Covid-19 Vaccination Campaign in Germany

The data used here were provided by Robert Koch Institute and the German federal ministry of Health.

These institutions publish the datasets and some analysis on the page impfdashboard.de.

Setup

Imports

In [1]:
```
# standard library
import datetime
import math
```

In [2]:
```
# third party
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import requests
import seaborn
```

Date this Notebook was run

In [3]:
```
today = datetime.datetime.today().strftime('%Y-%m-%d')
today
```

Out[3]:
```
'2021-10-21'
```

Set Defaults

In [4]:
```
# style like ggplot in R
plt.style.use('ggplot')
```

In [5]:
```
# Avoid cutting off part of the axis labels, see:
# https://stackoverflow.com/questions/6774086/why-is-my-xlabel-cut-off-in-my-matplotlib-plot
plt.rcParams.update({'figure.autolayout': True})
```

In [6]:
```
population_germany = 83_200_000
```

Get and Transform Data

In [7]:
```
vaccination_data_permalink = 'https://impfdashboard.de/static/data/germany_vaccinations_timeseries_v2.tsv'
vaccinations = pd.read_csv(
    vaccination_data_permalink,
    sep="\t")
```

Drop unnecessary / misleading columns

List all columns:

In [8]:
```
vaccinations.columns
```

Out[8]:
```
Index(['date', 'dosen_kumulativ', 'dosen_biontech_kumulativ',
       'dosen_biontech_erst_kumulativ', 'dosen_biontech_zweit_kumulativ',
       'dosen_biontech_dritt_kumulativ', 'dosen_moderna_kumulativ',
       'dosen_moderna_erst_kumulativ', 'dosen_moderna_zweit_kumulativ',
       'dosen_moderna_dritt_kumulativ', 'dosen_astra_kumulativ',
       'dosen_astra_erst_kumulativ', 'dosen_astra_zweit_kumulativ',
       'dosen_astra_dritt_kumulativ', 'dosen_johnson_kumulativ',
       'dosen_erst_kumulativ', 'dosen_zweit_kumulativ',
       'dosen_dritt_kumulativ', 'dosen_differenz_zum_vortag',
       'dosen_erst_differenz_zum_vortag', 'dosen_zweit_differenz_zum_vortag',
       'dosen_dritt_differenz_zum_vortag', 'personen_erst_kumulativ',
       'personen_voll_kumulativ', 'personen_auffrisch_kumulativ',
       'impf_quote_erst', 'impf_quote_voll', 'dosen_dim_kumulativ',
       'dosen_kbv_kumulativ', 'indikation_alter_dosen',
       'indikation_beruf_dosen', 'indikation_medizinisch_dosen',
       'indikation_pflegeheim_dosen', 'indikation_alter_erst',
       'indikation_beruf_erst', 'indikation_medizinisch_erst',
       'indikation_pflegeheim_erst', 'indikation_alter_voll',
       'indikation_beruf_voll', 'indikation_medizinisch_voll',
       'indikation_pflegeheim_voll'],
      dtype='object')
```

Columns with names starting with 'indikation_' will not be analyzed as the data providers stopped updating them.

In [9]:
```
cols_to_drop = vaccinations.columns[vaccinations.columns.str.contains('indikation_')]
vaccinations.drop(columns=cols_to_drop, inplace=True)
```

Some more columns can be dropped, as there is no interest in analyzing differences on a vaccine level - especially since in some cases vaccines were mixed.

In [10]:
```
more_cols_to_drop = ['dosen_biontech_erst_kumulativ', 'dosen_biontech_zweit_kumulativ',
                     'dosen_moderna_erst_kumulativ', 'dosen_moderna_zweit_kumulativ',
                     'dosen_astra_erst_kumulativ', 'dosen_astra_zweit_kumulativ']
vaccinations.drop(columns=more_cols_to_drop, inplace=True)
```

Some columns are labeled misleadingly. As stated by the data provider the columns `personen_erst_kumulativ` and `impf_quote_erst` contain people vaccinated with the Johnson & Johnson vaccine. As this requires only one shot. the same persons are included in `personen_voll_kumulativ` . Therefore more columns are dropped and recalculated later.

In [11]:
```
vaccinations.drop(columns=['impf_quote_erst', 'impf_quote_voll'], inplace=True)
```

Convert datatype of date column

In [12]:
```
vaccinations.iloc[ : , [0]] = vaccinations.iloc[ : , [0]].apply(pd.to_datetime)
```

Show Data

In [13]:
```
vaccinations.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 298 entries, 0 to 297
Data columns (total 21 columns):
 #   Column                            Non-Null Count  Dtype
---  ------                            --------------  -----
 0   date                              298 non-null    datetime64[ns]
 1   dosen_kumulativ                   298 non-null    int64
 2   dosen_biontech_kumulativ          298 non-null    int64
 3   dosen_biontech_dritt_kumulativ    298 non-null    int64
 4   dosen_moderna_kumulativ           298 non-null    int64
 5   dosen_moderna_dritt_kumulativ     298 non-null    int64
 6   dosen_astra_kumulativ             298 non-null    int64
 7   dosen_astra_dritt_kumulativ       298 non-null    int64
 8   dosen_johnson_kumulativ           298 non-null    int64
 9   dosen_erst_kumulativ              298 non-null    int64
 10  dosen_zweit_kumulativ             298 non-null    int64
 11  dosen_dritt_kumulativ             298 non-null    int64
 12  dosen_differenz_zum_vortag        298 non-null    int64
 13  dosen_erst_differenz_zum_vortag   298 non-null    int64
 14  dosen_zweit_differenz_zum_vortag  298 non-null    int64
 15  dosen_dritt_differenz_zum_vortag  298 non-null    int64
 16  personen_erst_kumulativ           298 non-null    int64
 17  personen_voll_kumulativ          298 non-null    int64
 18  personen_auffrisch_kumulativ     298 non-null    int64
 19  dosen_dim_kumulativ              298 non-null    int64
 20  dosen_kbv_kumulativ              298 non-null    int64
dtypes: datetime64[ns](1), int64(20)
memory usage: 49.0 KB
```

In [14]:

```
vaccinations.tail(3)
```

Out[14]:

	date	dosen_kumulativ	dosen_biontech_kumulativ	dosen_biontech_dritt_kumulativ	dosen_moderna_kumulativ	dosen_moderna_dritt_kumulativ	do
295	2021-10-18	110068859	84366075	1254634	9735044	49257	
296	2021-10-19	110240703	84529246	1308955	9739667	51290	
297	2021-10-20	110432440	84712908	1376545	9743944	53228	

3 rows × 21 columns

Check Validity

In [15]:

```
# get the last row / the newest available data
last_row = vaccinations.tail(1)
```

In [16]:

```
doses_used = last_row['dosen_kumulativ']
doses_used
```

Out[16]:

```
297    110432440
Name: dosen_kumulativ, dtype: int64
```

In [17]:

```
# The number of person having been vaccinated at least once, includes those fully vaccinated
at_least_once = last_row['personen_erst_kumulativ']
fully_vaccinated_people = last_row['personen_voll_kumulativ']
partially_vaccinated_people = at_least_once - fully_vaccinated_people
# The johnson & Johnson vaccine is the only one used in Germany that only needs a single shot:
johnson_doses = last_row['dosen_johnson_kumulativ']
```

In [18]:

```
# Must be exactly 0
result_substraction = doses_used - partially_vaccinated_people - (fully_vaccinated_people - johnson_doses) * 2 - johns
```

```
result_substraction
```

Out[18]:

```
297    1430675
dtype: int64
```

In [19]:

```
result_substraction ==  0
```

Out[19]:

```
297    False
dtype: bool
```

Calculate columns

In [20]:

```
vaccinations['partly vaccinated'] = round(
    (vaccinations['personen_erst_kumulativ'] - vaccinations['personen_voll_kumulativ']) * 100 / population_germany,
    2)
```

In [21]:

```
vaccinations['fully vaccinated'] = round(
    vaccinations['personen_voll_kumulativ'] * 100 / population_germany,
    2)
```

In [22]:

```
vaccinations.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 298 entries, 0 to 297
Data columns (total 23 columns):
 #   Column                           Non-Null Count  Dtype         
---  ------                           --------------  -----         
 0   date                             298 non-null    datetime64[ns]
 1   dosen_kumulativ                  298 non-null    int64         
 2   dosen_biontech_kumulativ         298 non-null    int64         
 3   dosen_biontech_dritt_kumulativ   298 non-null    int64         
 4   dosen_moderna_kumulativ          298 non-null    int64         
 5   dosen_moderna_dritt_kumulativ    298 non-null    int64         
 6   dosen_astra_kumulativ            298 non-null    int64         
 7   dosen_astra_dritt_kumulativ      298 non-null    int64         
 8   dosen_johnson_kumulativ          298 non-null    int64         
 9   dosen_erst_kumulativ             298 non-null    int64         
 10  dosen_zweit_kumulativ            298 non-null    int64         
 11  dosen_dritt_kumulativ            298 non-null    int64         
 12  dosen_differenz_zum_vortag       298 non-null    int64         
 13  dosen_erst_differenz_zum_vortag  298 non-null    int64         
 14  dosen_zweit_differenz_zum_vortag 298 non-null    int64         
 15  dosen_dritt_differenz_zum_vortag 298 non-null    int64         
 16  personen_erst_kumulativ          298 non-null    int64         
 17  personen_voll_kumulativ          298 non-null    int64
 18  personen_auffrisch_kumulativ     298 non-null    int64
 19  dosen_dim_kumulativ              298 non-null    int64
 20  dosen_kbv_kumulativ              298 non-null    int64
 21  partly vaccinated                298 non-null    float64
 22  fully vaccinated                 298 non-null    float64
dtypes: datetime64[ns](1), float64(2), int64(20)
memory usage: 53.7 KB
```

In [23]:

```
vaccinations.tail(3)
```

Out[23]:

	date	dosen_kumulativ	dosen_biontech_kumulativ	dosen_biontech_dritt_kumulativ	dosen_moderna_kumulativ	dosen_moderna_dritt_kumulativ	dos
295	2021-10-18	110068859	84366075	1254634	9735044	49257	
296	2021-10-19	110240703	84529246	1308955	9739667	51290	
297	2021-10-20	110432440	84712908	1376545	9743944	53228	

3 rows × 23 columns

Last Update

Often the data is not updated on weekends, so get the highest date in the dataset.

In [24]:

```
last_update = vaccinations.loc[vaccinations.index[-1], "date"].strftime('%Y-%m-%d')
last_update
```

Out[24]:

```
'2021-10-20'
```

Doses Used

In [25]:

```
doses = vaccinations.loc[ : , ['date', 'dosen_differenz_zum_vortag']]
# Rename columns
doses.columns = ['date', 'doses used']
```

In [26]:

```
# Scale number of doses as millions
```

```
doses['doses used'] = doses['doses used'] / 1_000_000
```

Doses Daily

In [27]:

```
doses_daily = doses.set_index('date', inplace=False)
doses_daily.tail(1)
```

Out[27]:

	doses used
date	
2021-10-20	0.191737

In [28]:

```
# What is the highest number of doses used in a day?
max_doses_daily = max(doses_daily['doses used'])
max_doses_daily
```

Out[28]:

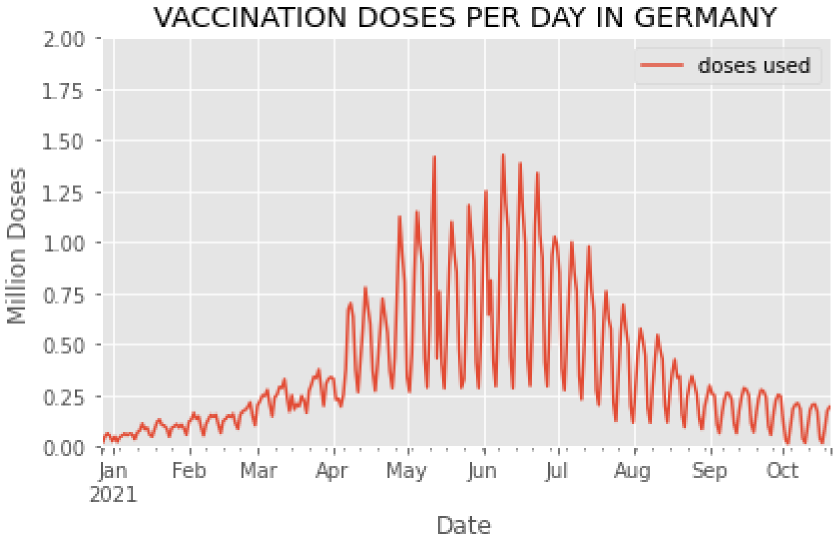
```
1.428048
```

In [29]:

```
doses_daily.plot(
    ylim=(0,math.ceil(max_doses_daily)),
    xlabel='Date',
    ylabel='Million Doses',
    title='VACCINATION DOSES PER DAY IN GERMANY')
```

Out[29]:

```
<AxesSubplot:title={'center':'VACCINATION DOSES PER DAY IN GERMANY'}, xlabel='Date', ylabel='Million Doses'>
```



Doses per Weekday (in the last 6 weeks)

In [30]:

```
last_6_weeks = doses.tail(42)
```

In [31]:

```
# Yields a warning, but exactly like the docs prescribe and it works
# https://pandas.pydata.org/docs/getting_started/intro_tutorials/05_add_columns.html
last_6_weeks['weekday'] = last_6_weeks['date'].dt.day_name()
```

```
<ipython-input-31-45013977109e>:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a
-view-versus-a-copy
  last_6_weeks['weekday'] = last_6_weeks['date'].dt.day_name()
```

In [32]:

```
# check:
last_6_weeks.tail(3)
```

Out[32]:

	date	doses used	weekday
295	2021-10-18	0.088180	Monday
296	2021-10-19	0.171844	Tuesday
297	2021-10-20	0.191737	Wednesday

In [33]:

```python
# drop the date column
last_6_weeks = last_6_weeks.drop(labels=['date'], axis=1)
```

In [34]:

```python
#last_6_weeks.set_index('weekday', inplace=True)
last_6_weeks.tail(3)
```

Out[34]:

	doses used	weekday
295	0.088180	Monday
296	0.171844	Tuesday
297	0.191737	Wednesday

In [35]:

```python
pivot_table =last_6_weeks.pivot(columns='weekday', values='doses used')
pivot_table.tail()
```

Out[35]:

weekday	Friday	Monday	Saturday	Sunday	Thursday	Tuesday	Wednesday
293	NaN	NaN	0.038857	NaN	NaN	NaN	NaN
294	NaN	NaN	NaN	0.016146	NaN	NaN	NaN
295	NaN	0.08818	NaN	NaN	NaN	NaN	NaN
296	NaN	NaN	NaN	NaN	NaN	0.171844	NaN
297	NaN	NaN	NaN	NaN	NaN	NaN	0.191737

In [36]:

```python
# Reorder the columns
pivot_table = pivot_table[['Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday', 'Saturday', 'Sunday']]
# Rename the columns
pivot_table.columns=['Mo', 'Tue', 'Wed', 'Thu', 'Fri', 'Sat', 'Sun']
pivot_table.tail()
```

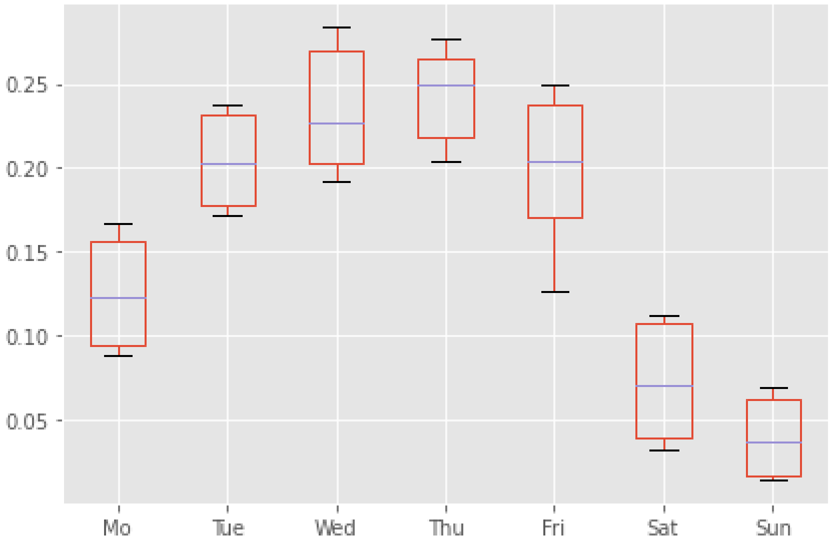
Out[36]:

	Mo	Tue	Wed	Thu	Fri	Sat	Sun
293	NaN	NaN	NaN	NaN	NaN	0.038857	NaN
294	NaN	NaN	NaN	NaN	NaN	NaN	0.016146
295	0.08818	NaN	NaN	NaN	NaN	NaN	NaN
296	NaN	0.171844	NaN	NaN	NaN	NaN	NaN

	Mo	Tue	Wed	Thu	Fri	Sat	Sun
297	NaN	NaN	0.191737	NaN	NaN	NaN	NaN

In [37]:

```
weekday_boxplot = pivot_table.boxplot()
```



In [38]:

```
fig = weekday_boxplot.get_figure()
fig.savefig('img/weekday_boxplot.png')
```

Doses per Week

In [39]:

```
# W-Mon in order to start the week on a Monday, see:
# https://pandas.pydata.org/pandas-docs/stable/user_guide/timeseries.html#anchored-offsets
doses_weekly = doses.groupby(pd.Grouper(key='date',freq='W-Mon')).sum()
doses_weekly.columns = ['million doses used']
doses_weekly.tail()
```

Out[39]:

	million doses used
date	
2021-09-27	1.326793
2021-10-04	0.985972

	million doses used
date	
2021-10-11	0.925920
2021-10-18	0.893364
2021-10-25	0.363581

In [40]:

```
# What is the highest number of doses used in a week?
max_million_doses_weekly = max(doses_weekly['million doses used'])
max_million_doses_weekly
```

Out[40]:

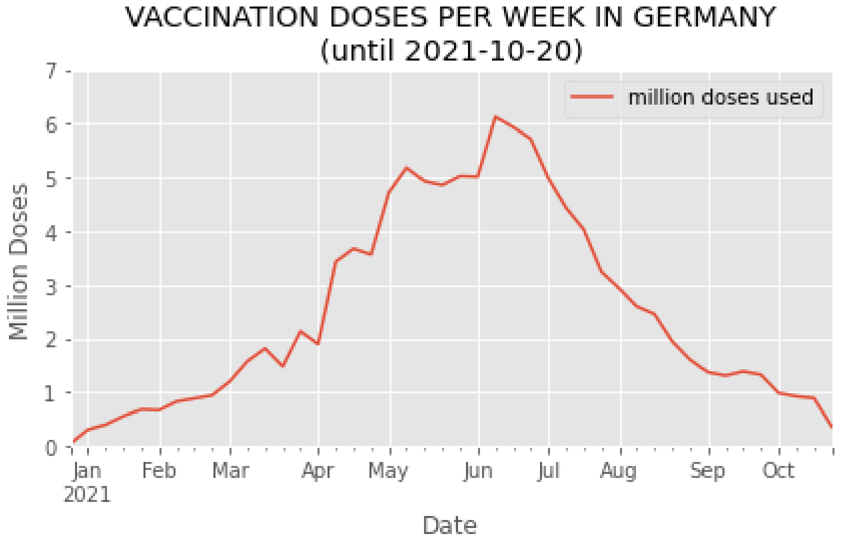
```
6.124477000000001
```

In [41]:

```
doses_weekly.plot(
    ylim=(0, math.ceil(max_million_doses_weekly)),
    xlabel='Date',
    ylabel='Million Doses',
    title=f"VACCINATION DOSES PER WEEK IN GERMANY\n(until {last_update})")
```

Out[41]:

```
<AxesSubplot:title={'center':'VACCINATION DOSES PER WEEK IN GERMANY\n(until 2021-10-20)'}, xlabel='Date', ylabel='Milli
on Doses'>
```



Doses per Month

In [42]:

```
# M = month end frequency
doses_monthly = doses.groupby(pd.Grouper(key='date',freq='M')).sum()
doses_monthly.tail()
```

Out[42]:

	doses used
date	
2021-06-30	24.757646
2021-07-31	17.262990
2021-08-31	9.269178
2021-09-30	5.872763
2021-10-31	2.450340

In [43]:

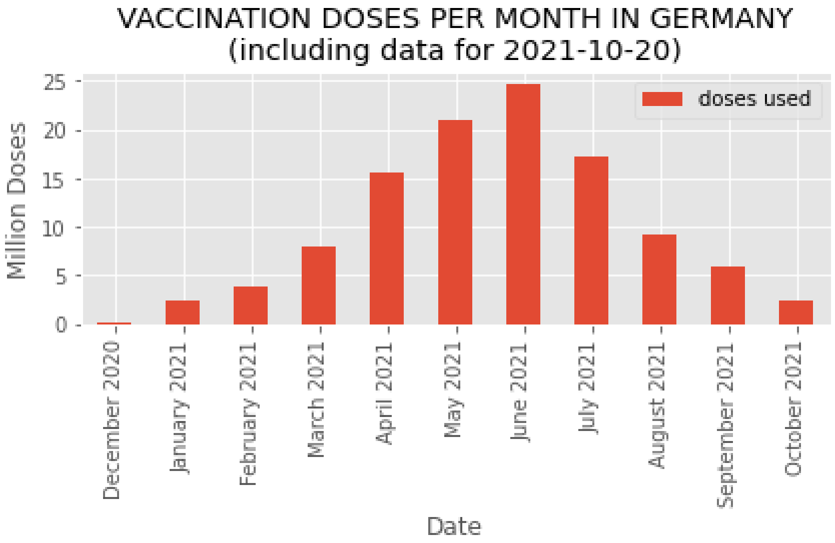
```
max_doses_monthly = max(doses_monthly['doses used'])
max_doses_monthly
doses_monthly['month'] = doses_monthly.index.strftime('%B')
doses_monthly['year'] =  doses_monthly.index.strftime('%Y')
doses_monthly['label'] = doses_monthly['month'] + ' ' + doses_monthly['year']
doses_monthly.drop(columns=['month', 'year'], inplace=True)
doses_monthly.set_index('label', inplace=True)
doses_monthly.tail(6)
```

Out[43]:

	doses used
label	
May 2021	21.057890
June 2021	24.757646
July 2021	17.262990
August 2021	9.269178
September 2021	5.872763
October 2021	2.450340

In [44]:

```
monthly_plot = doses_monthly.plot.bar(
    ylim=(0,math.ceil(max_doses_monthly) + 1),
    xlabel='Date',
    ylabel='Million Doses',
    title=f"VACCINATION DOSES PER MONTH IN GERMANY\n(including data for {last_update})")
```



In [45]:

```
fig = monthly_plot.get_figure()
fig.savefig('img/monthly_doses_germany.png')
```

Vaccination Campaign Progress

In [46]:

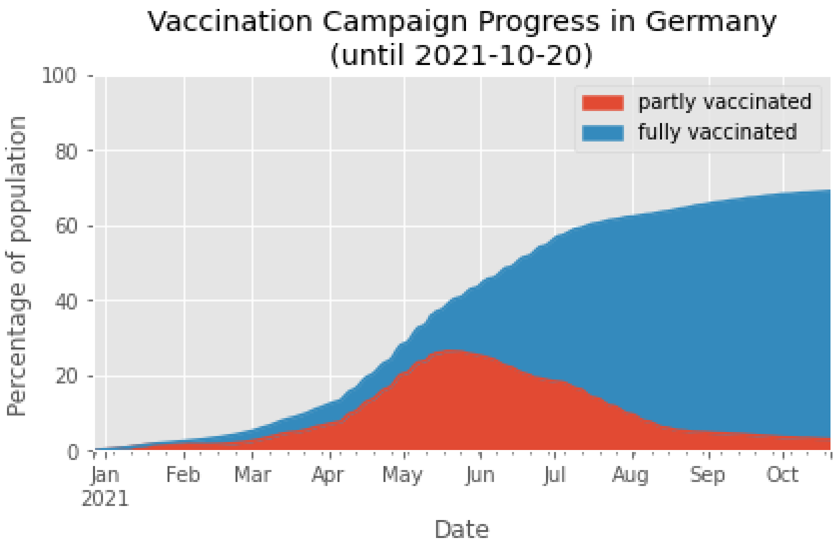
```
doses_cumulative = vaccinations.loc[ : , ['date', 'partly vaccinated', 'fully vaccinated']]
doses_cumulative.set_index('date', inplace=True)
doses_cumulative.tail(3)
```

Out[46]:

	partly vaccinated	fully vaccinated
date		
2021-10-18	3.07	65.79
2021-10-19	3.03	65.88
2021-10-20	2.98	65.98

