全球疫情分析

SXM

2020-02

1 读取数据及处理

```
import pandas as pd
import numpy as np

#疫情的确诊数（confirmed）
confirmed = pd.read_csv('./time_series_19-covid-Confirmed.csv')

#治愈数
recovered = pd.read_csv('./time_series_19-covid-Recovered.csv')

#死亡数
deaths = pd.read_csv('./time_series_19-covid-Deaths.csv')

print(confirmed.shape)
```

```
print(recovered.shape)
```

```
print(deaths.shape)
```

confirmed 表里面包含发生疫情的国家，经纬度，以及从 2020 年 1 月 22 日至 2020 年 2 月 28 日的每日的确诊数；recovered 表则记录了治愈数；deaths 表则记录了死亡数。三个表都是（101，42）维，即 114 行，42 列。

1.1 查看发生疫情国家

```
countries = confirmed['Country/Region'].unique()
print(countries)
```

```
print(countries.shape[0])
```

截止 2020.2.28，全世界共有 61 个国家有新冠肺炎病例。

1.2 每日所有地区新冠肺炎的确诊数，治愈数，死亡数。

```
all_confirmed = np.sum(confirmed.iloc[:,4:])
all_recovered = np.sum(recovered.iloc[:,4:])
all_deaths = np.sum(deaths.iloc[:,4:])
All = pd.DataFrame({'all_confirmed':all_confirmed,'all_recovered':all_
    recovered,'all_deaths':all_deaths})
All.to_csv('All.csv')
```

表 1　全球每日新冠肺炎数据

X	all_confirmed	all_recovered	all_deaths
1/22/20	555	28	17
1/23/20	653	30	18

1/24/20	941	36	26
1/25/20	1434	39	42
1/26/20	2118	52	56
1/27/20	2927	61	82
1/28/20	5578	107	131
1/29/20	6166	126	133
1/30/20	8234	143	171
1/31/20	9927	222	213
2/1/20	12038	284	259
2/2/20	16787	472	362
2/3/20	19881	623	426
2/4/20	23892	852	492
2/5/20	27636	1124	564
2/6/20	30818	1487	634
2/7/20	34392	2011	719
2/8/20	37121	2616	806
2/9/20	40151	3244	906
2/10/20	42763	3946	1013
2/11/20	44803	4683	1113
2/12/20	45222	5150	1118
2/13/20	60370	6295	1371
2/14/20	66887	8058	1523
2/15/20	69032	9395	1666
2/16/20	71226	10865	1770
2/17/20	73260	12583	1868
2/18/20	75138	14352	2007
2/19/20	75641	16121	2122
2/20/20	76199	18177	2247
2/21/20	76843	18890	2251
2/22/20	78599	22886	2458
2/23/20	78985	23394	2469
2/24/20	79570	25227	2629
2/25/20	80415	27905	2708
2/26/20	81397	30384	2770
2/27/20	82756	33277	2814
2/28/20	84124	36711	2867

1.3 中国大陆新冠肺炎的情况

```
last_update='2/28/20' #设置最新数据日期
China_cases=confirmed[['Province/State',last_update]][confirmed['Country
    /Region']=='Mainland China']
```

```
China_cases['recovered']=recovered[[last_update]][recovered['Country/
    Region']=='Mainland China']
China_cases['deaths']=deaths[[last_update]][deaths['Country/Region']=='
    Mainland China']
China_cases = China_cases.set_index('Province/State')
China_cases = China_cases.rename(columns = {last_update:'confirmed'})
China_cases.to_csv('Chinacases.csv')
```

表 2　中国大陆新冠肺炎数据

Province.State	confirmed	recovered	deaths
Anhui	990	821	6
Beijing	410	257	7
Chongqing	576	422	6
Fujian	296	235	1
Gansu	91	82	2
Guangdong	1348	935	7
Guangxi	252	168	2
Guizhou	146	112	2
Hainan	168	133	5
Hebei	318	277	6
Heilongjiang	480	283	13
Henan	1272	1112	20
Hubei	65914	26403	2682
Hunan	1017	830	4
Inner Mongolia	75	45	0
Jiangsu	631	515	0
Jiangxi	935	790	1
Jilin	93	73	1
Liaoning	121	93	1
Ningxia	72	68	0
Qinghai	18	18	0
Shaanxi	245	199	1
Shandong	756	405	6
Shanghai	337	279	3
Shanxi	133	112	0
Sichuan	538	338	3
Tianjin	136	102	3
Tibet	1	1	0
Xinjiang	76	52	3
Yunnan	174	156	2
Zhejiang	1205	975	1

