

# Exponential Growth Projections

by Loren Cobb

## ***Abstract***

This paper introduces a simple technique for estimating the growth rates of total returns for stocks that appear to be growing on an exponential trajectory. It is intended for use in conjunction with the stock screening methods of Mechanical Investing.

## ***Introduction***

To my mind, the perfect stock for a Mechanical Investing screen would have a constant total return over time. The graph of the stock price of this fantasy stock would be beautifully exponential, with total predictability. We would all make a fortune investing in this stock and its options, with no risk at all. In the real world, which I occasionally visit, things are more chancy. No real-world stock has a perfectly exponential trajectory, but some come close for periods measured in months and sometimes years.

For example, Figure 1 below shows the stock price of JDSU plotted on a logarithmic scale. If the trajectory is exponential then the graph should look like a straight line. Indeed, there was a time between November 1998 and November 1999 when the graph was remarkably linear. This is when people made a lot of money investing in JDSU and its options. It's intriguing to observe that now, in June of 2000, JDSU has returned to its projected line of exponential growth, after having been influenced by the infamous "internet bubble."



**Figure 1:** The split-adjusted stock price of JDSU on a logarithmic scale, over the last two years.

Now let's focus on the fluctuations. The week-to-week *increases* in  $\log(\text{Price})$  for a stock make a series of numbers that is of interest. The mean of this series of numbers is the average weekly gain in  $\log(\text{Price})$ , while the standard deviation measures the size of the typical fluctuation. These two statistics,  $m$  and  $s$  respectively, are what we will use to make projections into the future.

Since  $m$  is the mean weekly change in  $\log(\text{Price})$ , the expected weekly return is  $\exp[m]$ . Over  $t$  weeks it will be  $\exp[mt]$ . To convert this to a growth percentage, subtract one and multiply by 100. But this is only the expected gain. What about its variation? As a rule of thumb, two-thirds of the time the weekly gain will be in the range be-

tween  $\exp[m - s]$  and  $\exp[m + s]$ . This is why we calculated  $s$ . The range  $\exp[m \pm s]$  is sometimes called the *one-sigma range*. (For those unfamiliar with the notation,  $\exp[x]$  is just another way of writing  $e^x$ ).

