

Stock Price Data

In this exercise, you will be working with stock price data for Amazon.com. This stock is listed on the NASDAQ Stock Market (the second largest U.S. stock market, after the New York Stock Exchange). We will start with some pencil and paper exercises and then move to analyzing the data in Excel.

Amazon (AMZN) Stock Prices for Trading Days in December, 2013

Date	Open	High	Low	Close	Volume	Adj Close
12/31/2013	394.58	398.83	393.8	398.79	1996500	398.79
12/30/2013	399.41	399.92	392.45	393.37	2487100	393.37
12/27/2013	404.65	405.63	396.25	398.08	1986900	398.08
12/26/2013	401.79	404.52	396.81	404.39	1868500	404.39
12/24/2013	402.52	403.72	396.37	399.2	1380400	399.2
12/23/2013	403.69	405	399.2	402.92	2659500	402.92
12/20/2013	396.55	404.72	395.78	402.2	5033900	402.2
12/19/2013	394.27	397.29	392.6	395.19	2427200	395.19
12/18/2013	389.23	396.3	383.1	395.96	3489100	395.96
12/17/2013	390.65	391.36	386.5	387.65	2343900	387.65
12/16/2013	385.03	391.7	385	388.97	2251700	388.97
12/13/2013	385.32	389.42	383.8	384.24	3025000	384.24
12/12/2013	381.26	385	379.5	381.25	2122500	381.25
12/11/2013	387.34	388.98	382	382.19	2436000	382.19
12/10/2013	383.74	389.06	383.02	387.78	2736800	387.78
12/9/2013	388.11	388.21	382.57	384.89	2761800	384.89
12/6/2013	388.35	388.35	383.83	386.95	1984700	386.95
12/5/2013	386.65	386.65	381.37	384.49	1874400	384.49
12/4/2013	383.5	389.69	381.49	385.96	2355300	385.96
12/3/2013	390.11	390.95	383.1	384.66	3702900	384.66
12/2/2013	399	399	389.1	392.3	4714000	392.3

Key

- Open = the price when the market opened in the morning.
- Close = the price when the market closed in the afternoon.
- High = the highest price during that trading day.
- Low = the lowest price during that trading day.
- Volume = number of shares of the stock traded that day.
- Adj Close = a price adjusted to make prices comparable over time. In the trading month shown above, there are no adjustments (i.e., Adj Close = Close for every date)
- Note that the dates are list from most recent to least recent.

Part 1: Calculations for Buying and Selling Stocks

For Part 1, use the data shown on the previous page.

- 1) Looking at **12/18/2013**,
 - a. How much did the stock price change, in dollars and cents, from the **Close** price the previous day to the **Close** price that day?

 - b. What was the **percentage change** in the stock price from the **Close** price the previous day to the **Close** price that day?

For all of the following questions, assume there are no fees for the transactions.

- 2) If you bought **100 shares** of stock at the **Close** price on the **first trading day of the month**, how much would that cost?

- 3) If you bought **100 shares** of stock at the **Close** price on the **first trading day of the month** and held them until the **last trading day of the month**, and sold at the **Close** price,
 - a. How much money would you make (in dollars and cents)? (In other words, how much more money would have after the sale compared to before the purchase?)

 - b. By what percentage would your money have grown?

- 4) If you bought **500 shares** of stock at the **Close** price on the **first trading day of the month** and held them until the **last trading day of the month**, and sold at the **Close** price,
 - a. How much money would you make (in dollars and cents)?

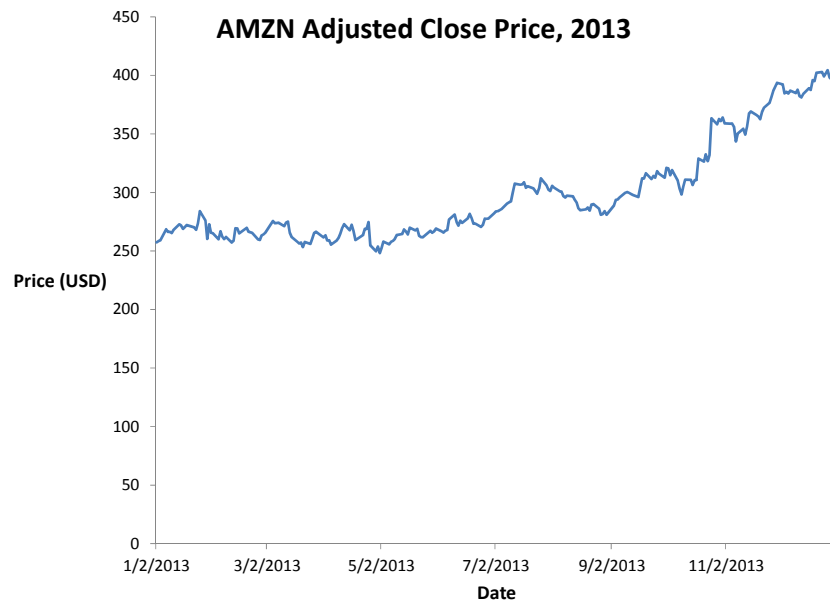
 - b. By what percentage would your money have grown?

- c. Are the answers to parts a and b in this question the *same* as or *different* from the answers to parts a and b in the previous question. Why?
- 5) Say you have **\$5,000** to spend on AMZN stock, and you buy stock at the **Close** price on the **first trading day of the month**. If you can only buy **whole shares** (not fractional parts),
- How many shares can you buy?
 - And how much of your \$5,000 would you spend?
 - Now say you hold those shares until the end of the month and sell at the **Close** price on the **last day of the month**.
 - How much money would you make (in dollars and cents)?
 - By what percentage would the money you invested have grown?
- 6) If you bought **100 shares** of stock at the **Close** price on the **first trading day of the month** and the stock price goes **up by 10%** from that purchase price,
- How much has your investment increased in value (in dollars and cents)?
 - If the stock price then decreased by 10%, is the stock worth *more*, *less*, or the *same* as the initial amount you paid for the 100 shares? If more, how much more? If less, how much less?
- 7) Say you bought some stock and then the stock price went down by 10% from the purchase price. By what percentage would the price then have to increase for the investment to be back at the original value?

Part 2: Graphing

Now using **all the trading days** in the spreadsheet, **create a graph of Adjusted Close** price as a function of time. Label the horizontal axis with dates in a readable manner.

Here is an example of a nicely labeled graph, but for only 2013. (Your task is to create such a graph for all the trading days.)



Check your work by going to finance.yahoo.com and examining the historical price charts for AMZN over the whole life of the stock.

Part 3: Daily Changes in Stock Prices

- 1) Create a column in the data in Excel that shows the **difference**, in dollars and cents, between the **High** and **Low** prices for each day. Call the column **Daily Range**. Note: you will write an Excel formula in the first row of data and drag it down the whole column.
 - a. Which day in the data set had the largest Daily Range?

 - b. Which day in the data set had the smallest Daily Range?

- 2) Create a column in the data in Excel that shows the **percentage increase** of the High over the Low. Call the column **Daily Range %**. Show your answer as a percentage with two decimal places, e.g., 10.12%.
 - a. Which day in the data set had the largest Daily Range %?

 - b. Which day in the data set had the smallest Daily Range %?

- 3) Create a column in the data in Excel that shows the **difference**, in dollars and cents, between the **Adjusted Close that day** and the **Adjusted Close the previous day**. Call the column **Daily Change**.
 - a. Which day in the data set had the largest positive Daily Change (i.e., biggest increase)?

 - b. Which day in the data set had the most negative Daily Change (i.e., biggest drop)?

- 4) Create a column in the data in Excel that shows the **percentage change (either increase or decrease)** of the **Adjusted Close that day** compared to the **Adjusted Close the previous day**. Call the column **Daily Change %**. Show your answer as a percentage with two decimal places, e.g., 10.12%.
 - a. Which day in the data set had the largest positive Daily Change %?

 - b. Which day in the data set had the most negative Daily Change % (i.e., biggest percentage drop)?

- 5) **For what percentage of days** in the data set was the **Adjusted Close** on a day **lower** than the **Adjusted Close** the previous day? Show your answer as a percentage with two decimal places, e.g., 10.12%.
- 6) **For what percentage of days** in the data set was the **Adjusted Close** on a day **higher** than the **Adjusted Close** the previous day? Show your answer as a percentage with two decimal places, e.g., 10.12%.

Is the sum of the answer to this question and the previous question 1? Why or why not?

- 7) Consider all the days in the data set for which the **stock dropped** (i.e., Adjusted Close that day < Adjusted Close the previous day). For what percentage of the days **following a day on which the stock dropped** did the **stock rise**?
- 8) Comparing your answers to the last two questions, answer this: if the stock dropped one day, does that increase the chance of it rising the next day?

Part 4: Changes in Stock Prices Over Time

- 1) Write formulas in Excel, using cell references, to calculate the following.
 - a. How much did the **Adjusted Close** price change, in dollars and cents, from the first trading day in the data set until the most recent one in the data set?

 - b. How much did the **Adjusted Close** price change, in percentage growth, from the first day to the most recent one in the data set? Show your answer as a percentage with two decimal places, e.g., 10.12%.

- 2) Now create a column in the stock price table that shows, for every trading day, how much the **Adjusted Close** price changed, in dollars and cents, from the first trading day. Use your calculations to fill in the blanks cells in the following table.

Date	Change in Adj. Close, in dollars and cents, from the first trading day until the given day
1/2/1998	\$3.23
1/3/2000	
1/2/2002	\$9.23
1/3/2005	

- 3) Now create a column in the stock price table that shows, for every trading day, how much the **Adjusted Close** price changed, in percentage terms, from the first trading day. Use your calculations to fill in the blank cells in the following table.

Date	Change in Adj. Close, in percentage terms, from the first trading day until the given day
1/2/1998	186.71%
1/3/2000	
1/2/2002	533.53%
1/3/2005	

4) If you invested \$10,000 in AMZN stock on the first day of trading in the data set, purchased at the **Close** price (*not* the Adjusted Close), purchasing only whole shares:

- a. How many shares would you have bought?

- b. How much would you have spent?

- c. Calculate the **value** of your investment on the following dates. *Hint: The percentage growth in investment value is the same as the percentage growth in the **Adjusted Close** price (which you calculated above).*

Date	Value of investment, in dollars and cents, on the given day
First day in the data set (amount of original investment)	
1/3/2000	\$515,652.85
1/2/2002	
1/2/2004	\$299,422.50
1/2/2009	
Most recent trading day in the data set	

Part 5: Applying Adjustments

The data set shows the Adjusted Close prices. The Adjustments help make the prices comparable over time. Adjustments for comparability are necessary when the stock splits or pays dividends. (For this class, don't worry if you don't understand those actions.) The data set does not show the adjustments for the other prices given, the Open, High, and Low prices. However, you can adjust those other prices using the ratio of the Adj. Close to the Close price.

- 1) Find the ratio of Adj. Close to Close price for every trading day in the data set. Fill in the blank cells in the table below

Date	Adj. Close/Close Ratio
6/2/1997	0.083
8/23/1999	
1/5/2001	
10/25/2005	1
3/4/2010	

- 2) Create a line graph for the Adjustment Ratio as a function of trading days.
- 3) Answer this question by looking at the graph: how many adjustments were made?
- 4) Create columns in the data for Adjusted High price (=Adjustment Ratio x High) and Adjusted Low price (=Adjustment Ratio x Low). Use those columns to fill in the blank cells in the following table.

Date	Adj. High	Adj. Low
8/21/1997		
7/7/1999		60
8/1/2003	41.63	

- 5) Create a line graph showing both the Adjusted High and Adjusted Low prices for days from the first trading day until December 31, 1999.

Part 6: Investments

- 1) If you invested **\$10,000** in AMZN stock on **1/3/2000**, purchased at the **Close** price, purchasing only whole shares:
- a. How many shares would you have bought?

 - b. How much would you have spent?

 - c. Calculate the value of your investment on the following dates.

Date	Value of investment, in dollars and cents, on the given day
1/3/2000 (amount of original investment)	
1/2/2002	
1/2/2004	
1/2/2009	\$6,033.96
Most recent trading day in the data set	

- 2) Say you invested **\$10,000** in AMZN stock on **9/16/1998**, purchasing only **whole shares** at the **Close** price, and then sold it on **5/3/1999** (when it had gone up a lot but was starting to go down). You then used the proceeds of the sale to buy (**whole**) shares again on **11/14/2002** (when it was going up again) at the **Close** price.
- a. How many shares did you buy on 9/16/1998? Your answer should be a whole number.
 - b. How much did you spend on 9/16/1998? Show your answer in dollars and cents.
 - c. By what percentage did the Adj. Close price grow from 9/16/1998 to 5/3/1999? Show your answer as a percentage with two decimal places, e.g., 10.12%.
 - d. What was the value of your shares when you sold on 5/3/1999? Show your answer in dollars and cents.
 - e. What was the **Close** price on 11/14/2002? Show your answer in dollars and cents.
 - f. How many shares did you buy on 11/14/2002? Your answer should be a whole number.
 - g. How much did you spend on 11/14/2002? Show your answer in dollars and cents.
 - h. Counting the original (9/16/1998) purchase and the second purchase (11/14/2002), how much unspent cash do you have? Show your answer in dollars and cents.
 - i. By what percentage did the Adj. Close price grow from 11/14/2002 to the last trading day in the data set? Show your answer as a percentage with two decimal places, e.g., 10.12%.
 - j. How much are the shares you purchased on 11/14/2002 worth on the last trading day in the data set? Show your answer in dollars and cents.
 - k. Using the value of the shares on the last trading day in the data set plus the unspent cash, by what percentage did your original \$10,000 grow? Show your answer as a percentage with two decimal places, e.g., 10.12%.

Part 7: Dollar-Cost Averaging

“Dollar Cost Averaging” means sticking to a regular investment pattern, such as investing \$1000 every year, without trying to anticipate whether the price of the stock (or other investment) is going to rise or fall.

- 1) Say you bought as many whole shares of AMZN stock as you could with \$1000 at the **Close** price on the first trading day of calendar years from 2001 until 2010. Fill in the blank cells in the following table that show how many shares you buy each year.

a. Table of Shares Bought in Each Year and Total Owned

As of	# new shares just purchased	Total # of shares owned
1/2/2001	72	72
1/2/2002		
1/2/2003	51	
1/2/2004		
1/3/2005	22	
1/3/2006		
1/3/2007		
1/2/2008		311
1/2/2009		
1/4/2010		

- b. How much would the shares owned be worth on the most recent trading day in the data set?
- c. How much would you have spent in total on these shares? (The answer will be under \$10,000: somewhat less than \$1000 per year for ten years.)

2) Let's compare that to what would have happened if you bought on the first trading day in the month of July each year.

a. Fill in the blanks cells in the following table:

As of	# new shares just purchased	Total # of shares owned
7/2/2001	68	68
7/1/2002		
7/1/2003		
7/1/2004	19	186
7/1/2005		
7/3/2006		241
7/2/2007		
7/1/2008	13	
7/1/2009		
7/1/2010		

b. How much would the shares owned be worth on the most recent trading day in the data set?

c. How much would you have spent in total on these shares? (The answer will be under \$10,000: somewhat less than \$1000 per year for ten years.)

Part 8: Average Annual Growth and Extrapolation

- 1) How much did AMZN **Adjusted Close** grow, in percentage terms, from the last trading day of 2012 (12/31/2012) to last trading day of 2013 (12/31/2013)? Show your answer as a percentage with two decimal places, e.g., 10.12%.

- 2) How much did AMZN **Adjusted Close** grow, in percentage terms, from the last trading day of 2008 (12/31/2008) to the last trading day of 2013? Show your answer as a percentage with two decimal places, e.g., 10.12%.

- 3) What was the **compound annual growth rate** in **Adjusted Close** from the last trading day of 2008 to the last trading day of 2013? Show your answer as a percentage with two decimal places, e.g., 10.12%.

*The **compound annual growth rate (CAGR)** for a span of years is a growth rate that, when compounded annually, yields the actual percentage growth over the whole period.*

- 4) If the growth rate in Adjusted Close from the last day of 2013 to the last day of 2014 is the same as the CAGR in Adjusted Close from the end of 2008 through 2013 calculated above, what will the Adjusted Close of the stock be on the last trading day of 2014 (assuming no further adjustments)? Show your answer as a dollar figure with two decimal places, e.g., 150.25.

- 5) If the growth rate in Adjusted Close for the years 2014, 2015, and 2016 is the same as the CAGR from the end of 2008 through 2013 calculated above, what will the Adjusted Close of the stock be on the last trading day of 2016 (assuming no further adjustments)? Show your answer as a dollar figure with two decimal places, e.g., 150.25.

- 6) Create a graph in Excel that shows a) the actual daily stock prices (using Adjusted Close prices) from the end of 2008 through the last trading day in the data set, and b) the Adjusted Close over that period if it grew smoothly at the 2008-2013 CAGR. Show the smooth growth trend starting from the end of 2008 out through the end of 2016.

- 7) How many years are in the data set? Show your answer as a number with two decimal places, e.g., 10.25.

- 8) What was the **CAGR** of the **Adjusted Close** from the first trading day in the data set to the last trading day in the data set?

- 9) If the growth rate in Adjusted Close from the last day of 2013 to the last day of 2014 is the same as the CAGR for the entire data set, what will the Adjusted Close of the stock be on the last trading day of 2014 (assuming no further adjustments)?

- 10) Create a graph in Excel that shows a) the actual daily stock prices (using Adjusted Close prices) from the first trading day through the last trading day in the data set, and b) the Adjusted Close if it grew smoothly at the CAGR. Use the CAGR computed over the whole data set. Show the smooth growth trend starting from the first trading day out through the end of 2016.

- 11) Write the equation for the curve of the smooth growth of the Adjusted Close as a function of time t , where t is in days since the first trading day.