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THE CONSEQUENCES OF GLOBAL WARMING

Abstract

It has been known for several years now that Global Warming is an unignorable issue. Since its effects are making a noticeable appearance, we decided to make it our project's idea. Our research question is to **Predict the effects of global warming on global temperature, carbon dioxide levels and annual electricity generation in the next 10-20 years**. Our goals are to analyze the data that we can get our hands on to find an answer to our question.

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Introduction

Our project problem is to find relations between global warming and our data attributes. It is important because it would reveal weather our study is positively or negatively correlated. Or not at all, which in turn will answer the formally debatable question; is global warning real? Or is it simply nature going through natural changes. Our hypothesis is that our research question would be answered positively: global warming is real and is affecting global temperature, carbon dioxide levels and annual electricity generation. mining algorithm that will be applicable is clustering.

Related work

Global temperature:

The global temperature change article is using global temperature as a measurement for climate change and comparing past predictions with the present. Then finally coming up with results to determine the magnitude of climate change and how it is human made.

Our project almost shares the same goal except that we are making new predictions rather than use past ones. And we used a couple more measurements for climate change.

At the beginning of the article, it included a description of the collected data and its sources with illustration and plots. According to their findings It is no longer correct to say ‘‘most global warming occurred before 1940.’’ A better summary is: slow global warming, with large fluctuations, over the century up to 1975, followed by rapid warming. They also concluded that global warming is a real climate change, not an artifact due to measurements in urban areas, is confirmed by surface temperature change inferred from borehole temperature profiles at remote locations. Finally, they suggested ways to prevent the progression of climate change, they suggested that considering the evidence that aerosol effects on clouds cause a large negative forcing, they suggest that seeding of clouds by ships plying selected ocean regions deserves investigation.

All the data shown in the article was undeniably evident and well presented. Their analysis uses documented procedures for data over land, satellite measurements of sea surface temperature. Including data recorded in the Goddard Institute for Space Studies analysis for 2005. Our project is concerned with more attributes to study and analyze, therefore it may be safe to say it is a bit more reliable when it comes to results regarding climate change. Let alone that the article was written in 2006, that means we have the advantage of more advanced technology and tools to manipulate and analyze the data. [1]

Carbon Dioxide:

This colloquium paper focuses on showing how much concentrations of greenhouse gases have risen and in result is causing climate change, but it mainly focuses on carbon dioxide because it is indisputably rising in concentration which is one of our project attributes that we are measuring for climate change.

In his paper Keeling starts with explaining the human beings' superiority to exploit the Earth's environment to their own advantage which led to many consequences and one that we are more concerned about is the rising of carbon dioxide and climate change

he further states that "the rates at which greenhouse gases emission into the air are roughly proportional to the global rate of energy consumption arising from human activity. Thus, as human population and per capita energy consumption have increased, concentrations of these gases have risen in nearly direct proportions to the product of both increases. They expect a rising temperature at the Earth's surface."[2 p.1] Concluding that rising concentration of greenhouse gases are causing climate change.

In conclusion, Keeling's paper and our project are similar in showing the relation between the rapid rising concentration of atmospheric carbon dioxide and its effect on climate change. even though Keeling didn't provide evidence of the rising concentration of atmospheric carbon dioxide, but he did explain the processes that affect, and are affected by, its concentration in the atmosphere. [2]

Electricity:

The global warming is the observed and projected increases in the average temperature of Earth's atmosphere and oceans. the earth's average temperature rose is about 0.6° Celsius. And according to different assumption about the future behavior and the main cause of global warming is our treatment of nature. Regardless of which term is used, different methods of electricity production can impact the earth's climate

The generation of electricity is the single largest source of CO2 emissions in the world. And it is responsible for roughly half of global warming, moreover; according to the American Energy Information Administration (EIA) and to the International Energy Agency (IEA), the world-wide energy consumption will be on average continue to increase by 2% per year. Increase by 2% leads to a doubling of the energy consumption every 35 years. This means the world-wide energy consumption is predicted to be twice as high in the year 2040 compared to 2007.

The one of the solution is a sensible energy consumption;

Moreover, Scientific researchers have shown that the quality of life is depending of the energy consumption up to a yearly energy consumption of 9'000 kWh per capita.

A reduction of the energy consumption per capita to less than 20'000 kWh per year as a global warming solution is a challenge for all industrialized countries .Basically, there are two potential ways to achieve this goal:

Reduction of the personal energy consumption by free will on account of a higher consciousness of the population.

Establishing appropriate commercial basic conditions within each country and between the countries.

On another hand, there is a solution of CO2 emission

The renewable energy -- wind and solar fuels in particular -- release negligible amounts of gases contributing to climate change, even when the manufacturing of the hardware is considered.

At the end the global warming is the major challenge for our global society.

It is your personal decision whether you want to be the cause of global warming or part of solution

Let's emphasize it again: Not the others need to change, we must change ourselves.to understand this hint from Nature [3]

DATA DESCRIPTION & PREPROCESSING

Data description

First table describing Global temperature, second one; Electricity generation, third one Carbon dioxide.

