Covid

October 17, 2020

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

0.0.1 firstly, let´s check the dataframe structure

```
[160]: df= pd.read_csv("covid-19-uk-historical-data.csv")
       df
```

```
[160]:        Unnamed: 0        date   country   areacode              area  \
       0               0  2020-01-30   England  E06000014              York
       1               1  2020-02-03   England  E10000002   Buckinghamshire
       2               2  2020-02-03     Wales  W11000028     Aneurin Bevan
       3               3  2020-02-03     Wales  W11000023   Betsi Cadwaladr
       4               4  2020-02-03     Wales  W11000029  Cardiff and Vale
       …           …         …       …        …               …
       23293       23293  2020-07-29  Scotland  S08000024           Lothian
       23294       23294  2020-07-29  Scotland  S08000025            Orkney
       23295       23295  2020-07-29  Scotland  S08000026          Shetland
       23296       23296  2020-07-29  Scotland  S08000030           Tayside
       23297       23297  2020-07-29  Scotland  S08000028     Western Isles

              totalcases
       0             1.0
       1             1.0
       2             0.0
       3             0.0
       4             0.0
       …           …
       23293      3192.0
       23294         9.0
       23295        54.0
       23296      1785.0
       23297         7.0
```

```
[23298 rows x 6 columns]
```

[161]:

```
date_lst=[]

for date in df.date:

    date=datetime.strptime(date, "%Y-%m-%d")
    date_lst.append(date)
df["datetime"]=date_lst



def find_days(df):
    days_lst=[0]
    m=0
    n=0
    for days in df["datetime"]:

            m+=1

            if m<df.shape[0]:

                delta=df["datetime"][m]-df["datetime"][n]
                n+=1

                #print(delta)
                #print(delta.days)
                days_lst.append(delta.days)
            else:
                break
    df["days"] = days_lst


find_days(df)
```

[162]:

```
df.days= df.datetime - df.datetime[0]    # simplest way to find intervals! No␣
 ↪function required, no for cycles no df.apply() etc
```

[163]:

```
time_range= df.datetime[df.shape[0]-1]-df.datetime[0]    #This trick is amazing␣
 ↪to avoid having a Series as a result. Not sure why it works

"this will be used for plotting later: "

tot_days= time_range.days
```

lockdown was imposed on the 23rd of March 2020, 23-03-2020

[361]:

```
df[df["date"]=="2020-04-09"].head(1)
```

[361]:

```
      Unnamed: 0        date  country   areacode                  area  \
5525        5525  2020-04-09  England  E09000002  Barking and Dagenham

      totalcases   datetime    days
5525       337.0 2020-04-09 70 days
```

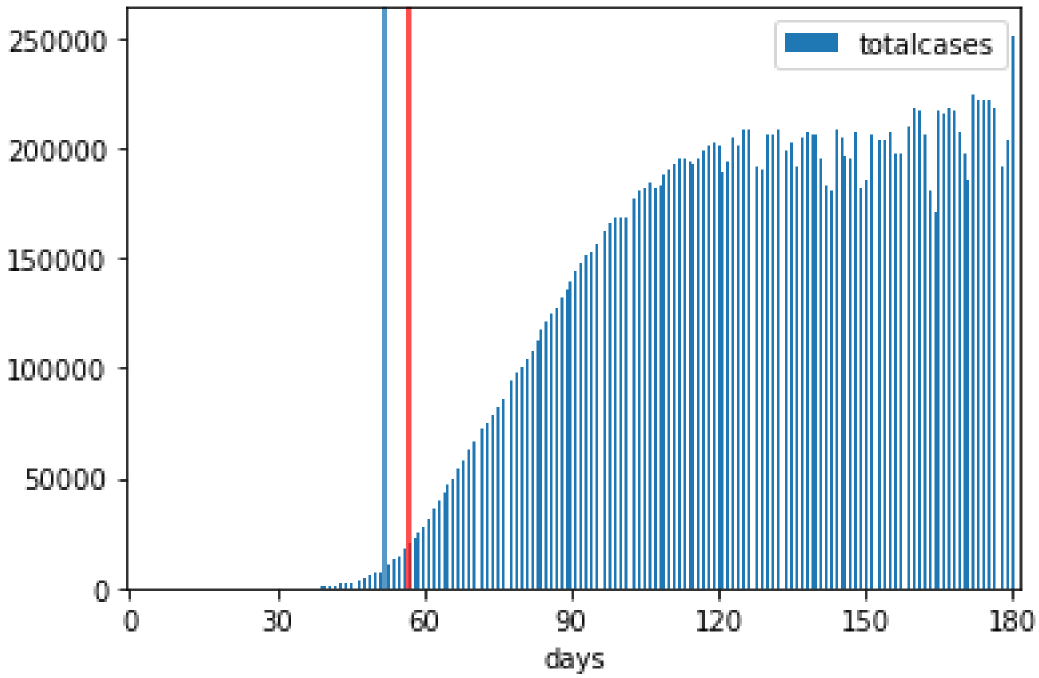
Lockdown began on day 52!

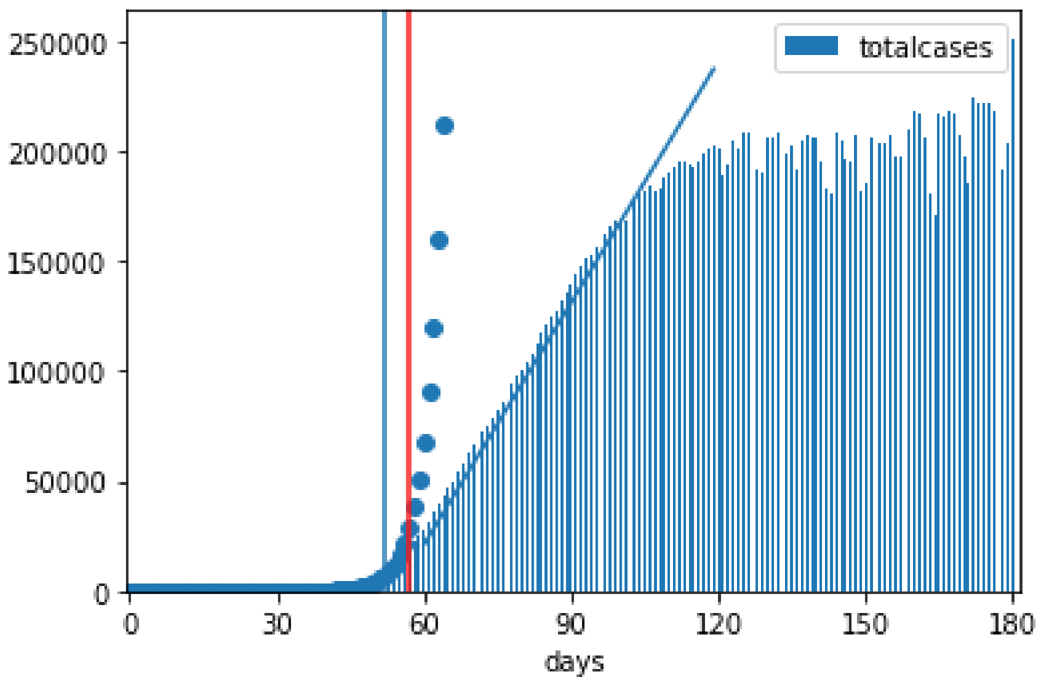
[363]:

```
England_df= df[df["country"]== "England"]

Scotland_df= df[df["country"]== "Scotland"]

Wales_df= df[df["country"]== "Wales"]

NI_df= df[df["country"]== "Northern Ireland"]



def get_total(df,d):     # d is the number of days to use to make predictions␣
 ↪using the machine learning model


    days=[]
    total_cases=[]
    for n in range(182):
        tot= df[df["days"] ==pd.Timedelta(n, unit='d') ].totalcases.sum()
        days.append(n)
        total_cases.append(tot)

    new_df= pd.DataFrame({"days": days,"totalcases": total_cases})
    new_df.plot(kind='bar',x='days',y='totalcases', xticks=range(0,182,30),␣
 ↪rot=0)

    plt.axvline(x=52)


    """the buffer period has been included to show possible delay in how the␣
 ↪measures affected transmission,
    namely up to 5 days after the lockdown started,
    the registered cases were still of infections occurred before the lockdown␣
 ↪itself"""
```

```
    plt.axvline(x=57, color='#ff1414') # a buffer period of 10 days has been considered



    '''MACHINE LEARNING PART WITH SCI-KIT LEARN '''
    '''MACHINE LEARNING PART WITH SCI-KIT LEARN '''


    Y_1= new_df[new_df["days"] < 57 ]
    Y_1= Y_1.totalcases
    Y_1= Y_1 + 0.01 # get rid of zeroes
    Y_1= np.log(Y_1)# to make it "fittable" with linear regression

    Y_2= new_df[new_df["days"] < 90 ][new_df["days"] > 57 ]
    Y_2= Y_2.totalcases


    'X used to train:'

    X_1=np.array(range(57))
    X_2=np.array(range(32))

    X_1=X_1.reshape(-1, 1)
    X_2=X_2.reshape(-1, 1)


    linear_1=LinearRegression()
    linear_2=LinearRegression()
    model_1=linear_1.fit(X_1,Y_1)
    model_2=linear_2.fit(X_2,Y_2)


    'X used to predict:'

    X_pred_2= np.array(range(60))
    X_pred_2= X_pred_2.reshape(-1, 1)

    X_pred_1= np.array(range(d))
    X_pred_1= X_pred_1.reshape(-1, 1)


    pred_1=model_1.predict(X_pred_1) #I expect this to be exponential
    pred_2=model_2.predict(X_pred_2) #I expect this to be linear

    ''' END OF THE MACHINE LEARNING PART '''
    ''' END OF THE MACHINE LEARNING PART '''
    pred_1= np.exp(pred_1)



    "Same code as before just to duplicate plot"
    new_df.plot(kind='bar',x='days',y='totalcases', xticks=range(0,182,30),␣
 ↪rot=0)
    plt.axvline(x=52)
    plt.axvline(x=57, color='#ff1414')
    "END"

    plt.scatter(np.array(range(d)),pred_1)

    #print(model_2.get_params())
    plt.plot(np.array(range(60,120)),pred_2)

    return new_df

total_England_df= get_total(England_df, 65)
```