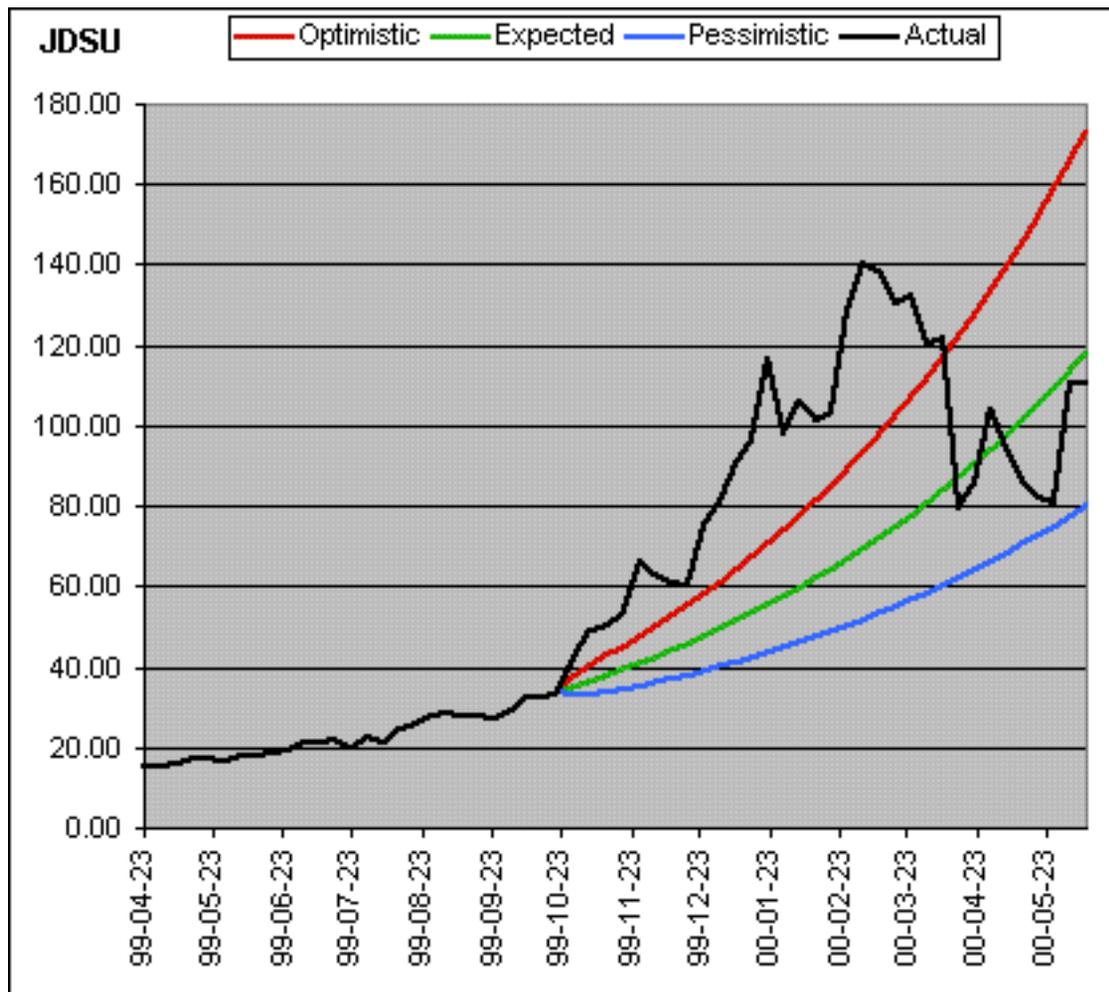
To project the range further into the future, we need one additional fact about random time series. When we add two independent random increments together, as we must to project two weeks ahead, the standard deviation of the sum is **not**  $2s$ . Instead, it is  $s\sqrt{2}$ . In general, when we add  $t$  independent random increments, for example to project  $t$  weeks into the future, then the standard deviation of the sum of the  $t$  increments is  $s\sqrt{t}$ . Therefore, the one-sigma range for the return of our nifty little stock after  $t$  weeks will be between  $\exp[mt - s\sqrt{t}]$  and  $\exp[mt + s\sqrt{t}]$ . Again, to convert these into growth percentages, subtract one and multiply by 100.

Anyone who wishes to see the mathematics behind these ideas in greater depth and detail should consult **Options, Futures, and other Derivative Securities, 2<sup>nd</sup> Edition**, by John C. Hull (Prentice-Hall, 1993), pp. 210-217. While this material is related to the Black-Scholes theory for pricing options, and is found within a chapter that uses the full apparatus of stochastic differential equations, it is not in itself particularly difficult or advanced.

One could reasonably call the limits of the one-sigma range "pessimistic" and "optimistic" projections. As a rule of thumb, if the stock continues to grow the way it has in the past, and if deviations from the exponential growth curve are statistically independent, then the actual rate of return will be within its one-sigma range about two-thirds of the time. Pessimists will most likely be comfortable focusing on the lower end of the one-sigma range, while optimists will happily study the higher end. The bottom of the one-sigma range for growth rates has often been called the "*risk-adjusted growth rate*." Investors who focus on the *expected* rate of return can be characterized as unconcerned with the size of the random fluctuations that may affect their stock choices. In contrast, pessimists worry that the fluctuations will go against them, while optimists tend to assume that they will break in their favor.

Figure 2 shows how these projections look in the case of JDSU, projecting forward from 23 April 1999, based on six months of prior weekly data.

**Figure 2:** Optimistic, expected, and pessimistic projections of JDSU, from 23 April 1999. These projections are based on six months of prior data. Unlike the previous figure, which was shown on a logarithmic scale, the stock price of JDSU (split-adjusted) is graphed here on a rectilinear scale.



I presented the JDSU case because it demonstrates an important point: even one year of almost perfect exponential growth does not guarantee that the exponential pattern will continue into the future. An investor who purchased JDSU on 23 October 1999, as many did, would have experienced first greater-than-expected growth over the next five months, then a sickening plunge, then a sudden recovery. This roller-coaster ride is what we have learned to expect from stocks that have very high relative strength (i.e. that tend to grow much faster than the overall market).

The JDSU case illustrates another phenomenon as well: serially correlated disturbances. Once JDSU had broken the pattern and diverged from its pure exponential trajectory, it engaged in quite a substantial excursion before returning to the trend. In plain English: *large external disturbances tend to last longer than one might expect, sometimes much longer*. The formulas used here to project the one-sigma range do **not** take into account the possibility of serially correlated disturbances; instead they assume that all disturbances are independent. The appropriate statistical correction will be presented later, after it has been studied and tested. Meanwhile, it would be fair to assume that the calculated one-sigma ranges are not quite as broad as they should be.

## **Method**

Projecting the growth in total return for a stock based on an exponential growth model is really not appropriate for the majority of stocks, because they simply do not grow exponentially. Some are cyclical, others are too sensitive to the overall market, and yet others grow only sporadically, with sudden lurches upward.

It is not yet clear what the best screen might be for generating candidates for exponential projections, but it is clear already that some of the Mechanical Investing screens do quite well. A stock that is steadily growing along an exponential curve is one that should make it onto one or other of the 13-week and 26-week Relative Strength screens.

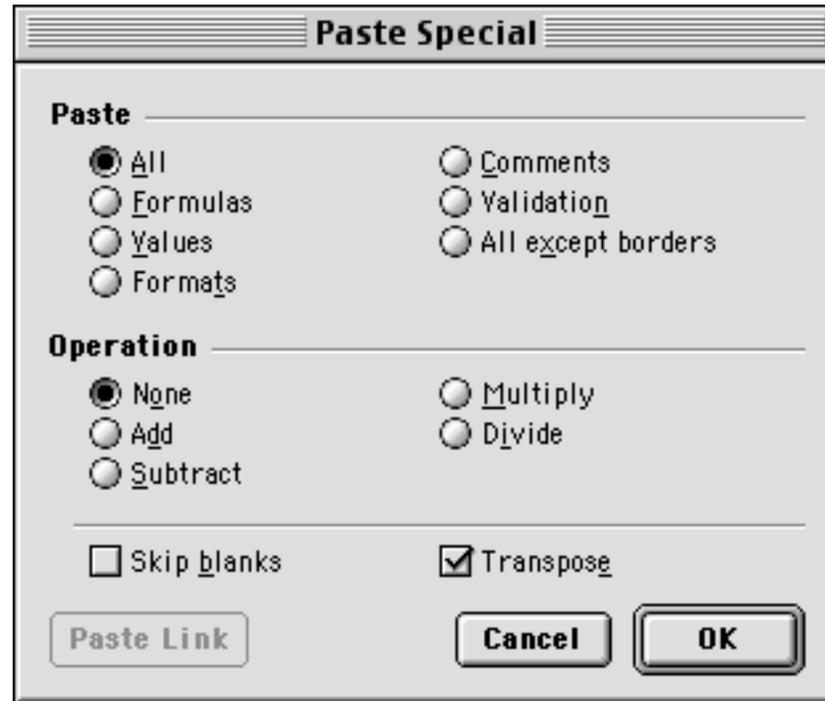
With this background in mind, here in detail are the steps that I follow to project exponential growth. The Excel spreadsheet "Projections.xls" which accompanies this article is designed to implement the calculations.

1. Merge the two weekly lists of the top 10 stocks from the RS-13wk and RS-26wk screens.

2. For each stock, visit the Yahoo historical quote site to obtain a time series of data:

<http://chart.yahoo.com/d?s=>

3. Enter the ticker symbol and set the time interval to the preceding 6 months + 1 week. Be sure to specify weekly quotes (daily quotes are unnecessary).
4. Click the button labeled "Get Historical Data." You will see a table of weekly figures; some rows of the table may specify stock splits and dividends. Note that the dates given in the table refer to the Mondays of the given weeks.
5. Scroll to the bottom of the table, and click the button labeled "Download Spreadsheet Format." This will produce a new page with raw weekly data, separated by commas, without the extraneous rows that give dividends and stock splits. This is the data that we will use.
6. Select and copy the entire page (CTRL/A, CTRL/V for PCs; CMD/A, CMD/V for Macs). Open the Excel spreadsheet "Projections.xls", click on the tab (in the lower left corner) that specifies the **Temp** worksheet, and paste the page into the worksheet at the indicated cell.
7. Excel may or may not have placed each number in its own cell. If not, then use the "Text to Columns..." command in the **Data** menu. Be sure to indicate that the delimiter is a **comma**. This command will distribute the data values correctly, one per cell.
8. Select and copy the 27 numbers in the data column labeled "Close," which gives the weekly closing prices.
9. Move to the **Results** worksheet (click the appropriate tab at the lower left corner of the window). Note that each stock has its own row of results and data. The data begins in the eighth column. Use the "Paste Special..." command under the **Edit** menu to paste the series of closing prices into this row. When the dialog box for this operation appears, check the "Transpose" checkbox (see Figure 3 for an illustration). This will convert the series from a vertical column to a horizontal row. Click the Okay button to complete the paste. Be sure to rename the row so that the first column contains the name of the stock.



**Figure 3:** The dialog box for the “Paste Special...” command (Macintosh version).

10. If you correctly pasted the data into a “live” row, i.e. one that has formulas for the calculations, then you should already see your results in the second through seventh columns. The mean of the weekly changes in  $\log(\text{Price})$  is in the second column, and the standard deviation in the third. The fourth through seventh columns should contain the projected growth rates. Note the cell D2, shaded in gray. You can specify the length of the projection here (the default is 52 weeks). See Figure 4 for an illustration.

RS Projection.xls									
	A	B	C	D	E	F	G	H	
1				<b>Projected Total Returns, Based on 6 Months of Data</b>					
2				<b>52</b>	<b>Weeks of Projection</b>				
3									
4	<b>Symbol</b>	<b>Mean</b>	<b>Sigma</b>	<b>(-2) Sigma</b>	<b>(-1) Sigma</b>	<b>Expected</b>	<b>(+1) Sigma</b>	<b>09-Jun-00</b>	
5	AD	0.0200	0.0478	42%	100%	183%	299%	35.8125	
6	ADBE	0.0213	0.1137	-41%	33%	202%	587%	118.375	
7	ADCT	0.0312	0.0799	60%	185%	407%	802%	76.5	
8	ADI	0.0370	0.1241	15%	181%	587%	1580%	94.6562	
9	AMD	0.0377	0.1127	40%	215%	609%	1499%	87.125	

**Figure 4:** An illustrative piece of the spreadsheet for calculating projected returns.

At this point one might be tempted to try to sort the table of results. Don't try it! All of the results will instantly change to completely invalid quantities. Instead, copy the table, paste it into a new spreadsheet, and close the current spreadsheet. This will prevent the inadvertent invalidation of results. [Note for spreadsheet wizards: this table should not be sorted because it relies on the other worksheets, which are not affected by the sort operation.]

### ***Interpreting the Results***

Projections are always troublesome to interpret, because the human mind wants predictions instead. Projections are not predictions! To make a prediction from a projection, all of its assumptions must be given. Thus a defensible prediction statement based on Figure 4 might read as follows:

“If the ADCT stock price continues to grow along the estimated exponential path that it followed during the six months prior to 9 June 2000, and if nothing in the market or the internals of ADC Telecomm occurs which might change the growth dynamic, then the graph of the price of ADCT over the next year will fall within the one-sigma range (growth rates between 185% and 802%) about two-thirds of the time.”

The big caveats in this statement are the two preliminary “if” conditions. Unfortunately, the chances are excellent that **neither** condition will be fulfilled during the next year, thus invalidating the entire prediction. It is an error to suppose that the probability statement at the end covers these contingencies. It does not. The probability statement applies only if both preliminary conditions hold. Furthermore, the model used assumes that external disturbances are “serially correlated.” Of course they are not. Therefore, it is best not to try to make predictions out of these projections.

### ***Using the Results***

Usage is another matter. I am personally comfortable with basing some of my investment decisions on these projections, because I believe that the rankings generated by this method actually reflect the relative quality of these potential investments reasonably well, and arguably better than the “overlap” method now used to combine the rankings of the RS-13wk and RS-26wk screens. In the absence of backtest data, however, this is merely a personal opinion.

*May all random fluctuations break in your favor!*

Loren Cobb, Ph.D.  
Carbondale, Colorado.