COUNTRY'S GDP CLUSTERING FOR FINANCIAL AID

HELP INTERNATIONAL

PROFILE

Help International is an nongovernmental organization (NGO) that focused in reducing poverty, provide facility and basic needs for people in third-world country in case of catastrophe.

BACKGROUND

Help International will give financial aid from the collected donation (USD 10mio) for countries in need.

The criteria to be fulfilled is the **health condition and socioeconomic** in each countries.

DATA

The data has 167 rows and 10 columns, as seen here.

- **Country :** name of the country.
- **Child Mortality:** child mortality under 5 years old per 1,000 births.
- **Export :** good and services export rate per capita.
- **Health Cost:** total of health cost per capita.
- **Import:** good and services import rate per capita.
- **Income Per Capita:** individual net income.
- **Inflation:** inflation rate as per GDP per year.
- **Life Expectancy:** the average number of years a newborn child can live after birth (with the same child mortality rate).
- **Fertility Rate:** the total of childbirth per woman (with the same fertility rate).
- **GDP Per Capita:** GDP per capita (Total of GDP divided by the total population).

	Country	Child Mortality	Export	Health Cost	Import	Income Per Capita	Inflation	Life Expectancy	Fertility Rate	GDP Per Capita
0	Afghanistan	90.2	10.0	7.58	44.9	1610	9.44	56.2	5.82	553
1	Albania	16.6	28.0	6.55	48.6	9930	4.49	76.3	1.65	4090
2	Algeria	27.3	38.4	4.17	31.4	12900	16.10	76.5	2.89	4460
3	Angola	119.0	62.3	2.85	42.9	5900	22.40	60.1	6.16	3530
4	Antigua and Barbuda	10.3	45.5	6.03	58.9	19100	1.44	76.8	2.13	12200

DATA

There is 167 data, and each column has values (non-null).

```
RangeIndex: 167 entries, 0 to 166
Data columns (total 10 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   Country            167 non-null    object
 1   Child Mortality    167 non-null    float64
 2   Export             167 non-null    float64
 3   Health Cost        167 non-null    float64
 4   Import             167 non-null    float64
 5   Income Per Capita  167 non-null    int64
 6   Inflation          167 non-null    float64
 7   Life Expectancy    167 non-null    float64
 8   Fertility Rate     167 non-null    float64
 9   GDP Per Capita     167 non-null    int64
dtypes: float64(7), int64(2), object(1)
```

GENERAL ANALYSIS

Categorize each column to the required parameter (health and socioeconomic).

Country	Child Mortality	Export	Health Cost	Import	Income Per Capita	Inflation	Life Expectancy	Fertility Rate	GDP Per Capita

