

IDS 476
BUSINESS FORECASTING USING TIME SERIES

TITLE : Global Temperature Change Prediction

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Global Temperature Change Prediction

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MOTIVATION

Global climate change has already had an evident effect on the environment. Glaciers have shrunk, ice on rivers and lakes is breaking up earlier, and trees are flowering sooner.

The effects of global climate change can now be felt such as loss of sea ice, accelerated sea level rise and longer, more intense heat waves and so on.

The rise in global warming is around 0.75C since the end of 19th century. It may sound like a small change, but scientific evidence suggests it is already leading to a range of impacts around the world.

The worrying factor is the significantly larger temperature rise (and associated changes in rainfall, snowfall, sea level and other phenomena) that scientists expect the world to go through in the coming decades and centuries.

Temperature plays an important role in shaping weather patterns, guiding the life cycle of various organisms and maintaining ocean levels. A shift in temperature can throw an entire ecosystem into chaos.

We, as an Analysts, can contribute to climate change and global warming by predicting future temperature changes and making others informed of the outcomes they will need to face. We have taken up this topic to dwell upon the rising concern of global warming and to gain insights from data that is available to us in the real world.

PROBLEM STATEMENT

To predict global temperatures by analyzing historical monthly city temperatures between 1750 and 2013.

GOALS AND TARGET VARIABLES

1. **Average Temperature**
Predicted temperature for a given city over a specified time period.
2. **Affected Cities**
The top 10 cities in the United States that will experience the most temperature change from 2013-2023
3. **Effect of Pollution**
Analyzing the correlation between pollution levels and temperature

DATA SOURCES

Temperature Data

[Climate Change: Earth Surface Temperature Data](#) from Kaggle

Pollution Data

[U.S. Pollution Data](#) from Kaggle

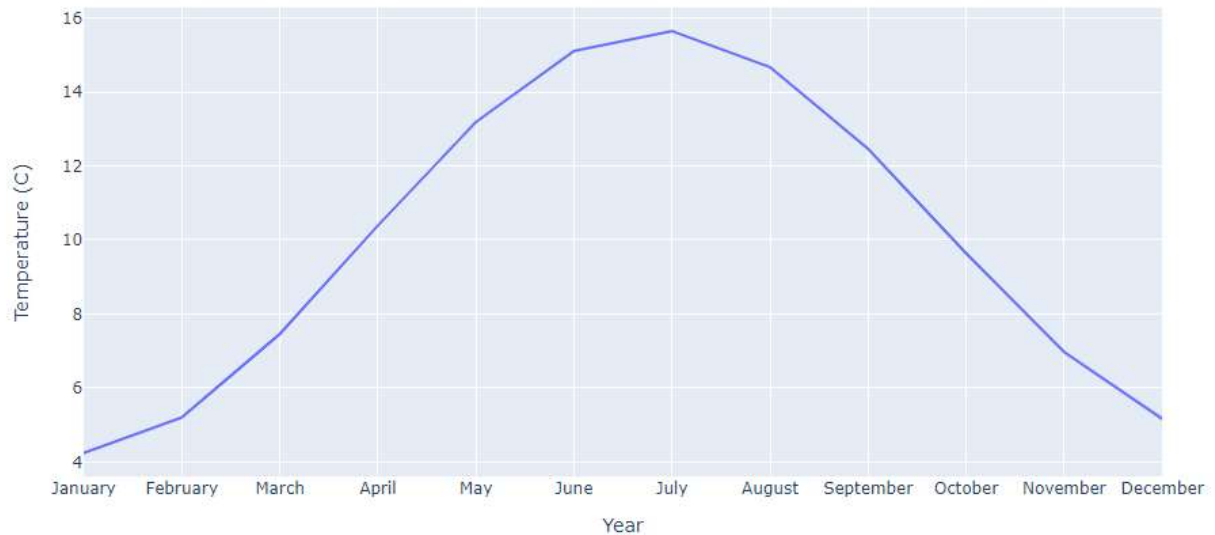
MODEL FOR FORECASTING

Since we have time series data, we have chosen to use an **ARIMA (AutoRegressive Integrated Moving Averages) model** for time series forecasting.

The process of estimating the best p , q parameters has been automated for the ARIMA model for any given time series data. The p, q values were chosen based on the pair that returned the lowest AIC (Akaike Information Criterion) values.

The model was used to successfully forecast the temperatures for a given city across a specified time period.

Predicted Temperatures for the Year 2023

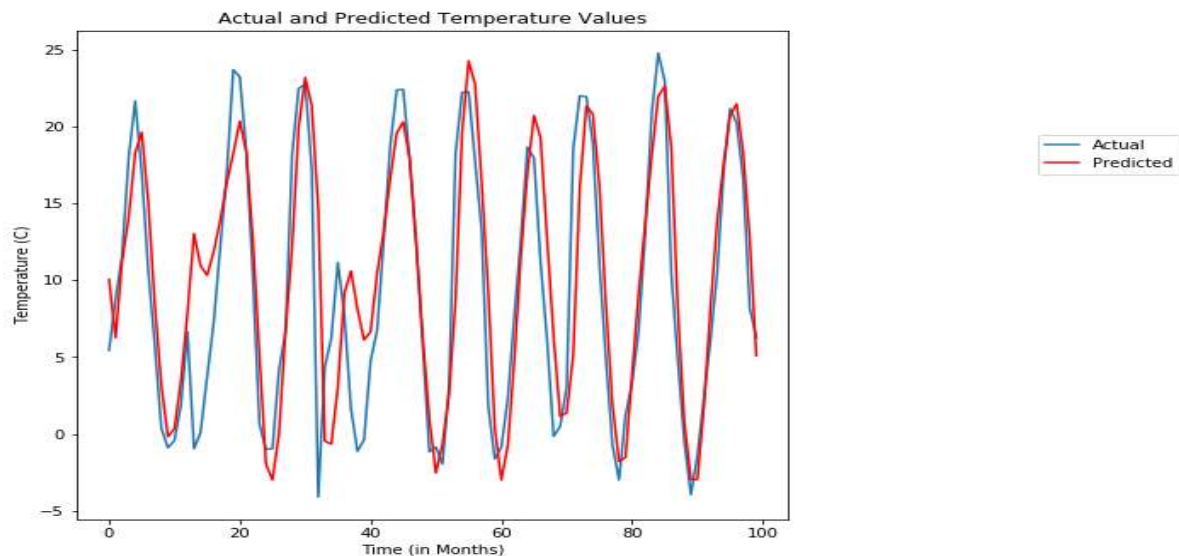


EVALUATION

We have used **Mean Squared Error (MSE)** and **Mean Absolute Error (MAE)** to evaluate the performance of the ARIMA model.

For Chicago, the ARIMA model achieved:

- Mean Squared Error: 6.22
- Mean Absolute Error: 1.93



ASSUMPTIONS / LIMITATIONS

The city-wise monthly temperature data had several missing values for certain cities. We chose to remove rows having missing values.

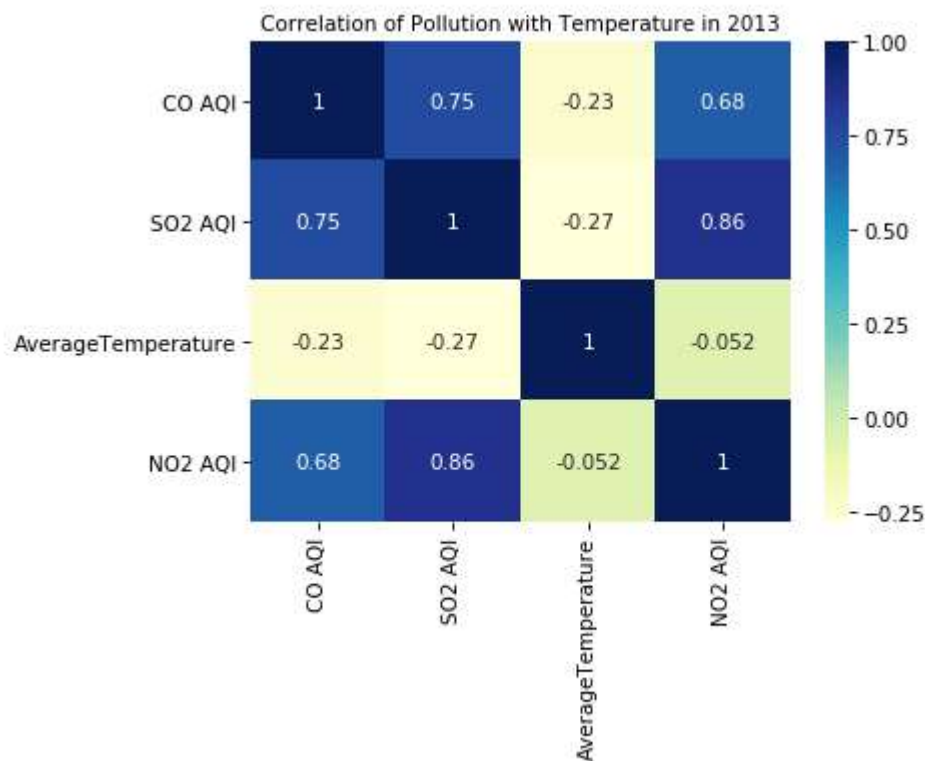
Also, we were not able to fully analyze the effect of Greenhouse gases on temperature change, due to the lack of data for gases like ozone (O3) and water vapor.

TOOLS / METHODOLOGIES / CONCEPTS INVOLVED

The root of our problem lies in **Time Series Forecasting**. We have used ACF and PACF plots, in combination with AIC values, to estimate the best p, q values for the ARIMA model and have forecasted the temperatures for cities over a given period of time.

We have used libraries including pandas, numpy, matplotlib, sklearn, and plotly

We have also analyzed the pairwise correlations between Pollution, and temperature change.



RESULTS

- We predicted the temperature of any given city across a specific time period.
- We also identified the top-10 cities in the US that are likely to experience the most temperature change.
- Additionally, we also analyzed the correlation between pollution levels and temperature, temperaturechange.
- Below are some of the visualizations which will help us with better understanding of our goals

Top 10 Cities with most Temperature Change in 10 Years
Hover for Details



Temperature and Pollution Plots

