Short-Term Trading Analysis
(Text Level-2)

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Introduction

Stock prices go up and down. It would seem that it is simple to make a fast profit from day trading. You need to buy stocks after a price drop and sell them after some time with a profit. Unfortunately, this is a minus sum game. Bad stock selection can easily kill you. The faster you trade, the faster your losses become large. Every transaction has a cost: bid-ask spread and brokerage commissions. Very tiny profits will disappear in a long run when you take into account these transaction costs.

Nevertheless, day traders still exist and many of them are very rich people. How did they do that? If you are a professional and trading on the floor of the exchange you can look for micro trends and catch the leaving train right on time. Big capital and zero commissions allow you to make micro profits constantly.

These notes are for nonprofessionals. Can you make profits by short term trading? Yes, you can. You should be very selective when buying stocks for trading and try to *anticipate* the stock price moves before professionals. Is this possible? The answer is yes. Let us show how to do that and what is the risk of short term trading.

We will consider trading stocks. We suppose that you are using on-line discount brokers and you are paying small commissions (10 dollars or less). We also suppose that you are able to watch stock quotes a few times a day and you are able to buy or sell stocks during the trading day.

These notes are not about day trading. Our time frame is 2 - 5 days. Computer analysis and our own experience has shown that this period of stock holding is long enough to make profits with reasonable risk level.

Chapter 1
Basics of stock trading

1.1 How much profit is enough

Let us demonstrate how short-term trading can give you a nice annual return. Suppose, you have developed method which allows to pick the stocks with 2% average move in one day. Suppose also, the transaction cost (bid-ask spread and brokerage commissions) is equal to 1%. Your average profit will be 1 % per trade. If you trade one stock per day your trading capital in one year will be increased as much as

$$1.01^{252} = 12.2 \text{ times}$$

So, if you find such trading system then your capital will pop up 12 times every year. But this is not realistic for a long run. How about 1% per week?

$$1.01^{52} = 1.68$$

In 5 years every dollar of your trading capital will be transformed to

$$1.68^{5} = 13.3 \text{ dollars.}$$

We did not consider taxes and possible withdrawing. To make 1% a week you need to earn in average about 0.2% per trade if you are trading one stock per day.

It was the demonstration of a miracle of numbers. Very small average daily returns can give you a large annual return. This is a main idea of the short-term stock trading. For illustration, let us show the dependence of the annual return on the average daily return.

Figure 1.1 Dependence of annual return on the average daily return.

You can see that even 0.1% per day produces annual return of 29%. This is about two times better then the average annual return of the S&P 500 index.

Large returns are always related to higher risk. What is the risk of short-term stock trading? Is it possible to develop a trading strategy which gives good average returns with low risk?

This is what these notes are about. We will consider different systems of trading which allow to achieve maximal average profits with minimal risk.

Before getting started let's consider some important definitions associated with stock trading theory.

1.2 Return and Risk

Return per Trade

Return per trade is the basic term of trading theory. Suppose you bought *n* shares of some stock at the price P_0 and sold them at the price P_1. Brokerage commissions are equal to *Com*. When you buy, you pay a cost price

$$Cost = nP_0 + Com$$

When you sell, you receive a sale price

$$Sale = nP_1 - Com$$

Your return in % for one trade is equal to

$$R = Return = (Sale - Cost) / Cost * 100\%$$

Return can be positive or negative depending on the difference (*Sale - Cost*). Later, we will use the letter *R* for notating return per trade in %.

Average Return

Suppose you have made *N* trades. Returns per trades were equal to R_1, R_2, ... R_N . The average return for *N* trades one can define as a simple average

$$<R> = (R_1 + R_2 + ...+ R_N)/N$$

This definition has some disadvantages. It is a good definition only for small returns. We will discuss this problem later when trading strategies will be considered.

Risk

You cannot be a winner in every trade you make. Any trading strategy must leave room for some losses. Your returns R_1, R_2, ... can be positive or negative. The Figure 1.2 shows returns per trade for one of our trading strategies for the 1996 year period.

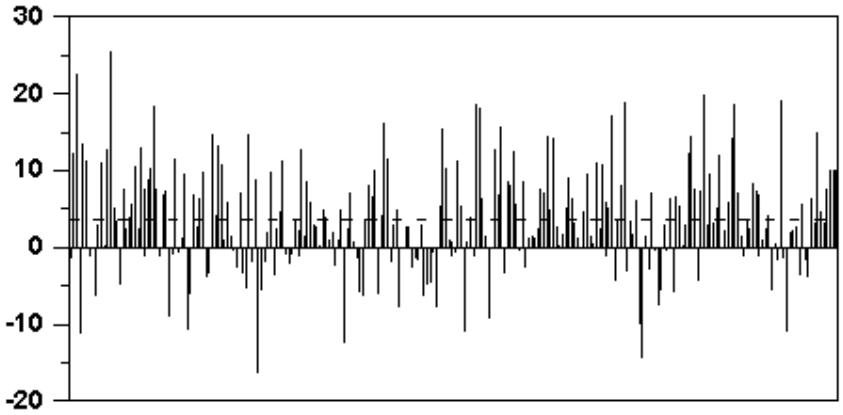


Figure 1.2. Returns per trade in 1996 for the first stock selected for the Basic Trading Strategy. The dashed line shows the average return per trade (3.64%).

You can see from this figure that returns were mostly positive. However, 29% of trades had negative returns. This number reflects the risk of trading. To characterize risk more "scientifically" people use the following definition:

Risk of returns is the standard deviation of the set of returns for some period of time.

You can calculate the standard deviation by using any computer spreadsheet program. To illustrate the definition of risk let us show the distribution of returns.

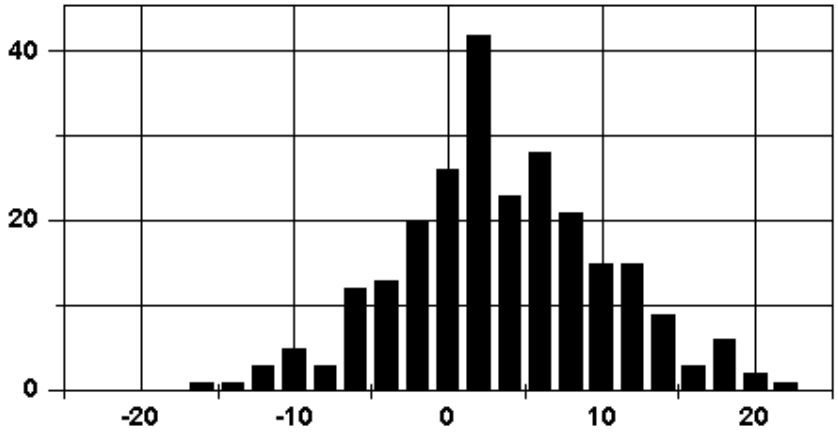


Figure 1.3 Distribution of returns per trade (1996)

Figure 1.3 presents the distribution (histogram) of returns per trade for data from Figure 1.2. These returns are pure returns - no transaction costs have been considered. The standard deviation σ is a characteristic of the distribution width and is equal to 6.9%.

It is clear that the larger the standard deviation, the larger probability of losing money. This is why the standard deviation of the set of returns is considered as risk.

1.3 Profiting from chaos?

Academicians like chaos. In the simplest stock market theory it is assumed that for short periods of time stock prices change randomly. So, probability of growth and decline are equal. In this case it can be shown that there is no chance of making any profit over the long run. You can try any strategy with different "stop" and "limit" order levels, but as a result you will be a loser because of brokerage commissions and bid-ask spreads.

```
                        S          L
____________________|_________|__________|____________________
                  stop          current      limit
                                price
```

On the diagram, S and L are the differences between the current stock price and the stop and limit order levels. The simplest strategy is to buy some stock and wait until the stock price touched the stop or limit levels (prices). If the stop level is touched first - you are a loser. If the stock price touches the limit level - you sell the stock with a profit and you are a winner. It can be shown that this strategy gives you zero average return in case of zero commissions. The squared risk for this strategy is equal to

$$\sigma^2 = S * L$$

So, the larger the deviations of the stop or limit order levels from the stock price, the larger the risk of this trading strategy.

The situation changes when the probability of growth is larger than the probability of decline. In this case the probability of touching the limit level is higher than the probability of touching the stop level and your average return is positive.

We will not write long equations to describe the dependence of average returns on the growth probability. Later we will consider this dependence using real examples. The important question is the levels of stop and limit orders given different probabilities of stock price growth. We will consider this problem in the next section. For now, we just want just to say, that a growth probability about 51-52% is not enough to make any profit, because of brokerage commissions and bid-ask spreads.

1.4 Optimization of the limit and stop orders

Consider the situation: an amateur is trading stocks. His choices are terrible and his style of trading is not getting better. What can we do for this guy? How can we improve his return?

Suppose the average growth probability of the stocks selected by this amateur is 40%. He cannot believe that his choice is always bad and he just wants to have some trading strategy to improve his return. He likes the stop-limit strategy described in the previous section and he wants to know what stops and limits are best for him.

The equations for calculating the optimal stop and limit levels are rather complicated, and here we will just give you the answer: L/S ratio should be more than 10 in this case. So, the stop order should be very close to the stock price at the moment of purchase. This is the only strategy that can help this guy to survive any longer in the market.

The same idea can be applied to a bear market. If you buy stocks when market is declining your stop orders should be as close to the purchase price as possible.

For experienced professional traders, when stock picks are excellent and the growth probability of these stocks is high (for example, 60%) the stop order level should be far away from the purchase price. The same rule can be applied to a bull market. Do not place stop orders close to the purchase price if you are sure about your stocks or when the market is rising. For example, if you expect a profit about 30% your stop orders should be about 20% less than the purchase price. We will consider this problem in detail later, when some specific trading strategies will be analyzed.

1.5 Computer analysis and the real life

It is so easy to lie using statistical analysis. Probabilities, distributions, standard deviations, ... - all this stuff is made specially to leave the truth in the dust. Give us any chart and we will develop an excellent trading system with 90% growth probability.

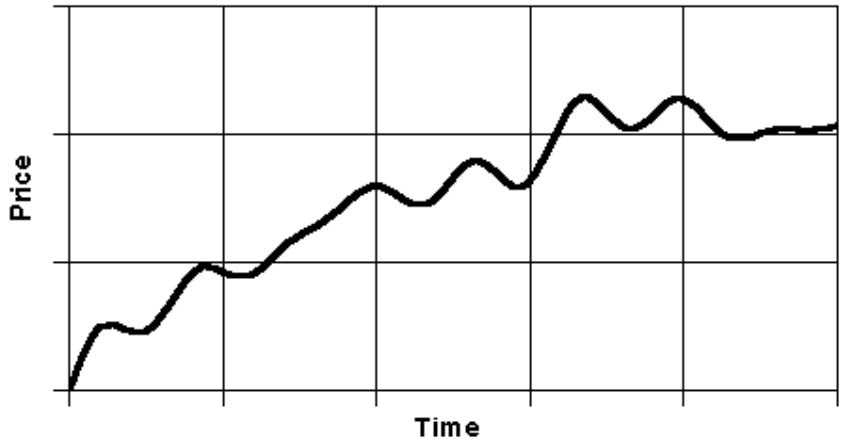


Figure 1.4 Funny curve

You can also draw some funny curve like the one shown in Figure 1.4, and we can "explain" every maximum and minimum of this curve. The analysis will show a 20% return on each trade, and we can write a nice book about a new revolutionary trading system.

When can one believe in the results of computer statistical analysis? Consider an example.

You can start your own analysis. Take the chart of some stock and find the patterns when the stock is ready to rise or to fall. Write down these patterns. Take another chart. Check all previously selected patterns and see what happened. Take another chart... Take another chart... Do it for thousands of stocks. Check your patterns for bull and bear markets. Look for what is working and what is not working. And give us the percentage of events when your patterns are working. If this number is more than 60%, we will use your patterns for trading. It can be profitable.

So, you have to analyze a large number of stocks over a long period of time to draw a conclusion. However, even after such analysis you can not give 100% guarantee of future

results. Your statistical analysis will give you the standard deviation of your expected returns, and you should use these numbers to estimate possible troubles.

What patterns do we believe in? We like trading ranges if we can call them as patterns. There is a real crowd psychology behind these patterns. All traders know about trading ranges, and this fact makes trading ranges rather reliable. Our computer analysis has shown: yes, they work.

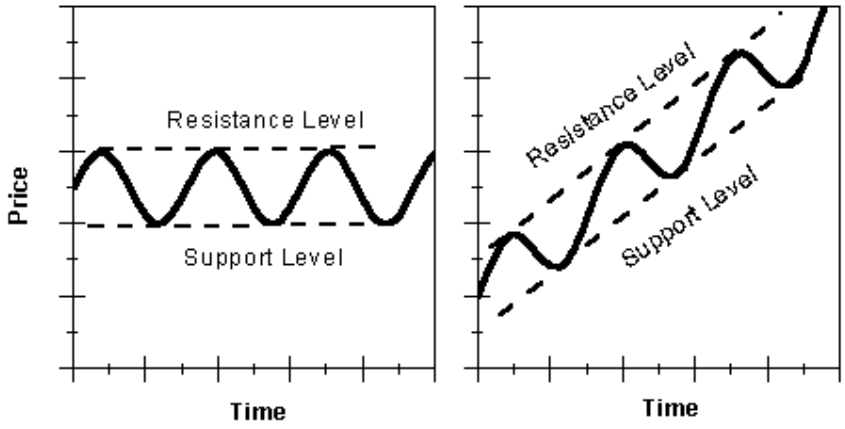


Figure 1.5 Trading ranges for stable and growing stocks

How do trading ranges work? What average profit can you obtain using trading ranges as a basic of your trading strategy? What time scale should you consider to obtain maximal profit? How about the trends?

These are the questions we are going to answer. We performed a computer analysis for thousands of US stocks for a period of almost 5 years. For some stocks, an 11 year trading history has been considered. Now, let us say a few words about general problems of computer analysis.

Every day you can load down the files from all the US stock exchanges. You can see in these files the opening price, maximum and minimum prices during the trading day, closing price and trading volume for thousands of stocks. We will use simple notations for these parameters:

OPE, MAX, MIN, CLO, VOL

You do not know what the bid-ask spreads are. However, this is important for short-term traders. We would not recommend short-term trading of stocks with spreads of 4% and more. Fortunately, the spreads are not so large. Usually, for active stock they are about 0.5 - 1%. See Table 1.1 as an example. So, you need to develop a trading strategy with an average profit of 1.5% to have an average 0.5 - 1% return per trade.

Table 1.1 Bid-Ask spreads of selected stocks from the list of potentially bullish stocks. March 25, 1999

Ticker	Price	Spread %
STK	26.2	0.2
PGNS	10.5	0.6
SWLDY	5.8	1.1
FSII	6.2	1.0
MYLX	6.5	1.9
RDRT	6.5	1.9
SANG	15.2	0.4
CATP	11.7	0.5
SFAM	12.2	1.0

HTCM	24.2	0.2
OXE	21.2	0.9
FRND	8.7	1.4
SKS	24.5	0.3
	Average spread =	0.88%

For other actively trading stocks like Intel, Microsoft, Yahoo!, ... spreads (in %) are much lower. In our calculations we will assume that transaction cost (bid - ask spread + brokerage commissions) is equal to 1.5%. Further, we will also analyze dependence of the average annual returns on the transaction cost.

1.6 How to buy low and sell high

Let us talk more about trading ranges and the possibility of making profits. The main problem is how to define the trading range. Everything is clear when the trading range has been established and you can see a couple of oscillations. Draw the support and resistance lines and you are ready to start trading. The problem with established ranges is their stability. They cannot exist forever. When you define support and resistance lines, the trading range is ready to disappear. What to do? Do not use trading ranges for making trading decisions!

Hey! a couple of paragraphs above we talked about tricks that work and now we recommend that you not use them? Yes, we repeat - do not use trading ranges! Do not use them if you want to make a *good* profit. You have to buy oversold stocks and sell short overbought stocks. Your profit will be much higher.

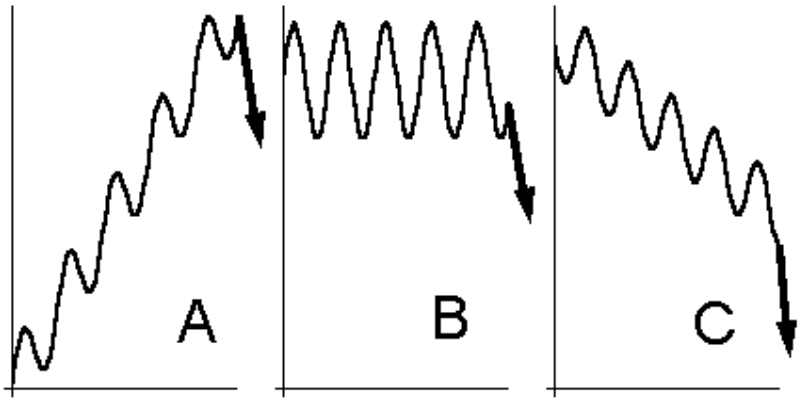


Figure 1.6 Which stock is oversold?

Let us illustrate what we are talking about. First, how do we define oversold and overbought stocks? Have a look at Figure 1.6. Which panel presents the best possibility to make a fast profit? We like panel C. The stock had a very well-established downtrend. One day, the stock price sharply went through the floor. What happened? Usually, downtrend is related to rumors about bad earnings. Do not see the fundamentals of this stock. They may be excellent. Low p/e ratio, small debt, good yield. But something is going on. The market is always right.

One day the bad news is released. This stock will be the main theme on CNBC. A special article at the MarketWatch Web site will be published. All major brokerage firms will downgrade the stock. It opens for trading with a downside price gap, and its price continues to fall further. In the middle of the trading day the stock can recover a little, but it can fall further by the market closing.

This is your stock. Buy it! The stock is oversold.

Why are the other stocks (panels A and B) not oversold? Ask technicians about that. They will tell you about breaking trading range, head and shoulders, etc. Fundamentalists will tell you about bad prospects for the industry and for this particular stock. There will be a lot of guys who

do not like this stock. A lot of people will hear these comments and selling pressure can accelerate.

The stock from panel C was a pure candidate for a long time. Everybody who knows about downtrends was out of this stock. Most of traders and investors like rising stocks. Our stock from panel C was out of the game. Nobody cared any longer about it.

Who is buying the stock from the panel C after sharp price drop? Why can the stock price rise in the next couple of days?

- **Short sellers will close their positions. They have nothing more to expect.**
- **Bottom fishers are ready to buy.**
- **The company will buy some shares back.**
- **The company becomes a target for acquisition.**

Do not worry about coming bad news. Let us show an example. Look at headline news about Osicom Technologies Inc. (FIBR). This news was released just before the stock jumped from 5 1/4 to 7 1/2 during intra-day activity.

PRN
04/23 13:06 Osicom Technologies Inc. Misled Investors About '$90 Million Contract', Pomerantz Lawsuit Alleges ...

BW
04/23 12:22 Stull, Stull & Brody Announces Class Periods for Class Action Complaints ...

PRN
04/23 10:02 Notice To Osicom Technologies Inc. Shareholders Who Purchased Securities From July 1, 1998 Through ...

PRN
04/23 09:58 Bernstein Liebhard & Lifshitz, LLP Commences Class Action on Behalf of Purchasers of Osicom Technologies,Inc....

BW
04/23 08:38 The Law Firm Of Abbey, Gardy & Squitieri, LLP Filed Class Action Against Osicom Technologies

BW
04/23 08:00 Osicom Technologies Comments on Current Status of Its Core Business Operations ...

However, it is still a risky game. More bad news can be released and the price will plummet even further. If the market is bad there is a little chance for fast recovery. Nevertheless, the risk of this game is smaller than for other strategies. This important fact will be discussed in detail later.

If you bought stock a after sharp drop - do not hold it for a long time. 3-4 days is enough to make a fast profit. After this period the stock becomes similar to other stocks. The probability of growth is diminishing and it is better to jump to other stocks with higher growth probabilities. This is the main idea of our trading strategies.

Chapter 2
Stock price time dependence

2.1 Market memory

In the textbooks you can read: the market has no memory and stock price changes are random. Generally, this is wrong. However, if you randomly pick some stock, then there is a small chance of finding a situation when the growth probability is much larger than 50%. Extraordinary events do not occur every day with any given stock. Our friends frequently ask us about some particular stocks. Usually, we have nothing to say. The computer shows 49 - 51% of growth probability for these stocks. It is really a random walk.

The situation is completely different if you analyze the whole market - thousands of stocks. In this case, you are able to find a group of stocks with high probabilities of strong upside or downside moves. Computer analysis showed that for some stocks the growth probability can be 66% or higher. The analysis is based on the stock price histories. So we can say: some stocks at some time have memory. The people who traded these stocks remember their actions, and the behavior of these people is predictable.

2.2 Trend and Volatility

Trend

Trend is a simple intuitive term. If a stock price is increasing one can say the trend of this stock is positive. If a stock is declining - the trend is negative. You can also say: a stock has momentum. This is standard terminology. In many books on technical analysis of the stock market you can read about momentum investments: buy stocks with the highest growth rates.

Do not do that for short-term trading. You can obtain the highest return if you do the opposite: buy stocks with the most negative trends.

We need to define trends mathematically. This is the only way to tell the computer how to find stocks with large negative trends. The simplest method is using the linear fit of stock price-time dependence.

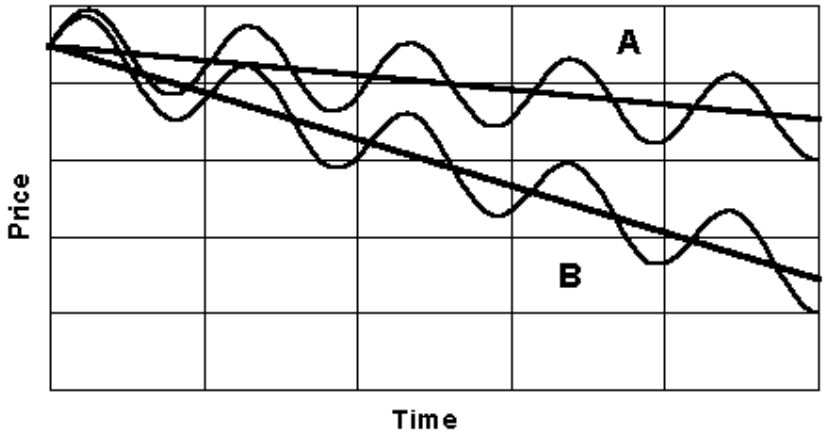
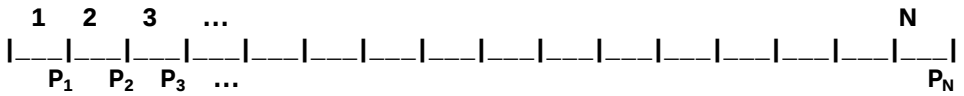


Figure 2.1 Different trends

Consider N trading days and draw the fitting line $L(i)$ through the points P_i, where P_i is the closing stock price on the i-th day.



The *N*-th day is the day of interest, the day of the analysis.

$$L(i) = A + Bi \qquad i = 1, 2, \ldots, N$$

The coefficient *B* is the slope of the fitting line. The slope can be considered as the price trend of the stock. It characterizes the average daily price change (in $) during *N* days. However, this value is not perfect when comparing trends of different stocks. The stock of Intel (INTC) can have *B* = 2 and the stock of Vivus (VVUS) can have *B* = 0.5 for certain periods of time. These numbers cannot be used to compare the trends of these stocks. This is because VVUS costs $5 and INTC costs $80. Relatively, VVUS has a larger trend than INTC.

We will define a trend as the average price change in % during one trading day. Mathematically this can be written as

$$\text{Trend} = T = \langle \Delta P / P \rangle * 100\%$$

This definition has one disadvantage. What price *P* should be used in this equation? Using the current stock price is not a good idea. In this case, trend will be very volatile. It is better to use a more stable price characteristic: the value of the linear fitting line on the day *# N* - the day of the analysis

$$P = A + B*N$$

The final equation for trend looks like

$$T = B / (A + B*N) * 100\%$$

This equation we used in our computer analysis of the stock market. Such a definition of trend substantially reduces the influence of price fluctuations during the final days. Figure 2.2 shows an example of trend calculations for a 16 day time frame.

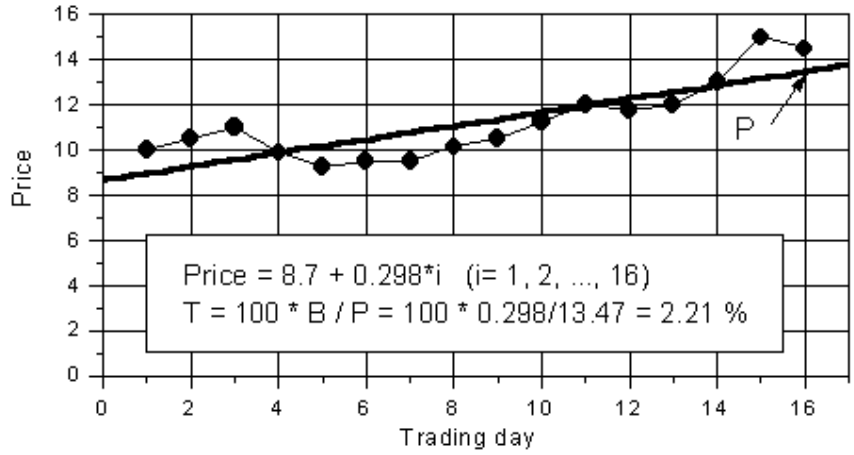


Figure 2.2 Example of stock trend calculations for a 16 day time frame.

Another way to define the trend is by using logarithmic scaling. This is a good idea if you study a stock's long history of price change, for example, from 1 to 100 dollars. For short-term trading this change is unrealistic and we will keep things as simple as possible. So, we will use simple linear fits, and trends are related to the slope of the fitting lines.

Volatility

Consider another important characteristic of stock time performance - the volatility. There are many different ways to determine this parameter. For our goal we need to relate this characteristic to the linear fitting line. One can define the volatility as the standard deviation of stock prices from the fitting line during some period of time.

$$\sigma^2 = \langle (P_i - A - Bi)^2 \rangle$$

where averaging is performed during *N* days.

So, when we talk about volatility we should mention how many days have been considered for averaging.

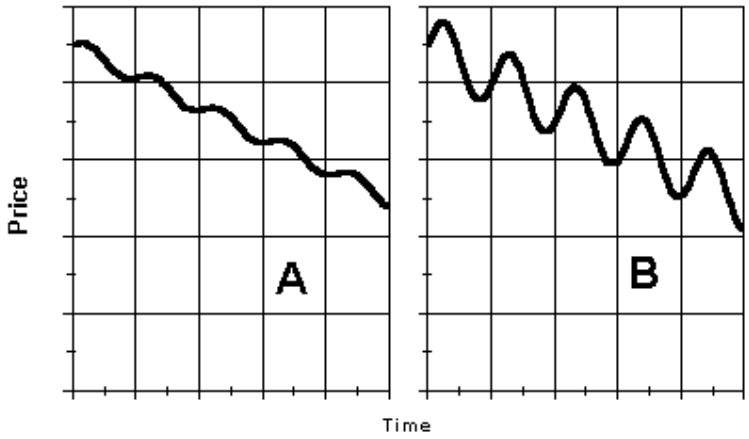


Figure 2.3 Different volatilities

There is a similar relativity problem in the definition of volatility. One should divide σ by the current stock price characteristic to be able to compare volatilities of different stocks. Similarly, as we did for trend, we define volatility *V* as the ratio of σ to the value of the linear fitting line on the day of the analysis

$$V = \sigma / P$$

where *P = A + B*N.*

The higher the stock volatility, the higher the trading return and the higher the risk. You should always remember this important fact when you select stocks for trading.

Deviation (D-parameter)

The deviation or D-parameter, which will be defined here, is crucial for short-term stock trading. Briefly, this is a characteristic of deviation of the current stock price from the fitting line. This characteristic is important for the definition of oversold or overbought stocks.

A simplest idea of the definition of overbought and oversold stocks is the location of the stock closing price relative to the trading range. We assume that when the stock price is in the trading range, the stock performance is normal. If the price is out of this range, the stock may be oversold or overbought.

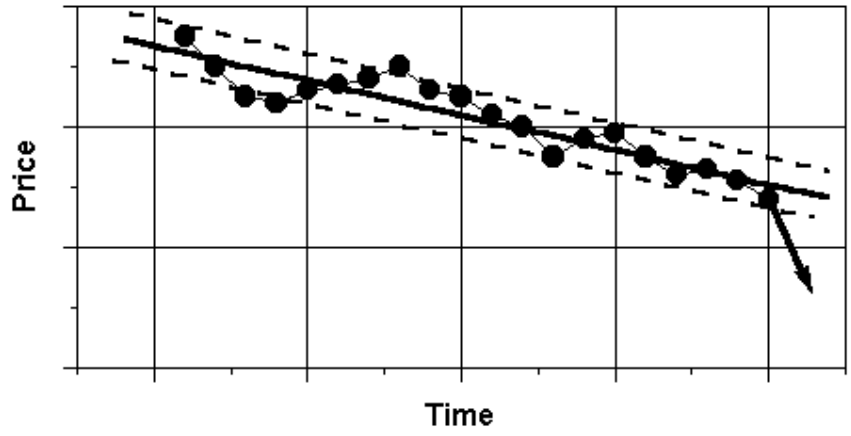


Figure 2.4 Illustration for the definition of D-parameter

We define trading range as a channel between support and resistance lines. Usually, these lines are determined intuitively from the stock price charts. This is not a good way if you

use the computer to analyze stock price performance. The line drawing depends on the trader's skill and this method can be used only for representation of stock performance in the past. Some traders use minimal and maximal prices to draw the support and resistance lines, others like closing prices. There is a problem of what to do with points which are far away from the trading channel, etc.

We suggest using the standard deviation σ ($\sigma^2 = <(P_i - A - Bi)^2>$) for the definition of the support and resistance lines. Mathematically this can be written as

$$\text{Support line} = A + Bi - \sigma$$
$$\text{Resistance line} = A + Bi + \sigma$$

where $A + Bi$ is the equation of the linear fitting stock price time dependence; i is the day number.

One should notice that the definition of the support and resistance lines depends on the number of trading days being considered. You should always indicate what time frame has been used. This important question will be analyzed in the next section.

To characterize the deviation of the stock closing price from the fitting line we have introduced a new stock price characteristic: - deviation, or D-parameter.

$$D = (P_N - A - BN) / \sigma$$

where N is the number of days which were used for linear fitting, P_N is the closing stock price on the day #N (the day of the analysis) A and B are the linear fitting parameters, and σ is the standard deviation of closing prices from the fitting line.

Let us explain the meaning of this equation. The difference ($P_N - A - BN$) is the deviation of the current stock price from the fitting line. D-parameter shows the value of this deviation in σ units. One can say

$D < -1$ **the stock may be oversold**
$D > +1$ **the stock may be overbought**

the words "oversold" and "overbought" should be used together with the number of trading days considered. So it more precise to say: the stock is oversold in the 30 day time frame.

We have now introduced some definitions. What about the practical use of these ideas? Are stocks really oversold or overbought if their prices are out of the trading channel? There should be some "forces" which attract the stock price back to the trading channel. These problems will be considered in the next chapters. Here, we should consider more methods of describing stock price time dependence so that we may be ready to better understand the results of computer analysis.

2.3 Time Scales

Suppose you found some stock which looks oversold on a monthly time scale. However, on a weekly time scale the stock price is close to the resistance line. Would you buy this stock for short-term trading? If you want to lose your money - buy! A good stock for trading should be oversold in many different time scales.

Which time scales (or the number of days in history N) should be considered for short-term trading? Short-term we define as 1 - 5 days. It is obvious that a period of one year is not interesting. Trades have already forgotten what happened a year ago. We will use the following time scales:

$N = 4$
$N = 8$
$N = 16$
$N = 32$

Computer analysis has shown that this is enough. Very little correlation between stock price moves and deviation D and trends T for longer time scales has been found. We will use the following notations for corresponding D and T

D_4, T_4
D_8, T_8
D_{16}, T_{16}
D_{32}, T_{32}

The volatility *V* will always be calculated over a 32 day period. This value is rather stable and reflects the last 1.5 month of stock price history.

$$V = \sigma_{32} / P$$

The parameters *D* and *T* for different time scales are not independent. If D_4 is large then D_8 will be larger than the average value. This is also true for *T* parameters. Large values of short period trends give larger values for longer trends. Later we will show correlation of different parameters.

The correlation of *D* and *T* is the reason why we do not consider parameters for continuous time scales like *N* = 4, 5, 6, and so on. The smaller time scales (*N* = 2 or *N* = 3) are not good for calculating fitting lines. However, the last day price change can be important, and we will consider this price change in the analysis of different trading strategies.

2.4 Correlation

Correlation is an important concept in statistics. It describes the relationship between two random variables. Quantitative description of correlation can be done by using the correlation coefficient *c*. For two random variables *X* and *Y* the correlation coefficient can be calculated as

$$c = \langle (X - X_o)(Y - Y_o) \rangle / (\sigma_X \sigma_Y)$$

where X_o and Y_o are the average values of *X* and *Y* ; σ_X and σ_Y are the standard deviations of these variables. The angular brackets denote averaging.

The correlation coefficients vary from -1 to +1. For positive *c* one can say that the variables *X* and *Y* are correlated or positively correlated. For negative *c* one can say that the variables *X* and *Y* are anticorrelated or negatively correlated. Positive correlation means that a change in the value of *X* causes a change in the value of *Y* in the same direction.

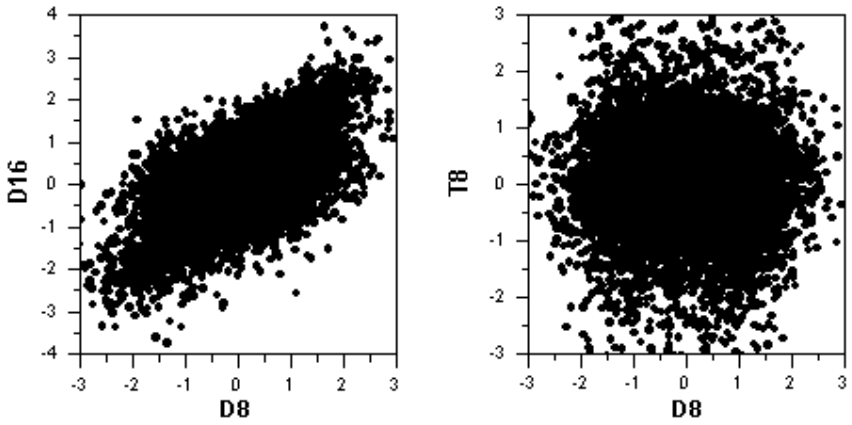


Figure 2.5 D8 - D16 and D8 - T8 correlation's

In the previous section we mentioned that trends *T* and deviations *D* for different time scales are correlated. Now we can present the values of the corresponding correlation coefficients. Figure 2.5 shows the correlation between D_8 and D_{16}. Data are collected for the period 1995 - 1999 for actively traded US stocks with prices > $10. One can see a strong correlation between these variables (*c* = 0.66). Fig. 2.5 shows little correlation between D_8 and T_8 parameters. The correlation coefficient in this case is equal to -0.03.

These observations give us the idea of using the two parameters *T* and *D* together to study the relationship between (T, D) pairs and trading returns.
Now we are ready to understand the concept of T-D mapping, which will be considered in the next section.

2.5 T-D Mapping

We have shown that trends *T* and deviations *D*, even for same time scale, are uncorrelated. So, they can be used as independent variables, and we will study different functions of these variables. For example:

$$\text{Return} = f_1(T, D)$$
$$\text{Risk} = f_2(T, D)$$
$$\text{Probability of Positive Returns} = f_3(T, D)$$

and so on. The simplest way to study these functions is to collect statistics and plot these functions as three dimensional graphs.

If the deviation parameter of some stock *D* < -1 it means the stock may be oversold, because its price is well below the fitting line for some time scale. This is not so clear for using trends *T*.

If *T* < -1 it may not indicate that we have a stock with a very negative trend. The market may drop during the time under consideration and most stocks will have a very negative *T*. We must use the difference *T* - <*T*>, where <*T*> is the average value for all stocks. The difference *T* - <*T*> should be divided by the standard deviation σ_T of the distribution of the stock trends for the day of analysis. So, here and further *T* means:

$$T \text{ ----> } (T - \langle T \rangle) / \sigma_T$$

To keep things similar, the same idea can be applied to the deviation parameters.

$$D \text{ ----> } (D - \langle D \rangle) / \sigma_D$$

In Chapter 1 we mentioned that the stock may be oversold if its price trend is negative and its price has sharply declined on some day. One can expect that the stock is oversold in some time frame if

$$T < -1 \quad \text{and} \quad D < -1$$

One can also expect that the stock is overbought in some time frame if

$$T > 1 \quad \text{and} \quad D > 1$$

How can we relate the future behavior of stock price with the D and T parameters? For example, considering some stock for which we found that T = -0.6 and D = +0.9. Is the stock bullish or bearish?

To elaborate this problem we performed a computer statistical analysis. Statistical data are limited. The stock market is changing and there is no sense in collecting stock histories over 20 or 30 years. The period of the last 3 - 5 years is optimal. In this case, we can collect about 1 million events to analyze.

A straightforward way to analyze the dependence of stock price move ΔP on the D, T parameters is to find a function

$$\Delta P = f(D,T)$$

Unfortunately, this is a very complicated way. The function is not linear and available statistical data are not sufficient to find the function parameters with good accuracy.

We used a different way. The plane D, T was divided into 16 cells as shown in Figure 2.6.

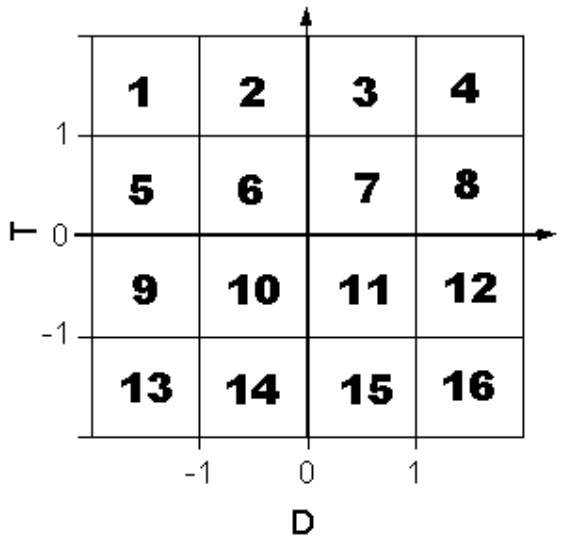


Figure 2.6 Definition of the T-D map

Cell #1 corresponds to
Cell #1 $T > 1$ and $D < -1$
Cell #2 corresponds to
Cell #2 $T > 1$ and $-1 < D < 0$

and so on. This division allows us to obtain good statistical data (10,000 - 100,000) for every cell. Using these data one can calculate the average stock return depending on the cell number.

