NAAN MUDHULVAN PHASE-5

Project Name:COVID Vaccines Analysis

DATA ANALYTICS AND COVID VACCINES ANALYSIS

ABSTRACT

The COVID-19 pandemic, caused by the SARS-CoV-2 virus, brought the world to a standstill, necessitating the rapid development and deployment of vaccines to combat the virus's spread. This project presents a comprehensive analysis of COVID-19 vaccination strategies with a focus on their impact, efficacy, and equity.

1.**Impact Assessment**

This study will examine the global impact of COVID-19 vaccination campaigns, considering factors such as the reduction in infection rates, hospitalizations, and mortality. The analysis will encompass various vaccine types, including mRNA, viral vector, and protein subunit vaccines, to compare their effectiveness.

2.**Efficacy Analysis**

The project will investigate the efficacy of COVID-19 vaccines in preventing infection, symptomatic disease, and transmission. Special attention will be given to the duration of protection and the effectiveness against emerging variants of the virus.

3.**Equity Evaluation**

Equity in vaccine distribution is crucial for achieving global immunity. This research will assess the equity of vaccine distribution at both national and international levels, considering factors such as vaccine accessibility, affordability, and vaccine hesitancy among different populations.

4.**Vaccine Deployment Strategies**

The study will also delve into the strategies employed for vaccine deployment, analyzing their strengths and weaknesses. This includes mass vaccination campaigns, prioritization of at-risk populations, booster dose strategies, and the use of technology in vaccination programs.

5.**Policy Implications**

This project will offer insights into the policy implications of the analyzed data, aiming to provide recommendations for policymakers and public health authorities to enhance vaccination strategies and equitable distribution.

6.**Future Outlook**

As the COVID-19 pandemic continues to evolve, the study will conclude with a discussion of the potential challenges and opportunities in the ongoing fight against the virus, including the development of next-generation vaccines and strategies for managing future pandemics.

This analysis combines data from diverse sources, including clinical trials, real-world studies, vaccination campaign reports, and demographic information, to provide a holistic view of the COVID-19 vaccination landscape.

7.Data source

Dataset is collected from the kaggle.com named “daily-website-visitors.csv” which has a data about the Days, Day of week, Date, page Loads, Unique visits, First-time visits, Returning Visits

Dataset link:

https://www.kaggle.com/datasets/gpreda/covid-world-vaccination-progress

DESIGN OF COVID VACCINES ANALYSIS

1.**Objectives and Scope**

Clearly outline the goals of your project. Are you analyzing vaccine distribution, efficacy,adverse effects, or something else? Define the scope of your analysis.

2.**Gather Data**

Collect relevant data from trusted sources such as health organizations, research papers, or public datasets. Ensure the data is up-to-date and comprehensive.

3.**Data Preprocessing**

Clean and preprocess the data to remove missing values, outliers, and ensure it's in a usable format. This may involve data cleaning, transformation, and normalization.

4.**Exploratory Data Analysis (EDA)**

Perform EDA to gain insights into the data. Visualize and summarize key statistics to understand the trends, patterns, and relationships within the data.

5.**Model Selection**

Decide on the appropriate statistical and machine learning models for your analysis. Choose models that align with your project goals, such as regression, classification, or time series analysis.

6.**Data Splitting**

Split your dataset into training, validation, and test sets. This is crucial for model training and evaluation.

7.**Model Training**

Train your chosen models using the training data. Optimize hyperparameters to improve model performance.

8.**Model Evaluation**

Assess the model's performance using appropriate metrics, such as accuracy, F1 score, or AUC. Use cross-validation to ensure robustness.

9.**Visualization and Reporting**

Create clear and informative visualizations to communicate your findings. Develop a comprehensive report or presentation summarizing the analysis.

10.**Peer Review and Validation**

If possible, involve peers or experts to review and validate your analysis for accuracy and reliability.

11.**Deployment**

If your analysis results in a tool or application, plan for its deployment, ensuring it's user-friendly and secure.

12.**Continuous Monitoring and Updates**

Keep your analysis up-to-date with the latest data and research. Monitor the impact of your analysis and be ready to make updates as needed.

13.**Documentation**

Properly document your entire project, including data sources, methods, and code. This ensures transparency and reproducibility.

14.**Publication or Presentation**

Share your findings with the scientific community through publications or presentations if applicable.

DEVELOPMENT PART-1

Introduction

The COVID-19 pandemic has had a profound impact on global health and society. Vaccination campaigns are one of the most significant strategies to control the spread of the virus and mitigate its effects. This project aims to utilize virtualization technology to analyze and visualize data related to COVID-19 vaccines, offering insights into their development, distribution, and effectiveness.

Preprocessing of given dataset and program implementation

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	country	iso_code	date	total_vacc	people_va	people_fu	daily_vacc	daily_vacc	total_vacc	people_va	people_fu	daily_vacc	vaccines	source_na	source_website			
2	Afghanist	AFG	22-02-2021	0	0				0	0			Johnson&	World He	https://covid19.who.int/			
3	Afghanist	AFG	23-02-2021					1367				34	Johnson&	World He	https://covid19.who.int/			
4	Afghanist	AFG	24-02-2021					1367				34	Johnson&	World He	https://covid19.who.int/			
5	Afghanist	AFG	25-02-2021					1367				34	Johnson&	World He	https://covid19.who.int/			
6	Afghanist	AFG	26-02-2021					1367				34	Johnson&	World He	https://covid19.who.int/			
7	Afghanist	AFG	27-02-2021					1367				34	Johnson&	World He	https://covid19.who.int/			
8	Afghanist	AFG	28-02-2021	8200	8200			1367	0.02	0.02		34	Johnson&	World He	https://covid19.who.int/			
9	Afghanist	AFG	01-03-2021					1580				40	Johnson&	World He	https://covid19.who.int/			
10	Afghanist	AFG	02-03-2021					1794				45	Johnson&	World He	https://covid19.who.int/			
11	Afghanist	AFG	03-03-2021					2008				50	Johnson&	World He	https://covid19.who.int/			
12	Afghanist	AFG	04-03-2021					2221				56	Johnson&	World He	https://covid19.who.int/			
13	Afghanist	AFG	05-03-2021					2435				61	Johnson&	World He	https://covid19.who.int/			
14	Afghanist	AFG	06-03-2021					2649				66	Johnson&	World He	https://covid19.who.int/			
15	Afghanist	AFG	07-03-2021					2862				72	Johnson&	World He	https://covid19.who.int/			
16	Afghanist	AFG	08-03-2021					2862				72	Johnson&	World He	https://covid19.who.int/			
17	Afghanist	AFG	09-03-2021					2862				72	Johnson&	World He	https://covid19.who.int/			
18	Afghanist	AFG	10-03-2021					2862				72	Johnson&	World He	https://covid19.who.int/			
19	Afghanist	AFG	11-03-2021					2862				72	Johnson&	World He	https://covid19.who.int/			
20	Afghanist	AFG	12-03-2021					2862				72	Johnson&	World He	https://covid19.who.int/			
21	Afghanist	AFG	13-03-2021					2862				72	Johnson&	World He	https://covid19.who.int/			
22	Afghanist	AFG	14-03-2021					2862				72	Johnson&	World He	https://covid19.who.int/			
23	Afghanist	AFG	15-03-2021					2862				72	Johnson&	World He	https://covid19.who.int/			
24	Afghanist	AFG	16-03-2021	54000	54000			2862	0.14	0.14		72	Johnson&	World He	https://covid19.who.int/			
25	Afghanist	AFG	17-03-2021					2882				72	Johnson&	World He	https://covid19.who.int/			

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
data = pd.read_csv("C:\\Users\Desktop\DataSets\covidcountry_vaccinations.csv")
data.head()
```

```
       country iso_code        date  total_vaccinations  people_vaccinated  \
0  Afghanistan      AFG  2021-02-22                 0.0                 0.0
1  Afghanistan      AFG  2021-02-23                 NaN                 NaN
2  Afghanistan      AFG  2021-02-24                 NaN                 NaN
3  Afghanistan      AFG  2021-02-25                 NaN                 NaN
4  Afghanistan      AFG  2021-02-26                 NaN                 NaN

   people_fully_vaccinated  daily_vaccinations_raw  daily_vaccinations  \
0                      NaN                     NaN                 NaN
1                      NaN                     NaN              1367.0
2                      NaN                     NaN              1367.0
3                      NaN                     NaN              1367.0
4                      NaN                     NaN              1367.0

   total_vaccinations_per_hundred  people_vaccinated_per_hundred  \
0                             0.0                            0.0
1                             NaN                            NaN
2                             NaN                            NaN
3                             NaN                            NaN
4                             NaN                            NaN

   people_fully_vaccinated_per_hundred  daily_vaccinations_per_million  \
0                                  NaN                             NaN
1                                  NaN                            34.0
2                                  NaN                            34.0
3                                  NaN                            34.0
4                                  NaN                            34.0

                                      vaccines  \
0  Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...
1  Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...
2  Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...
3  Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...
4  Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...

                source_name            source_website
0  World Health Organization  https://covid19.who.int/
1  World Health Organization  https://covid19.who.int/
```

```
2  World Health Organization  https://covid19.who.int/
3  World Health Organization  https://covid19.who.int/
4  World Health Organization  https://covid19.who.int/
```

```
data.describe()
```

```
       total_vaccinations  people_vaccinated  people_fully_vaccinated
\
count        4.360700e+04       4.129400e+04             3.880200e+04
mean         4.592964e+07       1.770508e+07             1.413830e+07
std          2.246004e+08       7.078731e+07             5.713920e+07
min          0.000000e+00       0.000000e+00             1.000000e+00
25%          5.264100e+05       3.494642e+05             2.439622e+05
50%          3.590096e+06       2.187310e+06             1.722140e+06
75%          1.701230e+07       9.152520e+06             7.559870e+06
max          3.263129e+09       1.275541e+09             1.240777e+09

       daily_vaccinations_raw  daily_vaccinations  \
count            3.536200e+04        8.621300e+04
mean             2.705996e+05        1.313055e+05
std              1.212427e+06        7.682388e+05
min              0.000000e+00        0.000000e+00
25%              4.668000e+03        9.000000e+02
50%              2.530900e+04        7.343000e+03
75%              1.234925e+05        4.409800e+04
max              2.474100e+07        2.242429e+07

       total_vaccinations_per_hundred  people_vaccinated_per_hundred
\
count                    43607.000000                   41294.000000
mean                        80.188543                      40.927317
std                         67.913577                      29.290759
min                          0.000000                       0.000000
25%                         16.050000                      11.370000
50%                         67.520000                      41.435000
75%                        132.735000                      67.910000
max                        345.370000                     124.760000

       people_fully_vaccinated_per_hundred
daily_vaccinations_per_million
count                         38802.000000
86213.000000
mean                             35.523243
3257.049157
std                              28.376252
3934.312440
```

```
min                                0.000000
0.000000
25%                                7.020000
636.000000
50%                               31.750000
2050.000000
75%                               62.080000
4682.000000
max                              122.370000
117497.000000
```

```
pd.to_datetime(data.date)
data.country.value_counts()
```

```
country
Norway                             482
Latvia                             480
Denmark                            476
United States                      471
Russia                             470
                                  ...
Bonaire Sint Eustatius and Saba    146
Tokelau                            114
Saint Helena                        92
Pitcairn                            85
Falkland Islands                    67
Name: count, Length: 223, dtype: int64
```

```
data.vaccines.value_counts()
```

```
vaccines
Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech
7608
Moderna, Oxford/AstraZeneca, Pfizer/BioNTech
6263
Oxford/AstraZeneca
6022
Oxford/AstraZeneca, Pfizer/BioNTech
4629
Johnson&Johnson, Moderna, Novavax, Oxford/AstraZeneca, Pfizer/BioNTech
3564

...
Johnson&Johnson, Oxford/AstraZeneca, Sinovac
312
Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac, Sputnik V
311
```

```
Johnson&Johnson, Moderna
251
Johnson&Johnson, Pfizer/BioNTech, Sinopharm/Beijing
228
EpiVacCorona, Oxford/AstraZeneca, QazVac, Sinopharm/Beijing, Sputnik
V, ZF2001     190
Name: count, Length: 84, dtype: int64
```

```
df = data[["vaccines", "country"]]
df.head()
```

```
                                             vaccines      country
0  Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...  Afghanistan
1  Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...  Afghanistan
2  Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...  Afghanistan
3  Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...  Afghanistan
4  Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...  Afghanistan
```

```
dict_ ={}
for i in df.vaccines.unique():
    dict_[i] = [df["country"][j] for j in df[df["vaccines"]==i].index]

vaccines = {}
for key, value in dict_.items():
    vaccines[key] =set(value)
for i, j in vaccines.items():
print(f"{i}:>>{j}")
```