1.4 中国大陆治愈率 VS 死亡率

```
confirmed_china = confirmed[confirmed['Country/Region']=='Mainland China
    ']
confirmed_china = np.sum(confirmed_china.iloc[:,4:])
recovered_china = recovered[recovered['Country/Region'] == 'Mainland
    China']
recovered_china = np.sum(recovered_china.iloc[:,4:])
deaths_china = deaths[deaths['Country/Region'] == 'Mainland China']
deaths_china = np.sum(deaths_china.iloc[:,4:])
recover_rate = (recovered_china/confirmed_china)*100
recover_rate1=(recover_rate/100).apply(lambda x: format(x, '.2%'))
death_rate = (deaths_china/confirmed_china)*100
death_rate1 = (death_rate/100).apply(lambda x: format(x, '.2%'))
re_de=pd.DataFrame({'recover_rate':recover_rate1,'death_rate':death_
    rate1})
re_de.to_csv('rede.csv')
```

表 3　中国大陆治愈率 VS 死亡率

X	recover_rate	death_rate
1/22/20	5.12%	3.11%
1/23/20	4.69%	2.82%
1/24/20	3.93%	2.84%
1/25/20	2.79%	3.00%
1/26/20	2.38%	2.72%
1/27/20	2.03%	2.86%
1/28/20	1.84%	2.38%
1/29/20	1.98%	2.19%
1/30/20	1.66%	2.10%
1/31/20	2.19%	2.18%
2/1/20	2.32%	2.18%
2/2/20	2.79%	2.17%
2/3/20	3.12%	2.16%
2/4/20	3.56%	2.07%
2/5/20	4.07%	2.05%
2/6/20	4.83%	2.07%
2/7/20	5.86%	2.10%
2/8/20	7.06%	2.19%
2/9/20	8.09%	2.27%
2/10/20	9.26%	2.39%
2/11/20	10.46%	2.51%
2/12/20	11.36%	2.50%
2/13/20	10.38%	2.29%
2/14/20	12.03%	2.29%
2/15/20	13.60%	2.43%

2/16/20	15.26%	2.51%
2/17/20	17.21%	2.57%
2/18/20	19.15%	2.70%
2/19/20	21.40%	2.84%
2/20/20	24.00%	2.98%
2/21/20	24.77%	2.96%
2/22/20	29.49%	3.17%
2/23/20	30.12%	3.18%
2/24/20	32.39%	3.36%
2/25/20	35.60%	3.43%
2/26/20	38.50%	3.48%
2/27/20	41.91%	3.50%
2/28/20	46.04%	3.54%

1.5 其他地区治愈率 VS 死亡率

```
confirmed_others = confirmed[confirmed['Country/Region'] != 'Mainland China']
confirmed_others = np.sum(confirmed_others.iloc[:,4:])
recovered_others = recovered[recovered['Country/Region'] != 'Mainland China']
recovered_others = np.sum(recovered_others.iloc[:,4:])
deaths_others = deaths[deaths['Country/Region'] != 'Mainland China']
deaths_others = np.sum(deaths_others.iloc[:,4:])
other_recover_rate = (recovered_others/confirmed_others)*100
other_recover_rate1=(other_recover_rate/100).apply(lambda x: format(x, '.2%'))
other_death_rate = (deaths_others/confirmed_others)
other_death_rate1 = (other_death_rate/100).apply(lambda x: format(x, '.2%'))
other_re_de=pd.DataFrame({'recover_rate':other_recover_rate1,'death_rate':other_death_rate1})
other_re_de.to_csv('otherrede.csv')
```

表 4　其他地区治愈率 VS 死亡率

X	recover_rate	death_rate
1/22/20	0.00%	0.00%
1/23/20	0.00%	0.00%
1/24/20	0.00%	0.00%
1/25/20	0.00%	0.00%
1/26/20	5.36%	0.00%
1/27/20	4.69%	0.00%
1/28/20	7.14%	0.00%
1/29/20	6.25%	0.00%
1/30/20	7.27%	0.00%

1/31/20	5.56%	0.00%
2/1/20	5.39%	0.00%
2/2/20	5.00%	0.01%
2/3/20	4.79%	0.01%
2/4/20	4.25%	0.01%
2/5/20	3.96%	0.01%
2/6/20	4.15%	0.01%
2/7/20	4.10%	0.01%
2/8/20	6.12%	0.01%
2/9/20	7.20%	0.01%
2/10/20	6.35%	0.00%
2/11/20	10.08%	0.00%
2/12/20	13.58%	0.00%
2/13/20	15.24%	0.01%
2/14/20	14.29%	0.01%
2/15/20	14.74%	0.01%
2/16/20	15.00%	0.01%
2/17/20	14.29%	0.01%
2/18/20	15.32%	0.01%
2/19/20	15.43%	0.01%
2/20/20	14.58%	0.01%
2/21/20	14.37%	0.01%
2/22/20	11.87%	0.01%
2/23/20	10.94%	0.01%
2/24/20	9.80%	0.01%
2/25/20	9.26%	0.02%
2/26/20	9.93%	0.02%
2/27/20	8.90%	0.02%
2/28/20	7.92%	0.01%

1.6 世界其他地区疫情数量

```
others = confirmed[['Country/Region',last_update]][confirmed['Country/
    Region'] != 'Mainland China']
others['recovered'] = recovered[[last_update]][recovered['Country/Region
    '] != 'Mainland China']
others['death'] = deaths[[last_update]][deaths['Country/Region'] != '
    Mainland China']
others_countries = others.rename(columns = {last_update:'confirmed'})
others_countries = others_countries.set_index('Country/Region')
others_countries = others_countries.groupby('Country/Region').sum()
others_countries.to_csv('otherscountries.csv')
```

表 5　世界其他地区疫情数量

Country.Region	confirmed	recovered	death
Azerbaijan	1	0	0
Afghanistan	1	0	0
Algeria	1	0	0
Australia	23	11	0
Austria	3	0	0
Bahrain	36	0	0
Belarus	1	0	0
Belgium	1	1	0
Brazil	1	0	0
Cambodia	1	1	0
Canada	14	6	0
Croatia	5	0	0
Denmark	1	0	0
Egypt	1	1	0
Estonia	1	0	0
Finland	2	1	0
France	57	11	2
Georgia	1	0	0
Germany	48	16	0
Greece	4	0	0
Hong Kong	94	30	2
Iceland	1	0	0
India	3	3	0
Iran	388	73	34
Iraq	7	0	0
Israel	4	1	0
Italy	888	46	21
Japan	228	22	4
Kuwait	45	0	0
Lebanon	2	0	0
Lithuania	1	0	0
Macau	10	8	0
Malaysia	23	18	0
Mexico	1	0	0
Nepal	1	1	0
Netherlands	1	0	0
New Zealand	1	0	0
Nigeria	1	0	0
North Ireland	1	0	0
North Macedonia	1	0	0

Norway	6	0	0
Oman	4	0	0
Others	705	10	1
Pakistan	2	0	0
Philippines	3	1	1
Romania	3	0	0
Russia	2	2	0
San Marino	1	0	0
Singapore	93	62	0
South Korea	2337	22	13
Spain	32	2	0
Sri Lanka	1	1	0
Sweden	7	0	0
Switzerland	8	0	0
Taiwan	34	6	1
Thailand	41	28	0
UK	20	8	0
US	62	7	0
United Arab Emirates	19	5	0
Vietnam	16	16	0

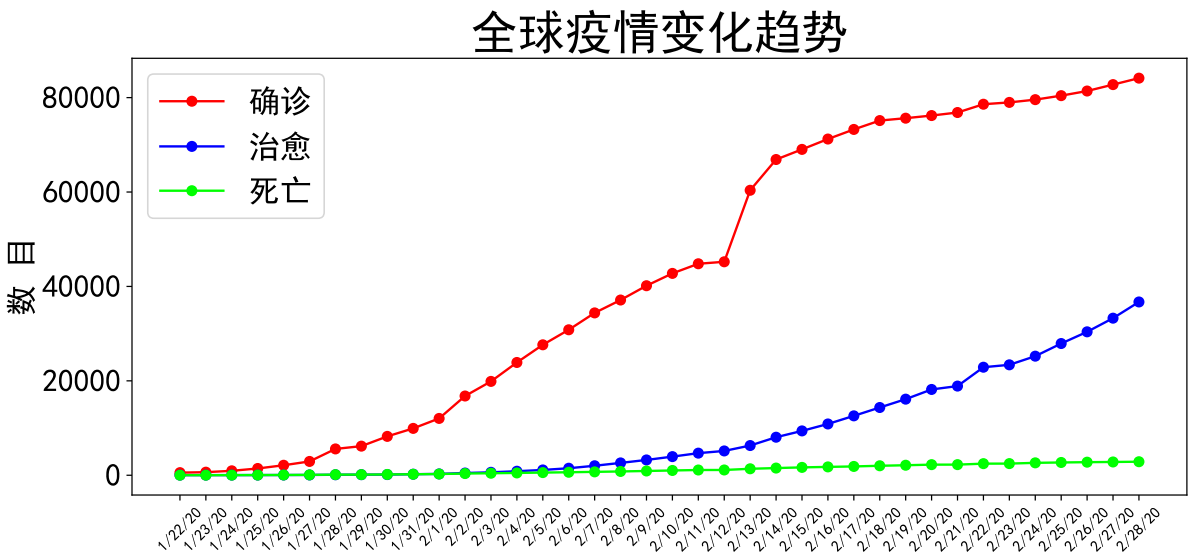
2 数据可视化

2.1 全球疫情变化趋势图

```
import matplotlib.pyplot as plt
plt.rcParams['font.sans-serif']=['SimHei']#用来正常显示中文标签
plt.rcParams['axes.unicode_minus']=False#用来显示正常负号
plt.figure(figsize=(12,5))
plt.plot(all_confirmed,c='r',label='确诊',marker ='o')
plt.plot(all_recovered,c = 'b',label = '治愈',marker = 'o')
plt.plot(all_deaths,c = 'lime',label = '死亡',marker = 'o')
plt.xticks(rotation=45,size=10)
```

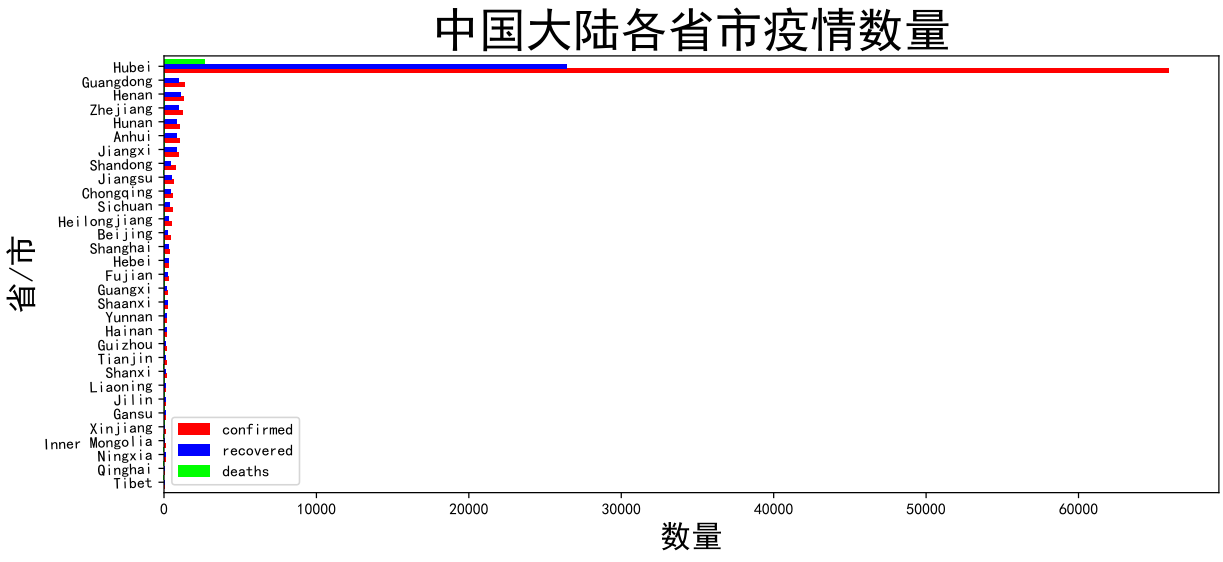
```
plt.yticks(size=20)
```

```
plt.xlabel('时 间',size = 20)
plt.ylabel('数 目',size = 20)
plt.title('全球疫情变化趋势',size = 30)
plt.legend(loc = "upper left",fontsize = 20)
plt.show()
```



2.2 中国大陆每个省份的疫情数量图

```
Mainland_china = China_cases.sort_values(by='confirmed',ascending=True)
Mainland_china.plot(kind='barh', figsize=(12,5), color = ['red','blue','
    lime'], width=1, rot=2)
plt.title('中国大陆各省市疫情数量',size=30)
plt.ylabel('省/市',size=20)
plt.xlabel('数量',size = 20)
plt.show()
```



可以看到，湖北省三项数据高居第一位，且远远高于其他省份。

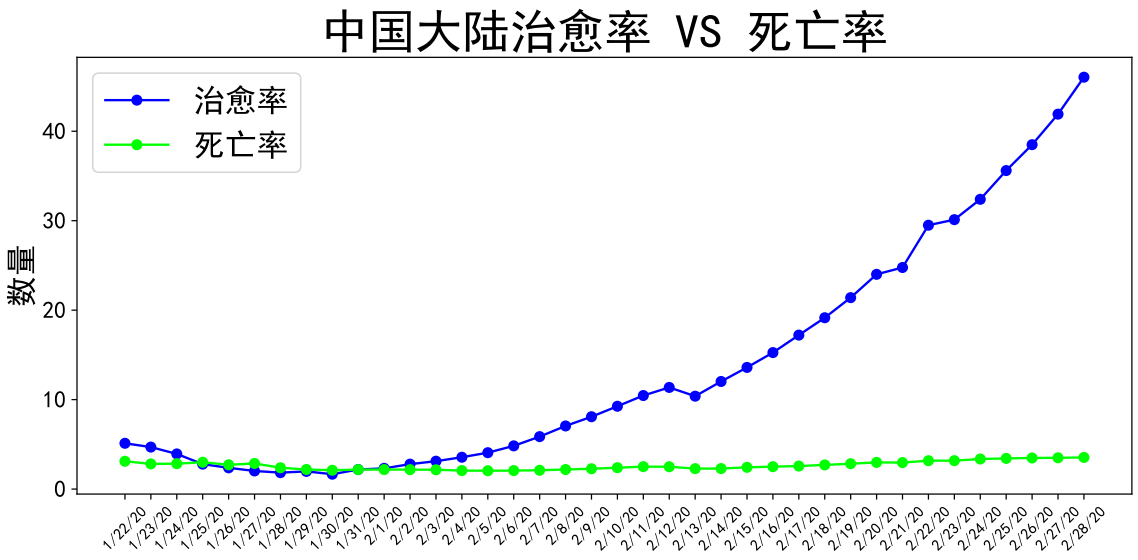
2.3 中国大陆治愈率 VS 死亡率趋势图

```
plt.figure(figsize=(12,5))
plt.plot(recover_rate, color = 'blue', label = '治愈率', marker = 'o')
plt.plot(death_rate, color = 'lime', label = '死亡率', marker = 'o')
plt.title('中国大陆治愈率 VS 死亡率',size=30)
```

```
plt.ylabel('数量',size=20)
plt.xlabel('时间',size=20)
plt.xticks(rotation=45,size=10)
```

```
plt.yticks(size=15)
```

```
plt.legend(loc = "upper left",fontsize = 20)
plt.show()
```



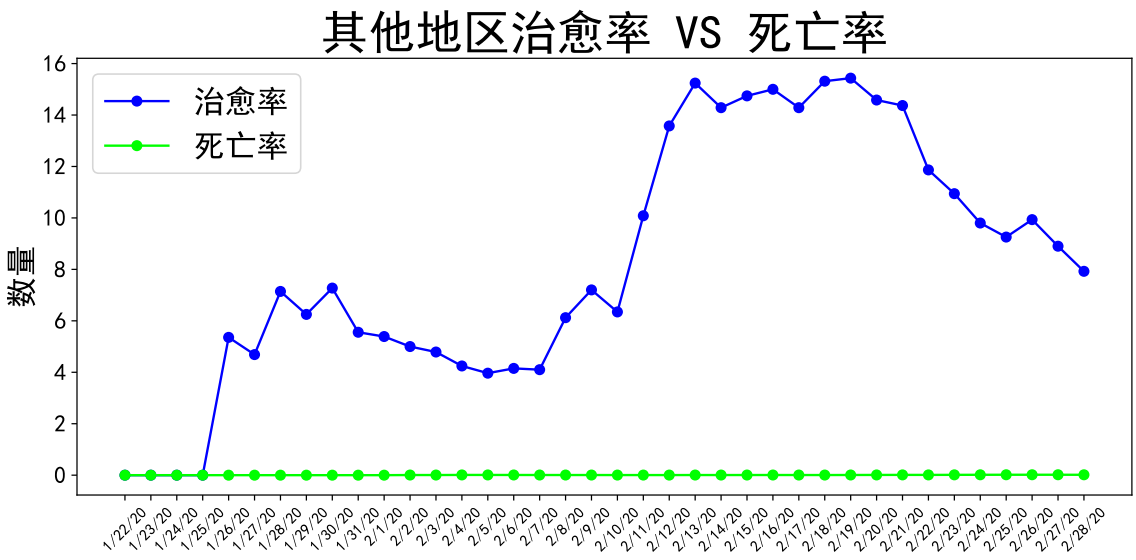
在 1 月 25 日-1 月 31 日期间死亡率略高于治愈率，但其他时间段，治愈率远远高于死亡率

2.4 其他地区治愈率 VS 死亡率趋势图

```
plt.figure(figsize=(12,5))
plt.plot(other_recover_rate, color = 'blue', label = '治愈率', marker =
    'o')
plt.plot(other_death_rate, color = 'lime', label = '死亡率', marker = 'o
    ')
plt.title('其他地区治愈率 VS 死亡率',size=30)
plt.ylabel('数量',size=20)
plt.xlabel('时间',size=20)
plt.xticks(rotation=45,size=10)
```

```
plt.yticks(size=15)
```

```
plt.legend(loc = "upper left",fontsize = 20)
plt.show()
```

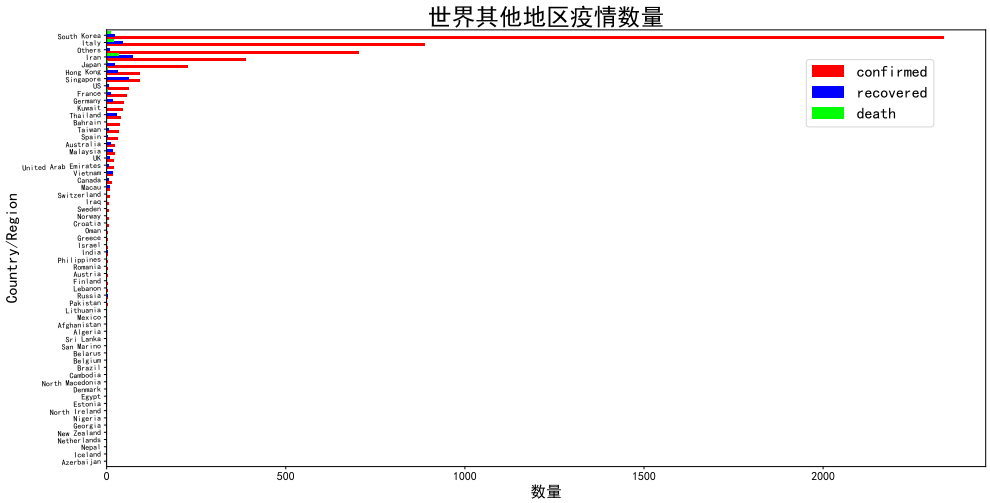


2.5 世界其他地区疫情数量

```
others_countries.sort_values(by = 'confirmed',ascending = True).plot(
    kind='barh',
figsize=(20,10), color = ['red','blue','lime'],
width=1, rot=2)
plt.title('世界其他地区疫情数量', size=30)
plt.ylabel('Country/Region',size = 20)
plt.xlabel('数量',size = 20)
plt.yticks(size=10)
```

```
plt.xticks(size=15)
```

```
plt.legend(bbox_to_anchor=(0.95,0.95),fontsize = 20)
plt.show()
```



3 绘制疫情地图

3.1 用 folium 包绘制

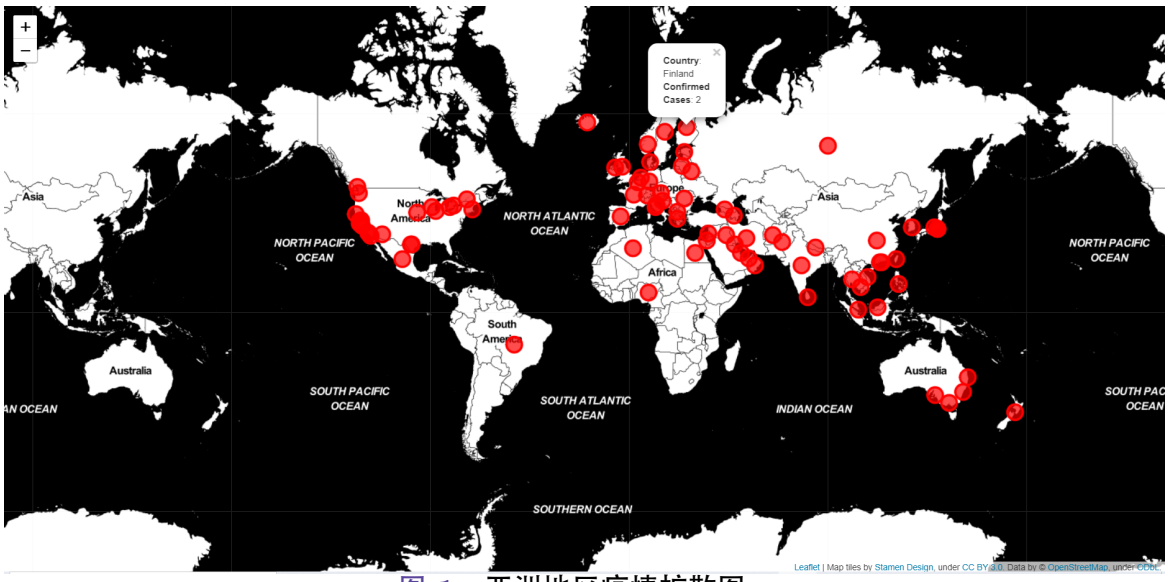


图 1　亚洲地区疫情扩散图

```
# 疫情地图数据
others=confirmed[['Country/Region','Lat','Long',last_update]][confirmed[
    'Country/Region'] != 'Mainland China']
others['recovered'] = recovered[[last_update]][recovered['Country/Region
    '] != 'Mainland China']
others['death'] = deaths[[last_update]][deaths['Country/Region'] != '
    Mainland China']
others_countries = others.rename(columns = {last_update:'confirmed'})
others_countries.loc['94'] = ['Mainland China',30.9756,112.2707,
    confirmed_china[-1],recovered_china[-1],deaths_china[-1]]
```

```
import folium
world_map = folium.Map(location=[10, -20], zoom_start=2.3,tiles='Stamen
    Toner')

for lat, lon, value, name in zip(others_countries['Lat'], others_
    countries['Long'],
others_countries['confirmed'], others_countries['Country/Region']):
    folium.CircleMarker([lat, lon],
    radius=10,
    popup = ('<strong>Country</strong>: ' + str(name).capitalize() + '<
    br>'
    '<strong>Confirmed Cases</strong>: ' + str(value) + '<br>'),
     color='red',
     fill_color='red',
     fill_opacity=0.7 ).add_to(world_map)
```

```
world_map
```

```
world_map.save("wordmap.html")
import webbrowser
webbrowser.open('wordmap.html')
```

