clean and process data

May 21, 2021

[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn import preprocessing
```

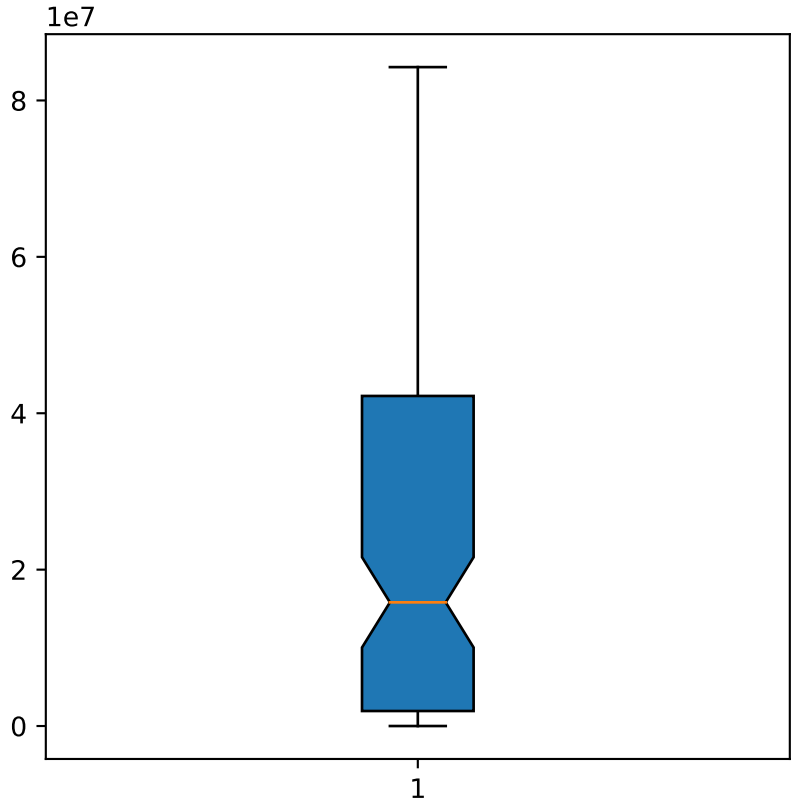
1 COVID-19 World Vaccination Progress/country_vaccinations.csv

[2]:
```
data = pd.read_csv("datasets/COVID-19 World Vaccination Progress/
 ↪country_vaccinations.csv")
usa_values=data.loc[data['iso_code']=='USA']
usa_values=usa_values.fillna(method="ffill")
# usa_values=usa_values.fillna(method="bfill")
usa_values=usa_values.fillna(0)
usa_values=usa_values.drop(columns=['vaccines', 'source_name','source_website'])

# printing nan
print(usa_values.isna().sum())
```

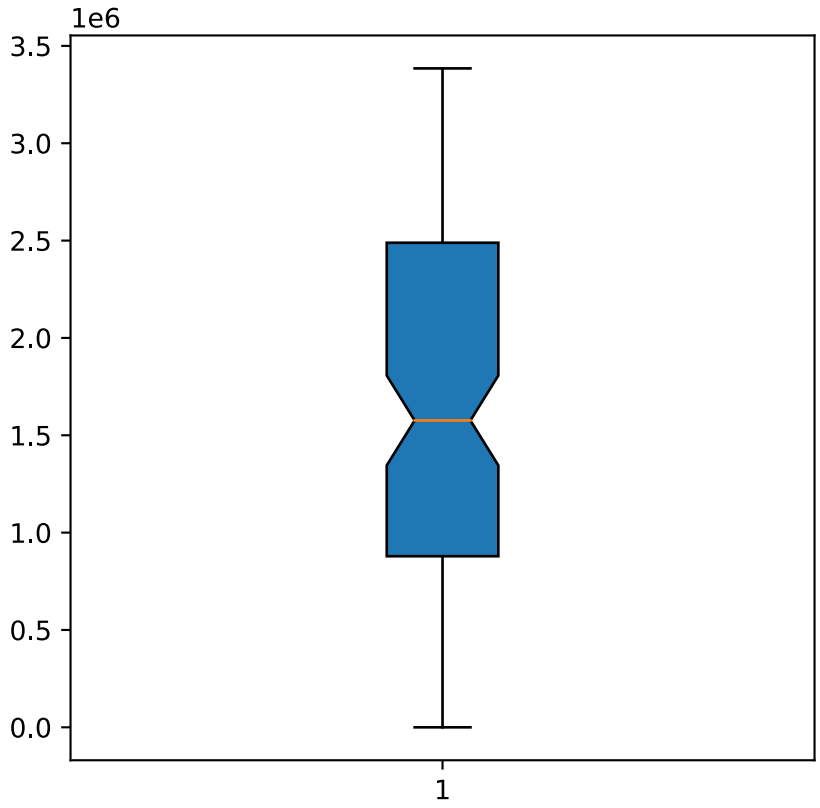
```
country                              0
iso_code                             0
date                                 0
total_vaccinations                   0
people_vaccinated                    0
people_fully_vaccinated              0
daily_vaccinations_raw               0
daily_vaccinations     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

1.1 Box plot to detect outliers

[3]:
```
# No outliers in people fully vaccinated
plt.figure(figsize=(5, 5))
plt.boxplot(usa_values['people_fully_vaccinated'], notch=True,␣
 ↪patch_artist=True)
plt.show()
```



