Technical Writing and Speaking in English
Class 4: writing scientific resutls

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Results Section

What do we write in the results section?

- Settings and configurations used to perform the experiments
- Visualizations of the results (Graphs)
- The meaning of the results (interpretation)

Visualizing results (Data)

	country	year	iso_code	population	gdp	cement_co2	cement_co2_per_capita	co2	co2_growth_abs
16357	France	1802	FRA	29217510.0	NaN	NaN	NaN	2.239	NaN
16358	France	1804	FRA	29436651.0	NaN	NaN	NaN	2.176	NaN
16359	France	1810	FRA	30104407.0	NaN	NaN	NaN	2.121	NaN
16360	France	1811	FRA	30217092.0	NaN	NaN	NaN	2.052	-0.070
16361	France	1812	FRA	30330200.0	NaN	NaN	NaN	2.217	0.165
...	...	...	...	...	...	...	...	...	...
16566	France	2017	FRA	64144092.0	2.536203e+12	6.291	0.098	337.458	3.018
16567	France	2018	FRA	64277812.0	2.581674e+12	6.495	0.101	322.527	-14.931
16568	France	2019	FRA	64399760.0	NaN	6.588	0.102	316.387	-6.140
16569	France	2020	FRA	64480052.0	NaN	5.994	0.093	280.032	-36.355
16570	France	2021	FRA	64531448.0	NaN	5.994	0.093	305.964	25.932

- Experimental data $\rightarrow$ tables
- Tables are hard to interpret
- A better approach: Visualizations (graphs)

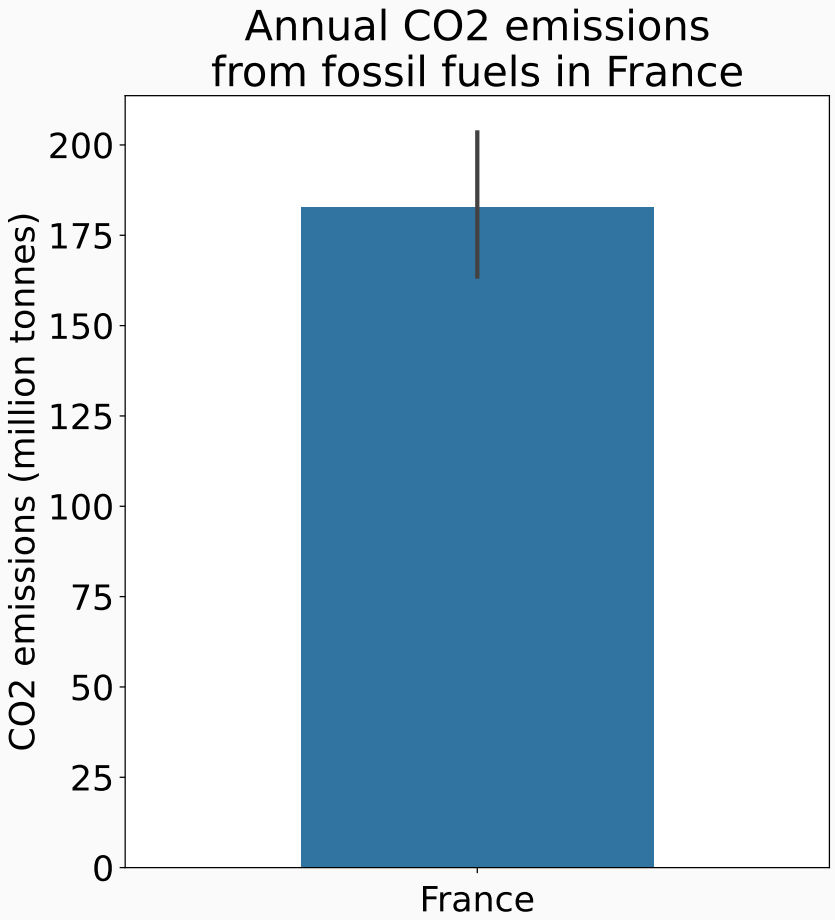
Visualizing data: one dimension

One dimension: values in an array

Example: Barplot

Points to pay attention:

