In [1]:
```
# !pip install plotly
# !pip install calmap
# !pip install cufflinks
# !pip install pycountry_convert
# !pip install folium
# !pip install keras
# !pip install tensorflow
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from matplotlib import ticker
import pycountry_convert as pc
import folium
import branca
from datetime import datetime, timedelta,date
from scipy.interpolate import make_interp_spline, BSpline
import plotly.express as px
import json, requests
import calmap

from keras.layers import Input, Dense, Activation, LeakyReLU
from keras import models
from keras.optimizers import RMSprop, Adam

%matplotlib inline
```

```
Using TensorFlow backend.
```

In [2]:
```
df_confirmed = pd.read_csv('https://raw.githubusercontent.com/CSSEGISandDat
df_deaths = pd.read_csv('https://raw.githubusercontent.com/CSSEGISandData/C

df_covid19 = pd.read_csv("https://raw.githubusercontent.com/CSSEGISandData/
df_table = pd.read_csv("https://raw.githubusercontent.com/CSSEGISandData/CC
```

In [3]:
```
df_confirmed = df_confirmed.rename(columns={"Province/State":"state","Count
df_deaths = df_deaths.rename(columns={"Province/State":"state","Country/Reg
df_covid19 = df_covid19.rename(columns={"Country_Region": "country"})
df_covid19["Active"] = df_covid19["Confirmed"]-df_covid19["Recovered"]-df_c
```

In [4]:
```
# Changing the conuntry names as required by pycountry_convert Lib
df_confirmed.loc[df_confirmed['country'] == "US", "country"] = "USA"
df_deaths.loc[df_deaths['country'] == "US", "country"] = "USA"
df_covid19.loc[df_covid19['country'] == "US", "country"] = "USA"
df_table.loc[df_table['Country_Region'] == "US", "Country_Region"] = "USA"

df_confirmed.loc[df_confirmed['country'] == 'Korea, South', "country"] = 'S
df_deaths.loc[df_deaths['country'] == 'Korea, South', "country"] = 'South K
df_covid19.loc[df_covid19['country'] == "Korea, South", "country"] = "South
df_table.loc[df_table['Country_Region'] == "Korea, South", "Country_Region"

df_confirmed.loc[df_confirmed['country'] == 'Taiwan*', "country"] = 'Taiwan
df_deaths.loc[df_deaths['country'] == 'Taiwan*', "country"] = 'Taiwan'
df_covid19.loc[df_covid19['country'] == "Taiwan*", "country"] = "Taiwan"
df_table.loc[df_table['Country_Region'] == "Taiwan*", "Country_Region"] = "

df_confirmed.loc[df_confirmed['country'] == 'Congo (Kinshasa)', "country"]
df_deaths.loc[df_deaths['country'] == 'Congo (Kinshasa)', "country"] = 'Dem
df_covid19.loc[df_covid19['country'] == "Congo (Kinshasa)", "country"] = "D
df_table.loc[df_table['Country_Region'] == "Congo (Kinshasa)", "Country_Reg

df_confirmed.loc[df_confirmed['country'] == "Cote d'Ivoire", "country"] = "
df_deaths.loc[df_deaths['country'] == "Cote d'Ivoire", "country"] = "Côte d
df_covid19.loc[df_covid19['country'] == "Cote d'Ivoire", "country"] = "Côte
df_table.loc[df_table['Country_Region'] == "Cote d'Ivoire", "Country_Region

df_confirmed.loc[df_confirmed['country'] == "Reunion", "country"] = "Réunic
df_deaths.loc[df_deaths['country'] == "Reunion", "country"] = "Réunion"
df_covid19.loc[df_covid19['country'] == "Reunion", "country"] = "Réunion"
df_table.loc[df_table['Country_Region'] == "Reunion", "Country_Region"] = "

df_confirmed.loc[df_confirmed['country'] == 'Congo (Brazzaville)', "country
df_deaths.loc[df_deaths['country'] == 'Congo (Brazzaville)', "country"] = '
df_covid19.loc[df_covid19['country'] == "Congo (Brazzaville)", "country"] =
df_table.loc[df_table['Country_Region'] == "Congo (Brazzaville)", "Country_

df_confirmed.loc[df_confirmed['country'] == 'Bahamas, The', "country"] = 'B
df_deaths.loc[df_deaths['country'] == 'Bahamas, The', "country"] = 'Bahamas
df_covid19.loc[df_covid19['country'] == "Bahamas, The", "country"] = "Baham
df_table.loc[df_table['Country_Region'] == "Bahamas, The", "Country_Region"

df_confirmed.loc[df_confirmed['country'] == 'Gambia, The', "country"] = 'Ga
df_deaths.loc[df_deaths['country'] == 'Gambia, The', "country"] = 'Gambia'
df_covid19.loc[df_covid19['country'] == "Gambia, The", "country"] = "Gambia
df_table.loc[df_table['Country_Region'] == "Gambia", "Country_Region"] = "G

countries = np.asarray(df_confirmed["country"])
countries1 = np.asarray(df_covid19["country"])
# Continent_code to Continent_names
continents = {
    'NA': 'North America',
    'SA': 'South America',
    'AS': 'Asia',
    'OC': 'Australia',
    'AF': 'Africa',
    'EU' : 'Europe',
```

```
    'na' : 'Others'
}

# Defininng Function for getting continent code for country.
def country_to_continent_code(country):
    try:
        return pc.country_alpha2_to_continent_code(pc.country_name_to_count
    except :
        return 'na'

df_confirmed.insert(2,"continent", [continents[country_to_continent_code(cc
df_deaths.insert(2,"continent",  [continents[country_to_continent_code(coun
df_covid19.insert(1,"continent",  [continents[country_to_continent_code(cou
df_table.insert(1,"continent",  [continents[country_to_continent_code(count
```

In [5]:
```
df_table = df_table[df_table["continent"] != "Others"]
```

In [6]:
```
df_confirmed = df_confirmed.replace(np.nan, '', regex=True)
df_deaths = df_deaths.replace(np.nan, '', regex=True)
```

In [7]:
```
def plot_params(ax,axis_label= None, plt_title = None,label_size=15, axis_f
    # Tick-Parameters
    ax.xaxis.set_minor_locator(ticker.AutoMinorLocator())
    ax.yaxis.set_minor_locator(ticker.AutoMinorLocator())
    ax.tick_params(which='both', width=1,labelsize=label_size)
    ax.tick_params(which='major', length=6)
    ax.tick_params(which='minor', length=3, color='0.8')

    # Grid
    plt.grid(lw = 1, ls = '-', c = "0.7", which = 'major')
    plt.grid(lw = 1, ls = '-', c = "0.9", which = 'minor')

    # Plot Title
    plt.title( plt_title,{'fontsize':title_fsize})

    # Yaxis sacle
    plt.yscale(scale)
    plt.minorticks_on()
    # Plot Axes Labels
    xl = plt.xlabel(axis_label[0],fontsize = axis_fsize)
    yl = plt.ylabel(axis_label[1],fontsize = axis_fsize)

def visualize_covid_cases(confirmed, deaths, continent=None , country = Non
    x = 0
    if figure == None:
        f = plt.figure(figsize=(10,10))
        # Sub plot
        ax = f.add_subplot(111)
    else :
        f = figure[0]
        # Sub plot
        ax = f.add_subplot(figure[1],figure[2],figure[3])
    ax.set_axisbelow(True)
    plt.tight_layout(pad=10, w_pad=5, h_pad=5)

    stats = [confirmed, deaths]
    label = ["Confirmed", "Deaths"]

    if continent != None:
        params = ["continent",continent]
    elif country != None:
        params = ["country",country]
    else:
        params = ["All", "All"]
    color = ["darkcyan","crimson"]
    marker_style = dict(linewidth=3, linestyle='-', marker='o',markersize=4
    for i,stat in enumerate(stats):
        if params[1] == "All" :
            cases = np.sum(np.asarray(stat.iloc[:,5:]),axis = 0)[x:]
        else :
            cases = np.sum(np.asarray(stat[stat[params[0]] == params[1]].il
        date = np.arange(1,cases.shape[0]+1)[x:]
        plt.plot(date,cases,label = label[i]+" (Total : "+str(cases[-1])+")
        plt.fill_between(date,cases,color=color[i],alpha=0.3)

    if params[1] == "All" :
```

```
        Total_confirmed = np.sum(np.asarray(stats[0].iloc[:,5:]),axis = 0)[
        Total_deaths = np.sum(np.asarray(stats[1].iloc[:,5:]),axis = 0)[x:]
    else :
        Total_confirmed =  np.sum(np.asarray(stats[0][stat[params[0]] == pa
        Total_deaths = np.sum(np.asarray(stats[1][stat[params[0]] == params

    text = "From "+stats[0].columns[5]+" to "+stats[0].columns[-1]+"\n"
    text += "Mortality rate : "+ str(int(Total_deaths[-1]/(Total_confirmed[
    text += "Last 5 Days:\n"
    text += "Confirmed : " + str(Total_confirmed[-1] - Total_confirmed[-6])
    text += "Deaths : " + str(Total_deaths[-1] - Total_deaths[-6])+"\n"
    text += "Last 24 Hours:\n"
    text += "Confirmed : " + str(Total_confirmed[-1] - Total_confirmed[-2])
    text += "Deaths : " + str(Total_deaths[-1] - Total_deaths[-2])+"\n"

    plt.text(0.02, 0.78, text, fontsize=15, horizontalalignment='left', ver

    # Plot Axes Labels
    axis_label = ["Days ("+df_confirmed.columns[5]+" - "+df_confirmed.colum

    # Plot Parameters
    plot_params(ax,axis_label,scale = scale)

    # Plot Title
    if params[1] == "All" :
        plt.title("COVID-19 Cases World",{'fontsize':25})
    else:
        plt.title("COVID-19 Cases for "+params[1] ,{'fontsize':25})

    # Legend Location
    l = plt.legend(loc= "best",fontsize = 15)

    if figure == None:
        plt.show()

def get_total_cases(cases, country = "All"):
    if(country == "All") :
        return np.sum(np.asarray(cases.iloc[:,5:]),axis = 0)[-1]
    else :
        return np.sum(np.asarray(cases[cases["country"] == country].iloc[:,

def get_mortality_rate(confirmed,deaths, continent = None, country = None):
    if continent != None:
        params = ["continent",continent]
    elif country != None:
        params = ["country",country]
    else :
        params = ["All", "All"]

    if params[1] == "All" :
        Total_confirmed = np.sum(np.asarray(confirmed.iloc[:,5:]),axis = 0)
        Total_deaths = np.sum(np.asarray(deaths.iloc[:,5:]),axis = 0)
        mortality_rate = np.round((Total_deaths/(Total_confirmed+1.01))*100
    else :
        Total_confirmed =  np.sum(np.asarray(confirmed[confirmed[params[0]]
        Total_deaths = np.sum(np.asarray(deaths[deaths[params[0]] == params
        mortality_rate = np.round((Total_deaths/(Total_confirmed+1.01))*100
```

```
    return np.nan_to_num(mortality_rate)
def dd(date1,date2):
    return (datetime.strptime(date1,'%m/%d/%y') - datetime.strptime(date2,'


out = ""#+"output/"
```

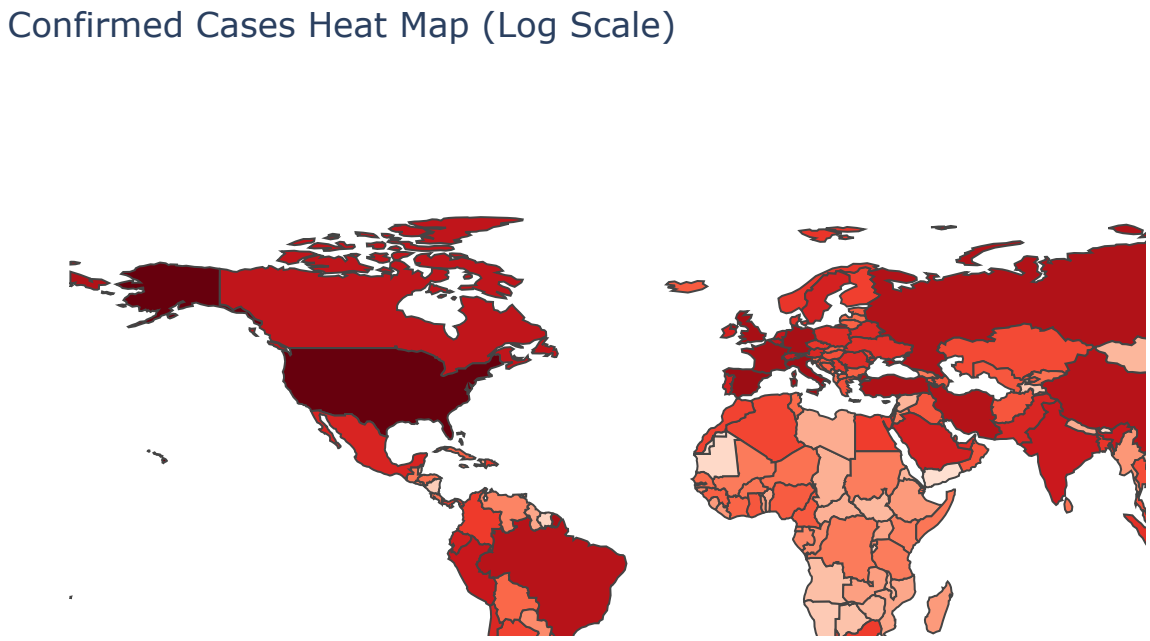
In [8]:
```
df_countries_cases = df_covid19.copy().drop(['Lat','Long_','continent','Las
df_countries_cases.index = df_countries_cases["country"]
df_countries_cases = df_countries_cases.drop(['country'],axis=1)

df_continents_cases = df_covid19.copy().drop(['Lat','Long_','country','Last
df_continents_cases = df_continents_cases.groupby(["continent"]).sum()
```

In [9]:
```
df_t = pd.DataFrame(pd.to_numeric(df_countries_cases.sum()),dtype=float).tr
df_t["Mortality Rate (per 100)"] = 100*df_t["Deaths"]/df_t["Confirmed"]
```

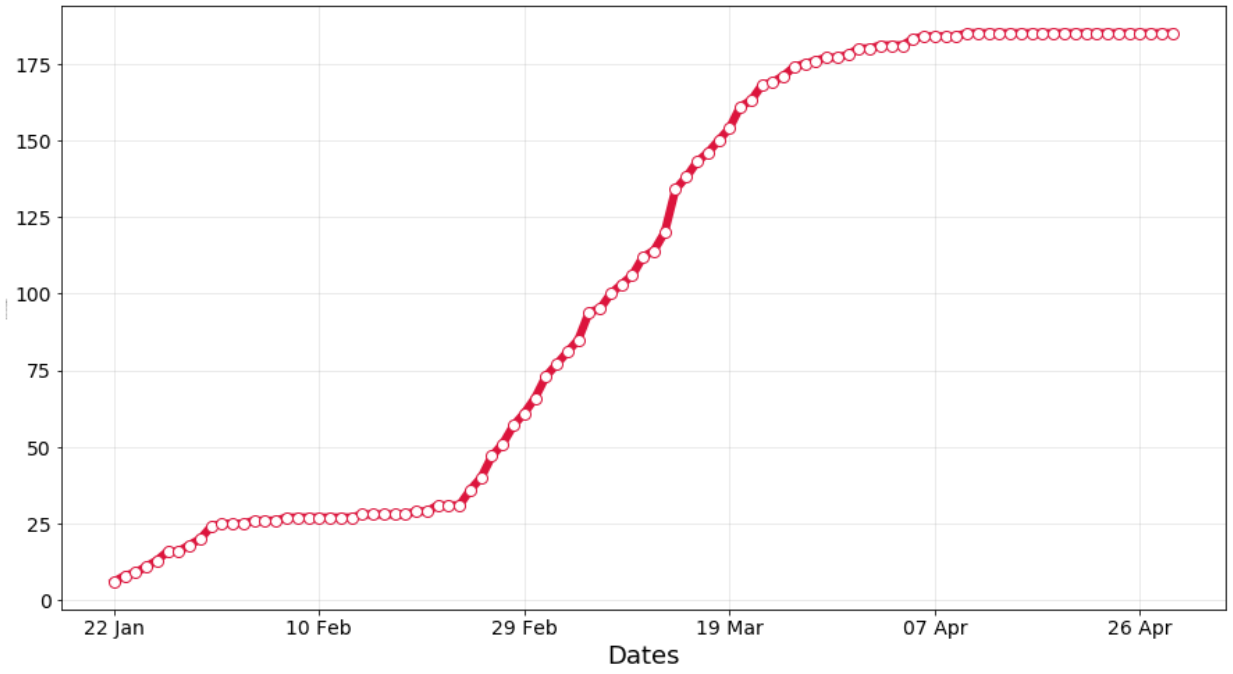
In [10]:
```
df_countries_cases["Mortality Rate (per 100)"] = np.round(100*df_countries_
```

In [11]:
```
world_map = folium.Map(location=[10,0], tiles="cartodbpositron", zoom_start
for i in range(0,len(df_confirmed)):
    folium.Circle(
        location=[df_confirmed.iloc[i]['Lat'], df_confirmed.iloc[i]['Long']
        tooltip = "<h5 style='text-align:center;font-weight: bold'>"+df_con
                  "<div style='text-align:center;'>"+str(np.nan_to_num(df
                  "<hr style='margin:10px;'>"+
                  "<ul style='color: #444;list-style-type:circle;align-it
        "<li>Confirmed: "+str(df_confirmed.iloc[i,-1])+"</li>"+
        "<li>Deaths:   "+str(df_deaths.iloc[i,-1])+"</li>"+
        "<li>Mortality Rate:   "+str(np.round(df_deaths.iloc[i,-1]/(df_conf
        "</ul>"
        ,
        radius=(int((np.log(df_confirmed.iloc[i,-1]+1.00001)))+0.2)*50000,
        color='#ff6600',
        fill_color='#ff8533',
        fill=True).add_to(world_map)
world_map

mw = folium.Map(location=[10, 0], zoom_start=2,max_zoom=6,min_zoom=2)
```

In [12]:
```
temp_df = pd.DataFrame(df_countries_cases['Confirmed'])
temp_df = temp_df.reset_index()
fig = px.choropleth(temp_df, locations="country",
                    color=np.log10(temp_df["Confirmed"]),
                    hover_name="country",
                    hover_data=["Confirmed"],
                    color_continuous_scale=px.colors.sequential.Plasma,loca
fig.update_geos(fitbounds="locations", visible=False)
fig.update_layout(title_text="Confirmed Cases Heat Map (Log Scale)")
fig.update_coloraxes(colorbar_title="Confirmed Cases(Log Scale)",colorscale
# fig.to_image("Global Heat Map confirmed.png")
fig.show()
```

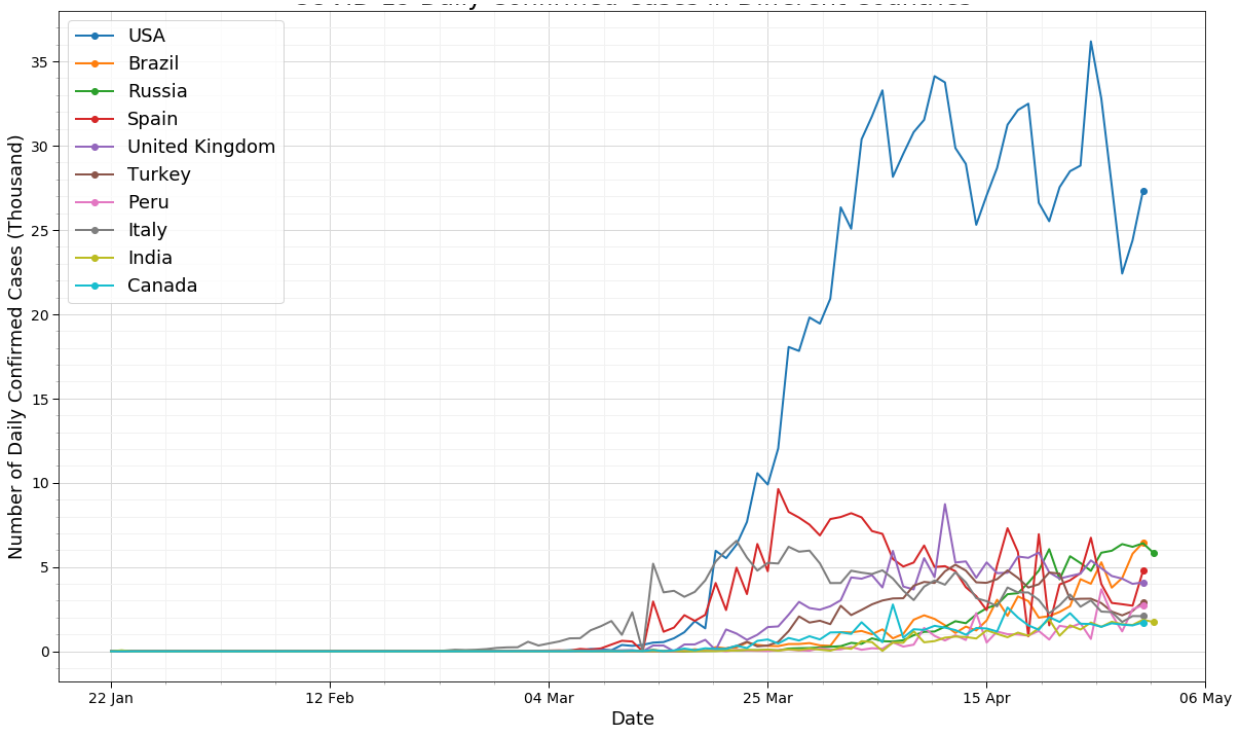


In [13]:
```
# number of countries affected over time
case_nums_country = df_confirmed.groupby("country").sum().drop(['Lat','Long
d = [datetime.strptime(date,'%m/%d/%y').strftime("%d %b") for date in case_

f = plt.figure(figsize=(15,8))
f.add_subplot(111)
marker_style = dict(c="crimson",linewidth=6, linestyle='-', marker='o',mark
plt.plot(d, case_nums_country,**marker_style)
plt.tick_params(labelsize = 14)
plt.xticks(list(np.arange(0,len(d),int(len(d)/5))),d[:-1:int(len(d)/5)]+[d[

#labels
plt.xlabel("Dates",fontsize=18)
plt.ylabel("Number of Countries/Regions",fontsize=1)
plt.grid(alpha = 0.3)

plt.savefig(out+'spread.png')
plt.show()
plt.close()
```



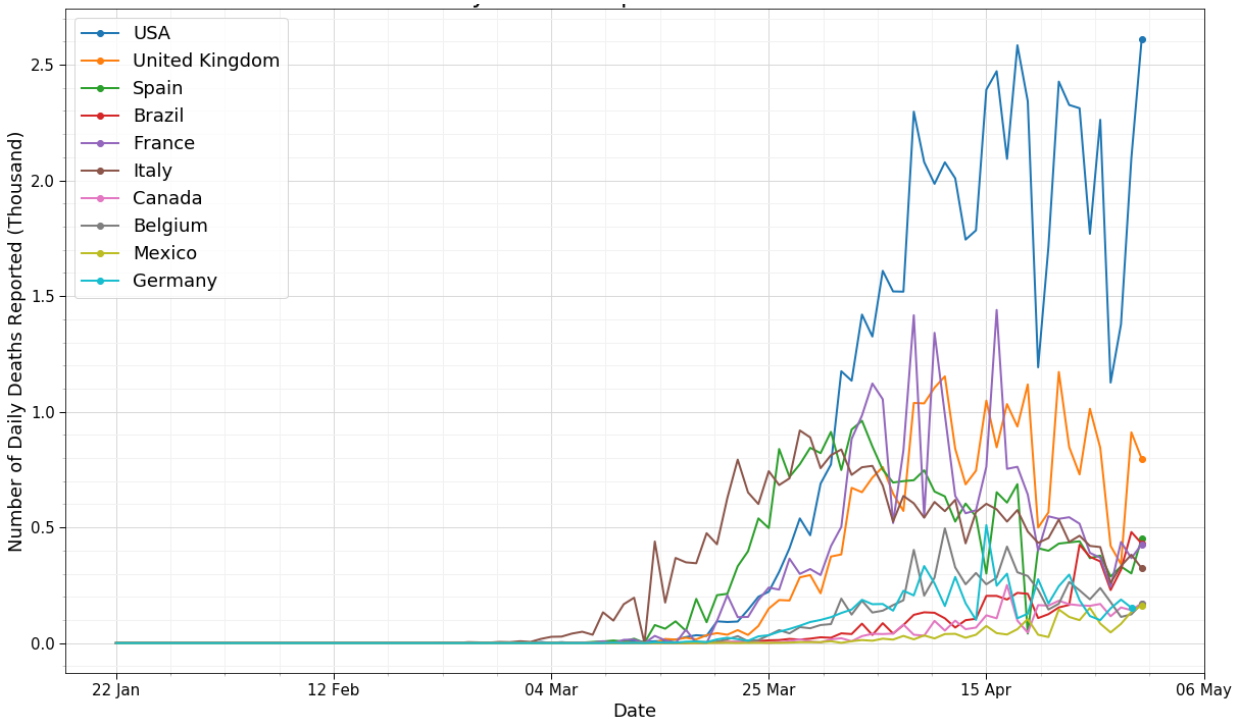
In [14]:
```
# daily new cases in different countries
thoudand = 1000
prediction_days = 10
temp = df_confirmed.groupby('country').sum().diff(axis=1).sort_values(df_de
threshold = 0
f = plt.figure(figsize=(20,12))
ax = f.add_subplot(111)
for i,country in enumerate(temp.index):
    t = temp.loc[temp.index== country].values[0]
    t = t[t>=threshold]

    date = np.arange(0,len(t[:]))
    plt.plot(date,t/thoudand,'-o',label = country,linewidth =2, markevery=[


nextdays = [(datetime.strptime(d[-1],'%d %b')+timedelta(days=i)).strftime("
total =d+nextdays

# X-axis
plt.xticks(list(np.arange(0,len(total),int(len(total)/5))),total[:-1:int(le

# Tick-Parameters
ax.xaxis.set_minor_locator(ticker.AutoMinorLocator())
ax.yaxis.set_minor_locator(ticker.AutoMinorLocator())
ax.tick_params(which='both', width=1,labelsize=14)
ax.tick_params(which='major', length=6)
ax.tick_params(which='minor', length=3, color='0.8')

# Grid
plt.grid(lw = 1, ls = '-', c = "0.85", which = 'major')
plt.grid(lw = 1, ls = '-', c = "0.95", which = 'minor')

# Plot Title
plt.title("COVID-19 Daily Confirmed Cases in Different Countries",{'fontsiz

# Axis Lable
plt.xlabel("Date",fontsize =18)
plt.ylabel("Number of Daily Confirmed Cases (Thousand)",fontsize =18)

# plt.yscale("log")
plt.legend(fontsize=18)
plt.savefig(out+"daily confirmed cases countrywise.png")
plt.show()
```

COVID-19 Dailv Confirmed Cases in Different Countries

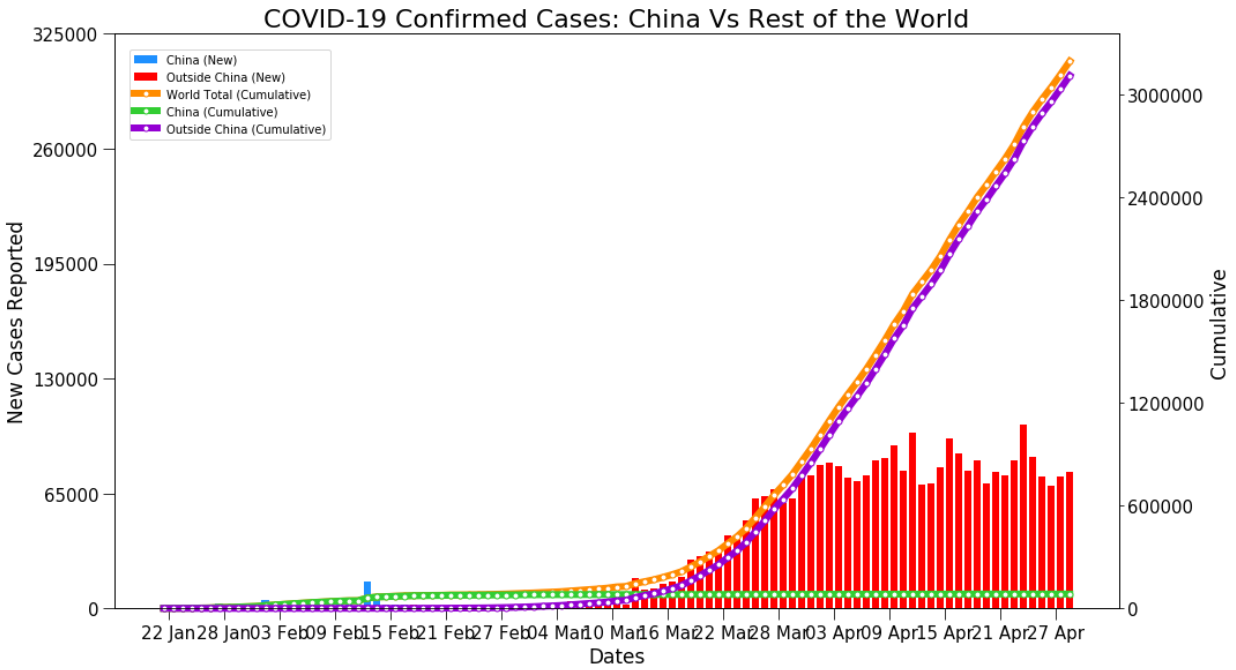

USA
Brazil
Russia
Spain
United Kingdom
Turkey
Peru
Italy
India
Canada
Number of Daily Confirmed Cases (Thousand)
0
5
10
15
20
25
30
35
22 Jan
12 Feb
04 Mar
25 Mar
15 Apr
06 May
Date

In [15]:
```
# daily death cases
thoudand = 1000
temp = df_deaths.groupby('country').sum().diff(axis=1).sort_values(df_death
threshold = 0
f = plt.figure(figsize=(20,12))
ax = f.add_subplot(111)
for i,country in enumerate(temp.index):
    t = temp.loc[temp.index== country].values[0]
    t = t[t>=threshold]

    date = np.arange(0,len(t[:]))
    plt.plot(date,t/thoudand,'-o',label = country,linewidth =2, markevery=[


nextdays = [(datetime.strptime(d[-1],'%d %b')+timedelta(days=i)).strftime("
total =d+nextdays

# X-axis
plt.xticks(list(np.arange(0,len(total),int(len(total)/5))),total[:-1:int(le

# Tick-Parameters
ax.xaxis.set_minor_locator(ticker.AutoMinorLocator())
ax.yaxis.set_minor_locator(ticker.AutoMinorLocator())
ax.tick_params(which='both', width=1,labelsize=15)
ax.tick_params(which='major', length=6)
ax.tick_params(which='minor', length=3, color='0.8')

# Grid
plt.grid(lw = 1, ls = '-', c = "0.85", which = 'major')
plt.grid(lw = 1, ls = '-', c = "0.95", which = 'minor')

# Plot Title
plt.title("COVID-19 Daily Deaths Reported in Different Countries",{'fontsiz

# Axis Lable
plt.xlabel("Date",fontsize =18)
plt.ylabel("Number of Daily Deaths Reported (Thousand)",fontsize =18)

# plt.yscale("log")
plt.legend(fontsize=18)
plt.savefig(out+"daily deaths reported countrywise.png")
plt.show()
```

COVID-19 Daily Deaths Reported in Different Countries


USA
United Kingdom
Spain
Brazil
France
Italy
Canada
Belgium
Mexico
Germany
Number of Daily Deaths Reported (Thousand)
0.0
0.5
1.0
1.5
2.0
2.5
22 Jan
12 Feb
04 Mar
25 Mar
15 Apr
06 May
Date

In [16]:
```
# China vs Outside China
df_confirmed_report = df_confirmed.copy()
df_confirmed_report.loc[df_confirmed_report['country'] != "China","country"
df_confirmed_report = df_confirmed_report.groupby("country").sum().drop(["L
df_confirmed_report.loc["Total"] = df_confirmed_report.sum()
df_confirmed_newcases = df_confirmed_report.groupby(level =0).diff(axis =1)
df_confirmed_newcases = df_confirmed_newcases.replace(np.nan, 0, regex=True
f = plt.figure(figsize=(15,8))
ax1 = f.add_subplot(111)

ax1.bar(df_confirmed_report[df_confirmed_report.index == "China"].columns,d
ax1.bar(df_confirmed_report[df_confirmed_report.index == "Outside China"].c

# Labels
ax1.set_xlabel("Dates",fontsize=17)
ax1.set_ylabel("New Cases Reported",fontsize =17)

ax1.tick_params(size=10,labelsize=15)
ax1.set_xticks(np.arange(0.5, len(df_confirmed_report.columns), 6))
ax1.set_xticklabels([datetime.strptime(date,'%m/%d/%y').strftime("%d %b") f
l = np.arange(0, df_confirmed_report.max(axis = 1)[2]/10+10000, 5000)
ax1.set_yticks(l[::int(len(l)/5)])
# ax1.spines['bottom'].set_position('zero')

ax2 = ax1.twinx()
marker_style = dict(linewidth=6, linestyle='-', marker='.',markersize=10, m

ax2.plot(df_confirmed_report[df_confirmed_report.index == "Total"].columns
ax2.plot(df_confirmed_report[df_confirmed_report.index == "China"].columns
ax2.plot(df_confirmed_report[df_confirmed_report.index == "Outside China"].
ax2.bar([0],[0])

ax2.tick_params(labelsize=15)
ax2.set_ylabel("Cumulative",fontsize =17)
ax2.set_xticks(np.arange(0.5, len(df_confirmed_report.columns), 6))
ax2.set_xticklabels([datetime.strptime(date,'%m/%d/%y').strftime("%d %b") f
l = np.arange(0, df_confirmed_report.max(axis = 1)[2]+100000, 100000)
ax2.set_yticks(l[::int(len(l)/5)])

f.tight_layout()
f.legend(loc = "upper left", bbox_to_anchor=(0.1,0.95))
plt.title("COVID-19 Confirmed Cases: China Vs Rest of the World",fontsize =
plt.savefig(out+'China vs Rest of the world.png')
plt.show()
```


COVID-19 Confirmed Cases: China Vs Rest of the World
China (New)
Outside China (New)
World Total (Cumulative)
China (Cumulative)
Outside China (Cumulative)
New Cases Reported
Cumulative
Dates
325000
260000
195000
130000
65000
0
3000000
2400000
1800000
1200000
600000
0
22 Jan
28 Jan
03 Feb
09 Feb
15 Feb
21 Feb
27 Feb
04 Mar
10 Mar
16 Mar
22 Mar
28 Mar
03 Apr
09 Apr
15 Apr
21 Apr
27 Apr

In [17]:
```
# USA
date_usa = datetime.strptime(df_confirmed.columns[-1],'%m/%d/%y').strftime(
df_temp = pd.read_csv("https://raw.githubusercontent.com/CSSEGISandData/COV
df_usa = df_temp.loc[df_temp["Country_Region"]== "US"]
df_usa = df_usa.rename(columns={"Admin2":"County"})

total = df_usa.sum()
total.name = "Total"
pd.DataFrame(total).transpose().loc[:,["Confirmed","Deaths"]].style.backgrc

df_usa = df_usa.replace(np.nan, 0, regex=True)
usa = folium.Map(location=[37, -102], zoom_start=4,max_zoom=8,min_zoom=4)
for i in np.int32(np.asarray(df_usa[df_usa['Confirmed'] > 0].index)):
    folium.Circle(
        location=[df_usa.loc[i]['Lat'], df_usa.loc[i]['Long_']],
        tooltip = "<h5 style='text-align:center;font-weight: bold'>"+df_usa
                  "<div style='text-align:center;'>"+str(np.nan_to_num(df
                  "<hr style='margin:10px;'>"+
                  "<ul style='color: #444;list-style-type:circle;align-it
        "<li>Confirmed: "+str(df_usa.loc[i]['Confirmed'])+"</li>"+
        "<li>Active:   "+str(df_usa.loc[i]['Active'])+"</li>"+
        "<li>Recovered:   "+str(df_usa.loc[i]['Recovered'])+"</li>"+
        "<li>Deaths:   "+str(df_usa.loc[i]['Deaths'])+"</li>"+
        "<li>Mortality Rate:   "+str(np.round(df_usa.loc[i]['Deaths']/(df_u
        "</ul>"
        ,
        radius=int((np.log2(df_usa.loc[i]['Confirmed']+1))*6000),
        color='#ff6600',
        fill_color='#ff8533',
        fill=True).add_to(usa)

usa
```

Out[17]:

In [18]:
```
state_geo = requests.get('https://raw.githubusercontent.com/python-visualiz
county_geo = requests.get('https://raw.githubusercontent.com/python-visuali

data_temp = df_usa.groupby(["Province_State"]).sum().reset_index().drop(["L
data_temp["Confirmed_log"] = np.log10(data_temp["Confirmed"]+1)
bins = list(data_temp['Confirmed_log'].quantile([0, 0.25, 0.5, 0.75,0.95 ,1
m = folium.Map(location=[37, -102], zoom_start=4,max_zoom=6,min_zoom=3)

# Add the color for the chloropleth:
folium.Choropleth(
    geo_data=state_geo,
    name='choropleth',
    data = data_temp,
    columns=['Province_State', 'Confirmed_log'],
    key_on='feature.properties.name',
    fill_color='Reds',
    fill_opacity=0.7,
    line_opacity=0.2,
    bins = bins,
    reset=True,
    legend_name='Confirmed cases log (10^x)'
).add_to(m)
folium.LayerControl().add_to(m)

legend_html = "<div style='padding:10px;background-color:rgba(255,255,255,0
legend_html += "<div style='width:100%;text-align:center;'><h4>Index for Le
legend_html += "<ul style='margin:0;padding:0;color: #555;list-style-type:c
for i in bins:
    legend_html += "<li style='margin:0;padding:0;line-height: 0;'>Value "+
legend_html += "</ul></div>"
m.get_root().html.add_child(folium.Element(legend_html))
m
```

Out[18]:

In [19]:
```
data_temp = df_usa.groupby(["FIPS"]).sum().reset_index().drop(["Lat","Long_
data_temp["Confirmed_log"] = np.log10(data_temp["Confirmed"]+1)

df_usa_series = data_temp.set_index('FIPS')['Confirmed_log']
colorscale = branca.colormap.linear.Reds_09.scale(0,data_temp["Confirmed_lo
# print(df_usa_series.max())
def style_function(feature):
    employed = df_usa_series.get(int(feature['id'][-5:]), 0)
    return {
        'fillOpacity': 0.5,
        'weight': 0,
        'fillColor': '#black' if employed is None else colorscale(employed)
    }


m = folium.Map(
    location=[37, -102],
    tiles='cartodbpositron',
    zoom_start=4,
    min_zoom=3,
    max_zoom=7
)

folium.TopoJson(
    county_geo,
    'objects.us_counties_20m',
    style_function=style_function
).add_to(m)
m
```

Out[19]:

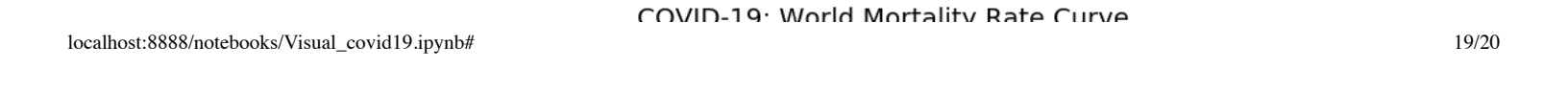
In [20]:
```
# Test data analysis
df_test = pd.read_csv("https://raw.githubusercontent.com/tarunk04/COVID-19-
df_test["country"] = [ c.split(" ")[0] for c in df_test["Entity"].values]
df_test.loc[17,"country"] ="USA"
df_test.loc[16,"country"] = "United Kingdom"
df_test.loc[15,"country"] = "South Korea"

df_test = df_test.loc[:,["country","Cumulative total","Cumulative total per
```

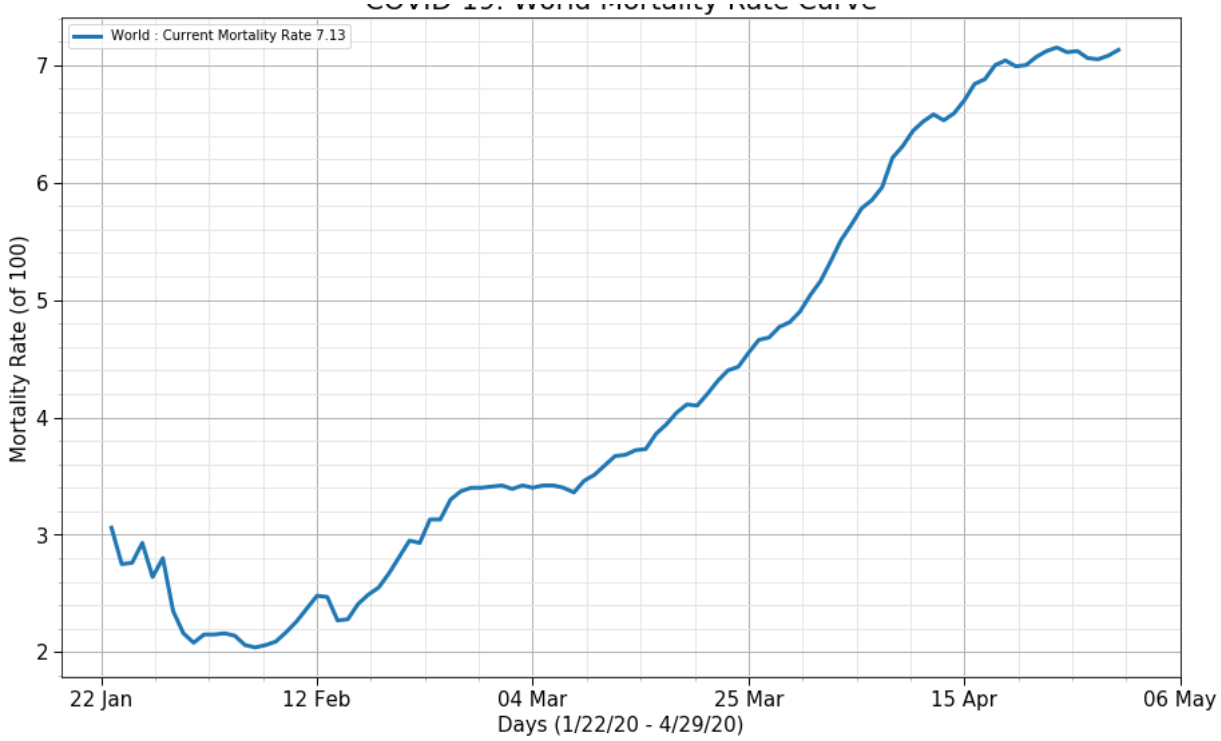
In [21]:
```
df_test["confirmed"] = [ df_countries_cases.loc[c,'Confirmed'] for c in df_
df_test["deaths"] = [ df_countries_cases.loc[c,'Deaths'] for c in df_test["
df_test["MR"] = np.round(100*df_test["deaths"]/df_test["confirmed"],2)
df_test["Positive"] = np.round(100*df_test["confirmed"]/df_test["Cumulative
df_test.style.background_gradient(cmap='Blues',subset=["Cumulative total"])
                        .background_gradient(cmap='Reds',subset=["Cumulativ
                        .background_gradient(cmap='Greens',subset=["confirm
                        .background_gradient(cmap='Purples',subset=["deaths
                        .background_gradient(cmap='YlOrBr',subset=["MR"])\
                        .background_gradient(cmap='bone_r',subset=["Positiv
```

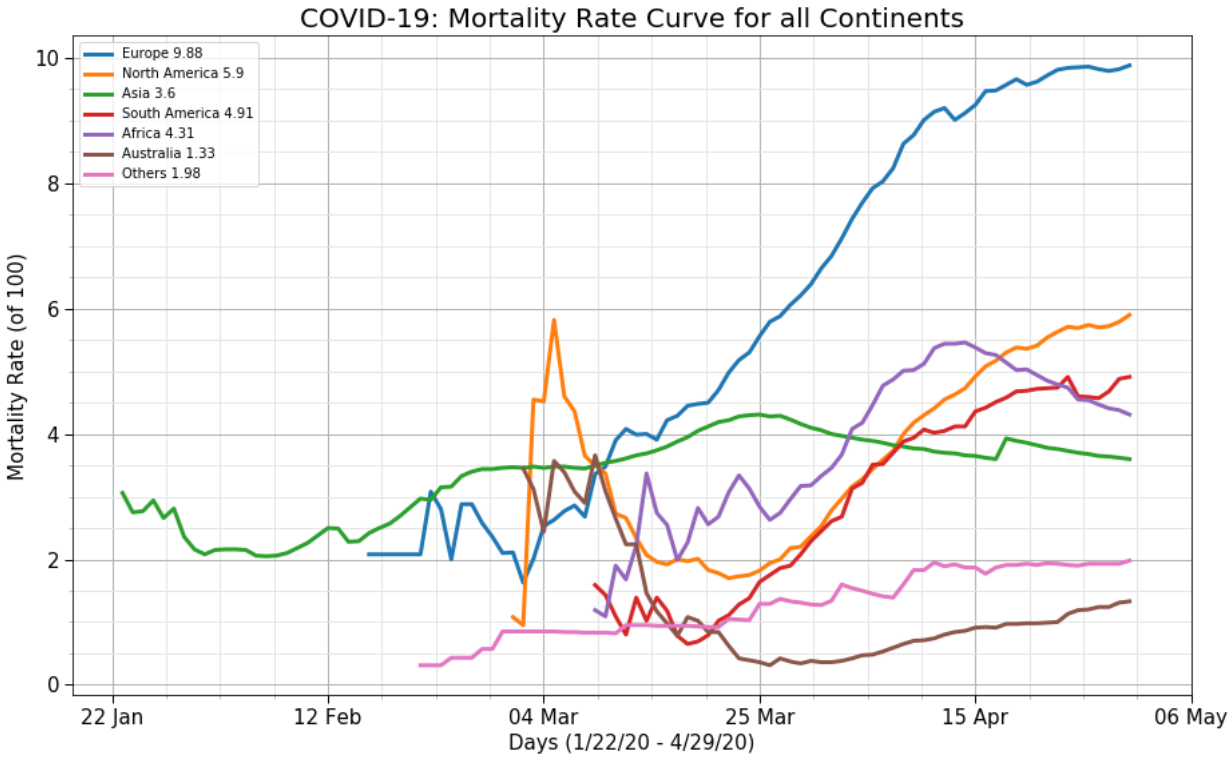
Out[21]:

	country	Cumulative total	Cumulative total per million	confirmed	deaths	MR	Positive
0	Australia	261000	10276.3	6754	92	1.36	2.59
1	Austria	98343	11198	15452	584	3.78	15.71
2	Bahrain	37996	22380	3040	8	0.26	8
3	Belgium	62867	5410.25	48519	7594	15.65	77.18
4	Canada	256933	6832.74	53977	3268	6.05	21.01
5	France	224254	3412.2	166628	24410	14.65	74.3
6	Germany	918460	11127.4	162375	6563	4.04	17.68
7	India	26798	19.3739	34862	1154	3.31	130.09
8	India	47951	34.6668	34862	1154	3.31	72.7
9	Indonesia	7621	27.9954	10118	792	7.83	132.76
10	Italy	581232	9829.39	205463	27967	13.61	35.35
11	Japan	39446	311.837	13965	425	3.04	35.4
12	Malaysia	47723	1451.9	6002	102	1.7	12.58
13	Pakistan	30308	145.458	16473	361	2.19	54.35
14	Philippines	5265	47.993	8488	568	6.69	161.22
15	South Korea	443273	8606.08	10765	247	2.29	2.43
16	United Kingdom	173784	2580.92	172478	26842	15.56	99.25
17	USA	1267658	3824.8	1056402	61867	5.86	83.33

In [22]:
```
df_continents= df_confirmed.groupby(["continent"]).sum()
continents = df_continents.sort_values(df_continents.columns[-1],ascending
continents = ["All"]+list(continents)

cols =1
rows = 2
axis_label = ["Days ("+df_confirmed.columns[5]+" - "+df_confirmed.columns[-

f = plt.figure(figsize=(15,10*rows))

#SubPlot 1
ax = f.add_subplot(211)
mortality_rate = get_mortality_rate(df_confirmed,df_deaths,continent=contin
plt.plot(np.arange(1,mortality_rate.shape[0]+1),mortality_rate,label = "Wor

nextdays = [(datetime.strptime(d[-1],'%d %b')+timedelta(days=i)).strftime("
total =d+nextdays

# X-axis
plt.xticks(list(np.arange(0,len(total),int(len(total)/5))),total[:-1:int(le
plt_title = "COVID-19: World Mortality Rate Curve"
plot_params(ax,axis_label,plt_title)
# Legend Location
l = plt.legend(loc= "best")


#SubPlot 2
ax = f.add_subplot(212)
for i, continent in enumerate(continents[1:]):
    mortality_rate = get_mortality_rate(df_confirmed,df_deaths,continent=cc
#     mortality_rate = mortality_rate.replace(np.nan, 0, regex=True)
    plt.plot(np.arange(1+mortality_rate[mortality_rate == 0].shape[0],morta
# X-axis
plt.xticks(list(np.arange(0,len(total),int(len(total)/5))),total[:-1:int(le

plt_title = "COVID-19: Mortality Rate Curve for all Continents"
plot_params(ax,axis_label,plt_title)

# Legend Location
l = plt.legend(loc= "best")

plt.minorticks_on()
plt.savefig(out+'Mortality rate.png')
plt.show()
```




World : Current Mortality Rate 7.13
Mortality Rate (of 100)
2
3
4
5
6
7
22 Jan
12 Feb
04 Mar
25 Mar
15 Apr
06 May
Days (1/22/20 - 4/29/20)


COVID-19: Mortality Rate Curve for all Continents
Europe 9.88
North America 5.9
Asia 3.6
South America 4.91
Africa 4.31
Australia 1.33
Others 1.98
Mortality Rate (of 100)
0
2
4
6
8
10
22 Jan
12 Feb
04 Mar
25 Mar
15 Apr
06 May
Days (1/22/20 - 4/29/20)

In [ ]: