations'):
            total_vaccines = int(v)
        percentage = ((total_vaccines/2)/population)*100

    percentage_country[country] = percentage
```

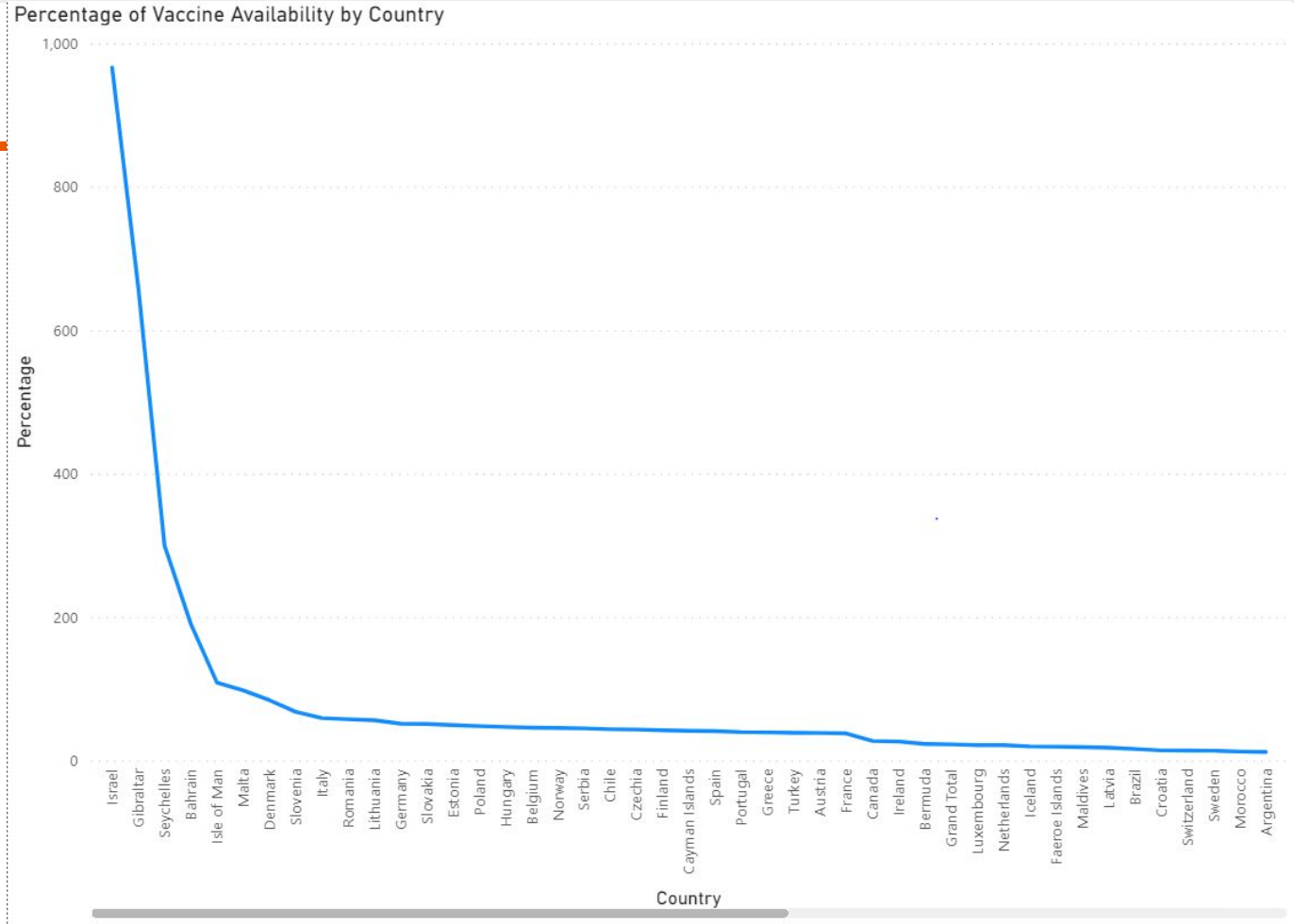
```
Result = df.sort_values(by= 'Percentage', ascending = False)
```

```
Result.head(10)
```

	Percentage
Israel	966.455653
Gibraltar	659.348471
Seychelles	299.679396
Bahrain	190.548226
Isle of Man	108.378782
Malta	97.631905
Denmark	84.043614
Slovenia	67.792554
Italy	59.111290
Romania	57.504259

```
Result.tail(10)
```

Data Visualizations



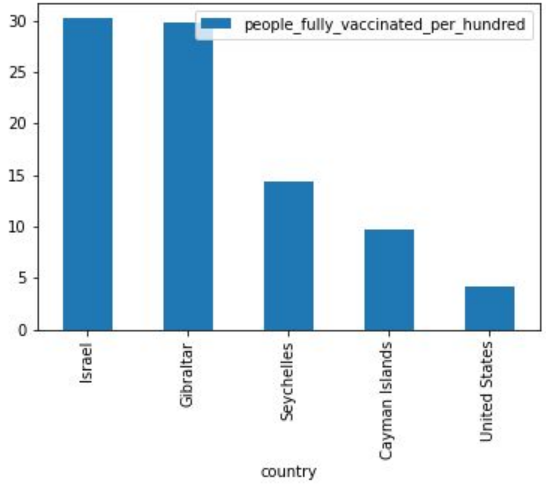
Code: Part 3

- Serves a similar function as the 1st & 2nd algorithms, but utilizes different Python packages
  - Imports packages to be utilized
    - **NumPy**, **pandas**, **matplotlib**, & **scikit-learn**
  - Reads dataset into Jupyter Notebook

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression
from sklearn import datasets

vaccination=pd.read_csv('country_vaccinations.csv')
```

