

What is Risk?

Lesson Summary

What is Risk? helps students to understand that an informed investor must recognize the risks involved with every investment.

Lesson Objectives

- Define and illustrate the three major kinds of risk.
- Examine companies and determine the risk involved in investing in these companies.
- Research two companies and decide the level of risk their Stock Market Game team would take if they invest in these companies.
- Write a persuasive letter motivating or discouraging an investor from purchasing stocks in a company they researched.
- Solve decimal multiplication problems.

NCTM Standards

1A - Understand numbers, ways of representing numbers, relationships among numbers, and number systems.

1B - Understand meanings of operations and how they relate to one another.

1C - Compute fluently and make reasonable estimates.

2A - Understand patterns, relations, and functions.

2B - Represent and analyze mathematical situations and structures using algebraic symbols.

2C - Use mathematical models to represent and understand quantitative relationships.

5A - Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.

5B - Select and use appropriate statistical methods to analyze data.

5C - Develop and evaluate inferences and predictions that are based on data.

5D - Understand and apply basic concepts of probability.

6B - Solve problems that arise in mathematics and in other contexts.

8A - Organize and consolidate mathematical thinking through communication.

8B - Communicate mathematical thinking coherently and clearly to peers, teachers, and others.

9C - Recognize and apply mathematics in contexts outside of mathematics.

10A - Create and use representations to organize, record, and communicate mathematical ideas.

10B - Select, apply, and translate among mathematical representations to solve problems.

10C - Use representations to model and interpret physical, social, and mathematical phenomena.

Mathematical Strands

	Thinking Algebraically	Students use differences in the percentage change in the market compared to the percentage change of a stock to explore what beta numbers mean.	
	Interpreting Statistics	Students will calculate beta numbers, and then match those stocks to the profiles of different investors.	
	Communicating Quantitative Information	Students investigate the connection between volatility (as represented on a graph) and betas.	
	Tackling Complex Problems	N/A	

THINKING ALGEBRAICALLY

What Does Beta Tell Us?

A stock's beta number is a measure of how volatile its price is compared to the market. Market analysts use sophisticated statistical tools to calculate the beta numbers for each stock, but you can get an idea of what beta measures by comparing the change in the market to the change in price of a stock.

Calculate the monthly percentage change in each stock and in the S&P 500 in each table, using the following formula.

Percentage change from month a to month b =

$$\frac{(\text{price_in_month_b}) - (\text{price_in_month_a})}{\text{price_in_month_a}} \cdot 100\%$$

Example:

Percentage change from November to December for Expedia = $\frac{20.98 - 18.16}{18.16} \cdot 100\% = 15.53\%$

Expedia, Inc. (EXPE)

	Expedia, Inc.		S & P 500	
	Price	% change	Value	% Change
November 2006	\$18.16		\$1,400.63	
December 2006	\$20.98	15.53%	\$1,418.30	
January 2007	\$21.45		\$1,438.24	
February 2007	\$21.26		\$1,406.82	
March 2007	\$23.18		\$1,420.86	

Avery Denison Corporation (AVY)

	Avery Denison Corporation		S & P 500	
	Price	% Change	Value	% Change
November 2006	\$67.47		\$1,400.63	
December 2006	\$67.93		\$1,418.30	
January 2007	\$68.36		\$1,438.24	
February 2007	\$66.43		\$1,406.82	
March 2007	\$64.26		\$1,420.86	

Edison International (EIX)

	Edison International		S & P 500	
	Price	% Change	Value	% Change
November 2006	\$45.98		\$1,400.63	
December 2006	\$45.48		\$1,418.30	
January 2007	\$44.98		\$1,438.24	
February 2007	\$47.00		\$1,406.82	
March 2007	\$49.13		\$1,420.86	

THINKING ALGEBRAICALLY

Eastman Kodak Company (EK)

	Eastman Kodak Company		S & P 500	
	Price	% Change	Value	% Change
November 2006	\$26.02		\$1,400.63	
December 2006	\$25.80		\$1,418.30	
January 2007	\$25.86		\$1,438.24	
February 2007	\$23.87		\$1,406.82	
March 2007	\$22.56		\$1,420.86	

1. Which of the stocks above had percentage changes that were very different from the market?
2. What do you think this means about their beta numbers?
3. Which of the stocks above had percentage changes that were fairly similar to the changes in the market?
4. What do you think this implies about its beta number?
5. Predict next to each company whether its beta number would be high or low.

INTERPRETING STATISTICS

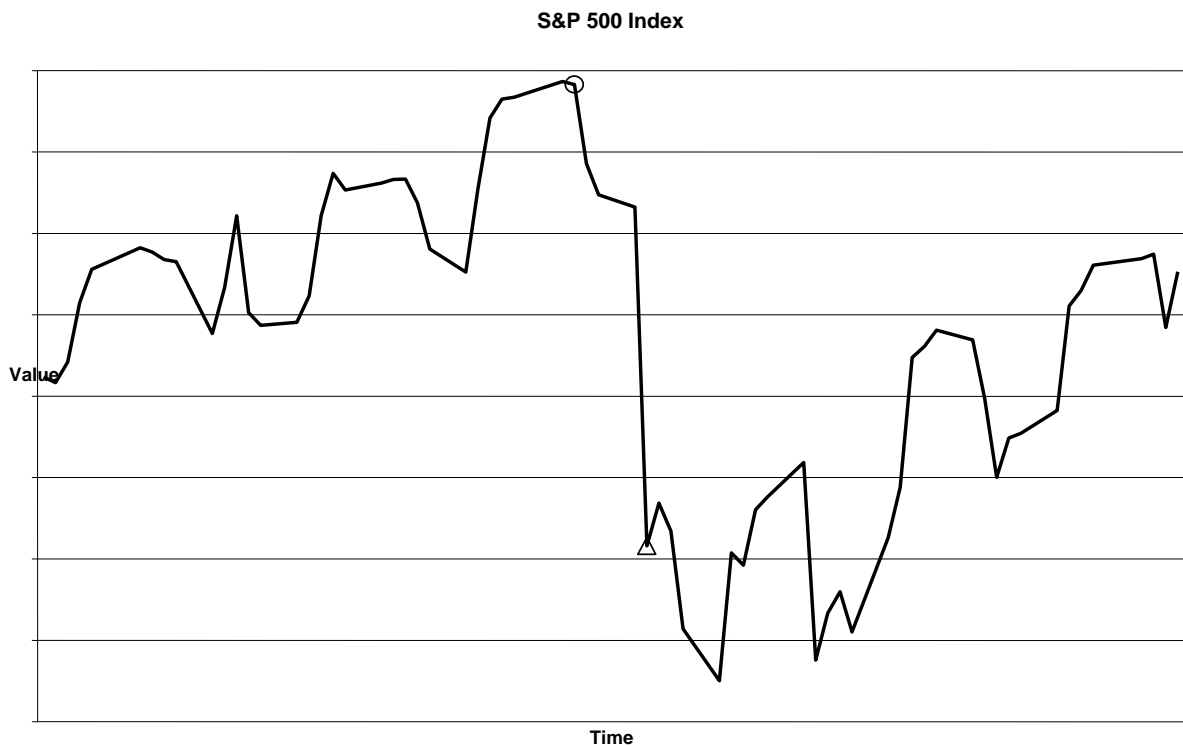
Interpreting Beta Numbers

If you were a financial advisor, you would need to understand your clients' tolerance for risk and then use your knowledge of beta numbers to help inform your clients about how risky investments can be.

In a meeting, your client who has low risk tolerance, says he does not want to invest in a certain stock because over a 52-week period the stock's price changed between a high of \$120.47 and a low of \$75.42. The client describes this change as "wild," and says that he does not want to invest in such a risky stock. You know that this stock has a Beta number of 1.01.

1. What is the overall percentage change of the stock's high and low prices?
2. As a percentage change, how big is this change in stock price?

Assume the chart below is a graph of the S&P 500 Index over the same period.



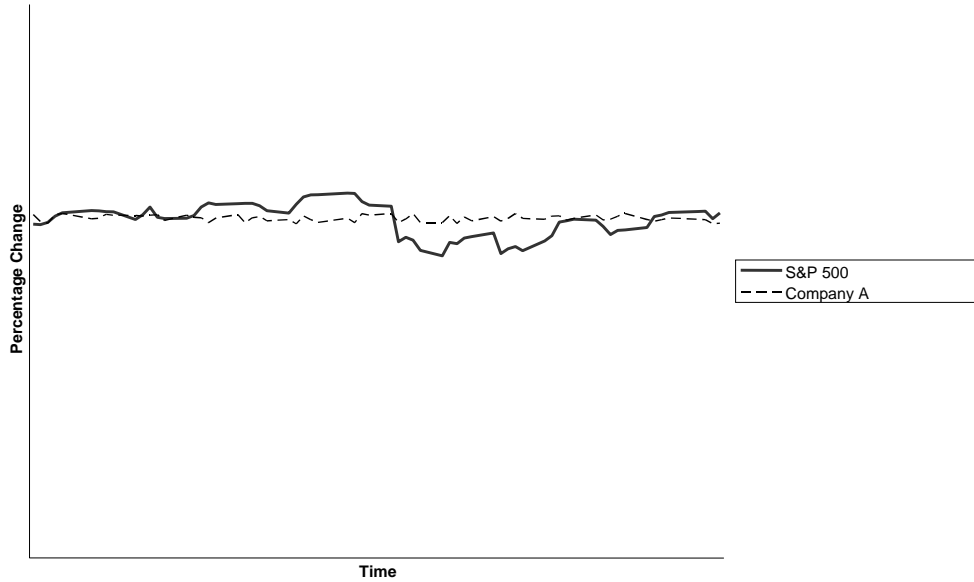
3. How does the chart above help explain why the dramatic change occurred, yet the stock has a beta of 1.01?
4. If the point circled on the graph represents a value \$12,783, calculate the value of the point with the triangle on it if the percentage change in the S&P 500 is the same as the percentage change you calculated in #2.
5. Use your knowledge of beta to explain to your client what may have been going on in the stock market during this same time, and why this fluctuation may not be that "wild" after all.

COMMUNICATING QUANTITATIVE INFORMATION

The following graphs illustrate how the relative performance of stocks with different beta numbers would perform against the market as a whole.

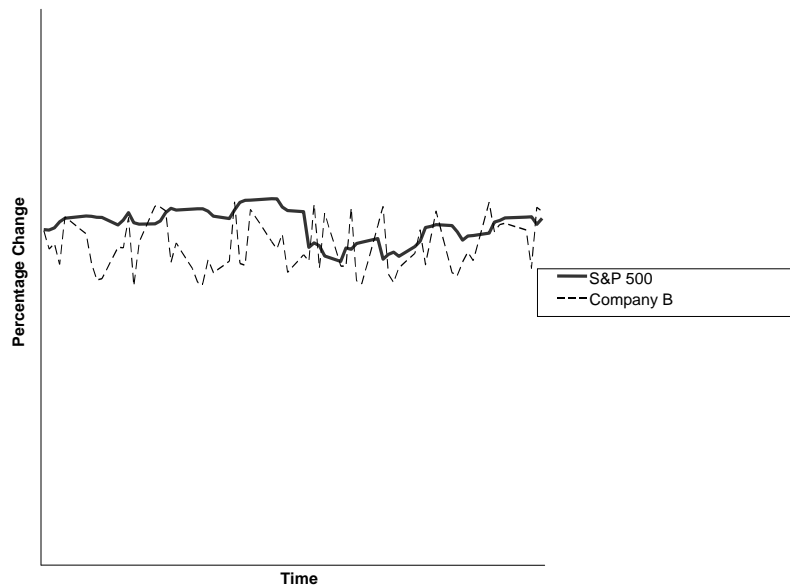
Company A has a beta of 1.02.

Changes in S&P 500 vs. Company A



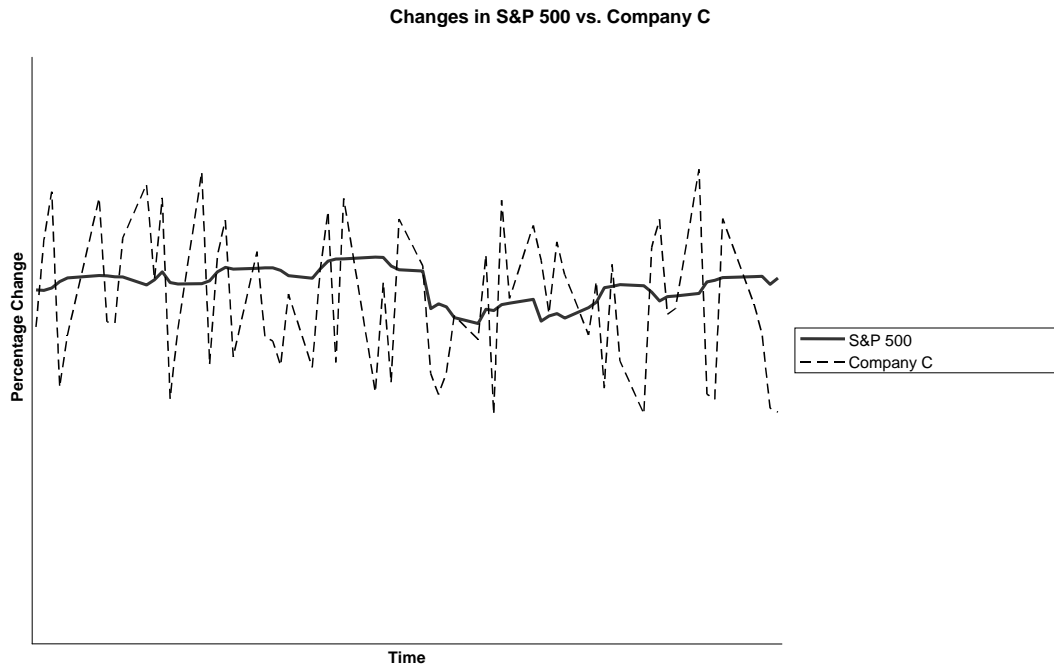
Company B has a beta of 2.3

Changes in S&P 500 vs. Company B



COMMUNICATING QUANTITATIVE INFORMATION

Company C has a beta of 5.8

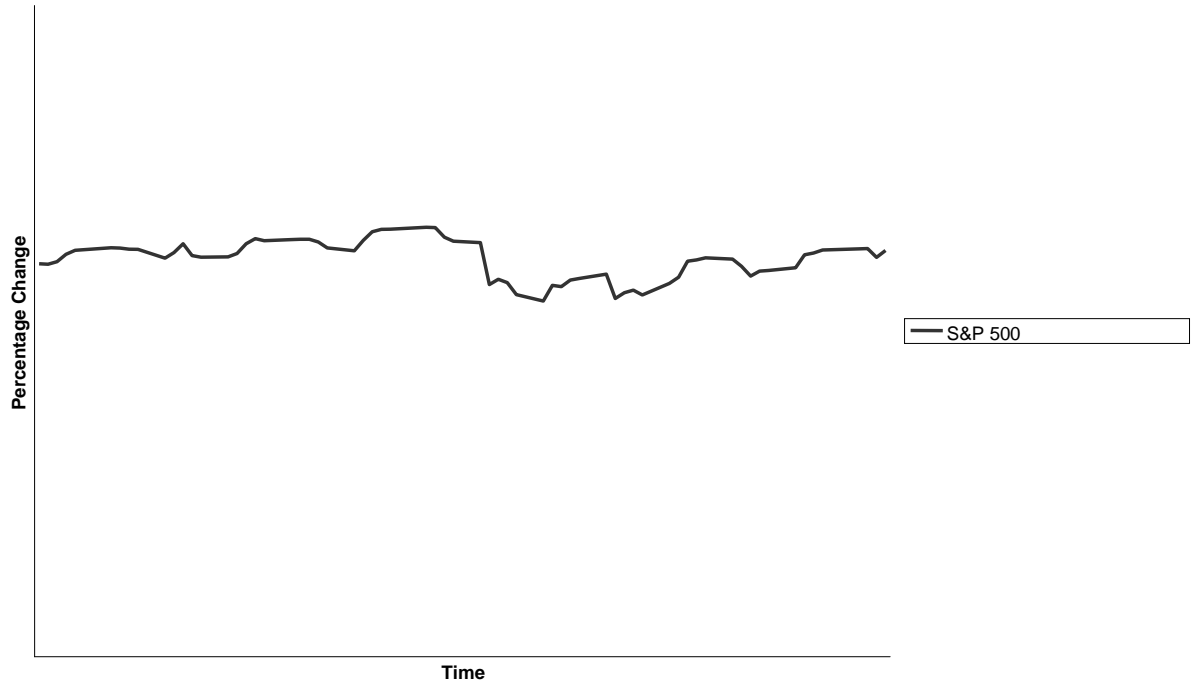


1. Which of the graphs shows a stock whose performance most closely resembles the trend of the S&P 500 Index?
2. Which of the graphs shows a stock whose performance showed more dramatic changes than the S&P 500 Index?
3. What is different about the graph of a stock's relative performance when it has a beta close to 1 compared to when it has a beta close to 5?

COMMUNICATING QUANTITATIVE INFORMATION

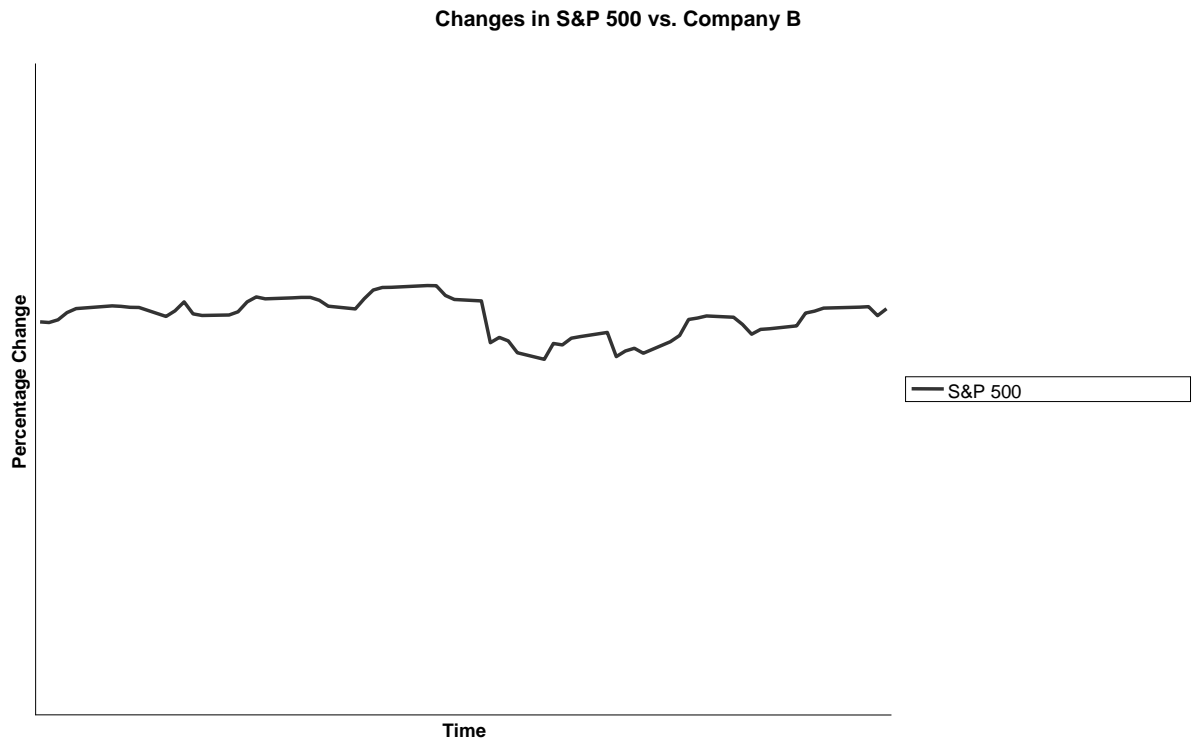
4. Describe what the graph of a stock's relative performance would look like compared to that of the S&P 500 Index if the stock has a beta of 3. Use the graph below to draw a graph of the stock's performance.

Changes in S&P 500 vs. Company B



COMMUNICATING QUANTITATIVE INFORMATION

5. Describe what the graph of a stock's relative performance would look like compared to that of the S&P 500 if the stock had a beta of 8.9. Use the graph below to draw a graph of the stock's performance.



What is Risk?

ANSWER KEY

Please Note: 1. Prices included in lesson are not representative of actual market data and are for instructional purposes only. 2. Discrepancies may occur between student responses and the answer keys as a result of how far calculations were taken past the decimal point. In most instances, numbers were rounded from the thousandth or ten thousandth place

What Does Beta Tell Us?

A stock's beta number is a measure of how volatile its price is compared to the market. Market analysts use sophisticated statistical tools to calculate the beta numbers for each stock, but you can get an idea of what beta measures by comparing the change in the market to the change in price of a stock.

Calculate the monthly percentage change in each stock and in the S&P 500 in each table, using the following formula.

$$\text{Percentage change from month a to month b} = \frac{(\text{price_in_month_b}) - (\text{price_in_month_a})}{\text{price_in_month_a}} \cdot 100\%$$

Example:

$$\begin{aligned} \text{Percentage change from November to December for Expedia} &= \frac{20.98 - 18.16}{18.16} \cdot 100\% \\ &= 15.53\% \end{aligned}$$

Answer:

Expedia, Inc. (EXPE)

	Expedia, Inc.		S & P 500	
	Price	% Change	Value	% Change
November 2006	\$18.16		\$1,400.63	
December 2006	\$20.98	15.53%	\$1,418.30	1.26%
January 2007	\$21.45	2.24%	\$1,438.24	1.41%
February 2007	\$21.26	-0.89%	\$1,406.82	-2.18%
March 2007	\$23.18	9.03%	\$1,420.86	1.00%

Avery Denison Corporation (AVY)

	Avery Denison Corporation		S & P 500	
	Price	% Change	Value	% Change
November 2006	\$67.47		\$1,400.63	
December 2006	\$67.93	0.68%	\$1,418.30	1.26%
January 2007	\$68.36	0.63%	\$1,438.24	1.41%
February 2007	\$66.43	-2.82%	\$1,406.82	-2.18%
March 2007	\$64.26	-3.27%	\$1,420.86	1.00%

THINKING ALGEBRAICALLY

Edison International (EIX)

	Edison International		S & P 500	
	Price	% Change	Value	% Change
November 2006	\$45.98		\$1,400.63	
December 2006	\$45.48	-1.09%	\$1,418.30	1.26%
January 2007	\$44.98	-1.10%	\$1,438.24	1.41%
February 2007	\$47.00	4.49%	\$1,406.82	-2.18%
March 2007	\$49.13	4.53%	\$1,420.86	1.00%

Eastman Kodak Company (EK)

	Eastman Kodak Company		S & P 500	
	Price	% Change	Value	% Change
November 2006	\$26.02		\$1,400.63	
December 2006	\$25.80	-0.85%	\$1,418.30	1.26%
January 2007	\$25.86	0.23%	\$1,438.24	1.41%
February 2007	\$23.87	-7.70%	\$1,406.82	-2.18%
March 2007	\$22.56	-5.49%	\$1,420.86	1.00%

- Which of the stocks above had percentage changes that were very different from the market?
Answer: Expedia and Eastman had percentage changes very different from the market.
- What do you think this means about their beta numbers?
Answer: An answer should include something about having beta numbers different from the S & P 500 beta (1.01). Their beta numbers should be a higher number such as 1.10.
- Which of the stocks above had percentage changes that were fairly similar to the changes in the market?
Answer: Avery had percentage numbers that were similar to the market.
- What do you think this implies about its beta number?
Answer: Avery's beta numbers would be close to the market's beta, because of their similarities in percentage changes.
- Predict next to each company whether its beta number would be high or low.
Answer: Expedia's beta would be high. Avery and Edison would have low beta numbers. Eastman's beta would be higher, but not as high as Expedia.

INTERPRETING STATISTICS

Interpreting Beta Numbers

If you were a financial advisor, you would need to understand your clients' tolerance for risk and then use your knowledge of beta numbers to help inform your clients about how risky investments can be.

In a meeting, your client who has low risk tolerance, says he does not want to invest in a certain stock because over a 52-week period the stock's price changed between a high of \$120.47 and a low of \$75.42. The client describes this change as "wild," and says that he does not want to invest in such a risky stock. You know that this stock has a Beta number of 1.01.

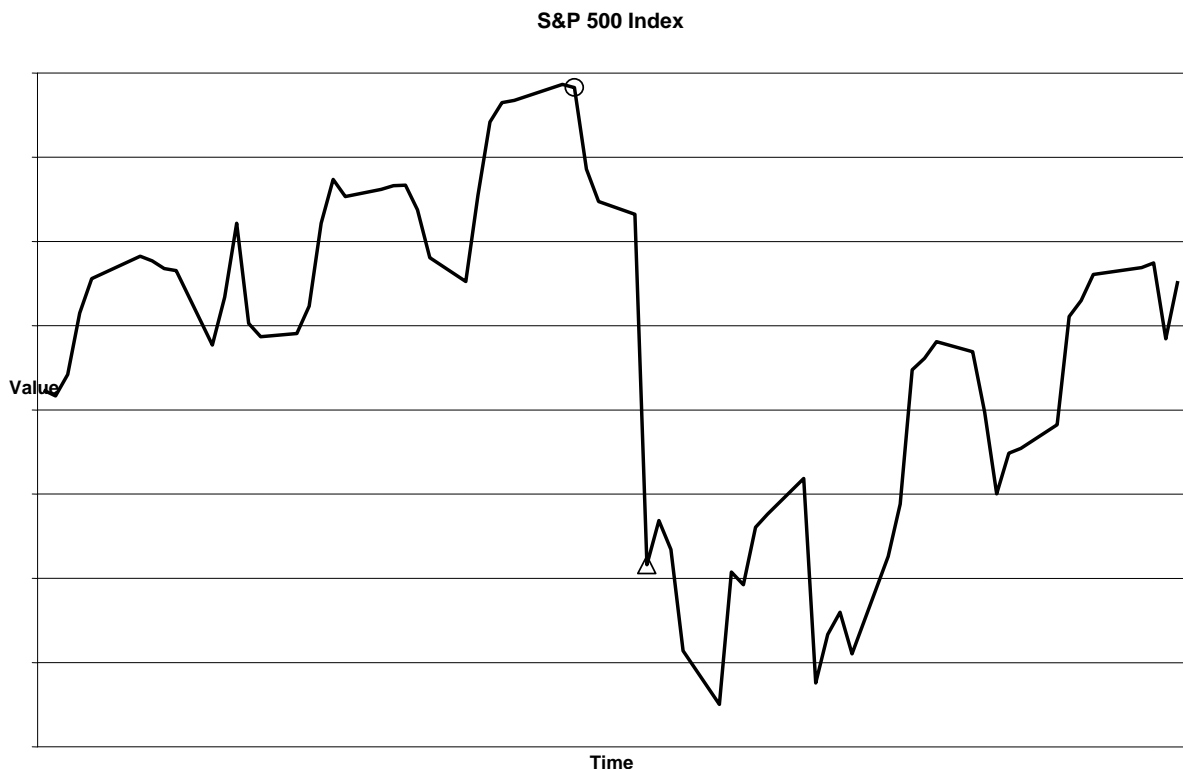
1. What is the overall percentage change of the stock's high and low prices?

Answer: $\$120.47 - \$75.42 \div \$75.42 \times 100 = 37.40\%$

2. As a percentage change, how big is this change in stock price?

Answer: 37% is a big change.

Assume the chart below is a graph of the S&P 500 Index over the same period.



3. How does the chart above help explain why the dramatic change occurred, yet the stock has a beta of 1.01?

Answer: The S&P also had dramatic changes like the company in question. If a company has a beta of 1.01, then it is expected to have changes over time similar to those of the S&P.

INTERPRETING STATISTICS

4. If the point circled on the graph represents a value \$12,783, calculate the value of the point with the triangle on it if the percentage change in the S&P 500 is the same as the percentage change you calculated in #2.

Answer: The low price will be 37.40% lower than the high price of \$12,783.

$$\begin{aligned} \text{Low price} &= \$17,873 - (0.3740)(\$17,873) = \$17,873 - \$6,684.50 \\ &= \$11,188.50 \end{aligned}$$

5. Use your knowledge of beta to explain to your client what may have been going on in the stock market during this same time, and why this fluctuation may not be that "wild" after all.

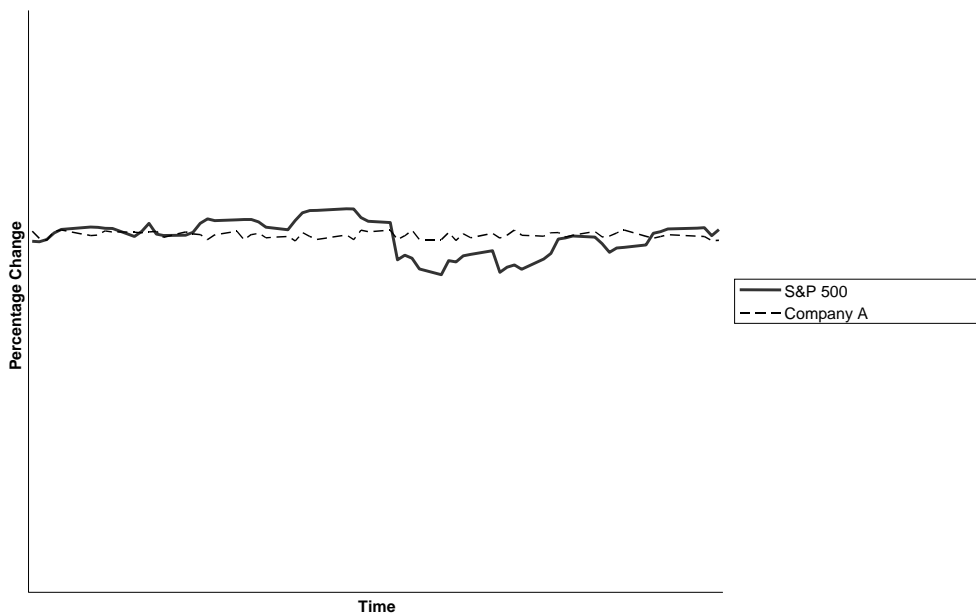
Answers may vary: Something probably happened that was not normal to cause such a drop in the S&P. It could have been a natural disaster or some other unfortunate event that caused fear among some investors.

TACKLING COMPLEX PROBLEMS

The following graphs illustrate how the relative performance of stocks with different beta numbers would perform against the market as a whole.

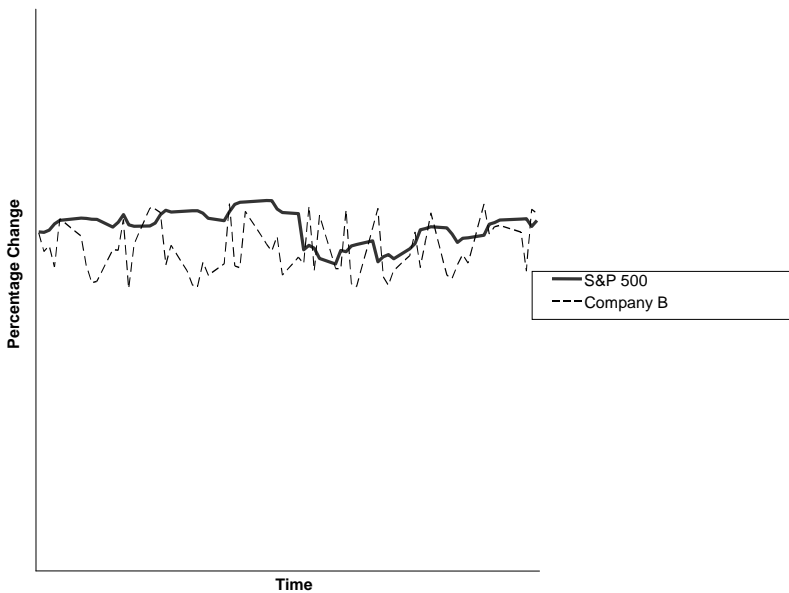
Company A has a beta of 1.02

Changes in S&P 500 vs. Company A

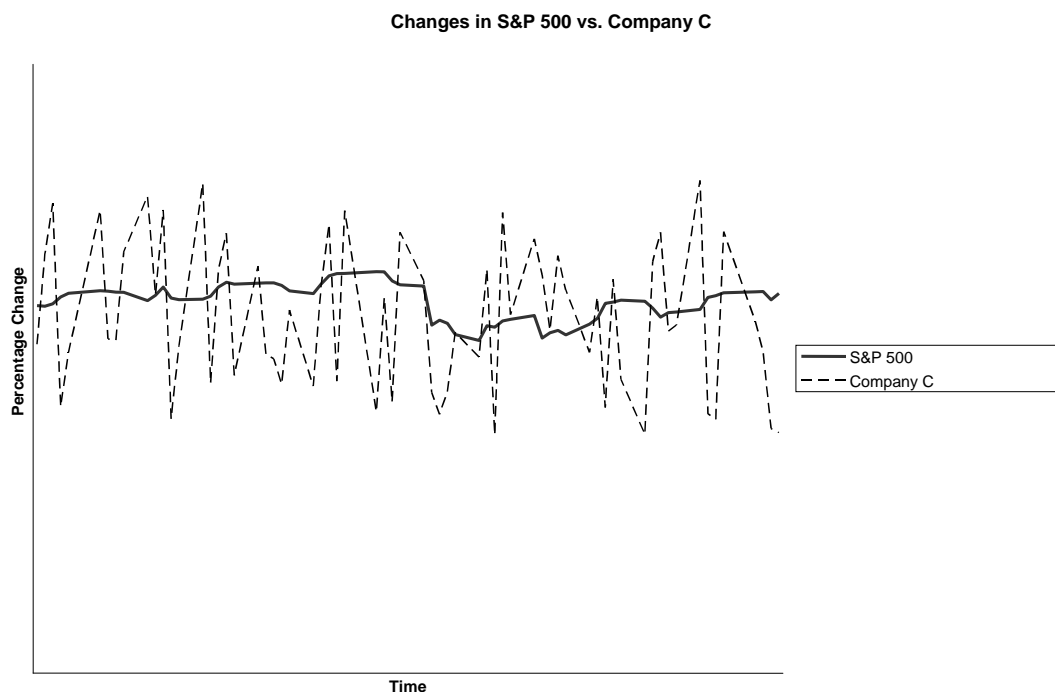


Company B has a beta of 2.3

Changes in S&P 500 vs. Company B



Company C has a beta of 5.8



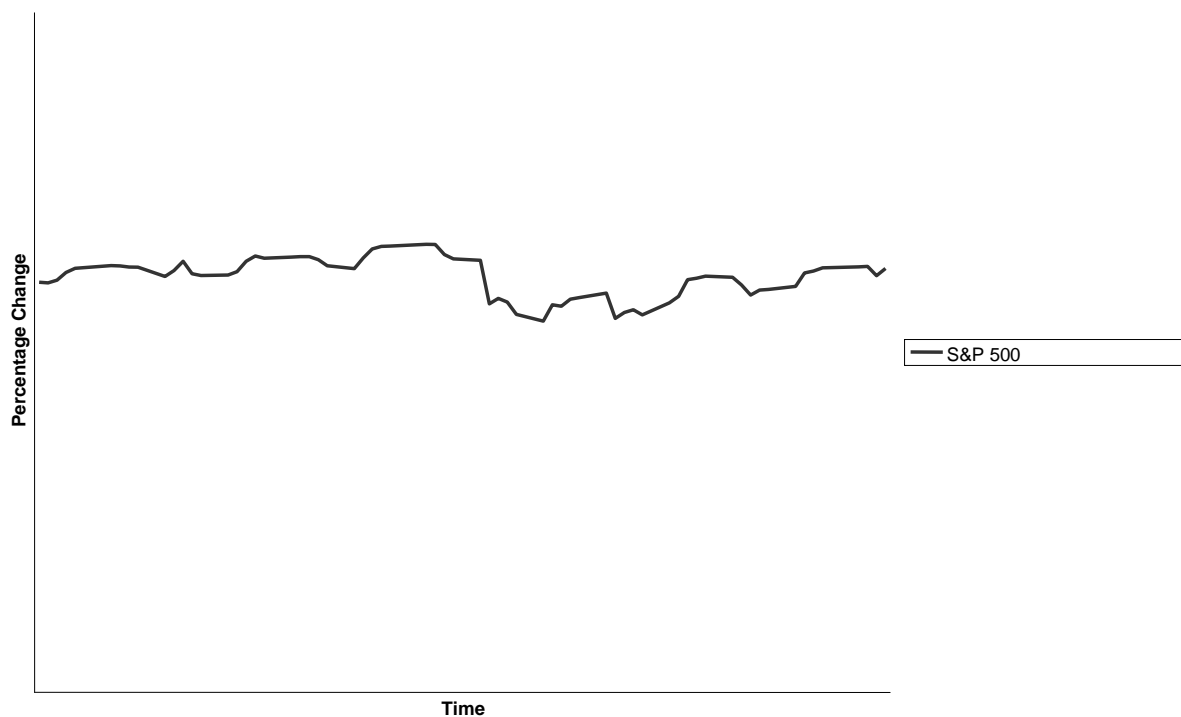
1. Which of the graphs shows a stock whose performance most closely resembles the trend of the S&P 500 Index?
Answer: Company A most closely resembles the S&P.
2. Which of the graphs shows a stock whose performance showed more dramatic changes than the S&P 500 Index?
Answer: Company C showed the most dramatic changes compared to the S&P.
3. What is different about the graph of a stock's relative performance when it has a beta close to 1 compared to when it has a beta close to 5?
Answer: When a company has a beta similar to the S&P, its trend line has a consistent resemblance to the trend line of the S&P. If a company has a beta of 5 its trend line deviates significantly from the trend line of the S&P.

TACKLING COMPLEX PROBLEMS

4. Describe what the graph of a stock's relative performance would look like compared to that of the S&P 500 Index if the stock has a beta of 3. Use the graph below to draw a graph of the stock's performance.

Answers will vary: Students can use previous graphs as examples.

Changes in S&P 500 vs. Company B



TACKLING COMPLEX PROBLEMS

5. Describe what the graph of a stock's relative performance would look like compared to that of the S&P 500 if the stock had a beta of 8.9. Use the graph below to draw a graph of the stock's performance.

Answers will vary. Students can use previous graphs from this section as examples.

Changes in S&P 500 vs. Company B