The T-D map is always related to some time frame for which the *T* and *D* parameters were calculated. The most crucial cells are cells # 4 and #13. One can expect that these cells correspond to overbought and oversold stocks. For example, if the trend of some stock is very negative ($T < -1$) and the deviation of stock price from the fitting line is also very negative ($D < -1$) it indicates sharp price drop and the stock may be oversold in the time scale corresponding to the T-D map.

To do things more clearly let us show a graph representation of the T-D map.

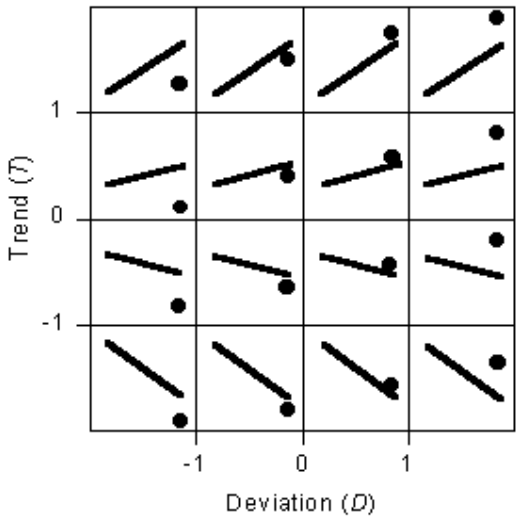


Figure 2.7 Graphical interpretation of the T-D map

In this figure the slopes of the lines represent trends (*T*) and the dot positions represent deviations (*D*).

We have developed a general theory of using T-D maps for stock price move prediction. The theory is rather complicated and in these notes we will consider only a few practical

questions which are related to the simple trading strategies. In the next chapter we will show using T-D maps for the prediction of the market indexes.

Chapter 3
Market statistics

3.1 Basic Definitions

Every day after the market closing the trader should start his or her market analysis. The goal of this analysis is the list of stocks to buy or sell tomorrow as well as the target prices for selling or buying. Let us call the day of analysis day #0. Tomorrow will be day #1 and so on.

DAY #0	DAY #1		DAY #2		DAY #3		DAY #4 ...	
CLO0	OPE1	CLO1	OPE2	CLO2	OPE3	CLO3	OPE4	CLO4

OPE1, CLO1, OPE2, CLO2, ... are the stock prices at market opening and market closing on the corresponding days. MAX1, MIN1, MAX2, MIN2, ... - are the maximal and minimal daily stock prices. These data you can obtain from many Internet services.

Usually, we will be interested in relative price change in %. In tables or in the text you will see equations like

$$\langle C3 - C1 \rangle = 3.3\%$$

this is a short notation of the full equation

$$100 \langle (CLO3 - CLO1)/CLO1 \rangle = 3.3$$

or O4-C1 is the same as

$$O4\text{-}C1 = 100 \langle (OPE4 - CLO1)/CLO1 \rangle$$

The angular brackets mean averaging over some group of stocks. What group? This will be additionally explained. These notations are very convenient to describe different trading strategies.

3.2 Dow Jones and others

Consider prediction of the price move for an individual stock or for a market index. We will analyze the market indexes, but all conclusions can be applied to individual stocks as well.

As an example, consider the Dow Jones Industrial Average (DJIA). We analyzed an eleven year history of this index. The first problem: how to define the average value of trends (*T*) and deviations (*D*)? The number of indexes is very limited and we cannot apply the methods described in Chapter 2, where we suggested comparing a selected stock with other stocks.

For calculation of the averages and standard deviations of D and T parameters one can use historical data of the index. We performed averaging over 252 previous days. The calculated averages are time dependent. This is not convenient for computer analysis, but it does reflect the market changes over the years.

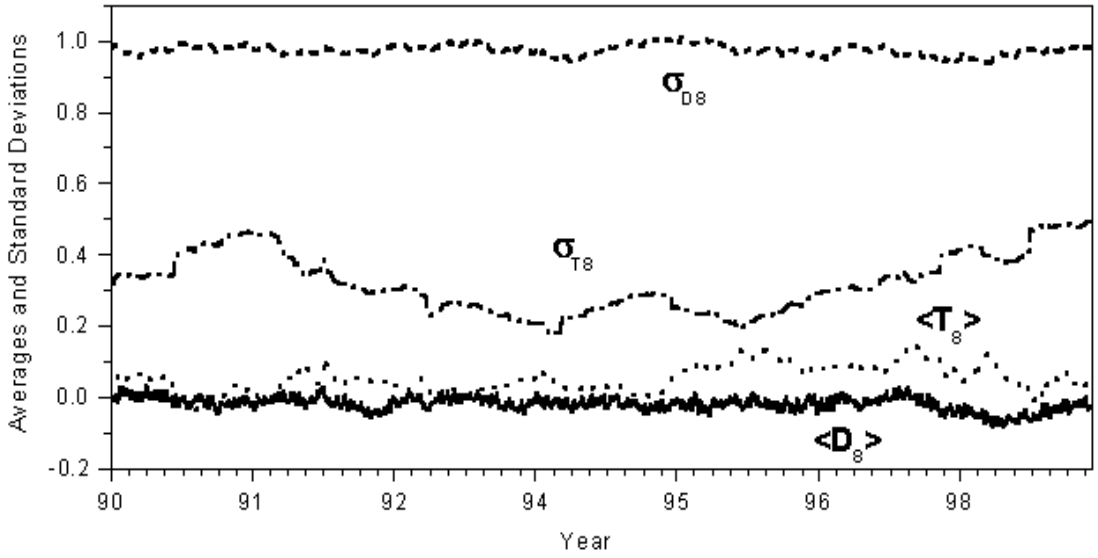


Figure 3.1 The averages (<*D*>, <*T*>) and standard deviations (σ_D, σ_T) of D8 and T8 parameters for the Dow Jones Industrial Average.

Figure 3.1 presents the time dependencies of the averages and standard deviations of the D_8 and T_8 parameters. You can see that these values fluctuate, but the amplitudes of these fluctuation are not large. The deviation parameters *D* are more stable than the trend parameters *T*.

To use the idea of T-D mapping to analyze the index price dependence one should consider the variables

$$(T - \langle T \rangle) / \sigma_T$$
$$(D - \langle D \rangle) / \sigma_D$$

and depending on the values of these variables determine the number of cells of the T-D map for every trading day. The cell number is different for different time scales. So, every day we can determine the T-D cell numbers of the index for 4, 8, 16, ... day frames. We performed the statistical analysis to calculated the growth probabilities depending on the cell numbers.

To eliminate the influence of large time scale market trends we calculated the averages of the index changes and calculated the probabilities of the index moves, which are larger than the average move. As an example, Figure 3.2 shows the probabilities of these moves of the DJIA depending on the cell number for a 32 day frame.

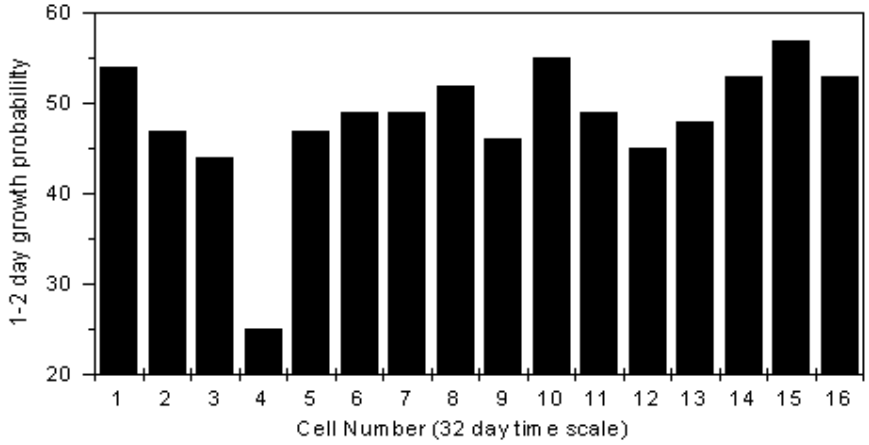


Figure 3.2 Growth probabilities versus D-T map (32 days) cell number for the DJIA

You can see that the lowest growth probability is observed when the index is in cell #4. This corresponds to the highest values of *D* and *T* parameters, i.e. overbought condition. The same idea can be used to calculate the growth probabilities for any index.

Attention! We want to repeat once again: prediction of one stock or index price move is not very reliable. It is based on the repetitive patterns. Statistical data for one index or stock (even for an 11 year history) is not large enough to make a sure conclusion. Using longer historical files is dangerous because of market changing. Consider these calculations only as an illustration of using T-D maps for prediction of stock or index price performance.

What can we do? Is it possible to predict the index performance and calculate the error of estimation? Yes, but you should always consider a group of stocks. The same calculations can be done for all 30 stocks in the Dow Jones Industrial Average. For every stock you can calculate the growth probability depending on the T-D map cell number. Using methods of statistical analysis the errors can be easily calculated.

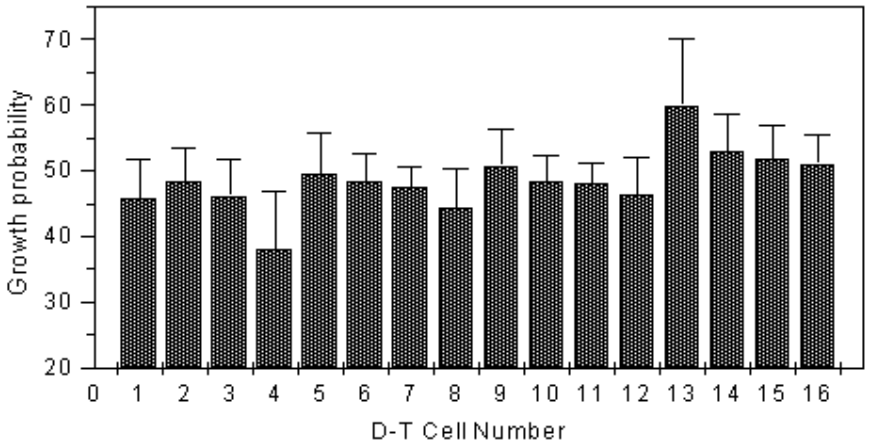


Figure 3.3 Two day growth probabilities versus D-T map (16 days) cell number for 30 companies from the DJIA.

Figure 3.3 presents these data. For the calculations, an eleven-year period of historical stock prices (1988 - 1998) has been used. You can see from this Figure that oversold and overbought stocks (cells #13 and #4) can be easily identified.
Using this approach for prediction of the DJIA performance will be discussed in the next section.

3.3 Short-Term Predictions

The idea of market index prediction is very simple. Let us explain it step-by-step. The Dow Jones Industrial Average will be considered as an example.
1. Take the long-term history files for each stock from the DJIA. Calculate the average values of *D* and *T* parameters for different time frames *N* = 4, 8, 16, 32, ...
2. Calculate the average 2 day returns of all stocks for every cell of the T-D map. The return can be calculated as $(CLO_2 - CLO_0)/CLO_0$.
3. For every day for which you need to predict the market determine the T-D cell number for all stocks from the index. The cell number will indicate the corresponding two day return of individual stock.
4. Calculate the sum of the returns multiplied by the stock price. This sum is the predicted index return.
5. The predicted index return depends on the T-D map time frame. This is why you should use many time frames (different *N*) for prediction. The smaller *N*, the more precisely the index return will be estimated for the period of 2 days.

Maybe this description is a bit complicated. Let us explain the main idea using "plain English".

What are these "mystic" T-D maps for? They simply indicate certain price patterns. The returns depend on these patterns. The computer analyzes the patterns in the past and uses them to predict the future.

The predicted index return we call growth parameter GP. Depending on the number of days which were used for patterns (T-D maps) we will use notations GP-4, GP-8 and so on.

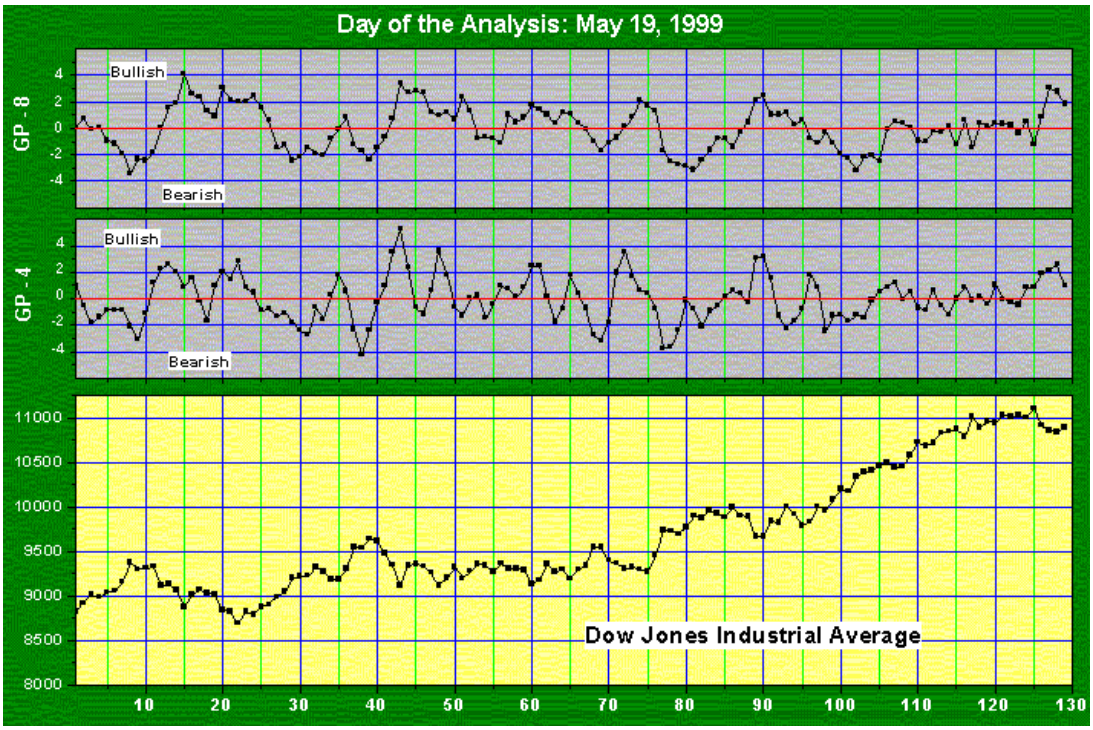


Figure 3.4 The Growth Parameters (GP-4 and GP-8) for 30 stocks of the DJIA. A period of 128 trading days has been considered.

Figure 3.4 shows the GP-4 and GP-8 parameters for 2-3 day index prediction of the DJIA. The period of 128 trading days ending May 19, 1999 has been considered. The higher the value of the GP parameters, the more bullish is the DJIA. The prediction is not bad and can be used for practical purposes: if you expect a bullish market then you can buy a greater number of shares. If you see a bearish signal, buy fewer shares or stay away. Wait for a while to have more profitable opportunities.

3.4 Average Stock and Average Investor

We do not like weighted market indexes - the sum of selected stock prices multiplied by the number of shares outstanding. Such indexes are good to estimate where the money goes, but for investors or traders it is much more important to know the average stock price change. You do not care about the number of shares outstanding when you reap the profit or take the loss.

The Dow Jones Industrial Average is calculated as the sum of the individual stock prices multiplied by some coefficient, and it well reflects the happiness of an average trader or investor. Nevertheless, market indexes such as the S&P 500 are extremely popular for estimating mutual fund performances and we should compare the performance of our trading strategies with this index as well.

We have performed a statistical analysis for all NYSE and NASDAQ stocks over the period from 1995 to 1999. Here, some important market statistics will be presented. We need these numbers to compare the performance of various trading strategies with the market averages. When thinking about short-term trading we will consider only active stocks. Let us clarify how we define active stocks.

Active Stocks

We consider only actively trading stocks. Trading volume on the day of analysis should be more than 200 000 shares. These stocks have enough liquidity, smaller bid-ask spread and afford the possibility to buy and sell stocks between bid and ask prices. The second condition: closing prices of selected stocks should be more than 10 dollars. Smaller stocks are extremely volatile and trading these stocks is very dangerous. The stocks should exist at least 32 previous days, so as to be able to calculate the deviations, trends and volatilities *D*, *T* and *V* for different time frames: *N* = 4, 8, 16, 32 days.

Computer analysis shows that every day one can find 1003 +/- 170 active stocks. It is important to note that the average daily return of these stocks is larger than daily return of the S&P 500 index. The daily returns have been calculated by comparing closing stock prices.

	S&P 500	Active Stocks
Average Daily Return	0.089 %	0.128% +/- 1.21 %

The daily returns of active stocks are high but these returns are not enough to make profits from short-term trading. The standard deviation (risk) of active stocks is very high, and we should develop stock selection systems to increase return and minimize risk.

More statistics for active stocks

It is interesting to note that active stock daily returns are not stable! Denote as usual CLO0 as a closing price on the day of analysis, CLO1 as the closing price on the next day, etc. We have calculated the average 1, 2, 3, 4 and 5 day returns of active stocks:

<CLO1 - CLO0> = 0.128% +/- 1.21 %
<CLO2 - CLO0> = 0.201% +/- 1.79 %
<CLO3 - CLO0> = 0.271% +/- 2.20 %
<CLO4 - CLO0> = 0.342% +/- 2.58 %
<CLO5 - CLO0> = 0.412% +/- 2.93 %

The values of <CLOm - CLO0> are very important because we have to develop methods of trading that beat these numbers. You can see that the average two day return <CLO2 - CLO0> for active stocks is less than 2 * <CLO1 - CLO0>. The daily return is decreasing with time! The next table is a good illustration of this statement.

<CLO1 - CLO0> = 0.128%
<CLO2 - CLO1> = 0.073%
<CLO3 - CLO2> = 0.070%
<CLO4 - CLO3> = 0.070%
<CLO5 - CLO4> = 0.070%

One can see that during the first day after analysis the price change is greater than normal (S&P 500 change) and for other days the price change is less. This is probably related to our active stock selection method. We have chosen stocks with a minimum trading volume as 200,000 shares on the day of analysis. This is abnormal activity for many stocks, and the large change of price on the first day after analysis is a reaction to this activity.

Conclusion: **If you select an active stock for trading and if its activity is not normal, do not hold the stock for a long time. There is a good chance that the stock will behave like a regular stock with an average market return. Take your profit early, while stock is still active.**

Chapter 4
Oversold Stocks

4.1 Bottom fishing and theory of probability

Let us remind you of some old market "axioms". They were taken from the classic book "The Stock Market" by R. Teweles, E. Bradley and T. Teweles.

1. **Avoid a too frequent switching.**
2. **The stock market has no past.**
3. **No one ever went broke taking profit.**
4. **Never buy a stock after a long decline.**

More axioms:

5. **Trend is your friend.**
6. **Never guess the bottom.**

Our axioms:

- **All market axioms should be statistically proven.**
- **Do not trust opinions. Trust the theory of probability.**

Our comments about old market axioms:

1. If you choose stocks with high growth probability, a frequent switching between these stocks can give a very good return.

2. The growth probability of some specially selected stocks can be very high. These stocks are selected from an analysis of the past. This means that some stocks have a past.

3. If you take tiny profits and large losses, you will go broke.

4. Buy stocks after a long decline if this decline is abnormally sharp.

5. Trend is your friend for a short time. It is better to anticipate the turning point.

6. Never guess the bottom. Rather rely on computer methods of bottom prediction. Be an equipped bottom fisher. Your tool is the theory of probability.

So, we are breaking six market axioms. This is a serious statement. It should be proven by statistical analysis. Let us show how we can do that. We will start with a simplest case: oversold stocks.

4.2 Stock Selection System

In this section we will outline our stock selection approach. Some ideas have been briefly described previously. Here, we will repeat the basics of our stock selection method and consider more important details.

