Chapter 10: Exponential Growth
April 8, 2026

10.1 What is Exponential Growth?

10.2 The Rule of 72

10.3 Catastrophe Is Closer Than You Think

10.4 Discounting

10.5 Putting It Together: The Social Cost of Carbon

Terms

Problems

Hands-on exercise (paired): Constructing models in Excel!

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Two terms for quantifying temperature increase (warming)

1) Radiation forcing (RF) directly captured by GHG and others

$$\mathrm{RF} = \Delta(E_{\mathrm{in}} - E_{\mathrm{out}}) = \Delta E_{\mathrm{in}} - \Delta E_{\mathrm{out}}$$

2) Feedback (g)

$$\Delta T_{\mathrm{f}} = \frac{\Delta T_{\mathrm{i}}}{(1-g)}$$

I = P x A x T [Eqn. 8.1]

T = EI x CI [Eqn. 8.2]

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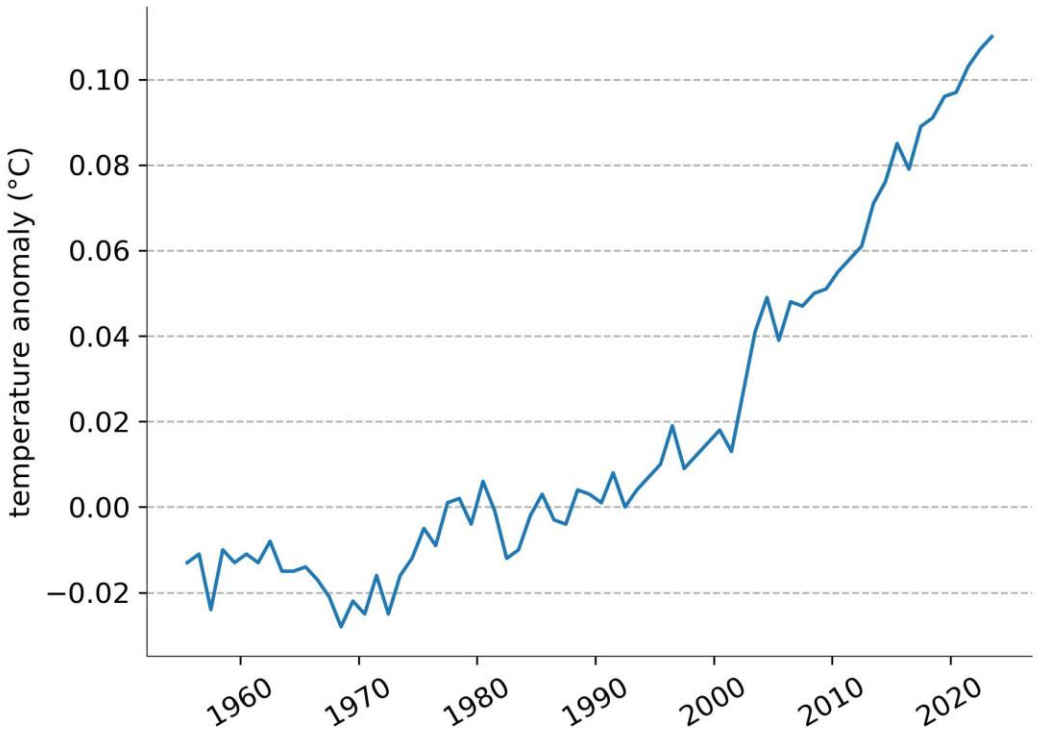
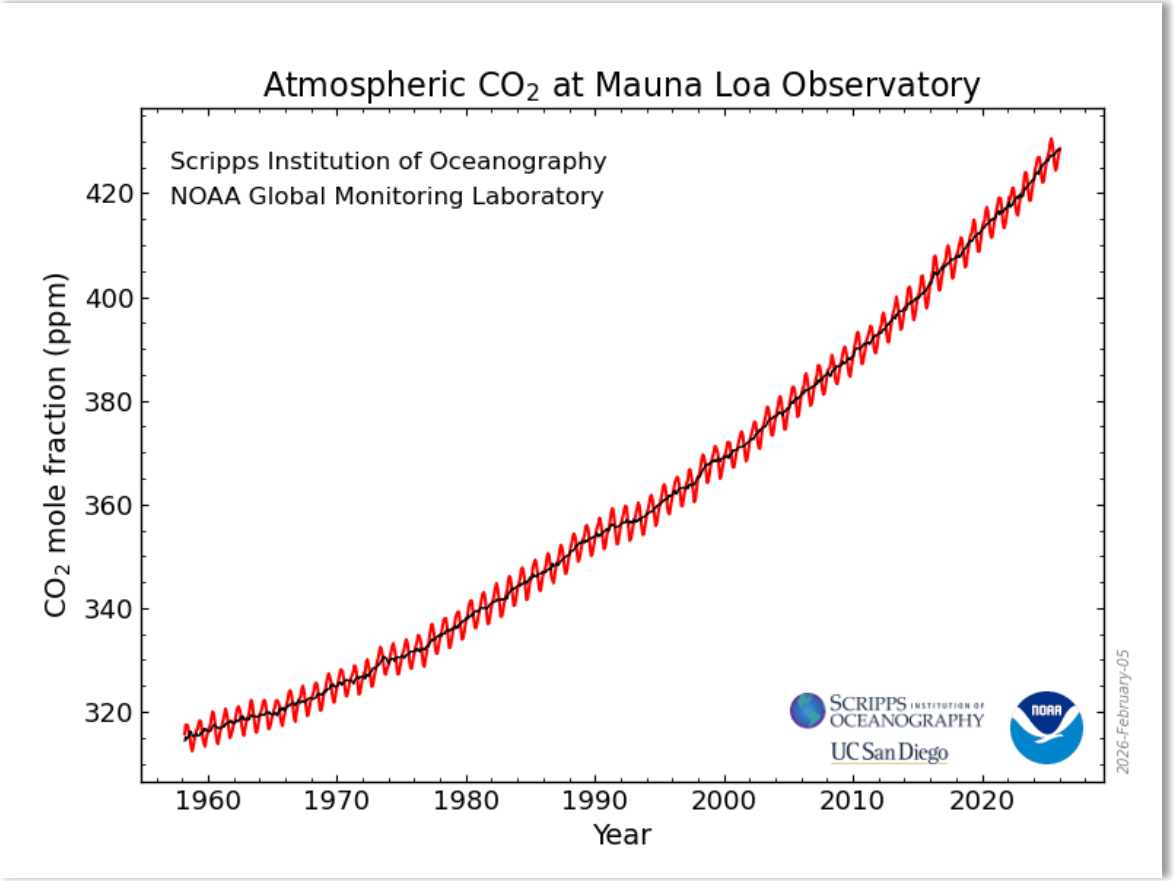


Fig. 2.8: Ocean temperature anomaly (°C) of top 2 km of world ocean.



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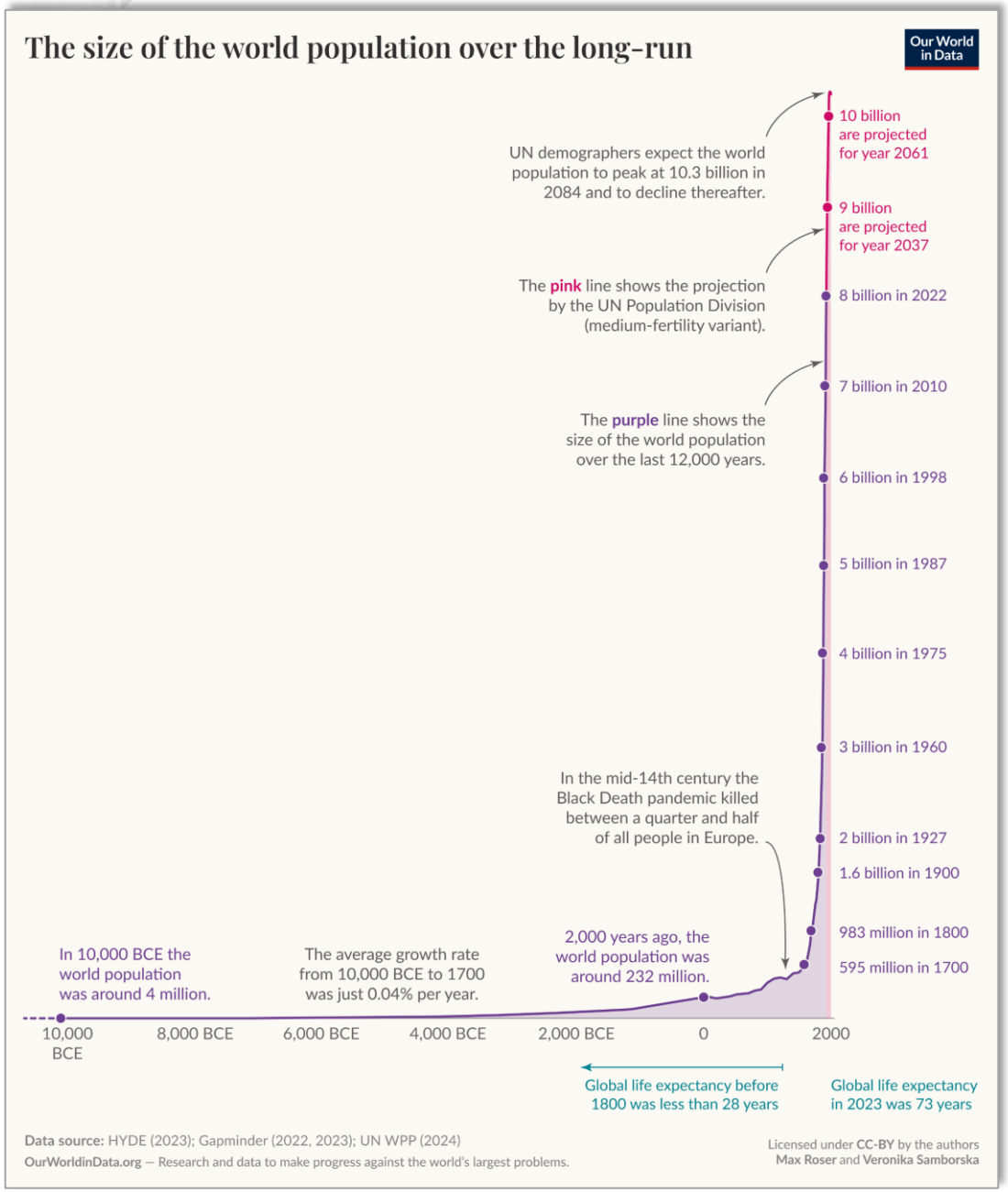

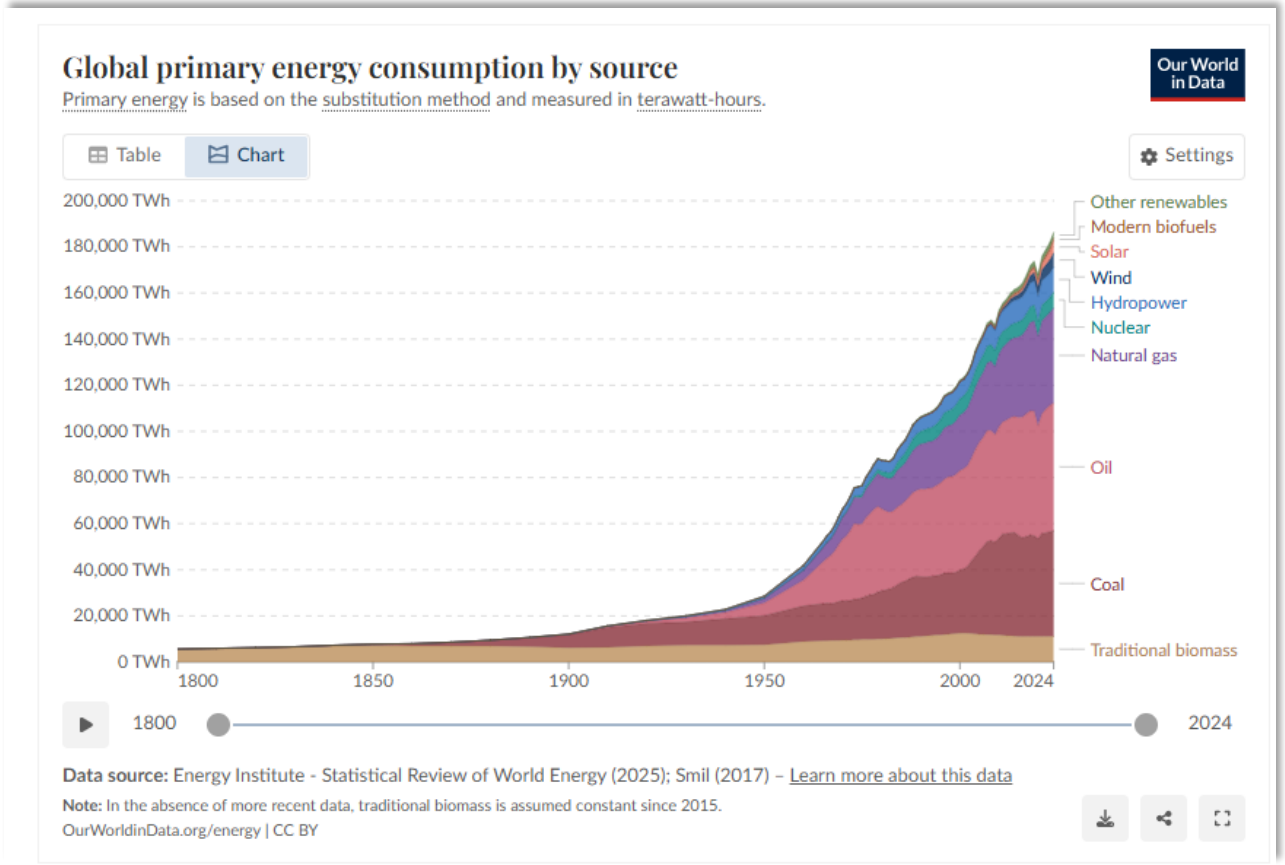

https://ourworldindata.org/population-growth-over-time

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Exercise

1) Understand the data (identify changes)
2) Quantify the rate of change (Δ) using both absolute and relative values
3) Compare linear vs. non-linear patterns
4) Construct linear and exponential models using Excel
5) Report the results back to the class

Dataset 1: Annual CO_2 concentration (CO2_annmean_mlo. xlsx)

Dataset 2: GDP per capita (US$) of 4 administrative entities since 1960 (GDP_pc.xlsx)

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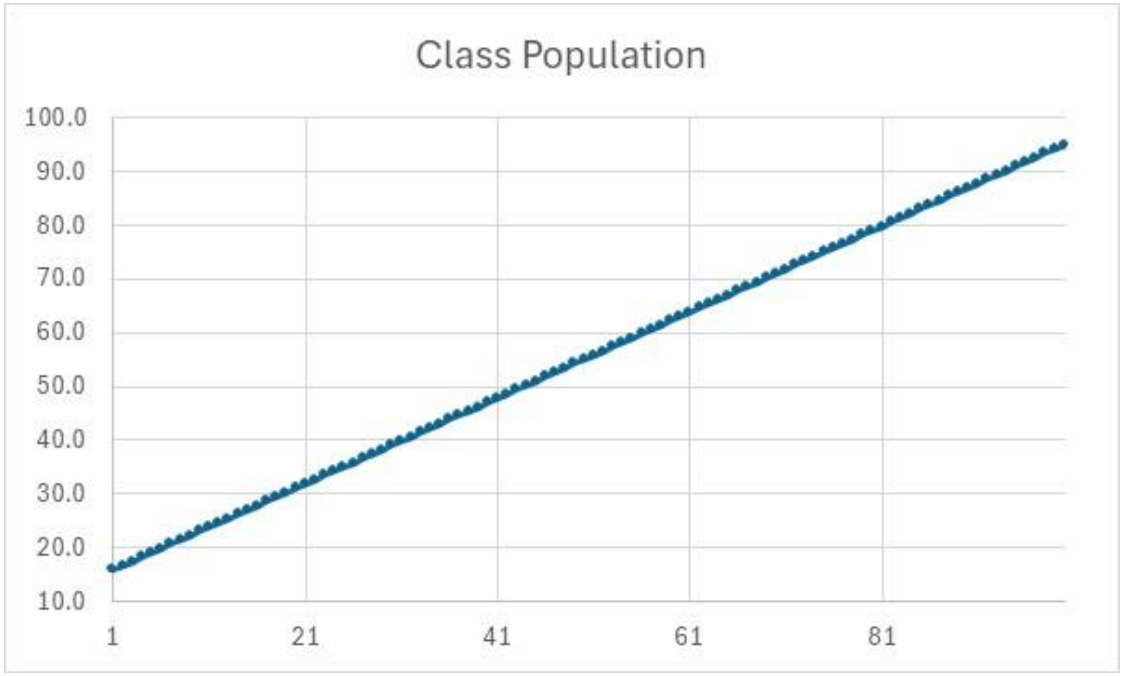
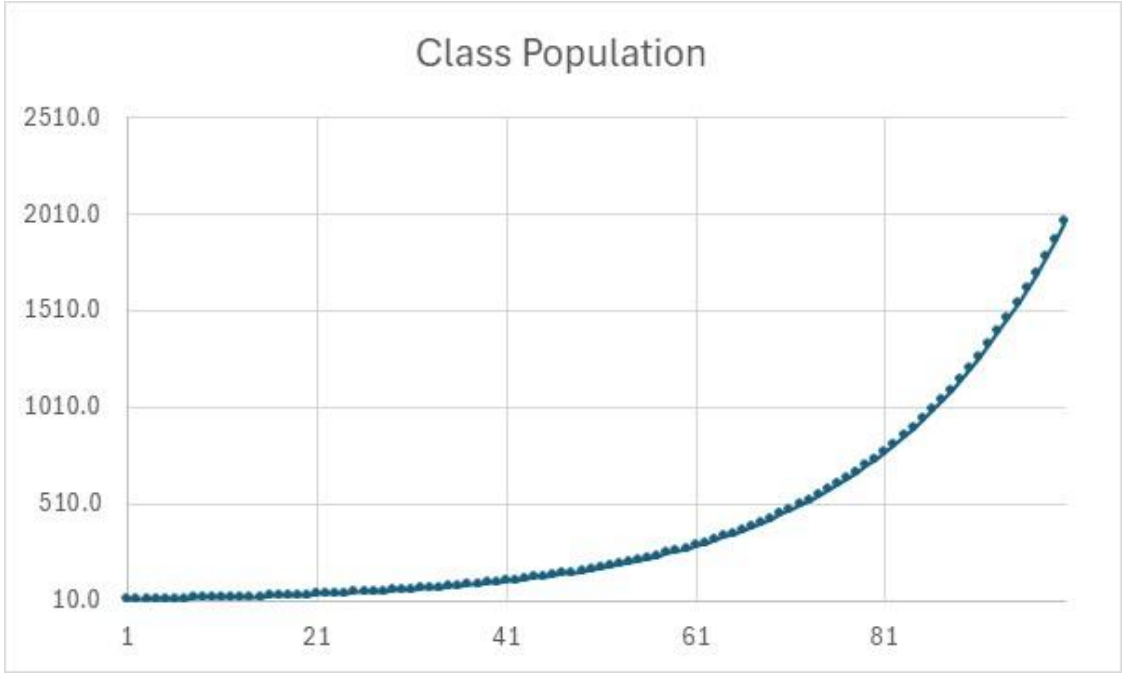
Demonstration 1: class population





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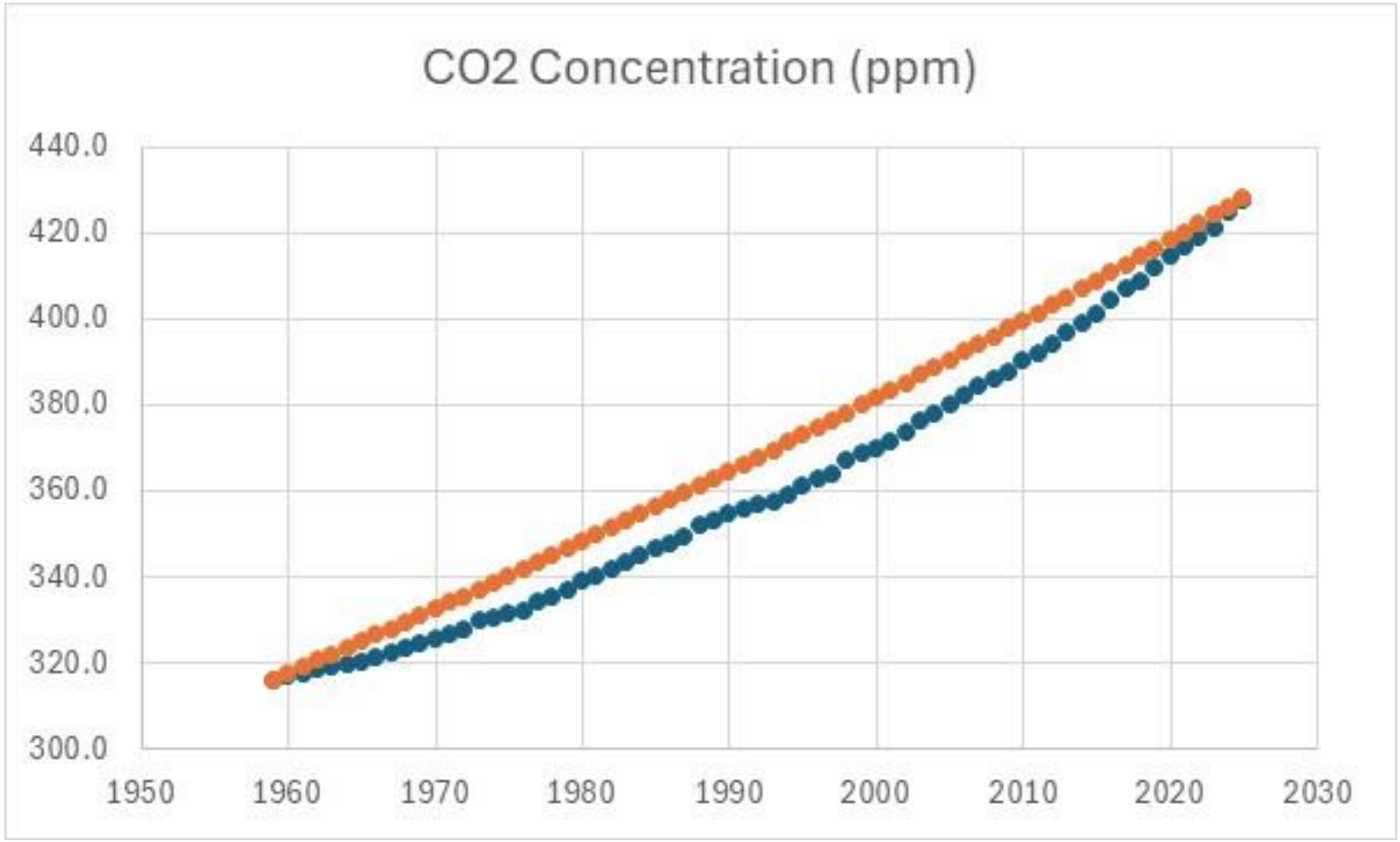
Demonstration 2: CO_2 concentration (ppm)



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Take-home-messages based on group exercise