app

October 7, 2019

0.1 Overview

This homework asks you to visualize data from the Gapminder Foundation (https://www.gapminder.org). Download the full Gapminder dataset from the Open Numbers Github repository: https://github.com/open-numbers/ddf–gapminder–systema_globalis

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

        %matplotlib inline
```

0.2 Problem 1

Take the Gapminder Test: http://forms.gapminder.org/s3/test-2018. What score did you receive? Did any of the answers surprise you? Choose a question from the test, re-state it, and answer it using visualization and summarization. Provide a figure and any relevant output with your answer.

What score did you receive? - 23%

Did any of the answers surprise you? - Yes

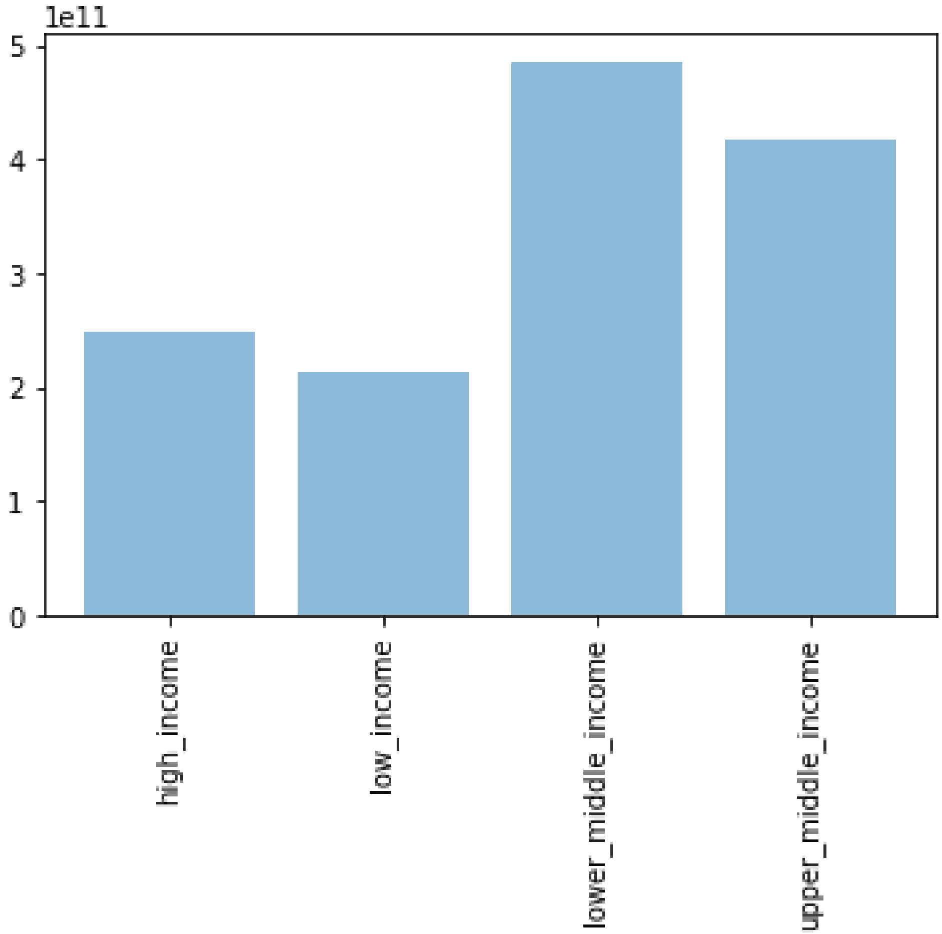
Choose a question from the test, re-state it, and answer it using visualization and summarization. Provide a figure and any relevant output with your answer.

5. Where does the majority of the world population live?

```
In [2]: def run_1():
            country_df = pd.read_csv('../input/ddf--gapminder--systema_globalis-master/ddf--en
            total_population_df = pd.read_csv('../input/ddf--gapminder--systema_globalis-maste
            df = total_population_df.merge(country_df[['country', 'income_groups']], left_on='
            grouped_df = df[['income_groups', 'population_total']].groupby(['income_groups']).
            grouped_df = grouped_df.reset_index()
            print(grouped_df)
            plt.bar(grouped_df['income_groups'], grouped_df['population_total'], align='center
            plt.xticks(rotation='vertical')
```

