

## **COVID VACCINES ANALYSIS**

### **PHASE 3-DATA ANALYTICS WITH COGNOS GROUP 2**

#### **DEVELOPMENT PART 1**

This phase involves designing of the steps that define in each phase of the previous documentation this involves importing necessary functions, data processing and so on. In this phase we have to begin our project by loading and preprocessing the dataset.

The IBM suggests using the jupyter notebook for loading and preprocess the dataset:

Here for this project title we need to define the loading of the libraries, understand the data and visualize the missing values. For this certain inputs are defined for this project.in this phase each of the input lines of the project is given as follows:

#### **DATASET:**

##### **Dataset link:**

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

The primary data source for this COVID-19 vaccine analysis project is the Kaggle dataset titled "COVID-19 World Vaccination Progress." It contains comprehensive and reliable information on global COVID-19 vaccination efforts, sourced from government health agencies, the World Health Organization, and other official records. The dataset includes key attributes like vaccine details, country-specific vaccination statistics, and population data. Preliminary data cleaning and preprocessing have been performed to ensure data quality. This dataset will serve as the foundation for subsequent analysis stages, including data exploration and modeling for insights into vaccine efficacy, distribution, and adverse effects.

# dac-cva-phase3

October 17, 2023

```
[1]: #1. Download the dataset from Kaggle: https://www.kaggle.com/datasets/gpreda/covid-world-vaccination-progress/
```

```
#2.Import the required libraries:
```

```
import pandas as pd
```

```
[2]: #3.Load the dataset into a Pandas DataFrame:
```

```
df = pd.read_csv('D:/country_vaccinations.csv')
```

```
df
```

```
[2]:
```

	country	iso_code	date	total_vaccinations	\
0	Afghanistan	AFG	2021-02-22	0.0	
1	Afghanistan	AFG	2021-02-23	NaN	
2	Afghanistan	AFG	2021-02-24	NaN	
3	Afghanistan	AFG	2021-02-25	NaN	
4	Afghanistan	AFG	2021-02-26	NaN	
...	...	...	...	...	
86507	Zimbabwe	ZWE	2022-03-25	8691642.0	
86508	Zimbabwe	ZWE	2022-03-26	8791728.0	
86509	Zimbabwe	ZWE	2022-03-27	8845039.0	
86510	Zimbabwe	ZWE	2022-03-28	8934360.0	
86511	Zimbabwe	ZWE	2022-03-29	9039729.0	

  

	people_vaccinated	people_fully_vaccinated	daily_vaccinations_raw	\
0	0.0	NaN	NaN	
1	NaN	NaN	NaN	
2	NaN	NaN	NaN	
3	NaN	NaN	NaN	
4	NaN	NaN	NaN	
...	...	...	...	
86507	4814582.0	3473523.0	139213.0	
86508	4886242.0	3487962.0	100086.0	
86509	4918147.0	3493763.0	53311.0	
86510	4975433.0	3501493.0	89321.0	

86511	5053114.0	3510256.0	105369.0
-------	-----------	-----------	----------

	daily_vaccinations	total_vaccinations_per_hundred	\
0	NaN	0.00	
1	1367.0	NaN	
2	1367.0	NaN	
3	1367.0	NaN	
4	1367.0	NaN	
...	...	...	
86507	69579.0	57.59	
86508	83429.0	58.25	
86509	90629.0	58.61	
86510	100614.0	59.20	
86511	103751.0	59.90	

	people_vaccinated_per_hundred	people_fully_vaccinated_per_hundred	\
0	0.00	NaN	
1	NaN	NaN	
2	NaN	NaN	
3	NaN	NaN	
4	NaN	NaN	
...	...	...	
86507	31.90	23.02	
86508	32.38	23.11	
86509	32.59	23.15	
86510	32.97	23.20	
86511	33.48	23.26	

	daily_vaccinations_per_million	\
0	NaN	
1	34.0	
2	34.0	
3	34.0	
4	34.0	
...	...	
86507	4610.0	
86508	5528.0	
86509	6005.0	
86510	6667.0	
86511	6874.0	

	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...	

```

...
86507 Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86508 Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86509 Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86510 Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86511 Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...

```

```

          source_name \
0      World Health Organization
1      World Health Organization
2      World Health Organization
3      World Health Organization
4      World Health Organization

```

```

...
86507      Ministry of Health
86508      Ministry of Health
86509      Ministry of Health
86510      Ministry of Health
86511      Ministry of Health

```

```

          source_website
0      https://covid19.who.int/
1      https://covid19.who.int/
2      https://covid19.who.int/
3      https://covid19.who.int/
4      https://covid19.who.int/

```

```

...
86507 https://www.arcgis.com/home/webmap/viewer.html...
86508 https://www.arcgis.com/home/webmap/viewer.html...
86509 https://www.arcgis.com/home/webmap/viewer.html...
86510 https://www.arcgis.com/home/webmap/viewer.html...
86511 https://www.arcgis.com/home/webmap/viewer.html...

```

[86512 rows x 15 columns]

[3]: *#DATA PREPROCESSING:*

```

#1.Handling Missing Values:

# Check for missing values
df.isnull().sum()

```

```

[3]: country          0
     iso_code         0
     date             0
     total_vaccinations 42905
     people_vaccinated 45218

```

```

people_fully_vaccinated      47710
daily_vaccinations_raw      51150
daily_vaccinations           299
total_vaccinations_per_hundred 42905
people_vaccinated_per_hundred 45218
people_fully_vaccinated_per_hundred 47710
daily_vaccinations_per_million 299
vaccines                     0
source_name                  0
source_website               0
dtype: int64

```

[4]: *# Fill missing values with appropriate values (e.g., mean, median, or a specific value)*

```

df.fillna({'total_vaccinations': 0,
          'people_vaccinated': 0,
          'people_fully_vaccinated':0,
          'daily_vaccinations_raw':0,
          'daily_vaccinations':0,
          'total_vaccinations_per_hundred': 0,
          'people_vaccinated_per_hundred': 0,
          'people_fully_vaccinated_per_hundred':0,
          'daily_vaccinations_per_million':0}, inplace=True)

df.isnull().sum()

```

[4]:

```

country      0
iso_code     0
date         0
total_vaccinations      0
people_vaccinated      0
people_fully_vaccinated      0
daily_vaccinations_raw      0
daily_vaccinations      0
total_vaccinations_per_hundred      0
people_vaccinated_per_hundred      0
people_fully_vaccinated_per_hundred      0
daily_vaccinations_per_million      0
vaccines      0
source_name    0
source_website 0
dtype: int64

```

[5]: *#2.Data Type Conversion:*

```

df['date'] = pd.to_datetime(df['date'])

```

df

```
[5]:
```

	country	iso_code	date	total_vaccinations	people_vaccinated	\
0	Afghanistan	AFG	2021-02-22	0.0	0.0	
1	Afghanistan	AFG	2021-02-23	0.0	0.0	
2	Afghanistan	AFG	2021-02-24	0.0	0.0	
3	Afghanistan	AFG	2021-02-25	0.0	0.0	
4	Afghanistan	AFG	2021-02-26	0.0	0.0	
...	...	...	...	...	...	
86507	Zimbabwe	ZWE	2022-03-25	8691642.0	4814582.0	
86508	Zimbabwe	ZWE	2022-03-26	8791728.0	4886242.0	
86509	Zimbabwe	ZWE	2022-03-27	8845039.0	4918147.0	
86510	Zimbabwe	ZWE	2022-03-28	8934360.0	4975433.0	
86511	Zimbabwe	ZWE	2022-03-29	9039729.0	5053114.0	

  

	people_fully_vaccinated	daily_vaccinations_raw	daily_vaccinations	\
0	0.0	0.0	0.0	
1	0.0	0.0	1367.0	
2	0.0	0.0	1367.0	
3	0.0	0.0	1367.0	
4	0.0	0.0	1367.0	
...	...	...	...	
86507	3473523.0	139213.0	69579.0	
86508	3487962.0	100086.0	83429.0	
86509	3493763.0	53311.0	90629.0	
86510	3501493.0	89321.0	100614.0	
86511	3510256.0	105369.0	103751.0	

  

	total_vaccinations_per_hundred	people_vaccinated_per_hundred	\
0	0.00	0.00	
1	0.00	0.00	
2	0.00	0.00	
3	0.00	0.00	
4	0.00	0.00	
...	...	...	
86507	57.59	31.90	
86508	58.25	32.38	
86509	58.61	32.59	
86510	59.20	32.97	
86511	59.90	33.48	

  

	people_fully_vaccinated_per_hundred	daily_vaccinations_per_million	\
0	0.00	0.0	
1	0.00	34.0	
2	0.00	34.0	
3	0.00	34.0	
4	0.00	34.0	

...	...	...
86507	23.02	4610.0
86508	23.11	5528.0
86509	23.15	6005.0
86510	23.20	6667.0
86511	23.26	6874.0

	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...
...	...
86507	Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86508	Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86509	Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86510	Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86511	Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...

	source_name \
0	World Health Organization
1	World Health Organization
2	World Health Organization
3	World Health Organization
4	World Health Organization
...	...
86507	Ministry of Health
86508	Ministry of Health
86509	Ministry of Health
86510	Ministry of Health
86511	Ministry of Health

	source_website
0	<a href="https://covid19.who.int/">https://covid19.who.int/</a>
1	<a href="https://covid19.who.int/">https://covid19.who.int/</a>
2	<a href="https://covid19.who.int/">https://covid19.who.int/</a>
3	<a href="https://covid19.who.int/">https://covid19.who.int/</a>
4	<a href="https://covid19.who.int/">https://covid19.who.int/</a>
...	...
86507	<a href="https://www.arcgis.com/home/webmap/viewer.html">https://www.arcgis.com/home/webmap/viewer.html</a> ...
86508	<a href="https://www.arcgis.com/home/webmap/viewer.html">https://www.arcgis.com/home/webmap/viewer.html</a> ...
86509	<a href="https://www.arcgis.com/home/webmap/viewer.html">https://www.arcgis.com/home/webmap/viewer.html</a> ...
86510	<a href="https://www.arcgis.com/home/webmap/viewer.html">https://www.arcgis.com/home/webmap/viewer.html</a> ...
86511	<a href="https://www.arcgis.com/home/webmap/viewer.html">https://www.arcgis.com/home/webmap/viewer.html</a> ...

[86512 rows x 15 columns]

[6]: #3.Handling Duplicates:

```
df.drop_duplicates(inplace=True)
```

df

```
[6]:
```

	country	iso_code	date	total_vaccinations	people_vaccinated	\
0	Afghanistan	AFG	2021-02-22	0.0	0.0	
1	Afghanistan	AFG	2021-02-23	0.0	0.0	
2	Afghanistan	AFG	2021-02-24	0.0	0.0	
3	Afghanistan	AFG	2021-02-25	0.0	0.0	
4	Afghanistan	AFG	2021-02-26	0.0	0.0	
...	...	...	...	...	...	
86507	Zimbabwe	ZWE	2022-03-25	8691642.0	4814582.0	
86508	Zimbabwe	ZWE	2022-03-26	8791728.0	4886242.0	
86509	Zimbabwe	ZWE	2022-03-27	8845039.0	4918147.0	
86510	Zimbabwe	ZWE	2022-03-28	8934360.0	4975433.0	
86511	Zimbabwe	ZWE	2022-03-29	9039729.0	5053114.0	
...	...	...	...	...	...	
	people_fully_vaccinated	daily_vaccinations_raw	daily_vaccinations	\		
0	0.0	0.0	0.0			
1	0.0	0.0	1367.0			
2	0.0	0.0	1367.0			
3	0.0	0.0	1367.0			
4	0.0	0.0	1367.0			
...	...	...	...			
86507	3473523.0	139213.0	69579.0			
86508	3487962.0	100086.0	83429.0			
86509	3493763.0	53311.0	90629.0			
86510	3501493.0	89321.0	100614.0			
86511	3510256.0	105369.0	103751.0			
...	...	...	...			
	total_vaccinations_per_hundred	people_vaccinated_per_hundred	\			
0	0.00	0.00				
1	0.00	0.00				
2	0.00	0.00				
3	0.00	0.00				
4	0.00	0.00				
...	...	...				
86507	57.59	31.90				
86508	58.25	32.38				
86509	58.61	32.59				
86510	59.20	32.97				
86511	59.90	33.48				
...	...	...				
	people_fully_vaccinated_per_hundred	daily_vaccinations_per_million	\			
0	0.00	0.0				



1	0.00	34.0
2	0.00	34.0
3	0.00	34.0
4	0.00	34.0
...	...	...
86507	23.02	4610.0
86508	23.11	5528.0
86509	23.15	6005.0
86510	23.20	6667.0
86511	23.26	6874.0

	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...
...	...
86507	Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86508	Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86509	Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86510	Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86511	Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...

	source_name \
0	World Health Organization
1	World Health Organization
2	World Health Organization
3	World Health Organization
4	World Health Organization
...	...
86507	Ministry of Health
86508	Ministry of Health
86509	Ministry of Health
86510	Ministry of Health
86511	Ministry of Health

	source_website
0	<a href="https://covid19.who.int/">https://covid19.who.int/</a>
1	<a href="https://covid19.who.int/">https://covid19.who.int/</a>
2	<a href="https://covid19.who.int/">https://covid19.who.int/</a>
3	<a href="https://covid19.who.int/">https://covid19.who.int/</a>
4	<a href="https://covid19.who.int/">https://covid19.who.int/</a>
...	...
86507	<a href="https://www.arcgis.com/home/webmap/viewer.html">https://www.arcgis.com/home/webmap/viewer.html</a> ...
86508	<a href="https://www.arcgis.com/home/webmap/viewer.html">https://www.arcgis.com/home/webmap/viewer.html</a> ...
86509	<a href="https://www.arcgis.com/home/webmap/viewer.html">https://www.arcgis.com/home/webmap/viewer.html</a> ...

```
86510 https://www.arcgis.com/home/webmap/viewer.html...
86511 https://www.arcgis.com/home/webmap/viewer.html...
```

```
[86512 rows x 15 columns]
```

```
[7]: #4. Data Scaling and Normalization:
```

```
from sklearn.preprocessing import StandardScaler
scaler = StandardScaler()
df[['total_vaccinations', 'people_vaccinated']] = scaler.
    ↪fit_transform(df[['total_vaccinations', 'people_vaccinated']])

df
```

```
[7]:
```

	country	iso_code	date	total_vaccinations	people_vaccinated	\
0	Afghanistan	AFG	2021-02-22	-0.143704	-0.170046	
1	Afghanistan	AFG	2021-02-23	-0.143704	-0.170046	
2	Afghanistan	AFG	2021-02-24	-0.143704	-0.170046	
3	Afghanistan	AFG	2021-02-25	-0.143704	-0.170046	
4	Afghanistan	AFG	2021-02-26	-0.143704	-0.170046	
...	...	...	...	...	...	
86507	Zimbabwe	ZWE	2022-03-25	-0.089753	-0.073170	
86508	Zimbabwe	ZWE	2022-03-26	-0.089132	-0.071728	
86509	Zimbabwe	ZWE	2022-03-27	-0.088801	-0.071086	
86510	Zimbabwe	ZWE	2022-03-28	-0.088247	-0.069933	
86511	Zimbabwe	ZWE	2022-03-29	-0.087593	-0.068370	

