Lung_Cancer_EDA_DB_notebook

February 12, 2023

[1]:
```
# Christine Orosco
# Store dataset to a local SQLite DD and conduct EDA
```

[2]:
```
# import libraries
import pandas as pd
import numpy as np
import sqlite3
import json
from sqlite3 import Error
import matplotlib.pyplot as plt
import seaborn as sns
```

[3]:
```
# Set context to `"paper"`
sns.set(rc={"font.size":15,"axes.labelsize":10})
#fig, ax = plt.subplots(figsize=(10,10))
sns.set(color_codes=True)
```

0.1 Read the flat file

[4]:
```
# Read csv file into df
clean_csv_df = pd.read_csv('~/cancer_csv.csv')
clean_csv_df.head(5)
```

[4]:
```
   Year       State State_Code  HHS_Region Age_Range   Benchmark Locality  \
0  2010     Alabama         AL           4      0-84  2010 Fixed      All
1  2010      Alaska         AK          10      0-84  2010 Fixed      All
2  2010     Arizona         AZ           9      0-84  2010 Fixed      All
3  2010    Arkansas         AR           6      0-84  2010 Fixed      All
4  2010  California         CA           9      0-84  2010 Fixed      All

   Observed_Deaths  Population  Expected_Deaths  Potentially_Excess_Deaths  \
0           8879.0   4704052.0           6279.0                     2600.0
1            798.0    705520.0            664.0                      134.0
2           8917.0   6288617.0           8177.0                      740.0
3           5547.0   2864516.0           3893.0                     1654.0
4          46065.0  36652988.0          41572.0                     4493.0
```

```
   Percent_Potentially_Excess_Deaths
0                               29.3
1                               16.8
2                                8.3
3                               29.8
4                                9.8
```

0.2 Connect to SQLite DB

[5]:
```
# Connect to DB and load table from pandas into sqlite
# Csv file
conn = sqlite3.connect('~/cancer_data.db')
c1 = conn.cursor()
```

[6]:
```
clean_csv_df.to_sql("clean_csv", conn, if_exists="replace")
```

[7]:
```
# Query table for data
results = c1.execute('Select * from clean_csv limit 10')
for row in results:
    print(row)
```

```
(0, 2010, 'Alabama', 'AL', 4, '0-84', '2010 Fixed', 'All', 8879.0, 4704052.0,
6279.0, 2600.0, 29.3)
(1, 2010, 'Alaska', 'AK', 10, '0-84', '2010 Fixed', 'All', 798.0, 705520.0,
664.0, 134.0, 16.8)
(2, 2010, 'Arizona', 'AZ', 9, '0-84', '2010 Fixed', 'All', 8917.0, 6288617.0,
8177.0, 740.0, 8.3)
(3, 2010, 'Arkansas', 'AR', 6, '0-84', '2010 Fixed', 'All', 5547.0, 2864516.0,
3893.0, 1654.0, 29.8)
(4, 2010, 'California', 'CA', 9, '0-84', '2010 Fixed', 'All', 46065.0,
36652988.0, 41572.0, 4493.0, 9.8)
(5, 2010, 'Colorado', 'CO', 8, '0-84', '2010 Fixed', 'All', 5879.0, 4959583.0,
5623.0, 263.0, 4.5)
(6, 2010, 'Connecticut', 'CT', 1, '0-84', '2010 Fixed', 'All', 5454.0,
3489199.0, 4723.0, 731.0, 13.4)
(7, 2010, 'Delaware', 'DE', 3, '0-84', '2010 Fixed', 'All', 1631.0, 882190.0,
1212.0, 419.0, 25.7)
(8, 2010, 'District of\nColumbia', 'DC', 3, '0-84', '2010 Fixed', 'All', 855.0,
591408.0, 657.0, 199.0, 23.3)
(9, 2010, 'Florida', 'FL', 4, '0-84', '2010 Fixed', 'All', 34229.0, 18367185.0,
28894.0, 5335.0, 15.6)
```

