Initial Data Exploration for Covid19 pandemic in Malaysia

Data Dictionary

Field	Description
Date	Date of incident
Province/State	If there is a breakdown in states
Lat	Latitude
Lon	Longitude
Confirmed	Confirmed cases
Recovered	Recovered cases
Deaths	Death cases
Active	Active cases

Analysis Summary

1. From worldwide perspective, the confirmed cases are the highest range and many outliers found in boxplot.
2. This analysis and machine learning model will predict COVID-19 deaths in Malaysia.
3. From time plots, the biggest jump is from October 2020 onwards.
4. By extracting individual cases by day, deaths peaked in April 2020 and October 2020 onwards.
5. Separate charts by Month and Day are plotted to see the distribution.

Feature Engineering

1. The dataset is transformed using diff method to extract per day for Confirmed, Recovered, Deaths and Active Cases.
2. Due to diff method, I imputed a NaN value as 0.0 as starting point.
3. Created separate month and day features from Date feature.

Import Libraries

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import statsmodels.api as sm
import datetime
import scipy.stats

%matplotlib inline
#sets the default autosave frequency in seconds
%autosave 60
sns.set_style('dark')
sns.set(font_scale=1.2)

import warnings
warnings.filterwarnings('ignore')

#import feature_engine.missing_data_imputers as mdi
#from feature_engine.outlier_removers import Winsorizer
#from feature_engine import categorical_encoders as ce

pd.set_option('display.max_columns',None)
#pd.set_option('display.max_rows',None)
pd.set_option('display.width', 1000)

np.random.seed(0)
np.set_printoptions(suppress=True)
```

```
Autosaving every 60 seconds
```

In [2]:
```
df = pd.read_csv("covid_19_data_cleaned.csv",parse_dates=['Date'], index_col=["Date"])
```

In [3]:
```
df
```

Out[3]:

Date	Province/State	Country	Lat	Long	Confirmed	Recovered	Deaths	Active
2020-01-22	NaN	Afghanistan	33.93911	67.709953	0	0	0	0
2020-01-23	NaN	Afghanistan	33.93911	67.709953	0	0	0	0
2020-01-24	NaN	Afghanistan	33.93911	67.709953	0	0	0	0
2020-01-25	NaN	Afghanistan	33.93911	67.709953	0	0	0	0
2020-01-26	NaN	Afghanistan	33.93911	67.709953	0	0	0	0
...	...	...	...	...	...	...	...	...
2020-11-21	NaN	Timor-Leste	-8.87420	125.727500	0	30	0	-30
2020-11-22	NaN	Timor-Leste	-8.87420	125.727500	0	30	0	-30
2020-11-23	NaN	Timor-Leste	-8.87420	125.727500	0	30	0	-30
2020-11-24	NaN	Timor-Leste	-8.87420	125.727500	0	30	0	-30
2020-11-25	NaN	Timor-Leste	-8.87420	125.727500	0	30	0	-30

85593 rows × 8 columns

Exploratory Data Analysis

In [4]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 85593 entries, 2020-01-22 to 2020-11-25
Data columns (total 8 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   Province/State  26265 non-null  object
 1   Country         85593 non-null  object
 2   Lat             85593 non-null  float64
 3   Long            85593 non-null  float64
 4   Confirmed       85593 non-null  int64
 5   Recovered       85593 non-null  int64
 6   Deaths          85593 non-null  int64
 7   Active          85593 non-null  int64
dtypes: float64(2), int64(4), object(2)
memory usage: 5.9+ MB
```

In [5]:
```
df.describe()
```

Out[5]:

	Lat	Long	Confirmed	Recovered	Deaths	Active
count	85593.000000	85593.000000	8.559300e+04	8.559300e+04	85593.000000	8.559300e+04
mean	20.916828	24.585736	5.867697e+04	3.708964e+04	1926.112906	1.966121e+04
std	25.065486	71.663375	4.359217e+05	2.917598e+05	11981.062356	1.936343e+05
min	-51.796300	-135.000000	0.000000e+00	0.000000e+00	0.000000	-2.818830e+05
25%	6.423800	-15.180400	1.600000e+01	0.000000e+00	0.000000	1.000000e+00
50%	22.300000	21.745300	5.130000e+02	2.000000e+02	6.000000	6.800000e+01
75%	41.112900	85.240100	6.442000e+03	2.913000e+03	118.000000	1.667000e+03
max	71.706900	178.065000	1.277265e+07	8.679138e+06	262222.000000	7.674475e+06

In [6]:
```
df.columns
```

Out[6]:
```
Index(['Province/State', 'Country', 'Lat', 'Long', 'Confirmed', 'Recovered', 'Deaths', 'Active'], dtype='object')
```

In [7]:
```
df["Country"].value_counts()
```

Out[7]:
```
China                       10815
Canada                       5253
France                       3399
United Kingdom               3399
Australia                    2472
                            ...
Angola                        309
Chile                         309
Central African Republic      309
Poland                        309
Malawi                        309
Name: Country, Length: 191, dtype: int64
```

In [8]:
```
df["Country"].unique()
```

Out[8]:
```
array(['Afghanistan', 'Albania', 'Algeria', 'Andorra', 'Angola',
       'Antigua and Barbuda', 'Argentina', 'Armenia', 'Australia',
       'Austria', 'Azerbaijan', 'Bahamas', 'Bahrain', 'Bangladesh',
       'Barbados', 'Belarus', 'Belgium', 'Belize', 'Benin', 'Bhutan',
       'Bolivia', 'Bosnia and Herzegovina', 'Botswana', 'Brazil',
       'Brunei', 'Bulgaria', 'Burkina Faso', 'Burma', 'Burundi',
       'Cabo Verde', 'Cambodia', 'Cameroon', 'Canada',
       'Central African Republic', 'Chad', 'Chile', 'China', 'Colombia',
       'Comoros', 'Congo (Brazzaville)', 'Congo (Kinshasa)', 'Costa Rica',
       "Cote d'Ivoire", 'Croatia', 'Cuba', 'Cyprus', 'Czechia', 'Denmark',
       'Diamond Princess', 'Djibouti', 'Dominica', 'Dominican Republic',
       'Ecuador', 'Egypt', 'El Salvador', 'Equatorial Guinea', 'Eritrea',
       'Estonia', 'Eswatini', 'Ethiopia', 'Fiji', 'Finland', 'France',
       'Gabon', 'Gambia', 'Georgia', 'Germany', 'Ghana', 'Greece',
       'Grenada', 'Guatemala', 'Guinea', 'Guinea-Bissau', 'Guyana',
       'Haiti', 'Holy See', 'Honduras', 'Hungary', 'Iceland', 'India',
       'Indonesia', 'Iran', 'Iraq', 'Ireland', 'Israel', 'Italy',
       'Jamaica', 'Japan', 'Jordan', 'Kazakhstan', 'Kenya',
       'Korea, South', 'Kosovo', 'Kuwait', 'Kyrgyzstan', 'Laos', 'Latvia',
       'Lebanon', 'Lesotho', 'Liberia', 'Libya', 'Liechtenstein',
       'Lithuania', 'Luxembourg', 'MS Zaandam', 'Madagascar', 'Malawi',
       'Malaysia', 'Maldives', 'Mali', 'Malta', 'Marshall Islands',
       'Mauritania', 'Mauritius', 'Mexico', 'Moldova', 'Monaco',
       'Mongolia', 'Montenegro', 'Morocco', 'Mozambique', 'Namibia',
       'Nepal', 'Netherlands', 'New Zealand', 'Nicaragua', 'Niger',
       'Nigeria', 'North Macedonia', 'Norway', 'Oman', 'Pakistan',
       'Panama', 'Papua New Guinea', 'Paraguay', 'Peru', 'Philippines',
       'Poland', 'Portugal', 'Qatar', 'Romania', 'Russia', 'Rwanda',
       'Saint Kitts and Nevis', 'Saint Lucia',
       'Saint Vincent and the Grenadines', 'San Marino',
       'Sao Tome and Principe', 'Saudi Arabia', 'Senegal', 'Serbia',
       'Seychelles', 'Sierra Leone', 'Singapore', 'Slovakia', 'Slovenia',
       'Solomon Islands', 'Somalia', 'South Africa', 'South Sudan',
       'Spain', 'Sri Lanka', 'Sudan', 'Suriname', 'Sweden', 'Switzerland',
       'Syria', 'Taiwan*', 'Tajikistan', 'Tanzania', 'Thailand',
       'Timor-Leste', 'Togo', 'Trinidad and Tobago', 'Tunisia', 'Turkey',
       'US', 'Uganda', 'Ukraine', 'United Arab Emirates',
       'United Kingdom', 'Uruguay', 'Uzbekistan', 'Vanuatu', 'Venezuela',
       'Vietnam', 'West Bank and Gaza', 'Western Sahara', 'Yemen',
       'Zambia', 'Zimbabwe'], dtype=object)
```