	Year	Temp
0	1980	0.27
1	1981	0.33
2	1982	0.14
3	1983	0.32
4	1984	0.17
5	1985	0.12
6	1986	0.19
7	1987	0.34
8	1988	0.41
9	1989	0.28
10	1990	0.44
11	1991	0.42
12	1992	0.23
13	1993	0.24
14	1994	0.32
15	1995	0.45
16	1996	0.34
17	1997	0.47
18	1998	0.63
19	1999	0.40
20	2000	0.41
21	2001	0.54
22	2002	0.63
23	2003	0.61
24	2004	0.54
25	2005	0.68
26	2006	0.63
27	2007	0.64
28	2008	0.52

	Year	Electricity generation
0	1980	8017.35507
1	1981	8072.79238
2	1982	8254.85475
3	1983	8593.10915
4	1984	9083.99023
5	1985	9460.20532
6	1986	9656.40728
7	1987	10096.05766
8	1988	10528.90639
9	1989	11057.88517
10	1990	11294.58401
11	1991	11531.71581
12	1992	11615.48969
13	1993	11888.03873
14	1994	12164.61258
15	1995	12598.23301
16	1996	12981.88867
17	1997	13310.40952
18	1998	13663.67833
19	1999	14002.84793
20	2000	14565.75017
21	2001	14849.91950
22	2002	15357.00432
23	2003	15884.30579
24	2004	16651.03465
25	2005	17343.87890
26	2006	18020.76875
27	2007	18794.80481
28	2008	19103.19600

	Year	CD
0	1980	314.81
1	1981	315.58
2	1982	316.43
3	1983	316.98
4	1984	317.58
5	1985	319.03
6	1986	320.04
7	1987	319.59
8	1988	318.18
9	1989	315.90
10	1990	314.17
11	1991	313.83
12	1992	315.00
13	1993	316.19
14	1994	316.90
15	1995	317.70
16	1996	318.54
17	1997	319.48
18	1998	320.58
19	1999	319.77
20	2000	318.57
21	2001	316.79
22	2002	314.99
23	2003	315.31
24	2004	316.10
25	2005	317.01
26	2006	317.94
27	2007	318.55
28	2008	319.68

FIVE NUMBER SUMMARIES:

Carbon dioxide

```
count     29.000000
mean     317.283448
std        1.896672
min      313.830000
25%      315.900000
50%      317.010000
75%      318.570000
max      320.580000
Name: CD, dtype: float64
```

Electricity generation

```
count       29.000000
mean     12704.956020
std       3297.602391
min       8017.355070
25%      10096.057660
50%      12164.612580
75%      14849.919500
max      19103.196000
Name: Electricity generation, dtype: float64
```

Global temperature

```
count    29.000000
mean      0.403793
std       0.164239
min       0.120000
25%       0.280000
50%       0.410000
75%       0.540000
max       0.680000
Name: Temp, dtype: float64
```

DATA TYPES:

Global temperature

```
Year       int64
Temp     float64
dtype: object
```

Carbon dioxide

```
Year       int64
CD       float64
dtype: object
```

Electricity generation

```
Year                          int64
Electricity generation      float64
dtype: object
```

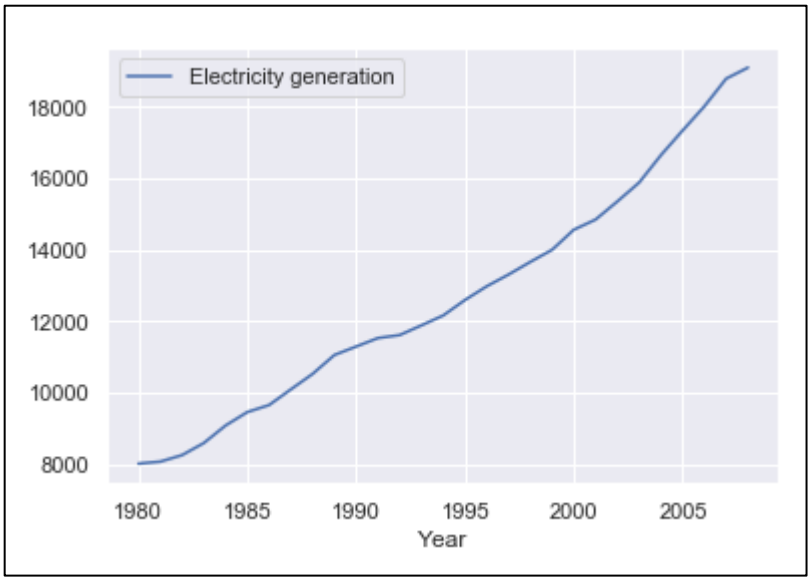
Correlation:

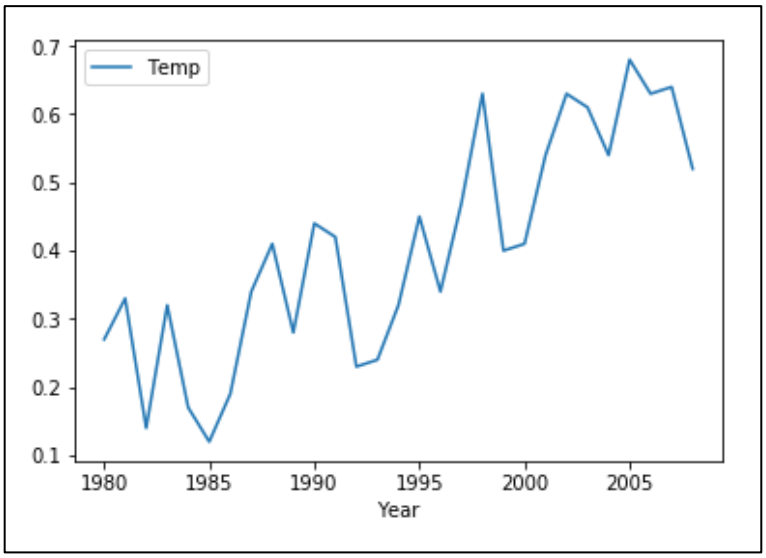
	Year	Electricity generation
Year	1.000000	0.989089
Electricity generation	0.989089	1.000000

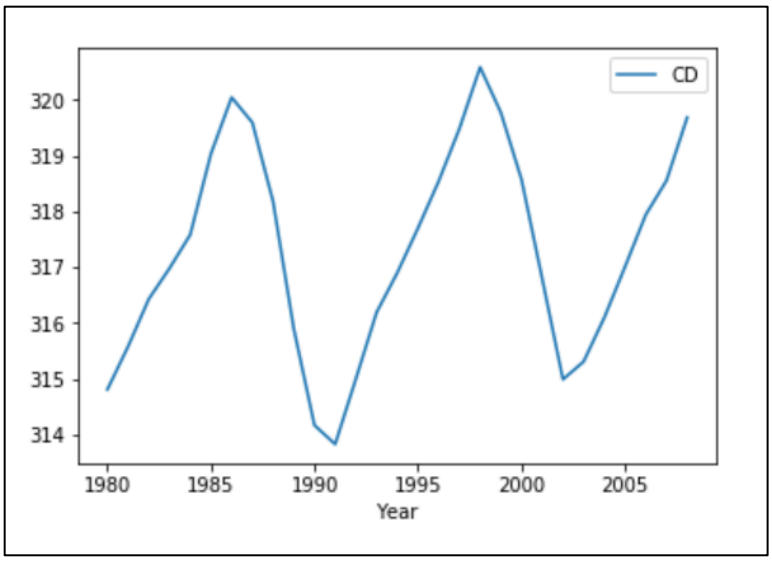
	Year	CD
Year	1.000000	0.198656
CD	0.198656	1.000000

	Year	Temp
Year	1.000000	0.825919
Temp	0.825919	1.000000

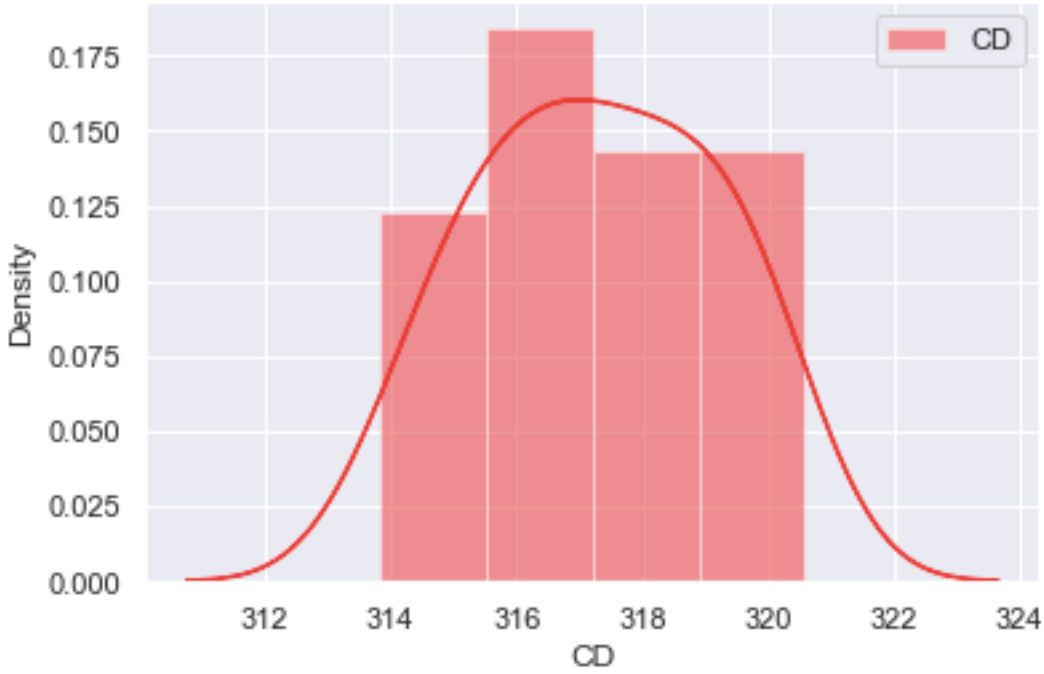
LINE CHARTS:

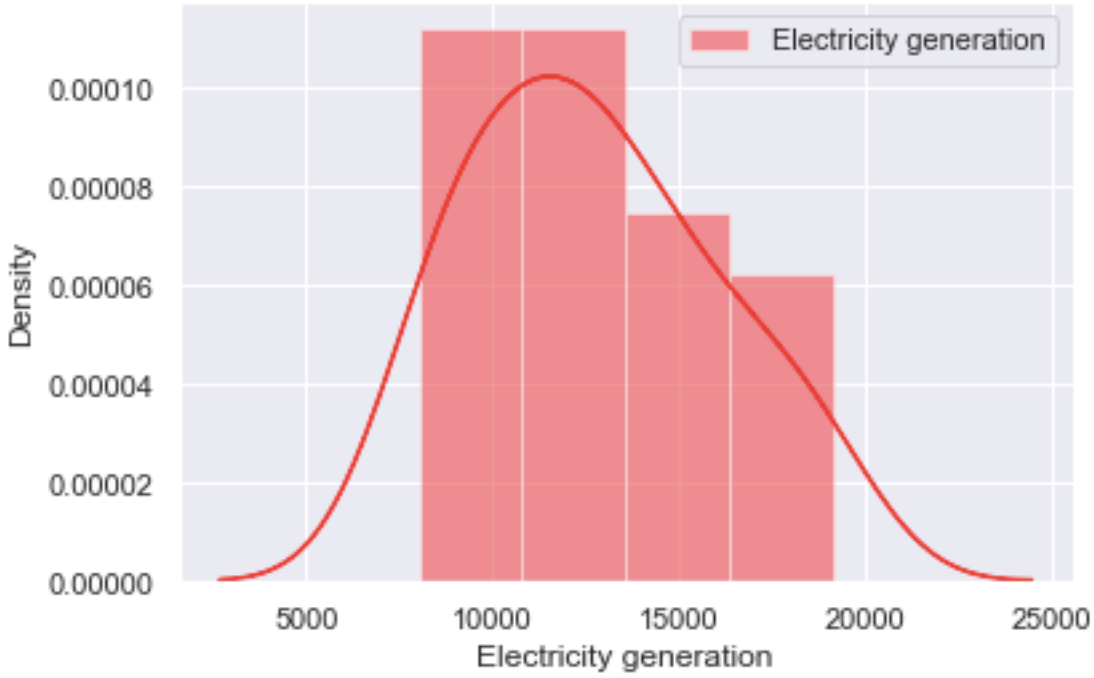

Electricity generation
18000
16000
14000
12000
10000
8000
1980
1985
1990
1995
2000
2005
Year

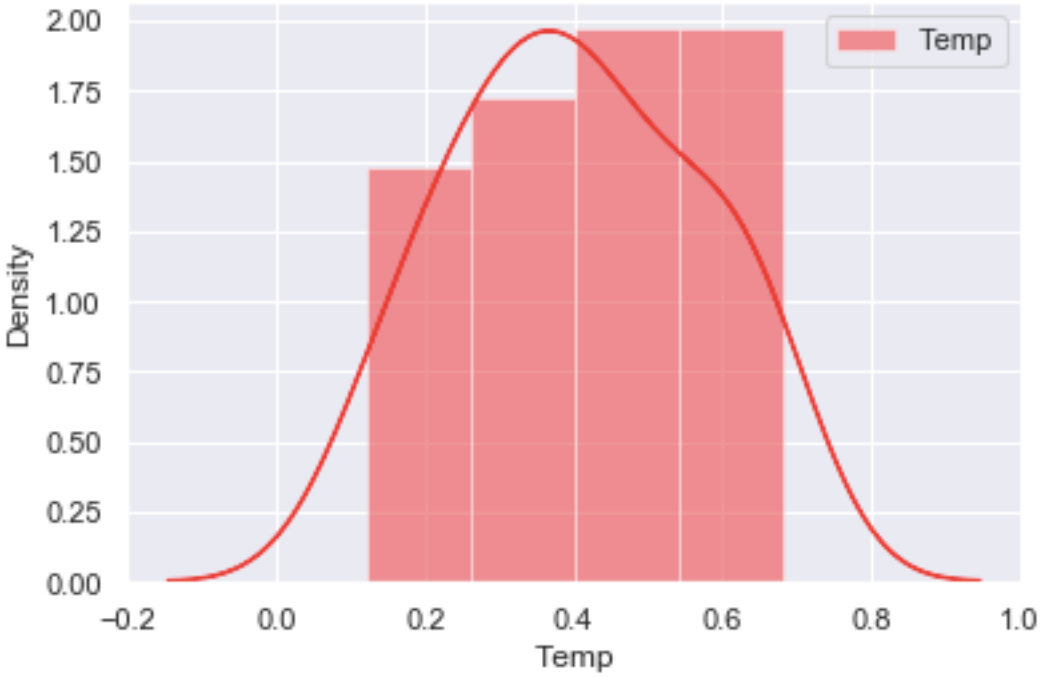

Temp
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1980
1985
1990
1995
2000
2005
Year


CD
320
319
318
317
316
315
314
1980
1985
1990
1995
2000
2005
Year

HISTOGRAMS:

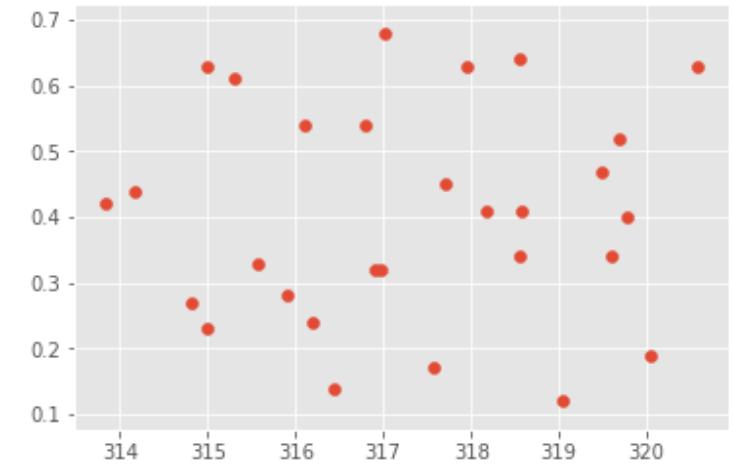

CD
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
Density
312
314
316
318
320
322
324
CD


Electricity generation
0.00010
0.00008
0.00006
0.00004
0.00002
0.00000
Density
5000
10000
15000
20000
25000
Electricity generation

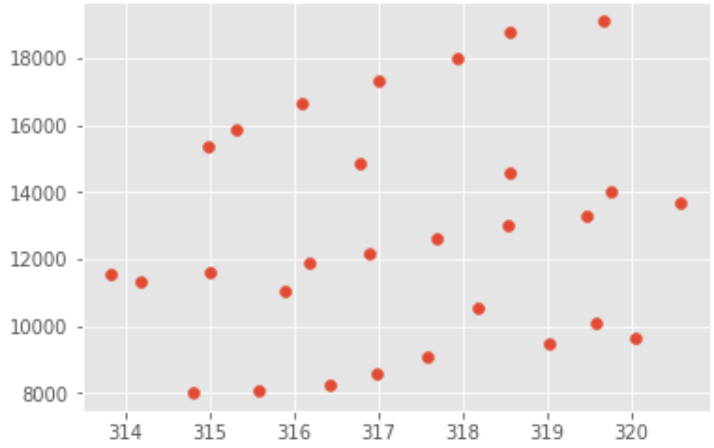

Temp
Density
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
−0.2
0.0
0.2
0.4
0.6
0.8
1.0
Temp

CORRELATION BETWEEN ATTRIBUTES:

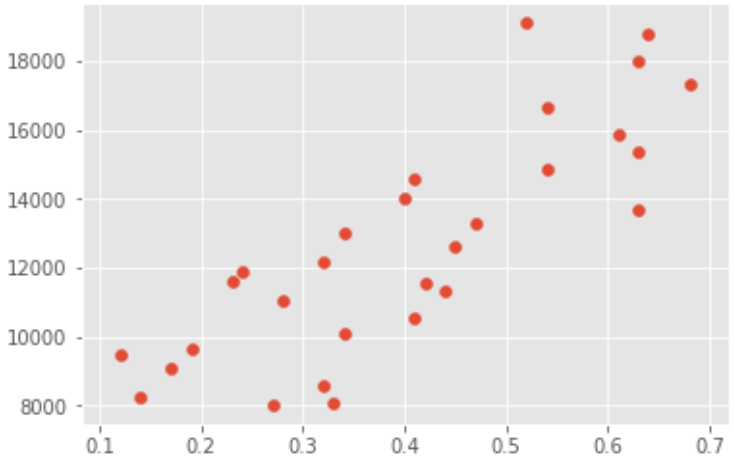
Carbon dioxide and Global temperature



Carbon dioxide and Electricity generation



Electricity generation and Global temperature



DATA PREPROCESSING

We did not need to preprocess the data since it is already clean and tidy.

These python illustrations show that all the data is complete and ready to analyze.

Electricity generation:

The sum of missing values

```
Year                    0
Electricity generation  0
dtype: int64
```

Boolean values of duplicated values

```
0      False
1      False
2      False
3      False
4      False
5      False
6      False
7      False
8      False
9      False
10     False
11     False
12     False
13     False
14     False
15     False
16     False
17     False
18     False
19     False
20     False
21     False
22     False
23     False
24     False
25     False
26     False
27     False
28     False
29     False
       ...
202    False
203    False
204    False
205    False
206    False
207    False
208    False
209    False
210    False
211    False
212    False
213    False
214    False
215    False
216    False
217    False
218    False
219    False
```

Global temperature:

The sum of missing values

```
Year    0
Temp    0
dtype: int64
```

Boolean values of duplicated values

```
0     False
1     False
2     False
3     False
4     False
5     False
6     False
7     False
8     False
9     False
10    False
11    False
12    False
13    False
14    False
15    False
16    False
17    False
18    False
19    False
20    False
21    False
22    False
23    False
24    False
25    False
26    False
27    False
28    False
dtype: bool
```

Carbon dioxide:

The sum of missing values

```
Year     0
CD       0
dtype: int64
```

Boolean values of duplicated values

```
0     False
1     False
2     False
3     False
4     False
5     False
6     False
7     False
8     False
9     False
10    False
11    False
12    False
13    False
14    False
15    False
16    False
17    False
18    False
19    False
20    False
21    False
22    False
23    False
24    False
25    False
26    False
27    False
28    False
dtype: bool
```

DATA MINING TECHNIQUES AND RESULTS

- **Clustering: k-means:**

K-means clustering is a type of unsupervised learning, which is used when you have unlabeled data (i.e., data without defined categories or groups). The goal of this algorithm is to find groups in the data, with the number of groups represented by the variable *K*.

The *K*-means clustering algorithm uses iterative refinement to produce a final result. The algorithm inputs are the number of clusters *K* and the data set. The data set is a collection of features for each data point. The algorithms start with initial estimates for the *K* centroids, which can either be randomly generated or randomly selected from the data set. We used it because it produced the best accuracy.

- **Classification: gradient Boosting classifier:**

Gradient boosting is a machine learning technique for regression and classification problems, which produces a prediction model in the form of an ensemble of weak prediction models, typically decision tree. It builds the model in a stage-wise fashion like other boosting methods do, and it generalizes them by allowing optimization of an arbitrary differentiable loss function.

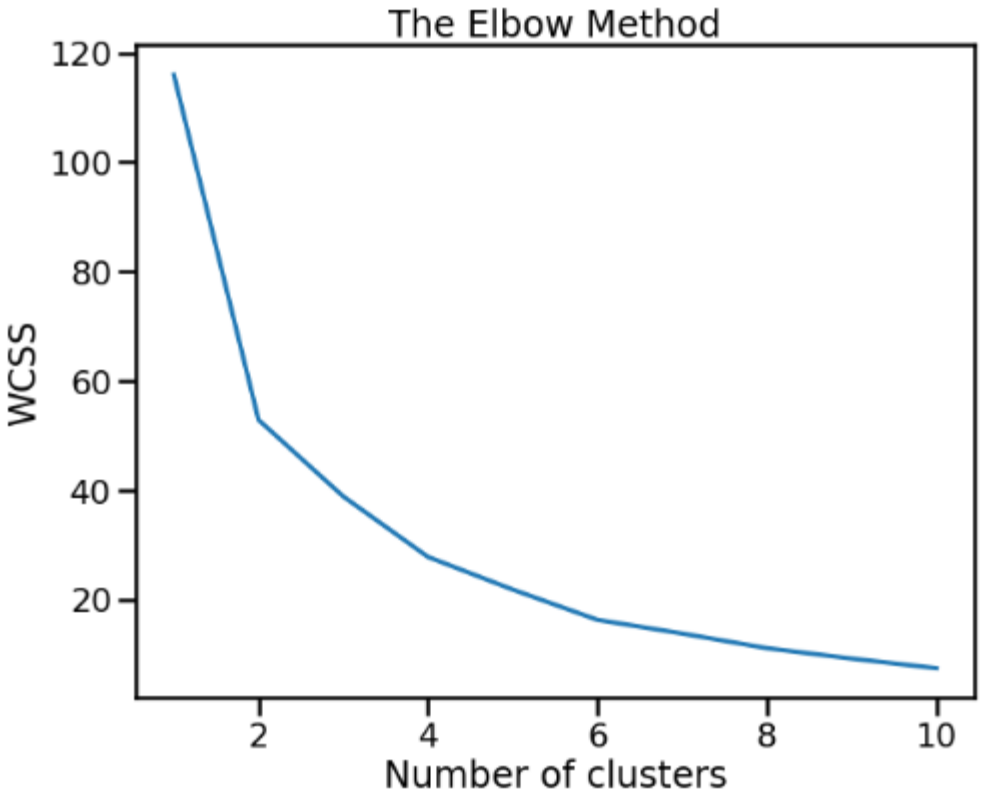
SCREENSHOTS:

```
Accuracy: 0.8888888888888888
```

Out [Dataset]

	Year	Temp	CD	Electricity generation
0	1980	0.27	314.81	8017.35507
1	1981	0.33	315.58	8072.79238
2	1982	0.14	316.43	8254.85475
3	1983	0.32	316.98	8593.10915
4	1984	0.17	317.58	9083.99023
5	1985	0.12	319.03	9460.20532
6	1986	0.19	320.04	9656.40728
7	1987	0.34	319.59	10096.05766
8	1988	0.41	318.18	10528.90639
9	1989	0.28	315.90	11057.88517
10	1990	0.44	314.17	11294.58401
11	1991	0.42	313.83	11531.71581
12	1992	0.23	315.00	11615.48969
13	1993	0.24	316.19	11868.03873
14	1994	0.32	316.90	12164.61258
15	1995	0.45	317.70	12598.23301
16	1996	0.34	318.54	12981.88867
17	1997	0.47	319.48	13310.40952
18	1998	0.63	320.58	13663.67833
19	1999	0.40	319.77	14002.84793
20	2000	0.41	318.57	14565.75017
21	2001	0.54	316.79	14849.91950
22	2002	0.63	314.99	15357.00432
23	2003	0.61	315.31	15884.30579
24	2004	0.54	316.10	16651.03465
25	2005	0.68	317.01	17343.87890
26	2006	0.63	317.94	18020.76875
27	2007	0.64	318.55	18794.80481
28	2008	0.52	319.68	19103.19600

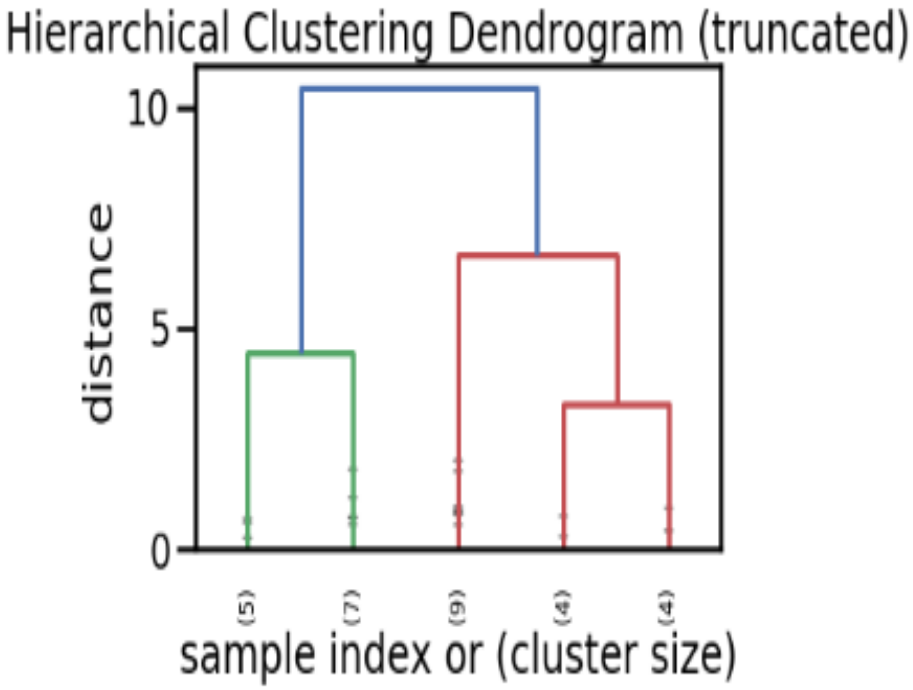
Out[Figuring out optimal number of clusters using the Elbow Method]



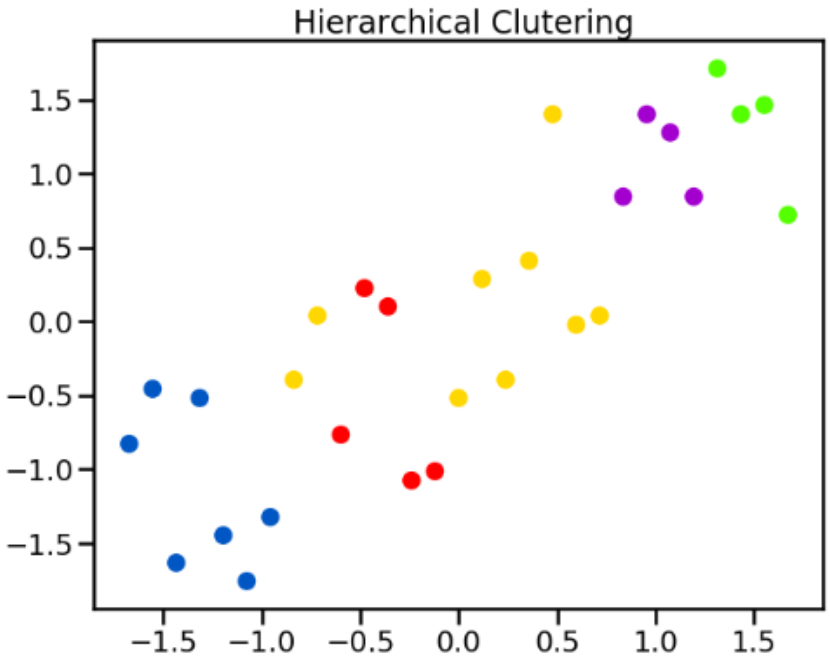
Out[the result extracting from graph using k-means. The cluster initiate by five groups]

cluster	Year	Temp	CD	Electricity generation
1	1982.0	0.2	316.3	8404.4
2	2004.5	0.6	317.0	17000.6
3	1997.5	0.4	319.1	13520.5
4	1991.5	0.3	315.3	11592.1
5	1986.5	0.3	319.2	9935.4

Out[hierarchical clustering for the dataset]

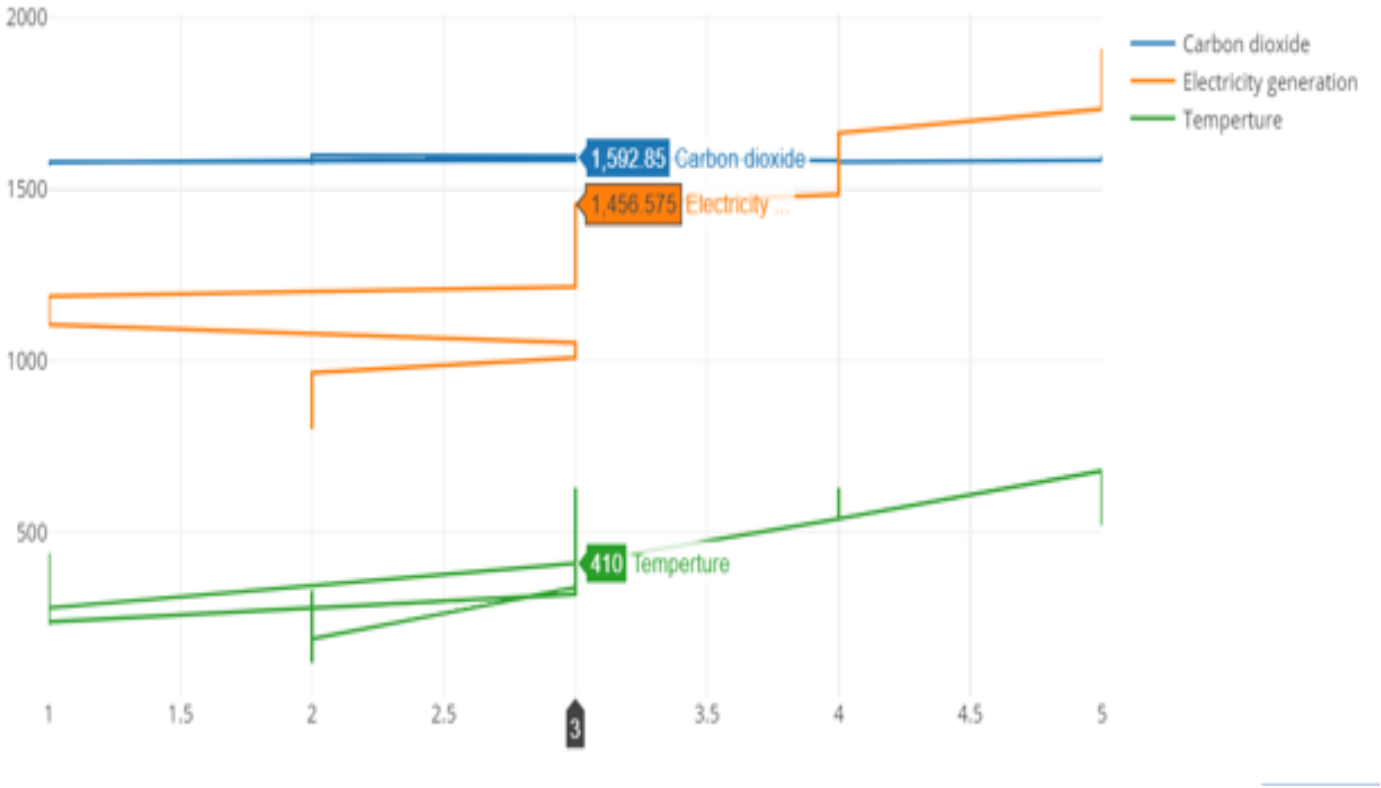


Out[Assigning the clusters and plotting the observations as per hierarchical clustering]



Out [using clustering and then add it to dataset. That means the dataset clustered into five groups that found it above]

	Year	Temp	CD	Electricity generation	cluster
0	1980	0.27	314.81	8017.35507	2
1	1981	0.33	315.58	8072.79238	2
2	1982	0.14	316.43	8254.85475	2
3	1983	0.32	316.98	8593.10915	2
4	1984	0.17	317.58	9083.99023	2
5	1985	0.12	319.03	9460.20532	2
6	1986	0.19	320.04	9656.40728	2
7	1987	0.34	319.59	10096.05766	3
8	1988	0.41	318.18	10528.90639	3
9	1989	0.28	315.90	11057.88517	1
10	1990	0.44	314.17	11294.58401	1
11	1991	0.42	313.83	11531.71581	1
12	1992	0.23	315.00	11615.48969	1
13	1993	0.24	316.19	11888.03873	1
14	1994	0.32	316.90	12164.61258	3
15	1995	0.45	317.70	12598.23301	3
16	1996	0.34	318.54	12981.88867	3
17	1997	0.47	319.48	13310.40952	3
18	1998	0.63	320.58	13663.67833	3
19	1999	0.40	319.77	14002.84793	3
20	2000	0.41	318.57	14565.75017	3
21	2001	0.54	316.79	14849.91950	4
22	2002	0.63	314.99	15357.00432	4
23	2003	0.61	315.31	15884.30579	4
24	2004	0.54	316.10	16651.03465	4
25	2005	0.68	317.01	17343.87890	5
26	2006	0.63	317.94	18020.76875	5
27	2007	0.64	318.55	18794.80481	5
28	2008	0.52	319.68	19103.19600	5



Out[the graph shows how to the **electricity generation and temperature are increased dramatically by x-axis but the carbon dioxide is rising slightly**]

CONCLUSION:

In conclusion, the result of prediction shows how the global warming is affected by consumption of electricity and the degree of temperatures as main reasons and that's base on the accuracy of our classification model which is equal 88%. as shown in figure 1 which agrees with our hypothesis.

Our research question was (Predict the effects of global warming on global temperature, carbon dioxide levels and annual electricity generation)

And the answer is: the global warming dramatically increases the consumption of electricity and the degree of temperatures, but the carbon dioxide increases slightly but steadily, which would produce noticeable effects in the future.

REFERENCES:

[1] ames Hansen, Makiko Sato, Reto Ruedy, Ken Lo, David W. Lea, and Martin Medina-Elizade Proc Natl Acad Sci USA September 26, 2006 103 (39) 14288-14293; https://doi.org/10.1073/pnas.0606291103

[2] C.D. Keeling, "Climate change and carbon dioxide: An introduction," The National Center for Biotechnology Information, Aug, 1997, [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC33714

[3] Pace University Center for Environmental Legal Studies, Environmental Costs of Electricity "Air Quality Issues of Electricity Production" Climate Change (1990) [Online] Available: http://www.powerscorecard.org/issue_detail.cfm?issue_id=1