Code: Part 3

- Uses the **pivot_table()** function to create a pivot table, determine countries with the **top 5 vaccination rates**
    - Outputs a **graph** & a list of the top 5 countries




```
The Countries with the Top 5 Vaccination Rates Are:
              people_fully_vaccinated_per_hundred
country
Israel                                      30.17
Gibraltar                                   29.84
Seychelles                                  14.42
Cayman Islands                               9.69
United States                                4.21
```

```
top5=vaccination.pivot_table(index=['country'],values=['people_fully_vaccinated_per_hundred'],aggfunc='max').nlargest(5,'people_fully_vaccinated_per_hundred')

top5.plot(kind='bar')
plt.show()

new_list=top5
print('The Countries with the Top 5 Vaccination Rates Are:')
print(new_list)
```

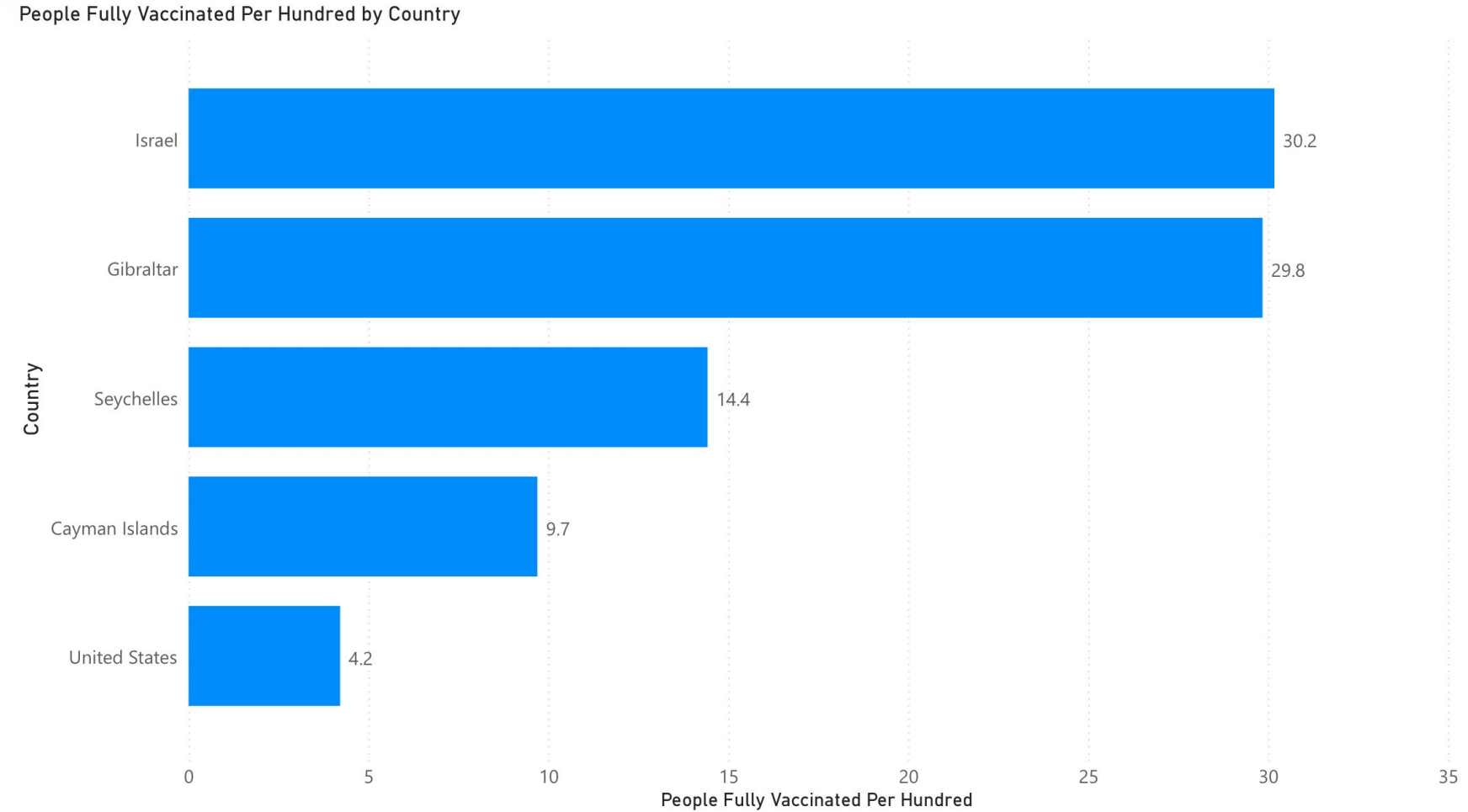
Code: Part 3

- Attempted to calculate when the U.S. would reach herd immunity of 70% by using daily vaccination updates and linear regressions functions from **Scikit-learn**

```
timeseries_df=vaccination[['country','date','people_fully_vaccinated_per_hundred']]

timeseries=timeseries_df[timeseries_df['country']=='United States'].copy()

#Convert date string to timedate format
series = timeseries

from datetime import datetime
con=series['date']
series['date']=pd.to_datetime(series['date'])
series.set_index('date',inplace=True)

#Copy new dataset to a separate file
series.to_csv('top5countries.csv')



#step3 - graph the US to see if there appears to be a pattern
vacdata=pd.read_csv('top5countries.csv')



vacdatamodel=vacdata['people_fully_vaccinated_per_hundred']
```

```
plt.plot(vacdatamodel)
#model_ts.plot(x='date',y='people_fully_vaccinated_per_hundred')
#plt.title('Number of fully vacinted per hundred per day')
#plt.xlabel('Date')
#plt.ylabel('%Fully Vaccinated')
plt.show()

#step4 - Perform linear regression with Scikit Learn

#separate training and testing data
X=vacdatamodel.values
y=vacdatamodel.values

from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=.3,random_state=0)

vacdatamodel=LinearRegression()
vacdatamodel.fit(X_train,y_train)
vacdatamodel.score(X_test,y_test)

print(vacdatamodel.intercept_)
print(vacdatamodel.coef_)

y_pred=vacdatamodel.predict(X_test)
```

Data Visualizations



Data Visualizations

World

6bn

Total Population

29M

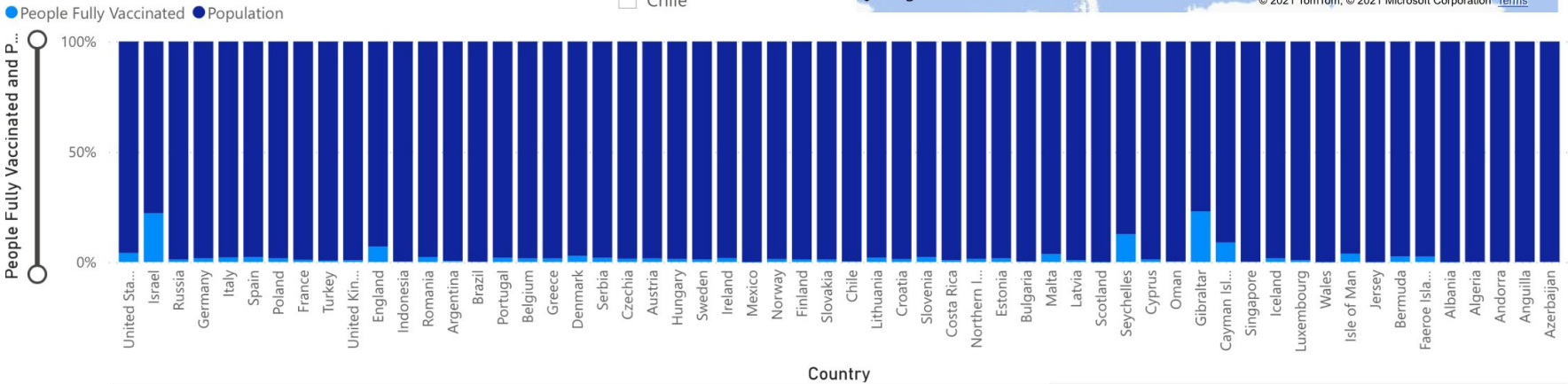
People Fully Vaccinated

Country

- Albania
- Algeria
- Andorra
- Anguilla
- Argentina
- Austria
- Azerbaijan
- Bahrain
- Bangladesh
- Belgium
- Bermuda
- Bolivia
- Brazil
- Bulgaria
- Cambodia
- Canada
- Cayman Islands
- Chile