```
In [3]: run_1()
```

```
          income_groups  population_total
0           high_income      249226583643
1            low_income      214102397309
2   lower_middle_income      485771893214
3   upper_middle_income      418248077494
```



As observed from the above plot, the majority of the population lives in middle income countries.

1 Problem 2

Visualize the distribution of income (GDP / capita) across countries and continents, and how the distribution of income changes over time. Interpret the visualization and what you notice. Are they any notable trends and/or deviations from that trend? What caveats apply to your conclusions?

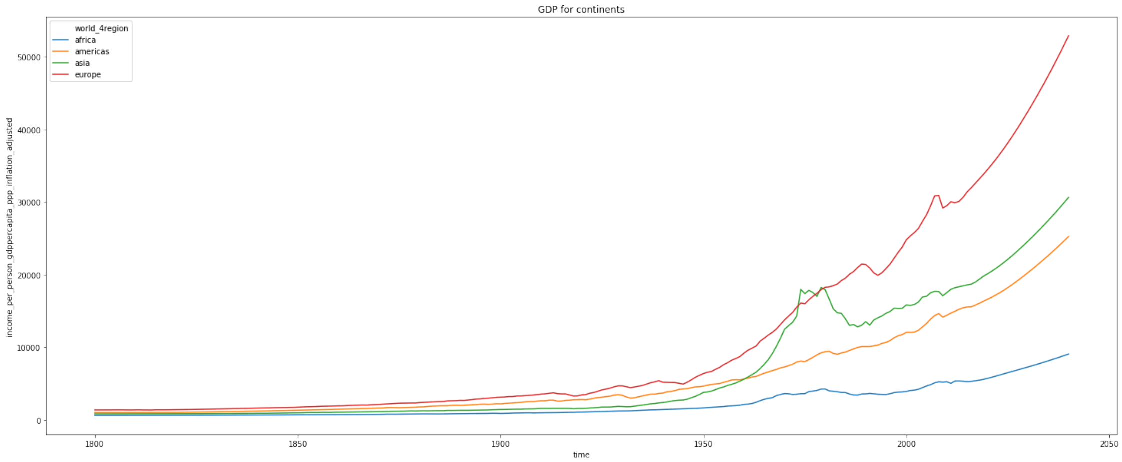
```
In [4]: def gdp_for_continents(gdp_continent_df):
            grouped_df = gdp_continent_df[['time', 'world_4region', 'income_per_person_gdpperca
```

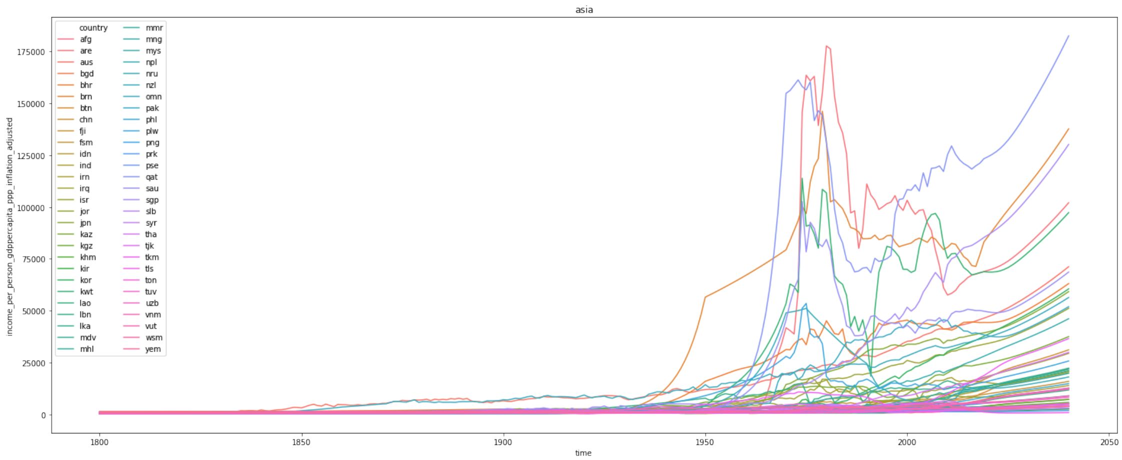
```
    fig, ax = plt.subplots(figsize=(25,10))
    ax.title.set_text("GDP for continents")
    sns.lineplot(x="time", y="income_per_person_gdppercapita_ppp_inflation_adjusted", h
    plt.legend(ncol=1, loc='upper left')
    plt.show()
```

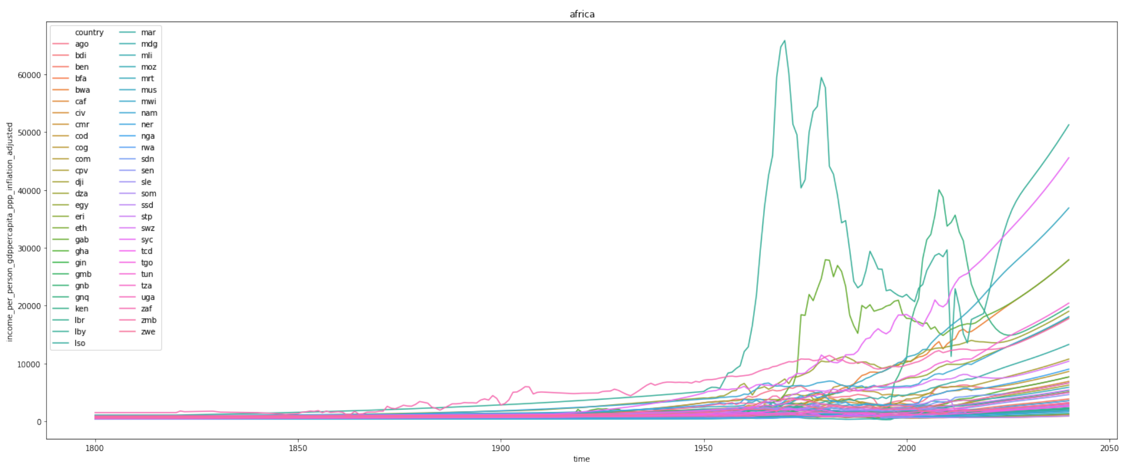
```
In [5]: def gdp_for_countries(gdp_continent_df):
            continents = gdp_continent_df['world_4region'].unique()
            for i in range(len(continents)):
                df = gdp_continent_df[gdp_continent_df['world_4region'] == continents[i]]
                fig, ax = plt.subplots(figsize=(25,10))
                ax.title.set_text(continents[i])
                sns.lineplot(x="time", y="income_per_person_gdppercapita_ppp_inflation_adjusted
                plt.legend(ncol=2, loc='upper left')
                plt.show()
```

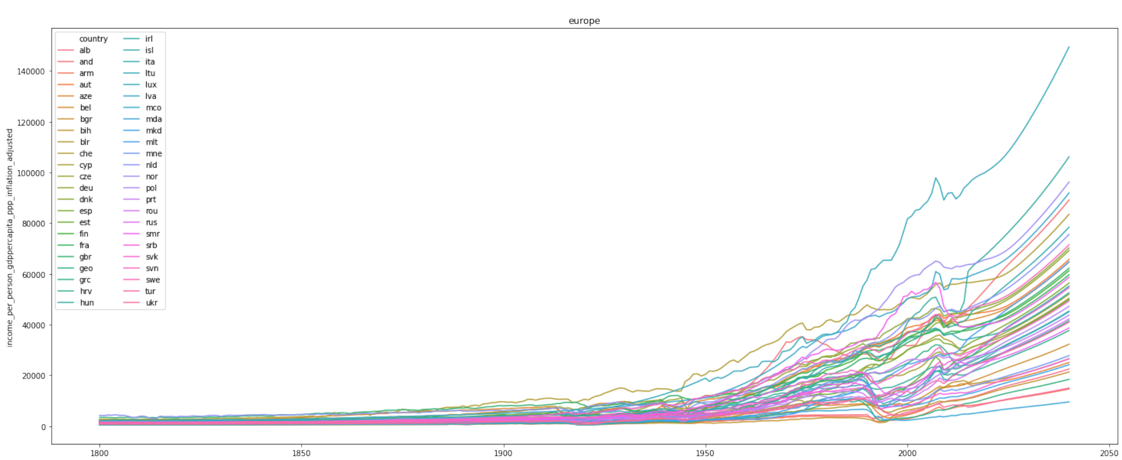
```
In [6]: def run_2():
            country_df = pd.read_csv('../input/ddf--gapminder--systema_globalis-master/ddf--ent
            gdp_df = pd.read_csv('../input/ddf--gapminder--systema_globalis-master/ddf--datapoi
            gdp_continent_df = pd.merge(gdp_df, country_df[['country', 'world_4region']], left_
            gdp_for_continents(gdp_continent_df)
            gdp_for_countries(gdp_continent_df)
```

```
In [7]: run_2()
```




asia
income_per_person_gdppercapita_ppp_inflation_adjusted
time
0
25000
50000
75000
100000
125000
150000
175000
1800
1850
1900
1950
2000
2050
country
afg
are
aus
bgd
bhr
brn
btn
chn
fji
fsm
idn
ind
irn
irq
isr
jor
jpn
kaz
kgz
khm
kir
kor
kwt
lao
lbn
lka
mdv
mhl
mmr
mng
mys
npl
nru
nzl
omn
pak
phl
plw
png
prk
pse
qat
sau
sgp
slb
syr
tha
tjk
tkm
tls
ton
tuv
uzb
vnm
vut
wsm
yem


africa
income_per_person_gdppercapita_ppp_inflation_adjusted
time
0
10000
20000
30000
40000
50000
60000
1800
1850
1900
1950
2000
2050
country
ago
bdi
ben
bfa
bwa
caf
civ
cmr
cod
cog
com
cpv
dji
dza
egy
eri
eth
gab
gha
gin
gmb
gnb
gnq
ken
lbr
lby
lso
mar
mdg
mli
moz
mrt
mus
mwi
nam
ner
nga
rwa
sdn
sen
sle
som
ssd
stp
swz
syc
tcd
tgo
tun
tza
uga
zaf
zmb
zwe


europe
income_per_person_gdppercapita_ppp_inflation_adjusted
time
0
20000
40000
60000
80000
100000
120000
140000
1800
1850
1900
1950
2000
2050
country
alb
and
arm
aut
aze
bel
bgr
bih
blr
che
cyp
cze
deu
dnk
esp
est
fin
fra
gbr
geo
grc
hrv
hun
irl
isl
ita
ltu
lux
lva
mco
mda
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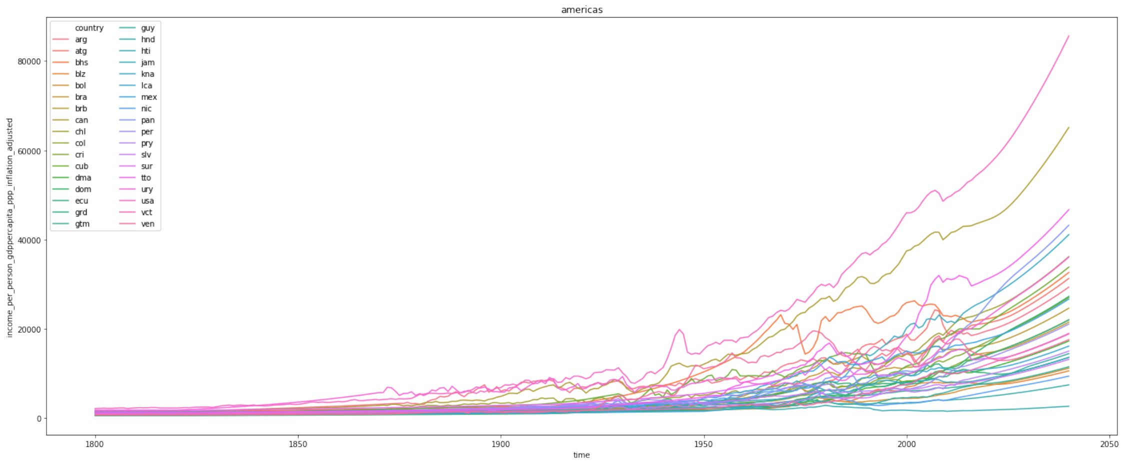
svk
svn
swe
tur
ukr



Around 1960, The gdp of asia has gone above that of the americas. The gdp of asia has also gone above that of europe on few occasions.

The gdp of all countries in europe and america seem to have steadily increased where as is asia nad africe, there seems to have a peak around 1970-1980's.

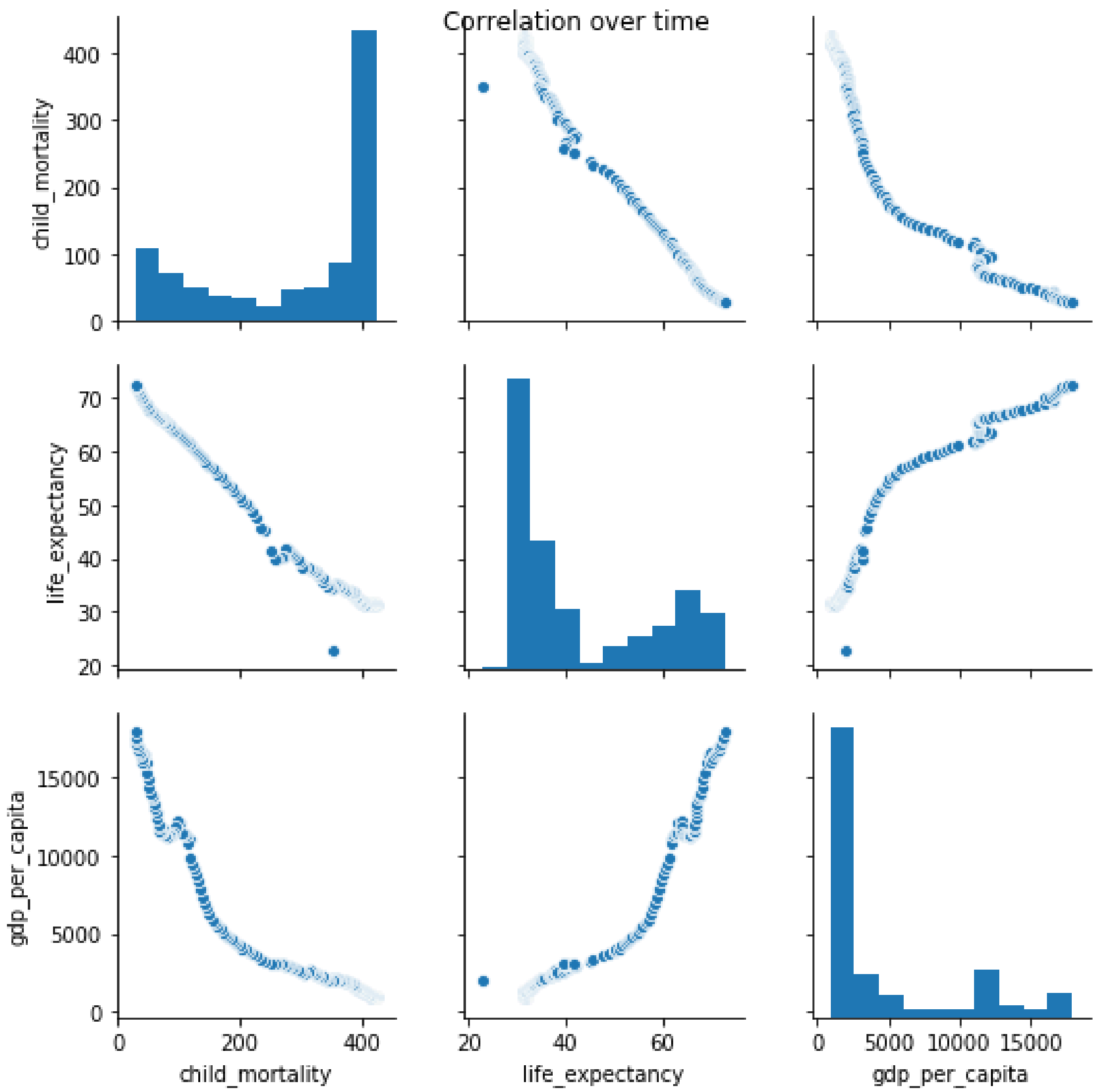
1.1 Problem 3

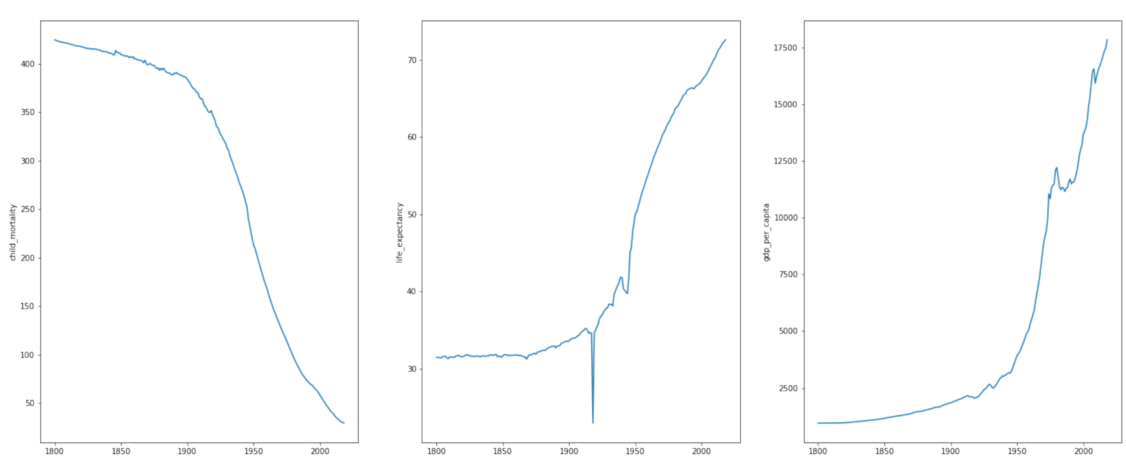
Use visualization to investigate the relationship between income (GDP / capita), life expectancy, and child mortality over time. How does each measure change over time within each continent? Interpret your visualizations, noting any trends and/or outliers.

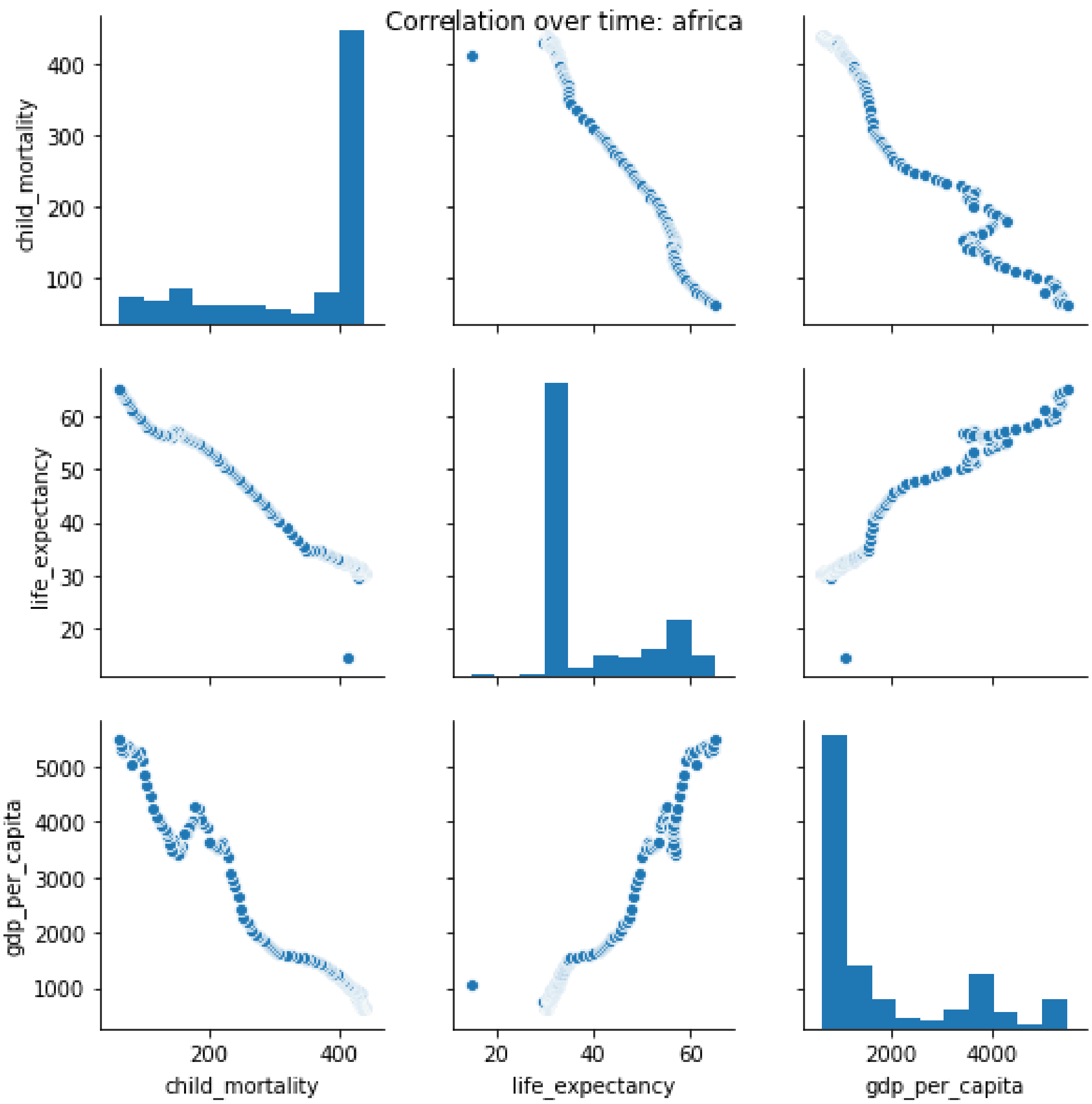
```
In [11]: def run_3():
             country_df = pd.read_csv('../input/ddf--gapminder--systema_globalis-master/ddf--e
             gdp_df = pd.read_csv('../input/ddf--gapminder--systema_globalis-master/ddf--datap
             child_mortality_df = pd.read_csv('../input/ddf--gapminder--systema_globalis-maste
             life_expectancy_df = pd.read_csv('../input/ddf--gapminder--systema_globalis-maste

             result_df = pd.merge(gdp_df, country_df[['country', 'world_4region']], left_on =
             result_df = pd.merge(result_df, child_mortality_df, on = ['geo', 'time'])
             result_df = pd.merge(result_df, life_expectancy_df, on = ['geo', 'time'])
             result_df.rename(columns={'child_mortality_0_5_year_olds_dying_per_1000_born':'ch
                                       'life_expectancy_years':'life_expectancy',
                                       'income_per_person_gdppercapita_ppp_inflation_adjusted
                              inplace=True)

             # Correlation over time between income (GDP / capita), life expectancy, and child
             grouped_time_df = result_df[['time', 'child_mortality', 'life_expectancy', 'gdp_p
             sns.pairplot(grouped_time_df[['child_mortality', 'life_expectancy', 'gdp_per_capi
             plt.suptitle('Correlation over time')
             fig, ax = plt.subplots(ncols=3, figsize=(25,10))
             sns.lineplot(x="time", y='child_mortality', data=grouped_time_df, ax=ax[0])
             sns.lineplot(x="time", y='life_expectancy', data=grouped_time_df, ax=ax[1])
```

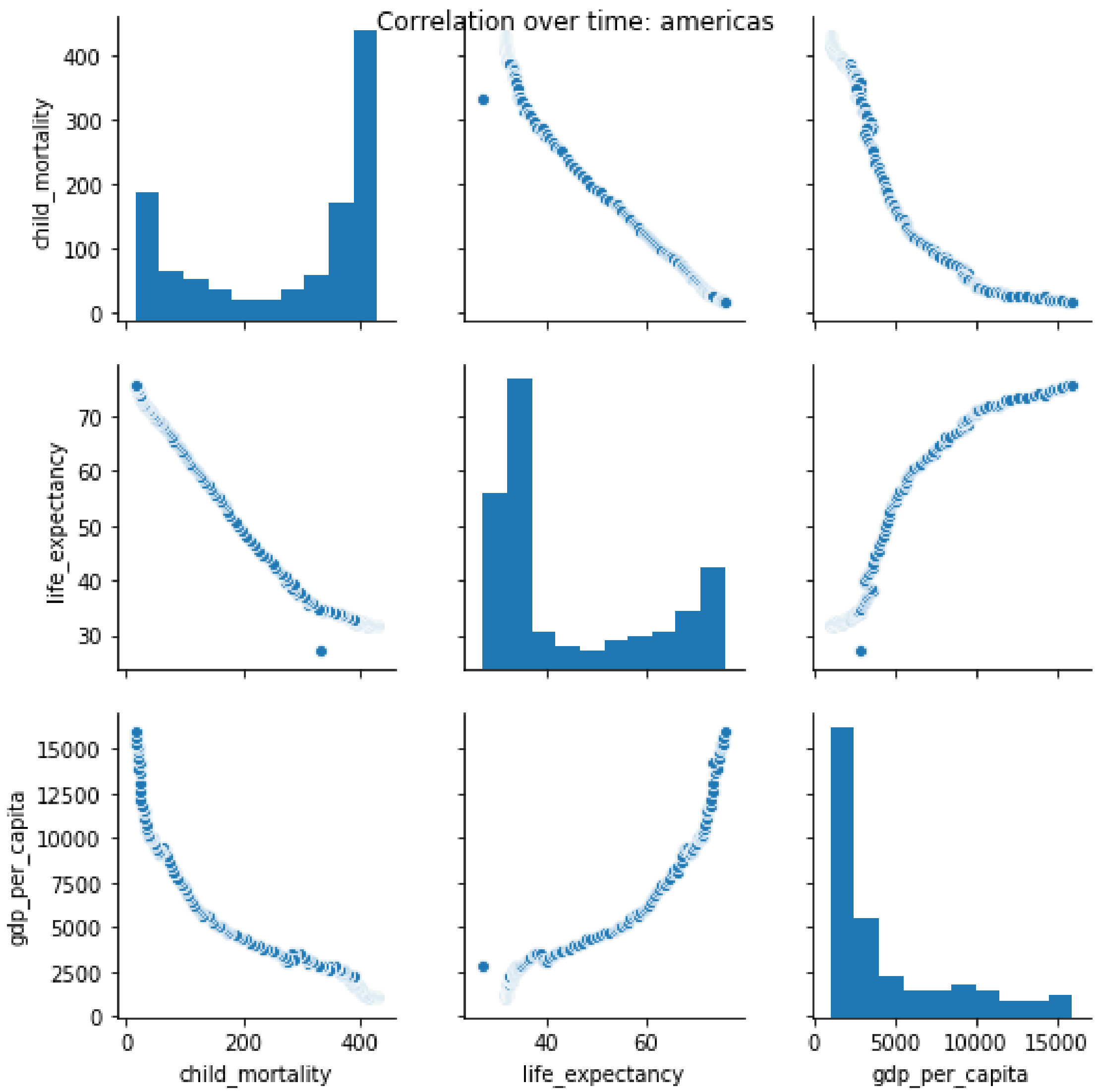
```
        sns.lineplot(x="time", y='gdp_per_capita', data=grouped_time_df, ax=ax[2])
        plt.show()

        grouped_continent_time_df = result_df.groupby(['world_4region', 'time']).mean().re

        # Correlation over time between income (GDP / capita), life expectancy, and child
        continents = grouped_continent_time_df['world_4region'].unique()
        for i in range(len(continents)):
            df = grouped_continent_time_df[grouped_continent_time_df['world_4region'] == c
            sns.pairplot(df[['child_mortality', 'life_expectancy', 'gdp_per_capita']])
            plt.suptitle('Correlation over time: {}'.format(continents[i]))

        fig, ax = plt.subplots(ncols=3, figsize=(25,10))
        sns.lineplot(x="time", y='child_mortality', hue='world_4region', data=grouped_cont
        sns.lineplot(x="time", y='life_expectancy', hue='world_4region', data=grouped_cont
        sns.lineplot(x="time", y='gdp_per_capita', hue='world_4region', data=grouped_conti
        plt.show()
```

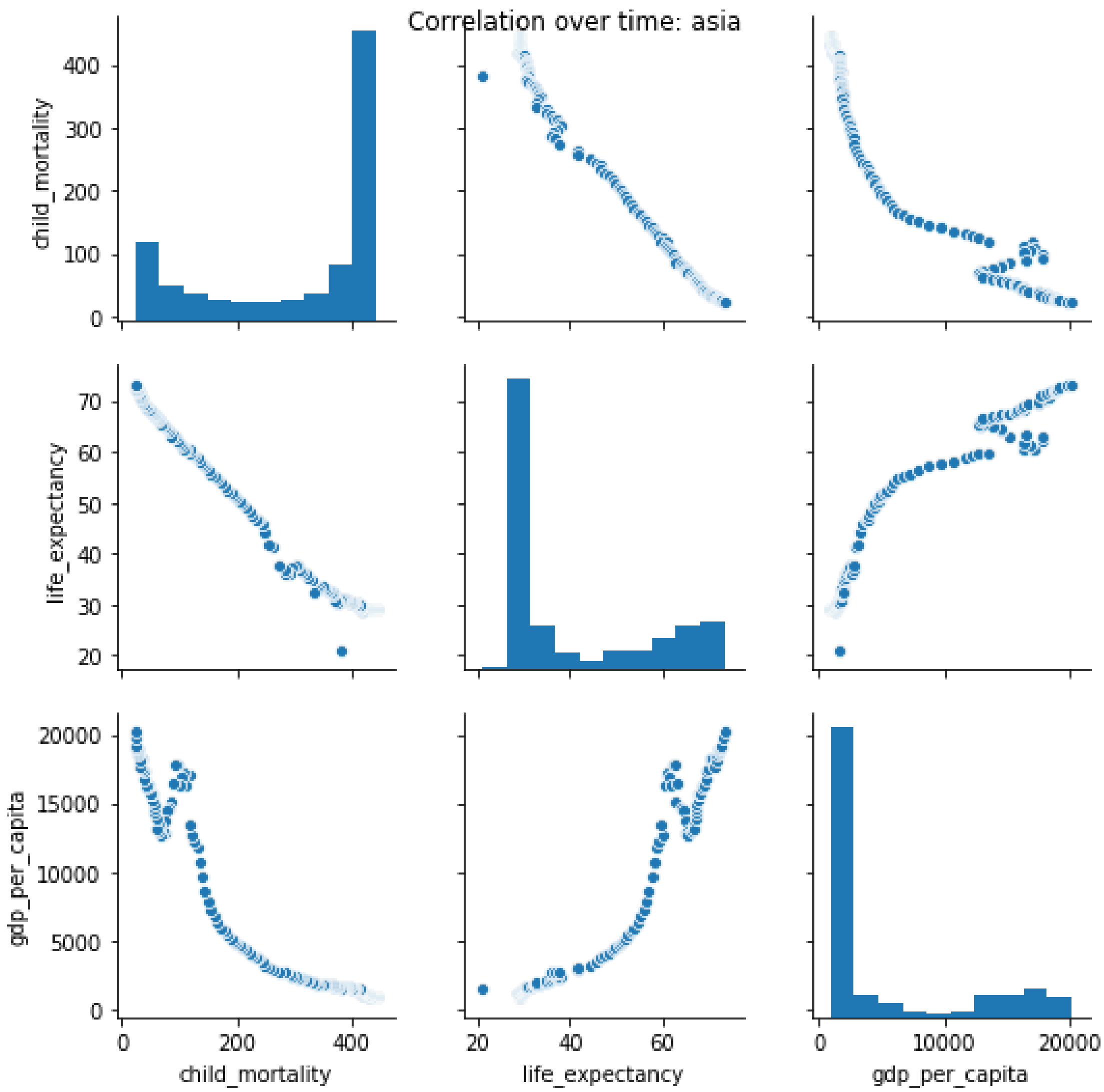
In [12]:
```
run_3()
```


Correlation over time
child_mortality
life_expectancy
gdp_per_capita
0
100
200
300
400
20
30
40
50
60
70
5000
10000
15000

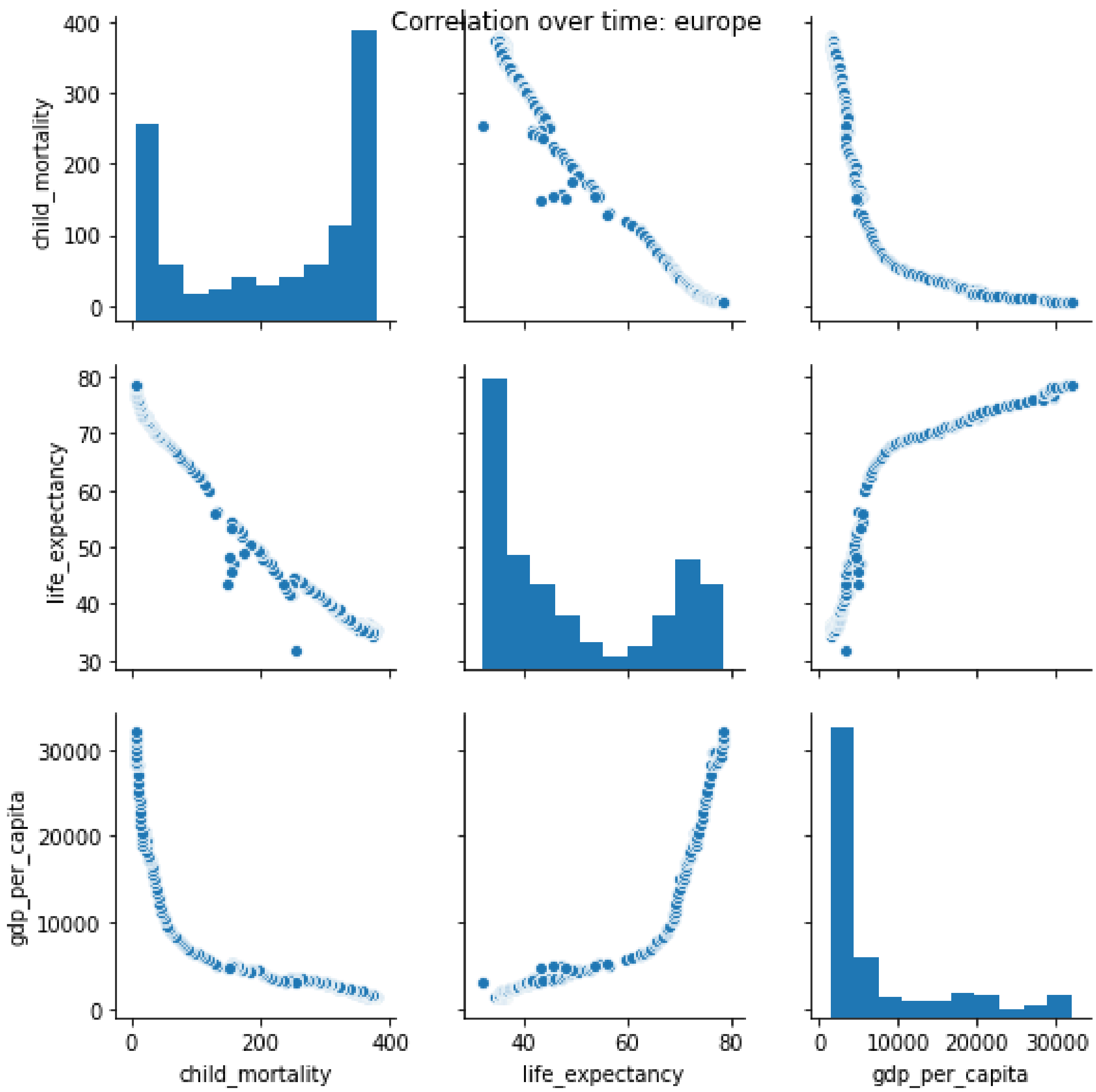

child_mortality
life_expectancy
gdp_per_capita
time
1800
1850
1900
1950
2000

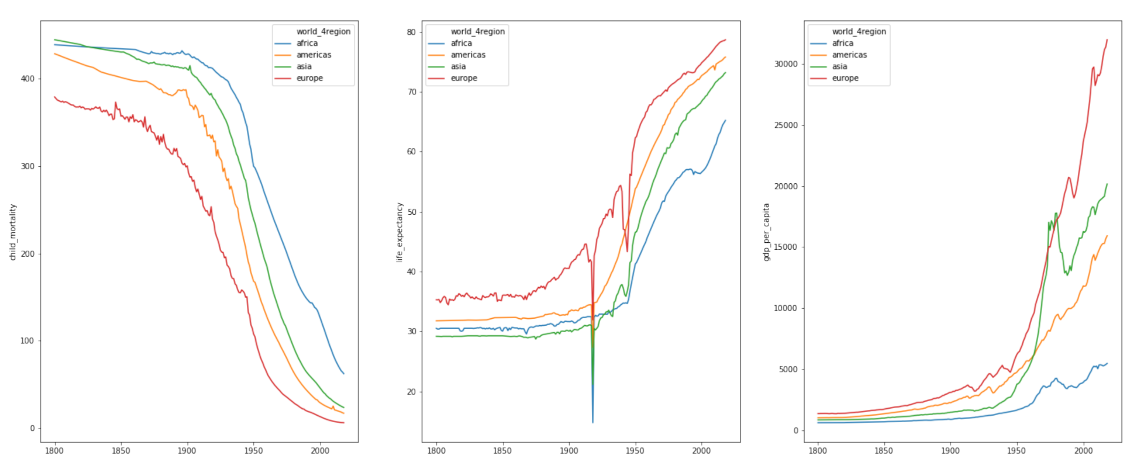

Correlation over time: africa
child_mortality
life_expectancy
gdp_per_capita
400
300
200
100
60
50
40
30
20
5000
4000
3000
2000
1000
200
400
20
40
60
2000
4000
child_mortality
life_expectancy
gdp_per_capita


Correlation over time: americas
child_mortality
life_expectancy
gdp_per_capita
child_mortality
life_expectancy
gdp_per_capita
0
100
200
300
400
30
40
50
60
70
0
2500
5000
7500
10000
12500
15000
0
200
400
40
60
0
5000
10000
15000



Correlation over time: asia
child_mortality
life_expectancy
gdp_per_capita
0
100
200
300
400
20
30
40
50
60
70
5000
10000
15000
20000
0
200
400
20
40
60
0
10000
20000
child_mortality
life_expectancy
gdp_per_capita


Correlation over time: europe
child_mortality
life_expectancy
gdp_per_capita
child_mortality
life_expectancy
gdp_per_capita


world_4region
africa
americas
asia
europe
child_mortality
life_expectancy
gdp_per_capita
time

Over the years, the child mortality has gone down where as the income and the life expectancy has gone up. However around the 1920's time frame, we can observe a sudden dip in the life expectancy.

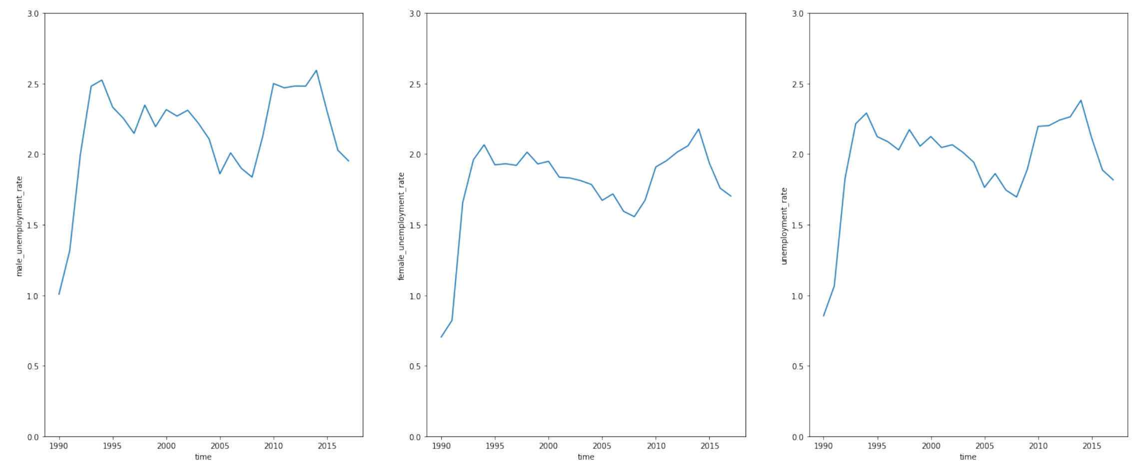
In terms of correlation, child mortality seems to have score of -0.9 with both life expectancy and income, whereas life expectancy and income seems to be strongly positively correlated with each other.

1.2 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

Variables Chosen - long_term_unemployment_rate, male_long_term_unemployment_rate, female_long_term_unemployment_rate

```
In [13]: def run_4():
             male_unemployed_df = pd.read_csv('../input/ddf--gapminder--systema_globalis-maste
             female_unemployed_df = pd.read_csv('../input/ddf--gapminder--systema_globalis-mas
             country_df = pd.read_csv('../input/ddf--gapminder--systema_globalis-master/ddf--e
             unemployed_df = pd.read_csv('../input/ddf--gapminder--systema_globalis-master/ddf

             result_df = pd.merge(male_unemployed_df, female_unemployed_df, on = ['geo', 'time
             result_df = pd.merge(result_df, unemployed_df, on = ['geo', 'time'])
             result_df = pd.merge(result_df, country_df[['country', 'world_4region', 'income_g
             result_df.rename(columns={'male_long_term_unemployment_rate_percent':'male_unempl
                                       'long_term_unemployment_rate_percent':'unemployment_rat
                                        'female_long_term_unemployment_rate_percent':'female_u
                              inplace=True)

             grouped_income_groups_time_df = result_df[['time', 'male_unemployment_rate', 'fema
             fig, ax = plt.subplots(ncols=3, figsize=(25,10))
             sns.lineplot(x="time", y='male_unemployment_rate', data=grouped_income_groups_tim
             ax[0].set_ylim([0,3])
             sns.lineplot(x="time", y='female_unemployment_rate', data=grouped_income_groups_t
             ax[1].set_ylim([0,3])
             sns.lineplot(x="time", y='unemployment_rate', data=grouped_income_groups_time_df,
             ax[2].set_ylim([0,3])
             plt.show()


In [14]: run_4()
```



The unemployeent rate has increased over time compared to the initial years, however last few years the curve is on the downward path. Similar charactertistics are observed when you see in particular for male and female.

1.3 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 to answer the above questions.

Dynamic visualizations tend to keep the user more engaging and also a great tool for data exploration. It also enables to convey more information with a single dynamic plot.

However, dynamic visualizations relatively takes more time to code up compared to static ones. With new libraries like plotly, python has enabled python programmers to easily create a dynamic visualization and close the gap.