MSDS422 Assignment 1 Group 4:

Exploring and Visualizing COVID 19 Data

COVID 19 is an ongoing threat. Data for the outbreak are available here: https://www.ecdc.europa.eu/en/publications-data/download-todays-data-geographic-distribution-covid-19-cases-worldwide (https://www.ecdc.europa.eu/en/publications-data/download-todays-data-geographic-distribution-covid-19-cases-worldwide)

Data preparation (10 points) Data exploration (10 points) Data visualization (10 points) Data scaling and comparisons (10 points) Insights from analysis (10 points)

To do List

Provide appropriate descriptive statistics / visualizations to help understand the spread of the disease (incidence) as well as its fatality rate.

You should also engage in feature creation and variable transformation.

At a bare minimum, feature creation should include generating rates per X in the population (i.e., rates per million).

Investigate time series as well as univariate and bivariate distribution graphs.

Write Up

Overview – As COVID-19 has impacted our daily lives in the US and around the world, we are seeing science at work to analyze and attempt to understand this novel virus. Our group used data analysis methods in an attempt to better understand how the virus is spreading and attribution.

Data preparation & exploration – We utilized the data source to analyze the 40K+ entries over 13 columns. We checked for missing values and drew up some initial summary statistics to understand the data itself. Then throughout the analysis kept track of any data issues (like negative numbers) to ensure we understood outliers or factors that would skew analysis.

Data visualization & understanding the spread of disease (incidence) as well as fatality rate –

From there we began to use various tools in Python to analyze (see detail in appendix). Based on our findings, we came up with the following conclusions around case trends:

1. From March onwards, there was a sudden spike in the number of cases for Europe which was later matched by the Americas in April 2020.
2. For Europe, the number of new cases saw a peak in May and then gradually went down until August. From September, Europe is again seeing a spike, which can be attributed to all the common places opening for public again.
3. For the Americas, we can observe a spike in the number of cases over every month, with an exception of September where we see a month over month decline, for the first time since the onset.
4. Asia initially had a slow trend in the number of cases. That can be because of a smaller number of testing that has happened because of insufficient number of testing equipment.
5. After July, we can observe a sudden spike in Asia which can be attributed to the surge in new COVID cases in India post lockdown, i.e. from the month of May 2020 onwards. The same is obvious from the country and month year pivot on number of cases. We can see that Asia has passed monthly cases of Americas in September 2020.
6. Africa and Oceania/Other are contributing through a small number to the overall number of cases.

We can observe following points on total number of deaths:

1. From March 2020 onwards, we can see the sudden growth in number of deaths, especially in Europe and America. This aligns in some ways to the data and trend we see with cases.
2. For Europe we can see that after May 2020, there is a drastic fall in total number of deaths, which by pattern is also in agreement with the pattern shown by number of cases. This can be due to severe lockdown measures implemented by the most affected countries in Europe like United Kingdom, Spain, Russia and Italy.
3. Americas saw a sudden peak in number of deaths in April 2020, post which there has been a steady month over month growth in the number of COVID related deaths.
4. Overall number of deaths compared to the total number of registered cases is less in Asia when compared to other continents.

In looking at data in the scatter plot we can negative death count for the month "5-2020" and continent "Europe". This may be based on an incorrect entry or an adjustment made in the data for Spain on 25-May-2020, where -372 new cases where registered and -1918 deaths we registered.

Furthermore, if we look at death percentage as a rate of death vs. cases and population per geographic region, we see that Europe had the highest rate of death, followed by America. When visualizing cases, deaths and rate of death in one visual, you see that America is highest in cases and deaths, but Europe had higher rate of death relative to cases. This could be a true indicator of how deadly the virus is, how different geographic regions responded, population density, and also may be skewed based on the number of test /

In [ ]:

```python
#Import all libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from pandas.plotting import scatter_matrix
import altair as alt
import json
import os
%matplotlib inline
```

In [ ]:

```python
#Read training data
FILE_PATH = os.path.join('')

def load_training_data(file_path=FILE_PATH):
    xl_path = os.path.join(file_path, 'COVID-19-geographic-disbtribution-worldwide-2020-09-14.xlsx')
    return pd.read_excel(xl_path)

#loading the data
df_train = load_training_data()
```

In [ ]:

```python
df_train.head()
```

Out[ ]:

```
     dateRep  day  month  year  cases  deaths  countriesAndTerritories  geoId  countryterrito
0 2020-09-14   14      9  2020     75       0              Afghanistan     AF
1 2020-09-13   13      9  2020     35       0              Afghanistan     AF
2 2020-09-12   12      9  2020     34       0              Afghanistan     AF
3 2020-09-11   11      9  2020     28       0              Afghanistan     AF
4 2020-09-10   10      9  2020     24       2              Afghanistan     AF
```

In [ ]:

```python
df_train["month_year"] = df_train["month"].astype(str) + '-' + df_train["year"].astype(str)
```

In [ ]:

```python
#df1_train = df_train[['month_year', 'cases', 'deaths', 'popData2019', 'continentExp', 'Cumulative_number_for_14_days_of_COVID-19_cases_per_100000']]
```

In [ ]:

```python
#df1_train
```

In [ ]:

```
df_train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 42673 entries, 0 to 42672
Data columns (total 13 columns):
 #   Column                                                      Non-
Null Count  Dtype         
---  ------                                                      
--------------  -----         
 0   dateRep                                                     4267
3 non-null  datetime64[ns]
 1   day                                                         4267
3 non-null  int64         
 2   month                                                       4267
3 non-null  int64         
 3   year                                                        4267
3 non-null  int64         
 4   cases                                                       4267
3 non-null  int64         
 5   deaths                                                      4267
3 non-null  int64         
 6   countriesAndTerritories                                     4267
3 non-null  object        
 7   geoId                                                       4248
9 non-null  object        
 8   countryterritoryCode                                        4260
9 non-null  object        
 9   popData2019                                                 4260
9 non-null  float64       
 10  continentExp                                                4267
3 non-null  object        
 11  Cumulative_number_for_14_days_of_COVID-19_cases_per_100000  3989
2 non-null  float64       
 12  month_year                                                  4267
3 non-null  object        
dtypes: datetime64[ns](1), float64(2), int64(5), object(5)
memory usage: 4.2+ MB
```

In [ ]:

```
df_train.describe()
```

Out[ ]:

	day	month	year	cases	deaths	popData2019
count	42673.000000	42673.000000	42673.000000	42673.000000	42673.000000	4.260900e+04
mean	15.613901	5.536194	2019.998430	680.738031	21.669580	4.302201e+07
std	8.878207	2.167818	0.039594	4243.550272	126.481505	1.582496e+08
min	1.000000	1.000000	2019.000000	-8261.000000	-1918.000000	8.150000e+02
25%	8.000000	4.000000	2020.000000	0.000000	0.000000	1.355982e+06
50%	15.000000	6.000000	2020.000000	9.000000	0.000000	8.519373e+06
75%	23.000000	7.000000	2020.000000	144.000000	3.000000	2.916192e+07
max	31.000000	12.000000	2020.000000	97570.000000	4928.000000	1.433784e+09

In [ ]:

```
# Checking the missing values
df_train.isnull().sum()
```

Out[ ]:

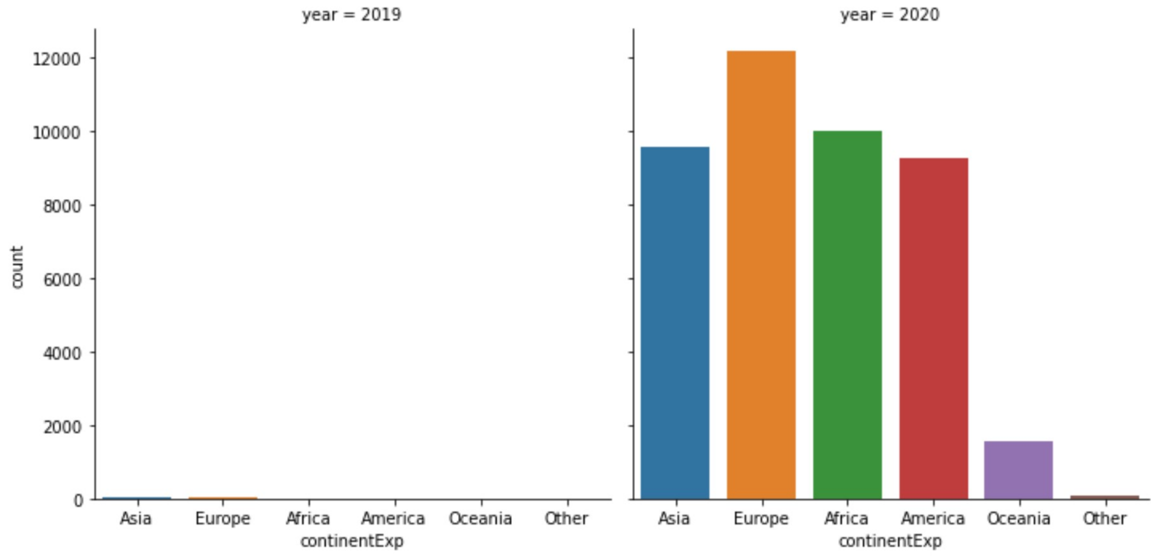
```
dateRep                                                       0
day                                                           0
month                                                         0
year                                                          0
cases                                                         0
deaths                                                        0
countriesAndTerritories                                       0
geoId                                                       184
countryterritoryCode                                         64
popData2019                                                  64
continentExp                                                  0
Cumulative_number_for_14_days_of_COVID-19_cases_per_100000 2781
month_year                                                    0
dtype: int64
```

In [ ]:

```
#Compare by Sex the total number of people who suvived vs not
sns.catplot(x='continentExp', col='year',  data=df_train, kind = 'count') # estimator=sum);

#ax = sns.barplot(x='EXIT', y='VEH_COUNT', data=df_grp, ci=None, estimator=sum)
```

Out[ ]:

```
<seaborn.axisgrid.FacetGrid at 0x1ffc5de85c0>
```



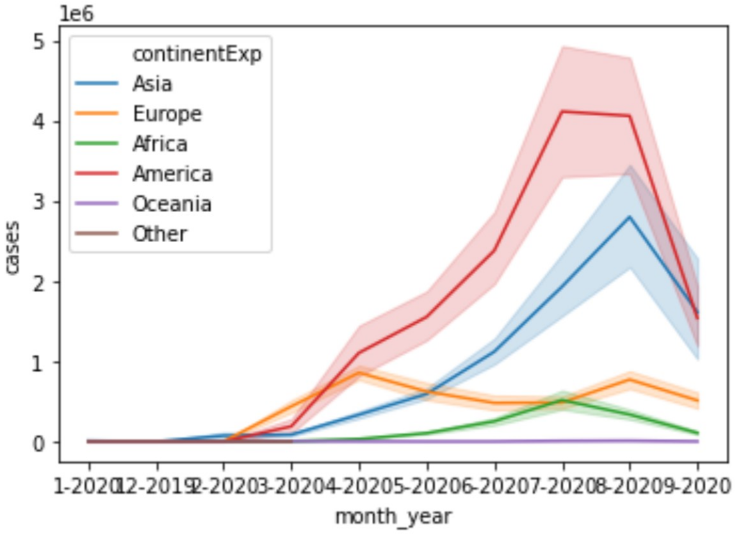
Number of cases and death trending over time (i.e. month-year) for each Continent

We can observe following points on total number of cases:

1. From March onwards there was a sudden spike in the number of cases for Europe which was later joined by Americas in April 2020.
2. For Europe, the number of new cases saw a peak in May and then it gradually went down until August. From September, Europe is again seeing spike, which can be attributed to all the common places opening for public again.
3. For Americas we can observe a spike in the number of cases over every month, with an exception of September where we see a Month over month decline in September.
4. Asia initially had a slow trend in the number of cases. That can be because of less number of testing that has happened bacause of insufficient number of testing equipments.
5. Post July, we can observe a sudden spike in Asia which can be attributed to the surge in new corona cases in India post lockdown, i.e. from the month of May 2020 onwards. The same is obvious from the country and month_year pivot on number of cases. We can see that Asia has passed monthly cases of Americas in September 2020.
6. Africa and 2 others are contributing through a small number to the overall number of cases.

In [ ]:

```
sns.lineplot(data=df_train, hue = "continentExp", x="month_year", y="cases", estimator="sum");
```



In [ ]:

```
x = df_train[(df_train['continentExp']=='Asia')] ## & (df_train['month_year'] == '4-2020')]
#x.groupby(['countriesAndTerritories']).sum()['cases'].reset_index()
x_agg = x.groupby(['countriesAndTerritories','month_year']).agg({'cases':sum})
x_agg.sort_values(['cases'],ascending=False).head(15)
```

Out[ ]:

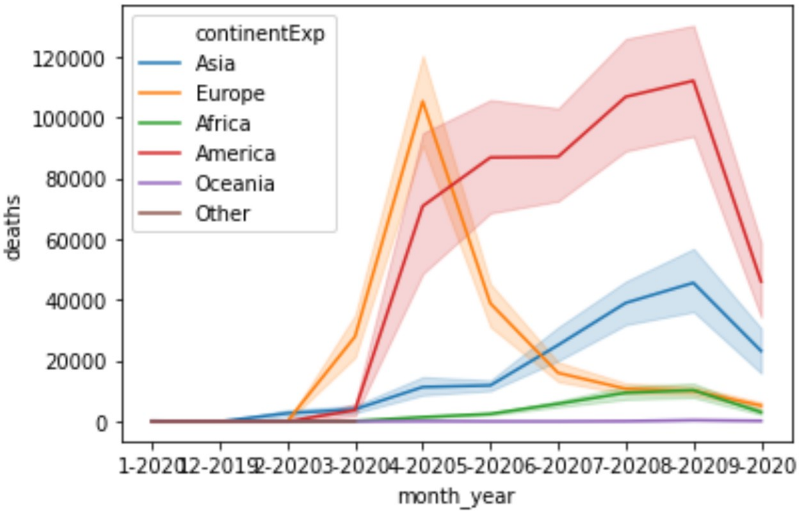
		cases
countriesAndTerritories	month_year	
India	8-2020	1982375
	9-2020	1225182
	7-2020	1072030
	6-2020	384697
	5-2020	149093
Pakistan	6-2020	139841
Philippines	8-2020	128022
Iraq	8-2020	109914
Turkey	4-2020	106762
Saudi_Arabia	6-2020	103052
Bangladesh	6-2020	97193
	7-2020	93088
Saudi_Arabia	7-2020	87783
Iran	7-2020	76325
	6-2020	76255

We can observe following points on total number of Deaths:

1. From March 2020 onwards, we can see the sudden growth in number of deaths, especially in Europe and America. This aligns in some ways to the data and trend we see with cases.
2. For Europe we can see that after May 2020, there is a drastic fall in total number of deaths, which by pattern is also in agreement with the pattern shown by number of cases. This can be due to severe lockdown measures implemented by the most affected countries in Europe like United Kingdom, Spain, Russia and Italy.
3. The Americas saw a sudden peak in number of deaths in April 2020, post which there has been a steady month over month growth in the number of COVID related deaths.
4. Overall number of deaths compared to the total number of registered cases is less in Asia when compared to other continents.

In [ ]:

```
# How number of deaths trend over time for each Continent
sns.lineplot(data=df_train, hue = "continentExp", x="month_year", y="deaths", estimator="sum");
```



In [ ]:

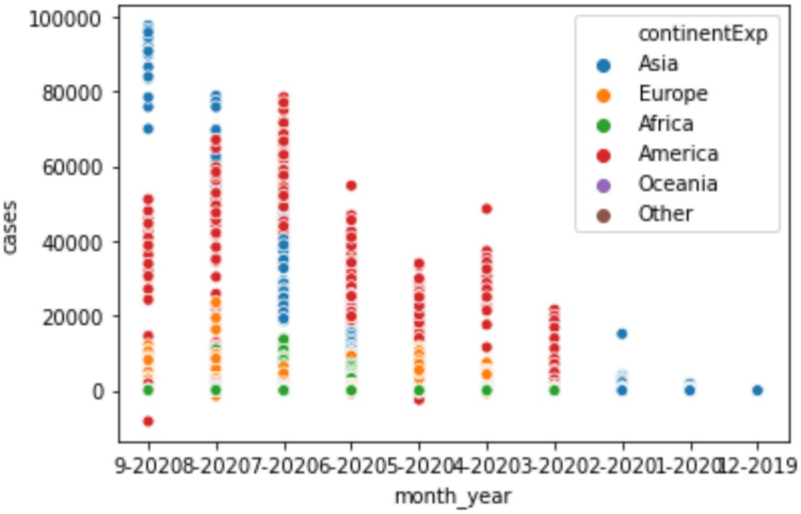
```
x = df_train[(df_train['continentExp']=='Europe')] ## & (df_train['month_year'] == '4-2020')]
#x.groupby(['countriesAndTerritories']).sum()['cases'].reset_index()
x_agg = x.groupby(['countriesAndTerritories','month_year']).agg({'deaths':sum})
x_agg.sort_values(['deaths'],ascending=False).head(15)
```

