Assignment 2- Halla Mohammed (900211491)

Part I

1. The probability of (winning/losing) of the most repeated countries in the dataset in terms of several factors.
2. The probability of (winning/losing) of the most repeated countries in the dataset in terms of several factors.
3. Comparing confidence intervals.
4. Drawing the corresponding graphs.
5. Description of the results.

In [304…

```
#importing necessary libraries

import pandas as pd
import numpy as np
import statsmodels.api as sm
import matplotlib.pyplot as plt
import scipy
from scipy import stats
import math
from statsmodels.stats.proportion import proportion_confint
from scipy.stats import norm,t


#importing a csv file from my laptop

import os
working_directory= os.getcwd()
print(working_directory)
```

```
/Users/halahatem
```

In [305…

```
excercise1 = working_directory + '/Desktop/results.csv'
dataframe= pd.read_csv(excercise1)
```

In [306…

```
dataframe.head()
```

Out[306…

	date	home_team	away_team	home_score	away_score	tournament	city	country
0	1872-11-30	Scotland	England	0	0	Friendly	Glasgow	Scotland
1	1873-03-08	England	Scotland	4	2	Friendly	London	England
2	1874-03-07	Scotland	England	2	1	Friendly	Glasgow	Scotland
3	1875-03-06	England	Scotland	2	2	Friendly	London	England
4	1876-03-04	Scotland	England	3	0	Friendly	Glasgow	Scotland

In [307…

```
x=dataframe['home_score']-dataframe['away_score']
conditions = [
    (x<0),
    (x>0),
    (x==0)
    ]
```

In [308…

```
values= ['win','lose','draw']
```

In [309…

```
dataframe['type_of_result'] = np.select(conditions, values)
```

In [310…

```
x=dataframe['type_of_result'].value_counts()
```

In [311…

```
dataframe['type_of_result'].value_counts(normalize=True)
```

Out[311…

```
lose    0.486455
win     0.283042
draw    0.230504
Name: type_of_result, dtype: float64
```

In [312…

```
dataframe.head()
```

Out[312...

	date	home_team	away_team	home_score	away_score	tournament	city	country
0	1872-11-30	Scotland	England	0	0	Friendly	Glasgow	Scotland
1	1873-03-08	England	Scotland	4	2	Friendly	London	England
2	1874-03-07	Scotland	England	2	1	Friendly	Glasgow	Scotland
3	1875-03-06	England	Scotland	2	2	Friendly	London	England
4	1876-03-04	Scotland	England	3	0	Friendly	Glasgow	Scotland

In [313...

```
x=dataframe['country'].unique()
```

France

In [314...

```
dffrance=dataframe[dataframe['country']=='France']
```

In [315...

```
dffrance.head()
```

Out[315...

	date	home_team	away_team	home_score	away_score	tournament	city
166	2/12/1905	France	Switzerland	1	0	Friendly	Paris
185	4/22/1906	France	Belgium	0	5	Friendly	Saint-Cloud
215	4/12/1908	France	Belgium	1	2	Friendly	Colombes
257	4/3/1910	France	Belgium	0	4	Friendly	Gentilly
277	1/1/1911	France	Hungary	0	3	Friendly	Maisons-Alfort

Tournament

In [316...

```
conditions = [
    (dffrance['tournament']=='FIFA World Cup qualification'),
    (dffrance['tournament']=='FIFA World Cup')
    ]
```

In [317…
```
#extracting unique values

y=dataframe['tournament'].unique()
```

In [318…
```
values=['FIFA World Cup qualification','FIFA World Cup']
```

In [319…
```
dffrance['typematch'] = np.select(conditions, values)
```

```
/var/folders/nn/br8l6_013s1_8h_kpkbg9m9w0000gn/T/ipykernel_2497/1704040084.
py:1: 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
  dffrance['typematch'] = np.select(conditions, values)
```

In [320…
```
dffrance['typematch'].value_counts()
```

Out[320…
```
0                                673
FIFA World Cup                    82
FIFA World Cup qualification      63
Name: typematch, dtype: int64
```

In [321…
```
dffrance=dffrance[dffrance['typematch']!="0"]
```

In [322…
```
z=pd.crosstab(dffrance['typematch'],dffrance['type_of_result'],margins=True
z
```

Out[322…

type_of_result	draw	lose	win	All
typematch				
FIFA World Cup	22	39	21	82
FIFA World Cup qualification	13	44	6	63
All	35	83	27	145

In [323…
```
z=np.array(z)
z
```

Out[323…
```
array([[ 22,  39,  21,  82],
       [ 13,  44,   6,  63],
       [ 35,  83,  27, 145]])
```

Confidence Interval (Tournament)

In [324...]
```
#FWCQ= FIFA World Cup qualification
CI_frwin_FWCQ=proportion_confint(count=z[0,2],nobs=z[0,3],alpha=(1-.95))
CI_frwin_FWCQ
```

Out[324...]
```
(0.16162582903253128, 0.3505692929186882)
```

Description of Results: This concludes that we are 95% confident that the proportion of France winning the FIFA World Cup qualification lies between 16% and 35% of the total.

In [325...]
```
#FWC= FIFA World Cup
CI_frwin_FWC=proportion_confint(count=z[1,2],nobs=z[1,3],alpha=(1-.95))
CI_frwin_FWC
```

Out[325...]
```
(0.022752731952352376, 0.16772345852383808)
```

Description of Results: This concludes that we are 95% confident that the proportion of France winning the FIFA World Cup lies between 2% and 16.7% of the total.

Plotting (Tournament)

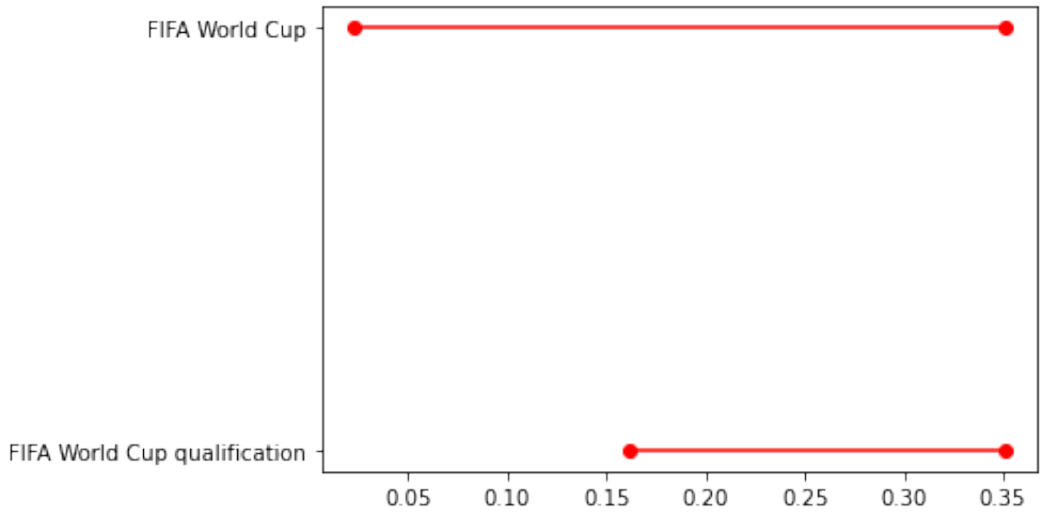
In [326...]
```
ci_frwin = {}
ci_frwin['Typematch'] = ['FIFA World Cup qualification','FIFA World Cup']
ci_frwin['lb'] = [CI_frwin_FWCQ[0],CI_frwin_FWC[0]]
ci_frwin['ub'] = [CI_frwin_FWCQ[1],CI_frwin_FWCQ[1]]
df_ci= pd.DataFrame(ci_frwin)
df_ci
```

Out[326...]

	Typematch	lb	ub
0	FIFA World Cup qualification	0.161626	0.350569
1	FIFA World Cup	0.022753	0.350569

In [327...]
```
for lb,ub,y in zip(df_ci['lb'],df_ci['ub'],range(len(df_ci))):
    plt.plot((lb,ub),(y,y),'ro-')
plt.yticks(range(len(df_ci)),list(df_ci['Typematch']))
```

Out[327…
```
([<matplotlib.axis.YTick at 0x7fc44edc0520>,
  <matplotlib.axis.YTick at 0x7fc44edba6d0>],
 [Text(0, 0, 'FIFA World Cup qualification'), Text(0, 1, 'FIFA World Cup')]
)
```



Home/ Away

In [328…
```
dffrance['home']=(dffrance['home_team']=='France')
```

In [329…
```
dffrance['home'].value_counts()
```

Out[329…
```
False    78
True     67
Name: home, dtype: int64
```

In [330…
```
x=pd.crosstab(dffrance['home'],dffrance['type_of_result'],margins=True)
x
```

Out[330…

type_of_result	draw	lose	win	All
home				
False	23	33	22	78
True	12	50	5	67
All	35	83	27	145

In [331…
```
x=np.array(x)
x
```

Out[331…
```
array([[ 23,  33,  22,  78],
       [ 12,  50,   5,  67],
       [ 35,  83,  27, 145]])
```

Confidence Interval (Home/Away)

In [332...
```
CI_frwin_home=proportion_confint(count=x[1,2],nobs=x[1,3],alpha=(1-.95))
CI_frwin_home
```

Out[332...
```
(0.011702806050245207, 0.13755092529303836)
```

Description of Results: This concludes that we are 95% confident that the proportion of France winning at home lies between 1.17% and 13.76% of the total.

In [333...
```
CI_frwin_away=proportion_confint(count=x[0,2],nobs=x[0,3],alpha=(1-.95))
CI_frwin_away
```

Out[333...
```
(0.18218668801004265, 0.3819158760925214)
```

Description of Results: This concludes that we are 95% confident that the proportion of France winning away from home lies between 18% and 38% of the total.

Plotting

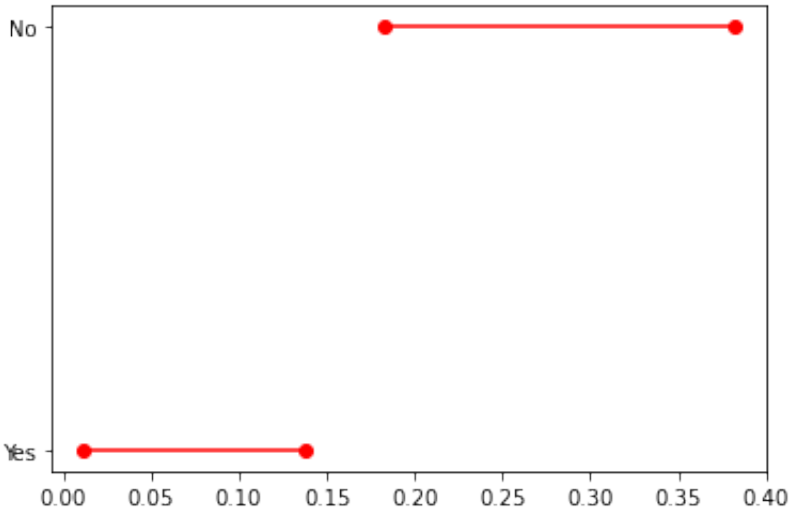
In [334...
```
ci_frwin = {}
ci_frwin['home'] = ['Yes','No']
ci_frwin['lb'] = [CI_frwin_home[0],CI_frwin_away[0]]
ci_frwin['ub'] = [CI_frwin_home[1],CI_frwin_away[1]]
df_ci= pd.DataFrame(ci_frwin)
df_ci
```

Out[334...

	home	lb	ub
0	Yes	0.011703	0.137551
1	No	0.182187	0.381916

In [335...
```
for lb,ub,y in zip(df_ci['lb'],df_ci['ub'],range(len(df_ci))):
    plt.plot((lb,ub),(y,y),'ro-')
plt.yticks(range(len(df_ci)),list(df_ci['home']))
```

Out[335…
```
([<matplotlib.axis.YTick at 0x7fc44e164130>,
  <matplotlib.axis.YTick at 0x7fc44e164640>],
 [Text(0, 0, 'Yes'), Text(0, 1, 'No')])
```



Egypt

In [336…
```
dfegy=dataframe[dataframe['country']=='Egypt']
```

In [337…
```
dfegy.head()
```

Out[337…

	date	home_team	away_team	home_score	away_score	tournament	city	co
1463	2/19/1932	Egypt	Hungary	0	0	Friendly	Cairo	
1661	3/16/1934	Egypt	Israel	7	1	FIFA World Cup qualification	Cairo	
1895	6/19/1936	Egypt	Greece	3	1	Friendly	Cairo	
2927	12/24/1948	Egypt	Norway	1	1	Friendly	Cairo	
3080	2/17/1950	Egypt	Greece	2	0	Friendly	Cairo	

Tournament

In [338…
```
conditions = [
    (dfegy['tournament']=='Friendly'),
    (dfegy['tournament']!='Friendly')
    ]
```

In [339…
```
values=['Friendly','Official']
```

In [340…
```
dfegy['typematch'] = np.select(conditions, values)
```

```
/var/folders/nn/br8l6_013s1_8h_kpkbg9m9w0000gn/T/ipykernel_2497/2597929672.
py:1: 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
  dfegy['typematch'] = np.select(conditions, values)
```

In [341…
```
dfegy['typematch'].value_counts()
```

Out[341…
```
Official    226
Friendly    181
Name: typematch, dtype: int64
```

In [342…
```
x=pd.crosstab(dfegy['typematch'],dfegy['type_of_result'],margins=True)
x
```

Out[342…

type_of_result	draw	lose	win	All
typematch				
Friendly	37	99	45	181
Official	40	139	47	226
All	77	238	92	407

In [343…
```
x=np.array(x)
x
```

Out[343…
```
array([[ 37,  99,  45, 181],
       [ 40, 139,  47, 226],
       [ 77, 238,  92, 407]])
```

Confidence Interval (Tournament)

In [344…
```
CI_egywin_friendly=proportion_confint(count=x[0,2],nobs=x[0,3],alpha=(1-.95
CI_egywin_friendly
```

Out[344…
```
(0.1856528084886489, 0.3115847605721246)
```

Description of Results: This concludes that we are 95% confident that the proportion of Egypt winning friendly matches lies between 18% and 31.16% of the total.

In [345…
```
CI_egywin_official=proportion_confint(count=x[1,2],nobs=x[1,3],alpha=(1-.95
CI_egywin_official
```

Out[345…
```
(0.1550517855722795, 0.2608774179675435)
```

Description of Results: This concludes that we are 95% confident that the proportion of Egypt winning other official matches lies between 15.5% and 26% of the total.

Plotting (Tournament)

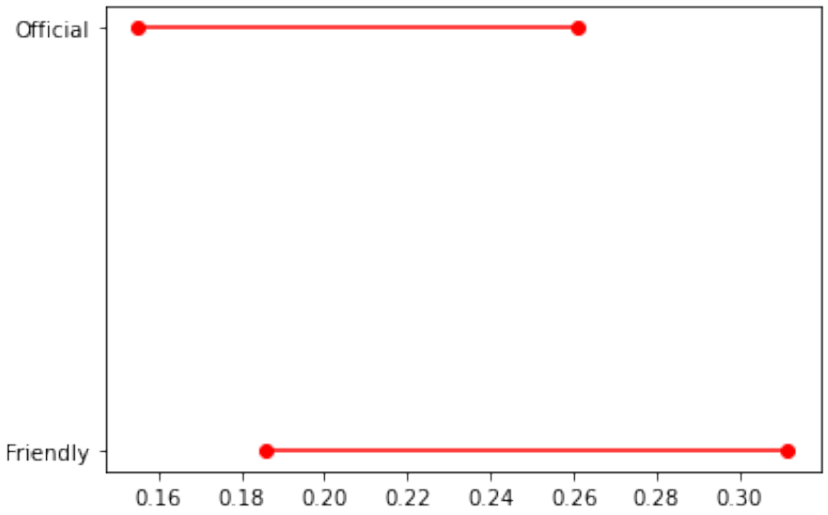
In [346…
```
ci_egywin = {}
ci_egywin['Typematch'] = ['Friendly','Official']
ci_egywin['lb'] = [CI_egywin_friendly[0],CI_egywin_official[0]]
ci_egywin['ub'] = [CI_egywin_friendly[1],CI_egywin_official[1]]
df_ci= pd.DataFrame(ci_egywin)
df_ci
```

Out[346…

	Typematch	lb	ub
0	Friendly	0.185653	0.311585
1	Official	0.155052	0.260877

In [347…
```
for lb,ub,y in zip(df_ci['lb'],df_ci['ub'],range(len(df_ci))):
    plt.plot((lb,ub),(y,y),'ro-')
plt.yticks(range(len(df_ci)),list(df_ci['Typematch']))
```

Out[347…
```
([<matplotlib.axis.YTick at 0x7fc44d910ca0>,
  <matplotlib.axis.YTick at 0x7fc44d910c40>],
 [Text(0, 0, 'Friendly'), Text(0, 1, 'Official')])
```



Home/ Away

In [348…
```
dfegy['home']=(dfegy['home_team']=='Egypt')
```

```
/var/folders/nn/br8l6_013s1_8h_kpkbg9m9w0000gn/T/ipykernel_2497/2175071764.
py:1: 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
  dfegy['home']=(dfegy['home_team']=='Egypt')
```

In [349…

```
dfegy['home'].value_counts()
```

Out[349…

```
True     258
False    149
Name: home, dtype: int64
```

In [350…

```
x=pd.crosstab(dfegy['home'],dfegy['type_of_result'],margins=True)
x
```

Out[350…

type_of_result	draw	lose	win	All
home				
False	33	67	49	149
True	44	171	43	258
All	77	238	92	407

In [351…

```
dfegy.head()
```

Out[351…

	date	home_team	away_team	home_score	away_score	tournament	city	co
1463	2/19/1932	Egypt	Hungary	0	0	Friendly	Cairo	
1661	3/16/1934	Egypt	Israel	7	1	FIFA World Cup qualification	Cairo	
1895	6/19/1936	Egypt	Greece	3	1	Friendly	Cairo	
2927	12/24/1948	Egypt	Norway	1	1	Friendly	Cairo	
3080	2/17/1950	Egypt	Greece	2	0	Friendly	Cairo	

In [352…

```
x=np.array(x)
x
```

Out[352…

```
array([[ 33,  67,  49, 149],
       [ 44, 171,  43, 258],
       [ 77, 238,  92, 407]])
```

In [353...
```
CI_egywin_home=proportion_confint(count=x[1,2],nobs=x[1,3],alpha=(1-.95))
CI_egywin_home
```

Out[353...
```
(0.12119174183927744, 0.21214159149405587)
```

Description of Results: This concludes that we are 95% confident that the proportion of Egypt winning home matches lies between 12.12% and 21.2% of the total.

In [354...
```
CI_egywin_away=proportion_confint(count=x[0,2],nobs=x[0,3],alpha=(1-.95))
CI_egywin_away
```

Out[354...
```
(0.25342513144684364, 0.40429298935852553)
```

Description of Results: This concludes that we are 95% confident that the proportion of Egypt winning matches away from the country lies between 25.34% and 40% of the total.

Plotting (Home/Away)

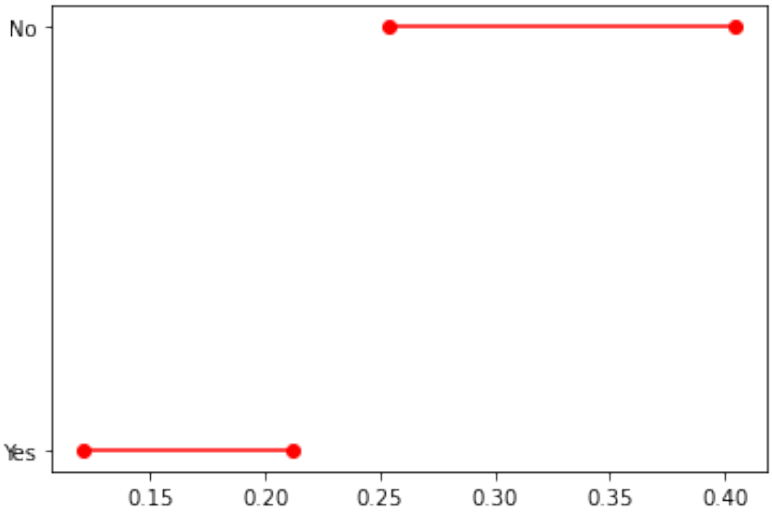
In [355...
```
ci_egywin = {}
ci_egywin['home'] = ['Yes','No']
ci_egywin['lb'] = [CI_egywin_home[0],CI_egywin_away[0]]
ci_egywin['ub'] = [CI_egywin_home[1],CI_egywin_away[1]]
df_ci= pd.DataFrame(ci_egywin)
df_ci
```

Out[355...

	home	lb	ub
0	Yes	0.121192	0.212142
1	No	0.253425	0.404293

In [356...
```
for lb,ub,y in zip(df_ci['lb'],df_ci['ub'],range(len(df_ci))):
    plt.plot((lb,ub),(y,y),'ro-')
plt.yticks(range(len(df_ci)),list(df_ci['home']))
```

Out[356…
```
([<matplotlib.axis.YTick at 0x7fc44e9e98e0>,
  <matplotlib.axis.YTick at 0x7fc44e9e9ee0>],
 [Text(0, 0, 'Yes'), Text(0, 1, 'No')])
```



United States

In [357…
```
dfus=dataframe[dataframe['country']=='United States']
```

In [358…
```
dfus.head()
```

Out[358…

	date	home_team	away_team	home_score	away_score	tournament	city	c
41	1885-11-28	United States	Canada	0	1	Friendly	Newark	
48	1886-11-25	United States	Canada	3	2	Friendly	Newark	
935	11/8/1925	United States	Canada	6	1	Friendly	New York	
1022	11/6/1926	United States	Canada	6	2	Friendly	New York	
1790	5/19/1935	United States	Scotland	1	5	Friendly	New York	

Tournament

In [359…
```
conditions = [
    (dfus['tournament']=='USA Cup'),
    (dfus['tournament']=='Copa América')
    ]
```

In [360…
```
values=['USA Cup','Copa América']
```

In [361...
```
dfus['typematch'] = np.select(conditions, values)
```

```
/var/folders/nn/br8l6_013s1_8h_kpkbg9m9w0000gn/T/ipykernel_2497/4109917591.
py:1: 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
  dfus['typematch'] = np.select(conditions, values)
```

In [362...
```
dfus=dfus[dfus['typematch']!="0"]
```

In [363...
```
x=pd.crosstab(dfus['typematch'],dfus['type_of_result'],margins=True)
x
```

Out[363...

type_of_result	draw	lose	win	All
typematch				
Copa América	6	16	10	32
USA Cup	11	17	9	37
All	17	33	19	69

In [364...
```
x=np.array(x)
x
```

Out[364...
```
array([[ 6, 16, 10, 32],
       [11, 17,  9, 37],
       [17, 33, 19, 69]])
```

Confidence Interval of United States (Tournament)

In [365...
```
#USC= USA Cup
CI_uswin_USC=proportion_confint(count=x[0,2],nobs=x[0,3],alpha=(1-.95))
CI_uswin_USC
```

Out[365...
```
(0.15190409616559103, 0.47309590383440897)
```

Description of Results: This concludes that we are 95% confident that the proportion of the United States winning USA Cup matches lies between 15.19% and 47.3% of the total.

In [366...
```
#CA= Copa América
CI_uswin_CA=proportion_confint(count=x[1,2],nobs=x[1,3],alpha=(1-.95))
CI_uswin_CA
```

Out[366...
```
(0.1049994075063076, 0.3814870789801789)
```

Description of Results: This concludes that we are 95% confident that the proportion of the United States winning Copa América matches lies between 10.5% and 38.15% of the total.

Plotting (Tournament)

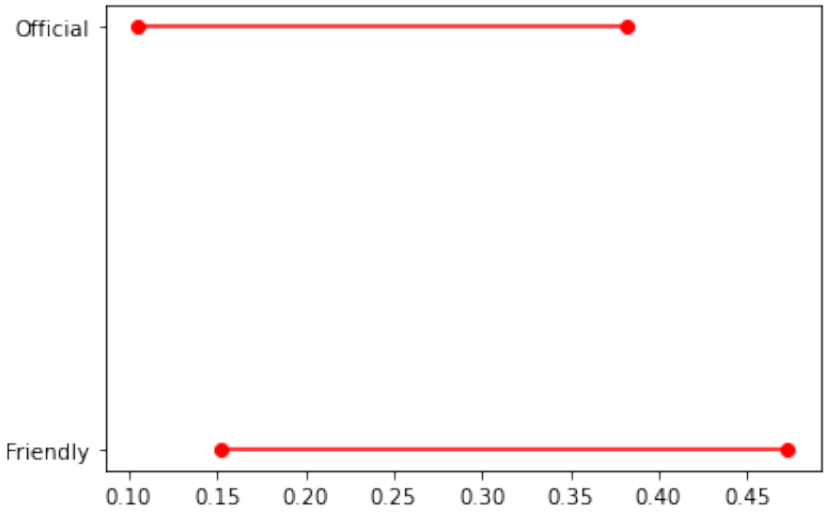
In [367…
```
ci_uswin = {}
ci_uswin['Typematch'] = ['Friendly','Official']
ci_uswin['lb'] = [CI_uswin_USC[0],CI_uswin_CA[0]]
ci_uswin['ub'] = [CI_uswin_USC[1],CI_uswin_CA[1]]
df_ci= pd.DataFrame(ci_uswin)
df_ci
```

Out[367…

	Typematch	lb	ub
0	Friendly	0.151904	0.473096
1	Official	0.104999	0.381487

In [368…
```
for lb,ub,y in zip(df_ci['lb'],df_ci['ub'],range(len(df_ci))):
    plt.plot((lb,ub),(y,y),'ro-')
plt.yticks(range(len(df_ci)),list(df_ci['Typematch']))
```

Out[368…
```
([<matplotlib.axis.YTick at 0x7fc44d2791c0>,
  <matplotlib.axis.YTick at 0x7fc44de75bb0>],
 [Text(0, 0, 'Friendly'), Text(0, 1, 'Official')])
```



Home/Away

In [369…
```
dfus['home']=(dfus['home_team']=='United States')
```

In [370…
```
dfus['home'].value_counts()
```

Out[370…
```
False    44
True     25
Name: home, dtype: int64
```

In [371…
```
x=pd.crosstab(dfus['home'],dfus['type_of_result'],margins=True)
x
```

Out[371…

type_of_result	draw	lose	win	All
home				
False	13	21	10	44
True	4	12	9	25
All	17	33	19	69

In [372…
```
dfus.head()
```

Out[372…

	date	home_team	away_team	home_score	away_score	tournament	ci
17069	5/30/1992	United States	Republic of Ireland	3	1	USA Cup	Washingt
17070	5/31/1992	Italy	Portugal	0	0	USA Cup	New Hav
17085	6/3/1992	United States	Portugal	1	0	USA Cup	Chica
17086	6/4/1992	Republic of Ireland	Italy	0	2	USA Cup	Foxborou
17090	6/6/1992	United States	Italy	1	1	USA Cup	Chica

In [373…
```
x=np.array(x)
x
```

Out[373…
```
array([[13, 21, 10, 44],
       [ 4, 12,  9, 25],
       [17, 33, 19, 69]])
```

Plotting (Home/Away)

In [374…
```
CI_uswin_home=proportion_confint(count=x[1,2],nobs=x[1,3],alpha=(1-.95))
CI_uswin_home
```

Out[374…
```
(0.1718434574841548, 0.5481565425158452)
```

Description of Results: This concludes that we are 95% confident that the proportion of the United States winning home matches lies between 17.18% and 54.8% of the total.

In [375…
```
CI_uswin_away=proportion_confint(count=x[0,2],nobs=x[0,3],alpha=(1-.95))
CI_uswin_away
```

Out[375… (0.10344767077452685, 0.3510977837709277)

Description of Results: This concludes that we are 95% confident that the proportion of the United States away matches lies between 10.34% and 35.12% of the total.

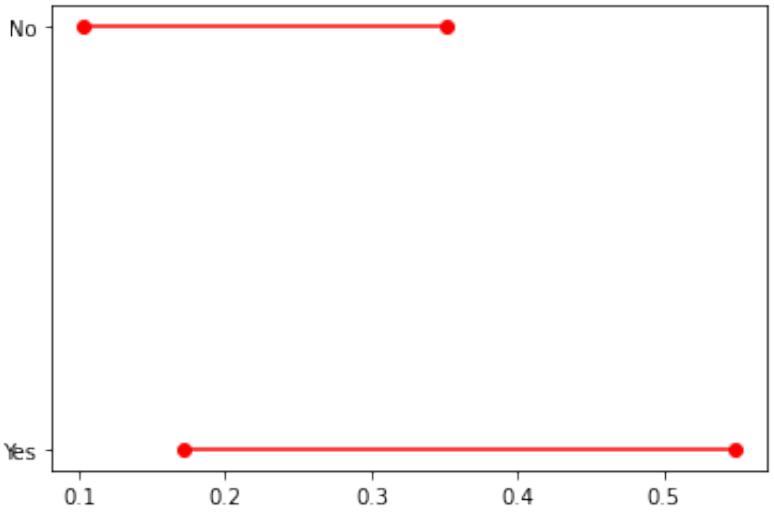
In [376…
```
ci_uswin = {}
ci_uswin['home'] = ['Yes','No']
ci_uswin['lb'] = [CI_uswin_home[0],CI_uswin_away[0]]
ci_uswin['ub'] = [CI_uswin_home[1],CI_uswin_away[1]]
df_ci= pd.DataFrame(ci_uswin)
df_ci
```

Out[376…

	home	lb	ub
0	Yes	0.171843	0.548157
1	No	0.103448	0.351098

In [377…
```
for lb,ub,y in zip(df_ci['lb'],df_ci['ub'],range(len(df_ci))):
    plt.plot((lb,ub),(y,y),'ro-')
plt.yticks(range(len(df_ci)),list(df_ci['home']))
```

Out[377…
```
([<matplotlib.axis.YTick at 0x7fc44dacb820>,
  <matplotlib.axis.YTick at 0x7fc44dacb880>],
 [Text(0, 0, 'Yes'), Text(0, 1, 'No')])
```



Part II

Using COVID-19 dataset that has been gathered during the pandemic to analyze the following:

1. The daily reported number of confirmed cases and deaths.
2. The ratio between the deaths and confirmed cases.
3. Comparing between 2020 and 2021 in terms of several factors like regions, income, and continents.
4. Description of the results.

To find the daily reported number of cases and deaths:

In [378…
```
DF=pd.read_csv('covid_data.csv',encoding='latin-1')
```

In [379…
```
DF.head()
```

Out[379…

	date	iso3c	country	income	region	continent	dcases	ddeaths	population	weel
0	2020-02-24	AFG	Afghanistan	Low income	South Asia	Asia	5	0	38041754	
1	2020-02-25	AFG	Afghanistan	Low income	South Asia	Asia	0	0	38041754	
2	2020-02-26	AFG	Afghanistan	Low income	South Asia	Asia	0	0	38041754	
3	2020-02-27	AFG	Afghanistan	Low income	South Asia	Asia	0	0	38041754	
4	2020-02-28	AFG	Afghanistan	Low income	South Asia	Asia	0	0	38041754	

In [380…
```
x= DF['country'].unique()
```

In [381…
```
#changed the data to categorical and making them strings
from pandas.api.types import CategoricalDtype
cat=['Fri', 'Sat', 'Sun','Mon','Tue','Wed','Thu']
cat_type = CategoricalDtype(categories=cat, ordered=True)
DF['weekdays'] = DF['weekdays'].astype(cat_type)
```

Daily Cases for all countries

In [382…
```
#grouped the data by day to find the total number of confirmed cases per we
stats=DF.groupby("weekdays").agg({"dcases": [np.mean, np.std, np.size]})
stats
```

Out[382...

	dcases		
	mean	std	size
weekdays			
Fri	2643.215039	13626.207863	17634
Sat	2174.297447	10922.667935	17472
Sun	1852.340706	9559.968071	17496
Mon	2116.600879	11700.105447	17521
Tue	2388.510716	11756.420050	17544
Wed	2601.990272	12848.605924	17578
Thu	2693.674338	14618.890740	17598

In [383...

```
#to get lower bound and higher bound to get the mean confidence interval
ci95_hi = []
ci95_lo = []
```

In [384...

```
#calculate the mean ci
#i used the for loop to calculate the ci per day
for i in stats.index:
    m, s, n = stats.loc[i]
    x=scipy.stats.t.interval(.95, n-1, m,s/np.sqrt(n-1))
    ci95_hi.append(x[1])
    ci95_lo.append(x[0])
x
```

Out[384...

```
(2477.6647308357324, 2909.6839451501755)
```

Because we can't calculate the exact mean, we estimate using the mean confidence interval. What we can conflude from the above interval is that the mean of confirmen daily cases lies between 2477.7 and 2909.7. Also, it is indicated that the level of confidence is 95 %.

In [385...

```
ci95_hi
```

Out[385...

```
[2844.351039005679,
 2336.2724620778636,
 1994.010612665055,
 2289.861880299358,
 2562.4914740100803,
 2791.950040008988,
 2909.6839451501755]
```

In [386...

```
ci95_lo
```

Out[386…
```
[2442.079039252232,
 2012.3224326107813,
 1710.670800229321,
 1943.3398775911735,
 2214.529957818465,
 2412.030503852657,
 2477.6647308357324]
```

In [387…
```
stats['ci95_hi'] = ci95_hi
stats['ci95_lo'] = ci95_lo
print(stats)
```

	dcases			ci95_hi	ci95_lo
	mean	std	size		
weekdays					
Fri	2643.215039	13626.207863	17634	2844.351039	2442.079039
Sat	2174.297447	10922.667935	17472	2336.272462	2012.322433
Sun	1852.340706	9559.968071	17496	1994.010613	1710.670800
Mon	2116.600879	11700.105447	17521	2289.861880	1943.339878
Tue	2388.510716	11756.420050	17544	2562.491474	2214.529958
Wed	2601.990272	12848.605924	17578	2791.950040	2412.030504
Thu	2693.674338	14618.890740	17598	2909.683945	2477.664731

In [388…
```
df_ci= pd.DataFrame(stats)
df_ci
```

Out[388…

	dcases			ci95_hi	ci95_lo
	mean	std	size		
weekdays					
Fri	2643.215039	13626.207863	17634	2844.351039	2442.079039
Sat	2174.297447	10922.667935	17472	2336.272462	2012.322433
Sun	1852.340706	9559.968071	17496	1994.010613	1710.670800
Mon	2116.600879	11700.105447	17521	2289.861880	1943.339878
Tue	2388.510716	11756.420050	17544	2562.491474	2214.529958
Wed	2601.990272	12848.605924	17578	2791.950040	2412.030504
Thu	2693.674338	14618.890740	17598	2909.683945	2477.664731

In [389…
```
df_ci['weekdays']=df_ci.index
df_ci
```

Out[389…

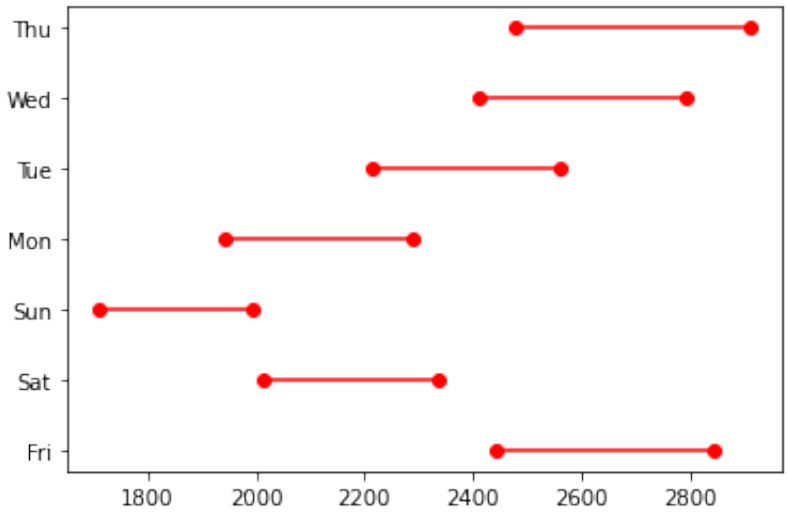
	dcases			ci95_hi	ci95_lo	weekdays
	mean	std	size			
weekdays						
Fri	2643.215039	13626.207863	17634	2844.351039	2442.079039	Fri
Sat	2174.297447	10922.667935	17472	2336.272462	2012.322433	Sat
Sun	1852.340706	9559.968071	17496	1994.010613	1710.670800	Sun
Mon	2116.600879	11700.105447	17521	2289.861880	1943.339878	Mon
Tue	2388.510716	11756.420050	17544	2562.491474	2214.529958	Tue
Wed	2601.990272	12848.605924	17578	2791.950040	2412.030504	Wed
Thu	2693.674338	14618.890740	17598	2909.683945	2477.664731	Thu

In [390…

```
#plotting the confidence interval for the above calculations
for lb,ub,y in zip(df_ci['ci95_lo'],df_ci['ci95_hi'],range(len(df_ci))):
    plt.plot((lb,ub),(y,y),'ro-')
plt.yticks(range(len(df_ci)),list(df_ci['weekdays']))
```

Out[390…

```
([<matplotlib.axis.YTick at 0x7fc44ee1bbe0>,
  <matplotlib.axis.YTick at 0x7fc44ee1b520>,
  <matplotlib.axis.YTick at 0x7fc44ee26400>,
  <matplotlib.axis.YTick at 0x7fc448a592e0>,
  <matplotlib.axis.YTick at 0x7fc44db48e50>,
  <matplotlib.axis.YTick at 0x7fc44d8e7760>,
  <matplotlib.axis.YTick at 0x7fc44d8e7bb0>],
 [Text(0, 0, 'Fri'),
  Text(0, 1, 'Sat'),
  Text(0, 2, 'Sun'),
  Text(0, 3, 'Mon'),
  Text(0, 4, 'Tue'),
  Text(0, 5, 'Wed'),
  Text(0, 6, 'Thu')])
```



Daily Deaths for all countries

In [391…

```
#now, i will do the same but for the number of confirmed deaths
stats=DF.groupby("weekdays").agg({"ddeaths": [np.mean, np.std, np.size]})
stats
```

Out[391…

	ddeaths		
	mean	std	size
weekdays			
Fri	47.990756	208.404740	17634
Sat	40.258413	177.949619	17472
Sun	31.856367	139.320870	17496
Mon	37.954968	155.752300	17521
Tue	50.840002	230.863861	17544
Wed	51.346968	226.105877	17578
Thu	49.695534	224.874945	17598

In [392…

```
ci95_hi = []
ci95_lo = []
```

In [393…

```
for i in stats.index:
    m, s, n = stats.loc[i]
    x=scipy.stats.t.interval(.95, n-1, m,s/np.sqrt(n-1))
    ci95_hi.append(x[1])
    ci95_lo.append(x[0])
```

In [394…

```
x
```

Out[394…

```
(46.372767894404106, 53.01829927231938)
```

A confidence interval displays the probability that a parameter will fall between a pair of values around the mean. Confidence intervals measure the degree of uncertainty or certainty in a sampling method. Here, it indicates that the level of confidence is 95 %. Because the true population mean is unknown, this range describes possible values that the mean could be, which lies between 46.4 and 53. This is an estimate mean for the confirmed number of daily deaths.

In [395…

```
ci95_hi
```

Out[395…
```
[51.06701191116553,
 42.89727352457211,
 33.9209739150721,
 40.26142611814076,
 54.25650741493992,
 54.68982229398611,
 53.01829927231938]
```

In [396…
```
ci95_lo
```

Out[396…
```
[44.914501075110984,
 37.61955339850481,
 29.79176042420544,
 35.64851052931087,
 47.4234971450236,
 48.004113307333725,
 46.372767894404106]
```

In [397…
```
stats['ci95_hi'] = ci95_hi
stats['ci95_lo'] = ci95_lo
print(stats)
```

```
            ddeaths                          ci95_hi    ci95_lo
               mean         std   size
weekdays
Fri        47.990756  208.404740  17634  51.067012  44.914501
Sat        40.258413  177.949619  17472  42.897274  37.619553
Sun        31.856367  139.320870  17496  33.920974  29.791760
Mon        37.954968  155.752300  17521  40.261426  35.648511
Tue        50.840002  230.863861  17544  54.256507  47.423497
Wed        51.346968  226.105877  17578  54.689822  48.004113
Thu        49.695534  224.874945  17598  53.018299  46.372768
```

In [398…
```
df_ci= pd.DataFrame(stats)
df_ci
```

Out[398…

	ddeaths			ci95_hi	ci95_lo
	mean	std	size		
weekdays					
Fri	47.990756	208.404740	17634	51.067012	44.914501
Sat	40.258413	177.949619	17472	42.897274	37.619553
Sun	31.856367	139.320870	17496	33.920974	29.791760
Mon	37.954968	155.752300	17521	40.261426	35.648511
Tue	50.840002	230.863861	17544	54.256507	47.423497
Wed	51.346968	226.105877	17578	54.689822	48.004113
Thu	49.695534	224.874945	17598	53.018299	46.372768

In [399…

```
df_ci['weekdays']=df_ci.index
df_ci
```

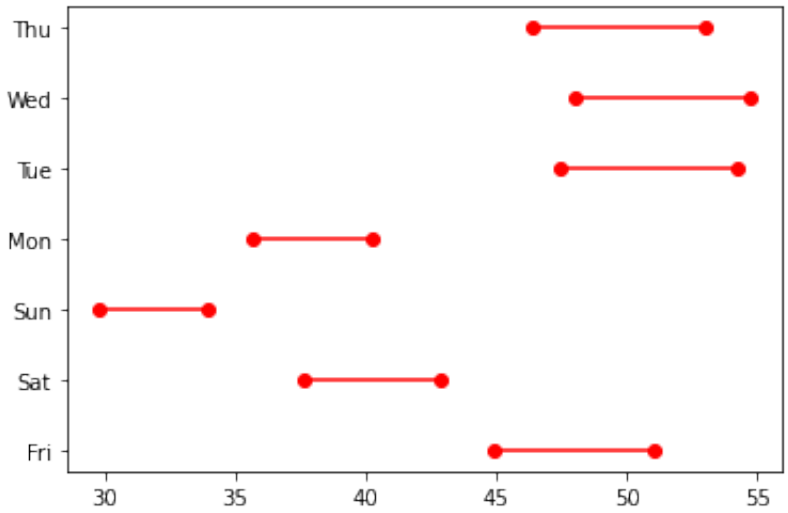
Out[399…

	ddeaths			ci95_hi	ci95_lo	weekdays
	mean	std	size			
weekdays						
Fri	47.990756	208.404740	17634	51.067012	44.914501	Fri
Sat	40.258413	177.949619	17472	42.897274	37.619553	Sat
Sun	31.856367	139.320870	17496	33.920974	29.791760	Sun
Mon	37.954968	155.752300	17521	40.261426	35.648511	Mon
Tue	50.840002	230.863861	17544	54.256507	47.423497	Tue
Wed	51.346968	226.105877	17578	54.689822	48.004113	Wed
Thu	49.695534	224.874945	17598	53.018299	46.372768	Thu

In [400…

```
for lb,ub,y in zip(df_ci['ci95_lo'],df_ci['ci95_hi'],range(len(df_ci))):
    plt.plot((lb,ub),(y,y),'ro-')
plt.yticks(range(len(df_ci)),list(df_ci['weekdays']))
```

Out[400…
```
([<matplotlib.axis.YTick at 0x7fc44e216550>,
  <matplotlib.axis.YTick at 0x7fc44e216df0>,
  <matplotlib.axis.YTick at 0x7fc44f2dea90>,
  <matplotlib.axis.YTick at 0x7fc44db50c10>,
  <matplotlib.axis.YTick at 0x7fc44e211550>,
  <matplotlib.axis.YTick at 0x7fc44e211ca0>,
  <matplotlib.axis.YTick at 0x7fc44e21e6d0>],
 [Text(0, 0, 'Fri'),
  Text(0, 1, 'Sat'),
  Text(0, 2, 'Sun'),
  Text(0, 3, 'Mon'),
  Text(0, 4, 'Tue'),
  Text(0, 5, 'Wed'),
  Text(0, 6, 'Thu')])
```



To get the ratio between the deaths and confirmed cases:

In [401…
```
x= DF['dcases'].sum()
x
```

Out[401…
```
289138394
```

In [402…
```
y= DF['ddeaths'].sum()
y
```

Out[402…
```
5441088
```

In [403…
```
ratio= y/x
ratio
```

Out[403…
```
0.01881828256955733
```

We can conclude from the above code that the ratio of deaths to confirmed cases is 18%, which is relatively high.

Now we will calculate the daily reported number for confirmed cases and deaths in 4 different countries: South Korea, Egypt, Japan, and United States.

In [404…
```
DF['country'].unique()
```

Out[404…
```
array(['Afghanistan', 'Angola', 'Albania', 'Andorra',
       'United Arab Emirates', 'Argentina', 'Armenia',
       'Antigua & Barbuda', 'Australia', 'Austria', 'Azerbaijan',
       'Burundi', 'Belgium', 'Benin', 'Burkina Faso', 'Bangladesh',
       'Bulgaria', 'Bahrain', 'Bahamas', 'Bosnia & Herzegovina',
       'Belarus', 'Belize', 'Bolivia', 'Brazil', 'Barbados', 'Brunei',
       'Bhutan', 'Botswana', 'Central African Republic', 'Canada',
       'Switzerland', 'Chile', 'China', 'Côte d\x92Ivoire', 'Cameroon',
       'Congo - Kinshasa', 'Congo - Brazzaville', 'Colombia', 'Comoros',
       'Cape Verde', 'Costa Rica', 'Cuba', 'Cyprus', 'Czechia', 'Germany',
       'Djibouti', 'Dominica', 'Denmark', 'Dominican Republic', 'Algeria',
       'Ecuador', 'Egypt', 'Spain', 'Estonia', 'Ethiopia', 'Finland',
       'Fiji', 'France', 'Gabon', 'United Kingdom', 'Georgia', 'Ghana',
       'Guinea', 'Gambia', 'Guinea-Bissau', 'Equatorial Guinea', 'Greece',
       'Grenada', 'Guatemala', 'Guyana', 'Honduras', 'Croatia', 'Haiti',
       'Hungary', 'Indonesia', 'India', 'Ireland', 'Iran', 'Iraq',
       'Iceland', 'Israel', 'Italy', 'Jamaica', 'Jordan', 'Japan',
       'Kazakhstan', 'Kenya', 'Kyrgyzstan', 'Cambodia', 'Kiribati',
       'St. Kitts & Nevis', 'South Korea', 'Kuwait', 'Laos', 'Lebanon',
       'Liberia', 'Libya', 'St. Lucia', 'Liechtenstein', 'Sri Lanka',
       'Lesotho', 'Lithuania', 'Luxembourg', 'Latvia', 'Morocco',
       'Monaco', 'Moldova', 'Madagascar', 'Maldives', 'Mexico',
       'Marshall Islands', 'North Macedonia', 'Mali', 'Malta',
       'Myanmar (Burma)', 'Montenegro', 'Mongolia', 'Mozambique',
       'Mauritania', 'Mauritius', 'Malawi', 'Malaysia', 'Namibia',
       'Niger', 'Nigeria', 'Nicaragua', 'Netherlands', 'Norway', 'Nepal',
       'New Zealand', 'Oman', 'Pakistan', 'Panama', 'Peru', 'Philippines',
       'Palau', 'Papua New Guinea', 'Poland', 'Portugal', 'Paraguay',
       'Palestinian Territories', 'Qatar', 'Romania', 'Russia', 'Rwanda',
       'Saudi Arabia', 'Sudan', 'Senegal', 'Singapore', 'Solomon Islands',
       'Sierra Leone', 'El Salvador', 'San Marino', 'Somalia', 'Serbia',
       'South Sudan', 'São Tomé & Príncipe', 'Suriname', 'Slovakia',
       'Slovenia', 'Sweden', 'Eswatini', 'Seychelles', 'Syria', 'Chad',
       'Togo', 'Thailand', 'Tajikistan', 'Timor-Leste',
       'Trinidad & Tobago', 'Tunisia', 'Turkey', 'Tanzania', 'Uganda',
       'Ukraine', 'Uruguay', 'United States', 'Uzbekistan',
       'St. Vincent & Grenadines', 'Venezuela', 'Vietnam', 'Vanuatu',
       'Samoa', 'Yemen', 'South Africa', 'Zambia', 'Zimbabwe'],
      dtype=object)
```

In [405…
```
DF['country'].value_counts()
```

Out[405…
```
South Korea          710
Thailand             710
United States        710
Japan                710
China                710
                    ...
Marshall Islands     430
Vanuatu              417
Samoa                409
Kiribati             228
Palau                132
Name: country, Length: 187, dtype: int64
```

We'll start with South Korea per weekday

In [406…
```
dfsouthkorea=DF[DF['country']=='South Korea']
```

In [407…
```
statsweekdays=dfsouthkorea.groupby("weekdays").agg({"dcases": [np.mean, np.
```

In [408…
```
stats=pd.DataFrame(stats)
```

In [409…
```
stats.shape
```

Out[409…
```
(7, 6)
```

In [410…
```
statsweekdays.columns
```

Out[410…
```
MultiIndex([('dcases', 'mean'),
            ('dcases',  'std'),
            ('dcases', 'size')],
           )
```

In [411…
```
statsweekdays.columns=['mean','std','size']
```

In [412…
```
statsweekdays.columns
```

Out[412…
```
Index(['mean', 'std', 'size'], dtype='object')
```

In [413…
```
#we are calculating the lober bound
def get_ci_lb(x, alpha=0.05):
    sample_s=np.std(x)
    sample_mean=np.mean(x)
    sample_size=len(x)
    margin_of_error = t.ppf(1 - alpha/2,sample_size-1)*sample_s/np.sqrt(sar
    return sample_mean - margin_of_error
```

In [414…
```
x=dfsouthkorea['dcases']
```

In [415…
```
get_ci_lb(x)
```

Out[415…
```
795.69347356921
```

In [416…
```
#get the upper bound
def get_ci_ub(x, alpha=0.05):
    sample_s=np.std(x)
    sample_mean=np.mean(x)
    sample_size=len(x)
    margin_of_error = t.ppf(1 - alpha/2,sample_size-1)*sample_s/np.sqrt(sar
    return sample_mean + margin_of_error
```

In [417…
```
get_ci_ub(x)
```

Out[417…
```
993.7515968533253
```

In [418…
```
ci_dcases=statsw=dfsouthkorea.groupby("weekdays").agg({"dcases": [np.mean,
statsw
```

Out[418…

	dcases				
	mean	std	size	get_ci_lb	get_ci_ub
weekdays					
Fri	960.705882	1423.739718	102	681.056866	1240.354898
Sat	865.712871	1280.278379	101	612.969859	1118.455884
Sun	734.099010	1080.646080	101	520.765918	947.432102
Mon	734.712871	1069.319852	101	523.615718	945.810024
Tue	1013.069307	1545.732896	101	707.922243	1318.216371
Wed	988.294118	1494.979861	102	694.652210	1281.936025
Thu	964.196078	1434.233649	102	682.485859	1245.906298

