Air Quality Predictions in Beijing, China

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Overview

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Background & Scope

- This project examines how air quality in Beijing, China is affected by
  - Time
  - Pollutants
  - Weather conditions

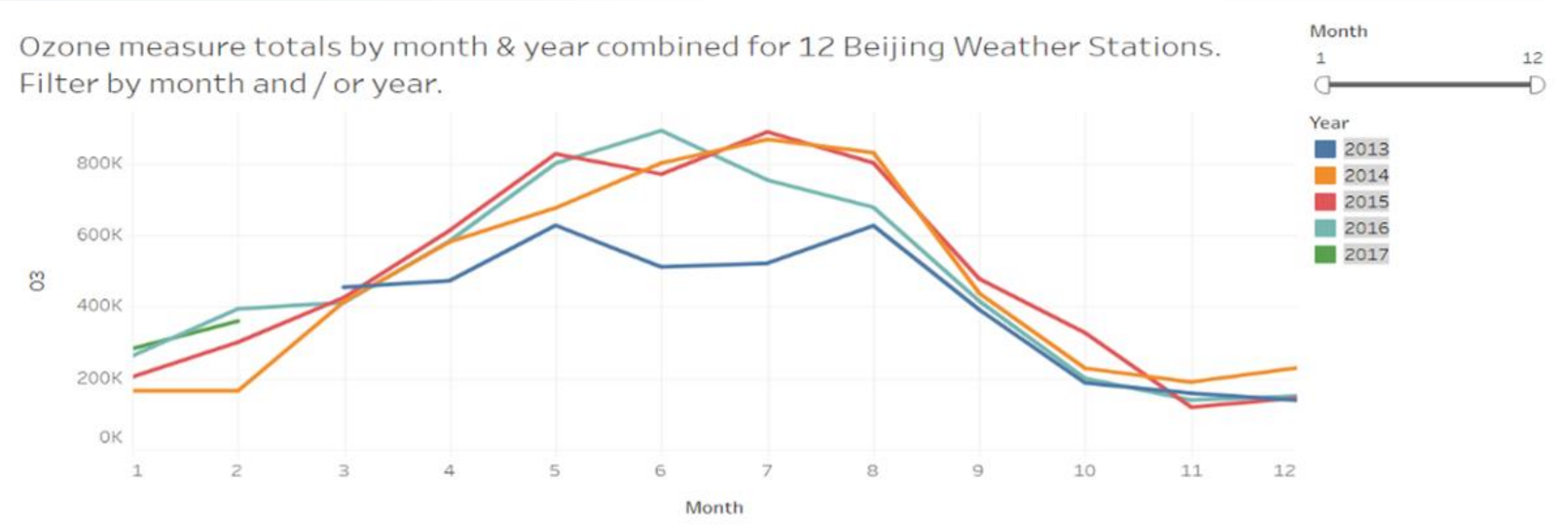
- Objectives:
  - Build models to predict the O_3 values

Data Preparation

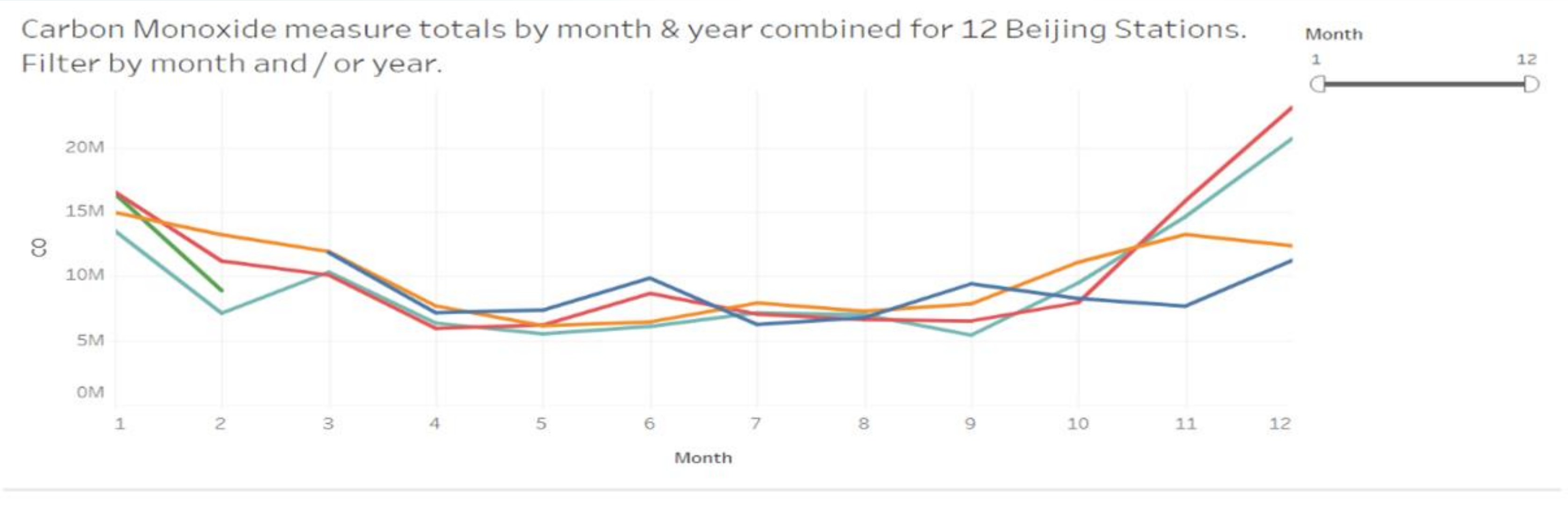
- Data gathered from UCI Machine Learning Repository
  - Includes data collected from 12 different sites in Beijing, China from 2013-2017
  - Includes different chemicals and weather conditions that affect the air quality