Out[ ]:

		deaths
countriesAndTerritories	**month_year**	
United_Kingdom	**4-2020**	23999
France	**4-2020**	21063
Spain	**4-2020**	17203
Italy	**4-2020**	16091
	3-2020	11570
United_Kingdom	**5-2020**	11336
Spain	**3-2020**	7340
Belgium	**4-2020**	6605
Germany	**4-2020**	5705
Italy	**5-2020**	5658
France	**5-2020**	4684
Russia	**7-2020**	4636
	6-2020	4611
Netherlands	**4-2020**	3847
Russia	**5-2020**	3583

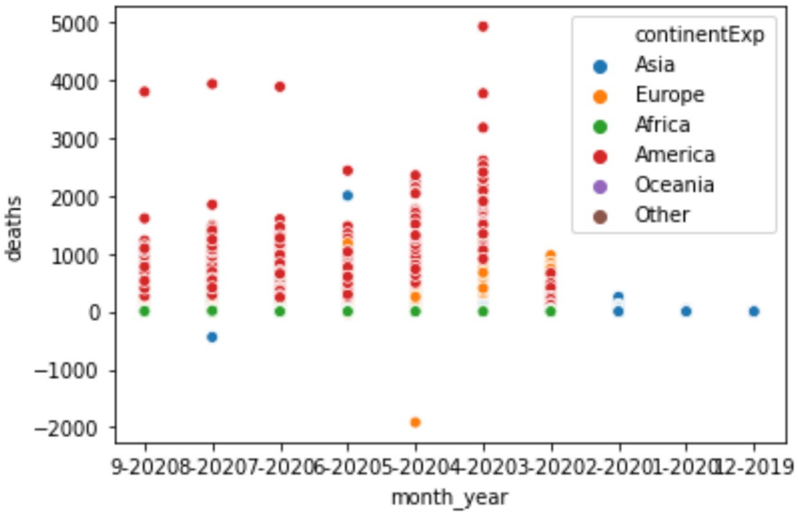
In [ ]:

```
sns.scatterplot(data=df_train, x="month_year", y="cases", hue="continentExp");
```



In [ ]:

```
#sns.swarmplot(data=df_train, x="month_year", y="deaths", hue="continentExp");
sns.scatterplot(data=df_train, x="month_year", y="deaths", hue="continentExp");
```



Data Issue

From the above scatter plot we can negative death count for the month "5-2020" and continent "Europe".

Investigating this further we can see that there was either a incorrect entry or an adjustment made in the data for Spain on 25-May-2020, where -372 new cases where registered and -1918 deaths we registered.

In [ ]:

```
neg_death = df_train[(df_train['continentExp']=='Europe') & (df_train['month_year'] == '5-2020')]
neg_death.sort_values(['deaths'],ascending=True).head(5)
```

Out[ ]:

	dateRep	day	month	year	cases	deaths	countriesAndTerritories	geoId	countryte
36521	2020-05-25	25	5	2020	-372	-1918	Spain	ES	
355	2020-05-31	31	5	2020	23	0	Albania	AL	
19857	2020-05-27	27	5	2020	0	0	Isle_of_Man	IM	
19858	2020-05-26	26	5	2020	0	0	Isle_of_Man	IM	
19859	2020-05-25	25	5	2020	0	0	Isle_of_Man	IM	

In [ ]:

```
#Conversion to Alpha 2 codes and Continents
#installation
#!pip install pycountry-convert
#!pip install geopy
#!pip install folium
```

In [ ]:

```
#function to get longitude and latitude data from country name
from geopy.geocoders import Nominatim
geolocator = Nominatim(user_agent='myapplication')
def geolocate(country):
    try:
        # Geolocate the center of the country
        loc = geolocator.geocode(country)
        # And return latitude and longitude
        return (loc.latitude, loc.longitude)
    except:
        # Return missing value
        return (0,0)
```

In [ ]:

```
cases_by_country = df_train.groupby("countriesAndTerritories")["case
s","deaths"].sum()
cases_by_country = cases_by_country.reset_index()
#cases_by_country
```

```
C:\Users\viranjan\AppData\Local\Continuum\anaconda3\lib\site-package
s\ipykernel_launcher.py:1: FutureWarning: Indexing with multiple keys
(implicitly converted to a tuple of keys) will be deprecated, use a l
ist instead.
  """Entry point for launching an IPython kernel.
```

In [ ]:

```
#***
lat = []
long = []
for i in range(len(cases_by_country)):
    lat.append(geolocate(cases_by_country['countriesAndTerritories
'][i])[0])
    long.append(geolocate(cases_by_country['countriesAndTerritories
'][i])[1])
cases_by_country["Lat"] = lat
cases_by_country["Long"] = long
cases_by_country
```

Out[ ]:

	countriesAndTerritories	cases	deaths	Lat	Long
0	Afghanistan	38716	1420	33.768006	66.238514
1	Albania	11353	334	41.000028	19.999962
2	Algeria	48254	1612	28.000027	2.999983
3	Andorra	1344	53	42.540717	1.573203
4	Angola	3335	132	-11.877577	17.569124
...	...	...	...	...	...
205	Vietnam	1063	35	13.290403	108.426511
206	Western_Sahara	766	1	0.000000	0.000000
207	Yemen	2013	583	16.347124	47.891527
208	Zambia	13539	312	-14.518624	27.559916
209	Zimbabwe	7526	224	-18.455496	29.746841