- X and Y labels (with units)
- Font size
- Vector graphics
- Confidence intervals (the error bar)



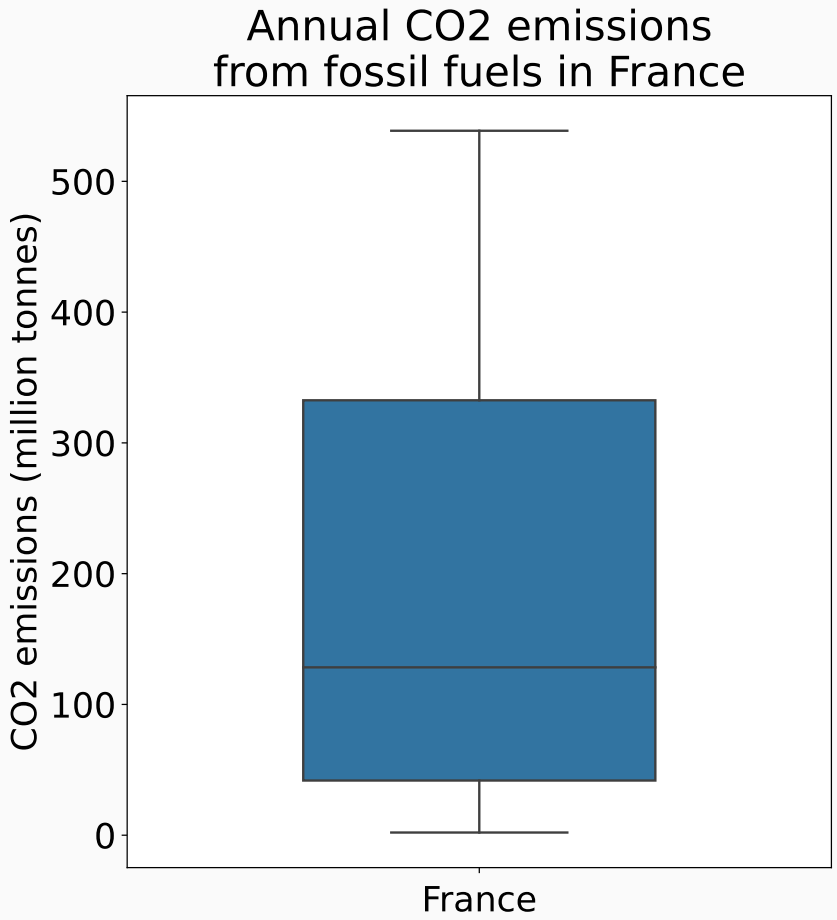
Visualizing data: one dimension

One dimension: values in an array

Example: Boxplot

Points to pay attention:

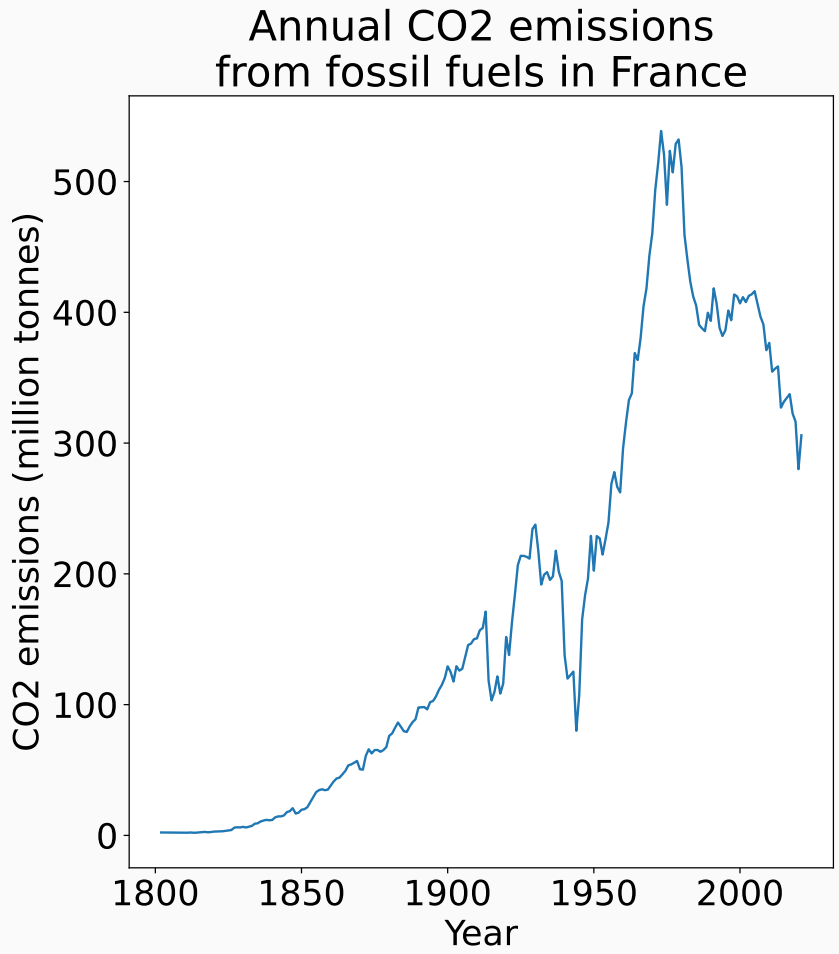
- X and Y labels (with units)
- Font size
- Vector graphics
- Data dispersion (box and the whiskers)



Visualizing data: two dimensions

Points to pay attention:

- X and Y labels (with units)
- Font size

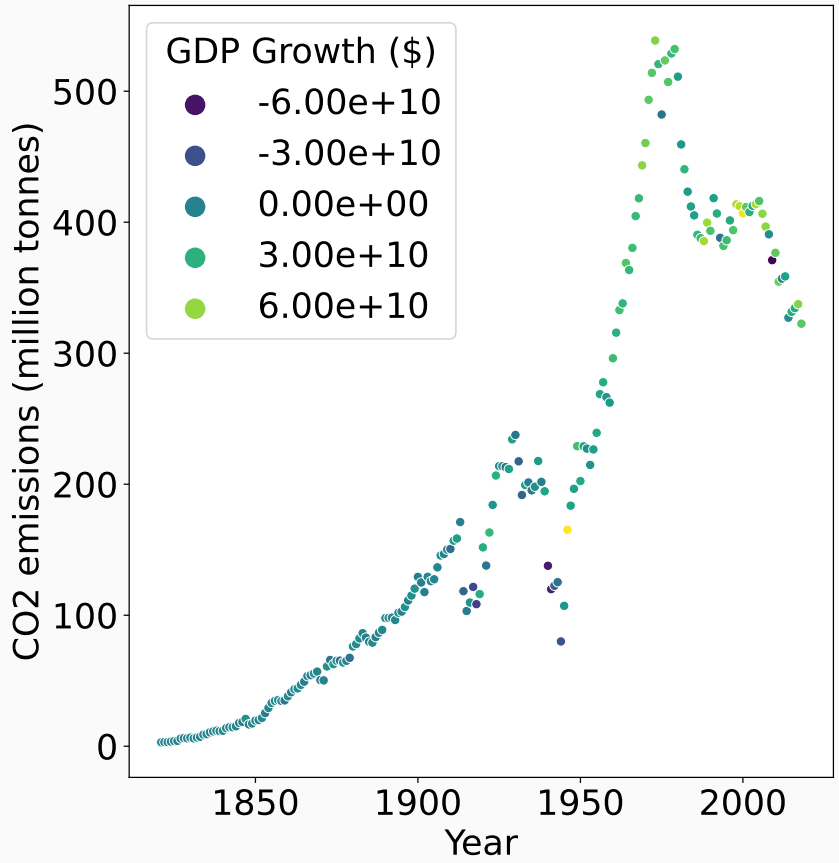


Visualizing data: three dimensions

Use color to represent the third dimension.

Points to pay attention

- Color-blind friendliness
- Dark to bright colors[1]
- Well formatted legend
- Colors must help understanding the figure.
  We can do better here



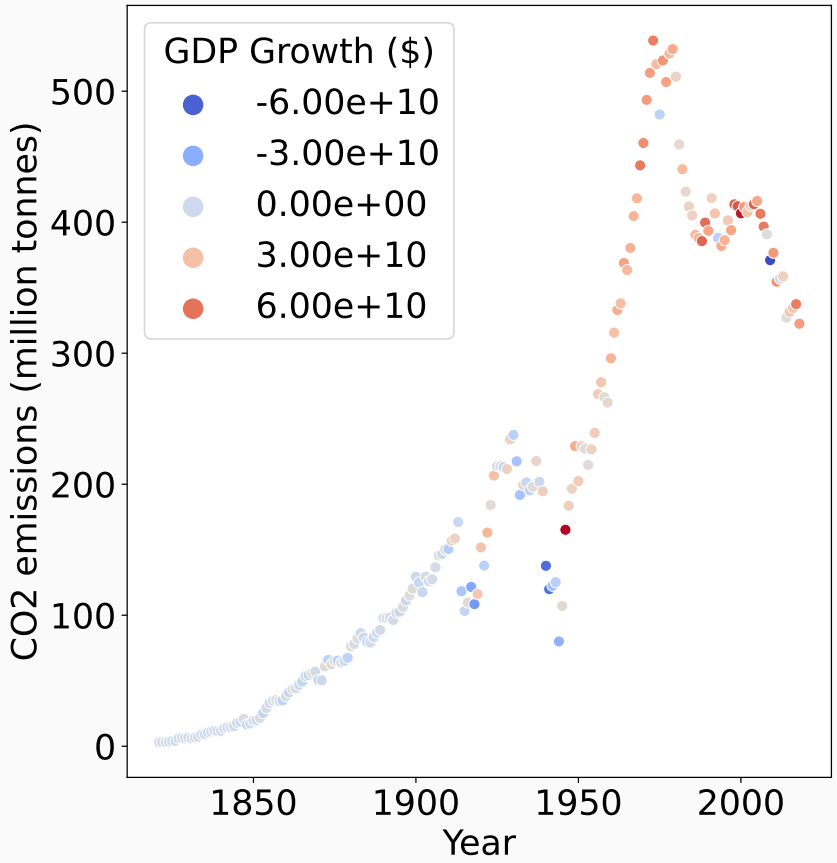
[1] https://seaborn.pydata.org/tutorial/color_palettes.html#perceptually-uniform-palettes

Visualizing data: three dimensions

Use color to represent the third dimension.

Points to pay attention

- Color-blind friendliness
- Dark to bright colors[1]
- Well formatted legend
- Colors must help understanding the figure. **Here, it's better**
- **Drawback:** not good when printing in grayscale

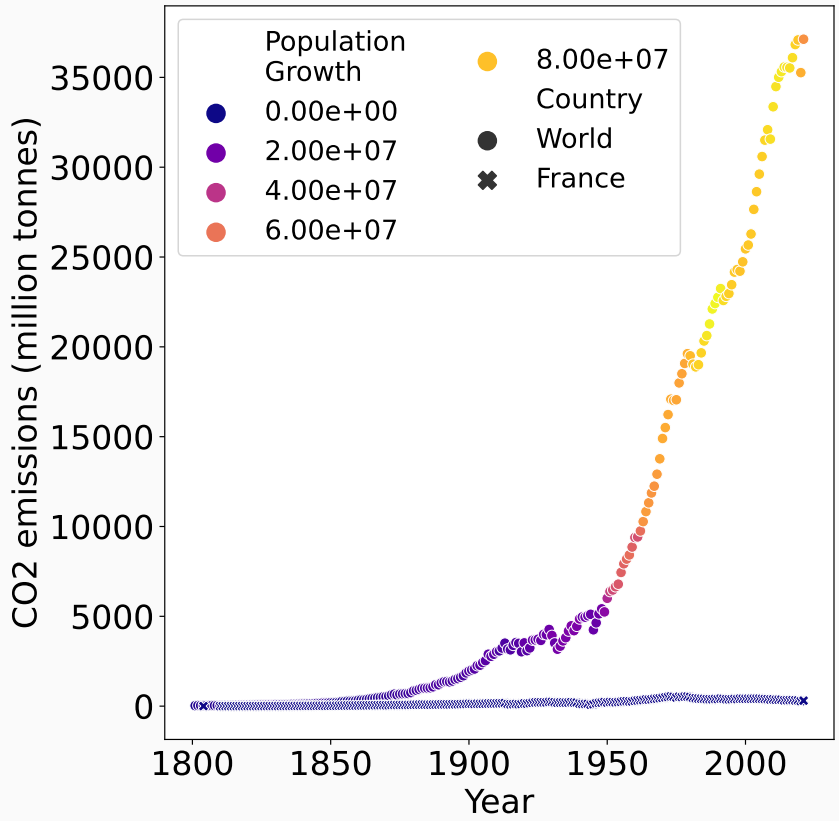


[1] https://seaborn.pydata.org/tutorial/color_palettes.html#perceptually-uniform-palettes

Visualizing data: four dimensions

Example adding a dimension with a categorical variable: change the shape of the points

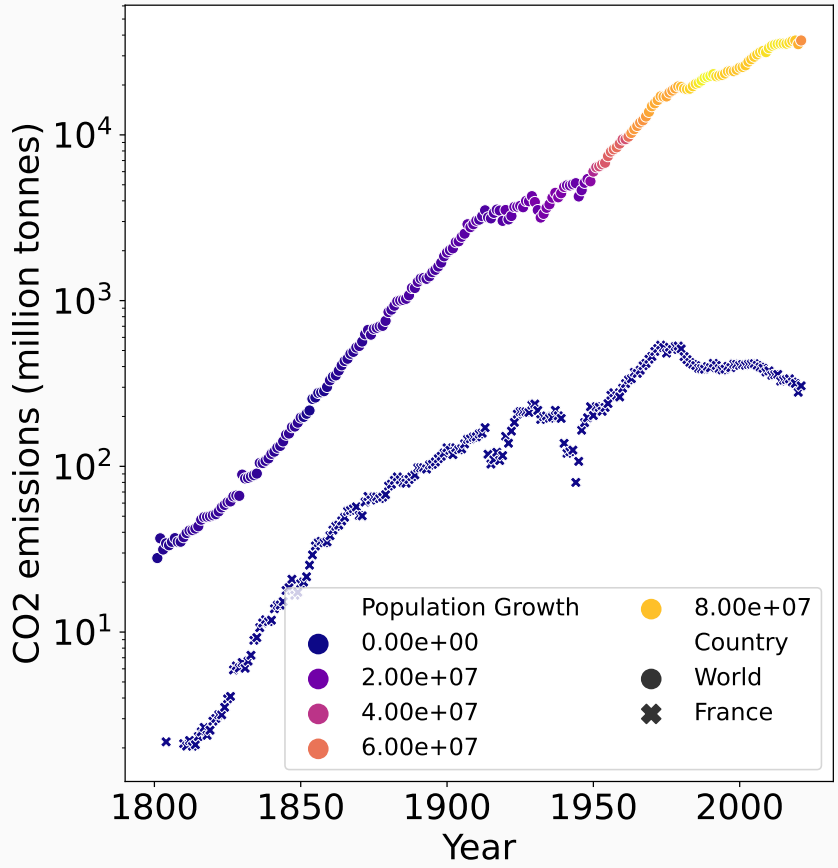
- **Problem 1:** France's points flatten when we plot with World's data



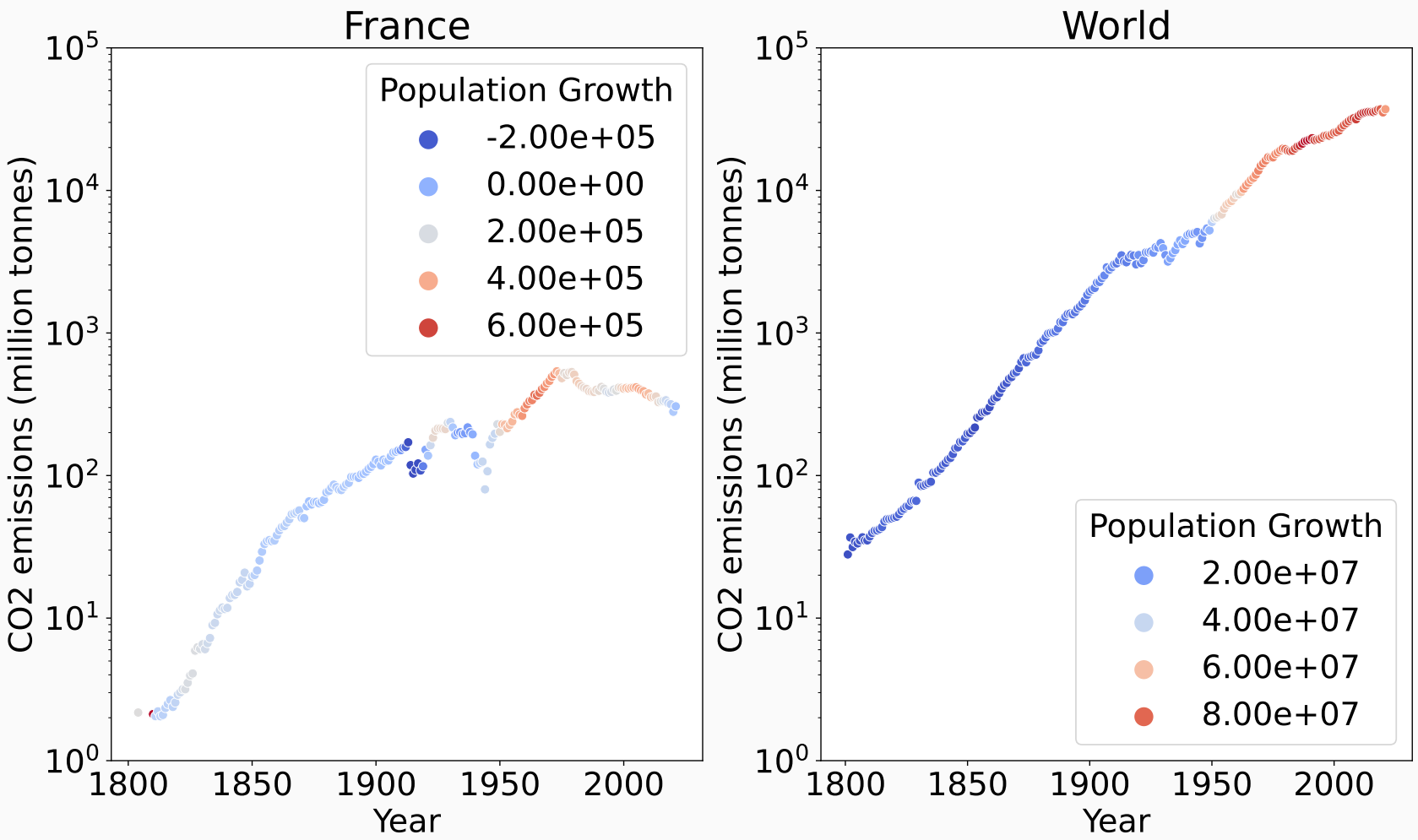
Visualizing data: four dimensions

Example adding a dimension with a categorical variable: change the shape of the points

- **Problem 1:** France's points flatten when we plot with World's data
- **Solution:** Use log scale in the y axis
- **Problem 2:** Both curves use the same color map. Hard to see changes in France's population growth



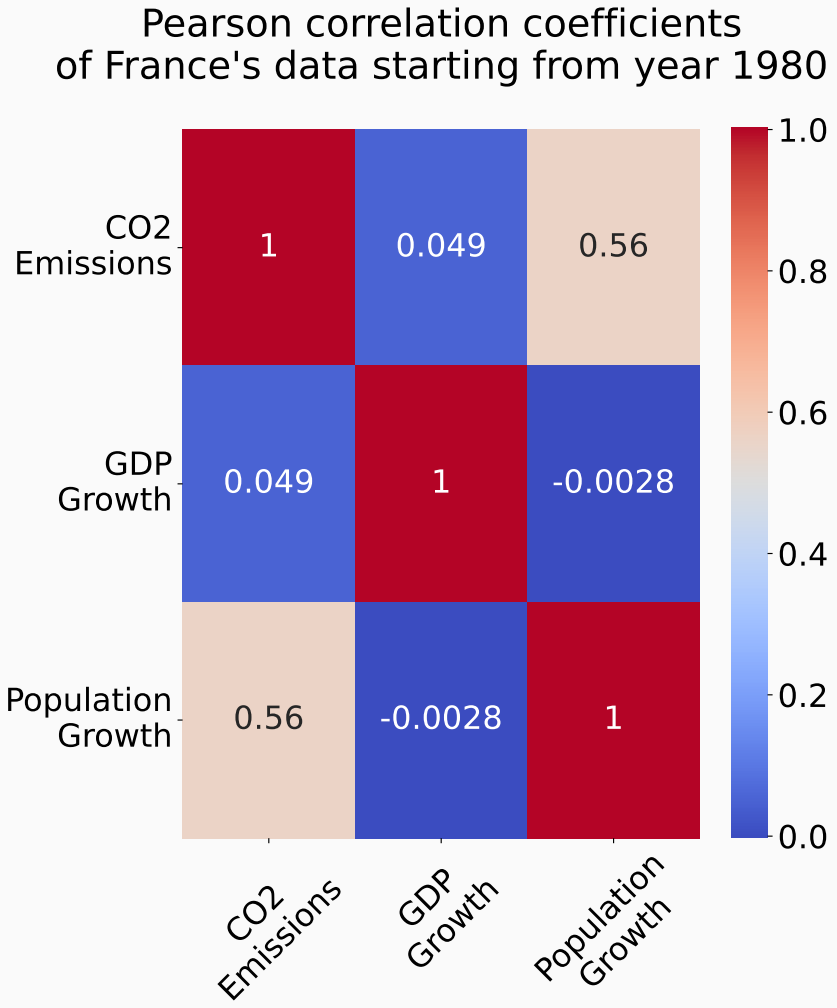
Visualizing data: four dimensions



Visualizing data: another example

Example of plotting data that does not "fit" in a line: heatmap
Points to pay attention

- Color-blind friendliness
- Colors must help understanding the figure.
- Well formatted labels
  - Rotations and line breaks to save figure size, and to be easier to read



Presenting and interpreting results

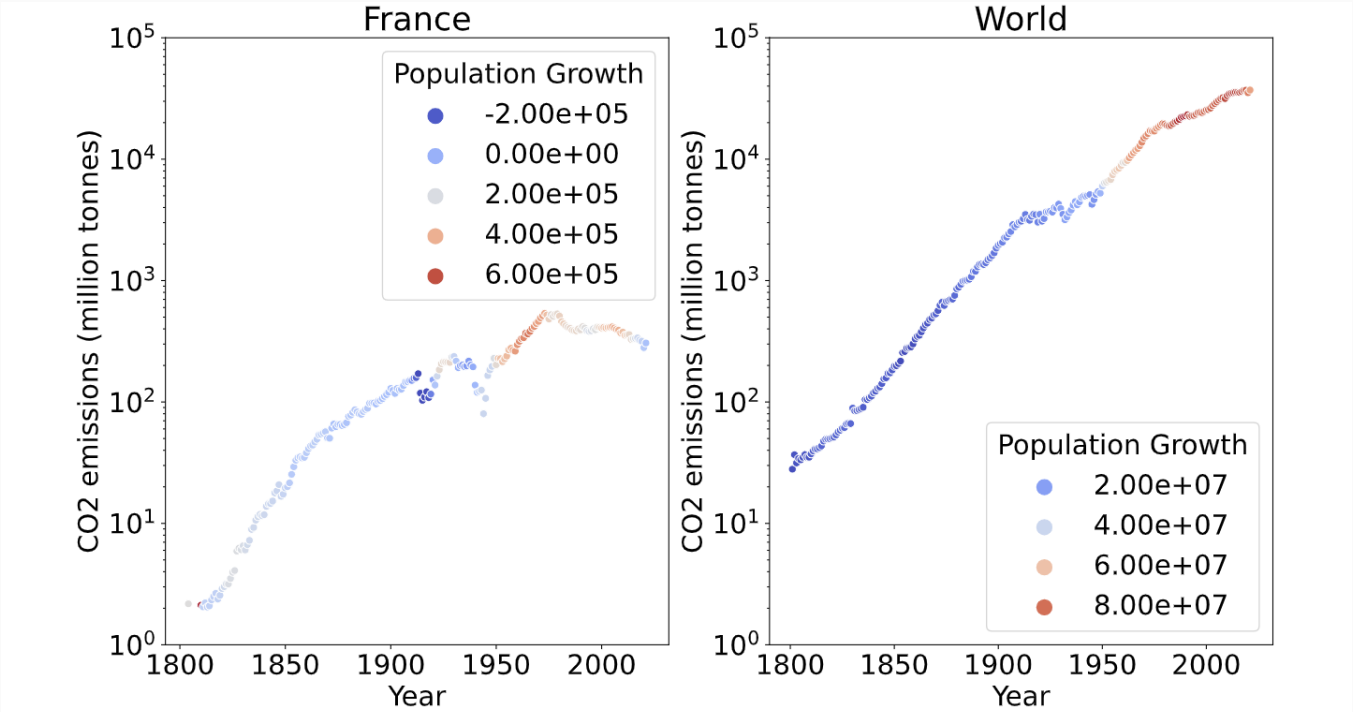


Figure 1: Annual CO2 emissions from fossil fuels and annual population growth in France (left) and World (right). Log scale in the y axis

Figure 1 shows the annual CO2 emissions from fossil fuels and the annual population growth of France and in the World, ranging from 1800 to 2021. We can notice a decreasing trend in the annual emissions in France starting in around 1980. Conversely, the global annual emissions increase exponentially (mind the log scale in the y axis) through the whole time range. We can also observe that the population growth in France follows a decreasing trend, which seems to be in pair with the decrease in CO2 emissions.

Presenting and interpreting results

Points to pay attention:

- Help the reader to read and interpret the results
- Show the results and our interpretation

Following this observation, we investigated the correlation between the annual emissions and the population growth in France, from 1980 to 2021. Figure 2 shows the Pearson correlation coefficients between the annual CO2 emissions in France, the annual population growth, and the annual GDP growth. The data of Figure 2 ranges from 1980 to 2021. Positive values indicate a positive linear correlation, with a perfect linear correlation having a value of 1.0, and negative values indicate a negative linear correlation, with a perfect linear correlation having a value of −1.0. Values close to 0 indicate no linear correlation.

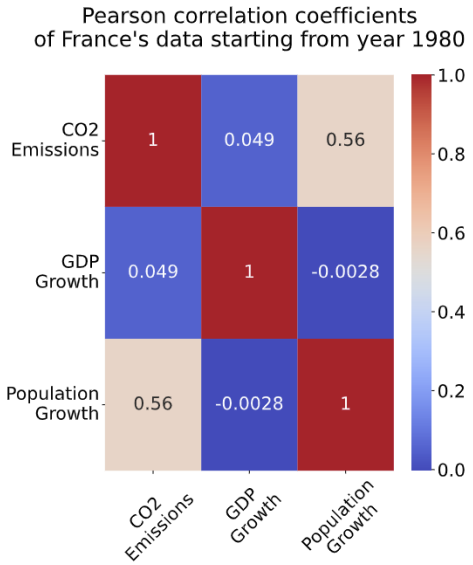


Figure 2: Pearson correlation coefficients between the annual CO2 emissions in France, the annual population growth, and the annual GDP growth, from 1980 to 2021

For the annual CO2 emissions, we observe a correlation coefficient of 0.049 and 0.56 with the annual GDP growth and population growth, respectively. These correlation coefficients indicate a no linear correlation for the annual GDP growth and a moderate linear correlation for the annual population growth.

Presenting Algorithms and Proofs

Theoretical papers may have results which are not 'plotable'.

Presenting algorithms and proofs in a clear way is challenging.

Presenting Algorithms and Proofs

Theoretical papers may have results which are not 'plotable'.

Presenting algorithms and proofs in a clear way is challenging.

Questions you may ask yourself:

- How much detail should I include?

- Should I put the proof to the Appendix?

- Should I break down the proof to Lemmas?

- Should I add the explanations within the pseudo-code or after?

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