Clustering of countries

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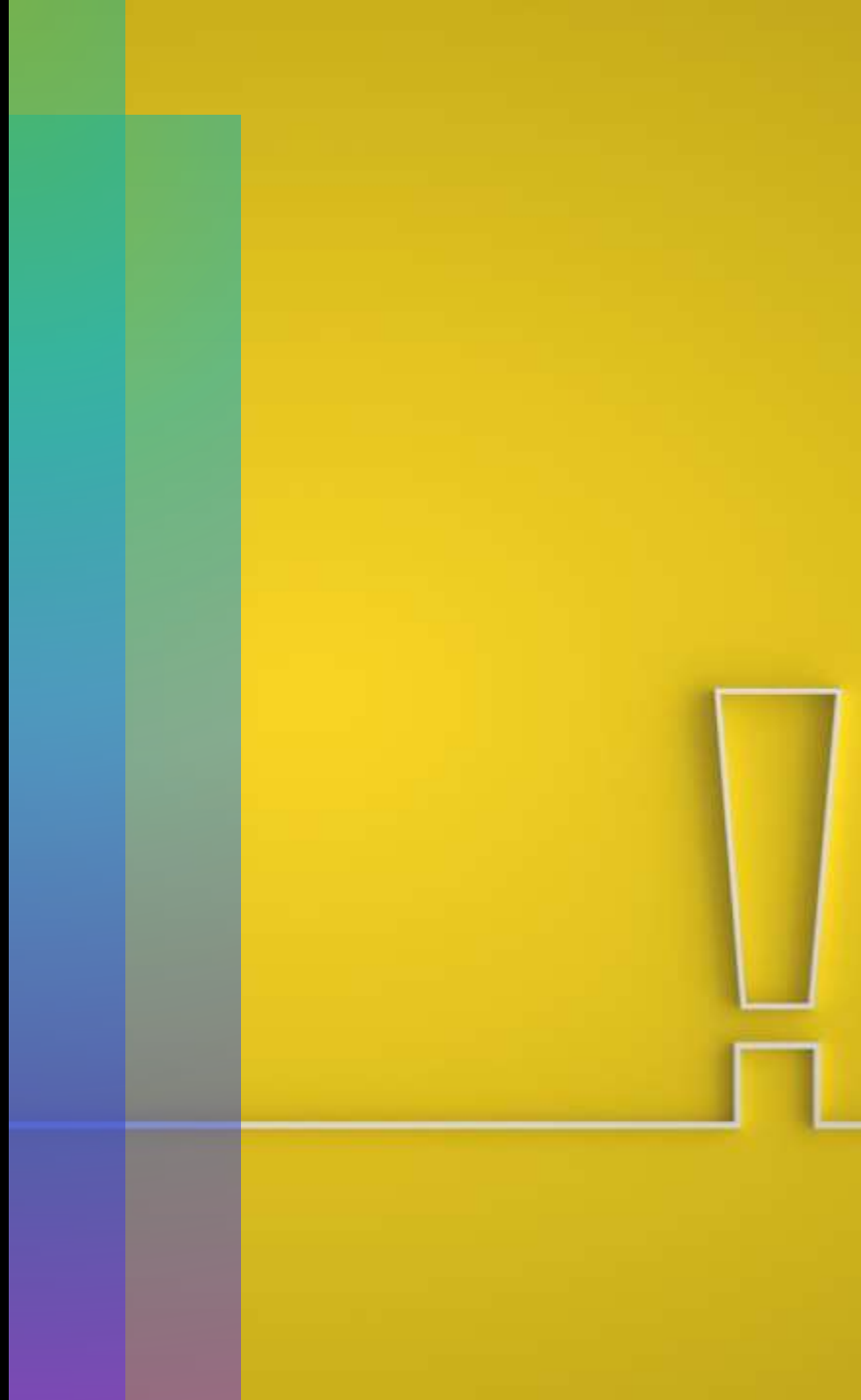
Abstract

- ***Objective:***
- We, at HELP International, are a dedicated humanitarian NGO striving to combat poverty and ensure essential services for underprivileged nations, especially during disasters and natural calamities. We frequently execute various projects, while also conducting advocacy campaigns for both awareness and fundraising purposes.
- ***Problem statement:***
- From our recent fundraising initiatives, we successfully gathered approximately $10 million. As analysts, it's our responsibility to identify the countries most urgently in need of assistance.