People Fully Vaccinated as a % of World Vaccinations by Country

People Fully Vaccinated & Population by Country



Data Visualizations

United States

Country

331M

Total Population

14M

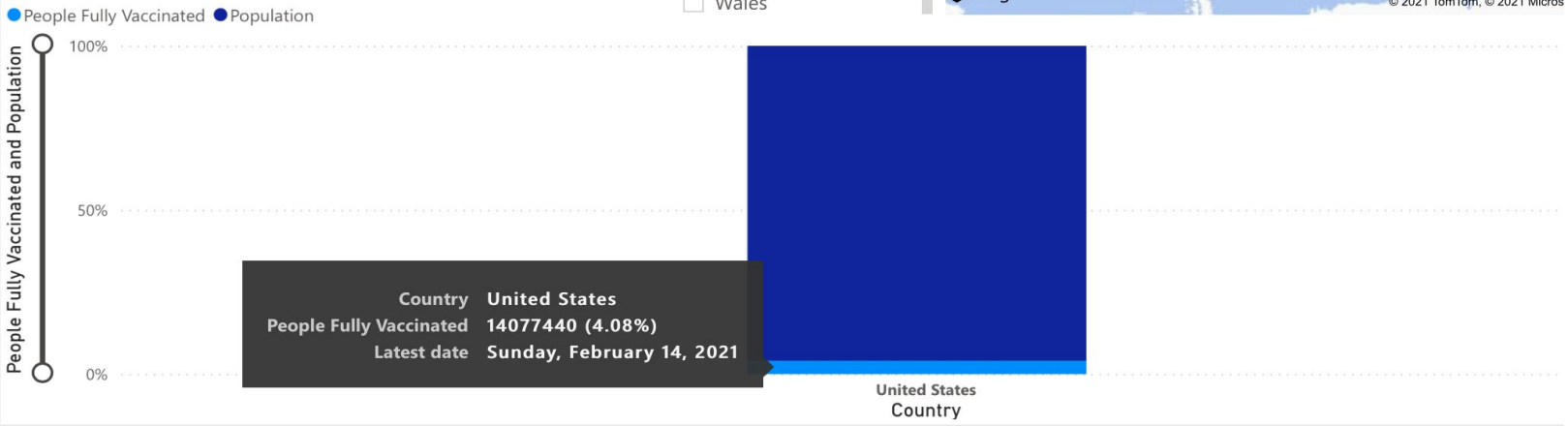
People Fully Vaccinated

Country

- Saint Helena
- Saudi Arabia
- Scotland
- Serbia
- Seychelles
- Singapore
- Slovakia
- Slovenia
- Spain
- Sri Lanka
- Sweden
- Switzerland
- Turkey
- Turks and Caicos Islands
- United Arab Emirates
- United Kingdom
- United States
- Wales

People Fully Vaccinated as a % of World Vaccinations

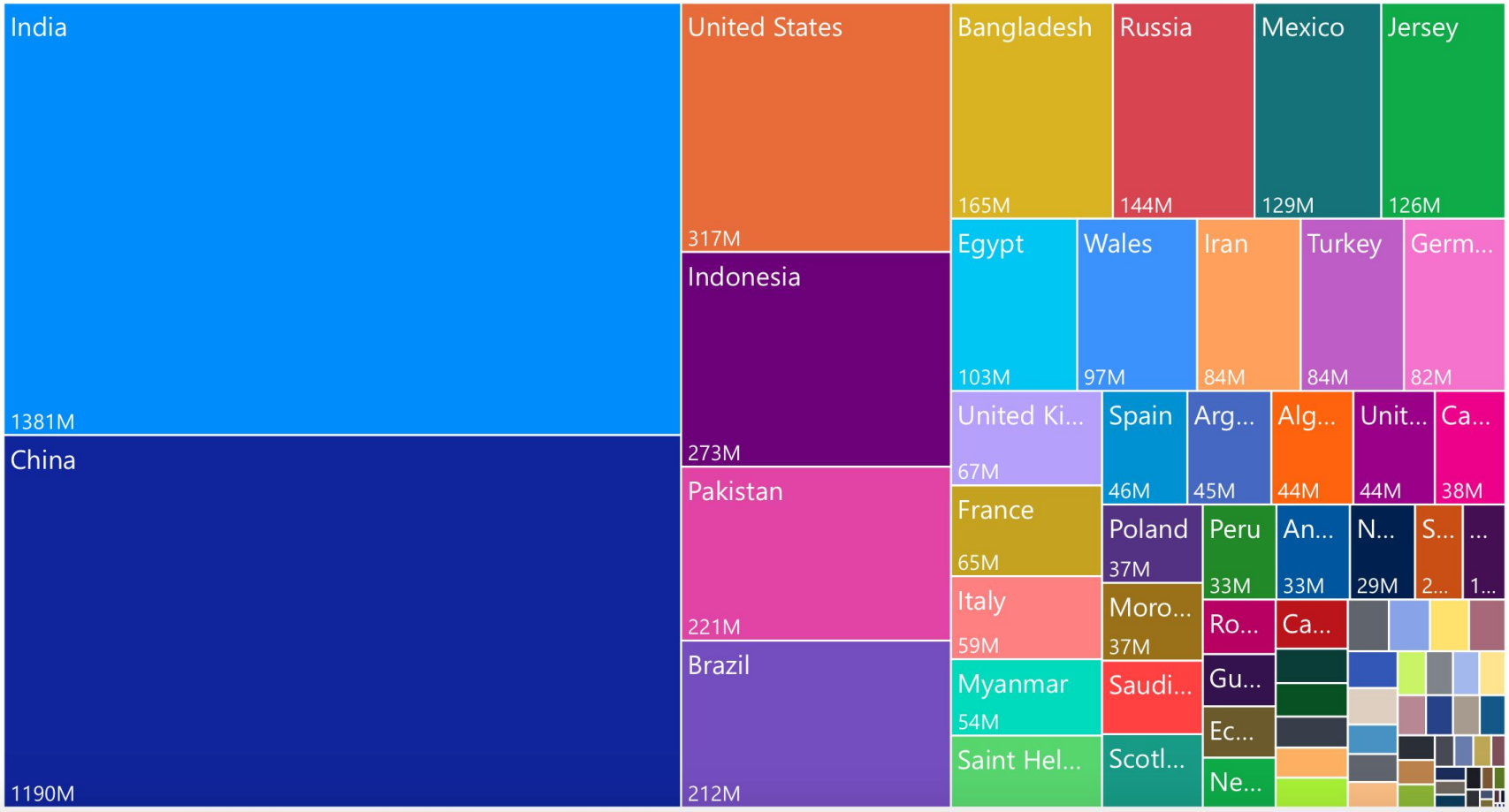
People Fully Vaccinated & Population by Country



Data Visualizations

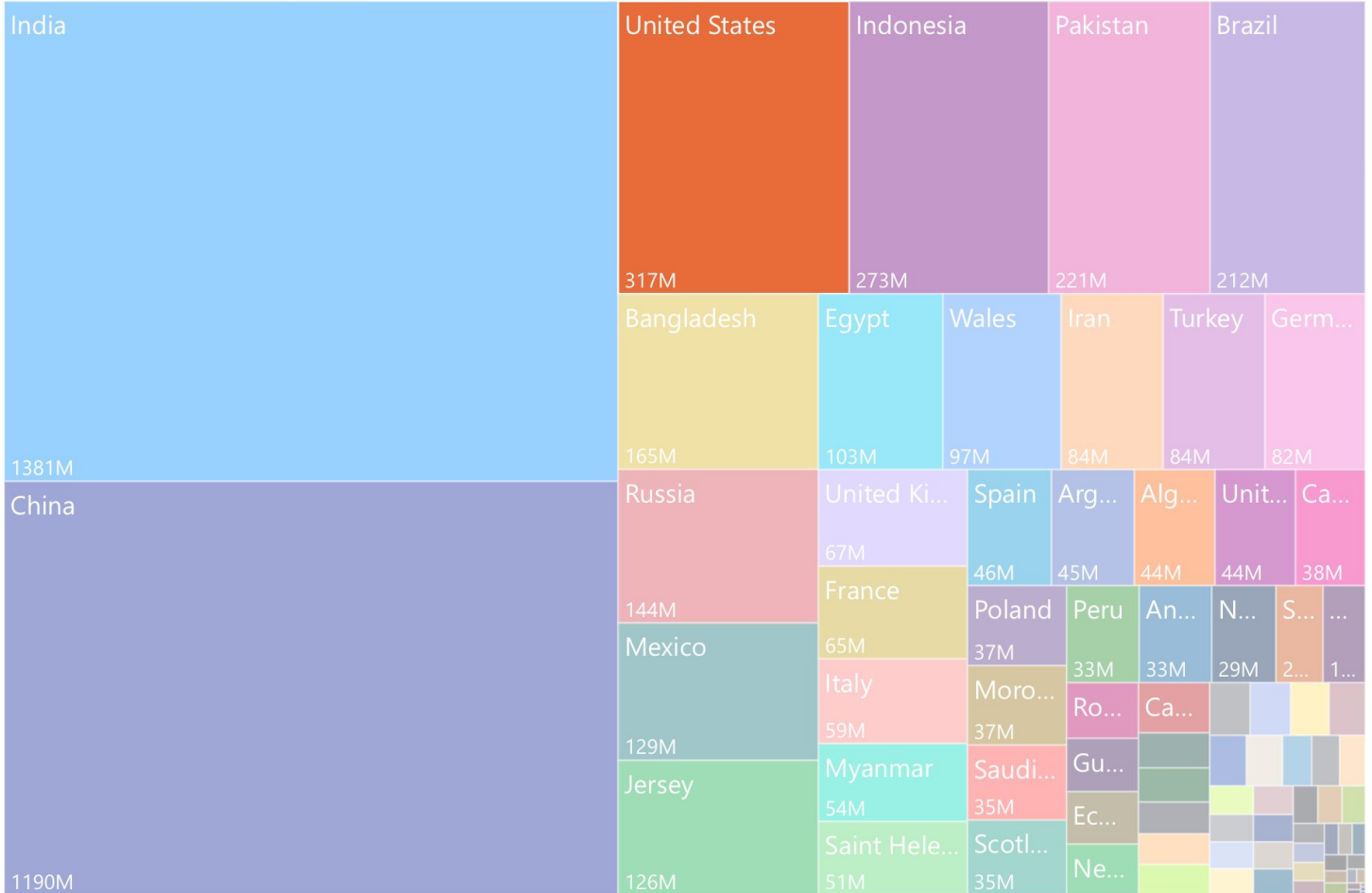
Back to report

PEOPLE LEFT TO VACCINATE, BY COUNTRY



Data Visualizations

People Left To Vaccinate, by Country



317M

People Left To Vaccinate

Country

- Peru
- Poland
- Portugal
- Qatar
- Romania
- Russia
- Saint Helena
- Saudi Arabia
- Scotland
- Serbia
- Seychelles
- Singapore
- Slovakia
- Slovenia
- Spain
- Sri Lanka
- Sweden
- Switzerland
- Turkey
- Turks and Caicos Islands
- United Arab Emirates
- United Kingdom
- United States

Data Visualizations

Country	Weeks Until 80% Vaccination	Weeks Until 100% Vacccination
Algeria	167,337.43	209,171.86
Egypt	53,498.57	66,873.14
Anguilla	25,278.14	31,597.57
Jersey	16,401.14	20,501.43
Guernsey	8,139.14	10,174.00
Pakistan	7,429.71	9,287.29
Saudi Arabia	7,365.43	9,206.71
Mauritius	4,845.71	6,057.14
Ecuador	4,351.86	5,439.86
Albania	4,009.86	5,012.29
Mexico	3,238.29	4,047.86
Iran	3,203.71	4,004.71
Bolivia	1,617.29	2,021.57
Cambodia	1,282.43	1,603.00
Sri Lanka	621.57	777.00
India	448.86	561.14
Kuwait	436.00	545.00
Wales	424.86	531.00
Myanmar	422.29	527.86
Indonesia	368.86	461.00
Argentina	366.57	458.14
Azerbaijan	356.86	446.14
Andorra	315.43	394.29
Latvia	310.29	387.86
Bulgaria	298.57	373.14
Peru	283.86	354.86
Qatar	237.57	296.86
Total	**317,115.15**	**396,394.75**

167.34K

Max # of weeks until 80% vaccination

(based on current vaccination rates per country)

209.17K

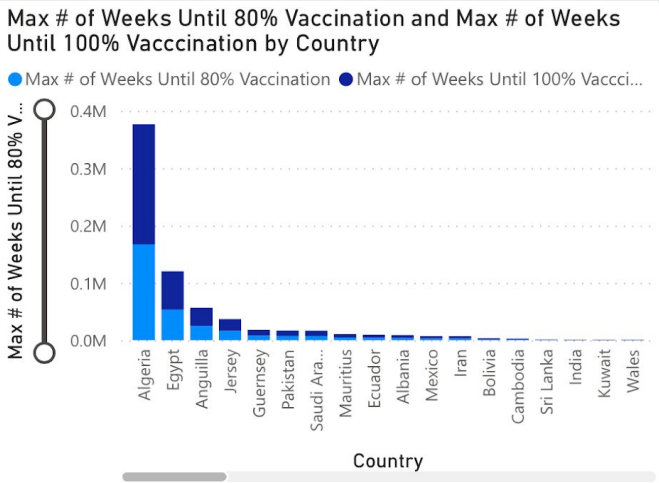
Max # of weeks until 100% vacccination

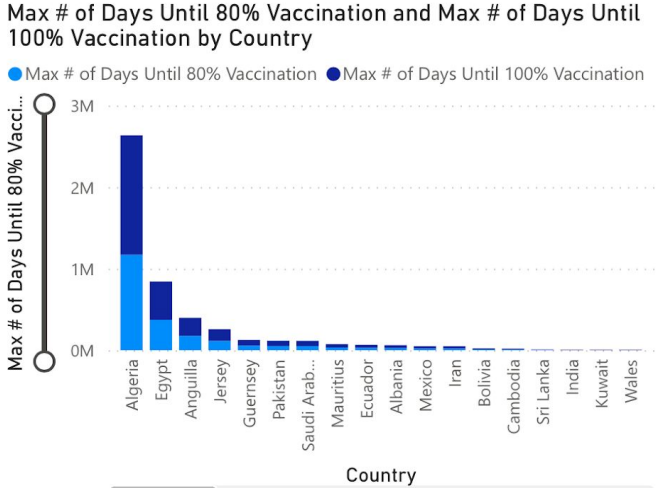
1M

Max # of days until 80% vaccination

1M

Max # of days until 100% vaccination



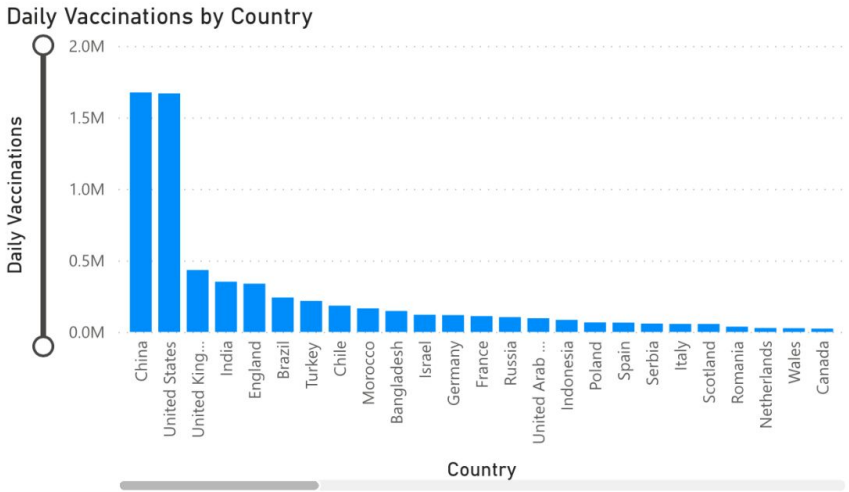


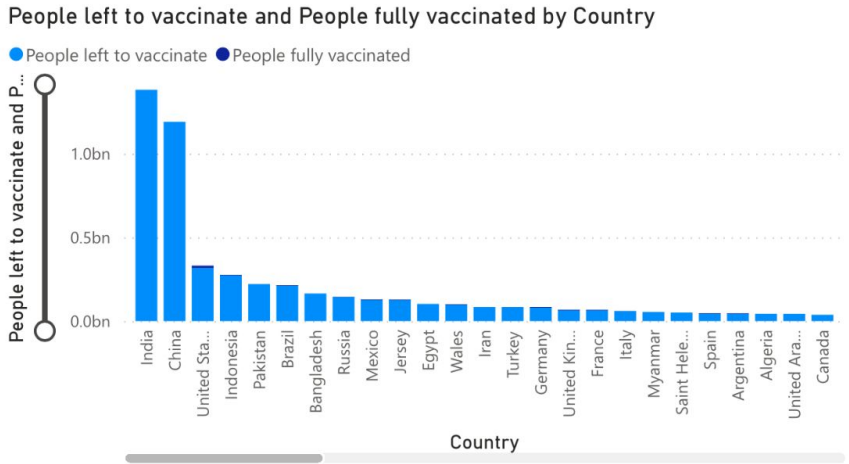
Data Visualizations

Country	Weeks Until 80% Vaccination	Weeks Until 100% Vacccination
England	2.00	2.57
Gibraltar	2.71	3.43
Seychelles	4.00	5.00
Israel	6.29	7.86
Cayman Islands	11.86	14.86
Chile	11.86	14.86
Bermuda	14.71	18.43
Maldives	15.00	18.71
Serbia	16.71	20.86
Northern Ireland	17.29	21.57
United Kingdom	17.71	22.29
Turks and Caicos Islands	20.00	25.00
United States	21.71	27.14
Morocco	25.57	32.00
Isle of Man	26.29	32.86
Bahrain	27.43	34.29
Malta	27.43	34.29
Monaco	35.57	44.57
Cyprus	39.86	49.86
Faeroe Islands	40.29	50.43
Turkey	44.14	55.29
United Arab Emirates	52.00	64.86
Norway	53.71	67.00
Romania	57.86	72.29
Greece	59.71	74.71
Portugal	60.14	75.14
Switzerland	61.29	76.57
Slovakia	61.71	77.14
Poland	63.86	79.86
France	66.57	83.29

Country	Weeks Until 80% Vaccination	Weeks Until 100% Vacccination
Costa Rica	185.29	231.57
Canada	187.14	234.00
Nepal	193.29	241.71
Qatar	237.57	296.86
Peru	283.86	354.86
Bulgaria	298.57	373.14
Latvia	310.29	387.86
Andorra	315.43	394.29
Azerbaijan	356.86	446.14
Argentina	366.57	458.14
Indonesia	368.86	461.00
Myanmar	422.29	527.86
Wales	424.86	531.00
Kuwait	436.00	545.00
India	448.86	561.14
Sri Lanka	621.57	777.00
Cambodia	1,282.43	1,603.00
Bolivia	1,617.29	2,021.57
Iran	3,203.71	4,004.71
Mexico	3,238.29	4,047.86
Albania	4,009.86	5,012.29
Ecuador	4,351.86	5,439.86
Mauritius	4,845.71	6,057.14
Saudi Arabia	7,365.43	9,206.71
Pakistan	7,429.71	9,287.29
Guernsey	8,139.14	10,174.00
Jersey	16,401.14	20,501.43
Anguilla	25,278.14	31,597.57
Egypt	53,498.57	66,873.14
Algeria	167,337.43	209,171.86

Data Visualizations

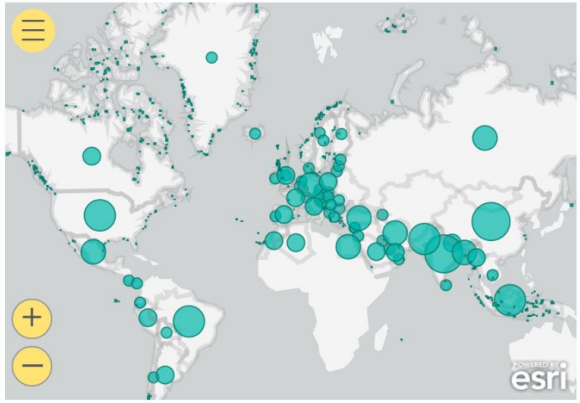




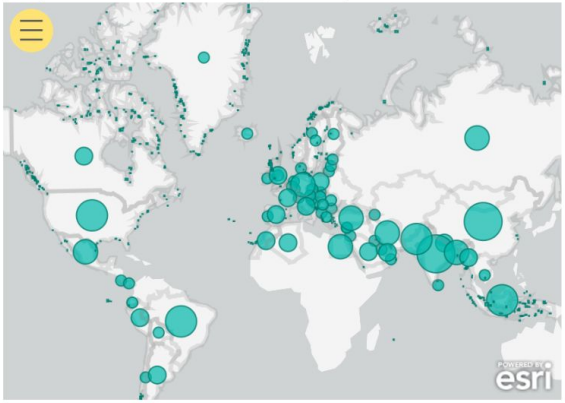
Country	Weeks Until 80% Vaccination	Weeks Until 100% Vaccination
Greenland	0.00	0.00
Panama	0.00	0.00
Saint Helena	0.00	0.00
England	2.00	2.57
Gibraltar	2.71	3.43
Seychelles	4.00	5.00
Israel	6.29	7.86
Cayman Islands	11.86	14.86
Chile	11.86	14.86
Bermuda	14.71	18.43
Maldives	15.00	18.71
Serbia	16.71	20.86
Northern Ireland	17.29	21.57
United Kingdom	17.71	22.29
Turks and Caicos Islands	20.00	25.00
United States	21.71	27.14
Morocco	25.57	32.00
Isle of Man	26.29	32.86
Bahrain	27.43	34.29
Malta	27.43	34.29
Monaco	35.57	44.57
Cyprus	39.86	49.86
Faeroe Islands	40.29	50.43
Turkey	44.14	55.29
United Arab Emirates	52.00	64.86
Norway	53.71	67.00
Romania	57.86	72.29
Total	**317,115.15**	**396,394.75**

