

What's coming up....

- Lab 6 - bring 2 copies of paper for peer revisions THURSDAY
 - **If you do not bring a copy of your paper you will receive a 0 for lab 6!**
- Snapshot 6- linear, exponential, extrapolation, interpolation
- Excel Spreadsheet due via D2L Monday, Oct 14th at 10 pm
- Homework 7 due Monday, Oct 14th at 10 pm
- Writing Project due via D2L Monday, Nov 4th at 10 pm

- HELPFUL videos on **mth101.com**

pollev.com/msumath

Lecture 6

— Exponential Growth —
Log Scales

Writing Project

Questions about the project?

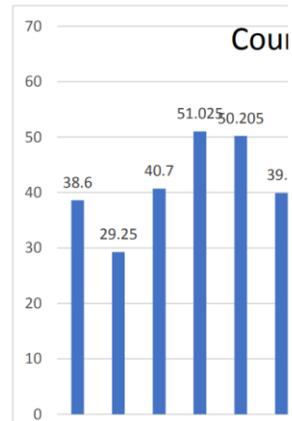
Summary:

- You need to write a 500-700 word paper (press release)
- Includes a table/chart or graph
- Explains your rankings
 - Metrics, weights, why they are important, positive or negative?
 - Limitations
 - Geographical patterns
- Correct file name + pdf format

Samples from previous semesters....

1. Japan
2. South Korea
3. United States
4. Singapore
5. Brazil
6. Mexico
7. Russia
8. China
9. India
10. Ukraine
11. Bangladesh
12. The Democratic Republic of the Congo
13. Botswana
14. Ethiopia
15. Nigera
16. South Africa

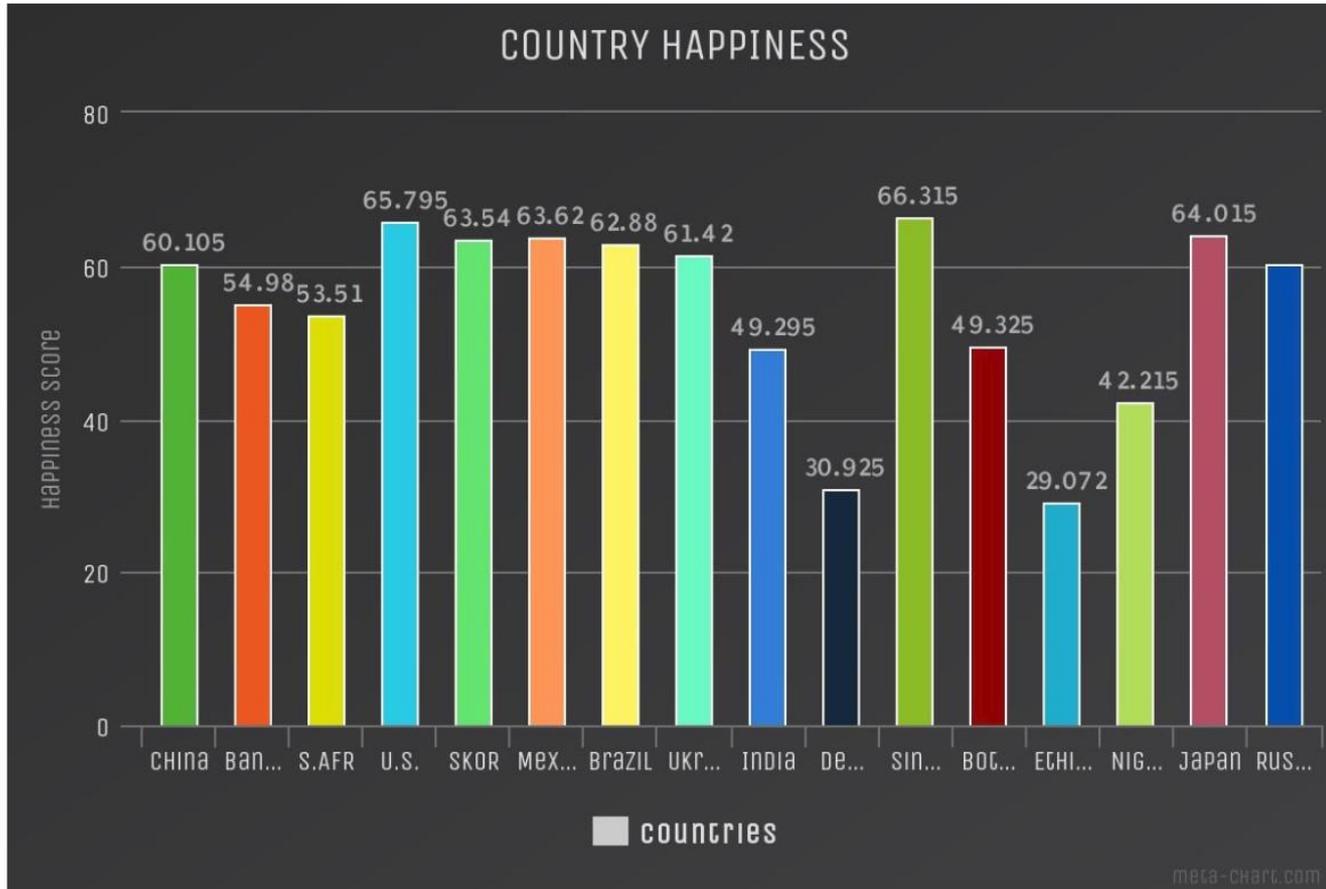
Metric Name	life expectancy %	internet users %		
Desired weight (insert in the green cell a decimal between 0 and 1)	0.25	0.1		
China	62	62	53.2	53
Bangladesh	45.8	45.8	18.2	18
South Africa	64.2	64.2	54	54
United States	79.1	79.1	76	76
South Korea	66.3	66.3	92.8	92.8
Mexico	70	70	59.5	59.5
Brazil	60.3	60.3	61	61
Ukraine	75.3	75.3	52.5	52.5
India	72.3	72.3	29.5	29.5
The Democratic Republic of the Congo	61.5	61.5	61	61
Singapore	82.1	82.1	81	81
Botswana	74	74	39.4	39.4
Ethiopia	69.2	69.2	15.4	15.4
Nigeria	67.2	67.2	25.7	25.7
Japan	72.3	72.3	93.2	93.2
Russia	71.1	71.1	73	53



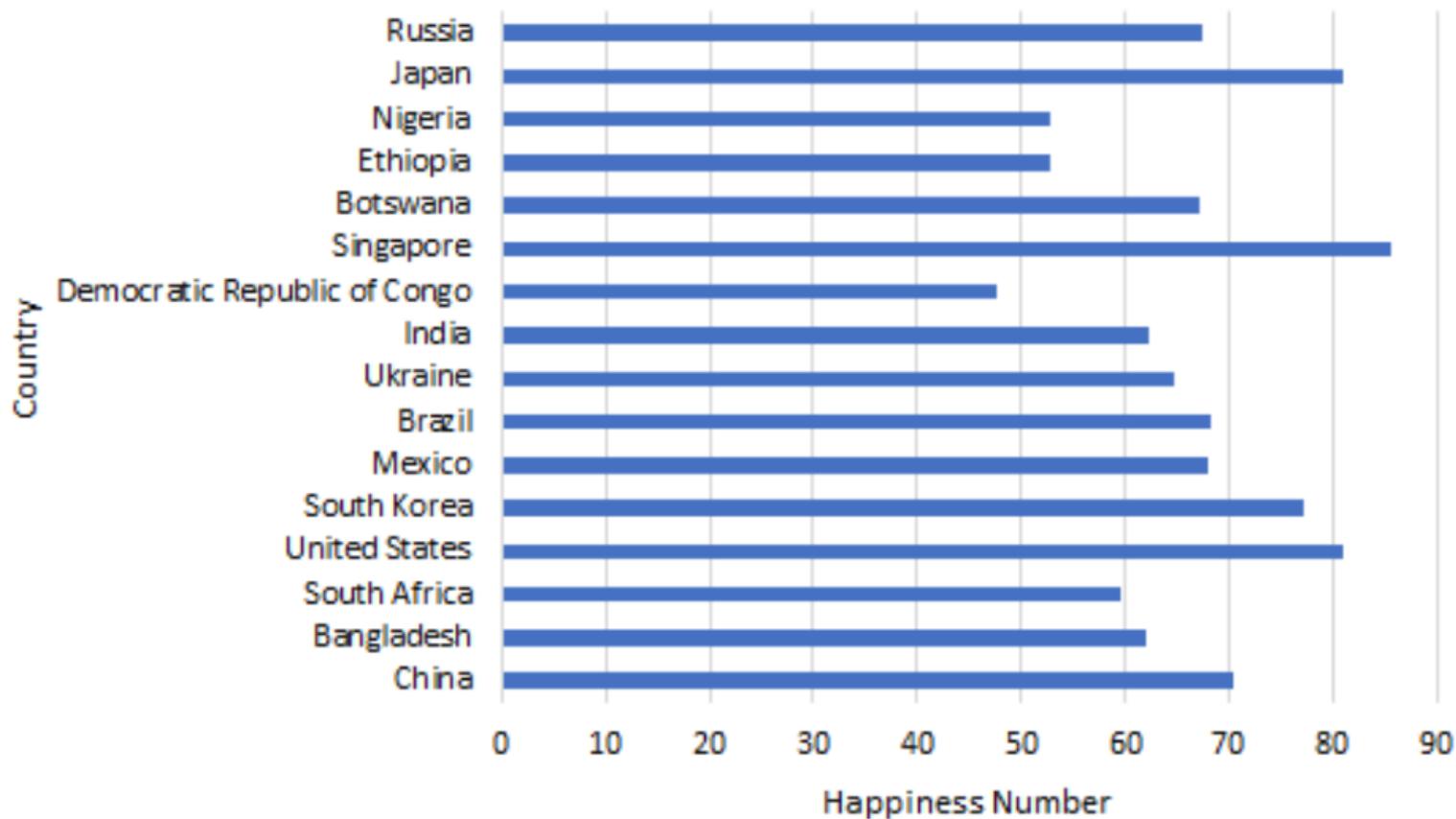
Metric 3, Unrefined literacy rate	Metric 3, Refined / youth	Metric 4, Unrefined exports % of gdp	Metric 4, Refined of gdp	Metric 5, Unrefined unemployment (15-24)	Metric 5, Refined (15-24)	Happiness Score
	0.2		0.2		0.25	1
73	73	31	31	12	-12	38.6
78.7	78	22	22	16	-16	29.25
76	76	44	44	19	-19	40.7
95	95	35	35	9.4	-9.4	51.025
77	77	56	56	9	-9	50.205
65	65	31	31	11	-11	39.9
97.5	97.5	29	29	7.2	-7.2	44.675
78	78	28	28	12	-12	42.275
82	82	36	36	8	-8	42.625
86	86	49	49	10.3	-10.3	45.9
99.7	99.7	78	78	2.9	-2.9	63.44
86	86	47	47	5.8	-5.8	47.59
88	88	57	57	14	-14	44.34
74	74	68	68	12	-12	44.77
65	65	54	54	6.8	-6.8	49.495
97	97	67	67	5.8	-5.8	54.445



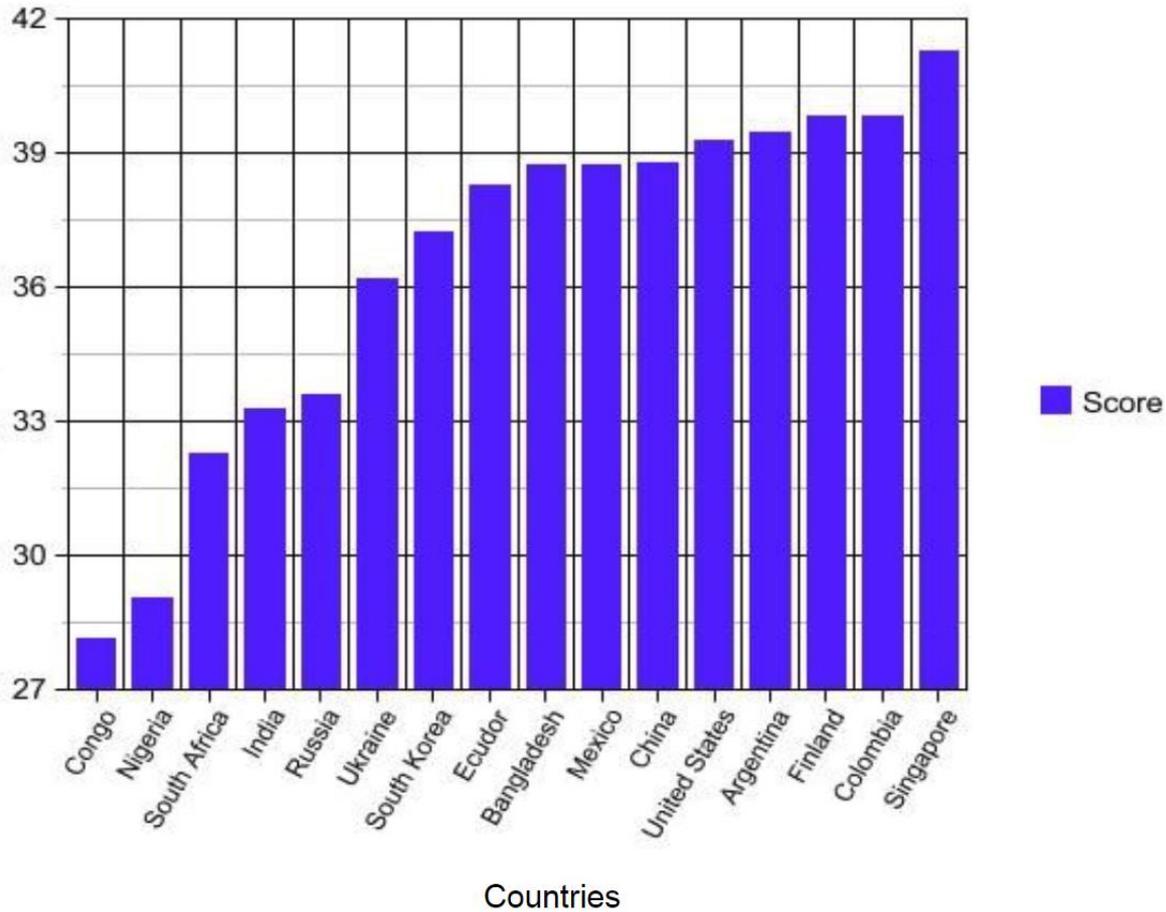
GRAPH REPRESENTING DATA



Happiness Country Rankings



Happiness Score by Country



HAPPINESS RANKINGS

MTH 101 SEC 011



What is Happiness?

According to Google, Happiness is simple: It's the state of being happy. As a growing society, we all measure

what is the best way to determine happiness in life. We all value different things in our lives in order to be happy and fulfill our desires. Happiness is evident to vary from culture to culture, person to person and in this case; country to country. In this article, five different metrics* were used to determine sixteen different countries happiness rankings and scores. However, please note that these sixteen countries potentially obtain different limitations in their data provided.

the data is given and taken per 100k people in each country. Mental health is a big component, in my opinion, factoring towards happiness for the sake of mind. If you don't take the time to bring public awareness towards mental health; the result could potentially be suicide which is why it's a negative weight towards the total ranking.

Income Per Person



Mental Health
(suicide per 100k)

Metric Weight : 20%



Income Per Person

Metric Weight : 10%



Country	Rank	Score
Singapore	1	61.9
United States	2	58.9
Japan	3	55.7
South Korea	4	52.9
Mexico	5	46.6
Brazil	6	46.1
Russia	7	45.5
China	8	42.2
Ukraine	9	42
Botswana	10	41.2

Relative Variable* - a quantity that accounts for it's relative size in some way. (refined)

Absolute Variable* - a quantity that does not account for its relative size in any way. (unrefined)

Metric* - a means of measuring something.

  [rankings_pdf.pdf](#) (265.42 KB)

  [MTH 101 Writing Assignment RD.doc](#) (44 KB)

  [press release.pdf](#) (101.54 KB)

 *Incorrect Naming!*

Review of Key terms:

Linear

Exponential

Interpolation

Extrapolation

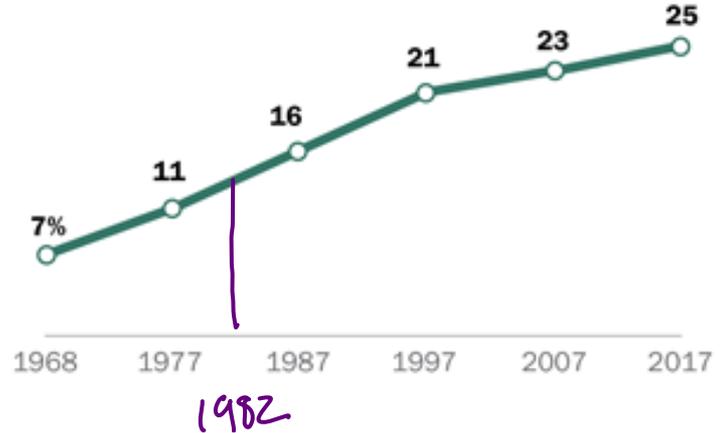
PollEverywhere L6-Q1

The percent of unmarried parents among all parents living with a child 1982 was about _____ and this estimation is called _____.

- A. 11%, interpolation
- B. 14%, interpolation
- C. 11%, extrapolation
- D. 14%, extrapolation

One-in-four U.S. parents are unmarried

% unmarried, among all parents living with a child



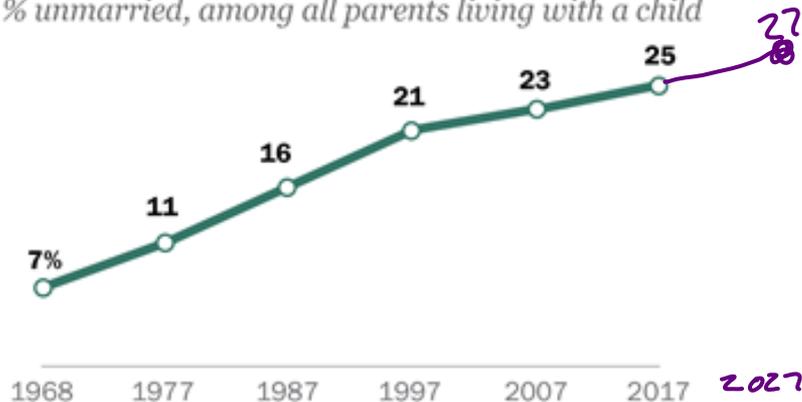
PollEverywhere L6-Q2

If the trend continues, the percent of unmarried parents among all parents living with a child in 2027 is about:

- A. 25%
- B. 27%**
- C. 30%
- D. 35%

One-in-four U.S. parents are unmarried

% unmarried, among all parents living with a child



Radioactive Decay and Half-life

Radioactive isotopes eventually decay, or disintegrate, to harmless materials.

Some isotopes decay in hours or even minutes, but others decay very slowly.

Strontium-90 and cesium-137 have half-lives of about 30 years (half the radioactivity will decay in 30 years).

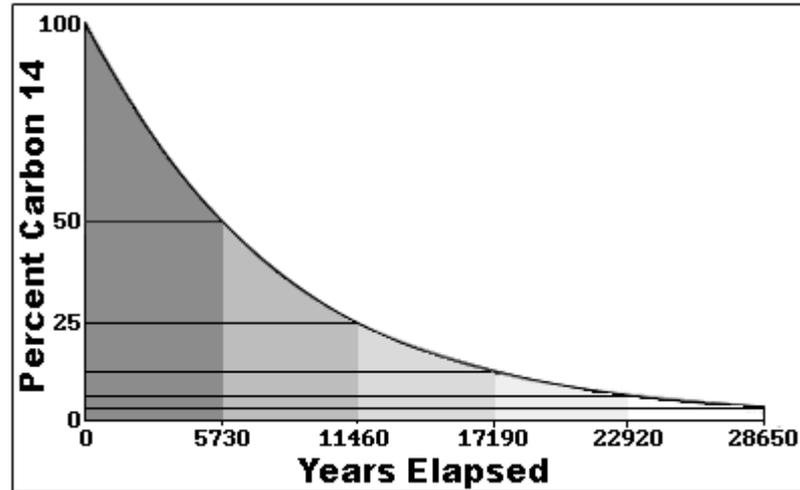
Plutonium-239 has a half-life of 24,000 years.

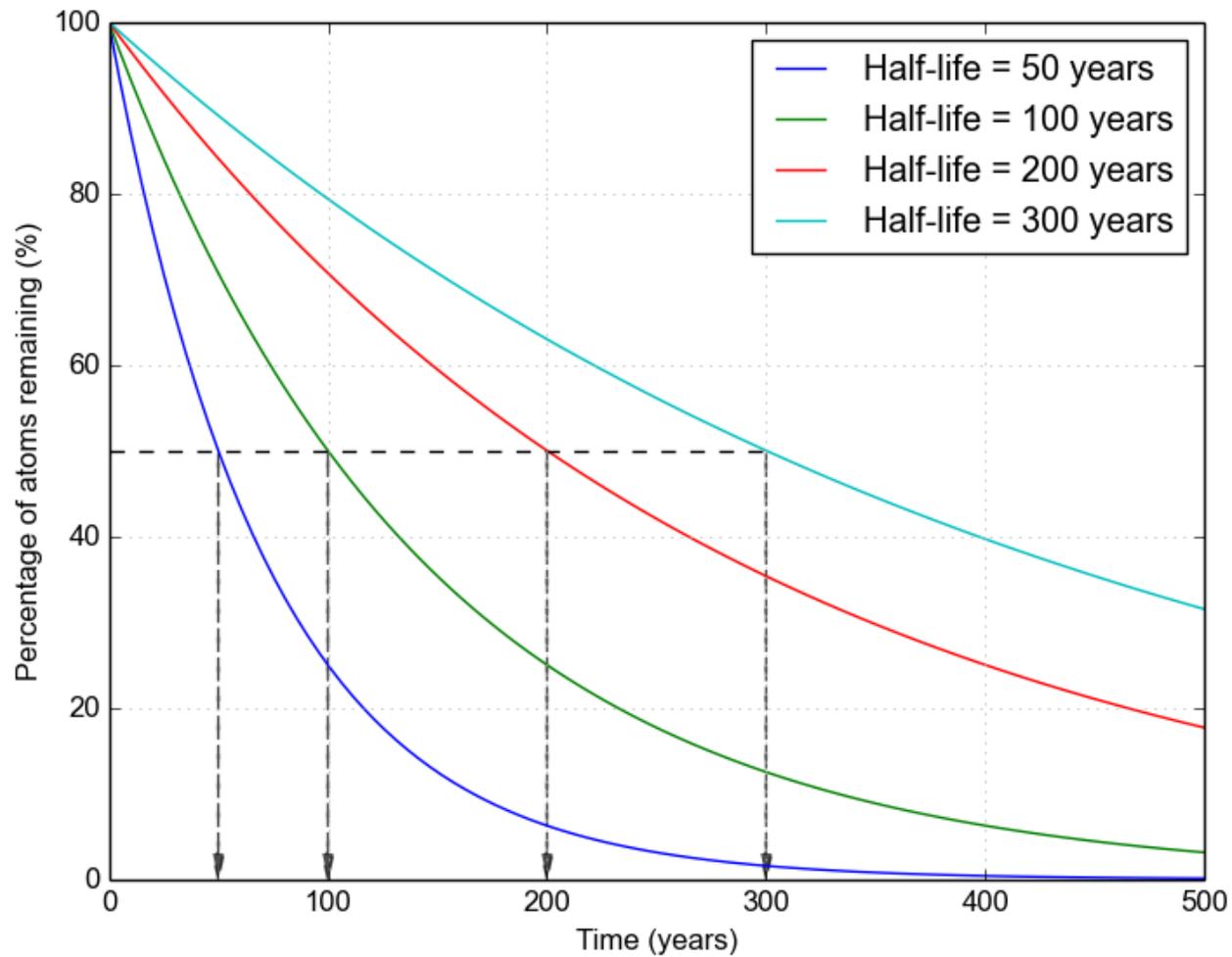
Poll Everywhere L6-Q3

The half-life of plutonium-244 is about 24,000 years. If there is 100 mg of plutonium-239 buried underground, we can say the following:

- A. In 48,000 years, there will be only 50 mg of Pu-239.
- B. In 48,000 years, there will be only 25 mg of Pu-239.
- C. In 48,000 years there will be 0 mg of Pu-239. After 2 half-lives, the entire substance will decay.
- D. We can't tell with the given information.

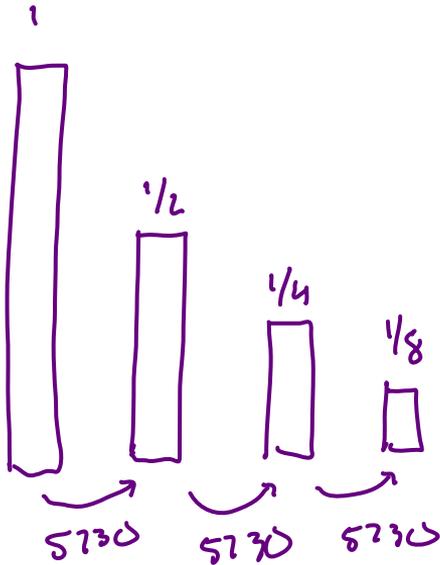
Carbon-14 and Dating Remains





Decay

Carbon-14 has a half-life of about 5,730 years. Suppose you find a bone and chemical analysis tells you that only $\frac{1}{8}$ of the bone's original Carbon-14 remains. How old is the bone?



$$5730 \cdot 3 = 17,190 \text{ years}$$

Exponential Growth/Decay Formula

From last week...

$$Q = Q_0 \times (1 + r)^t$$

Q = the value of exponentially going (or decaying) quantity at time t

Q_0 = initial value of quantity (at $t=0$)

r = fractional / decimal growth rate (decay if $r < 0$)

t = time

Half Life Formula

$$Q = Q_0 \times (0.5)^{t/h}$$

t= time

h= half life

Example

The half-life of Americium-241 (which is used in smoke detectors) is 432 years. If a sample contains 10 mg, how many milligrams will remain after 1000 years?

$$\begin{aligned} Q &= Q_0(0.5)^{t/h} \\ &= 10(0.5)^{1000/432} \\ &= 2.009 \approx \boxed{2 \text{ grams}} \end{aligned}$$

Example

The half-life of Nitrogen-13 is ten minutes. After 30 minutes a sample of Nitrogen-13 has been reduced to a mass of 2 mg. What was the initial mass (in mg) of the sample?

$$Q = Q_0(0.5)^{t/h}$$

$$2 = Q_0(0.5)^{30/10}$$

$$Q_0 = \frac{2}{0.5^3} = \boxed{16 \text{ mg}}$$

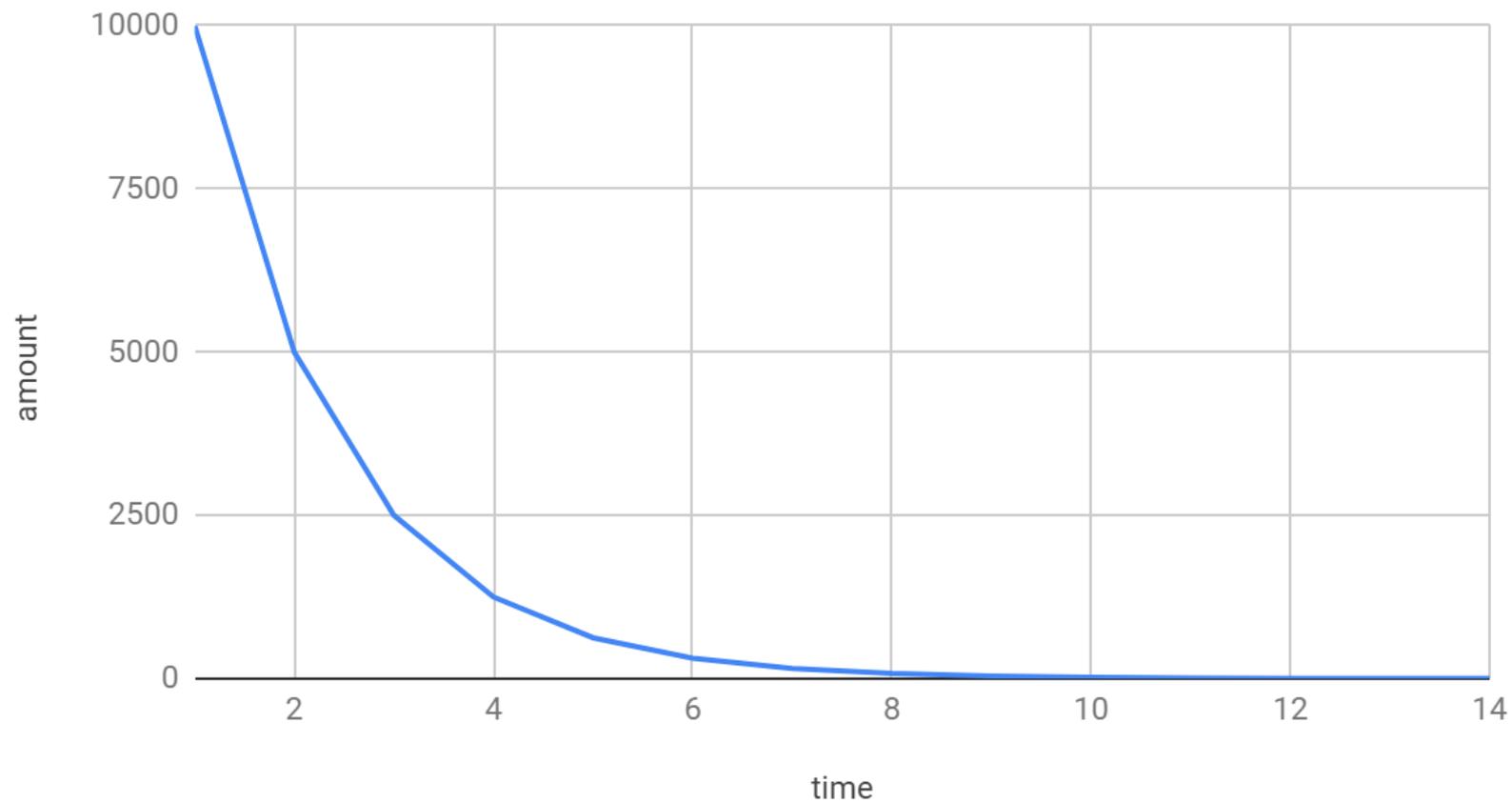
What is the mass 2 hours after the start?

$$Q = 16(0.5)^{120/10} = \boxed{0.0039 \text{ mg}}$$

Think about...

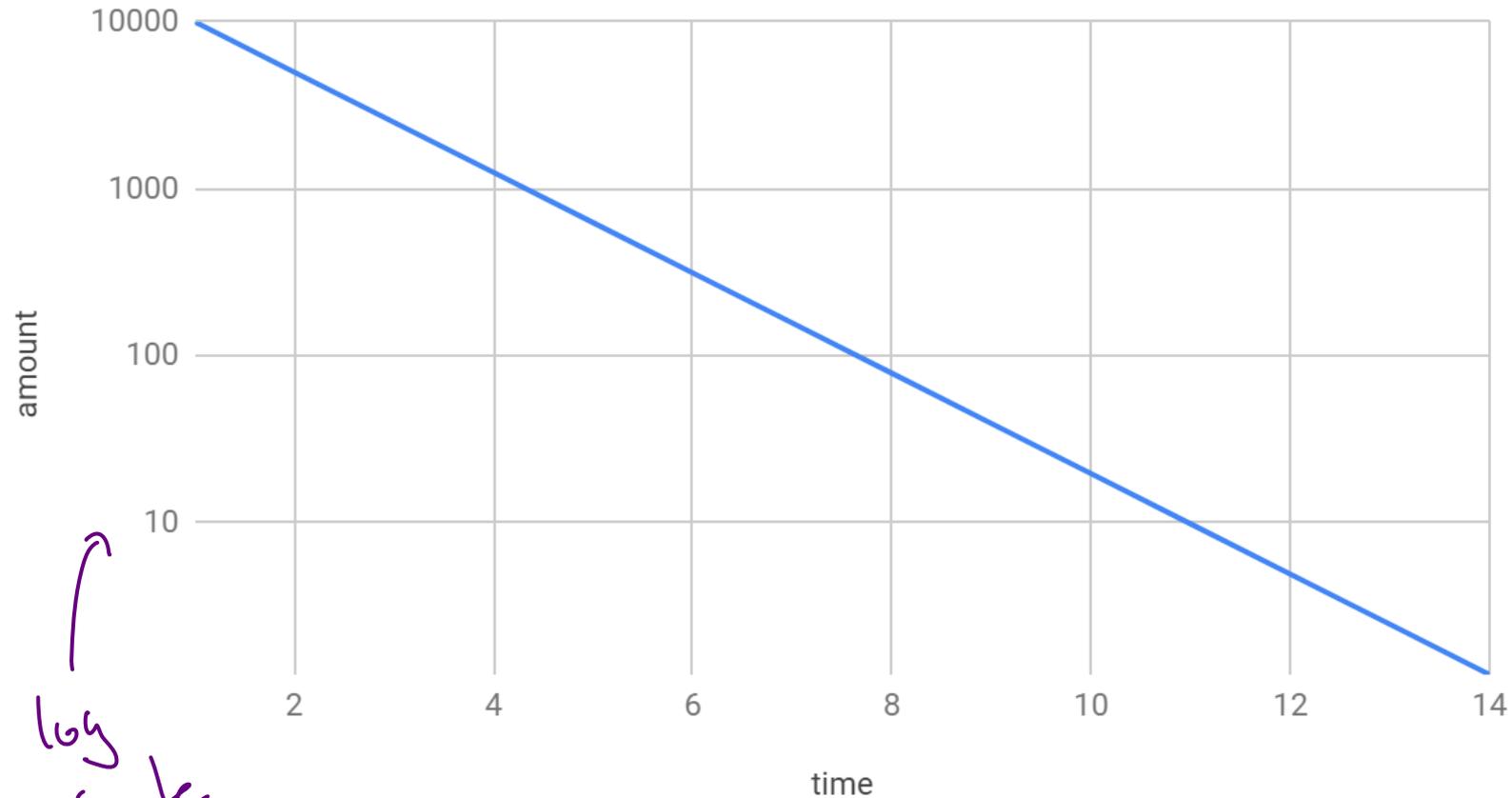
Let there be 10,000 grams of a substance with a half life of 1 hour.

amount (grams) vs. time (hrs)



Change the scale of the vertical axis...

amount (grams) vs. time (hrs)



log
Scale

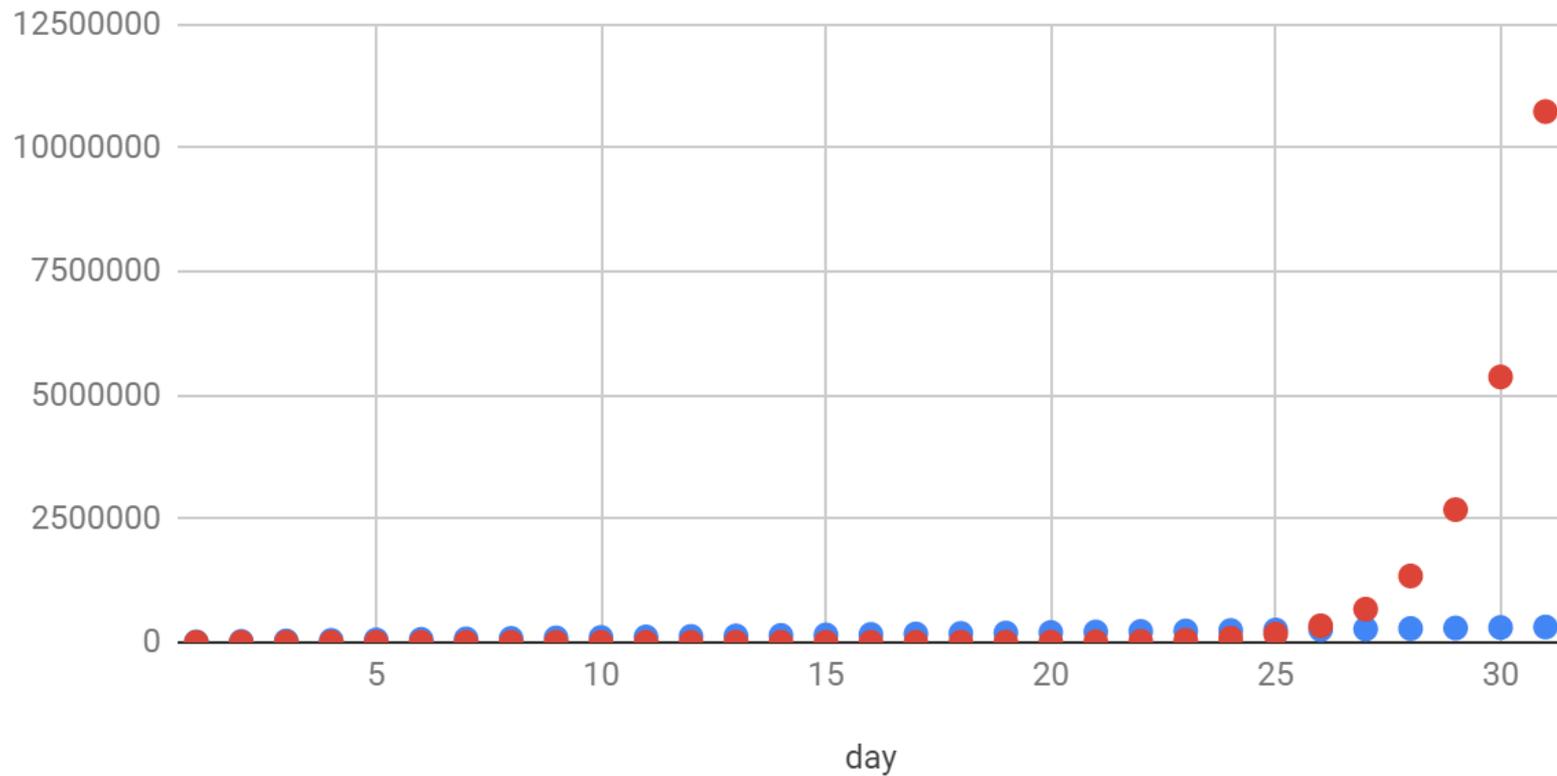
LOG scale

- Can help graph exponential growth/decay
- Linear scale- a constant distance between each tick mark (time)
- Log scale- a constant ratio between each tick mark (previous example)

Revisit example from last week

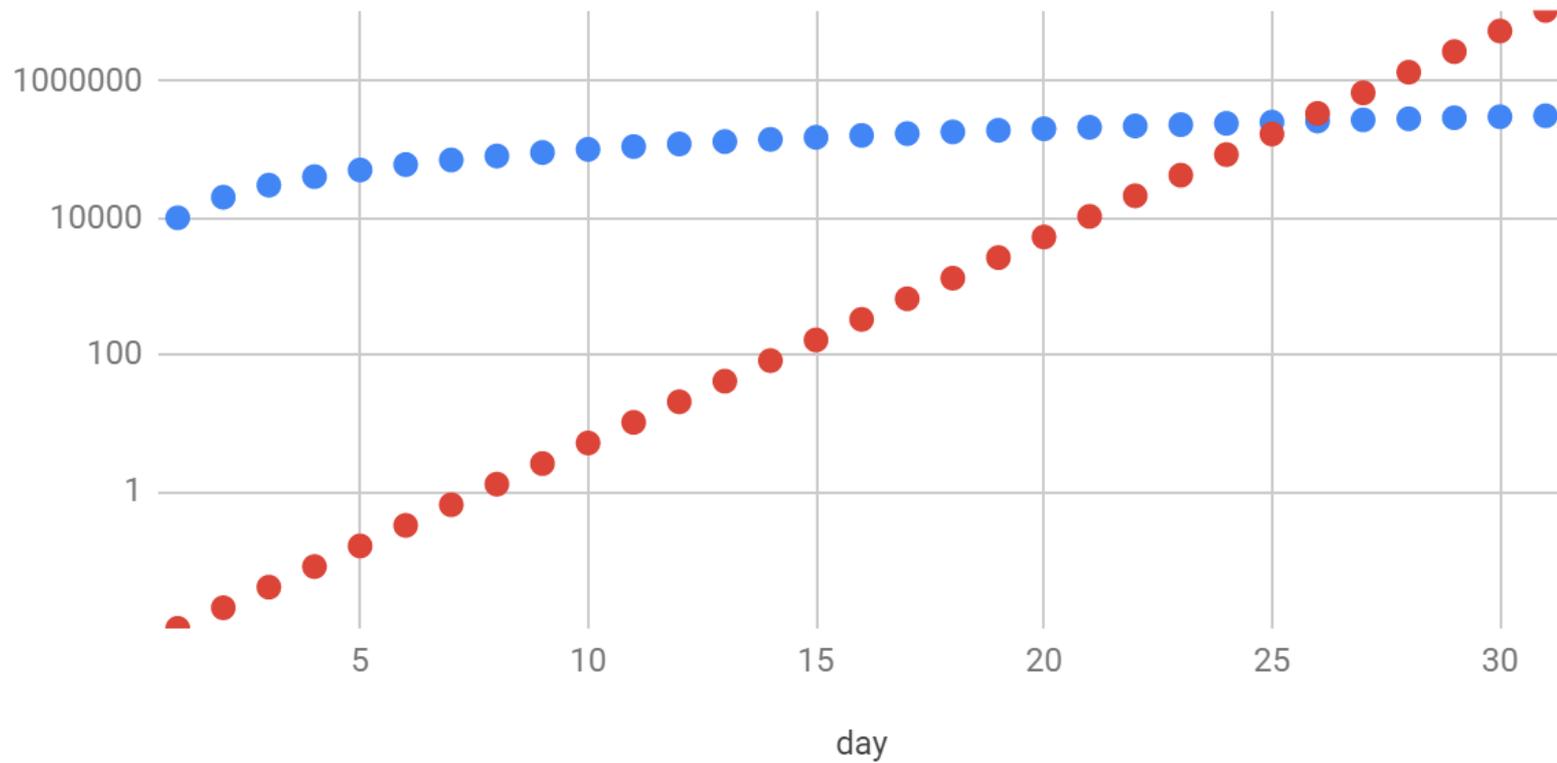
option 1 and option 2

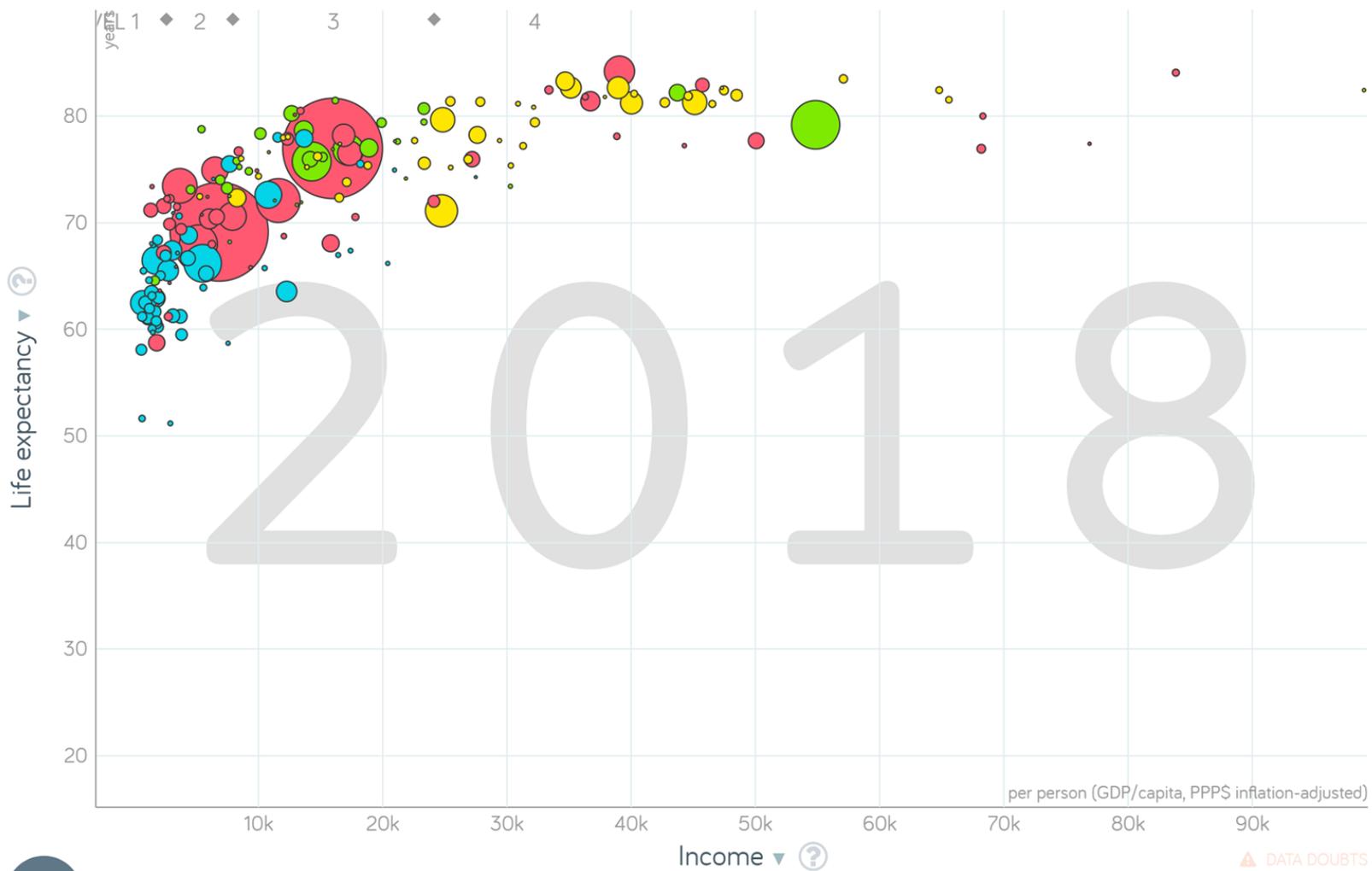
● option 1 ● option 2

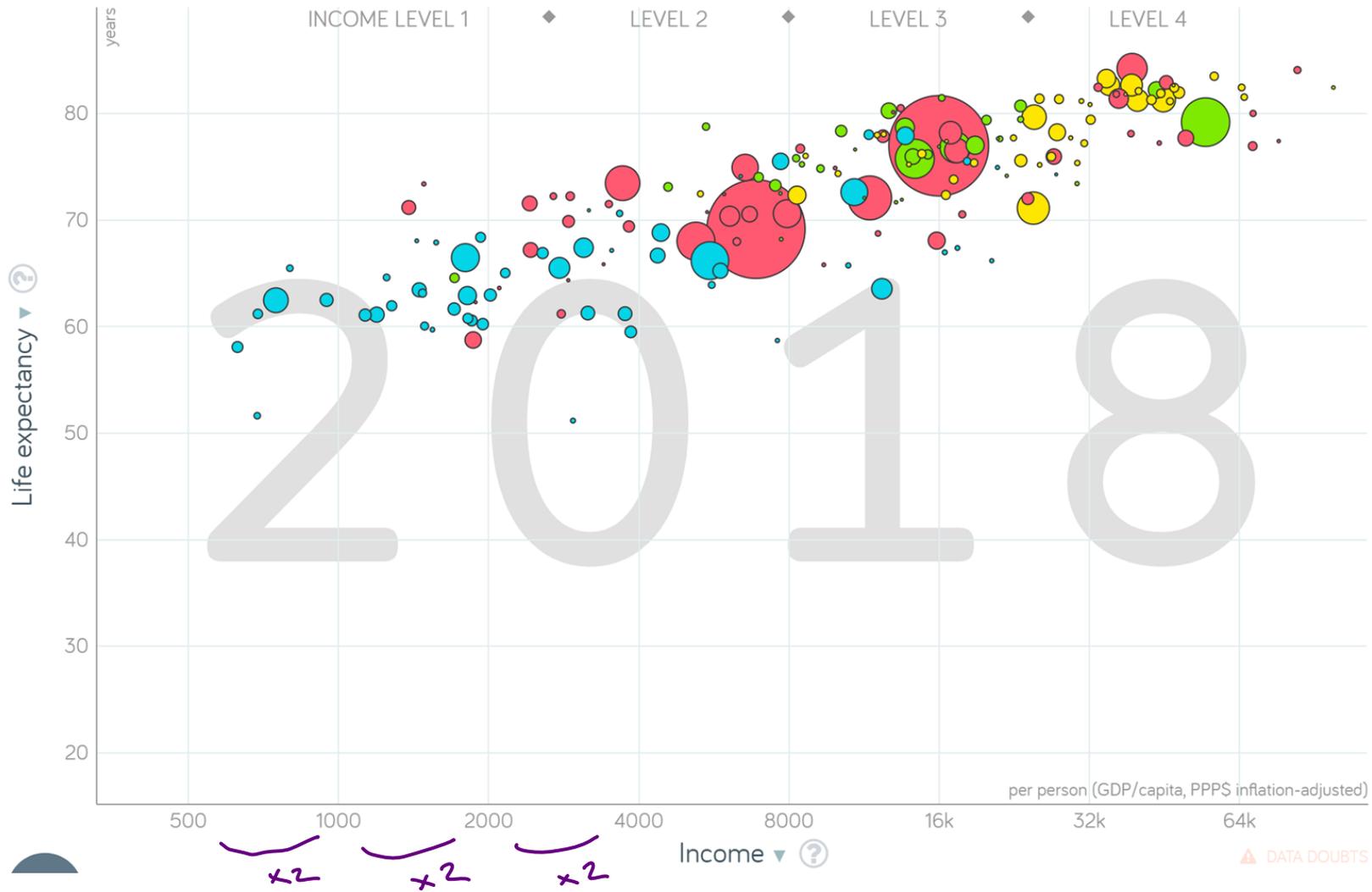


option 1 and option 2

● option 1 ● option 2







Measuring Earthquakes

How does an Earthquake of magnitude 2 compare with an Earthquake of magnitude 3? Or 4?

S&P 500 Trailing Year Earnings per Share January 1950 - April 2016



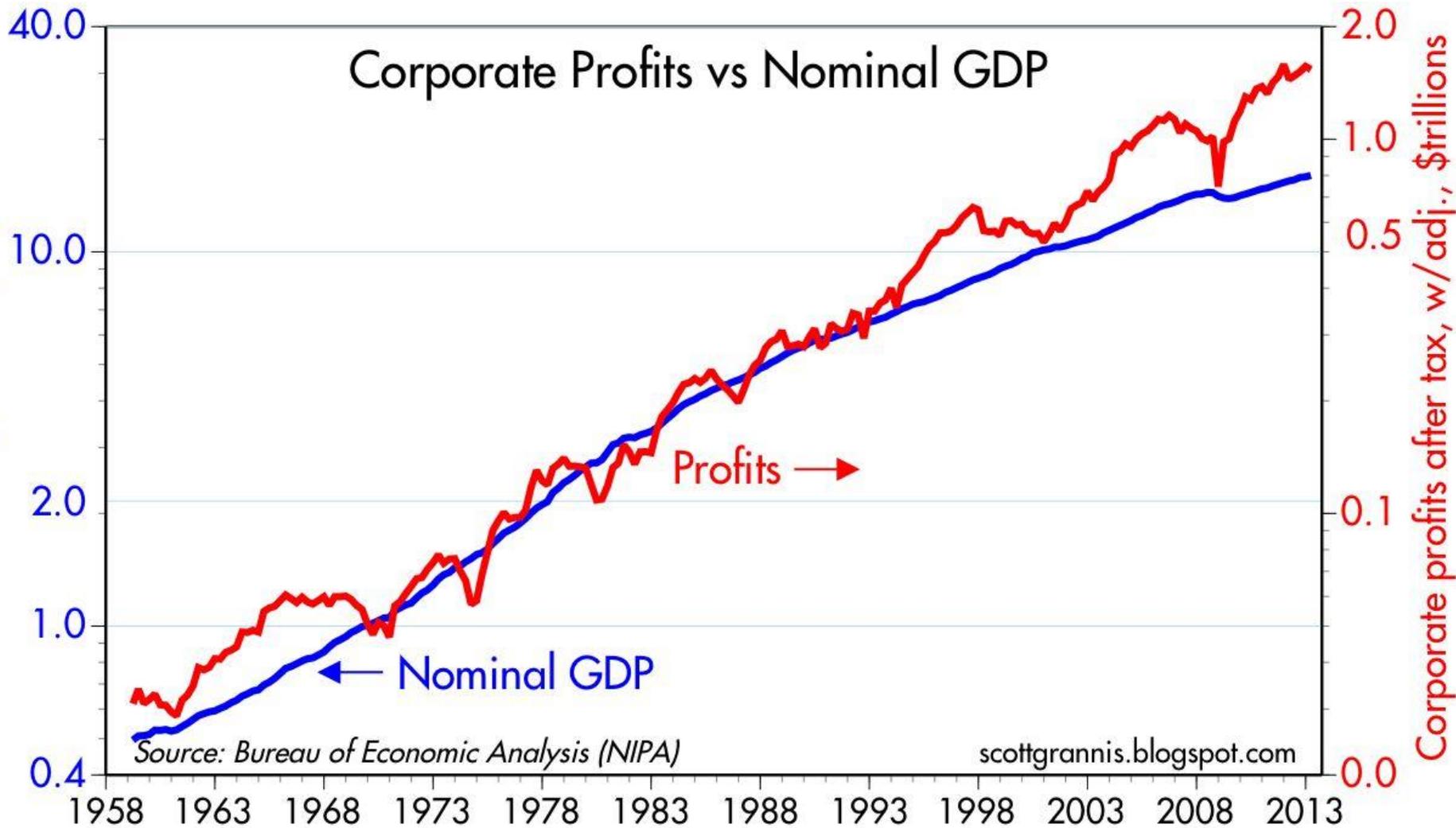
Source: Robert Shiller, Standard & Poor, Author's Calculations

Note: Average monthly value represents average of values recorded at the close of trading for the S&P 500 index and its predecessors on each trading day during a calendar month.

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Corporate Profits vs Nominal GDP

Nominal GDP, \$trillions, log scale



Source: Bureau of Economic Analysis (NIPA)

scottgrannis.blogspot.com

Profits →

← Nominal GDP

Corporate profits after tax, w/adj., \$trillions