	people_fully_vaccinated	daily_vaccinations_raw	daily_vaccinations	\
0	0.0	0.0	0.0	
1	0.0	0.0	1367.0	
2	0.0	0.0	1367.0	
3	0.0	0.0	1367.0	
4	0.0	0.0	1367.0	
...	...	...	...	
86507	3473523.0	139213.0	69579.0	
86508	3487962.0	100086.0	83429.0	
86509	3493763.0	53311.0	90629.0	
86510	3501493.0	89321.0	100614.0	
86511	3510256.0	105369.0	103751.0	

	total_vaccinations_per_hundred	people_vaccinated_per_hundred	\
0	0.00	0.00	
1	0.00	0.00	
2	0.00	0.00	
3	0.00	0.00	
4	0.00	0.00	
...	...	...	

86507	57.59	31.90
86508	58.25	32.38
86509	58.61	32.59
86510	59.20	32.97
86511	59.90	33.48

	people_fully_vaccinated_per_hundred	daily_vaccinations_per_million \
0	0.00	0.0
1	0.00	34.0
2	0.00	34.0
3	0.00	34.0
4	0.00	34.0
...	...	...
86507	23.02	4610.0
86508	23.11	5528.0
86509	23.15	6005.0
86510	23.20	6667.0
86511	23.26	6874.0

	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...
...	...
86507	Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86508	Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86509	Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86510	Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...
86511	Oxford/AstraZeneca, Sinopharm/Beijing, Sinovac...

	source_name \
0	World Health Organization
1	World Health Organization
2	World Health Organization
3	World Health Organization
4	World Health Organization
...	...
86507	Ministry of Health
86508	Ministry of Health
86509	Ministry of Health
86510	Ministry of Health
86511	Ministry of Health

	source_website
0	<a href="https://covid19.who.int/">https://covid19.who.int/</a>

```

1          https://covid19.who.int/
2          https://covid19.who.int/
3          https://covid19.who.int/
4          https://covid19.who.int/
...
86507 https://www.arcgis.com/home/webmap/viewer.html...
86508 https://www.arcgis.com/home/webmap/viewer.html...
86509 https://www.arcgis.com/home/webmap/viewer.html...
86510 https://www.arcgis.com/home/webmap/viewer.html...
86511 https://www.arcgis.com/home/webmap/viewer.html...

```

[86512 rows x 15 columns]

[8]: #5.Encoding Categorical Variables:

```
df = pd.get_dummies(df, columns=['country', 'vaccines'], drop_first=True)
```

df

```

[8]:      iso_code      date  total_vaccinations  people_vaccinated \
0          AFG  2021-02-22          -0.143704          -0.170046
1          AFG  2021-02-23          -0.143704          -0.170046
2          AFG  2021-02-24          -0.143704          -0.170046
3          AFG  2021-02-25          -0.143704          -0.170046
4          AFG  2021-02-26          -0.143704          -0.170046
...
86507      ZWE  2022-03-25          -0.089753          -0.073170
86508      ZWE  2022-03-26          -0.089132          -0.071728
86509      ZWE  2022-03-27          -0.088801          -0.071086
86510      ZWE  2022-03-28          -0.088247          -0.069933
86511      ZWE  2022-03-29          -0.087593          -0.068370

      people_fully_vaccinated  daily_vaccinations_raw  daily_vaccinations \
0                          0.0                      0.0                0.0
1                          0.0                      0.0             1367.0
2                          0.0                      0.0             1367.0
3                          0.0                      0.0             1367.0
4                          0.0                      0.0             1367.0
...
86507                    3473523.0                139213.0             69579.0
86508                    3487962.0                100086.0             83429.0
86509                    3493763.0                 53311.0             90629.0
86510                    3501493.0                 89321.0            100614.0
86511                    3510256.0                105369.0            103751.0

      total_vaccinations_per_hundred  people_vaccinated_per_hundred \