用 folium 绘制每日疫情扩散地图如图1所示。这是一种可交互的地图，可以随意移动缩放，鼠标点击地图上红点，即可出现地区的疫情信息。

3.2 用 plotly 绘制每日疫情扩散地图

```
import plotly.express as px

#确诊数
confirmed = confirmed.melt(id_vars = ['Province/State', 'Country/Region', 'Lat', 'Long'],var_name='date',value_name = 'confirmed')
#confirmed.head()

#把date列转换成datetime格式
confirmed['date_dt'] = pd.to_datetime(confirmed.date, format="%m/%d/%y")
confirmed.date = confirmed.date_dt.dt.date
confirmed.rename(columns={'Country/Region': 'country', 'Province/State': 'province'}, inplace=True)
#confirmed

#治愈数、死亡数
recovered = recovered.melt(id_vars = ['Province/State','Country/Region', 'Lat', 'Long'],var_name='date',value_name = 'recovered')
recovered['date_dt'] = pd.to_datetime(recovered.date, format="%m/%d/%y")
recovered.date = recovered.date_dt.dt.date
recovered.rename(columns={'Country/Region': 'country', 'Province/State': 'province'}, inplace=True)

deaths = deaths.melt(id_vars = ['Province/State', 'Country/Region', 'Lat', 'Long'],var_name='date', value_name = 'deaths')
deaths['date_dt'] = pd.to_datetime(deaths.date, format="%m/%d/%y")
deaths.date = deaths.date_dt.dt.date
deaths.rename(columns={'Country/Region': 'country', 'Province/State': 'province'}, inplace=True)

#将三种数据合并在一起
merge_on = ['province', 'country', 'date']
all_date = confirmed.merge(deaths[merge_on + ['deaths']], how='left', on=merge_on). \
merge(recovered[merge_on + ['recovered']], how='left', on=merge_on)

Coronavirus_map = all_date.groupby(['date_dt', 'province'])['confirmed', 'deaths',
'recovered', 'Lat', 'Long'].max().reset_index()
Coronavirus_map['size'] = Coronavirus_map.confirmed.pow(0.5)  # 创建实心圆大小
Coronavirus_map['date_dt'] = Coronavirus_map['date_dt'].dt.strftime('%Y-%m-%d')

fig = px.scatter_geo(Coronavirus_map, lat='Lat', lon='Long',scope='asia',
color="size", size='size', hover_name='province',
hover_data=['confirmed', 'deaths', 'recovered'],
projection="natural earth",animation_frame="date_dt",
title='亚洲地区疫情扩散图')
```

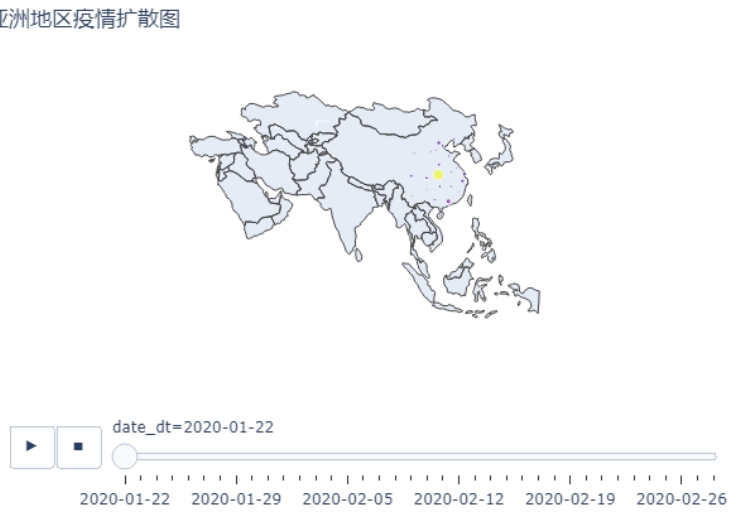


图 2　亚洲地区疫情扩散图

```
39 fig.update(layout_coloraxis_showscale=False)
1  fig.show()
```

用 plotly 绘制每日疫情扩散地图如图2所示