

# Assignment 4: Becoming an Independent Data Scientist

## 1 Region and Domain

State the region and the domain category that your data sets are about.

International trade of the top 4 economies; USA, China, Germany, Europe.  
Economics and CO<sub>2</sub> Consumption

## 2 Research Question

You must state a question about the domain category and region that you identified as being interesting.

How efficiently do the world's largest economies trade in terms of CO<sub>2</sub> emissions per dollar of international trade, and how has this efficiency changed over time?

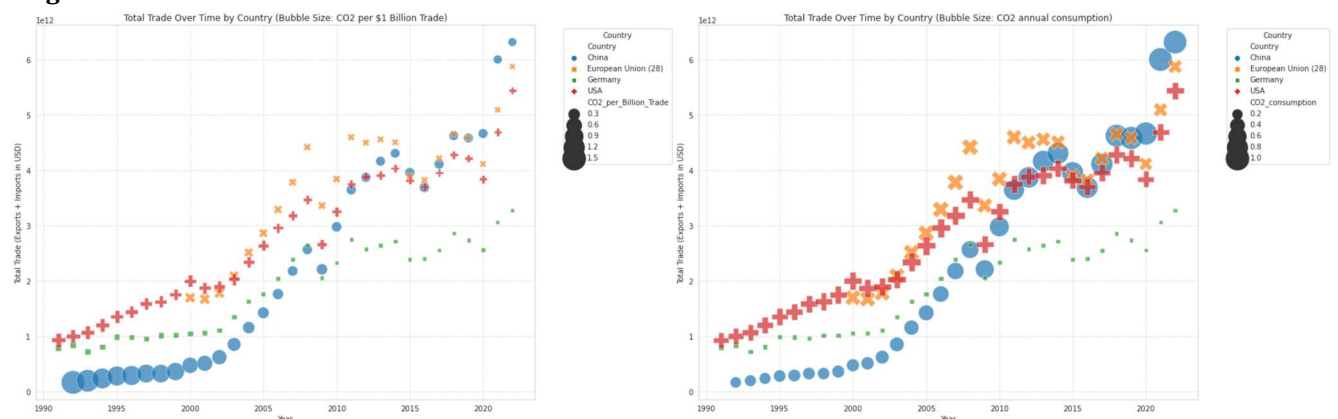
## 3 Links

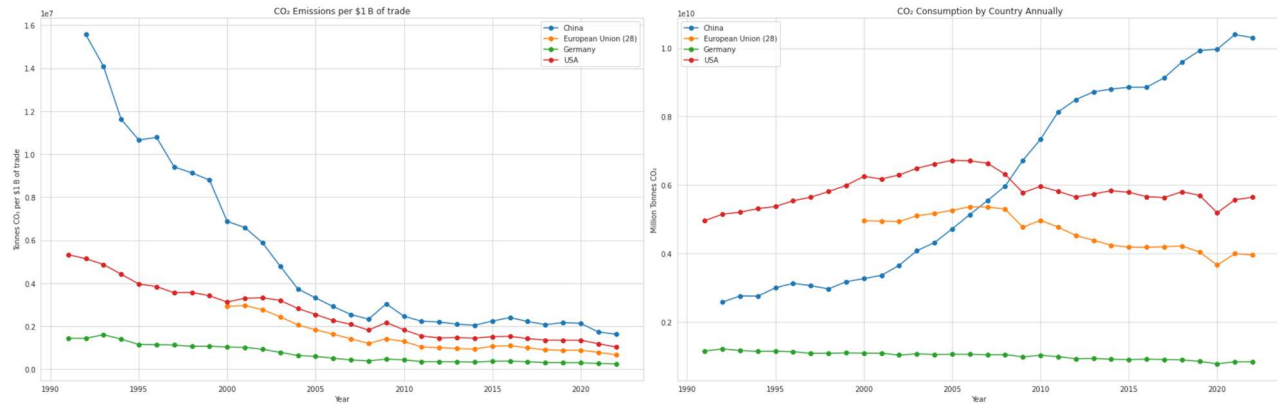
You must provide at least two links to publicly accessible datasets. These could be links to files such as CSV or Excel files, or links to websites which might have data in tabular form, such as Wikipedia pages.

- <http://data.un.org/Data.aspx?d=ComTrade&f=l1Code%3a1>
- <https://zenodo.org/api/records/14106218/files-archive>

## 4 Image

You must upload an image which addresses the research question you stated. In addition to addressing the question, this visual should follow Cairo's principles of truthfulness, functionality, beauty, and insightfulness.





## 5 Discussion

**You must contribute a short (1-2 paragraph) written justification of how your visualization addresses your stated research question.**

The visualizations aim to explore the link between economic activity (measured by total exports and imports) and environmental cost (measured by consumption-based CO<sub>2</sub> emissions). The first set of scatter plots visualizes how CO<sub>2</sub> emissions scale with total trade over time, using bubble sizes to indicate either emissions per trade unit or total emissions. This provides an intuitive sense of both efficiency and impact. The second set of line plots tracks the year-by-year trends of CO<sub>2</sub> emissions per \$1 billion traded, highlighting which countries are becoming carbon-efficient in their trade practices. Together, these visualizations allow us to identify trends, compare countries, and assess whether economic growth is being decoupled from environmental harm—an essential question in sustainable development.

China has undergone a dramatic transformation over the past few decades, evolving from one of the world's smallest trading economies into the largest by total trade volume. In the early years of the dataset, China lagged behind other countries like the USA and Germany in terms of export and import activity. However, through rapid industrialization, investment in manufacturing, and integration into global supply chains, China's trade surged—eventually surpassing all other economies analyzed. Interestingly, this explosive growth initially came at a high environmental cost. China was the least efficient among the four economies in terms of CO<sub>2</sub> emissions per dollar of trade, reflecting its heavy reliance on coal and energy-intensive production. Over time, however, China has significantly improved its carbon efficiency, reducing its CO<sub>2</sub> emissions per \$1 billion of trade. This improvement suggests a shift toward cleaner technologies, better energy standards, and a growing focus on environmental responsibility alongside economic growth.