```
Johnson&Johnson, Oxford/AstraZeneca, Pfizer/BioNTech,
Sinopharm/Beijing:>>{'Trinidad and Tobago', 'Afghanistan', 'Namibia',
'Cameroon', 'Belize'}
Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac, Sputnik V:>>{'Albania',
'Bosnia and Herzegovina', 'Azerbaijan', 'Oman'}
Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac, Sputnik
V:>>{'Zimbabwe', 'Algeria'}
Moderna, Oxford/AstraZeneca, Pfizer/BioNTech:>>{'United Kingdom',
'England', 'Scotland', 'Guernsey', 'Finland', 'Fiji', 'Northern
Ireland', 'Sweden', 'Isle of Man', 'Jersey', 'Wales', 'Sint Maarten
(Dutch part)', 'Japan', 'Australia', 'Andorra'}
Oxford/AstraZeneca:>>{'Mali', 'Saint Vincent and the Grenadines',
'Angola', 'Nigeria', 'Saint Helena', 'Samoa', 'Liberia', 'Tuvalu',
'Nauru', 'Pitcairn', 'Tonga', 'Vanuatu', 'Togo', 'Kiribati', 'Papua
New Guinea', 'Democratic Republic of Congo', 'Solomon Islands', 'Sao
Tome and Principe', 'Falkland Islands', 'Montserrat'}
Oxford/AstraZeneca, Pfizer/BioNTech:>>{'New Zealand', 'Bermuda',
'Kosovo', 'Saudi Arabia', 'Cayman Islands', 'Gibraltar', 'Costa Rica',
'Panama', 'Saint Kitts and Nevis', 'Saint Lucia', 'Anguilla'}
```

Oxford/AstraZeneca, Pfizer/BioNTech, Sputnik V:>>{'Antigua and Barbuda'}
CanSino, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sputnik V:>>{'Argentina'}
Moderna, Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac, Sputnik V:>>{'Armenia'}
Pfizer/BioNTech:>>{'Niue', 'New Caledonia', 'Cook Islands', 'Tokelau', 'Monaco', 'Turks and Caicos Islands', 'Aruba'}
Johnson&Johnson, Moderna, Novavax, Oxford/AstraZeneca, Pfizer/BioNTech:>>{'Germany', 'Austria', 'Czechia', 'Lithuania', 'Netherlands', 'South Korea', 'Italy', 'Slovenia'}
Johnson&Johnson, Oxford/AstraZeneca, Pfizer/BioNTech:>>{'Bahamas', 'Grenada', 'Eswatini'}
Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sputnik Light, Sputnik V:>>{'Bahrain'}
Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sinovac:>>{'Bangladesh'}
Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing:>>{'Maldives', 'Suriname', 'Peru', 'Barbados', 'Dominica'}
Sinopharm/Beijing, Sputnik V:>>{'Belarus', 'Kyrgyzstan'}
Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech:>>{'Ireland', 'Romania', 'Luxembourg', 'Belgium', 'Jamaica', 'Bulgaria', 'Iceland', 'Greece', 'Estonia', 'Poland', 'Spain', 'Croatia', 'Portugal', 'Cyprus', 'Canada', 'Malta', 'France'}
Johnson&Johnson, Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac:>>{'Brazil', 'Benin'}
Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing:>>{'Bhutan', 'Cape Verde'}
Johnson&Johnson, Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sputnik V:>>{'Morocco', 'Bolivia', "Cote d'Ivoire", 'Moldova'}
Moderna, Pfizer/BioNTech:>>{'Israel', 'Norway', 'Curacao', 'Bonaire Sint Eustatius and Saba', 'Qatar', 'Faeroe Islands'}
Covaxin, Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac:>>{'Botswana'}
Johnson&Johnson, Oxford/AstraZeneca:>>{'British Virgin Islands', 'Malawi', 'South Sudan'}
Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing:>>{'Kuwait', 'Brunei', 'Nepal', 'Kenya'}
Johnson&Johnson, Oxford/AstraZeneca, Sinopharm/Beijing:>>{'Burkina Faso', 'Mozambique', 'Lesotho', 'Senegal', 'Zambia', 'Gambia', 'Madagascar'}
Sinopharm/Beijing:>>{'Burundi', 'Equatorial Guinea', 'Chad'}
Johnson&Johnson, Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac:>>{'Somalia', 'Cambodia'}
Covaxin, Oxford/AstraZeneca:>>{'Central African Republic'}

CanSino, Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac:>>{'Ecuador', 'Chile'}
CanSino, Sinopharm/Beijing, Sinopharm/Wuhan, Sinovac, ZF2001:>>{'China'}
Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac:>>{'Ukraine', 'Uganda', 'Colombia'}
Covaxin, Oxford/AstraZeneca, Sinopharm/Beijing:>>{'Mauritius', 'Comoros'}
Moderna, Oxford/AstraZeneca, Sinopharm/Beijing, Sputnik V:>>{'Congo'}
Abdala, Soberana Plus, Soberana02:>>{'Cuba'}
Johnson&Johnson, Moderna, Pfizer/BioNTech:>>{'United States', 'Denmark', 'Liechtenstein', 'Switzerland'}
Johnson&Johnson, Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sinovac, Sputnik V:>>{'Djibouti', 'Guinea', 'Egypt'}
Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sinovac:>>{'Dominican Republic', 'El Salvador', 'Georgia'}
Covaxin, Johnson&Johnson, Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac:>>{'Ethiopia'}
Johnson&Johnson, Pfizer/BioNTech:>>{'South Africa', 'French Polynesia'}
Pfizer/BioNTech, Sinopharm/Beijing, Sputnik V:>>{'Gabon'}
Oxford/AstraZeneca, Sputnik V:>>{'Ghana'}
Moderna:>>{'Greenland', 'Wallis and Futuna'}
Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sputnik V:>>{'Guatemala'}
Oxford/AstraZeneca, Sinopharm/Beijing:>>{'Niger', 'Guinea-Bissau', 'Myanmar', 'Mauritania', 'Sierra Leone'}
Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sputnik V:>>{'Guyana', 'Sri Lanka'}
Johnson&Johnson, Moderna:>>{'Haiti'}
Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sputnik V:>>{'Honduras'}
Pfizer/BioNTech, Sinovac:>>{'Hong Kong'}
Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sputnik V:>>{'Jordan', 'Hungary'}
Covaxin, Oxford/AstraZeneca, Sputnik V:>>{'India'}
Johnson&Johnson, Moderna, Novavax, Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sinovac:>>{'Indonesia'}
COVIran Barekat, Covaxin, FAKHRAVAC, Oxford/AstraZeneca, Razi Cov Pars, Sinopharm/Beijing, Soberana02, SpikoGen, Sputnik V:>>{'Iran'}
Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sputnik V:>>{'Lebanon', 'Mongolia', 'Iraq', 'Serbia', 'Montenegro'}
QazVac, Sinopharm/Beijing, Sputnik V:>>{'Kazakhstan'}
Johnson&Johnson, Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sinovac, Sputnik Light, Sputnik V:>>{'Laos'}

Johnson&Johnson, Moderna, Novavax, Pfizer/BioNTech:>>{'Latvia'}
Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing, Sinovac,
Sputnik V:>>{'Libya', 'North Macedonia'}
Pfizer/BioNTech, Sinopharm/Beijing:>>{'Macao'}
CanSino, Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing,
Sinovac:>>{'Malaysia'}
CanSino, Johnson&Johnson, Moderna, Oxford/AstraZeneca,
Pfizer/BioNTech, Sinovac, Sputnik V:>>{'Mexico'}
Abdala, Johnson&Johnson, Oxford/AstraZeneca, Pfizer/BioNTech,
Soberana02, Sputnik Light, Sputnik V:>>{'Nicaragua'}
Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac:>>{'Uruguay', 'Northern
Cyprus', 'Timor'}
CanSino, Covaxin, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech,
Sinopharm/Beijing, Sinovac, Sputnik V:>>{'Pakistan'}
Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech,
Sinopharm/Beijing, Sinovac, Sputnik Light, Sputnik V:>>{'Palestine',
'Philippines'}
Covaxin, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech,
Sinopharm/Beijing, Sinovac, Sputnik V:>>{'Paraguay'}
EpiVacCorona, Sputnik V:>>{'Russia'}
Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech,
Sinopharm/Beijing, Sinovac, Sputnik V:>>{'Rwanda', 'Tunisia'}
Pfizer/BioNTech, Sputnik V:>>{'San Marino'}
Oxford/AstraZeneca, Sinopharm/Beijing, Sputnik V:>>{'Seychelles'}
Moderna, Pfizer/BioNTech, Sinopharm/Beijing, Sinovac:>>{'Singapore'}
Johnson&Johnson, Moderna, Novavax, Oxford/AstraZeneca,
Pfizer/BioNTech, Sputnik V:>>{'Slovakia'}
Johnson&Johnson, Oxford/AstraZeneca, Pfizer/BioNTech,
Sinopharm/Beijing, Sinovac:>>{'Sudan'}
Johnson&Johnson, Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac,
Sputnik Light, Sputnik V:>>{'Syria'}
Medigen, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech:>>{'Taiwan'}
Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac, Sputnik
V:>>{'Tajikistan'}
Johnson&Johnson, Pfizer/BioNTech, Sinopharm/Beijing:>>{'Tanzania'}
Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing,
Sinovac:>>{'Thailand'}
Pfizer/BioNTech, Sinovac, Turkovac:>>{'Turkey'}
EpiVacCorona, Oxford/AstraZeneca, QazVac, Sinopharm/Beijing, Sputnik
V, ZF2001:>>{'Turkmenistan'}
Oxford/AstraZeneca, Pfizer/BioNTech, Sinopharm/Beijing,
Sinopharm/Wuhan, Sputnik V:>>{'United Arab Emirates'}
Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac, Sputnik Light,
Sputnik V, ZF2001:>>{'Uzbekistan'}
Abdala, Sinopharm/Beijing, Sinovac, Soberana02, Sputnik Light, Sputnik
V:>>{'Venezuela'}

