

# Pop Quiz

Math 113-001/6 College Algebra  
Colorado Mesa University Fall 2022

1. Below is a table reporting the US national debt<sup>1</sup>, presented in *trillions* of dollars, for select years.

year	1992	2001	2007	2011	2017	2021
debt (in trillions)	4.06	5.81	9.00	14.79	20.24	28.43

- (a) Do you think an exponential model or a logarithmic model would fit the data best?
- (b) Based on your choice in the previous part, perform regression to find a function of  $t$  years after 1990 that models the data. Write this function below with parameters ( $a$  and  $b$ ) rounded to two decimal places. (If you do not have a calculator capable of regression, simply write “no calc” and circle whichever of these functions you think fits the data best.) Use this function as your model for the remaining questions.

$$3(1.07)^t \quad -4 + 7\ln(t) \quad 4(0.92)^t \quad 2 + 4.06\ln(t)$$

- (c) What does your model predict the national debt this year to be?
- (d) The actual national debt this year is about 30.93 trillion dollars. What is the difference between this figure and your model's prediction?
- (e) According to your model, when will the national debt be one quadrillion (1000 trillion) dollars?

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<sup>1</sup>[fiscaldata.treasury.gov/datasets/historical-debt-outstanding](https://fiscaldata.treasury.gov/datasets/historical-debt-outstanding)

2. Coloramo Credit Union offers *Certificates of Deposit* (CDs) to its account holders<sup>2</sup>. A CD is a special account where you deposit a certain amount of cash and promise not to withdraw that cash for a pre-determined amount of time. In return for this promise the credit union offers you a higher interest rate than they do for a typical savings account.
- (a) Coloramo offers a four-year CD with a 1.837% interest rate compounded quarterly (once every three months). If you invest \$1000 into this CD, how much will your CD be worth after those four years?
- (b) How much more would the CD be worth if instead of compounding the interest quarterly Coloramo compounded the interest every month?
- (c) How much more would the CD be worth if instead of compounding the interest quarterly Coloramo compounded the interest *continually*?
- (d) Suppose you plan on graduating college in four years. You're living on campus now, so you don't have a car, but you know you'll need a car to commute to work after you graduate. You estimate that \$21,000 should be enough to buy an adequate car in four years when you graduate, and figure why not deposit some money into Coloramo's four-year CD and collect that \$21,000 in four years. How much money should you deposit in Coloramo's four year CD such that after four years it will be worth \$21,000?

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<sup>2</sup>[coloramo.org/rates/#certificate](https://coloramo.org/rates/#certificate)

The table gives the life expectancy (life span) for people in the United States for select birth years from 1920 and through 2018<sup>3</sup>.

	Year	Life Span
1. Using technology, perform regression to find a logarithmic function $f(t) = a + b\ln(t)$ that models the data, with $t$ equal to 0 in 1900.	1920	54.1
	1930	59.7
2. Using technology, perform regression to find a power model $g(t) = a \cdot b^t$ that models the data, with $t$ equal to 0 in 1900.	1940	62.9
	1950	68.2
3. Using technology, plot the graphs of each of these functions along with the data on the same set of axis and decide which model fits the data best. On your plot make sure the domain of $t$ matches up with the years 1920–2030.	1960	69.7
	1970	70.8
4. What does the model that you decided fits the data best predict your own life expectancy to be?	1975	72.6
	1980	73.7
5. What does the model that you decided fits the data best predict the life expectancy of a baby born today to be?	1987	75.0
	1988	74.9
6. What year does the logarithmic model predict will be the year life expectancy is 80 years?	1989	75.2
	1990	75.4
7. In the years since 2018, life expectancy in the US has started to decline <sup>4</sup> . This is suspected to be due to the COVID-19 pandemic. Someone born in the US in 2019, 2020, and 2021 has a life expectancy of 79 years, 77 years, and 76.1 years respectively. Add this new data to the data set.	1992	75.8
	1994	75.7
Both logarithmic and power functions are increasing functions. Since life expectancy is decreasing in recent years though, these functions may no longer provide the most accurate models. What's a type of function that more accurately models data that initially increases, but then begins to decrease? Using technology, perform regression to find such function $h(t)$ that models the data, again with $t$ equal to 0 in 1900.	1996	76.1
	1998	76.7
8. What does this new model predict the life expectancy of a baby born today to be? How does this compare to the figure predicted by either your logarithmic or power model?	1999	76.7
	2000	76.8
	2001	77.2
	2002	77.0
	2003	77.6
	2004	77.5
	2005	77.6
	2010	78.7
	2015	78.7
	2016	78.7
	2017	78.6
	2018	78.7

<sup>3</sup>[cdc.gov/nchs/data-visualization/mortality-trends](https://www.cdc.gov/nchs/data-visualization/mortality-trends)

<sup>4</sup>[npr.org/sections/health-shots/2022/08/31/1120192583](https://www.npr.org/sections/health-shots/2022/08/31/1120192583)