WileyWinters_Assignment7

March 2, 2024

1 Week 7 Assignment

Wiley Winters MSDS 670 Data Visualization 2024-MAR-03

Import required packages and libraries

[1]:
```
# Import Libraries
import pandas as pd

#Import plotly libraries
import plotly.express as px
import plotly
from plotly.offline import init_notebook_mode, iplot
init_notebook_mode(connected=True)
plotly.offline.init_notebook_mode(connected=True)

# Suppress Warnings
import warnings
warnings.filterwarnings('ignore')
```

Load dataset into Pandas DataFrame and perform some basic EDA

[2]:
```
covid_df = pd.read_csv('../data/
 ↪Provisional_COVID-19_Deaths_by_Sex_and_Age_20240227.csv')
abbrv_df = pd.read_csv('../data/stateAbb.csv')
popul_df = pd.read_csv('../data/statesPop2023.csv')
```

[3]:
```
covid_df.columns
```

[3]:
```
Index(['Data As Of', 'Start Date', 'End Date', 'Group', 'Year', 'Month',
       'State', 'Sex', 'Age Group', 'COVID-19 Deaths', 'Total Deaths',
       'Pneumonia Deaths', 'Pneumonia and COVID-19 Deaths', 'Influenza Deaths',
       'Pneumonia, Influenza, or COVID-19 Deaths', 'Footnote'],
      dtype='object')
```

I will change column names to be ones that are easier to work with.

```
[4]: cols = ['date', 'start', 'end', 'group', 'year', 'month', 'state', 'sex',␣
      ↪'age_group',
             'covid_deaths', 'total_deaths', 'pneunonia_deaths',␣
      ↪'pneunonia_covid_deaths',
             'influenza_deaths', 'pneumonia_influenza_covid_deaths', 'footnote']
     covid_df.columns = cols
     covid_df.columns
```

```
[4]: Index(['date', 'start', 'end', 'group', 'year', 'month', 'state', 'sex',
            'age_group', 'covid_deaths', 'total_deaths', 'pneunonia_deaths',
            'pneunonia_covid_deaths', 'influenza_deaths',
            'pneumonia_influenza_covid_deaths', 'footnote'],
           dtype='object')
```

Merge all of the dataframes into one. covid_df will be the dataframe merged into

```
[5]: all_df = covid_df.merge(abbrv_df, on='state', how='left').merge(popul_df,␣
      ↪on='state',
                                                                 how='left')
     all_df.columns
```

```
[5]: Index(['date', 'start', 'end', 'group', 'year', 'month', 'state', 'sex',
            'age_group', 'covid_deaths', 'total_deaths', 'pneunonia_deaths',
            'pneunonia_covid_deaths', 'influenza_deaths',
            'pneumonia_influenza_covid_deaths', 'footnote', 'abbreviation',
            'population'],
           dtype='object')
```

The formula for it is $crudedeathrate = (numberofdeaths/totalpopulation) * 100,000$. This will give the *crude death rate* per *100,000* people. For this project I will use a *crude death rate* per *10,000* people instead of 100,000. Some of the western states have very small populations

```
[6]: all_df['crude_deaths'] = round((all_df['covid_deaths'] / all_df['population'])␣
      ↪* 1000)
```

There are a lot of missing values. For this study I want to concentrate on COVID-19 deaths. I will drop the other columns

```
[7]: drop_cols = ['pneunonia_deaths', 'pneunonia_covid_deaths', 'influenza_deaths',
                  'pneumonia_influenza_covid_deaths', 'footnote']
     all_df.drop(drop_cols, axis=1, inplace=True)
     all_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 137700 entries, 0 to 137699
Data columns (total 14 columns):
 #   Column         Non-Null Count   Dtype
---  ------         --------------   -----
 0   date           137700 non-null  object
 1   start         137700 non-null  object
 2   end           137700 non-null  object
 3   group         137700 non-null  object
 4   year          134946 non-null  float64
 5   month         123930 non-null  float64
 6   state         137700 non-null  object
 7   sex           137700 non-null  object
 8   age_group     137700 non-null  object
 9   covid_deaths  98270 non-null   float64
 10  total_deaths  118191 non-null  float64
 11  abbreviation  130050 non-null  object
 12  population    130050 non-null  float64
 13  crude_deaths  92261 non-null   float64
dtypes: float64(6), object(8)
memory usage: 14.7+ MB
```

In addition, there are some columns marked as objects that are actually dates. I will be using dates in this analysis, so have to convert data type to date.

[8]:

```python
date_cols = ['date', 'start', 'end']
all_df[date_cols] = all_df[date_cols].astype('datetime64[ns]')
```

[9]:

```python
print(all_df.info())
print('\nNaN Values:\n', all_df.isna().sum())
print('\nDuplicates: ', all_df.duplicated().sum())
print('\nSize: ', all_df.size)
print('\nDistribution:\n', all_df.describe().T)
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 137700 entries, 0 to 137699
Data columns (total 14 columns):
 #   Column        Non-Null Count   Dtype
---  ------        --------------   -----
 0   date          137700 non-null  datetime64[ns]
 1   start         137700 non-null  datetime64[ns]
 2   end           137700 non-null  datetime64[ns]
 3   group         137700 non-null  object
 4   year          134946 non-null  float64
 5   month         123930 non-null  float64
 6   state         137700 non-null  object
 7   sex           137700 non-null  object
 8   age_group     137700 non-null  object
 9   covid_deaths  98270 non-null   float64
 10  total_deaths  118191 non-null  float64
 11  abbreviation  130050 non-null  object
 12  population    130050 non-null  float64
 13  crude_deaths  92261 non-null   float64
dtypes: datetime64[ns](3), float64(6), object(5)
memory usage: 14.7+ MB
```

```
None

NaN Values:
 date                0
start               0
end                 0
group               0
year             2754
month           13770
state               0
sex                 0
age_group           0
covid_deaths    39430
total_deaths    19509
abbreviation     7650
population       7650
crude_deaths    45439
dtype: int64

Duplicates:  0

Size:  1927800

Distribution:
                  count                 mean                  min  \
date            137700  2023-09-27 00:00:00  2023-09-27 00:00:00
start           137700  2021-10-08 05:45:36  2020-01-01 00:00:00
end             137700  2021-12-27 23:02:24  2020-01-31 00:00:00
year          134946.0          2021.408163               2020.0
month         123930.0                  6.2                  1.0
covid_deaths   98270.0           313.586547                  0.0
total_deaths  118191.0          2841.952585                  0.0
population    130050.0        6566958.72549             584057.0
crude_deaths   92261.0             0.010373                  0.0

                              25%                  50%                  75%  \
date          2023-09-27 00:00:00  2023-09-27 00:00:00  2023-09-27 00:00:00
start         2020-11-01 00:00:00  2021-10-16 12:00:00  2022-10-01 00:00:00
end           2020-12-31 00:00:00  2021-12-31 00:00:00  2022-12-31 00:00:00
year                       2020.0               2021.0               2022.0
month                         3.0                  6.0                  9.0
covid_deaths                  0.0                  0.0                 50.0
total_deaths                 43.0                153.0                657.0
population              1770071.0            4526154.0            7812880.0
crude_deaths                  0.0                  0.0                  0.0

                              max             std
date          2023-09-27 00:00:00             NaN
```

```
start          2023-09-01 00:00:00            NaN
end            2023-09-23 00:00:00            NaN
year                        2023.0       1.086439
month                         12.0       3.350635
covid_deaths             1146774.0    5992.341375
total_deaths            12303399.0   56201.384331
population              38965193.0  7387212.368041
crude_deaths                   5.0       0.130162
```

There are many missing values; however, according to the dataset's website, the information may have not been recorded yet. Therefore, I will leave them as NaN for now.

Perform EDA to determine what type of information can be obtained from this dataset

```
[10]: all_df.groupby('year').agg({'crude_deaths': 'mean'}). \
               sort_values('crude_deaths', ascending=False)
```

```
[10]:         crude_deaths
       year
       2021.0      0.006120
       2020.0      0.005143
       2022.0      0.002639
       2023.0      0.000000
```

```
[11]: data_df = all_df[(all_df.group == 'By Total') & (all_df.state != 'United␣
       ↪States') & \
                        (all_df.end > '12/31/2022') & (all_df.sex == 'All Sexes') & \
                        (all_df.age_group == 'All Ages')]
       data_df.head()
```

```
[11]:           date       start         end     group  year  month       state  \
       51   2023-09-27 2020-01-01 2023-09-23  By Total   NaN    NaN     Alabama
       102  2023-09-27 2020-01-01 2023-09-23  By Total   NaN    NaN      Alaska
       153  2023-09-27 2020-01-01 2023-09-23  By Total   NaN    NaN     Arizona
       204  2023-09-27 2020-01-01 2023-09-23  By Total   NaN    NaN    Arkansas
       255  2023-09-27 2020-01-01 2023-09-23  By Total   NaN    NaN  California

                  sex age_group  covid_deaths  total_deaths abbreviation  population  \
       51   All Sexes  All Ages       21520.0      231602.0           AL   5108468.0
       102  All Sexes  All Ages        1492.0       20039.0           AK    733406.0
       153  All Sexes  All Ages       30307.0      284393.0           AZ   7431344.0
       204  All Sexes  All Ages       12663.0      140174.0           AR   3067732.0
       255  All Sexes  All Ages      109248.0     1178346.0           CA  38965193.0

            crude_deaths
       51            4.0
       102           2.0
```

```
153            4.0
204            4.0
255            3.0
```

The data I want to use has been filtered out of the original DataFrame. For the choropleth only a few columns are required. I will drop the rest.

[12]:
```
drop_cols = ['date', 'start', 'end', 'group', 'year', 'month', 'state', 'sex',
             'age_group', 'total_deaths']
data_df.drop(drop_cols, axis=1, inplace=True)
```

[13]:
```
data_df.head()
```

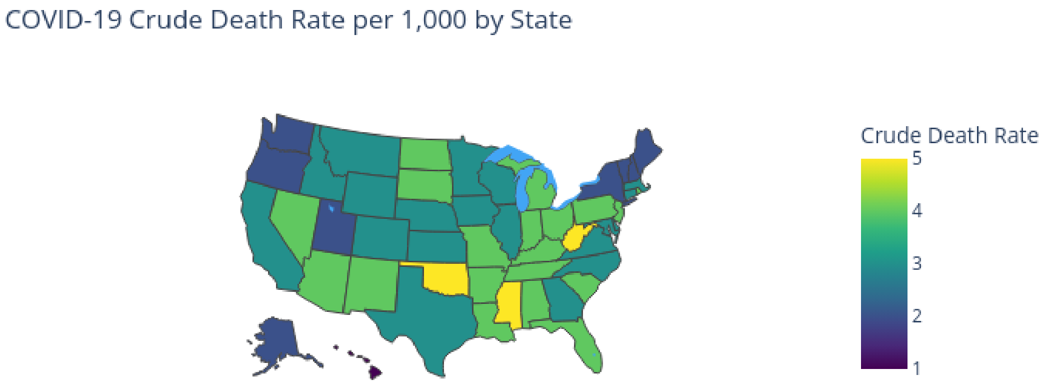
[13]:
```
     covid_deaths abbreviation  population  crude_deaths
51        21520.0           AL   5108468.0           4.0
102        1492.0           AK    733406.0           2.0
153       30307.0           AZ   7431344.0           4.0
204       12663.0           AR   3067732.0           4.0
255      109248.0           CA  38965193.0           3.0
```