```
Abdala, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech,
Sinopharm/Beijing, Sputnik V:>>{'Vietnam'}
Johnson&Johnson, Oxford/AstraZeneca, Sinovac:>>{'Yemen'}
```

DEVELOPMENT PART-2

Program implementation:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
data = pd.read_csv("C:\Users\student\Documents\country_vaccinations.csv")
data.head()
```

```
country iso_code        date  total_vaccinations  people_vaccinated  \
0  Afghanistan      AFG  2021-02-22                 0.0                 
0.0
1  Afghanistan      AFG  2021-02-23                 NaN                 
NaN
2  Afghanistan      AFG  2021-02-24                 NaN                 
NaN
3  Afghanistan      AFG  2021-02-25                 NaN                 
NaN
4  Afghanistan      AFG  2021-02-26                 NaN                 
NaN

   people_fully_vaccinated  daily_vaccinations_raw  daily_vaccinations
\
0                      NaN                     NaN                 NaN
1                      NaN                     NaN              1367.0
2                      NaN                     NaN              1367.0
3                      NaN                     NaN              1367.0
4                      NaN                     NaN              1367.0

   total_vaccinations_per_hundred  people_vaccinated_per_hundred  \
0                             0.0                            0.0
1                             NaN                            NaN
2                             NaN                            NaN
3                             NaN                            NaN
4                             NaN                            NaN
```

```
   people_fully_vaccinated_per_hundred  daily_vaccinations_per_million
\
0                                   NaN                             NaN
1                                   NaN                            34.0
2                                   NaN                            34.0
3                                   NaN                            34.0
4                                   NaN                            34.0

                                             vaccines  \
0  Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...
1  Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...
2  Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...
3  Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...
4  Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...

                 source_name            source_website
0  World Health Organization  https://covid19.who.int/
1  World Health Organization  https://covid19.who.int/
2  World Health Organization  https://covid19.who.int/
3  World Health Organization  https://covid19.who.int/
4  World Health Organization  https://covid19.who.int/
```

```
data.describe()
```

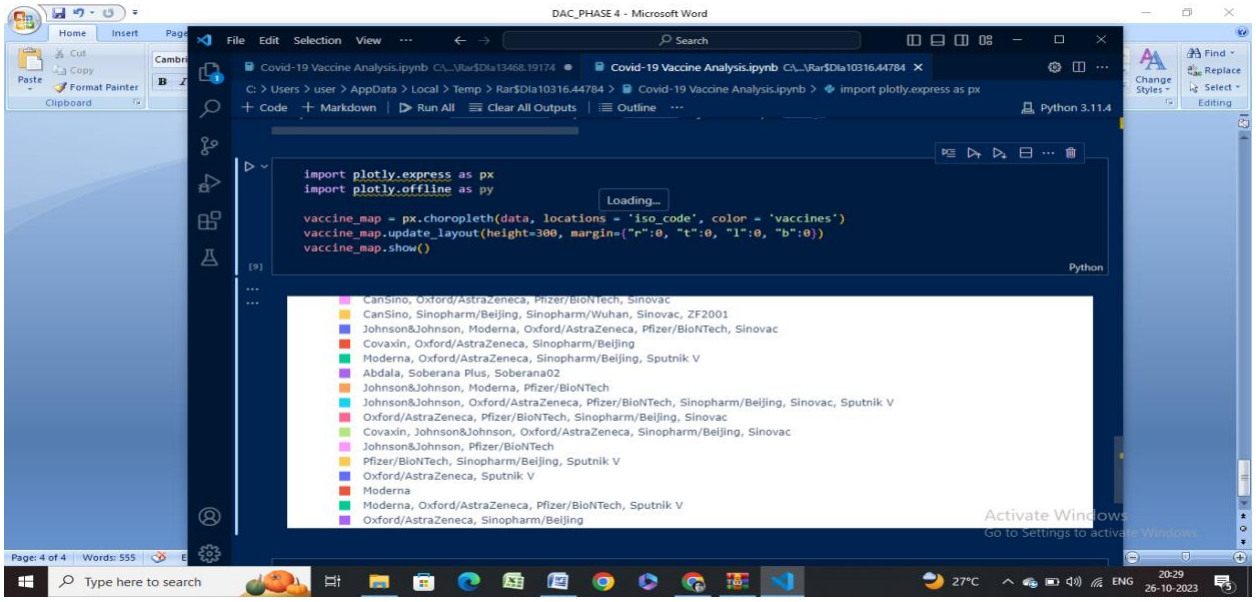
```
       total_vaccinations  people_vaccinated  people_fully_vaccinated  \
count        4.360700e+04       4.129400e+04             3.880200e+04
mean         4.592964e+07       1.770508e+07             1.413830e+07
std          2.246004e+08       7.078731e+07             5.713920e+07
min          0.000000e+00       0.000000e+00             1.000000e+00
25%          5.264100e+05       3.494642e+05             2.439622e+05
50%          3.590096e+06       2.187310e+06             1.722140e+06
75%          1.701230e+07       9.152520e+06             7.559870e+06
max          3.263129e+09       1.275541e+09             1.240777e+09


       daily_vaccinations_raw  daily_vaccinations  \
count            3.536200e+04        8.621300e+04
mean             2.705996e+05        1.313055e+05
std              1.212427e+06        7.682388e+05
min              0.000000e+00        0.000000e+00
25%              4.668000e+03        9.000000e+02
50%              2.530900e+04        7.343000e+03
75%              1.234925e+05        4.409800e+04
max              2.474100e+07        2.242429e+07
```

	total_vaccinations_per_hundred	people_vaccinated_per_hundred	\
count	43607.000000	41294.000000	
mean	80.188543	40.927317	
std	67.913577	29.290759	
min	0.000000	0.000000	
25%	16.050000	11.370000	
50%	67.520000	41.435000	
75%	132.735000	67.910000	
max	345.370000	124.760000	

	people_fully_vaccinated_per_hundred	daily_vaccinations_per_million
count	38802.000000	86213.000000
mean	35.523243	3257.049157
std	28.376252	3934.312440
min	0.000000	0.000000
25%	7.020000	636.000000
50%	31.750000	2050.000000
75%	62.080000	4682.000000
max	122.370000	117497.000000

```
pd.to_datetime(data.date)
data.country.value_counts()
```

```
country
Norway                                 482
Latvia                                 480
Denmark                                476
United States                          471
Russia                                 470
                                      ...
Bonaire Sint Eustatius and Saba        146
Tokelau                                114
Saint Helena                            92
Pitcairn                                85
Falkland Islands                        67
Name: count, Length: 223, dtype: int 64
```



Statistical Analysis:

1. **Hypothesis Testing**

Perform hypothesis tests to determine if there are statistically significant differences in vaccination rates between different groups or regions. For example, you can use t-tests or ANOVA to compare vaccination rates by age groups or between different states.

