EE GEE Coding

The Climate Change Project
Landsat 7 Collection 1 Tier 1 8-Day NDVI Composite

GROUP - 13

Submitted by

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Introduction

❑ A century and half of industrialization, deforestation, and large scale agriculture has deeply affected our environment.Through this project we investigated the effect of such processes by looking at different attributes which quantify different environmental factors.

❑ We focussed on the 'vegetation' attribute of environment by doing data analysis of NDVI values collected from Google Earth Engine for the past 20 years.

❑ We also did multivariate analysis by taking into consideration Precipitation and Temperature attributes and how it affects NDVI, which is our primary focus.

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Objective

➢ Extract NDVI values for monitoring 'vegetation' attribute at a District level across the country for the past 20 years using Javascript Code from the Google Earth Engine.
➢ Explore the Landsat 7 Collection 1 Tier 1 8-Day NDVI Composite.dataset.
➢ Do Data Analysis and implement Machine learning algorithms on the dataset to understand the changes in 'Vegetation' across the country in the past 20 years and predict the NDVI values for the upcoming years.
➢ Based on the analysis, justify whether climate change is a myth or not and should the government take immediate steps.

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Tools

- Python Interpreter
- Numpy library
- Pandas library
- Matplotlib library
- Seaborn library
- Scikit-learn library
- Statsmodels library
- Geopandas library

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Datasets

- The datasets that are used for analysis :
    1. LANDSAT NDVI : Deals with vegetation.
    2. NEX_Precip : Deals with precipitation.
    3. MOD11A1.006 Terra Land Surface Temperature and Emissivity dataset. : Deals with temperature.
- LANDSAT NDVI dataset is used for both univariate and multivariate analysis.
- NEX_Precip and MODIS_TEMP are used for multivariate analysis.
- The timestamps are different in each dataset.

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Univariate analysis

▶ The analysis is done for Landsat NDVI dataset.

▶ The dataset is divided into 3 type
  1. Country data
  2. State data
  3. District data

▶ The above datasets are again divided into two types
  1. Year wise
  2. Month wise

▶ ML models are used for predictions. If the data points available are less, then statistical model(Auto Regression) is used for prediction.

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Models used

- ML models used
    1. Linear regression
    2. Decision Tree
    3. Random Forest
    4. Gradient Boosting
- Auto Regression used in the code is implemented using Linear Regression.

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Variations in mean using violinplot

▶ Violinplot is used for distribution and checking outliers.

▶ There are no outliers as most of the data is between 0 and 0.4.

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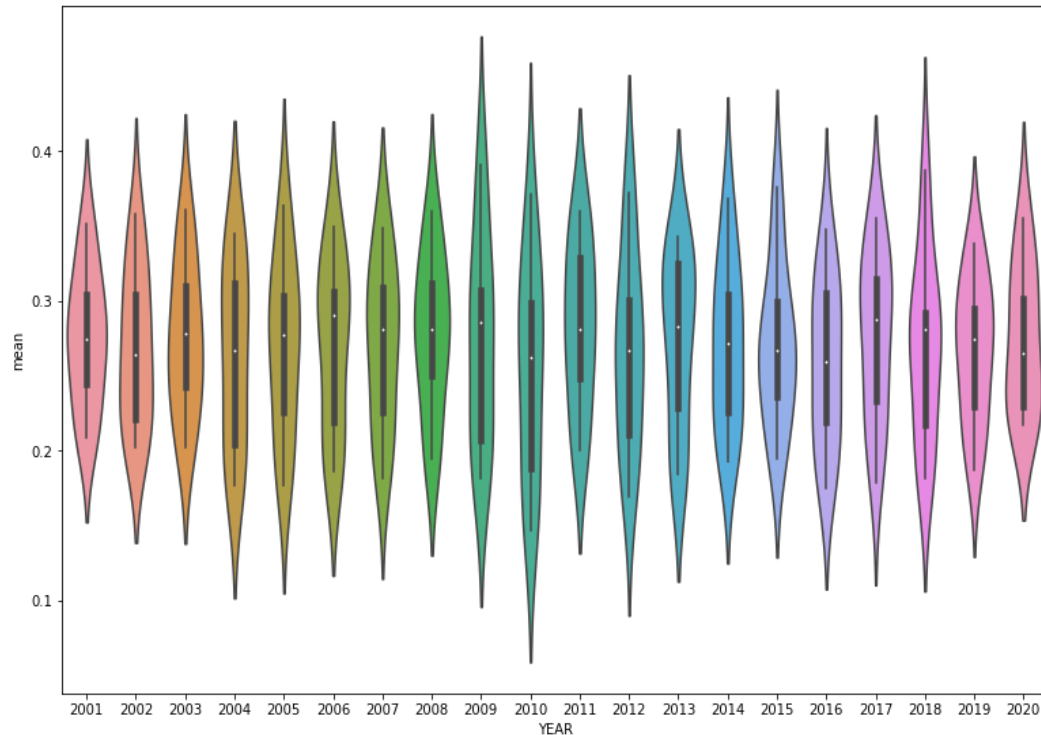
Month wise country data

▶ Monthly NDVI mean over 20 years

Seasonal trend is observed.
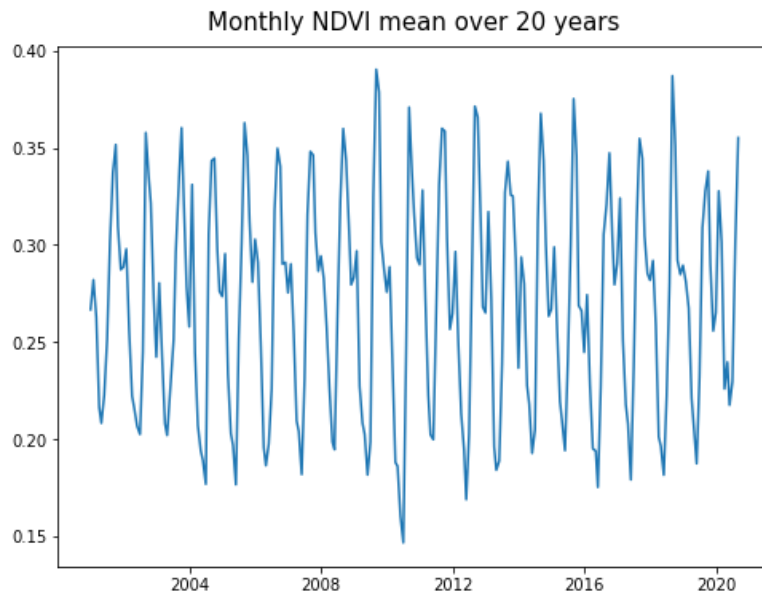
▶ Pearson correlation

From the below graph it is clear that there is no significant linear relation between the mean and year or month.

Monthly NDVI mean over 20 years

Pearson correlation using heatmap

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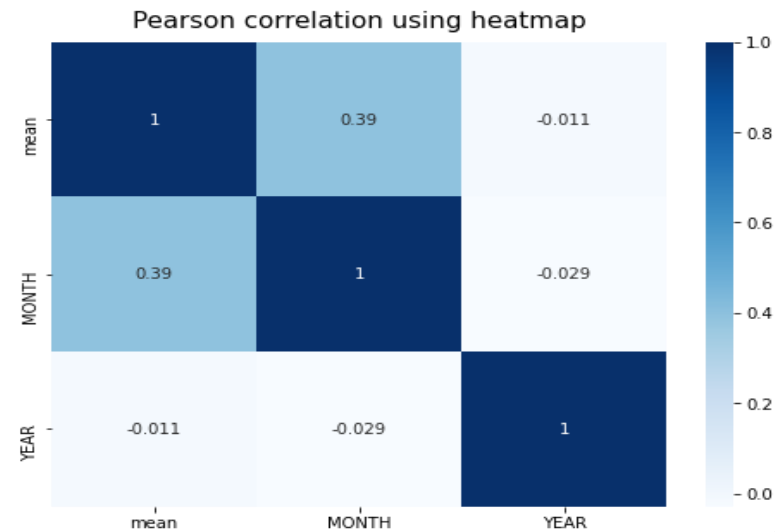
Month wise country data predictions using ML model