[14]:
```
data_df['text'] = 'State: '+data_df.abbreviation + '<br>' + \
                  'Crude Deaths: '+data_df.crude_deaths.astype(str)
text = data_df['text'].tolist()
```

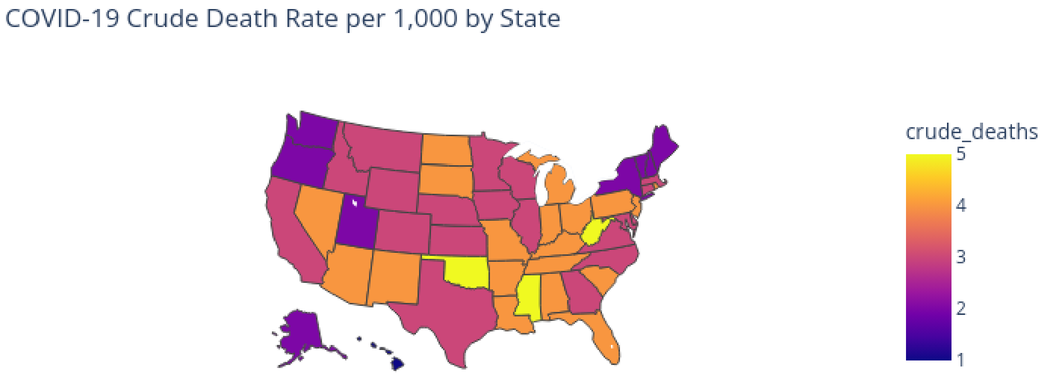
[15]:
```
data = [dict(type='choropleth', autocolorscale=False, locations=data_df.
 ↪abbreviation,
             z=data_df.crude_deaths, locationmode='USA-states', text=['text'],
             colorscale='Viridis', colorbar=dict(title='Crude Death Rate'))]
```

[16]:
```
layout = dict(title='COVID-19 Crude Death Rate per 1,000 by State',
              geo=dict(scope='usa', projection=dict(type='albers usa'),
                       showlakes=True, lakecolor='rgb(66,165,245)'))
```

[17]:
```
# Save choropleth to a HTML file
plotly.offline.plot({'data': data, 'layout': layout},
                    filename='../images/mapUSA01.html')
# Display choropleth in jupyter-lab
plotly.offline.iplot({'data': data, 'layout': layout})
```



[18]:
```
fig = px.choropleth(data_df, locations='abbreviation',␣
 ↪locationmode='USA-states',
                        color='crude_deaths', scope='usa',
                        title='COVID-19 Crude Death Rate per 1,000 by State',
                        hover_data='crude_deaths')
fig.update_layout(hoverlabel=dict(bgcolor='wheat', font_size=15))
fig.show()
fig.write_html('../images/mapUSA.html')
```



[19]:

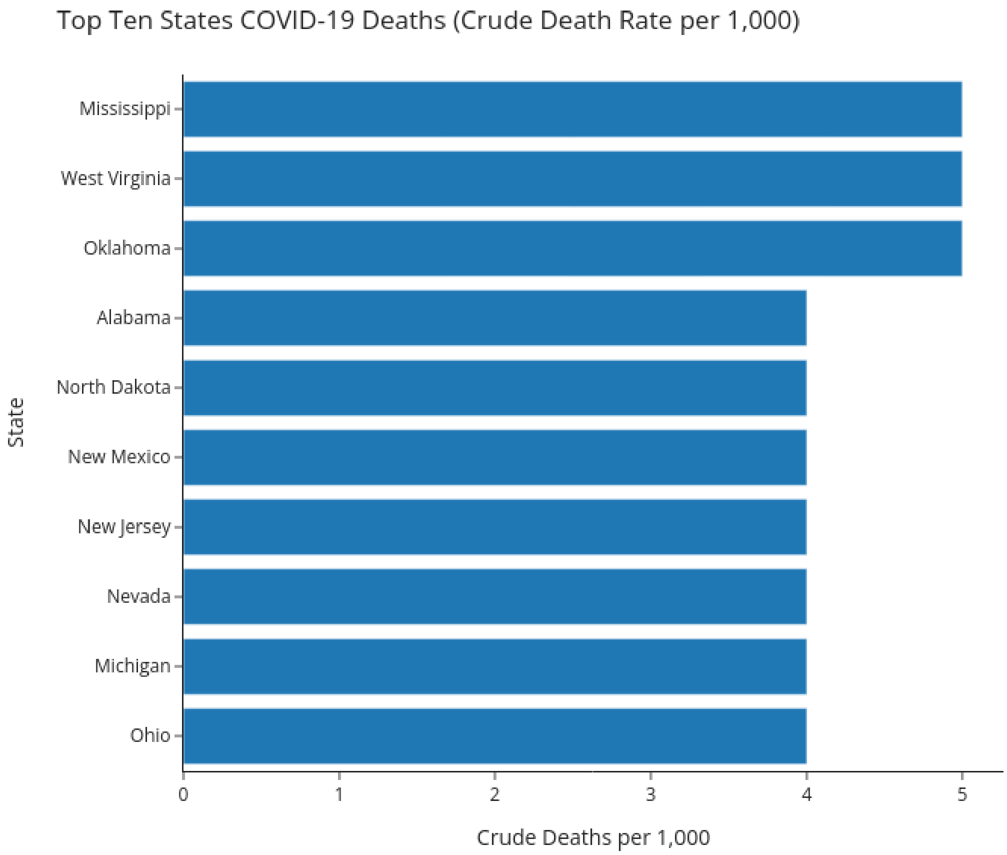
```
data_df.groupby('abbreviation').agg({'crude_deaths':'max'}). \
        sort_values('crude_deaths', ascending=False).head(10)
```

[19]:

```
              crude_deaths
abbreviation
MS                     5.0
OK                     5.0
WV                     5.0
AL                     4.0
MO                     4.0
MI                     4.0
NJ                     4.0
NM                     4.0
NV                     4.0
LA                     4.0
```

[20]:

```
plot = all_df.groupby('state').agg({'crude_deaths':'max'}). \
              sort_values('crude_deaths', ascending=False).reset_index().
 ↪head(10)
fig = px.bar(plot, x='crude_deaths', y='state', template='simple_white',
             width=800, height=600, labels={'crude_deaths': 'Crude Deaths per␣
 ↪1,000',
                                            'state': 'State'})
fig.update_layout(title='Top Ten States COVID-19 Deaths (Crude Death Rate per␣
 ↪1,000)',
                  hoverlabel=dict(bgcolor='wheat', font_size=15), hovermode='x')
fig.update_layout(yaxis={'categoryorder':'total ascending'})
fig.show()
fig.write_html('../images/top10CRD.html')
```



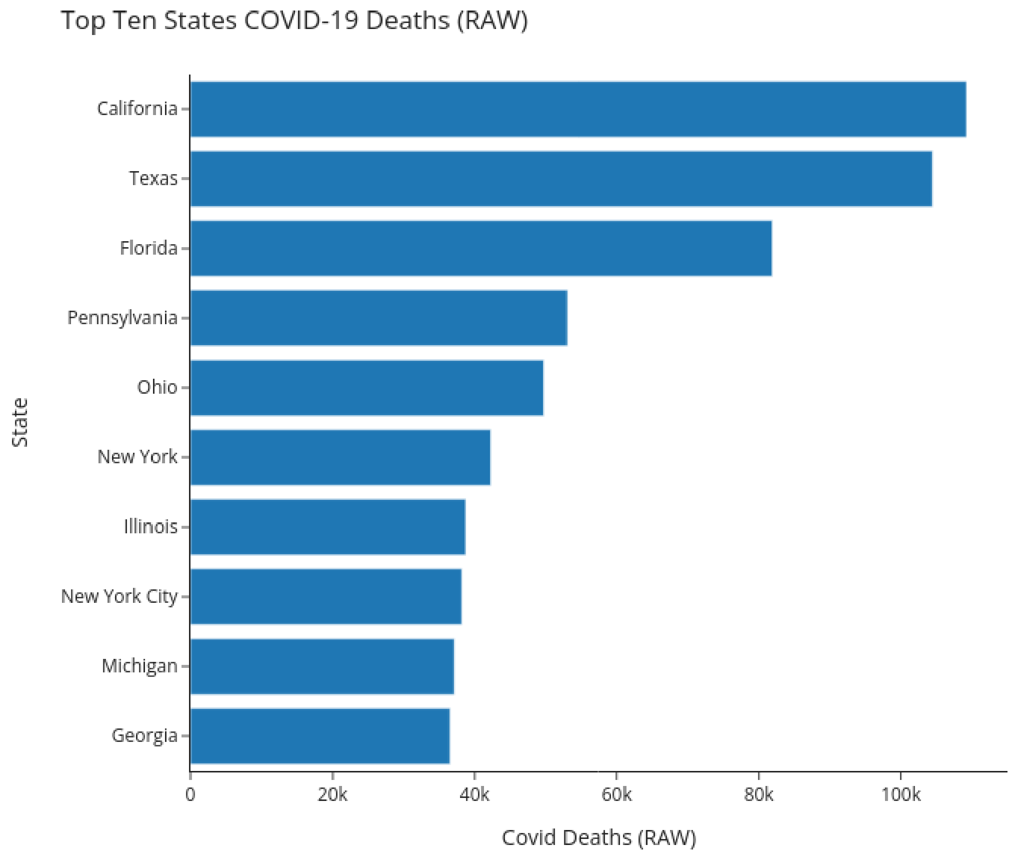
```
[21]: all_usa = all_df[all_df.state != 'United States']
      all_usa.groupby('state').agg({'crude_deaths':'max'}). \
             sort_values('crude_deaths', ascending=False).head(10)
```

```
[21]:                crude_deaths
      state
      Oklahoma                5.0
      West Virginia           5.0
      Mississippi             5.0
      Ohio                    4.0
      Michigan                4.0
      Nevada                  4.0
      New Jersey              4.0
      New Mexico              4.0
      North Dakota            4.0
      Alabama                 4.0
```

```
[22]: all_df.groupby('state').agg({'covid_deaths':'max'}). \
             sort_values('covid_deaths', ascending=False).head(10)
```

[22]:
```
                    covid_deaths
state
United States          1146774.0
California              109248.0
Texas                   104421.0
Florida                  81894.0
Pennsylvania             53049.0
Ohio                     49729.0
New York                 42273.0
Illinois                 38724.0
New York City            38167.0
Michigan                 37102.0
```

[23]:
```
plot = all_usa.groupby('state').agg({'covid_deaths':'max'}). \
               sort_values('covid_deaths', ascending=False).reset_index().
 ↪head(10)
fig = px.bar(plot, x='covid_deaths', y='state', template='simple_white',
             width=800, height=600, labels=({'covid_deaths': 'Covid Deaths␣
 ↪(RAW)',
                                             'state': 'State'}))
fig.update_layout(title='Top Ten States COVID-19 Deaths (RAW)',
                  hoverlabel=dict(bgcolor='wheat', font_size=15), hovermode='x')
fig.update_layout(yaxis={'categoryorder':'total ascending'})
fig.show()
fig.write_html('../images/top10RAW.html')
```


Top Ten States COVID-19 Deaths (RAW)
State
California
Texas
Florida
Pennsylvania
Ohio
New York
Illinois
New York City
Michigan
Georgia
0
20k
40k
60k
80k
100k
Covid Deaths (RAW)

```
[ ]:
```