In [419…
```
statsw.index
```

Out[419…
```
CategoricalIndex(['Fri', 'Sat', 'Sun', 'Mon', 'Tue', 'Wed', 'Thu'], categor
ies=['Fri', 'Sat', 'Sun', 'Mon', 'Tue', 'Wed', 'Thu'], ordered=True, dtype=
'category', name='weekdays')
```

In [420…
```
statsw.columns=['mean','std','size','lb','ub']
```

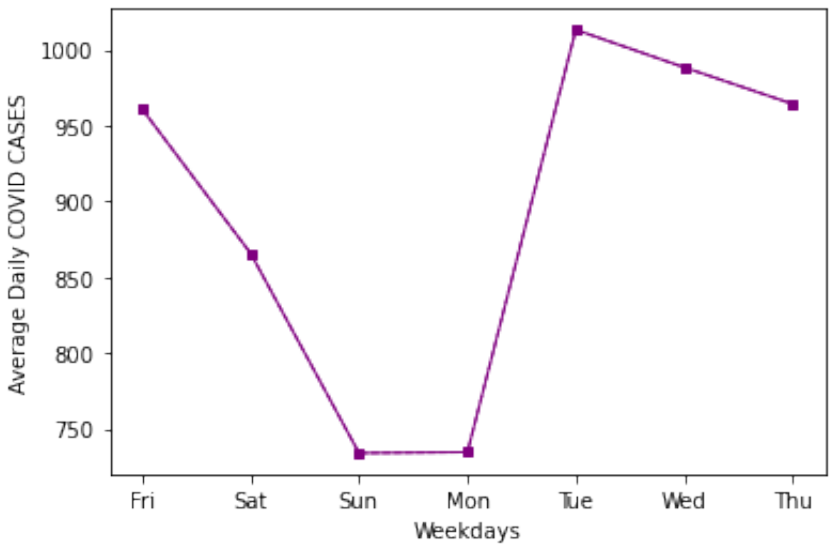
In [421...
```
statsw['weekdays']=statsw.index
```

In [422...
```
statsw
```

Out[422...

weekdays	mean	std	size	lb	ub	weekdays
Fri	960.705882	1423.739718	102	681.056866	1240.354898	Fri
Sat	865.712871	1280.278379	101	612.969859	1118.455884	Sat
Sun	734.099010	1080.646080	101	520.765918	947.432102	Sun
Mon	734.712871	1069.319852	101	523.615718	945.810024	Mon
Tue	1013.069307	1545.732896	101	707.922243	1318.216371	Tue
Wed	988.294118	1494.979861	102	694.652210	1281.936025	Wed
Thu	964.196078	1434.233649	102	682.485859	1245.906298	Thu

In [423...
```
plt.plot( 'weekdays', 'mean', data=statsw, marker='s', color='purple', mark
plt.plot( 'weekdays', 'mean', data=statsw, marker='o', color='purple',  mar
plt.xlabel("Weekdays")
plt.ylabel("Average Daily COVID CASES")
plt.show()
```



After drawing plotting the graph, it is evident that the average daily cases was at its lowest during sundays and mondays and highest on tuesday reaching 1000 cases.

In [424...
```
statsweekdays=dfsouthkorea.groupby("weekdays").agg({"ddeaths": [np.mean, np
```

In [425...
```
statsweekdays=pd.DataFrame(stats)
```

In [426…
```
statsweekdays.shape
```

Out[426…
```
(7, 6)
```

In [427…
```
statsweekdays.columns
```

Out[427…
```
MultiIndex([( 'ddeaths', 'mean'),
            ( 'ddeaths',  'std'),
            ( 'ddeaths', 'size'),
            ( 'ci95_hi',     ''),
            ( 'ci95_lo',     ''),
            ('weekdays',     '')],
           )
```

In [428…
```
def get_ci_lb(x, alpha=0.05):
    sample_s=np.std(x)
    sample_mean=np.mean(x)
    sample_size=len(x)
    margin_of_error = t.ppf(1 - alpha/2,sample_size-1)*sample_s/np.sqrt(sar
    return sample_mean - margin_of_error
```

In [429…
```
x=dfsouthkorea['ddeaths']
```

In [430…
```
get_ci_lb(x)
```

Out[430…
```
6.855949683991252
```

In [431…
```
ci_ddeaths=statsw=dfsouthkorea.groupby("weekdays").agg({"ddeaths": [np.mear
statsw
```

Out[431…

	ddeaths				
	mean	std	size	get_ci_lb	get_ci_ub
weekdays					
Fri	9.049020	17.251418	102	5.660520	12.437520
Sat	7.455446	13.362279	101	4.817564	10.093327
Sun	6.138614	10.153846	101	4.134117	8.143110
Mon	8.237624	14.519744	101	5.371244	11.104003
Tue	7.455446	13.259355	101	4.837883	10.073009
Wed	8.656863	16.159168	102	5.482901	11.830825
Thu	8.441176	15.643664	102	5.368469	11.513884

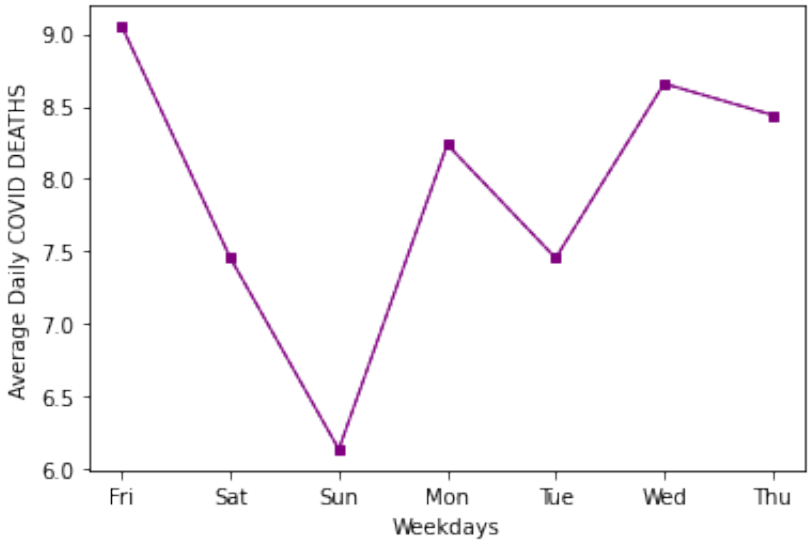
In [432…
```
statsw.index
```

Out[432…
```
CategoricalIndex(['Fri', 'Sat', 'Sun', 'Mon', 'Tue', 'Wed', 'Thu'], categor
ies=['Fri', 'Sat', 'Sun', 'Mon', 'Tue', 'Wed', 'Thu'], ordered=True, dtype=
'category', name='weekdays')
```

In [433…
```
statsw.columns=['mean','std','size','lb','ub']
```

In [434…
```
statsw['weekdays']=statsw.index
```

In [435…
```
plt.plot( 'weekdays', 'mean', data=statsw, marker='s', color='purple', mark
plt.plot( 'weekdays', 'mean', data=statsw, marker='o', color='purple',  mar
plt.xlabel("Weekdays")
plt.ylabel("Average Daily COVID DEATHS")
plt.show()
```



On the other hand, through looking at the graph, it is clear that the average daily Covid deaths was at its lowest during sundays and highest on fridays reaching 1000 cases.

Next, we have Egypt but we will calculate it by months this time

In [436…
```
dfegy=DF[DF['country']=='Egypt']
```

In [437…
```
from pandas.api.types import CategoricalDtype
cats=['Jan', 'Feb', 'Mar','Apr','May','Jun','Jul','Aug','Sep','Oct','Nov','
cat_type = CategoricalDtype(categories=cats, ordered=True)
DF['month'] = DF['month'].astype(cat_type)
```

In [438…
```
stats=dfegy.groupby("month").agg({"dcases": [np.mean, np.std, np.size]})
```

In [439…
```
stats=pd.DataFrame(stats)
```

In [440…
```
stats.shape
```

Out[440…
```
(12, 3)
```

In [441…
```
stats.columns
```

Out[441…
```
MultiIndex([('dcases', 'mean'),
            ('dcases',  'std'),
            ('dcases', 'size')],
           )
```

In [442…
```
stats.columns=['mean','std','size']
```

In [443…
```
stats.columns
```

Out[443…
```
Index(['mean', 'std', 'size'], dtype='object')
```

In [444…
```
def get_ci_lb(x, alpha=0.05):
    sample_s=np.std(x)
    sample_mean=np.mean(x)
    sample_size=len(x)
    margin_of_error = t.ppf(1 - alpha/2,sample_size-1)*sample_s/np.sqrt(sar
    return sample_mean - margin_of_error
```

In [445…
```
x=dfegy['dcases']
```

In [446…
```
get_ci_lb(x)
```

Out[446…
```
529.7945911276133
```

In [447…
```
def get_ci_ub(x, alpha=0.05):
    sample_s=np.std(x)
    sample_mean=np.mean(x)
    sample_size=len(x)
    margin_of_error = t.ppf(1 - alpha/2,sample_size-1)*sample_s/np.sqrt(sar
    return sample_mean + margin_of_error
```

In [448…
```
get_ci_ub(x)
```

Out[448…
```
592.694491841819
```

In [449…
```
ci_dcases=statsm=dfegy.groupby("month").agg({"dcases": [np.mean, np.std, np
statsm
```

Out[449…

	dcases				
	mean	std	size	get_ci_lb	get_ci_ub
month					
Apr	504.133333	354.246465	60	412.621768	595.644899
Aug	145.806452	60.683224	62	130.395798	161.217105
Dec	792.709677	300.346870	62	716.435854	868.983501
Feb	374.409091	288.087868	44	286.822374	461.995808
Jan	899.645161	251.335970	31	807.454383	991.835939
Jul	463.661290	437.595552	62	352.532828	574.789752
Jun	1032.633333	454.674216	60	915.178529	1150.088138
Mar	329.290323	310.292849	62	250.490694	408.089951
May	879.774194	346.475245	62	791.785956	967.762431
Nov	598.616667	370.082496	60	503.014220	694.219113
Oct	497.580645	362.321547	62	405.568201	589.593089
Sep	339.033333	225.855584	60	280.688649	397.378017

In [450…
```
statsm.index
```

Out[450…
```
Index(['Apr', 'Aug', 'Dec', 'Feb', 'Jan', 'Jul', 'Jun', 'Mar', 'May', 'Nov'
,
       'Oct', 'Sep'],
      dtype='object', name='month')
```

In [451…
```
statsm.columns=['mean','std','size','lb','ub']
```

In [452…
```
statsm['month']=statsm.index
```

In [453…
```
statsm
```

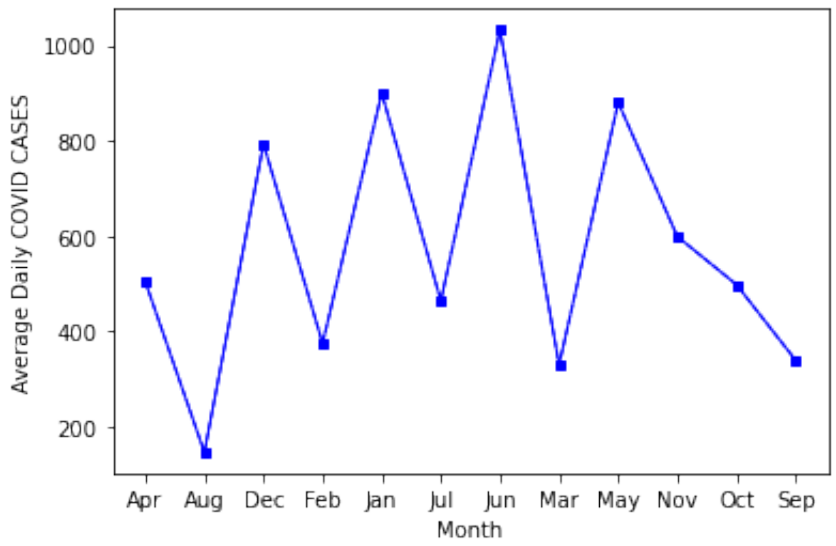
Out[453...

month	mean	std	size	lb	ub	month
Apr	504.133333	354.246465	60	412.621768	595.644899	Apr
Aug	145.806452	60.683224	62	130.395798	161.217105	Aug
Dec	792.709677	300.346870	62	716.435854	868.983501	Dec
Feb	374.409091	288.087868	44	286.822374	461.995808	Feb
Jan	899.645161	251.335970	31	807.454383	991.835939	Jan
Jul	463.661290	437.595552	62	352.532828	574.789752	Jul
Jun	1032.633333	454.674216	60	915.178529	1150.088138	Jun
Mar	329.290323	310.292849	62	250.490694	408.089951	Mar
May	879.774194	346.475245	62	791.785956	967.762431	May
Nov	598.616667	370.082496	60	503.014220	694.219113	Nov
Oct	497.580645	362.321547	62	405.568201	589.593089	Oct
Sep	339.033333	225.855584	60	280.688649	397.378017	Sep

Through observing the table, we can get that the month with the highest estimated mean is June while the lowest is August.

In [454...

```
plt.plot( 'month', 'mean', data=statsm, marker='s', color='blue', markersiz
plt.plot( 'month', 'mean', data=statsm, marker='o', color='blue',  markersi
plt.xlabel("Month")
plt.ylabel("Average Daily COVID CASES")
plt.show()
```



This graph illustrates the mean we calculated after finding the confidence interval, lower bound, and upper bound,

Now we will do the same but for deaths

In [455…
```
stats=dfegy.groupby("month").agg({"ddeaths": [np.mean, np.std, np.size]})
```

In [456…
```
stats=pd.DataFrame(stats)
```

In [457…
```
stats.columns=['mean','std','size']
```

In [458…
```
def get_ci_lb(x, alpha=0.05):
    sample_s=np.std(x)
    sample_mean=np.mean(x)
    sample_size=len(x)
    margin_of_error = t.ppf(1 - alpha/2,sample_size-1)*sample_s/np.sqrt(sar
    return sample_mean - margin_of_error
```

In [459…
```
x=dfegy['ddeaths']
```

In [460…
```
get_ci_lb(x)
```

Out[460…
```
29.98105462075952
```

In [461…
```
def get_ci_ub(x, alpha=0.05):
    sample_s=np.std(x)
    sample_mean=np.mean(x)
    sample_size=len(x)
    margin_of_error = t.ppf(1 - alpha/2,sample_size-1)*sample_s/np.sqrt(sar
    return sample_mean + margin_of_error
```

In [462…
```
get_ci_ub(x)
```

Out[462…
```
33.34354508811966
```

In [463…
```
ci_dcases=statsm=dfegy.groupby("month").agg({"ddeaths": [np.mean, np.std, r
statsm
```

Out[463...

	ddeaths				
	mean	std	size	get_ci_lb	get_ci_ub
month					
Apr	28.166667	17.826058	60	23.561707	32.771626
Aug	13.354839	7.503216	62	11.449379	15.260299
Dec	36.435484	15.919491	62	32.392690	40.478278
Feb	31.181818	24.163467	44	23.835453	38.528184
Jan	54.354839	3.638208	31	53.020333	55.689344
Jul	35.596774	27.745010	62	28.550861	42.642687
Jun	51.116667	23.279504	60	45.102933	57.130400
Mar	21.822581	20.717083	62	16.561427	27.083735
May	37.483871	20.947821	62	32.164120	42.803621
Nov	36.783333	27.679211	60	29.633035	43.933632
Oct	26.709677	16.823468	62	22.437316	30.982038
Sep	18.400000	7.962199	60	16.343146	20.456854

In [464...

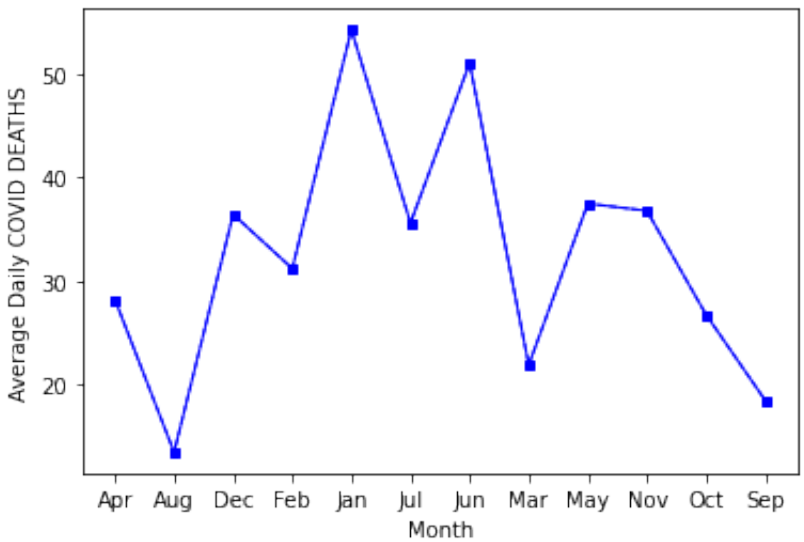
```
statsm.columns=['mean','std','size','lb','ub']
```

In [465...

```
statsm['month']=statsm.index
```

In [466...

```
plt.plot( 'month', 'mean', data=statsm, marker='s', color='blue', markersiz
plt.plot( 'month', 'mean', data=statsm, marker='o', color='blue',  markersi
plt.xlabel("Month")
plt.ylabel("Average Daily COVID DEATHS")
plt.show()
```



Unlike the last one, the highest average of daily deaths occured on Jan while the lowest took place August. Knowing that, we can conclude that August was the least month in both deaths and cases. Also, we can get that Covid wasn't as bas as the rest of the months.

The next country is Japan and we are going to calculate it by days like we did in South Korea.

In [467…
```
dfjapan=DF[DF['country']=='Japan']
```

In [468…
```
stats=dfjapan.groupby("weekdays").agg({"dcases": [np.mean, np.std, np.size]
```

In [469…
```
stats=pd.DataFrame(stats)
```

In [470…
```
stats.shape
```

Out[470… (7, 3)

In [471…
```
stats.columns
```

Out[471…
```
MultiIndex([('dcases', 'mean'),
            ('dcases',  'std'),
            ('dcases', 'size')],
           )
```

In [472…
```
stats.columns=['mean','std','size']
```

In [473…
```
stats.columns
```

Out[473… Index(['mean', 'std', 'size'], dtype='object')

In [474…
```
def get_ci_lb(x, alpha=0.05):
    sample_s=np.std(x)
    sample_mean=np.mean(x)
    sample_size=len(x)
    margin_of_error = t.ppf(1 - alpha/2,sample_size-1)*sample_s/np.sqrt(sar
    return sample_mean - margin_of_error
```

In [475…
```
x=dfjapan['dcases']
```

In [476…
```
get_ci_lb(x)
```

Out[476… 2125.3916111398644

In [477…
```
def get_ci_ub(x, alpha=0.05):
    sample_s=np.std(x)
    sample_mean=np.mean(x)
    sample_size=len(x)
    margin_of_error = t.ppf(1 - alpha/2,sample_size-1)*sample_s/np.sqrt(sar
    return sample_mean + margin_of_error
```

In [478…
```
get_ci_ub(x)
```

Out[478… 2754.3154311136564

In [479…
```
ci_ddeaths=statsw=dfjapan.groupby("weekdays").agg({"dcases": [np.mean, np.s
statsw
```

Out[479…

	dcases				
	mean	std	size	get_ci_lb	get_ci_ub
weekdays					
Fri	2673.098039	4696.199364	102	1750.676957	3595.519121
Sat	2719.465347	4648.056145	101	1801.880756	3637.049937
Sun	2292.396040	4011.712370	101	1500.433693	3084.358386
Mon	1700.762376	3082.632093	101	1092.212131	2309.312622
Tue	2262.237624	3887.670349	101	1494.762728	3029.712520
Wed	2666.500000	4580.092283	102	1766.884513	3566.115487
Thu	2756.823529	4716.551949	102	1830.404820	3683.242239

In [480…
```
statsw.index
```

Out[480… CategoricalIndex(['Fri', 'Sat', 'Sun', 'Mon', 'Tue', 'Wed', 'Thu'], categor
ies=['Fri', 'Sat', 'Sun', 'Mon', 'Tue', 'Wed', 'Thu'], ordered=True, dtype=
'category', name='weekdays')

In [481…
```
statsw.columns=['mean','std','size','lb','ub']
```

In [482…
```
statsw['weekdays']=statsw.index
```

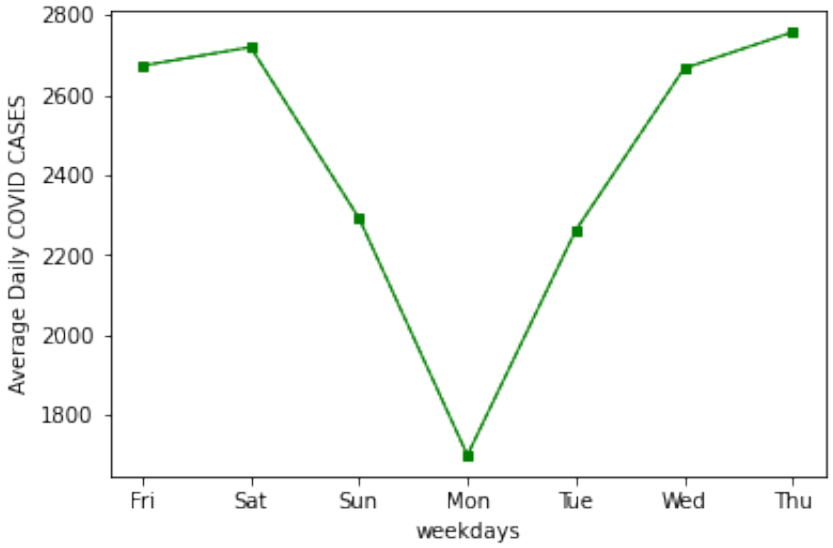
In [483…
```
statsw
```

Out[483...

weekdays	mean	std	size	lb	ub	weekdays
Fri	2673.098039	4696.199364	102	1750.676957	3595.519121	Fri
Sat	2719.465347	4648.056145	101	1801.880756	3637.049937	Sat
Sun	2292.396040	4011.712370	101	1500.433693	3084.358386	Sun
Mon	1700.762376	3082.632093	101	1092.212131	2309.312622	Mon
Tue	2262.237624	3887.670349	101	1494.762728	3029.712520	Tue
Wed	2666.500000	4580.092283	102	1766.884513	3566.115487	Wed
Thu	2756.823529	4716.551949	102	1830.404820	3683.242239	Thu

In [484...

```
plt.plot( 'weekdays', 'mean', data=statsw, marker='s', color='green', marke
plt.plot( 'weekdays', 'mean', data=statsw, marker='o', color='green',  mark
plt.xlabel("weekdays")
plt.ylabel("Average Daily COVID CASES")
plt.show()
```



The shape of this graph shows that the average daily cases in Japan were high, then low, and then high. This is also shown in the table.

Now, we will compute the same thing but for deaths

In [485...

```
stats=dfjapan.groupby("weekdays").agg({"ddeaths": [np.mean, np.std, np.size
```

In [486...

```
stats=pd.DataFrame(stats)
```

In [487...

```
stats.columns=['mean','std','size']
```

In [488…
```
def get_ci_lb(x, alpha=0.05):
    sample_s=np.std(x)
    sample_mean=np.mean(x)
    sample_size=len(x)
    margin_of_error = t.ppf(1 - alpha/2,sample_size-1)*sample_s/np.sqrt(sar
    return sample_mean - margin_of_error
```

In [489…
```
x=dfjapan['ddeaths']
```

In [490…
```
get_ci_lb(x)
```

Out[490…
```
23.688763297929274
```

In [491…
```
def get_ci_ub(x, alpha=0.05):
    sample_s=np.std(x)
    sample_mean=np.mean(x)
    sample_size=len(x)
    margin_of_error = t.ppf(1 - alpha/2,sample_size-1)*sample_s/np.sqrt(sar
    return sample_mean + margin_of_error
```

In [492…
```
get_ci_ub(x)
```

Out[492…
```
28.111236702070723
```

In [493…
```
ci_ddeaths=statsw=dfjapan.groupby("weekdays").agg({"ddeaths": [np.mean, np.
statsw
```

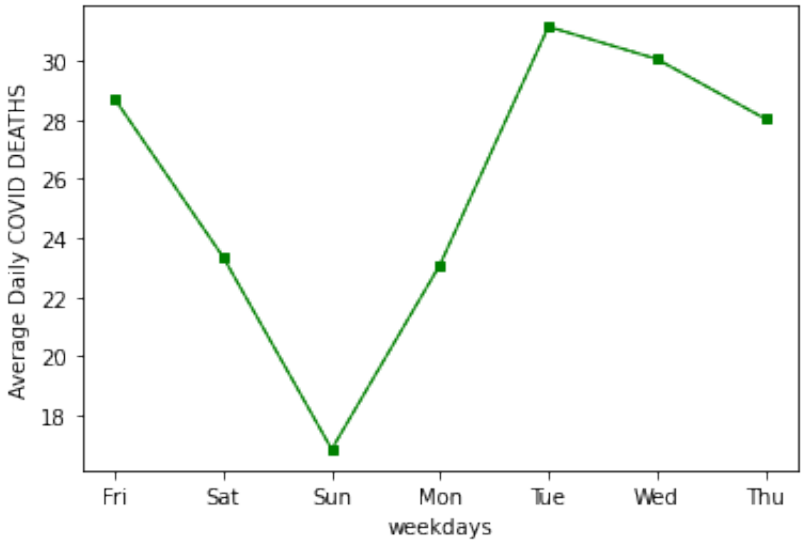
Out[493…

	ddeaths				
	mean	std	size	get_ci_lb	get_ci_ub
weekdays					
Fri	28.686275	31.542830	102	22.490675	34.881874
Sat	23.346535	27.007938	101	18.014829	28.678240
Sun	16.861386	18.954171	101	13.119595	20.603177
Mon	23.099010	25.410433	101	18.082672	28.115348
Tue	31.138614	36.701779	101	23.893222	38.384005
Wed	30.049020	33.656205	102	23.438314	36.659726
Thu	28.029412	31.470387	102	21.848041	34.210782

In [494…
```
statsw.columns=['mean','std','size','lb','ub']
```

In [495…
```
statsw['weekdays']=statsw.index
```

In [496…
```
plt.plot( 'weekdays', 'mean', data=statsw, marker='s', color='green', marke
plt.plot( 'weekdays', 'mean', data=statsw, marker='o', color='green',  mark
plt.xlabel("weekdays")
plt.ylabel("Average Daily COVID DEATHS")
plt.show()
```



Here, Sun is the lowest according to the average daily Covid deaths and Tue is the highest.

Lastly, we will look at the confirmed cases and deaths per month in the US.

In [497…
```
dfus=DF[DF['country']=='United States']
```

In [498…
```
stats=dfus.groupby("month").agg({"dcases": [np.mean, np.std, np.size]})
```

In [499…
```
stats=pd.DataFrame(stats)
```

In [500…
```
stats.shape
```

Out[500…
```
(12, 3)
```

In [501…
```
stats.columns
```

Out[501…
```
MultiIndex([('dcases', 'mean'),
            ('dcases',  'std'),
            ('dcases', 'size')],
           )
```

In [502…
```
stats.columns=['mean','std','size']
```

In [503…
```
stats.columns
```

Out[503…
```
Index(['mean', 'std', 'size'], dtype='object')
```

In [504…
```
def get_ci_lb(x, alpha=0.05):
    sample_s=np.std(x)
    sample_mean=np.mean(x)
    sample_size=len(x)
    margin_of_error = t.ppf(1 - alpha/2,sample_size-1)*sample_s/np.sqrt(sar
    return sample_mean - margin_of_error
```

In [505…
```
x=dfus['dcases']
```

In [506…
```
get_ci_lb(x)
```

Out[506…
```
71642.2273804623
```

In [507…
```
def get_ci_ub(x, alpha=0.05):
    sample_s=np.std(x)
    sample_mean=np.mean(x)
    sample_size=len(x)
    margin_of_error = t.ppf(1 - alpha/2,sample_size-1)*sample_s/np.sqrt(sar
    return sample_mean + margin_of_error
```

In [508…
```
get_ci_ub(x)
```

Out[508…
```
82752.31909841094
```

In [509…
```
ci_dcases=statsm=dfus.groupby("month").agg({"dcases": [np.mean, np.std, np.
statsm
```

Out[509…

	dcases				
	mean	std	size	get_ci_lb	get_ci_ub
month					
Jan	150053.024390	96139.362790	41	119707.697286	180398.351494
Feb	42262.649123	46506.630379	57	29922.779102	54602.519143
Mar	32362.080645	28088.831049	62	25228.853207	39495.308083
Apr	46206.983333	19424.943033	60	41188.988453	51224.978214
May	26359.209677	9226.362611	62	24016.152296	28702.267059
Jun	20927.733333	10905.385581	60	18110.573513	23744.893153
Jul	51912.387097	28977.563351	62	44553.463914	59271.310280
Aug	93187.225806	66340.454536	62	76339.904900	110034.546713
Sep	89110.316667	66304.148991	60	71982.138755	106238.494579
Oct	71428.387097	29855.299548	62	63846.560657	79010.213537
Nov	116959.483333	49303.330529	60	104223.082522	129695.884144
Dec	206309.548387	104452.758335	62	179783.514589	232835.582185

In [510…
```
statsm.index
```

Out[510…
```
CategoricalIndex(['Jan', 'Feb', 'Mar', 'Apr', 'May', 'Jun', 'Jul', 'Aug',
                  'Sep', 'Oct', 'Nov', 'Dec'],
                 categories=['Jan', 'Feb', 'Mar', 'Apr', 'May', 'Jun', 'Jul
', 'Aug', ...], ordered=True, dtype='category', name='month')
```

In [511…
```
statsm.columns=['mean','std','size','lb','ub']
```

In [512…
```
statsm['month']=statsm.index
```

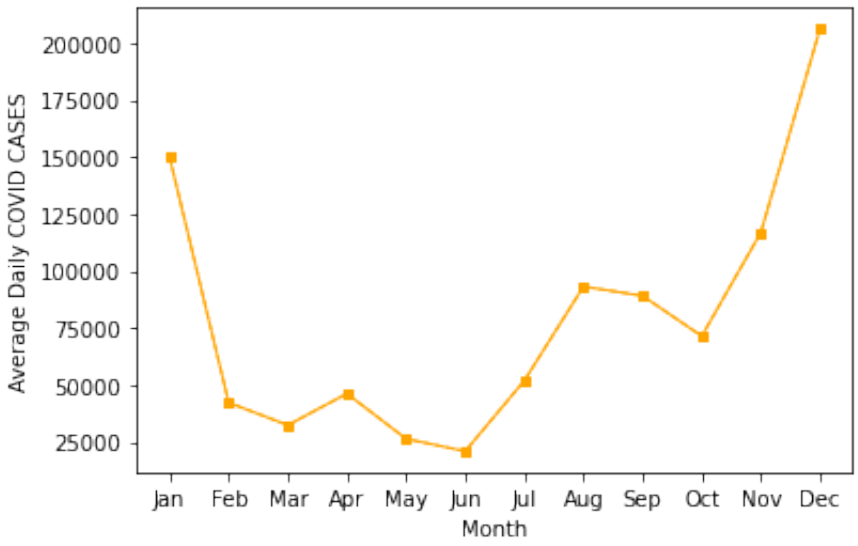
In [513…
```
statsm
```

Out[513...

month	mean	std	size	lb	ub	month
Jan	150053.024390	96139.362790	41	119707.697286	180398.351494	Jan
Feb	42262.649123	46506.630379	57	29922.779102	54602.519143	Feb
Mar	32362.080645	28088.831049	62	25228.853207	39495.308083	Mar
Apr	46206.983333	19424.943033	60	41188.988453	51224.978214	Apr
May	26359.209677	9226.362611	62	24016.152296	28702.267059	May
Jun	20927.733333	10905.385581	60	18110.573513	23744.893153	Jun
Jul	51912.387097	28977.563351	62	44553.463914	59271.310280	Jul
Aug	93187.225806	66340.454536	62	76339.904900	110034.546713	Aug
Sep	89110.316667	66304.148991	60	71982.138755	106238.494579	Sep
Oct	71428.387097	29855.299548	62	63846.560657	79010.213537	Oct
Nov	116959.483333	49303.330529	60	104223.082522	129695.884144	Nov
Dec	206309.548387	104452.758335	62	179783.514589	232835.582185	Dec

In [514...

```
plt.plot( 'month', 'mean', data=statsm, marker='s', color='orange', markers
plt.plot( 'month', 'mean', data=statsm, marker='o', color='orange',  marker
plt.xlabel("Month")
plt.ylabel("Average Daily COVID CASES")
plt.show()
```



During December, the US was at it peak and then follows Jan. With this information we can predict that it is probable that these two months account for the highest number of daily deaths, too.

Now for deaths

In [515…
```
stats=dfus.groupby("month").agg({"ddeaths": [np.mean, np.std, np.size]})
```

In [516…
```
stats=pd.DataFrame(stats)
```

In [517…
```
stats.columns=['mean','std','size']
```

In [518…
```
def get_ci_lb(x, alpha=0.05):
    sample_s=np.std(x)
    sample_mean=np.mean(x)
    sample_size=len(x)
    margin_of_error = t.ppf(1 - alpha/2,sample_size-1)*sample_s/np.sqrt(sam
    return sample_mean - margin_of_error
```

In [519…
```
x=dfus['ddeaths']
```

In [520…
```
get_ci_lb(x)
```

Out[520…
```
1095.4251914837605
```

In [521…
```
get_ci_ub(x)
```

Out[521…
```
1236.7128366852535
```

In [522…
```
ci_dcases=statsm=dfus.groupby("month").agg({"ddeaths": [np.mean, np.std, np
statsm
```

Out[522...

	ddeaths				
	mean	std	size	get_ci_lb	get_ci_ub
month					
Jan	2357.414634	1603.225498	41	1851.374228	2863.455040
Feb	1154.175439	1343.239370	57	797.766060	1510.584817
Mar	687.435484	656.579103	62	520.695613	854.175355
Apr	1411.483333	734.926342	60	1221.631728	1601.334939
May	965.983871	529.435192	62	831.532507	1100.435235
Jun	503.683333	245.604718	60	440.236907	567.129760
Jul	567.338710	380.578806	62	470.689790	663.987630
Aug	927.016129	468.429692	62	808.057261	1045.974997
Sep	1370.183333	930.381469	60	1129.840315	1610.526352
Oct	1168.403226	737.480279	62	981.118303	1355.688149
Nov	1226.083333	571.936683	60	1078.336421	1373.830245
Dec	2051.258065	1003.319604	62	1796.462594	2306.053535

In [523...

