

CO₂ Emissions: Will we meet our goals?

Module 4 Project: Time Series Analysis Ben Geissel



Analysis Introduction

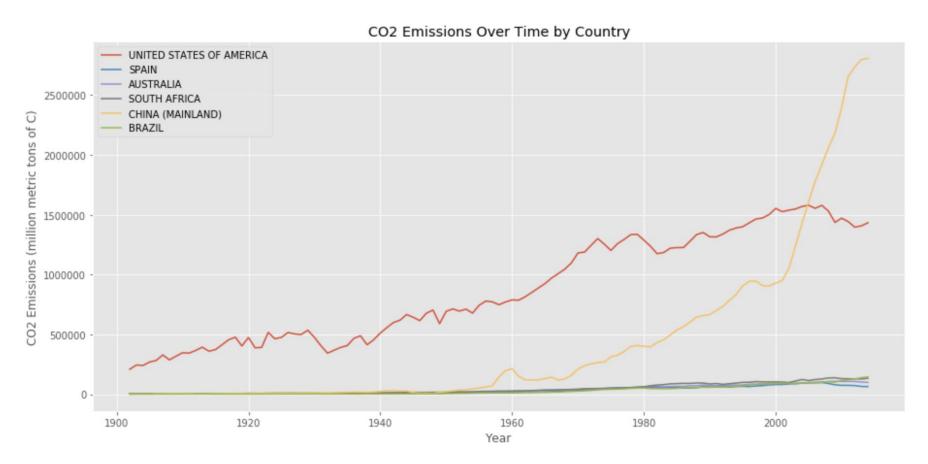
- How are CO₂ emissions from different countries across the world trending towards the future?
- Will we meet our Paris Climate Agreement goals?
 - 40% reduction of 1990 CO₂ emissions levels by 2030
- Study aimed towards governments and policymakers to inform policy decisions regarding climate change.
- South Africa will be used as a case study in this presentation.



Data Sources

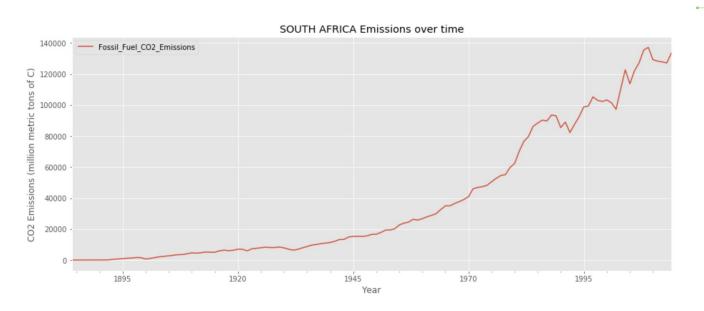
- The CO₂ emissions data by country comes from the Carbon Dioxide Information Analysis Center.
- Yearly data for 1902 2014.
- Time series analysis utilizes only the total CO₂ emissions.

Initial Time Series Visualization - Select Countries



Initial Time Series Visualization - South Africa

- Upward trend roughly exponential
- Little to no seasonality present

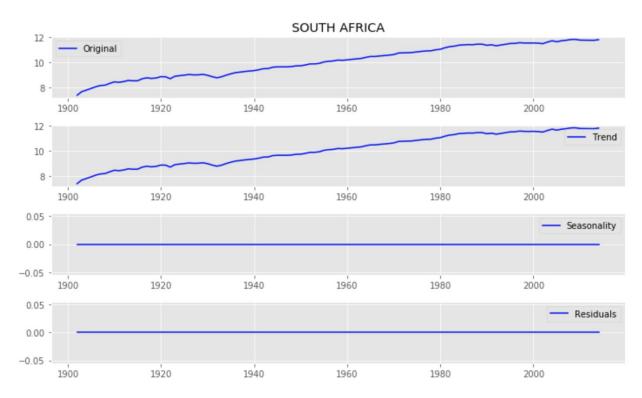


Case Study - South Africa:

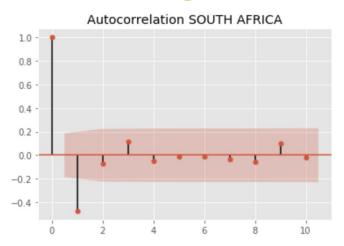
- 25th most populous country
- Classified as a developing country
- 0.7 on Human
 Development
 Index (USA is
 0.92)

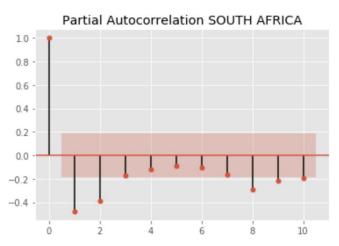
Decomposition - South Africa

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



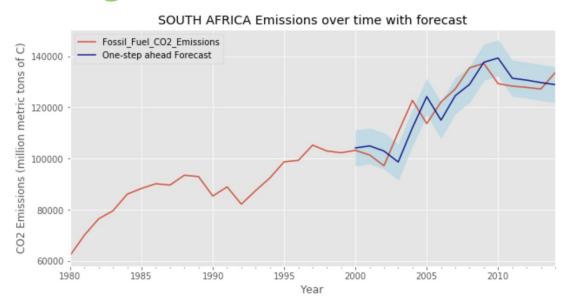
Determining AR and MA terms - South Africa





- 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 $\rightarrow 2$
- MA: Determined by Autocorrelation → 1
- Time Series has been 2nd Order differenced.

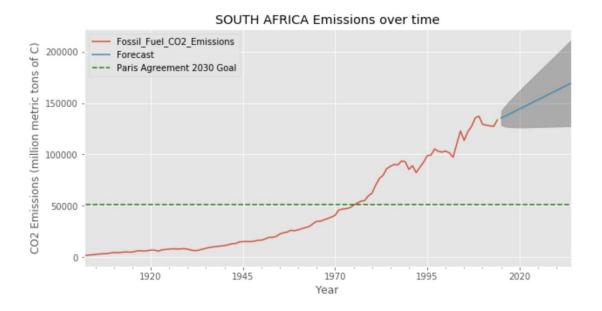
Fitting an ARIMA Model - South Africa



- 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)

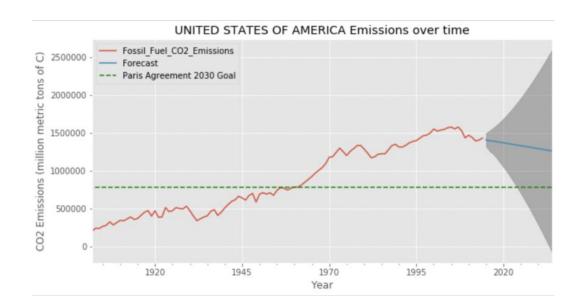
Forecasting CO₂ Emissions - South Africa



Paris Climate Agreement goal is far below the ${\rm CO_2}$ 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 ${\rm CO_2}$ emissions given the current trends.

- 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