210 rows × 5 columns

In [ ]:

```
cases_by_continent = df_train.groupby("continentExp")["cases","death
s"].sum()
cases_by_continent = cases_by_continent.reset_index()
#cases_by_continent
```

```
C:\Users\viranjan\AppData\Local\Continuum\anaconda3\lib\site-package
s\ipykernel_launcher.py:1: FutureWarning: Indexing with multiple keys
(implicitly converted to a tuple of keys) will be deprecated, use a l
ist instead.
  """Entry point for launching an IPython kernel.
```

In [ ]:

```
#***
lat = []
long = []
for i in range(len(cases_by_continent)):
    lat.append(geolocate(cases_by_continent['continentExp'][i])[0])
    long.append(geolocate(cases_by_continent['continentExp'][i])[1])
cases_by_continent["Lat"] = lat
cases_by_continent["Long"] = long
```

In [ ]:

```
cases_by_continent['death_pct'] = round((cases_by_continent['deaths'] /
cases_by_continent['cases'])*100 ,2)

cases_by_continent
```

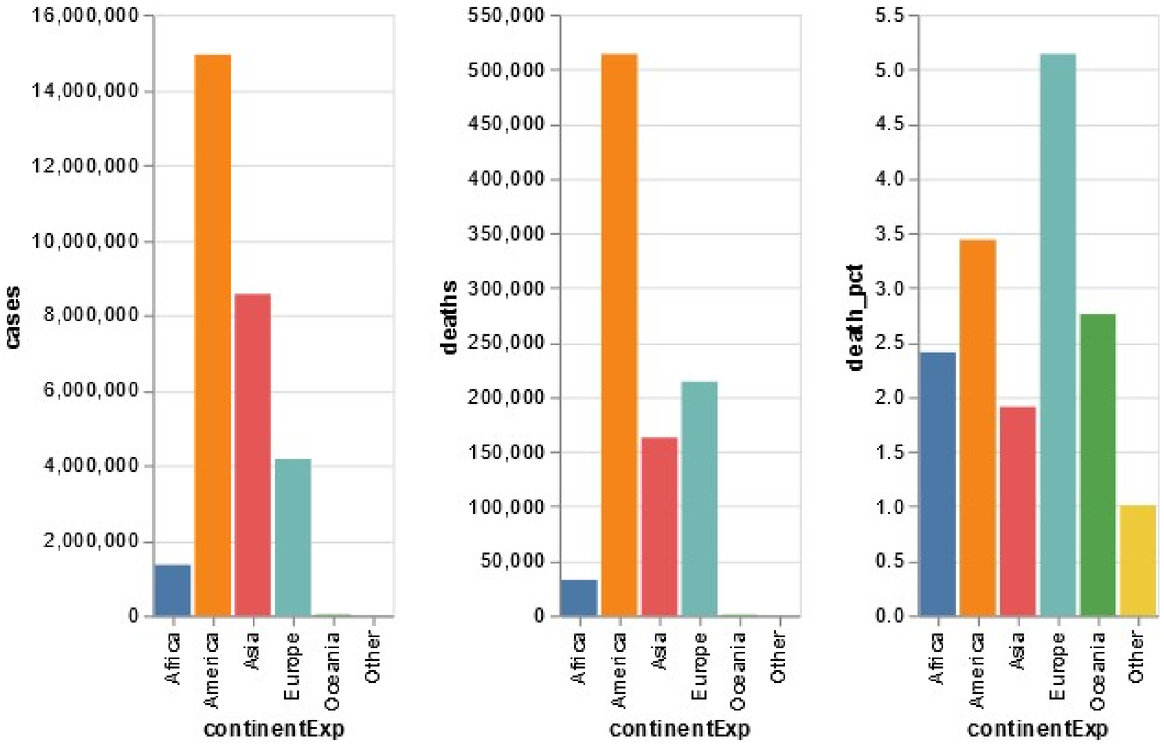
Out[ ]:

	continentExp	cases	deaths	Lat	Long	death_pct
0	Africa	1354032	32620	11.502434	17.757812	2.41
1	America	14935345	513860	51.447704	5.966069	3.44
2	Asia	8557253	163076	51.208697	89.234375	1.91
3	Europe	4170299	214272	51.000000	10.000000	5.14
4	Oceania	31509	871	-18.312800	138.515600	2.76
5	Other	696	7	60.599136	-134.880251	1.01

In [ ]:

```
#sns.catplot(x='continentExp', hue='continentExp', col='cases', kind='count', data=cases_by_continent);

chart1 = alt.Chart(cases_by_continent).mark_bar().encode(
    x='continentExp',
    y='cases',
    color='continentExp',
    order=alt.Order('continentExp',sort='ascending')
)

chart2 = alt.Chart(cases_by_continent).mark_bar().encode(
    x='continentExp',
    y='deaths',
    color='continentExp'
)

chart3 = alt.Chart(cases_by_continent).mark_bar().encode(
    x='continentExp',
    y='death_pct',
    color='continentExp'
)

(chart1 | chart2 | chart3)
```

Out[ ]:



In [ ]:

In [ ]:

```
# Create a world map to show distributions of users
import folium
from folium import plugins
from folium.plugins import MarkerCluster
import psycopg2
from area import area
#empty map
#world_map= folium.Map(tiles="cartodbpositron")
#marker_cluster = MarkerCluster().add_to(world_map)
```

In [ ]:

```
world_map_country = folium.Map(location =(0, 0),zoom_start=1.5)
world_map_continent = folium.Map(location =(0, 0),zoom_start=1.5)
```

In [ ]:

```
#print world_map_country
for i in range(len(cases_by_country)):
    #print(cases_by_country.countriesAndTerritories[i])
    country_location = (cases_by_country.Lat[i],cases_by_country.Long
[i])
    folium.Marker(location = country_location,
                  popup = folium.Popup(html=f"Country: {cases_by_cou
ntry.countriesAndTerritories[i]} has Total Number of Cases:{cases_by_co
untry.cases[i]}, and Total Number of Deaths:{cases_by_country.deaths
[i]}",max_width=450)
                 ).\
add_to(world_map_country)
world_map_country
```

Out[ ]: Make this Notebook Trusted to load map: File -> Trust Notebook

In [ ]:

```
#print world_map_continent
for i in range(len(cases_by_continent)):
    continent_location = (cases_by_continent.Lat[i],cases_by_continent.
Long[i])
    folium.Marker(location = continent_location,
                     popup = folium.Popup(html=f"Continent: {cases_by_c
ontinent.continentExp[i]} has Total Number of Cases:{cases_by_continen
t.cases[i]}, and Total Number of Deaths:{cases_by_continent.deaths
[i]}",max_width=450)
                 ).\
add_to(world_map_continent)
world_map_continent
```

Out[ ]:

Make this Notebook Trusted to load map: File -> Trust Notebook

In [ ]:

```
# Import modules
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn import tree
from sklearn.metrics import accuracy_score
from sklearn import preprocessing
from sklearn.preprocessing import MinMaxScaler
# Figures inline and set visualization style
%matplotlib inline
sns.set()
```

```
/usr/local/lib/python3.6/dist-packages/statsmodels/tools/_testing.py:
19: FutureWarning: pandas.util.testing is deprecated. Use the functio
ns in the public API at pandas.testing instead.
  import pandas.util.testing as tm
```

In [ ]:

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remou
nt, call drive.mount("/content/drive", force_remount=True).
```

In [ ]:

```
# Import test and train datasets
covid_train ='/content/drive/My Drive/COVID-19-geographic-disbtribution
-worldwide-2020-09-26.csv'
df_train = pd.read_csv(covid_train)
```

In [ ]:

```
df_train = df_train.drop(['countryterritoryCode', 'day','month', 'year
'], axis=1)
df_train.head()
```

Out[ ]:

	dateRep	cases	deaths	countriesAndTerritories	geoId	popData2019	continentExp	Cumu
0	9/26/2020	6	2	Afghanistan	AF	38041757.0	Asia	
1	9/25/2020	16	0	Afghanistan	AF	38041757.0	Asia	
2	9/24/2020	25	5	Afghanistan	AF	38041757.0	Asia	
3	9/23/2020	71	2	Afghanistan	AF	38041757.0	Asia	
4	9/22/2020	30	3	Afghanistan	AF	38041757.0	Asia	

In [ ]:

```
df_train = df_train.rename(columns={"dateRep": "date", "countriesAndTer
ritories": "country/territory", "geoId": "geoID", "continentExp": "cont
inent", "Cumulative_number_for_14_days_of_COVID-19_cases_per_100000": "
cases in last 14 days per 100000" })
df_train.head()
```

Out[ ]:

	date	cases	deaths	country/territory	geoID	popData2019	continent	cases in last 14 days per 100000
0	9/26/2020	6	2	Afghanistan	AF	38041757.0	Asia	1.540413
1	9/25/2020	16	0	Afghanistan	AF	38041757.0	Asia	1.614016
2	9/24/2020	25	5	Afghanistan	AF	38041757.0	Asia	1.645560
3	9/23/2020	71	2	Afghanistan	AF	38041757.0	Asia	1.642931
4	9/22/2020	30	3	Afghanistan	AF	38041757.0	Asia	1.524640

In [ ]:

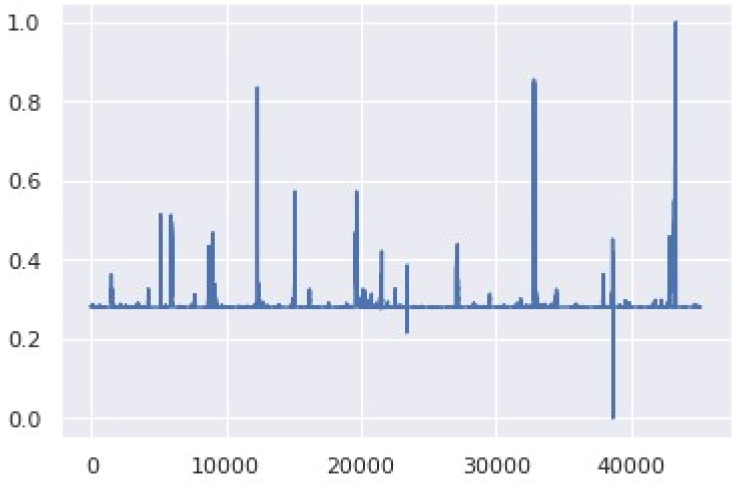
```
scaler = MinMaxScaler()
```

In [ ]:

```
df_scaled = scaler.fit_transform(df_train[['deaths']])
```

```
In [ ]: plt.plot(df_scaled)
```

```
Out[ ]: [<matplotlib.lines.Line2D at 0x7fbe7847a208>]
```



```
In [ ]: df_train.continent.drop_duplicates()
```

```
Out[ ]: 0           Asia
        261       Europe
        463       Africa
        1115     America
        2144     Oceania
        8012       Other
        Name: continent, dtype: object
```

```
In [ ]: df_train['country/territory'].nunique()
```

```
Out[ ]: 210
```

In [ ]:

```
print(df_train['date'])
df_train['date'] = pd.to_datetime(df_train['date'], format="%m/%d/%Y")
print(df_train['date'])
```

```
0        9/26/2020
1        9/25/2020
2        9/24/2020
3        9/23/2020
4        9/22/2020
           ...
45176    3/25/2020
45177    3/24/2020
45178    3/23/2020
45179    3/22/2020
45180    3/21/2020
Name: date, Length: 45181, dtype: object
0       2020-09-26
1       2020-09-25
2       2020-09-24
3       2020-09-23
4       2020-09-22
           ...
45176   2020-03-25
45177   2020-03-24
45178   2020-03-23
45179   2020-03-22
45180   2020-03-21
Name: date, Length: 45181, dtype: datetime64[ns]
```

In [ ]:

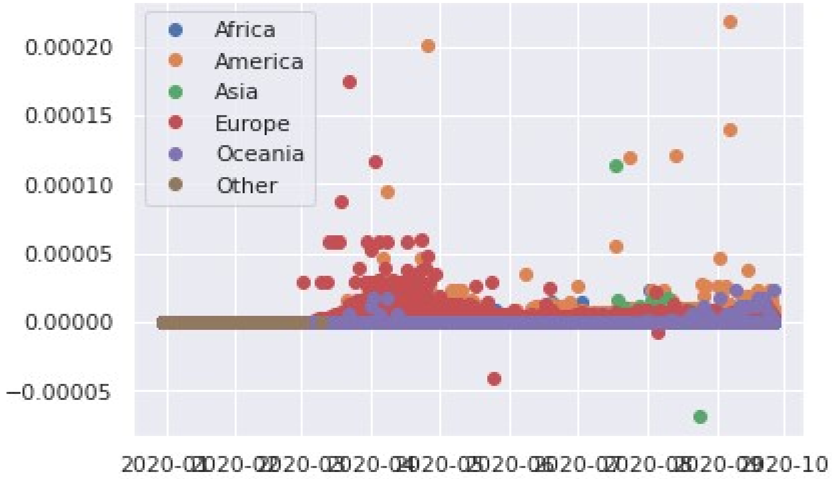
```
df_train['deathbypop'] = df_train['deaths']/ df_train['popData2019']
```

In [ ]:

```
df_train['deathbypop'] = df_train['deathbypop'].fillna(0)
```

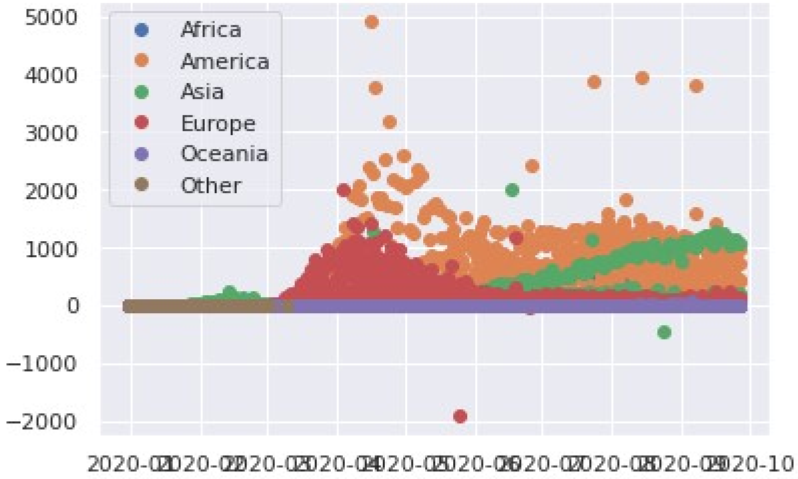
In [ ]:
```
groups = df_train.groupby('continent')
for name, group in groups:
    plt.plot(group['date'], group['deathbypop'], marker='o', linestyle=
'', label=name)
plt.legend()
```

Out[ ]:
```
<matplotlib.legend.Legend at 0x7fbe754e26a0>
```



In [ ]:
```
groups = df_train.groupby('continent')
for name, group in groups:
    plt.plot(group['date'], group['deaths'], marker='o', linestyle='',
label=name)
plt.legend()
```

Out[ ]:
```
<matplotlib.legend.Legend at 0x7fbe75a3d898>
```



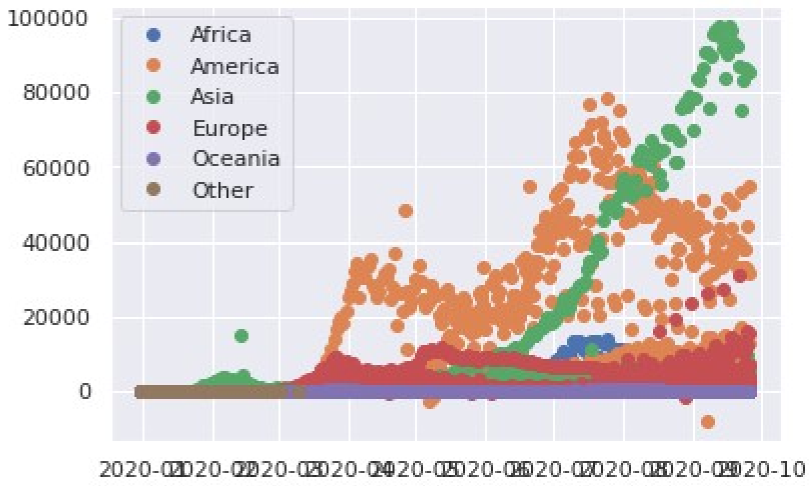
In [ ]:
```
df_america = df_train[df_train['continent'] == 'America']
df_asia = df_train[df_train['continent'] == 'Asia']
df_europe = df_train[df_train['continent'] == 'Europe']
df_africa = df_train[df_train['continent'] == 'Africa']
df_oceania = df_train[df_train['continent'] == 'Oceania']
```

In [ ]:

```
groups = df_train.groupby('continent')
for name, group in groups:
    plt.plot(group['date'], group['cases'], marker='o', linestyle='', label=name)
plt.legend()
```

Out[ ]:

```
<matplotlib.legend.Legend at 0x7fbe755c2b00>
```



In [ ]:

```
df_train['deathrate'] = df_train['deaths']/ df_train['cases']
```

In [ ]:

```
df_train.head()
```

Out[ ]:

	date	cases	deaths	country/territory	geoID	popData2019	continent	cases in last 14 days per 100000	dea
0	2020-09-26	6	2	Afghanistan	AF	38041757.0	Asia	1.540413	5.25
1	2020-09-25	16	0	Afghanistan	AF	38041757.0	Asia	1.614016	0.00(
2	2020-09-24	25	5	Afghanistan	AF	38041757.0	Asia	1.645560	1.31
3	2020-09-23	71	2	Afghanistan	AF	38041757.0	Asia	1.642931	5.25
4	2020-09-22	30	3	Afghanistan	AF	38041757.0	Asia	1.524640	7.88

In [ ]:

```
df_train['deathrate'] = df_train['deathrate'].fillna(0)
```

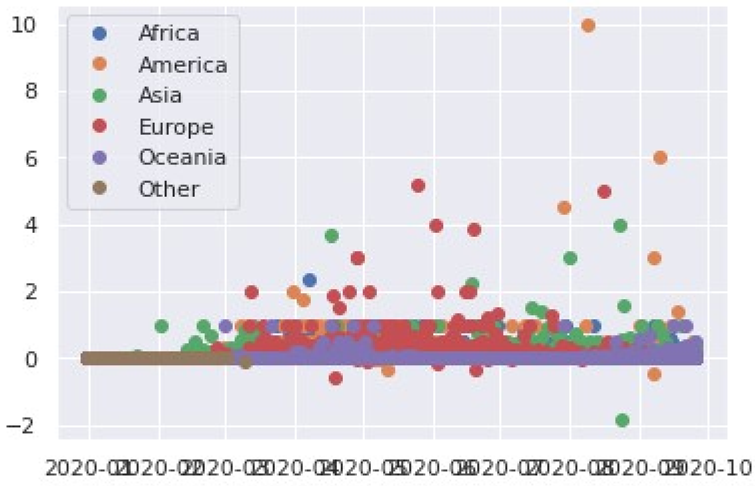
```
In [ ]: df_train.head()
```

Out[ ]:

	date	cases	deaths	country/territory	geoID	popData2019	continent	cases in last 14 days per 100000	dea
0	2020-09-26	6	2	Afghanistan	AF	38041757.0	Asia	1.540413	5.25
1	2020-09-25	16	0	Afghanistan	AF	38041757.0	Asia	1.614016	0.00(
2	2020-09-24	25	5	Afghanistan	AF	38041757.0	Asia	1.645560	1.31
3	2020-09-23	71	2	Afghanistan	AF	38041757.0	Asia	1.642931	5.25
4	2020-09-22	30	3	Afghanistan	AF	38041757.0	Asia	1.524640	7.88

```
In [ ]: groups = df_train.groupby('continent')
        for name, group in groups:
            plt.plot(group['date'], group['deathrate'], marker='o', linestyle=
        '', label=name)
        plt.legend()
```

```
Out[ ]: <matplotlib.legend.Legend at 0x7fbe754af390>
```

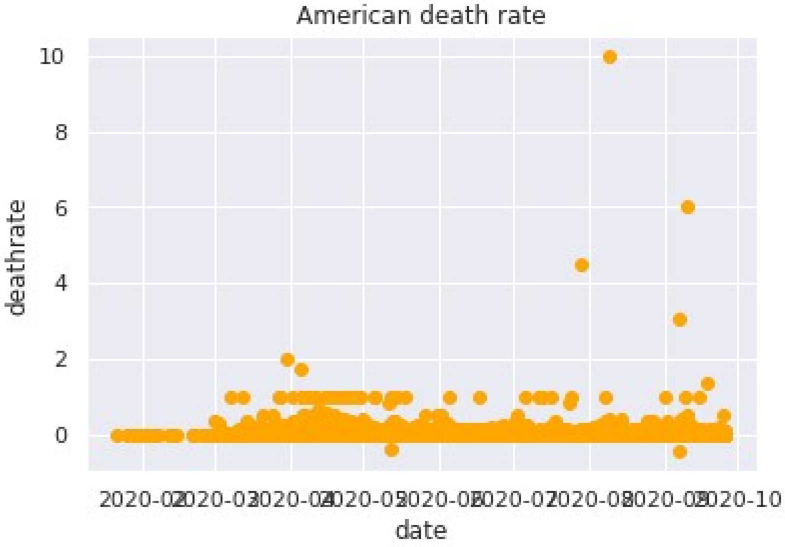


```
In [ ]: df_america['deathrate'] = df_america['deaths']/ df_america['cases']
```

```
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:1: Setti
ngWithCopyWarning:
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/panda
s-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  """Entry point for launching an IPython kernel.
```

In [ ]:

```
fig, axis = plt.subplots()
axis.set_xlabel('date')
axis.set_ylabel('deathrate')
plt.title('American death rate')
scatter_plot = axis.scatter(df_america['date'],
    df_america['deathrate'],
    facecolors = 'orange',
    edgecolors = 'orange')
```


American death rate
deathrate
date