Covid-19- Analysis,Prediction & Visualisation

April 4, 2020

1 COVID-19 Analysis and Prediction

" A Complex Analysis yet for a Layman "

1.0.1 Required Modules

[192]:
```
import pandas as pd
from covid import Covid
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.preprocessing import PolynomialFeatures
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, r2_score
from sklearn.model_selection import train_test_split
import datetime
sns.set(style = 'darkgrid')
```

1.0.2 Script which Dynamically fetches the Data of a particular 'Country'

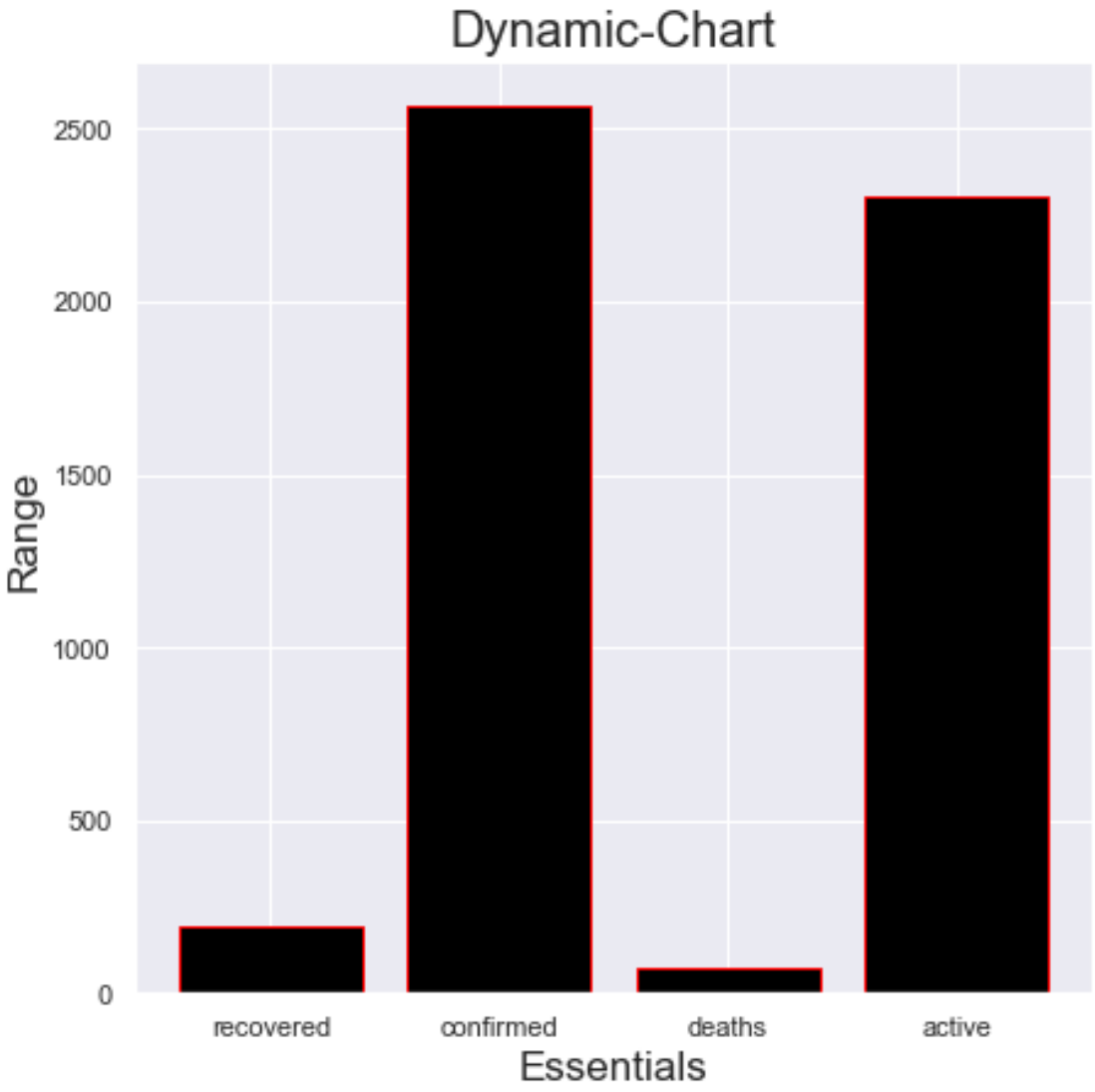
The output Bar-Chart is the representation of the country's current status of this unprecedented pandemic