The main idea is very simple: the stocks should be oversold. Buy low - sell high. This axiom still works. The only question is: how can we define these "lows" and "highs"?

Previously, we defined oversold stocks as stocks with a deviation parameter of D < -1. From the results of Chapter 2 you can figure out that in the case when D < -1, the stock price should be lower than the support level of the trading range.

This contradicts a widely held opinion: breaking down the support level is a bearish signal. The key point in our method is the analysis of trends T as we described them in Chapter 2. For oversold stock the trend should be negative. The more negative the stock price trend, the more oversold this stock.

It is mathematically clear how to define oversold stocks by using the deviation parameter D. The trend analysis is more complicated. When we analyze historical data for one stock we can calculate the average short-term trend Tav and its standard deviation sT. So, for a given stock one can define the oversold condition as:

$$D < -1$$

$$T < Tav - sT$$

This approach is good when you analyze one stock. However, we can suggest a much better idea about how to define an oversold stock in the case when we are trying to find such stock on some particular day among many other stocks. Mathematically, it is more complicated but this definition is very effective.

First of all, we should take into account the market performance during the few last days. Let us illustrate this idea by a simple example.

Suppose that during the last 16 days the market has sharply declined. The standard deviation of the trend T for the stock XYZ is 3%. During this period the trend of XYZ is lower than 3% than its average and its deviation parameter D < -1. Should we consider XYZ as oversold?

This stock is oversold if we use the equations shown above. However, you will get hundreds of oversold stocks if you use this definition. Practically, it is not useful. What to do? You should consider the average trends T for all stocks and compare the trend of your stock with the averages.

Considering all stocks is a worthless idea. Some stocks have so little activities that taking them into account would distort the real situation. We suggest considering only active stocks, as we did in the previous chapter.

1. Trading volume on the day of analysis is more than 200,000.

2. The closing price is more than $10.

3. Stocks should have at least a 32 day trading history before the day of analysis.

Active stocks make the market. Every stock should be compared with other active stocks. We should calculate the average trend for all active stocks and the standard deviation of the distribution of these trends to compare with given stock trends. In such a manner, we are considering the stock together with the market. We can use the equations on this page to define oversold stocks but remember that the average trend Tav and the standard deviation sT should be calculated for all active stocks. So, to calculate the average trend one can use the equation:

$$Tav = (T1 + T2 + T3 + \ldots + Tn)/n$$

where n is the number of active stocks on the day of analysis; Tk are the trends of stocks. The standard deviation sT is the characteristic of distribution of Tk.

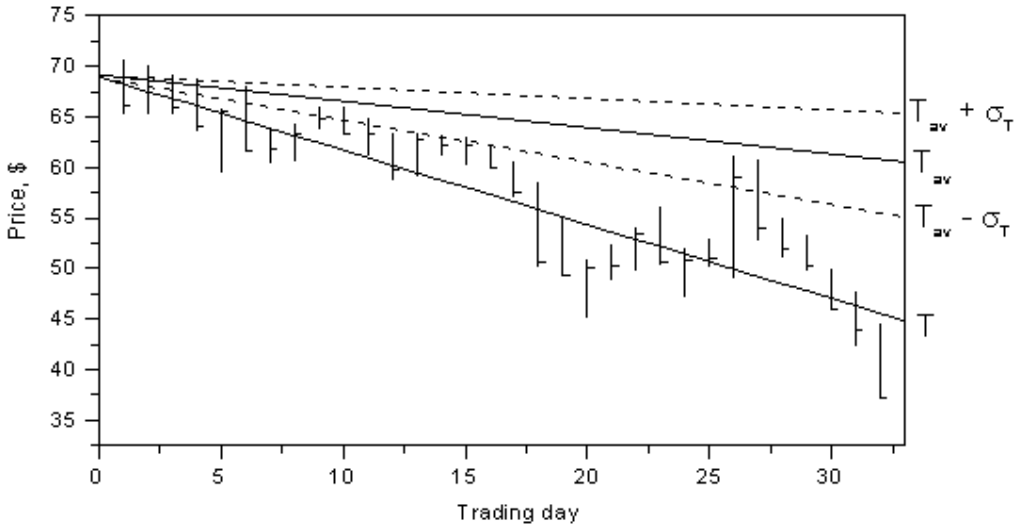


Figure 4.1 Comparison of the stock trend T with the average value Tav for active stocks.

The trends T and deviations D depend on the time frame. Stocks can be oversold in a 128 day frame and overbought in a 4 day frame. If you want to buy stocks and sell them in 2 - 5 days you do not need to consider a one year time period. We have performed the 11 year history analysis of 250 stocks from the S&P 500 index and found a very little correlation between short-term returns and deviation D and trend T parameters for 128 and more days. The optimum time frames are 16 - 32 days. Stocks which are oversold in these time frames give the maximal expected returns if only one time frame is considered.

For more detailed analysis one should consider two time frames. In Chapter 2 we have shown that D and T parameters for different time intervals are correlated. The smaller the difference between time frames, the smaller the difference between (D, T) prediction potential of stock performance. So, consideration of 16 and 32 day frames gives very similar results.

If we have a 32 day frame as a basic we should consider much smaller periods of time. 4 days is the minimal interval for which the deviation D and trend T parameters can be calculated (see Chapter 2 for details). Computer analysis shows that stocks have very good growth potential if they are oversold in both 4 and 32 day frames.

In order to sort stocks by their growth potential we introduced the sorting parameter:

$$\text{Sorting parameter} = (T/sT)32 + D32 + (T/sT)4 + D4$$

The smaller the value of the sorting parameter, the larger the growth potential of the stock. This is a method of sorting stocks in our daily list of potentially bullish stocks.

The most bullish stocks are located in T-D cell #13 (see Chapters 2 and 3) for 32 and 4 day time frames. Let us remind you: a stock is in cell #13 when its trend and deviation are very negative. On a graph you can see an accelerated drop of the stock price. Such stocks are very oversold.

There is a problem related to real trading. If you perform your analysis on day #0 after market closing and find some bullish stocks, then there is a good chance to see an overnight price gap for these stocks. For short-term trading this means you will have nothing to buy in the morning. Your profit is gone. How can one overcome this problem?

You can buy expensive services and before market closing perform a price screening for the whole market. After calculating the sorting parameters (SP) for all stocks you have to choose those with minimal SP. These stocks are very bullish.

We suggest using a cheaper method. Computer testing and our experience show that this method works very well. The idea is simple. You have to be prepared before market closing. You should have a list of potentially bullish stocks and before market closing check the prices of stocks from this list. If you find stocks which are oversold in 32 and 4 day frames - these stocks are potential winners. There is a good chance for these stocks to open with an upside gap and go up further.

How can you know that stocks are oversold in both time frames by the end of the trading day without performing calculations? Here, the theory of probability starts working. You should select stocks which are oversold in 16 - 32 day time frames (using our language, they are in T-D cell #13 in these frames). The stocks may be not oversold in shorter time frames. This is why we regard these stocks as potentially bullish stocks.

Our goal is to be prepared for the next day. The stocks from the list will or will not be bullish at the end of the next trading day (day #1) depending on price performance during day #1. If the prices of listed stocks fall during the next day the stocks will still be oversold in the 16 - 32 day frames.

If the price drop is between 5 and 10%, the probability is very high that the stock will be oversold in a 4 day frame. So, it is highly possible that the stock will be oversold in both time frames and that it is very bullish. You can buy this stock before market closing and you are ready to catch the overnight upside price gap.

We will call the stocks from the list of potentially bullish stocks as oversold stocks if their prices drop during the next trading day.

You can ask: why don't we consider only stocks which are oversold in 32 and 4 day frames on the day of the analysis? If they drop further during the next day they will be "superoversold" stocks.

It is not a bad idea if you want to be placed in the Guinness Book of World Records to set a record average return per one trade. If your goal to make a good annual return, however you should think in a different way.

The probability of finding "superoversold" stocks is very low. Most of these stocks go up during the next day and they will not be oversold at the end of day #1. Week after week you will have nothing to buy. Your annual return will be small if you trade only such "superoversold" stocks. In the next section we will show some statistical data to illustrate this statement.

So, we have to balance between the number of stocks in the list and the quality of these stocks.

The last trick involves stock price performance during the day of analysis. The stock price drop during the day of analysis increases the growth probability of this stock. The daily number of stocks which are oversold in a 16-32 day frame is relatively large and we can leave in the list only stocks which declined during the day of analysis. This additional condition slightly reduces the list of potentially bullish stocks but increases the average growth probability of the stocks from the list.

This selection method was obtained from our computer analysis. We will continue our work, and if we find a more efficient way of stock selection it will be published. We have presented the general idea of finding potentially bullish stocks. Even non-professional traders can use this approach, which seems to be a profitable one.

4.3 Statistics for Oversold Stocks

Let's remind ourselves of some definitions introduced in the previous sections.

Active stocks - these are the stocks with trading volumes on the day of analysis of more than 200,000, with closing prices of more than $10 and with at least a 32 day trading history before the day of analysis.

Potentially bullish stocks - active stocks which are located in DT cell #13 in the 16 or 32 day frame. They are oversold in these frames. In this section we will not consider the condition that stocks should decline during the day of analysis.

Oversold stocks - these are the stocks from the list of potentially bullish stocks and their prices dropped during the next trading day, i.e. closing price CLO1 on day #1 is less than the closing price CLO0 on day #0: CLO1 < CLO0.

Now we should consider some statistics to prove our statement that "potentially bullish stocks" really are bullish. First of all, we need to mention that the number of potentially bullish stocks is about 2.3% of active stocks. On average, you can find 23 +/- 11 stocks per day.

We calculated the average price change for 1, 2, 3, 4, and 5 days as well as the risk to return ratios for active and potentially bullish stocks. The results are presented in Table 4.1.

Table 4.1 Average price change (returns) for active and potentially bullish stocks. Risk to return ratios are shown in parenthesis.

Price change	Active stocks	Potentially bullish stocks
<CLO1 - CLO0>	0.13 % (9.3)	0.62% (9.2)
<CLO2 - CLO0>	0.20 % (9.0)	1.14% (6.7)
<CLO3 - CLO0>	0.27 % (8.1)	1.38% (6.6)
<CLO4 - CLO0>	0.34 % (7.6)	1.55% (5.9)
<CLO5 - CLO0>	0.41 % (7.1)	1.73% (6.3)

One can see that average returns for potentially bullish stocks are 4 - 5 times larger than for active stocks. Risk to return ratios for potentially bullish stocks are less than the ratios for active stocks. However, risk of trading is still high and let us show the methods of stock selections which allow us to reduce trading risk.

The simplest risk reduction method is trading only oversold stocks. Remember, these stocks appear only at the end of day #1 (next day after the analysis).

You are able to buy these stocks at price CLO1. So, we can consider only the price change between day #1 and day #2, #3, ...

Table 4.2 represents some statistical data. We have considered stocks with various levels of price drops during day #1. Let us repeat again: potentially bullish stocks have no restrictions for closing prices CLO1 and CLO0. In this table, for simplicity, we are using C0, C1 , .. notations instead of CLO0, CLO1, ...

Table 4.2 Average price change per day in % for all potentially bullish stocks and for oversold stocks (C0 < C1) with various levels of price drop during trading day #1.

	Potentially Bullish Stocks	C1 < C0	C1 < 0.95C0	C1 < 0.9C0
$<N_{st}$/day>	23.1	9.71	2.36	0.65
C2 - C1	0.53 (10)	0.56 (10)	1.53 (5.3)	2.63 (3.9)
C3 - C2	0.26 (20)	0.51 (11)	1.24 (5.8)	2.03 (3.8)
C4 - C3	0.19 (26)	0.38 (14)	0.56 (12)	0.27 (27)
C5 - C4	0.21 (23)	0.32 (16)	0.21 (30)	0.44 (14)

Risk to Return ratios are shown in parenthesis. $<N_{st}$ /day> is the average number of stocks which were observed per day.

You can see that oversold stocks with a price drops of more than 5% and 10% on day #1 give excellent returns during the first two days of trading (days #2 and #3). The risk to return ratio for oversold stocks with a price drop more than 10% is remarkably low. During the first two days after the day of purchase (day #1) this ratio is less than a half of that for all potentially bullish stocks! This is why we called a trading strategy with selection of such stocks low risk strategy.

The only disadvantage of applying a low risk strategy is the fact that these stocks are rare. The average number of such stocks per day $<N_{st}$ /day> = 0.65, i.e. you are able to find such a stock only once during two trading days. So, if you choose the strategy to buy and sell only stocks with C1 < 0.9C0, you'll have relatively few trading opportunities and your annual return can suffer.

In the next chapters we will analyze various trading strategies in detail. Here, let's outline some problems related to the trading strategy optimizations. Stock selection is one of these problems. The second problem is the time of stock holding. You buy stocks at market closing on day #1. When should you sell these stocks to obtain maximum return with minimum risk?

A simple idea is to wait until daily price changing become normal, i.e. close to the daily price change of all active stocks. From the data presented in Table 4.3.2 you can see that for a

larger drop of stock price the predicted return is higher. The closing price change between succeeding days for oversold stocks is larger than "normal" (about 0.1%) even for the 5-th day.

You can say that a good strategy is very simple: buy such stocks and hold them for a time period longer than 5 days, since average daily growth is larger than return of the market.

Yes, you are right. This is not a bad strategy if you are thinking about getting the maximum from one trade. But your annual return can suffer in this case, because daily price growth decreases with time. You might be better off switching to other stocks. Then you can catch the larger price moves, which occur during the first days after analysis. Later we will consider this problem in detail.

It may be interesting to consider the probabilities of daily growth. In other words, we will calculate the probability of CLOm > CLOn. These data you can see in Table 4.3.

Table 4.3 Probability of stock price growth.

	Potentially Bullish Stocks	C1 < C0	C1 < 0.95C0	C1 < 0.9C0
C2 > C1	0.563	0.561	0.608	0.608
C3 > C2	0.539	0.561	0.594	0.610
C4 > C3	0.529	0.534	0.528	0.511
C5 > C4	0.534	0.544	0.527	0.532

The higher the price drop on day #1, the higher the probability of price growth during the following days. Note the decrease in probability between the second and the third lines of this table. It means the probability of growth on the forth day becomes significantly lower than that for the first two trading days.

It seems that we are ready to state a profitable trading strategy. No, we are not ready! We have to perform a more detailed analysis of stock performance during the days immediately following purchase. The most important questions are the overnight price moves and the maximal daily prices. This problem will be considered in the next section.

4.4 Overnight Moves

Let us recall some notations. OPE1 is the stock price at the market opening on day #1, the next day after the day of the analysis. OPE2 is the stock price at the market opening on day #2, etc.

<O2-C1> = <(OPE2 - CLO1)/CLO1> 100% is the return if you buy stock at the market closing on day #1 and sell it at the market opening on day #2.

Now we are ready to understand the results which are presented in Table 4.4.

Table 4.4 Average overnight price change in %

	Pot. Bullish Stocks	C1 < C0	C1 < 0.95C0	C1 < 0.9C0
<O2-C1>	0.54	0.50	0.85	1.06
<O3-C2>	0.49	0.59	1.20	2.10
<O4-C3>	0.41	0.53	0.90	1.11
<O5-C4>	0.39	0.48	0.67	1.11

The presented results show that overnight stock price moves can be very large. The more a stock is oversold, the larger the overnight move. For oversold stocks when C1 < 0.95C0 the overnight price moves are the largest during two first nights. So, do not sell stocks before market closing. The best time to sell is the morning.

For traders the relationship between closing price and the maximum price of the next day is important. This value can be used for planning limit orders for the next day of trading. You can also catch the maximum price by monitoring the stock for the whole trading day. This

monitoring is quite boring and nonprofessionals cannot watch the computer screen for the whole day. Nevertheless, we will show some numbers to have an idea of what you could get by doing this job. Let us introduce the notations:

$$Mn\text{-}Cm = 100\%(MAXn - CLOm)/CLOm$$

This value shows maximum stock gains on the n-th day with respect to closing on the m-th day. After averaging, we obtain:

Table 4.5 Maximum price gain during the trading day in %

	Potentially Bullish Stocks	C1 < C0	C1 < 0.95C0	C1 < 0.9C0
<M2-C1>	3.54	3.82	6.27	9.42
<M3-C2>	3.29	3.72	5.54	6.93
<M4-C3>	3.11	3.49	4.70	5.14
<M5-C4>	3.07	3.43	4.53	6.46

Some numbers look fantastic! You can obtain the biggest gain during day #2. But how can we guess the maximum during the trading day? What strategy can utilize these possible gains? These questions will be considered in Chapter 8.

In the next chapter the basic trading strategy will be considered. This is a strategy when you buy two potentially bullish stocks with the maximum price drop during day #1. The problems related to the risk and returns, transaction costs, and correlation with the market performance will be considered.

Chapter 5
Basic Trading Strategy

5.1 Statistical Analysis of the Basic Trading Strategy

Basic Trading Strategy

This strategy is very simple. Maybe it is not the best, but a simplicity and high profitability allow us to call this trading strategy the Basic Trading Strategy. Let's describe the general idea of this strategy.

1. We should prepare the list of potentially bullish stocks after market closing on day #0. These stocks are partially oversold in the 16 - 32 day time frames. The stocks from the list may not be oversold on the day of analysis for all possible time frames. We did not take into account the behavior of these stocks during the last 4 days. This is why we call these stocks potentially bullish stocks. You can find more details about stock selection method in Section 4.2.

2. Before market closing on day #1 one should check the prices of all stocks from the list and buy two stocks with maximal % price drop during day #1. Mathematically, this can be written as

$$CLO1/CLO0 \text{ -----> } minimal \qquad (*)$$

Note that in this strategy the stocks can rise during trading day #1. The only important thing in this case: their rises should be minimal among the stocks from the list. The equation (*) describes this statement.

3. During the next two days (#2 and #3) one should hold the stocks. At the market opening on day # 4 these stocks should be sold.

Trading Capital

We have performed computer analysis of this strategy and found a high profitability using this method. An important part of this strategy is dividing the trading capital between stocks.

Days #2 and #3 are the days of holding stocks which were bought on day #1. If we do not buy other stocks during these days we will lose possible profits. So as to be able to buy stocks every day the trading capital should be divided into three equal parts. Every part of the capital should be used to buy two stocks. Let's illustrate this idea graphically. A, B, and C are the part of the trading capital.