Analysis methodology

Data collection and cleaning

Import the data

Identifying the data quality
Identifying the data quality issues and clean the data

Outlier analysis and removal

Removing the outlier wherever required as per understanding the problem statement.

Visualizing the data

Visualizing few original data variables to look for any pattern or correlation.

Scaling the data

Standardizing all the continuous variables.

Analysis methodology

PCA on the data

To derive principal components

To check the variance ratios

Scree plot - plotting the cumulative variance against the number of components

Going ahead and doing dimensionality reduction using incremental PCA

Reducing the correlation to almost zeroizing all the continuous variables.

Hopkins Statistics

To check if data has tendency to form clusters

K means clustering

Identify the ‘k’ by silhouette analysis and sum of squared distances graph.

Forming n – clusters on PCA modified data

Visualizing the clusters with various variables

Analyzing the clusters

Identifying the countries which requires aid.

Hierarchical Clustering

Identify the ‘n’ via dendrogram.

Forming n – clusters on PCA modified data

Visualizing the clusters with various variables

Analyzing the clusters

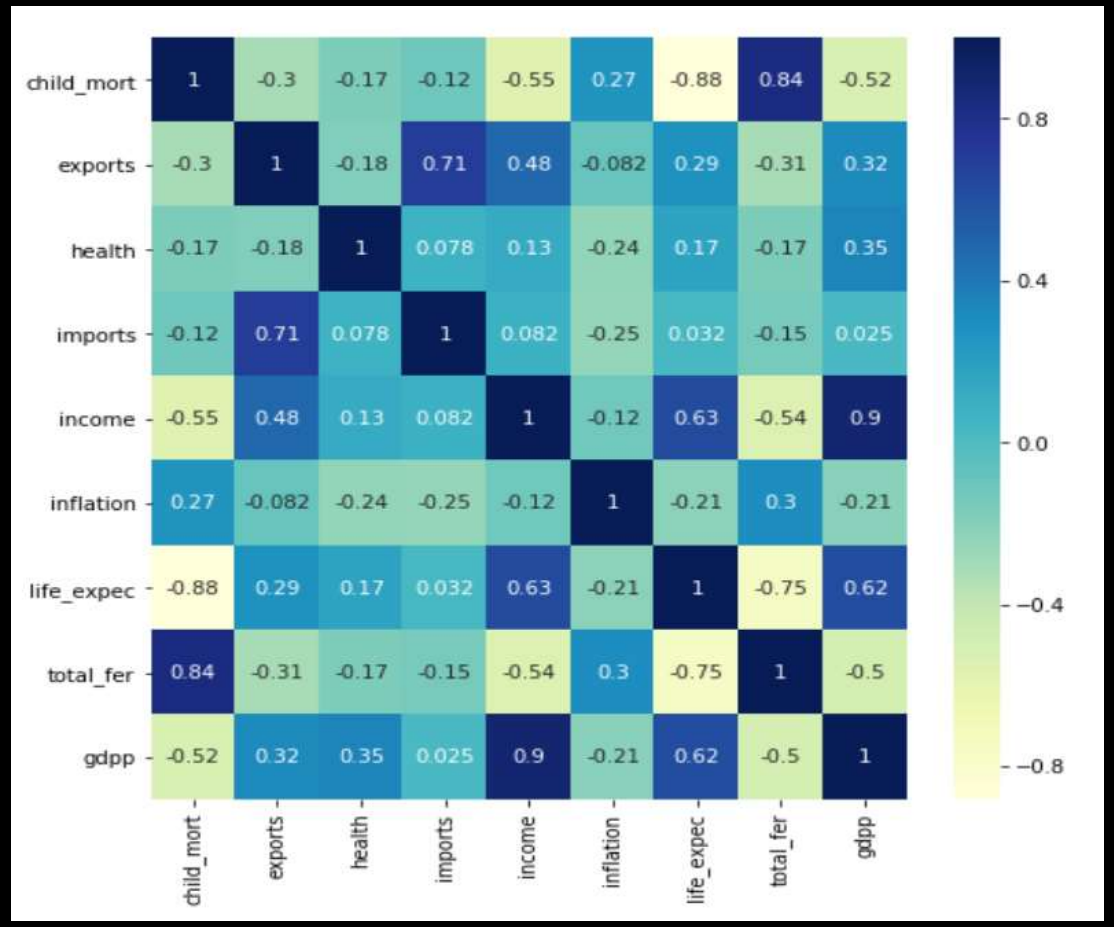
Identifying the countries which requires aid.

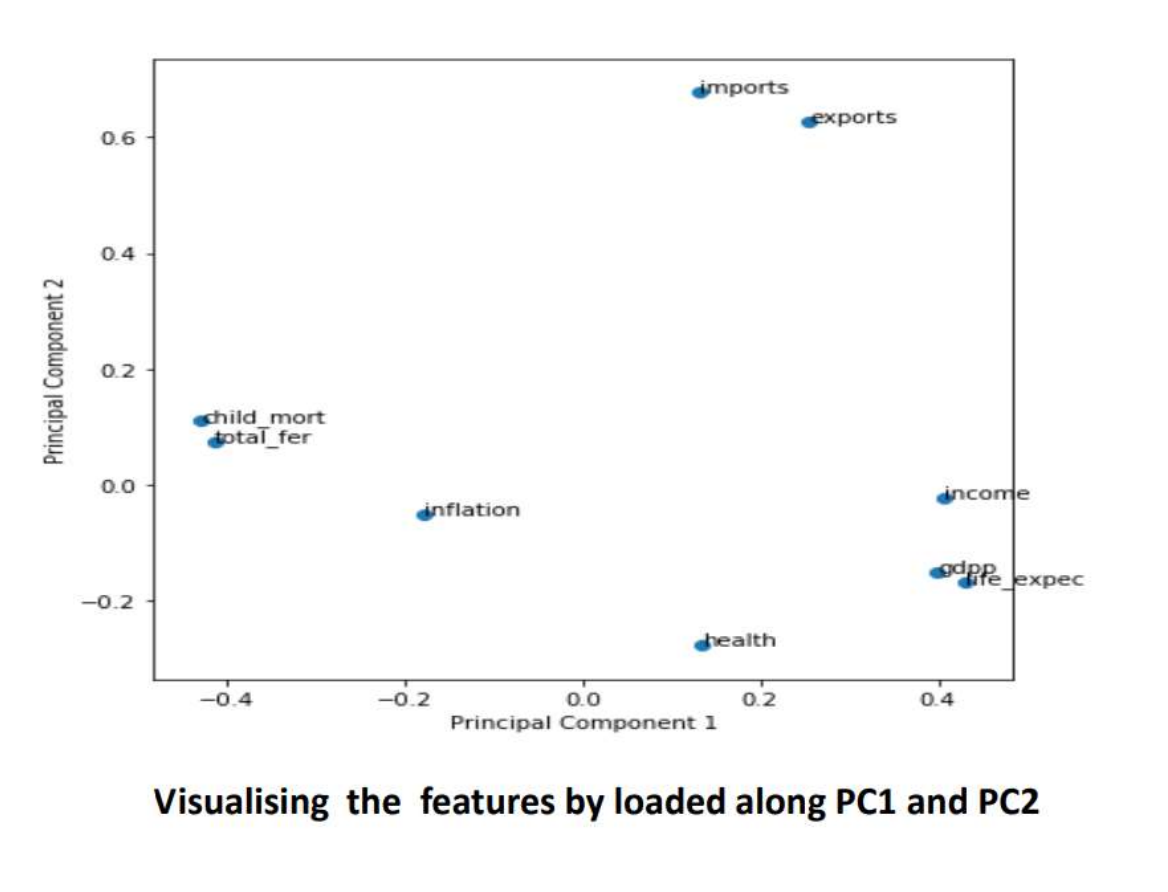
Decision Making

Identifying the countries which requires aid by analyzing both K-means and Hierarchical Clustering results.

Correlation in the data:

- After data cleaning , we removed outlier from gdpp column because the country with high gdpp would not require any aid as there are already doing good.
- We did standardized scaling to standardize all parameters on cleaned, outlier removed data.
- Looking at the heatmap, we see that few variables like (total fertility, child mortality) , (income , gdpp) and (imports and exports) have high correlation.

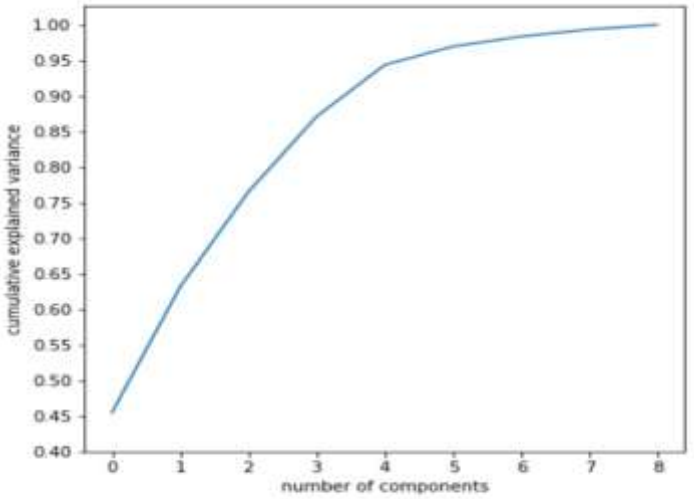




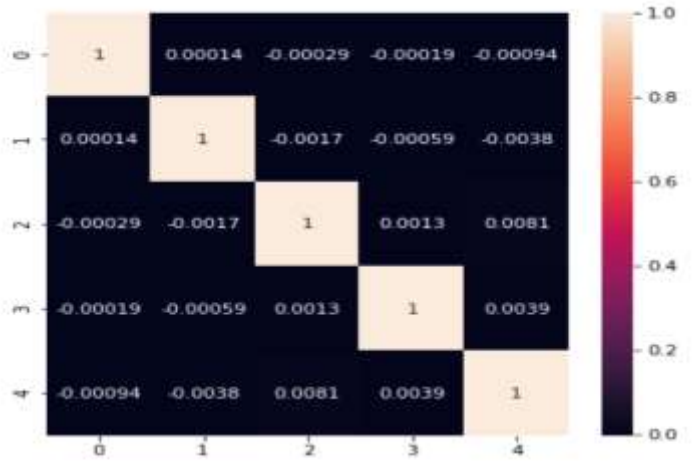
Visualising the features by loaded along PC1 and PC2

Principal Component Analysis

- We see that features like gdpp, life expectancy and income are along the direction of PC1 and other features like total fertility and child mortality are along PC2 direction.

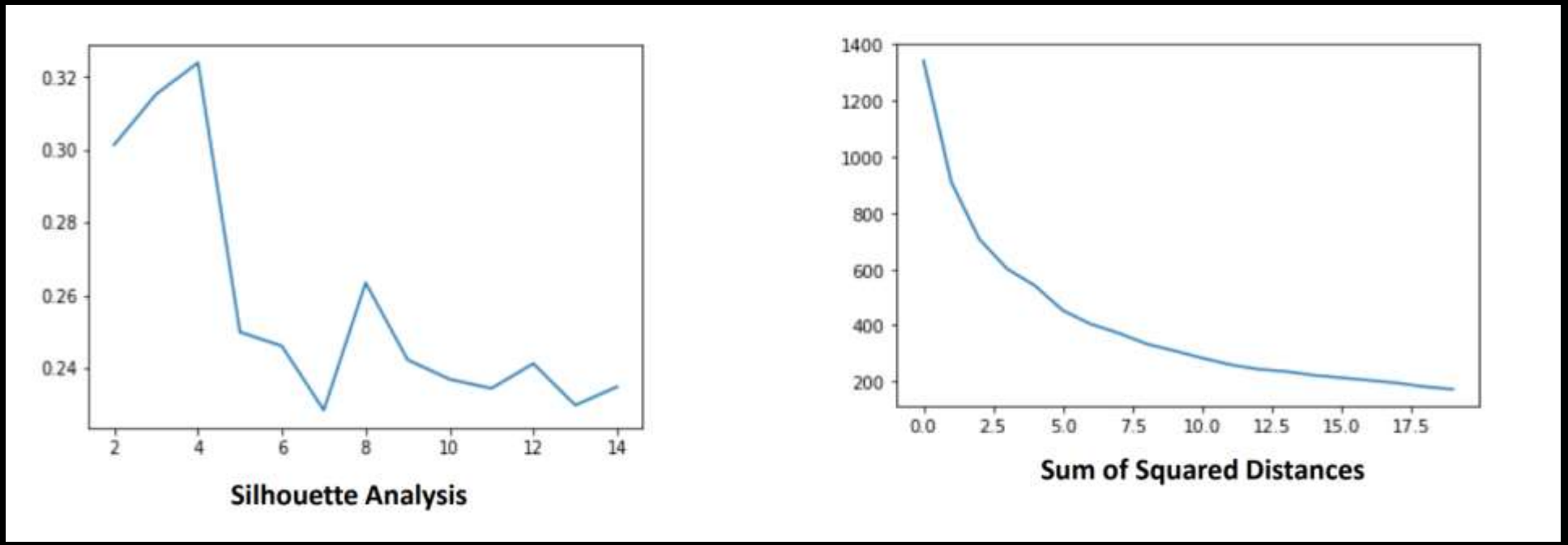


Looking at the **screeplot** , we see that 95% of variance in the data is explained by 5 components.



After doing dimensionality reduction via incremental PCA by taking 5 components, we see that the correlation in the data has almost reduced to zero.

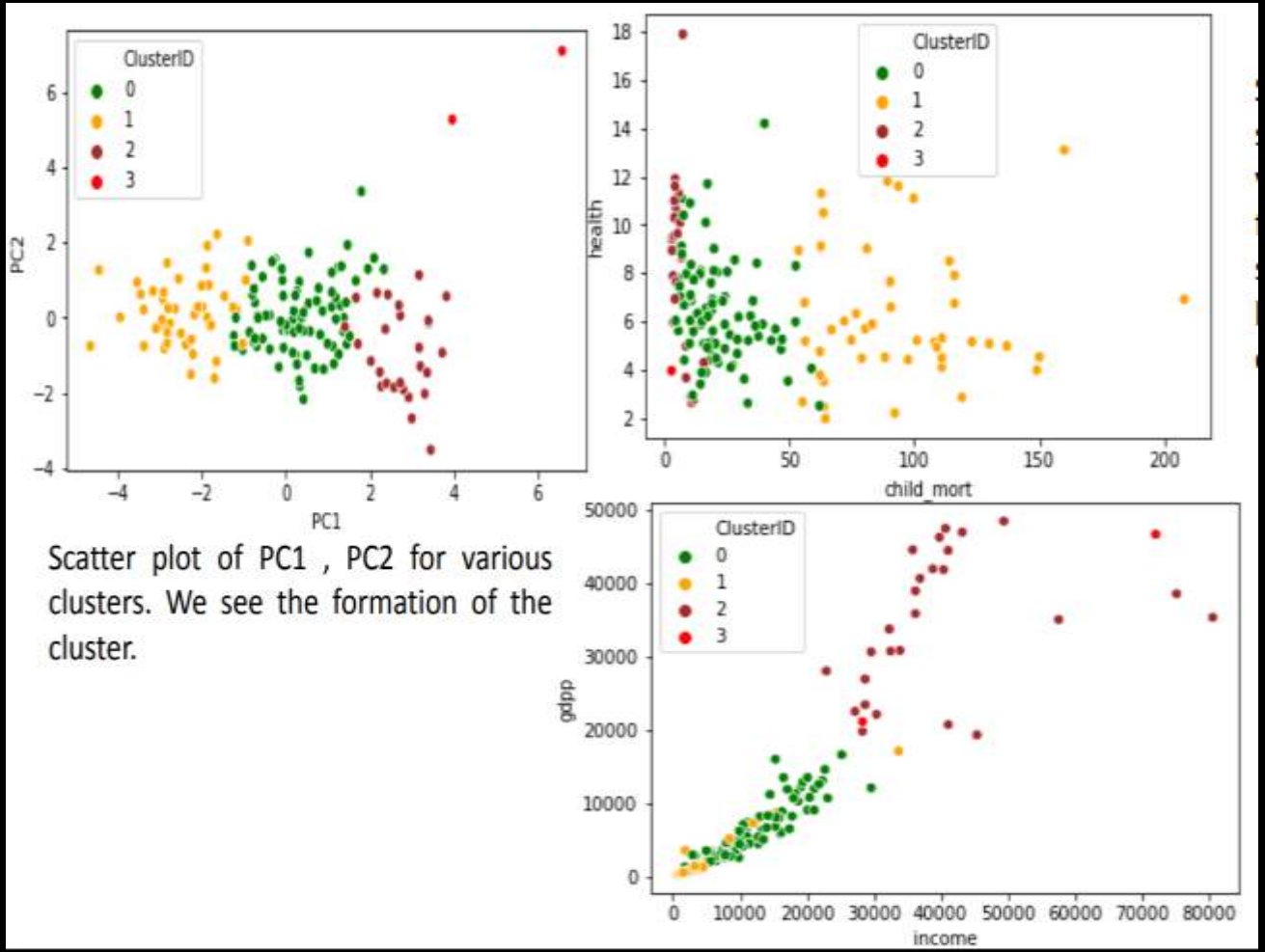
Principal Component Analysis



K-means clustering

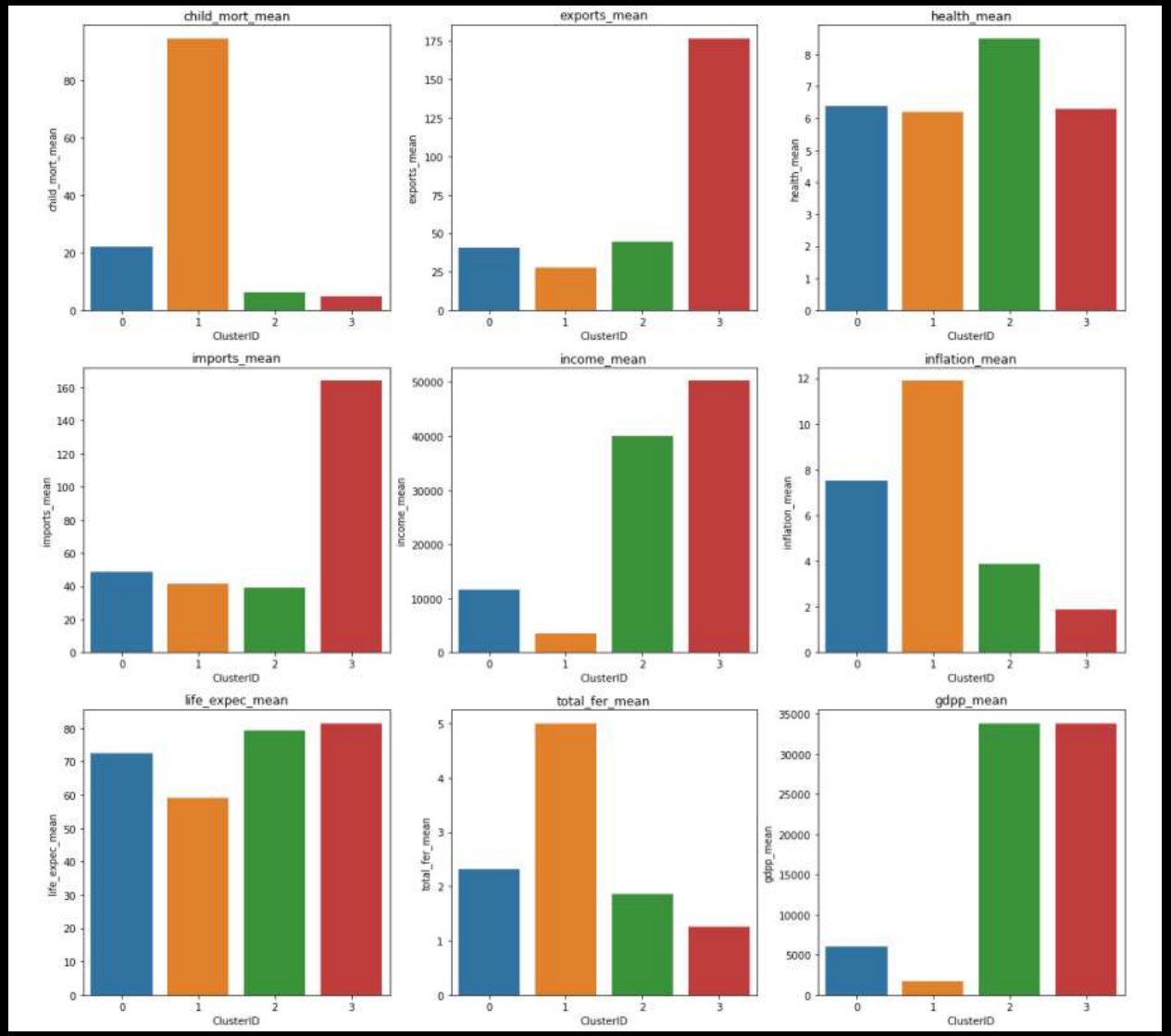
- By looking silhouette analysis, we see the highest peak is at k =4 and in sum of squared distances graph , we see that the elbow is in the range of 3 to 5 , so we are going ahead with k as 4.

K-means clustering



Scatter plot of PC1 , PC2 for various clusters. We see the formation of the cluster.

- Scatter plot of health spending , child mortality for various clusters. We see that for cluster 1, the health spending as % of gdp is lower and at the same time child mortality is very high.
- Scatter plot of gdpp , income for various clusters. We see that for cluster 1 , both gdpp and net income per person are very low.



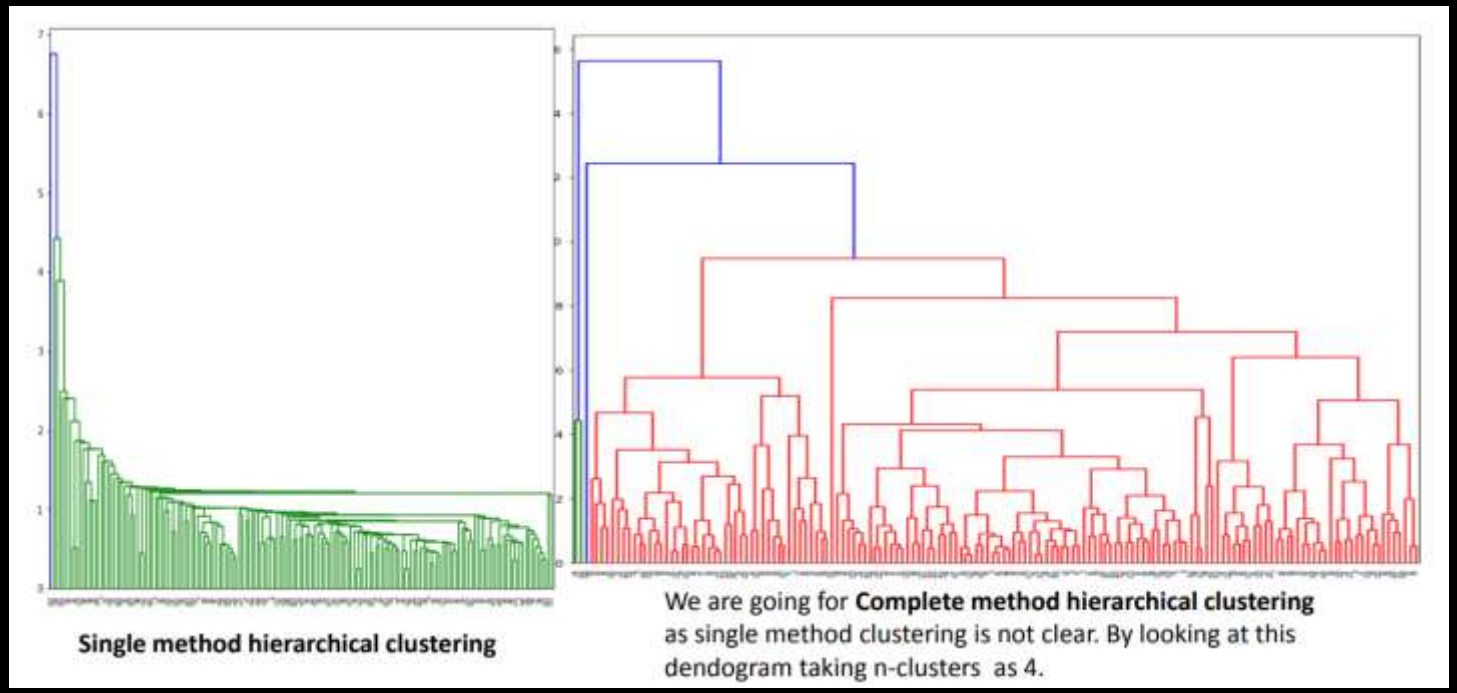
K-means clustering

- As per our K- means clustersCluster 1 is area of concern due to :
- Low gdpp
- Low income
- High child mortality
- High inflation
- High total fertility

10 countries under cluster 1 are:

country	child_mort	exports	health	imports	income	inflation	life_expec	total_fer	gdpp	ClusterID
Burundi	93.6	8.92	11.60	39.2	764	12.30	57.7	6.26	231	1
Liberia	89.3	19.10	11.80	92.6	700	5.47	60.8	5.02	327	1
Congo, Dem. Rep.	116.0	41.10	7.91	49.6	609	20.80	57.5	6.54	334	1
Niger	123.0	22.20	5.16	49.1	814	2.55	58.8	7.49	348	1
Sierra Leone	160.0	16.80	13.10	34.5	1220	17.20	55.0	5.20	399	1
Madagascar	62.2	25.00	3.77	43.0	1390	8.79	60.8	4.60	413	1
Mozambique	101.0	31.50	5.21	46.2	918	7.64	54.5	5.56	419	1
Central African Republic	149.0	11.80	3.98	26.5	888	2.01	47.5	5.21	446	1
Malawi	90.5	22.80	6.59	34.9	1030	12.10	53.1	5.31	459	1
Eritrea	55.2	4.79	2.66	23.3	1420	11.60	61.7	4.61	482	1

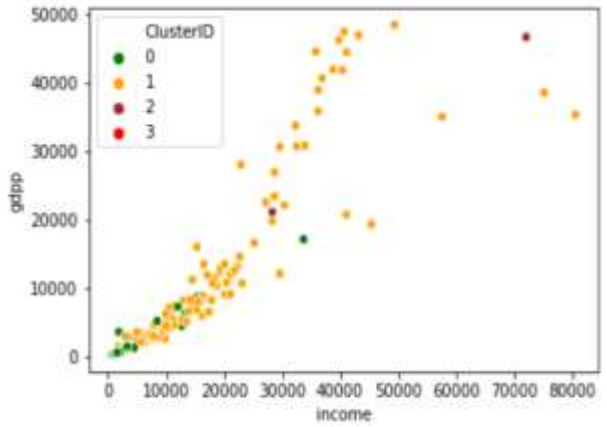
K-means clusterin



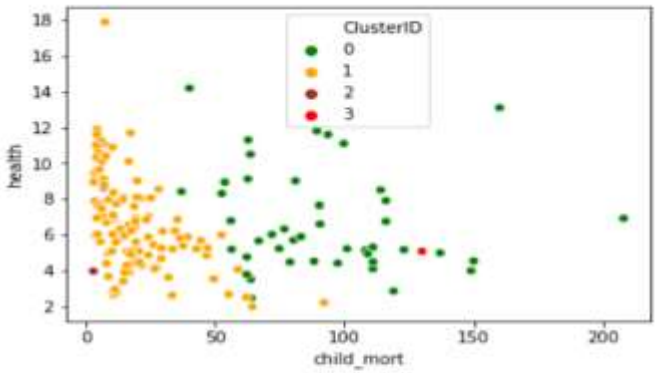
Single method hierarchical clustering

We are going for **Complete method hierarchical clustering** as single method clustering is not clear. By looking at this dendogram taking n-clusters as 4.

Hierarchical Clustering



Scatter plot of gdpp , income for various clusters. We see that for cluster 0 , both gdpp and net income per person are very low.



Scatter plot of health spending , child mortality for various clusters. We see that for cluster 0, the health spending as % of gdp of few countries is lower and for those countries -the child mortality is very high.

Hierarchical Clustering

10 countries under cluster 0 are:

country	child_mort	exports	health	imports	income	inflation	life_expec	total_fer	gdpp	ClusterID
Burundi	93.6	8.92	11.60	39.2	764	12.30	57.7	6.26	231	0
Liberia	89.3	19.10	11.80	92.6	700	5.47	60.8	5.02	327	0
Congo, Dem. Rep.	116.0	41.10	7.91	49.6	609	20.80	57.5	6.54	334	0
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Malawi	90.5	22.80	6.59	34.9	1030	12.10	53.1	5.31	459	0
Togo	90.3	40.20	7.65	57.3	1210	1.18	58.7	4.87	488	0

Hierarchical Clustering

- As per our Hierarchical clustersCluster 0 is area of concern due to :
- Low gdpp
- Low income
- High child mortality
- High inflation
- High total fertility

As by both K means and Hierarchical clustering method - we have got same countries which requires aid.

The following are the countries which are in direst need of aid by considering socio – economic factor into consideration:

country	child_mort	exports	health	imports	income	inflation	life_expec	total_fer	gdpp
Burundi	93.6	8.92	11.60	39.2	764	12.30	57.7	6.26	231
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Summary