Danmarks Tekniske Universitet

DTU

42578 Advanced Business Analytics

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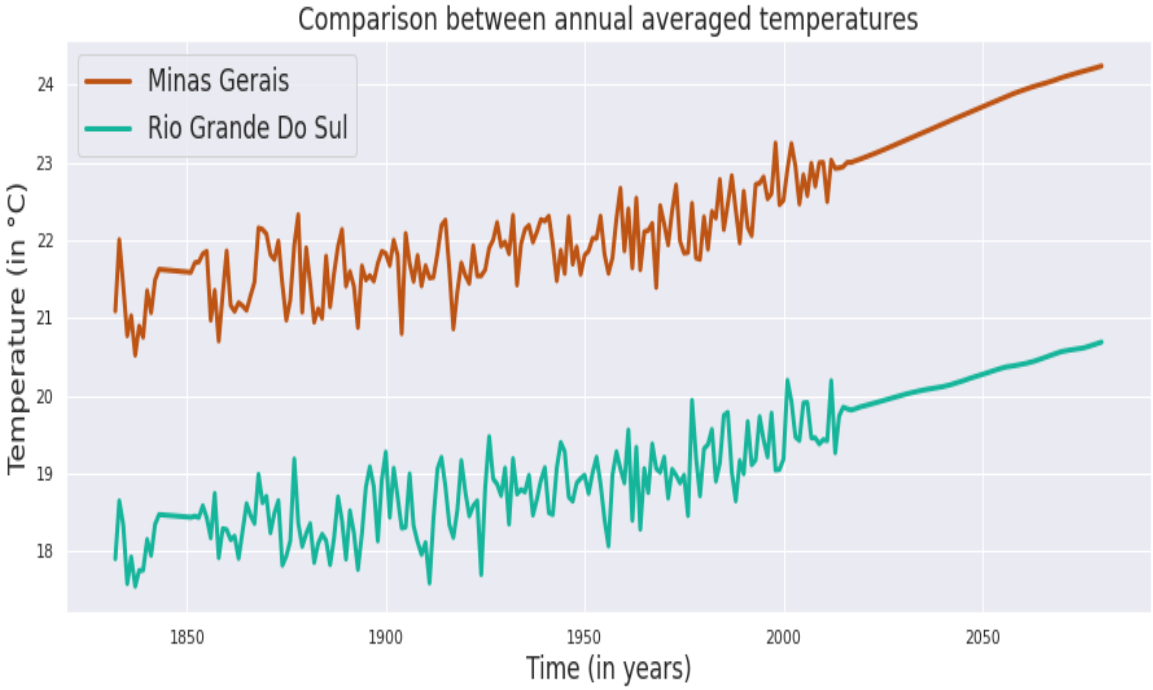
Executive Summary

1 Problem Statement

Climate change has impacted the coffee production in Brazil, the world's largest coffee producer. *Arabica*, the most popular variety of coffee, is under the risk of declining yield and quality due to global changes in temperature. Temperatures between 18°C and 22°C is the ideal climatic condition for *arabica* coffee production. Agricultural areas with average annual temperature above 24 °C are found to be unsuitable for *Arabica* production.

2 Analysis and Prediction

We analyzed the historical data of average monthly temperatures of two of the states in Brazil - Minas Gerais and Rio Grande Do Sul. The former being responsible for nearly 50% of the country's coffee output, 75% of which is *arabica*, and the latter being a state with rich agricultural potential. Our analysis was built using a seasonal ARIMA model, and finally a stacked LSTM model, which we used to forecast the mean annual temperatures upto the year 2080.



The mean annual temperature of Minas Gerais is expected to exceed 24°C in 2065. The average yearly increase in temperature is $\sim$ 0.02°C. On the other hand, the mean annual

temperature in Rio Grande Do Sul is only expected to hit about 20.5°C in 2065 with a yearly average increase of ~ 0.014°C.

3 Solution

The Brazilian coffee sector could adapt to rising temperatures by migrating to extreme south of the country such as Rio Grande Do Sol. With rich agricultural land and low climate risk, Rio Grande Do Sul is a potential candidate for a shift in agricultural investments pertaining to *arabica* coffee production. An increase in temperature leads to the proliferation of pests, so the use of more resistant species such as Roast coffee should be encouraged in high climate risk areas such as Minas Gerais. *Robusta* coffee, albeit not as popular, is more robust to climate change and pests, requiring about 24-30°C, and could be grown in Minas Gerais instead.

4 Conclusion

Our results provide useful information for the targeting of agricultural policies and climate planning. To prepare for climate change in coffee production regions, focus should be given to Minas Gerais where majority of production occurs. Improved coffee varieties, agricultural loans for irrigation might enable coffee farmers to improve their yield under climate hazards. Similar analyses can be carried out to identify low climate risk regions for other crops, and the impacts on the global agricultural economy.