Global Warning

A study of global carbon dioxide emissions over time

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Introduction

- Global Warming
  - Shift in weather patterns due to an increase in global emissions
  - Increase in production of greenhouse gases - namely carbon dioxide
- Our goal
  - Explore how carbon dioxide emissions have changed over time
    - Which countries contribute the most?
    - Which continue to increase over time? Why?
- What does this mean for our future?

The Data

- Raw dataset found on Kaggle
- Time series data set ranging from 1751-2017
- Dataset is comprised of observations under the variable name ‘Entity’
    - These Entities are comprised of individual countries, territories, continents, and others
- The main metric being shown in the data set is tonnes of emissions (Co2)

Experimental Design - Data Cleaning

- Created different data sets with dropped entities
  - We dropped some territories, continents, and other entities for some specific datasets
- Removed non informational data
  - Years with unreported carbon emission years
- Created new columns for Year of Year percent change, and total percentage of the world emissions for that entity in the given year

Experimental Design - Queries

- Which year had the greatest increase in emissions?
- When did countries decrease their emissions?
- In what instances did countries have net carbon emission of 0 during modern times?
- Which portion of Co2 emissions came from international transport?
- What are the continental emissions figures over the given time interval?

Experimental Design - Testing

- Unit testing
- Print statements
- Data set examination

Experimental Design - Visualization

- Pie chart of global emissions for 2017
- Graph of total world emissions from 1751-2017
- The effects of World War II on emissions for the top 5 emission producing nations
- Plot of Continental emissions between 1940-2017

Beyond the Original Specifications

- Why is carbon dioxide emissions important to global warming
  - Carbon dioxide ppm has increased from 280 ppm to 400+ ppm
  - Predict what might happen in the future
  - How can everyday events lower carbon emissions
    - Removing single use plastic
    - Using carbon emissions free travel for work
    - Showering 2 minutes less

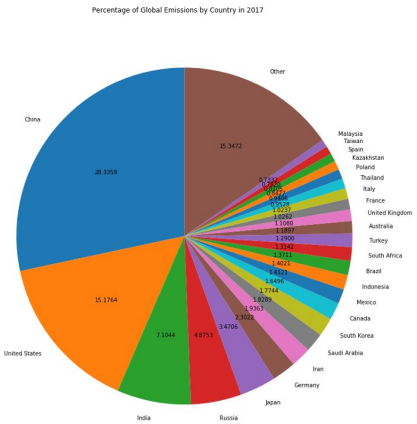
Beyond the Original Specifications

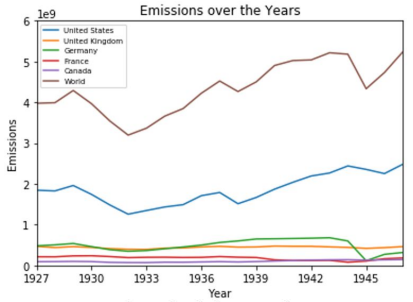
- Project Structure
  - Analysis
  - Visualization Tool
    - (User interaction!)
  - Functions
  - Unit Testing

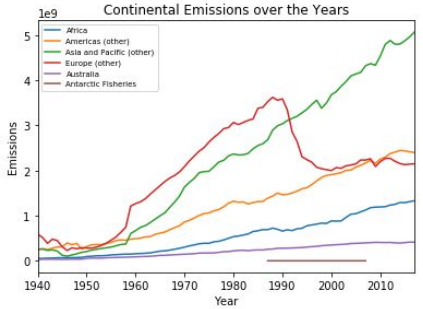
```
246 observations found.

--Filters--
Countries:
United States, Canada, Brazil, India, China, Russia
Years:
1975 to 2015

[1] Filter by Country
[2] Filter by Year
[3] Clear Filters
[4] Produce Visualization
[5] Export Data
[6] Learn about emissions in context

[0] Quit

Please make a selection:
```

Results

- Global Emission Distribution by Countries in 2017
- YoY Decrease and Doubling in Emissions
- Globally Significant Events
- Emissions grouped by Continents
- Emissions due to International Transport







Results - Carbon Dioxide Emissions vs everyday human production

- Estimated year for 100 billion metric tons of CO_2 emissions = 2174
- Average annual individual decrease
  - Plastic waste: 0.3 metric tons of carbon dioxide[1]
  - Emission free travel: 3.16 metric tons of carbon dioxide[2]
  - 25% decrease in shower time: 0.155 metric tons of carbon dioxide[3]

Results - Carbon Dioxide Emissions vs everyday human production

- Total CO2 emissions in the US in the year 2017 was 5.3 billion metric tons
  - The whole population of the US
    - 53.6 years of removing single use plastic
    - 5.1 years of emission free work travel
    - 103.6 years of showering 2 fewer minutes

Testing

- Test-Driven Design
- Output verification
- Unit Testing

```
class SubsetYearTestCase(unittest.TestCase):

    def test_is_subset_year_handling_single_year(self):

        sampledf = subset_by_year(data_countries, 2005)
        years_included = sampledf['Year'].unique()
        # Test
        self.assertEqual(years_included, [2005])
```

```
class SubsetEntityTestCase(unittest.TestCase):

    def test_is_subset_entity_working(self):

        sampledf = subset_by_entity(data_countries, 'Ecuador')
        entities_included = sampledf['Entity'].unique()
        # Test
        self.assertEqual(entities_included, ['Ecuador'])
```

Conclusion

- Findings: Gained context for the history and present state of the emissions problem.
- Ideas to expand the scope and usability of our project.
- Gained valuable experience with the data science process.

Project Repository

https://github.com/bmfeciura/cs5010-project

Sources

Data:

https://www.kaggle.com/yoannboyere/co2-ghg-emissionsdata

[1] Pamuła, Hanna. “Plastic Footprint Calculator.” *Check Your Environmental Impact*, Omni Calculator, 16 May 2019, www.omnicalculator.com/ecology/plastic-footprint.

[2] Harris, David. “How Far Do Americans Drive to Work on Average?” *It Still Runs*, 10 Jan. 2019, itstillruns.com/far-americans-drive-work-average-7446397.html.

[3] Lindberg, Sara. “Shower Time: How Long to Take and Are Longer Showers Better?” *Healthline*, Healthline Media, 20 May 2020, www.healthline.com/health/shower-time.