Covid19 Germany Deutschland (RKI data)

July 29, 2020

[1]:
```
# This Python 3 environment comes with many helpful analytics libraries␣
 ↪installed
# It is defined by the kaggle/python docker image: https://github.com/kaggle/
 ↪docker-python
# For example, here's several helpful packages to load in

import os
import urllib
import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
import matplotlib as mpl
import matplotlib.pyplot as plt
import seaborn as sns

# Input data files are available in the "../input/" directory.
# For example, running this (by clicking run or pressing Shift+Enter) will list␣
 ↪all files under the input directory

# import os
# for dirname, _, filenames in os.walk('/kaggle/input'):
#     for filename in filenames:
#         print(os.path.join(dirname, filename))

# # Any results you write to the current directory are saved as output.

sns.set()
%matplotlib inline

# This checks if the notebook is executed on Kaggle or on your local machine and
# acts accordingly with filenames. On Kaggle the dataset is already managed by␣
 ↪a managed
# and downloaded to (URLs are linked) a dataset there.
try:
    os.environ['KAGGLE_DATA_PROXY_TOKEN']
except KeyError:
    # daily infections in Germany
```

```
    url_daily_corona = "https://opendata.arcgis.com/datasets/
↪dd4580c810204019a7b8eb3e0b329dd6_0.csv"

    # infections per 100k residents in German states
    url_corona_bl_100k = "https://opendata.arcgis.com/datasets/
↪ef4b445a53c1406892257fe63129a8ea_0.csv"

    # infections per 100k residents in German provinces
    url_corona_provinces = "https://opendata.arcgis.com/datasets/
↪917fc37a709542548cc3be077a786c17_0.csv"

    fname1 = "./RKI_covid19_daily_de.csv"
    fname2 = "./RKI_covid19_states_100k.csv"
    fname3 = "./RKI_covid19_provinces_100k.csv"

    urllib.request.urlretrieve(url_daily_corona, fname1)
    urllib.request.urlretrieve(url_daily_corona, fname2)
    urllib.request.urlretrieve(url_daily_corona, fname3)

    fname4 = "./additional_data/covid19_events_measures.csv"

else:
    dirname = "/kaggle/input/covid19-data-germany-robert-koch-institute/"
    dirname_additional = "/kaggle/input/additional-covid19-data/additional_data/
↪"
    # daily infections in Germany
    fname1 = dirname + "dd4580c810204019a7b8eb3e0b329dd6_0.csv"

    # infections per 100k residents in German states
    fname2 = dirname + "ef4b445a53c1406892257fe63129a8ea_0.csv"

    # infections per 100k residents in German provinces
    fname3 = dirname + "917fc37a709542548cc3be077a786c17_0.csv"

    fname4 = dirname_additional + "covid19_events_measures.csv"


df_daily_data = pd.read_csv(fname1, parse_dates=["Meldedatum"],␣
↪date_parser=lambda ts: pd.Timestamp(ts).strftime('%Y-%m-%d'))
df_measures_events = pd.read_csv(fname4, parse_dates=["Date"])

df_daily_data.sort_values(['Meldedatum'], inplace=True)
df_measures_events.sort_values(['Date'], inplace=True)
```

[2]:
```
df_daily_data
```

[2]:

	ObjectId	IdBundesland	Bundesland	Landkreis	\
113391	23238440	9	Bayern	LK Landsberg a.Lech	
117699	23242748	9	Bayern	LK Starnberg	
112367	23237416	9	Bayern	LK Fürstenfeldbruck	
104923	23229972	9	Bayern	SK München	
118298	23243347	9	Bayern	LK Traunstein	
…	…	…	…	…	
142695	23267744	9	Bayern	LK Oberallgäu	
17430	23142479	3	Niedersachsen	LK Vechta	
51384	23176433	5	Nordrhein-Westfalen	SK Dortmund	
17382	23142431	3	Niedersachsen	LK Vechta	
64107	23189156	6	Hessen	LK Limburg-Weilburg	

	Altersgruppe	Geschlecht	AnzahlFall	AnzahlTodesfall	Meldedatum	\
113391	A15-A34	M	1	0	2020-01-28	
117699	A35-A59	M	1	0	2020-01-28	
112367	A15-A34	M	1	0	2020-01-29	
104923	A15-A34	W	1	0	2020-01-29	
118298	A35-A59	M	1	0	2020-01-31	
…	…	…	…	…	…	
142695	A05-A14	M	1	0	2020-07-27	
17430	A35-A59	M	1	0	2020-07-27	
51384	A35-A59	W	1	0	2020-07-27	
17382	A15-A34	W	3	0	2020-07-27	
64107	A15-A34	M	1	0	2020-07-27	