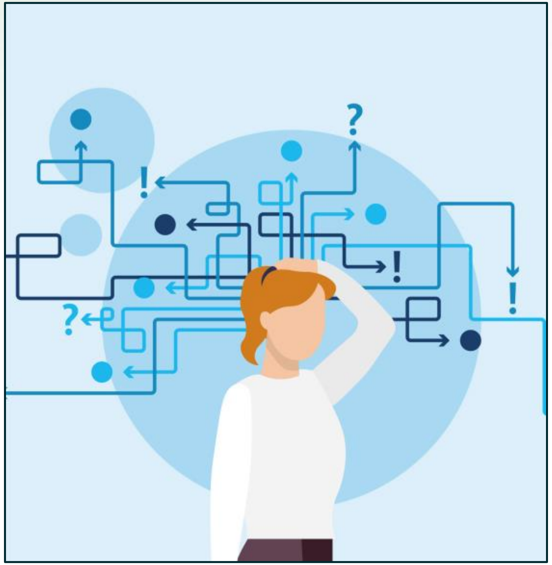
- Clean data is concatenated and put into S3 buckets
  - Data with NaN values dropped
  - Data with NaN values replaced with the median value for each station
  - Data with NaN values and station names dropped

Data Exploration (O_3)



Data Exploration (CO)





Modeling Implementation and Optimization

Models Used/Attempted

- Neural Network
- Simple Linear Regression
- Multivariable Linear Regression
- Decision Tree Regressor

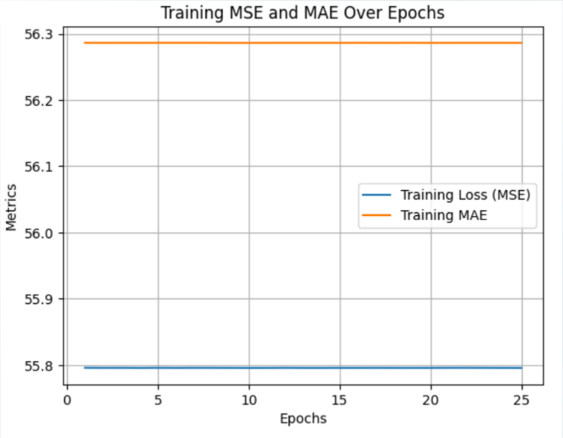
Neural Network

This model uses

- O_3 as the target variable (y)
- The rest of the columns of interest in the dataset as the predictor (X)
- Layers and nodes with different values to train the model

The results of this model are not statistically significant:

- Loss = ~55
- MSE = ~6500
- MAE = ~56



Linear Regression

Simple

- Target y = O_3, x = Temperature
- 1: NAN dropped

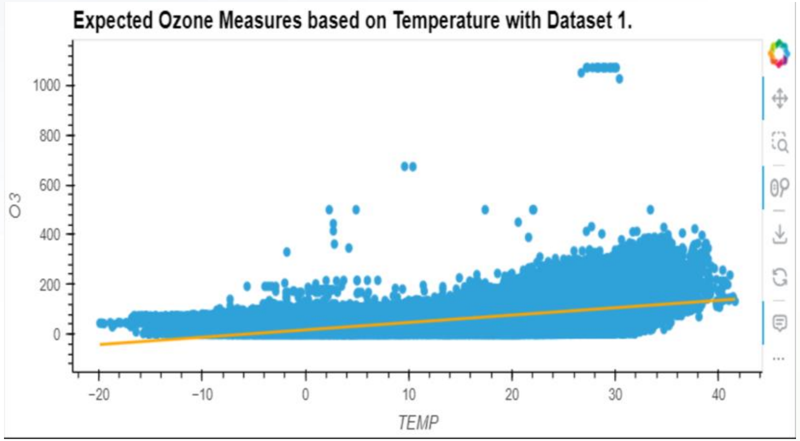
  `y= 17.31191562019925 + 2.963656055355665X`

  `r2 is 0.3565257008834236`

- 2: NAN median

  `y= 18.118847608324636 + 2.866120914930229X`

  `r2 is 0.34434693063035227`



Multivariable

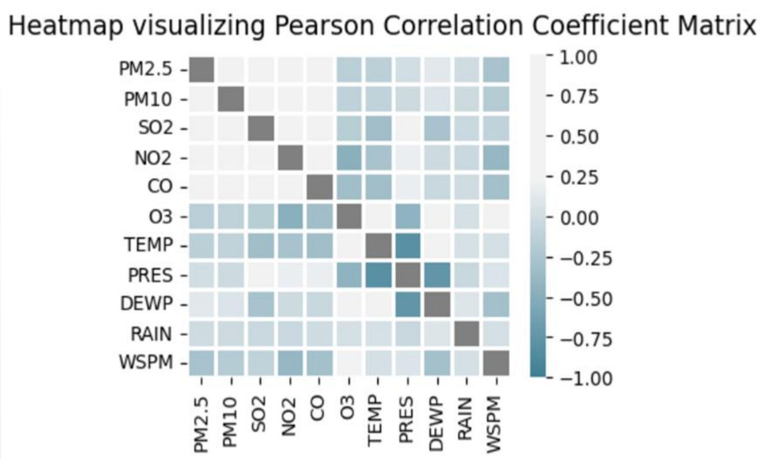
- Model 1: y = O_3

  `r2 is 0.5724457157382516`

- Model 2: y = CO

  `r2 is 0.723158568713435`

- Correlation coefficient of the variables



Decision Tree Regressor

- Variables:
  - Date info (year, month, day, hour)
  - Other pollutants(NO_2, SO_2, etc.)
  - Weather conditions (temp, rain, wind speed, etc.)
- Ozone was best predicted by date
- R-Squared value of 0.87

```
#Previously attempted data inputs and their associated R-squared (R2) values.

#air_data_df.drop(["wd"],axis=1,inplace=True)
    #(R2 = 0.83) --> ran model with all columns containing numerical values

#air_data_df.drop(["wd","year","month","day","hour",,axis=1,inplace=True)
    #(R2 = 0.67) --> evaluated chemical compounds and weather variables as prec

#air_data_df.drop(["wd","year","month","day","hour","PM2.5","PM10","SO2","NO2",
    #(R2 =0.63) --> evaluated weather variables as predictor of O3

#air_data_df.drop(["wd","TEMP","PRES","DEWP","RAIN","WSPM","year","month","day"
    #(R2 = 0.03) --> evaluated other chemical compounds as predictor of O3

#air_data_df.drop(["wd","PM2.5","PM10","SO2","NO2","CO","PRES","DEWP","RAIN","W
    #(R2 = 0.84) --> evaluated date and temperature as predictor of ozone

##Attempt to see if calculating relative humidity optimizes model --> R2 = 0.82
  #formula obtained from https://bmcnoldy.earth.miami.edu/Humidity.html retriev
```

Results / Conclusions

O_3 varies across time

O3 values are affected by the months and show a similar trend across years

Weather Impacts

Temperature has a weak correlation with O_3 & CO

Chemicals are correlated

O_3 & CO presented a weak correlation with pollutants present in the air

Decision Tree: Best model

Decision tree was the best predictor of O_3

Next Steps

- Explore how well models can predict values for other compounds
- Modify parameters
- Seasonal time series analysis

THANK YOU!

Thank you to Hunter, Sam, Randy, tutors, and our amazing classmates for all of their help on this project and over the course of the semester!

Slides: https://slidesgo.com/theme/air-quality-index-analysis-aqi#search-air&position-15&results-23&rs=search