



CO₂ Emissions: Will we meet our goals?

Module 4 Project: Time Series Analysis
Ben Geissel



Analysis Introduction

- How are CO₂ emissions from different countries across the world trending towards the future?
- Will we meet our Paris Climate Agreement goals?
 - 40% reduction of 1990 CO₂ 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.

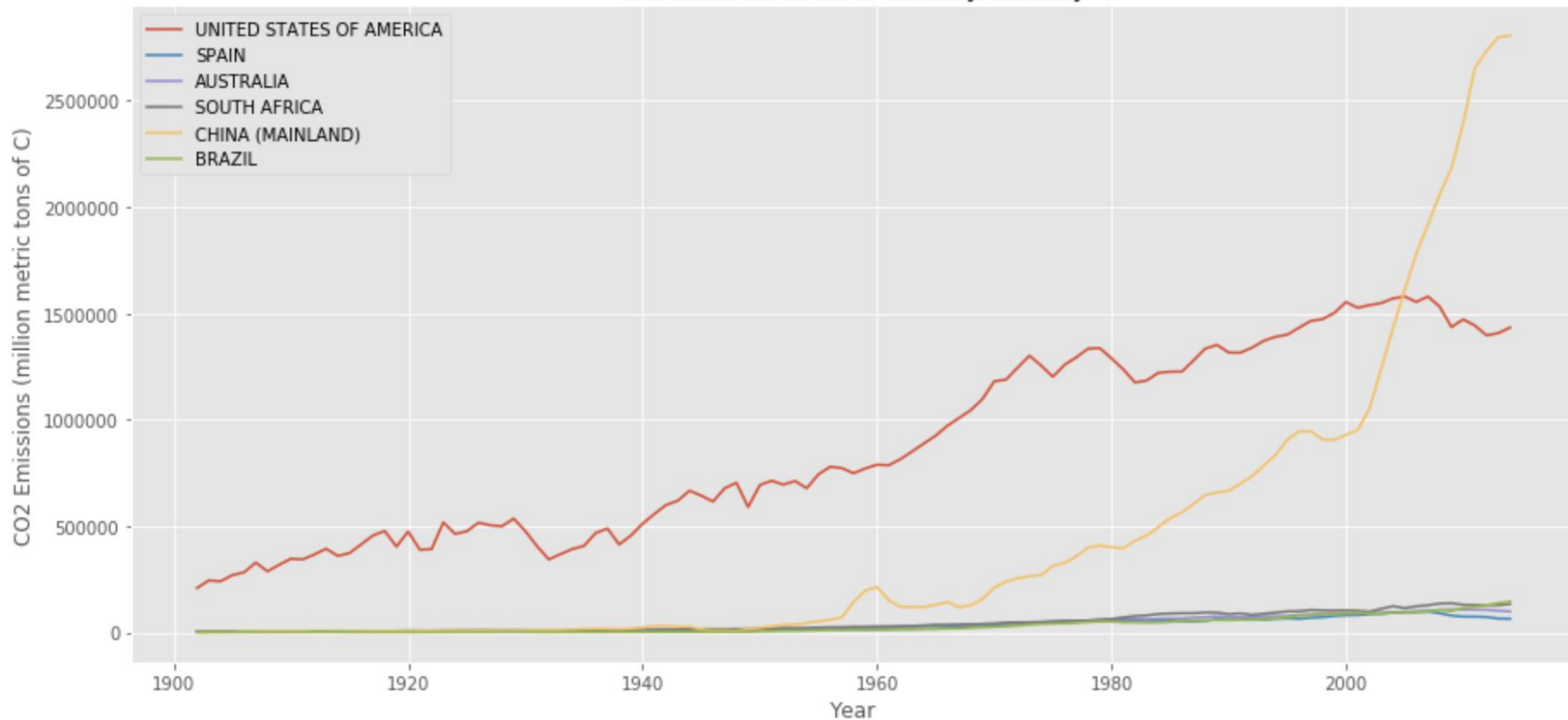


Data Sources

- The CO₂ emissions data by country comes from the Carbon Dioxide Information Analysis Center.
- Yearly data for 1902 - 2014.
- Time series analysis utilizes only the total CO₂ emissions.

