CO_2 Emissions: Will we meet our goals?

Module 4 Project: Time Series Analysis

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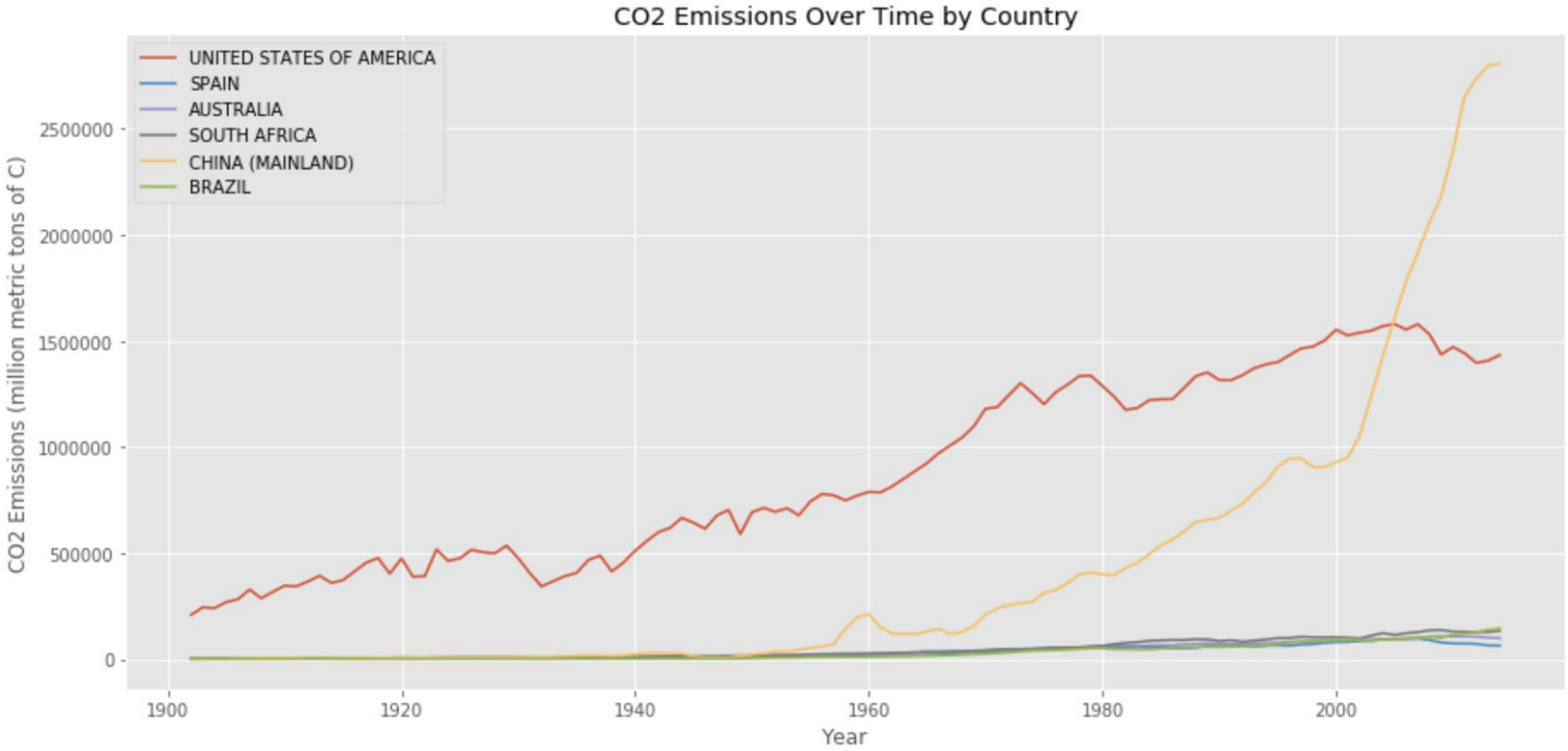
Analysis Introduction

- How are CO_2 emissions from different countries across the world trending towards the future?
- Will we meet our Paris Climate Agreement goals?
  - 40% reduction of 1990 CO_2 emissions levels by 2030
- Study aimed towards governments and policymakers to inform policy decisions regarding climate change.
- South Africa will be used as a case study in this presentation.