[4]:
```
# No outliers in daily vaccinations
plt.figure(figsize=(5, 5))
plt.boxplot(usa_values['daily_vaccinations'], notch=True, patch_artist=True)
plt.show()
```



[5]:
```
usa_values.head()
```

[5]:

	country	iso_code	date	total_vaccinations	people_vaccinated	people_fully_vaccinated	daily_vaccinations_raw	daily_vaccinations	total_vaccinations_per_hundred
12061	United States	USA	2020-12-20	556208.0	556208.0	0.0	0.0	0.0	0.17
12062	United States	USA	2020-12-21	614117.0	614117.0	0.0	57909.0	57909.0	0.18
12063	United States	USA	2020-12-22	614117.0	614117.0	0.0	57909.0	127432.0	0.18
12064	United States	USA	2020-12-23	1008025.0	1008025.0	0.0	57909.0	150606.0	0.30
12065	United States	USA	2020-12-24	1008025.0	1008025.0	0.0	57909.0		

```
12065           191001.0                              0.30

       people_vaccinated_per_hundred  people_fully_vaccinated_per_hundred  \
12061                           0.17                                  0.0
12062                           0.18                                  0.0
12063                           0.18                                  0.0
12064                           0.30                                  0.0
12065                           0.30                                  0.0

       daily_vaccinations_per_million
12061                             0.0
12062                           173.0
12063                           381.0
12064                           450.0
12065                           571.0
```

[6]:
```
usa_values=usa_values[['date','total_vaccinations','people_vaccinated','people_fully_vaccinate
usa_values.head()
```

[6]:
```
            date  total_vaccinations  people_vaccinated  \
12061  2020-12-20            556208.0           556208.0
12062  2020-12-21            614117.0           614117.0
12063  2020-12-22            614117.0           614117.0
12064  2020-12-23           1008025.0          1008025.0
12065  2020-12-24           1008025.0          1008025.0

       people_fully_vaccinated
12061                      0.0
12062                      0.0
12063                      0.0
12064                      0.0
12065                      0.0
```

[7]:
```
import os
if not os.path.exists('cleaned/COVID-19 World Vaccination Progress'):
    os.makedirs('cleaned/COVID-19 World Vaccination Progress')
f=open(f'cleaned/COVID-19 World Vaccination Progress/country_vaccinations.csv',␣
 ↪"w")
usa_values.to_csv(path_or_buf=f,index=False,line_terminator='\n')
f.close()
```

[8]:
```
usa_values['date'] = pd.to_datetime(usa_values.date)

groupedByMonth=usa_values.groupby(pd.Grouper(key='date', freq='1M')).max().
 ↪reset_index()
groupedByMonth
```

[8]:
```
         date  total_vaccinations  people_vaccinated  people_fully_vaccinated
0 2020-12-31           2794588.0          2794588.0                      0.0
1 2021-01-31          31123299.0         25201143.0                5657142.0
2 2021-02-28          75236003.0         49772180.0               24779920.0
3 2021-03-31         150273292.0         97593290.0               54607041.0
4 2021-04-30         209406814.0        131247546.0               84263408.0
```

[9]:
```
import os
if not os.path.exists('cleaned/COVID-19 World Vaccination Progress'):
    os.makedirs('cleaned/COVID-19 World Vaccination Progress')
f=open(f'cleaned/COVID-19 World Vaccination Progress/
 ↪country_vaccinations_grouped_by_month.csv', "w")
groupedByMonth.to_csv(path_or_buf=f,index=False,line_terminator='\n')
f.close()
```

[10]:
```
data = usa_values['total_vaccinations']
normalized_arr = preprocessing.normalize([data])
usa_values['total_vaccinations']=normalized_arr[0]
data = usa_values['people_vaccinated']
normalized_arr = preprocessing.normalize([data])
usa_values['people_vaccinated']=normalized_arr[0]
data = usa_values['people_fully_vaccinated']
normalized_arr = preprocessing.normalize([data])
usa_values['people_fully_vaccinated']=normalized_arr[0]
```

[11]:
```
usa_values.head()
```

[11]:
```
            date  total_vaccinations  people_vaccinated  \
12061 2020-12-20            0.000533           0.000818
12062 2020-12-21            0.000588           0.000904
12063 2020-12-22            0.000588           0.000904
12064 2020-12-23            0.000966           0.001483
12065 2020-12-24            0.000966           0.001483

       people_fully_vaccinated
12061                      0.0
12062                      0.0
12063                      0.0
12064                      0.0
12065                      0.0
```

[12]:
```
import os
if not os.path.exists('cleaned/COVID-19 World Vaccination Progress'):
    os.makedirs('cleaned/COVID-19 World Vaccination Progress')
f=open(f'cleaned/COVID-19 World Vaccination Progress/
 ↪country_vaccinations_normalized.csv', "w")
usa_values.to_csv(path_or_buf=f,index=False,line_terminator='\n')
```

```
f.close()
```

[13]:
```
usa_values['date'] = pd.to_datetime(usa_values.date)

groupedByMonth=usa_values.groupby(pd.Grouper(key='date', freq='1M')).max().
 ↪reset_index()
groupedByMonth.head()
```

[13]:

	date	total_vaccinations	people_vaccinated	people_fully_vaccinated
0	2020-12-31	0.002677	0.004112	0.000000
1	2021-01-31	0.029811	0.037080	0.014819
2	2021-02-28	0.072063	0.073232	0.064913
3	2021-03-31	0.143936	0.143594	0.143047
4	2021-04-30	0.200575	0.193111	0.220734

[14]:
```
import os
if not os.path.exists('cleaned/COVID-19 World Vaccination Progress'):
    os.makedirs('cleaned/COVID-19 World Vaccination Progress')
f=open(f'cleaned/COVID-19 World Vaccination Progress/
 ↪country_vaccinations_normalized_grouped_by_month.csv', "w")
groupedByMonth.to_csv(path_or_buf=f,index=False,line_terminator='\n')
f.close()
```

[ ]:
```

```

2 us-daily-vaccines.csv

[15]:
```
us_daily_vaccines=pd.read_csv("datasets/us-daily-vaccines.csv")


states_to_exclude=["American Samoa","Bureau of Prisons","Dept of␣
 ↪Defense","District of Columbia","Federated States of␣
 ↪Micronesia","Guam","Indian Health Svc","Long Term Care","Marshall␣
 ↪Islands","Northern Mariana Islands","Puerto Rico","Republic of␣
 ↪Palau","Veterans Health","United States","Virgin Islands"]

us_daily_vaccines=us_daily_vaccines.drop(columns=['Code'])

count =0
for s in states_to_exclude:
    us_daily_vaccines=us_daily_vaccines[us_daily_vaccines['Entity']!
 ↪=states_to_exclude[count]]
    count+=1

# printing nan
print(us_daily_vaccines.isna().sum())
```

```
us_daily_vaccines.describe()
```

```
Entity                0
Day                   0
daily_vaccinations    0
dtype: int64
```

[15]:

	daily_vaccinations
count	5050.000000
mean	40493.919010
std	53026.532755
min	0.000000
25%	10468.250000
50%	23898.500000
75%	48924.000000
max	494575.000000

[16]:
```
us_daily_vaccines.head()
```

[16]:

	Entity	Day	daily_vaccinations
0	Alabama	2021-01-13	5906
1	Alabama	2021-01-14	7083
2	Alabama	2021-01-15	7478
3	Alabama	2021-01-16	7498
4	Alabama	2021-01-17	7509

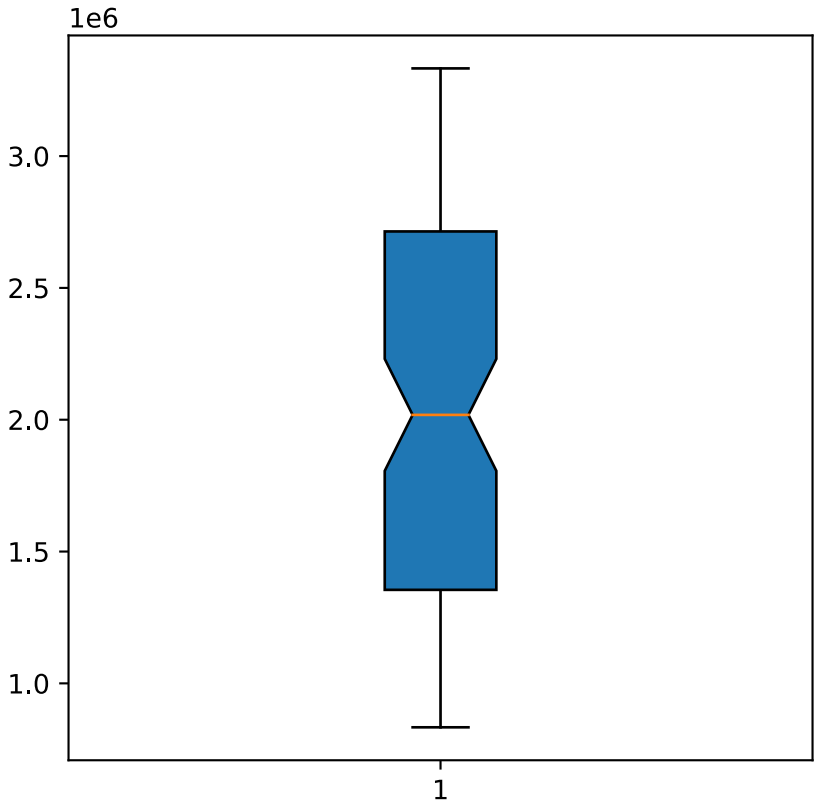
[17]:
```
days=set(us_daily_vaccines["Day"])
temp={"Day":[],"daily_vaccinations":[]}
for d in days:
    temp["Day"].append(d)
    sum=us_daily_vaccines[us_daily_vaccines["Day"]==d]["daily_vaccinations"].
 ↪sum()
    temp["daily_vaccinations"].append(sum)
us_daily_vaccines=pd.DataFrame(temp)
```

