Name:

Date:

# LOG Scale

Part I: Defining LOG Scale

The linear function $y = 2x + 1$ generates the following table:

| x | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | ... |
|---|---|---|---|---|---|---|---|---|-----|
| y | 3 | 5 | 7 | 9 | 11 | 13 | 15 | 17 | ... |

1. If we increase the *x* by one what happens to the *y*?

    *If we increase the x by one, y goes up by adding 2.*

2. Describe this relationship such that it holds for any two consecutive *y* values.

    *Every time x increases by 1, y increases by adding 2 to the previous y.*

The exponential function $y = 3^x$ generates the following table:

| x | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | ... |
|---|---|---|---|---|---|---|---|---|-----|
| y | 3 | 9 | 27 | 81 | 243 | 729 | 2,187 | 19,683 | ... |

3. If we increase the *x* by one what happens to the *y*?
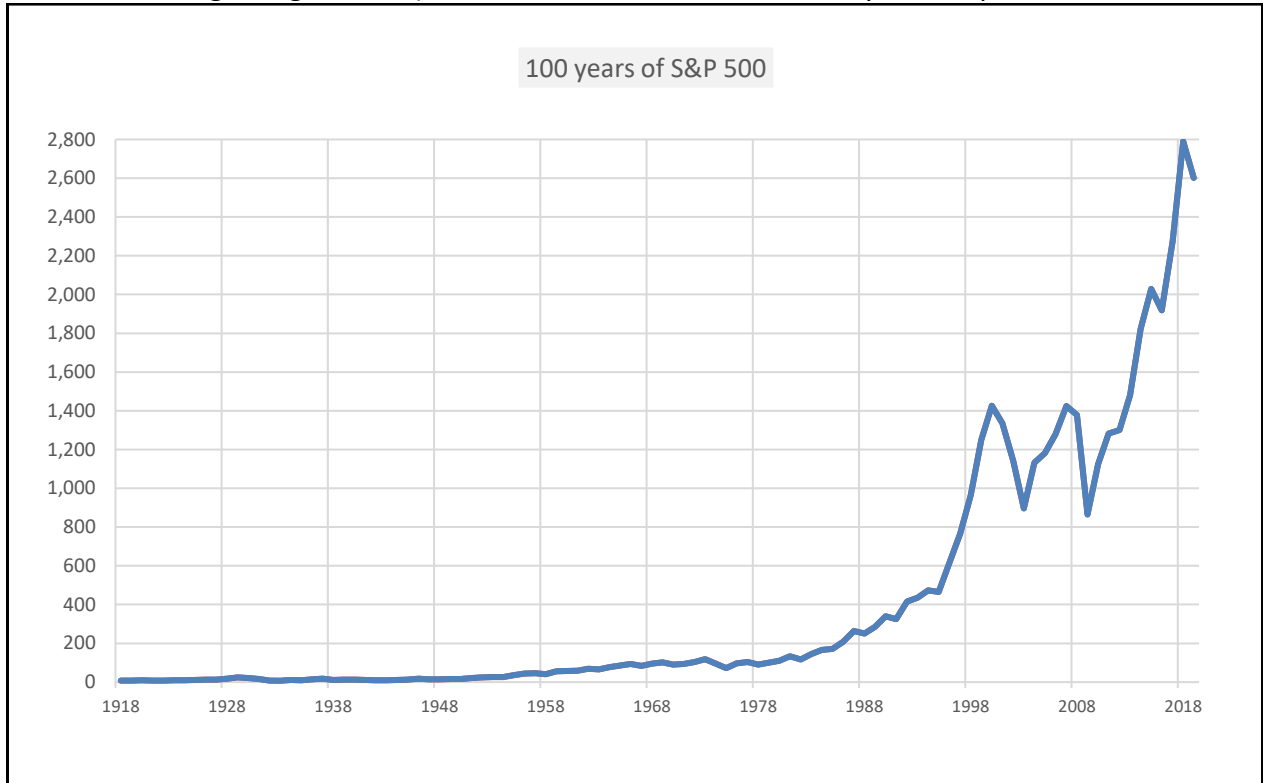
    *If we increase the x by one, y increases by a multiple of 3.*

4. Describe this relationship such that it holds for any two consecutive *y* values.

    *Every time x increases by 1, y increases by multiplying the previous y by 3.*

Part II: Linear Scale

Dow Jones Industrial Average is a stock market index that can be used to track the overall behavior the stock market. Below is a graph of the S&P 500 from 1918 till 2018 (all of our recorded history of the market since its beginning till 2018). We refer to the numbers on the y-axis as points.

**100 years of S&P 500**



*Source: Mutpl - https://www.multpl.com/s-p-500-historical-prices/table/by-year*

The y-axis is using a *linear scale*. You can tell because even amount of space on the graph represent the same amount of points.

1. Along the x-axis, how much time does one unit (one box) represent?

   *10 years*

2. Along the y-axis, how much does one unit (one box) represent?

   *200 points*

3. What kind of sequence do the numbers along a linear scale form?
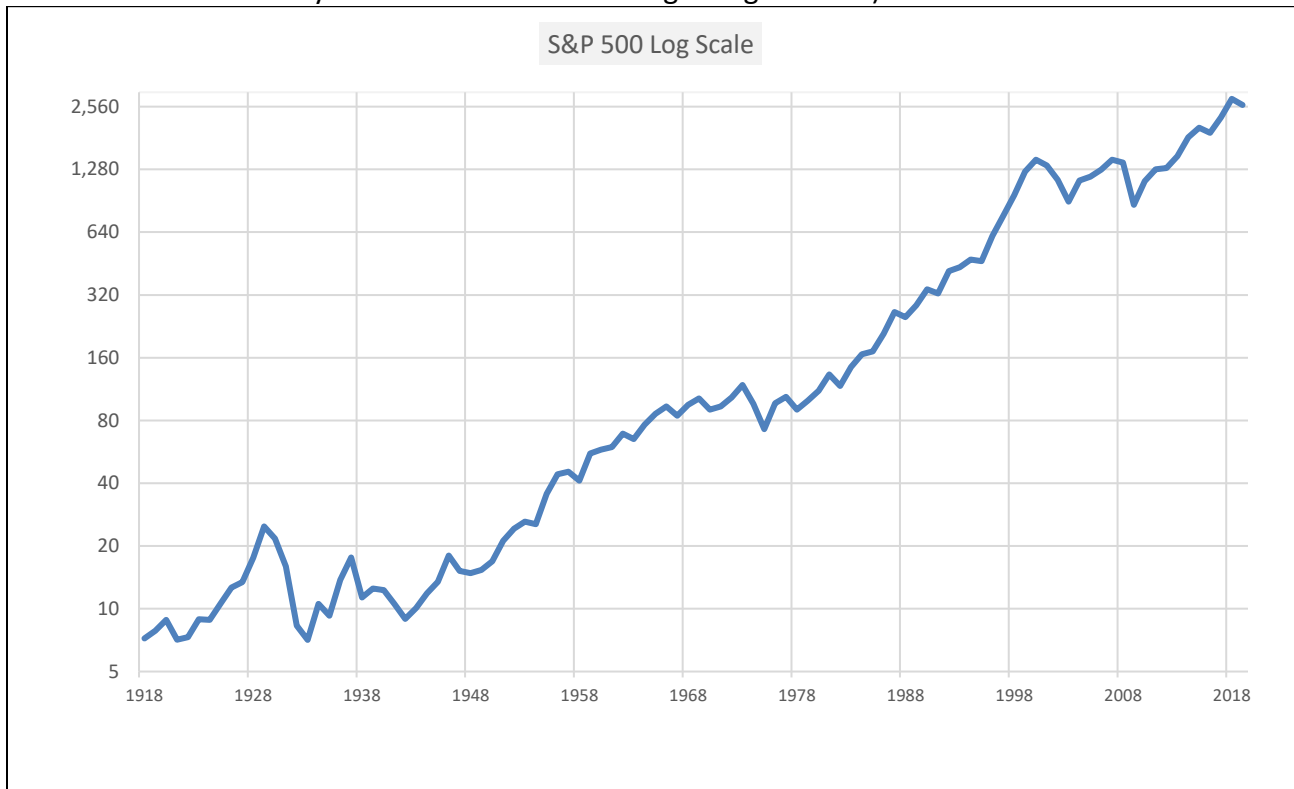
   *arithmetic*

4. Using this graph, approximately what year (or years) was the biggest drop in the history of the stock market?

   *around 2002 or around 2008*

Below is a graph of the S&P 500 from 1918 till 2018
(all of our recorded history of the market since its beginning till 2018)

**S&P 500 Log Scale**



Source: Multpl - https://www.multpl.com/s-p-500-historical-prices/table/by-year

The y-axis is using a *logarithmic scale*. You can tell because even amount of space on the graph

represents the same ratio (or same percent increase) between the numbers along the axis.

1.  Along the x-axis, what does one unit (one box) represent? *10 Years*

2.  Looking vertically along the y-axis, pick any two boxes that are
    the same size and compare the larger and the smaller number
    at the top and bottom of each of those boxes? What do they
    have in common? Do they have a common difference? Do they
    have a common ratio?

    |  | Box 1 | Box 2 |
    |---|---|---|
    | Larger # (on y axis) | 10 | 80 |
    | Smaller # (on y axis) | 5 | 40 |

    *Each of the smaller number doubles as we move from one box to the next. They have a common ratio of 2.*

3.  Looking again at each box you chose, what is the percent increase from the smaller number at the

    bottom of the box to the larger number at the top of the box? Do this for the other box you chose?

    *The percent increase is 100% in both cases.*

4.  What kind of sequence do the numbers along a Log scale form?

    *geometric*

5.  Using this graph, approximately what year (or years) was the biggest drop in the history of the stock market?

    *1929 (This coincided with the beginning of the great depression.)*

Part IV: Comparing Linear Scale and LOG Scale

Compare the two graphs from Part II and Part III:
1.  Are these two graphs showing you the same data? Explain your reasoning.

    *This is the same data. One looks different from the other because of the scale used for the y-axis.*

2.  What is the difference between the two graphs?

    *One uses a linear scale (the graph in part II) and the other uses a Log scale (the graph in part III).*

3.  Historians and economists point the great depression of the 1930s as the most severe economic decline since the begging of the stock market. The depression had a profound effect on the stock market, causing many stocks to drastically drop in value. Which scale allows us to see this drop in the stock market better?

    *The Log scale (the graph in part III) makes it much easier to see this drop. Using a linear scale, you cannot even see the 1929 drop.*