	IdLandkreis	Datenstand	NeuerFall	NeuerTodesfall	\
113391	9181	28.07.2020, 00:00 Uhr	0	-9	
117699	9188	28.07.2020, 00:00 Uhr	0	-9	
112367	9179	28.07.2020, 00:00 Uhr	0	-9	
104923	9162	28.07.2020, 00:00 Uhr	0	-9	
118298	9189	28.07.2020, 00:00 Uhr	0	-9	
…	…	…	…	…	
142695	9780	28.07.2020, 00:00 Uhr	1	-9	
17430	3460	28.07.2020, 00:00 Uhr	1	-9	
51384	5913	28.07.2020, 00:00 Uhr	1	-9	
17382	3460	28.07.2020, 00:00 Uhr	1	-9	
64107	6533	28.07.2020, 00:00 Uhr	1	-9	

	Refdatum	NeuGenesen	AnzahlGenesen	IstErkrankungsbeginn	\
113391	2020/01/23 00:00:00	0	1	1	
117699	2020/01/27 00:00:00	0	1	1	
112367	2020/01/25 00:00:00	0	1	1	
104923	2020/01/23 00:00:00	0	1	1	
118298	2020/01/24 00:00:00	0	1	1	
…	…	…	…	…	
142695	2020/07/27 00:00:00	-9	0	0	

```
17430   2020/07/27 00:00:00          -9              0                    0
51384   2020/07/27 00:00:00          -9              0                    0
17382   2020/07/27 00:00:00          -9              0                    0
64107   2020/07/27 00:00:00          -9              0                    0

            Altersgruppe2
113391  Nicht übermittelt
117699  Nicht übermittelt
112367  Nicht übermittelt
104923  Nicht übermittelt
118298  Nicht übermittelt
…                     …
142695  Nicht übermittelt
17430   Nicht übermittelt
51384   Nicht übermittelt
17382   Nicht übermittelt
64107   Nicht übermittelt

[166624 rows x 18 columns]
```

[3]:
```
print("Measures taken and events/incidents concerning Covid19."
      + "These might show a connection to the falling or rising of the curves:")
df_measures_events
```

```
Measures taken and events/incidents concerning Covid19.These might show a
connection to the falling or rising of the curves:
```

[3]:
```
         Date                                          In_Short   State  \
0 2020-03-16                Schools, day care centers closed.    Alle
1 2020-03-16            Entry bans and strict border controls.    Alle
2 2020-03-20    Quarantine Bavaria, only vital locations open.  Bayern
3 2020-03-22  Quarantine country-wide, only vital locations …    Alle

                                      Description
0                 Schools, day care centers closed.
1  Germany has decided on entry bans and strict c…
2  Only vital location, like supermarkets, doctor…
3  Only vital location, like supermarkets, doctor…
```

[4]:
```
print("Total sum of cases in Germany:")
df_daily_data["AnzahlFall"].sum()
```

```
Total sum of cases in Germany:
```

[4]:
```
206236
```

[5]:
```
print("Describe number of cases per day in Germany:")
df_daily_data.groupby("Meldedatum").sum()["AnzahlFall"].describe()
```

```
Describe number of cases per day in Germany:
```

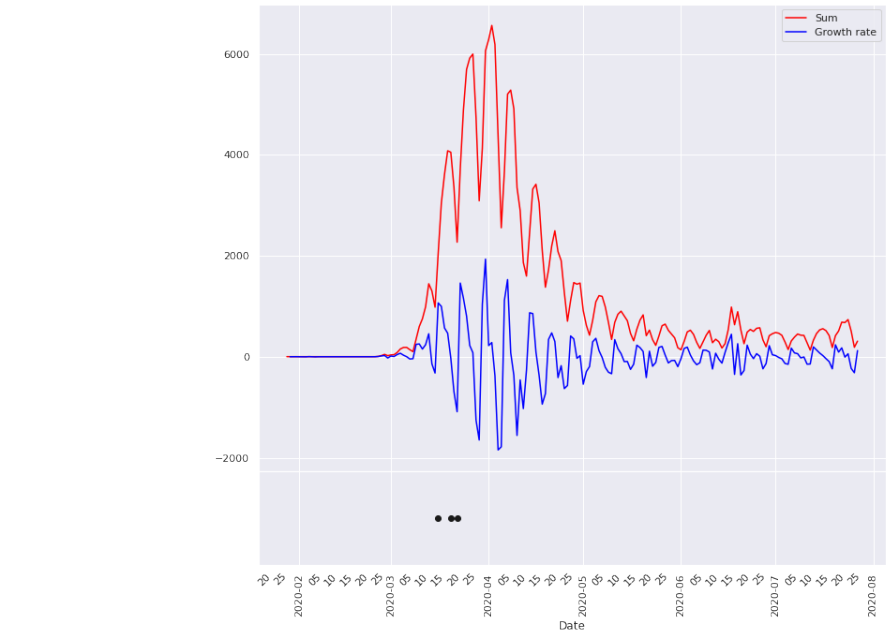
[5]:
```
count     166.000000
mean     1242.385542
std      1596.577239
min         1.000000
25%       297.250000
50%       529.000000
75%      1443.000000
max      6562.000000
Name: AnzahlFall, dtype: float64
```

[6]:
```
# def annotationsForDate(df, date):
#     """
#     Takes the measures df and a time index and returns all the short
#     measure descriptions as a string for the annotations below
#     """
#     query = df_measures_events.query("Date == '{}'".format(date))
#     ann = ""
#     for i in query.index:
#         state = ""
#         if query["State"].iloc[i]:
#             state = query["State"].iloc[i] + ": "
#         s = query["In_Short"].iloc[i]
#         ann += s + '\n'
#     return ann.rstrip()
```

[7]:
```
gr_day_reported = df_daily_data.groupby('Meldedatum')

# TODO: make these relative to screen size somehow
figsize = (12,11)
fig, ax = plt.subplots(2, 1, figsize=figsize, sharex=True,␣
 ↪gridspec_kw={'height_ratios': [5, 1]})
fig.subplots_adjust(hspace=0.0)
suptitel_attr = {"fontsize" : 16, "fontweight" : "bold", "ha" : "center", "va" :
 ↪ "bottom", "y" : 0.94}

# set plot stuff
fig.suptitle("Sum of confirmed cases per day and growth rate thereof for␣
 ↪Germany. Below are points "
             + "for political measures or events/incidents.", **suptitel_attr)

for axis in ax.flat:
    axis.set_xlabel('Date')
```

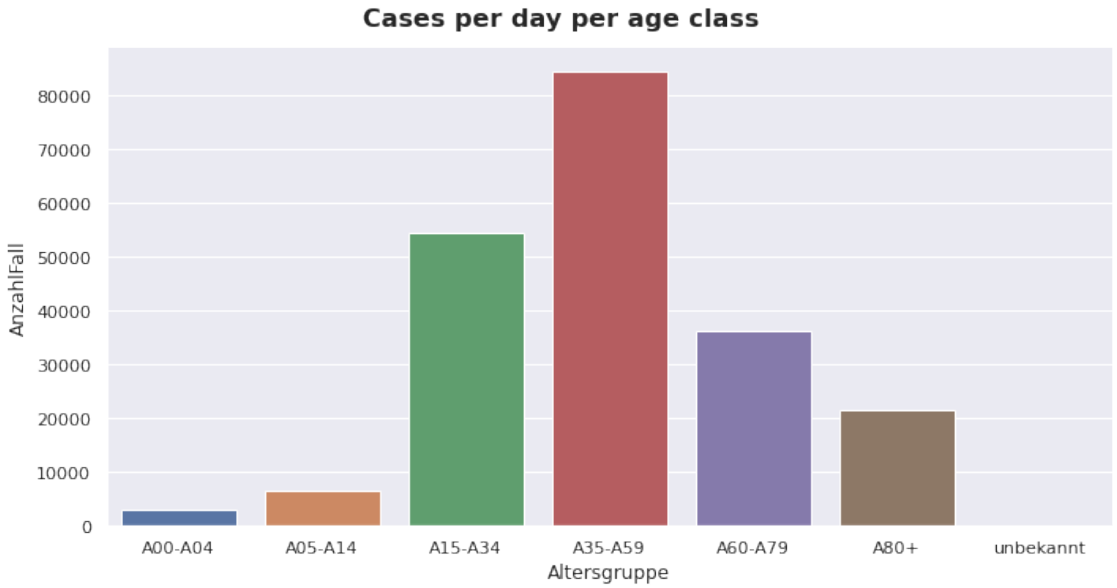
```
    rule = mpl.dates.rrulewrapper(mpl.dates.MONTHLY,  bymonthday=(5, 10, 15,␣
↪20, 25))
    axis.xaxis.set_minor_locator(mpl.dates.RRuleLocator(rule))
    axis.xaxis.set_minor_formatter(mpl.dates.DateFormatter("%d"))
    axis.xaxis.set_major_locator(mpl.dates.MonthLocator(bymonthday=1))
    axis.xaxis.set_major_formatter(mpl.dates.DateFormatter('%Y-%m'))

ax[1].yaxis.set_minor_locator(mpl.ticker.NullLocator())
ax[1].yaxis.set_major_locator(mpl.ticker.NullLocator())

sum_cases_per_day = gr_day_reported['AnzahlFall'].sum()
growth_rate = sum_cases_per_day.diff()

ax[0].plot(sum_cases_per_day, color='red', label='Sum')
ax[0].plot(growth_rate, color='blue', label='Growth rate')

plt.setp(ax[0].xaxis.get_majorticklabels(), rotation=90)
plt.setp(ax[0].xaxis.get_minorticklabels(), rotation=45)


for d in df_measures_events["Date"].unique():
    #s = annotationsForDate(df_measures_events, d)
    #axs[1].annotate(s = "bla", xy=(d, sum_cases_per_day[d]), xytext=(-50,-10),␣
↪xycoords="data")
    pass

ax[1].scatter(df_measures_events["Date"].unique(),␣
↪len(df_measures_events["Date"].unique()) * [100], c='k')

for axis in ax.flat:
    plt.setp(axis.xaxis.get_majorticklabels(), rotation=90)
    plt.setp(axis.xaxis.get_minorticklabels(), rotation=45)

ax[0].legend()
```

[7]: <matplotlib.legend.Legend at 0x7f62b71284d0>



[8]:
```
g_ages = df_daily_data.groupby("Altersgruppe")
ages_cases = g_ages["AnzahlFall"].sum().reset_index()
cp = sns.catplot("Altersgruppe", "AnzahlFall", data=ages_cases, kind="bar",␣
↪aspect = 2)
suptitel_attr = {"fontsize" : 16, "fontweight" : "bold", "ha" : "center", "va" :
↪ "bottom", "y" : 1}
cp.fig.suptitle("Cases per day per age class", **suptitel_attr)
```

[8]: Text(0.5, 1, 'Cases per day per age class')



[9]:
```
print("Total sum of cases per German state")
df_daily_data.groupby(['Bundesland'])["AnzahlFall"].sum()
```

```
Total sum of cases per German state
```

[9]:
```
Bundesland
Baden-Württemberg          36914
Bayern                     50588
Berlin                      9020
Brandenburg                 3527
Bremen                      1752
Hamburg                     5326
Hessen                     11742
Mecklenburg-Vorpommern       845
Niedersachsen              14288
Nordrhein-Westfalen        47739
Rheinland-Pfalz             7442
Saarland                    2852
Sachsen                     5518
Sachsen-Anhalt              1991
Schleswig-Holstein          3341
Thüringen                   3351
Name: AnzahlFall, dtype: int64
```

[10]:
```
print("Describe sum of daily cases per day per German state.")
df_daily_data.groupby(['Bundesland', "Meldedatum"])['AnzahlFall'].sum().
 ↪unstack().T.fillna(0).describe().round(decimals=0)
```

Describe sum of daily cases per day per German state.

[10]:

Bundesland	Baden-Württemberg	Bayern	Berlin	Brandenburg	Bremen	Hamburg
count	166.0	166.0	166.0	166.0	166.0	166.0
mean	222.0	305.0	54.0	21.0	11.0	32.0
std	336.0	466.0	59.0	31.0	13.0	51.0
min	0.0	0.0	0.0	0.0	0.0	0.0
25%	24.0	42.0	16.0	2.0	1.0	2.0
50%	52.0	88.0	35.0	6.0	7.0	5.0
75%	288.0	309.0	68.0	26.0	15.0	40.0
max	1423.0	1988.0	286.0	136.0	108.0	211.0

Bundesland	Hessen	Mecklenburg-Vorpommern	Niedersachsen
count	166.0	166.0	166.0
mean	71.0	5.0	86.0
std	80.0	9.0	101.0
min	0.0	0.0	0.0
25%	18.0	0.0	16.0
50%	38.0	1.0	50.0
75%	90.0	5.0	99.0
max	329.0	50.0	410.0

Bundesland	Nordrhein-Westfalen	Rheinland-Pfalz	Saarland	Sachsen
count	166.0	166.0	166.0	166.0
mean	288.0	45.0	17.0	33.0
std	297.0	61.0	32.0	52.0
min	0.0	0.0	0.0	0.0
25%	94.0	7.0	1.0	1.0
50%	184.0	17.0	3.0	8.0
75%	337.0	54.0	18.0	36.0
max	1205.0	271.0	178.0	250.0

Bundesland	Sachsen-Anhalt	Schleswig-Holstein	Thüringen
count	166.0	166.0	166.0
mean	12.0	20.0	20.0
std	17.0	29.0	23.0
min	0.0	0.0	0.0
25%	1.0	1.0	2.0
50%	4.0	7.0	10.0
75%	15.0	24.0	31.0
max	78.0	117.0	85.0

[11]:
```
# Get daily cases and growth rate per German state

loc_unknown_col = "-nicht erhoben-"
state_names = df_daily_data['Bundesland'].unique()
# remove column name for unknown location of the case
```

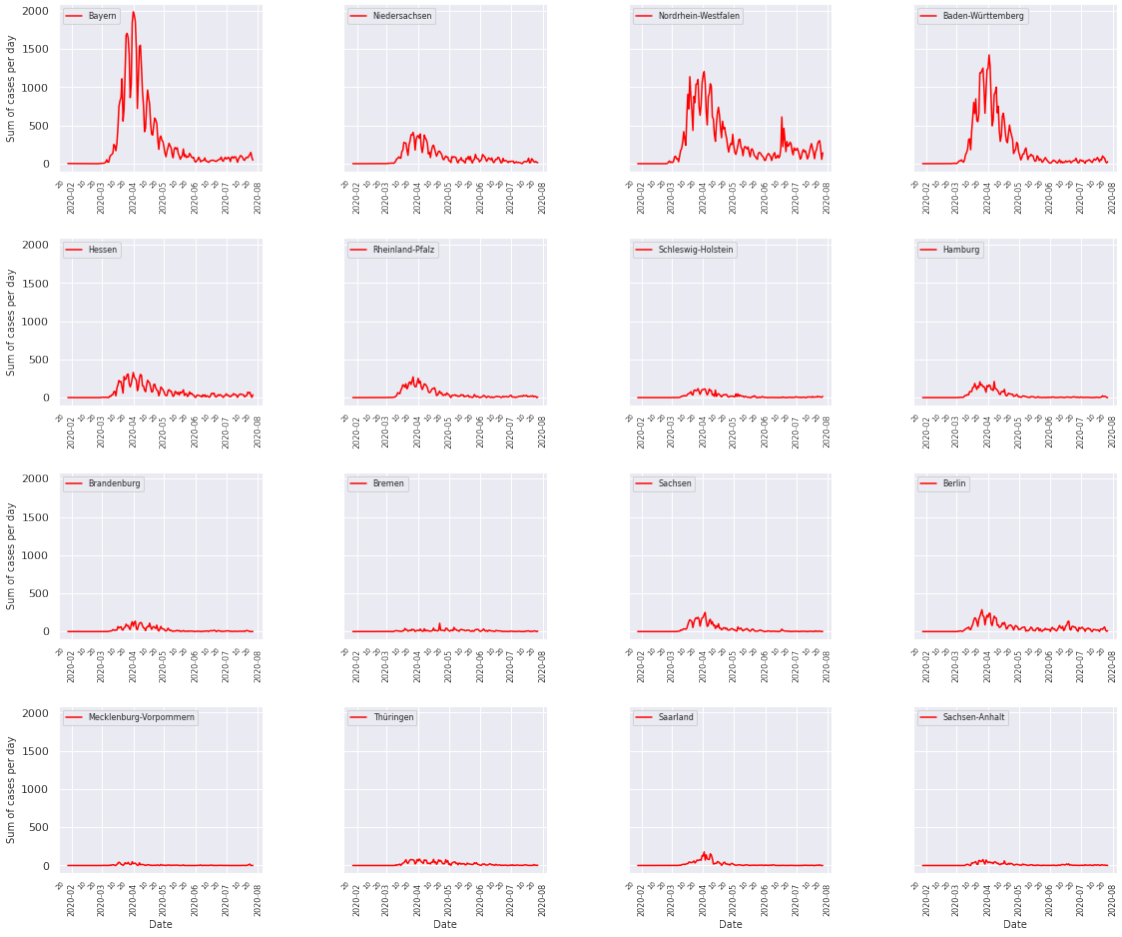
```
index = np.where(state_names == loc_unknown_col)
state_names = np.delete(state_names, index)

states_daily = df_daily_data.groupby(['Meldedatum',␣
↪'Bundesland'])['AnzahlFall'].sum()
df_per_state_daily = pd.DataFrame()
for state in state_names:
    df_per_state_daily[state] = states_daily.unstack()[state].fillna(0)
```