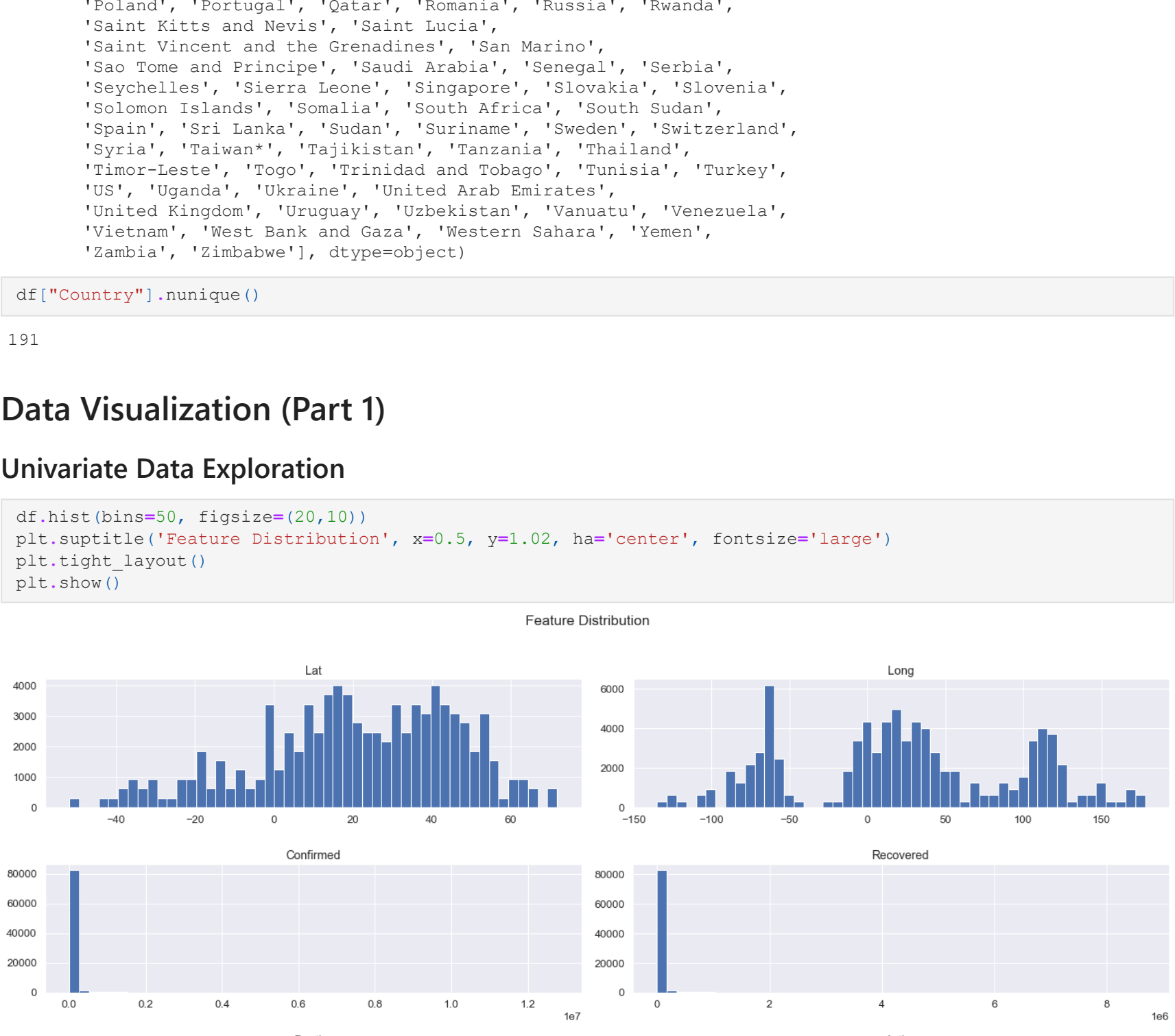
In [9]:
```
df["Country"].nunique()
```

Out[9]:
```
191
```

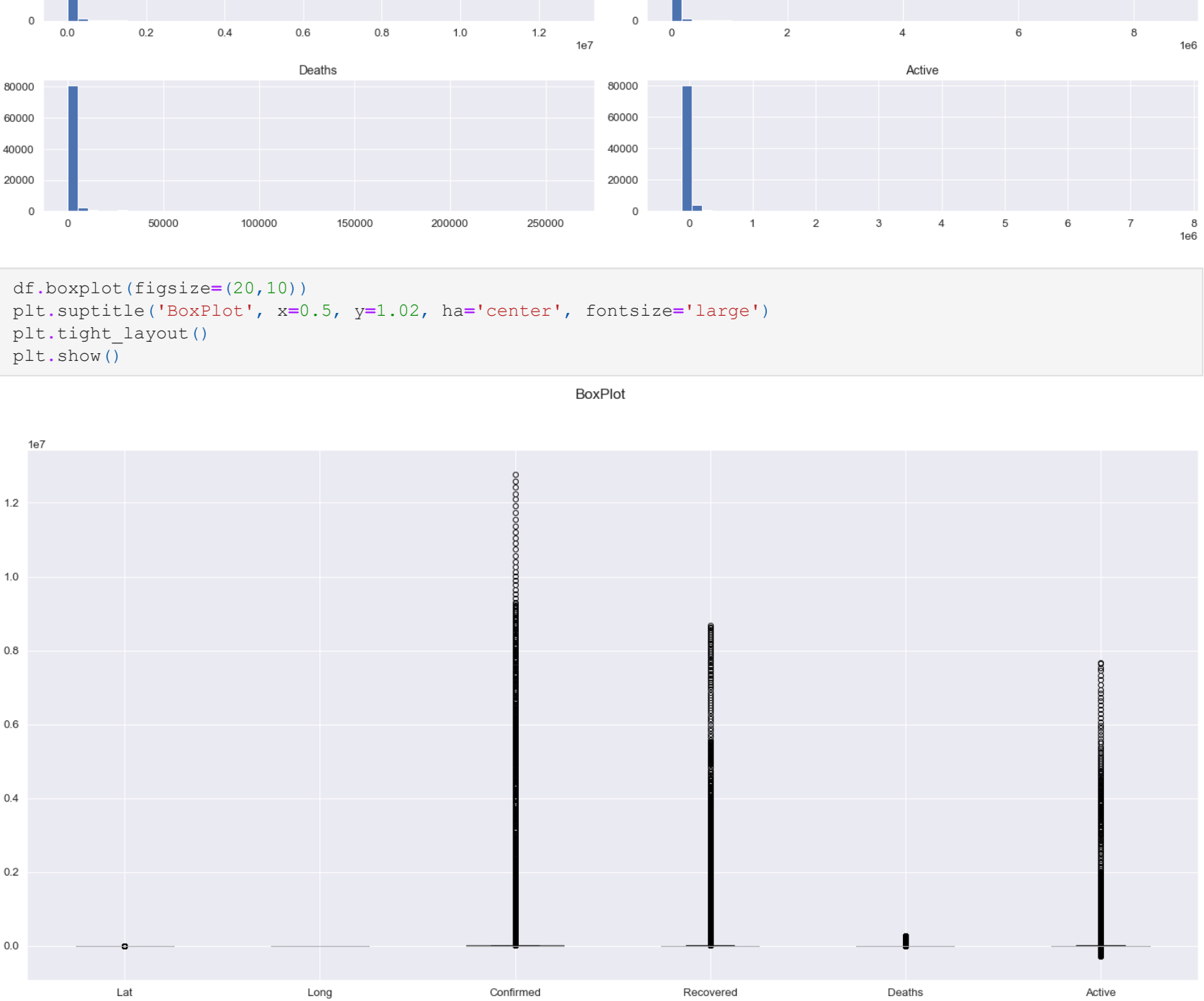
Data Visualization (Part 1)

Univariate Data Exploration

In [10]:
```
df.hist(bins=50, figsize=(20,10))
plt.suptitle('Feature Distribution', x=0.5, y=1.02, ha='center', fontsize='large')
plt.tight_layout()
plt.show()
```



In [11]:
```
df.boxplot(figsize=(20,10))
plt.suptitle('BoxPlot', x=0.5, y=1.02, ha='center', fontsize='large')
plt.tight_layout()
plt.show()
```



Extract country Malaysia from dataset for analysis and machine learning

In [12]:
```
malaysia = df[df["Country"] == "Malaysia"]
```

In [13]:
```
malaysia
```

Out[13]:

Date	Province/State	Country	Lat	Long	Confirmed	Recovered	Deaths	Active
2020-01-22	NaN	Malaysia	4.210484	101.975766	0	0	0	0
2020-01-23	NaN	Malaysia	4.210484	101.975766	0	0	0	0
2020-01-24	NaN	Malaysia	4.210484	101.975766	0	0	0	0
2020-01-25	NaN	Malaysia	4.210484	101.975766	3	0	0	3
2020-01-26	NaN	Malaysia	4.210484	101.975766	4	0	0	4
...	...	...	...	...	...	...	...	...
2020-11-21	NaN	Malaysia	4.210484	101.975766	53679	40493	332	12854
2020-11-22	NaN	Malaysia	4.210484	101.975766	54775	41597	335	12843
2020-11-23	NaN	Malaysia	4.210484	101.975766	56659	42480	337	13842
2020-11-24	NaN	Malaysia	4.210484	101.975766	58847	44153	341	14353
2020-11-25	NaN	Malaysia	4.210484	101.975766	59817	46501	345	12971

309 rows × 8 columns

Drop unwanted features

In [14]:
```
malaysia.columns
```

Out[14]:
```
Index(['Province/State', 'Country', 'Lat', 'Long', 'Confirmed', 'Recovered', 'Deaths', 'Active'], dtype='object')
```

In [15]:
```
malaysia.drop(['Province/State', 'Country', 'Lat', 'Long'],axis=1,inplace=True)
```

In [16]:
```
malaysia
```

Out[16]:

Date	Confirmed	Recovered	Deaths	Active
2020-01-22	0	0	0	0
2020-01-23	0	0	0	0
2020-01-24	0	0	0	0
2020-01-25	3	0	0	3
2020-01-26	4	0	0	4
...	...	...	...	...
2020-11-21	53679	40493	332	12854
2020-11-22	54775	41597	335	12843
2020-11-23	56659	42480	337	13842
2020-11-24	58847	44153	341	14353
2020-11-25	59817	46501	345	12971

309 rows × 4 columns

In [17]:
```
malaysia.reset_index(inplace=True)
```

In [18]:
```
#Save to csv
#malaysia.to_csv("malaysiacovid.csv",index=False)
```

Time-Series Analysis

In [19]:
```
df = pd.read_csv("malaysiacovid.csv", parse_dates=["Date"])
```

In [20]:
```
df
```

Out[20]:

	Date	Confirmed	Recovered	Deaths	Active
0	2020-01-22	0	0	0	0
1	2020-01-23	0	0	0	0
2	2020-01-24	0	0	0	0
3	2020-01-25	3	0	0	3
4	2020-01-26	4	0	0	4
...	...	...	...	...	...
304	2020-11-21	53679	40493	332	12854
305	2020-11-22	54775	41597	335	12843
306	2020-11-23	56659	42480	337	13842
307	2020-11-24	58847	44153	341	14353
308	2020-11-25	59817	46501	345	12971