▶ Using Linear Regression

▶ Using Gradient Boosting

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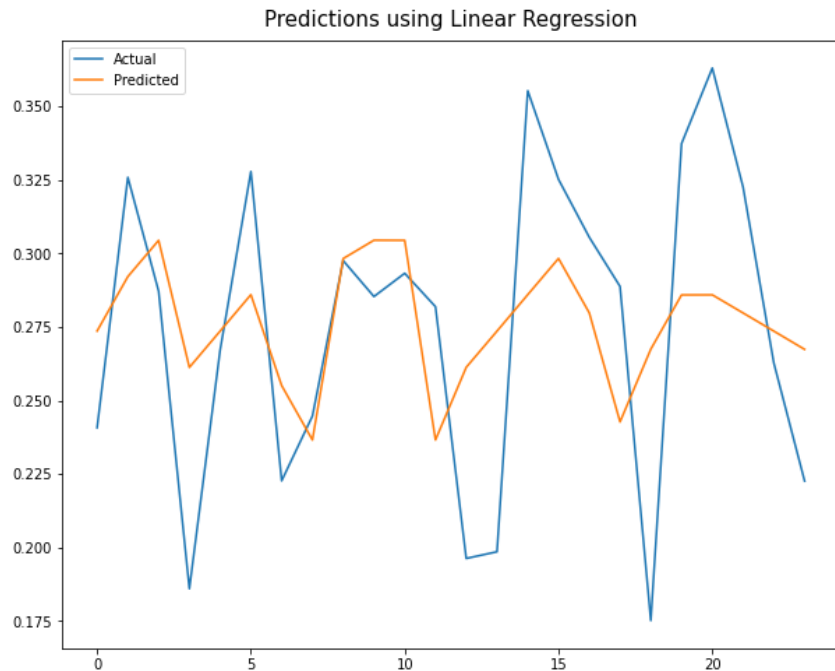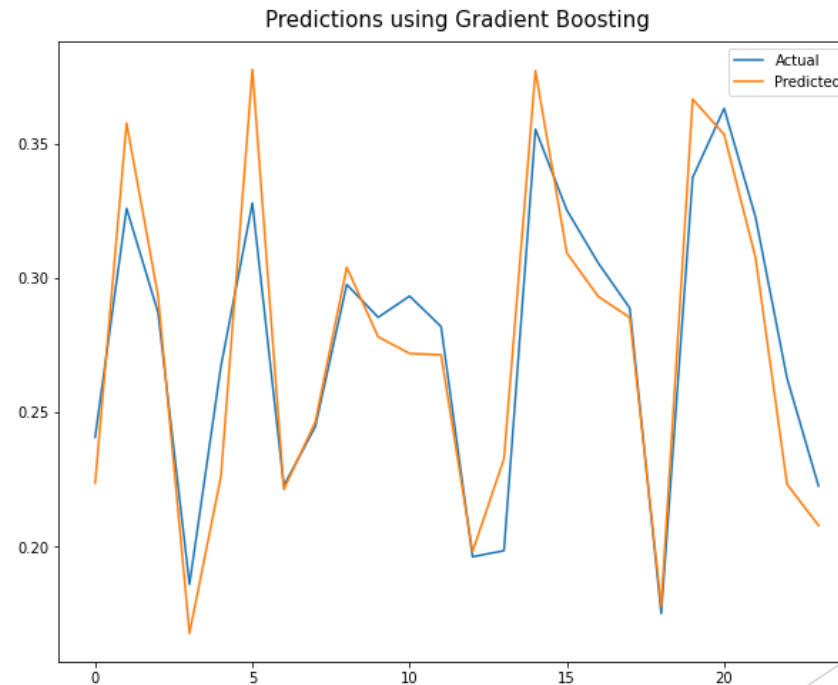
Month wise country data predictions using statistical model

► Partial autocorrelation
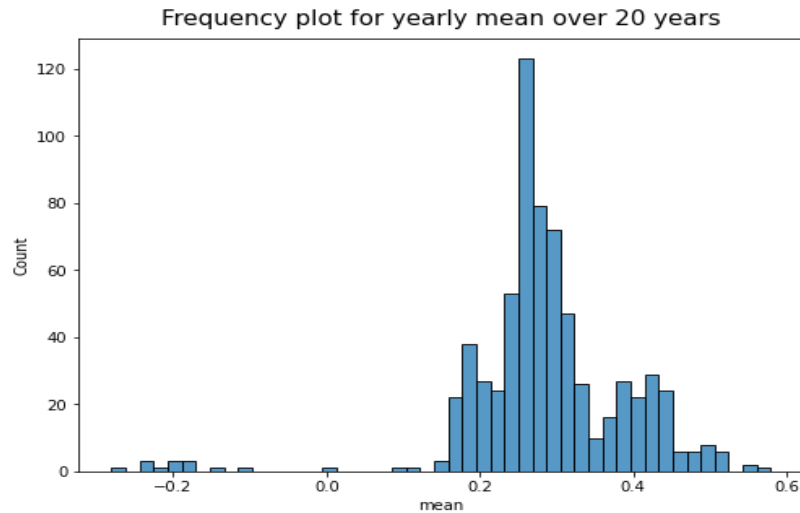
Lags = 2.

► Predictions

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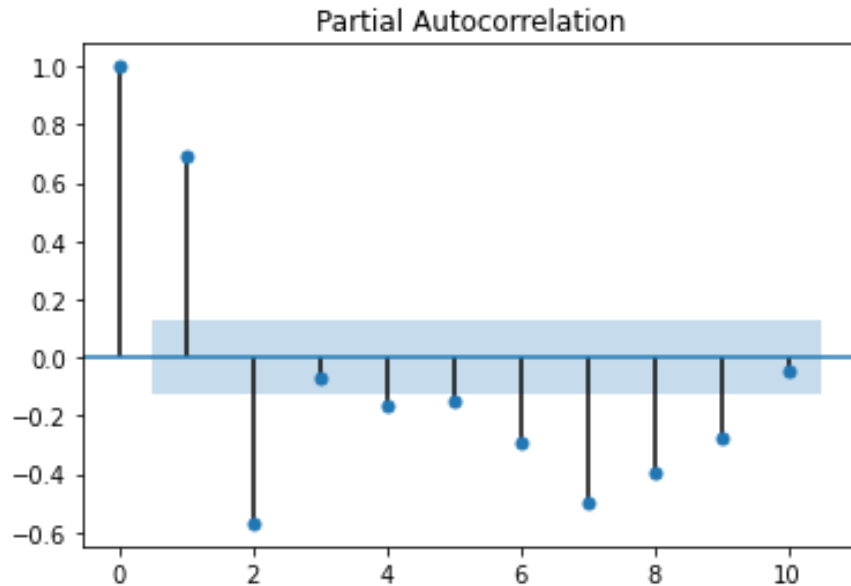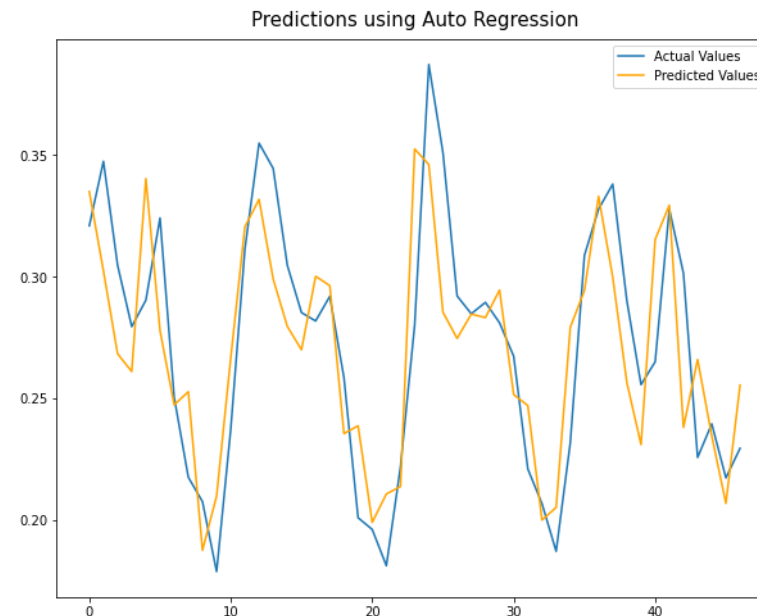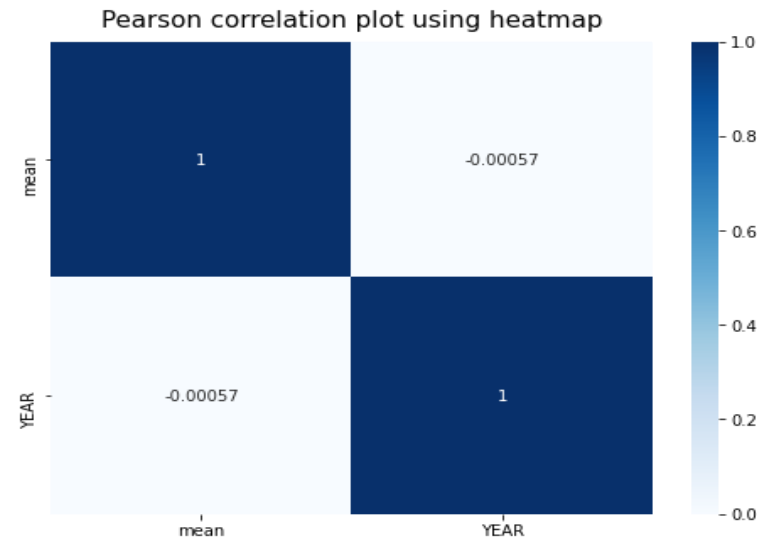
Year wise state data

- ▶ Yearly mean NDVI frequency over 20 years

Most of the values positive and they are between 0.2 and 0.4.

