Cluster analysis of Nigerian real GDP

Ette Harrison Etuk
Department of Mathematics
River State University
Port Harcourt
Nigeria
Correspondence to: Ette H. Email: ettetuk@yahoo.com

Abstract

Background: The Central Bank of Nigeria has itemized Nigerian real Gross Domestic Product (GDP) into the following: crop production, livestock, forestry, fishing, crude petroleum and natural gas, solid minerals, manufacturing, construction, trade, transport, information and communication, utilities, accommodation and food services, finance and insurance, real estate, professional, scientific and technical services, administrative, support and business services, public administration, education, human health and social services, arts, entertainment and recreation and other services.

Objective: This paper is an attempt to break Nigerian real GDP into clusters on the basis of their contributions in the year 2018 and the first three quarters of 2019.

Methodology: The researcher made use of a combination of two distances: (i) the Pearson's (correlation coefficient) distance and (ii) the absolute correlation coefficient distance to assist into breaking Nigeria's GDP into clusters. Additionally, two linkage methods were applied. They are: (i) The complete linkage method and (ii) the centroid linkage method. The combination of the correlation coefficient distance and the centroid linkage method was chosen because it isolated the mainstay of the Nigerian economy namely, crude oil into a cluster of its own.

Results: The three clusters which emerged were: Cluster 1: crop production, livestock, forestry, solid minerals, manufacturing, trade, transportation, utilities, real estate, professional, scientific and technical services, administrative, support and business services, public administration, education, human health and social services. Cluster 2: fishing, construction, information and communication, finance, arts, entertainment and recreation, other services. Cluster 3: crude oil

Unique contribution: The researcher suggested the most appropriate method of classifying Nigerian GDP by clustering of the mainstay of the Nigerian economy, crude oil, into a cluster of its own.

Conclusion: A combination of Pearson's (correlation coefficient) distance and the centroid linkage method are the most appropriate method for examining Nigerian GDP because it results in the clustering of crude oil into a cluster of its own.

Key recommendation: We recommend that the Central Bank of Nigeria should categorize Nigeria's GDP into clusters on the basis of importance to the Nigerian economy.

Keywords: Nigerian real GDP, Pearson distance, absolute correlation coefficient distance, complete linkage, centroid linkage, cluster analysis

Introduction

Gross domestic product (GDP) of a country is the financial value of all finished goods and services of the country. It provides an economic picture of the nation and measures the strength of the economy. The central Bank of Nigeria (CBN) lists items of the real GDP as: crop production, livestock, forestry, solid minerals, manufacturing, trade, transportation, utilities,

accommodation, real estate, professional, scientific and technical services, administrative, support and business services, public administration, education, human health and social services, fishing, construction, information and communication, finance, arts, crude oil and other services. It is the intention of this research work to apply cluster analysis to break up the list into three clusters on the basis of importance to the Nigerian economy.

Cluster analysis is a scientific tool for data exploration and mining. It breaks up a set of data into clusters such that intra-cluster variability is little compared to inter-cluster variability. Of the various items of Nigeria real gross domestic product, this work broke up the list into groupings called clusters such that members of each cluster are similar in some respect whereas members of different groupings are dissimilar as much as possible. Literature relevant to this is much already. For example, Rencher (2002) in a textbook on multivariate analysis devoted 14 to a detailed discussion of cluster analysis, with various applications displayed. Kembe and Onoja (2017) consider cluster analysis of macroeconomic indices in Nigeria to include external reserve, consumption, net savings, net import, public finance, forex rate, public debt, private investment, balance of payments, interest rate, inflation rate, fixed asset, net export and gross domestic product. Haldar *et al.* (2008) conducted cluster analysis of asthma phenotypes by the k-mean method and note that two clusters of patients were common to the two asthma populations they considered. Zhao *et al.* (2014) studied the need for topic modeling in respect of large medical data and concluded that topic modeling could provide an advanced method of analyzing vast biological data. Battaglia *et al.* (2016) discussed how cluster analysis could be applied to the field of education. In particular, it was with reference to questionnaire made up of open-ended questions. Darcan and Badur (2012)used cluster analysis to group students who registered as Management Information System students of Bogaziici University, Istanbul, Turkey. Jackson and Mentzer (2017)used cluster analysis to distinguish between high-performing, medium-performing and low-performing students.

Materials and methods

Data

The data for this work was sourced from the Central Bank of Nigeria (CBN) website 2019 Statistical Bulletin – Real Sector www.cbn.org. the data have been provided in the appendix.

Cluster Analysis

Cluster Analysis is a mathematical / statistical technique used to group a set of multivariate data into groupings called clusters such that the members of a cluster have similarity among themselves more than with members of other clusters. The technique involves distance between sample items and between clusters. Let x_{ij} be the yield for the j[th] variable in the sample vector $\mathbf{X_i}$; n be the number of sample elements and p is the number of variables.

Pearson's (correlation coefficient) distance (Jackson and Mentzer, 2017) is defined by

$$D(\mathbf{X_i}, \mathbf{X_j}) = \left| \frac{\sum_{k=1}^{p}(x_{ik}-\bar{x}_i)(x_{jk}-\bar{x}_j)}{\sqrt{\sum_{k=1}^{p}(x_{ik}-\bar{x}_i)(x_{jk}-\bar{x}_j)}} \right| \quad \ldots\ldots (1)$$

where $\bar{x}_i = \sum_{k=1}^{p} x_{ik}$ /p and $\bar{x}_j = \sum_{k=1}^{p} x_{jk}$/p where

$\mathbf{X_i} = \begin{pmatrix} x_{i1} \\ x_{i2} \\ . \\ . \\ . \\ x_{ip} \end{pmatrix}$ and $\mathbf{X_j} = \begin{pmatrix} x_{j1} \\ x_{j2} \\ . \\ . \\ . \\ x_{jp} \end{pmatrix}$

The **absolute correlation distance** is defined by

$d(\mathbf{X_i}, \mathbf{X_j}) = 1 - |D(\mathbf{X_i}, \mathbf{X_j})|$ **……(2)**

where $D(\mathbf{X_i}, \mathbf{X_j})$ is as defined in (1).

Rencher (2002) says that Jardine and Sibson (1971) and Wishart (1971) have questioned the employment of (1) because of its limitation in that it does not take into account profile point distance. He says that Strauss, Bartko, and Carpenter (1973) have found it superior to the Euclidean distance.

Characteristics of Distance measures of association

Let $D(\mathbf{X_i}, \mathbf{X_j})$ be distance between $\mathbf{X_i}$ **and** $\mathbf{X_j}$,

1. **Symmetry.** Then $D(\mathbf{X_i}, \mathbf{X_j}) = D(\mathbf{X_j}, \mathbf{X_i})$**'**
2. **Positivity.** Then $D(\mathbf{X_i}, \mathbf{X_j}) > \mathbf{0}$.
3. **Identity.** $D(\mathbf{X_i}, \mathbf{X_i}) = \mathbf{0}$
4. **Triangular Inequality:** $D(\mathbf{X_i}, \mathbf{X_j}) + D(\mathbf{X_j}, \mathbf{X_k}) > D(\mathbf{X_i}, \mathbf{X_k})$

Agglomerative hierarchical approach

It is prohibitive to consider all possible clusters in a set of data of high dimension. For example according to Rencher (2002)for a sample size of n = 25, there is a total of more than 10^{19} possible clusters that could arise. Algorithms for clustering arise to help find a reasonable cluster out of data of all sizes. Agglomerative hierarchical approach involves combining starting with each data point as a cluster and combining two clusters with the nearest distance between them. The cluster distances used in this work are the complete linkage and the centroid linkage distances. They are hereby defined.

The complete linkage method is otherwise called the farthest neighbor linkage method. The complete linkage method defines the distance between two clusters as the furthest distance between a point in the first cluster and the second. At the end the clusters are combined which have the shortest distance between them.

The centroid method involves combining two clusters that have the shortest distance between their centroids, which in physics might be likened to their centres of gravity.

Dendrogram

This is a tree diagram within two axes. One axis is the distance axis and the other is the sample elements axis.

Computer Software: Minitab 17 is the software which was used to undertake all computations for this work.

Results

Correlation Coefficient Distance and Complete Linkage

Table 1:

Cluster Analysis of Variables: crop p, livest, forestry, fishing, crude oil, solid m, ...

Correlation Coefficient Distance, Complete Linkage
Amalgamation Steps

Step	Number of clusters	Similarity level	Distance level	Clusters joined		New cluster	Number of obs. in new cluster
1	21	99.1683	0.01663	6	15	6	2
2	20	98.6222	0.02756	1	17	1	2
3	19	98.1516	0.03697	12	20	12	2
4	18	98.0508	0.03898	7	19	7	2
5	17	98.0082	0.03984	2	9	2	2
6	16	97.4208	0.05158	4	22	4	2
7	15	95.3818	0.09236	6	12	6	4
8	14	95.3395	0.09321	1	16	1	3
9	13	94.0255	0.11949	2	7	2	4
10	12	91.8800	0.16240	3	11	3	2
11	11	90.0796	0.19841	8	14	8	2
12	10	89.2565	0.21487	6	18	6	5
13	9	88.2397	0.23521	4	21	4	3
14	8	86.5838	0.26832	10	13	10	2
15	7	72.5815	0.54837	2	10	2	6
16	6	72.3060	0.55388	1	6	1	8
17	5	57.8187	0.84363	4	8	4	5
18	4	36.2588	1.27482	1	3	1	10
19	3	25.9485	1.48103	2	5	2	7
20	2	19.0260	1.61948	1	2	1	17
21	1	4.4346	1.91131	1	4	1	22

Table 2: Clusters from Correlation Coefficient Distance and Complete Linkage

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Final Partition

Cluster 1
  crop p  forestry  solid m  ict  utilities  real est  profession  admin  public  human
Cluster 2
  livest  crude oil  manuf  trade  transp  accomm  education
Cluster 3
  fishing  constr  finance  arts  others
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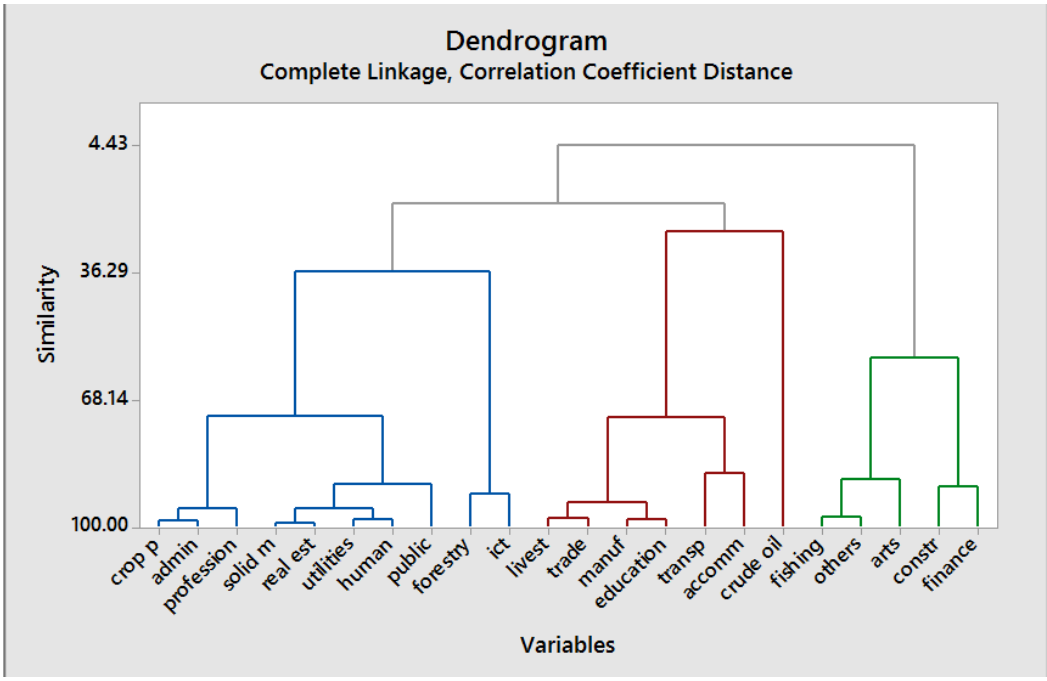

Figure 1: Dendrogram of Correlation Coefficient Distance and Complete Linkage

The dendrogram of Figure 1 may be given the following interpretation:

Cluster 1: **Solid minerals** and **real estate** have the lowest correlation coefficient distance and so they are combined into a cluster C_1. **Crop production** and **administrative** have the next lowest distance and they are combined together into a cluster C_2. **Utilities** and **human** are next combined into a cluster C_3. Then C_1 is combined with C_3 into C_4. The cluster C_4 is combined with **public** to yield C_5 . Then C_2 is combined with **profession** to yield C_6. Then C_6 is combined with C_5 to yield C_7 **Forestry** is combined with ICT to yield C_8. Then C_8 is combined with C_7 to form C_9.
Cluster 2: **Manufacturing** and **education** have the minimum distance and they form cluster C_{10}. **Livestock** and **trade** form the next cluster C_{11}. Then C_{11} and C_{10} combine into C_{12}. **Transportation** and **accommodation** combine into cluster C_{13}. Cluster C_{12} joins **crude oil** into another cluster C_{14}.
Cluster 3: **Fishing** and **others** combine to yield C_{15}. **Construction** and **finance** combine into C_{16}. C_{15} and arts combine into C_{17}. Finally C_{16} and C_{17} combine into C_{18}.

Absolute Correlation Coefficient Distance and Complete Linkage

Table 3

Cluster Analysis of Variables: crop p, livest, forestry, fishing, cruc

Absolute Correlation Coefficient Distance, Complete Linkage
Amalgamation Steps

Step	Number of clusters	Similarity level	Distance level	Clusters joined		New cluster	Number of obs. in new cluster
1	21	98.3366	0.016634	6	15	6	2
2	20	97.2445	0.027555	1	17	1	2
3	19	96.3031	0.036969	12	20	12	2
4	18	96.1015	0.038985	7	19	7	2
5	17	96.0164	0.039836	2	9	2	2
6	16	94.8415	0.051585	4	22	4	2
7	15	90.7637	0.092363	6	12	6	4
8	14	90.6789	0.093211	1	16	1	3
9	13	88.0509	0.119491	2	7	2	4
10	12	83.7601	0.162399	3	11	3	2
11	11	80.1591	0.198409	8	14	8	2
12	10	78.5129	0.214871	6	18	6	5
13	9	76.4794	0.235206	4	21	4	3
14	8	73.1676	0.268324	10	13	10	2
15	7	71.5175	0.284825	5	8	5	3
16	6	45.1630	0.548370	2	10	2	6
17	5	44.6120	0.553880	1	6	1	8
18	4	15.6375	0.843625	4	5	4	6
19	3	2.9913	0.970087	1	4	1	14
20	2	2.7394	0.972606	1	2	1	20
21	1	0.0604	0.999396	1	3	1	22

Table 4

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Final Partition

Cluster 1
  crop p  fishing  crude oil  solid m  constr  utilities  finance  real est  profession
     admin  public  human  arts  others
Cluster 2
  livest  manuf  trade  transp  accomm  education
Cluster 3
  forestry  ict
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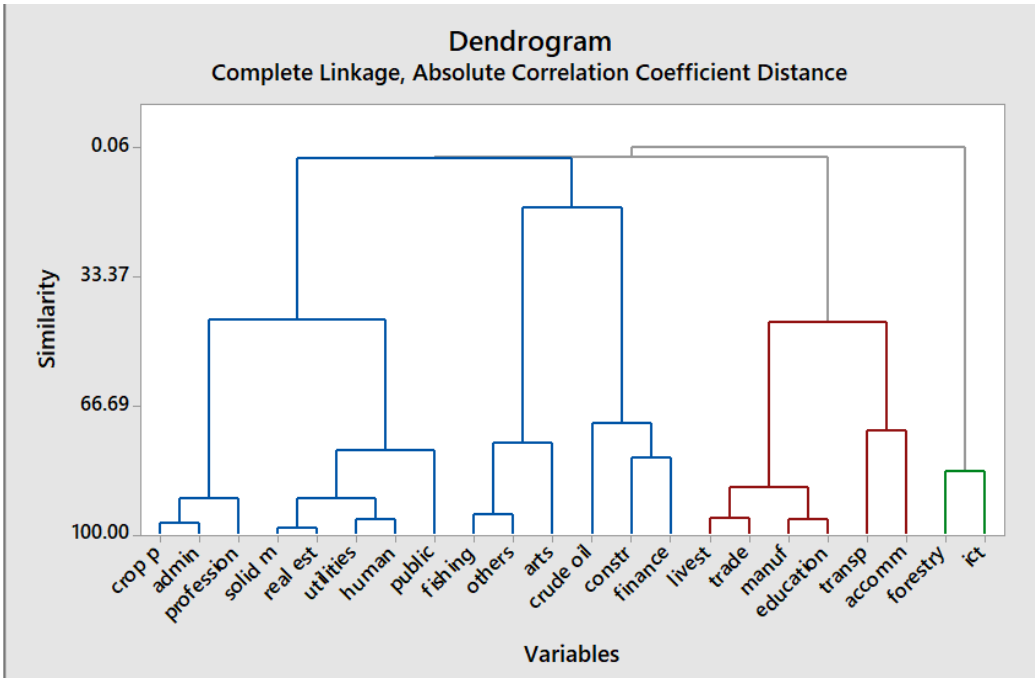

Figure 2: Dendrogram of Absolute Correlation Coefficient and Complete Linkage

The above dendrogram of Figure 2 may be interpreted like this:
Cluster 1: **Solid minerals** and **real estate** are combined into the cluster D_1. **Crop production** and **administration** are combined into the cluster D_2. **Utilities** and **human** are combined into D_3. D_1 and D_3 are joined into D_5. D_2 is combined with profession into D_6. D_6 and D_5 are joined into D_7. **Fishing** and **others** are combined into D_8. **Construction** and **finance** are joined into D_9. D_8 and arts are combined into D_{10}. D_9 and **crude oil** are combined into D_{11}. D_{10} and D_{11} are combined into D_{12}. Finally, D_7 and D_{12} combine into D_{13}.
Cluster 2: **Livestock** and **trade** combine into D_{14}. **Manufacturing** and **education** combine into D_{15}. D_{14} and D_{15} combine into D_{16}. **Transportation** and **accommodation** combine into D_{17}. Finally D_{16} and D_{17} combine into D_{18}.
Cluster 3**:** **Forestry** and **ICT** combine into D_{19}.

Correlation Coefficient Distance and Centroid Linkage

Table 5:

Cluster Analysis of Variables: crop p, livest, forestry, fishing, crude oil, solid m, ...

Correlation Coefficient Distance, Centroid Linkage
Amalgamation Steps

Step	Number of clusters	Similarity level	Distance level	Clusters joined		New cluster	Number of obs. in new cluster
1	21	99.1683	0.016634	6	15	6	2
2	20	98.6222	0.027555	1	17	1	2
3	19	98.1516	0.036969	12	20	12	2
4	18	98.0508	0.038985	7	19	7	2
5	17	98.0082	0.039836	2	9	2	2
6	16	97.4208	0.051585	4	22	4	2
7	15	97.3406	0.053188	6	12	6	4
8	14	96.4777	0.070445	1	16	1	3
9	13	95.8675	0.082651	2	7	2	4
10	12	92.2490	0.155021	3	6	3	5
11	11	91.8417	0.163165	3	18	3	6
12	10	91.6772	0.166456	4	21	4	3
13	9	90.0796	0.198409	8	14	8	2
14	8	86.5838	0.268324	10	13	10	2
15	7	85.1602	0.296796	2	10	2	6
16	6	82.5490	0.349020	1	3	1	9
17	5	81.7051	0.365899	8	11	8	3
18	4	75.7540	0.484921	1	2	1	15
19	3	74.1416	0.517168	4	8	4	6
20	2	63.8146	0.723707	1	4	1	21
21	1	56.9174	0.861652	1	5	1	22

Table 6:

Final Partition

Cluster 1
crop p livest forestry solid m manuf trade transp utilities accomm real est
profession admin public education human
Cluster 2
fishing constr ict finance arts others
Cluster 3
crude oil

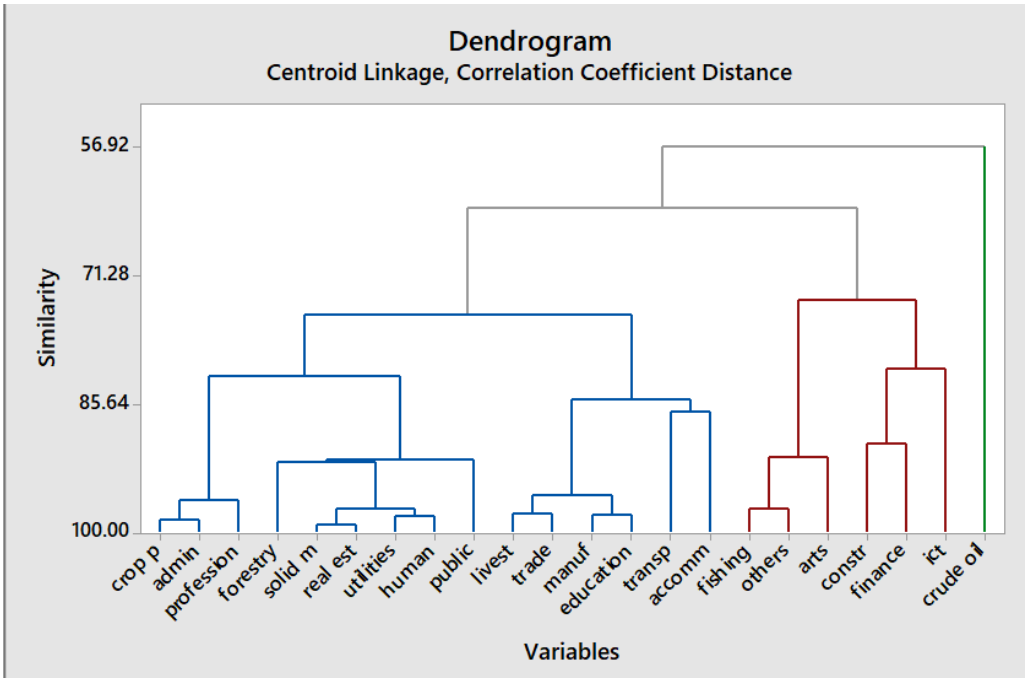

Figure 3: Dendrogram of Correlation Coefficient Distance and Centroid Linkage

The dendrogram of Figure 3 may be interpreted like this.
Cluster 1: **Solid minerals** and **real estate** combine into E_1. **Crop production** and **administration** combine into E_2. **Utilities** and **human** combine into E_3. E_1 and E_3 combine into E_4. E_2 and **profession** combine into E_5. **Forestry** and E_4 combine into E_6. E_6 and **public** combine into E_7. E_5 and E_7 combine into E_8**.** **Livestock** and **trade** combine into E_9. **Manufacturing** and **education** combine into E_{10}. E_9 and E_{10} combine into E_{11}. **Transportation** and **accommodation** combine into E_{12}. E_{11} and E_{12} combine into E_{13}. Finally E_8 and E_{13} combine into E_{14}.
Cluster 2: **Fishing** and **others** combine into E_{15}. E_{15} and **arts** combine into E_{16}**.** **Construction** and **finance** combine into E_{17}. **ICT** and E_{17} combine into E_{18}. Finally, E_{16} and E_{18} combine into E_{19}.
Cluster 3: **Crude oil**

Absolute Correlation Coefficient Distance and Centroid Linkage

Table 7:

Cluster Analysis of Variables: crop p, livest, forestry, fishing, crude oil, solid m, ...

Absolute Correlation Coefficient Distance, Centroid Linkage
Amalgamation Steps

Step	Number of clusters	Similarity level	Distance level	Clusters joined		New cluster	Number of obs. in new cluster
1	21	98.3366	0.016634	6	15	6	2
2	20	97.2445	0.027555	1	17	1	2
3	19	96.3031	0.036969	12	20	12	2
4	18	96.1015	0.038985	7	19	7	2
5	17	96.0164	0.039836	2	9	2	2
6	16	94.8415	0.051585	4	22	4	2
7	15	94.6812	0.053188	6	12	6	4
8	14	92.9555	0.070445	1	16	1	3
9	13	91.7349	0.082651	2	7	2	4
10	12	84.4979	0.155021	3	6	3	5
11	11	84.3681	0.156319	1	14	1	4
12	10	83.6835	0.163165	3	18	3	6
13	9	83.3544	0.166456	4	21	4	3
14	8	78.0044	0.219956	8	11	8	2
15	7	74.1965	0.258035	5	8	5	3
16	6	73.1676	0.268324	10	13	10	2
17	5	70.3204	0.296796	2	10	2	6
18	4	63.9860	0.360140	1	4	1	7
19	3	69.2435	0.307565	1	3	1	13
20	2	66.4938	0.335062	1	2	1	19
21	1	63.8029	0.361971	1	5	1	22

Table 8:

Final Partition

Cluster 1
  crop p forestry fishing solid m utilities finance real est profession admin public
    human arts others
Cluster 2
  livest manuf trade transp accomm education
Cluster 3
  crude oil constr ict

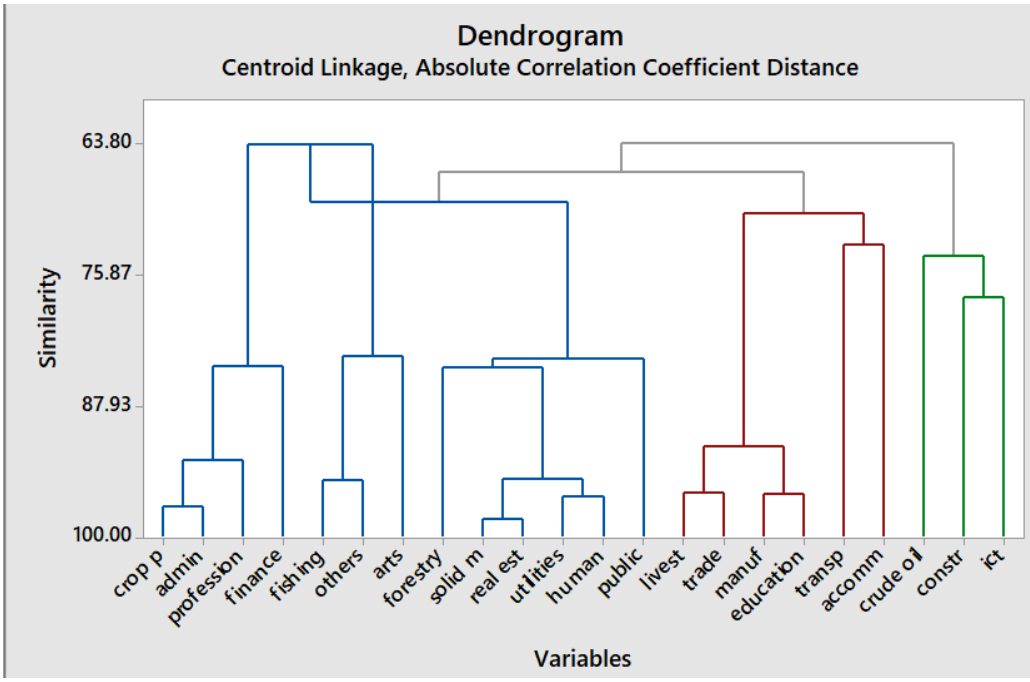

Figure 4: Dendrogram of Absolute Correlation Coefficient Distance and Centroid Linkage

The dendrogram of Figure 4 may be interpreted like this.
Cluster 1: **Crop production** joins with **administration** to form F_1. **Profession** joins with F_1 to form F_2. F_2 joins with **finance** to form F_3. **Fishing** joins with **others** to form F_4. F_4 joins with **arts** to form F_5. **Solid minerals** joins with **real estate** to form F_5. **Utilities** join with **human** to form F_7. F_7 combine with F_5 to form F_6. **Forestry** combines with F_6 to form F_8 and F_8 combines with **public** to form F_9. F_3 and F_5 combine to form F_{10}. Finally, F_{10} and F_9 combine to form F_{11}.

Cluster 2: **Livestock** and **trade** combine to form F_{12}. **Manufacturing** and **education** combine to form F_{13}. **Transportation** and **accommodation** join to form F_{15} which now joins with F_{14} to form F_{16}.

Cluster 3: **Construction** and **ICT** join to form F_{17} which now joins with **crude oil** to form F_{18}.
DISCUSSION
The best algorithm shown here is the one with Correlation Coefficient distance and the Centroid linkage method of clustering because it has rightly identified Crude Oil into a cluster of its own, being the mainstay of the Nigerian economy.
Cluster 3:
Nigeria is running a mono-cultural economy, with crude oil as the predominant product. To underscore this fact the President of Nigeria, Muhammad Buhari, doubles as the Federal Minister of Petroleum. The states from which this product come from are the Niger Delta States: Rivers State, Bayelsa State, Delta State, Akwa Ibom State, Edo State, Imo state, Abia State and Lagos State. There is 13% derivation principle whereby each of the states is paid allocation based on the oil production. When the global price rises the country is better off and when it goes down the country suffers. According to Oluwagbemiga and Alabi (2017), crude oil was discovered in Nigeria in 1956 at Oloibiri in Bayelsa State at a time when it was not lucrative. It was agriculture that was the mainstay of the economy then. It became lucrative in 1973 during the Arab-Isreali

war, in fact, so lucrative that all other sectors of the economy were neglected in favour of the oil sector. Oil is important to Nigeria in that it brings in high financial gains and creates a lot of employment for the Nigerian populace.

Cluster 2:

Information and communication has really improved in usage in this country of late. This follows development in computer education and practice. According to Oladimeji and Folayan (2018) the fundamental roles of ICT include substitute for other more expensive channels of communication like physical travels. Finance and insurance sector of the economy is growing by the day: 20.79% in the first quarter of 2020 (Proshare, 2020). Arts, Entertainment & Recreation sector in Nigeria are largely led by the private sector and operate in the nation's informal economic sector (Akinola, 2019). The construction sector has infrastructural and financial challenges. Fishing is coming up as a sector.

Cluster 1: Major crops cultivated in Nigeria are cassava, groundnut, cocoa, beans, nuts, cashew, gum Arabic, millet, rice, melon, palm kernels, rubber, sorghum, banana, yams, etc. Challenges before farmers include finances and need for soil nutrients for the betterment of crop yield. There seems to be improvement in this crop production sector over time. Livestock in Nigeria is another sector of the economy worth considering. The major animals available are ruminants which include cattle, goats, fowls,etc. Forestry constitutes another sector. It is a major contributor to foreign exchange in the country. Okunlola and Akinyele (2014) say the Nigerian forest have over 500 species of trees which reach a height of 12m and a width of 60m. Solid minerals constitute a sector of the economy worth discussing. Solid minerals in Nigeria include talc, gypsum, iron ore, lead, zinc, bentonite, barite, gold, bitumen, rock salt, gemstones, kaolin, etc. Manufacturing is a sector which has been growing over the years. Raji (2018) says it has grown from -2.9% in the third quarter of 2017 to 0.1% in the fourth quarter of 2017 to 3.7% in the first quarter of 2018. trade in Nigeria involved exportation of crude oil, cocoa, rubber, palm oil and kernels, etc. and the importation of machines, chemicals, transport equipment, food, etc. Transportation in Nigeria has improved with the construction of roads, construction of airports, and the purchase of trains, etc. Utilities in Nigeria involve the provision of water, power and electricity. Real estate business is the property of buying and selling of land and building. Education is a sector that is too obvious to be left out. It involves the the (1)-6-3-3-4 system: one-year pre-primary education, six years of primary education, 3-year junior secondary education, 3-years of senior secondary education and 4-years of university education.

Conclusion

It is worthwhile to conclude that the combination of the correlation coefficient distance and the Cetroid linkage methods has given resulted to a good collection of clusters since it has been able to isolate the mainstay of the Nigerian economy into a cluster of its own. It is our position that there is need for the diversification of the economy beyond crude oil. Nigeria is blessed with diverse human and natural resources. There is a lot of room for this diversification. Nigeria shall continue to be the leading African nation economically if it diversifies into other areas. The coronavirus pandemic experienced nowadays globally has been a major concern as it has reduced the pace of growth in the country.

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Appendix

DATA: NIGERIA'S REAL GDP

Activity Sector	Quarter 1 2018	Quarter 2 2018	Quarter 3 2018	Quarter 4 2018	Quarter 1 2019	Quarter 2 2019	Quarter 3 2019
Crop production	3045163.11	3378030.03	4877078.38	4486166.16	3144587.69	3443607.45	4994729.88
Livestock	292386.84	283577.69	291160.54	341002.97	294971.65	283559.35	291218.38
Forestry	41360.26	48008.51	43341.10	50038.06	42265.37	499559.78	44980.39
Fishing	108402.70	80103.89	76759.20	101568.29	116091.37	80979.01	78050.27
Crude petroleum & natural gas	1537038.44	1418073.13	1696606.69	1344156.80	1514641.29	1519802.94	1806746.96
Solid minerals	11186.87	25620.64	27270.56	32523.95	12421.19	24969.86	23764.98
Manufacturing	1595563.65	1539566.75	1599043.51	1686416.37	1608461.83	1537522.17	1616584.64
construction	650767.19	747860.30	544228.74	662431.53	671448.37	752833.66	557147.53
Trade	2747170.57	2728125.96	2857370.77	3141123.70	2770454.69	2721316.70	2815887.74
Transport	241534.71	216351.50	221416.44	277338.67	288637.00	233705.81	261809.92
Information & Communication	1999209.11	2259564.73	1907885.53	2360999.95	2188810.43	2463113.02	2096318.89
Utilities	61027.25	111806.01	104510.68	127728.46	64825.41	117091.44	94995.15
Accommodation and food services	176498.55	105401.85	157259.25	181031.20	183831.29	108482.91	160848.58
Finance & insurance	571134.17	549432.14	456182.57	517927.07	527749.58	537150.37	461049.43
Real estate	907593.68	1131763.57	1175656.69	1256847.82	916064.55	1088267.52	1148470.43
Professional Scientific & Technical Services	564694.65	594967.30	677860.50	706613.23	574481.80	602156.45	660127.24
Administrative and Support	3307.92	3324.81	3870.51	3937.63	3355.32	3392.34	3988.47

Services Business Services							
Public administration	358496.20	380006.76	365540.65	427,538.21	307550.32	367112.43	367755.38
Education	345537.77	297293.69	386568.22	478161.40	346165.27	300161.48	391169.57
Human health & Social services	112685.85	118790.00	117455.89	123769.86	112506.18	120126.87	118468.79
Arts, entertainment & Recreation	47132.89	38366.32	33646.20	37338.61	50489.39	38677.98	34619.58
Other services	678761.98	524471.99	460629.46	696777.64	694742.66	537845.35	465381.99