309 rows × 5 columns

In [21]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 309 entries, 0 to 308
Data columns (total 5 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   Date       309 non-null    datetime64[ns]
 1   Confirmed  309 non-null    int64
 2   Recovered  309 non-null    int64
 3   Deaths     309 non-null    int64
 4   Active     309 non-null    int64
dtypes: datetime64[ns](1), int64(4)
memory usage: 12.2 KB
```

In [22]:
```
df.set_index(["Date"],inplace=True)
```

In [23]:
```
df
```

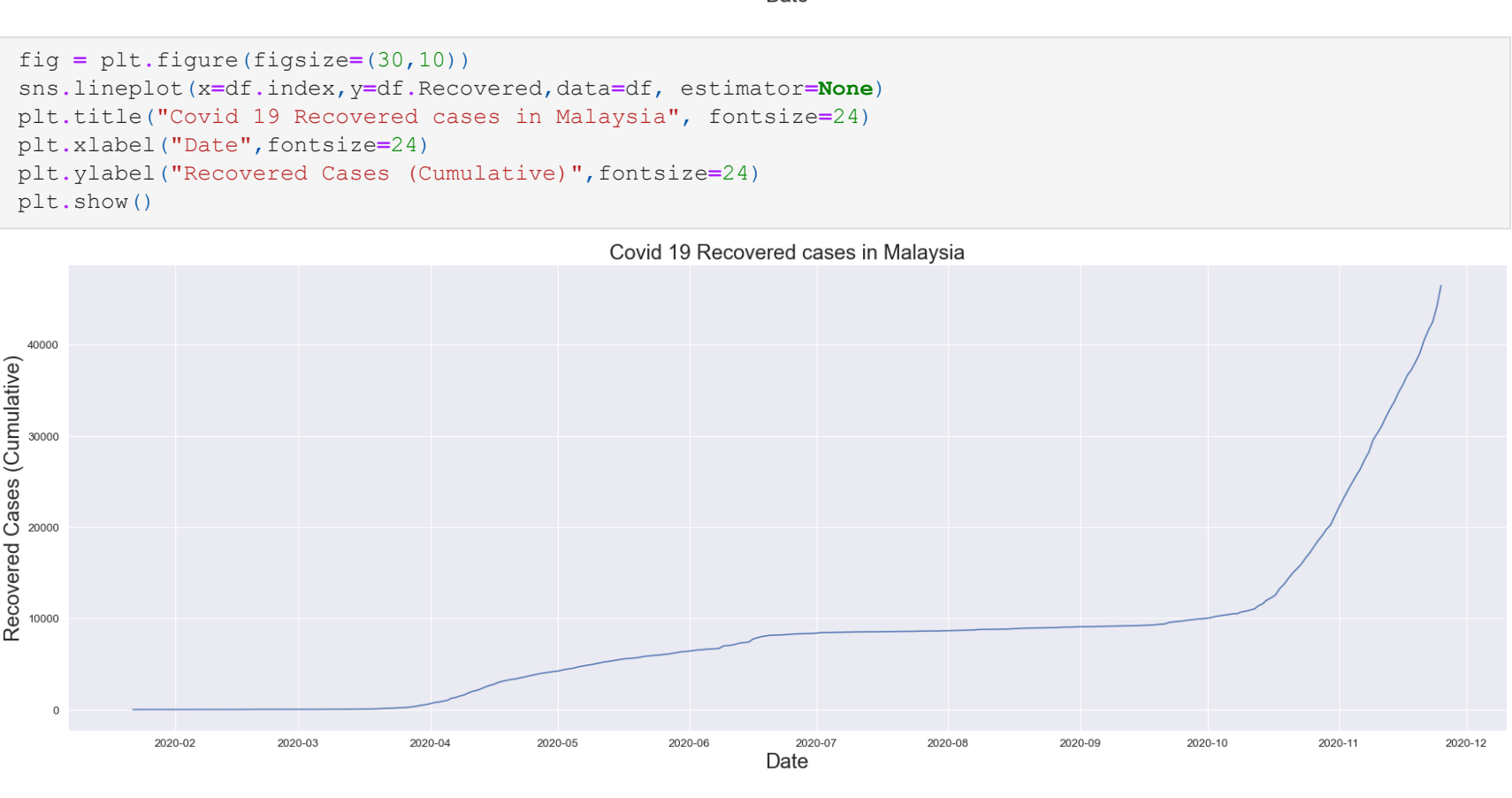
Out[23]:

Date	Confirmed	Recovered	Deaths	Active
2020-01-22	0	0	0	0
2020-01-23	0	0	0	0
2020-01-24	0	0	0	0
2020-01-25	3	0	0	3
2020-01-26	4	0	0	4
...	...	...	...	...
2020-11-21	53679	40493	332	12854
2020-11-22	54775	41597	335	12843
2020-11-23	56659	42480	337	13842
2020-11-24	58847	44153	341	14353
2020-11-25	59817	46501	345	12971

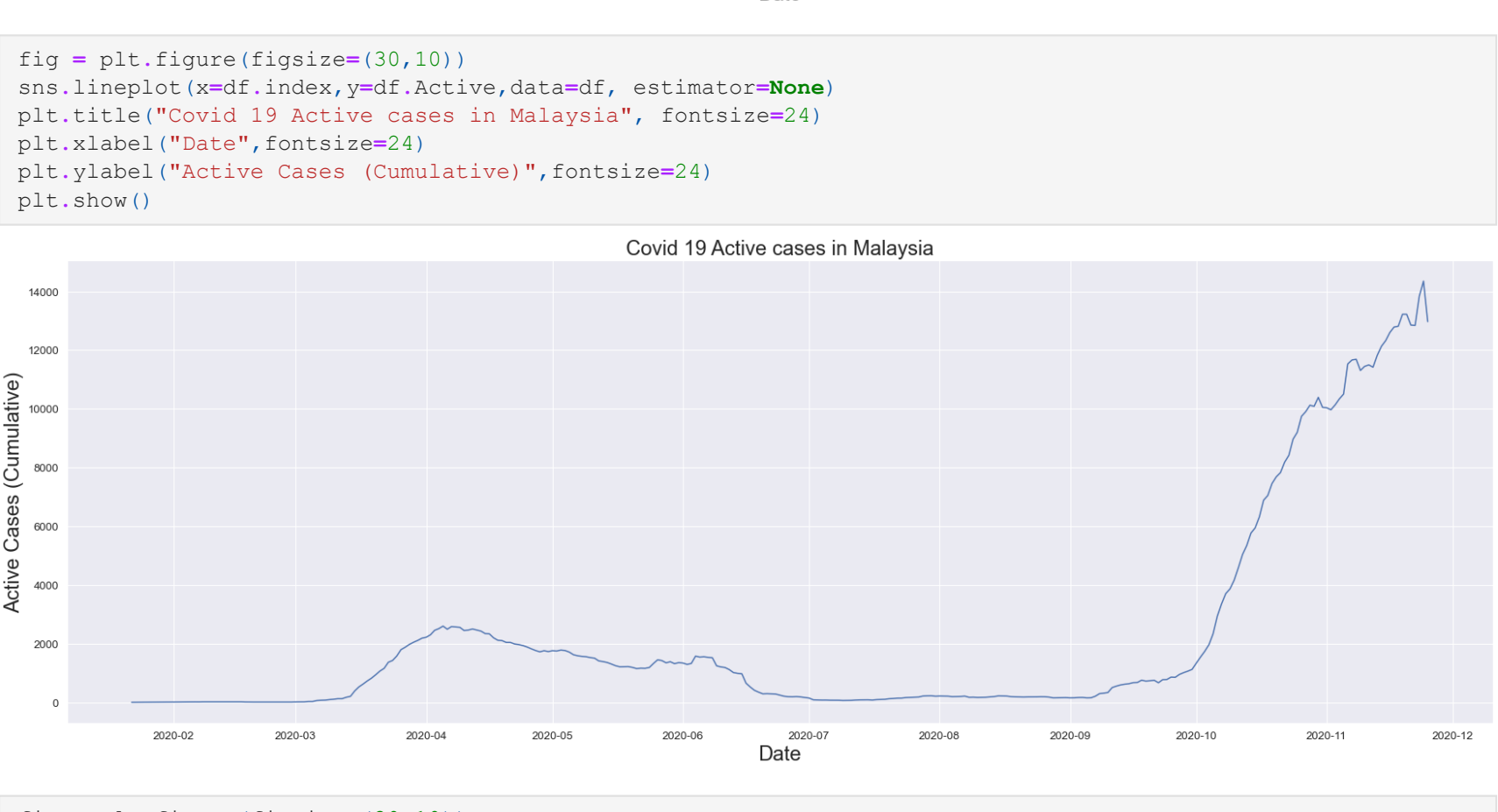
309 rows × 4 columns

In [24]:
```
fig = plt.figure(figsize=(30,10))
sns.lineplot(x=df.index,y=df.Confirmed,data=df, estimator=None)
plt.title("Covid 19 confirmed cases in Malaysia", fontsize=24)
plt.xlabel("Date",fontsize=24)
plt.ylabel("Confirmed Cases (Cumulative)",fontsize=24)
plt.show()
```

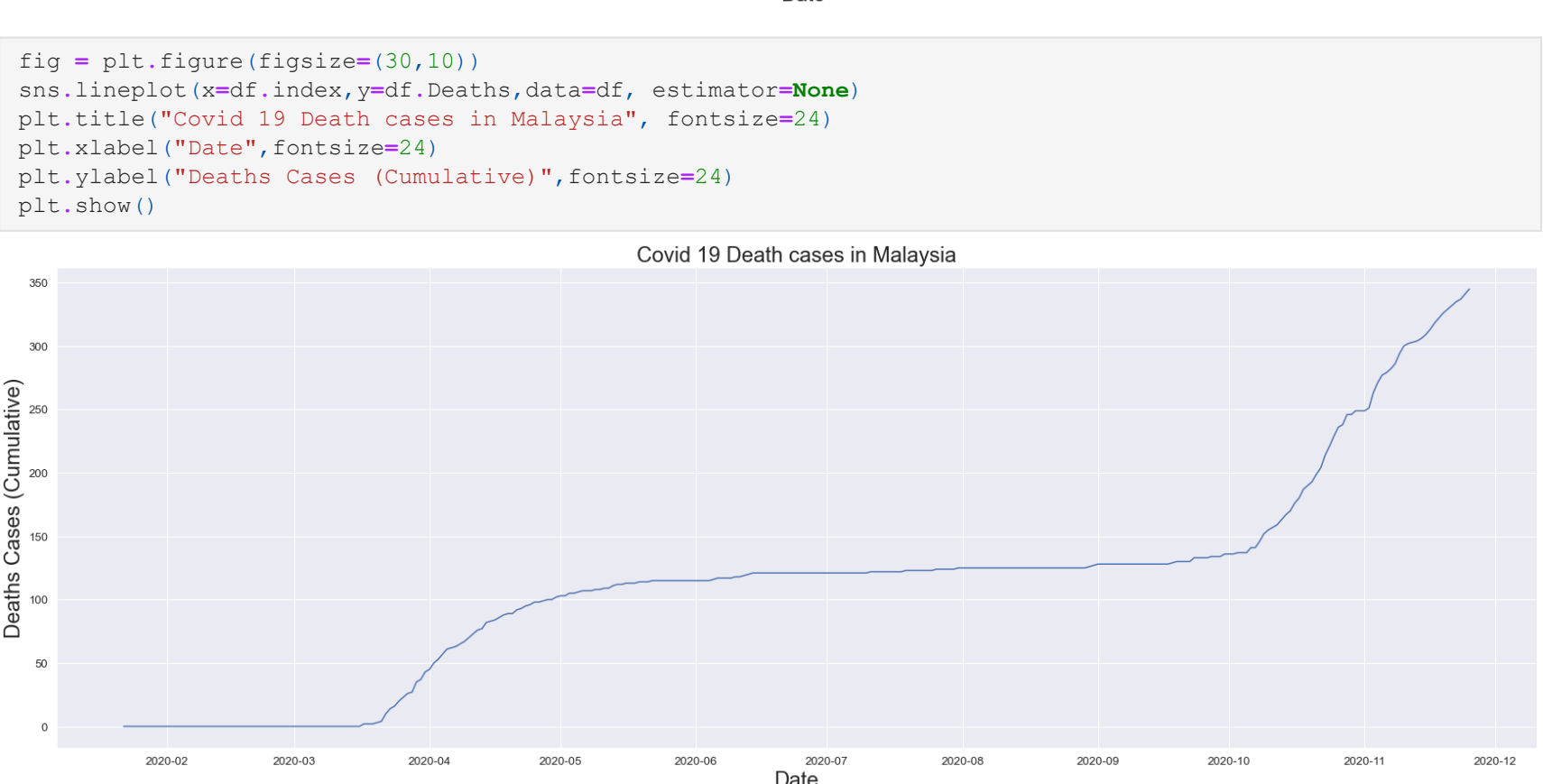
In [25]:
```
fig = plt.figure(figsize=(30,10))
sns.lineplot(x=df.index,y=df.Recovered,data=df, estimator=None)
plt.title("Covid 19 Recovered cases in Malaysia", fontsize=24)
plt.xlabel("Date",fontsize=24)
plt.ylabel("Recovered Cases (Cumulative)",fontsize=24)
plt.show()
```



In [26]:
```
fig = plt.figure(figsize=(30,10))
sns.lineplot(x=df.index,y=df.Active,data=df, estimator=None)
plt.title("Covid 19 Active cases in Malaysia", fontsize=24)
plt.xlabel("Date",fontsize=24)
plt.ylabel("Active Cases (Cumulative)",fontsize=24)
plt.show()
```



In [27]:
```
fig = plt.figure(figsize=(30,10))
sns.lineplot(x=df.index,y=df.Deaths,data=df, estimator=None)
plt.title("Covid 19 Death cases in Malaysia", fontsize=24)
plt.xlabel("Date",fontsize=24)
plt.ylabel("Deaths Cases (Cumulative)",fontsize=24)
plt.show()
```



In [28]:
```
df.head()
```

Out[28]:

Date	Confirmed	Recovered	Deaths	Active
2020-01-22	0	0	0	0
2020-01-23	0	0	0	0
2020-01-24	0	0	0	0
2020-01-25	3	0	0	3
2020-01-26	4	0	0	4

In [29]:
```
df["ConfirmDiff"] = df["Confirmed"].diff()
```

In [30]:
```
df["DeathsDiff"] = df["Deaths"].diff()
```

In [31]:
```
df["RecoverDiff"] = df["Recovered"].diff()
```

In [32]:
```
df["ActiveDiff"] = df["Active"].diff()
```

In [33]:
```
df
```

Out[33]:

Date	Confirmed	Recovered	Deaths	Active	ConfirmDiff	DeathsDiff	RecoverDiff	ActiveDiff
2020-01-22	0	0	0	0	NaN	NaN	NaN	NaN
2020-01-23	0	0	0	0	0.0	0.0	0.0	0.0
2020-01-24	0	0	0	0	0.0	0.0	0.0	0.0
2020-01-25	3	0	0	3	3.0	0.0	0.0	3.0
2020-01-26	4	0	0	4	1.0	0.0	0.0	1.0
...	...	...	...	...	...	...	...	...
2020-11-21	53679	40493	332	12854	1041.0	3.0	1405.0	-367.0
2020-11-22	54775	41597	335	12843	1096.0	3.0	1104.0	-11.0
2020-11-23	56659	42480	337	13842	1884.0	2.0	883.0	999.0
2020-11-24	58847	44153	341	14353	2188.0	4.0	1673.0	511.0
2020-11-25	59817	46501	345	12971	970.0	4.0	2348.0	-1382.0

309 rows × 8 columns

In [34]:
```
df.reset_index(inplace=True)
```

In [35]:
```
df
```

Out[35]:

	Date	Confirmed	Recovered	Deaths	Active	ConfirmDiff	DeathsDiff	RecoverDiff	ActiveDiff
0	2020-01-22	0	0	0	0	NaN	NaN	NaN	NaN
1	2020-01-23	0	0	0	0	0.0	0.0	0.0	0.0
2	2020-01-24	0	0	0	0	0.0	0.0	0.0	0.0
3	2020-01-25	3	0	0	3	3.0	0.0	0.0	3.0
4	2020-01-26	4	0	0	4	1.0	0.0	0.0	1.0
...	...	...	...	...	...	...	...	...	...
304	2020-11-21	53679	40493	332	12854	1041.0	3.0	1405.0	-367.0
305	2020-11-22	54775	41597	335	12843	1096.0	3.0	1104.0	-11.0
306	2020-11-23	56659	42480	337	13842	1884.0	2.0	883.0	999.0
307	2020-11-24	58847	44153	341	14353	2188.0	4.0	1673.0	511.0
308	2020-11-25	59817	46501	345	12971	970.0	4.0	2348.0	-1382.0

309 rows × 9 columns

In [36]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 309 entries, 0 to 308
Data columns (total 9 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   Date         309 non-null    datetime64[ns]
 1   Confirmed    309 non-null    int64
 2   Recovered    309 non-null    int64
 3   Deaths       309 non-null    int64
 4   Active       309 non-null    int64
 5   ConfirmDiff  308 non-null    float64
 6   DeathsDiff   308 non-null    float64
 7   RecoverDiff  308 non-null    float64
 8   ActiveDiff   308 non-null    float64
dtypes: datetime64[ns](1), float64(4), int64(4)
memory usage: 21.9 KB
```

In [37]:
```
df.replace(to_replace=np.nan, value=0.0, inplace=True)
```

In [38]:
```
df
```

Out[38]:

	Date	Confirmed	Recovered	Deaths	Active	ConfirmDiff	DeathsDiff	RecoverDiff	ActiveDiff
0	2020-01-22	0	0	0	0	0.0	0.0	0.0	0.0
1	2020-01-23	0	0	0	0	0.0	0.0	0.0	0.0
2	2020-01-24	0	0	0	0	0.0	0.0	0.0	0.0
3	2020-01-25	3	0	0	3	3.0	0.0	0.0	3.0
4	2020-01-26	4	0	0	4	1.0	0.0	0.0	1.0
...	...	...	...	...	...	...	...	...	...
304	2020-11-21	53679	40493	332	12854	1041.0	3.0	1405.0	-367.0
305	2020-11-22	54775	41597	335	12843	1096.0	3.0	1104.0	-11.0
306	2020-11-23	56659	42480	337	13842	1884.0	2.0	883.0	999.0
307	2020-11-24	58847	44153	341	14353	2188.0	4.0	1673.0	511.0
308	2020-11-25	59817	46501	345	12971	970.0	4.0	2348.0	-1382.0

309 rows × 9 columns

Treat Missing Values

In [39]:
```
df.isnull().sum()
```

Out[39]:
```
Date           0
Confirmed      0
Recovered      0
Deaths         0
Active         0
ConfirmDiff    0
DeathsDiff     0
RecoverDiff    0
ActiveDiff     0
dtype: int64
```

In [40]:
```
df["Month"] = df["Date"].dt.month
```

In [41]:
```
df["Day"] = df["Date"].dt.day
```

In [42]:
```
df
```

Out[42]:

	Date	Confirmed	Recovered	Deaths	Active	ConfirmDiff	DeathsDiff	RecoverDiff	ActiveDiff	Month	Day
0	2020-01-22	0	0	0	0	0.0	0.0	0.0	0.0	1	22
1	2020-01-23	0	0	0	0	0.0	0.0	0.0	0.0	1	23
2	2020-01-24	0	0	0	0	0.0	0.0	0.0	0.0	1	24
3	2020-01-25	3	0	0	3	3.0	0.0	0.0	3.0	1	25
4	2020-01-26	4	0	0	4	1.0	0.0	0.0	1.0	1	26
...	...	...	...	...	...	...	...	...	...	...	...
304	2020-11-21	53679	40493	332	12854	1041.0	3.0	1405.0	-367.0	11	21
305	2020-11-22	54775	41597	335	12843	1096.0	3.0	1104.0	-11.0	11	22
306	2020-11-23	56659	42480	337	13842	1884.0	2.0	883.0	999.0	11	23
307	2020-11-24	58847	44153	341	14353	2188.0	4.0	1673.0	511.0	11	24
308	2020-11-25	59817	46501	345	12971	970.0	4.0	2348.0	-1382.0	11	25

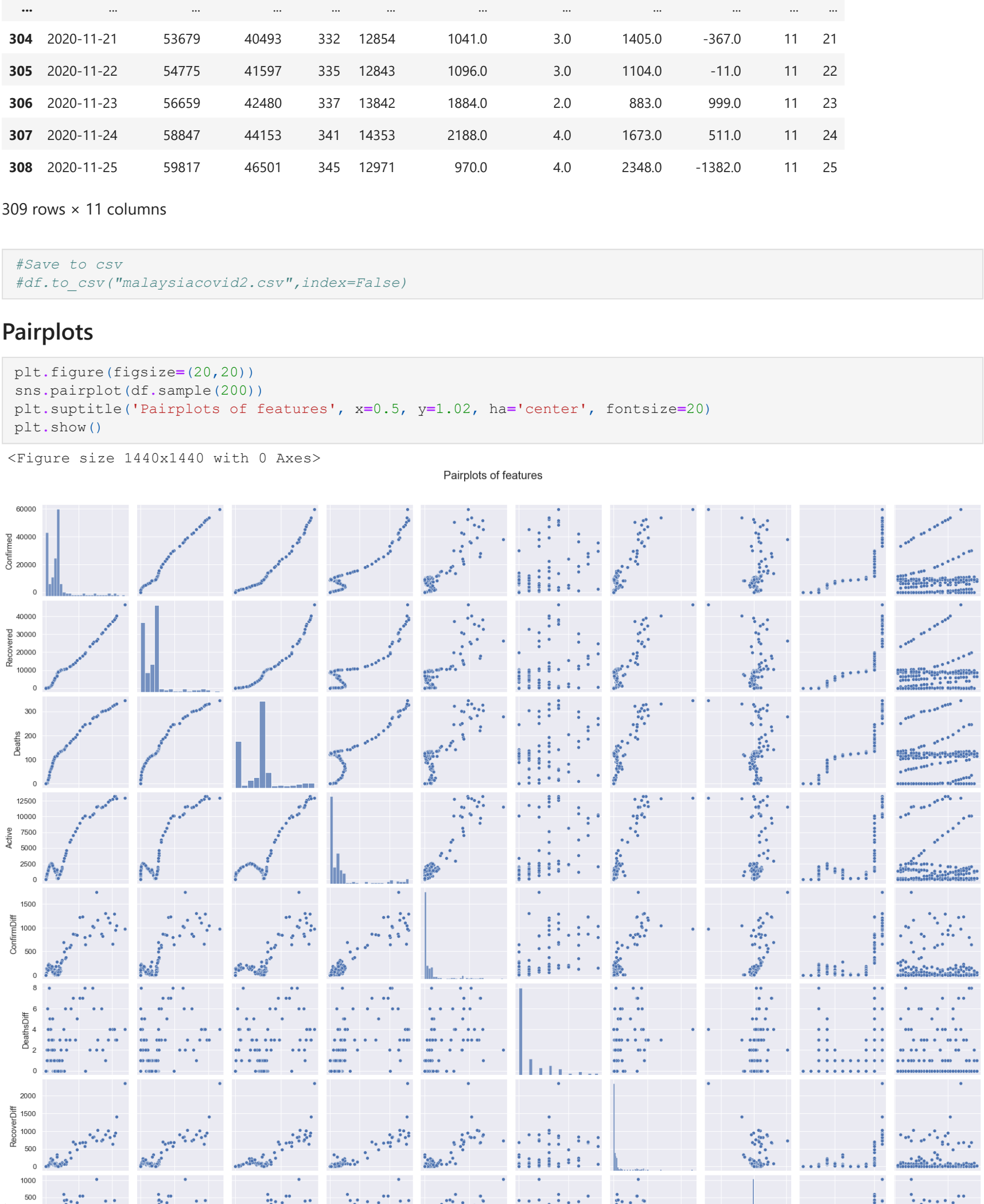
309 rows × 11 columns

In [43]:
```
#Save to csv
#df.to_csv("malaysiacovid2.csv",index=False)
```

Pairplots

In [44]:
```
plt.figure(figsize=(20,20))
sns.pairplot(df.sample(200))
plt.suptitle('Pairplots of features', x=0.5, y=1.02, ha='center', fontsize=20)
plt.show()
```

```
<Figure size 1440x1440 with 0 Axes>
```



Data Visualization (Part 2)

In [45]:
```
df.head()
```

Out[45]:

	Date	Confirmed	Recovered	Deaths	Active	ConfirmDiff	DeathsDiff	RecoverDiff	ActiveDiff	Month	Day
0	2020-01-22	0	0	0	0	0.0	0.0	0.0	0.0	1	22
1	2020-01-23	0	0	0	0	0.0	0.0	0.0	0.0	1	23
2	2020-01-24	0	0	0	0	0.0	0.0	0.0	0.0	1	24
3	2020-01-25	3	0	0	3	3.0	0.0	0.0	3.0	1	25
4	2020-01-26	4	0	0	4	1.0	0.0	0.0	1.0	1	26