Frequency plot for yearly mean over 20 years

- ▶ Pearson correlation

There is no linear relation between year and mean.

Pearson correlation plot using heatmap

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Year wise state data predictions

▶ Using Linear Regression

▶ Using Gradient Boosting

Predictions using Linear Regression
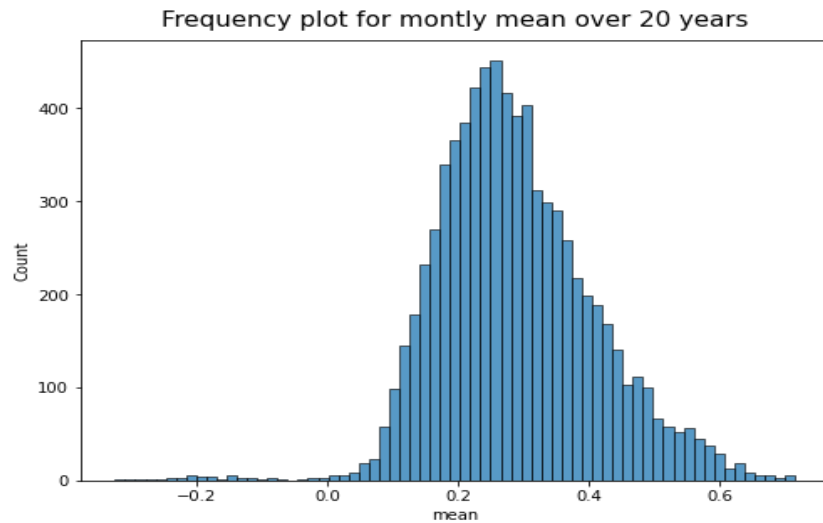

Predictions using Gradient Boosting

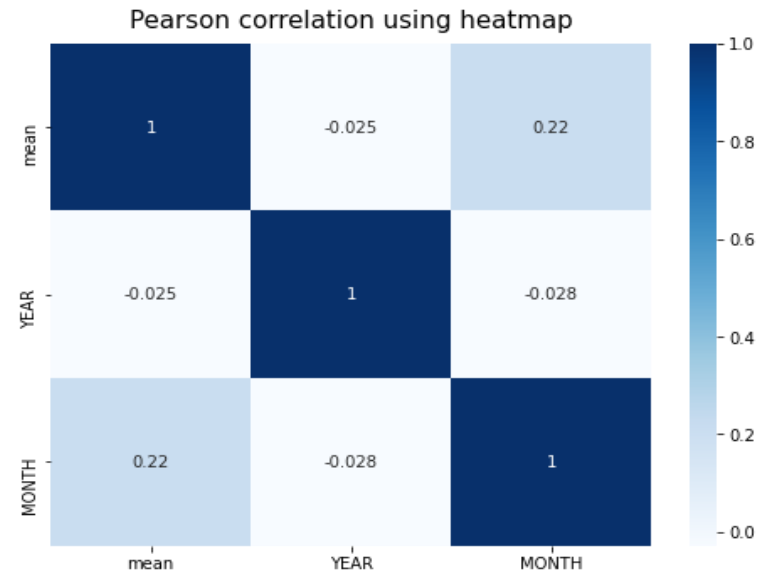Made by: Yacha Venkata Rakesh B180427CS
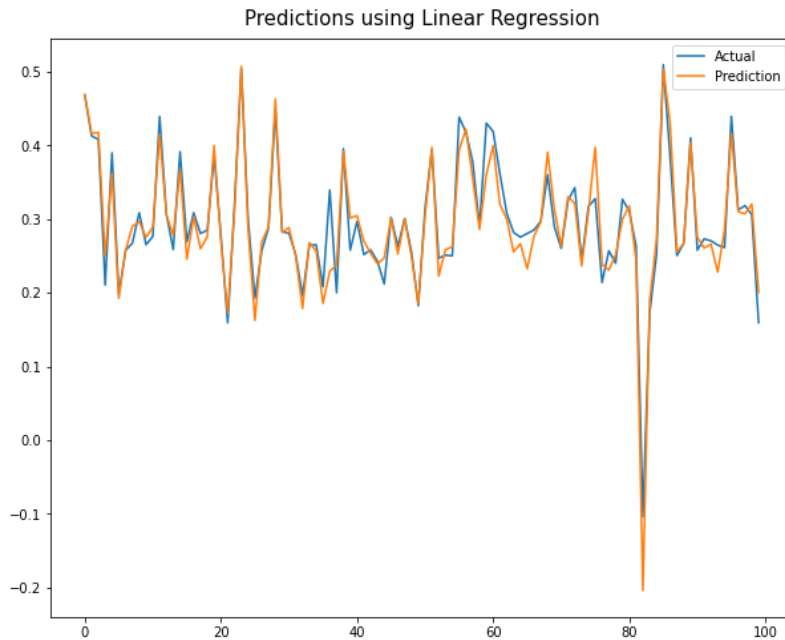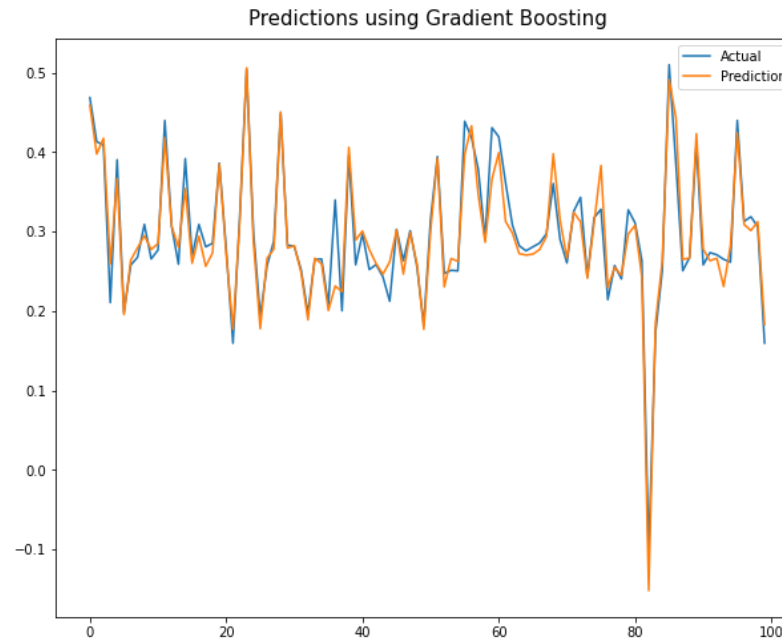
Month wise state data

▶ Monthly mean NDVI frequency over 20 years

Most of the values are between 0 and 0.4.

▶ Pearson correlation

There is no significant linear relation between mean and year or month.

Frequency plot for montly mean over 20 years

Pearson correlation using heatmap

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Month wise state data predictions

▶ Using Random Forest

▶ Using Gradient Boosting

Predictions using Random Forest

Predictions using Gradient Boosting

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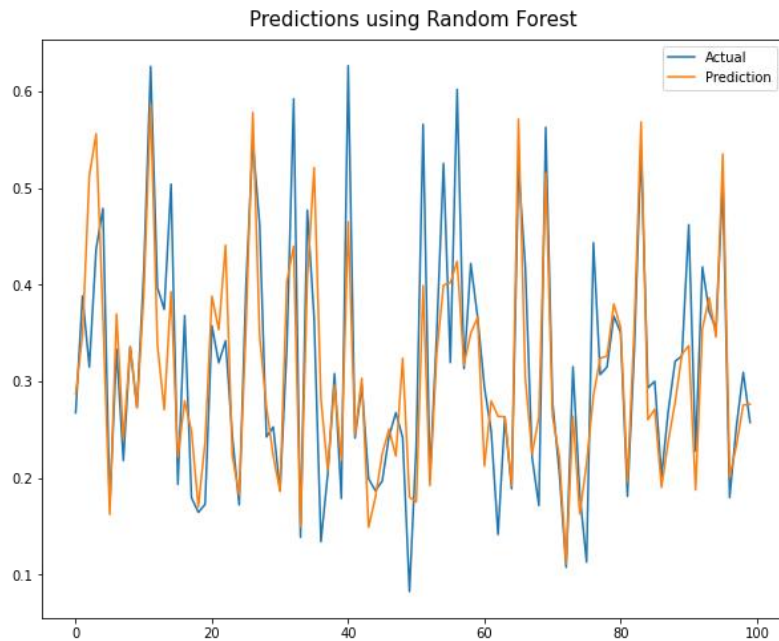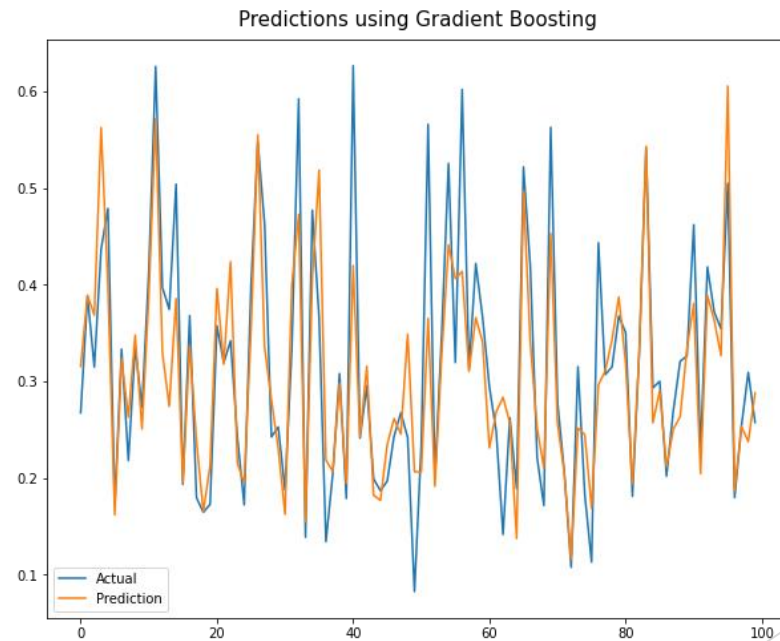
Year wise district data

► Monthly mean NDVI frequency over 20 years

Frequency plot for yearly mean over 20 years
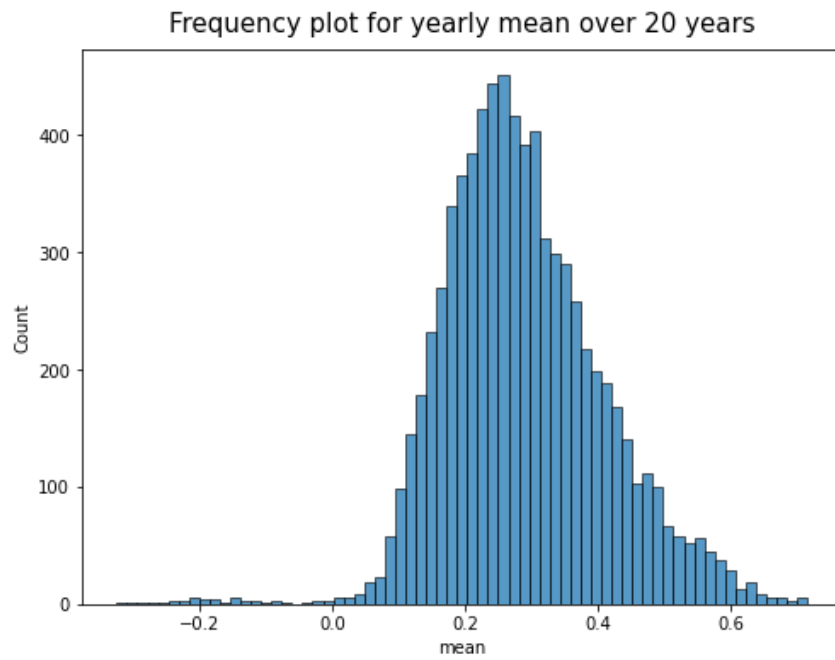
► Pearson correlation

There is linear relation between mean and year

Pearson correlation using heatmap

Made by: Dommeti Sree Gnanesh B180440CS
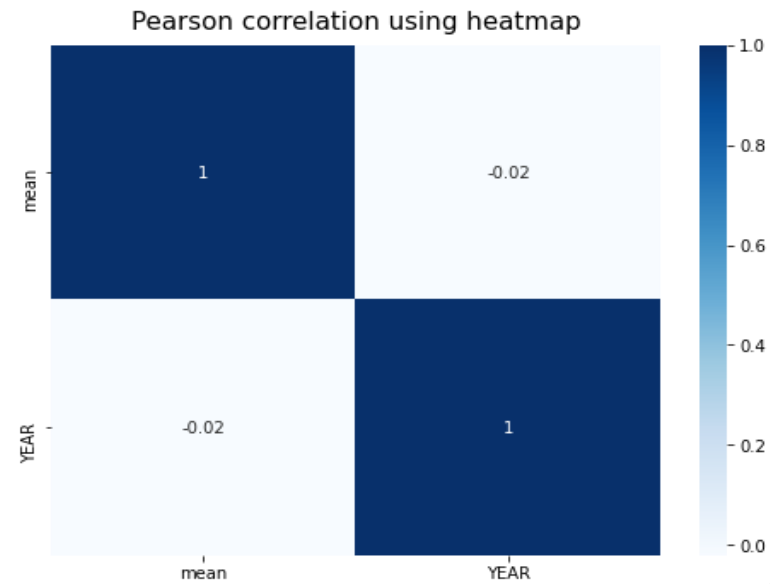
Year wise district data predictions

▶ Using Decision Tree

▶ Using Gradient Boosting

Made by: Deepak Abhiram Inagandla B180228CS
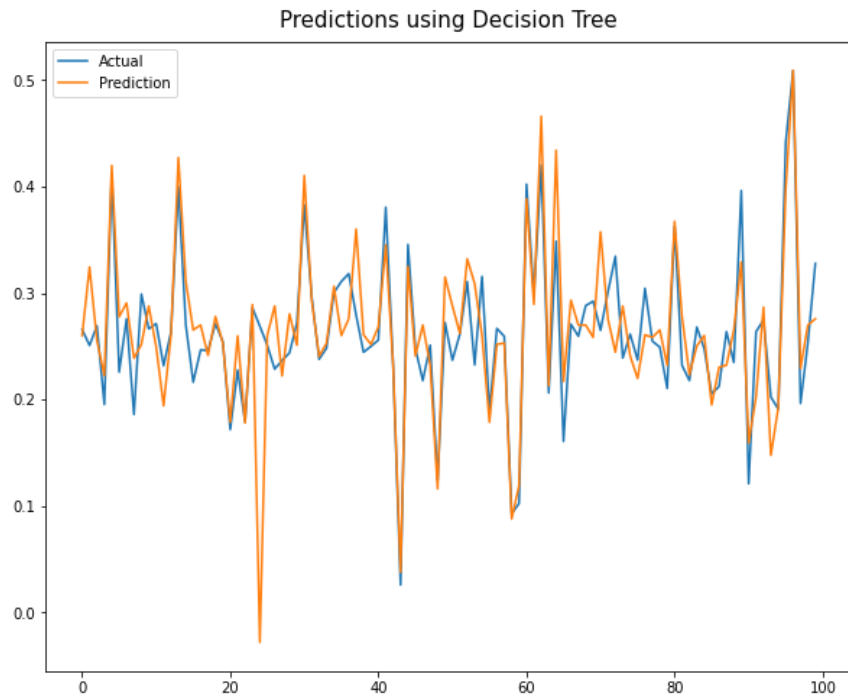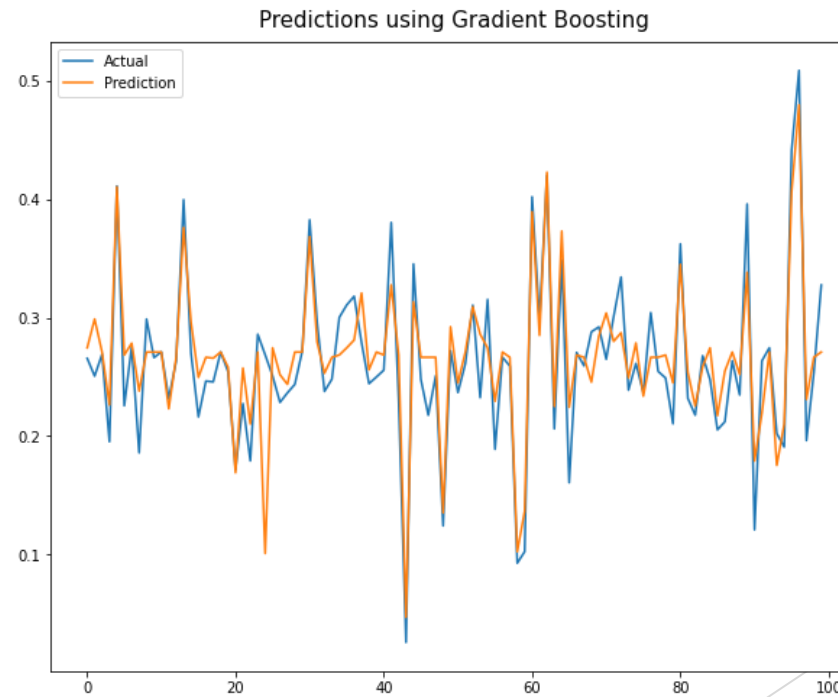
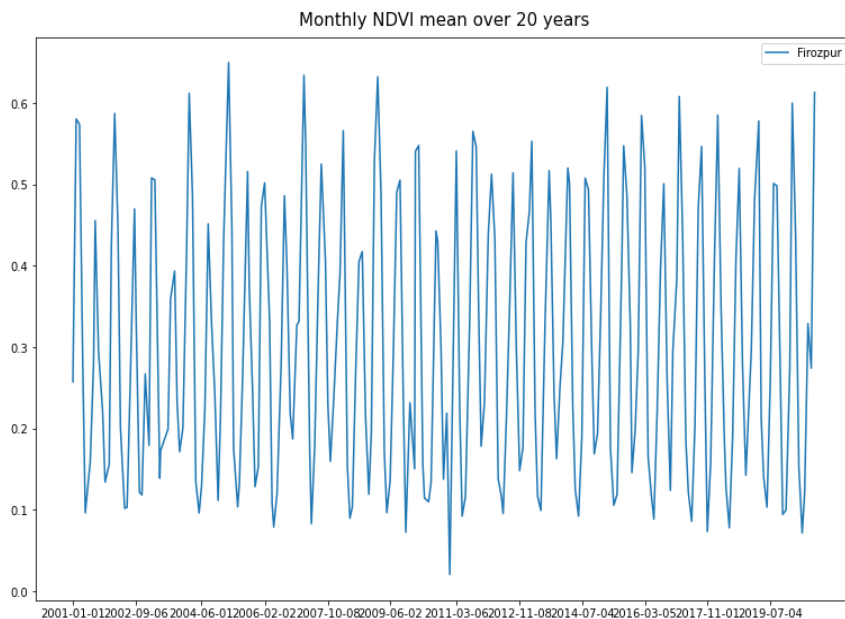# Month wise per district data

▶ The time taken for training a ML model for month wise districts(all districts) is very high.

▶ Hence month wise per district data is taken for analysis.

▶ Districts are chosen based on the maximum number of data points available.

▶ The districts that are chosen are

1. Churu
2. Firozpur
3. Ganganagar
4. Leh

▶ Since the data points for each district is very low, Auto regression is used for prediction.

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Month wise per district(Firozpur) data

► Monthly NDVI mean over 20 years

Seasonal trend is observed
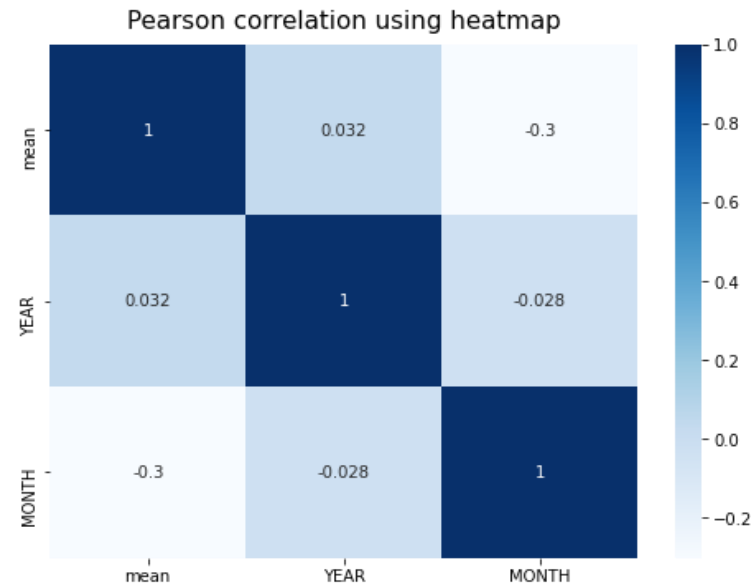

Monthly NDVI mean over 20 years

► Pearson Correlation

There is no significant linear relation between mean and year or month.

Pearson correlation using heatmap

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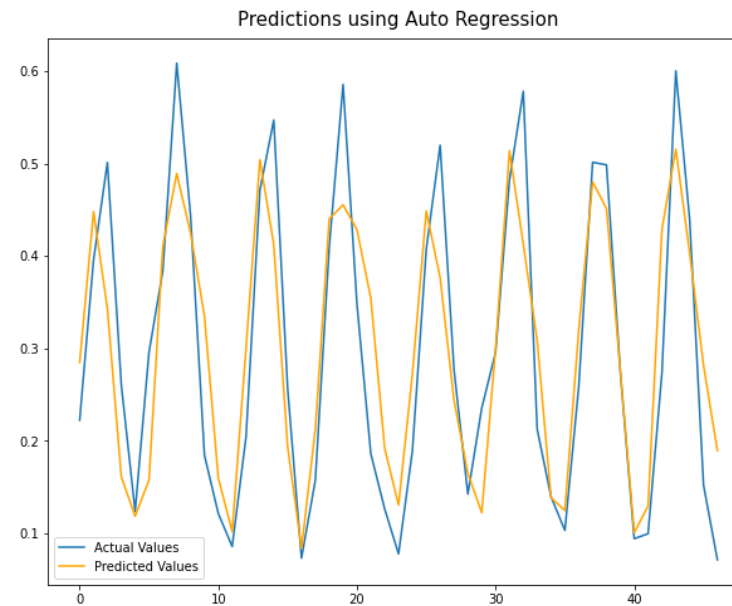# Month wise per district(Firozpur) data predictions

▶ Partial autocorrelation

Lags = 4.
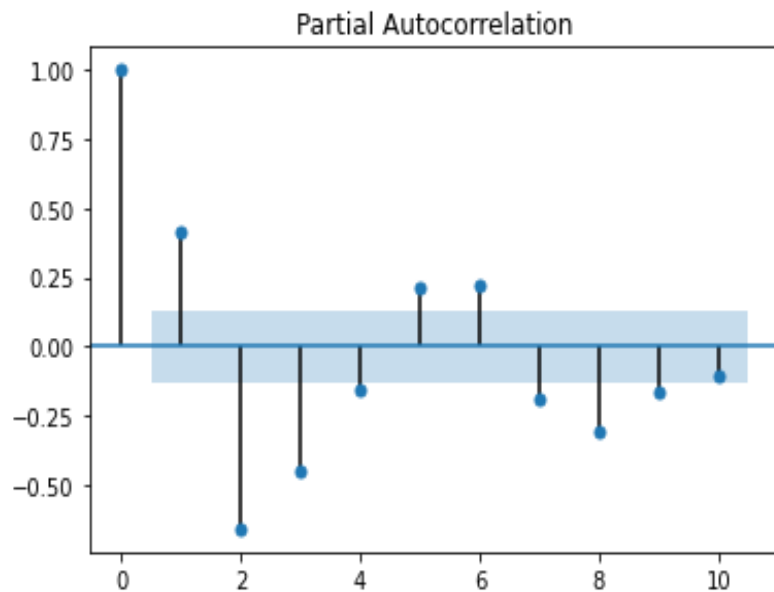
▶ Predictions using auto regression

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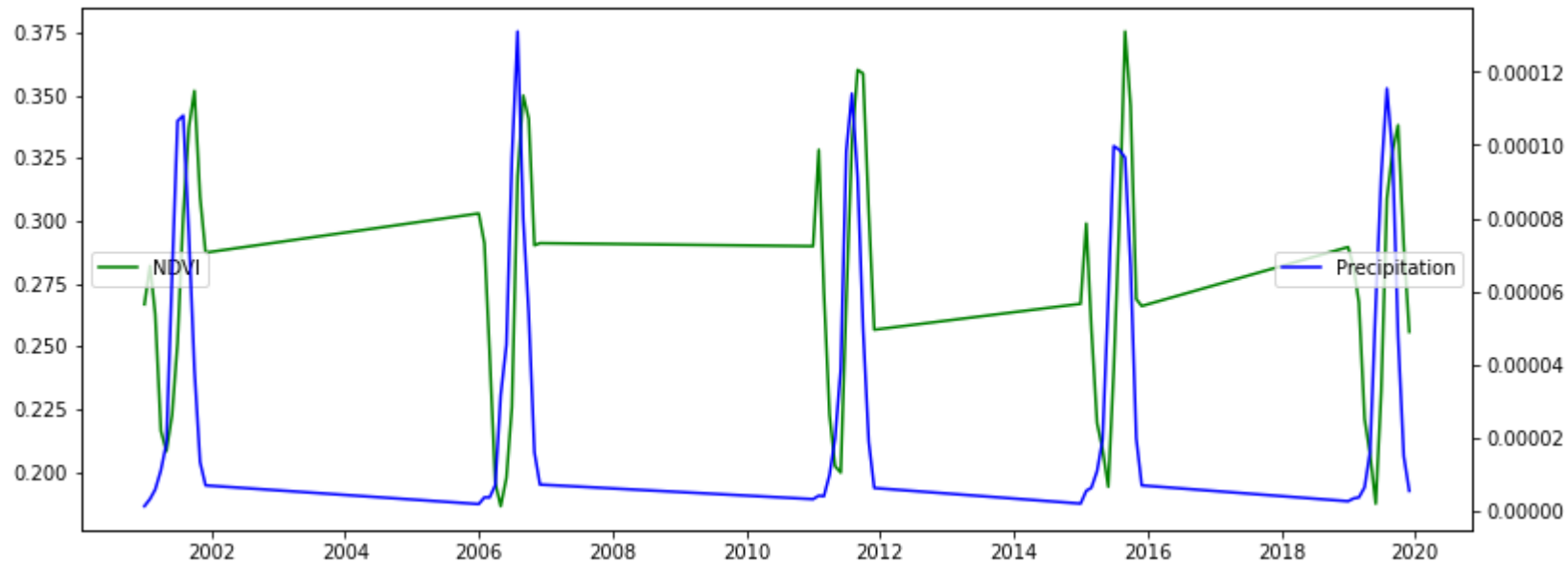
Multivariate Analysis

➢ Compare NDVI attribute with Precipitation attribute from NEX-GDDP dataset and Temperature attribute from MOD11A1.006 Terra Land Surface Temperature and Emissivity dataset.

➢ Use pearson correlation coefficient and Spearman's rank correlation coefficient to quantitatively understand the relation between Precipitation,Temperature and NDVI.

➢ Visualise this relation by plotting graphs.

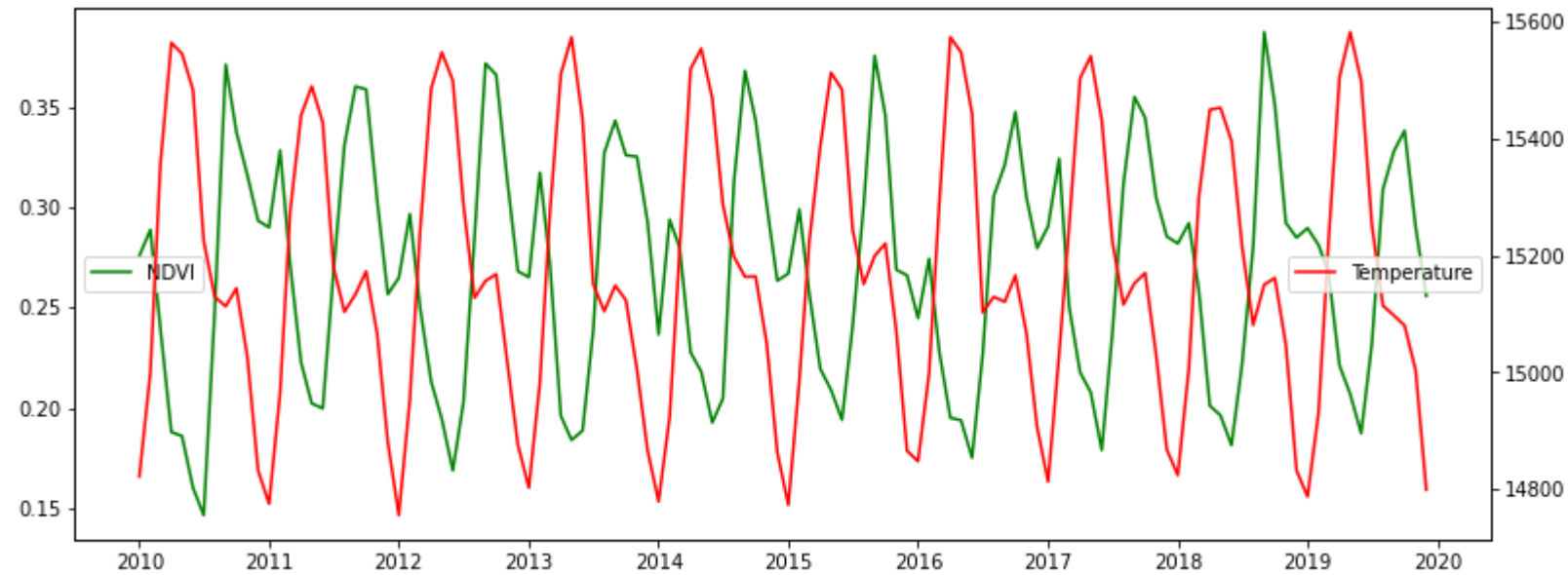Made by: Goutham P B180330CS

Datasets used for Multi variate Analysis
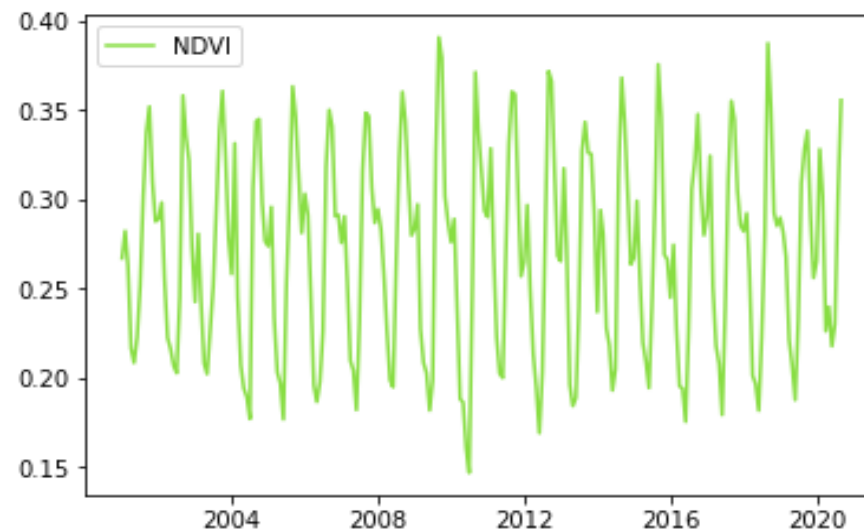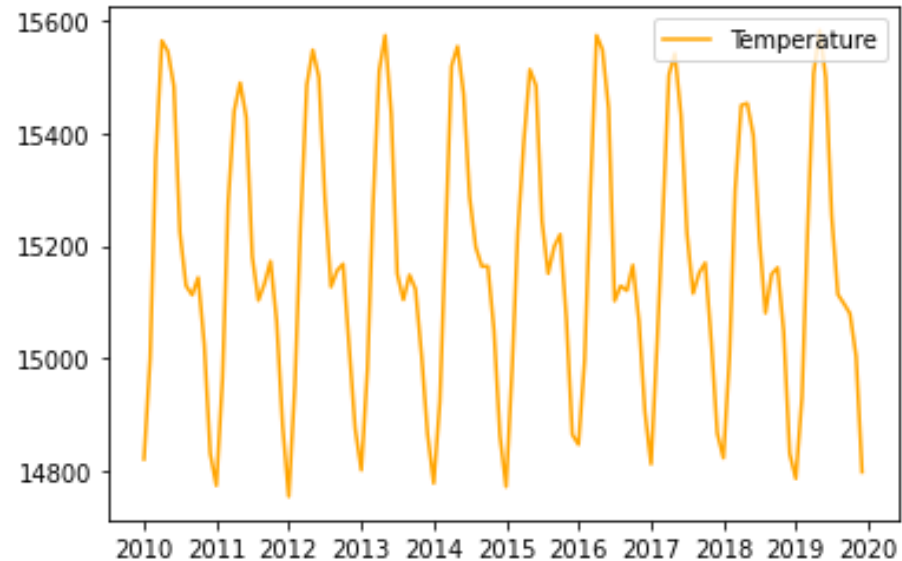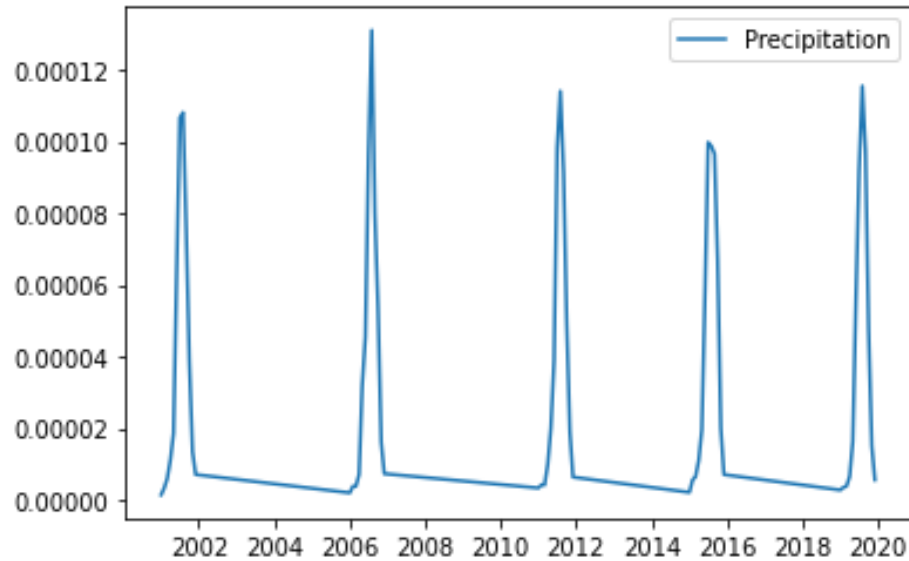
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Twin Plot between NDVI and Precipitation

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Twin Plot between NDVI and Temperature

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Seaborn Pair plot for all the three variables NDVI, Precipitation, Temperature

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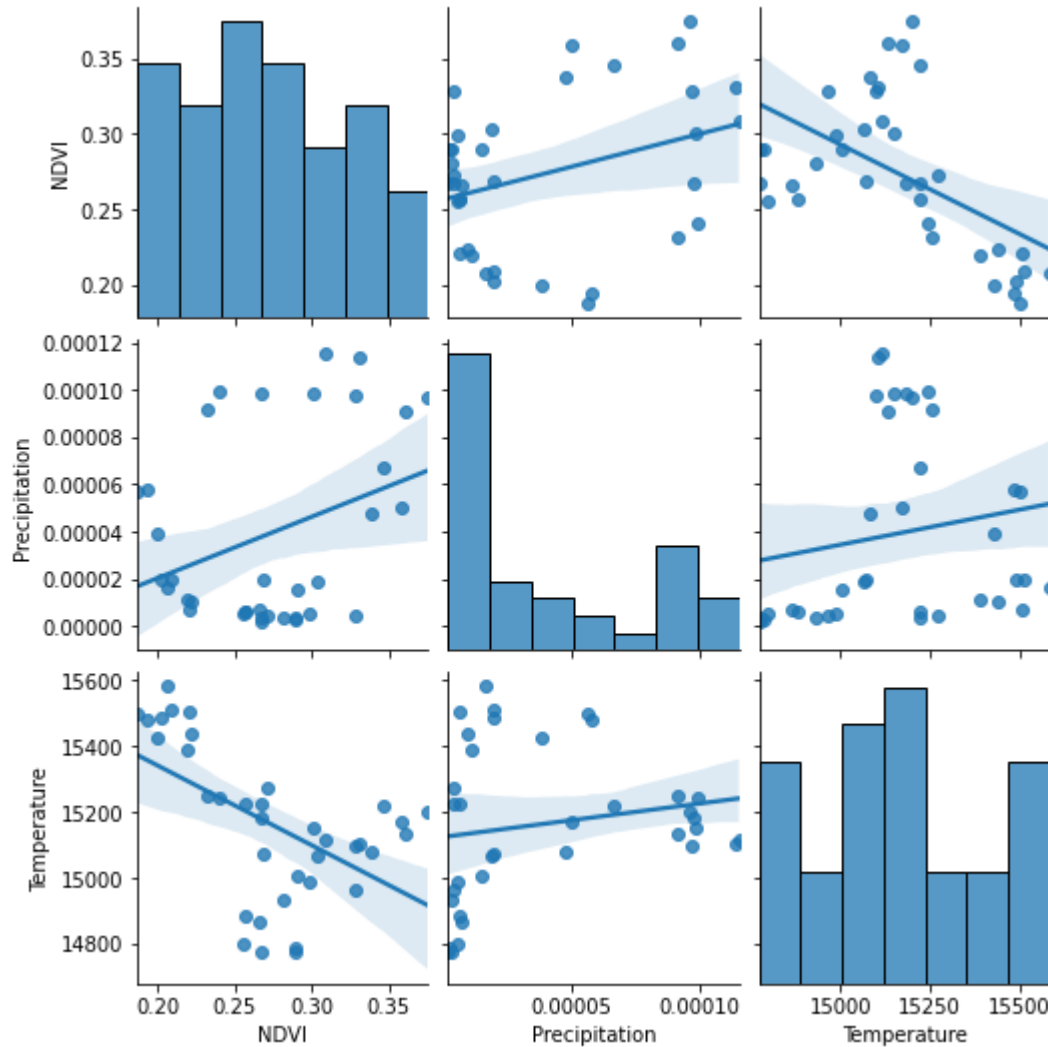
HeatMap showing the correlation between the three variables NDVI, Precipitation, Temperature
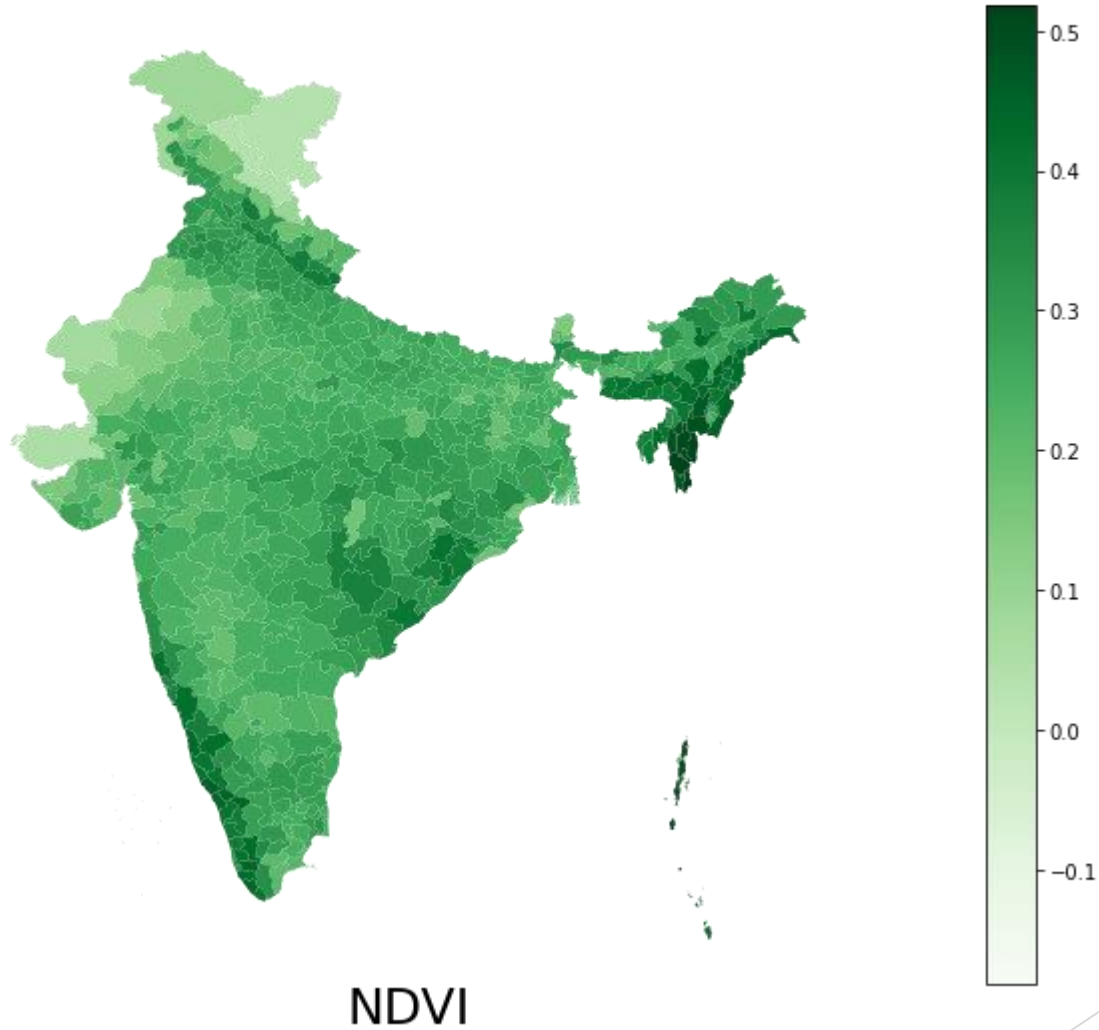

Made by: Goutham P B180330CS
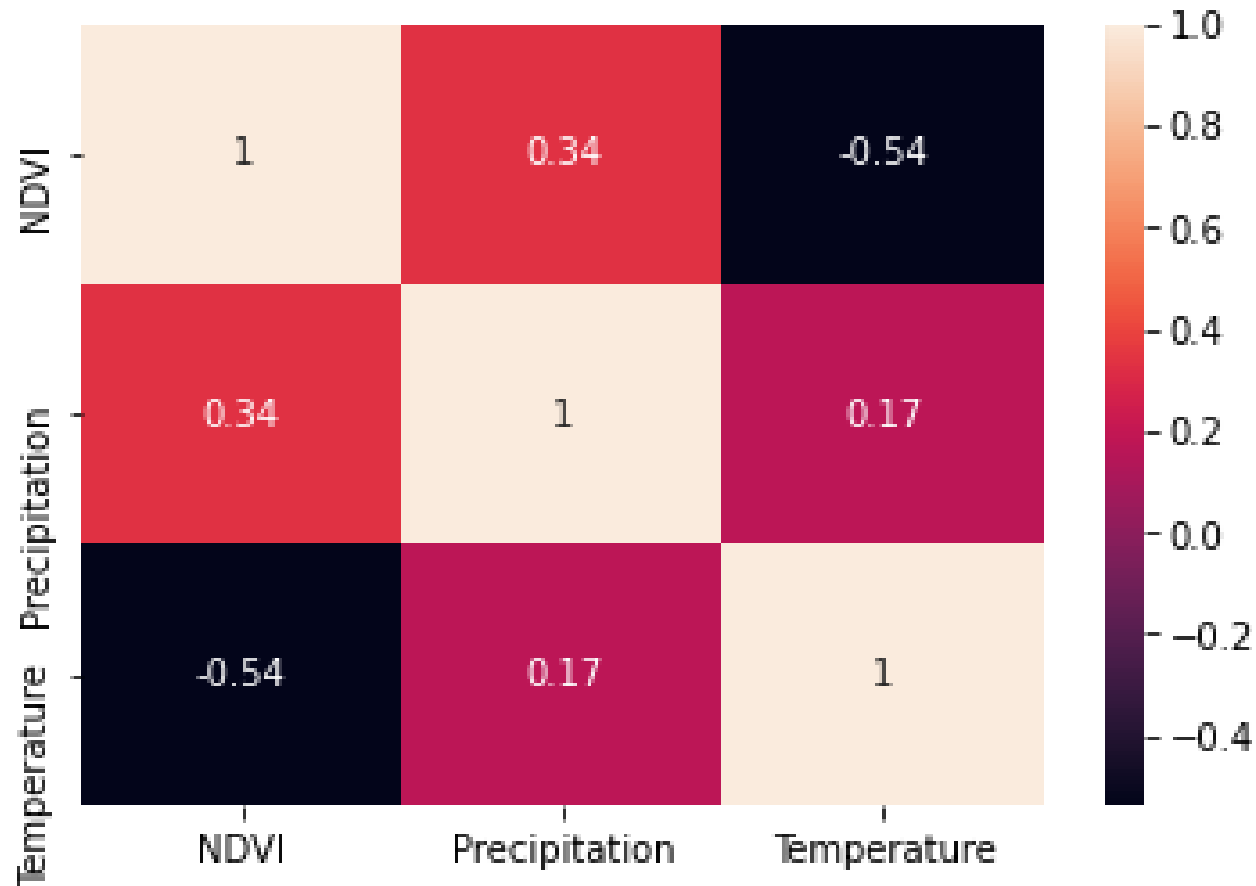
2001 India Shapefile
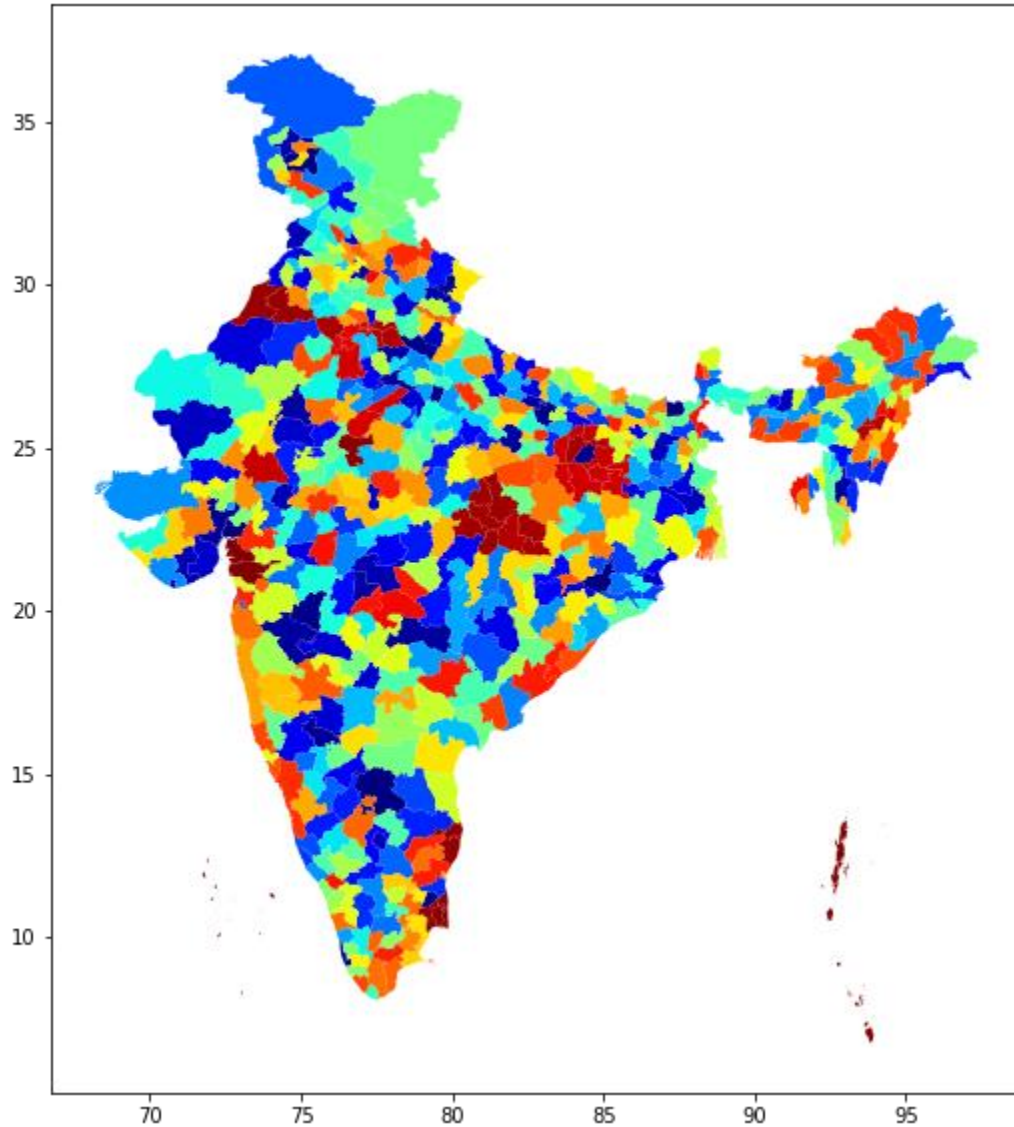
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Vegetation Cover of various districts

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Inference

❑ The correlation between NDVI and Precipitation is 0.34, which indicates that there is a very small positive correlation between them.

❑ NDVI and Precipitation correlation is 0.34,which is between 0 and 0.5, the there is a small correlation between them.

❑ The correlation between NDVI and Temperature is -0.54, which indicates the negative correlation between them. Thus NDVI value decreases with increase in Temperature value.

❑ NDVI and Temperature correlation is -0.54, which is <-0.5, thus there is a strong negative correlation between them.

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Conclusion

❑ Climate change is not a myth.

❑ Although the NDVI values for the past twenty years are consistently lying between 2.6 and 2.8 ,we can't rule out climate change from this.

❑ The mean temperature of the earth has increased by 1-2 degrees from 1880's to the present day. Although it might seem small, according to NASA a 5 degree drop in the global temperature can actually cause ice age.

❑ Thus the temperatures are increasing world wide, greenhouse gases are increasing everywhere, global warming is here. Add to this the increase in pollution in India, we have dangerous levels of PM2.5 in many major areas of our country, even in the national capital Delhi.

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Conclusion

❑ We have found that max temperature and NDVI have a strong negative correlation, hence in order to cope with this increasing pollution, global warming, one of the best and beneficial thing we can do is to increase our vegetation cover.

❑ Hence we should aim to see an increasing NDVI plot in the coming years, then only we can even think of reducing the climate change.

❑ Until that happens, climate change is a very scary reality that will haunt mankind in the days to come.

❑ Climate change is not a myth and the government needs to take measures to reduce it.

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THANK YOU