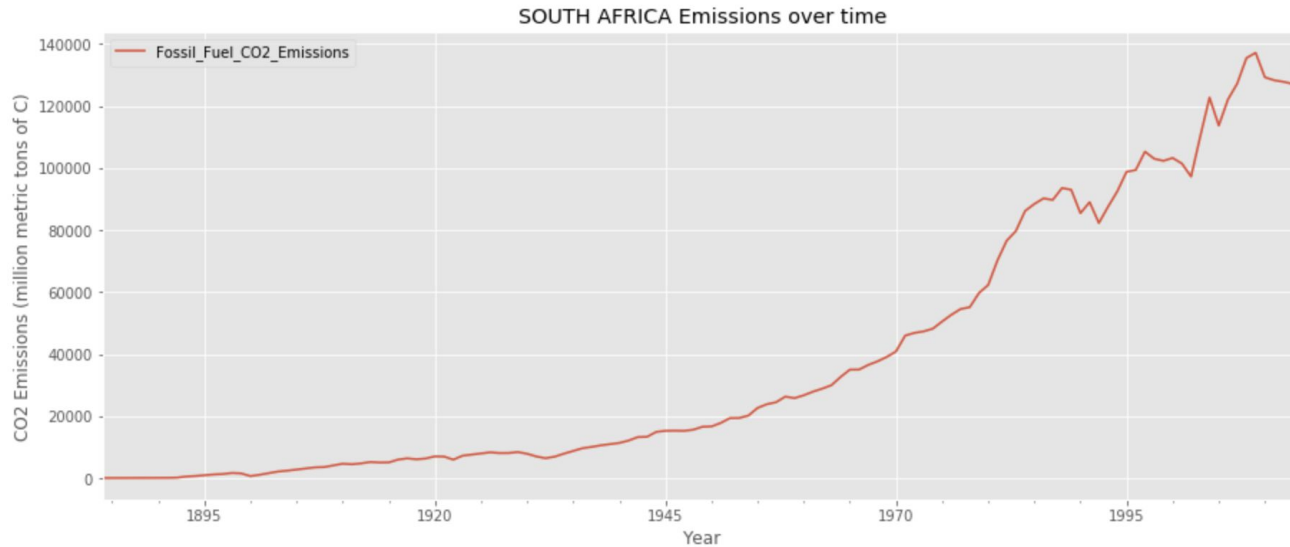
Initial Time Series Visualization – Select Countries

CO2 Emissions Over Time by Country



Initial Time Series Visualization – South Africa

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

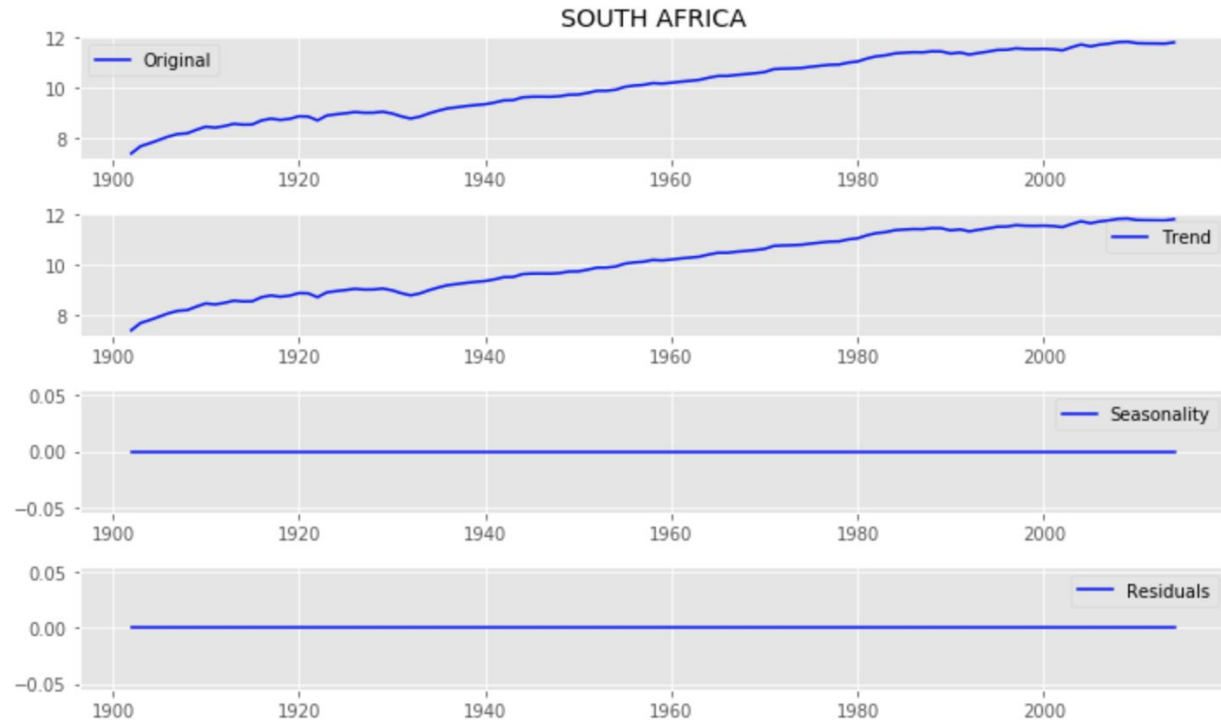


Case Study – South Africa:

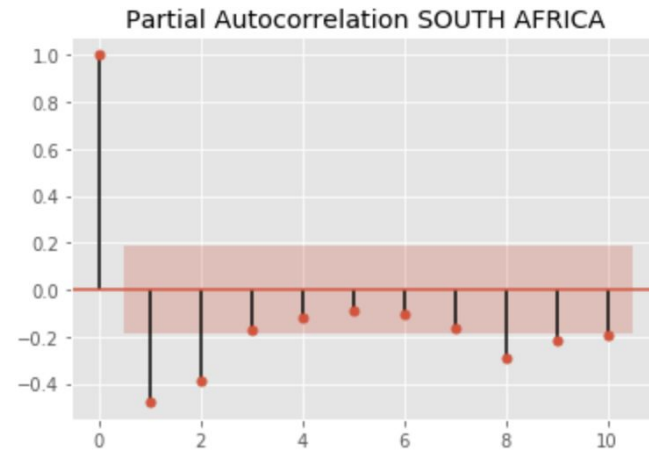
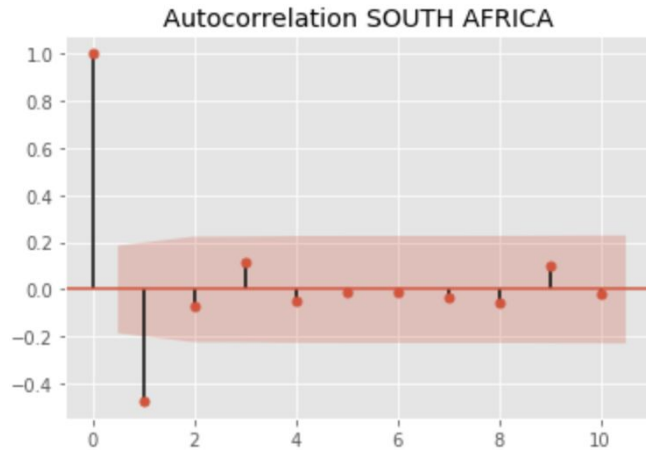
- 25th most populous country
- Classified as a developing country
- 0.7 on Human Development Index (USA is 0.92)

Decomposition – South Africa

- This time series is based entirely on trend.
- No seasonality implies that predictions into the future will be linear trend lines.

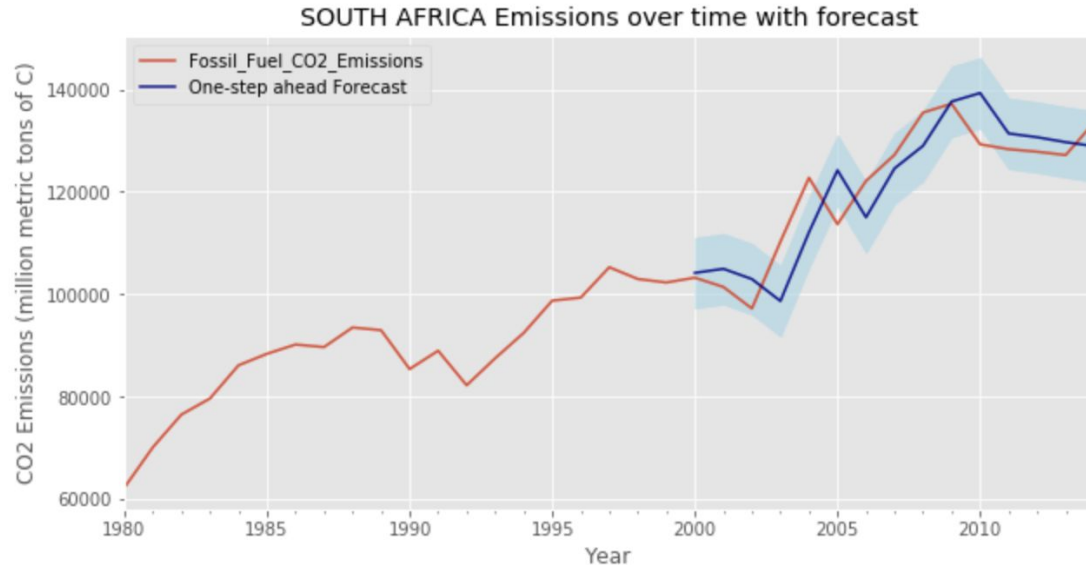


Determining AR and MA terms – South Africa



- 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.

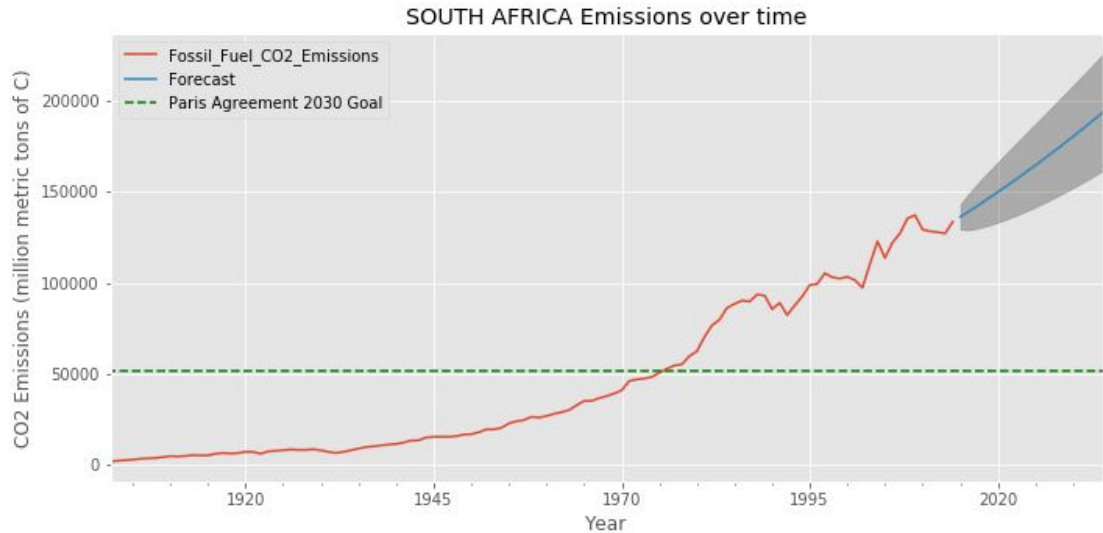
Fitting an ARIMA Model – South Africa



- ARIMA model fit with parameters found from autocorrelation plots.
- AIC score of 2077.632
- Auto-ARIMA confirms this is the best model for South Africa's CO₂ emissions.

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

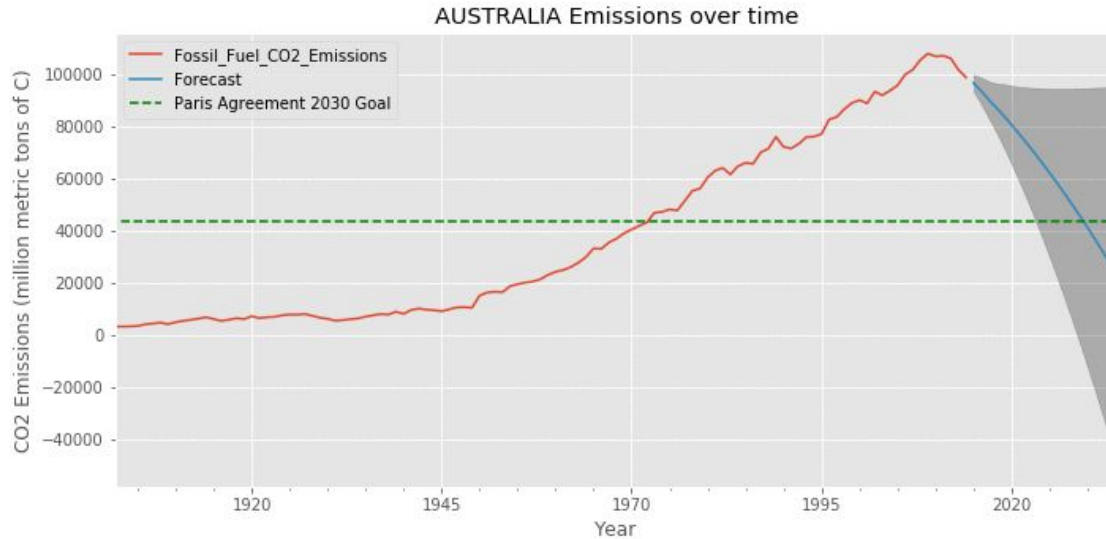
Forecasting CO₂ Emissions – South Africa



Paris Climate Agreement goal is far below the CO₂ emissions forecast for South Africa.

- Forecast for South Africa shows a continuing upward trend in CO₂ 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 CO₂ 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