Data Sources

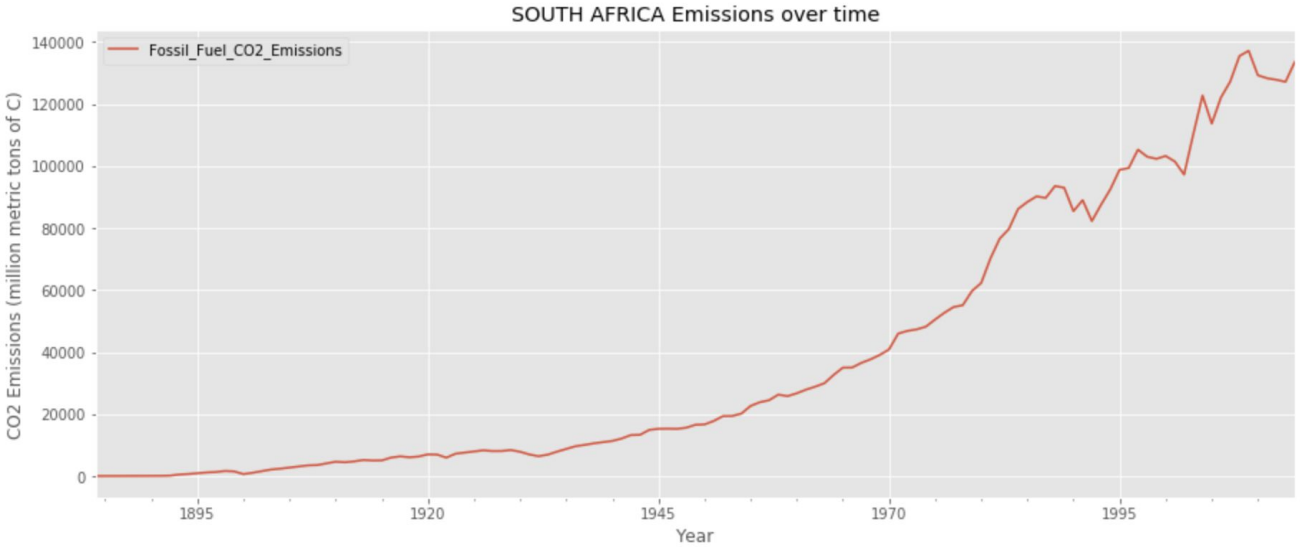
- The CO_2 emissions data by country comes from the Carbon Dioxide Information Analysis Center.
- Yearly data for 1902 - 2014.
- Time series analysis utilizes only the total CO_2 emissions.