[8]:
```
# Load Website data file into pandas
clean_html_df = pd.read_csv('~/website_deaths.csv')
clean_html_df.head(5)
```

```
[8]:            State  Avg_Ann_Count Recent_Trend  AA_Death_Rate_100K(95%CI)  \
     0       Kentucky           3307      falling                       60.4
     1  West Virginia           1416      falling                       53.6
     2       Arkansas           2002      falling                       52.8
     3    Mississippi           1880      falling                       52.8
     4      Tennessee           4212      falling                       51.3

        AA_CI_lower  AA_CI_upper  Recent_5yr_Death_Rate(95%CI)  \
     0         59.5         61.3                          -5.6
     1         52.3         54.8                          -1.9
     2         51.8         53.9                          -3.1
     3         51.7         53.9                          -2.6
     4         50.6         52.0                          -5.4

        5yr_Death_Rate_CI_lower  5yr_Death_Rate_CI_upper
     0                     -7.7                     -3.4
     1                     -2.2                     -1.5
     2                     -3.9                     -2.3
     3                     -3.0                     -2.1
     4                     -7.3                     -3.5
```

```
[9]: # Connect to DB and load table from pandas into sqlite
     # website file
     c1 = conn.cursor()
     clean_html_df.to_sql('clean_html', conn, if_exists='replace')
     conn.commit()
```

```
[10]: # Query table for data
      results = c1.execute('Select * from clean_html limit 10')
      for row in results:
          print(row)
```

```
(0, 'Kentucky', 3307, 'falling', 60.4, 59.5, 61.3, -5.6, -7.7, -3.4)
(1, 'West Virginia', 1416, 'falling', 53.6, 52.3, 54.8, -1.9, -2.2, -1.5)
(2, 'Arkansas', 2002, 'falling', 52.8, 51.8, 53.9, -3.1, -3.9, -2.3)
(3, 'Mississippi', 1880, 'falling', 52.8, 51.7, 53.9, -2.6, -3.0, -2.1)
(4, 'Tennessee', 4212, 'falling', 51.3, 50.6, 52.0, -5.4, -7.3, -3.5)
(5, 'Oklahoma', 2323, 'falling', 50.0, 49.1, 50.9, -2.5, -3.1, -2.0)
(6, 'Indiana', 3843, 'falling', 48.7, 48.0, 49.5, -4.5, -6.3, -2.6)
(7, 'Missouri', 3762, 'falling', 48.7, 48.0, 49.4, -4.6, -6.0, -3.2)
(8, 'Alabama', 2998, 'falling', 48.5, 47.8, 49.3, -3.3, -3.9, -2.7)
(9, 'Louisiana', 2569, 'falling', 47.5, 46.7, 48.4, -4.7, -6.6, -2.7)
```

```
[11]: # # Load API data file into pandas
      clean_api_df = pd.read_csv('~/api_deaths.csv')
      conn.commit()
      clean_api_df.head(5)
```

[11]:

```
  State_Code  yearstart  yearend    Strat Value_Type    Value
0         AK       2010     2014  Overall     AA_Nbr    255.0
1         AL       2010     2014  Overall     AA_Nbr   3149.0
2         AR       2010     2014  Overall     AA_Nbr   2118.0
3         AZ       2010     2014  Overall     AA_Nbr   2736.0
4         CA       2010     2014  Overall     AA_Nbr  12590.0
```

[12]:

```python
# Connect to DB and load table from pandas into sqlite
# website file
c1 = conn.cursor()
clean_api_df.to_sql('clean_api', conn, if_exists='replace')
conn.commit()
```

[13]:

```python
# Query table for data
results = c1.execute('Select * from clean_api limit 10')
for row in results:
    print(row)
```

```
(0, 'AK', 2010, 2014, 'Overall', 'AA_Nbr', 255.0)
(1, 'AL', 2010, 2014, 'Overall', 'AA_Nbr', 3149.0)
(2, 'AR', 2010, 2014, 'Overall', 'AA_Nbr', 2118.0)
(3, 'AZ', 2010, 2014, 'Overall', 'AA_Nbr', 2736.0)
(4, 'CA', 2010, 2014, 'Overall', 'AA_Nbr', 12590.0)
(5, 'CO', 2010, 2014, 'Overall', 'AA_Nbr', 1591.0)
(6, 'CT', 2010, 2014, 'Overall', 'AA_Nbr', 1712.0)
(7, 'DC', 2010, 2014, 'Overall', 'AA_Nbr', 241.0)
(8, 'DE', 2010, 2014, 'Overall', 'AA_Nbr', 568.0)
(9, 'FL', 2010, 2014, 'Overall', 'AA_Nbr', 11896.0)
```

0.3 Merge 3 tables into 1

[14]:

```python
# Merge the 3 tables into 1 large table within Sqlite using SQL JOIN
c1.execute('create table big_tab as \
select a.*, b.* , c.* from clean_api a \
inner join clean_csv b on b.State_Code = a.State_Code \
inner join clean_html c on c.State = b.State')
```

[14]:

```
<sqlite3.Cursor at 0x7fe9ca7cb2d0>
```

[15]:

```python
conn.commit()
```

[44]:

```python
# select the data from the table that contains all three tables joined together
results = c1.execute('select * from big_tab limit 10')
for row in results:
    print(row)
```

```
(0, 'AK', 2010, 2014, 'Overall', 'AA_Nbr', 255.0, 1, 2010, 'Alaska', 'AK', 10,
'0-84', '2010 Fixed', 'All', 798.0, 705520.0, 664.0, 134.0, 16.8, 33, 'Alaska',
228, 'falling', 36.6, 34.3, 38.9, -7.5, -10.3, -4.6)
(0, 'AK', 2010, 2014, 'Overall', 'AA_Nbr', 255.0, 53, 2011, 'Alaska', 'AK', 10,
'0-84', '2010 Fixed', 'All', 836.0, 717624.0, 692.0, 145.0, 17.3, 33, 'Alaska',
228, 'falling', 36.6, 34.3, 38.9, -7.5, -10.3, -4.6)
(0, 'AK', 2010, 2014, 'Overall', 'AA_Nbr', 255.0, 103, 2012, 'Alaska', 'AK', 10,
'0-84', '2010 Fixed', 'All', 830.0, 726076.0, 719.0, 111.0, 13.4, 33, 'Alaska',
228, 'falling', 36.6, 34.3, 38.9, -7.5, -10.3, -4.6)
(0, 'AK', 2010, 2014, 'Overall', 'AA_Nbr', 255.0, 154, 2013, 'Alaska', 'AK', 10,
'0-84', '2010 Fixed', 'All', 913.0, 729443.0, 734.0, 179.0, 19.6, 33, 'Alaska',
228, 'falling', 36.6, 34.3, 38.9, -7.5, -10.3, -4.6)
(0, 'AK', 2010, 2014, 'Overall', 'AA_Nbr', 255.0, 205, 2014, 'Alaska', 'AK', 10,
'0-84', '2010 Fixed', 'All', 882.0, 730801.0, 749.0, 138.0, 15.6, 33, 'Alaska',
228, 'falling', 36.6, 34.3, 38.9, -7.5, -10.3, -4.6)
(0, 'AK', 2010, 2014, 'Overall', 'AA_Nbr', 255.0, 255, 2015, 'Alaska', 'AK', 10,
'0-84', '2010 Fixed', 'All', 884.0, 732295.0, 769.0, 117.0, 13.2, 33, 'Alaska',
228, 'falling', 36.6, 34.3, 38.9, -7.5, -10.3, -4.6)
(1, 'AL', 2010, 2014, 'Overall', 'AA_Nbr', 3149.0, 0, 2010, 'Alabama', 'AL', 4,
'0-84', '2010 Fixed', 'All', 8879.0, 4704052.0, 6279.0, 2600.0, 29.3, 8,
'Alabama', 2998, 'falling', 48.5, 47.8, 49.3, -3.3, -3.9, -2.7)
(1, 'AL', 2010, 2014, 'Overall', 'AA_Nbr', 3149.0, 52, 2011, 'Alabama', 'AL', 4,
'0-84', '2010 Fixed', 'All', 8992.0, 4724997.0, 6403.0, 2591.0, 28.8, 8,
'Alabama', 2998, 'falling', 48.5, 47.8, 49.3, -3.3, -3.9, -2.7)
(1, 'AL', 2010, 2014, 'Overall', 'AA_Nbr', 3149.0, 102, 2012, 'Alabama', 'AL',
4, '0-84', '2010 Fixed', 'All', 8963.0, 4741919.0, 6545.0, 2418.0, 27.0, 8,
'Alabama', 2998, 'falling', 48.5, 47.8, 49.3, -3.3, -3.9, -2.7)
(1, 'AL', 2010, 2014, 'Overall', 'AA_Nbr', 3149.0, 153, 2013, 'Alabama', 'AL',
4, '0-84', '2010 Fixed', 'All', 9011.0, 4751746.0, 6678.0, 2333.0, 25.9, 8,
'Alabama', 2998, 'falling', 48.5, 47.8, 49.3, -3.3, -3.9, -2.7)
```

[17]:

```
# Combine the data from the tables by importing each table into a DF then␣
 ↪combine all DFs into 1 large DF using pandas
# PD.JOIN
```

[18]:

```
# Read the three tables from sqlite into seperate DFs
clean_csv_df = pd.read_sql_query("SELECT * from clean_csv", conn,␣
 ↪index_col=['State_Code', 'State'])
clean_csv_df.head(5)
```

[18]:

```
                       index  Year  HHS_Region Age_Range   Benchmark Locality  \
State_Code State
AL         Alabama         0  2010           4      0-84  2010 Fixed      All
AK         Alaska          1  2010          10      0-84  2010 Fixed      All
AZ         Arizona         2  2010           9      0-84  2010 Fixed      All
AR         Arkansas        3  2010           6      0-84  2010 Fixed      All
CA         California      4  2010           9      0-84  2010 Fixed      All

                       Observed_Deaths  Population  Expected_Deaths  \
State_Code State
AL         Alabama             8879.0   4704052.0           6279.0
AK         Alaska               798.0    705520.0            664.0
AZ         Arizona             8917.0   6288617.0           8177.0
AR         Arkansas            5547.0   2864516.0           3893.0
CA         California         46065.0  36652988.0          41572.0

                       Potentially_Excess_Deaths  \
State_Code State
AL         Alabama                        2600.0
AK         Alaska                          134.0
AZ         Arizona                         740.0
AR         Arkansas                       1654.0
CA         California                     4493.0

                       Percent_Potentially_Excess_Deaths
State_Code State
AL         Alabama                                  29.3
AK         Alaska                                   16.8
AZ         Arizona                                   8.3
AR         Arkansas                                 29.8
CA         California                                9.8
```

```
[19]: clean_html_df = pd.read_sql_query("SELECT * from clean_html", conn,␣
       ↪index_col='State')
      clean_html_df.head(5)
```

```
[19]:                index  Avg_Ann_Count Recent_Trend  AA_Death_Rate_100K(95%CI)  \
      State
      Kentucky           0           3307      falling                       60.4
      West Virginia      1           1416      falling                       53.6
      Arkansas           2           2002      falling                       52.8
      Mississippi        3           1880      falling                       52.8
      Tennessee          4           4212      falling                       51.3

                     AA_CI_lower  AA_CI_upper  Recent_5yr_Death_Rate(95%CI)  \
      State
      Kentucky              59.5         61.3                          -5.6
      West Virginia         52.3         54.8                          -1.9
      Arkansas              51.8         53.9                          -3.1
      Mississippi           51.7         53.9                          -2.6
      Tennessee             50.6         52.0                          -5.4

                     5yr_Death_Rate_CI_lower  5yr_Death_Rate_CI_upper
      State
      Kentucky                          -7.7                     -3.4
      West Virginia                     -2.2                     -1.5
```

```
Arkansas                                -3.9                     -2.3
Mississippi                             -3.0                     -2.1
Tennessee                               -7.3                     -3.5
```

```
[20]: clean_api_df = pd.read_sql_query("SELECT * from clean_api", conn,␣
       ↪index_col='State_Code')
```

```
[21]: clean_api_df.head(5)
```

```
[21]:             index  yearstart  yearend    Strat Value_Type    Value
      State_Code
      AK              0       2010     2014  Overall     AA_Nbr    255.0
      AL              1       2010     2014  Overall     AA_Nbr   3149.0
      AR              2       2010     2014  Overall     AA_Nbr   2118.0
      AZ              3       2010     2014  Overall     AA_Nbr   2736.0
      CA              4       2010     2014  Overall     AA_Nbr  12590.0
```

0.4 Combine 3 Dataframes into 1

```
[22]: # Combine all three DFs into 1 DF using PD.JOIN

      big_df1 = clean_csv_df.join(clean_api_df, on='State_Code',␣
       ↪lsuffix="State_Code_x", rsuffix="State_Code_y")\
          .join(clean_html_df, on='State', lsuffix="State_x", rsuffix="State_y" )
      big_df1.columns
```

```
[22]: Index(['indexState_Code_x', 'Year', 'HHS_Region', 'Age_Range', 'Benchmark',
             'Locality', 'Observed_Deaths', 'Population', 'Expected_Deaths',
             'Potentially_Excess_Deaths', 'Percent_Potentially_Excess_Deaths',
             'indexState_Code_y', 'yearstart', 'yearend', 'Strat', 'Value_Type',
             'Value', 'index', 'Avg_Ann_Count', 'Recent_Trend',
             'AA_Death_Rate_100K(95%CI)', 'AA_CI_lower', 'AA_CI_upper',
             'Recent_5yr_Death_Rate(95%CI)', '5yr_Death_Rate_CI_lower',
             '5yr_Death_Rate_CI_upper'],
            dtype='object')
```

```
[23]: # drop columns
      big_df1.drop(columns = ['indexState_Code_x', 'HHS_Region', 'index',␣
       ↪'indexState_Code_y', 'Locality'], axis=1, inplace=True)
```

```
[24]: big_df1.dtypes
```

```
[24]: Year                                     int64
      Age_Range                               object
      Benchmark                               object
      Observed_Deaths                        float64
      Population                             float64
```

```
Expected_Deaths                           float64
Potentially_Excess_Deaths                 float64
Percent_Potentially_Excess_Deaths         float64
yearstart                                   int64
yearend                                     int64
Strat                                      object
Value_Type                                 object
Value                                     float64
Avg_Ann_Count                             float64
Recent_Trend                               object
AA_Death_Rate_100K(95%CI)                 float64
AA_CI_lower                               float64
AA_CI_upper                               float64
Recent_5yr_Death_Rate(95%CI)              float64
5yr_Death_Rate_CI_lower                   float64
5yr_Death_Rate_CI_upper                   float64
dtype: object
```

[25]:

```
# Reset the index to State_Code and Year
big_df1.reset_index(inplace=True)
```

0.5 Create Visualization Functions

[ ]:

```

```

[27]:

```
# Create Histogram Plot Function
def Hist_Plot(subtitle, xlab, ser1, xval):
    """Plot histogram"""

    # Main Title
    fig = plt.figure(figsize=(15,10))
    title = fig.suptitle(subtitle, fontsize=14, fontweight="bold")

    fig.subplots_adjust(top=0.88, wspace=0.3)

    # Histogram
    ax1 = fig.add_subplot(1,1,1)
    ax1.set_xlabel(xlab)
    ax1.set_ylabel(ylab)
    sns.histplot(data=ser1, x=xval, bins=20, color='darksalmon')
    plt.show()

    return

# Create Scatter Plot function

def sns_Scatter(subtitle, xlab, ylab, xval, yval, data):
    """Scatter plot"""
    fig = plt.figure(figsize=(15,10))
    title = fig.suptitle(subtitle, \
                         fontsize=14, fontweight="bold")
    fig.subplots_adjust(top=0.88, wspace=0.3)
    # Scatter Plots
    ax1 = fig.add_subplot(1,1,1)
    ax1.set_xlabel(xlab)
    ax1.set_ylabel(ylab)
    sns.scatterplot(x = xval, y = yval, data=ser1)
    plt.show()
    return

# Create a barplot function

def sns_bar(subtitle, ser1, xlab, ylab,  xval, yval):
    """Plot a bar plot"""

    fig = plt.figure(figsize=(15,10))
    title = fig.suptitle(subtitle, \
                     fontsize=14, fontweight="bold")
    fig.subplots_adjust(top=0.88, wspace=0.3)
    ax1 = fig.add_subplot(1,1,1)
    ax1.set_xlabel(xlab)
    ax1.set_ylabel(ylab)
    sns.barplot(data=ser1, x=xval, y=yval, label=xlab, ax=ax1)
    plt.show()
    return

# Create a line chart function

def sns_line(subtitle, ser1, xlab, ylab,  xval, yval, t_hue):
    """Plot a line plot"""

    fig = plt.figure(figsize=(15,10))
    title = fig.suptitle(subtitle, \
                     fontsize=14, fontweight="bold")
    fig.subplots_adjust(top=0.88, wspace=0.3)
    ax1 = fig.add_subplot(1,1,1)
    ax1.set_xlabel(xlab)
    ax1.set_ylabel(ylab)

    sns.lineplot(data=ser1, x = xval, y = yval, hue=t_hue)
    plt.show()
    return

# Create a regression chart function
```

```python

def sns_reg(subtitle, ser1, xlab, ylab,  xval, yval):
    """Plot a linear regression"""

    fig = plt.figure(figsize=(15,10))
    title = fig.suptitle(subtitle, \
                     fontsize=14, fontweight="bold")
    fig.subplots_adjust(top=0.88, wspace=0.3)
    ax1 = fig.add_subplot(1,1,1)
    ax1.set_xlabel(xlab)
    ax1.set_ylabel(ylab)

    sns.regplot(data=ser1, x = xval, y = yval)
    plt.show()
    return
```

0.6 Create Scatter Plots

[28]:

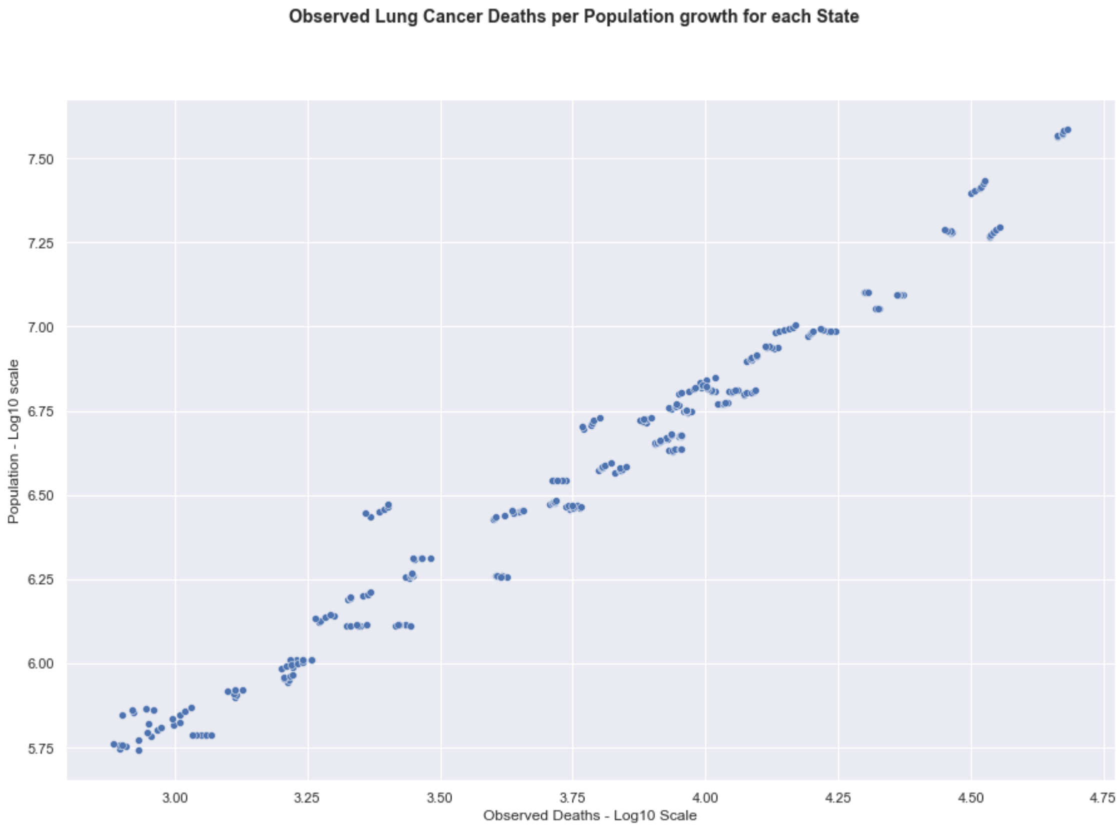
```python
# create a DF with only the observed_deaths and Year
ser1 = big_df1[['Observed_Deaths', 'Population']].copy()
```

[29]:

```python
# Compute log values for better visualization
ser1['Population_log'] = np.log10(ser1[['Population']])
ser1['Observed_Deaths_log'] = np.log10(ser1[['Observed_Deaths']])
```

[30]:

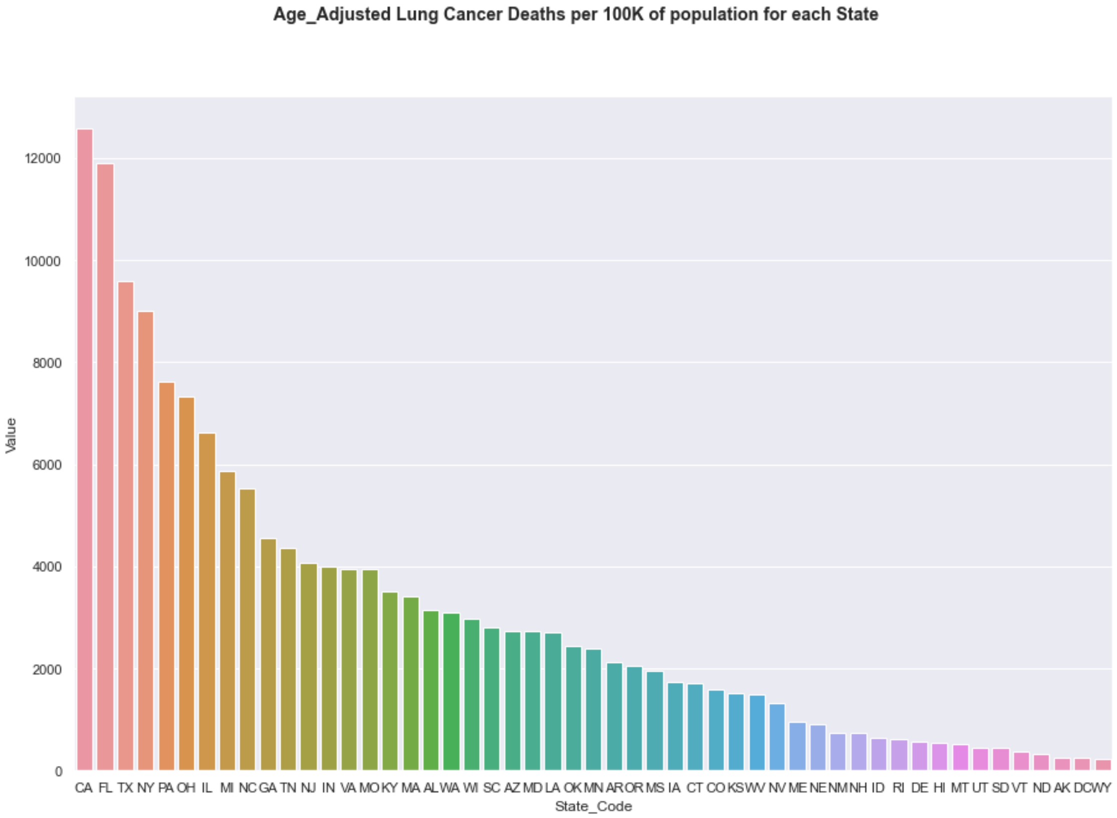
```python
# Create a Scatter plot for Population and observed number of deaths
subtitle = 'Observed Lung Cancer Deaths per Population growth for each State'
xval = 'Observed_Deaths_log'
yval = 'Population_log'
xlab = 'Observed Deaths - Log10 Scale'
ylab = 'Population - Log10 scale'
sns_Scatter(subtitle, xlab, ylab, xval, yval, ser1)
```



0.7 Create Bar Plots

[31]:
```
# Create a bar chart of the Age_adjusted Number per 100K deaths for each state.
# Drop duplicates because values are repeated for each year. Only need one row␣
    ↪per state
ser1 = big_df1[['State_Code', 'Value']].sort_values('Value', ascending = False).
    ↪copy()
ser1.drop_duplicates(keep='first', inplace=True)
```

[45]:
```
# Define Plot params
ser1 = big_df1[['State_Code', 'Value']].sort_values('Value', ascending = False).
    ↪copy()
subtitle = "Age_Adjusted Lung Cancer Deaths per 100K of population for each␣
    ↪State"
xlab = "State"
xval = 'State_Code'
ylab = 'Age_Adjusted Annual Lung Cancer Number'
yval = 'Value'
sns_bar(subtitle, ser1, xlab, ylab, xval, yval)
```



0.8 Create Line Charts

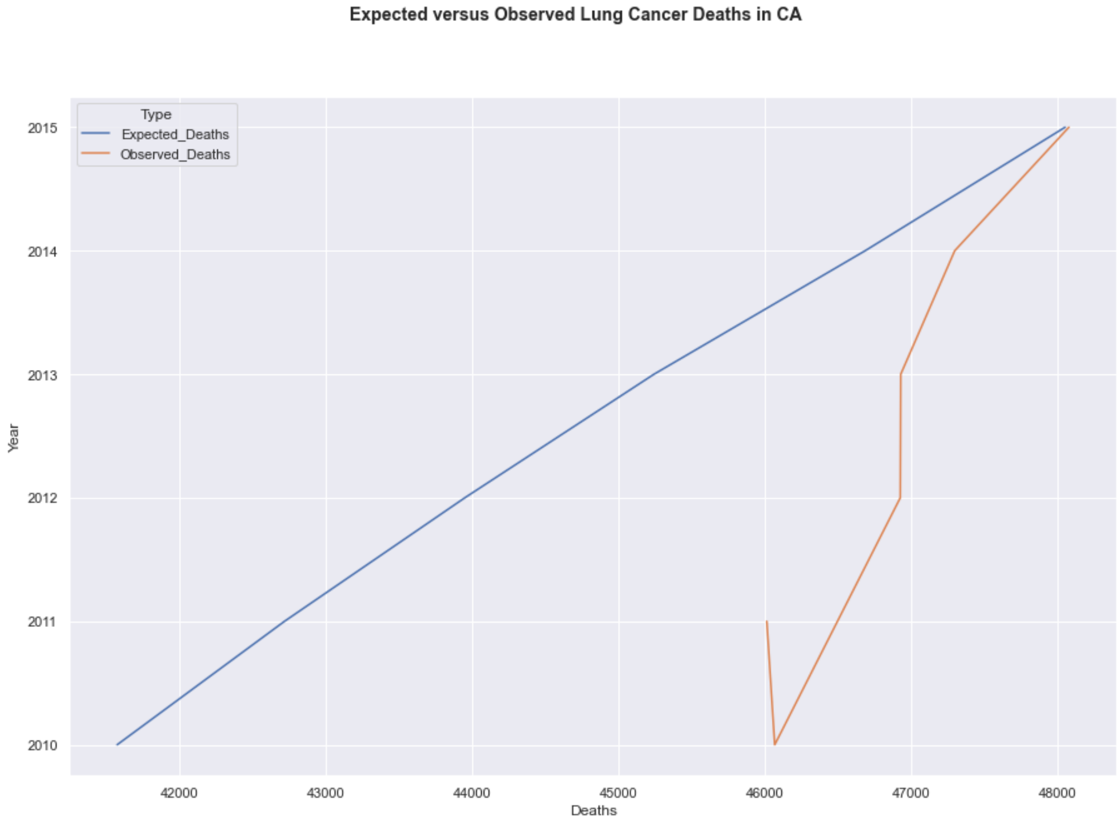
[33]:
```
# Create a line chart showing the observed_deaths vs expected deaths for 5␣
↪years for CA.
```

[34]:
```
# Reshape the data to show two lines representing Observed Deaths and Expected␣
↪Deaths
tmp_df = big_df1[['Expected_Deaths', 'Observed_Deaths', 'State_Code', 'Year']].
↪copy()
ser1 = tmp_df[tmp_df['State_Code'] == 'CA'].copy()
ser1.drop(columns='State_Code', inplace=True)
tmp = pd.melt(ser1, id_vars=['Year'], var_name='Type', value_name =␣
↪'Nbr_Of_Deaths')
tmp.head(5)
```

[34]:
```
   Year             Type  Nbr_Of_Deaths
0  2010  Expected_Deaths        41572.0
1  2011  Expected_Deaths        42716.0
2  2012  Expected_Deaths        43948.0
3  2013  Expected_Deaths        45240.0
4  2014  Expected_Deaths        46683.0
```

[46]:

```
# Create line plot showing the two categories of values
ser1 = tmp
subtitle = "Expected versus Observed Lung Cancer Deaths in CA"
xlab = 'Deaths'
xval = 'Nbr_Of_Deaths'
ylab = 'Year'
yval = 'Year'
t_hue = 'Type'
sns_line(subtitle, ser1, xlab, ylab,  xval, yval, t_hue)
```



[36]:

```
# Show the observed deaths for California because the line graph shows an␣
  ↪anomaly
tmp2 = big_df1[['State_Code', 'Year','Observed_Deaths']].copy()
tmp2[(tmp2['State_Code'] == 'CA')]
```

[36]:

```
    State_Code  Year  Observed_Deaths
4           CA  2010          46065.0
51          CA  2011          46011.0
106         CA  2012          46923.0
157         CA  2013          46926.0
208         CA  2014          47295.0
```

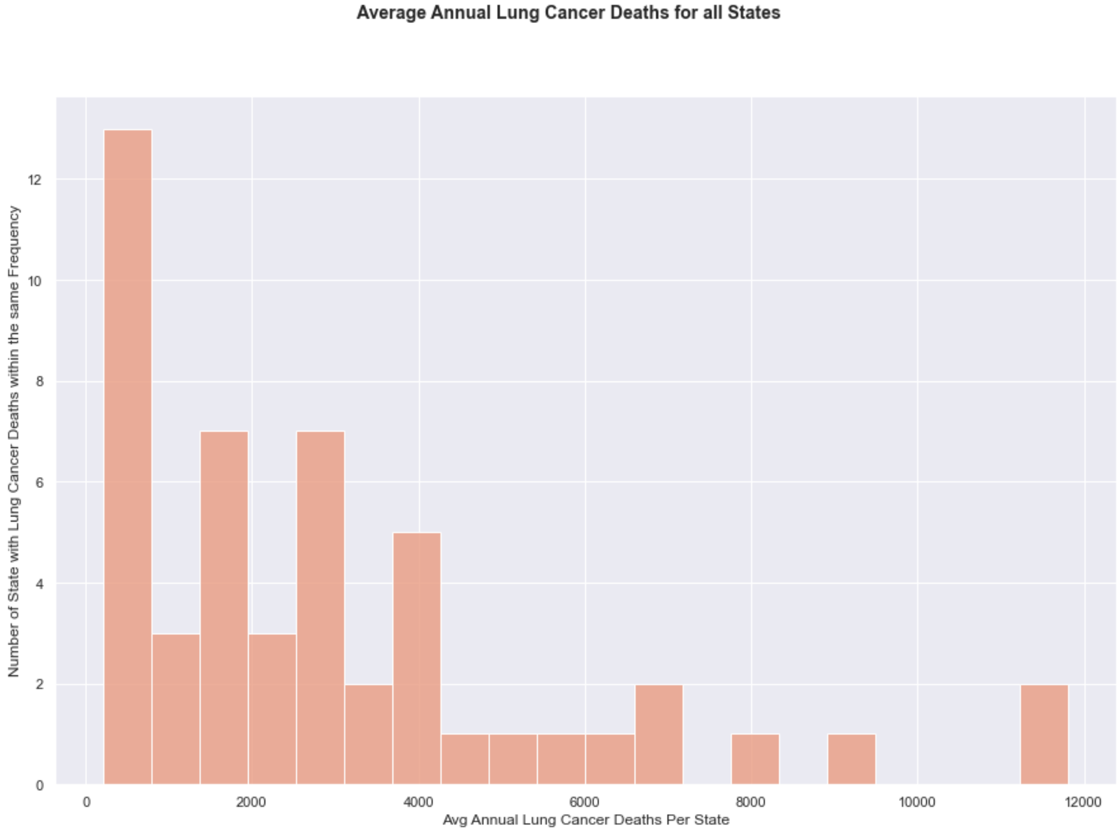
```
259          CA  2015          48075.0
```

0.9 Create Histogram

```
[37]: # Create a histogram of the average annaul death rates for all states.
```

```
[48]: # Select a subset for the histogram. Drop duplicate rows as all the years␣
       ↪reflect the same value
      ser1 = big_df1[['State_Code', 'Avg_Ann_Count']].copy()
      ser1.drop_duplicates(keep='first', inplace=True)
```

```
[50]: # Define Plot Params
      subtitle = "Average Annual Lung Cancer Deaths for all States"
      xlab = "Avg Annual Lung Cancer Deaths Per State"
      xval = 'Avg_Ann_Count'
      ylab = 'Number of State with Lung Cancer Deaths within the same Frequency'
      yval = 'Value'
      Hist_Plot(subtitle, xlab, ser1, xval)
```

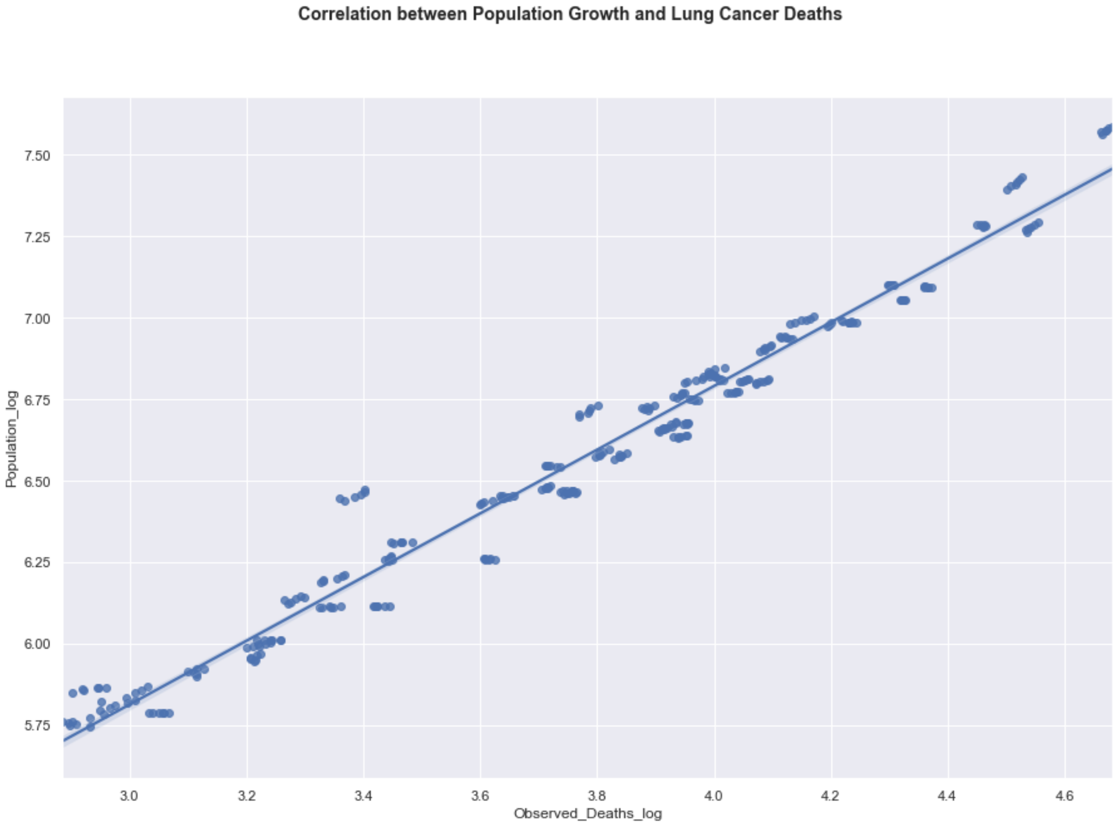


0.10 Create Linear Regression Plot

[40]:
```
# Create a linear regression plot to show correlation between population growth␣
↪and cancer deaths
```

[41]:
```
# Create subset for with observed deaths and population for each state
# Change the population to log10 for better visualization
ser1 = big_df1[['State_Code', 'Population', 'Year', 'Observed_Deaths']].copy()
ser1['Population_log'] = np.log10(ser1[['Population']])
ser1['Observed_Deaths_log'] = np.log10(ser1[['Observed_Deaths']])
```

[42]:
```
# Create Regression Plot
subtitle = "Correlation between Population Growth and Lung Cancer Deaths"
xval = "Observed_Deaths_log"
xlab = 'Number of Lung Cancer Deaths'
ylab = 'Population'
yval = 'Population_log'
sns_reg(subtitle, ser1, xlab, ylab, xval, yval)
```



[ ]: