

1/28/2026 Patterns in (environmental) math Class Notes

Today: Math (graphs and functions) and (Climate change) environment.

Please view climate change related videos on **update page**.

- 1. Please read all the information on update page and course page.**
 - 2. Quiz 2 will be friday, on number systems, bases, and graphs unless otherwise notified**
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From videos on climate change :

Greenhouse gases: Carbon dioxide, Methane, etc.,

Water vapour is also a greenhouse gas but its amount has been stable.

Fossil fuels (cause greenhouse gas emissions): Coal, Petroleum, natural gas, etc.,

Other sources of emissions: Agriculture and animal farms ; Industry

Climate change, graphs, functions

Each graph has two components : one on x axis and one on y axis.

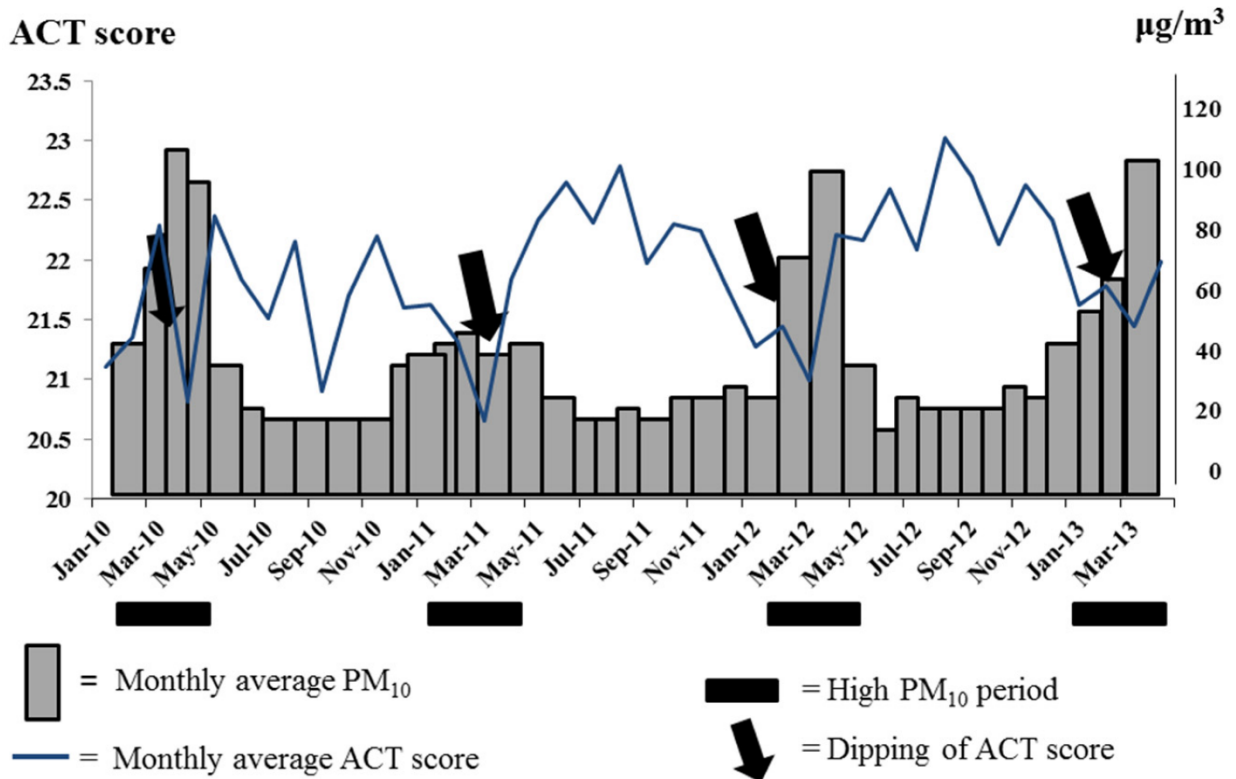
Scale has to be chosen properly or the graph could be misleading.

Graphs and Correlations

These graphs show correlation between two different quantities, for example, pollution and the incidence of asthma.

Source: <https://www.mdpi.com/2073-4433/14/2/410>

“Influence of Particulate Matter on Asthma Control in Adult Asthma”



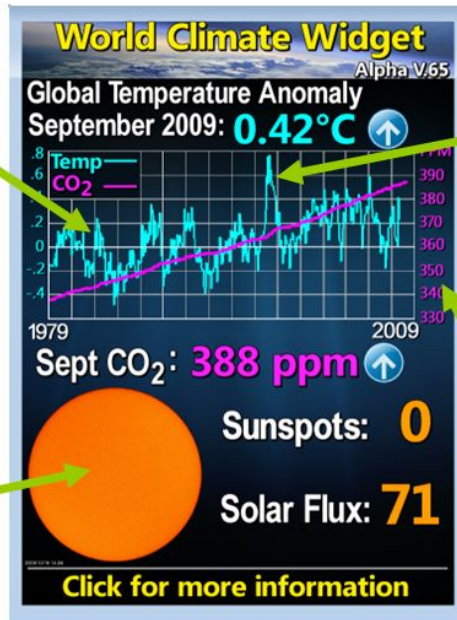
Warning: CORRELATION DOESN'T MEAN CAUSATION !

There should be more data to support the connection. Sometimes two graphs may look similar, but there may be no connection.

Changing the scale of graphs

Ploy #1: Monthly data are shown. These show large variations due to the weather, so the trend looks relatively small.

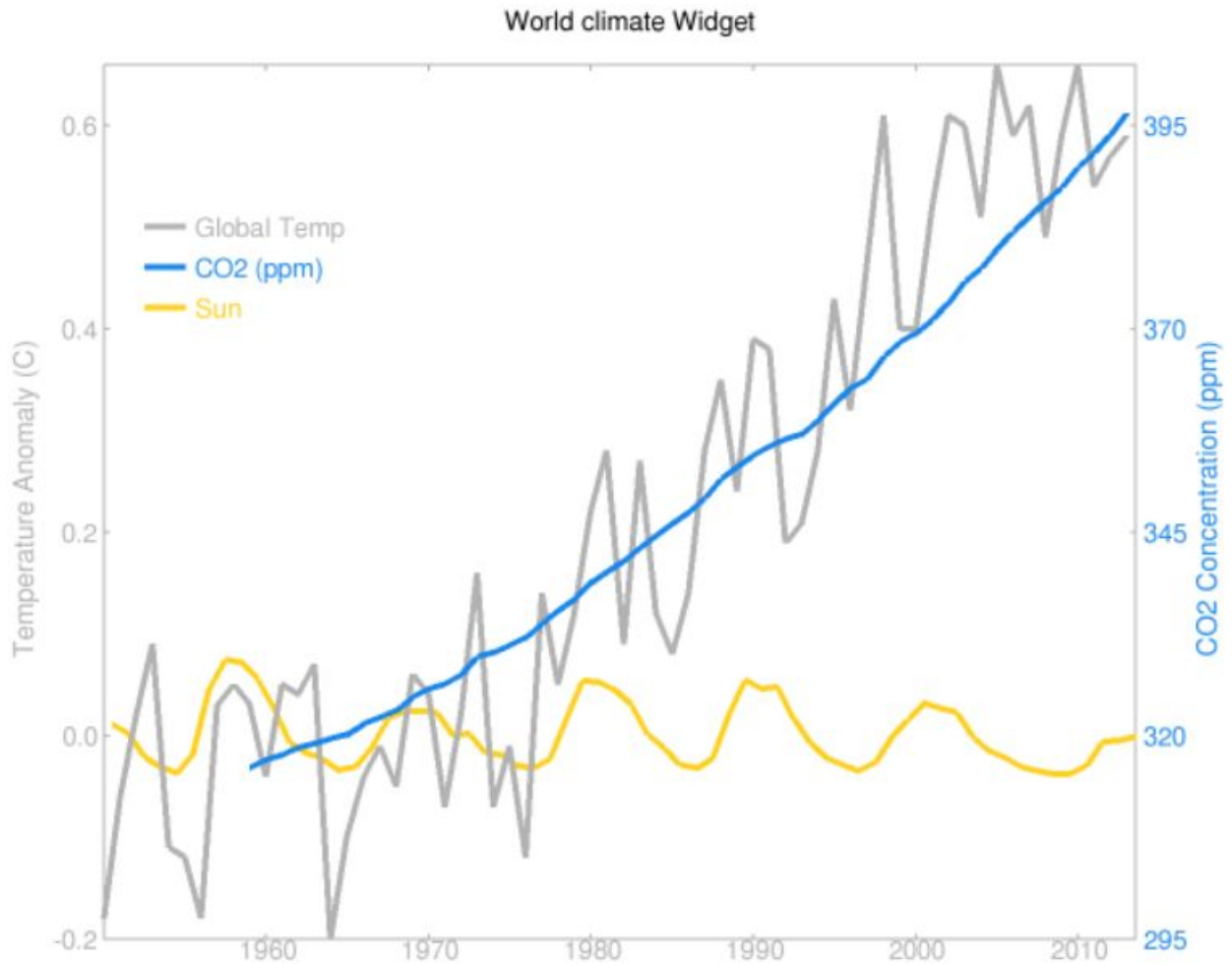
Ploy #4: A snapshot of the sun and the daily sunspot number suggests an important role of the sun. Not shown is the time series of sunspot numbers which shows it has almost nothing to do with global temperature.



Ploy #2: Shown is not the surface temperature but that from several km up in the troposphere. This shows larger variability, e.g. the El Niño peak of 1998 is twice as high as at the surface. This makes the climate trend look smaller.

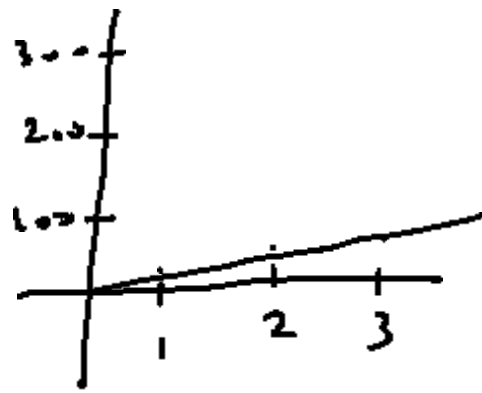
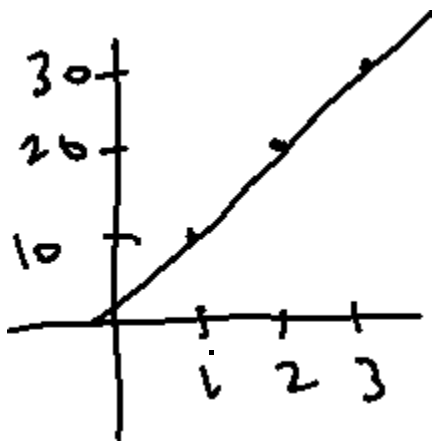
Ploy #3: A scale is chosen where the CO₂ rise appears much too steep. 70 ppm corresponds to 1.4 °C; that is about two and a half times faster than the relation predicted by climate science.

A more accurate graph is given in the next page. Notice how the scale for carbondioxide levels in the graph above (on the right side, in purple) are from 330 to 390 and the scale for temperature (on the left side, in blue) is from -0.8 to 0.8. In the next page, you have a graph with a more accurate scale that shows the correlation between the rise of carbondioxide and the rise of temperature.



In the next page there is a small demonstration of how a graph looks different when you change the scale.

It shows the graph of the same line, $y = 10x$, passing through (1,10), (2,20), (3,30),....on two different scales for the y-axis.

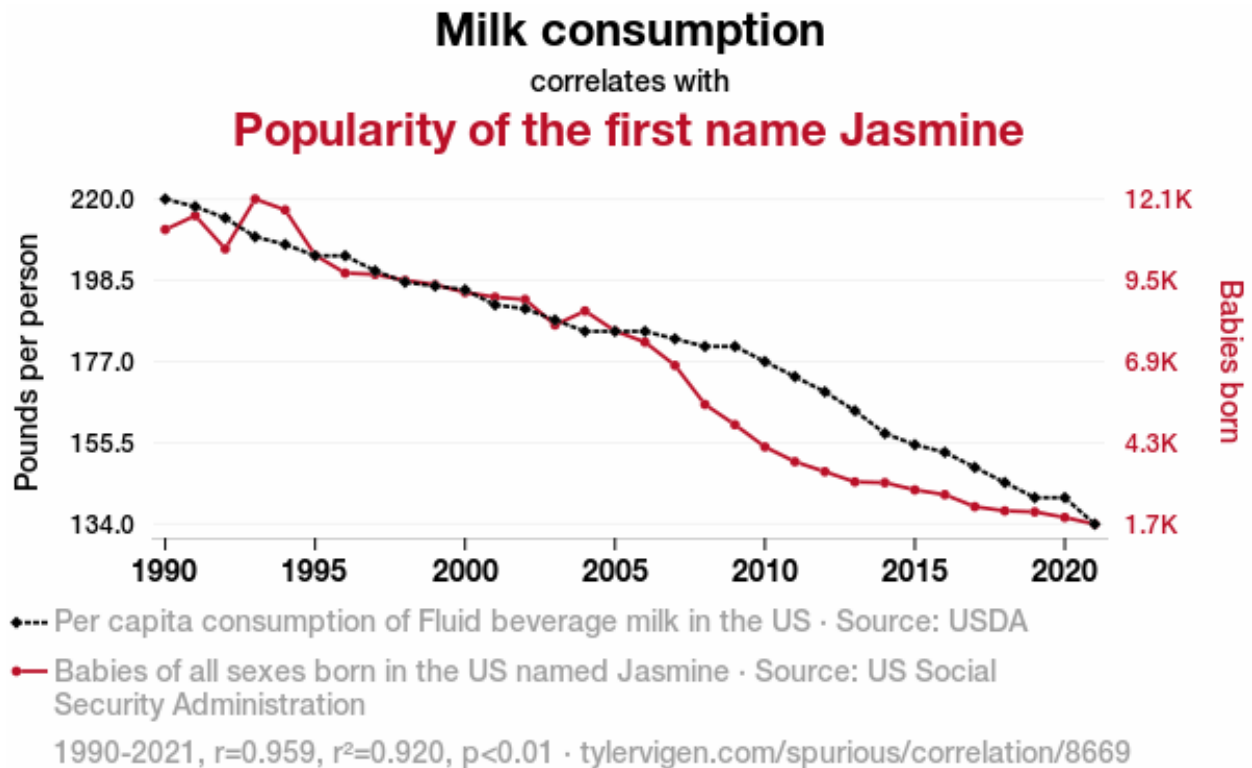


Climate change temperature observations:

Each year - study average of temperatures of all weather stations all over the earth over the whole year

Over centuries - historic weather data obtained from ice core samples from Antarctica

POLL QUESTIONS FROM TODAY



1. What does Milk v Jasmine graph show? The graph shows that:

- A. Milk consumption and popularity of “Jasmine” increased by the same amount, 1990 to 2021
- B. Milk consumption and popularity of “Jasmine” decreased by the same amount, 1990 to 2021
- C. Rate of Milk consumption and popularity of “Jasmine” increased by the same amount, 1990 to 2021
- D. Rate of Milk consumption and popularity of “Jasmine” decreased by the same amount, 1990 to 2021

The correct answer is D. The rates of decrease were the same. (It should say “the amounts decreased at the same rate”)

POLL QUESTION 2: (see climate change graph in page 3)

Why is climate change graph misleading?

Graph is misleading because

- A. The colors for temperature and CO₂ are different
- B. It doesn't show the actual amounts of temperature variation or CO₂ increase
- C. The scales are chosen to make the two quantities look unrelated
- D. They show the variation only over a short period of time

Correct answer is C. It is about the scale, as discussed above.

PRACTICE PROBLEMS FROM TODAY

1. Using data on the website https://world-weather.info/forecast/usa/washington_1/december-2024/ graph the high temperature of each day of December 2024, with the dates on the x axis and the temperatures on the y axis.
2. What things are logically wrong with the following statements, and how would you correct it?
 - a) "I get sick from viruses even if I eat healthy and exercise. So I am not going to eat healthy or exercise"
 - b) "Even though the electric cars themselves don't emit Carbon-dioxide, they get electricity from power plants that do, so we might as well drive gasoline cars" (NOTE: As mentioned in the article "Yes, EVs are green..." on update page, power plants on average are emitting less CO₂ now).

c) “The number of days of high temperature in DC below 65 in December was same as the number of days of high temperature was below 65 in Mars, so the weather in Mars is same as the weather in DC.”

3. Using the graph title “World Climate Widget” in page 4 of these notes, estimate the amount of CO₂ and global temperature rise in 2030.