In [46]:
```
df.set_index(["Date"],inplace=True)
```

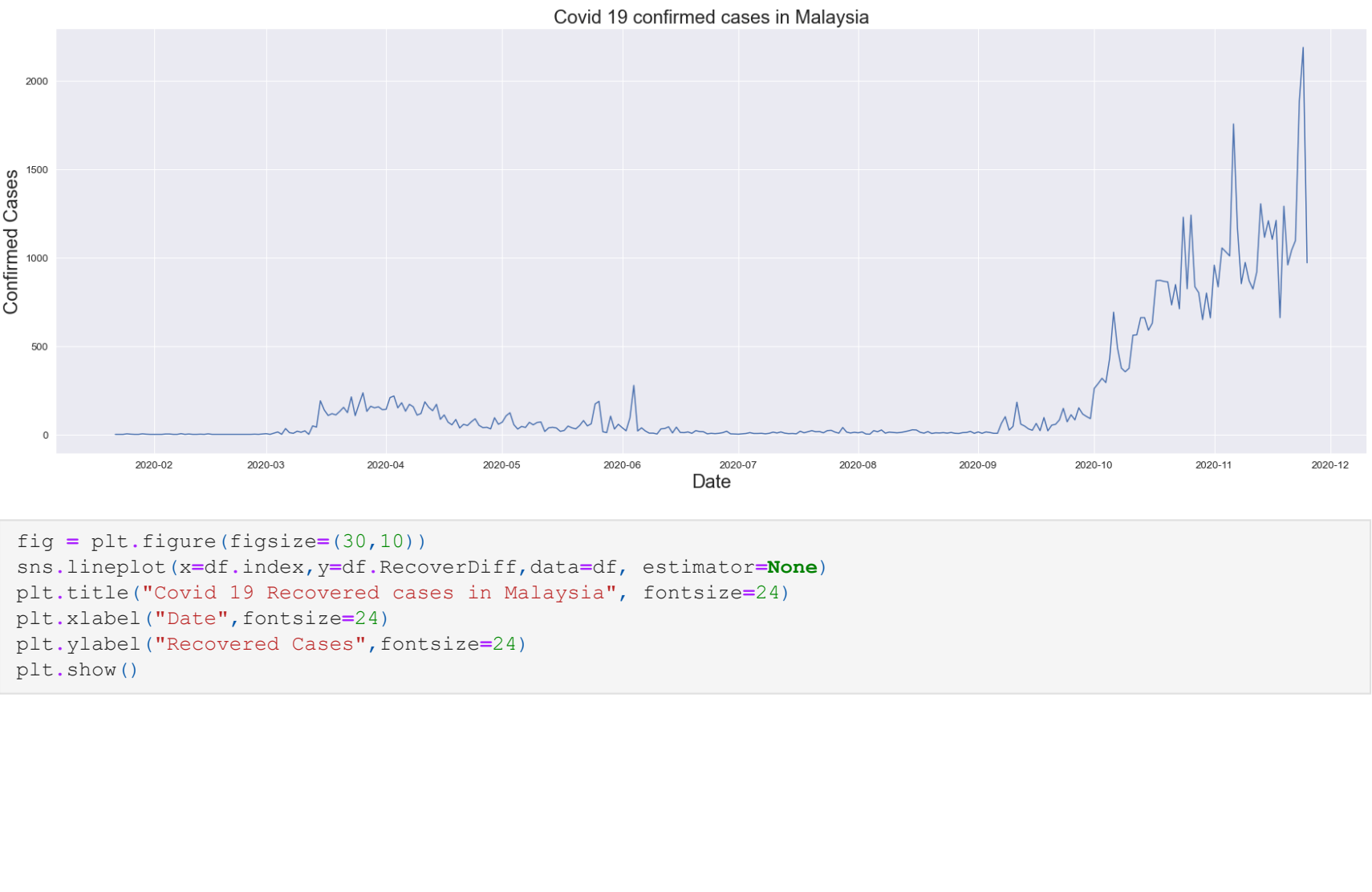
In [47]:
```
df
```

Out[47]:

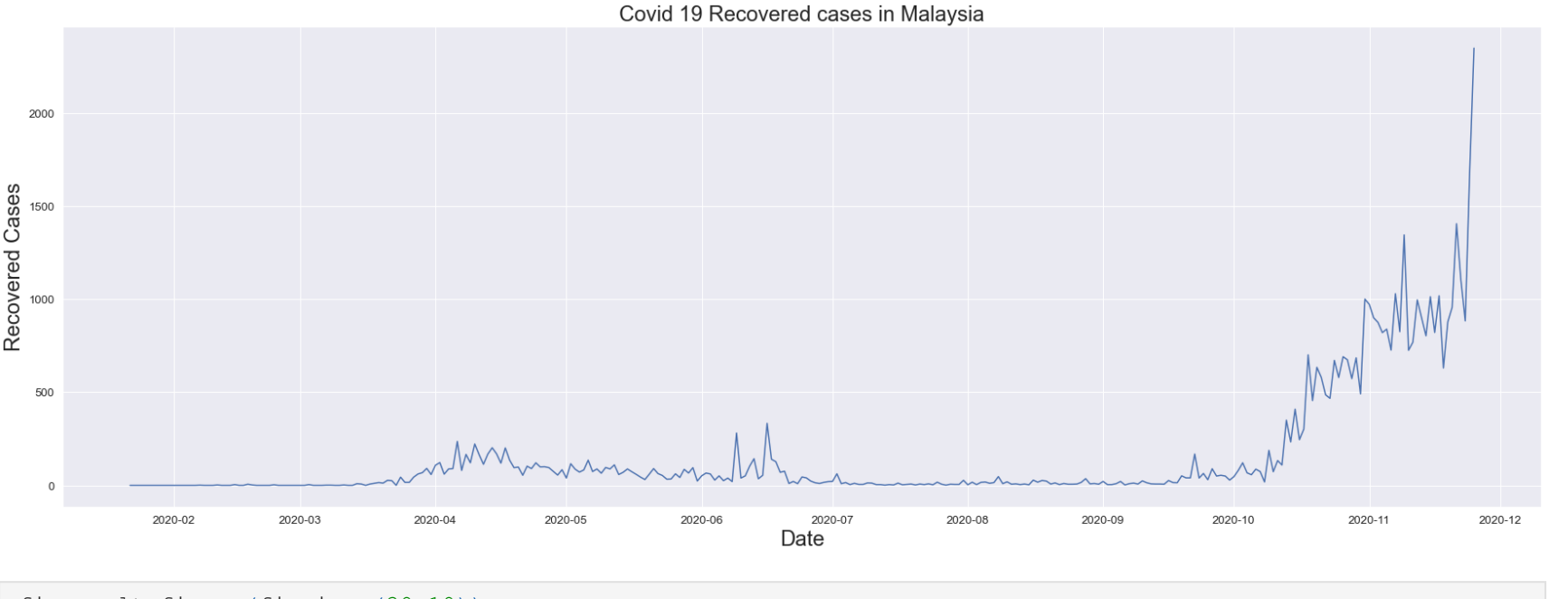
Date	Confirmed	Recovered	Deaths	Active	ConfirmDiff	DeathsDiff	RecoverDiff	ActiveDiff	Month	Day
2020-01-22	0	0	0	0	0.0	0.0	0.0	0.0	1	22
2020-01-23	0	0	0	0	0.0	0.0	0.0	0.0	1	23
2020-01-24	0	0	0	0	0.0	0.0	0.0	0.0	1	24
2020-01-25	3	0	0	3	3.0	0.0	0.0	3.0	1	25
2020-01-26	4	0	0	4	1.0	0.0	0.0	1.0	1	26
...	...	...	...	...	...	...	...	...	...	...
2020-11-21	53679	40493	332	12854	1041.0	3.0	1405.0	-367.0	11	21
2020-11-22	54775	41597	335	12843	1096.0	3.0	1104.0	-11.0	11	22
2020-11-23	56659	42480	337	13842	1884.0	2.0	883.0	999.0	11	23
2020-11-24	58847	44153	341	14353	2188.0	4.0	1673.0	511.0	11	24
2020-11-25	59817	46501	345	12971	970.0	4.0	2348.0	-1382.0	11	25

309 rows × 10 columns

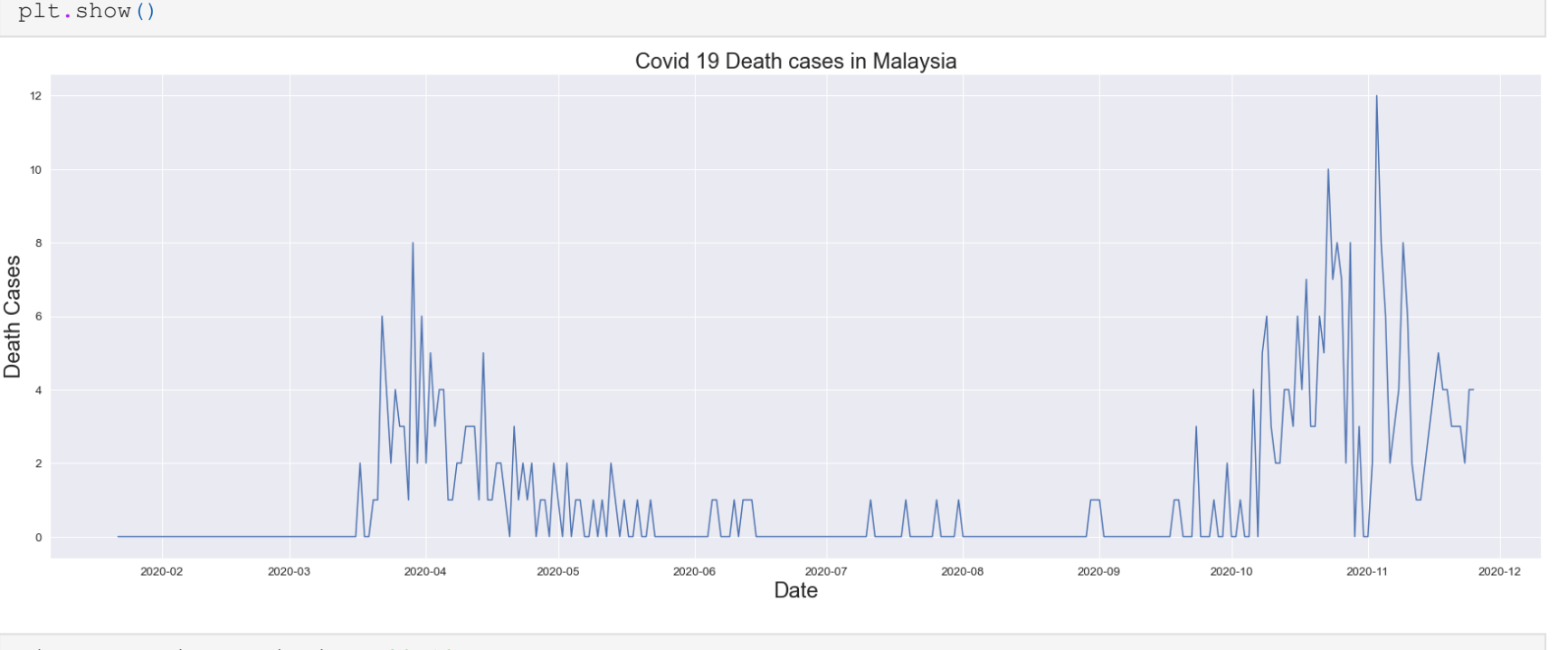
In [48]:
```
fig = plt.figure(figsize=(30,10))
sns.lineplot(x=df.index,y=df.ConfirmDiff,data=df, estimator=None)
plt.title("Covid 19 confirmed cases in Malaysia", fontsize=24)
plt.xlabel("Date",fontsize=24)
plt.ylabel("Confirmed Cases",fontsize=24)
plt.show()
```



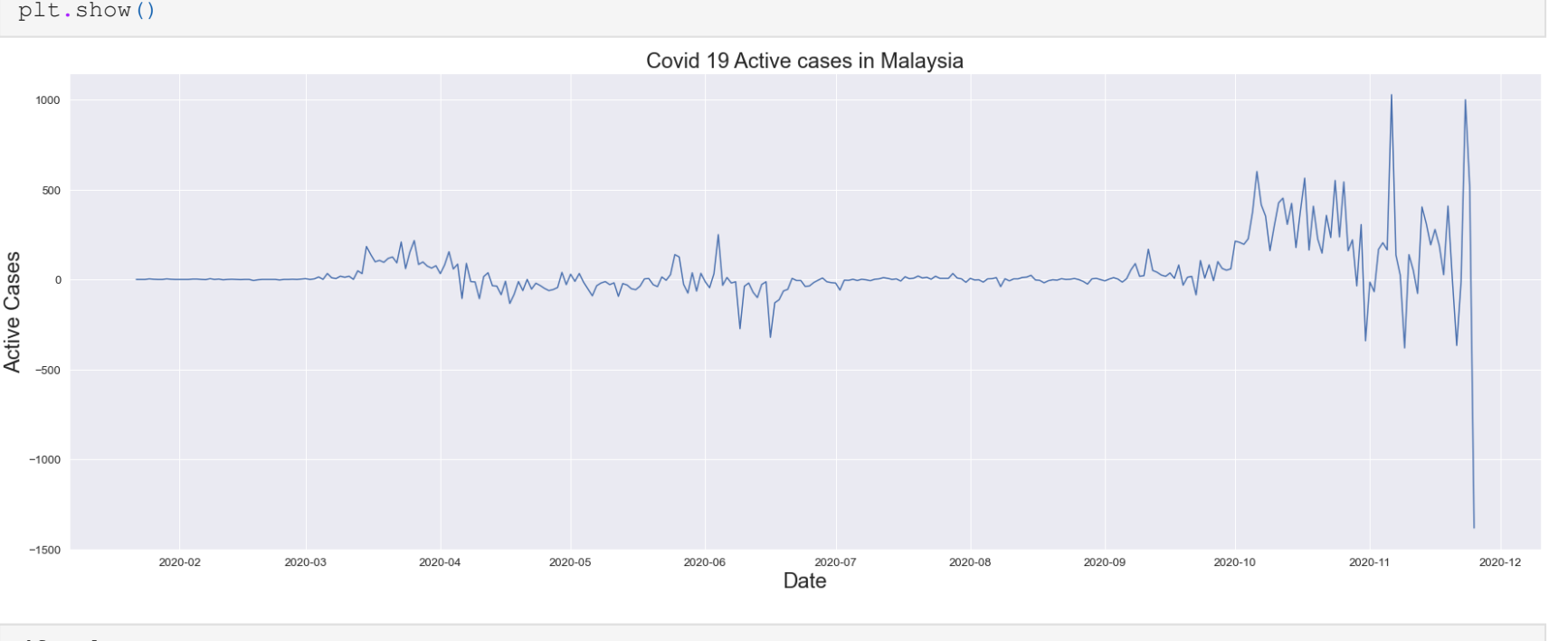
In [49]:
```
fig = plt.figure(figsize=(30,10))
sns.lineplot(x=df.index,y=df.RecoverDiff,data=df, estimator=None)
plt.title("Covid 19 Recovered cases in Malaysia", fontsize=24)
plt.xlabel("Date",fontsize=24)
plt.ylabel("Recovered Cases",fontsize=24)
plt.show()
```



In [50]:
```python
fig = plt.figure(figsize=(30,10))
sns.lineplot(x=df.index,y=df.DeathsDiff,data=df, estimator=None)
plt.title("Covid 19 Death cases in Malaysia", fontsize=24)
plt.xlabel("Date",fontsize=24)
plt.ylabel("Death Cases",fontsize=24)
plt.show()
```



In [51]:
```python
fig = plt.figure(figsize=(30,10))
sns.lineplot(x=df.index,y=df.ActiveDiff,data=df, estimator=None)
plt.title("Covid 19 Active cases in Malaysia", fontsize=24)
plt.xlabel("Date",fontsize=24)
plt.ylabel("Active Cases",fontsize=24)
plt.show()
```



In [52]:
```python
df.columns
```

Out[52]:
```
Index(['Confirmed', 'Recovered', 'Deaths', 'Active', 'ConfirmDiff', 'DeathsDiff', 'RecoverDiff', 'ActiveDif
f', 'Month', 'Day'], dtype='object')
```

In [53]:
```python
df.drop(['Confirmed', 'Recovered', 'Deaths', 'Active'],axis=1, inplace=True)
```

In [54]:
```python
df
```

Out[54]:

Date	ConfirmDiff	DeathsDiff	RecoverDiff	ActiveDiff	Month	Day
2020-01-22	0.0	0.0	0.0	0.0	1	22
2020-01-23	0.0	0.0	0.0	0.0	1	23
2020-01-24	0.0	0.0	0.0	0.0	1	24
2020-01-25	3.0	0.0	0.0	3.0	1	25
2020-01-26	1.0	0.0	0.0	1.0	1	26
...	...	...	...	...	...	...
2020-11-21	1041.0	3.0	1405.0	-367.0	11	21
2020-11-22	1096.0	3.0	1104.0	-11.0	11	22
2020-11-23	1884.0	2.0	883.0	999.0	11	23
2020-11-24	2188.0	4.0	1673.0	511.0	11	24
2020-11-25	970.0	4.0	2348.0	-1382.0	11	25

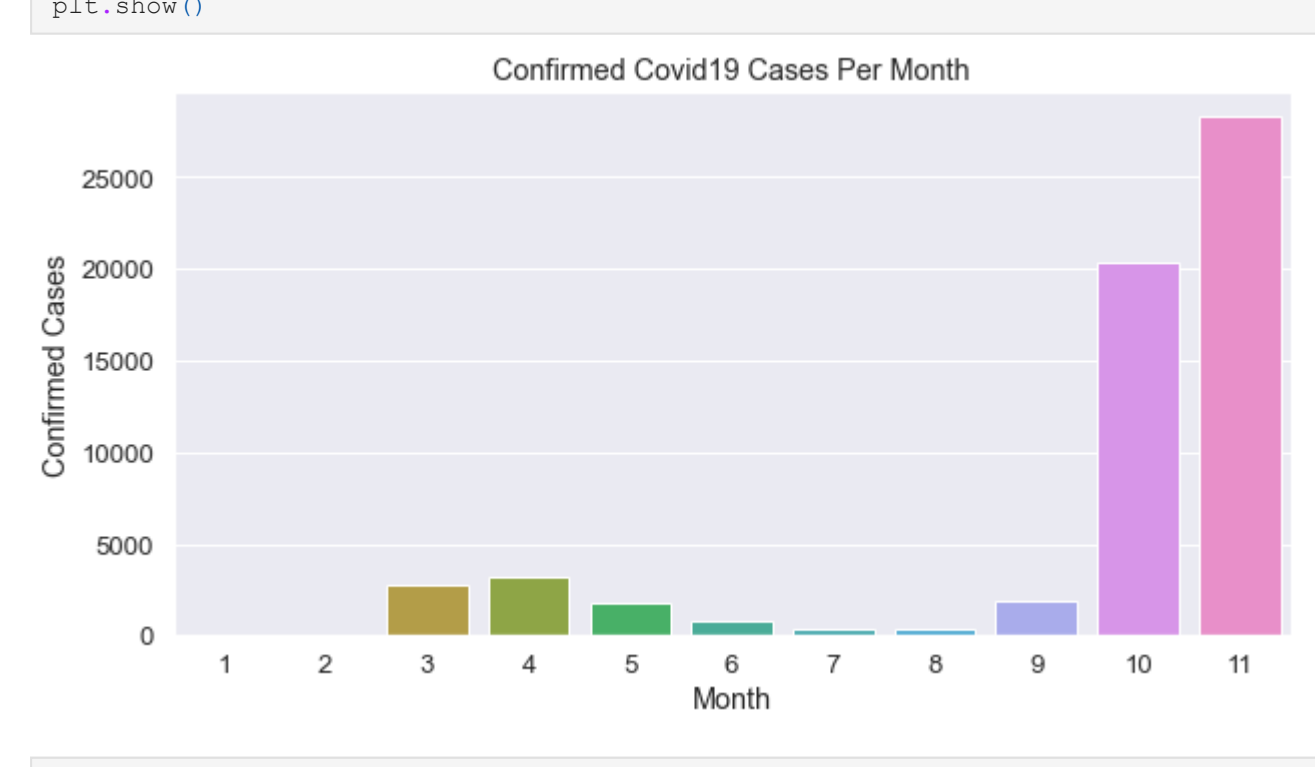
309 rows × 6 columns

In [55]:
```python
df2 = df.groupby("Month")["ConfirmDiff","DeathsDiff","RecoverDiff","ActiveDiff"].sum()
df2
```

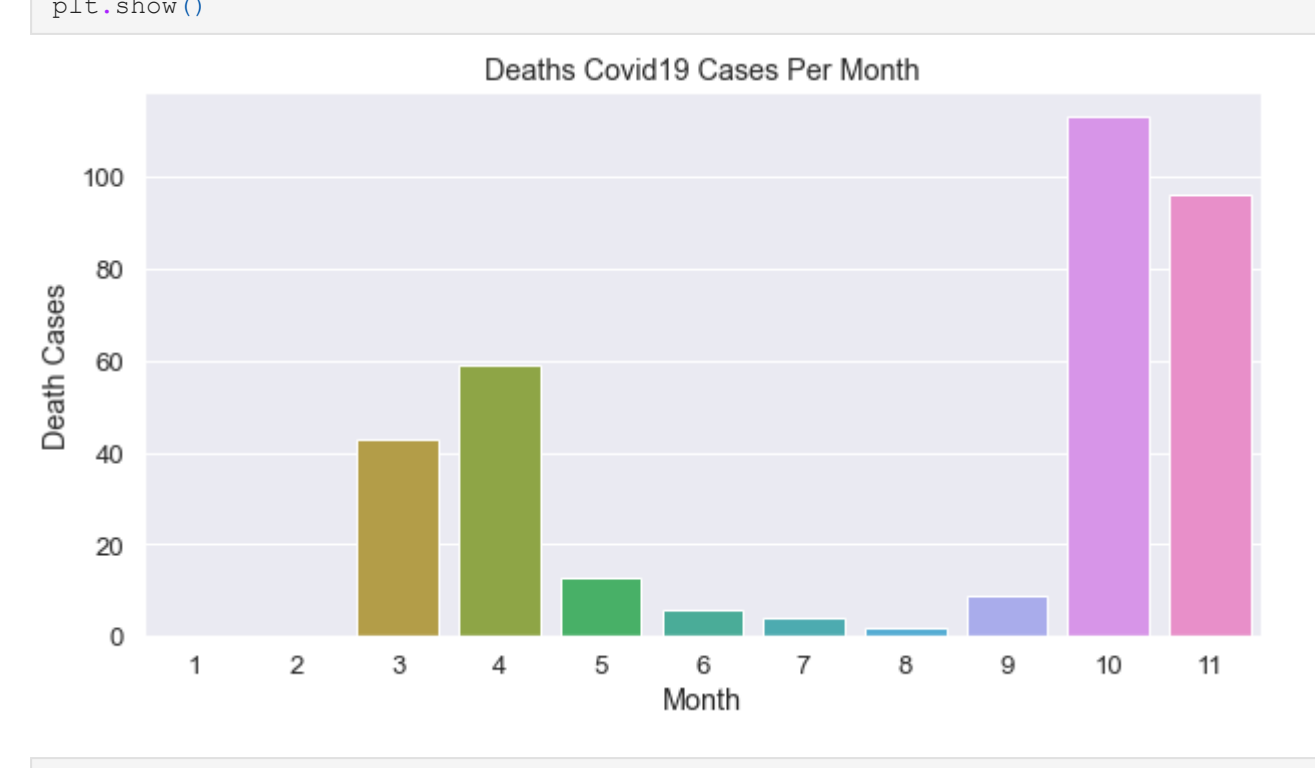
Out[55]:

Month	ConfirmDiff	DeathsDiff	RecoverDiff	ActiveDiff
1	8.0	0.0	0.0	8.0
2	17.0	0.0	18.0	-1.0
3	2741.0	43.0	519.0	2179.0
4	3236.0	59.0	3634.0	-457.0
5	1817.0	13.0	2182.0	-378.0
6	820.0	6.0	2001.0	-1187.0
7	337.0	4.0	290.0	43.0
8	364.0	2.0	410.0	-48.0
9	1884.0	9.0	913.0	962.0
10	20324.0	113.0	11281.0	8930.0
11	28269.0	96.0	25253.0	2920.0

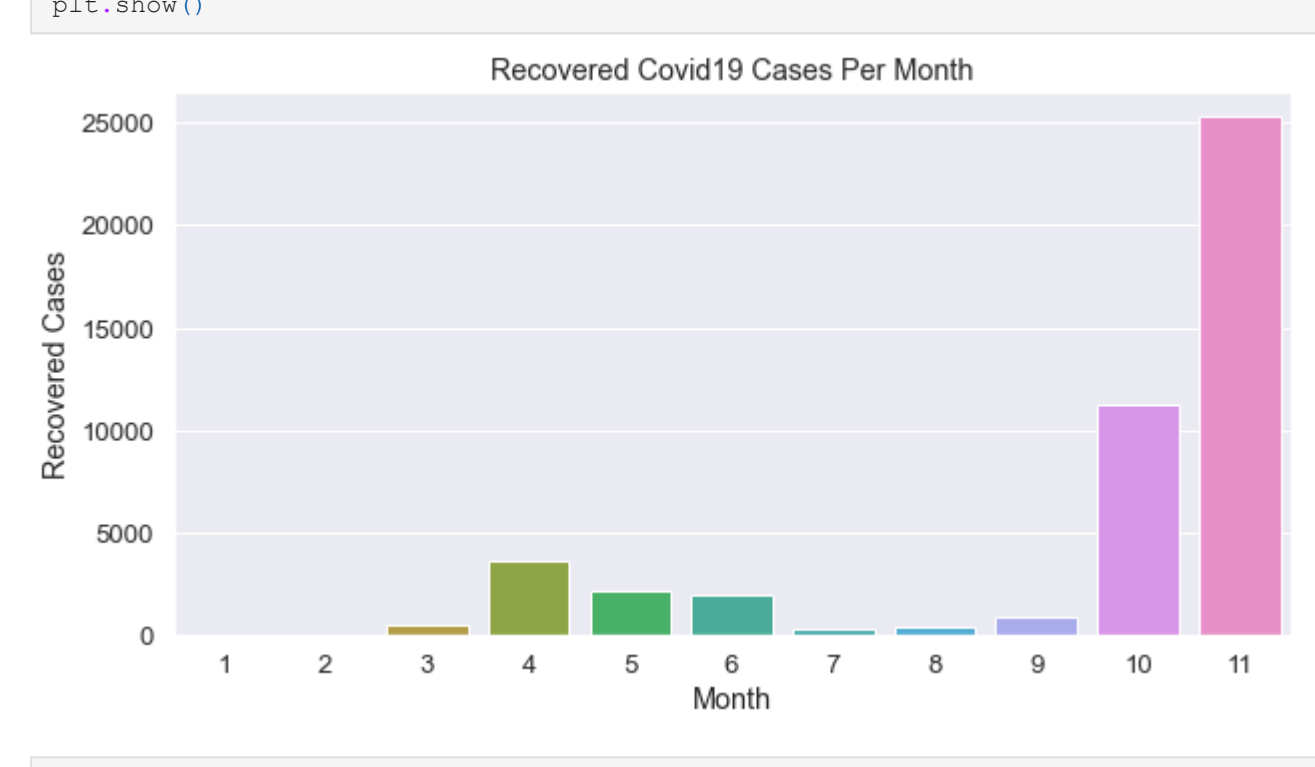
In [56]:
```python
plt.figure(figsize=(10,5))
sns.barplot(x=df2.index,y=df2.ConfirmDiff, data=df2, ci=None, estimator=sum)
plt.title("Confirmed Covid19 Cases Per Month")
plt.xlabel("Month")
plt.ylabel("Confirmed Cases")
plt.show()
```



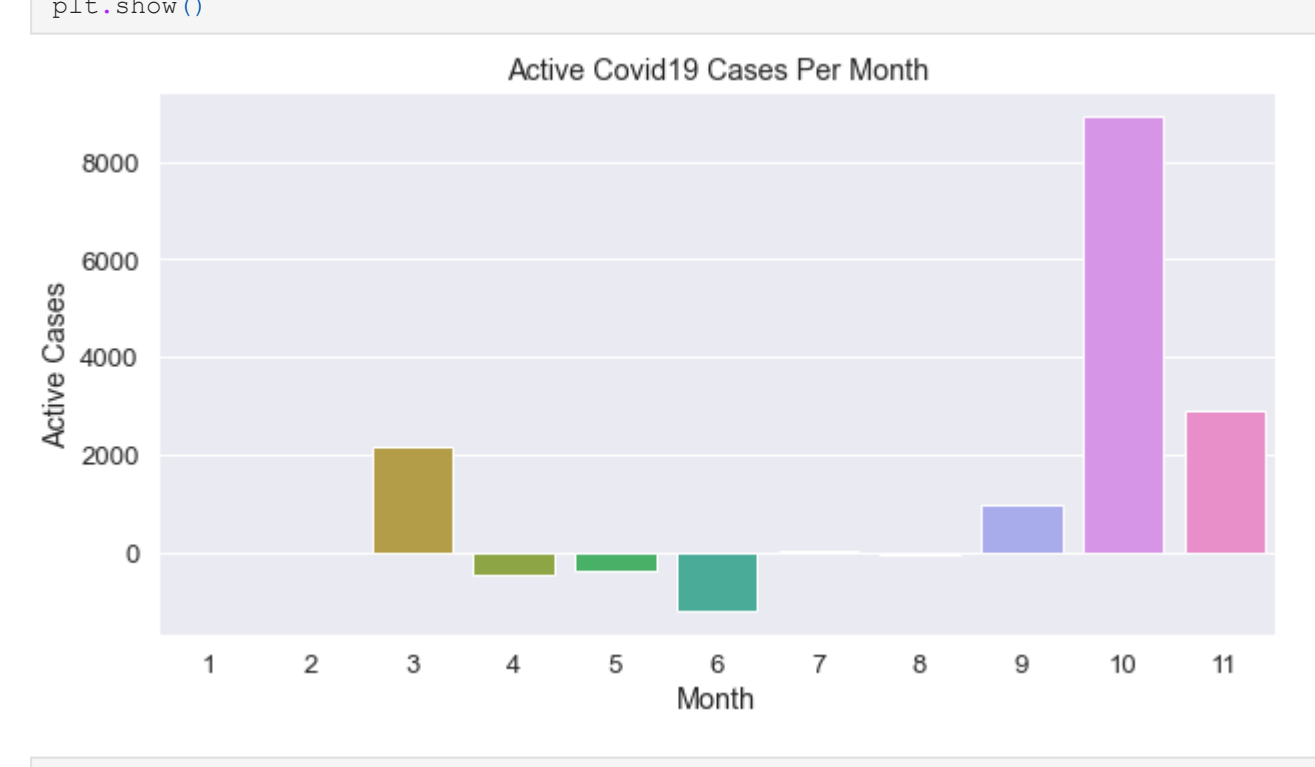
In [57]:
```python
plt.figure(figsize=(10,5))
sns.barplot(x=df2.index,y=df2.DeathsDiff, data=df2, ci=None, estimator=sum)
plt.title("Deaths Covid19 Cases Per Month")
plt.xlabel("Month")
plt.ylabel("Death Cases")
plt.show()
```



In [58]:
```python
plt.figure(figsize=(10,5))
sns.barplot(x=df2.index,y=df2.RecoverDiff, data=df2, ci=None, estimator=sum)
plt.title("Recovered Covid19 Cases Per Month")
plt.xlabel("Month")
plt.ylabel("Recovered Cases")
plt.show()
```



In [59]:
```python
plt.figure(figsize=(10,5))
sns.barplot(x=df2.index,y=df2.ActiveDiff, data=df2, ci=None, estimator=sum)
plt.title("Active Covid19 Cases Per Month")
plt.xlabel("Month")
plt.ylabel("Active Cases")
plt.show()
```

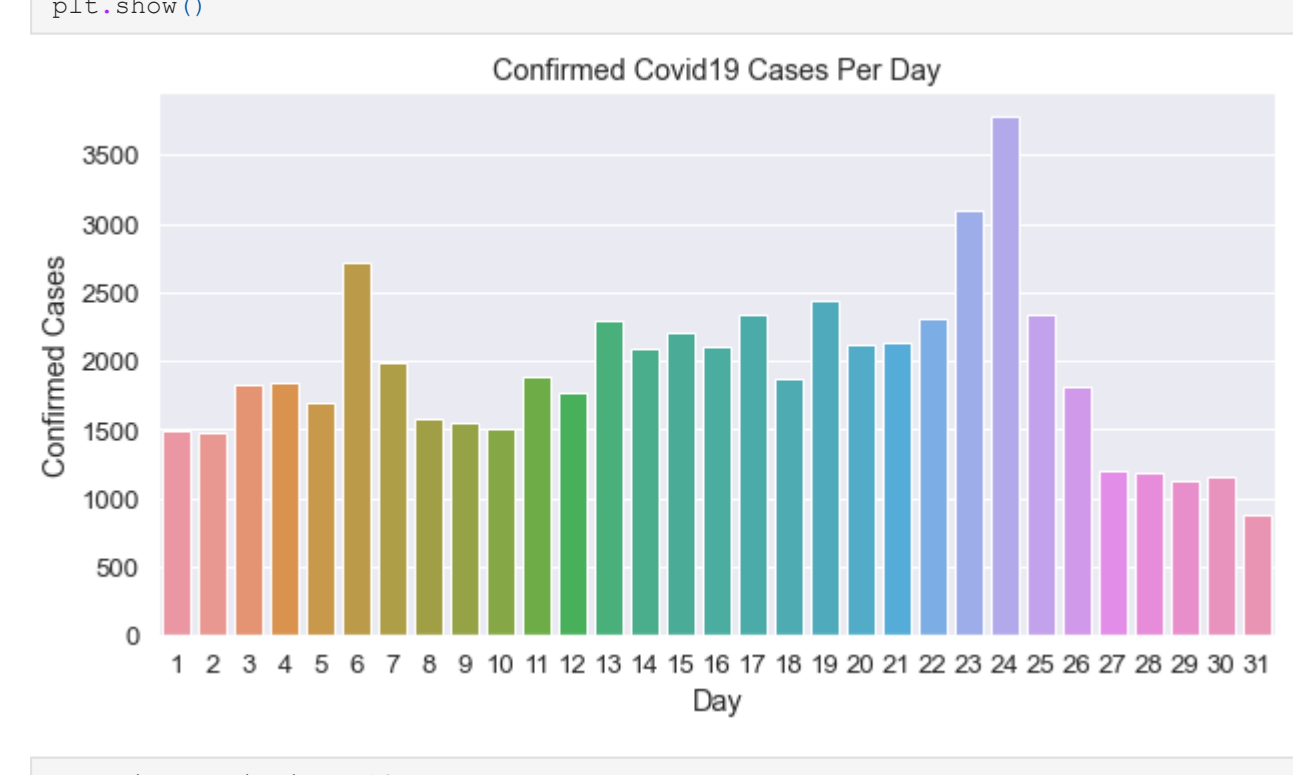


In [60]:
```python
df3 = df.groupby("Day")["ConfirmDiff","DeathsDiff","RecoverDiff","ActiveDiff"].sum()
df3
```

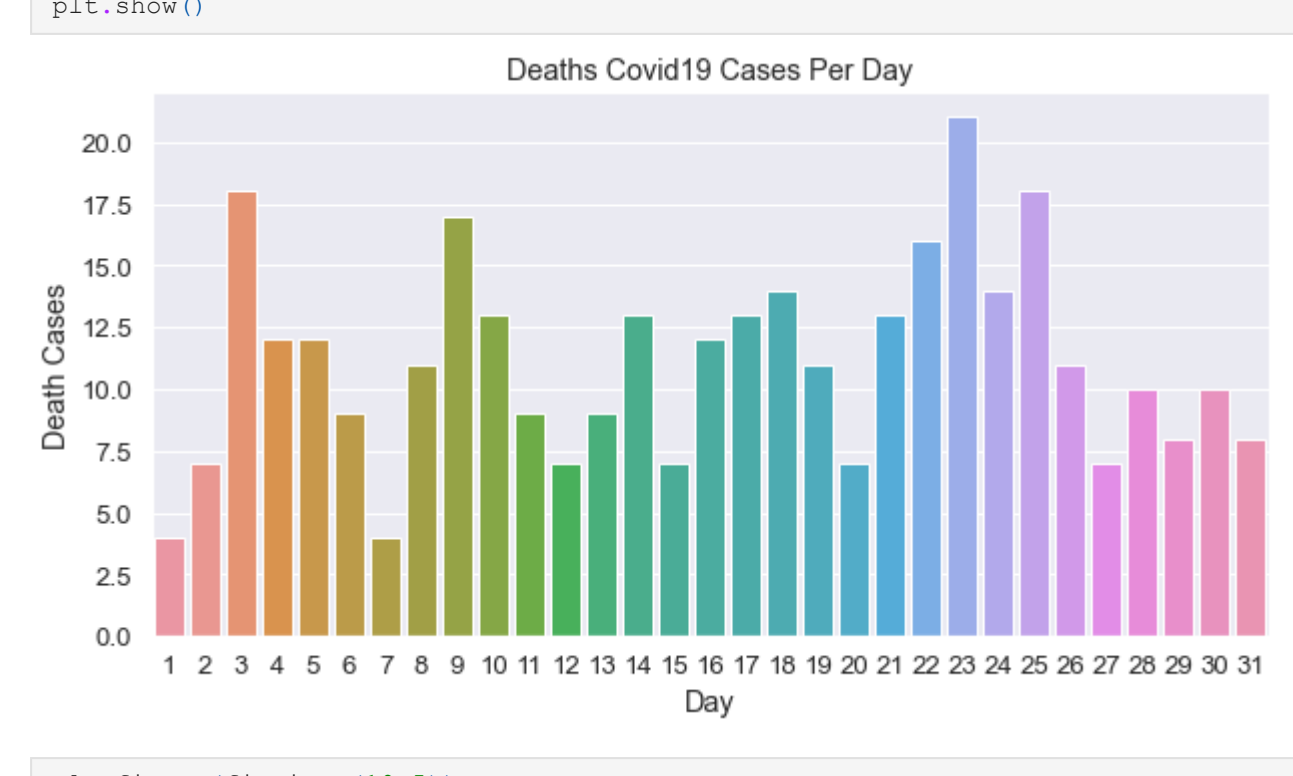
Out[60]:

Day	ConfirmDiff	DeathsDiff	RecoverDiff	ActiveDiff
1	1494.0	4.0	1262.0	228.0
2	1477.0	7.0	1368.0	102.0
3	1831.0	18.0	1225.0	588.0
4	1845.0	12.0	1114.0	719.0
5	1703.0	12.0	1163.0	528.0
6	2718.0	9.0	1233.0	1476.0
7	1988.0	4.0	1327.0	657.0
8	1578.0	11.0	1182.0	385.0
9	1557.0	17.0	2029.0	-489.0
10	1513.0	13.0	1210.0	290.0
11	1887.0	9.0	1234.0	644.0
12	1767.0	7.0	1451.0	309.0
13	2296.0	9.0	1631.0	656.0
14	2088.0	13.0	1370.0	705.0
15	2206.0	7.0	1755.0	444.0
16	2098.0	12.0	1657.0	429.0
17	2338.0	13.0	1762.0	563.0
18	1874.0	14.0	1699.0	161.0
19	2443.0	11.0	1627.0	805.0
20	2116.0	7.0	1885.0	224.0
21	2130.0	13.0	2226.0	-109.0
22	2315.0	16.0	1978.0	321.0
23	3094.0	21.0	1559.0	1514.0
24	3775.0	14.0	2663.0	1098.0
25	2340.0	18.0	3169.0	-847.0
26	1808.0	11.0	994.0	803.0
27	1193.0	7.0	936.0	250.0
28	1183.0	10.0	901.0	272.0
29	1129.0	8.0	953.0	168.0
30	1159.0	10.0	824.0	325.0
31	874.0	8.0	1114.0	-248.0

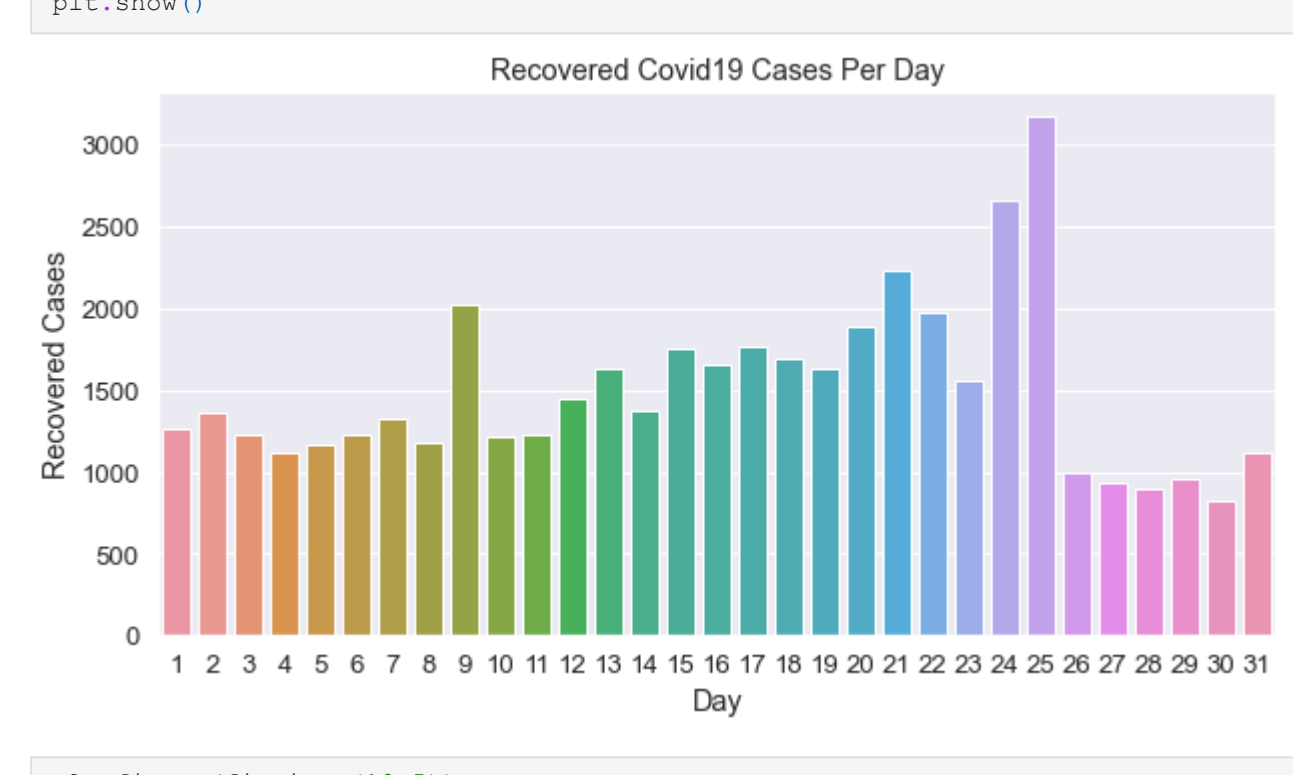
In [61]:
```python
plt.figure(figsize=(10,5))
sns.barplot(x=df3.index,y=df3.ConfirmDiff, data=df3, ci=None, estimator=sum)
plt.title("Confirmed Covid19 Cases Per Day")
plt.xlabel("Day")
plt.ylabel("Confirmed Cases")
plt.show()
```



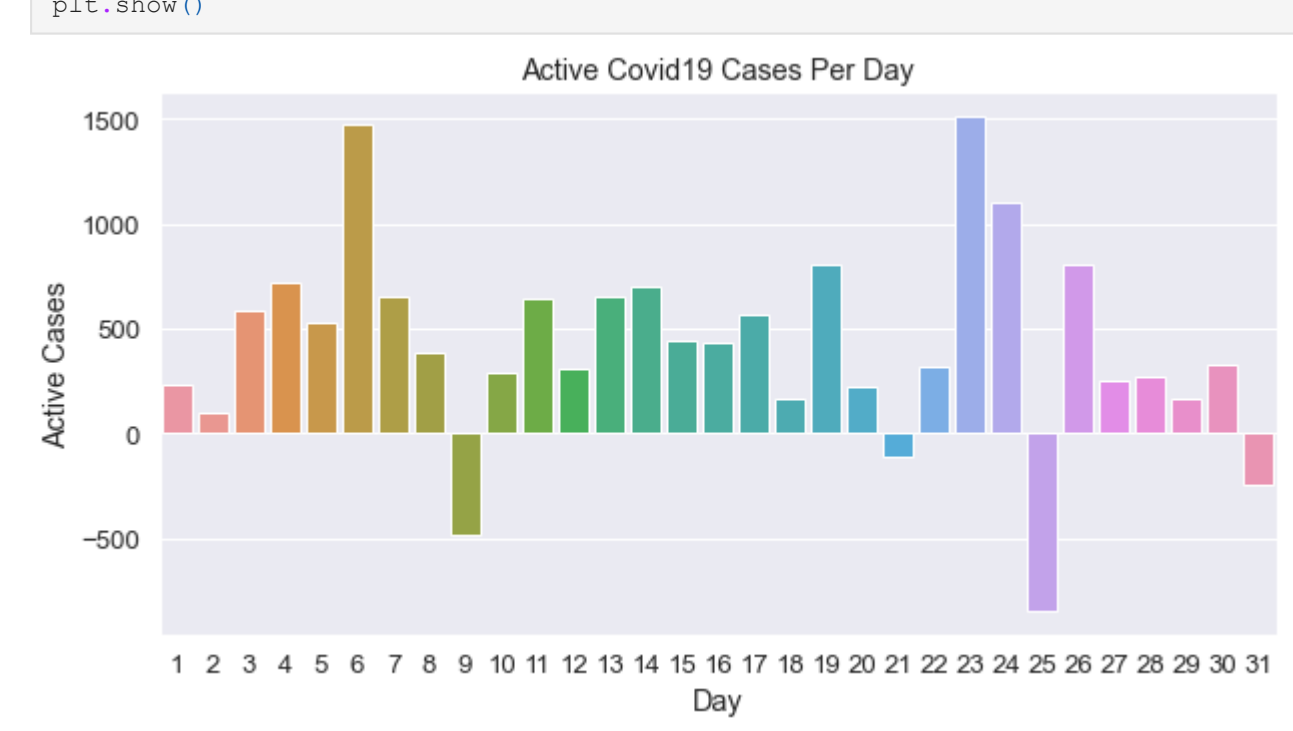
In [62]:
```python
plt.figure(figsize=(10,5))
sns.barplot(x=df3.index,y=df3.DeathsDiff, data=df3, ci=None, estimator=sum)
plt.title("Deaths Covid19 Cases Per Day")
plt.xlabel("Day")
plt.ylabel("Death Cases")
plt.show()
```



In [63]:
```python
plt.figure(figsize=(10,5))
sns.barplot(x=df3.index,y=df3.RecoverDiff, data=df3, ci=None, estimator=sum)
plt.title("Recovered Covid19 Cases Per Day")
plt.xlabel("Day")
plt.ylabel("Recovered Cases")
plt.show()
```



In [64]:
```python
plt.figure(figsize=(10,5))
sns.barplot(x=df3.index,y=df3.ActiveDiff, data=df3, ci=None, estimator=sum)
plt.title("Active Covid19 Cases Per Day")
plt.xlabel("Day")
plt.ylabel("Active Cases")
plt.show()
```



In [65]:
```python
df.head()
```

Out[65]:

Date	ConfirmDiff	DeathsDiff	RecoverDiff	ActiveDiff	Month	Day
2020-01-22	0.0	0.0	0.0	0.0	1	22
2020-01-23	0.0	0.0	0.0	0.0	1	23
2020-01-24	0.0	0.0	0.0	0.0	1	24
2020-01-25	3.0	0.0	0.0	3.0	1	25
2020-01-26	1.0	0.0	0.0	1.0	1	26

Correlation

In [66]:
```python
df.corr()
```

Out[66]:

	ConfirmDiff	DeathsDiff	RecoverDiff	ActiveDiff	Month	Day
ConfirmDiff	1.000000	0.641523	0.875959	0.517088	0.604269	0.002108
DeathsDiff	0.641523	1.000000	0.561145	0.326380	0.341420	0.035592
RecoverDiff	0.875959	0.561145	1.000000	0.040080	0.545945	0.027499
ActiveDiff	0.517088	0.326380	0.040080	1.000000	0.283484	-0.044819
Month	0.604269	0.341420	0.545945	0.283484	1.000000	-0.098535
Day	0.002108	0.035592	0.027499	-0.044819	-0.098535	1.000000

In [67]:
```python
plt.figure(figsize=(16,9))
sns.heatmap(df.corr(),cmap="coolwarm",annot=True,fmt='.2f',linewidths=2)
plt.show()
```