[12]:
```
# TODO: make these relative to screen size somehow
figsize = (19,16)
ax_label_fontsize = 10.0
legend_fontsize = 8.0
major_tick_fontsize = 8.0
minor_tick_fontsize = 7.0
tick_monthdays = (10, 20)
```

[13]:
```
# Plot sum of confirmed cases per day per German state

fig, ax = plt.subplots(4, 4, sharey=True, figsize=figsize)
fig.subplots_adjust(hspace = 0.4, wspace = 0.4)

fig.suptitle("Sum of cases per day per German state", **suptitel_attr)

for axis in ax.flat:
    rule = mpl.dates.rrulewrapper(mpl.dates.MONTHLY,  bymonthday=tick_monthdays)
    axis.xaxis.set_minor_locator(mpl.dates.RRuleLocator(rule))
    axis.xaxis.set_minor_formatter(mpl.dates.DateFormatter("%d"))
    axis.xaxis.set_major_locator(mpl.dates.MonthLocator(bymonthday=1))
    axis.xaxis.set_major_formatter(mpl.dates.DateFormatter('%Y-%m'))

    for tick in axis.xaxis.get_major_ticks():
            tick.label.set_fontsize(tick_fontsize)

for plt_row in ax:
    plt_row[0].set_ylabel('Sum of cases per day', fontsize=ax_label_fontsize)

for column_plots in ax.T:
    column_plots[-1].set_xlabel('Date', fontsize=ax_label_fontsize)

ix = 0
for subp in ax.flat:
    state = state_names[ix]
    subp.plot(df_per_state_daily[state], color='red', label = "{}".
↪format(state))
    subp.legend(fontsize=legend_fontsize, loc="upper left")
    plt.setp(subp.xaxis.get_majorticklabels(), rotation=90)
```