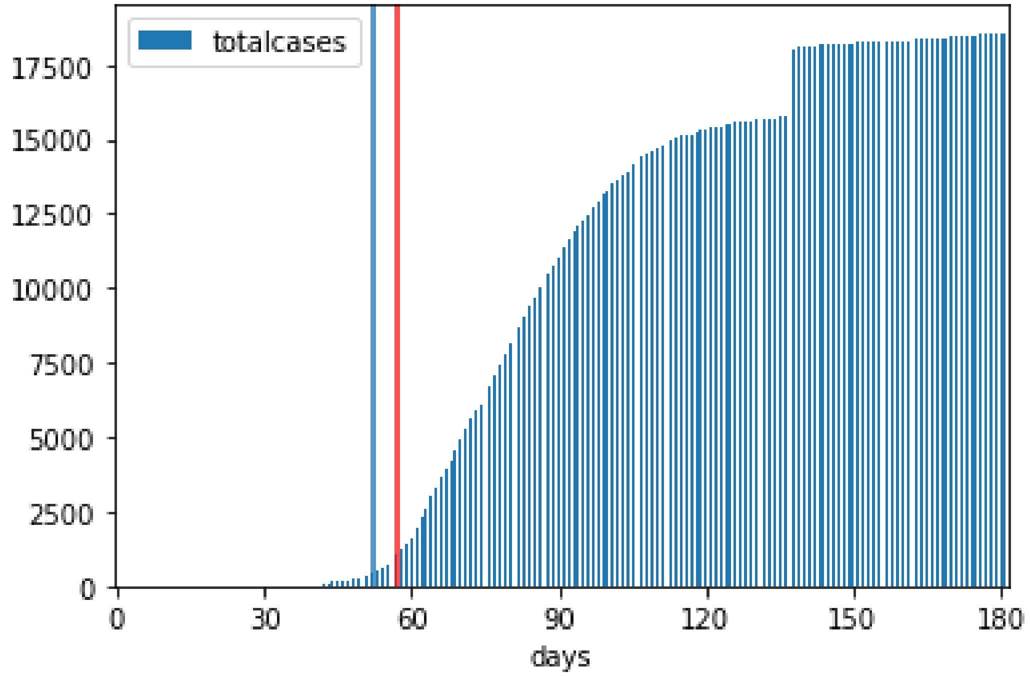
```
<ipython-input-363-60769bac4ae3>:44: UserWarning: Boolean Series key will be
reindexed to match DataFrame index.
  Y_2= new_df[new_df["days"] < 90 ][new_df["days"] > 57 ]
```

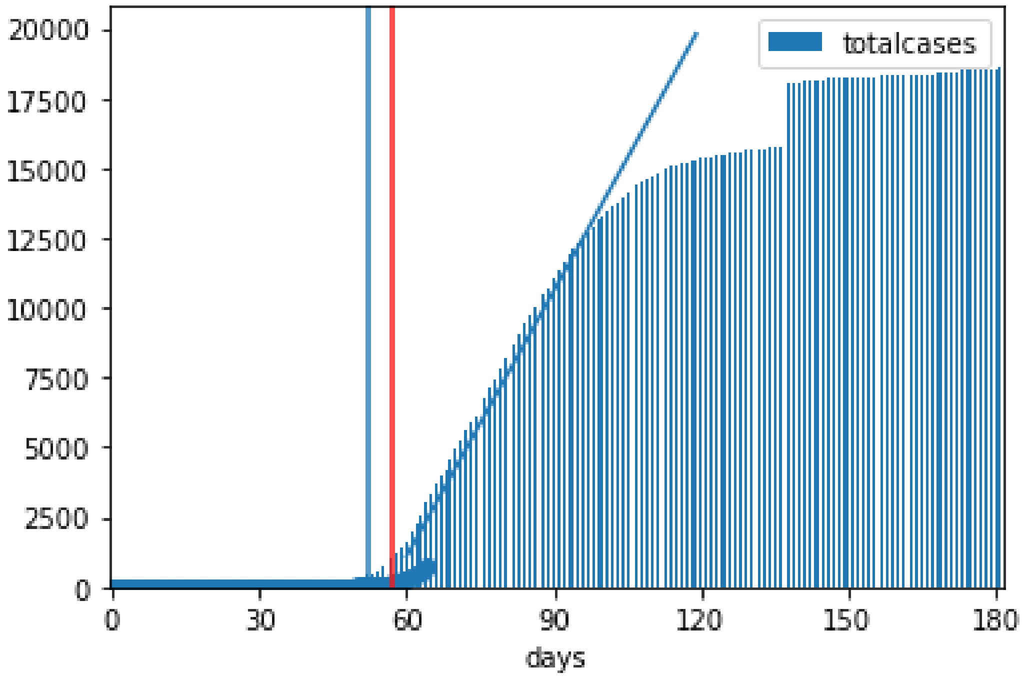




```
[350]: total_Scotland_df= get_total(Scotland_df,65)
```

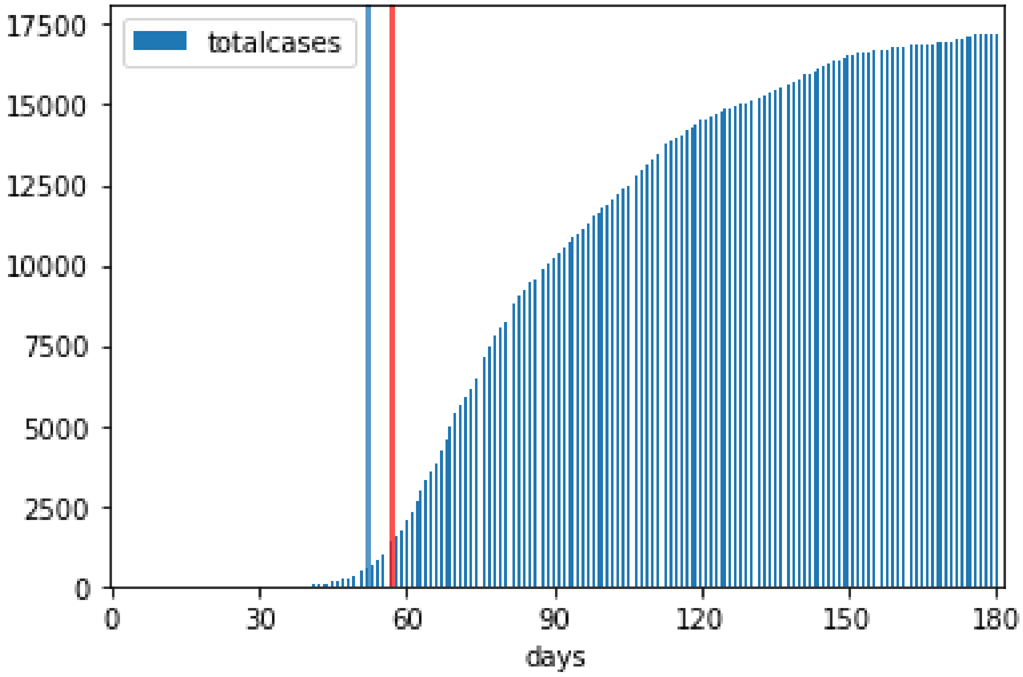
```
<ipython-input-347-1a57a89acc89>:44: UserWarning: Boolean Series key will be
reindexed to match DataFrame index.
  Y_2= new_df[new_df["days"] < 90 ][new_df["days"] > 57 ]
```

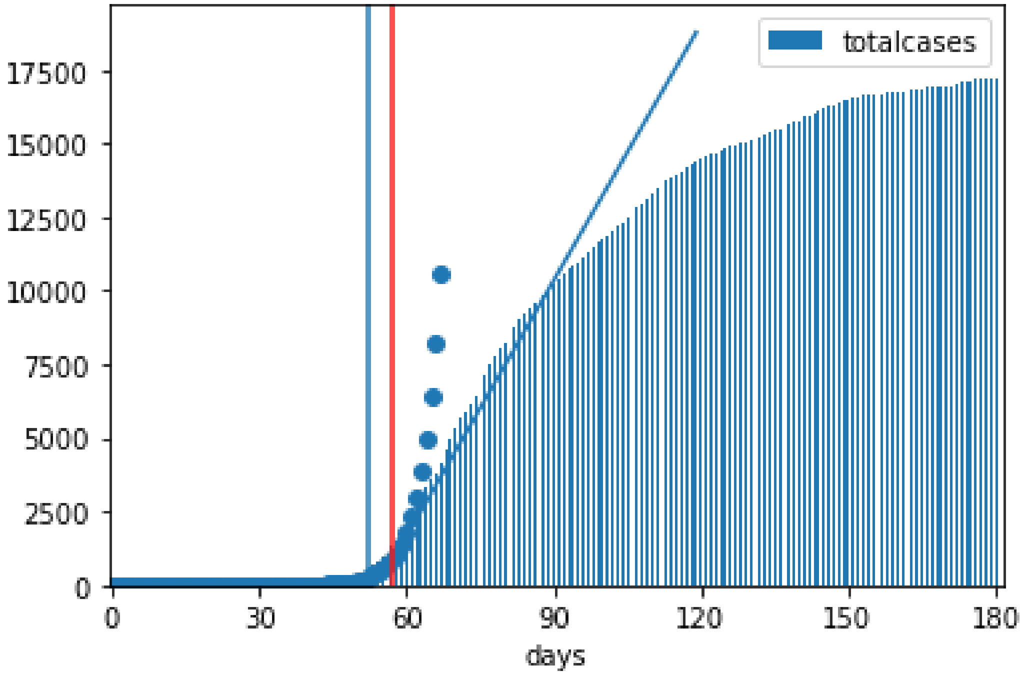




```
[352]: total_Wales_df= get_total(Wales_df, 68)
```

```
<ipython-input-347-1a57a89acc89>:44: UserWarning: Boolean Series key will be
reindexed to match DataFrame index.
  Y_2= new_df[new_df["days"] < 90 ][new_df["days"] > 57 ]
```

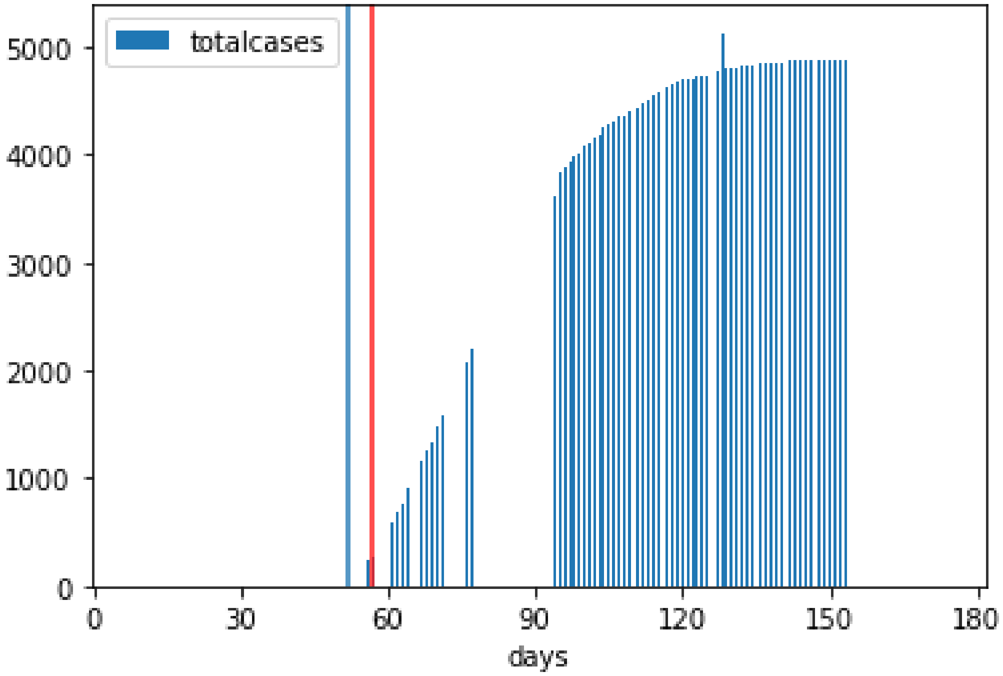


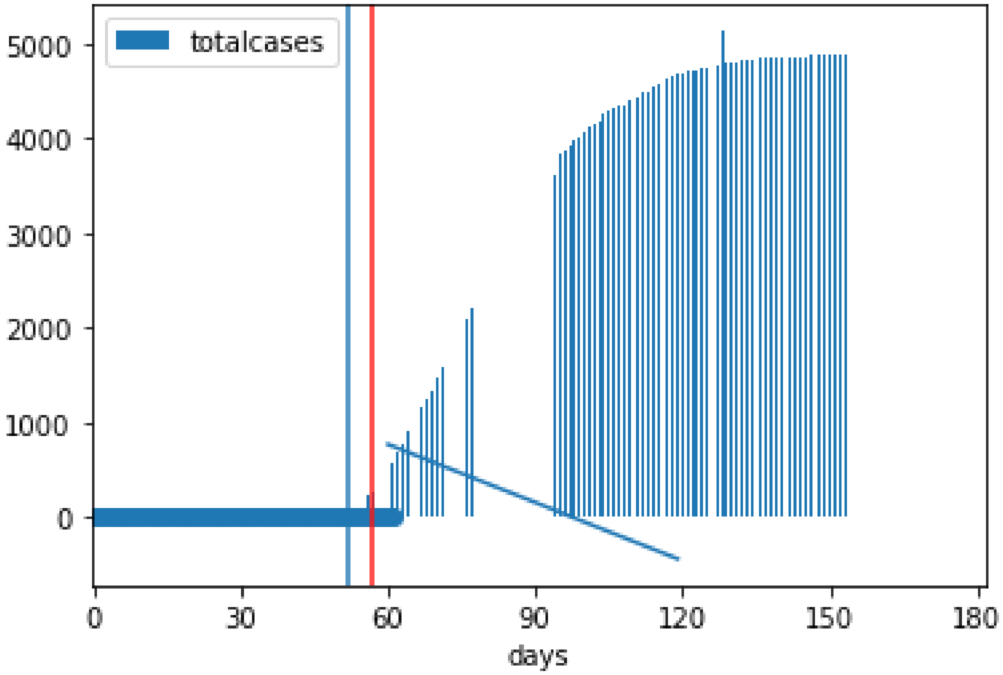


[341]:
```
total_NI_df= get_total(NI_df)
```

```
<ipython-input-338-445e17944fa8>:44: UserWarning: Boolean Series key will be
```

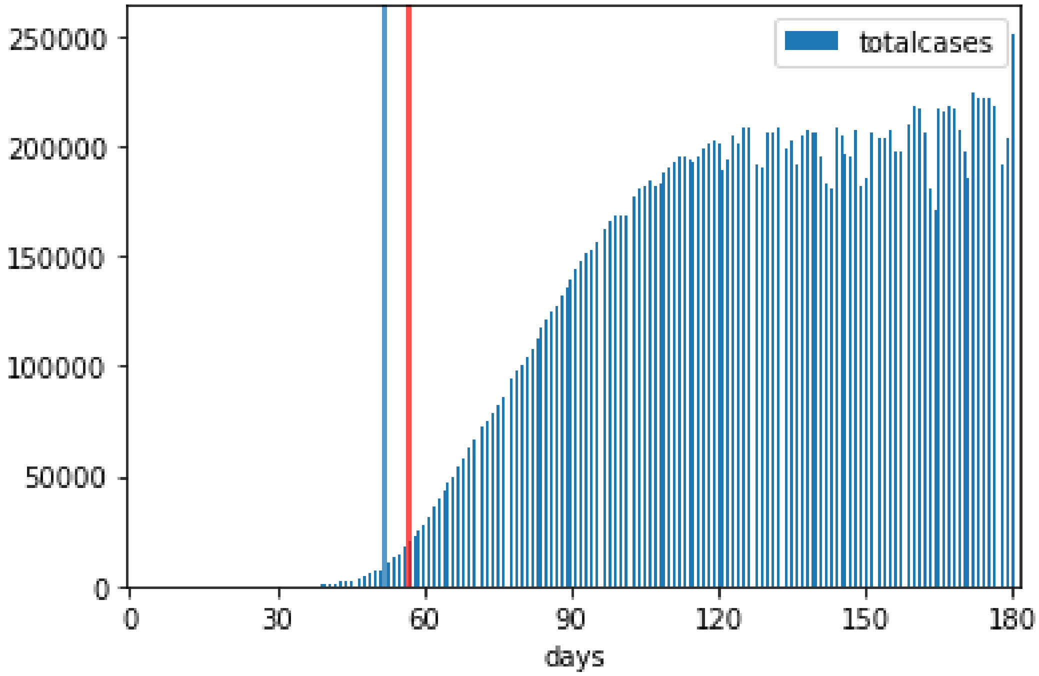
```
reindexed to match DataFrame index.
  Y_2= new_df[new_df["days"] < 90 ][new_df["days"] > 57 ]
```

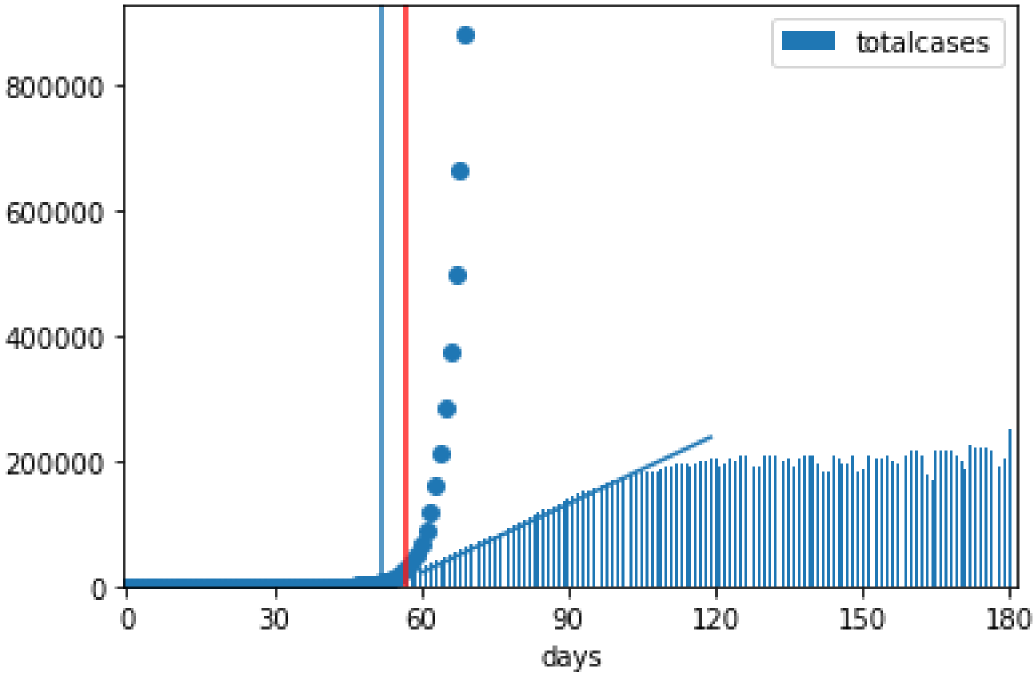




[364]:
```
total_England_df= get_total(England_df, 70)  #let´s check the exponential␣
↪progression at day 70
```

```
<ipython-input-363-60769bac4ae3>:44: UserWarning: Boolean Series key will be
reindexed to match DataFrame index.
  Y_2= new_df[new_df["days"] < 90 ][new_df["days"] > 57 ]
```





According to the model, more than the current total amount of cases in the whole of the UK would have been reached on day 70, which corresponds to the 9th of April 2020 if the virus kept spreading exponentially. Obviously immunity and other factors would have slowed down the spread if compared to the beginning of the pandemic and **it is important to note that data at the beginning of the pandemic were highly unrealiable due to the small number of tests!!**

```
[ ]:
```