[ ]:
```

```

[ ]:
```

```

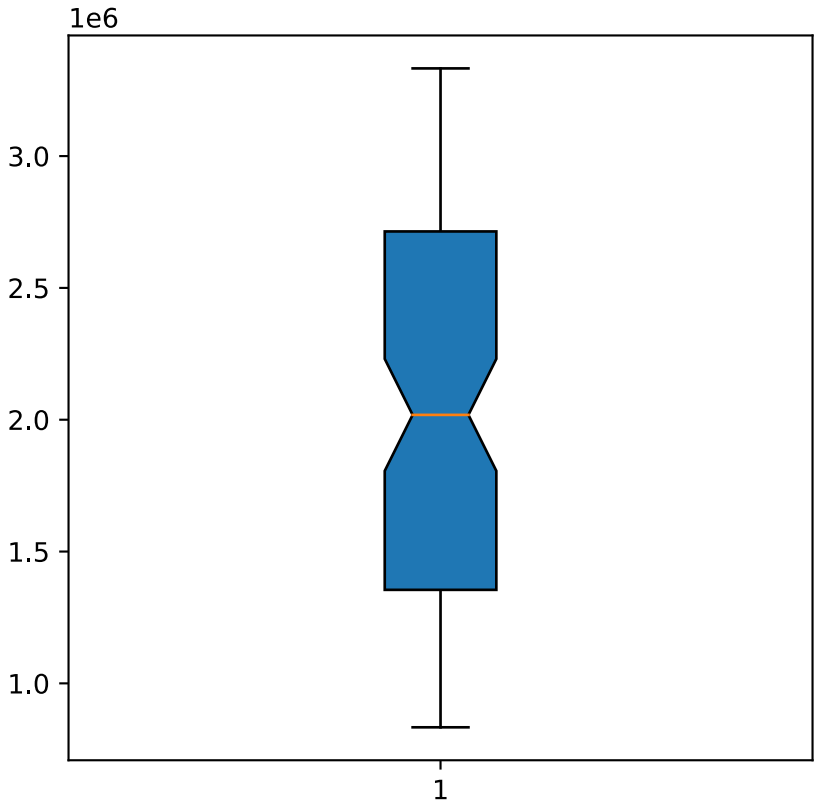
2.1 Boxplot to detect outliers.

[18]:
```
plt.figure(figsize=(5, 5))
plt.boxplot(us_daily_vaccines['daily_vaccinations'], notch=True,␣
 ↪patch_artist=True)
plt.show()
```



2.1.1 Hide outliers

[19]:
```
plt.figure(figsize=(5, 5))
plt.boxplot(us_daily_vaccines['daily_vaccinations'], notch=True,␣
↪patch_artist=True, showfliers=False)
plt.show()
```



2.2 IQR range to find statistical dispersion.

[20]:
```
from scipy.stats import iqr

data = us_daily_vaccines['daily_vaccinations']
iqr(data, axis=0)
```

[20]:
```
1359464.0
```

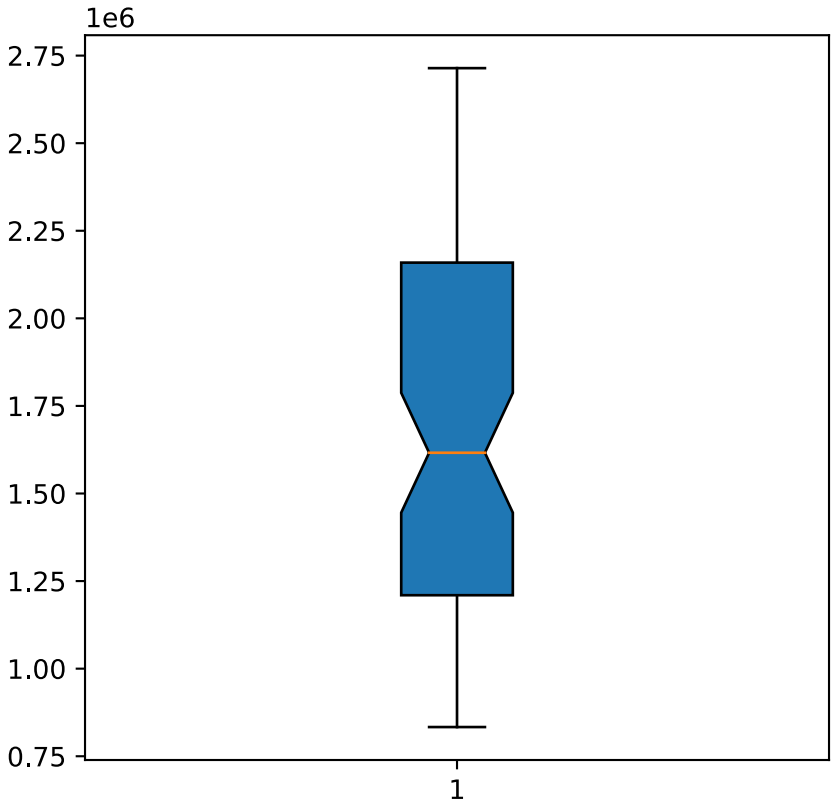
[21]:
```
'''
Warning!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
every time you run this block it will remove outliers assumed to be in Q3
'''
print(us_daily_vaccines.shape)
#find Q1, Q3, and interquartile range for each column
Q1 =  us_daily_vaccines["daily_vaccinations"].quantile(q=.25)
Q3 =  us_daily_vaccines["daily_vaccinations"].quantile(q=.75)
IQR = us_daily_vaccines["daily_vaccinations"].apply(iqr)
print(Q1)
print(Q3)
```

```
#only keep rows in dataframe that have values within 1.5*IQR of Q1 and Q3
us_daily_vaccines =␣
 ↪us_daily_vaccines[~((us_daily_vaccines["daily_vaccinations"] > (Q3+1.
 ↪5*IQR)))]

print(us_daily_vaccines.shape)
```

```
(101, 2)
1354719.0
2714183.0
(76, 2)
```

2.3 Boxplot graph without outliers

[22]:
```
plt.figure(figsize=(5, 5))
plt.boxplot(us_daily_vaccines['daily_vaccinations'], notch=True,␣
 ↪patch_artist=True)
plt.show()
```