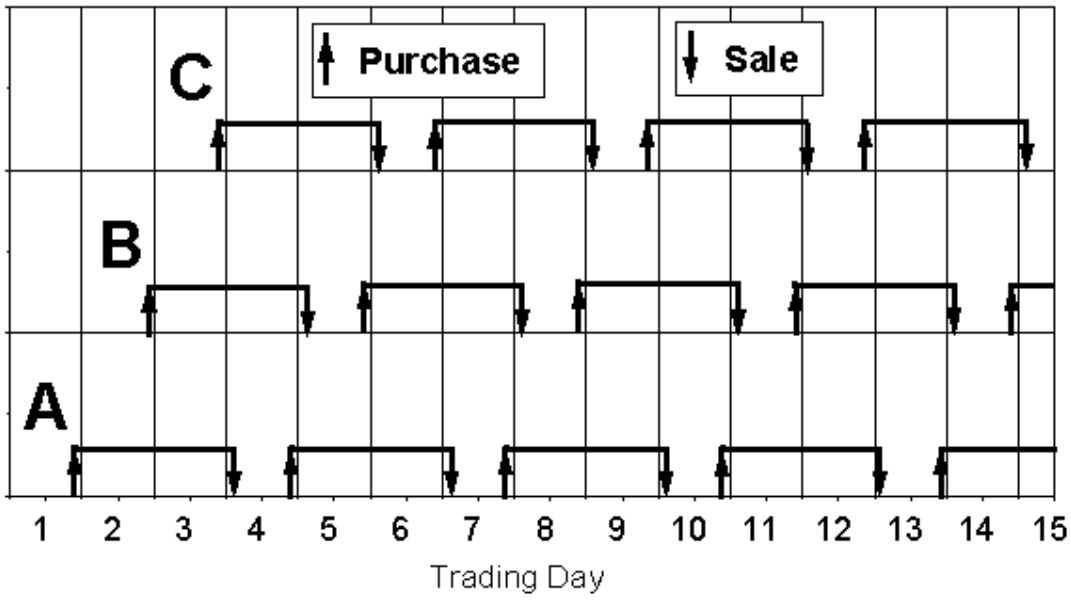


Figure 5.1 The time diagram for the Basic Trading Strategy

So, the sum

A + B + C = *Trading Capital* = *TC*

will be the current trading capital. At the beginning of trading, the current trading capital is equal to *Initial Trading Capital* and the parts A, B, and C are equal to,
A = B = C = (*Initial Trading Capital*)/3
Part A should be used on day #1 to buy two stocks. This part becomes A' on day #4 and should be used to buy new stocks. Correspondingly, part B should be used to buy stocks on day #2, #5, etc.

day #1	day #2	day #3	day #4	day #5	day#6
A	B	C	A'	B'	C'

The computer analysis has been performed for the case when each part (A, B, or C) was divided equally between two stocks.

So, if you buy two stocks which cost $20 and $30 and your available part of the capital (A, for example) is equal to $10 000, you should buy

5000 / 20 = 250 shares of the first stock and
5000 / 30 = 166 shares of the second stock.

So, you should use 1/6 part of your capital to buy one stock. To keep transaction costs small, the capital should be about $30 000 or more to use the advantages of this strategy.

The values of A, B, and C change with time. This difference can characterize the risk of the strategy.

Returns

Here we will show how to determine the average returns for the basic trading strategy. One can define many types of returns. Let's mention some of them.

Average Return per purchase:

This is an average return per daily two stock purchase. It can be calculated as

***Return per purchase* = 100 * <(X' - X)/X >**

where X' represents the sell prices of two stocks and X represents the cost prices of two stocks purchased. It should be noted that this is not a daily return, since the stock holding period is equal to 3 days.

Average Daily Return:

This return is related to the current trading capital *TC*. It can be estimated as

$$ADR = Average\ Daily\ Return = 100 * <(X' - X)/TC>$$

For estimation, one can suppose that the trading capital is approximately equal to 3*X. In this case, one can write a simple equation for the average daily return

$$ADR = Average\ Daily\ Return = (Return\ per\ purchase)/3$$

Note: This equation is approximate. It is valid only in the case of small daily returns (< 2%). The average daily returns are small for any strategy and one can use this equation as a good estimation of the returns.

Statistics

Let us show some statistical data for the basic trading strategy. The computer analysis was performed during the period from November, 1995 to May, 1999.

Number of trading days analyzed = 861
Average return per purchase (%) = 3.25 +/- 8.2
Risk/Return Ratio for return per purchase = 2.53
Average daily return (%) = 1.08 +/- 2.74
Probability of positive pure daily returns, % 67.8
Return (Risk/Return) for the first stock selected: 3.55 (3.28)
Return (Risk/Return) for the second stock selected: 2.94 (3.35)

One can see that return for the first stock selected is much higher than the return per purchase. However, the risk to return ratio when you buy two stocks every day is much lower. This is why the Basic Trading Strategy assumes buying two stocks every day.

5.2 Transaction cost and the Basic Trading Strategy

In the previous section all returns have been calculated assuming zero transaction cost. This is not realistic, even in the case of large trading capital when the brokerage commissions are relatively very small. We mentioned before that bid-ask spreads can substantially reduce trading returns. Traders try to catch small stock growth and even 0.5% of transaction cost can kill a bad trading strategy.

The transaction cost will be considered in % of the part of capital for daily stock purchasing. We will calculate an expected annual return (*EAR*) as a function of the transaction cost. One can write a simple equation which is related *EAR* to the average daily return (*DR*)

$$EAR = [(ADR - TC/3)/100 + 1) \wedge 252$$

Here, *TC* is the transaction cost in %. It was supposed that there are 252 trading days per year. We divided transaction cost by 3 because we calculate *TC* as a percentage of the part of the trading capital using for daily stock purchasing.

The Figure 5.2 shows the dependence of the expected annual return on the transaction cost. The average daily return was taken as 1.08 %, as we found in the previous section.

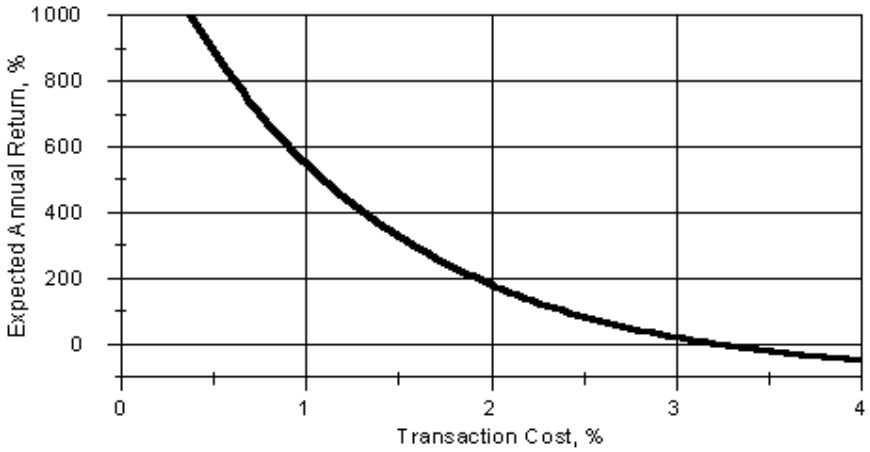


Figure 5.2 Expected Annual Return as a function of the transaction cost. The average daily return is equal to 1.08%.

From Figure 5.2 one can see that a transaction cost of more than 3% renders the annual return of the Basic Trading Strategy close to zero. Higher transaction costs make annual returns even negative. This is why it is necessary to chose stocks with small bid-ask spreads and to use brokerage firms with minimal commissions.

5.3 How dangerous is this game?

We described risk as the standard deviation of the set of returns. For mathematicians this definition is clear. However, it would be better to present another interpretation of risk. For traders it is very important to know what is the probability of large price drops for selected stocks.

Consider the Basic Trading Strategy. What is the probability for selected stocks to fall -30%? Or -20%? The next table shows some results of computer analysis.

Probability of price decline more than -30%	**0.46%**
Probability of price decline more than -20%	**1.39%**
Probability of price decline more than -10%	**4.18%**
Probability of price growth more than 30%	**1.10%**
Probability of price growth more than 20%	**3.72%**
Probability of price growth more than 10%	**14.6%**

So, the probabilities of large price drops are about 3 times less than probabilities of large price growth. It is worth showing this result graphically.

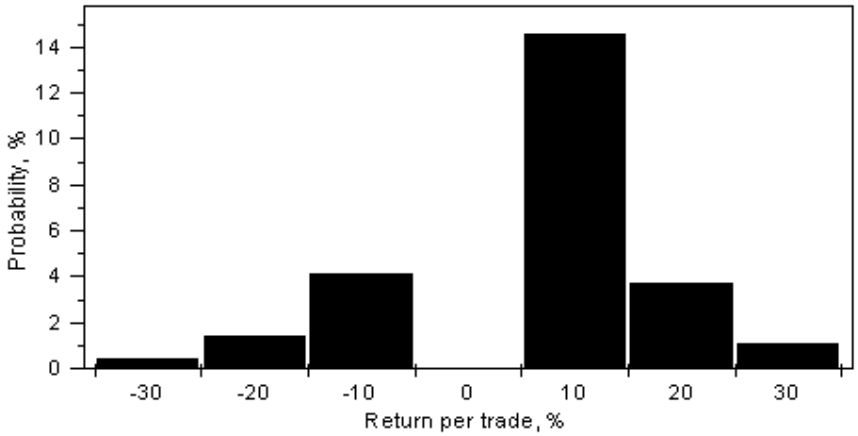


Figure 5.3 The probabilities of large price drops and growth for selected stocks for the Basic Trading Strategy. Statistical data for 1995 - 1999.

Attention! The probability of large price drops for selected stocks is small, but it is not equal to zero. To avoid a large decline of your trading capital - diversify!

5.4 Correlation with the market

How does the Basic Trading Strategy work when market is falling? Not so good, not so bad. Let's illustrate this by some examples.

We performed calculations of returns per purchase and changes in the S&P 500 index (OPE4 - CLO1) for 1995 - 1999 period. Figure 5.4 shows the correlation of return per purchase and the change in the S&P 500 index during the same period of time.

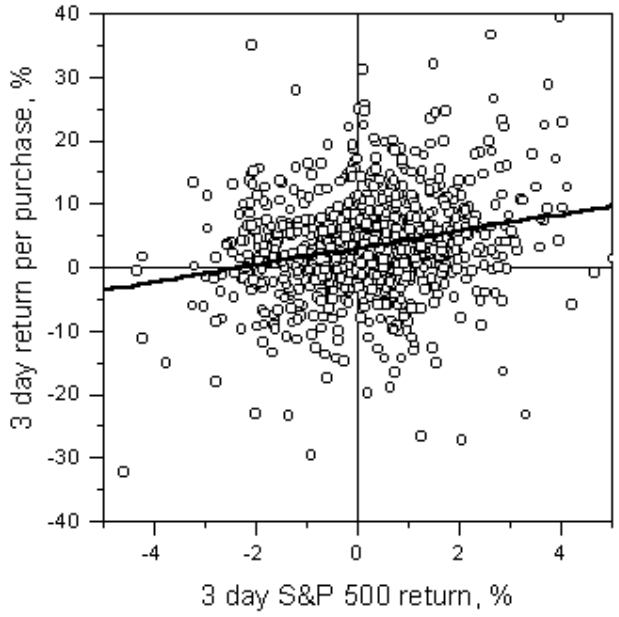


Figure 5.4 The return per purchase for the Basic Trading Strategy depending on the change in the S&P 500 index.

The straight line is the result of linear fitting. One can see that the average return per purchase becomes negative when the change in the S&P 500 index is very negative (less than -2%). The correlation coefficient is equal to 0.245.

The correlation is relatively small, but you can not expect a large profit when the market is falling. So, if you think the market is overbought - stay away or do not buy large number of shares. The risk of losing money is very high.

Chapter 6
Lower Risk Strategies

6.1 Stock are oversold - how much?

In the previous chapter you read about the Basic Trading Strategy. We like this strategy, but there are many people who cannot affort the risk related to this trading method. During the Fall of 1998 the trading portfolio for this strategy dropped about 50%! There was a nice recovery during next two quarters, but a 50% drop can repel many traders. It is hard to trust a strategy which allows such swings. Many people would give up trading stocks after such a terrible quarter.

There are many trading strategies with much lower risk. The main idea of these strategies is trading our selected potentially bullish stocks. The differences between strategies lie in the methods of stock selection at the market closing on day #1, i.e. on the next day after the analysis.

To reduce risk one should be very selective choosing stocks to buy. The simplest idea is to buy stocks with some level of price drop during day #1. In the Basic Trading Strategy one buys stocks with maximum price decline during the day #1. Sometimes the maximum price drop is not large. Usually this is an indication of strong market growth during day #1. You can avoid buying stocks if they do not decline significantly. For example, you can consider only stocks with a price decline of more than 5 or 10%. This method can be illustrated by the following scheme.

Table 6.1 Low risk trading strategies

1. Before market closing on the next day after the analysis check the stocks in the potentially bullish stock list.
2. Find two stocks with maximum price (in %) decline during day #1, i.e., the ratio CLO1/CLO0 should be minimal.
3. If the price decline of *both* stocks is more than 10%, buy these stocks. Percentage of decline we will call the level of selection.
4. Hold these stocks for two days.
5. Sell the stocks at the market opening on day #4.

The average profit from one purchase can be very substantial. The Figure 6.1 illustrates the average price change for various levels of selections.

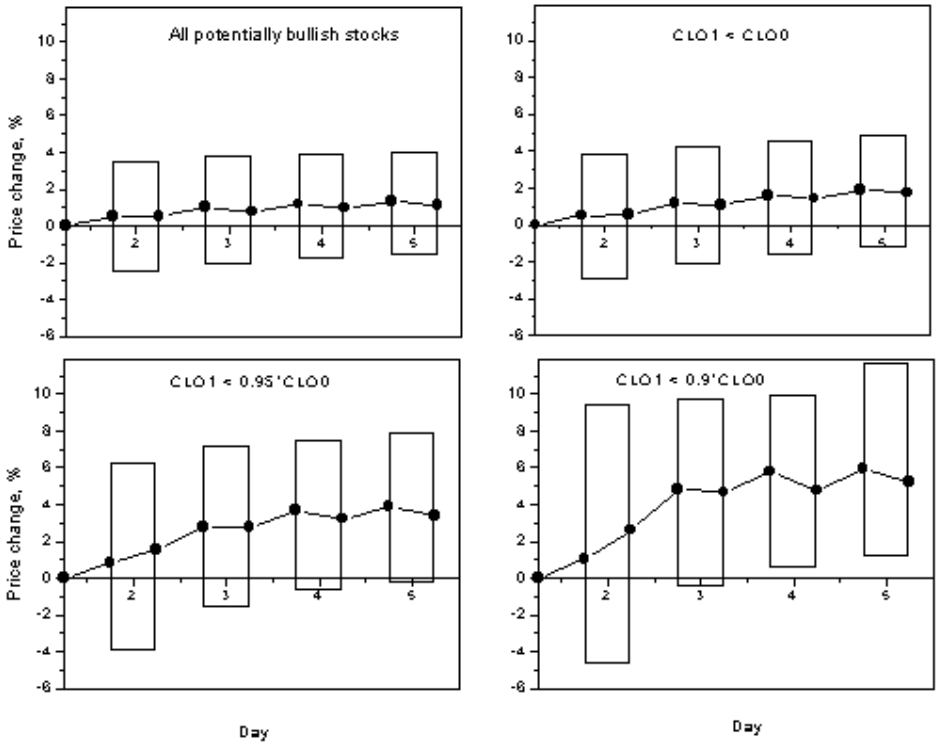


Figure 6.1 Average price changes relative to CLO1 price of potentially bullish stocks with various price levels CLO1 (selection levels). Vertical bars show the average minimal and maximal daily prices. Black circles are the average opening and closing stock prices.

From this figure one can conclude that the OPE4 price is the optimum price for selling stocks. If you hold stocks longer the probability of growth is close to the growth probability of average stock. One can also see: the larger the price drop during day #1, the larger the potential return. If stocks fall more than 10% during day #1 (CLO1 < 0.9 CLO0) the average minimal price during day #4 is larger than CLO1. This does not mean that you will always be a winner in this case. There are broad distributions for all the mentioned prices, but your chance of winning is rather great.

When you select a trading strategy you should remember about average annual number of trades. If the potentially bullish stocks become oversold, i.e. their prices dropped during day #1, the number of such stocks can be very small. The total number of trades per year will also be small, and the annual return will be low. We have mentioned this before, but this idea is so important and it is worth repeating it once again. The next table shows the probability of finding oversold stocks at various selection levels.

Table 6.2 The probabilities of findings an oversold stock and average returns per trade (in %) at various selection levels.

Selection Level	C1 < C0	C1 < 0.95C0	C1 < 0.9C0
Probability of finding selected stocks	0.98	0.76	0.37
Average return per trade (OPE4-CLO1)	1.6	3.7	5.8

To estimate the profitability of various strategies one should multiply the return per trade *R* by the probability *P* to find selected stocks. The results are presented in Table 6.3.

Table 6.3 Profitability of trading strategies at various selection levels.

Selection Level	C1 < C0	C1 < 0.95C0	C1 < 0.9C0
*R*P*	1.57	2.81	2.15

So, the strategy with selection level -5% (C1 < 0.95C0) is the most profitable among these strategies. However, the risk of this strategy is higher then the risk of the strategy with the selection level -10%. The risk to return ratios for these strategies are equal to 3.1 and 2.3 respectively. This is why we prefer the trading strategy with the selection level = -10% and it is called the low risk strategy.

We think it will be interesting to see your chance of winning when using different strategies. In Table 6.4 you can find the probabilities of stock price growth from CLO1 to OPE4.

Table 6.4 Probabilities of OPE4 > CLO1 or OPE5 > CLO1 for oversold stocks.

Selection Level	C1 < C0	C1 < 0.95C0	C1 < 0.9C0
P(OPE4 > CLO1)	0.60	0.67	0.71
P(OPE5 > CLO1)	0.61	0.67	0.68

This table illustrates once again why the OPE4 price is an optimal point to sell stocks. Selling stocks at the price OPE5 can be less profitable for some strategies because of the drop in the growth probability.

In the next section we will consider some statistical data for the low risk trading strategy with the selection level 10%.

6.2 Low risk strategy

The main idea of the low risk strategy was described in Table 6.1. Let us recall that for this strategy one should find two stocks from the list of potentially bullish stocks with a price drop of more than 10% during day #1. Calculations for the period 1995 - 1999 showed that this probability is equal to 13%. Instead of 861 trading days during this period there were only 112 days when two stocks from the list dropped more than 10%. This why annual return is much smaller than for the Basic Trading Strategy.

Why do we recommend buying two stocks? The reason is simple: diversification. We are strongly urge diversification. There is always a chance of a large price drop even for this selection method. Mathematically this chance can be described using risk to return ratios. For returns per purchase of two stocks this ratio is equal to 1.5. For one stock from the selection list this ratio is equal to 1.9 - 2.1. This is 33% larger. If you want to reduce risk, buy two stocks. Your profit will be smaller, but risk will be also smaller. The next table presents some statistics for the low risk trading strategy (1995 - 1999).

Number of trading days = 112
Average return per purchase (%) = 6.95 +/- 10.5
Risk/Return Ratio for return per purchase = 1.51
Probability of positive pure daily returns = 77.7 %
Return(Risk/Return) for the first stock selected: 7.0 (2.1)
Return(Risk/Return) for the second stock selected: 6.9 (1.93)

During November 1995 - May 1999 the trading portfolio was increased 6.08 times with a 1.5% transaction cost. The S&P 500 index during same period of time increased 2.28 times. It is not a bad result for a strategy with low risk.

However, there is risk of losing money even with this strategy. Let us show the results of calculating of the probabilities of large price moves, just as we did for the Basic Trading Strategy in the previous chapter.

Probability of price decline more than -30%	**0.45%**
Probability of price decline more than -20%	**1.3%**
Probability of price decline more than -10%	**4.01%**
Probability of price growth more than 30%	**3.1%**
Probability of price growth more than 20%	**8.9%**
Probability of price growth more than 10%	**26.8%**

The probability of large price drops are close to those for the Basic Trading Strategy. However, the probabilities of large price upside moves are much higher.

How can we reduce the probability of large price drops? This will be described in the next section.

6.3 Very low risk strategy

Who likes risk? We don't. At least, when we trade our own accounts. We do not like stock price drops on the next day after purchase. We become very upset when the stocks go down on the next day. We blame ourselves and dream about canceling the purchase and starting over today to buy stocks after two days of large price drops.

What is happening when you buy stocks after a two day price drop? It does not happen often, but return may be much greater. Consider the results of computer analysis. The buying price is CLO2 for this strategy. In the tables the average returns X - CLO2 are presented for different values of drop coefficients K1 and K2 so that

$$CLO1 < K1 * CLO0$$
$$CLO2 < K2 * CLO1$$

Tables 6.5 Returns and risk/return ratios in the case of two day stock price drops.

OPE3 - CLO2, %

	K2 = 1.00	K2 = 0.95	K2 = 0.90
K1 = 1.00	0.45 (7.3)	0.70 (5.9)	1.26 (4.3)
K1 = 0.95	1.09 (3.8)	1.29 (3.2)	2.46 (1.9)
K1 = 0.90	2.17 (2.1)	2.71 (1.7)	3.74 (1.4)

CLO3 - CLO2, %

	K2 = 1.00	K2 = 0.95	K2 = 0.90
K1 = 1.00	0.43 (14)	1.26 (6.3)	2.16 (4.7)
K1 = 0.95	1.59 (5.0)	2.31 (3.7)	4.06 (2.6)
K1 = 0.90	3.25 (2.3)	4.67 (1.7)	4.97 (1.7)

OPE4 - CLO2, %

	K2 = 1.00	K2 = 0.95	K2 = 0.90
K1 = 1.00	1.06 (6.8)	2.72 (3.3)	4.71 (2.5)
K1 = 0.95	2.90 (3.2)	4.40 (2.3)	7.16 (1.7)
K1 = 0.90	4.86 (2.1)	7.29 (1.4)	8.70 (1.3)

CLO4 - CLO2, %

	K2 = 1.00	K2 = 0.95	K2 = 0.90
K1 = 1.00	1.11 (7.7)	3.02 (3.6)	5.26 (2.6)
K1 = 0.95	3.04 (3.7)	4.90 (2.5)	7.61 (1.9)
K1 = 0.90	4.93 (2.5)	7.59 (1.8)	8.77 (1.7)

OPE5 - CLO2, %

	K2 = 1.00	K2 = 0.95	K2 = 0.90
K1 = 1.00	1.63 (5.6)	3.84 (3.0)	6.19 (2.4)
K1 = 0.95	3.87 (3.1)	5.85 (2.3)	8.60 (1.9)
K1 = 0.90	6.59 (2.1)	9.71 (1.5)	11.5 (1.4)

CLO5 - CLO2, %

	K2 = 1.00	K2 = 0.95	K2 = 0.90
K1 = 1.00	1.58 (6.3)	3.32 (3.8)	4.74 (3.8)
K1 = 0.95	3.51 (3.8)	4.98 (3.0)	5.89 (3.6)
K1 = 0.90	6.17 (2.5)	8.41 (2.0)	8.92 (2.5)

OK! The tables look very attractive. The only problem is how often you will find stocks with two-day drops in a row during day #1 and #2? The next table shows these probabilities.

Table 6.6 Probabilities (in %) of finding some stocks in the list of potentially bullish stocks with two day price drops.

	K2 = 1.00	K2 = 0.95	K2 = 0.90
K1 = 1.00	90.2	51.8	18.3
K1 = 0.95	50.5	25.1	9.6
K1 = 0.90	19.7	9.6	3.9

The best trades when you find stocks with two day price drops of 10% you can make about once a month. Drops of -5%, -10% or -10%, -5% you can find on the average once in two weeks. The stocks which were bought on the evening of the day #2 should be sold on the morning of the day #5. This will give a large return and a low risk to return ratio.

This trading method is boring. Day after day you will do analysis just to recognize that there are no stocks to buy. The market will go up, but you will be waiting and watching as other people make money. If you don't like such stock fishing you can use this analysis to draw a very important conclusion - if you bought a stock on day #1 and at the end of day #2 the stock price went down, then you should buy more shares of this stock. The odds are on your side.

Chapter 7
You bought and ...

7.1 Further price drop

Consider strategy CLO1 - OPE4. Suppose, you bought shares of stock at CLO1 price in the case of CLO1 < K1*CLO0. The stock price went down so that

$$CLO2 < K2*CLO1$$

You double your position in this stock: you are buying additional shares. How about your profit and risk to return ratios?

The answer is in Table 7.1. The probabilities of CLO2 < K2*CLO1 in the case of CLO1 < K1*CLO0 are shown, as well as returns for described strategy. For comparison, the simple trading strategy (CLO1 - OPE4, if CLO1 < K1*CLO0) is shown as $Return_0$.

Table 7.1
Returns (in %) of strategies of trading oversold stocks. In parentheses is the risk/return ratio. Position is open at CLO1 if CLO1 < K1*CLO0. The number of shares is doubled at CLO2 if CLO2 < K2*CLO1. The whole position is closed at OPE4. For comparison, the returns of simple trading strategy (CLO1 - OPE4, if CLO1 < K1*CLO0) are shown as $Return_0$

K1	K2	Probability	Return	$Return_0$
1	1	43.9	2.41 (3.4)	1.61 (5.5)
1	0.95	10.5	2.06 (4.1)	1.61 (5.5)
1	0.9	2.5	1.79 (4.8)	1.61 (5.5)
0.95	1	39.2	4.69 (2.3)	3.67 (3.1)
0.95	0.95	15.1	4.40 (2.5)	3.67 (3.1)
0.95	0.9	4.7	4.04 (2.8)	3.67 (3.1)
0.9	1	39.2	6.96 (1.8)	5.77 (2.3)
0.9	0.95	17.6	6.72 (1.9)	5.77 (2.3)
0.9	0.9	7	6.34 (2.0)	5.77 (2.3)

You can see that in all cases increasing positions after falling stock price gives you better return and less risk to return ratio. Do it and you will have better chance to win!

7.2 Moving up

What should we do if your stock moves up during the first day? Trend is your friend - this is the old Wall Street saying. Should you buy more shares following this proverb or you should sell early and take the profit? To answer these questions we performed a computer analysis. Let us show some results.
We will consider oversold stocks, i.e.

$$CLO1 < K1*CLO0$$

We will also suppose that during day #2 the stocks moved up. The closing price on day #2 CLO2 should be larger than CLO1

$$CLO2 > K2*CLO1$$

Consider the average price changes relative to CLO2 price for different values of K1 and K2. The results are presented in the Tables.

Table 7.2 "Remaining" returns (in %), i.e. the differences X - CLO2 in the case of price growth during the day #2. The risk to return ratios are shown in parentheses.

K2 = 1

	K1 = 1	K1 = 0.95	K1 = 0.9
OPE3 - CLO2	0.9 (3.7)	1.6 (2.1)	2.3 (1.7)
CLO3 - CLO2	0.7 (7.4)	1.3 (5.1)	1.6 (4.7)
OPE4 - CLO2	1.2 (5.2)	2.0 (3.9)	2.5 (3.5)
CLO4 - CLO2	0.8 (9.3)	1.2 (7.2)	1.2 (7.9)
OPE5 - CLO2	1.3 (6.2)	1.9 (5.0)	2.2 (4.7)
CLO5 - CLO2	1.0 (9.1)	1.4 (7.4)	1.4 (7.7)

K2 = 1.05

	K1 = 1	K1 = 0.95	K1 = 0.9
OPE3 - CLO2	1.4 (3.0)	1.9 (1.7)	2.6 (1.5)
CLO3 - CLO2	1.0 (6.6)	1.5 (4.8)	1.8 (4.2)
OPE4 - CLO2	1.5 (4.9)	2.1 (3.8)	2.5 (3.6)
CLO4 - CLO2	0.7 (12)	0.9 (10)	1.2 (8.5)
OPE5 - CLO2	1.2 (7.8)	1.6 (9.8)	2.2 (5.0)
CLO5 - CLO2	0.8 (13)	1.1 (9.1)	1.4 (8.0)

K2 = 1.10

	K1 = 1	K1 = 0.95	K1 = 0.9
OPE3 - CLO2	1.9 (2.5)	2.4 (1.5)	3.0 (1.3)
CLO3 - CLO2	1.3 (6.0)	1.8 (4.1)	2.7 (3.0)
OPE4 - CLO2	1.8 (4.9)	2.4 (3.7)	3.3 (3.1)
CLO4 - CLO2	0.7 (13)	1.2 (8.0)	1.6 (6.6)
OPE5 - CLO2	1.2 (8.4)	2.0 (4.9)	2.9 (3.8)
CLO5 - CLO2	0.5 (20)	1.5 (6.7)	2.0 (6.0)

These tables can be useful for reference. You can see that the risk to return ratio decreases with time. So, it is not a good idea to hold stocks which moved up on day #2 for a long time. For better presentation let us show Figure 7.1, which illustrates the stock-time performance. The opening and closing prices are shown for days #3, #4, and #5.

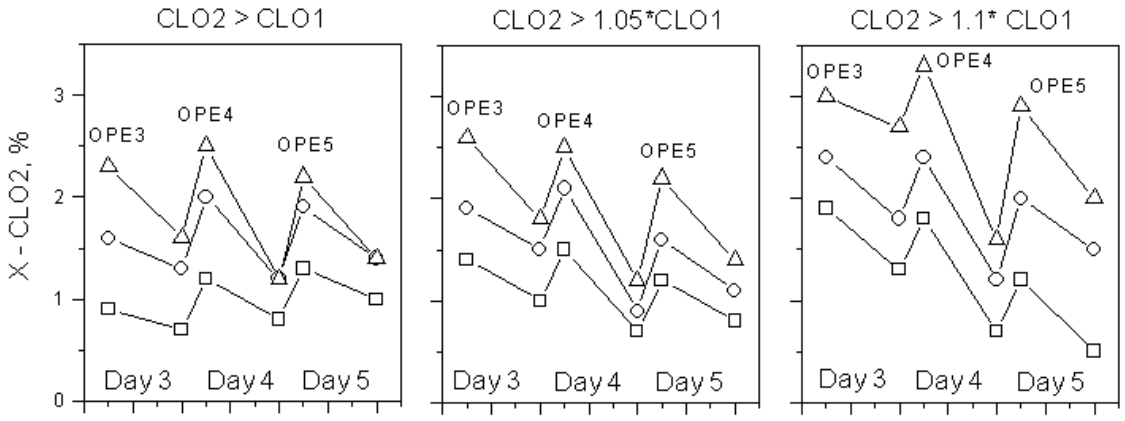


Figure 7.1 Price changes for oversold stocks which moved up during the day #2.
Squares - CLO1 < CLO0
Circles - CLO1 < 0.95*CLO0
Triangles - CLO1 < 0.9*CLO0

One can see that a trader can obtain maximum returns by selling stocks at OPE3 or OPE4 prices. However, from table 7.2 one can conclude that it is better to sell at OPE3 because of the lower risk to return ratio.

***Conclusion*: If you bought the oversold stock and it moved up significantly during the day #2 it is a good idea to sell this stock on the morning of day #3. At this point the average return is close to maximum and the risk to return ratio is minimal.**

7.3 When to sell

So, sometimes you need to break the rules of trading strategies depending on stock performance. Your annual return can be larger if you take into account large upside or downside stock moves.

Here we'd like to discuss an additional advantage of selling earlier after big upside moves. For the Basic Trading Strategy you should hold stocks for three days. So, your trading capital should be divided into three parts to trade every day. If you sell stocks in two days you need to divide your capital into two parts. This is important if your trading capital is small and brokerage commissions represent a substantial contribution to transaction cost.

Another advantage of selling early is accumulation of cash reserve. If you are using the Basic Trading Strategy and after a large upside stock move you sold early, you can use this money to increase positions as we described in Section 7.1.

Chapter 8
Limits and Stops

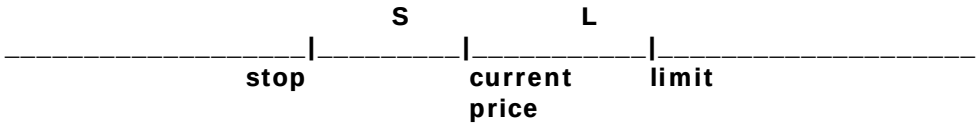
8.1 General remarks
8.2 Limit orders and average returns
8.3 Stop orders and average returns

8.1 General remarks

In Chapter 1 we briefly considered the general idea of using stop and limit orders to sell stocks. We mentioned that when there is high growth probability the stop order should be placed far away from the current stock price. In a bear market, when the growth probability is low, the stop should be very close to the current stock price.

Let us write some equations to demonstrate this statement. If you do not like equations you can skip this section and start reading Section 8.2.

Consider the problem which was mentioned in the first chapter. You buy stock at some current price and sell it when its price touches stop or limit prices.



Here, S and L are the differences between the current stock price and the stop and limit order levels. Let $P(L)$ be a probability of first touching the limit level. If this happens, you win. It can be shown that if the probability of stock growth and decline are equal, then the average return is equal to zero for any values of L and S.

The situation is different if the growth probability p is not equal to the decline probability q. To have some idea about the dependence of your profit on the stop order level let us consider a very simple model. Suppose, the stock price changes by 1 dollar. In this case p is the probability of an upside move and q is the probability of an downside move. The probability of winning $P(L)$ can be written as

$$P(L) = 1 - [1-(p/q)^{L}] / [1-(p/q)^{S+L}]$$

The average return R for this strategy is equal to

$$R = L*P(L) - S*[1 - P(L)]$$

This is a case when the market is bullish or you have a nice trading strategy which allow you to select stocks with high probability of growth. Let us plot the average return as a function of the stop order limit S. As an example, consider a case when $p = 0.6$ and $q = 0.4$ and $L = 5$.

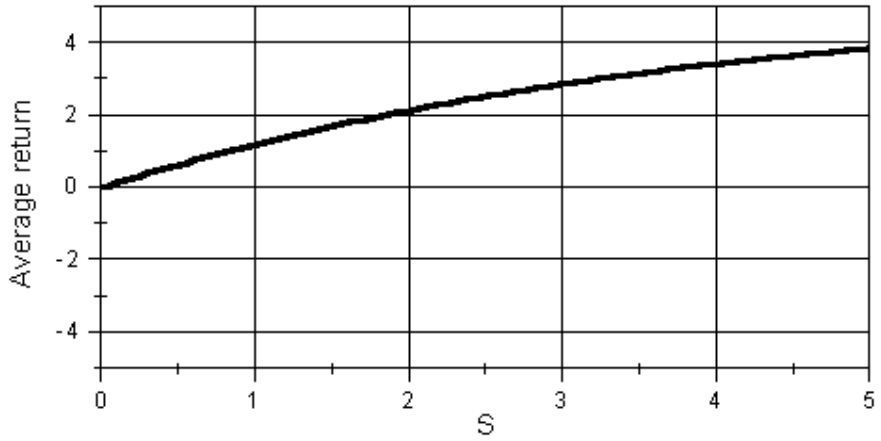


Figure 8.1 Average return as a function of the difference between the current stock price and the stop order level. The growth probability is larger than the probability of decline.

You can see that to have a maximal profit (= 5 in this case) you should place a stop order very far away from the current stock price.

In bear market the situation is opposite. The Figure 8.2 shows the average return in the case of p = 0.6 and q = 0.4. i.e. when the probability of growth is less than the probability of decline.

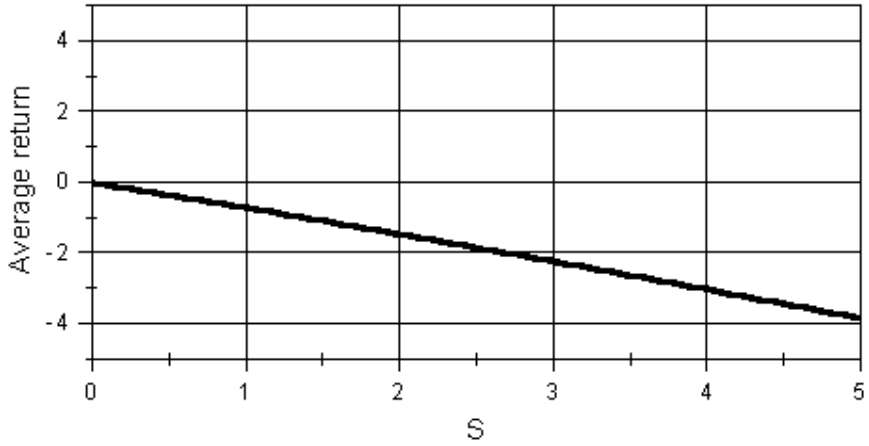


Figure 8.2 Average return as a function of the difference between the current stock price and the stop order level. The growth probability is smaller than the probability of decline.

You can see that the average return is always negative in this case and to reduce the loss one should place a stop order close to the current stock price.

8.2 Limit orders and average returns

Using limit orders to sell stocks is a bad idea. Consider the strategy for trading oversold stocks

CLO1 < K1*CLO0

LIM is the stock price limit to sell during day #2 or day #3. The limits should be

LIM < MAX2

LIM < MAX3

where MAX2 and MAX3 are maximal prices on days #2 and #3. If the prices do not touch this limit, you are selling at the price OPE4. The results are in Table 8.1, where the control returns (no limits for sale) are shown. The limits are chosen as 5 and 10% and 1+V , where V is the stock volatility.

Table 8.1 Using limit orders to sell stocks in comparison to the standard strategy CLO1-OPE4 (Return0).

K1	LIM	Return	Return0
0.95	(1+V)*CLO1	2.43 (4.0)	3.67 (3.1)
0.9	1.05*CLO1	2.86 (3.4)	5.77 (2.3)
0.9	1.1*CLO1	4.28 (2.6)	5.77 (2.3)
0.9	(1+V)*CLO1	4.53 (2.6)	5.77 (2.3)

You can see that for any limit the average return is less than for a return for standard strategy and the risk to return ratio is higher. So, do not use limits to sell stocks. You can miss the large price moves.

Another way of using limit orders can be profitable. You can try to to catch the minimum at day #2 to double your position. Consider trading oversold stocks CLO1 < K1*CLO0. LIM is the stock price limit to buy additional shares during day #2 if

LIM > MIN2

The results are in Table 8.2, where the control returns (no additional buying) are shown.

Table 8.2 Using limit orders to buy additional shares of stock in comparison to the standard strategy CLO1-OPE4 (Return0)

K1	LIM	Return	Return0
0.95	(1-*V*)* CLO1	4.33 (2.6)	3.67 (3.1)
0.9	(1-*V*)*CLO1	6.63 (2.0)	5.77 (2.3)

In contrast to the previous limit strategy, this strategy is more profitable and less risky than standard strategy CLO1 - OPE4. So, if you see the large price drop of your stock during the trading day, do not wait until market closing. Take a risk and try to buy more shares at some local price minimum. If you do not have time to watch the stock for the whole day, you can place a limit order to buy more shares during the trading day. When the stock price touches the limit the shares will be bought automatically.

8.3 Stop orders and average returns

In Section 8.1 we considered a theoretical model to calculate the average return as a function of stop levels. Real life is more complicated. The growth probability can be different for day #2 and day #3. The total price change includes 2 or 3 overnight moves. All this makes the dependence of return on the stop order level very complicated.

To illustrate the problem let us show the results of computer modeling. We studied an 11 year history of 250 stocks from S&P 500 index. We took such a long history in order to have enough statistics to perform a study for different market conditions. Using strategy CLO3 - CLO0 we calculated the total (11 years) returns for different stop levels. Figure 8.3 shows the results of our calculations. Return0 is the return without using stop orders.

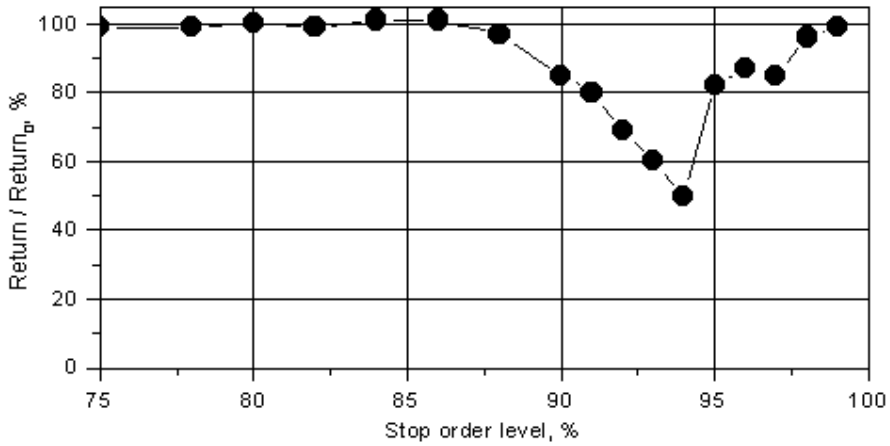


Figure 8.3 The dependence of 11 year return for 250 stocks on the stop order level. Return0 is the return calculated without using stop orders.

One can see that placing stop orders very close to the current stock price very slightly reduces the total return. However, the best results were obtained for the strategies that don't use stop orders.

Chapter 9
Small Stocks

9.1 Statistics for small stocks

We define small stocks as stocks with closing prices less than $10 on the day of the analysis (day #0). The number of these stocks is very large but for trading we select those with a trading volume of more than 100,000 shares on the day of the analysis. We will call these stocks *active small stocks*. The number of active small stocks is about 3 times less than the number of active stocks with a price of more than $10 and a volume more than 200,000. So, one can expect that the number of trades per month for strategies using small stocks will be less than the number of trades for our basic strategy.

The average daily return of small active stocks is higher than for "normal" stocks, i.e. for stocks with prices higher than $10. For the period 1995 - 1999 the average daily returns are equal to:

S&P 500	**0.089 %**
Active stocks	**0.13 % +/- 1.2 %**
Small active stocks	**0.38 % +/- 1.4 %**

This effect is probably related to abnormal activities of selected stocks. Usually, for many of them the trading volume is much lower and some activities attract many traders who hope to find a good bargain and make a large quick profit.

To confirm this statement let us show the average closing prices of active small stocks during 5 days after the day of analysis (day #0).

$$\langle CLO1 - CLO0 \rangle = 0.38\ \%$$

$$\langle CLO2 - CLO0 \rangle = 0.55\ \%$$

$$\langle CLO3 - CLO0 \rangle = 0.66\ \%$$

$$\langle CLO4 - CLO0 \rangle = 0.74\ \%$$

$$\langle CLO5 - CLO0 \rangle = 0.81\ \%$$

The difference between closing prices is diminishing with time, and by the fifth day after the day of analysis it becomes even less than for the S&P 500 index.

Figure 9.1 illustrates the difference in behavior of active stocks (price > $10, volume > 200,000) and small active stocks (price < $10, volume > 100,000)

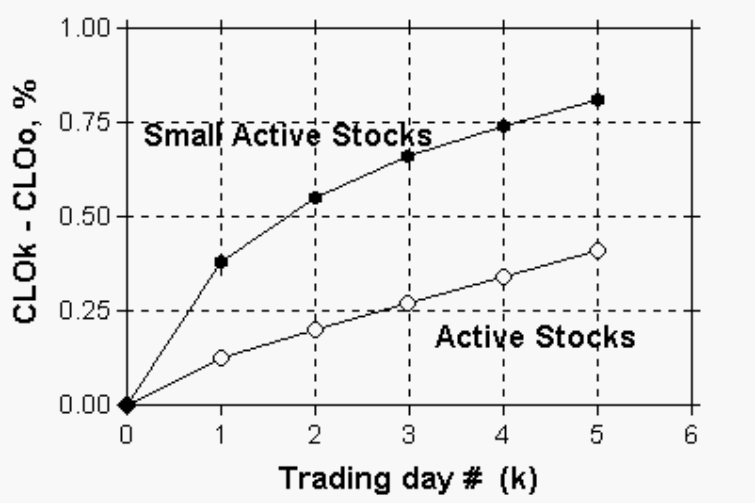


Figure 9.1. Closing price differences CLOk - CLO0 (k = 1, 2, 3, 4, 5) for active stocks and for small active stocks. Day #0 is the day of the analysis.

So, the statistics for the active small stocks are similar to the statistics for active stocks with prices > $10 described early. However, the price changes for small active stocks are larger what can be used to obtain higher returns per trade.
In the next section we consider methods of stock selection which allow to reduce risk of small stock trading and increase trading returns.

9.2 Risk and return

Let's try to apply to trading small stocks the ideas which have been described in the previous chapters. Consider potentially bullish stocks selected by the same criteria we used for selecting active stocks with prices higher than $10 (see Chapter 4 for details). We will define oversold small stocks as stocks from the list of potentially bullish small stocks with a price drop during day #1:

$$CLO1 < CLO0$$

Consider some statistics for oversold small stocks. We suppose that traders buy oversold small stocks at the market closing on day #1. So, we will present the oversold small stock price change relative to the CLO1 price. The risk to return ratios are shown in parentheses. Closing and opening prices will be considered.

Table 9.1 Closing prices of oversold small stocks relatively to CLO1 (in %).

	CLO1 < CLO0	CLO1 < 0.95*CLO0	CLO1 < 0.9*CLO0
<CLO2 - CLO1>	1.88 (6.2)	2.81 (5.1)	4.35 (4.2)
<CLO3 - CLO1>	3.58 (4.3)	5.37 (3.5)	7.58 (3.1)
<CLO4 - CLO1>	4.57 (3.8)	6.65 (3.1)	8.57 (3.0)
<CLO5 - CLO1>	4.92 (4.0)	6.90 (3.4)	8.44 (3.3)

Table 9.2 Opening prices of oversold small stocks relatively to CLO1 (in %).

	CLO1 < CLO0	CLO1 < 0.95*CLO0	CLO1 < 0.9*CLO0
<OPE2 - CLO1>	1.87 (3.9)	2.69 (3.6)	4.37 (3.2)
<OPE3 - CLO1>	3.36 (4.0)	4.94 (3.3)	7.33 (2.9)
<OPE4 - CLO1>	4.99 (3.4)	7.39 (2.8)	10.2 (2.6)
<OPE5 - CLO1>	5.83 (3.2)	8.25 (2.79)	10.8 (2.7)

The returns look very attractive, but these returns are pure returns - no transaction costs have been taken into account. For small stocks these costs can be very significant. The bid-ask spreads can be 5% and more. Our estimation shows that the *average* spread for small stocks from our list of potentially bullish small stocks is equal to about 2.5%. Table 9.3 shows an example of the bid-ask spreads for some small stocks.

Table 9.3 Bid - ask spreads for small stocks from the list of potentially bullish small stocks on June 4, 1999.

Ticker	Price	Bid-Ask Spread in %
HPH	2.38	2.63
VCSTW	2.10	6.06
EFCX	1.44	2.20
BDT	2.5	2.50
NRMI	4.63	2.63
VVID	2.63	3.57
JBOH	9.00	0.69
VCST	5.13	3.66
NAVR	8.88	1.39
FEET	6.38	0.98
COOL	9.88	0.63
		Average = 2.45%

If we subtract the average transaction cost from the returns, then the risk/return ratios will be substantially higher. However, <OPE4 - CLO1> return is profitable even for these large transaction costs.

9.3 Small stocks trading strategies

You can use a part of your capital to trade small stocks. Taking into account the large transaction cost we recommend trading small stocks only when they are very oversold. You should consider only stocks with 5 - 10% price drops during day #1. The old trading strategy CLO1 - OPE4 is the best one for small stocks. It works for transaction costs up to 8%!

However, you should remember: because of the large transaction cost the risk/return ratio for small stocks is larger than for stocks with prices greater than $10.

It is worth considering trading small stocks if you do not see any opportunity in "normal" stocks. Do not spend a large part of your trading capital to buy small stocks. Wait for big opportunities in small stocks when the potential return is very high. Buy small stocks with small bid-ask spreads.

To make the risk of trading small stocks lower you can consider very low risk strategies. One of them is buying more shares when there is a large price decline during the day #2 as described in Chapter 6. Let us show some statistical data for this strategy.

Suppose you bought some oversold small stock at the market closing on day #1 at the price CLO1. This stock is very oversold, so that CLO1 < 0.9*CLO0. Nevertheless, the stock went down more than 5% or 10% during day #2. We will show the predicted returns if you buy additional shares at the price CLO2. The risk to return ratios are in parentheses.

Table 9.4 The average returns <X - CLO2> (in %) of oversold small stocks in the case of a price drop during day #2.

	CLO2 < 0.95*CLO1	CLO2 < 0.9*CLO1
OPE3-CLO2	3.8 (2.2)	5.4 (1.7)
CLO3-CLO2	6.2 (3.1)	9.1 (2.5)
OPE4-CLO2	9.8 (2.2)	13.1 (1.9)
CLO4-CLO2	11.6 (2.4)	17.3 (1.9)
OPE5-CLO2	13.5 (2.0)	17.2 (1.9)
CLO5-CLO2	15.6 (2.0)	20.9 (1.8)

One can see that buying additional shares after a price drop during day#2 is rather safe and profitable. Even high transaction costs do not play significant role for these trades. The only bad thing is that these buying opportunities are very rare. During 1995 - 1999 we found only 80 potentially bullish small stocks with double price drops

CLO1 < 0.9*CLO0
CLO2 < 0.9*CLO1

However, the expected returns are so high that it is worth watching small stocks every day to catch such opportunities.

Chapter 10
Selling Short

10.1 How to define overbought stocks

Selling short is a risky game. You borrow shares and sell them just after borrowing. After some time you buy back these shares. If the stock price went down during this time, you are lucky. You buy shares at a lower price and the cost price is lower than the sell price. Your profit is the difference between the sell price and the cost price.

The things can go in the opposite direction. The stock price can go up and you will be forced to buy the shares back at a higher price and you will lose money. There is no upside price limit for stock, and your losses can be very high.

There are many other disadvantages to selling short. One of them is the uptick rule. You are able to sell short some stock if the current bid price is higher than the previous bid price. So, when stock is falling you should wait for pull back to open a short position.

There are some other problems with selling short. You need larger capital to open a short position. Many securities are restricted for selling short during a certain period of time. For example, "Yahoo!" was prohibited for selling short for a couple of weeks in 1999.

This is why selling short is not popular among individual investors and traders. About 80-90% of short positions are held by professionals. Nevertheless, selling short can be very profitable, and using this tool you are able to make money even when the market is falling.

After this introduction it is clear that we should be very selective in earmaking a stock for selling short. We cannot reverse the list of potentially bullish stocks. The criteria of overbought stocks should be stronger.

We suggest establishing the list of potentially bearish stocks using the following conditions:

1. Stocks should be active. The trading volume should be more than 200,000 shares per day.
2. Closing stock prices on the day of analysis should more than $10.
3. Stocks should be overbought in 16 and 32 day frames.
4. Stocks should rise during the previous day.

Mathematically, one can write condition #3 as:

$$D16 > 1$$
$$D32 > 1$$
$$T16 > T16av + \sigma 16_T$$
$$T32 > T32av + \sigma 32_T$$

where $\sigma 16_T$ and $\sigma 32_T$ are the standard deviations of 16 and 32 day trends. In other words, the stocks should be in T-D cell #4 for 16 and 32 day frames. One can find more about these terms in Chapter 2.

Note that stocks should be oversold in 16 or 32 day frames to be included in the list of potentially bullish stocks. So, the conditions for being bearish are stronger than those for being bullish. The list of potentially bearish stocks is smaller than the list of potentially bullish stocks. We did this to increase the safety of selling short.

What is the optimal time to start selling short and to close the short position? Is it worth selecting stocks using even more stringent conditions? To answer these questions let's consider the results of computer analysis.

10.2 Statistics for overbought stocks

The trading strategy for selling short is different from the strategies for buying stocks. First of all, you should open a short position at the market opening. Morning prices are usually higher. Very often after strong growth during trading day #0 (the day of the analysis) stocks continue their rally on the morning of the next day, and this time is the best to start selling short.

In our computer analysis we consider stock price changes relative to the OPE1 price. Two methods of stock selection will be analyzed. One was described in the previous section: stocks should be overbought in the 16 and 32 day scale. The second selection method: stocks should be overbought in 4, 16 and 32 day scales. So, the additional condition is added:

$$D4 > 1$$

$$T4 > T4av + \sigma 4_T$$

Some data can be found in Table 10.1. Thesetatistical data are the result of the analysis for years 1995 - 1999.

Table 10.1 Price (in %) of potentially bearish stocks relative to the OPE1 price (=100%) for two selection methods.
1. Stock are overbought in 16 and 32 day scales
2. Stock are overbought in 4, 16 and 32 day scales

	Selection-1	Selection-2
<CLO1>	99.2	98.2
<CLO2>	98.8	97.5
<CLO3>	98.5	97.3
<CLO4>	98.6	97.2
<CLO5>	98.8	97.4
<OPE2>	99.5	98.6
<OPE3>	99.0	98.0
<OPE4>	98.9	97.7
<OPE5>	98.9	97.7
Number of selected stocks per day	8.5	1.2

Conclusions:
1. Our method of determining oversold and overbought stocks works. Even in bull market one can buy overbought stocks and make some profit from selling short.
2. The idea of fractal market analysis also works. Adding the overbought condition for an additional time frame improves the stock selection method.
3. The number of stocks in the list of potentially bearish stocks is very small if one uses three overbought conditions (4, 16, 32 day frames).
4. It is better to close a short position at the market closing.
5. Return from selling short is small if one uses only stocks from the list of potentially bearish stocks. Some additional conditions are necessary to improve the average return.

What is the best strategy for selling short? This question will be considered in the next section.

10.3 Selling short strategies

In the previous section we have shown that using three time frame overbought conditions substantially reduces the number of stocks in the list of potential candidates for selling short. Later, we will consider only stocks selected by using 16 and 32 day frames. The number of such stocks is 7 times larger and statistically is more reliable. One should note that

stocks which are overbought in 3 time frames (32, 16 and 4 days) are better for selling short, and you can use a larger part of your trading capital to sell short these stocks.

We also mentioned that one should introduce an additional condition for stock selection to improve returns. This condition is very simple. The potential winners for selling short should have higher prices at the market opening on day #1 with respect to prices at the market closing on the day of the analysis (#0).

OPE1 > K1*CLO0

Table 10.2 shows the price changes depending on the coefficient K1. Only closing prices are shown because they are lower than opening prices.

Table 10.2 The price changes (in %) of the potentially bearish stocks relative to the OPE1 price. The risk to return ratios are shown in parentheses.

	OPE1 > CLO0	OPE1 > 1.05*CLO0	OPE1 > 1.1*CLO0
<CLO2 - OPE1>	-2.1 (5.0)	-5.3 (3.6)	-7.5 (3.4)
<CLO3 - OPE1>	-2.4 (4.8)	-6.9 (3.1)	-10.1 (2.5)
<CLO4 - OPE1>	-2.3 (5.6)	-7.2 (3.1)	-11.5 (2.3)
<CLO5 - OPE1>	-2.0 (6.9)	-6.6 (3.6)	-11.4 (2.4)

You can see that selling short is a rather profitable game if you use the right strategy. Potentially bearish stocks become really bearish if they move up during the night after the day of the analysis. The optimal time to close your short position is the market closing on day #3 or #4. The risk to return ratio is low and the return is large enough to make a profit even with large transaction costs.

What should you do if the stock went up on the morning of day #2? The answer is in Table 10.3.

Table 10.3 The price changes (in %) of the potentially bearish stocks relative to the OPE2 price in case OPE2 > OPE1. The risk to return ratios are shown in parentheses.

	OPE1 > CLO0 OPE2 > OPE1	OPE1 > 1.05*CLO0 OPE2 > OPE1	OPE1 > 1.1*CLO0 OPE2 > OPE1
<CLO3 - OPE2>	-2.6 (3.8)	-8.0 (2.1)	-13.4 (1.4)
<CLO4 - OPE2>	-2.8 (4.1)	-9.0 (2.2)	-15.9 (1.3)
<CLO5 - OPE2>	-2.6 (4.9)	-8.6 (2.7)	-16.4 (1.5)

You can see that in the case of rising price during day #1 you can increase your short position. The expected return is large and the risk to return ratio is small.

Chapter 11
Other trading strategies

11.1 How many days to hold?

We define the basic trading strategy as a method of buying certain selected stocks and holding them for three days. You can ask: why three days? Maybe two or four days would be better?

To answer this question let us consider some results of our theory of trading. As an example, consider the basic trading strategy. For this strategy the trading capital should be divided into three parts A, B, and C. Your initial trading capital TC is equal to

$$TC = A + B + C$$

After N days (for example, N = 252 to calculate the annual return) your trading capital will be

$$TC' = A' + B' + C'$$

For every part of capital (A, B, or C) there were N/3 trades.

$$Ntr = N/3$$

If you hold stocks for four days the number of trades would N/4, etc. Let us define the growth coefficient k per one trade

$$k = \langle X1/X0 \rangle$$

where X0 is the stock price at the moment of purchase and X1 is the stock price at the moment of selling. The angular brackets denote averaging. Every part of trading capital after Ntr trades will be increased as

$$A' = Ak^{Ntr}$$
$$B' = Bk^{Ntr}$$
$$C' = Ck^{Ntr}$$

Using these equation one can easily obtain that after N days your trading capital will be

$$TC' = TC*k^{Ntr} = TC*k^{N/3}$$

The last equation can be written as

$$TC' = TC*[k^{1/3}]^N$$

So, the coefficient $K = k^{1/3}$ can be considered as the growth coefficient per one day for the whole trading capital. If you hold stocks 4 days $K = k^{1/4}$, etc. In general, if you hold stocks n days the coefficient K is equal to

$$K = k^{1/n}$$

The best trading strategy is the strategy with the maximal daily growth coefficient.

As an example, consider trading oversold stocks (see Chapter 6 for details). If you buy some oversold stocks at the price CLO1 and sell them at the prices OPE2, OPE3, OPE4, or OPE5

your average returns are shown in Table 11.1. In this table the returns are shown for various levels of stock price drops during day #1.

Table 11.1 The average returns (in %) for oversold stocks (selling at the market opening on the days #2, #3, #4, and #5) for different levels of stock price drops during the day #1.

	CLO1 < CLO0	CLO1 < 0.95*CLO0	CLO1 < 0.9*CLO0
<OPE2 - CLO1>	0.50	0.85	1.06
<OPE3 - CLO1>	1.17	2.77	4.81
<OPE4 - CLO1>	1.61	3.67	5.77
<OPE5 - CLO1>	1.91	3.90	5.93

These data can be rewritten in terms of growth coefficients *k* per one trade. Calculated k are presented in Table 11.2.

Table 11.2 The growth coefficients per one trade *k* for oversold stocks (selling at the market opening on days #2, #3, #4, and #5) for various levels of stock price drops during day #1.

	CLO1 < CLO0	CLO1 < 0.95*CLO0	CLO1 < 0.9*CLO0
<OPE2 - CLO1>	1.0050	1.0085	1.0106
<OPE3 - CLO1>	1.0117	1.0277	1.0481
<OPE4 - CLO1>	1.0161	1.0367	1.0577
<OPE5 - CLO1>	1.0191	1.0390	1.0593

Now we are ready to consider four strategies: selling at OPE2, at OPE3, at OPE4 and OPE5. For the first strategy you hold stocks 1 day (n = 1) , for the second strategy you hold stocks 2 days (n = 2), etc. Using the equation for the growth coefficient per one day for the whole trading capital $K = k^{1/n}$ one can obtain these coefficients for the four mentioned strategies for every level of stock price drops. (Actually, twelve trading strategies will be considered.)

Table 11.3 The growth coefficient per one day for the whole trading capital *K* for oversold stocks (selling at the market opening on days #2, #3, #4, and #5) for variuos levels of stock price drops during the day #1.

	CLO1 < CLO0	CLO1 < 0.95*CLO0	CLO1 < 0.9*CLO0
<OPE2 - CLO1>	1.0050	1.0085	1.0106
<OPE3 - CLO1>	1.0058	1.0138	1.0238
<OPE4 - CLO1>	1.0053	1.0121	1.0189
<OPE5 - CLO1>	1.0047	1.0096	1.0145

One can see that for all levels of stock price drops during day #1 the best strategy is selling at the market opening on day #3.

However, in the basic trading strategy we recommend selling on the morning of day #4. Why? Because we should consider transaction costs. They substantially reduce the average returns and growth coefficients will be different. The absolute return for the strategy OPE4 - CLO1 is higher, and you have a better chance of reducing the influence of transaction costs.

If you are an experienced trader and your trading capital is large (> $30 000) your transaction costs can be small. In this case, you can use the more profitable strategy OPE3 - CLO1 due to small transaction costs.

This section is an introduction to the general approach to trading strategy analysis. You can try to analyze other strategies using the ideas in this section. We did not consider risk

analysis. Mathematically, such analysis is much more complicated. Contact us if you want to know more about this type of analysis.

11.2 How many stocks to buy?

In the basic trading strategy we recommended dividing your trading capital into 6 parts and using the whole part to buy shares of stock. You could find other advice - try to buy equal numbers of shares. In this case you will use a small part of your capital to buy low priced stocks and large part of your capital to buy high priced stocks.

There is a contradiction between these advises. Which is better?

Theoretically, it is better to follow the first advice: every day use equal amounts of money for two stock purchases. In this case you will buy a larger number of shares of lower price stock. The average return will suffer if you spend more money buying higher price stocks. Let us show the results of computer analysis.

We calculated the average return per two stock purchase for the basic trading strategy for different levels of stock price. Suppose, you do not like stocks which cost less than $12. You will select stocks from the list of potentially bullish stocks which cost more than $12. Your return will be substantially smaller: 2.92% instead of 3.25% with the regular limit of $10. Table 11.4 shows the average returns per purchase depending on the stock price limits.

Table 11.4 The average returns per purchase depending on the stock price limits

Price limit	Average return per purchase, %
10	3.25
11	3.08
12	2.92
13	2.69
15	2.61

If you are an experienced trader and your capital is large you can use the basic trading strategy. For beginners, it is better to be more selective in stocks and not place large capital in small stocks. They are very volatile and a couple of bad trades can kill you. Try to buy smaller numbers of shares of small stocks untill you get some good trading experience. Do not be upset if you see large price moves for low priced stocks. They can also go down. Slowly but surely. This old advice is very good for beginners.

11.3 Upgrades and downgrades

We will describe a very simple trading strategy. This strategy is good for traders who are able to watch the market for the whole trading day.

Every trading day you can find the list of stocks which are upgraded or downgraded by various brokerage firms. You can find this list, for example, at http://biz.yahoo.com/c/u.html web page provided by Briefing.com. At this site, the information is updated three times daily on days on which U.S. stocks markets are open (9:30am, 12pm, 4pm Eastern).

The ratings are listed in descending order from positive to negative. Many firms include long-term (L-T), intermediate term (I-T), and near term (N-T) classifications within their ratings systems. One can find more information about equity rating systems at http://biz.yahoo.com/f/bc.html#ratings.

Let's consider upgraded stocks. The prices of these stocks go up very quickly after the upgrade announcement. If you are not a professional it is very hard to catch these moves. However, there is a good chance to win in this game. Wait for the price pullback after the first rally. Never buy at the current maximum day price. Buy this stock when pullback is over. Sell this stock on the morning of the next day.

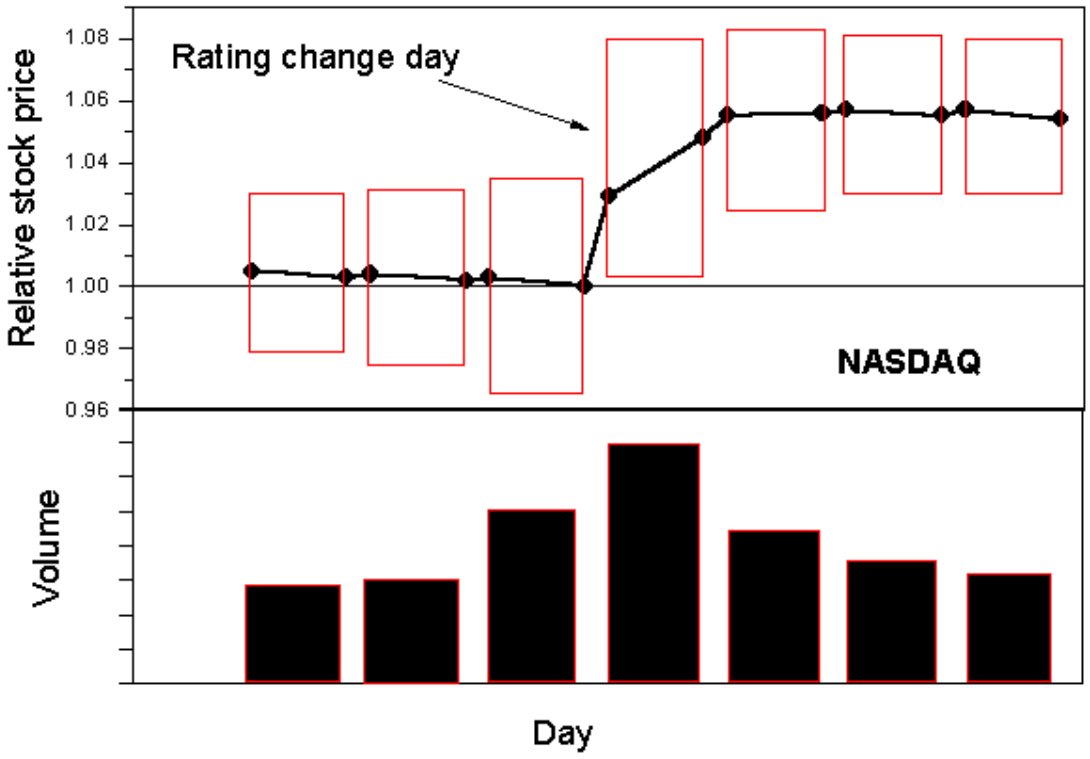


Figure 11.1 Price and volume change for upgraded stocks.

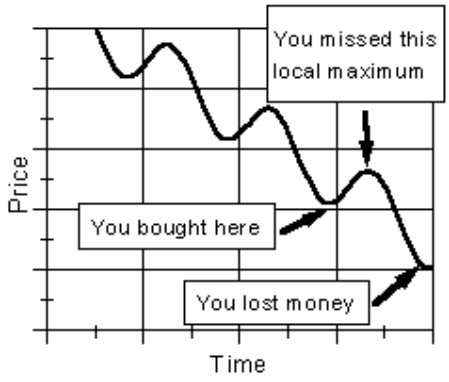
Figure 11.1 illustrates the price change of upgraded stocks during the day before and after the upgrade announcement. (1996-1997 year statistics) You can see that profit is not large but this game is rather safe.

11.4 Trading tips

These trading tips are the result of our own trading experience. Our mistakes were analyzed, some conclusion have been formulated and written down as tips.

Follow the strategy! If you bought a stock and it goes down the next day while analysis shows this stock is still bullish - buy more shares of this stock and consider the purchase an independent trade.
Do not trade stocks with a large bid-ask spread. If some stock looks very attractive - try to buy it at the price between bid and ask. Use the limit order in this case. Remember: a transaction cost of more than 3% will kill any good strategy.
If you see an unusually large positive price change during the first or second day, sell this stock early.
It is helpful to read the headline news about the stock. It is very good when bad news had come out already. Do not be afraid of a bad earnings report, analysts downgrading, or bad news about an industry. Stock can go up anyway. Short sellers will close their positions and bargain hunters are always ready to take a risk.
Try to buy equal amounts of shares of stocks. The smaller the price, the larger the risk. Do not put a huge amount of money in small stocks.
Use on-line brokers to reduce commissions. If you are buying 100 - 200 shares of stock, commissions should not be larger than $10.

Do not hold stocks for a long time if they are on the downtrend. If you missed the local maximum the stock may shortly drop, and your loss will be large.



It is better to have a real time quote service. Some brokers give you this service for free.

Write your results in a spreadsheet. Calculate your average return R and standard deviation S. Try to keep the ratio of S/R as small as possible. If it is increasing over time, think about your mistakes.

You are not a computer and your psychology can make results better or worse than average. Many times you will sell stocks too early and you will not buy some stocks just because you do not like them. It is OK when your decisions are based on your experience or on additional analysis. It is bad if they are influenced by pure fear. Analyze your mistakes. S/R ratio is a good tool for this analysis.

If you are very sure about a stock, you can keep it longer. But we don't have any idea how you can be very sure. The only sure thing in the market is uncertainty.
Our advice:
If you want to hold stocks longer - place a stop order closely to current price.

Chapter 12
Trading portfolio

12.1 Theory of efficient portfolio
12.2 Using the theory of efficient portfolio

12.1 Theory of efficient portfolio

The theory of efficient portfolio was developed by Harry Markowitz in 1952. (H.M.Markowitz, "Portfolio Selection," Journal of Finance, 7, 77 - 91, 1952.) Markowitz considered portfolio diversification and showed how an investor can reduce the risk of investment by choosing stocks that do not move together.

Let us outline the main ideas of Markowitz's theory. Consider a simple example. Suppose, you bought two stocks. The average returns of these stocks are equal to R1 and R2. The standard deviations of these returns are $\sigma 1$ and $\sigma 2$. Let q1 and q2 be parts of your capital invested in these stocks.

$$q1 + q2 = 1$$

Using the theory of probabilities one can show that the average return for this portfolio is equal to

$$R = q1*R1 + q2*R2$$

The squared standard deviation (variance) of the average return can be calculated from the equation

$$\sigma^2 = (q1*\sigma 1)^2 + (q2*\sigma 2)^2 + 2*c*q1*\sigma 1*q2*\sigma 2$$

where c is the correlation coefficient for the returns R1 and R2. (See Chapter 2 to learn more about correlation coefficients.)

<u>The problem</u>: find q1 and q2 which give return R with minimal risk σ.

To solve this problem it is good idea to draw the graph R , σ for different values of q1 and q2. Let us show an example. Suppose every day you buy two stocks from some list of bullish stocks. The first stock from the list is very bullish and its return R1 is two times larger then the return R2 of the second stock. However, the risk of trading the first stock is higher than the risk of trading the second stock.

$$R1 = 1.0 \ +/- \ 3.0\ \%$$
$$R2 = 0.5 \ +/- \ 2.0\ \%$$

Suppose the correlation coefficient for these returns is equal to zero.

$$c = 0$$

Figure 12.1 shows R , σ / R plot for this trading method.

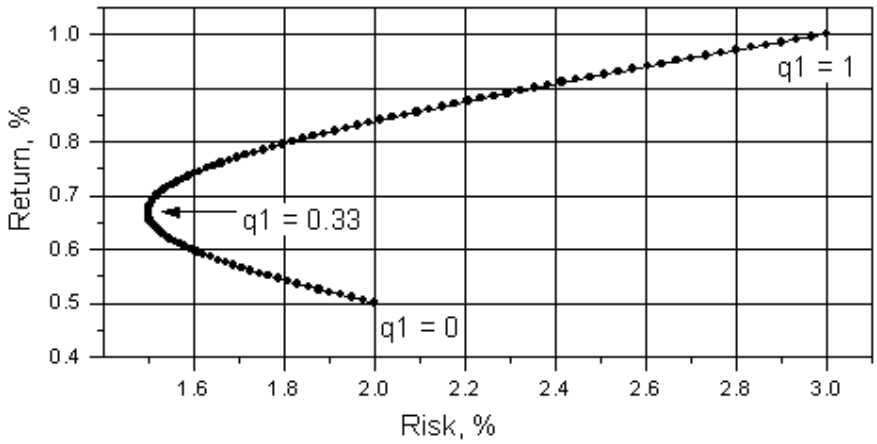


Figure 12.1 Return-Risk plot for the trading portfolio described in the text.

This plot shows the answer to the problem. The risk is minimal if the part of trading capital used to buy the first stock from the list is equal to 0.33. The risk is two times less than for the strategy when you spend the whole capital to buy the first stock only.

So, the trading portfolio which provides the minimal risk consists of two stocks. 1/3 of the capital is in the first stock and the 2/3 of the capital is in the second stock. The expected return for this portfolio is smaller than maximal expected value and the trader can adjust his holdings depending on how much risk he can afford. People who like getting rich quickly can increase position in the first stock. If you want a more peaceful life you can use q1= 1/3 and q2 = 2/3.

This is the main idea of building portfolio depending on risk. If you trade more securities the Return-Risk plot becomes more complicated. It is not a single line but some complicated figure. Special computer methods of analysis of such plots have been developed. In our notes, we will consider some simple cases only to demonstrate the general ideas, and we will use these methods for building a trading portfolio with minimal risk.

12.2 Using the theory of efficient portfolio

Let us consider some practical use of the theory of effective portfolio. For the basic trading strategy we recommended buying two stocks every day and using equal amounts of money for each stock. The first stock is the stock from the list of potentially bullish stocks with maximal price drop during trading day #1. The second stock is the stock with maximal price drop from the rest of the list. In Chapter 5 we showed that the average return per purchase for the first and the second stocks are equal to

R1 = 3.55 +/- 11.6 %
R2 = 2.94 +/- 9.9 %

The correlation coefficient for these returns can be calculated using the equation from section 2.4. Figure 12.2 shows R1 versus R2. One can see that the correlation is small. Calculations show that the correlation coefficient c = 0.165.

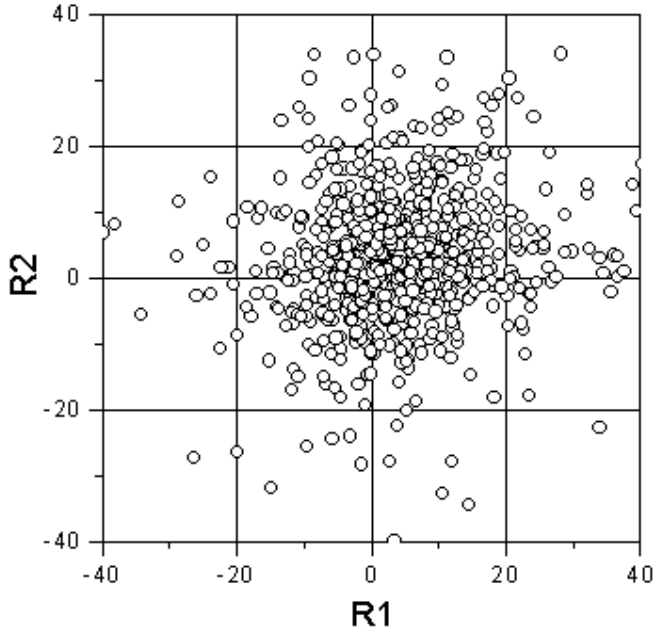


Figure 12.2 Return per purchase for the first and for the second stocks selected from the list of potentially bullish stocks.

Using equations from Section 12.1 we calculated return R and standard deviation σ (risk) for variuos values of q1 - part of the capital used for purchase of the first stock. Figure 12.3 shows the return - risk plot for various values of q1.

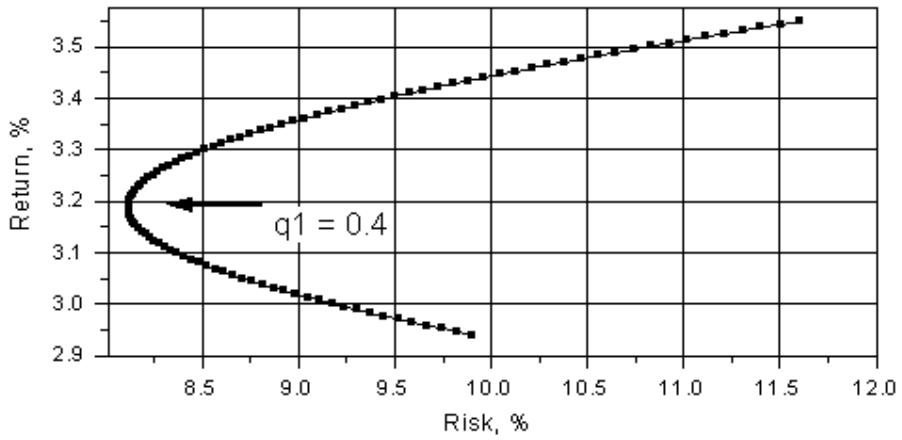


Figure 12.3 Return - risk plot for various values of q1 for the basic trading strategy.

You can see that minimal risk is observed when q1 = 0.4, i.e. 40% of trading capital should be spend for the stock from the list of potentially bullish stocks with maximal price drop during trading day #1. The total return is smaller but this is what the trader should decide for himself: lower risk or better return.

Our opinion: the absolute value of risk is not a good characteristic of trading strategy. It is more important to study the risk to return ratios. Minimal value of this ratio is the main criterion of the best strategy. Let us plot the risk to return ratio as a function of q1.

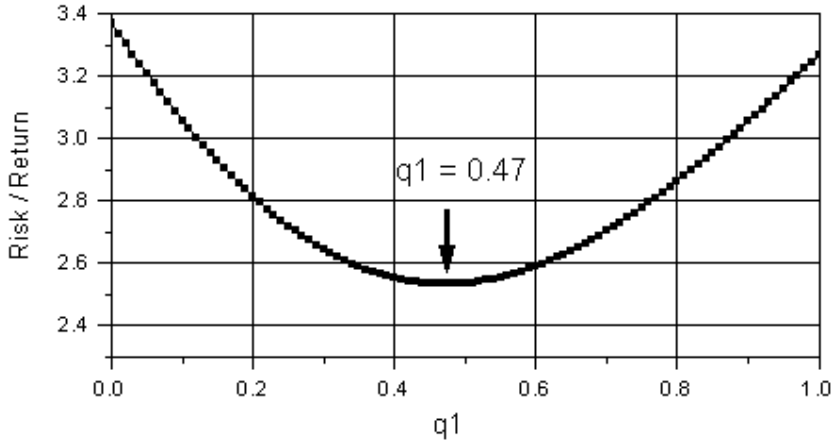


Figure 12.4 The risk to return ratio as a function of q1 for the basic trading strategy.

You can see that the minimum of the risk to return ratio one can observe is when q1 = 0.47, i.e. it is close to the recommended value of q1 = 0.5. So, to obtain the minimal risk to return ratio for the basic trading strategy one should spend equal dollar amounts to buy two stocks from the list of potentially bullish stocks with minimal price drop during the next day after analysis.

Conclusion

So, the text is over. We hope you learned something new and useful. Many questions were not described or were described briefly because we tried to keep things as simple as possible. However, many other stock trading problems can be described without artificial complexity. We would appreciate if our readers show us the problems which are worth being discussed in the newer version of the text.

We wrote an analytical text. This not a guide to "how to get rich quickly." Nevertheless, this text can be useful to improve your trading performance. Our goal was to show how to analyze the trading strategies. We hope this text will help you to avoid many expensive trading mistakes.

We think this text can be used for further development of various trading strategies. We described general approaches to stock trading analysis. Similar methods can be applied to the analysis of trading options, futures, bonds, etc.

This is an interactive book. Write us and we will include your questions and our answers in the text. If your question is difficult to answer, give us some time to do additional research and analysis. We expect our common work will be useful for all of us.

With Best Wishes,
Vladimir Daragan