[193]:
```
covid = Covid()

countries = list(covid.list_countries())
countries_list = list()

countries_list = [list(dict(countries[x]).values())[1] for x in␣
↪range(len(countries))]
print(countries_list)
while True:
    try:
         country = input('Enter the country of desire : ')
         data = covid.get_status_by_country_name(country)

    except ValueError:
         print('Entered country name was invalid, \nRe-Enter : ')
```

```
            continue
        else:
            data = covid.get_status_by_country_name(country)

        break

dictionary = {
     key : data[key]


     for key in data.keys() & ("confirmed","active","deaths","recovered")
}


key = list(dictionary.keys())
values = list(map(int,dictionary.values()))

print(dictionary)

active_tot = int(covid.get_total_active_cases())
recovered_tot = int(covid.get_total_recovered())
confirmed_tot = int(covid.get_total_confirmed_cases())

total_numericals = dict({'Total Recovered' : recovered_tot, 'Total Active' :␣
 ↪active_tot, 'Total Confirmmed': confirmed_tot,})

print("Total Cases around the world : {} ".format(total_numericals))

plt.figure(figsize=(7,7))
plt.title("Dynamic-Chart",size=20)
plt.xlabel("Essentials",size=17)
plt.ylabel("Range",size=17)
plt.bar(key,values,color='black',edgecolor = 'red')
plt.show()
```

```
['US', 'Italy', 'Spain', 'Germany', 'China', 'France', 'Iran', 'United Kingdom',
'Turkey', 'Switzerland', 'Belgium', 'Netherlands', 'Canada', 'Austria', 'Korea,
South', 'Portugal', 'Brazil', 'Israel', 'Sweden', 'Australia', 'Norway',
'Ireland', 'Russia', 'Czechia', 'Denmark', 'Chile', 'Ecuador', 'Malaysia',
'Poland', 'Romania', 'Philippines', 'Pakistan', 'Japan', 'Luxembourg', 'India',
'Saudi Arabia', 'Indonesia', 'Thailand', 'Finland', 'Greece', 'Mexico', 'South
Africa', 'Dominican Republic', 'Panama', 'Peru', 'Iceland', 'Argentina',
'Algeria', 'Serbia', 'Colombia', 'Singapore', 'Croatia', 'Qatar', 'United Arab
Emirates', 'Estonia', 'Ukraine', 'Slovenia', 'New Zealand', 'Egypt', 'Iraq',
'Armenia', 'Morocco', 'Diamond Princess', 'Lithuania', 'Bahrain', 'Hungary',
'Moldova', 'Bosnia and Herzegovina', 'Lebanon', 'Tunisia', 'Latvia', 'Bulgaria',
'Kazakhstan', 'Slovakia', 'Azerbaijan', 'Andorra', 'North Macedonia', 'Kuwait',
```

```
'Costa Rica', 'Cyprus', 'Uruguay', 'Belarus', 'Taiwan*', 'Cameroon', 'Albania',
'Burkina Faso', 'Jordan', 'Afghanistan', 'Cuba', 'Oman', 'San Marino',
'Vietnam', 'Honduras', 'Uzbekistan', 'Senegal', 'Ghana', 'Malta', "Cote
d'Ivoire", 'West Bank and Gaza', 'Nigeria', 'Mauritius', 'Montenegro', 'Sri
Lanka', 'Georgia', 'Venezuela', 'Brunei', 'Congo (Kinshasa)', 'Bolivia',
'Kyrgyzstan', 'Kosovo', 'Kenya', 'Cambodia', 'Niger', 'Trinidad and Tobago',
'Paraguay', 'Rwanda', 'Liechtenstein', 'Madagascar', 'Bangladesh', 'Monaco',
'Guinea', 'Guatemala', 'Djibouti', 'Jamaica', 'Barbados', 'El Salvador',
'Uganda', 'Togo', 'Zambia', 'Mali', 'Ethiopia', 'Bahamas', 'Congo
(Brazzaville)', 'Eritrea', 'Gabon', 'Burma', 'Tanzania', 'Guyana', 'Maldives',
'Haiti', 'Equatorial Guinea', 'Syria', 'Mongolia', 'Namibia', 'Benin', 'Saint
Lucia', 'Dominica', 'Libya', 'Grenada', 'Laos', 'Mozambique', 'Seychelles',
'Sudan', 'Suriname', 'Antigua and Barbuda', 'Eswatini', 'Guinea-Bissau', 'MS
Zaandam', 'Saint Kitts and Nevis', 'Zimbabwe', 'Angola', 'Central African
Republic', 'Chad', 'Fiji', 'Holy See', 'Liberia', 'Cabo Verde', 'Mauritania',
'Nepal', 'Bhutan', 'Nicaragua', 'Somalia', 'Belize', 'Botswana', 'Gambia',
'Burundi', 'Malawi', 'Saint Vincent and the Grenadines', 'Sierra Leone', 'Papua
New Guinea', 'Timor-Leste']
Enter the country of desire : india
{'recovered': 192, 'confirmed': 2567, 'deaths': 72, 'active': 2303}
Total Cases around the world : {'Total Recovered': 223697, 'Total Active':
534611, 'Total Confirmmed': 1066706}
```



1.0.3 Getting to know the Dataset

[194]:
```
data = pd.read_csv('covid_19_data.csv')
data.head(10)
```

[194]:

	SNo	ObservationDate	Province/State	Country/Region	Last Update	\
0	1	01/22/2020	Anhui	Mainland China	1/22/2020 17:00	
1	2	01/22/2020	Beijing	Mainland China	1/22/2020 17:00	
2	3	01/22/2020	Chongqing	Mainland China	1/22/2020 17:00	
3	4	01/22/2020	Fujian	Mainland China	1/22/2020 17:00	
4	5	01/22/2020	Gansu	Mainland China	1/22/2020 17:00	
5	6	01/22/2020	Guangdong	Mainland China	1/22/2020 17:00	
6	7	01/22/2020	Guangxi	Mainland China	1/22/2020 17:00	

```
7    8      01/22/2020        Guizhou  Mainland China  1/22/2020 17:00
8    9      01/22/2020         Hainan  Mainland China  1/22/2020 17:00
9   10      01/22/2020          Hebei  Mainland China  1/22/2020 17:00

   Confirmed  Deaths  Recovered
0        1.0     0.0        0.0
1       14.0     0.0        0.0
2        6.0     0.0        0.0
3        1.0     0.0        0.0
4        0.0     0.0        0.0
5       26.0     0.0        0.0
6        2.0     0.0        0.0
7        1.0     0.0        0.0
8        4.0     0.0        0.0
9        1.0     0.0        0.0
```

[195]:
```
print("Number of Datapoints : {}".format(data.size))
print("Shape of the DataSet : {}".format(data.shape))
```

```
Number of Datapoints : 75392
Shape of the DataSet : (9424, 8)
```

[196]:
```
dates = np.unique(data.ObservationDate) #dates
print("These are the Recored Dates Starting from 01/22/2020 \n\n {}".
 ↪format(dates))
print("\nLast Dates recorded : {}".format(data.iat[(data.shape[0]-1),1]))
```

```
These are the Recored Dates Starting from 01/22/2020

 ['01/22/2020' '01/23/2020' '01/24/2020' '01/25/2020' '01/26/2020'
 '01/27/2020' '01/28/2020' '01/29/2020' '01/30/2020' '01/31/2020'
 '02/01/2020' '02/02/2020' '02/03/2020' '02/04/2020' '02/05/2020'
 '02/06/2020' '02/07/2020' '02/08/2020' '02/09/2020' '02/10/2020'
 '02/11/2020' '02/12/2020' '02/13/2020' '02/14/2020' '02/15/2020'
 '02/16/2020' '02/17/2020' '02/18/2020' '02/19/2020' '02/20/2020'
 '02/21/2020' '02/22/2020' '02/23/2020' '02/24/2020' '02/25/2020'
 '02/26/2020' '02/27/2020' '02/28/2020' '02/29/2020' '03/01/2020'
 '03/02/2020' '03/03/2020' '03/04/2020' '03/05/2020' '03/06/2020'
 '03/07/2020' '03/08/2020' '03/09/2020' '03/10/2020' '03/11/2020'
 '03/12/2020' '03/13/2020' '03/14/2020' '03/15/2020' '03/16/2020'
 '03/17/2020' '03/18/2020' '03/19/2020' '03/20/2020' '03/21/2020'
 '03/22/2020' '03/23/2020' '03/24/2020' '03/25/2020' '03/26/2020'
 '03/27/2020']

Last Dates recorded : 03/27/2020
```

Knowing the Datatypes of the Datapoints involved in the Dataset

[197]:
```
# knowing the datatypes
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9424 entries, 0 to 9423
Data columns (total 8 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   SNo              9424 non-null   int64
 1   ObservationDate  9424 non-null   object
 2   Province/State   5164 non-null   object
 3   Country/Region   9424 non-null   object
 4   Last Update      9424 non-null   object
 5   Confirmed        9424 non-null   float64
 6   Deaths           9424 non-null   float64
 7   Recovered        9424 non-null   float64
dtypes: float64(3), int64(1), object(4)
memory usage: 589.1+ KB
```

Converting the 'float64' type data to 'int64'

[198]:
```
# Conversion
data[["Confirmed","Deaths","Recovered"]]␣
 ↪=data[["Confirmed","Deaths","Recovered"]].astype(int)
```

Verifying the Conversion

[199]:
```
#verifying
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9424 entries, 0 to 9423
Data columns (total 8 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   SNo              9424 non-null   int64
 1   ObservationDate  9424 non-null   object
 2   Province/State   5164 non-null   object
 3   Country/Region   9424 non-null   object
 4   Last Update      9424 non-null   object
 5   Confirmed        9424 non-null   int64
 6   Deaths           9424 non-null   int64
 7   Recovered        9424 non-null   int64
dtypes: int64(4), object(4)
memory usage: 589.1+ KB
```

1.0.4 describe() is a Pandas Library function used to calculate the basic Statistical results such as Mean, Standard Deviation, and the 3 Quantiles

1.0.5 Explanation for the Result

The following output of the ___dataDescription_ returns a DataFrame object which is basically the Statistic details of the Numericals i.e the 'int64' type Data Points only #### In this DataFrame object output, the Essentials are ['Mean', 'Three Quantiles' , 'Max'] Values

[200]:
```
dataDescription = data.describe()
dataDescription.drop('count',inplace =True)
print("Total Number of Data Points : {}".format(7313))
dataDescription
```

```
Total Number of Data Points : 7313
```

[200]:

	SNo	Confirmed	Deaths	Recovered
mean	4712.500000	804.795840	30.740025	260.849745
std	2720.618802	5467.174746	302.358757	2870.788709
min	1.000000	0.000000	0.000000	0.000000
25%	2356.750000	3.000000	0.000000	0.000000
50%	4712.500000	23.000000	0.000000	0.000000
75%	7068.250000	169.000000	1.000000	11.000000
max	9424.000000	86498.000000	9134.000000	61732.000000

1.0.6 Data Preprocessing

Calculating the percentage of the Missing Values

[268]:
```
#Percentage of NAN Values
missingvalues = [(iterator, data[iterator].isna().mean()*100) for iterator in␣
↪data]
missingvalues = pd.DataFrame(missingvalues, columns=["column_name", "Mean"])
missingvalues
```

[268]:

	column_name	Mean
0	SNo	0.0
1	ObservationDate	0.0
2	Province/State	0.0
3	Country/Region	0.0
4	Last Update	0.0
5	Confirmed	0.0
6	Deaths	0.0
7	Recovered	0.0
8	ActiveCases	0.0

From the above result we can comprehend that about 45.2% of the Datapoints are Not-Registered

Filling the NaN Values with Not-Registered making it an Object-Type Datapoint

[202]:
```
# inserting
data["Province/State"]= data["Province/State"].fillna('Not-Registered')
```

1.0.7 Relational Analysis and Basic Visualisation

[203]:
```
# knowing the currently Active_cases
data['ActiveCases'] = data['Confirmed'] - data['Deaths'] - data['Recovered']
data.head(20)
```

[203]:

	SNo	ObservationDate	Province/State	Country/Region	Last Update	Confirmed	Deaths	Recovered	ActiveCases
0	1	01/22/2020	Anhui	Mainland China	1/22/2020 17:00	1	0	0	1
1	2	01/22/2020	Beijing	Mainland China	1/22/2020 17:00	14	0	0	14
2	3	01/22/2020	Chongqing	Mainland China	1/22/2020 17:00	6	0	0	6
3	4	01/22/2020	Fujian	Mainland China	1/22/2020 17:00	1	0	0	1
4	5	01/22/2020	Gansu	Mainland China	1/22/2020 17:00	0	0	0	0
5	6	01/22/2020	Guangdong	Mainland China	1/22/2020 17:00	26	0	0	26
6	7	01/22/2020	Guangxi	Mainland China	1/22/2020 17:00	2	0	0	2
7	8	01/22/2020	Guizhou	Mainland China	1/22/2020 17:00	1	0	0	1
8	9	01/22/2020	Hainan	Mainland China	1/22/2020 17:00	4	0	0	4
9	10	01/22/2020	Hebei	Mainland China	1/22/2020 17:00	1	0	0	1
10	11	01/22/2020	Heilongjiang	Mainland China	1/22/2020 17:00	0	0	0	0
11	12	01/22/2020	Henan	Mainland China	1/22/2020 17:00	5	0	0	5
12	13	01/22/2020	Hong Kong	Hong Kong	1/22/2020 17:00	0	0	0	0
13	14	01/22/2020	Hubei	Mainland China	1/22/2020 17:00	444	17	28	399
14	15	01/22/2020	Hunan	Mainland China	1/22/2020 17:00				
15	16	01/22/2020	Inner Mongolia	Mainland China	1/22/2020 17:00				
16	17	01/22/2020	Jiangsu	Mainland China	1/22/2020 17:00				
17	18	01/22/2020	Jiangxi	Mainland China	1/22/2020 17:00				
18	19	01/22/2020	Jilin	Mainland China	1/22/2020 17:00				
19	20	01/22/2020	Liaoning	Mainland China	1/22/2020 17:00				

```
14          4       0          0           4
15          0       0          0           0
16          1       0          0           1
17          2       0          0           2
18          0       0          0           0
19          2       0          0           2
```

[204]:
```
#coverting the Object-type date&time to date&time object
data['ObservationDate'] = pd.to_datetime(data['ObservationDate'])
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9424 entries, 0 to 9423
Data columns (total 9 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   SNo              9424 non-null   int64
 1   ObservationDate  9424 non-null   datetime64[ns]
 2   Province/State   9424 non-null   object
 3   Country/Region   9424 non-null   object
 4   Last Update      9424 non-null   object
 5   Confirmed        9424 non-null   int64
 6   Deaths           9424 non-null   int64
 7   Recovered        9424 non-null   int64
 8   ActiveCases      9424 non-null   int64
dtypes: datetime64[ns](1), int64(5), object(3)
memory usage: 662.8+ KB
```

1.0.8 Correlation

[205]:
```
numerical_data = data.select_dtypes(exclude=['object'])
numerical_data=numerical_data.drop('SNo',axis=1)
numerical_data.corr(method='spearman')
```

[205]:

	Confirmed	Deaths	Recovered	ActiveCases
Confirmed	1.000000	0.717369	0.665774	0.861102
Deaths	0.717369	1.000000	0.532884	0.561755
Recovered	0.665774	0.532884	1.000000	0.384268
ActiveCases	0.861102	0.561755	0.384268	1.000000

1.0.9 Frequency Tables

[206]:
```
pd.crosstab(index=data['Country/Region'],columns ='count' ,dropna=True)
# number of times these Countries are registered in the Dataset
```

[206]:

col_0	count
Country/Region	

```
 Azerbaijan                          1
('St. Martin',)                      1
Afghanistan                         33
Albania                             19
Algeria                             32
…                                   …
Vietnam                             65
West Bank and Gaza                   2
Zambia                              10
Zimbabwe                             8
occupied Palestinian territory       7

[211 rows x 1 columns]
```

The Above result is a Cross-Tabulation of the Features "Country/Region" and its count.

This result gives the Numerical idea of the Number of Cases registered in the country named across the value, Multiple value means the cases can be from one or different States or Provinces

[207]:
```
pd.crosstab(index=data['Country/Region'],columns =data['Province/State'],␣
↪,dropna=True)
```

[207]:
```
Province/State                 Montreal, QC   Norfolk County, MA  Alabama  \
Country/Region
 Azerbaijan                               0                    0        0
('St. Martin',)                           0                    0        0
Afghanistan                               0                    0        0
Albania                                   0                    0        0
Algeria                                   0                    0        0
…                                       …                    …        …
Vietnam                                   0                    0        0
West Bank and Gaza                        0                    0        0
Zambia                                    0                    0        0
Zimbabwe                                  0                    0        0
occupied Palestinian territory            0                    0        0

Province/State                 Alameda County, CA  Alaska  Alberta  \
Country/Region
 Azerbaijan                                     0       0        0
('St. Martin',)                                 0       0        0
Afghanistan                                     0       0        0
Albania                                         0       0        0
Algeria                                         0       0        0
…                                             …       …        …
Vietnam                                         0       0        0
```

```
West Bank and Gaza                          0       0        0
Zambia                                      0       0        0
Zimbabwe                                    0       0        0
occupied Palestinian territory              0       0        0

Province/State                 American Samoa  Anhui  Arizona  Arkansas  …  \
Country/Region                                                          …
 Azerbaijan                                0      0        0         0  …
('St. Martin',)                            0      0        0         0  …
Afghanistan                                0      0        0         0  …
Albania                                    0      0        0         0  …
Algeria                                    0      0        0         0  …
…                                        …    …      …       …  …
Vietnam                                    0      0        0         0  …
West Bank and Gaza                         0      0        0         0  …
Zambia                                     0      0        0         0  …
Zimbabwe                                   0      0        0         0  …
occupied Palestinian territory             0      0        0         0  …

Province/State                 Western Australia  Williamson County, TN  \
Country/Region
 Azerbaijan                                  0                      0
('St. Martin',)                              0                      0
Afghanistan                                  0                      0
Albania                                      0                      0
Algeria                                      0                      0
…                                          …                      …
Vietnam                                      0                      0
West Bank and Gaza                           0                      0
Zambia                                       0                      0
Zimbabwe                                     0                      0
occupied Palestinian territory               0                      0

Province/State                 Wisconsin  Wuhan Evacuee  Wyoming  Xinjiang  \
Country/Region
 Azerbaijan                            0              0        0         0
('St. Martin',)                        0              0        0         0
Afghanistan                            0              0        0         0
Albania                                0              0        0         0
Algeria                                0              0        0         0
…                                    …              …      …       …
Vietnam                                0              0        0         0
West Bank and Gaza                     0              0        0         0
Zambia                                 0              0        0         0
Zimbabwe                               0              0        0         0
occupied Palestinian territory         0              0        0         0
```

```
Province/State                  Yolo County, CA  Yukon  Yunnan  Zhejiang
Country/Region
 Azerbaijan                                  0      0       0         0
('St. Martin',)                              0      0       0         0
Afghanistan                                  0      0       0         0
Albania                                      0      0       0         0
Algeria                                      0      0       0         0
…                                          …    …      …       …
Vietnam                                      0      0       0         0
West Bank and Gaza                           0      0       0         0
Zambia                                       0      0       0         0
Zimbabwe                                     0      0       0         0
occupied Palestinian territory               0      0       0         0

[211 rows x 291 columns]
```

The above result is a Cross-Tabulation of 'Country/Region' and 'Province/State'

The Following output of byCountryDat is the Summary of the Above Cross-Tabulation

[208]:
```
byCountryDat = data.groupby(['Country/
 ↪Region'])[['Confirmed','Recovered','Deaths','ActiveCases']].sum()
byCountryDat
```

[208]:
```
                              Confirmed  Recovered  Deaths  ActiveCases
Country/Region
 Azerbaijan                           1          0       0            1
('St. Martin',)                       2          0       0            2
Afghanistan                         651         15      13          623
Albania                            1357         81      45         1231
Algeria                            2563        449     185         1929
…                                     …        …       …            …
Vietnam                            2153        659       0         1494
West Bank and Gaza                  175         34       2          139
Zambia                               67          0       0           67
Zimbabwe                             24          0       5           19
occupied Palestinian territory       25          0       0           25

[211 rows x 4 columns]
```

Essenstial Numericals i.e ['Confirmed' , 'ActiveCases' , 'Recovered', 'Deaths'] Across the Reported Dates

[209]:
```
byObservedDate = data.
 ↪groupby(["ObservationDate"])["Confirmed","ActiveCases","Recovered","Deaths"].
 ↪sum().reset_index()
byObservedDate
```

```
/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:1:
FutureWarning: Indexing with multiple keys (implicitly converted to a tuple of
keys) will be deprecated, use a list instead.
  """Entry point for launching an IPython kernel.
```

[209]:

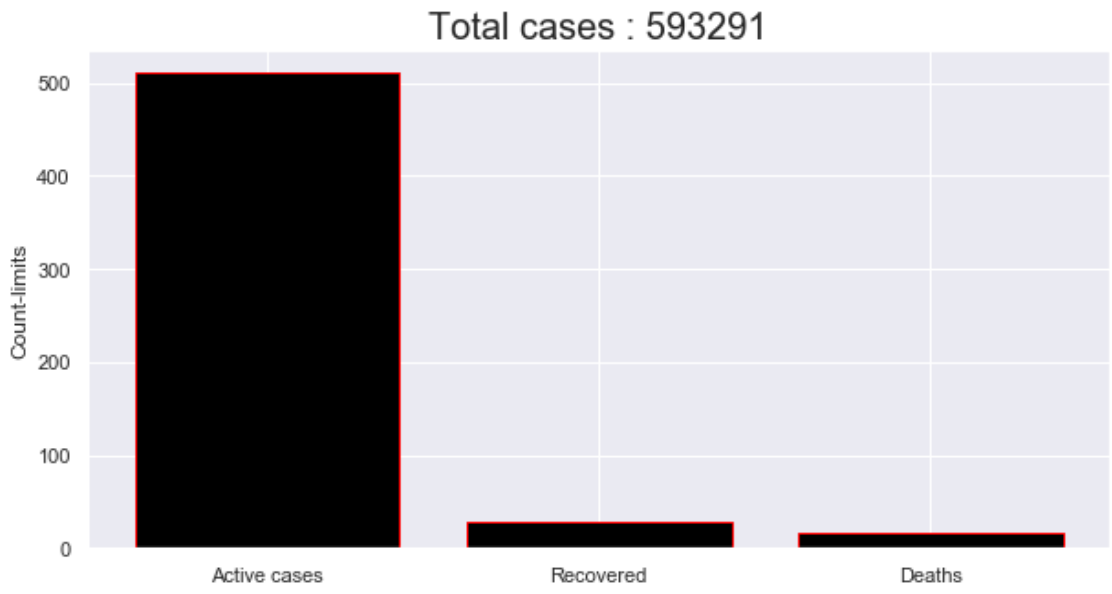
	ObservationDate	Confirmed	ActiveCases	Recovered	Deaths
0	2020-01-22	555	510	28	17
1	2020-01-23	653	605	30	18
2	2020-01-24	941	879	36	26
3	2020-01-25	1438	1357	39	42
4	2020-01-26	2118	2010	52	56
..	…	…	…	…	…
61	2020-03-23	378287	260832	100958	16497
62	2020-03-24	417966	291646	107705	18615
63	2020-03-25	467594	332643	113770	21181
64	2020-03-26	529591	383471	122150	23970
65	2020-03-27	593291	435178	130915	27198

[66 rows x 5 columns]

1.0.10 Visualization

[210]:
```
labels = ["Active cases","Recovered","Deaths"]
values = byObservedDate.loc[0, ["ActiveCases","Recovered","Deaths"]]
plt.figure(figsize=(10, 5))
plt.title('Total cases : '+str(byObservedDate.Confirmed[byObservedDate.
 ↪Confirmed.size-1]),size=20)
plt.ylabel('Count-limits')
plt.bar(labels,values,color='black',edgecolor='red')
print('According to the Last Reporting date : {}'.format(data.iat[(data.
 ↪shape[0]-1),1]))
```

```
According to the Last Reporting date : 2020-03-27 00:00:00
```



1.0.11 Mortality Rate

Mortality Rate Determine how Lethal a Virus can be.

For Context the Mortality rate for Ebola: 50%

Mortality rate is the Ratio of Total Number of Deaths to Total Confirmed Cases at that Period of time

Note- ***Mortality Rate Varies with Time Period and the Exponential Growth of the Numericals***

[211]:
```
tot_deaths = data.Deaths.sum()
tot_confirmed = data.Confirmed.sum()
Mortality_rate = tot_deaths/tot_confirmed
Mortality_rate = Mortality_rate*100
print("Estimated Mortaltity Rate {:.2f}%".format(Mortality_rate))
```

```
Estimated Mortaltity Rate 3.82%
```

1.0.12 Covid19's spread in India in contrast to Italy

[212]:
```
data.columns
```

[212]:
```
Index(['SNo', 'ObservationDate', 'Province/State', 'Country/Region',
       'Last Update', 'Confirmed', 'Deaths', 'Recovered', 'ActiveCases'],
      dtype='object')
```

[213]:
```
confirmed_df = pd.read_csv('time_series_covid_19_confirmed.csv')
recovered_df = pd.read_csv('time_series_covid_19_recovered.csv')
deaths_df = pd.read_csv('time_series_covid_19_deaths.csv')
```

[214]:
```
indian_confirmed_df = confirmed_df[confirmed_df['Country/Region'] == 'India']
indian_recovered_df = recovered_df[recovered_df['Country/Region'] == 'India']
indian_deaths_df = deaths_df[deaths_df['Country/Region'] == 'India']
```

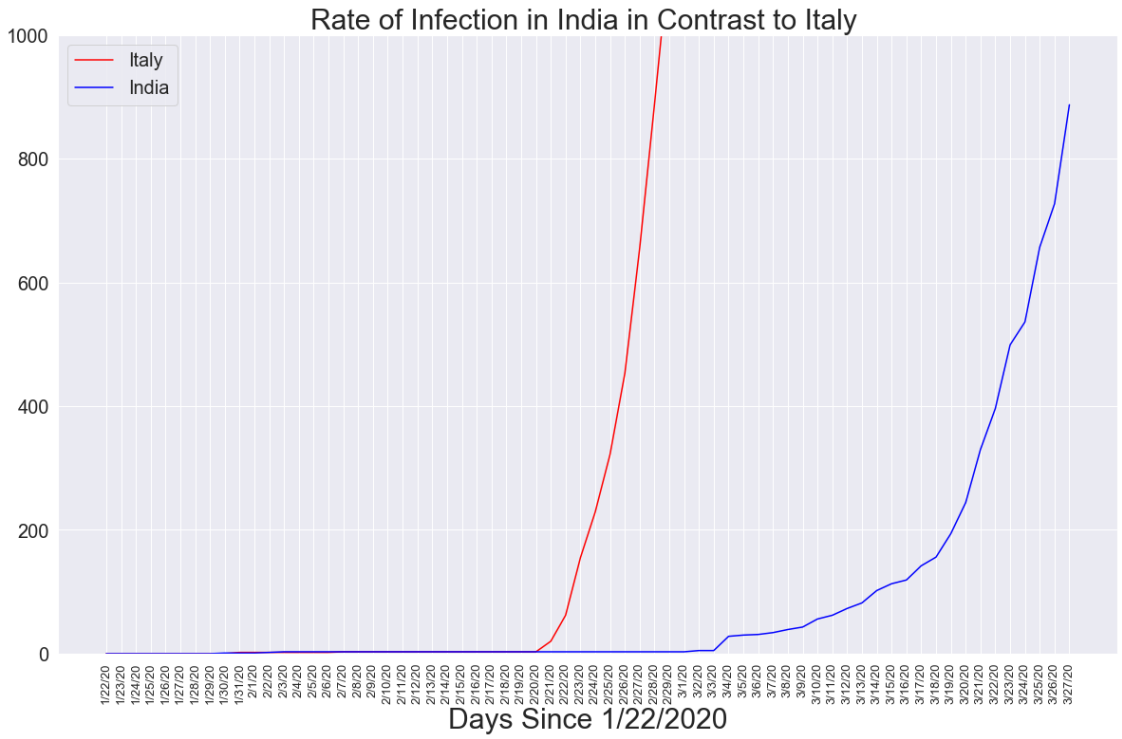
[215]:
```
confirmed = indian_confirmed_df.iloc[:, 4:].T
deaths = indian_deaths_df.iloc[:, 4:].T
recovered = indian_recovered_df.iloc[:, 4:].T
```

[216]:
```
italy_confirmed_df = confirmed_df[confirmed_df['Country/Region'] == 'Italy']
italy_recovered_df = recovered_df[recovered_df['Country/Region'] == 'Italy']
italy_deaths_df = deaths_df[deaths_df['Country/Region'] == 'Italy']
italy_deaths_df
```

[216]:
```
    Province/State Country/Region   Lat  Long  1/22/20  1/23/20  1/24/20  \
137            NaN          Italy  43.0  12.0        0        0        0

     1/25/20  1/26/20  1/27/20  …  3/18/20  3/19/20  3/20/20  3/21/20  \
137        0        0        0  …     2978     3405     4032     4825

     3/22/20  3/23/20  3/24/20  3/25/20  3/26/20  3/27/20
137     5476     6077     6820     7503     8215     9134

[1 rows x 70 columns]
```

[217]:
```
itconfirmed = italy_confirmed_df.iloc[:, 4:].T
itdeaths = italy_deaths_df.iloc[:, 4:].T
itrecovered = italy_recovered_df.iloc[:, 4:].T
```

[218]:
```
plt.figure(figsize=(20, 12))
plt.xlabel('Days Since 1/22/2020', size=30)
plt.plot(confirmed.index,itconfirmed,color='red')
plt.plot(confirmed.index,confirmed,color='blue')
plt.ylim(0,1000)
plt.xticks(size = 13,rotation=90)
plt.yticks(size=20)
plt.legend(['Italy', 'India'], prop={'size': 20})
plt.title("Rate of Infection in India in Contrast to Italy ",size =30)
plt.show()
```



1.1 Building a Model

[219]:
```
confirmed = confirmed.rename(columns={list(confirmed.columns)[0]:␣
 ↪"ConfirmedCases"})
deaths = deaths.rename(columns={list(deaths.columns)[0]: "Deaths"})
recovered = recovered.rename(columns={list(recovered)[0]: "Recovered"})
confirmed.index = pd.to_datetime(confirmed.index)
deaths.index = pd.to_datetime(deaths.index)
recovered.index = pd.to_datetime(recovered.index)
print('The Dates Registered in the DataSet are\n :- {}'.format(confirmed.index))
```

```
The Dates Registered in the DataSet are
 :- DatetimeIndex(['2020-01-22', '2020-01-23', '2020-01-24', '2020-01-25',
                '2020-01-26', '2020-01-27', '2020-01-28', '2020-01-29',
                '2020-01-30', '2020-01-31', '2020-02-01', '2020-02-02',
                '2020-02-03', '2020-02-04', '2020-02-05', '2020-02-06',
                '2020-02-07', '2020-02-08', '2020-02-09', '2020-02-10',
                '2020-02-11', '2020-02-12', '2020-02-13', '2020-02-14',
                '2020-02-15', '2020-02-16', '2020-02-17', '2020-02-18',
                '2020-02-19', '2020-02-20', '2020-02-21', '2020-02-22',
                '2020-02-23', '2020-02-24', '2020-02-25', '2020-02-26',
                '2020-02-27', '2020-02-28', '2020-02-29', '2020-03-01',
                '2020-03-02', '2020-03-03', '2020-03-04', '2020-03-05',
```

```
       '2020-03-06', '2020-03-07', '2020-03-08', '2020-03-09',
       '2020-03-10', '2020-03-11', '2020-03-12', '2020-03-13',
       '2020-03-14', '2020-03-15', '2020-03-16', '2020-03-17',
       '2020-03-18', '2020-03-19', '2020-03-20', '2020-03-21',
       '2020-03-22', '2020-03-23', '2020-03-24', '2020-03-25',
       '2020-03-26', '2020-03-27'],
      dtype='datetime64[ns]', freq=None)
```

Predicting the spread of Covid19 in India

[220]:
```
print("-- Cases According to this Dataset -- ")
print('Indian Confirmed Cases ' + str(confirmed['ConfirmedCases'][-1]))
print('Indian Death Cases ' + str(deaths['Deaths'][-1]))
print('Indian Recovery Cases ' + str(recovered['Recovered'][-1]))
indian_active_cases = (confirmed['ConfirmedCases'] - deaths['Deaths'] -␣
 ↪recovered['Recovered'])
print('Active cases in India ' + str(indian_active_cases[-1]))
```

```
-- Cases According to this Dataset --
Indian Confirmed Cases 887
Indian Death Cases 20
Indian Recovery Cases 73
Active cases in India 794
```

[221]:
```
dates = confirmed.index
days_since_1_22 = np.array([i for i in range(len(dates))]).reshape(-1, 1)
indian_cases = confirmed['ConfirmedCases'].T
indian_total_deaths = deaths['Deaths'].T
indian_total_recovered = recovered['Recovered'].T
```

[222]:
```
# calculate rates
summation_deaths = deaths['Deaths'][-1]
summation_Confirmed = confirmed['ConfirmedCases'][-1]
summation_recovered = recovered['Recovered'][-1]
mortality_rate = summation_deaths/summation_Confirmed
recovery_rate = summation_recovered/summation_Confirmed
print('Indian Mortality Rate as per date(mention) : {:.2f}%'.
 ↪format(mortality_rate*100))
print('Indian Recovery Rate as per date(mention) : {:.2f}%'.
 ↪format(recovery_rate*100))
```

```
Indian Mortality Rate as per date(mention) : 2.25%
Indian Recovery Rate as per date(mention) : 8.23%
```

[223]:
```
Future_dates_limit = 30
forcast = np.array([i for i in range(len(dates)+Future_dates_limit)]).
 ↪reshape(-1, 1)
adj_dates = forcast[:-30]
```

```
start = '1/22/2020'
start_date = datetime.datetime.strptime(start, '%m/%d/%Y')
future_forcast_dates = []
for i in range(len(forcast)):
    future_forcast_dates.append((start_date + datetime.timedelta(days=i)).
 ↪strftime('%m/%d/%Y'))
len(forcast)
```

[223]:
```
96
```

[224]:
```
confirmed_cases = np.array(confirmed['ConfirmedCases']).reshape(-1, 1)
```

1.1.1 Polynomial Linear Regression

Polynomial Regression is a form of linear regression in which the relationship between the independent variable x and the dependent vairiable y is modeled as the nth degree polynomial. Polynmial Regression fits a non-linear relationship between the values of x and the corresponding conditional mean y.

[231]:
```
poly = PolynomialFeatures(degree=5)
poly_X_train_confirmed = poly.fit_transform(days_since_1_22)
poly_future_forcast = poly.fit_transform(forcast)
```

[232]:
```
linear_model = LinearRegression(normalize=True, fit_intercept=False)
linear_model.fit(poly_X_train_confirmed, confirmed_cases)
linear_pred = linear_model.predict(poly_future_forcast)
```

[267]:
```
# Future predictions using Polynomial Regression
linear_pred = linear_pred.reshape(1,-1)[0]
print('Polynomial regression future predictions in INDIA : "Confirmed_Cases"')
finalresult = set(zip(future_forcast_dates[-30:], np.round(linear_pred[-30:])))
finalresult
```

```
Polynomial regression future predictions in INDIA : "Confirmed_Cases"
```

[267]:
```
{('03/28/2020', 999.0),
 ('03/29/2020', 1147.0),
 ('03/30/2020', 1313.0),
 ('03/31/2020', 1497.0),
 ('04/01/2020', 1701.0),
 ('04/02/2020', 1926.0),
 ('04/03/2020', 2174.0),
 ('04/04/2020', 2447.0),
 ('04/05/2020', 2746.0),
 ('04/06/2020', 3073.0),
 ('04/07/2020', 3430.0),
 ('04/08/2020', 3818.0),
 ('04/09/2020', 4241.0),
```

```
 ('04/10/2020', 4700.0),
 ('04/11/2020', 5197.0),
 ('04/12/2020', 5734.0),
 ('04/13/2020', 6314.0),
 ('04/14/2020', 6940.0),
 ('04/15/2020', 7614.0),
 ('04/16/2020', 8338.0),
 ('04/17/2020', 9116.0),
 ('04/18/2020', 9950.0),
 ('04/19/2020', 10844.0),
 ('04/20/2020', 11799.0),
 ('04/21/2020', 12820.0),
 ('04/22/2020', 13909.0),
 ('04/23/2020', 15071.0),
 ('04/24/2020', 16307.0),
 ('04/25/2020', 17623.0),
 ('04/26/2020', 19022.0)}
```

1.2 Ending Notes

1.2.1 Virus is a Non-living Entity, It requires a Host for its living and Duplicating, Before we self proclaim ourselves as an Intellectually sophesticated living beings just use common sense stay home and stay safe

1.2.2 Analysis by - N. Rohan Sai

[ ]: