HW1

October 5, 2019

```
In [1]: import pandas as pd
        import numpy as np
        import matplotlib.pyplot as plt
        import seaborn as sns
```

1 Problem 1

My score was 46%. I was more optimistic than reality. I would like to know more about the question 'What is the life expectancy of the world population?'

The life expectancy had increased drastically between 1950s to 1970s and it has been steadily growing with the advancement in biology

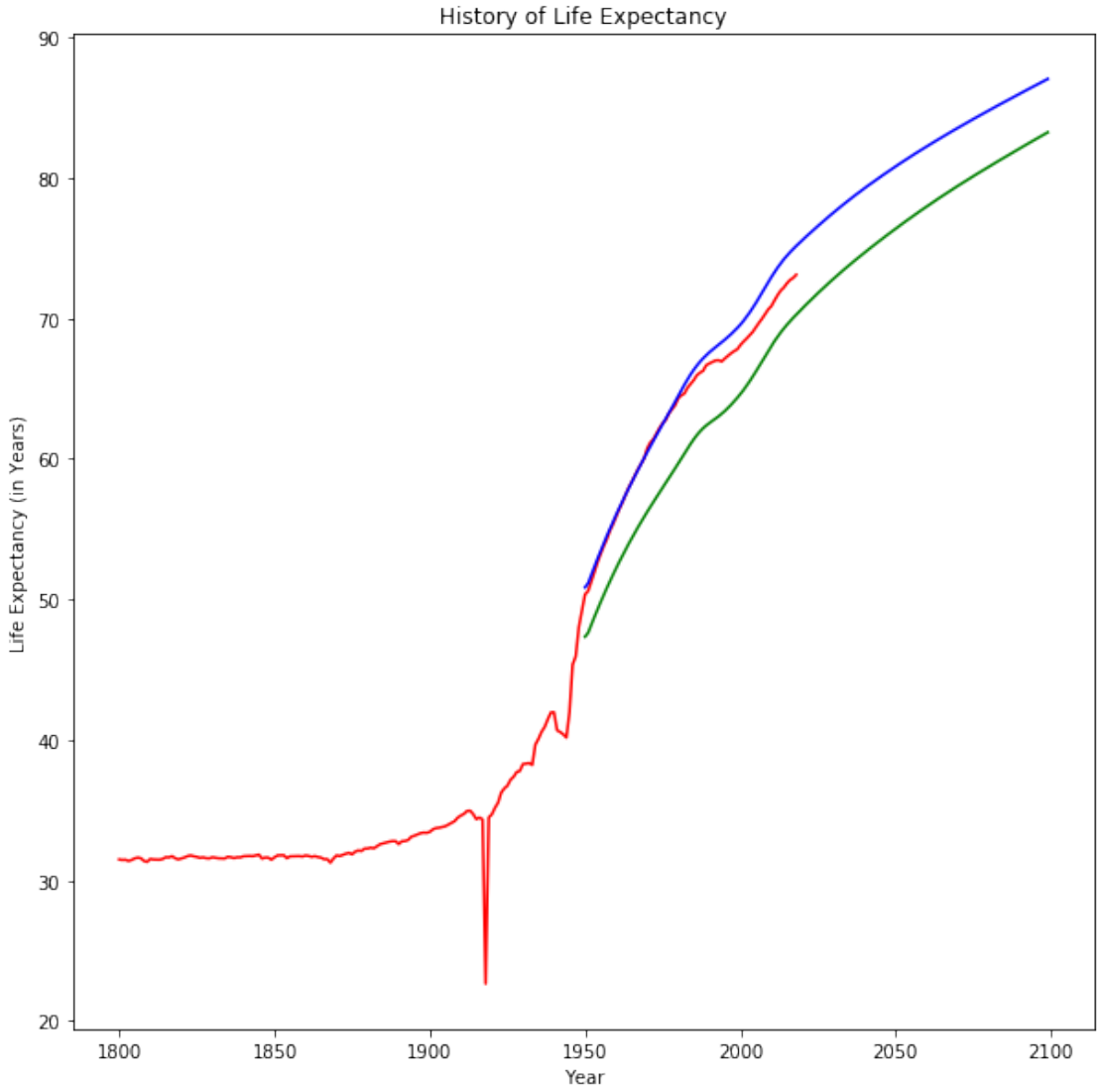
```
In [2]: life_expectancy = pd.read_csv('../data/ddf--datapoints--life_expectancy_years--by--geo
        life_expectancy_m = pd.read_csv('../data/ddf--datapoints--life_expectancy_male--by--ge
        life_expectancy_f = pd.read_csv('../data/ddf--datapoints--life_expectancy_female--by--

        life_expectancy = life_expectancy.groupby('time').mean().reset_index()
        life_expectancy_m = life_expectancy_m.groupby('time').mean().reset_index()
        life_expectancy_f = life_expectancy_f.groupby('time').mean().reset_index()

        life_expectancy = pd.merge(life_expectancy, life_expectancy_m, on='time', how='outer')
        life_expectancy = pd.merge(life_expectancy, life_expectancy_f, on='time', how='outer')

        life_expectancy.head()
```

Out[2]:

	time	life_expectancy_years	life_expectancy_male	life_expectancy_female
0	1800	31.486020	NaN	NaN
1	1801	31.448905	NaN	NaN
2	1802	31.463483	NaN	NaN
3	1803	31.377413	NaN	NaN
4	1804	31.446318	NaN	NaN

```
In [3]: plt.figure(figsize=(10,10))
        plt.plot(life_expectancy['time'].values, life_expectancy['life_expectancy_years'], '-r
        plt.plot(life_expectancy['time'].values, life_expectancy['life_expectancy_male'], '-g'
        plt.plot(life_expectancy['time'].values, life_expectancy['life_expectancy_female'], '-
        plt.xlabel('Year')
```

```
plt.ylabel('Life Expectancy (in Years)')
plt.title('History of Life Expectancy')
plt.show()
```



2 Problem 2

Visualize the distribution of income (GDP / capita) across countries and continents, and how the distribution of income changes over time.

The distribution becomes long tailed on right which indicates over all income growth for all continents

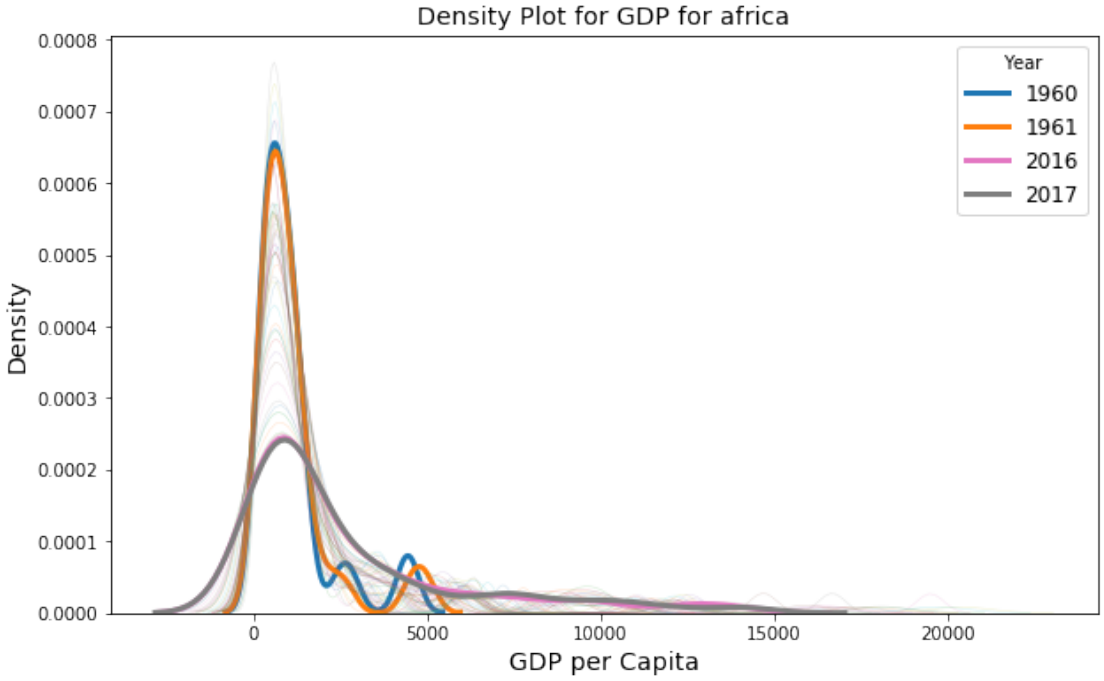
```
In [4]: gdp_capita_df = pd.read_csv("../data/ddf--datapoints--gdppercapita_us_inflation_adjuste
        country = pd.read_csv('../data/ddf--entities--geo--country.csv')[['country', 'world_4re
        gdp_continent = pd.merge(gdp_capita_df, country, left_on = 'geo', right_on='country')
```

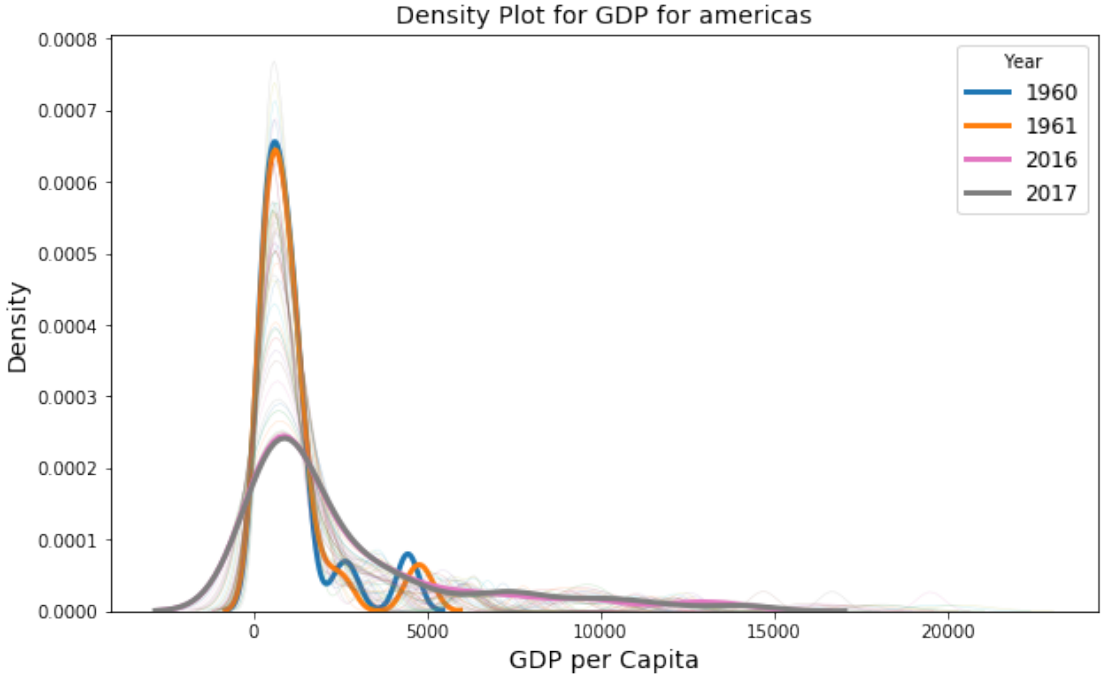
```
In [5]: gdp_continent.head()
```

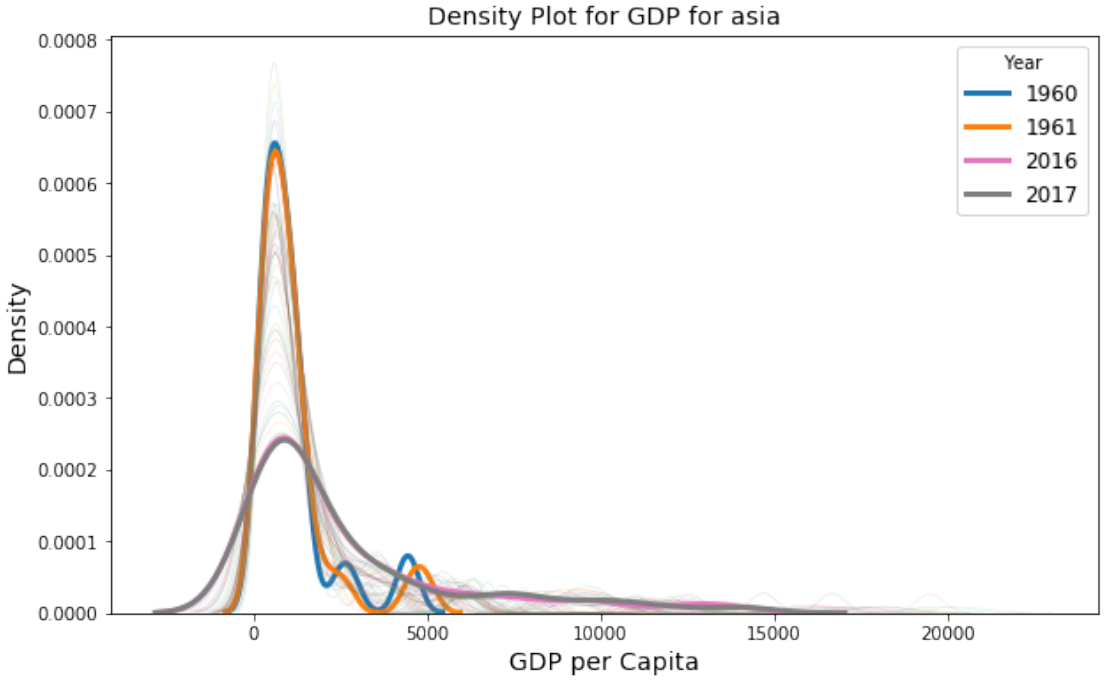
Out[5]:

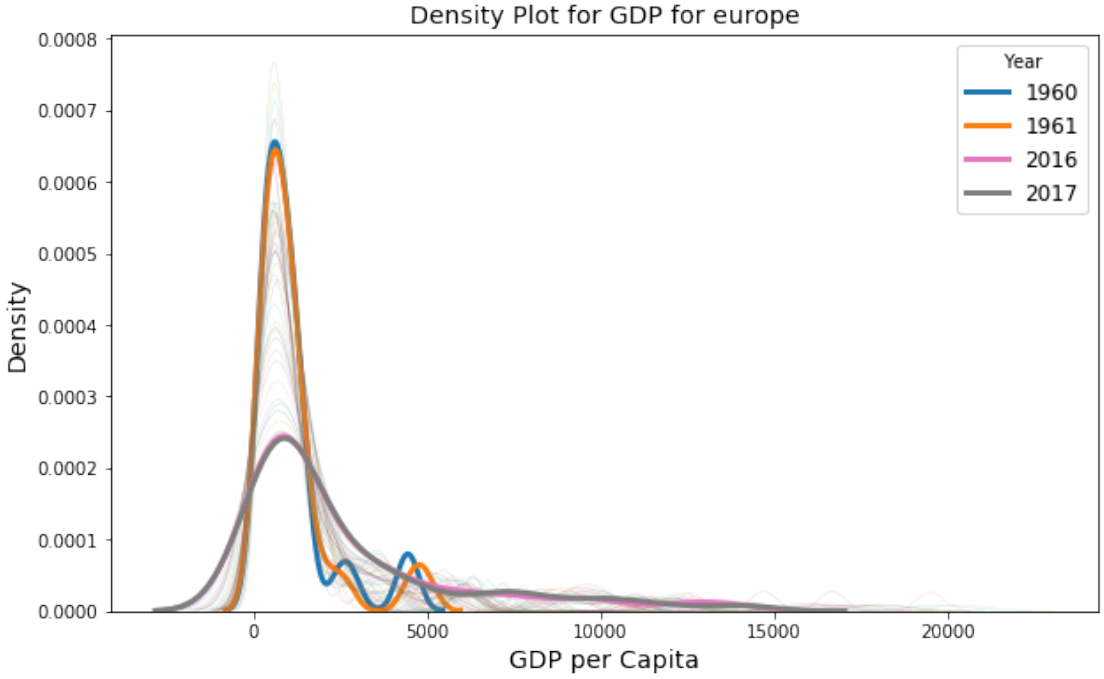
	geo	time	gdppercapita_us_inflation_adjusted	country	world_4region
0	abw	2010	24271.94042	abw	americas
1	afg	2002	364.57057	afg	asia
2	afg	2003	376.75871	afg	asia
3	afg	2004	364.09544	afg	asia
4	afg	2005	389.41636	afg	asia

```
In [6]: years = np.unique(gdp_continent['time'])

        for i,c in enumerate(np.unique(gdp_continent['world_4region'])):
            plt.figure(figsize=(10,6))
            for year in years:
                subset = gdp_continent[(gdp_continent['time'] == year) & (gdp_continent['world
                if year < 1962 or year > 2015:
                    width = 3
                    alpha = 1
                    l = year
                else:
                    width = 0.5
                    alpha=0.2
                    l='_nolegend_'
                sns.distplot(subset['gdppercapita_us_inflation_adjusted'], hist = False, kde =
                             kde_kws = {'linewidth': width, 'alpha': alpha},
                             label = l)
            plt.legend(prop={'size': 12}, title = 'Year')
            plt.title('Density Plot for GDP for ' + c, fontsize=14)
            plt.xlabel('GDP per Capita', fontsize=14)
            plt.ylabel('Density', fontsize=14)
            plt.show()
```


Density Plot for GDP for africa
Year
1960
1961
2016
2017
Density
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0.0000
0
5000
10000
15000
20000
GDP per Capita


Density Plot for GDP for americas
Year
1960
1961
2016
2017
Density
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0.0000
0
5000
10000
15000
20000
GDP per Capita


Density Plot for GDP for asia
Year
1960
1961
2016
2017
Density
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0.0000
0
5000
10000
15000
20000
GDP per Capita


Density Plot for GDP for europe
Year
1960
1961
2016
2017
Density
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0.0000
0
5000
10000
15000
20000
GDP per Capita

3 Problem 3:

Use visualization to investigate the relationship between income (GDP / capita), life expectancy, and child mortality over time. How does each measure change over time within each continent? Interpret your visualizations, noting any trends and/or outliers.

Child mortality and life expectancy is inversely proportional as expected and there is strong inverse relationship between child mortality and GDP which makes sense. For every continent the child mortality has gone down and life expectancy has gone up over time. Africa being one of the prime winners. The GDP has been rising for all continents but Africa is the weakest and the gap between the growth is significant between EU v/s everyone else.

```
In [7]: life_expectency = pd.read_csv('../data/ddf--datapoints--life_expectancy_years--by--geo
        child_mortality = pd.read_csv('../data/ddf--datapoints--child_mortality_0_5_year_olds_
        country = pd.read_csv('../data/ddf--entities--geo--country.csv')[['country', 'world_4re
        q3 = pd.merge(child_mortality, life_expectency, on = ['geo', 'time'])
        q3 = pd.merge(q3, gdp_capita_df, on = ['geo', 'time'])
        q3 = pd.merge(q3, country, left_on = 'geo', right_on='country')
        continent = q3.groupby(['world_4region', 'time']).mean().reset_index()
        colors = np.unique(continent['world_4region'])
        q3.head()
```

Out[7]:

	geo	time	child_mortality_0_5_year_olds_dying_per_1000_born	life_expectancy_years	gdppercapita_us_inflation_adjusted	country	world_4region
0	abw	2010	17.969	75.06	24271.94042	abw	americas
1	afg	2002	122.200	52.43	364.57057	afg	asia
2	afg	2003	118.300	53.03	376.75871	afg	asia
3	afg	2004	114.400	53.50	364.09544	afg	asia
4	afg	2005	110.300	53.87	389.41636	afg	asia

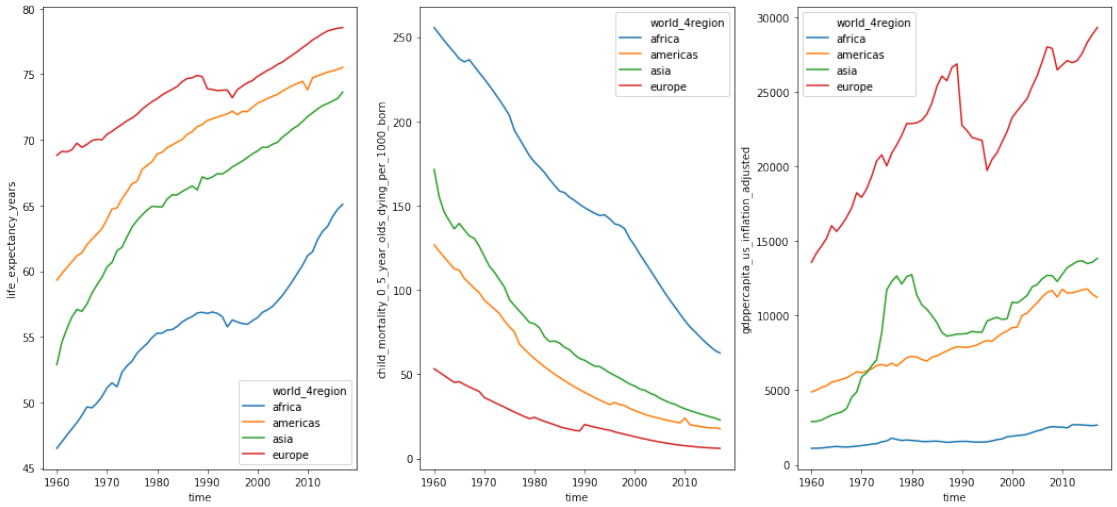
```
In [8]: q3_corr = q3[['child_mortality_0_5_year_olds_dying_per_1000_born', 'life_expectancy_yea
        q3_corr.style.background_gradient(cmap='coolwarm').set_precision(3)
```

```
Out[8]: <pandas.io.formats.style.Styler at 0x124920320>
```

```
In [9]: f, axes = plt.subplots(1, 3, figsize=(18,8))
        # fig, ax = plt.subplots(figsize=(20, 10
```

```
sns.lineplot(y='life_expectancy_years', x= 'time', hue='world_4region', hue_order=colo
sns.lineplot(y='child_mortality_0_5_year_olds_dying_per_1000_born', x= 'time', hue='wo
sns.lineplot(y='gdppercapita_us_inflation_adjusted', x= 'time', hue='world_4region', hu
```

```
Out[9]: <matplotlib.axes._subplots.AxesSubplot at 0x1249d7160>
```



4 Problem 4

Choose two variables you have not investigated yet, and visualize their distributions, their relationship with each other, and how these change over time. Interpret your visualizations, noting any trends and/or outliers.

There is a very strong trend in the government spending per person and the GDP which makes sense as the GDP increases the government is able to invest more for its people.

```
In [10]: spending = pd.read_csv('../data/ddf--datapoints--total_health_spending_per_person_int
         q4 = pd.merge(spending, gdp_capita_df, on = ['geo', 'time'])
         q4_plot = q4.groupby('time').mean().reset_index()
         ## Normalizing to see trend more clearly
         for col in ['total_health_spending_per_person_international_dollar', 'gdppercapita_us
             q4_plot[col] = (q4_plot[col] - q4_plot[col].mean())/q4_plot[col].std()
         q4_plot.head()
```

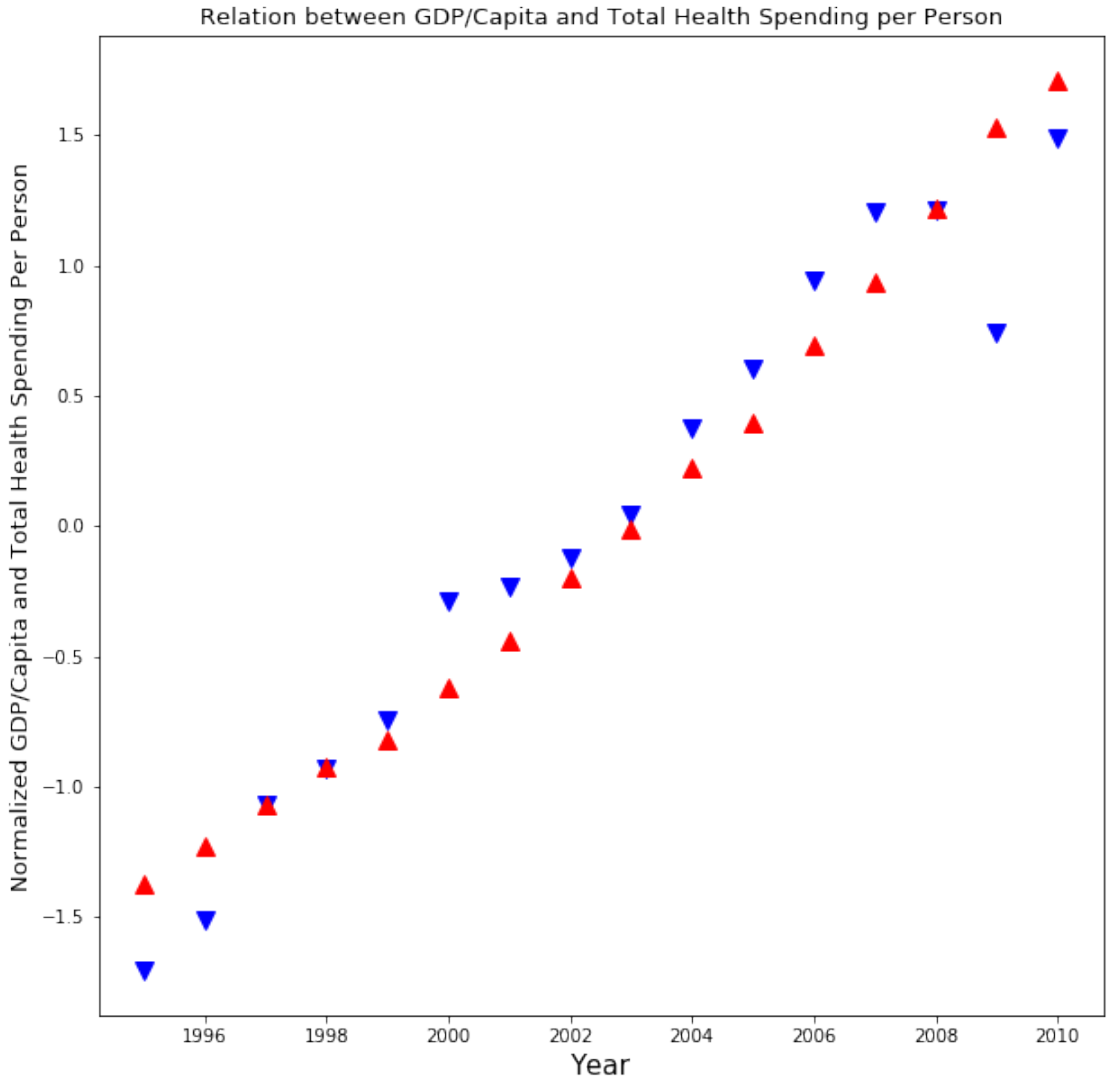
```
Out[10]:    time  total_health_spending_per_person_international_dollar  \
         0  1995                                          -1.375390
         1  1996                                          -1.230598
         2  1997                                          -1.067717
         3  1998                                          -0.926885
         4  1999                                          -0.823571

            gdppercapita_us_inflation_adjusted
```

```
0                              -1.705371
1                              -1.512394
2                              -1.068741
3                              -0.930916
4                              -0.746056
```

In [11]:
```
q4_corr = q4[['gdppercapita_us_inflation_adjusted', 'total_health_spending_per_person_
q4_corr.style.background_gradient(cmap='coolwarm').set_precision(3)
```

Out[11]:
```
<pandas.io.formats.style.Styler at 0x124571d30>
```

In [12]:
```
plt.figure(figsize=(10,10))
plt.plot(q4_plot['time'], q4_plot['gdppercapita_us_inflation_adjusted'], 'vb', markers
plt.plot(q4_plot['time'], q4_plot['total_health_spending_per_person_international_doll
plt.xlabel('Year', fontsize=15)
plt.ylabel('Normalized GDP/Capita and Total Health Spending Per Person', fontsize=13)
plt.title('Relation between GDP/Capita and Total Health Spending per Person', fontsize
plt.show()
```



5 Problem 5

Did you use static or interactive plots to answer the previous problems?

Explore the data using the interactive visualization tools at https://www.gapminder.org/tools, and watch the TED talk "The best stats you've ever seen" at https://www.youtube.com/watch?v=hVimVzgtD6w.

Discuss the advantages, disadvantages, and relative usefulness of using interactive/dynamic visualizations versus static visualizations.

I used static plots.

Advantages of Static Plot - Disadvantage of Dynamic Plot : 1. Data doesn't flow to fast so that user has time to understand each plot. 2. Can print them / showcase them.

Disadvantage of Static Plot - Advantage of Dynamic Plot : 1. Can see trends across different features quickly 2. Keeps the user engaged

It is more useful to use static plots when we are observing only 2 features when we want to use 3 features dynamic plots are more helpful. Simple interactions are much more readible in static plots where as while telling a story dynamic plots can keep user enages. If we have to showcase the plots as charts/prints one cannot use dynamic plots