

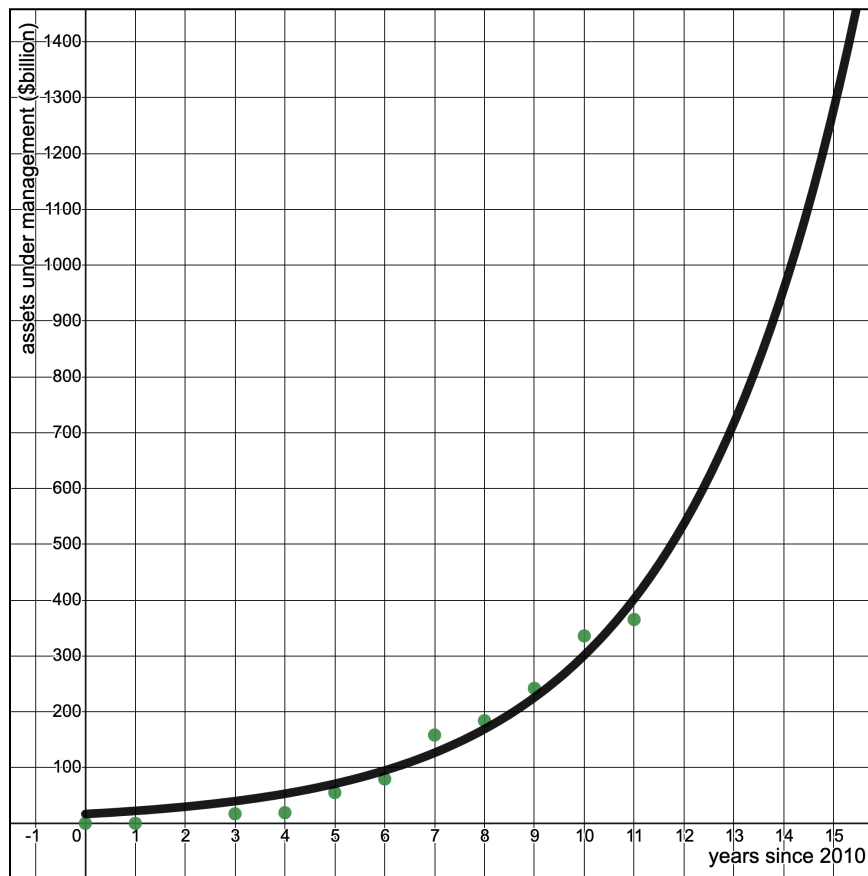
Name:

APPLICATION: Exponential Regression & Investing Trends

Level 1

Part I: Robo Advisors

Robo advisors have been growing in popularity ever since they were first made available to the public approximately 15 years ago. The data points show how many billions of dollars were managed by robo-advisors each year since 2010 in the US. The curve is an exponential regression model for the data.



- Based on the data points, approximately how many assets did robo advisors have under management in 2015?

2. Here are the results of the exponential regression. Write the equation for the exponential model by substituting the values for a and b into the equation. Round to the nearest hundredth.

$$y_1 \sim a \cdot b^{x_1}$$

☐ Log Mode ?

STATISTICS

$$R^2 = 0.9613$$

RESIDUALS

e_1

PARAMETERS ?

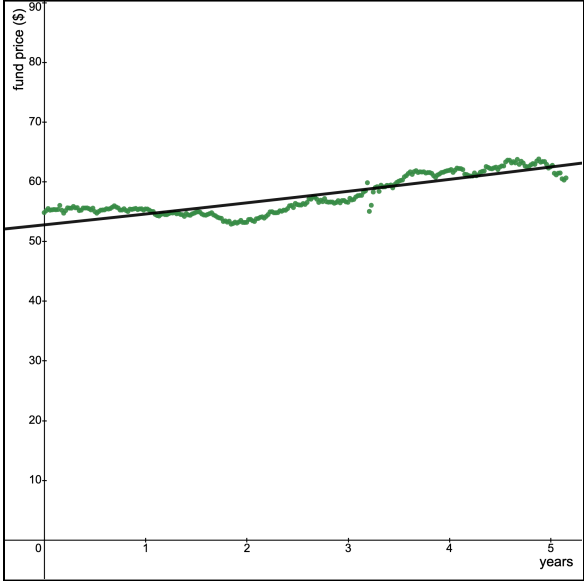
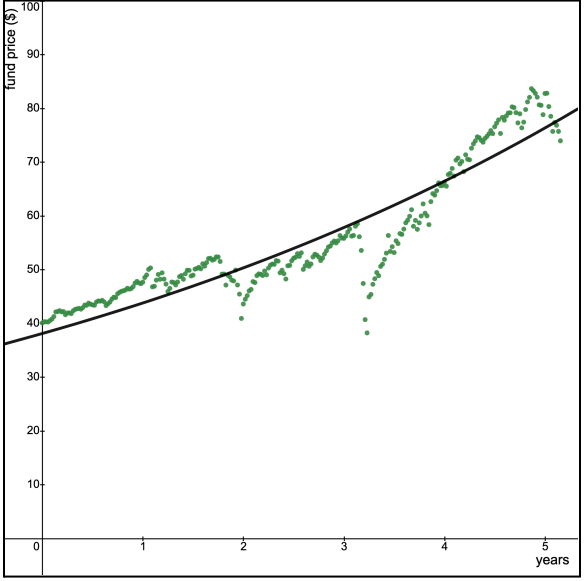
$$a = 16.6624$$

$$b = 1.33559$$

3. Based on the regression, what is the average annual growth rate of robo-advisor's assets under management?
4. Based on the exponential regression model, predict the assets under management for robo-advisors in 2025.
5. Do you think this model provides an accurate prediction for the future? Why or why not?

Level 2

- Complete the table by writing the equation and r^2 values based on the regression results. Round to the nearest hundredth.

	Bond Fund (SCHP)	Stock Fund (SWTSX)
Graph		
Regression Results	$y_3 \sim a \cdot b^{x_3}$ ☐ Log Mode ? STATISTICS $R^2 = 0.7633$ PARAMETERS ? $a = 52.7454$ RESIDUALS e_3 plot $b = 1.03426$	$y_4 \sim a \cdot b^{x_4}$ ☐ Log Mode ? STATISTICS $R^2 = 0.85$ PARAMETERS ? $a = 38.0904$ RESIDUALS e_4 plot $b = 1.14913$
r^2		
Equation		

- Based on the regression model, what is the average annual rate of return of the Stock Fund?
- Amar decides to invest \$100 in the Stock Fund. He learns it has a total expense ratio of 0.03%. Write an equation to model the predicted value of his investment after x years.
- Based on the regression model, what is the predicted price of the Bond Fund after 15 years?

5. Why does the exponential function of best fit for the Bond Fund appear almost linear?

6. Which fund is more volatile? Explain your reasoning.

7. Which fund do you think would be a better long-term investment? Why?

Level 3

Part I: Fund Performance Over Time

Use exponential regression to summarize trends in an example ETF: the iShares Russell 2000 Growth ETF (IWO). This fund tracks the Russell 2000 Index (RUT), which includes small-cap US growth stocks.

1. Open this [Desmos graph](#) and complete the exponential regression. Write the equation for the exponential function that best fits the data below. Round to the nearest hundredth.
2. What is your r^2 value? What does that tell you about the model?
3. Maria decides to invest \$500 in IWO, which has a net expense ratio of 0.24%. Based on your regression model, write a function that models her predicted investment's value after x years.
4. What are the limitations of using this model to predict future fund prices?

Part II: What Does R^2 Mean in Finance?

In investing, R^2 can have a specific meaning. It is a value that measures how well a fund tracks a particular benchmark index. R^2 is calculated using the same formula as in regression; however, it is expressed as a percentage between 0 and 100, rather than a decimal between 0 and 1. R^2 is one of many different metrics that investors use when researching an asset.

5. Open the article [R-Squared](#) and scroll to the embedded video. Watch the video. What does it mean if a security has an R^2 value of 90?
6. How can R^2 help an investor understand changes in an asset's price?
7. Imagine you're investing in an actively managed fund with a 1.7% expense ratio (annual fees). Would you want that fund to have a high R^2 value, compared to the S&P 500? Why or why not?

Part III: Find R^2

Let's calculate R^2 for the fund IWO. To find R^2 in this context, we will use a linear regression model, not an exponential one.

8. Open [Desmos graph](#), which compares the fund IWO from Part I to its benchmark, the Russell 2000 index (RUT). Follow the directions to complete the linear regression and find R^2 .
 - a. What is the correlation (r) between the price of IWO and RUT?
 - b. How would you describe the correlation (r) between the prices of IWO and RUT? Consider: How highly correlated are they, if at all? Are they positively or negatively correlated?
 - c. What is the R^2 value for IWO? Convert it from a decimal to a percentage.
 - d. What does this R^2 value tell you about the fund?
9. You calculated the R^2 for this fund based on its benchmark index: the Russell 2000 index, which is made up of 2000 small-cap US stocks. Now, imagine you completed the same regression using the S&P 500 as a benchmark index, which is made up of 500 large US companies. Would you expect the R^2 value for IWO to be higher or lower? Explain your reasoning.