Health

- Health Cost
- Child Mortality
- Fertility Rate
- Life Expectancy

Socioeconomic

- GDP Per Capita
- Income Per Capita
- Import
- Export
- Inflation

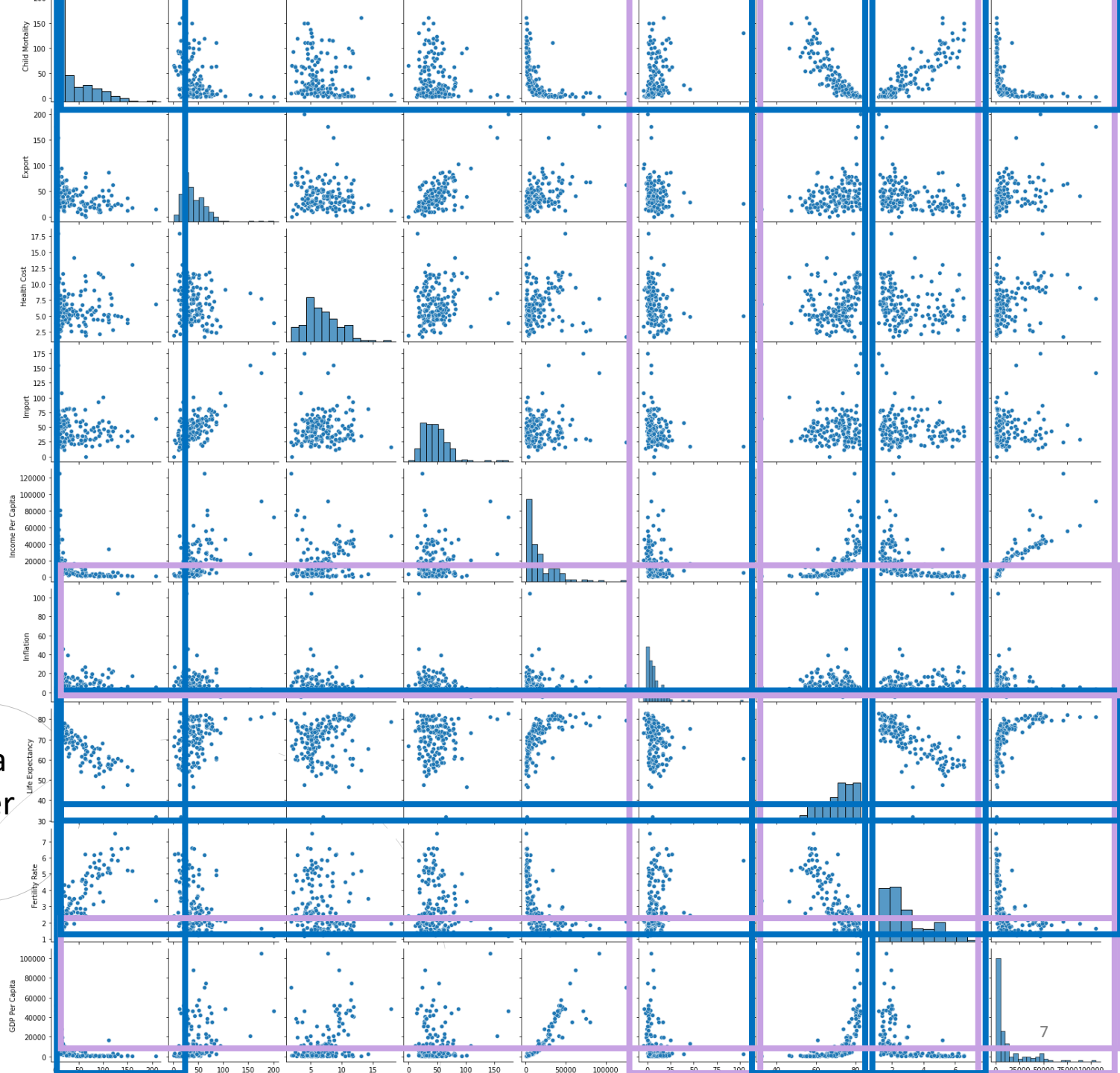
GENERAL ANALYSIS

Looking for correlation among values.

Data that could be recognized easily as correlated are:

- Socioeconomic: GDP Per capita and Inflation.
- Health: Fertility Rate, Life Expectancy, and Child Mortality.

As seen on graphic, the correlation is most likely **negative correlation**, e.g: when the GDP per capita increase, the Child Mortality decrease, or the lower the Inflation, the higher the Life Expectancy.

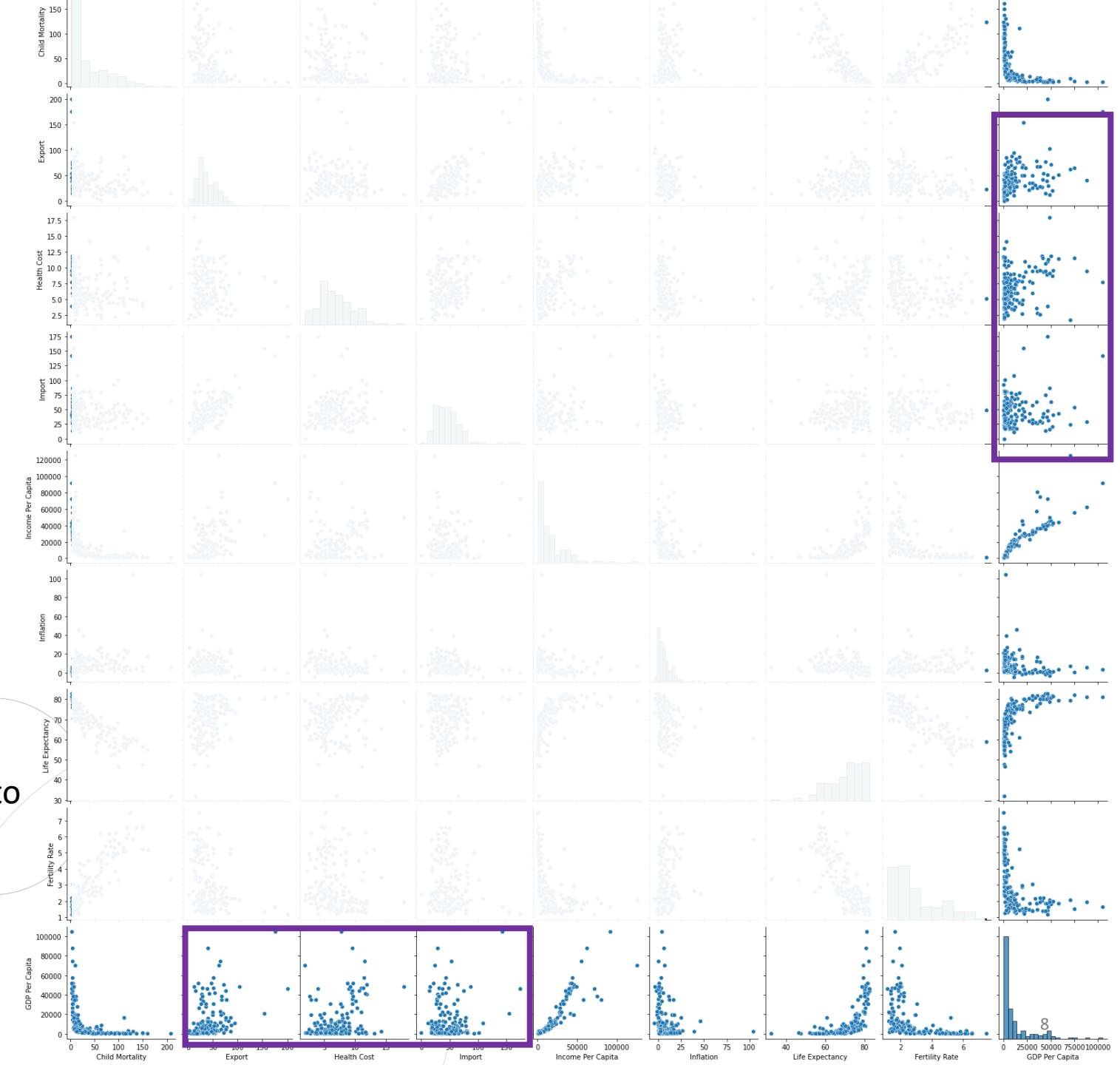


GENERAL ANALYSIS

Based on *World Bank*, country's **economy** and **wellbeing** could be measured through GDP per capita.

If we see the correlation between **GDP Per capita** and other column, there are 3 columns that have different correlation from before, those are: **Import**, **Export**, and **Health**.

Because Export and Import are both in socio-economic parameter. The data that we are going to focus on is **Health**.



GENERAL ANALYSIS

5 Countries with the highest GDP per capita are all developed countries.

On the other hand, if we see the countries with the highest health cost, there are **2 underdeveloped countries**. It should be questioned that there is **significant difference** between the GDP per capita and the health cost, or ***inequality*****.**

Data from GDP Per Capita–Health Cost.

Country List (Highest GDP Per Capita)

	Country	GDP Per Capita	Health Cost
91	Luxembourg	105000	7.77
114	Norway	87800	9.48
145	Switzerland	74600	11.50
123	Qatar	70300	1.81
44	Denmark	58000	11.40
...	...	...	...
132	Sierra Leone	399	13.10
112	Niger	348	5.16
37	Congo, Dem. Rep.	334	7.91
88	Liberia	327	11.80
26	Burundi	231	11.60

167 rows × 3 columns

Country List (Highest Health Cost)

	Country	GDP Per Capita	Health Cost
159	United States	48400	17.90
101	Micronesia, Fed. Sts.	2860	14.20
132	Sierra Leone	399	13.10
110	Netherlands	50300	11.90
54	France	40600	11.90
...	...	...	...
154	Turkmenistan	4440	2.50
38	Congo, Rep.	2740	2.46
116	Pakistan	1040	2.20
107	Myanmar	988	1.97
123	Qatar	70300	1.81

167 rows × 3 columns

OUTLIERS

As seen on the graphic, there are some data that are beyond the range of other values. Those are outliers of the **GDP Per capita** with range from 0-1000000.

So, the outliers filtering focused on **GDP Per capita**.

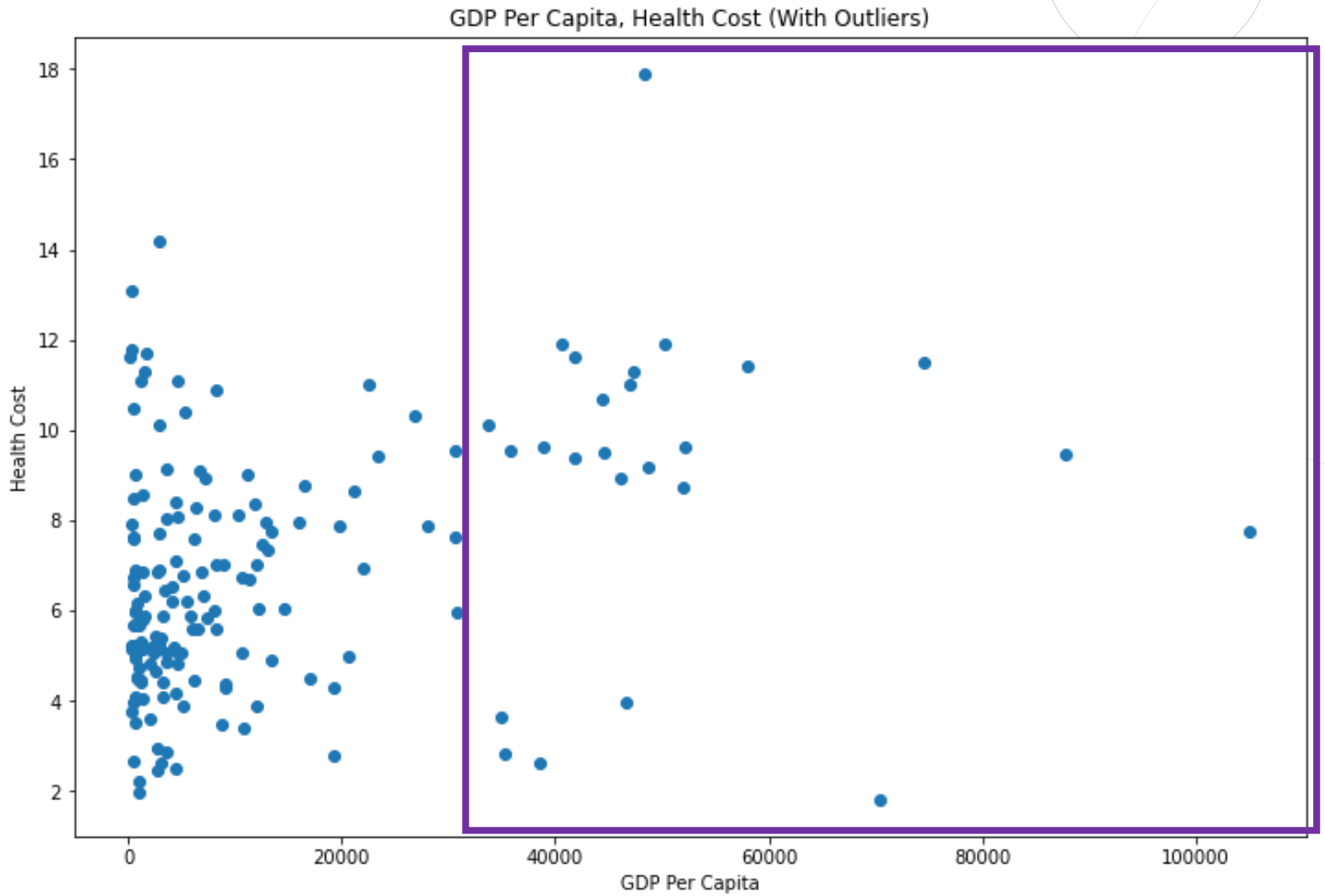
With the calculation of quartile range:

Q1 = 1330

Q3 = 14050

IQR = 12445

Identifying outliers from GDP Per capita–Health



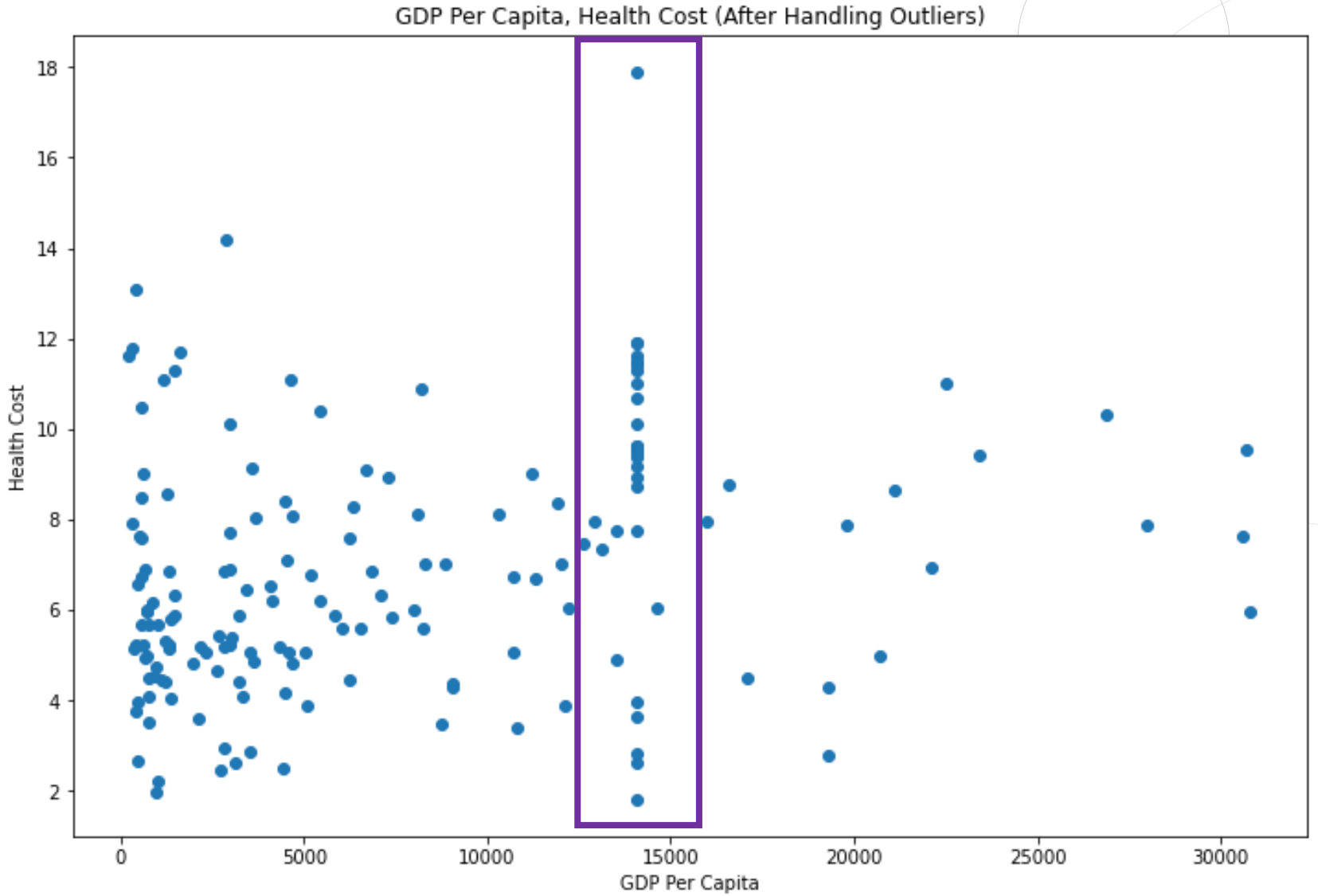
OUTLIERS

The outliers are turned into the base-range.

So, if it is higher than Q3, it is changed to Q3. The same for those values under Q1.

There are still 167 data.

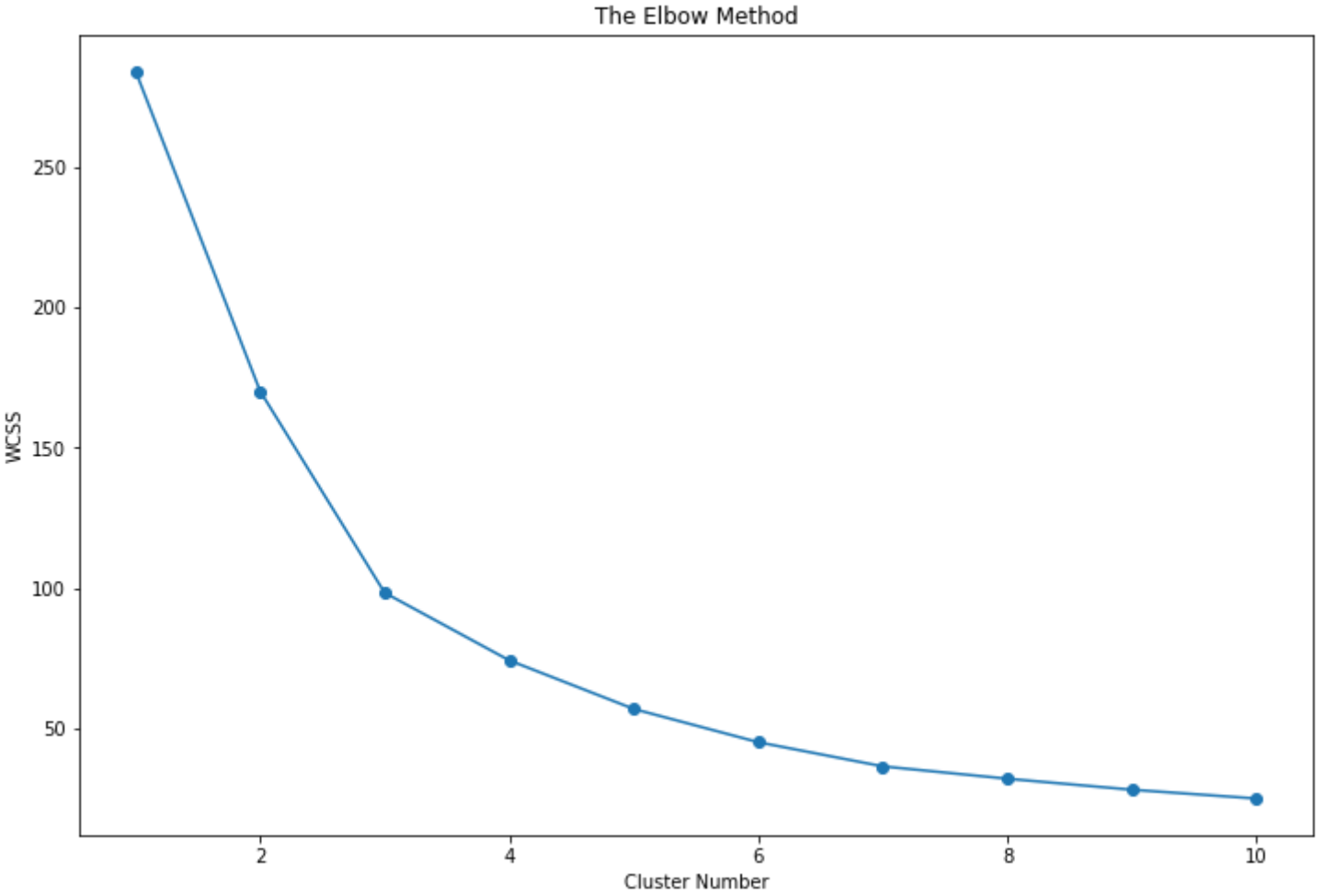
The range of GDP is also changed to 0-30000.



CLUSTERING

For clustering, **elbow method** is used. The number of cluster is based on which number has an acute angle (<60^{o})

From the graphic, **the cluster number = 4**, with consideration the degree created after 4 is already an obtuse angle and there is no significant difference.



CLUSTERING

There are 4 clusters with criteria as followed:

- **Cluster 0**
  Low GDP, High Health Cost

GDP Per capita < 10000; Health Cost > 8

- **Cluster 1**
  Low GDP, Low Health Cost

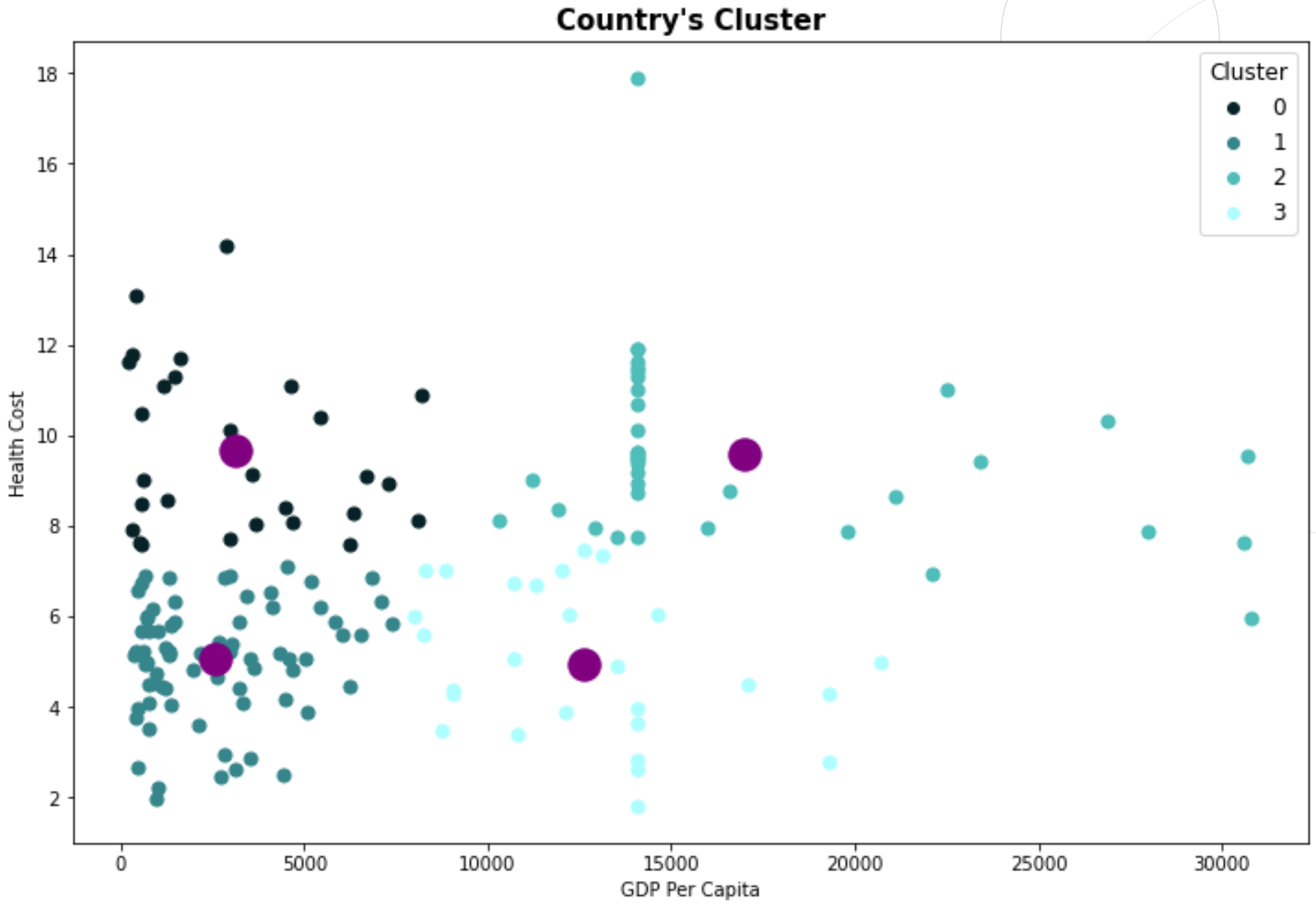
GDP Per capita < 10000; Health Cost < 8

- **Cluster 2**
  High GDP, High Health Cost

GDP Per capita > 10000; Health Cost > 8

- **Cluster 3**
  High GDP, Low Health Cost

GDP Per capita > 10000; Health Cost < 8



CLUSTERING – RATIO

Based on the clustering result, the cluster 0 is the one with an unbalanced Health Cost and GDP. But there is a problem is choosing which countries to pick.

So, a new parameter is used. This parameter is calculated by dividing the **'Health' with 'GDP Per capita'.**

```
df['Ratio'] = (df[Health Cost']/df['GDP Per Capita'])*100
```

Why?

So, it is more obvious to see how different is the health cost from a country to its GDP per capita.

If **the parameter is higher**, it means **the health cost is higher and not balanced with a low GDP per capita**.

	Country	GDP Per Capita	Health Cost	Cluster	Ratio
0	Afghanistan	553.0	7.58	0	1.370705
1	Albania	4090.0	6.55	1	0.160147
2	Algeria	4460.0	4.17	1	0.093498
3	Angola	3530.0	2.85	1	0.080737
4	Antigua and Barbuda	12200.0	6.03	2	0.049426

CLUSTER 0

Here is the table if choosing the country only based on 'GDP Per capita' or 'Health'.

From this two table, there are **4 countries** in both tables.

What lacking from this method is there is a bias between GDP Per capita or Health cost that has small difference.

E.g: Compared to Rwanda, GDP per capita of Congo, Dem. Rep. is lower. But the health cost is higher in Rwanda.

Which one should be chosen, Rwanda or Congo, Dem. Rep?

If choosing the country only based on one value.

Country	GDP Per Capita	Health Cost	Cluster	Ratio
Burundi	231.0	11.60	0	5.021645
Liberia	327.0	11.80	0	3.608563
Congo, Dem. Rep.	334.0	7.91	0	2.368263
Sierra Leone	399.0	13.10	0	3.283208
Togo	488.0	7.65	0	1.567623
Guinea-Bissau	547.0	8.50	0	1.553931
Afghanistan	553.0	7.58	0	1.370705
Rwanda	563.0	10.50	0	1.865009
Uganda	595.0	9.01	0	1.514286
Lesotho	1170.0	11.10	0	0.948718

List of Country

(10 Lowest GDP Per capita)

Country	GDP Per Capita	Health Cost	Cluster	Ratio
Micronesia, Fed. Sts.	2860.0	14.2	0	0.496503
Sierra Leone	399.0	13.1	0	3.283208
Liberia	327.0	11.8	0	3.608563
Moldova	1630.0	11.7	0	0.717791
Burundi	231.0	11.6	0	5.021645
Kiribati	1490.0	11.3	0	0.758389
Lesotho	1170.0	11.1	0	0.948718
Bosnia and Herzegovina	4610.0	11.1	0	0.240781
Costa Rica	8200.0	10.9	0	0.132927
Rwanda	563.0	10.5	0	1.865009

List of Country

(10 Highest Health cost)

FINAL RECOMMENDATION

From cluster 0, there are 4 countries with **ratio > 2** (which means, the **health costs 2 times higher than the GDP**), they are:

Burundi, Liberia, Sierra Leone, and **Congo, Dem.Rep.**

Country	GDP Per Capita	Health Cost	Cluster	Ratio
Burundi	231.0	11.60	0	5.021645
Liberia	327.0	11.80	0	3.608563
Sierra Leone	399.0	13.10	0	3.283208
Congo, Dem. Rep.	334.0	7.91	0	2.368263
Rwanda	563.0	10.50	0	1.865009
Togo	488.0	7.65	0	1.567623
Guinea-Bissau	547.0	8.50	0	1.553931
Uganda	595.0	9.01	0	1.514286
Afghanistan	553.0	7.58	0	1.370705
Lesotho	1170.0	11.10	0	0.948718

THANK YOU