2.4 group by month whole USA (discretize data)

[23]:
```
us_daily_vaccines['Day'] = pd.to_datetime(us_daily_vaccines.Day)

groupedByMonth=us_daily_vaccines.groupby(pd.Grouper(key='Day', freq='1M')).
 ↪sum().reset_index()
groupedByMonth.head()
```

[23]:

	Day	daily_vaccinations
0	2021-01-31	18665480
1	2021-02-28	43038036
2	2021-03-31	66948906

[24]:
```
import os
if not os.path.exists('cleaned'):
    os.makedirs('cleaned')
f=open(f'cleaned/us-daily-vaccines-discretize-not-normalized.csv', "w")
groupedByMonth.to_csv(path_or_buf=f,index=False,line_terminator='\n')
f.close()
```

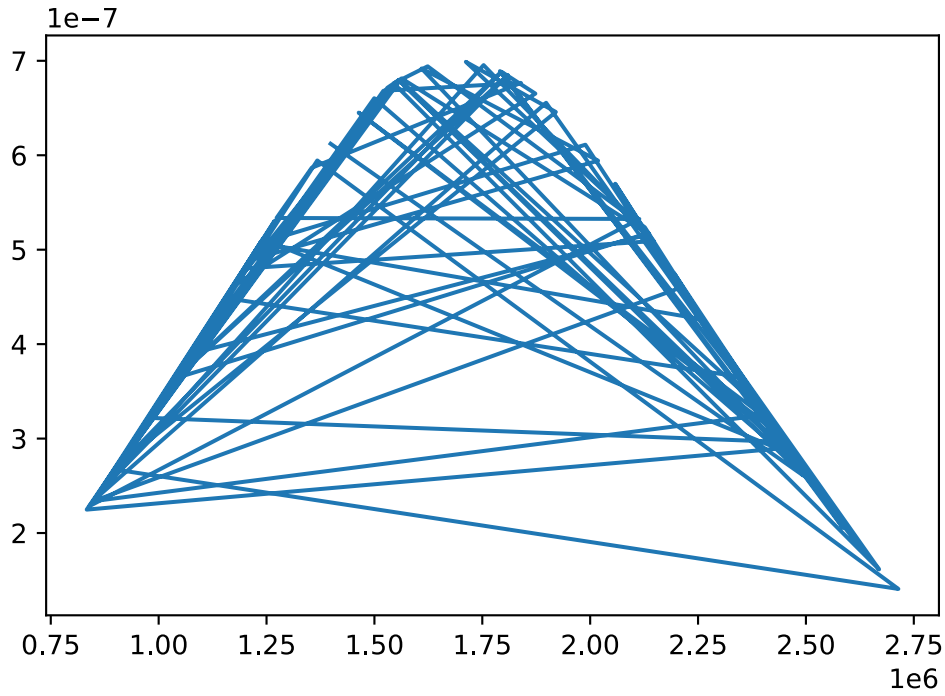
[25]:
```
data = groupedByMonth['daily_vaccinations']
normalized_arr = preprocessing.normalize([data])
groupedByMonth['daily_vaccinations'] = normalized_arr[0]
```

[26]:
```
import os
if not os.path.exists('cleaned'):
    os.makedirs('cleaned')
f=open(f'cleaned/us-daily-vaccines-discretize-normalized.csv', "w")
groupedByMonth.to_csv(path_or_buf=f,index=False,line_terminator='\n')
f.close()
```

2.5 Graph normal distribution of the dataset

[27]:
```
from scipy.stats import norm
import statistics

data = us_daily_vaccines['daily_vaccinations']
mean = statistics.mean(data)
sd = statistics.stdev(data)
# norm.pdf(data, mean, sd)
# plt.plot(norm.pdf(data, mean, sd))
# plt.show()
plt.plot(data, norm.pdf(data, mean, sd))
# plt.show()
```

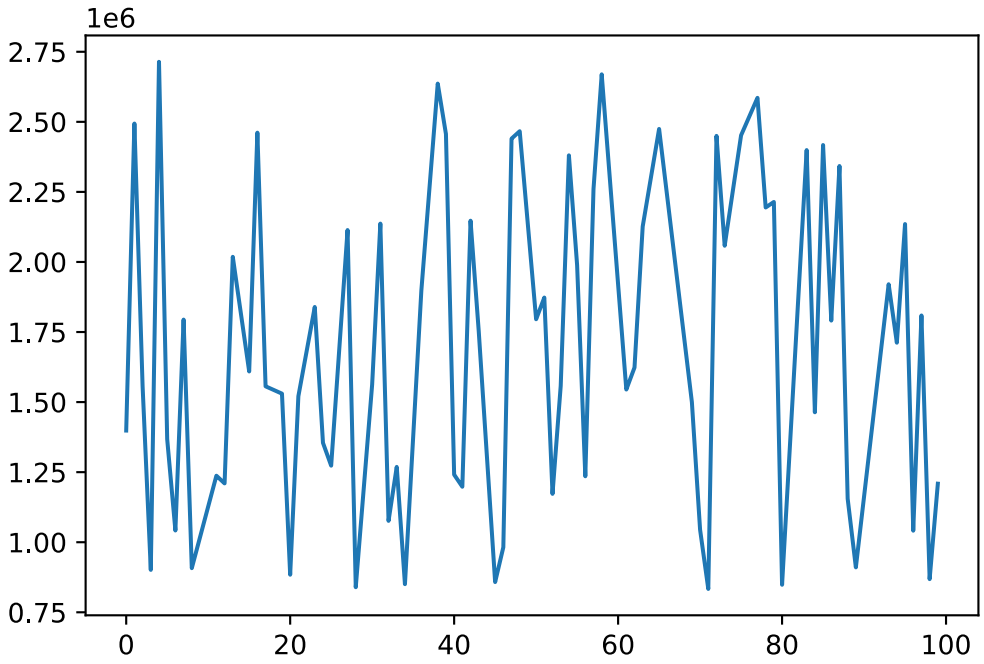
[27]:
```
[<matplotlib.lines.Line2D at 0x19f0eaa1b20>]
```

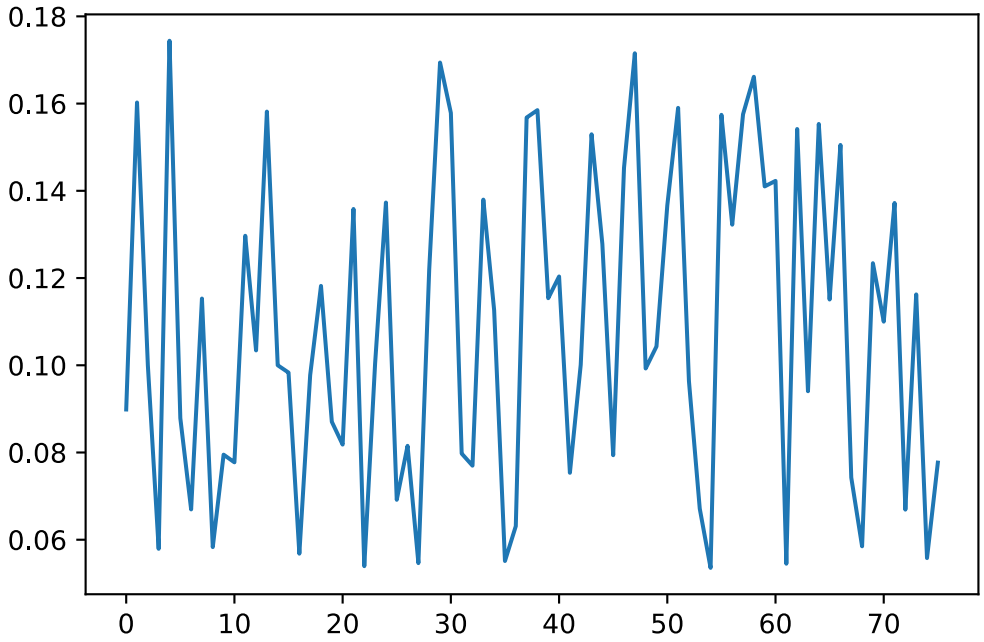


2.6 Preprocess and normalize the data

[28]:
```
data = us_daily_vaccines['daily_vaccinations']
normalized_arr = preprocessing.normalize([data])
print(normalized_arr)

plt.plot( us_daily_vaccines['daily_vaccinations'])
plt.show()
plt.plot(normalized_arr[0])
plt.show()
```

```
[[0.08986206 0.16025117 0.10001154 0.05791397 0.17440574 0.08788024
  0.06694866 0.11529672 0.05830735 0.07950367 0.0777454  0.12969219
  0.1034085  0.15816108 0.100003   0.09832152 0.05680405 0.09772958
  0.11819671 0.08705042 0.08181083 0.13583293 0.0539385  0.10042086
  0.13731232 0.06915358 0.08152732 0.05463788 0.1219528  0.16941013
  0.15784712 0.07975434 0.07697939 0.13797835 0.11264161 0.05511936
  0.06310858 0.15678874 0.15849374 0.11537794 0.1203544  0.07534533
  0.10010652 0.15295882 0.12780457 0.07937709 0.14525573 0.17153358
  0.09926372 0.10431196 0.13665195 0.15901641 0.09636411 0.06712735
  0.05354493 0.15742276 0.13223408 0.15754858 0.16614593 0.14100711
  0.14227529 0.05450159 0.15416942 0.09404758 0.15532676 0.11507645
  0.15051621 0.07425585 0.05848926 0.12340283 0.11000187 0.13720758
  0.06690168 0.11624529 0.05579342 0.07767581]]
```





[29]:
```
import os
if not os.path.exists('cleaned'):
    os.makedirs('cleaned')
```

```
f=open(f'cleaned/us-daily-vaccines.csv', "w")
us_daily_vaccines.to_csv(path_or_buf=f,index=False,line_terminator='\n')
f.close()
```

[30]:
```
us_daily_vaccines['daily_vaccinations'] = normalized_arr[0]
import os
if not os.path.exists('cleaned'):
    os.makedirs('cleaned')
f=open(f'cleaned/us-daily-vaccines-normalized.csv', "w")
us_daily_vaccines.to_csv(path_or_buf=f,index=False,line_terminator='\n')
f.close()
```

[ ]:
```

```

3 Novel Corona Virus 2019 Dataset/covid_19_data.csv

[31]:
```
data = pd.read_csv("datasets/Novel Corona Virus 2019 Dataset/covid_19_data.csv")
data=data[data["Country/Region"]=="US"]
display(data)



# printing nan
print(data.isna().sum())
```

```
           SNo ObservationDate Province/State Country/Region  \
31          32      01/22/2020     Washington             US
70          71      01/23/2020     Washington             US
119        120      01/24/2020     Washington             US
120        121      01/24/2020        Chicago             US
161        162      01/25/2020     Washington             US
…          …              …              …              …
285273  285274      05/02/2021       Virginia             US
285283  285284      05/02/2021     Washington             US
285286  285287      05/02/2021  West Virginia             US
285288  285289      05/02/2021      Wisconsin             US
285289  285290      05/02/2021        Wyoming             US

                Last Update  Confirmed   Deaths  Recovered
31          1/22/2020 17:00        1.0      0.0        0.0
70            1/23/20 17:00        1.0      0.0        0.0
119           1/24/20 17:00        1.0      0.0        0.0
120           1/24/20 17:00        1.0      0.0        0.0
161           1/25/20 17:00        1.0      0.0        0.0
…                       …        …        …          …
285273  2021-05-03 04:20:39   661314.0  10791.0        0.0
```

```
285283  2021-05-03 04:20:39   404709.0   5499.0        0.0
285286  2021-05-03 04:20:39   153918.0   2686.0        0.0
285288  2021-05-03 04:20:39   661685.0   7567.0        0.0
285289  2021-05-03 04:20:39    58142.0    707.0        0.0

[25174 rows x 8 columns]
```

```
SNo                0
ObservationDate    0
Province/State     0
Country/Region     0
Last Update        0
Confirmed          0
Deaths             0
Recovered          0
dtype: int64
```

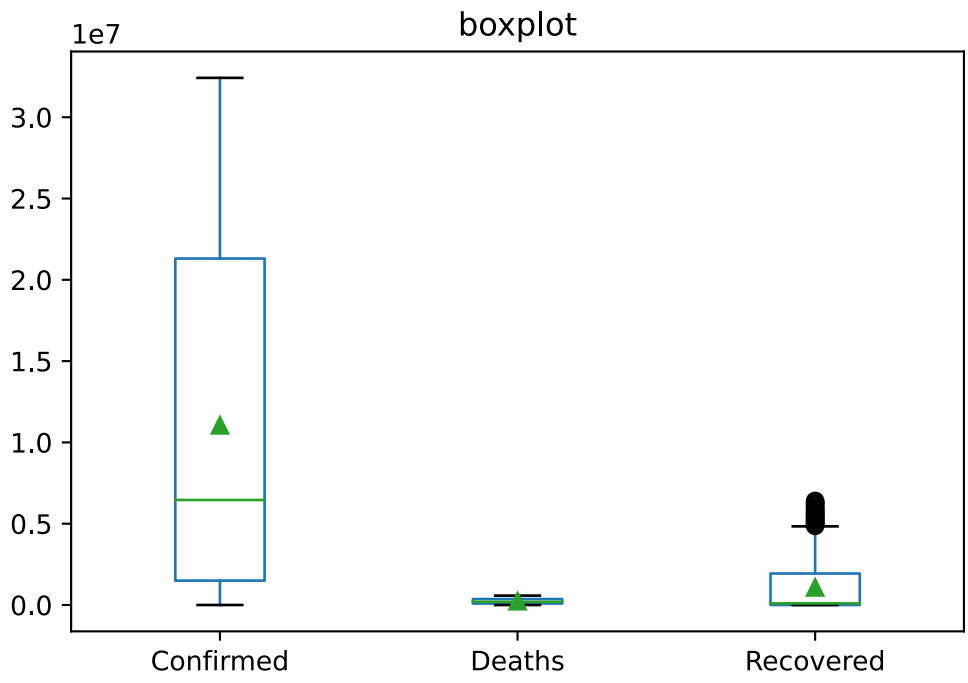
combine the values of all the states for every day

[32]:
```
from datetime import datetime

dates=list(data['ObservationDate'].unique())
dates.sort(key=lambda date: datetime.strptime(date, "%m/%d/%Y"))

cleaned = pd.DataFrame({'ObservationDate':[],'Confirmed':[],'Deaths':
 ↪[],'Recovered':[]})
for d in dates:
    temp=data[data["ObservationDate"]==d]
    d=datetime.strptime(d, "%m/%d/%Y")
    d=d.strftime('%Y-%m-%d')
    cleaned.loc[len(cleaned.index)] = [d, temp['Confirmed'].
 ↪sum(),temp['Deaths'].sum(),temp['Recovered'].sum()]
```

3.1 Boxplots to detect outliers.

[33]:
```
plt.figure(figsize=(10, 10))
ax = cleaned[['Confirmed', 'Deaths', 'Recovered']].plot(kind='box',␣
 ↪title='boxplot', showmeans=True)
plt.show()
```

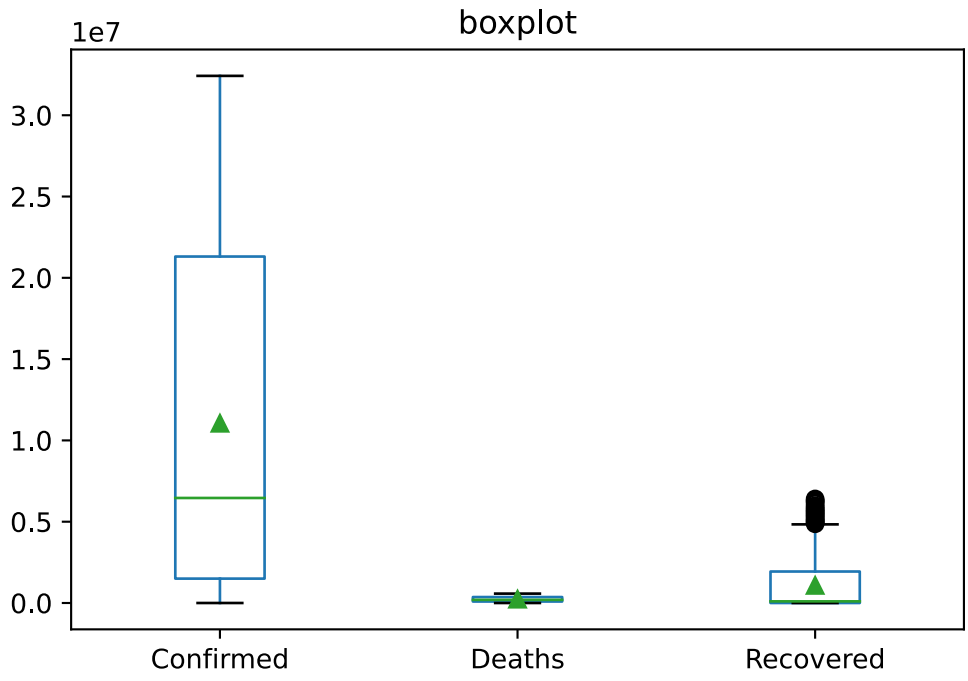
```
<Figure size 720x720 with 0 Axes>
```



3.2 Boxplot graph without outliers

[35]:
```
plt.figure(figsize=(10, 10))
ax = cleaned[['Confirmed', 'Deaths', 'Recovered']].plot(kind='box',␣
 ↪title='boxplot', showmeans=True)
plt.show()
```

```
<Figure size 720x720 with 0 Axes>
```



[36]:
```
import os
if not os.path.exists('cleaned/Novel Corona Virus 2019 Dataset'):
    os.makedirs('cleaned/Novel Corona Virus 2019 Dataset')
f=open(f'cleaned/Novel Corona Virus 2019 Dataset/covid_19_data.csv', "w")
cleaned.to_csv(path_or_buf=f,index=False,line_terminator='\n')
f.close()
```

3.3 group by month (discretize data)

[37]:
```
cleaned['ObservationDate'] = pd.to_datetime(cleaned.ObservationDate)

groupedByMonth=cleaned.groupby(pd.Grouper(key='ObservationDate', freq='1M')).
 ↪max().reset_index()
```

[38]:
```
import os
if not os.path.exists('cleaned/Novel Corona Virus 2019 Dataset'):
    os.makedirs('cleaned/Novel Corona Virus 2019 Dataset')
f=open(f'cleaned/Novel Corona Virus 2019 Dataset/covid_19_data_grouped_by_month.
 ↪csv', "w")
groupedByMonth.to_csv(path_or_buf=f,index=False,line_terminator='\n')
f.close()
```

3.4 normalize

[39]:
```
cleaned["Confirmed"] = (preprocessing.normalize([cleaned["Confirmed"]]))[0]
print(cleaned["Confirmed"])
cleaned["Deaths"] = preprocessing.normalize([cleaned["Deaths"]])[0]
print(cleaned["Deaths"])
cleaned["Recovered"] = preprocessing.normalize([cleaned["Recovered"]])[0]
print(cleaned["Recovered"])
```

```
0      2.940369e-09
1      2.940369e-09
2      5.880739e-09
3      5.880739e-09
4      1.470185e-08
           …
462    9.477060e-02
463    9.494173e-02
464    9.511204e-02
465    9.524525e-02
466    9.533128e-02
Name: Confirmed, Length: 467, dtype: float64
0      0.000000
1      0.000000
2      0.000000
3      0.000000
4      0.000000
         …
462    0.090126
463    0.090260
464    0.090423
465    0.090500
466    0.090551
Name: Deaths, Length: 467, dtype: float64
0      0.0
1      0.0
2      0.0
3      0.0
4      0.0
      …
462    0.0
463    0.0
464    0.0
465    0.0
466    0.0
Name: Recovered, Length: 467, dtype: float64
```

[40]:
```
import os
if not os.path.exists('cleaned/Novel Corona Virus 2019 Dataset'):
    os.makedirs('cleaned/Novel Corona Virus 2019 Dataset')
f=open(f'cleaned/Novel Corona Virus 2019 Dataset/covid_19_data_normalized.csv',␣
 ↪"w")
cleaned.to_csv(path_or_buf=f,index=False,line_terminator='\n')
f.close()
```

4 Countries population by year 2020

[41]:
```
data = pd.read_csv("datasets/Countries population by year 2020/
 ↪population_by_country_2020.csv")
data=data[data["Country (or dependency)"]=="United States"]
data=data[["Country (or dependency)","Population (2020)","Density (P/Km²)","Med.
 ↪ Age"]]
data.head()
```

[41]:

	Country (or dependency)	Population (2020)	Density (P/Km²)	Med. Age
2	United States	330610570	36	38

[42]:
```
import os
if not os.path.exists('cleaned/Countries population by year 2020'):
    os.makedirs('cleaned/Countries population by year 2020')
f=open(f'cleaned/Countries population by year 2020/population_by_country_2020.
 ↪csv', "w")
data.to_csv(path_or_buf=f,index=False,line_terminator='\n')
f.close()
```