Initial Time Series Visualization – Select Countries



Initial Time Series Visualization – South Africa

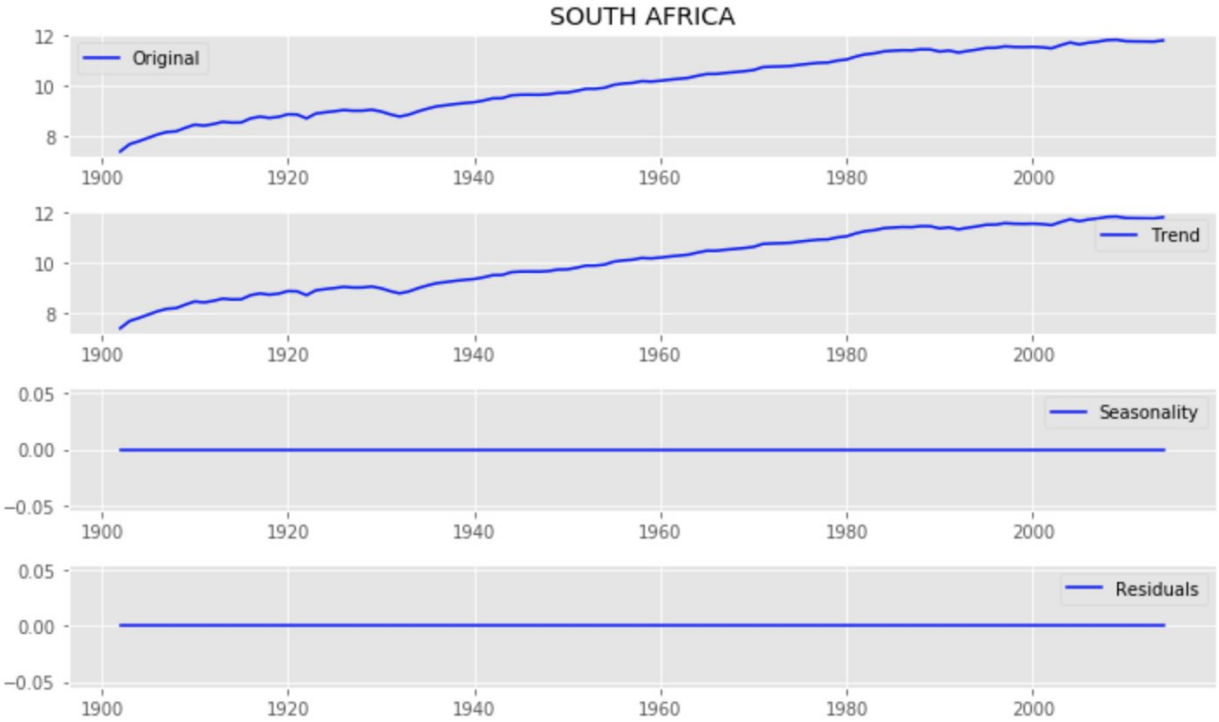
- Upward trend – roughly exponential
- Little to no seasonality present



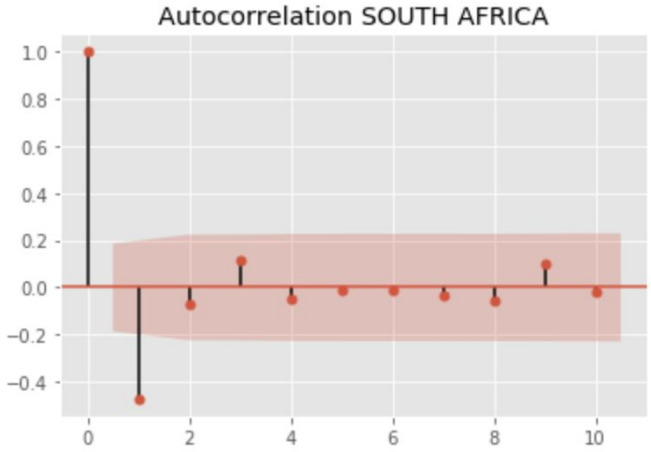
- Case Study - South Africa:
  - 25th most populous country
  - Classified as a developing country
  - 0.7 on Human Development Index (USA is 0.92)

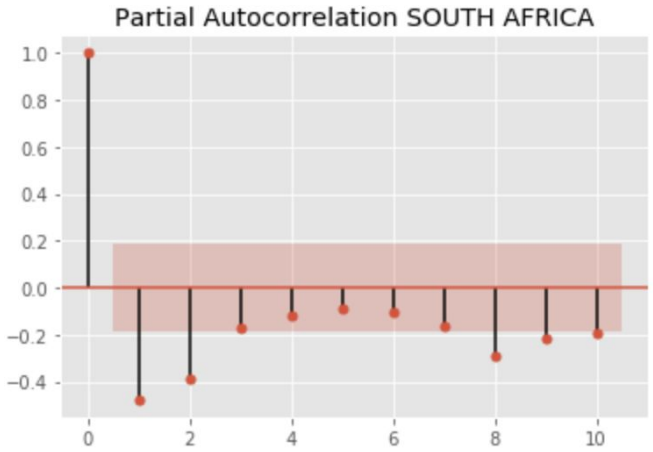
Decomposition - South Africa

- This time series is based entirely on trend.
- No seasonality implies that predictions into the future will not reflect any seasonality.



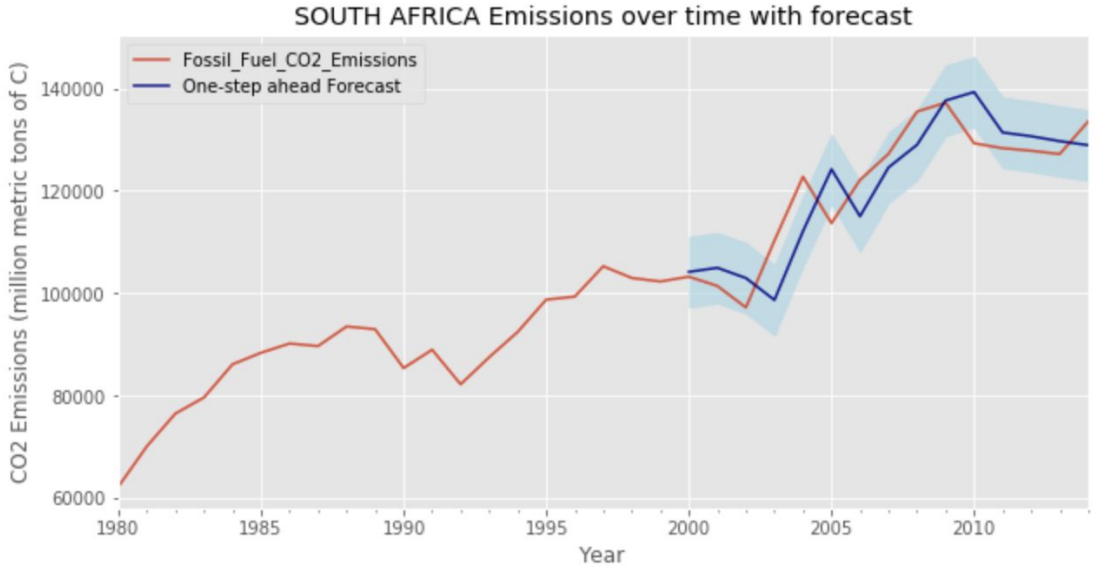
Determining AR and MA terms – South Africa





- The Autocorrelation and Partial Autocorrelation plots inform us of the Autoregressive (AR) and Moving Average (MA) terms needed for the ARIMA model.
- AR: Determined by Partial Autocorrelation → 2
- MA: Determined by Autocorrelation → 1
- Time Series has been 2nd Order differenced.

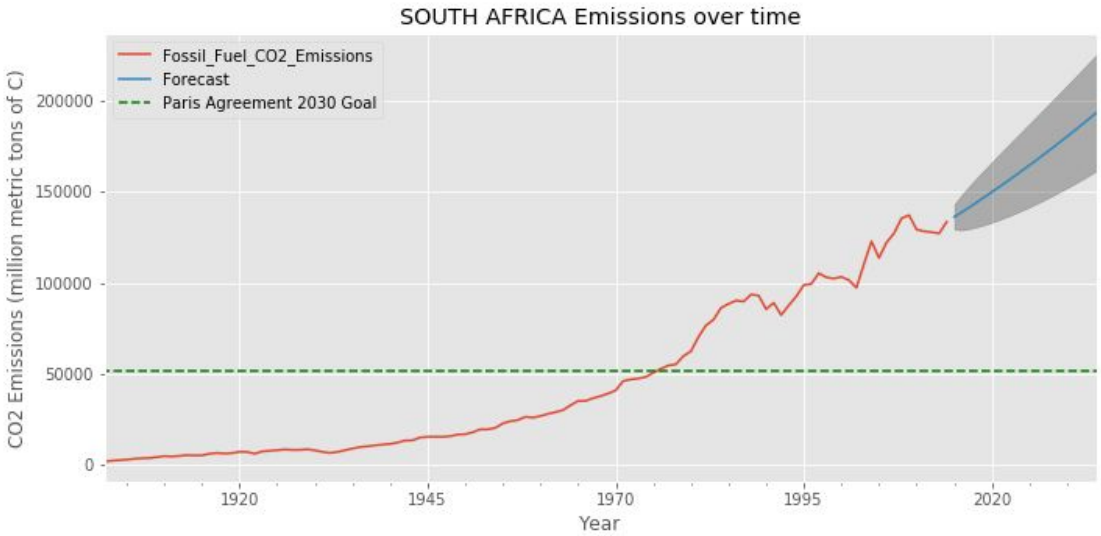
Fitting an ARIMA Model - South Africa



ARIMA Model predictions perform well against validation data (2000 - 2014)

- ARIMA model fit with parameters found from autocorrelation plots.
- AIC score of 2077.632
- Auto-ARIMA confirms this is the best model for South Africa's CO_2 emissions.

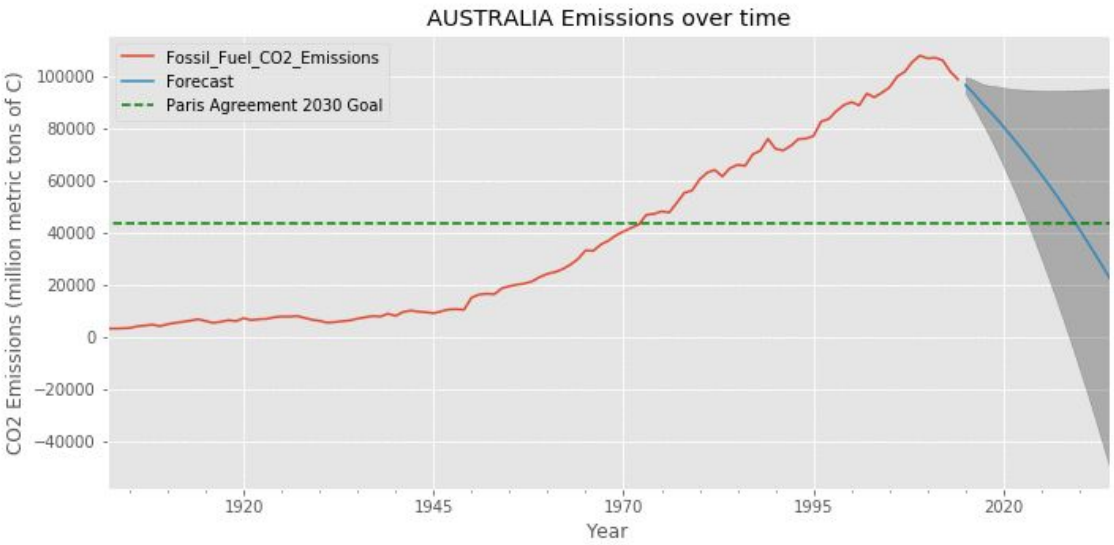
Forecasting CO_2 Emissions – South Africa



Paris Climate Agreement goal is far below the CO_2 emissions forecast for South Africa.

- Forecast for South Africa shows a continuing upward trend in CO_2 emissions.
- Action will need to be taken to decrease emissions in order to meet the Paris Climate Agreement goal.
- Status quo will not work.

Conclusions



Many countries will struggle to meet their Paris Climate Agreement goals for CO_2 emissions given the current trends.

- Governments and policymakers for many countries should take drastic action regarding climate change and emissions in order to meet international goals.
- Continuing the current trends will not work for most countries as shown by the ARIMA Time Series models.

Thank You