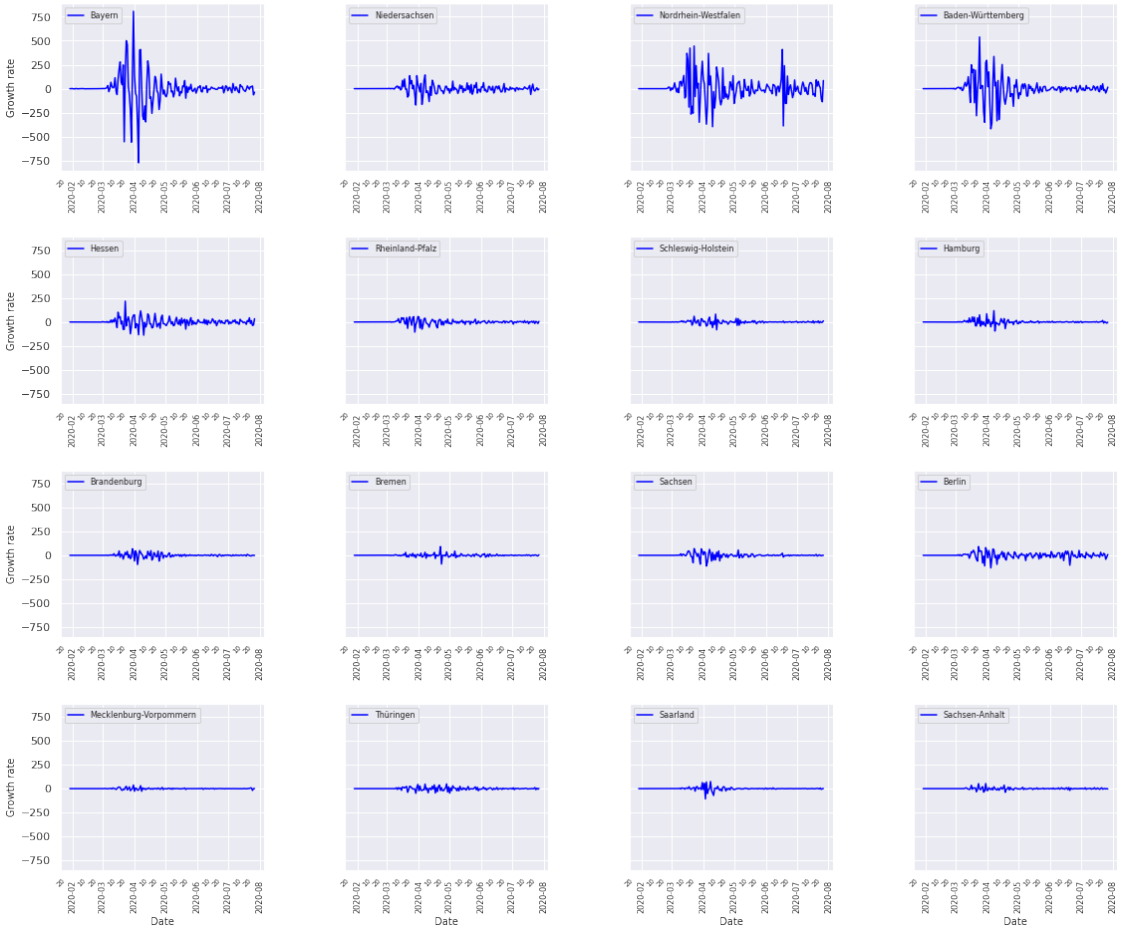
```
    plt.setp(subp.xaxis.get_minorticklabels(), rotation=45)
    for tick in subp.xaxis.get_major_ticks():
            tick.label.set_fontsize(major_tick_fontsize)
    for tick in subp.xaxis.get_minor_ticks():
            tick.label.set_fontsize(minor_tick_fontsize)
    ix += 1
```

Sum of cases per day per German state



[14]:
```
# Plot growth rate of daily confirmed cases per German state

fig, ax = plt.subplots(4, 4, sharey=True, figsize=figsize)
fig.subplots_adjust(hspace = 0.4, wspace = 0.4)

fig.suptitle("Growth rate of cases per day per German state", **suptitel_attr)
```

```
for axis in ax.flat:
    rule = mpl.dates.rrulewrapper(mpl.dates.MONTHLY,  bymonthday=tick_monthdays)
    axis.xaxis.set_minor_locator(mpl.dates.RRuleLocator(rule))
    axis.xaxis.set_minor_formatter(mpl.dates.DateFormatter("%d"))
    axis.xaxis.set_major_locator(mpl.dates.MonthLocator(bymonthday=1))
    axis.xaxis.set_major_formatter(mpl.dates.DateFormatter('%Y-%m'))

    for tick in axis.xaxis.get_major_ticks():
            tick.label.set_fontsize(tick_fontsize)

for plt_row in ax:
    plt_row[0].set_ylabel('Growth rate', fontsize=ax_label_fontsize)

for column_plots in ax.T:
    column_plots[-1].set_xlabel('Date', fontsize=ax_label_fontsize)

ix = 0
for subp in ax.flat:
    state = state_names[ix]
    subp.plot(df_per_state_daily[state].diff(), color='blue', label = "{}".
 ↪format(state))
    subp.legend(fontsize=legend_fontsize, loc="upper left")
    plt.setp(subp.xaxis.get_majorticklabels(), rotation=90)
    plt.setp(subp.xaxis.get_minorticklabels(), rotation=45)
    for tick in subp.xaxis.get_major_ticks():
            tick.label.set_fontsize(major_tick_fontsize)
    for tick in subp.xaxis.get_minor_ticks():
            tick.label.set_fontsize(minor_tick_fontsize)
    ix += 1
```


Growth rate of cases per day per German state
Bayern
Niedersachsen
Nordrhein-Westfalen
Baden-Württemberg
Hessen
Rheinland-Pfalz
Schleswig-Holstein
Hamburg
Brandenburg
Bremen
Sachsen
Berlin
Mecklenburg-Vorpommern
Thüringen
Saarland
Sachsen-Anhalt
Growth rate
Date