



Computerized Stock Trading System

An Interactive Qualifying Project Report

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1 Abstract

This IQP combines fundamental and technical analysis by adding value to the stocks selected by the Guru Stock Screener (Guru Stock Screener) through utilizing the concept of complete trading strategies. The method of using the Guru Stock Screener to selected 100 stocks is based on Value/Growth investment methodology developed by James P. O'Shaughnessy (James P. O'Shaughnessy, Founder, Chairman and Chief Executive Officer, O'Shaughnessy Asset Management L.L.C, 2010) who is known to be a famous "guru". We utilize TradeStation trading platform to evaluate four additional screening criteria: Moving Average Crossover, Average Directional Index, Volatility and Efficiency indicators on 100 stocks that are selected by the Guru Stock Screener to further refine the stock list down to only five stocks plus GOOG and X that satisfy certain criteria. By back-testing five Value/Growth stocks plus GOOG and X from 3/21/2002 to 3/21/2008 we then apply optimized parameters within strategy on each of these stocks to compare and contrast each stock's performance relative to a simply "Buy and Hold" strategy from 3/21/2008 to 3/21/2010. We find Strategy 5 generates a higher net profit than "Buy and Hold". In particular, we find the following:

- GOOG and X performs extremely well using Strategy 5 compared to "Buy and Hold", both on net profit and annual rate of return. In particular, GOOG performs the best using Strategy 5 based on Profit Factor, with a win of \$36838 and a 59.24% annual rate of return. X performs the best using Strategy 5 based on Expectancy per Trade, with a win of \$5707 and a 14.24% annual rate of return
- CE performs the best using Strategy 5 based on Profit Factor, with a win of \$2815 and a 7.37% annual rate of return
- TUP performs the best using Strategy 5 based on Expectancy per Trade, with a win of \$2441 and a 6.44% annual rate of return
- VSEC and JAS perform best using "Buy and Hold" strategy, with a net profit of \$1924 and \$1654 respectively
- PTR loses money in both strategies.

2 Introduction and Statement of the Problem

The stock market is one of the important sources for companies to raise their money. It allows businesses to raise capital by selling ownership to the public. The liquidity of the stock market also enables investors to exchange their ownership easily. The size of the world stock market was estimated at about \$46.8 trillion. (Bespoke Investment Group, 2010) The stock market has become an integral part of the dynamics of the world economy and its importance to the financial system cannot be understated.

Individuals can invest in the stock market directly by buying shares of stocks or indirectly through mutual funds. With on-going computerization of the stock markets, more and more people have opened up their brokerage accounts and

attempt to take control of their financial futures. But few of them know how to invest scientifically. They don't know which stocks to buy or sell, when to buy or sell, and when to take profits and when to stop losses.

In particular, NASDAQ.com provides a powerful Guru Stock Screener where you can pick your favorite stock "guru" or "gurus" and get a list of stocks that scanned by each guru's investment methodology. This powerful tool enables investors to pick their stocks the same way as gurus and many mutual fund managers do. But there are several drawbacks to this Guru Stock Screener. First, although it provides a list of stocks that satisfy guru's investment methodology, it does not tell investors which stocks to buy, because an individual investor with limited capital cannot buy all the stocks on the list. Second, even investors with required capital manage to buy all the stocks on the list, but they have limited information as to when to buy and sell the stock, or will they earn a better return using a conservative "Buy and Hold" strategy? This IQP will help prepare investors to answer those questions.

The goal of this IQP is to help these investors manage their financial futures by introducing them to a complete trading system. We incorporate fundamental and technical analysis in this project and we decide that the fundamental analysis has already been perfected by the Value/Growth investment methodology created by James P. O'Shaughnessy and the Guru Stock Screener. That's why we will not decide which stocks will have the necessary fundamental characteristics but concentrate on the technical aspect of the analysis. James P. O'Shaughnessy stock screening method on the Guru Stock Screener only provides a list of 100 stocks but offers limited advice on how to trade those stocks scientifically. In this IQP, we will solve this problem using TradeStation as our professional trading platform to test different entry criteria and exit rules.

In the first part of the report, we will introduce to you what fundamental and technical analyses are and what are the measures of each analysis. Then we will talk about the investment methodology of James P. O'Shaughnessy and the Guru Stock Screener and its stocks screening criteria. Followed by explanations on the components of a complete trading system and how each component works – set-up, entry, exit with a profit, exit with a loss, and money management stop. After that, we will guide you through the four technical indicators that we used to refine the list down to five tradable stocks plus GOOG and X using Moving Average Crossover, Average Directional Index, Volatility and Kaufman Efficiency indicators. We will analyze the performances of Value/Growth stocks by back-testing them from 3/21/2002 to 3/21/2008 using TradeStation and optimized them to achieve maximum profit factor and expectancy per trade.

We will test the optimized strategy on the same stocks from 3/21/2008 to 3/21/2010 to compare the performance of each stock relative to a Buy & Hold strategy. As a result we find Strategy 5 generates a higher net profit than "Buy and Hold". In particular, we find the following:

- GOOG and X performs extremely well using Strategy 5 compared to "Buy and Hold", both on net profit and annual rate of return. In particular, GOOG performs the best using Strategy 5 based on Profit Factor, with a win of \$36838 and a 59.24% annual rate of return. X performs the best using

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3 Background Research

3.1 Fundamental Analysis

Fundamental Analysis is a valuation of a company stock. It predicts probable price movements based on the company's earnings, management, production and other criteria. It often uses the company's financial statements and ratios to figure out the company's intrinsic value in comparison to the market value. If the intrinsic value is above the market value, then the stock is undervalued and should be bought; if the intrinsic value is below the market value, then the stock is overvalued and should be sold. Fundamental analysis is based on the assumption that the market may misprice the intrinsic value of the stock in the short run but will eventually make its correction. Therefore profits can be gained during the time when the stock price reaches its equilibrium price. Some of the measures of fundamental analysis that are relevant to James P. O'Shaughnessy Value/Growth investment methodology are explained below:

3.1.1 Market Capitalization

Market Capitalization is the total dollar market value of all of a company's outstanding shares. Market capitalization is calculated by multiplying a company's shares outstanding by the current market price of one share. (Glossary-M, 1999-2010) The investment community uses this figure to determining a company's size, as opposed to sales or total asset figures. It is frequently referred to as "market cap".

3.1.2 Earnings Growth

Earnings Growth is the annual rate of growth of retained earnings that company achieves on its balance sheet.

3.1.3 Return on Equity

Return on Equity is the amount of net income returned as a percentage of shareholders equity. (Return on Equity, 2010) Return on Equity measures a corporation's profitability by revealing how much profit a company generates with the money shareholders have invested.

ROE is expressed as a percentage and calculated as:

Return on Equity = Net Income / Shareholder's Equity

Net income is for the full fiscal year (before dividends paid to common stock holders but after dividends paid to preferred stock). Shareholder's equity does not include preferred shares.

It is also known as "Return on Net Worth" (RONW).

3.1.4 Profit Margin

Profit Margin is a ratio of profitability calculated as net income divided by revenues, or net profits divided by sales. (Profit Margin, 2010) It measures how much out of every dollar of sales a company actually keeps in earnings. Profit margin is very useful when comparing companies in similar industries. A higher profit margin indicates a more profitable company that has better control over its costs compared to its competitors. Profit margin is displayed as a percentage; a 20%

profit margin, for example, means the company has a net income of \$0.20 for each dollar of sales.

It is also known as Net Profit Margin.

3.1.5 Price-to-Earnings Ratio

The Price-to-Earning ratio is a valuation ratio of a company's current share price compared to its per-share earnings. (Price-Earnings Ratio-P/E Ratio, 2010) It is interpreted as amount of money investors are willing to pay for one dollar of a company's earning. It is calculated as:

Price-to-Earning = Market Value per Share/ Earning per Share

For example, if a company is currently trading at \$40 a share and earnings over the last 12 months were \$20 per share, the P/E ratio for the stock would be 2 (\$40/\$20). EPS is usually from the last four quarters (trailing P/E), but sometimes it can be taken from the estimates of earnings expected. In the next four quarters (projected or forward P/E). A third variation uses the sum of the last two actual quarters and the estimates of the next two quarters. P/E ratio is also known as "price multiple" or "earnings multiple".

3.1.6 Cash Flow

Cash flow is the revenue or expense streams that change a cash account over a given period. (Cash Flow, 2010) Cash inflows usually arise from one of three activities - financing, operations or investing. Cash outflows result from expenses or investments.

For a corporation, a statement of cash flows is an accounting statement that shows the amount of cash generated and used by a company in a given period. It is calculated by adding noncash charges (such as depreciation) to net income after taxes. Cash flow can be attributed to a specific project, or to a business as a whole. Cash flow can be used as an indication of a company's financial strength.

3.1.7 Price-to-Sale Ratio

The Price-to-Sale Ratio is a ratio for valuing a stock relative to its own past performances, other companies or the market itself. Price-to-Sale is calculated by dividing a stock's current price by its revenue per share for the trailing 12 months:

Price-to-Sale Ratio = Market Value per Share/ Revenue per Share

3.1.8 Dividends

Dividends are a distribution of a portion of a company's earnings, decided by the board of directors, to a class of its shareholders. The dividend is most often quoted in terms of the dollar amount each share receives (dividends per share). Utility stocks in general have high dividend yields. Thus utility stocks are likely to grow slower than a company with a low dividend yield, where the money is plowed back into the company for its own investments.

3.2 Technical Analysis

Technical analysis is another way of evaluating a security based on the past market data, primarily price and volume to make predictions of the future movements of the stock's price. Technical analysis is based on the assumption that

history repeats itself; any patterns that are revealed during the past are likely to happen in the future. Therefore, price patterns and trends of historical stock prices are explored extensively in order to predict the future direction of the stock price.

People who use technical analysis seek to identify and exploit patterns and trends in financial markets by using various tools and methods. Many more technical tools and theories have been developed through the use of computers in recent decades. They study various indicators such as Moving Averages, Average Directional Index, and other indicators. They use Support and Resistance, Channels and Bands in an effort to discover underlying trends of stocks. Below are the technical indicators that are pertinent to our technical analysis:

3.2.1 Open-High-Low-Close (OHLC) Chart

This is a stock chart that clearly shows the opening, high, low and closing prices for a stock. A bar is red when the closing price is less than the opening price and is green when the closing price is greater than opening price. This chart is often used by technical analysts to spot trends and view stock movements, particularly on a shorter term basis.

Here's a typical OHLC chart showing daily data.



Figure 1- Open-High-Low-Close Chart

3.2.2 Average True Range (ATR)

Average True Range is a measure of volatility, which equals the moving average (generally 14 days) of the True Range. (Average True Range, 2010)

3.2.2.1 True Range

The True Range indicator is the greatest of the following:

- Current high less the current low.
- The absolute value of the current high less the previous close.
- The absolute value of the current low less the previous close.

$$\text{True Range} = \text{Max} (H - L, \text{ABS}(C [1] - H), \text{ABS}(C [1] - L))$$

Below is the graphical interpretation of the True Range:

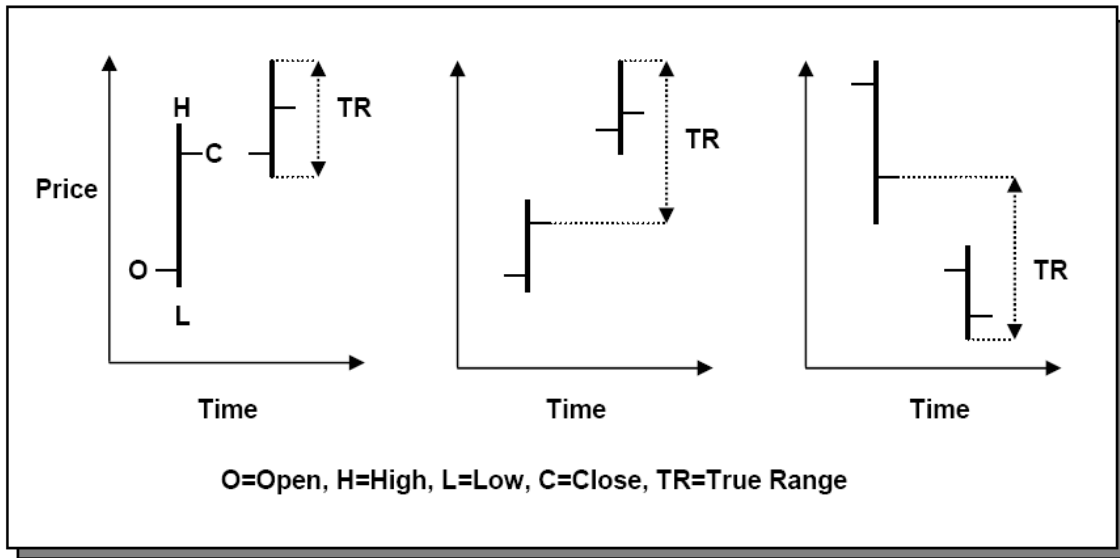


Figure 2- True Range Chart (Wilder, 1978)

Average True Range can be used as an indicator for stocks and indexes. A high ATR indicates the stock has a high level of volatility, and a lower ATR shows low volatility.

3.2.3 Average Directional Index (ADX)

ADX is an indicator used in technical analysis as an objective value for the strength of trend. ADX is non-directional so it will quantify a trend's strength regardless of whether the trend is up or down. (Average Directional Index, 2010)

Usually, increasing values above 20 suggest that the trend's strength is increasing. An ADX value crossing below 40 suggests that the trend is getting exhausted and is likely to reverse. (Wilder, 1978)

3.2.4 Moving Average

A moving average is usually referred to as simple moving average, and is calculated by adding the closing prices of the security for a number of time periods and then dividing this total by the number of time periods. In other words, this is the average stock price over a certain period of time. (Simple Moving Average, 2010)

Short-term averages respond quickly to changes in the price of the underlying stock, while long-term averages are slow to react. Many traders watch for short-term averages to cross above longer-term averages to signal the beginning of an uptrend.

Here is an example of simple moving averages:

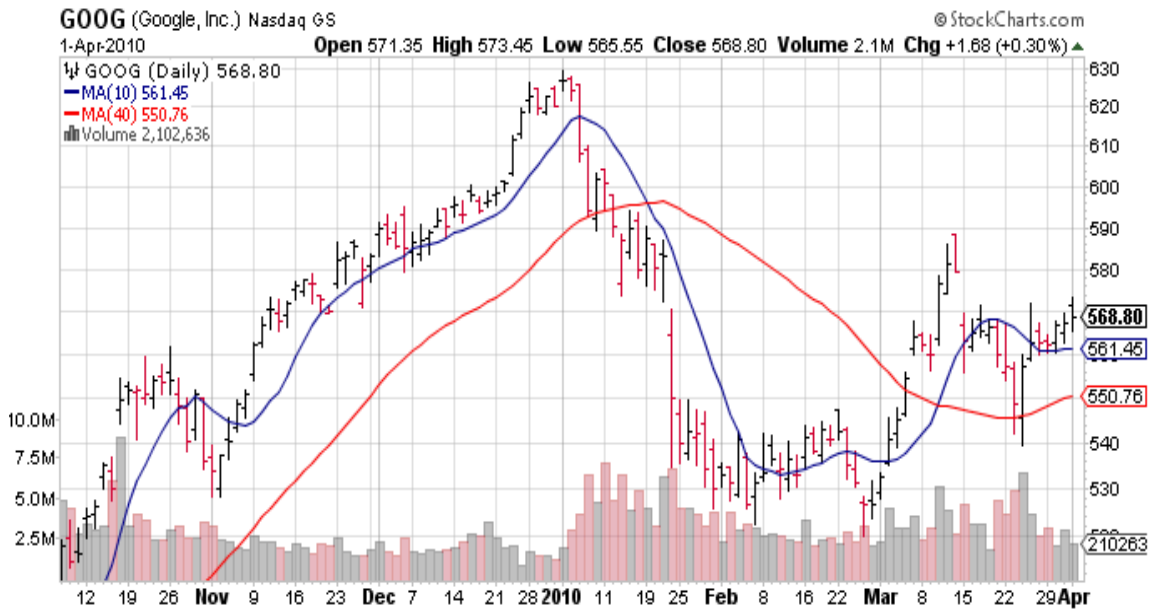


Figure 3- GOOG 10-Day, 40-Day Moving Average

Notice when GOOG goes down in 2010, the blue 10-day moving average falls below the red 40-day moving average, thus the short term moving average responds more quickly to price changes than long-term moving average.

3.2.5 Volatility

Volatility is a statistical measure of the dispersion of returns for a given security or market index. Volatility can either be measured by using the standard deviation or variance between returns from that same security or market index. (Volatility, 2010)

In other words, volatility refers to the amount of uncertainty or risk about the size of changes in a stock's return. A higher volatility means that a stock's return can potentially be spread out over a larger range of returns. This means that the price of the stock can change dramatically over a short time period in either direction. A lower volatility means that a stock's return does not fluctuate dramatically, but changes in return at a steady pace over a period of time.

3.3 James P O'Shaughnessy and Value/Growth Investment Methodology

James P. O'Shaughnessy is the Chief Executive Officer of O'Shaughnessy Asset Management. Prior to founding his company, O'Shaughnessy was the Director of Systematic Equity as well as the Senior Management Director at Bear Stearns Asset Management. He is a leading expert and a pioneer in quantitative equity analysis. He has written four best-selling books, *Invest Like the Best* (1994), *What Works on Wall Street* (2005), *How to Retire Rich* (1998) and *Predicting the Markets of Tomorrow* (2006). He is recognized by Barron's and Higher Returns as a "statistical guru", "world-beater" and "one of the most original market thinker we've come across." (James P. O'Shaughnessy, Founder, Chairman and Chief Executive Officer, O'Shaughnessy Asset Management L.L.C, 2010)

In his book *What Works on Wall Street (2005)*, O'Shaughnessy presents his most-in depth quantitative analysis of the stock market, in which he uses a computer program called Compustat to back-test how well different stock-picking approaches have worked from 1951 to 1994. He studies factors such as market capitalization, the price-to-earning ratios, cash flows and other fundamental statistics on stock performances over more than four decades. He develops two investment techniques based on what he found and calls them the Cornerstone Growth and Cornerstone Value method. (O'Shaughnessy's *Tried & True One-Two Punch*, 2010) Below we will describe an overview of his findings.