```

0	0.00	0.00
1	0.00	0.00
2	0.00	0.00
3	0.00	0.00
4	0.00	0.00
...	...	...
86507	57.59	31.90
86508	58.25	32.38
86509	58.61	32.59
86510	59.20	32.97
86511	59.90	33.48

	people_fully_vaccinated_per_hundred	...	\
0	0.00	...	
1	0.00	...	
2	0.00	...	
3	0.00	...	
4	0.00	...	
...	...	...	
86507	23.02	...	
86508	23.11	...	
86509	23.15	...	
86510	23.20	...	
86511	23.26	...	

	vaccines_Oxford/AstraZeneca, Sputnik V	vaccines_Pfizer/BioNTech	\
0	0	0	
1	0	0	
2	0	0	
3	0	0	
4	0	0	
...	...	...	
86507	0	0	
86508	0	0	
86509	0	0	
86510	0	0	
86511	0	0	

	vaccines_Pfizer/BioNTech, Sinopharm/Beijing	\
0	0	
1	0	
2	0	
3	0	
4	0	
...	...	
86507	0	
86508	0	

86509	0
86510	0
86511	0

  

vaccines_Pfizer/BioNTech, Sinopharm/Beijing, Sputnik V \	
0	0
1	0
2	0
3	0
4	0
...	...
86507	0
86508	0
86509	0
86510	0
86511	0

  

vaccines_Pfizer/BioNTech, Sinovac \	
0	0
1	0
2	0
3	0
4	0
...	...
86507	0
86508	0
86509	0
86510	0
86511	0

  

vaccines_Pfizer/BioNTech, Sinovac, Turkovac \	
0	0
1	0
2	0
3	0
4	0
...	...
86507	0
86508	0
86509	0
86510	0
86511	0

  

vaccines_Pfizer/BioNTech, Sputnik V \	
0	0
1	0
2	0

3	0
4	0
...	...
86507	0
86508	0
86509	0
86510	0
86511	0

vaccines_QazVac, Sinopharm/Beijing, Sputnik V \	
0	0
1	0
2	0
3	0
4	0
...	...
86507	0
86508	0
86509	0
86510	0
86511	0

vaccines_Sinopharm/Beijing		vaccines_Sinopharm/Beijing, Sputnik V	
0	0		0
1	0		0
2	0		0
3	0		0
4	0		0
...	...	...	
86507	0		0
86508	0		0
86509	0		0
86510	0		0
86511	0		0

[86512 rows x 318 columns]

[9]: #6.Feature Selection:

```
df = df[['iso_code', 'date', 'total_vaccinations', 'people_vaccinated']]
df
```

	iso_code	date	total_vaccinations	people_vaccinated
0	AFG	2021-02-22	-0.143704	-0.170046
1	AFG	2021-02-23	-0.143704	-0.170046
2	AFG	2021-02-24	-0.143704	-0.170046

3	AFG	2021-02-25	-0.143704	-0.170046
4	AFG	2021-02-26	-0.143704	-0.170046
...	...	...	...	...
86507	ZWE	2022-03-25	-0.089753	-0.073170
86508	ZWE	2022-03-26	-0.089132	-0.071728
86509	ZWE	2022-03-27	-0.088801	-0.071086
86510	ZWE	2022-03-28	-0.088247	-0.069933
86511	ZWE	2022-03-29	-0.087593	-0.068370

[86512 rows x 4 columns]

[10]: *#7.Date-Based Features:*

```
df['month'] = df['date'].dt.month
df['day_of_week'] = df['date'].dt.dayofweek
```

*#8.Outlier Detection and Handling:*

```
import numpy as np
from scipy import stats
```

*# Detect outliers using the IQR method*

```
Q1 = df['total_vaccinations'].quantile(0.25)
Q3 = df['total_vaccinations'].quantile(0.75)
IQR = Q3 - Q1
lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR
```

*# Remove outliers*

```
df = df[(df['total_vaccinations'] >= lower_bound) & (df['total_vaccinations']_
    ↪ <= upper_bound)]
```

```
df
```

C:\Users\PC\AppData\Local\Temp\ipykernel\_8540\1495377907.py:3:

SettingWithCopyWarning:

A value is trying to be set on a copy of a slice from a DataFrame.

Try using `.loc[row_indexer,col_indexer] = value` instead

See the caveats in the documentation: [https://pandas.pydata.org/pandas-docs/stable/user\\_guide/indexing.html#returning-a-view-versus-a-copy](https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)

```
df['month'] = df['date'].dt.month
```

C:\Users\PC\AppData\Local\Temp\ipykernel\_8540\1495377907.py:4:

SettingWithCopyWarning:

A value is trying to be set on a copy of a slice from a DataFrame.

Try using `.loc[row_indexer,col_indexer] = value` instead



See the caveats in the documentation: [https://pandas.pydata.org/pandas-docs/stable/user\\_guide/indexing.html#returning-a-view-versus-a-copy](https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)

```
df['day_of_week'] = df['date'].dt.dayofweek
```

```
[10]:
```

	iso_code	date	total_vaccinations	people_vaccinated	month	\
0	AFG	2021-02-22	-0.143704	-0.170046	2	
1	AFG	2021-02-23	-0.143704	-0.170046	2	
2	AFG	2021-02-24	-0.143704	-0.170046	2	
3	AFG	2021-02-25	-0.143704	-0.170046	2	
4	AFG	2021-02-26	-0.143704	-0.170046	2	
...	...	...	...	...	...	
86507	ZWE	2022-03-25	-0.089753	-0.073170	3	
86508	ZWE	2022-03-26	-0.089132	-0.071728	3	
86509	ZWE	2022-03-27	-0.088801	-0.071086	3	
86510	ZWE	2022-03-28	-0.088247	-0.069933	3	
86511	ZWE	2022-03-29	-0.087593	-0.068370	3	

```

      day_of_week
0              0
1              1
2              2
3              3
4              4
...
86507          4
86508          5
86509          6
86510          0
86511          1

```

[70909 rows x 6 columns]

```
[11]: #9.Data Splitting:

from sklearn.model_selection import train_test_split

# Replace 'actual_target_column_name' with the correct column name
X = df.drop('total_vaccinations', axis=1) # Features
y = df['people_vaccinated'] # Target variable

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,
                                                    random_state=42)

#10.Save Preprocessed Data:

df.to_csv('preprocessed_data.csv', index=False)
```

```
df
```

```
[11]:
```

	iso_code	date	total_vaccinations	people_vaccinated	month	\
0	AFG	2021-02-22	-0.143704	-0.170046	2	
1	AFG	2021-02-23	-0.143704	-0.170046	2	
2	AFG	2021-02-24	-0.143704	-0.170046	2	
3	AFG	2021-02-25	-0.143704	-0.170046	2	
4	AFG	2021-02-26	-0.143704	-0.170046	2	
...	...	...	...	...	...	
86507	ZWE	2022-03-25	-0.089753	-0.073170	3	
86508	ZWE	2022-03-26	-0.089132	-0.071728	3	
86509	ZWE	2022-03-27	-0.088801	-0.071086	3	
86510	ZWE	2022-03-28	-0.088247	-0.069933	3	
86511	ZWE	2022-03-29	-0.087593	-0.068370	3	

	day_of_week
0	0
1	1
2	2
3	3
4	4
...	...
86507	4
86508	5
86509	6
86510	0
86511	1

```
[70909 rows x 6 columns]
```

```
[ ]:
```