UPenn Bootcamp
Group 5 - Project 1

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Project Objective:

Study the relationship between the effect of global warming to the earth's surface temperatures by displaying historical surface temperature data. We hope to gain insights into whether temperatures have risen in a particular area of the world or at scale due to the rise in CO2 emissions.

Research Questions

Question 1

The current growth of global land temperatures - How has surface temperatures increased in the last 100 years by country?

Question 2

Correlate CO2 emissions by country to surface temperatures - do CO2 emissions increase surface temperatures?

Data References

Berkeley Earth - Surface Temperatures

CO2 Emissions - OurWorldInData

Population - The World Bank

GeoCode - Google Public Data

Data Analysis Process

Data Load

- Download data sources
- Load csv into dataframes to be used to transform/cleanse

Data Transformation

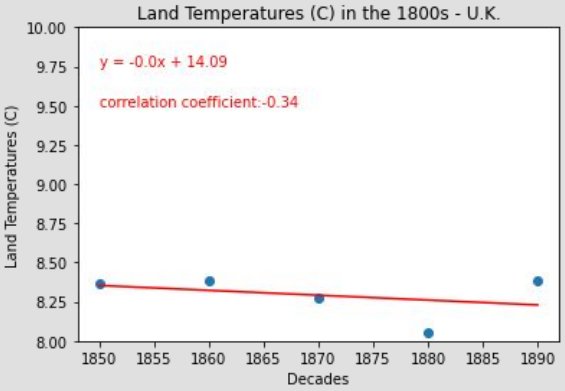
- Review CSVs and removed unnecessary columns.
- Rename columns appropriately
- Transform rows and take mean over decades
- Merge dataframes to a singular dataframe

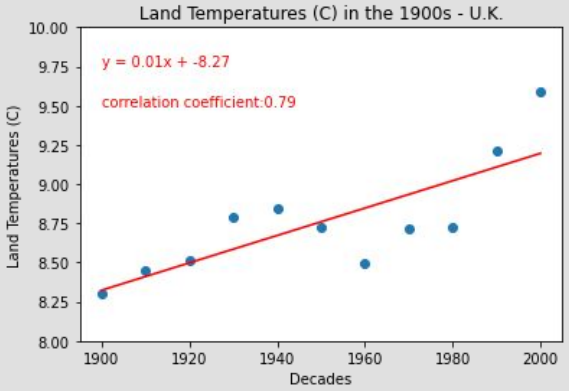
Data Analysis & Visualization

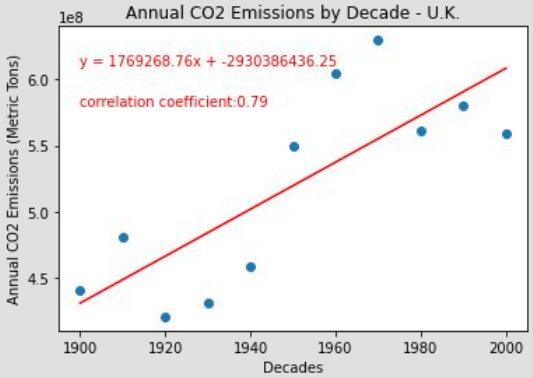
- Graph appropriate visuals based on countries researched
- Analyze trends based on line equations, regressions etc.

Findings

United Kingdom





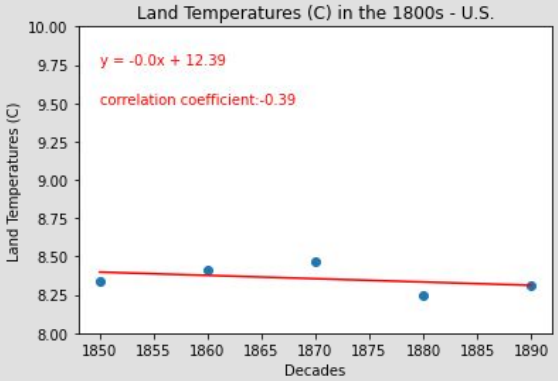


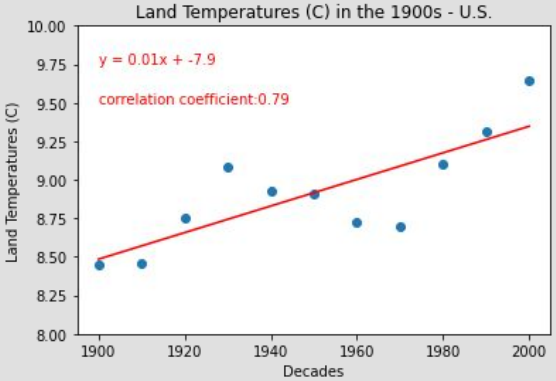
- Land Temperatures increased the steepest amongst all countries reviewed at 1.13 (delta of correlation coefficient between 1800s and 1900s)

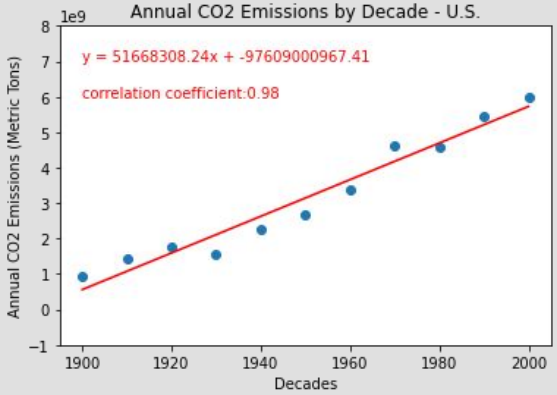
- Land Temperatures have been on a steady incline with a correlation coefficient of 0.79 (1900) vs. -0.34 (1800)

- CO2 Emissions have been rising in the U.K. with a correlation coefficient of 0.79.

United States







- While temperatures were in a decline in the U.S. in 1800s, the turn of the century brought an increase in surface temperatures.

- Just like the U.K., the U.S. saw a decline in surface temperatures from 1930 to 1960 that affected the overall correlation coefficient. Could World War II be a factor based on the increase in production and wartime effects?

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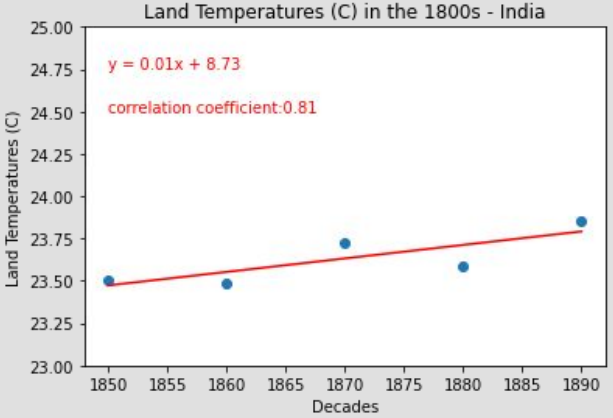
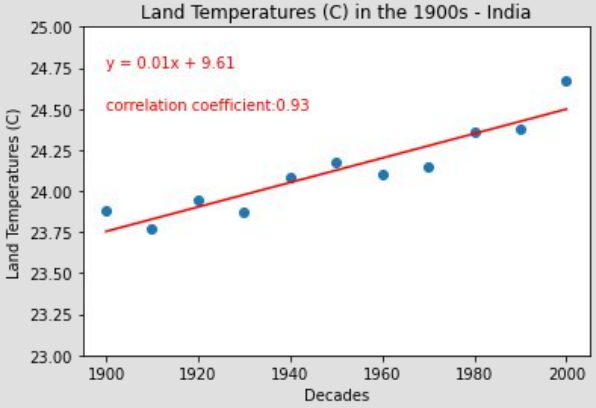
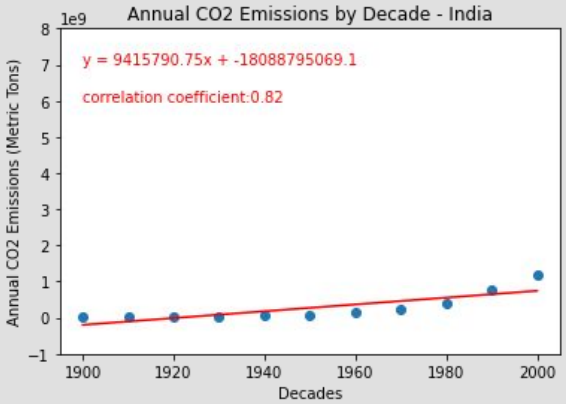
- CO2 emissions have been steadily rising at a correlation coefficient of almost 1 (0.98).

India

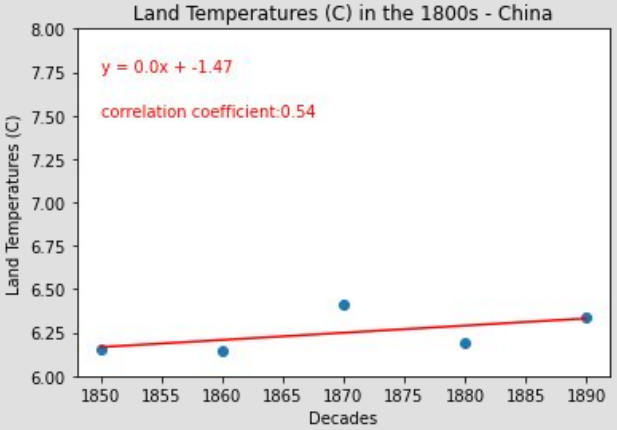


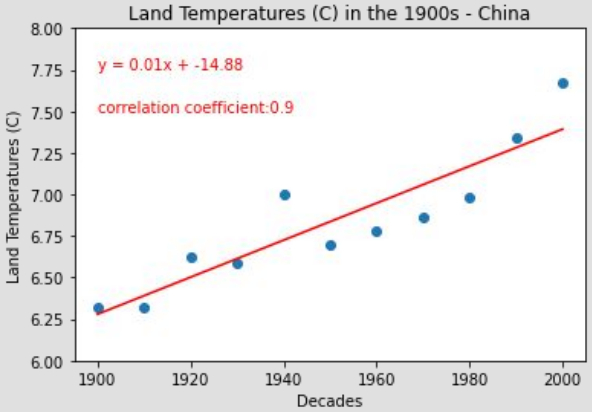


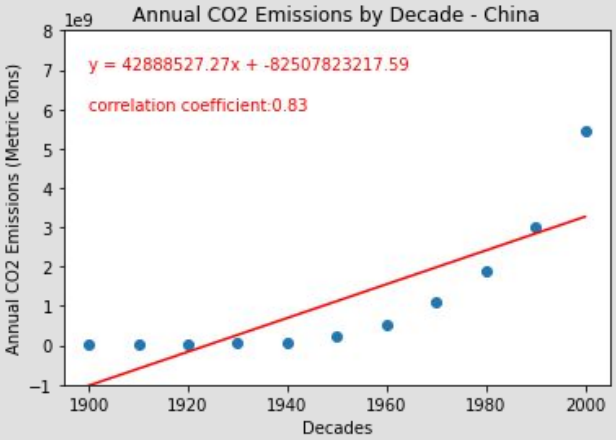


- India is one of the few countries we saw that had a steady rise in temperatures in both the 1800s and 1900s.
- The 1900s saw a greater rise in land temperatures
- India produced almost 1B Metric Tons of CO2 in 2000

China

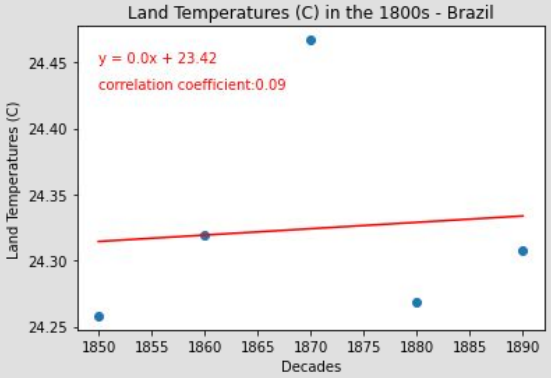


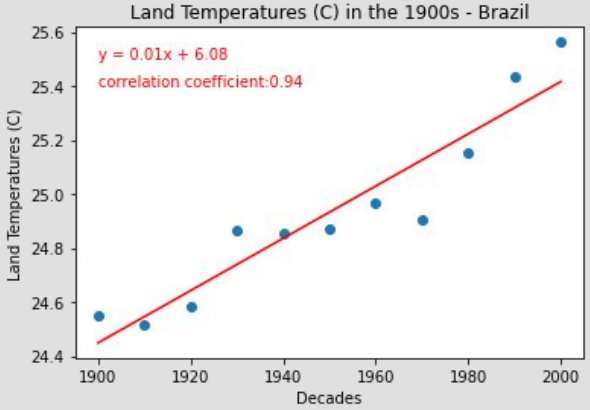


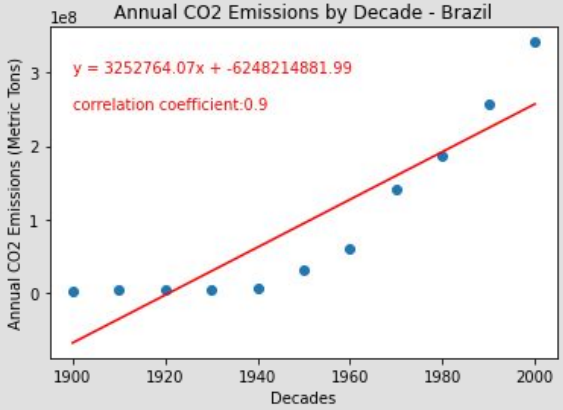


- Land temperatures remain rather consistent (1800s) - Correlation Coefficient: 0.54
- Steep incline in land temperatures (1900s) - Correlation Coefficient: 0.9
- Land Temperatures in china remain consistent during the 1800s until a steep incline in temperatures in the 1900s - Correlation Coefficient between 1800s and 1900s: 0.83