3.3.1 Market Leaders

Market Leaders are stocks that are defined as follows in the book:

- Come from the “large” stock universe. The large stocks are defined as stocks that are within the 16th percentile of market capitalization in the Compustat database
- Have more common shares outstanding than the average stock in the Compustat database
- Have cash flows per share exceeding the Compustat mean
- Have sales 1.5 times or better than the Compustat mean
- They are not utility stocks

Market Leaders can be thought of as the elite stocks of the “blue chips” companies. They have better than average liquidity, cash flows, sales and dividend yields. Notice they are not utility stocks because utility stocks typically have the highest dividend yield.

3.3.2 Cornerstone Value

The Cornerstone Value method is only used with Market Leaders stocks. By selecting those companies with strong sales and cash flow and high dividend yield, the method is able to exclude all but 570 of the 9889 stocks in Compustat, only 6% of the whole stocks universe. Low price-earning ratio and high dividend yield of Market Leaders result in a higher rate of return. Volatility or the risk that investors would take is also considerably smaller than other stocks, with only 16.95%, only slightly above the “large stocks” volatility of 16.01%. The maximum loss during a year is also small, with only 15% drop in one year. And it has never lost money over 5 years. It performs extremely well in the both bear and bull markets. (O'Shaughnessy, 1998) Overall, this strategy not only has great returns and lower risks, it is one of the simplest to implement. You only have to buy blue chip stocks with the highest dividend yield.

3.3.3 Cornerstone Growth

The Cornerstone Growth method works better with small stocks. They are the stocks within the “all stock” universe with at least \$150 million market capitalizations. The earnings-per-share should be higher than the previous year's and the price-to-sale ratio should be below 1.5. Fifty stocks are chosen from the list with the highest one-year previous performance. The increase of price-to-sale ratio

to 1.5 makes the strategy less selective which allows more stocks to be included. (O'Shaughnessey, 1998)

This method suits investors with a tolerance for a slightly higher risk than those who use Cornerstone Value Strategy. The increase in volatility or risk is well compensated by an increase in return. This method adds a value factor on top of a growth factor, making it more appealing to investors. The price-to-sale ratio of 1.5 filters out any overpriced stocks, which reduces the amount of risk to which investors are exposed. (O'Shaughnessey, 1998)

3.3.4 Sharpe Ratio

The Sharpe Ratio is used in risk analysis to rank strategies. It is defined as the average return from the strategy, from which the risk-free rate (by the 90-day Treasury bill rate) is subtracted and into which the standard deviation of the returns is divided. (What Works on Wall Street-James O'Shaughnessey) It is simply the amount of return for a given amount of risk. The higher the Sharpe Ratio the better the strategy withstands risk and has a higher rate of return.

By using a 50-50 approach, allocating half the portfolio to the Cornerstone Growth strategy and half to the Cornerstone Value strategy, the results were only marginally inferior to the results of the Cornerstone Growth strategy, but with a similar volatility to the "all stocks" index, only 19.99%, compared to "all stocks" 19.70%. This is extraordinary, accounting for an exceptional Sharpe Ratio of 68, one of the highest found.

The author recommends this strategy for all investors except those very near to retirement. Those who are approaching retirement can reduce their growth portfolio and increase the value portion to make the returns even more secure.

Date: 12/31/1952 to 12/31/1996	(Return, Volatility, Sharpe Ratio)
Large Stocks (S&P 500)	(13.19%, 16.18%, 45)
Cornerstone Value	(16.73%, 17.14%, 64)
Cornerstone Growth	(21.72%, 25.59%, 63)
Cornerstone Value and Growth	(19.23%, 19.99%, 68)

Table 1- Comparison of Each Investment Method

Table 1 tells the whole story. The first parameter in the second column is the return, the second is standard deviation of the return (volatility) and the third is the Sharpe Ratio. Over the period tested (Dec 31 1952 - Dec 31 1996), "large stocks" (read: S&P 500) grew a compound 13.19% (16.18%, 45) a year. The Cornerstone Value approach returned 16.73% (17.14%, 64), the Cornerstone Growth strategy gave 21.72% (25.59%, 63) and the Corner stone Value and Growth Strategy gave 19.23% (19.99%, 68). (What Works on Wall Street-James O'Shaughnessey)

O'Shaughnessey developed his investment strategy based on three guidelines in which he believes are the most important: Test an investment strategy for as a long period of time as possible; clearly define the factors used to select stocks and why; remain disciplined and consistent with the strategy. (James P. O'Shaughnessey, Founder, Chairman and Chief Executive Officer, O'Shaughnessey Asset Management L.L.C, 2010) These three guidelines are the cornerstone of his Value/Growth

investment method. Being consistent and disciplined are vital elements that a successful trader should possess.

3.4 Charlie Wright

Charlie Wright is an experienced trader who is also the author of *Trading as a Business*. He believes people need to be consistent and disciplined in order to trade successfully. In his book *Trading as a Business* he shows how objective trading (i.e., strategy trading) produces far superior results than non-objective forms of trading (i.e., discretionary trading). Automatic trading will avoid or reduce the possibility of indecisions of traders that arise from emotions or anxiety. Therefore the goal of a trader is to develop a complete trading system, automate his or her trading rules, and execute trades without indecision. The system should always be tailored to its individuals' needs and personalities. (Wright)

Strategy traders use objective entry and exit criteria that have been validated by historical testing and quantitative data. Wright strongly believes effective use of historical data, along with software to test it, that enable him thoroughly test his trading strategies and improve upon it by applying business concepts into trading. This process enables him to become a successful trader and he is able to manage his financial future very well.

3.5 Michael J. Radzicki and Introduction to Trading System Development I & II

Michael J. Radzicki is an Associate Professor of Economics at Worcester Polytechnic Institute in Worcester, Massachusetts. He also teaches a course called Introduction to Trading System Development at Worcester Polytechnic Institute. He is the advisor to the Investment Club at WPI. Below are some important concepts that are taken from his class notes as well as Paul M. King's *The SmartTrader Series of eBooks* that are deemed to be important in our IQP. (The SmartTrader™ Series of eBooks, 2008)

3.5.1 Components of a Complete Trading System

Any trading system, whether based on fundamental or technical analysis, whether auto-traded or manually traded, must possess the following components:

3.5.1.1 An Objective

A system can have either single, or multiple, objectives. For example, a system can have a high winning percentage (but still possesses a positive expectancy); high annual return; low drawdown; robustness across different market conditions; low time commitment for trading; be in the market only a small percentage of time; and not allow holding trades over night

3.5.1.2 A Particular Financial Instrument to Trade

The Instrument for trading should be selected with a trader's particular financial objective in mind and the trading system should be developed for the specific financial instrument, such as stocks, bonds, currency pairs, options, futures contracts, ETFs, mutual funds and etc.

3.5.1.3 A Particular Time Frame Over Which Trades will be Made

Traders can decide whether they want to be a scalper (seconds to minutes), day trader (flat at the end of a day), swing trader (two days to two weeks), intermediate-term position trader (three weeks to three months), long-term position trader (four months to two years), active investor (buy, hold and manage), and investor (buy, hold and offload).

3.5.1.4 Entry Rules

Entry rules determine when a trading system enters a position. Although there has been research done that shows a random entry can still be profitable when other components of the system are properly designed. Entry rules should ensure that no big moves are missed. There are two types of entry rules: set-up rules and trigger rules.

3.5.1.4.1 Set-Up Rules

Set-up rules identify conditions that signal the time is generally favorable for initiating a position in the market. Ideas come from macroeconomic conditions, world events, sector rotation, inter-market analysis, fundamental analysis, technical analysis, psychology and others.

3.5.1.4.2 Trigger Rules

Trigger rules confirm the set-up rules and indicate the time is right to initiate a position in the market immediately.

3.5.1.5 Exit Rules

Exit rules can significantly influence the expectancy of the system. Expectancy is the average amount an investor can expect to win or lose per dollar at risk. Thus exit rules should be tailored to the psychology and objectives of the trader. The two major exit rules are exit with a profit and exit with a loss.

3.5.1.6 Position Sizing and Risk Management

Position sizing and risk management rules specify how much money is risked on each trade and all open trades in total. They determine the number of contracts or shares that should be bought/sold short.

3.5.1.7 System Design and Testing

Each trader must make sure that a system has satisfied all of his/her criteria prior to trading with real money.

3.5.1.7.1 Back-testing

Back-testing is often used to determine a system's characteristics, including whether or not the system has a positive expectancy. Back-testing must avoid curve-fitting.

3.5.1.7.2 Optimization

Optimization involves having a computer iterate over combinations of different parameters until the system's objective function is minimized or maximized. Never optimize a system that is unprofitable before the optimization.

3.5.1.8 System Monitoring Techniques

A trader must monitor a system's actual behavior and compare it to its "normal" behavior. If actual behavior deviates from its normal behavior, then the system should be allocated with less money, suspended and wait until it becomes normal, or retired.

3.5.1.9 Asset Allocation Rules

Asset allocation rules specify a way of allocating your trading funds into a "system of systems". It could be done by dividing the expectancy of a particular system by sum of expectancy of all systems.

3.5.2 Conclusion

Due to the length and time of this IQP, we will not have the chance to explore Position Sizing and Risk Management, System Design and Testing, System Monitoring Techniques and Asset Allocation Rules.

3.5.3 Sequence for Back-Testing Strategies

Below are the steps that individual investor should take to design a trading system that are taken from Paul M. King's *The Complete Guide to Building a Successful Trading Business*. (King)

3.5.3.1 Set-up (No Trigger) + Fixed Exit Signal + Fixed Position Size + No Implementation Costs

Begin with a set-up; it could be 50 day moving average crosses above 200 day moving average, which signals to buy. There is no trigger to confirm the set-up. The fixed exit signal could be exit the trade 20 days later since the date of entry. Position size could be to buy 100 shares. And there is no commission or slippage. Commission is fees paid to brokers when they execute orders and slippage is the difference between the price at which the system pays to buy or sell short and the price at which the trade actually occurs.

3.5.3.2 Set-up + Trigger + Fixed Exit Signal + Fixed Position Size + No Implementation Costs

Next add a trigger to your strategy which could be buying the stock at 1 point higher than the market close price. This confirms the moving average set-up by adding a stronger condition which indicates an uptrend is promising.

3.5.3.3 Set-up + Trigger + Variable Exit Signal + Fixed Position Size + No Implementation Costs

The variable exit signal could be when the 50 day moving average crosses below the 200 day moving average, which indicates it is time to exit the position.

3.5.3.4 Set-up + Trigger + Variable Exit Signal + Variable Position Size + No Implementation Costs

Once all three conditions work out fine under your objectives, you can allocate say 1% of your equity to each stock and adjust risks accordingly.

3.5.3.5 Set-up + Trigger + Variable Exit Signal + Variable Position Size + Implementation Costs (Slippage & Commission)

The last step is to add commission and slippage costs to your strategy. Make sure your objective is satisfied before your add implementation costs.

3.5.4 Conclusion

Due to the length of this IQP, we will not explore Variable Position Size and Implementation Costs and we will only focus on the first three steps of the sequence.

3.5.5 Trending & Efficiency Measure

Next we will talk about how to measure strength and efficiency of a trend.

3.5.5.1 Trending

The market is up-trending if it makes higher highs and higher lows and is down-trending if it makes lower highs and lower lows. We will use Moving-Average Crossover Method to determine whether the stock trends or not and we will use Average Directional Index to measure the strength of a trend.

3.5.5.1.1 Moving-Average Crossover Method

For example, if the 10-day moving average is above 40-day moving average and both are rising, the market is in an up-trend. As shown below:

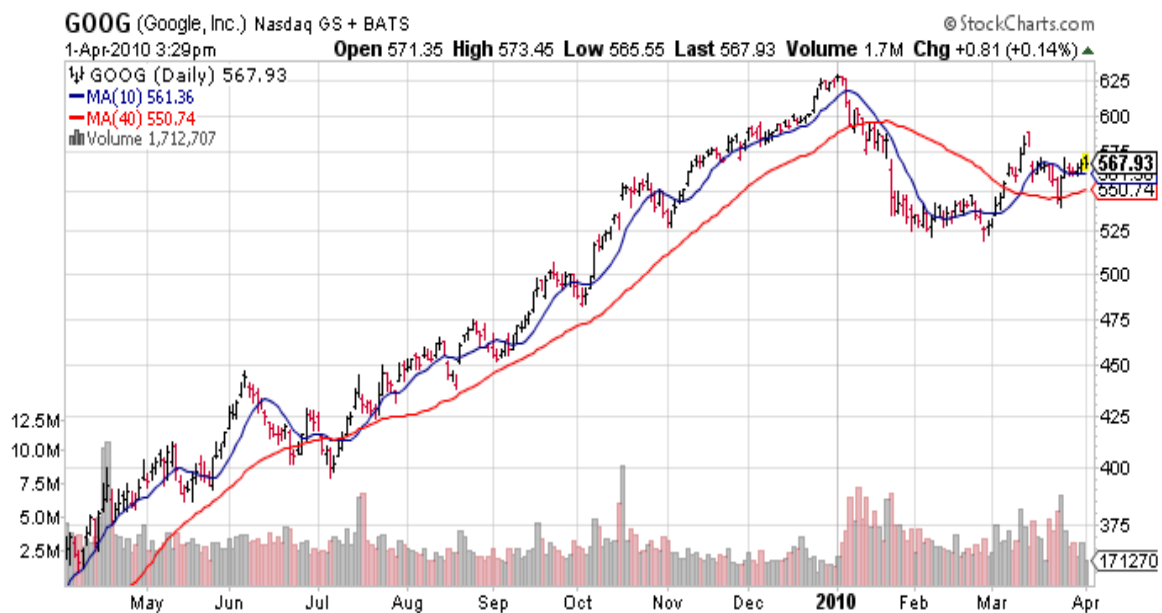


Figure 4- GOOG Moving Average Crossover Method

3.5.5.1.2 Average Directional Index

The black line in the OHLC chart below is Average Directional Index or ADX, the green line is DI+ and the red line is DI-. ADX that is above 20 and is increasing indicates a strong trend while ADX below 40 and decreasing indicates the trend is exhausted. When DI+ is above DI-, this indicates an up-trend; and when DI+ is below DI-, this indicates a downtrend. Notice ADX alone only tells you the strength of a trend, but not the direction.

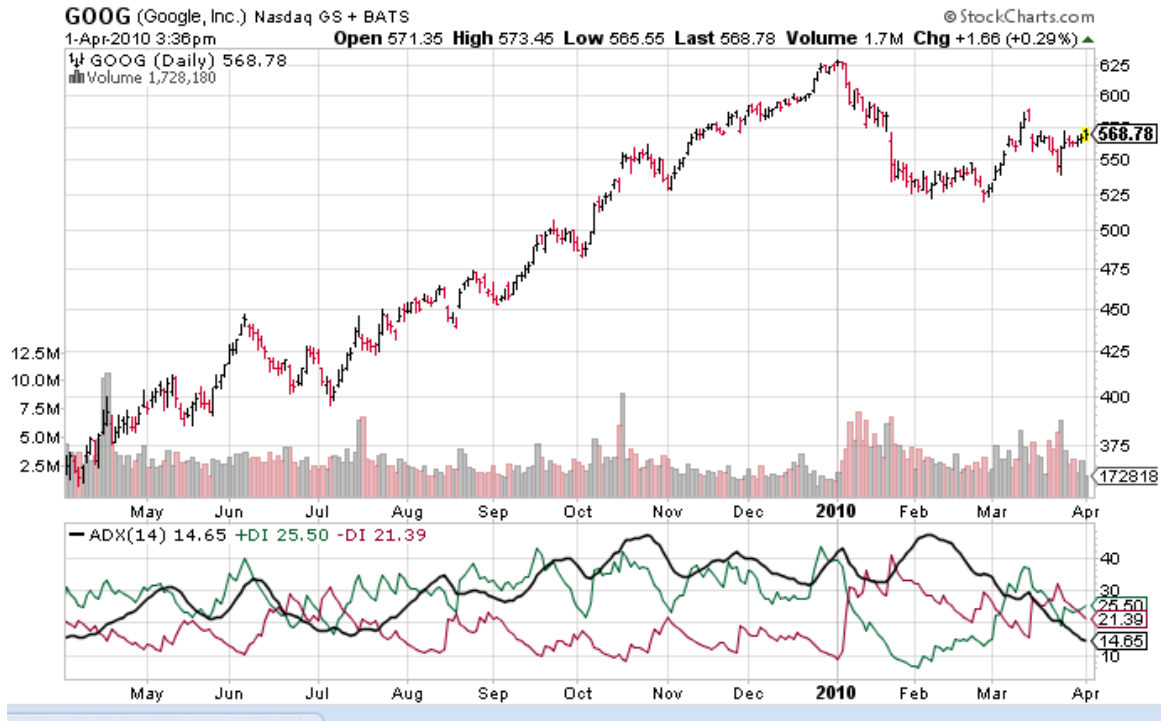


Figure 5- GOOG Average Directional Index (StockCharts.com)

3.5.5.2 Efficiency

Efficiency is a measure of the degree to which a stock's price moves from one point to another in a straight line. (King)

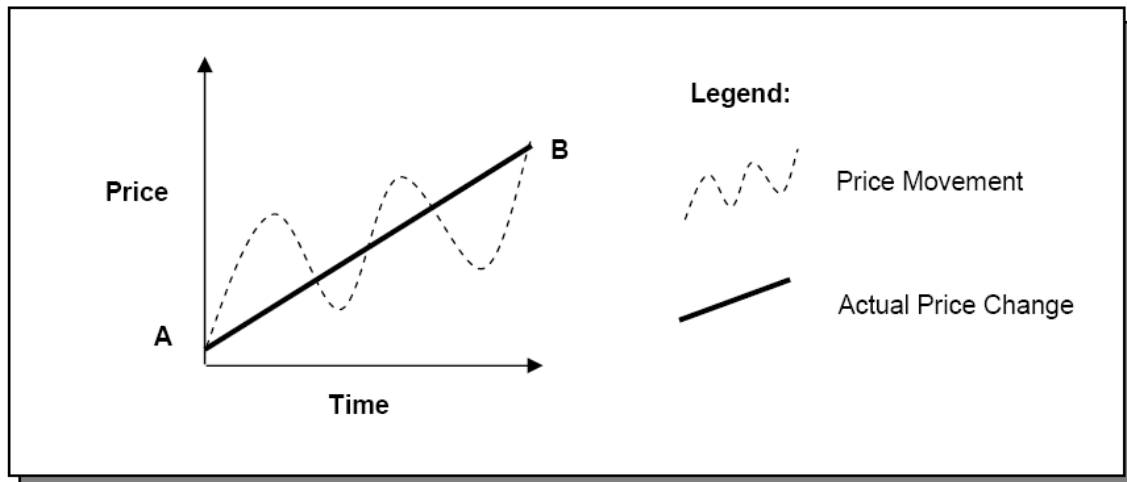


Figure 6- Efficiency (King)

3.5.5.3 Kaufman Efficiency Ratio:

Perry Kaufman is the author of *Smarter Trading (1995)*, he notes that the efficiency of a trend is calculated by net movement over a certain time period, say 20 trading days, divided by the summation of absolute value of the day-to-day price

changes over the same time period. For example, if a stock's trend is at perfect efficiency, say 20 points over 20 days, and each of those days it moved up by exactly 1 point. This would mean that the ratio of net movement over combined movement was 20/20 or 100%. If the stock downtrends by 20 points with the same perfect efficiency, its maximum downtrend reading would be -100%. (Indicator Library: The Efficiency Ratio, 2009)

Although perfect efficiency seems unrealistic, an Efficiency Ratio readings above +30% are very favorable to define a persistent uptrend and readings under -30% often indicate a downtrend. Here is the formula for Efficiency Ratio:

Movement Speed= Close Today-Close N days ago

Volatility=Summation (AbsoluteValue(Close Today-Close Yesterday)) for all days in between

Efficiency Ratio= Movement Speed/Volatility

Notice in this formula, the closer the efficiency ratio is to 100%, the more efficient the price movement.

For example, as shown below:

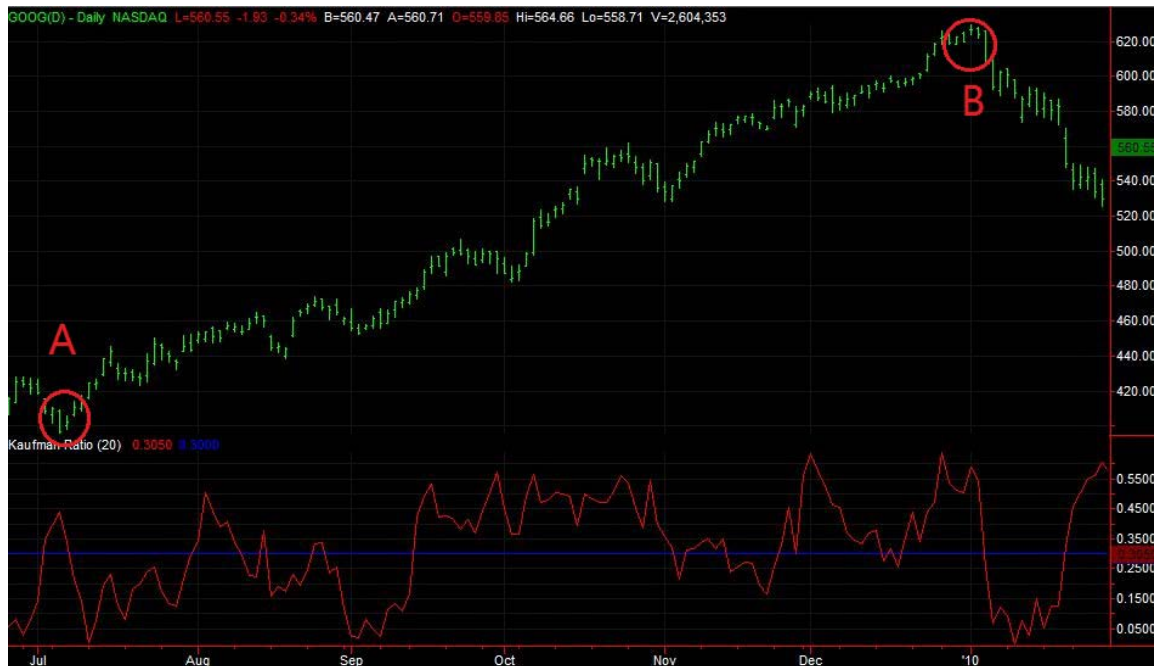


Figure 7- GOOG Efficiency



Figure 8- X Efficiency

GOOG has moved from point A to point B with little zigzag along the path while X has moved from point A to point B with a big swing in the middle of its path, which makes X not as efficient as GOOG.

By Calculation, GOOG has an average Kaufman Efficiency of 23.32% from July 6, 2009 to Jan 5, 2010, while X's Efficiency is 13.52%. These data reveal our conclusion before is correct. (We use TradeStation to Calculate it out, and here is our code:

```

//Efficiency Ratio:
input: length ( 20);
var: NetChange(1),ITC(1),TotalChange(1),ERatio(0);
NetChange = close - close[length];
ITC = AbsValue(close - close[1]);
TotalChange = summation(ITC,length);
ERatio = absvalue((NetChange/TotalChange));
// Sum ERatio
Var: SumRatio (0);
If Date > 1090706 and Date < 1100105 then
// Avg ERatio
Var: AvgRatio (0);
AvgRatio = SumRatio/183;
plot1 (AvgRatio);

```

3.5.6 Van K. Tharp's Expectancy

This function is proposed by Van K. Tharp in his book *Trading Your Way to Financial Freedom (1999)* as a way to measure strategy performance.

3.5.6.1 Expectancy

The Expectancy function is defined by Tharp as follows:

$$\text{Expectancy} = (AW * PW - AL * PL) / AL$$

=expected profit per dollar risked per trade

Where AW=average winning trade, PW=probability of winning trade, AL=average losing trade, PL=probability of losing trade.

System design must focus on creating as high a positive expectancy as possible.

3.6 TradeStation and EasyLanguage

TradeStation is a technical analysis tool that is used in analyzing and trading in the financial markets. It uses a built-in proprietary programming language called EasyLanguage.

3.6.1 TradeStation

TradeStation is a professional trading platform where you can create and test your trading ideas, customize and test on historical data and automate your execution of trading strategies in real-time. It also provides brokerage services to investors. (Trading Platform, 2010)

3.6.2 EasyLanguage

EasyLanguage is a proprietary programming language that was developed by TradeStation Securities, Inc. It is used to create custom technical indicators for charts and algorithmic trading strategies for the financial markets. (How to Create and Test Your Own Trading Strategy, 2010)

4 This IQP's Trading System

4.1 An Overview

We will choose 100 stocks using the Guru Stock Screener. (Guru Screener, 2010) The stocks selected depend on the date you access the website. In this IQP, we will use stocks that are on 3/21/2010 as our starting point. We will then apply Moving Average Crossover, Average Directional Index, Volatility, and Kaufman Efficiency indicators in order to refine the list of 100 stocks to just five stocks, namely PTR, VSEC, CE, TUP, and JAS, plus GOOG and X. Since GOOG is known to be a good trending stock (American Association of Individual Investors), we will use GOOG as our reference stock to test the sequence of our strategy set-up, entry, exits with profit, exit with a loss, Expectancy and Expectancy per Trade. And we will use the tested strategy to back-test those five stocks from 3/21/2002 to 3/21/2008 and get optimization of each stock based on Profit Factor for All Trade and Expectancy Per Trade. The resulting optimizations of their parameters are applied to them for trading from 3/21/2008 to 3/21/2010 and the results of both periods are compared and contrasted. The list of 100 stocks is attached in Appendix 8.1.

4.2 100 Stock Selection

The selection of stocks is done by accessing the website <http://www.nasdaq.com/reference/guru.stm> and selects Growth/Value Investor with Strong interest. The date we access the website is 3/21/2010. And we attached the list of 100 stocks in our Appendix 8.1.

4.2.1 Guru Stock Screener (March 21)

NASDAQ.com provides a Guru Stock Screener which includes stock gurus such as Benjamin Graham, Peter Lynch, James P. O'Shaughnessy, David Dreman, Martin Zweig, and Kenneth Fisher. In particular, we are interested in James P. O'Shaughnessy investment methodology and use this website <http://www.nasdaq.com/reference/guru.stm> as our scanner to get 100 stocks. The details of how those stocks are selected and what is James P. O'Shaughnessy investment methodology is covered in section **3.3 James P O'Shaughnessy and Value/Growth Investment Methodology**.

Investors can choose their interest level and their favorite guru on the Guru Stock Screener website as described above. In this IQP, we use "strong" interest level James P. O'Shaughnessy strategy. A sample list of stocks with stocks is presented below. Symbols and companies' names are listed in the first two columns. Other columns include Interest Level, Guru's Quant Score, Previous Close Price, Market Value, Relative Strength, P/E ratio, PEG Ratio, and Projected P/E 12 months.

Symbol	Company	Interest Level	Guru's Quant Score	Previous Close	Mkt Value \$(mil)	Rel. Strength	P/E	P/E /G	Proj. P/E 12 mon.
ARO	AEROP OSTAL E, INC.	4 / 2	100%	30.59	2,882	57	13	0.4	11
TJX	THE TJX COMPA NIES, INC.	3 / 2	100%	45.68	18,701	66	16	0.8	14
FUQI	FUQI INTER NATIO NAL, INC.	2 / 3	100%	11.50	318	82	6	0.1	7
NEU	NEWM ARKET CORPO RATIO N	1 / 4	100%	109.53	1,666	82	10	0.2	10
JAS	JO-ANN STORE S, INC.	2 / 2	100%	44.20	1,207	86	18	0.4	15
AMED	AMED SYS, INC.	2 / 2	100%	60.52	1,712	78	12	0.3	11
JOSB	JOS. A. BANK CLOTH IERS, INC.	2 / 2	1	60.88	1,117	61	16	0.8	14

Table 2- Guru Stock Screener

4.2.2 Moving Average Crossover

If a stock trends, then two different moving averages of this stock should be both rising and the number of times for them to cross should be small. Thus we develop a Moving Average Crossover Counter indicator to count the number of crossovers of two moving averages, 20 and 50 days respectively, in the past 6 year period from 3/21/2002 to 3/21/2008. We use the counter as an indicator to find out stocks with lower number of crossovers, which would indicate a stronger tendency to trend of a stock.

Fewer crossovers indicate a stronger tendency to trend of a stock. As shown in the graph below, if a stock is bearing a trend moving, then there should not be many crossovers for 20-day and 50-day moving averages. (Cyan line and pink line are 50-day and 20-day moving average respectively. Blue line shows the count number: a step up is a crossover)

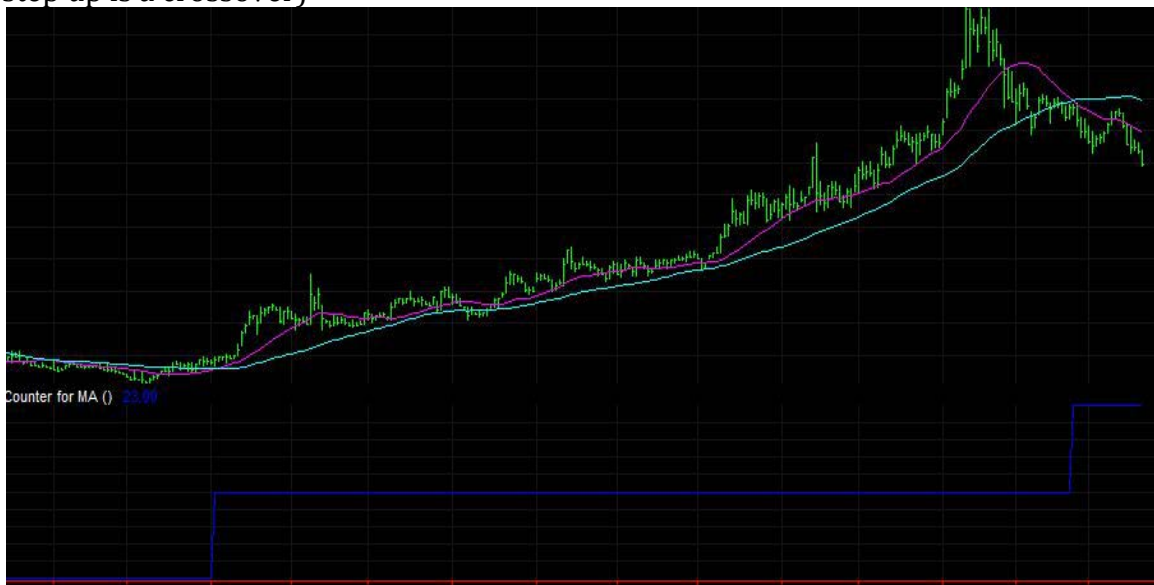


Figure 9- Moving Average Crossover Indicator 1

On the other hand, the more crossovers occur, the weaker the trend is. As shown below:



Figure 10- Moving Average Crossover Indicator 2

The code for this indicator is:

<code>//Moving Average Crossover Indicator</code>
<code>Variable: counter (0);</code>
<code>If AverageFC(close, 20) crosses above AverageFC(close, 50)</code>
<code>or AverageFC(close, 20) crosses below AverageFC(close, 50)</code>
<code>then</code>
<code> counter = counter + 1;</code>
<code>Plot1 (counter, "MACrossover");</code>

Table 3- Moving Average Crossover Indicator Code

NOTE:

For an incomplete data situation, as shown in the graph below, it does not have many trades to offer enough information. Even though the two moving averages cross few times, there is no indication that the stock has a tendency to trend. Therefore we would not take this case into consideration to test the moving average crossover indicator.



Figure 11- Moving Average Crossover Indicator 3

4.2.3 Average Directional Index

The Average Directional Index is a measure of trending strength of a stock. In particular, an Average Directional Index above 20 is a good indicator of trending strength. Thus, we count the number of times a 14-days ADX crosses above 20 for the past 6 years from 3/21/2002 to 3/21/2008. We use this counter as an indicator to find out stronger trend following stocks.

Usually, when ADX crosses above 20, there will be a trend, so fewer crossovers indicate a consistent and maybe a stronger trend over the period, as shown in the graph below:

(Yellow line is 14-days ADX, and blue line shows the count number)



Figure 12- ADX Indicator 1

In contrast, more crossovers indicate a weaker trend or choppy market over the period. As shown below:



Figure 13- ADX Indicator 2

The code for this indicator is:

<code>//Average Direction Crossover Indicator</code>
<code>Variable: counter (0);</code>
<code>If ADX(14) crosses over 20</code>
<code>then</code>
<code> counter = counter + 1;</code>
<code>Plot1 (counter, "ADXCrossover");</code>

Table 4- ADX Indicator Code

We use Moving Average Crossover Indicator and Average Directional Index Indicator to refine the 100 stocks that we get from the Guru Stock Screener. In particular, we let the number of times both Moving Average and ADX should cross to be less than or equal to 25. The list of 100 stocks is then down to only 36 stocks plus GOOG and X for comparison. The list of 38 stocks is attached in Appendix 8.2.

4.2.4 Volatility Screener

We count the number of days when volatility is between 4% and 9% in the past 6 years from 3/21/2002 to 3/21/2008. We use this counter as an indicator to find out the strength of trending stocks.

When 20-days volatility is between 4% and 9%, the trend is promising. Therefore, more days in the range of the stock indicates a stronger trend. (First red line is the Volatility, and blue and yellow lines are constant 0.04 and 0.09 respectively. Second Red line is the counter for numbers of days of being between 0.04 and 0.09 and the counter increases as more days are in the range).



Figure 14- Volatility Indicator 1

When the stock do not trend, volatility tends to be less than 4%. As shown below:



Figure 15- Volatility Indicator 2

The code for this indicator is:

```
//Volatility Indicator
Input: Price(close);
Variable: counter (0), Volatility(0);
Volatility= (AvgTrueRange(20) / Price);
If Volatility >= 0.04 and Volatility <= 0.09 then
    counter = counter + 1;
plot1 (counter, "Volatility");
```

Table 5- Volatility Indicator Code

We apply the Volatility Indicator to the 36 stocks excluded GOOG and X from before. In particular, we let the number of times Efficiency is between 0.04 and 0.09 to be greater than and equal to 200. The resulting criteria have filtered the 36 stocks down to 21 stocks plus GOOG and X. The result is attached in Appendix 8.3.

4.2.5 Kaufman Efficiency Screener

We count the number of days when Kaufman Efficiency is above 30% in the past 6 years from 3/21/2002 to 3/21/2008. We use this counter as an indicator to find out whether the trend of stock is efficient or not.

When 20-days Efficiency is above 30%, the trend is moving efficiently. There is no unnecessary sideways moves of the stock. Thus the stock tends to be trending. Therefore, bigger the percentage indicates a stronger trend.

(First red line is the Efficiency, and blue line is constant 30%. Second Red line is the counter for numbers of days which has the ratio larger than 30%)



Figure 16- Kaufman Efficiency Indicator 1

When the stock does not trend, Efficiency tends to be less than 30%.

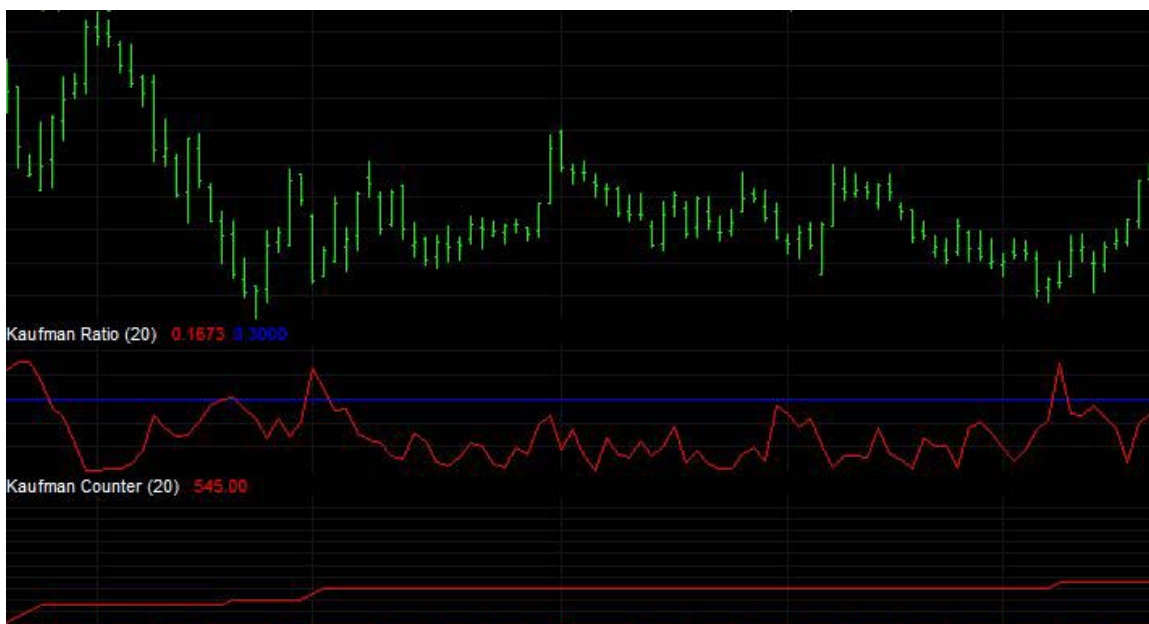


Figure 17- Kaufman Efficiency Indicator 2

The code for this indicator is:

<code>//Kaufman Efficiency Code</code>
<code>Input: length (20);</code>
<code>Var: NetChange(1),ITC(1),TotalChange(1),ERatio(0), counter(0);</code>
<code>NetChange = close - close[length];</code>
<code>ITC = AbsValue(close - close[1]);</code>
<code>TotalChange = summation(ITC,length);</code>
<code>ERatio = absvalue((NetChange/TotalChange) * 100);</code>
<code>If ERatio > 30 then</code>
<code> counter = counter + 1;</code>

Table 6- Kaufman Efficiency Code

4.2.6 Stocks Selection Criteria

We let the Kaufman Efficiency Counter to be greater than or equal to 400. Again, we apply Kaufman Efficiency Screener to the 21 stocks and get 5 stocks that satisfy all criteria:

Moving Average Crossover Counter	<=25
ADX Counter	<=25
Volatility Counter	>=200
Kaufman Efficiency Counter	>=400

Table 7- Summary of Technical Indicators

The list of 5 stocks plus GOOG and X that withstand all criteria is attached in Appendix 8.4.

4.2.7 Conclusion

	Symbol	Company	MovAvg	ADX	Volatility	Kaufman
1	PTR	PETROCHINA COMPANY LIMITED (ADR)	23	15	233	436
2	VSEC	VSE CORPORATION	25	18	665	446
3	CE	CELANESE CORPORATION	25	18	267	433
4	TUP	TUPPERWARE BRANDS CORPORATION	24	21	267	478
5	JAS	JO-ANN STORES, INC.	24	22	517	545
6	GOOG	Google	21	13	207	516
7	X	American Steel	22	22	547	437

We have shown how to refine the list of 100 stocks that are initially selected from Guru Stock Screener down to only five stocks using Moving Average Crossover, Average Directional Index, Volatility and Kaufman Efficiency Indicators. And we will use our trading system to PTR, VSEC, CE, TUP, JAS these five stocks plus GOOG and X. Before we do that, we need to devise a trading strategy using GOOG as our reference stock.

4.3 GOOG as a Reference Stock

We will use GOOG as an example to illustrate each step in the sequence for back-testing as described in section **3.5.3 Sequence for Back-Testing Strategies**. Although GOOG is not one of the stocks that satisfied the Guru Stock screening criteria, GOOG is a trending stock and is recommended to be scientifically tested, compared and analyzed for reference.

4.3.1 Sequence for Back-Testing Strategies

We use historical daily chart data of GOOG from 1/1/2005 to 1/1/2010 to back test our strategies in this case. As shown below:

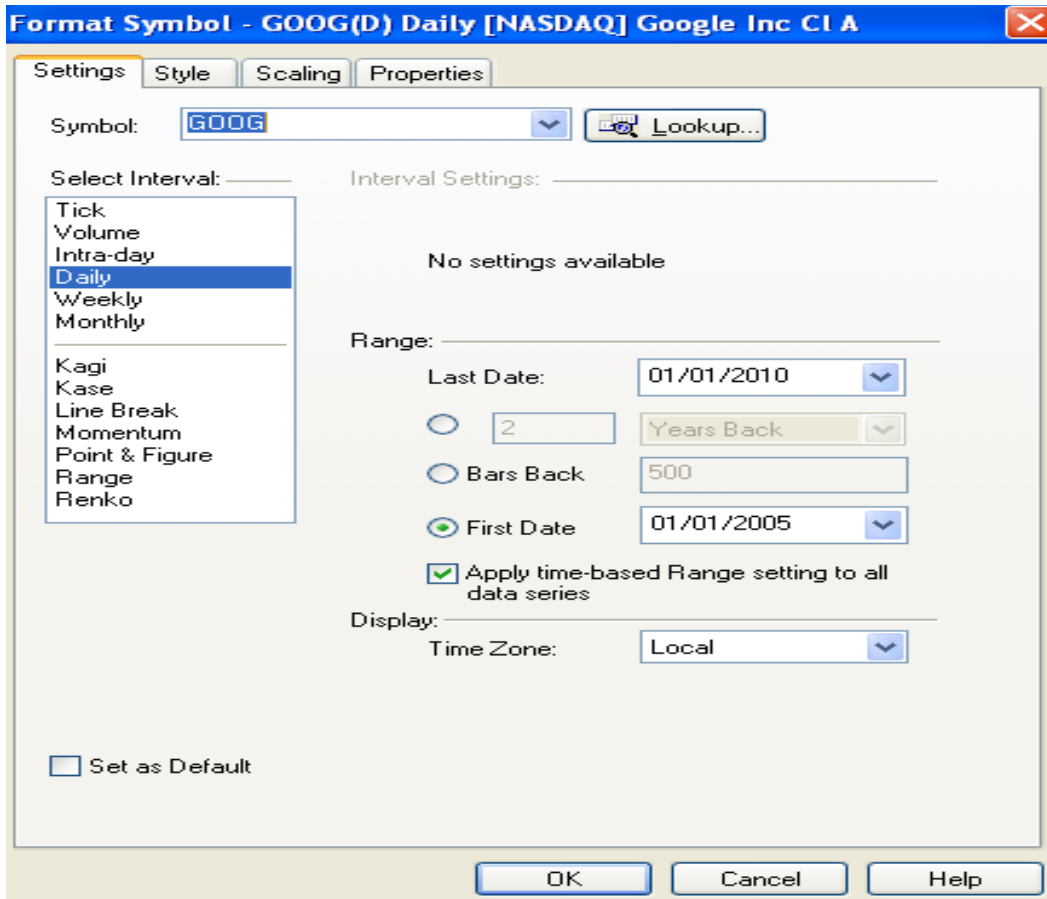


Figure 18- GOOG Format Symbol

We use 50 as our “maximum number of bar study will reference” because when we optimize our strategy, the input parameter is likely to vary so we let it to be below 50. We buy or sell 1 share of stock for each trade. As shown below:

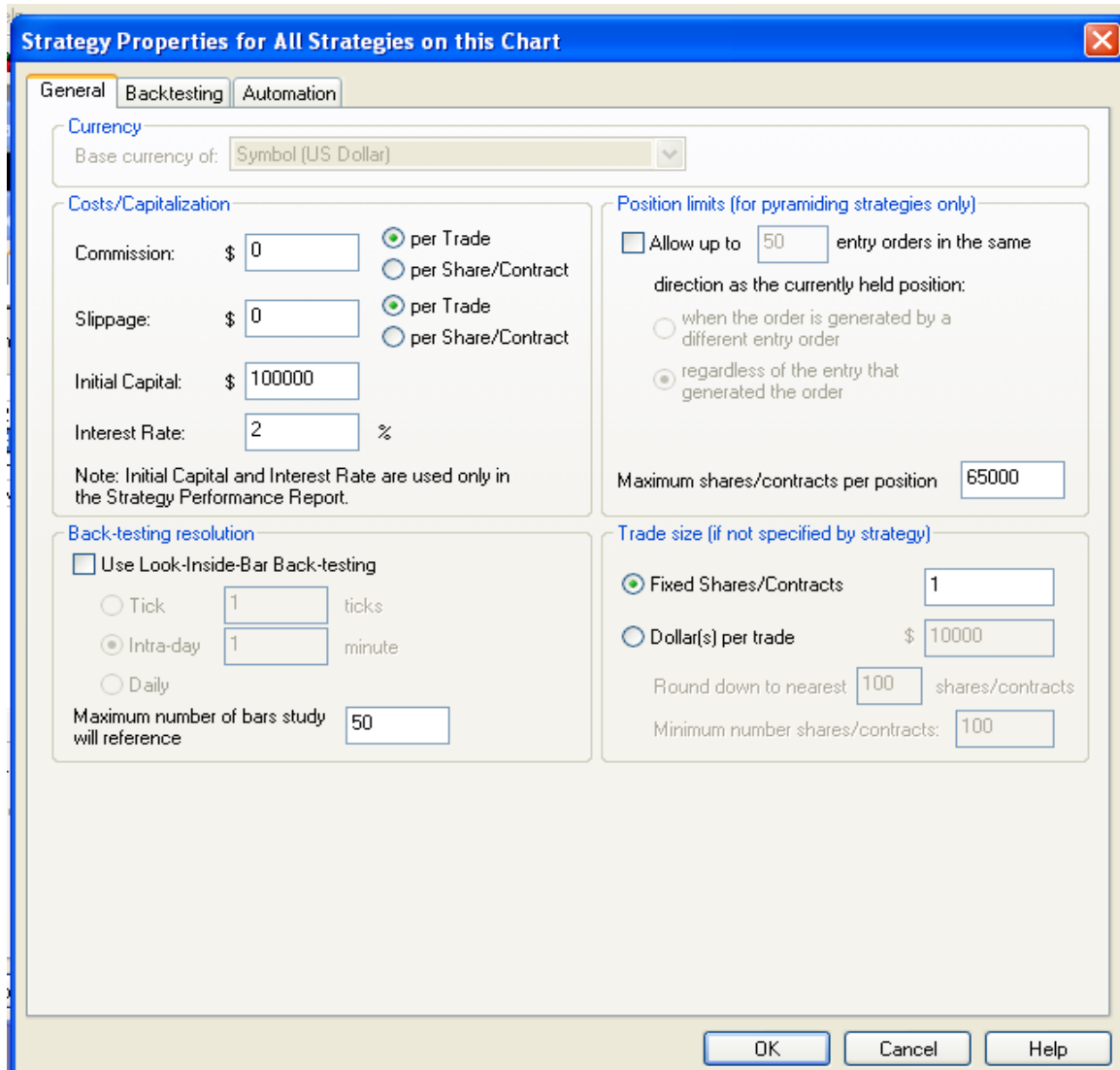


Figure 19- GOOG Strategy Properties for All Strategies

4.3.1.1 Set-up (No Trigger) + Fixed Exit Signal + Fixed Position Size + No Implementation Costs

Our set-up is to buy the stock at market price tomorrow when today's close has exceeded the last 20-day high, excluding today's high. Our fixed exit signal is to sell the stock 20 days later since the day of entry. We will buy 1 share of stock and we assume no commission and slippage costs.

Here is the code for this Strategy 1: (Notice words after "//" and colored green are comments in the EasyLanguage code)

```

Inputs: Length (20);
Variables: LowerBand( 0 ), UpperBand( 0 ) ;
LowerBand = Lowest (Low, Length) [1];
//Calculate the 20-day low for yesterday and set it to LowerBand
UpperBand = Highest (High, Length) [1];
//Calculate the 20-day high for yesterday and set it to UpperBand
If Close > UpperBand then buy next bar market;
//Buy a market order tomorrow if today's close
is greater than yesterday's 20-day high, or UpperBand
If MarketPosition=1 and BarsSinceEntry=20 then sell next bar at market;
//Sell the stock 20 days after the day we entered using a market order
If Date = 1091230 and MarketPosition = 1 Then Sell Next Bar at Market;
//Sell the stock on 12/30/2010 if we still have an open position at that time

```

Table 8- Strategy 1 EasyLanguage Code

Here is a summary of Performance Report for Strategy 1:

TradeStation Strategy Performance Report - GOOG Daily (1/3/2005-12/31/2009)			
TradeStation Performance Summary Expand			
	All Trades	Long Trades	Short Trades
Total Net Profit	\$281.61	\$281.61	\$0.00
Gross Profit	\$691.20	\$691.20	\$0.00
Gross Loss	(\$409.59)	(\$409.59)	\$0.00
Profit Factor	1.69	1.69	n/a
Total Number of Trades	31	31	0
Percent Profitable	61.29%	61.29%	0.00%
Winning Trades	19	19	0
Losing Trades	12	12	0
Even Trades	0	0	0
Avg. Trade Net Profit	\$9.08	\$9.08	\$0.00
Avg. Winning Trade	\$36.38	\$36.38	\$0.00
Avg. Losing Trade	(\$34.13)	(\$34.13)	\$0.00
Ratio Avg. Win:Avg. Loss	1.07	1.07	n/a
Largest Winning Trade	\$96.41	\$96.41	\$0.00
Largest Losing Trade	(\$77.24)	(\$77.24)	\$0.00
Max. Consecutive Winning Trades	8	8	0
Max. Consecutive Losing Trades	3	3	0
Avg. Bars in Winning Trades	21.47	21.47	0.00
Avg. Bars in Losing Trades	22.00	22.00	0.00
Avg. Bars in Even Trades	0.00	0.00	0.00
Max. Shares/Contracts Held	1	1	0
Total Shares/Contracts Held	31	31	0
Account Size Required	\$146.43	\$146.43	\$0.00
Return on Initial Capital	0.28%		
Annual Rate of Return	0.06%		
Return Retracement Ratio	0.40		
RINA Index	25.11		
Trading Period	4 Yrs, 9 Mths, 16 Dys		
Percent of Time in the Market	53.06%		
Max. Equity Run-up	\$315.72		
Max. Drawdown (Intra-day Peak to Valley)			
Value	(\$264.02)	(\$264.02)	\$0.00
Net Profit as % of Drawdown	106.66%	106.66%	n/a
Max. Drawdown (Trade Close to Trade Close)			
Value	(\$146.43)	(\$146.43)	\$0.00
Net Profit as % of Drawdown	192.32%	192.32%	n/a
Max. Trade Drawdown	(\$103.46)	(\$103.46)	\$0.00

Performance Summary | Trade Analysis | Trades List | Periodical Returns | Performance Graphs | Trade Graphs | Settings

Figure 20- GOOG Strategy 1 Performance Report

There are several important terms within the TradeStation Performance Report that we think are important in evaluating the stocks' performances. We have listed the terms and their definition with the following table:

Total Net Profit	How much a strategy made or lost
Profit Factor	The number of dollars (profit) made for every dollar lost
Total Number of Trades	The total number of trades that were generated by the strategy
Percentage Profitable	The percentage of trades that was profitable
Avg. Trade Net Profit	The amount of money won or lost in the average trade.
Account Size Required	This field calculates the amount of money you must have in your account to trade the strategy.
Max. Trade Drawdown	Displays the largest intraday (bar to bar) drawdown experienced by the strategy on a single closed out trade (see Note) looking across all trades, for the trading strategy during the specified period. This is the largest potential unrealized Loss.
Initial Capital	set by the user in the Strategy Properties dialog on the Format Strategy dialog
Return on Initial Capital	Return on Initial Capital displays the percentage return of the Total Net Profit to the initial starting capital, (including commissions and slippage if specified), during the specified period. Return on Initial Capital = Total Net Profit divided by Initial Capital.
Annual Rate of Return	Displays the percentage return of the strategy for the testing period of the strategy. Displays for All Trades only.
Buy & Hold Return	Displays the percentage return of holding the security in a long position for the entire testing period of the strategy, as a comparison to the strategy return. Displays for All Trade only.
Return on Account	This field represents the amount of money you would make versus the amount of money required to trade the strategy, taking into consideration margin and margin calls. This value is calculated by dividing the net profit by the account size required.

Table 9- Performance Report Terms and Definitions

Notice the profit factor in the Performance Report of Strategy 1 is 1.69 which means the ratio of gross profit to gross loss exceeds one. The total number of trades is 31 and 61.29% of them are profitable. The Average Trade Net Profit is \$9.08. The Maximum Trade Drawdown is \$103.46.

4.3.1.2 Set-up + Trigger + Fixed Exit Signal + Fixed Position Size + No Implementation Costs

Once the set-up is profitable, we then add a trigger that will confirm the direction of the set-up. We will use a stop order instead of a market order which allows us to enter the market when the stock moves 1 point higher than the today's close. Here is the code of this Strategy 2:

Inputs: Length (20);
Variables: LowerBand(0), UpperBand(0) ;
LowerBand = Lowest (Low, Length) [1];
UpperBand = Highest (High, Length) [1];
If Close > UpperBand then buy next bar at close+1 point stop;
<i>//Buy a stop order tomorrow at 1 point higher than today's close if today's close is greater than yesterday's 20-day high, or UpperBand</i>
If MarketPosition=1 and BarsSinceEntry=20 then sell next bar at market;
If Date = 1091230 and MarketPosition = 1 Then Sell Next Bar at Market;

Table 10- Strategy 2 Easy Language Code

Below is the Performance Report for Strategy 2 when we add this trigger:

TradeStation Strategy Performance Report - GOOG Daily (1/3/2005-12/31/2009)			
TradeStation Performance Summary Expand ▾			
	All Trades	Long Trades	Short Trades
Total Net Profit	\$268.77	\$268.77	\$0.00
Gross Profit	\$655.55	\$655.55	\$0.00
Gross Loss	(\$386.78)	(\$386.78)	\$0.00
Profit Factor	1.69	1.69	n/a
Total Number of Trades	29	29	0
Percent Profitable	62.07%	62.07%	0.00%
Winning Trades	18	18	0
Losing Trades	11	11	0
Even Trades	0	0	0
Avg. Trade Net Profit	\$9.27	\$9.27	\$0.00
Avg. Winning Trade	\$36.42	\$36.42	\$0.00
Avg. Losing Trade	(\$35.16)	(\$35.16)	\$0.00
Ratio Avg. Win:Avg. Loss	1.04	1.04	n/a
Largest Winning Trade	\$96.41	\$96.41	\$0.00
Largest Losing Trade	(\$77.24)	(\$77.24)	\$0.00
Max. Consecutive Winning Trades	8	8	0
Max. Consecutive Losing Trades	3	3	0
Avg. Bars in Winning Trades	21.44	21.44	0.00
Avg. Bars in Losing Trades	22.00	22.00	0.00
Avg. Bars in Even Trades	0.00	0.00	0.00
Max. Shares/Contracts Held	1	1	0
Total Shares/Contracts Held	29	29	0
Account Size Required	\$138.62	\$138.62	\$0.00
Return on Initial Capital	0.27%		
Annual Rate of Return	0.06%		
Return Retracement Ratio	0.42		
RINA Index	25.96		
Trading Period	4 Yrs, 9 Mths, 16 Dys		
Percent of Time in the Market	49.17%		
Max. Equity Run-up	\$280.29		
Max. Drawdown (Intra-day Peak to Valley)			
Value	(\$234.63)	(\$234.63)	\$0.00
Net Profit as % of Drawdown	114.55%	114.55%	n/a
Max. Drawdown (Trade Close to Trade Close)			
Value	(\$138.62)	(\$138.62)	\$0.00
Net Profit as % of Drawdown	193.89%	193.89%	n/a
Max. Trade Drawdown	(\$97.43)	(\$97.43)	\$0.00
Performance Summary Trade Analysis Trades List Periodical Returns Performance Graphs Trade Graphs Settings			

Figure 21- GOOG Strategy 2 Performance Report

Notice the Profit Factor stays the same as we add a trigger. The total number of trades is 29 and 62.07% of them are profitable. The average trade net profit is \$9.27. The Maximum Trade Drawdown is \$97.43

4.3.1.3 Set-up + Trigger + Variable Exit Signal + Fixed Position Size + No Implementation Costs

Once both set-up and trigger are implemented and tested for this strategy, then we change the fixed exit signal to a variable exit signal. For all trend-following strategies, investors should always be in the market in case of missing a big move. Thus it's appropriate to tweak the exit signal so that it allows us to short the stock in stead of selling the stock. The short selling condition will mostly mimic the long condition where we short the stock when today's close reaches below yesterday's 20-day low. Since shorting a stock requires another set-up condition, thus it's appropriate to add a trigger, which would be to short stock at 1 point below today's close tomorrow, or equivalently a stop order.

The code of this Strategy 3 is shown below:

Inputs: Length (20);
Variables: LowerBand(0), UpperBand(0);
LowerBand = Lowest (Low, Length) [1];
UpperBand = Highest (High, Length) [1];
If Close > UpperBand then buy next bar at close+1 point stop;
//Buy a stop order tomorrow at 1 point higher than today's close
if today's close is greater than yesterday's 20-day high, or UpperBand
If Close < LowerBand then sell short next bar at close-1 point stop;
//Short a stop order tomorrow at 1 point lower than today's close
if today's close is lower than yesterday's 20-day low, or LowerBand
If Date = 1091230 and MarketPosition = 1 Then Sell Next Bar at Market;
//Sell the stock on 12/30/2010 if we still have an open position at that time
If Date = 1091230 and MarketPosition = -1 Then Buy to Cover Next Bar at Market;
//Buy shares to cover the short position on 12/30/2010
if we still have a short position at that time

Table 11- Strategy 3 EasyLanguage Code

Below is the Performance Report for Strategy 3

TradeStation Performance Summary			
	All Trades	Long Trades	Short Trades
Total Net Profit	\$425.84	\$428.41	(\$2.57)
Gross Profit	\$843.62	\$577.41	\$266.21
Gross Loss	(\$417.78)	(\$149.00)	(\$268.78)
Profit Factor	2.02	3.88	0.99
Total Number of Trades	25	13	12
Percent Profitable	36.00%	53.85%	16.67%
Winning Trades	9	7	2
Losing Trades	16	6	10
Even Trades	0	0	0
Avg. Trade Net Profit	\$17.03	\$32.95	(\$0.21)
Avg. Winning Trade	\$93.74	\$82.49	\$133.10
Avg. Losing Trade	(\$26.11)	(\$24.83)	(\$26.88)
Ratio Avg. Win:Avg. Loss	3.59	3.32	4.95
Largest Winning Trade	\$260.25	\$260.25	\$156.39
Largest Losing Trade	(\$46.27)	(\$44.14)	(\$46.27)
Max. Consecutive Winning Trades	2	3	2
Max. Consecutive Losing Trades	5	2	9
Avg. Bars in Winning Trades	89.67	82.71	114.00
Avg. Bars in Losing Trades	25.63	26.83	24.90
Avg. Bars in Even Trades	0.00	0.00	0.00
Max. Shares/Contracts Held	1	1	1
Total Shares/Contracts Held	25	13	12
Account Size Required	\$209.56	\$55.88	\$231.43
Return on Initial Capital	0.43%		
Annual Rate of Return	0.09%		
Return Retracement Ratio	0.24		
RINA Index	22.12		
Trading Period	4 Yrs, 9 Mths, 16 Dys		
Percent of Time in the Market	98.69%		
Max. Equity Run-up	\$544.85		
Max. Drawdown (Intra-day Peak to Valley)			
Value	(\$288.81)	(\$163.07)	(\$251.91)
Net Profit as % of Drawdown	147.45%	262.72%	(1.02%)
Max. Drawdown (Trade Close to Trade Close)			
Value	(\$209.56)	(\$55.88)	(\$231.43)
Net Profit as % of Drawdown	203.21%	766.66%	(1.11%)
Max. Trade Drawdown	(\$49.00)	(\$45.29)	(\$49.00)

Figure 22- GOOG Strategy 3 Performance Report

The Profit Factor for all trades is 2.02. Total number of trades is 25 and only 36% of them are profitable. The average trade net profit is \$17.03 and the Maximum Trade Drawdown is \$49.

There are several drawbacks of Strategy 3:

First, the Total Net Profit for Short Trades is negative; it loses \$2.57 over this 4-year trading period. Second, its profit factor for short trades is 0.99 which is less than 1. Third, there are two places where we could exit the position earlier, as shown below:



Figure 23- GOOG Chart Strategy 3

The two circles indicate where we should exit earlier but our price channel strategy lags behind. One way to improve it is to add a Moving Average Crossover exit criteria. Here is the modified strategy code of Strategy 4:

//Price Channel Part
Inputs: Length (20);
Variables: LowerBand(0), UpperBand(0) ;
LowerBand = Lowest (Low, Length) [1];
UpperBand = Highest (High, Length) [1];
If Close > UpperBand then buy next bar at close+1 point stop;
If Close < LowerBand then sell short next bar at close-1 point stop;
//Moving Average Part
Inputs: FastLength(8), SlowLength(20);
Variables: FastMoveAvg(0), SlowMoveAvg(0);
FastMoveAvg = AverageFC(Close, FastLength);
//Fast Moving Average of 8 days
SlowMoveAvg = AverageFC(Close, SlowLength);
//Slow Moving Average of 20 days
If MarketPosition = 1 and FastMoveAvg crosses below SlowMoveAvg
then sell short next bar at close -1 point stop;
//Sell short when the fast moving average crosses below
the slow moving average if already in long position
If MarketPosition = -1 and FastMoveAvg crosses above SlowMoveAvg
then buy next bar at close +1 point stop;
//buy when the fast moving average crosses above the
slow moving average if already in short position
If Date = 1091230 and MarketPosition = 1 Then Sell Next Bar at Market;
If Date = 1091230 and MarketPosition = -1 Then Buy to Cover Next Bar at Market;

Table 12- Strategy 4 EasyLanguage Code

Here is the Performance Report for Strategy 4:

TradeStation Strategy Performance Report - GOOG Daily (1/3/2005-12/31/2009)			
TradeStation Performance Summary Expand ▾			
	All Trades	Long Trades	Short Trades
Total Net Profit	\$881.26	\$656.12	\$225.14
Gross Profit	\$1,317.65	\$816.54	\$501.11
Gross Loss	(\$436.39)	(\$160.42)	(\$275.97)
Profit Factor	3.02	5.09	1.82
Total Number of Trades	39	20	19
Percent Profitable	58.97%	70.00%	47.37%
Winning Trades	23	14	9
Losing Trades	16	6	10
Even Trades	0	0	0
Avg. Trade Net Profit	\$22.60	\$32.81	\$11.85
Avg. Winning Trade	\$57.29	\$58.32	\$55.68
Avg. Losing Trade	(\$27.27)	(\$26.74)	(\$27.60)
Ratio Avg. Win:Avg. Loss	2.10	2.18	2.02
Largest Winning Trade	\$215.85	\$186.57	\$215.85
Largest Losing Trade	(\$70.71)	(\$54.55)	(\$70.71)
Max. Consecutive Winning Trades	5	4	3
Max. Consecutive Losing Trades	3	2	4
Avg. Bars in Winning Trades	42.96	46.21	37.89
Avg. Bars in Losing Trades	15.19	18.00	13.50
Avg. Bars in Even Trades	0.00	0.00	0.00
Max. Shares/Contracts Held	1	1	1
Total Shares/Contracts Held	39	20	19
Account Size Required	\$111.49	\$55.74	\$142.31
Return on Initial Capital	0.88%		
Annual Rate of Return	0.18%		
Return Retracement Ratio	0.28		
RINA Index	46.28		
Trading Period	4 Yrs, 9 Mths, 16 Dys		
Percent of Time in the Market	98.69%		
Max. Equity Run-up	\$892.78		
Max. Drawdown (Intra-day Peak to Valley)			
Value	(\$228.38)	(\$161.46)	(\$187.34)
Net Profit as % of Drawdown	385.87%	406.37%	120.18%
Max. Drawdown (Trade Close to Trade Close)			
Value	(\$111.49)	(\$55.74)	(\$142.31)
Net Profit as % of Drawdown	790.44%	1177.11%	158.20%
Max. Trade Drawdown	(\$81.42)	(\$54.55)	(\$81.42)

Figure 24- GOOG Strategy 4 Performance Report

The Profit Factor is 3.02 for All Trades, total number of trade is 39 and 58.97% of them are profitable. The average trade net profit is \$22.60. The Maximum Trade Drawdown is \$81.42.



Figure 25- GOOG Chart Strategy 4

Although the problem of exiting early is fixed on the left circle, the problem still exists on the right circle, where we exit the long position too late. One way to fix this is to add a Chandelier Exit from the top. A Chandelier Exit is a volatility measure using the Average True Range to help set stop losses. The exit is computed by finding the highest value over the period and then subtracting a multiple of the ATR for that period. (Chuck LeBeau, 1991)

The code for this Strategy 5 is shown below:

//Price Channel Part
Inputs: Length (20);
Variables: LowerBand(0), UpperBand(0) ;
LowerBand = Lowest (Low, Length) [1];
UpperBand = Highest (High, Length) [1];
If Close > UpperBand then buy next bar at close+1 point stop;
If Close < LowerBand then sell short next bar at close-1 point stop;
//Moving Average Part
Inputs: FastLength(8), SlowLength(20);
Variables: FastMoveAvg(0), SlowMoveAvg(0);
FastMoveAvg = AverageFC(Close, FastLength);
SlowMoveAvg = AverageFC(Close, SlowLength);
If MarketPosition = 1 and FastMoveAvg crosses below SlowMoveAvg
then sell short next bar at close -1 point stop;
If MarketPosition = -1 and FastMoveAvg crosses above SlowMoveAvg
then buy next bar at close +1 point stop;
//Chandelier Stop
If MarketPosition = 1 and High < Highest (High, 50) - 3 * AvgTrueRange(20)
then sell next bar at close -1 point stop;
//Sell the stock if today's high is lower than
3 times the average true range of twenty bars from 50-day high
If Date = 1091230 and MarketPosition = 1 Then Sell Next Bar at Market;
If Date = 1091230 and MarketPosition = -1 Then Buy to Cover Next Bar at Market;

Table 13- Strategy 5 EasyLanguage Code

Notice the exit is earlier in Strategy 5 on the right circle; the stock is sold at \$657.74 in Strategy 5 rather than \$629.64 in Strategy 4.

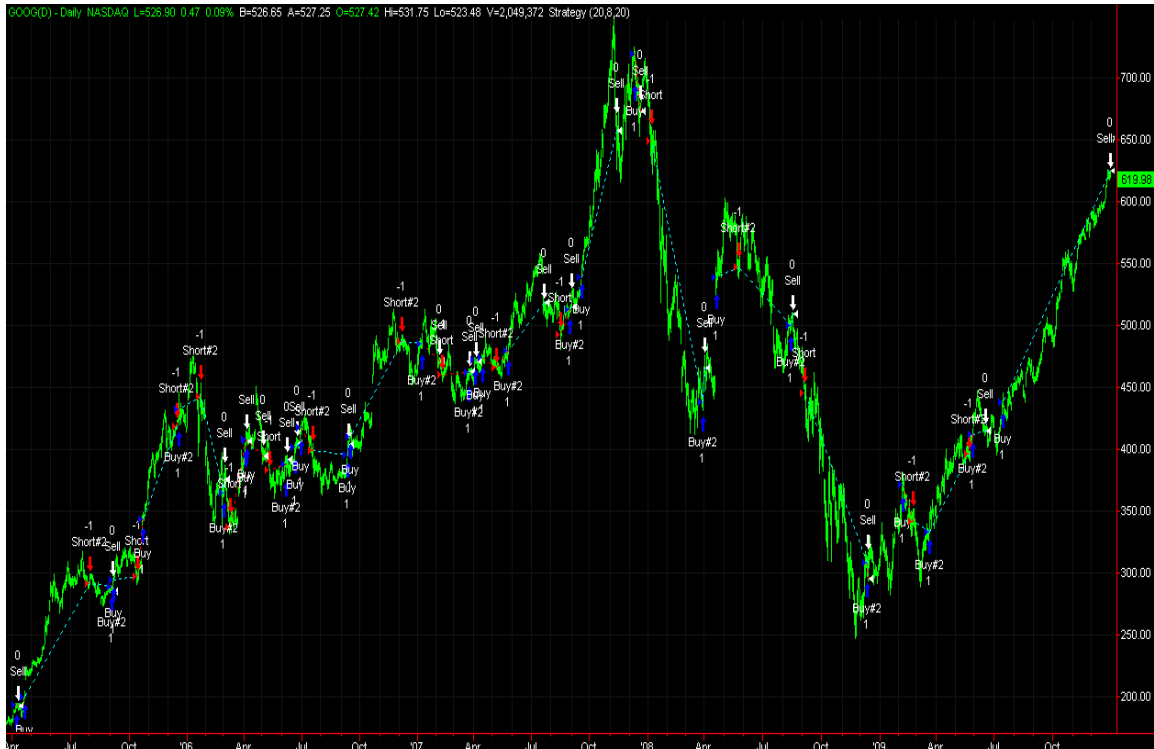


Figure 26- GOOG Chart Strategy 5

Below is the Performance Report for Strategy 5:

TradeStation Strategy Performance Report - GOOG Daily (1/3/2005-12/31/2009)			
TradeStation Performance Summary Expand ▾			
	All Trades	Long Trades	Short Trades
Total Net Profit	\$898.63	\$593.82	\$304.81
Gross Profit	\$1,233.57	\$744.15	\$489.42
Gross Loss	(\$334.94)	(\$150.33)	(\$184.61)
Profit Factor	3.68	4.95	2.65
Total Number of Trades	46	30	16
Percent Profitable	58.70%	63.33%	50.00%
Winning Trades	27	19	8
Losing Trades	19	11	8
Even Trades	0	0	0
Avg. Trade Net Profit	\$19.54	\$19.79	\$19.05
Avg. Winning Trade	\$45.69	\$39.17	\$61.18
Avg. Losing Trade	(\$17.63)	(\$13.67)	(\$23.08)
Ratio Avg. Win:Avg. Loss	2.59	2.87	2.65
Largest Winning Trade	\$211.15	\$186.57	\$211.15
Largest Losing Trade	(\$70.71)	(\$46.60)	(\$70.71)
Max. Consecutive Winning Trades	6	4	4
Max. Consecutive Losing Trades	4	2	3
Avg. Bars in Winning Trades	30.96	27.37	39.50
Avg. Bars in Losing Trades	10.84	9.00	13.38
Avg. Bars in Even Trades	0.00	0.00	0.00
Max. Shares/Contracts Held	1	1	1
Total Shares/Contracts Held	46	30	16
Account Size Required	\$101.52	\$46.60	\$104.51
Return on Initial Capital	0.90%		
Annual Rate of Return	0.19%		
Return Retracement Ratio	0.28		
RINA Index	82.45		
Trading Period	4 Yrs, 9 Mths, 16 Dys		
Percent of Time in the Market	82.30%		
Max. Equity Run-up	\$902.19		
Max. Drawdown (Intra-day Peak to Valley)			
Value	(\$156.94)	(\$156.94)	(\$139.65)
Net Profit as % of Drawdown	572.59%	378.37%	218.27%
Max. Drawdown (Trade Close to Trade Close)			
Value	(\$101.52)	(\$46.60)	(\$104.51)
Net Profit as % of Drawdown	885.18%	1274.29%	291.66%
Max. Trade Drawdown	(\$70.71)	(\$67.44)	(\$70.71)
Performance Summary Trade Analysis Trades List Periodical Returns Performance Graphs Trade Graphs Settings			

Figure 27- GOOG Strategy 5 Performance Report

The Profit Factor is 3.68 for All Trades. The total number of trades is 46 and 58.70% of them are profitable. The average trade net profit is \$19.54 and the Maximum Trade Drawdown is \$70.71.

4.3.1.4 Conclusion:

After testing GOOG from 1/1/2005 to 1/1/2010 using 50 bars as our maximum bars the study will reference and trading 1 share of this stock, we reach the conclusion that Strategy 5 is the strategy that we will use for our five stocks that are selected from Guru Stock Screener and technical indicators.

4.3.1.5 Set-up + Trigger + Variable Exit Signal + Variable Position Size + No Implementation Costs

We will not be able to test variable position size due to the time constraint of this IQP.

4.3.1.6 Set-up + Trigger + Variable Exit Signal + Variable Position Size + Implementation Costs (Slippage & Commission)

We will not include implementation costs as well.

4.3.2 Optimization and Testing

Strategy optimization is the search for the set of optimum parameters for the defined criteria. By testing a range of signal input values, optimization aids in selecting the values that correspond, based on historical data, to the best strategy performance. Optimization aids in better understanding of strategy's characteristics and in creating new criteria for entries and exits. (Trading Software, Trading Systems, Signals, Strategy Testing and Optimization)

TradeStation offers two optimization methods: Exhaustive Optimization and Genetic Algorithms: Exhaustive optimization systematically goes through all the potential combinations in search for the best solution. The length of time required to find the solution it is proportional to the total number of all possible solutions. By using the genetic algorithms, a near-optimum solution can be found in a fraction of the time required by the brute-force approach. The "breeding" process of genetic solutions screens out the over-optimized, curve-fitting solutions that would not prove effective in real trading. (Trading Software, Trading Systems, Signals, Strategy Testing and Optimization)

Since Exhaustive method cost too much time, we will use Genetic method to optimize. We will optimize the strategy based on Net Profit, and find the parameters that will generate the best Net Profit factor for All Trades for Strategy 5. We will keep the highest 10 results and attach them in Appendix 8.5.

The optimizing result shows parameters of [Length(22), FastLength(4), SlowLength(30)] generates the highest Profit Factor for All trades of GOOG. We attach the detailed excel file in Appendix 5. Below are the Performance Report and chart of this optimized Strategy 5 with optimized parameters:

TradeStation Strategy Performance Report - GOOG Daily (1/3/2005-12/31/2009)			
Account (US Dollar) ?			
TradeStation Performance Summary Expand ▾			
	All Trades	Long Trades	Short Trades
Total Net Profit	\$886.57	\$599.86	\$286.71
Gross Profit	\$1,094.52	\$707.11	\$387.41
Gross Loss	(\$207.95)	(\$107.25)	(\$100.70)
Profit Factor	5.26	6.59	3.85
Total Number of Trades	40	27	13
Percent Profitable	57.50%	62.96%	46.15%
Winning Trades	23	17	6
Losing Trades	17	10	7
Even Trades	0	0	0
Avg. Trade Net Profit	\$22.16	\$22.22	\$22.05
Avg. Winning Trade	\$47.59	\$41.59	\$64.57
Avg. Losing Trade	(\$12.23)	(\$10.72)	(\$14.39)
Ratio Avg. Win:Avg. Loss	3.89	3.88	4.49
Largest Winning Trade	\$192.23	\$186.57	\$192.23
Largest Losing Trade	(\$45.94)	(\$44.14)	(\$45.94)
Max. Consecutive Winning Trades	9	7	3
Max. Consecutive Losing Trades	4	3	2
Avg. Bars in Winning Trades	34.87	31.41	44.67
Avg. Bars in Losing Trades	12.29	9.60	16.14
Avg. Bars in Even Trades	0.00	0.00	0.00
Max. Shares/Contracts Held	1	1	1
Total Shares/Contracts Held	40	27	13
Account Size Required	\$65.60	\$44.14	\$51.88
Return on Initial Capital	0.89%		
Annual Rate of Return	0.18%		
Return Retracement Ratio	0.28		
RINA Index	107.45		
Trading Period	4 Yrs, 9 Mths, 16 Dys		
Percent of Time in the Market	80.47%		
Max. Equity Run-up	\$890.13		
Max. Drawdown (Intra-day Peak to Valley)			
Value	(\$117.31)	(\$113.08)	(\$84.20)
Net Profit as % of Drawdown	755.75%	530.47%	340.51%
Max. Drawdown (Trade Close to Trade Close)			
Value	(\$65.60)	(\$44.14)	(\$51.88)
Net Profit as % of Drawdown	1351.48%	1358.99%	552.64%
Max. Trade Drawdown	(\$49.00)	(\$45.29)	(\$49.00)
Performance Summary	Trade Analysis	Trades List	Periodical Returns
	Performance Graphs	Trade Graphs	Settings

Figure 28- GOOG Optimization Performance Report

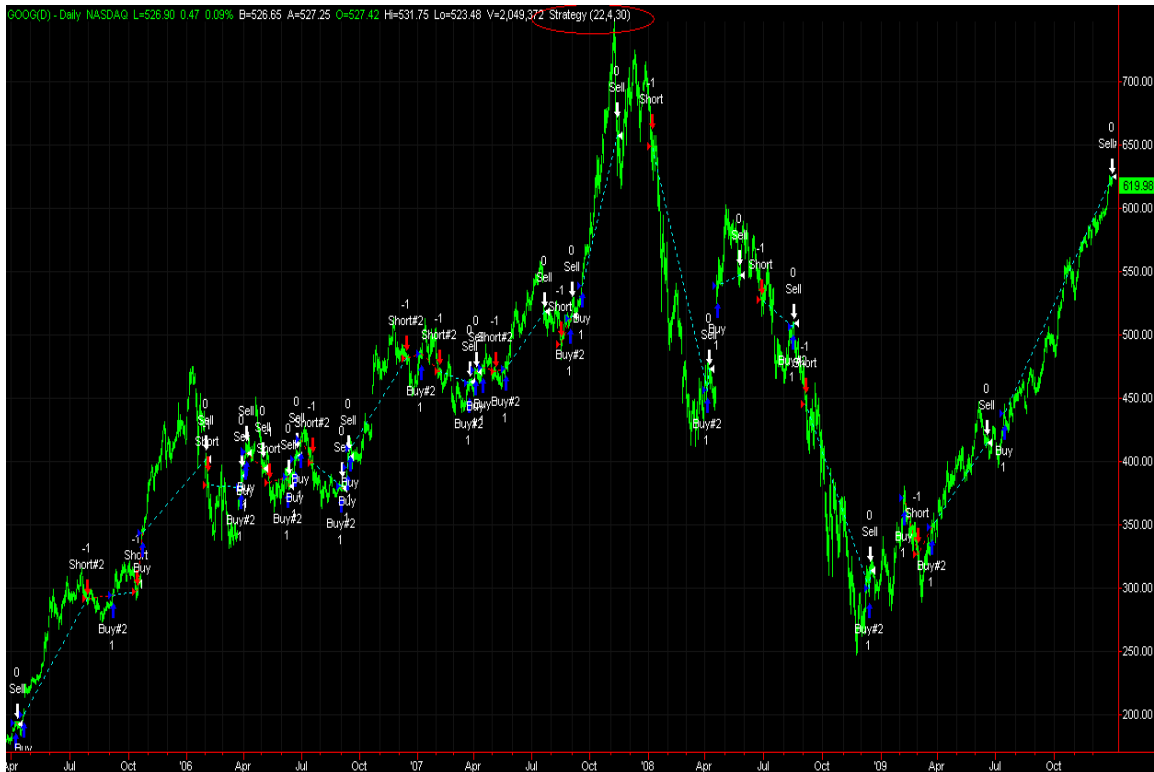


Figure 29- GOOG Chart after Optimization

Notice the parameters are circled on the top of the chart. [Length(22), FastLength(4), SlowLength(30)].

4.3.3 Expectancy and Expectancy per Trade

As described in **3.5.6 Van K. Tharp's Expectancy**, Expectancy and Expectancy per Trade developed by Van K. Tharp are strategy performance analysis tools that assess the health of the system based on its profit for every dollar loss. A system should have as high positive Expectancy per Trade as possible.

Thanks to www.hightick.com, we have a Van K. Tharp Expectancy Function. (HighTick, 2010) With this function, we just add appropriate code within our strategy that allows us to calculate the Expectancy and Expectancy per Trade. We export the results into a text file, and we can import it into Excel file. We attach the code of this function as well as our Strategy 5 with Expectancy in Appendix 8.6.

In order to get the parameters that generate the highest Expectancy or Expectancy per Trade, we will optimize the Strategy 5 with Expectancy and Expectancy per Trade using the following Input Values and do an exhaustive optimization. The optimization results will be saved into a file that you can view it through text file and import it to an Excel file. The optimization criteria are shown below:

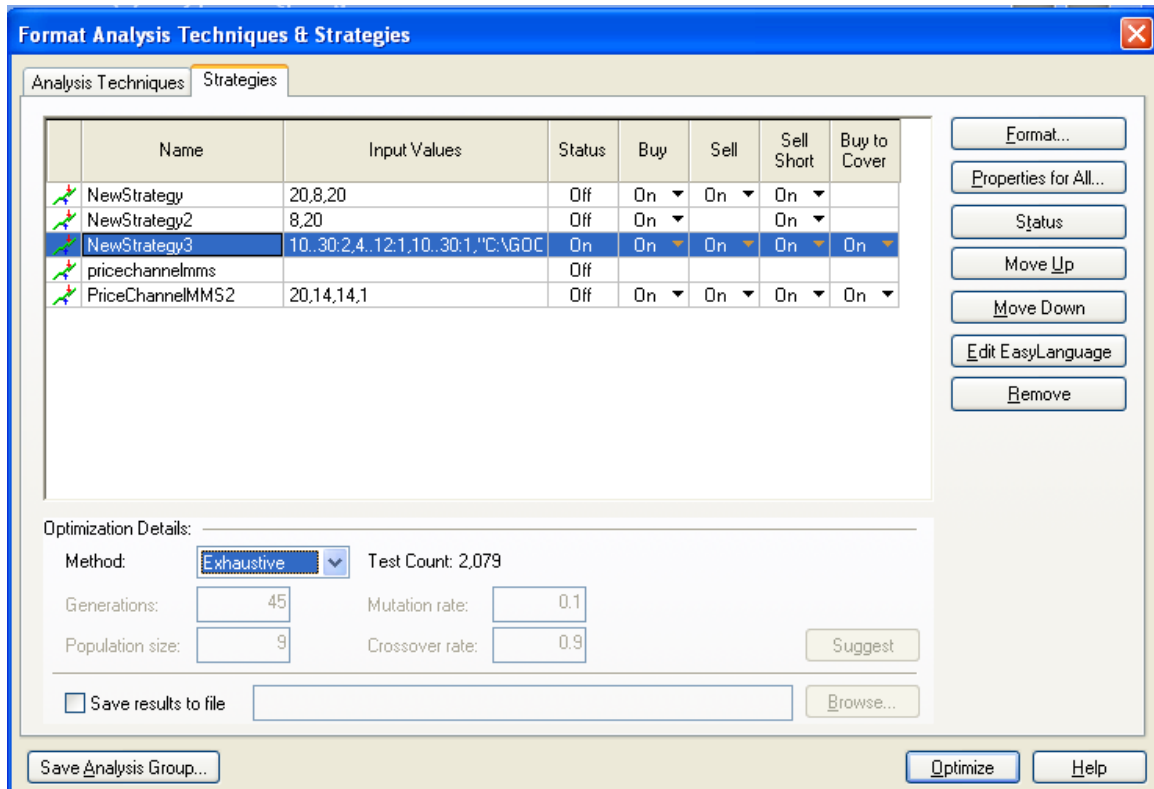


Figure 30- Format Analysis Techniques and Strategies 5

The highest Expectancy per Trade is 1.549 given the parameters of (Length(28), FastLength(10), SlowLength(16)). The first 50 results of this optimization sorted by Expectacy Per Trade is attached in the Appendix 8.7.

4.4 Out of Sample Test

We will apply Strategy 5 on PTR, VSEC, CE, TUP, JAS, GOOG and X now. In particular, we will optimize Strategy 5 on each stock based on both "All Net Profit Factor" and "Expectancy Per Trade" from 3/21/2002 to 3/21/2008 using 50 bars as our "maximum number of bars study will reference", \$20,000 as our initial capital for each stock, and we will trade 100 shares instead of 1 share. Once the optimizations are complete, we will use the resulting parameters for each optimization and trade the stocks from 3/21/2008 to 3/21/2010 to analyze each stock's performance. This out of sample test enables us to see how stocks were doing in last two years based on previous six years' data. If they are doing well, then it is safe to say that our strategy is fit for future trade.

4.5 Strategy 5 on 5 stocks selected

We will apply Strategy 5 on PTR, VSEC, CE, TUP, JAS, GOOG and X. In particular, we will optimize Strategy 5 on each stock based on both "All Net Profit Factor" and "Expectancy Per Trade" from 3/21/2002 to 3/21/2008 using 50 bars as our "maximum number of bars study will reference", \$20,000 as our initial capital for each stock, and we will trade 100 shares instead of 1 share. Once the optimizations are complete, we will use the resulting parameters for each optimization and trade the stocks from 3/21/2008 to 3/21/2010 to analyze each stock's performance.

The resulting optimized parameters are applied to all five stocks and we will not provide a detailed explanation as to how the stocks perform from 3/21/2008 to 3/21/2010. In particular, we will not include a stock chart and a Performance Report generated by TradeStation for both “All Net Profit Factor Optimization” and “Expectancy Per Trade Optimization” for each of the five stocks.

Below we will summarize the performances of each stock from 3/21/2008 to 3/21/2010 based on the terms described section **4.3.1.1 Set-up (No Trigger) + Fixed Exit Signal + Fixed Position Size + No Implementation Costs**. Since we will exit the position before 3/21/2010, the new code of the Strategy 5 with Expectancy for all five stocks will be changed and included in Appendix 8.8 because we do not want any open position. For convenience, we will label optimization based on “Highest Profit Factor for All Trades” as Optimization 1, and we will label optimization based on “Highest Expectancy Per Trade” as Optimization 2. The Optimization processes are done in a similar way as we have done to GOOG, thus we will not repeat redundantly. Only the Initial Capital in the Format Strategies will be set to \$20,000 for each of the five stocks plus GOOG and X. Below is the summary of the performance of each of the five stocks plus GOOG and X:

4.6 Summary of 5 Stocks Performances based on Profit Factor:

Optimization 1	PTR	VSEC	CE	TUP	JAS	GOOG	X
Length	10	28	17	11	23	22	27
FastLength	7	11	7	7	5	4	8
ShortLength	15	22	21	11	14	30	27
Total Net Profit	-949	-2677	2816	1375	-328	36838	4839
Profit Factor	0.9	0.46	2.51	1.44	0.84	6.26	1.6
Total Number of Trades	36	16	21	48	22	11	18
Percentage Profitable	41.67%	25%	38.10%	41.67%	36.36%	72.73%	44.44%
Avg. Trade Net Profit	-26.36	-167.31	134.1	28.65	-14.91	3348.91	268.83
Account Size Required	5600	3371	730	804	901	6560	4056
Max. Trade Drawdown	-1574	-1209	-797	-399	-397	-4529	-4234
Initial Capital	20000	20000	20000	20000	20000	20000	20000
Return on Initial Capital	-4.75%	-13.38%	14.08%	6.88%	-1.64%	184.19%	24.19%
Annual Rate of Return	-2.59%	-7.03%	7.37%	3.72%	-0.91%	59.24%	12.29%
Buy & Hold Return	-10.88%	65.04%	-34.48%	30.71%	103.25%	6.23%	-68.75%
Return on Account	-16.95%	-79.41%	385.75%	171.02%	-36.40%	561.55%	119.30%
Buy & Hold Net Profit	-1275	1924	-1894	762	1654	3217	-14078

Table 9- Stock Performance based on Profit Factor

4.7 Summary of 5 Stocks Performances based on Expectancy per Trade

Optimization 2	PTR	VSEC	CE	TUP	JAS	GOOG	X
Length	13	11	19	11	26	23	23
FastLength	11	6	8	8	4	12	5
ShortLength	23	19	12	16	16	14	29
Total Net Profit	-5483	-2094	484	2441	-511	12454	5707
Profit Factor	0.54	0.54	1.14	1.93	0.76	1.6	1.77
Total Number of Trades	25	23	28	34	20	28	21
Percentage Profitable	32%	34.78%	32.14%	47.06%	35%	39.29%	38.10%
Avg. Trade Net Profit	-219.32	-91.04	17.29	71.79	-25.55	444.79	271.76
Account Size Required	9363	3184	1358	1373	1289	8012	4056
Max. Trade Drawdown	-2026	-823	-797	-456	-477	-4174	-4234
Initial Capital	20000	20000	20000	20000	20000	20000	20000
Return on Initial Capital	-27.41%	-10.47%	2.42%	12.20%	-2.56%	62.27%	28.53%
Annual Rate of Return	-13.55%	-5.57%	1.34%	6.44%	-1.41%	27.46%	14.24%
Buy & Hold Return	-10.88%	65.04%	-34.48%	30.71%	103.25%	6.23%	-68.75%
Return on Account	-58.56%	-65.77%	35.64%	177.79%	-39.64%	155.44%	140.71%
Buy & Hold Net Profit	-1275	1924	-1894	762	1654	3217	-14078

Table 10- Stock Performance based on Expectancy per Trade

4.8 “Buy and Hold” vs. Strategy 5

Optimization 1	PTR	VSEC	CE	TUP	JAS	Sum	GOOG	X
Return on Initial Capital	-4.75%	-13.38%	14.08%	6.88%	-1.64%	1.19%	184.19%	24.19%
Annual Rate of Return	-2.59%	-7.03%	7.37%	3.72%	-0.91%	0.56%	59.24%	12.29%
Buy & Hold Net Profit	-1275	1924	-1894	762	1654	1171	3217	-14078
Total Net Profit	-949	-2677	2816	1375	-328	237	36838	4839
Optimization 2	PTR	VSEC	CE	TUP	JAS	Sum	Goog	X
Return on Initial Capital	-27.41%	-10.47%	2.42%	12.20%	-2.56%	-25.82%	62.27%	28.53%
Annual Rate of Return	-13.55%	-5.57%	1.34%	6.44%	-1.41%	-12.75%	27.46%	14.24%
Buy & Hold Net Profit	-1275	1924	-1894	762	1654	1171	3217	-14078
Total Net Profit	-5483	-2094	484	2441	-511	-5163	12454	5707

Table 11- "Buy and Hold" vs. Strategy 5

4.9 Summary of Performances

By using an initial capital of \$20,000 for each stock, we can see the following:

PTR: PTR does not perform well in either “Buy and Hold” strategy or Strategy 5. It loses \$1275 in “Buy and Hold” strategy, and it loses \$949 in Strategy 5 based on All Net Profit Factor Optimization and it loses \$5483 in Strategy 5 based on Expectancy Per Trade Optimization. The negative Return on Initial Capital using Strategy 5 and negative return on “Buy and Hold” strategy indicate PTR does not perform well in both strategies.

VSEC: “Buy and Hold” strategy works better with net profit of \$1924, while both Optimizations base on All Net Profit Factor and Expectancy Per Trade has negative total net profits. Moreover, All Net Profit Factor Optimization loses \$2677 and has a negative 7.03% annual rate of return while Expectancy Per Trade Optimization loses \$2094 and has a negative 5.57% annual rate of return.

CE: Strategy 5 performs better than “Buy and Hold” strategy. Net Profit Factor Optimization has a positive total net profit of \$2816 while Expectancy Per Trade Optimization has a positive total net profit of \$484, compares to “Buy and Hold” loss of \$1894. All Net Profit Factor Optimization has an annual rate of return of 7.37% while Expectancy Per Trade Optimizations has an annual rate of return of 1.34%.

TUP: Strategy 5 performs better than “Buy and Hold” strategy. Net Profit Factor Optimization has a positive total net profit of \$1375 while Expectancy Per Trade Optimization has a positive total net profit of \$2441, compares to “Buy and Hold” win of \$762. All Net Profit Factor Optimization has an annual rate of return of 3.72% while Expectancy Per Trade Optimizations has an annual rate of return of 6.44%.

JAS: “Buy and Hold” strategy works better with net profit of \$1654, while both Optimizations base on All Net Profit Factor and Expectancy Per Trade has negative total net profits. Moreover, All Net Profit Factor Optimization loses \$328 and has a negative 0.91% annual rate of return while Expectancy Per Trade Optimization loses \$511 and has a negative 1.41% annual rate of return.

GOOG: Strategy 5 performs better than “Buy and Hold” strategy. Net Profit Factor Optimization has a positive total net profit of \$36838 while Expectancy Per Trade Optimization has a positive total net profit of \$12454, compares to “Buy and

Hold” win of \$3217. All Net Profit Factor Optimization has an annual rate of return of 59.24 % while Expectancy Per Trade Optimizations has an annual rate of return of 27.46%.

X: Strategy 5 performs better than “Buy and Hold” strategy. Net Profit Factor Optimization has a positive total net profit of \$4839 while Expectancy Per Trade Optimization has a positive total net profit of \$5707, compares to “Buy and Hold” loss of \$14078. All Net Profit Factor Optimization has an annual rate of return of 12.29% while Expectancy Per Trade Optimizations has an annual rate of return of 14.24%.

Portfolio (Sum):”Buy and Hold” strategy performs better than Strategy 5 in a portfolio on the five screened stocks. After summing the net profit of the 5 stocks on 100 shares, Net Profit Factor Optimization has a positive total net profit of \$237 while Expectancy Per Trade Optimization has a loss of \$5163, compares to “Buy and Hold” a positive total net profit of \$1171.

4.10 Conclusions

In conclusion, we find Strategy 5 generates a higher net profit than “Buy and Hold”. In particular, we find the following:

- GOOG and X performs extremely well using Strategy 5 compared to “Buy and Hold”, both on net profit and annual rate of return. In particular, GOOG performs the best using Strategy 5 based on Profit Factor, with a win of \$36838 and a 59.24% annual rate of return. X performs the best using Strategy 5 based on Expectancy per Trade, with a win of \$5707 and a 14.24% annual rate of return
- CE performs the best using Strategy 5 based on Profit Factor, with a win of \$2815 and a 7.37% annual rate of return
- TUP performs the best using Strategy 5 based on Expectancy per Trade, with a win of \$2441 and a 6.44% annual rate of return
- VSEC and JAS perform best using “Buy and Hold” strategy, with a net profit of \$1924 and \$1654 respectively
- PTR loses money in both strategies.
- The Portfolio of the 5 screened stocks (PTR, VSEC, CE, TUP, and JAS) on average weight performs better using Buy and Hold strategy compared to Strategy 5.

5 Conclusions

The NASDAQ.com provides a powerful Guru Stock Screener where you can pick your favorite stock guru or gurus and get a list of stocks that scanned by each guru's investment methodology. This powerful tool enables investors to pick their stocks but fails to tell investors which stocks among many to buy, because an individual investor with limited capital cannot buy all the stocks on the list. The Guru Stock Screener also has limited information for investors as to when to buy and sell the stock, or whether they will earn a better return using a conservative "Buy and Hold" strategy.

Throughout this IQP, we combine James P. O'Shaughnessy investment methodology with technical analysis through TradeStation trading platform. We refine 100 stocks down to only five stocks namely PTR, VSEC, CE, TUP, and JAS, plus GOOG and X, using Moving Average, Average Directional Index, Volatility and Kaufman Efficiency indicators. We analyze the performances of five Value/Growth stocks plus GOOG and X by back-testing them from 3/21/2002 to 3/21/2008 using TradeStation and optimized them to achieve maximum profit factor and expectancy per trade.

We test the optimized strategy on the same stocks from 3/21/2008 to 3/21/2010 to compare the performance of each stock relative to a Buy & Hold strategy. As a result, we find Strategy 5 generates a higher net profit than "Buy and Hold". In particular, we find the following:

- GOOG and X performs extremely well using Strategy 5 compared to "Buy and Hold", both on net profit and annual rate of return. In particular, GOOG performs the best using Strategy 5 based on Profit Factor, with a win of \$36838 and a 59.24% annual rate of return. X performs the best using Strategy 5 based on Expectancy per Trade, with a win of \$5707 and a 14.24% annual rate of return
- CE performs the best using Strategy 5 based on Profit Factor, with a win of \$2815 and a 7.37% annual rate of return
- TUP performs the best using Strategy 5 based on Expectancy per Trade, with a win of \$2441 and a 6.44% annual rate of return
- VSEC and JAS perform best using "Buy and Hold" strategy, with a net profit of \$1924 and \$1654 respectively
- PTR loses money in both strategies.
- The Portfolio of the 5 screened stocks (PTR, VSEC, CE, TUP, and JAS) on average weight performs better using Buy and Hold strategy compared to Strategy 5.

6 Further Work

Although this IQP serves to help investors to begin using trading platform, in particular TradeStation to manage their financial futures, there are still several areas that we are not able to cover. Below is a list of those aspects that are important in developing a complete trading system and are necessary for further study:

- **Position Sizing and Risk Management:** It specifies how much money is risked on each trade and all open trades in total. It is one of the important elements in complete trading system that gives guidance to investors on how to position their trades scientifically.
- **System Design and Testing:** System Quality Controls are important in assessing the health of the system. Measures such as expectancy, profitability rule and fundamental law of trading are necessary to develop a health system.
- **Monte Carlo Experiments:** They are also an integral part of System Design and should be furthered studied. Monte Carlo Experiments can give investors a statistical “edge” or confidence level of certain measure of the system, such as maximum drawdown or maximum number of consecutive losing trades.
- **System Monitoring Techniques:** The system should be frequently monitored when traded in real time to assess and compare its “normal” behaviors. If the results deviate from what are expected, proper actions should be taken.
- **Asset Allocation Rules:** This is more comprehensive where you have multiple systems and decide how much capital should be allocated to each system.
- **Implementation Costs (Slippage & Commission):** These costs should be included in evaluation of profits. These costs might depend on the type of brokerage services received.

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8 Appendixes

8.1 List of 100 Stocks

	Symbol	Company
1	FUQI	FUQI INTERNATIONAL, INC.
2	PRIM	PRIMORIS SERVICES CORP
3	BGH	BUCKEYE GP HOLDINGS L.P.
4	PM	PHILIP MORRIS INTERNATIONAL INC.
5	ABC	AMERISOURCEBERGEN CORP.
6	MRK	MERCK & CO., INC.
7	PTR	PETROCHINA COMPANY LIMITED (ADR)
8	BAGL	EINSTEIN NOAH RESTAURANT GROUP, INC.
9	BIG	BIG LOTS, INC.
10	SAY	SATYAM COMPUTER SERVICES LIMITED(ADR)
11	PUK	PRUDENTIAL PUBLIC LIMITED COMPANY (ADR)
12	CSH	CASH AMERICA INTERNATIONAL, INC.
13	PFE	PFIZER INC.
14	REP	REPSOL YPF, S.A. (ADR)
15	ARG	AIRGAS, INC.
16	CHL	CHINA MOBILE LTD. (ADR)
17	BWLRF	BREAKWATER RESOURCES LTD. (USA)
18	VSEC	VSE CORPORATION
19	SORL*	SORL AUTO PARTS, INC.
20	EMS*	EMERGENCY MEDICAL SERVICES CORPORATION
21	HS*	HEALTHSPRING, INC
22	PSYS	PSYCHIATRIC SOLUTIONS, INC.
23	KFT	KRAFT FOODS INC.
24	DD	E.I. DU PONT DE NEMOURS & COMPANY
25	VIV	VIVO PARTICIPACOES SA (ADR)
26	CE	CELANESE CORPORATION
27	PG	THE PROCTER & GAMBLE COMPANY
28	T	AT&T INC.
29	TUP	TUPPERWARE BRANDS CORPORATION
30	ZFSVY	ZURICH FINANCIAL SERVICES (ADR)
31	BT	BT GROUP PLC (ADR)
32	JAS	JO-ANN STORES, INC.
33	TEF	TELEFONICA S.A. (ADR)
34	MRO	MARATHON OIL CORPORATION
35	TLVT	TELVENT GIT, S.A

36	STO	STATOIL ASA(ADR)
37	VZ	VERIZON COMMUNICATIONS INC.
38	ESRX	EXPRESS SCRIPTS, INC.
39	ARO	AEROPOSTALE, INC.
40	TJX	THE TJX COMPANIES, INC.
41	LUKOY	LUKOIL (ADR)
42	AIR	AAR CORP.
43	ABT	ABBOTT LABORATORIES
44	CHDX	CHINDEX INTERNATIONAL, INC.
45	NABZY	NATIONAL AUSTRALIA BANK LTD. (ADR)
46	JOSB	JOS. A. BANK CLOTHIERS, INC.
47	TDY	TELEDYNE TECHNOLOGIES INCORPORATED
48	VMI	VALMONT INDUSTRIES, INC.
49	PEP	PEPSICO, INC.
50	BRS	BRISTOW GROUP INC.
51	DSCM	DRUGSTORE.COM, INC.
52	HBC	HSBC HOLDINGS PLC (ADR)
53	TSEM	TOWER SEMICONDUCTOR LTD. (USA)
54	RTN	RAYTHEON COMPANY
55	CGV	CGG VERITAS (ADR)
56	NVS	NOVARTIS AG (ADR)
57	DT	DEUTSCHE TELEKOM AG (ADR)
58	TWX	TIME WARNER INC.
59	TI	TELECOM ITALIA S.P.A. (ADR)
60	RDS.A	ROYAL DUTCH SHELL PLC (ADR)
61	RHHBY	ROCHE HOLDING LTD. (ADR)
62	RKT	ROCK-TENN COMPANY
63	FTE	FRANCE TELECOM SA (ADR)
64	WSII	WASTE SERVICES, INC.
65	NEU	NEWMARKET CORPORATION
66	CXW	CORRECTIONS CORPORATION OF AMERICA
67	HAS	HASBRO, INC.
68	CHSI	CATALYST HEALTH SOLUTIONS, INC.
69	BASFY	BASF SE (ADR)
70	CBRL	CRACKER BARREL OLD COUNTRY STORE, INC.
71	GLBC	GLOBAL CROSSING LTD.
72	UHS	UNIVERSAL HEALTH SERVICES, INC.
73	SNX	SYNNEX CORPORATION
74	PHG	KONINKLIJKE PHILIPS ELECTRONICS NV (ADR)
75	GSK	GLAXOSMITHKLINE PLC (ADR)

76	BAYRY	BAYER AG (ADR)
77	HD	THE HOME DEPOT, INC.
78	VOD	VODAFONE GROUP PLC (ADR)
79	AZN	ASTRAZENECA PLC (ADR)
80	AFAM	ALMOST FAMILY, INC.
81	E	ENI S.P.A. (ADR)
82	AZSEY	ALLIANZ SE (ADR)
83	TOT	TOTAL S.A. (ADR)
84	TGI	TRIUMPH GROUP, INC.
85	ENS	ENERSYS
86	SNP	CHINA PETROLEUM & CHEMICAL CORP. (ADR)
87	HON	HONEYWELL INTERNATIONAL INC.
88	SNY	SANOFI-AVENTIS SA (ADR)
89	CVX	CHEVRON CORPORATION
90	BP	BP PLC (ADR)
91	COP	CONOCOPHILLIPS
92	PSSI	PSS WORLD MEDICAL, INC.
93	INTC	INTEL CORPORATION
94	AMED	AMEDISYS, INC.
95	INT	WORLD FUEL SERVICES CORPORATION
96	KO	THE COCA-COLA COMPANY
97	UPS	UNITED PARCEL SERVICE, INC.
98	JNJ	JOHNSON & JOHNSON
99	XOM	EXXON MOBIL CORPORATION
100	ROST	ROSS STORES, INC.
101*	GOOG	Google
102*	X	American Steel

8.2 38 Stocks selected after MA and ADX

	Symbol	Company	MovAvg	ADX	Volatility	Kaufman
1	ABC	AMERISOURCEBERGEN CORP.	20	17	76	344
2	MRK	MERCK & CO., INC.	20	17	144	357
3	PTR	PETROCHINA COMPANY LIMITED (ADR)	23	15	233	436
4	BAGL	EINSTEIN NOAH RESTAURANT GROUP, INC.	22	16	630	364
5	BIG	BIG LOTS, INC.	20	19	400	390
6	SAY	SATYAM COMPUTER SERVICES LIMITED(ADR)	20	19	441	295
7	PUK	PRUDENTIAL PUBLIC LIMITED COMPANY (ADR)	20	19	190	245
8	CSH	CASH AMERICA INTERNATIONAL, INC.	17	23	458	336
9	PFE	PFIZER INC.	17	23	106	363
10	REP	REPSOL YPF, S.A. (ADR)	20	21	115	388
11	ARG	AIRGAS, INC.	20	21	165	348
12	CHL	CHINA MOBILE LTD. (ADR)	20	22	211	298
13	BWLRF	BREAKWATER RESOURCES LTD. (USA)	22	20	777	359
14	VSEC	VSE CORPORATION	25	18	665	446
15	SORL	SORL AUTO PARTS, INC.	23	20	719	390
16	EMS	EMERGENCY MEDICAL SERVICES CORPORATION	20	23	477	310
17	HS	HEALTHSPRING, INC	23	20	433	300
18	PSYS	PSYCHIATRIC SOLUTIONS, INC.	19	24	332	285
19	DD	E.I. DU PONT DE NEMOURS & COMPANY	21	22	174	333
20	VIV	VIVO PARTICIPACOES SA (ADR)	20	23	771	282
21	CE	CELANESE CORPORATION	25	18	267	433
22	PG	THE PROCTER & GAMBLE COMPANY	24	20	51	344
23	T	AT&T INC.	24	21	134	317
24	TUP	TUPPERWARE BRANDS CORPORATION	24	21	267	478
25	ZFSVY	ZURICH FINANCIAL SERVICES (ADR)	25	20	144	299
26	BT	BT GROUP PLC (ADR)	24	21	129	371
27	JAS	JO-ANN STORES, INC.	24	22	517	545
28	TEF	TELEFONICA S.A. (ADR)	24	22	78	337
29	MRO	MARATHON OIL CORPORATION	25	21	295	357
30	TLVT	TELVENT GIT, S.A	24	22	535	388
31	VZ	VERIZON COMMUNICATIONS INC.	24	23	106	343
32	AIR	AAR CORP.	24	24	409	364
33	ABT	ABBOTT LABORATORIES	25	23	53	291
34	TDY	TELEDYNE TECHNOLOGIES INCORPORATED	24	25	241	348
35	VMI	VALMONT INDUSTRIES, INC.	24	25	386	356
36	TWX	TIME WARNER INC.	25	25	150	330
37	GOOG*	Google	21	13	207	516
38	X*	American Steel	22	22	547	437

8.3 Stocks Selected after Volatility

	Symbol	Company	MovAvg	ADX	Volatility	Kaufman
1	PTR	PETROCHINA COMPANY LIMITED (ADR)	23	15	233	436
2	BAGL	EINSTEIN NOAH RESTAURANT GROUP, INC.	22	16	630	364
3	BIG	BIG LOTS, INC.	20	19	400	390
4	SAY	SATYAM COMPUTER SERVICES LIMITED(ADR)	20	19	441	295
5	CSH	CASH AMERICA INTERNATIONAL, INC.	17	23	458	336
6	CHL	CHINA MOBILE LTD. (ADR)	20	22	211	298
7	BWLRF	BREAKWATER RESOURCES LTD. (USA)	22	20	777	359
8	VSEC	VSE CORPORATION	25	18	665	446
9	SORL*	SORL AUTO PARTS, INC.	23	20	719	390
10	EMS*	EMERGENCY MEDICAL SERVICES CORPORATION	20	23	477	310
11	HS*	HEALTHSPRING, INC	23	20	433	300
12	PSYS	PSYCHIATRIC SOLUTIONS, INC.	19	24	332	285
13	VIV	VIVO PARTICIPACOES SA (ADR)	20	23	771	282
14	CE	CELANESE CORPORATION	25	18	267	433
15	TUP	TUPPERWARE BRANDS CORPORATION	24	21	267	478
16	JAS	JO-ANN STORES, INC.	24	22	517	545
17	MRO	MARATHON OIL CORPORATION	25	21	295	357
18	TLVT	TELVENT GIT, S.A	24	22	535	388
19	AIR	AAR CORP.	24	24	409	364
20	TDY	TELEDYNE TECHNOLOGIES INCORPORATED	24	25	241	348
21	VMI	VALMONT INDUSTRIES, INC.	24	25	386	356
22	GOOG	Google	21	13	207	516
23	X	American Steel	22	22	547	437

8.4 Stocks selected after Kaufman Efficiency

	Symbol	Company	MovAvg	ADX	Volatility	Kaufman
1	PTR	PETROCHINA COMPANY LIMITED (ADR)	23	15	233	436
2	VSEC	VSE CORPORATION	25	18	665	446
3	CE	CELANESE CORPORATION	25	18	267	433
4	TUP	TUPPERWARE BRANDS CORPORATION	24	21	267	478
5	JAS	JO-ANN STORES, INC.	24	22	517	545
6	GOOG	Google	21	13	207	516
7	X	American Steel	22	22	547	437

8.5 GOOG Highest 10 Net Profit Factor Parameters and Results:

Test #	1	2	3	4	5	6	7	8	9	10
Length	22	24	26	28	22	24	26	30	22	24
FastLength	4	4	4	4	6	6	6	4	5	5
SlowLength	30	30	30	30	25	25	25	30	25	25
All: Net Profit	886.57	886.57	879.62	867.49	921.44	921.44	912.09	849.76	933.62	933.62
All: Gross Profit	1094.52	1094.52	1085.97	1083.26	1151.33	1151.33	1142.78	1064.76	1173.05	1173.05
All: Gross Loss	-207.95	-207.95	-206.35	-215.77	-229.89	-229.89	-230.69	-215.00	-239.43	-239.43
All: Total Trades	40.00	40.00	39.00	38.00	42.00	42.00	41.00	37.00	43.00	43.00
All: % Profitable	57.50	57.50	58.97	57.89	54.76	54.76	56.10	59.46	51.16	51.16
All: Winning Trades	23.00	23.00	23.00	22.00	23.00	23.00	23.00	22.00	22.00	22.00
All: Losing Trades	17.00	17.00	16.00	16.00	19.00	19.00	18.00	15.00	21.00	21.00
All: Max Winning Trade	192.23	192.23	192.23	192.23	201.50	201.50	201.50	178.02	211.15	211.15
All: Max Losing Trade	-45.94	-45.94	-45.94	-45.94	-45.94	-45.94	-45.94	-45.94	-45.94	-45.94
All: Avg Winning Trade	47.59	47.59	47.22	49.24	50.06	50.06	49.69	48.40	53.32	53.32
All: Avg Losing Trade	-12.23	-12.23	-12.90	-13.49	-12.10	-12.10	-12.82	-14.33	-11.40	-11.40
All: Win/Loss Ratio	3.89	3.89	3.66	3.65	4.14	4.14	3.88	3.38	4.68	4.68
All: Avg Trade	22.16	22.16	22.55	22.83	21.94	21.94	22.25	22.97	21.71	21.71
All: Max Consecutive Winners	9.00	9.00	9.00	9.00	8.00	8.00	8.00	9.00	4.00	4.00
All: Max Consecutive Losers	4.00	4.00	4.00	5.00	6.00	6.00	5.00	5.00	6.00	6.00
All: Avg Bars in Winner	35.00	35.00	35.00	36.00	33.00	33.00	33.00	36.00	36.00	36.00
All: Avg Bars in Loser	12.00	12.00	13.00	13.00	13.00	13.00	13.00	14.00	10.00	10.00
All: Max Intraday Drawdown	-78.16	-78.16	-78.16	-78.16	-61.32	-61.32	-61.32	-78.16	-64.43	-64.43
All: ProfitFactor	5.26	5.26	5.26	5.02	5.01	5.01	4.95	4.95	4.90	4.90
All: Max Contracts Held	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
All: Required Account Size	78.16	78.16	78.16	78.16	61.32	61.32	61.32	78.16	64.43	64.43
All: Return on Account	1134.30	1134.30	1125.41	1109.89	1502.67	1502.67	1487.43	1087.21	1449.05	1449.05

Long: Net Profit	599.86	599.86	592.91	590.20	616.52	616.52	609.57	590.97	597.58	597.58
Long: Gross Profit	707.11	707.11	698.56	695.85	753.73	753.73	745.18	695.85	722.71	722.71
Long: Gross Loss	-107.25	-107.25	-105.65	-105.65	-137.21	-137.21	-135.61	-104.88	-125.13	-125.13
Long: Total Trades	27.00	27.00	26.00	25.00	28.00	28.00	27.00	24.00	29.00	29.00
Long: % Profitable	62.96	62.96	65.38	64.00	57.14	57.14	59.26	66.67	48.28	48.28
Long: Winning Trades	17.00	17.00	17.00	16.00	16.00	16.00	16.00	16.00	14.00	14.00
Long: Losing Trades	10.00	10.00	9.00	9.00	12.00	12.00	11.00	8.00	15.00	15.00
Long: Max Winning Trade	186.57	186.57	178.02	178.02	186.57	186.57	178.02	178.02	186.57	186.57
Long: Max Losing Trade	-44.14	-44.14	-44.14	-44.14	-29.66	-29.66	-29.66	-44.14	-29.66	-29.66
Long: Avg Winning Trade	41.59	41.59	41.09	43.49	47.11	47.11	46.57	43.49	51.62	51.62
Long: Avg Losing Trade	-10.73	-10.73	-11.74	-11.74	-11.43	-11.43	-12.33	-13.11	-8.34	-8.34
Long: Win/Loss Ratio	3.88	3.88	3.50	3.70	4.12	4.12	3.78	3.32	6.19	6.19
Long: Avg Trade	22.22	22.22	22.80	23.61	22.02	22.02	22.58	24.62	20.61	20.61
Long: Max Consecutive Winners	7.00	7.00	7.00	7.00	6.00	6.00	6.00	7.00	3.00	3.00
Long: Max Consecutive Losers	3.00	3.00	3.00	5.00	4.00	4.00	3.00	5.00	4.00	4.00
Long: Avg Bars in Winner	31.00	31.00	31.00	33.00	31.00	31.00	31.00	33.00	36.00	36.00
Long: Avg Bars in Loser	10.00	10.00	10.00	10.00	10.00	10.00	11.00	11.00	9.00	9.00
Long: Max Intraday Drawdown	-56.70	-56.70	-56.70	-56.70	-55.42	-55.42	-55.42	-56.70	-54.86	-54.86
Long: ProfitFactor	6.59	6.59	6.61	6.59	5.49	5.49	5.50	6.63	5.78	5.78
Long: Max Contracts Held	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Long: Required Account Size	56.70	56.70	56.70	56.70	55.42	55.42	55.42	56.70	54.86	54.86
Long: Return on Account	1057.95	1057.95	1045.70	1040.92	1112.45	1112.45	1099.91	1042.28	1089.28	1089.28
Short: Net Profit	286.71	286.71	286.71	277.29	304.92	304.92	302.52	258.79	336.04	336.04
Short: Gross Profit	387.41	387.41	387.41	387.41	397.60	397.60	397.60	368.91	450.34	450.34
Short: Gross Loss	-100.70	-100.70	-100.70	-110.12	-92.68	-92.68	-95.08	-110.12	-114.30	-114.30
Short: Total Trades	13.00	13.00	13.00	13.00	14.00	14.00	14.00	13.00	14.00	14.00
Short: % Profitable	46.15	46.15	46.15	46.15	50.00	50.00	50.00	46.15	57.14	57.14
Short: Winning Trades	6.00	6.00	6.00	6.00	7.00	7.00	7.00	6.00	8.00	8.00
Short: Losing Trades	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	6.00	6.00
Short: Max Winning Trade	192.23	192.23	192.23	192.23	201.50	201.50	201.50	173.73	211.15	211.15
Short: Max Losing Trade	-45.94	-45.94	-45.94	-45.94	-45.94	-45.94	-45.94	-45.94	-45.94	-45.94
Short: Avg Winning Trade	64.57	64.57	64.57	64.57	56.80	56.80	56.80	61.49	56.29	56.29
Short: Avg Losing Trade	-14.39	-14.39	-14.39	-15.73	-13.24	-13.24	-13.58	-15.73	-19.05	-19.05
Short: Win/Loss Ratio	4.49	4.49	4.49	4.10	4.29	4.29	4.18	3.91	2.95	2.95
Short: Avg Trade	22.05	22.05	22.05	21.33	21.78	21.78	21.61	19.91	24.00	24.00
Short: Max Consecutive Winners	3.00	3.00	3.00	3.00	4.00	4.00	4.00	3.00	3.00	3.00
Short: Max Consecutive Losers	2.00	2.00	2.00	2.00	3.00	3.00	3.00	2.00	3.00	3.00
Short: Avg Bars in Winner	45.00	45.00	45.00	45.00	38.00	38.00	38.00	45.00	38.00	38.00
Short: Avg Bars in Loser	16.00	16.00	16.00	16.00	17.00	17.00	17.00	16.00	14.00	14.00
Short: Max Intraday Drawdown	-64.68	-64.68	-64.68	-68.39	-50.45	-50.45	-50.45	-86.09	-68.55	-68.55
Short: ProfitFactor	3.85	3.85	3.85	3.52	4.29	4.29	4.18	3.35	3.94	3.94
Short: Max Contracts Held	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Short: Required Account Size	64.68	64.68	64.68	68.39	50.45	50.45	50.45	86.09	68.55	68.55
Short: Return on Account	443.27	443.27	443.27	405.45	604.40	604.40	599.64	300.60	490.21	490.21

8.6 Expectancy Function Code and Strategy 5 Code with Expectancy: Expectancy Function:

```
{  
Function:    _Expectancy
```

Description: Calculate annualized Expectancy (oExpectancy) and Expectancy per trade (oExpectPerTrade) popularized by Van K. Tharp and used to assess strategy performance.

Author: Modification of function "Tharp" from Hook and _SystemQuality function from Alex Matulich (2/1/04) of Unicorn Research Corp

Methodology proposed by Van K. Tharp and discussed in "Trade Your Way To Financial Freedom"

Recoded by MarkSanDiego.

Updated: 09/09/09 initial revision
09/16/09 DoCalc variable removed.
Original function created as series function
in error. As a simple function, DoCalc variable is unnecessary.

Usage:

```
vars:  
    int TradingDays(0),  
    float oExpectPerTrade(0),  
    float oExpectancy(0);  
  
    { within calling strategy }  
    if Date <> Date[1] then TradingDays = TradingDays + 1;  
  
        if LastBarOnChart then begin  
            value1 = _Expectancy(TradingDays, oExpectPerTrade, oExpectancy);  
            end;  
    }
```

```
inputs:  
    int TradingDays(NumericRef),    { strategy trading days used to annualize  
the expectancy score }
```

```

{ outputs }
float oExpectPerTrade(NumericRef), { expectancy per trade }
float oExpectancy(NumericRef);      { expectancy score annualized =
expectancy * opportunities per year }

```

vars:

```

float TradesPerYear(0),          { annualized trading opportunities in a year
by multiplying TotalTrades by:
                                trading days per year (252) / strategy trading days
                                OR  calendar days in year (365) / strategy calendar days
}
float AW(0),                     { average winning trade }
float PW(0),                     { probability of winning trade ( total wins /
opportunities ) }
float AL(0),                     { average lossing trade }
float PL(0);                     { probability of losing trade ( total losses /
opportunities ) }

```

```

AW = iff( NumWinTrades > 0, GrossProfit / NumWinTrades, 0);

```

```

AL = iff( NumLosTrades > 0, GrossLoss / NumLosTrades, 0);

```

```

if TotalTrades > 0 then begin

```

```

    PW = NumWinTrades / TotalTrades;

```

```

    PL = NumLosTrades / TotalTrades;

```

```

end else begin

```

```

    PW = 0;

```

```

    PL = 0;

```

```

end;

```

```

oExpectPerTrade = iff(AL = 0, AW * PW, -(AW * PW + AL * PL) / AL);

```

```

{ annualize results by calculating number of trades occuring per year }

```

```

{ There are 252 trading days per year. MaxList ensures a partial trading day
is counted as at least 1 trading day }

```

```

TradesPerYear = TotalTrades * 252 / MaxList(TradingDays, 1);

```

```

{ annualize expectancy }

```

```

oExpectancy = oExpectPerTrade * TradesPerYear;

```

```

_Expectancy = oExpectancy;

```

Strategy 5 with Expectancy Code:

```
//Strategy 5+ Expectancy
//Price Channel Part
Inputs: Length (20);
Variables: LowerBand( 0 ), UpperBand( 0 ),
           int TradingDays(0), float oExpectPerTrade(0), float
oExpectancy(0);
LowerBand = Lowest (Low, Length) [1];
UpperBand = Highest (High, Length) [1];
If Close > UpperBand then buy next bar at close+1 point stop;
If Close < LowerBand then sell short next bar at close-1 point stop;

//Moving Average Part
Inputs: FastLength(8), SlowLength(20);
Variables: FastMoveAvg(0), SlowMoveAvg(0);
FastMoveAvg = AverageFC(Close, FastLength);
SlowMoveAvg = AverageFC(Close, SlowLength);
If MarketPosition=1 and FastMoveAvg crosses below SlowMoveAvg then sell
short next bar at close -1 point stop;
If MarketPosition=-1 and FastMoveAvg crosses above SlowMoveAvg then buy
next bar at close +1 point stop;

//Chandelier Stop
If MarketPosition = 1 and High < Highest (High, 50) - 3 * AvgTrueRange(20)
then sell next bar at close -1 point stop;
//Sell the stock if today's high is lower than 3 times the average true range of
twenty bars from 50-day high

If Date = 1091230 and MarketPosition = 1 Then Sell Next Bar at Market;
If Date = 1091230 and MarketPosition = -1 Then Buy to Cover Next Bar at
Market;

Inputs: filename("C:\GOOGExpectancy");
if Date <> Date[1] then TradingDays = TradingDays + 1;
if LastBarOnChart then begin
    value1 = _Expectancy(TradingDays, oExpectPerTrade, oExpectancy);
    {print(oExpectancy, "exp");}
    fileappend (filename, numtostr(Length,3)+ "," +
numtostr(FastLength,3)+ "," + numtostr(SlowLength,3)+ "," +
numtostr(oExpectancy,3)+ "," + numtostr(oExpectPerTrade,3)+ newline);
end;
```


8.7 First 50 Results of GOOG Expectancy Per Trade:

Test #	Length	FastLength	SlowLength	Expectancy	Expectancy per Trade
1	28	10	16	17.434	1.549
2	22	10	16	17.995	1.542
3	24	10	16	17.995	1.542
4	26	10	16	17.352	1.514
5	30	10	16	16.569	1.5
6	16	10	16	18.528	1.389
7	18	10	16	17.037	1.385
8	22	7	21	14.116	1.328
9	24	7	21	14.116	1.328
10	22	8	20	12.255	1.307
11	24	8	20	12.255	1.307
12	12	10	16	17.883	1.3
13	20	10	16	15.418	1.298
14	26	7	21	13.509	1.296
15	22	8	21	12.323	1.285
16	24	8	21	12.323	1.285
17	28	7	21	12.926	1.266
18	14	10	16	16.786	1.258
19	26	8	20	11.463	1.25
20	22	8	18	12.953	1.243
21	26	8	21	11.629	1.24
22	12	11	19	15.125	1.23
23	28	8	20	10.969	1.224
24	30	7	21	12.153	1.215
25	28	8	21	11.143	1.215
26	18	7	21	13.145	1.19
27	22	7	22	12.366	1.187
28	24	7	22	12.366	1.187
29	28	8	18	11.556	1.18
30	18	8	20	11.744	1.174
31	24	8	18	12.178	1.169
32	30	8	21	10.433	1.164
33	30	8	20	10.183	1.163
34	18	8	21	11.63	1.162
35	22	9	21	10.574	1.153

Test #	Length	FastLength	SlowLength	Expectancy	Expectancy per Trade
36	24	9	21	10.574	1.153
37	18	8	18	12.641	1.144
38	26	8	18	11.589	1.135
39	22	9	16	13.174	1.129
40	16	7	21	13.173	1.129
41	30	8	18	10.8	1.126
42	20	7	21	12.131	1.119
43	26	9	21	10.032	1.119
44	12	11	20	13.052	1.118
45	12	7	21	13.415	1.11
46	20	8	20	10.625	1.108
47	12	7	22	13.393	1.108
48	28	9	21	9.613	1.098
49	20	8	21	10.746	1.097
50	28	9	16	11.985	1.085

8.8 Strategy 5 with Expectancy Code for all five stocks:

```
//Strategy 5+ Expectancy GOOG
//Price Channel Part
Inputs: Length (20);
Variables: LowerBand( 0 ), UpperBand( 0 ),
           int TradingDays(0), float oExpectPerTrade(0), float
oExpectancy(0);
LowerBand = Lowest (Low, Length) [1];
UpperBand = Highest (High, Length) [1];
If Close > UpperBand then buy next bar at close+1 point stop;
If Close < LowerBand then sell short next bar at close-1 point stop;

//Moving Average Part
Inputs: FastLength(8), SlowLength(20);
Variables: FastMoveAvg(0), SlowMoveAvg(0);
FastMoveAvg = AverageFC(Close, FastLength);
SlowMoveAvg = AverageFC(Close, SlowLength);
If MarketPosition=1 and FastMoveAvg crosses below SlowMoveAvg then sell
short next bar at close -1 point stop;
If MarketPosition=-1 and FastMoveAvg crosses above SlowMoveAvg then buy
next bar at close +1 point stop;

//Chandelier Stop
If MarketPosition = 1 and High < Highest (High, 50) - 3 * AvgTrueRange(20)
then sell next bar at close -1 point stop;
//Sell the stock if today's high is lower than 3 times the average true range of
twenty bars from 50-day high

If Date = 1100318 and MarketPosition = 1 Then Sell Next Bar at Market;
If Date = 1100318 and MarketPosition = -1 Then Buy to Cover Next Bar at
Market;

Inputs: filename("C:\GOOGExpectancy");
if Date <> Date[1] then TradingDays = TradingDays + 1;
if LastBarOnChart then begin
    value1 = _Expectancy(TradingDays, oExpectPerTrade, oExpectancy);
    {print(oExpectancy, "exp");}
    fileappend (filename, numtostr(Length,3)+ "," +
numtostr(FastLength,3)+ "," + numtostr(SlowLength,3)+ "," +
numtostr(oExpectancy,3)+ "," + numtostr(oExpectPerTrade,3)+ newline);
end;
```