In [47]:

```
doses_area_plot = doses_cumulative.plot.area(
    ylim=(0,100),
    xlabel='Date',
    ylabel='Percentage of population',
    title=f"Vaccination Campaign Progress in Germany\n(until {last_update})")
```



In [48]:

```
fig = doses_area_plot.get_figure()
fig.savefig('img/vaccinations_germany_area_plot.png')
```

As of Today

In [49]:

```
# get the last line of the data
current_state = doses_cumulative.iloc[-1]
current_state
```

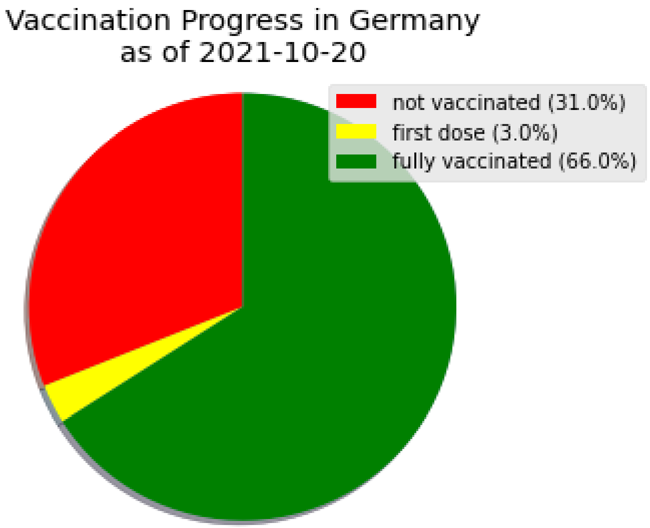
Out[49]:

```
partly vaccinated     2.98
fully vaccinated     65.98
Name: 2021-10-20 00:00:00, dtype: float64
```

In [50]:

```
percentage_not_vacc = 100 - current_state['partly vaccinated'] - current_state['fully vaccinated']
labels = [f"not vaccinated ({round(percentage_not_vacc, 1)}%)",
          f"first dose ({round(current_state['partly vaccinated'], 1)}%)",
          f"fully vaccinated ({round(current_state['fully vaccinated'], 1)}%)"]
colors = ['red', 'yellow', 'green']
sizes = [percentage_not_vacc,
         current_state['partly vaccinated'],
         current_state['fully vaccinated']]
fig1, ax1 = plt.subplots()
```

```
ax1.pie(sizes, shadow=True, startangle=90)
ax1.axis('equal')  # Equal aspect ratio ensures that pie is drawn as a circle.
patches, texts = plt.pie(sizes, colors=colors, startangle=90)
plt.legend(patches, labels, loc="best")
plt.title(f"Vaccination Progress in Germany\nas of {last_update}")
# plt.savefig must be before show()
# BEWARE plt.savefig must be in the same Jupyter code cell that creates the graph!
# See comment by ijoseph here:
# https://stackoverflow.com/questions/9012487/matplotlib-pyplot-savefig-outputs-blank-image
plt.savefig('img/vaccination_in_germany_pie.png', bbox_inches='tight')
plt.show()
```



Vaccines in Use

```
In [51]: vaccinations.columns
```

```
Out[51]: Index(['date', 'dosen_kumulativ', 'dosen_biontech_kumulativ',
                'dosen_biontech_dritt_kumulativ', 'dosen_moderna_kumulativ',
                'dosen_moderna_dritt_kumulativ', 'dosen_astra_kumulativ',
                'dosen_astra_dritt_kumulativ', 'dosen_johnson_kumulativ',
                'dosen_erst_kumulativ', 'dosen_zweit_kumulativ',
                'dosen_dritt_kumulativ', 'dosen_differenz_zum_vortag',
                'dosen_erst_differenz_zum_vortag', 'dosen_zweit_differenz_zum_vortag',
                'dosen_dritt_differenz_zum_vortag', 'personen_erst_kumulativ',
                'personen_voll_kumulativ', 'personen_auffrisch_kumulativ',
                'dosen_dim_kumulativ', 'dosen_kbv_kumulativ', 'partly vaccinated',
                'fully vaccinated'],
               dtype='object')
```

In [52]:

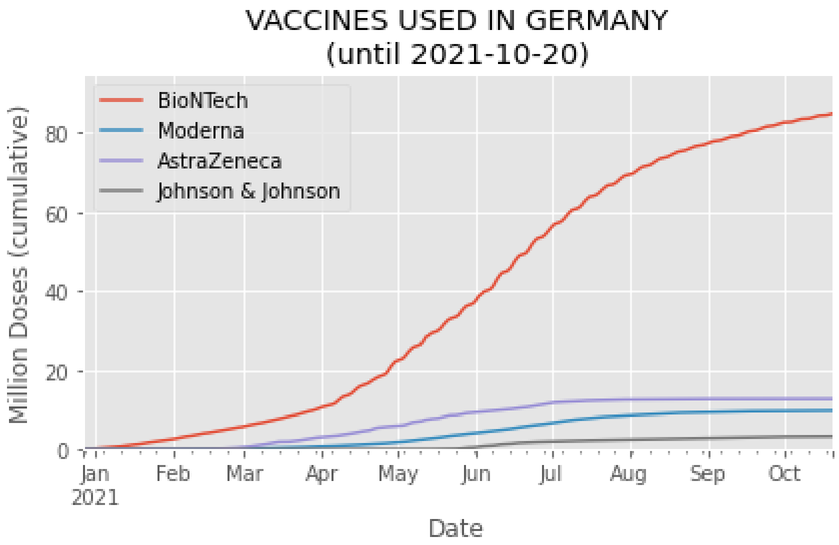
```
vaccine_use = vaccinations.loc[ : , ['date', 'dosen_biontech_kumulativ',
                                     'dosen_moderna_kumulativ',
                                     'dosen_astra_kumulativ',
                                     'dosen_johnson_kumulativ']]
# Rename columns
vaccine_use.columns = ['date', 'BioNTech', 'Moderna', 'AstraZeneca', 'Johnson & Johnson']
# make 'date' an index
vaccine_use.set_index('date', inplace=True)
# divide columns by 1 million
vaccine_use["BioNTech"] = vaccine_use["BioNTech"] / 1_000_000
vaccine_use["Moderna"] = vaccine_use["Moderna"] / 1_000_000
vaccine_use["AstraZeneca"] = vaccine_use["AstraZeneca"] / 1_000_000
vaccine_use["Johnson & Johnson"] = vaccine_use["Johnson & Johnson"] / 1_000_000
vaccine_use.tail(3)
```

Out[52]:

	BioNTech	Moderna	AstraZeneca	Johnson & Johnson
date				
2021-10-18	84.366075	9.735044	12.700061	3.267679
2021-10-19	84.529246	9.739667	12.700271	3.271519
2021-10-20	84.712908	9.743944	12.700428	3.275160

In [53]:

```
vaccines_used = vaccine_use.plot(
    # as it is cumulative, the last row must contain the single highest number
    ylim=(0,math.ceil(max(vaccine_use.iloc[-1]))+10),
    xlabel='Date',
    ylabel='Million Doses (cumulative)',
    title=f"VACCINES USED IN GERMANY\n(until {last_update})")
```



In [54]:

```
fig = vaccines_used.get_figure()
fig.savefig('img/vaccines_used_in_germany.png')
```

Vaccination Centers versus Doctor’s Practices

In [55]:

```
vaccinations.tail()
```

Out[55]:

	date	dosen_kumulativ	dosen_biontech_kumulativ	dosen_biontech_dritt_kumulativ	dosen_moderna_kumulativ	dosen_moderna_dritt_kumulativ	dos
293	2021-10-16	109964533	84271375	1225813	9729384	47118	
294	2021-10-17	109980679	84284332	1228369	9731541	47819	
295	2021-10-18	110068859	84366075	1254634	9735044	49257	
296	2021-10-19	110240703	84529246	1308955	9739667	51290	
297	2021-10-20	110432440	84712908	1376545	9743944	53228	

5 rows × 23 columns

In [56]:
```
by_place = vaccinations.loc[ : , ['date', 'dosen_dim_kumulativ', 'dosen_kbv_kumulativ']]
by_place.columns = ['date', 'vaccination centers', 'practices']
```

In [57]:
```
by_place['vaccination centers daily'] = by_place['vaccination centers'].diff()
by_place['practices daily'] = by_place['practices'].diff()
```

In [58]:
```
by_place['percentage practices'] =  round(
    by_place['practices daily'] * 100 /
    (by_place['vaccination centers daily'] + by_place['practices daily']), 2)

by_place['percentage centers'] = 100 - by_place['percentage practices']
```

In [59]:
```
# make 'date' an index
by_place.set_index('date', inplace=True)
```

In [60]:
```
by_place
```

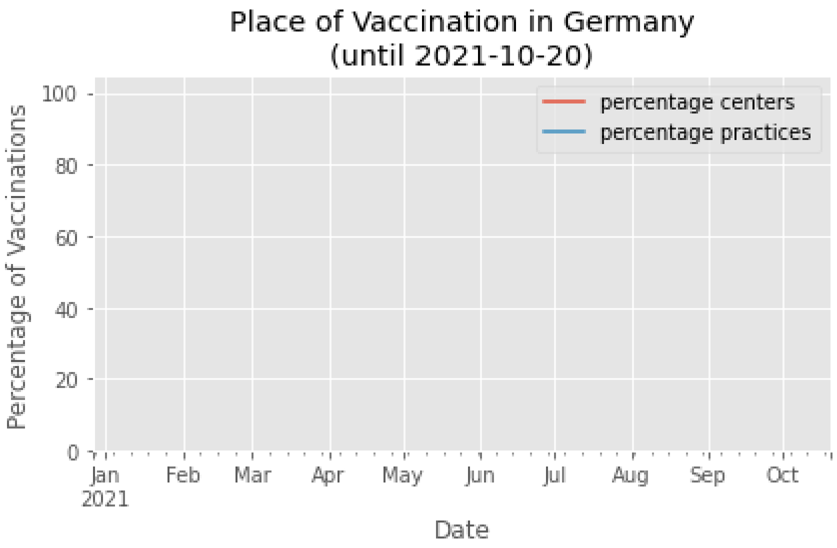
Out[60]:

	vaccination centers	practices	vaccination centers daily	practices daily	percentage practices	percentage centers
date						
2020-12-27	0	0	NaN	NaN	NaN	NaN
2020-12-28	0	0	0.0	0.0	NaN	NaN
2020-12-29	0	0	0.0	0.0	NaN	NaN
2020-12-30	0	0	0.0	0.0	NaN	NaN
2020-12-31	0	0	0.0	0.0	NaN	NaN
...	...	...	...	...	...	...
2021-10-16	0	0	0.0	0.0	NaN	NaN
2021-10-17	0	0	0.0	0.0	NaN	NaN
2021-10-18	0	0	0.0	0.0	NaN	NaN
2021-10-19	0	0	0.0	0.0	NaN	NaN
2021-10-20	0	0	0.0	0.0	NaN	NaN

298 rows × 6 columns

In [61]:
```
share = by_place.loc[ : , ['percentage centers', 'percentage practices']]
```

In [62]:
```
vacc_shares = share.plot(
    # as it is cumulative, the last row must contain the single highest number
    ylim=(0, 105),  # above 100 to see the line
    xlabel='Date',
    ylabel='Percentage of Vaccinations',
    title=f"Place of Vaccination in Germany\n(until {last_update})")
```



In [63]:
```
fig = vacc_shares.get_figure()
fig.savefig('img/vaccinations_germany_by_place.png')
```

Other units of Time

In [64]:
```
by_place_daily = by_place.loc[ : , ['vaccination centers daily', 'practices daily']]
by_place_daily.columns = ['vaccination centers', 'practices']
by_place_daily.reset_index(inplace=True)
```

Monthly

In [65]:
```
by_place_monthly = by_place_daily.groupby(pd.Grouper(key='date',freq='M')).sum()
```

```
by_place_monthly.tail()
```

Out[65]:

```
            vaccination centers  practices
      date
2021-06-30                  0.0        0.0
2021-07-31                  0.0        0.0
2021-08-31                  0.0        0.0
2021-09-30                  0.0        0.0
2021-10-31                  0.0        0.0
```

Scale:

In [66]:

```
by_place_monthly['vaccination centers'] = by_place_monthly['vaccination centers'] / 1_000_000
by_place_monthly['practices'] = by_place_monthly['practices'] / 1_000_000
```

Rename the columns

In [67]:

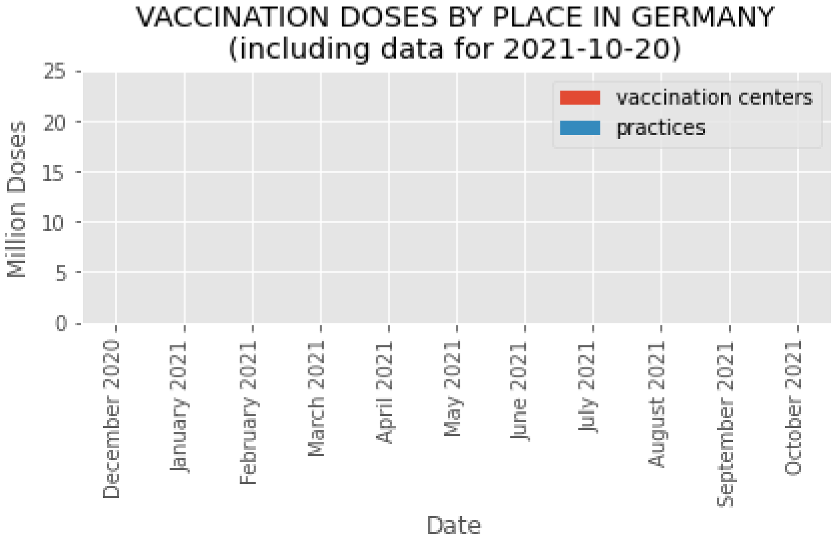
```
by_place_monthly['month'] = by_place_monthly.index.strftime('%B')
by_place_monthly['year'] =  by_place_monthly.index.strftime('%Y')
by_place_monthly['label'] = by_place_monthly['month'] + ' ' + by_place_monthly['year']
by_place_monthly.drop(columns=['month', 'year'], inplace=True)
by_place_monthly.set_index('label', inplace=True)
by_place_monthly.tail(6)
```

Out[67]:

```
                vaccination centers  practices
          label
       May 2021                 0.0        0.0
      June 2021                 0.0        0.0
      July 2021                 0.0        0.0
    August 2021                 0.0        0.0
 September 2021                 0.0        0.0
   October 2021                 0.0        0.0
```

In [68]:

```
monthly_plot = by_place_monthly.plot.bar(
    stacked=True,
    ylim=(0, 25),
    xlabel='Date',
    ylabel='Million Doses',
    title=f"VACCINATION DOSES BY PLACE IN GERMANY\n(including data for {last_update})")
```



In [69]:

```
fig = monthly_plot.get_figure()
fig.savefig('img/monthly_doses_by_place_germany.png')
```