Brazil

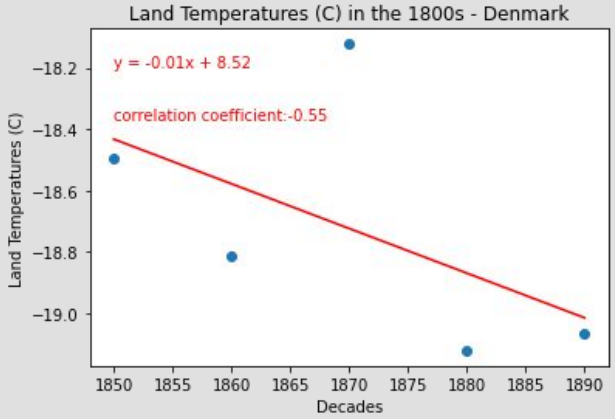


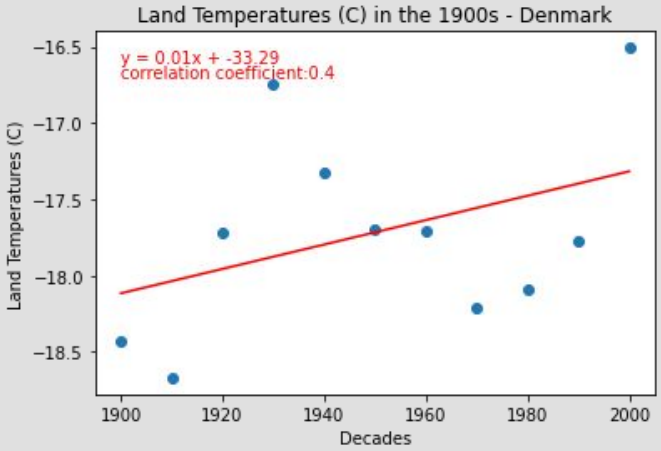


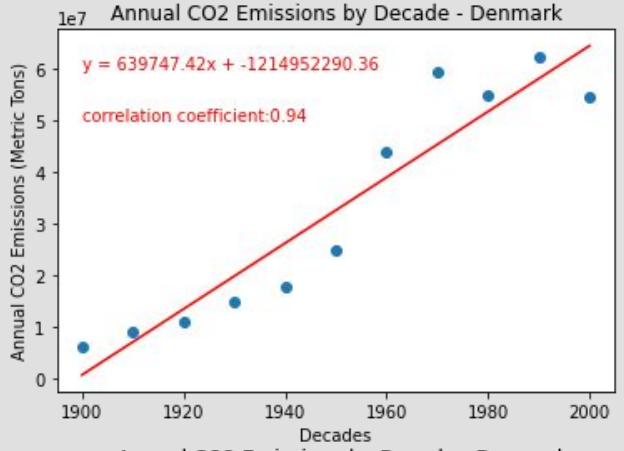


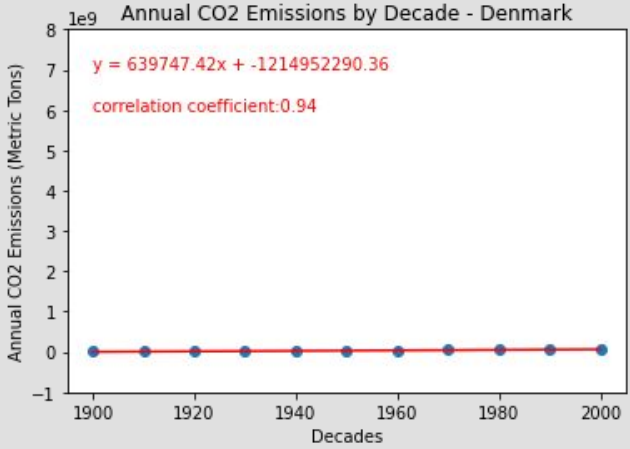
- Land Temperatures saw almost no increase in the 1800s in Brazil. However, we saw the highest temperature increase out of all countries in the 1900s.
- CO2 Emissions have been rising in Brazil with a correlation coefficient of 0.9.

Denmark









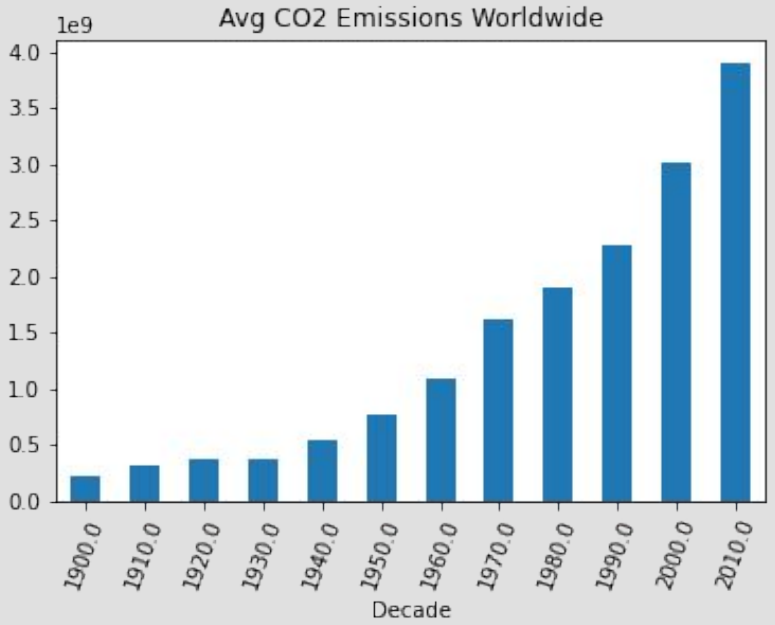
- Land Temperatures saw a steep decline in the 1800s. In the 1900s, they have been fluctuating (decline from 1930 to 1970, and an increase from 1970 to 2000)

- CO2 Emissions rose at a rate of 0.94, however, in comparison to the rest of the world, Denmark still has a relatively low CO2 emission count

CO2 Emissions Analysis

- Both CO2 emissions and temperature have steadily increased since 1900.

- Emissions were 2 million tonnes (metric tons) in 1900 vs. 4 billion tonnes in 2010



Analysis

Final Analysis

CO2 Emissions	• CO2 Emissions have risen across the world since 1900 • Of all 5 countries researched, CO2 emissions increased for each country.
Land Temperatures	• For all countries researched, from 1940 onwards, land temperatures have significantly increased. • Even though we observed slight rises in temperatures in the 1800s, the 1900s saw an exponential growth.
Correlation	• There is a strong correlation between the rise of CO2 emissions and surface land temperatures based on the countries compared. • Other factors can participate in the growth of surface land temperatures as well
Future Work	• Population vs. CO2 Emissions • Forecasting the rise of surface temperatures - when will the world end :)

Data Limitations

Significant Gaps in Temperature Data	• 215993 valid measurements in the 1800s • 31601 measurements dropped as NaN
High Levels of Uncertainty	• Average temperature uncertainties of 4.0 degrees in 1700s, 1.9 in 1800s, .46 in 1900s
Early Data in Particular is Lacking	• Only 76 of 243 possible entities have recorded measures in the 1700s
Colonialism	• Several of those entities were distinguished as France/France (Europe), ect