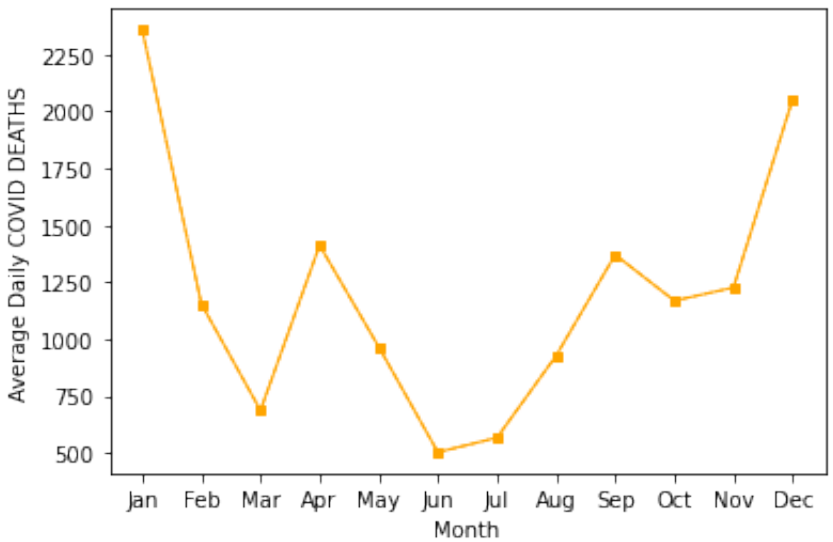
```
statsm.columns=['mean','std','size','lb','ub']
```

In [524...

```
statsm['month']=statsm.index
```

In [525...

```
plt.plot( 'month', 'mean', data=statsm, marker='s', color='orange', markers
plt.plot( 'month', 'mean', data=statsm, marker='o', color='orange',  marker
plt.xlabel("Month")
plt.ylabel("Average Daily COVID DEATHS")
plt.show()
```



Comparing between 2020 and 2021 in terms of several factors like regions, income, and continents:

We will do the same graph now but only on the year 2021.

In [526…
```
DF['date'][0]
```

Out[526…
```
'2020-02-24'
```

In [527…
```
DF['date'] = pd. to_datetime(DF['date'],format='%Y-%m-%d')
```

In [528…
```
DF['date'][0]
```

Out[528…
```
Timestamp('2020-02-24 00:00:00')
```

In [529…
```
DF['year'] = pd. DatetimeIndex(DF['date']). year
```

In [530…
```
DF['year'][0]
```

Out[530…
```
2020
```

Now, let's calculate it by country, by year, by month the following statistics on the daily COVID cases: mean, std, size, CI(95%) LB, and UB.

In [531…
```
statsdcases=DF.groupby(['country','year','month']).agg({"dcases": [np.mean,
```

In [532…
```
statsdcases
```

Out[532...

			dcases				
			mean	std	size	get_ci_lb	get_ci_ub
country	year	month					
Afghanistan	2020	Jan	NaN	NaN	NaN	NaN	NaN
		Feb	0.833333	2.041241	6.0	-1.308818	2.975485
		Mar	5.258065	10.871883	31.0	1.270225	9.245904
		Apr	55.366667	40.385627	30.0	40.286426	70.446908
		May	430.741935	266.692078	31.0	332.918491	528.565379
...	...	...	...	...	...	...	...
Zimbabwe	2021	Aug	513.322581	386.841948	31.0	371.427809	655.217353
		Sep	201.566667	135.119789	30.0	151.112108	252.021225
		Oct	69.580645	58.035492	31.0	48.293055	90.868235
		Nov	54.933333	82.622087	30.0	24.081739	85.784928
		Dec	2536.548387	2572.199964	31.0	1593.057823	3480.038951

4488 rows × 5 columns

In [533...

```
statsdcases=statsdcases.reset_index()
```

In [534...

```
statsdcases
```

Out[534...

	country	year	month					dcase
				mean	std	size	get_ci_lb	get_ci_u
0	Afghanistan	2020	Jan	NaN	NaN	NaN	NaN	Nal
1	Afghanistan	2020	Feb	0.833333	2.041241	6.0	-1.308818	2.97548
2	Afghanistan	2020	Mar	5.258065	10.871883	31.0	1.270225	9.24590
3	Afghanistan	2020	Apr	55.366667	40.385627	30.0	40.286426	70.44690
4	Afghanistan	2020	May	430.741935	266.692078	31.0	332.918491	528.56537
...	...	...	...	...	...	...	...	.
4483	Zimbabwe	2021	Aug	513.322581	386.841948	31.0	371.427809	655.21735
4484	Zimbabwe	2021	Sep	201.566667	135.119789	30.0	151.112108	252.02122
4485	Zimbabwe	2021	Oct	69.580645	58.035492	31.0	48.293055	90.86823
4486	Zimbabwe	2021	Nov	54.933333	82.622087	30.0	24.081739	85.78492
4487	Zimbabwe	2021	Dec	2536.548387	2572.199964	31.0	1593.057823	3480.03895

4488 rows × 8 columns

Filter now the South Korea data

In [535...

```
statsSK=statsdcases[(statsdcases['country']=='South Korea') & (statsdcases[
```

In [536...

```
statsSK
```

Out[536...

	country	year	month	dcases				
				mean	std	size	get_ci_lb	get_ci_ub
3684	South Korea	2021	Jan	539.967742	174.473395	31.0	475.970384	603.965100
3685	South Korea	2021	Feb	411.535714	85.023954	28.0	378.566867	444.504562
3686	South Korea	2021	Mar	438.967742	51.100870	31.0	420.223791	457.711692
3687	South Korea	2021	Apr	633.166667	93.227228	30.0	598.355048	667.978286
3688	South Korea	2021	May	585.967742	83.493506	31.0	555.342077	616.593407
3689	South Korea	2021	Jun	564.133333	117.192071	30.0	520.373095	607.893572
3690	South Korea	2021	Jul	1356.903226	328.360001	31.0	1236.459805	1477.346647
3691	South Korea	2021	Aug	1730.903226	270.906670	31.0	1631.533857	1830.272594
3692	South Korea	2021	Sep	2010.933333	453.940444	30.0	1841.429186	2180.437481
3693	South Korea	2021	Oct	1697.193548	368.263259	31.0	1562.113494	1832.273602
3694	South Korea	2021	Nov	2865.466667	829.541325	30.0	2555.710845	3175.222488
3695	South Korea	2021	Dec	5900.096774	1138.981719	31.0	5482.314907	6317.878642

In [537...

```
statsSK.columns
```

Out[537...

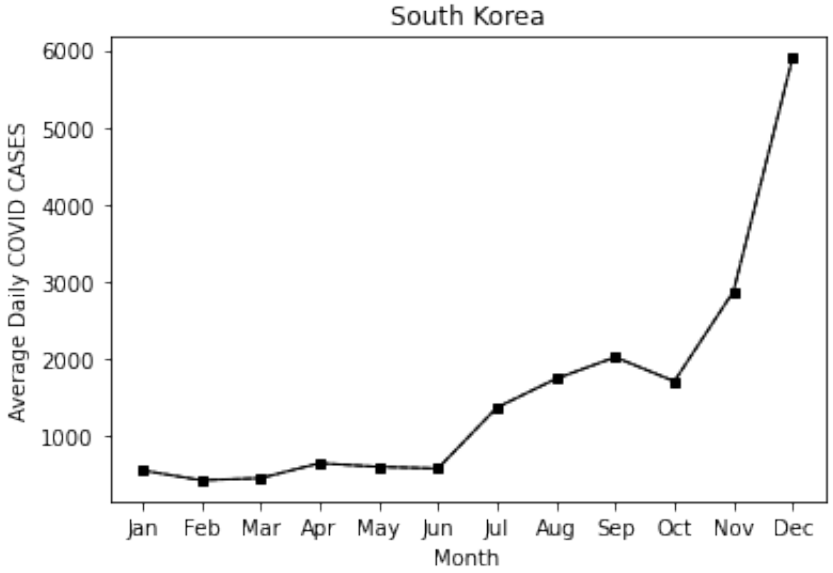
```
MultiIndex([('country',          ''),
            (   'year',          ''),
            (  'month',          ''),
            ( 'dcases',      'mean'),
            ( 'dcases',       'std'),
            ( 'dcases',      'size'),
            ( 'dcases', 'get_ci_lb'),
            ( 'dcases', 'get_ci_ub')],
           )
```

In [538...

```
statsSK.columns=['country','year','month','mean','std','size','lb','ub']
```

In [539…

```
plt.plot( 'month', 'mean', data=statsSK, marker='s', color='black', markers
plt.plot( 'month', 'mean', data=statsSK, marker='o', color='black',  marker
plt.xlabel("Month")
plt.ylabel("Average Daily COVID CASES")
plt.title("South Korea")
plt.show()
```



In [540…

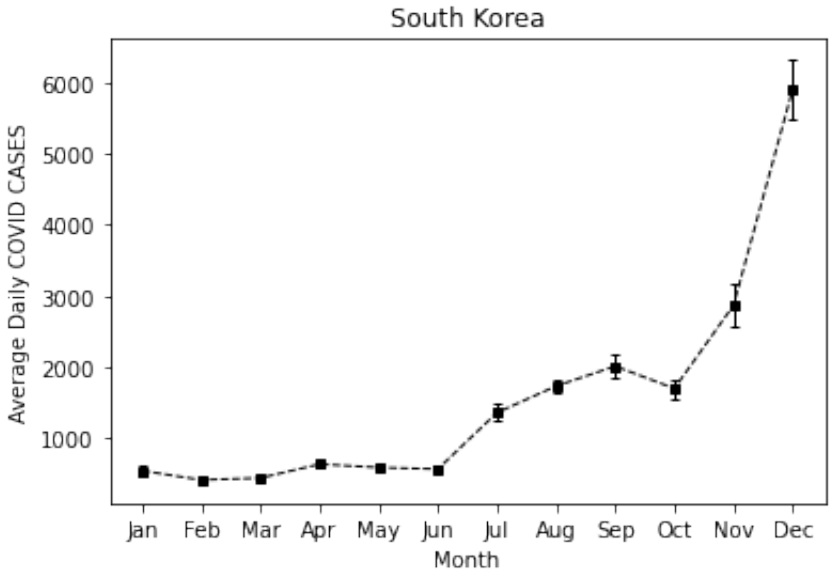
```
ci_lb_ub=[statsSK['lb'],statsSK['ub']]
```

In [541…

```
err = np.abs(ci_lb_ub - statsSK['mean'].to_numpy())
```

In [542…

```
plt.errorbar('month', 'mean',  yerr=err, data=statsSK,marker='s', capsize=2
             color='black', markersize=4, linewidth=1, linestyle='--')
plt.xlabel("Month")
plt.ylabel("Average Daily COVID CASES")
plt.title("South Korea")
plt.show()
```



We will do the same but for 2021 so we can be able to compare between both years

In [543…

```
statsSK21=statsdcases[(statsdcases['country']=='South Korea')
                      & (statsdcases['year']==2021)]
statsSK21
```

Out[543...

	country	year	month	dcases				
				mean	std	size	get_ci_lb	get_ci_ub
3684	South Korea	2021	Jan	539.967742	174.473395	31.0	475.970384	603.965100
3685	South Korea	2021	Feb	411.535714	85.023954	28.0	378.566867	444.504562
3686	South Korea	2021	Mar	438.967742	51.100870	31.0	420.223791	457.711692
3687	South Korea	2021	Apr	633.166667	93.227228	30.0	598.355048	667.978286
3688	South Korea	2021	May	585.967742	83.493506	31.0	555.342077	616.593407
3689	South Korea	2021	Jun	564.133333	117.192071	30.0	520.373095	607.893572
3690	South Korea	2021	Jul	1356.903226	328.360001	31.0	1236.459805	1477.346647
3691	South Korea	2021	Aug	1730.903226	270.906670	31.0	1631.533857	1830.272594
3692	South Korea	2021	Sep	2010.933333	453.940444	30.0	1841.429186	2180.437481
3693	South Korea	2021	Oct	1697.193548	368.263259	31.0	1562.113494	1832.273602
3694	South Korea	2021	Nov	2865.466667	829.541325	30.0	2555.710845	3175.222488
3695	South Korea	2021	Dec	5900.096774	1138.981719	31.0	5482.314907	6317.878642

In [544...

```
statsSK20=statsdcases[(statsdcases['country']=='South Korea')
                      & (statsdcases['year']==2020)]
statsSK20
```

Out[544...

	country	year	month	dcases				
				mean	std	size	get_ci_lb	get_ci_ub
3672	South Korea	2020	Jan	1.100000	2.131770	10.0	-0.424977	2.624977
3673	South Korea	2020	Feb	108.241379	202.959823	29.0	31.039592	185.443167
3674	South Korea	2020	Mar	214.064516	205.026329	31.0	138.860251	289.268781
3675	South Korea	2020	Apr	32.933333	29.040914	30.0	22.089278	43.777389
3676	South Korea	2020	May	23.516129	16.249864	31.0	17.555631	29.476627
3677	South Korea	2020	Jun	44.900000	10.356907	30.0	41.032667	48.767333
3678	South Korea	2020	Jul	47.935484	17.946096	31.0	41.352803	54.518165
3679	South Korea	2020	Aug	188.580645	137.604209	31.0	138.107014	239.054276
3680	South Korea	2020	Sep	123.566667	49.279417	30.0	105.165430	141.967903
3681	South Korea	2020	Oct	88.580645	26.303072	31.0	78.932600	98.228690
3682	South Korea	2020	Nov	267.233333	148.384794	30.0	211.825541	322.641126
3683	South Korea	2020	Dec	874.741935	208.677577	31.0	798.198382	951.285489

In [545...
```
statsSK20.columns=['country','year','month','mean','std','size','lb','ub']
```

In [546...
```
statsSK21.columns=['country','year','month','mean','std','size','lb','ub']
```

In [547...
```
x=statsSK20['month']
x
```

Out[547…
```
3672    Jan
3673    Feb
3674    Mar
3675    Apr
3676    May
3677    Jun
3678    Jul
3679    Aug
3680    Sep
3681    Oct
3682    Nov
3683    Dec
Name: month, dtype: category
Categories (12, object): ['Jan' < 'Feb' < 'Mar' < 'Apr' ... 'Sep' < 'Oct' <
'Nov' < 'Dec']
```

In [548…
```
y1=statsSK20['mean']
y1
```

Out[548…
```
3672      1.100000
3673    108.241379
3674    214.064516
3675     32.933333
3676     23.516129
3677     44.900000
3678     47.935484
3679    188.580645
3680    123.566667
3681     88.580645
3682    267.233333
3683    874.741935
Name: mean, dtype: float64
```

In [549…
```
y2=statsSK21['mean']
y2
```

Out[549…
```
3684     539.967742
3685     411.535714
3686     438.967742
3687     633.166667
3688     585.967742
3689     564.133333
3690    1356.903226
3691    1730.903226
3692    2010.933333
3693    1697.193548
3694    2865.466667
3695    5900.096774
Name: mean, dtype: float64
```

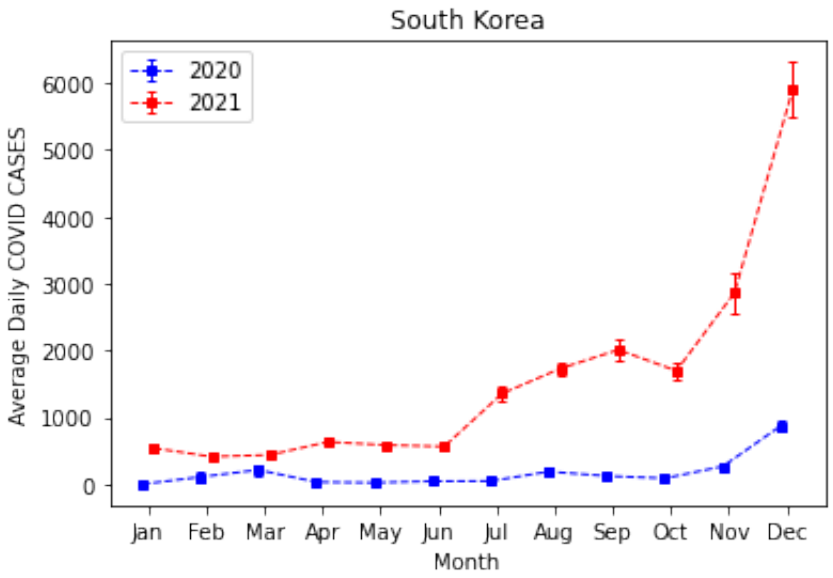
In [550…
```
ci_lb_ub20=[statsSK20['lb'],statsSK20['ub']]
err20 = np.abs(ci_lb_ub20 - statsSK20['mean'].to_numpy())
```

In [551…
```
ci_lb_ub21=[statsSK21['lb'],statsSK21['ub']]
err21 = np.abs(ci_lb_ub21 - statsSK21['mean'].to_numpy())
```

In [552…
```
from matplotlib.transforms import Affine2D
```

In [553…
```
fig, ax = plt.subplots()

trans1 = Affine2D().translate(-0.1, 0.0) + ax.transData
trans2 = Affine2D().translate(+0.1, 0.0) + ax.transData
plt.errorbar('month', 'mean',  yerr=err20, data=statsSK20,marker='s', capsi
             color='blue', markersize=4, linewidth=1, linestyle='--',transf
plt.errorbar('month', 'mean',  yerr=err21, data=statsSK21,marker='s', capsi
             color='red', markersize=4, linewidth=1, linestyle='--',transfo
plt.legend(['2020','2021'])
plt.xlabel("Month")
plt.ylabel("Average Daily COVID CASES")
plt.title("South Korea")
plt.show()
```



In South Korea, it is so clear that daily cases were at their peak during Dec 2021 and at their lowest during Jan 2020

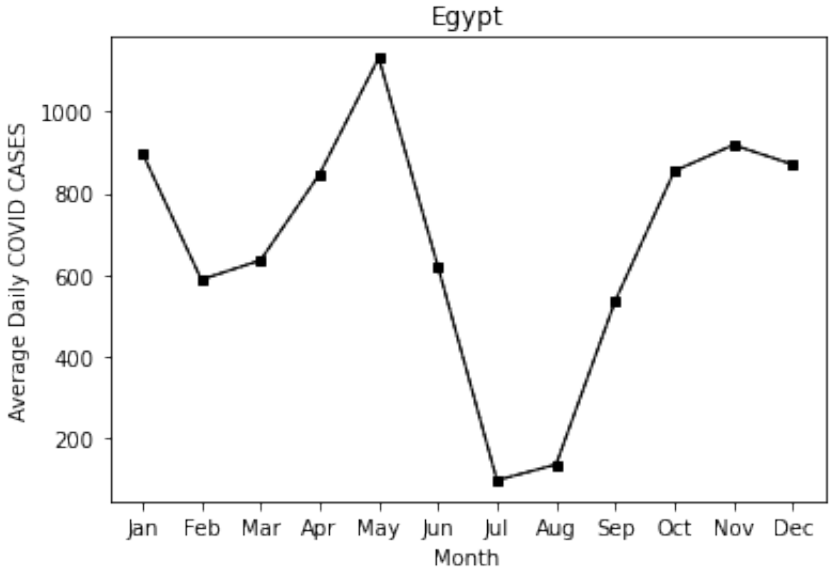
Next, we will try to filter Egypt's data

In [554…
```
statsEgy=statsdcases[(statsdcases['country']=='Egypt') & (statsdcases['yea
```

In [555…
```
statsEgy.columns=['country','year','month','mean','std','size','lb','ub']
```

In [556…

```
plt.plot( 'month', 'mean', data=statsEgy, marker='s', color='black', marker
plt.plot( 'month', 'mean', data=statsEgy, marker='o', color='black',  marke
plt.xlabel("Month")
plt.ylabel("Average Daily COVID CASES")
plt.title("Egypt")
plt.show()
```



In [557…

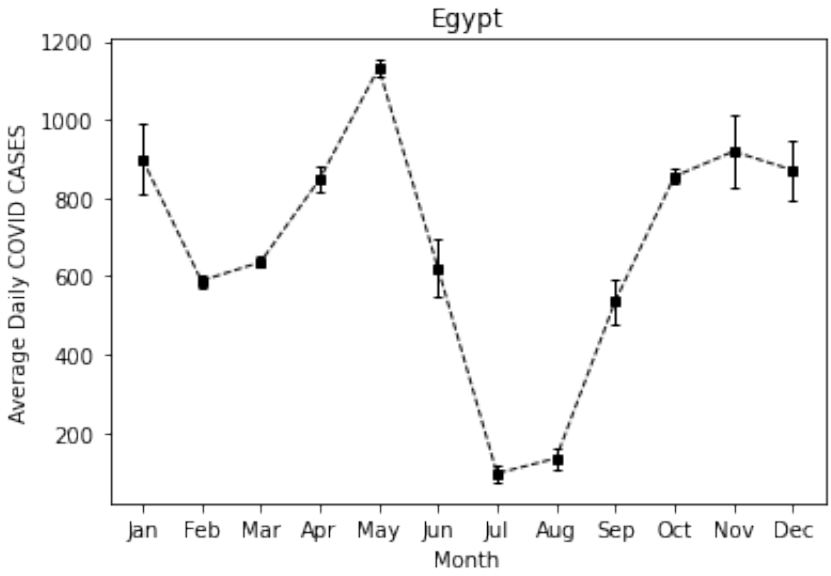
```
ci_lb_ub=[statsEgy['lb'],statsEgy['ub']]
```

In [558…

```
err = np.abs(ci_lb_ub - statsEgy['mean'].to_numpy())
```

In [559…

```
plt.errorbar('month', 'mean',  yerr=err, data=statsEgy,marker='s', capsize=
             color='black', markersize=4, linewidth=1, linestyle='--')
plt.xlabel("Month")
plt.ylabel("Average Daily COVID CASES")
plt.title("Egypt")
plt.show()
```



In [560…

```
statsEgy21=statsdcases[(statsdcases['country']=='Egypt')
                       & (statsdcases['year']==2021)]
statsEgy21
```

Out[560…

	country	year	month	dcases				
				mean	std	size	get_ci_lb	get_ci_ub
1236	Egypt	2021	Jan	899.645161	251.335970	31.0	807.454383	991.835939
1237	Egypt	2021	Feb	588.321429	40.989659	28.0	572.427298	604.215559
1238	Egypt	2021	Mar	635.709677	36.309038	31.0	622.391415	649.027940
1239	Egypt	2021	Apr	847.366667	92.416405	30.0	812.857814	881.875520
1240	Egypt	2021	May	1132.193548	55.087457	31.0	1111.987306	1152.399791
1241	Egypt	2021	Jun	621.066667	197.770841	30.0	547.217821	694.915513
1242	Egypt	2021	Jul	96.129032	61.659139	31.0	73.512277	118.745787
1243	Egypt	2021	Aug	134.806452	73.635326	31.0	107.796796	161.816107
1244	Egypt	2021	Sep	536.100000	151.276488	30.0	479.612431	592.587569
1245	Egypt	2021	Oct	854.612903	53.664189	31.0	834.928720	874.297087
1246	Egypt	2021	Nov	918.700000	248.217528	30.0	826.014052	1011.385948
1247	Egypt	2021	Dec	870.870968	212.967093	31.0	792.754007	948.987928

In [561…

```
statsEgy20=statsdcases[(statsdcases['country']=='Egypt')
                       & (statsdcases['year']==2020)]
statsEgy20
```

Out[561...

	country	year	month	dcases				
				mean	std	size	get_ci_lb	get_ci_ub
1224	Egypt	2020	Jan	NaN	NaN	NaN	NaN	NaN
1225	Egypt	2020	Feb	0.062500	0.250000	16.0	-0.070716	0.195716
1226	Egypt	2020	Mar	22.870968	20.228267	31.0	15.451179	30.290756
1227	Egypt	2020	Apr	160.900000	54.996144	30.0	140.364102	181.435898
1228	Egypt	2020	May	627.354839	330.723908	31.0	506.044330	748.665347
1229	Egypt	2020	Jun	1444.200000	176.114853	30.0	1378.437633	1509.962367
1230	Egypt	2020	Jul	831.193548	326.183427	31.0	711.548501	950.838595
1231	Egypt	2020	Aug	156.806452	42.607839	31.0	141.177770	172.435133
1232	Egypt	2020	Sep	141.966667	23.389481	30.0	133.232891	150.700442
1233	Egypt	2020	Oct	140.548387	24.650678	31.0	131.506445	149.590329
1234	Egypt	2020	Nov	278.533333	71.137426	30.0	251.970182	305.096485
1235	Egypt	2020	Dec	714.548387	354.179036	31.0	584.634468	844.462306

In [562...

```
statsEgy20.columns=['country','year','month','mean','std','size','lb','ub']
```

In [563...

```
statsEgy21.columns=['country','year','month','mean','std','size','lb','ub']
```

In [564...

```
x=statsEgy20['month']
x
```

Out[564...

```
1224    Jan
1225    Feb
1226    Mar
1227    Apr
1228    May
1229    Jun
1230    Jul
1231    Aug
1232    Sep
1233    Oct
1234    Nov
1235    Dec
Name: month, dtype: category
Categories (12, object): ['Jan' < 'Feb' < 'Mar' < 'Apr' ... 'Sep' < 'Oct' <
'Nov' < 'Dec']
```

In [565...

```
y1=statsEgy20['mean']
y1
```

Out[565…
```
1224            NaN
1225       0.062500
1226      22.870968
1227     160.900000
1228     627.354839
1229    1444.200000
1230     831.193548
1231     156.806452
1232     141.966667
1233     140.548387
1234     278.533333
1235     714.548387
Name: mean, dtype: float64
```

In [566…
```
y2=statsEgy21['mean']
y2
```

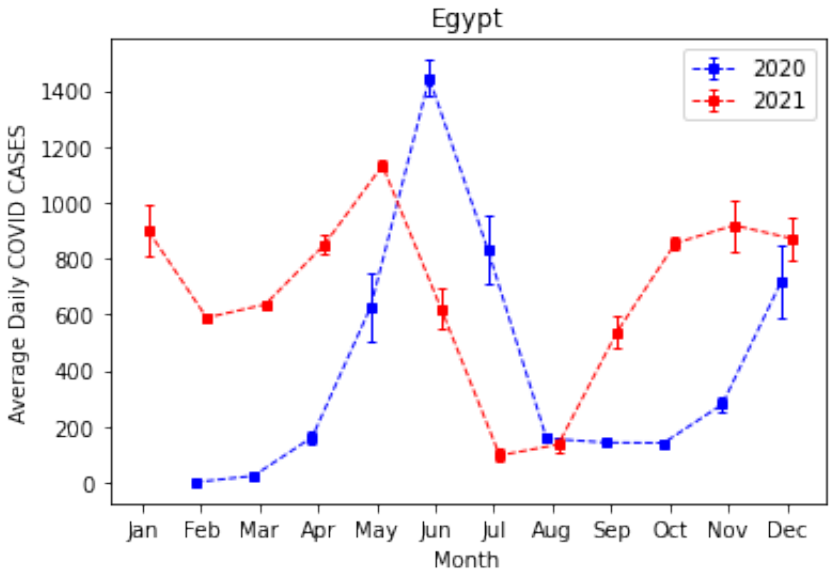
Out[566…
```
1236     899.645161
1237     588.321429
1238     635.709677
1239     847.366667
1240    1132.193548
1241     621.066667
1242      96.129032
1243     134.806452
1244     536.100000
1245     854.612903
1246     918.700000
1247     870.870968
Name: mean, dtype: float64
```

In [567…
```
ci_lb_ub20=[statsEgy20['lb'],statsEgy20['ub']]
err20 = np.abs(ci_lb_ub20 - statsEgy20['mean'].to_numpy())
```

In [568…
```
ci_lb_ub21=[statsEgy21['lb'],statsEgy21['ub']]
err21 = np.abs(ci_lb_ub21 - statsEgy21['mean'].to_numpy())
```

In [569…
```
fig, ax = plt.subplots()

trans1 = Affine2D().translate(-0.1, 0.0) + ax.transData
trans2 = Affine2D().translate(+0.1, 0.0) + ax.transData
plt.errorbar('month', 'mean',  yerr=err20, data=statsEgy20,marker='s', caps
             color='blue', markersize=4, linewidth=1, linestyle='--',transf
plt.errorbar('month', 'mean',  yerr=err21, data=statsEgy21,marker='s', caps
             color='red', markersize=4, linewidth=1, linestyle='--',transfo
plt.legend(['2020','2021'])
plt.xlabel("Month")
plt.ylabel("Average Daily COVID CASES")
plt.title("Egypt")
plt.show()
```



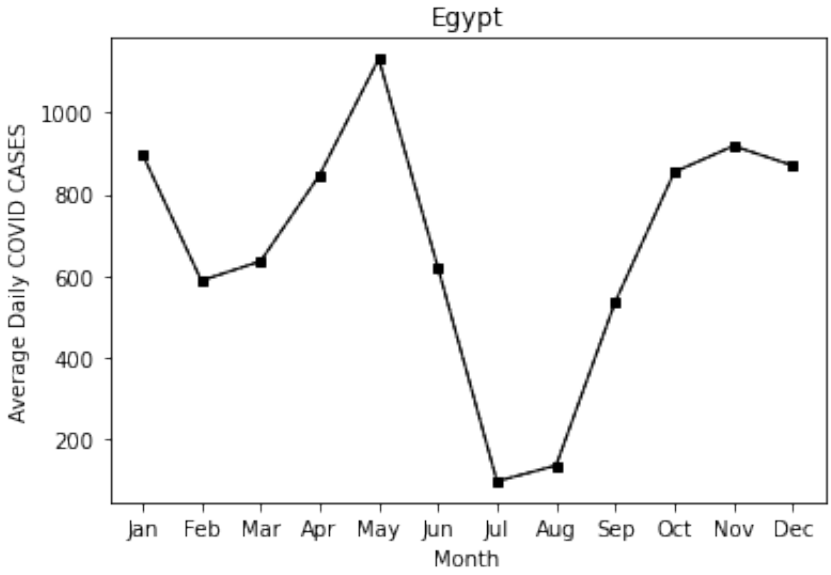
we can track from the graph that in Egypt 2020 (labeled blue) had the highest covid cases in comparison with 2021, the one in red. Also, Feb 2020 has the least number of daily cases.

Thirdly, we will also try to filter Japan's data and compare 2021 with 2021

In [570…
```
statsjapan=statsdcases[(statsdcases['country']=='Japan') & (statsdcases['ye
```

In [571…
```
statsjapan.columns=['country','year','month','mean','std','size','lb','ub']
```

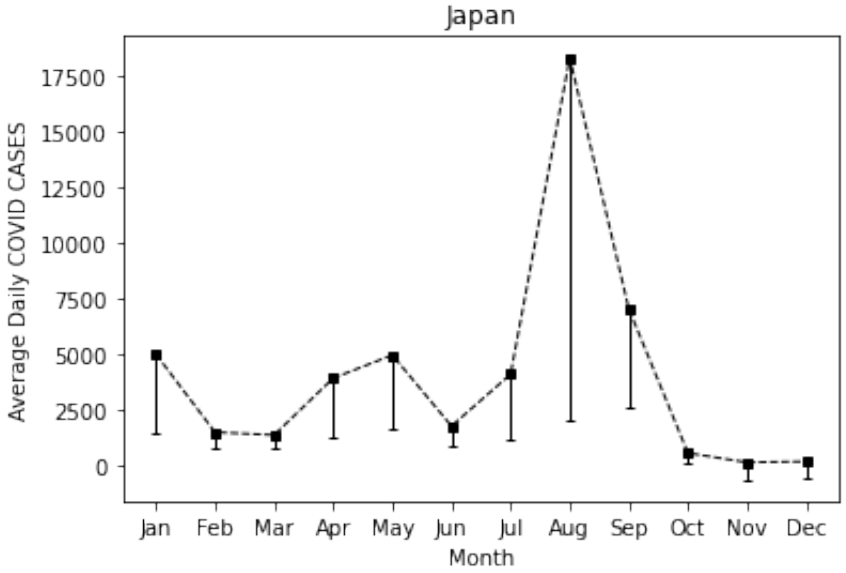
In [572…
```
plt.plot( 'month', 'mean', data=statsEgy, marker='s', color='black', marker
plt.plot( 'month', 'mean', data=statsEgy, marker='o', color='black',  marke
plt.xlabel("Month")
plt.ylabel("Average Daily COVID CASES")
plt.title("Egypt")
plt.show()
```



In [573…
```
ci_lb_ub=[statsjapan['lb'],statsEgy['ub']]
```

In [574…
```
err = np.abs(ci_lb_ub - statsEgy['mean'].to_numpy())
```

In [575…
```
plt.errorbar('month', 'mean',  yerr=err, data=statsjapan,marker='s', capsi
             color='black', markersize=4, linewidth=1, linestyle='--')
plt.xlabel("Month")
plt.ylabel("Average Daily COVID CASES")
plt.title("Japan")
plt.show()
```



In [576…
```
statsjapan21=statsdcases[(statsdcases['country']=='Japan')
                         & (statsdcases['year']==2021)]
statsjapan21
```

Out[576...

	country	year	month	dcases				
				mean	std	size	get_ci_lb	get_ci_ub
2004	Japan	2021	Jan	4999.709677	1556.661475	31.0	4428.721639	5570.697716
2005	Japan	2021	Feb	1496.285714	523.376775	28.0	1293.341387	1699.230041
2006	Japan	2021	Mar	1369.354839	488.049215	31.0	1190.336941	1548.372736
2007	Japan	2021	Apr	3922.833333	1179.424292	30.0	3482.429065	4363.237602
2008	Japan	2021	May	4958.580645	1353.906540	31.0	4461.963717	5455.197573
2009	Japan	2021	Jun	1769.866667	552.869925	30.0	1563.421644	1976.311690
2010	Japan	2021	Jul	4097.451613	3039.684412	31.0	2982.486369	5212.416857
2011	Japan	2021	Aug	18315.096774	5044.434090	31.0	16464.783412	20165.410137
2012	Japan	2021	Sep	7023.333333	5442.825276	30.0	4990.948974	9055.717693
2013	Japan	2021	Oct	557.129032	335.894501	31.0	433.921934	680.336130
2014	Japan	2021	Nov	143.100000	58.422569	30.0	121.284654	164.915346
2015	Japan	2021	Dec	182.580645	97.970327	31.0	146.644839	218.516451

In [577...

```
statsjapan20=statsdcases[(statsdcases['country']=='Japan')
                         & (statsdcases['year']==2020)]
statsjapan20
```

Out[577...

	country	year	month	dcases				
				mean	std	size	get_ci_lb	get_ci_ub
1992	Japan	2020	Jan	1.500000	1.715938	10.0	0.272492	2.727508
1993	Japan	2020	Feb	7.931034	7.591965	29.0	5.043205	10.818863
1994	Japan	2020	Mar	64.838710	55.332990	31.0	44.542405	85.135014
1995	Japan	2020	Apr	400.966667	143.180495	30.0	347.502191	454.431142
1996	Japan	2020	May	79.258065	70.789815	31.0	53.292151	105.223978
1997	Japan	2020	Jun	62.133333	28.085747	30.0	51.645943	72.620724
1998	Japan	2020	Jul	569.387097	367.041839	31.0	434.755063	704.019130
1999	Japan	2020	Aug	1036.419355	322.038898	31.0	918.294534	1154.544176
2000	Japan	2020	Sep	506.466667	130.100951	30.0	457.886173	555.047160
2001	Japan	2020	Oct	572.387097	151.149744	31.0	516.944923	627.829271
2002	Japan	2020	Nov	1583.366667	649.812996	30.0	1340.722506	1826.010827
2003	Japan	2020	Dec	2804.032258	705.835981	31.0	2545.129530	3062.934986

In [578…
```
statsjapan20.columns=['country','year','month','mean','std','size','lb','ub
```

In [579…
```
statsjapan21.columns=['country','year','month','mean','std','size','lb','ub
```

In [580…
```
x=statsjapan20['month']
x
```

Out[580…
```
1992    Jan
1993    Feb
1994    Mar
1995    Apr
1996    May
1997    Jun
1998    Jul
1999    Aug
2000    Sep
2001    Oct
2002    Nov
2003    Dec
Name: month, dtype: category
Categories (12, object): ['Jan' < 'Feb' < 'Mar' < 'Apr' ... 'Sep' < 'Oct' <
'Nov' < 'Dec']
```

In [581…
```
y1=statsjapan20['mean']
y1
```

Out[581…
```
1992       1.500000
1993       7.931034
1994      64.838710
1995     400.966667
1996      79.258065
1997      62.133333
1998     569.387097
1999    1036.419355
2000     506.466667
2001     572.387097
2002    1583.366667
2003    2804.032258
Name: mean, dtype: float64
```

In [582…
```
y2=statsjapan21['mean']
y2
```

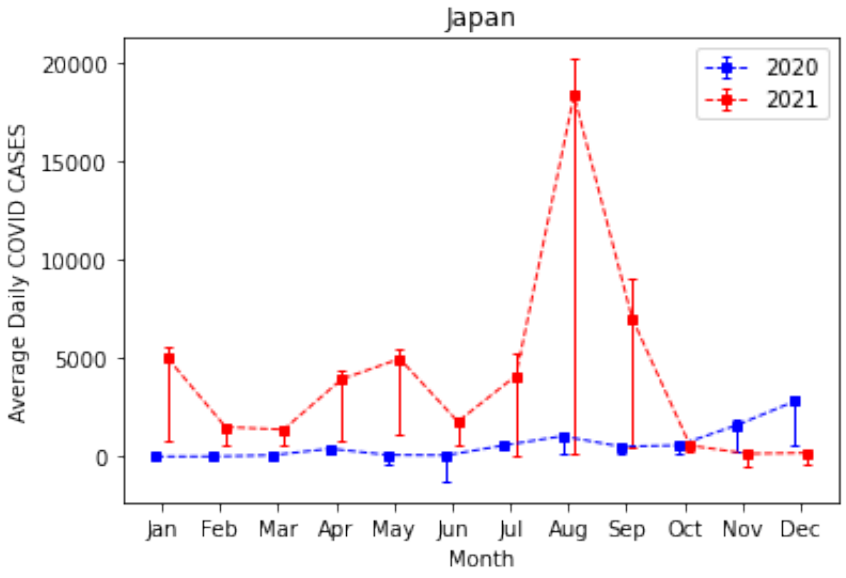
Out[582...
```
2004     4999.709677
2005     1496.285714
2006     1369.354839
2007     3922.833333
2008     4958.580645
2009     1769.866667
2010     4097.451613
2011    18315.096774
2012     7023.333333
2013      557.129032
2014      143.100000
2015      182.580645
Name: mean, dtype: float64
```

In [583...
```
ci_lb_ub20=[statsEgy20['lb'],statsjapan20['ub']]
err20 = np.abs(ci_lb_ub20 - statsjapan20['mean'].to_numpy())
```

In [584...
```
ci_lb_ub21=[statsEgy21['lb'],statsjapan21['ub']]
err21 = np.abs(ci_lb_ub21 - statsjapan21['mean'].to_numpy())
```

In [585...
```
fig, ax = plt.subplots()

trans1 = Affine2D().translate(-0.1, 0.0) + ax.transData
trans2 = Affine2D().translate(+0.1, 0.0) + ax.transData
plt.errorbar('month', 'mean',  yerr=err20, data=statsjapan20,marker='s', ca
             color='blue', markersize=4, linewidth=1, linestyle='--',transf
plt.errorbar('month', 'mean',  yerr=err21, data=statsjapan21,marker='s', ca
             color='red', markersize=4, linewidth=1, linestyle='--',transfo
plt.legend(['2020','2021'])
plt.xlabel("Month")
plt.ylabel("Average Daily COVID CASES")
plt.title("Japan")
plt.show()
```



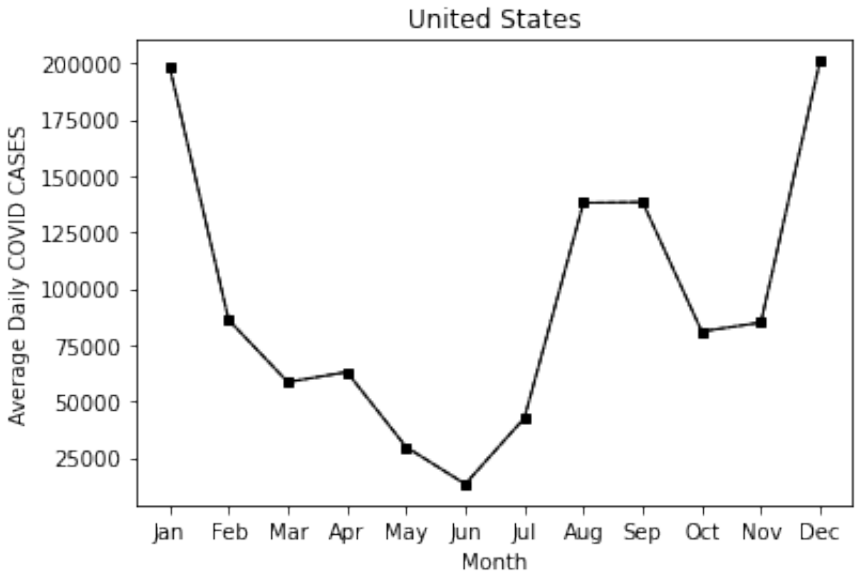
The results here show that August 2021 had the highest daily average.

Finally, we will filter the U.S. Data

In [586…
```
statsus=statsdcases[(statsdcases['country']=='United States') & (statsdcase
```

In [587…
```
statsus.columns=['country','year','month','mean','std','size','lb','ub']
```

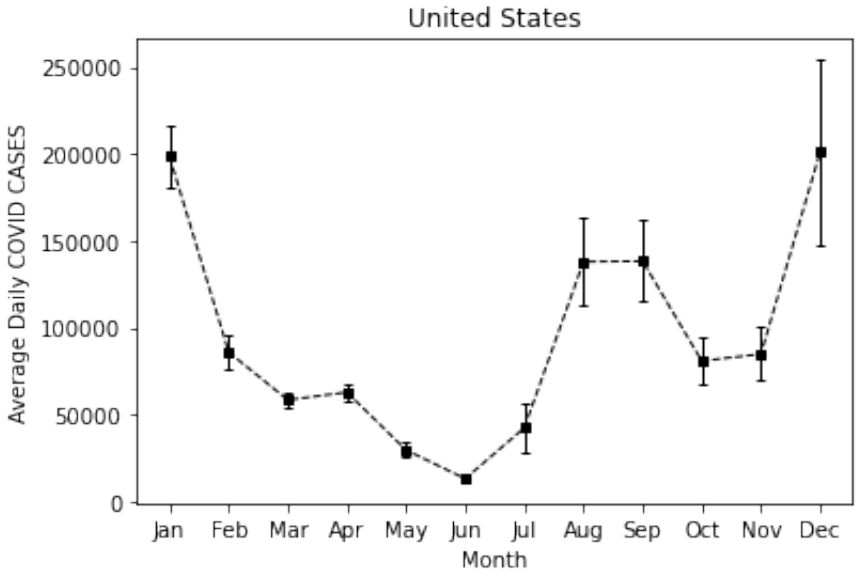
In [588…
```
plt.plot( 'month', 'mean', data=statsus, marker='s', color='black', markers
plt.plot( 'month', 'mean', data=statsus, marker='o', color='black',  marker
plt.xlabel("Month")
plt.ylabel("Average Daily COVID CASES")
plt.title("United States")
plt.show()
```



In [589…
```
ci_lb_ub=[statsus['lb'],statsus['ub']]
```

In [590…
```
err = np.abs(ci_lb_ub - statsus['mean'].to_numpy())
```

In [591…
```
plt.errorbar('month', 'mean',  yerr=err, data=statsus,marker='s', capsize=2
             color='black', markersize=4, linewidth=1, linestyle='--')
plt.xlabel("Month")
plt.ylabel("Average Daily COVID CASES")
plt.title("United States")
plt.show()
```



In [592…

```
statsus21=statsdcases[(statsdcases['country']=='United States')
                      & (statsdcases['year']==2021)]
statsus21
```

Out[592...

	country	year	month	mean	std	size	get_ci_lb	ge
4284	United States	2021	Jan	198456.967742	48963.656236	31.0	180496.953637	216416
4285	United States	2021	Feb	86034.071429	24096.956170	28.0	76690.247272	95377
4286	United States	2021	Mar	58528.870968	11091.423385	31.0	54460.504025	6259
4287	United States	2021	Apr	62969.866667	13326.331302	30.0	57993.732778	67946
4288	United States	2021	May	29748.451613	11654.944186	31.0	25473.383571	34023
4289	United States	2021	Jun	13276.666667	5477.556971	30.0	11231.313279	15322
4290	United States	2021	Jul	42530.096774	38371.307282	31.0	28455.387633	56604
4291	United States	2021	Aug	138009.096774	68559.671456	31.0	112861.206256	163156
4292	United States	2021	Sep	138317.533333	62395.681666	30.0	115018.602892	161616
4293	United States	2021	Oct	80985.838710	36717.953309	31.0	67517.584702	94454
4294	United States	2021	Nov	84910.333333	41307.383674	30.0	69485.902776	100334
4295	United States	2021	Dec	200893.903226	144836.878947	31.0	147767.307118	254020

In [593...

```
statsus20=statsdcases[(statsdcases['country']=='United States')
                      & (statsdcases['year']==2020)]
statsus20
```

Out[593...

	country	year	month	mean	std	size	get_ci_lb	get
4272	United States	2020	Jan	0.800000	1.032796	10.0	0.061183	1.5
4273	United States	2020	Feb	0.586207	1.592779	29.0	-0.019654	1.1
4274	United States	2020	Mar	6195.290323	8136.094990	31.0	3210.946587	9179.6
4275	United States	2020	Apr	29444.100000	2951.205287	30.0	28342.101835	30546.0
4276	United States	2020	May	22969.967742	3675.815070	31.0	21621.667889	24318.2
4277	United States	2020	Jun	28578.800000	9530.864738	30.0	25019.916618	32137.6
4278	United States	2020	Jul	61294.677419	7287.514718	31.0	58621.595440	63967.7
4279	United States	2020	Aug	48365.354839	9820.975222	31.0	44762.992044	51967.
4280	United States	2020	Sep	39903.100000	6415.896956	30.0	37507.364704	42298.8
4281	United States	2020	Oct	61870.935484	16595.228308	31.0	55783.756596	67958.
4282	United States	2020	Nov	149008.633333	33377.003387	30.0	136545.455442	161471.
4283	United States	2020	Dec	211725.193548	33854.121304	31.0	199307.401601	224142.9

In [594...
```
statsus20.columns=['country','year','month','mean','std','size','lb','ub']
```

In [595...
```
statsus21.columns=['country','year','month','mean','std','size','lb','ub']
```

In [596...
```
x=statsus20['month']
x
```

Out[596…
```
4272    Jan
4273    Feb
4274    Mar
4275    Apr
4276    May
4277    Jun
4278    Jul
4279    Aug
4280    Sep
4281    Oct
4282    Nov
4283    Dec
Name: month, dtype: category
Categories (12, object): ['Jan' < 'Feb' < 'Mar' < 'Apr' ... 'Sep' < 'Oct' <
'Nov' < 'Dec']
```

In [597…
```
y1=statsus20['mean']
y1
```

Out[597…
```
4272         0.800000
4273         0.586207
4274      6195.290323
4275     29444.100000
4276     22969.967742
4277     28578.800000
4278     61294.677419
4279     48365.354839
4280     39903.100000
4281     61870.935484
4282    149008.633333
4283    211725.193548
Name: mean, dtype: float64
```

In [598…
```
y2=statsus21['mean']
y2
```

Out[598…
```
4284    198456.967742
4285     86034.071429
4286     58528.870968
4287     62969.866667
4288     29748.451613
4289     13276.666667
4290     42530.096774
4291    138009.096774
4292    138317.533333
4293     80985.838710
4294     84910.333333
4295    200893.903226
Name: mean, dtype: float64
```

In [599…
```
ci_lb_ub20=[statsus20['lb'],statsus20['ub']]
err20 = np.abs(ci_lb_ub20 - statsus20['mean'].to_numpy())
```

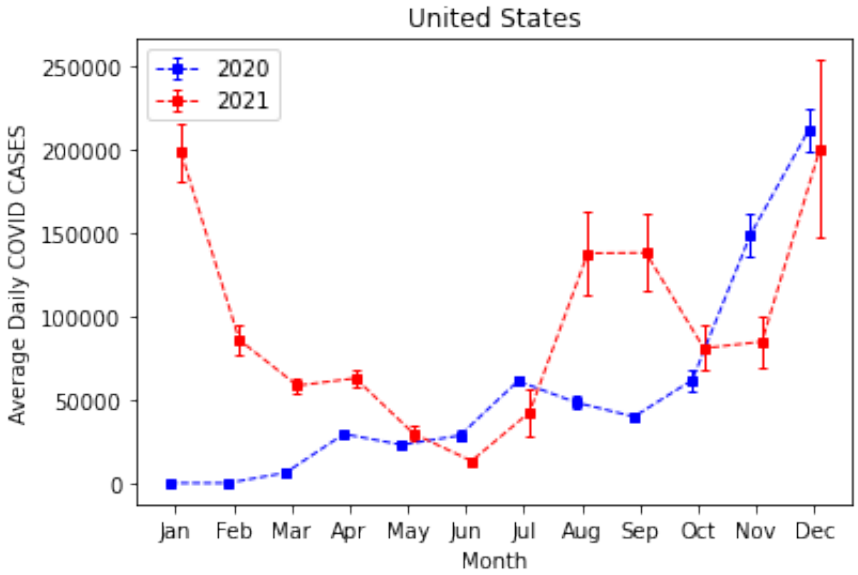
In [600…

```
ci_lb_ub21=[statsus21['lb'],statsus21['ub']]
err21 = np.abs(ci_lb_ub21 - statsus21['mean'].to_numpy())
```

In [601…

```
fig, ax = plt.subplots()

trans1 = Affine2D().translate(-0.1, 0.0) + ax.transData
trans2 = Affine2D().translate(+0.1, 0.0) + ax.transData
plt.errorbar('month', 'mean',  yerr=err20, data=statsus20,marker='s', capsi
             color='blue', markersize=4, linewidth=1, linestyle='--',transf
plt.errorbar('month', 'mean',  yerr=err21, data=statsus21,marker='s', capsi
             color='red', markersize=4, linewidth=1, linestyle='--',transfo
plt.legend(['2020','2021'])
plt.xlabel("Month")
plt.ylabel("Average Daily COVID CASES")
plt.title("United States")
plt.show()
```



The last graph shows that as a whole 2021 has more daily cases than 2020 in America.

The End

In [ ]: