Strategies for Buying Stocks

Purpose: The purpose of this lab is to give you practice working with difference quotients and rates of change. We shall do this by considering different strategies for purchasing stocks. For simplicity we will examine a single stock which had the price (per share) of $100 on January 1 of a particular year, and track it for two years. The price of the stock at the beginning of each month over the following two years is given in this lab’s spreadsheet.

Part I: Rate Strategies

Stock brokerage firm #1 recommends to its clients to buy a stock if its price is increasing at a yearly rate greater than 10% of the current price of the stock. Let’s compute the yearly rate of increase of the stock in January 2000. We will measure time in years. The price of the stock on January 1, 2000, was $100 and on February 1, 2000, was $106. Thus, the yearly rate of increase in January was

$$\frac{106 - 100}{1/12} = 72 \text{ (dollars per year)}.$$  

This is the amount that the price would increase in a year if it kept increasing each month by the same amount that it did in January. Since $72 is larger than $10.6 (which is 10% of the current price on February 1), firm #1 recommends buying this stock in February 2000.

1. Computing rates:
   (a) Open the spreadsheet for this lab, make a copy, and rename it with your group names.
   (b) In Column C, compute the rates of change of the stock price.

2. Using the Rates:
   (a) Fill in column E in the spreadsheet giving firm #1’s recommendations with a “b” for buy or an “nb” for don’t buy for each month during the two year period.
   (b) Firm #2 has a more conservative strategy. It only recommends buying if the stock increases by a yearly rate greater than 20% of the stock’s current price for two months in a row. Fill in column F in the spreadsheet to indicate in which months firm #2 recommends buying and in which months it does not.

3. Graphing: On the ‘Graphs’ tab of your spreadsheet, insert a graph showing both stock prices and their rates. Note that in order to get lines (rather than just points) to appear on your graph, you’ll need to select ‘Line Chart’ under the ‘Data’ tab, and check the ‘Plot null values’ box under ‘Chart Style’ in the ‘Customize’ tab of the Chart Editor.

On the graphing page given to you by your TAs, carefully copy the graphs of the stock price and its rate. Note that the rates are drawn in between months!

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1Note that if you are copying a formula down (which you should!), you will need to go back and delete zeros.
2You can get the spreadsheet to do this (and the previous question) automatically by using IF statements, but that is beyond the scope of the spreadsheet skills for this class.
Part II: Acceleration Strategies

Firm #3 has a more sophisticated strategy. It will recommend buying only if the rate of increase computed the previous month was positive and if the rate at which the price was increasing the previous month was itself increasing. How can we compute the rate at which the rate is increasing? In January 2000 the rate of increase was

$$\frac{\$106 - \$100}{1/12} = 72 \text{ (dollars per year)},$$

and in February 2000 the rate of increase was

$$\frac{\$109 - \$106}{1/12} = 36 \text{ (dollars per year)}.$$

To calculate the rate at which the rate is changing we subtract the two rates and divide by 1/12 obtaining

$$\frac{\frac{\$109 - \$106}{1/12} - \frac{\$106 - \$100}{1/12}}{1/12} = \frac{36 - 72}{1/12} = -432 \text{ (dollars per year per year)}.$$

Thus, $-432$ is the yearly rate at which the rate changed between January and February 2000. It’s negative because the rate of increase got smaller as we moved from January to February. The rate at which the rate is changing is called the “acceleration.” (Why is the use of this term consistent with its use in the context of time and motion?) We just calculated the acceleration for February 1, 2000. Note that our calculation used the stock prices for January, February, and March. Thus, the first time one could buy based on the acceleration for February 1 would be on March 1. Calculate and fill in the acceleration for the rest of the months in the table.

1. **Computing Acceleration:** In column $D$ of your spreadsheet, compute all the accelerations of the stock price. Again, you’ll have to delete zeros.

2. **Using Accelerations:**

   (a) Firm #3 recommends buying if the rate of change computed the previous month was positive and the acceleration the previous month was positive. Indicate in column $G$ which months firm #3 recommends buying.

   (b) Firm #4 has a somewhat different strategy which uses acceleration. Firm #4 does not care if a stock’s price is increasing. It recommends buying if the acceleration has been positive for the two previous months. Indicate in column $H$ when firm #4 recommends buying and when it does not.

3. **Visualizing Acceleration:** On your graph of the price and rate of change of the price, indicate for which months the acceleration is positive and for which it is negative. (One way to do this would be to color the parts of both the price and rate graph in a different color at times when the acceleration is negative.)
Part III: Calculating Results (i.e., Making Money)

We are now ready to calculate the results of using these strategies in the following (very oversimplified) situation. You start January 1, 2000, with $1000. Until your firm recommends buying you leave your money in a saving account which earns 0.25% interest each month (no compounding of interest). When your firm recommends buying, you do it, and then sell in January 2002 at the price of $116.

For example, if you choose to buy the stock at the beginning of March 2000, you will have $1000(1+0.0025 \times 2) = $1005.00 with which to buy stock. When you sell the stock in January 2002, you will have a balance of \((1005.00/109) \times 116 = 1069.54\).

1. **Calculating Profit:** For each of the four different strategies, calculate how much money you would make and compare it to the 5th strategy of leaving your money in a savings account for the entire time (no compounding of interest). You may use the spreadsheet if you like.

2. **Analyzing Results:** Write a short paragraph discussing why the two rate strategies did not work as well as the two acceleration strategies.

3. **Different Stock Histories:** Do you think that the ordering of the strategies from best to worst would always come out the same no matter what the price history of the stock? Make a sketch of a stock price over this two year period that would have given a different result and explain why the result would be different.

Part IV: Buy Low, Sell High

That sounds like good advice! But how do you do it? Our stock reached its low point in March 2001 and none of our previous strategies resulted in buying then. Invent a strategy that would have recommended buying for the first time on or near March 1, 2001.

Part V: A Selling Strategy

Until now we have assumed that you would sell the stock at the beginning of January 2002. In reality, you may want to sell the stock before the price falls dramatically. Devise a strategy to decide when to sell the stock. This strategy should incorporate the acceleration of the stock price.
Graphs of Price and Rate of Change of Price