2. **Regression Analysis**

Perform regression analysis to model the factors that influence vaccination rates. Multiple linear regression or logistic regression can help you understand which variables have the most significant impact on vaccination rates.

```
data.vaccines.value_counts()
```

```
vaccines
Johnson&Johnson, Moderna, Oxford/AstraZeneca, Pfizer/BioNTech                 7608
Moderna, Oxford/AstraZeneca, Pfizer/BioNTech                                  6263
Oxford/AstraZeneca                                                            6022

Oxford/AstraZeneca, Pfizer/BioNTech                                           4629
Johnson&Johnson, Moderna, Novavax, Oxford/AstraZeneca, Pfizer/BioNTech        3564
                                                                               ...
Johnson&Johnson, Oxford/AstraZeneca, Sinovac                                   312
Moderna, Oxford/AstraZeneca, Pfizer/BioNTech, Sinovac, Sputnik V               311
Johnson&Johnson, Moderna                                                       251
Johnson&Johnson, Pfizer/BioNTech, Sinopharm/Beijing                            228
EpiVacCorona, Oxford/AstraZeneca, QazVac, Sinopharm/Beijing, Sputnik V, ZF2001 190
Name: count, Length: 84, dtype: int64
```

```
df = data[["vaccines", "country"]]
```

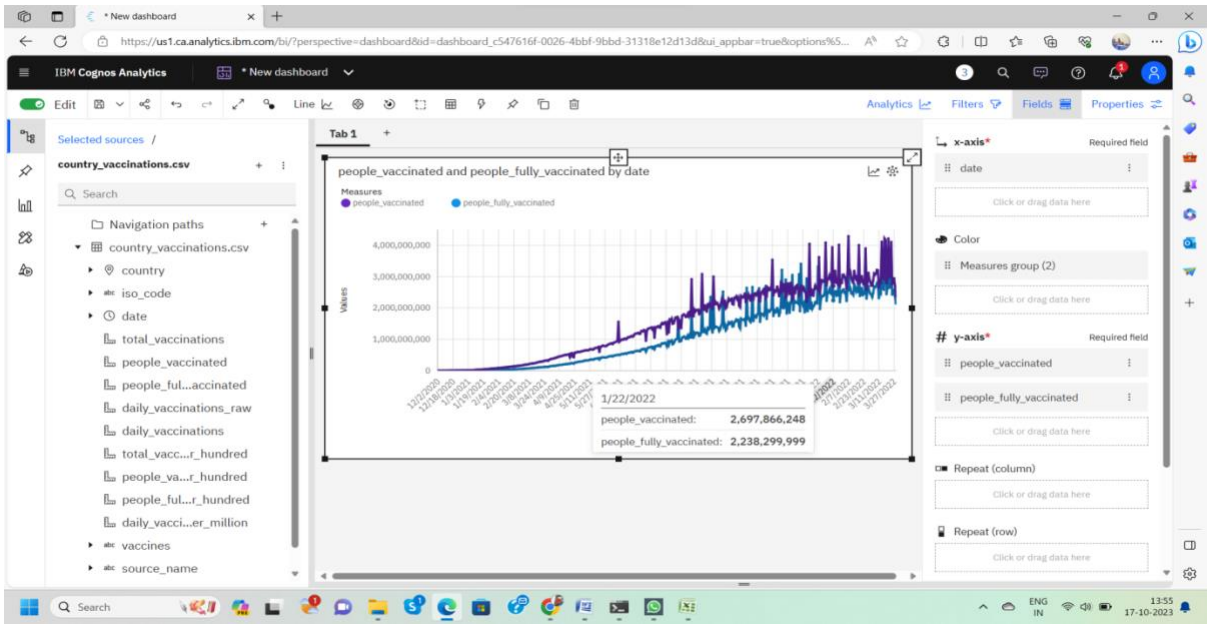
```
df.head()
```

	vaccines	country
0	Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...	Afghanistan
1	Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...	Afghanistan
2	Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...	Afghanistan
3	Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...	Afghanistan
4	Johnson&Johnson, Oxford/AstraZeneca, Pfizer/Bi...	Afghanistan

Exploratory Data Analysis

Data Virtualization

It an approach to data management that allows an application to retrieve and manipulate data without requiring technical details about the data, such as how it is formatted at source, or where it is physically located, and can provide a single customer view of the overall data.



Conclusion

In this initial phase of our COVID-19 vaccine analysis project, we successfully collected and preprocessed the vaccine data.

Summarize your findings, including any significant correlations or differences identified in the analysis.

Provide recommendations based on your analysis. For example, you might recommend prioritizing vaccination efforts in countries with low vaccination rates to reduce infection rates and mortality.