Data Visualizations

population by country

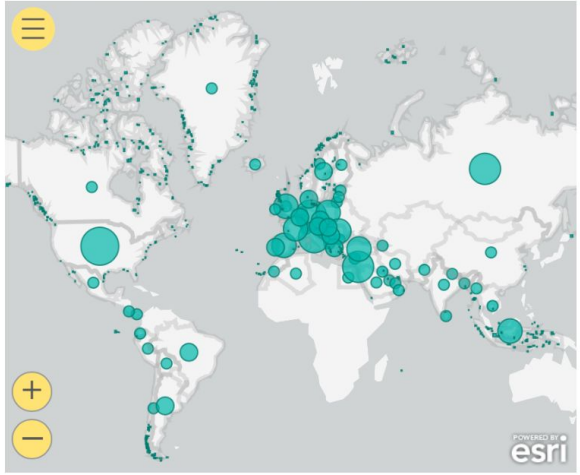


people left to vaccinate by country

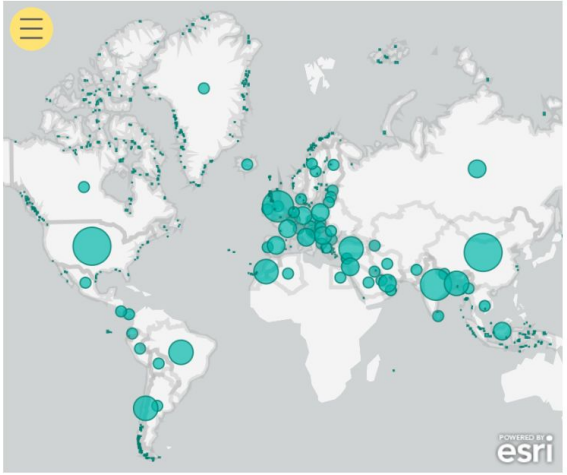


country	population	people left to vaccinate
Greenland	56780	56780
Panama	4321282	4321282
Saint Helena	51273732	51273732
Liechtenstein	38139	38139
Andorra	77278	77278
Algeria	43926079	43926079
Mauritius	1271985	1271985
Albania	2877470	2877032
Monaco	39270	39270
Faeroe Islands	48882	47661
Anguilla	32956300	32956300
Egypt	102516525	102516525
Turks and Caicos Islands	38768	38768
Total	**5728910235**	**5700186810**

people_fully_vaccinated by country



daily_vaccinations by country



6bn
population

6bn
people left to vaccinate

29M
people_fully_vaccinated

7M
daily_vaccinations

Albania
First country

Major Results & Findings: Part 1

- 10 countries that will take the **longest** to distribute vaccines to their populations (based on rates of vaccination when data was collected)
    - Numerous countries could take hundreds, even thousands of weeks to reach herd immunity
    - Includes countries that have not begun vaccination distribution or whose complete data was not available within the dataset

country	weeks till 80 percent Vaccination	weeks till full vacccination
Algeria	167,337.43	209,171.86
Egypt	53,498.57	66,873.14
Anguilla	25,278.14	31,597.57
Jersey	16,401.14	20,501.43
Guernsey	8,139.14	10,174.00
Pakistan	7,429.71	9,287.29
Saudi Arabia	7,365.43	9,206.71
Mauritius	4,845.71	6,057.14
Ecuador	4,351.86	5,439.86
Albania	4,009.86	5,012.29

- 10 countries that will lead the world in herd immunity
    - Some countries with zero weeks left are likely to have not started their vaccination process.
    - Others likely in final weeks of vaccine distribution before reaching herd immunity

country	weeks till 80 percent Vaccination	weeks till full vacccination
Greenland	0.00	0.00
Panama	0.00	0.00
Saint Helena	0.00	0.00
England	2.00	2.57
Gibraltar	2.71	3.43
Seychelles	4.00	5.00
Israel	6.29	7.86
Cayman Islands	11.86	14.86
Chile	11.86	14.86
Bermuda	14.71	18.43

Major Results & Findings: Part 2

- **Countries leading vaccine availability (< 100%):**
  - Malta: 97.63%
  - Denmark 84.04%
  - Slovenia 67.79%
- **Countries with 0% total vaccination availability:**
  - Cambodia, Iran, Egypt, & Algeria
- **Countries on the lower end of the spectrum (with at least .01% vaccination availability):**
  - Pakistan, Mauritius, & Ecuador

- **Multiple countries with percentages > 100%**
  - This means the amount of vaccines available outnumbered theses countries' populations
  - Israel: 966.46% (this means that the number of vaccines available would allow the nation to vaccinate its entire population 9 times)
  - Gibraltar: 659.35%
  - Seychelles: 299.68%
  - Bahrain: 190.55%
  - Isle of Man: 108.38%.

Major Results & Findings: Part 3

- Countries with the most people fully vaccinated per hundred
  - **Israel:** 30.17% of its population is fully vaccinated
  - **Gibraltar:** 29.84%
  - **Seychelles:** 14.42%
  - **Cayman Islands:** 9.69%
  - **United States:** 4.21%

Major Results & Findings: Overall

- Interesting how our algorithms all came together to form an analysis of worldwide vaccination distribution
    - Countries like Israel, Gibraltar, & Seychelles
        - have **more vaccines than their total populations**
        - yet still have **less than half of their populations fully vaccinated**
    - Those nations with the **largest populations** will also require a **longer time** until recovery due to **lack of vaccinations available**

Limitations

- **Some vaccines require multiple doses**
    - Important to consider that countries may have only distributed the 1st dose to those that have been vaccinated so far, contributing to smaller population of fully vaccinated individuals
- **Dataset only contains data from December 12th, 2020 through January 25th, 2021**
    - Data may not realistically align w/ current vaccine distribution rates
    - Rates of vaccine distribution may have shifted in some countries since the data was collected
    - Some countries' data is not included in the dataset, so our analyses might be slightly skewed as a result

Questions?

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