LUND UNIVERSITY
School of Economics and Management

HIGH PROBABILITY TRADING

MEASURING SHORT-TERM MARKET RISK

BACHELOR THESIS

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ABSTRACT

Title: High Probability Trading – Measuring Short-Term Market Risk

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Keywords: High probability trading, Life-expectancy profiles, Probability distributions, Dow Theory, Value at Risk

Purpose: We aim to measure probabilities in the equity markets in order to achieve higher success in trading. The results are not to be seen as a trading strategy of any kind, but as a tool in risk management in short-term trading in the studied markets.

Methodology: A deductive approach, using empirical data to calculate probabilities in the chosen financial markets.

Theoretical Perspectives: The theoretical perspective can be derived from a combination of Dow Theory and Value at Risk.

Empirical Foundation: Standard & Poor's 500 Index (1990-2008), Dow Jones EURO STOXX 50 (1987-2008), OMX Stockholm 30 (1987-2008) and ABB Ltd (1997-2008).

Conclusion: Our probability calculations should be an excellent tool for the short-term trader. A combination of our life-expectancy distributions for the short-term trend, and VaR will improve the risk control for market participants. The results also show that bear markets have higher daily advances and declines than bull markets, which can be explained by higher volatility in bear markets, mainly caused by fear and risk aversion, but also by the asymmetric volatility phenomenon.

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1. INTRODUCTION

In this first chapter we will introduce ourselves, and our personal backgrounds in the field of finance. We will strive to give a thorough background of the trading world, and we hope we can shed some light on the important areas that is vital to this thesis. The background provides a general discussion on the subject, and leads to a problem specification. Finally, we will present the foundation for the thesis' purpose, limitations, and outline.

1.1 OUTLINE

Chapter 1 begins with a brief introduction of the writers, to shed some light on the choice of equity and equity indexes, then we will provide with some insight into the trading world. We will continue with a brief discussion of the most important elements in trading, namely the focus on risk and having a positive expectancy. The chapter continues with a problem specification, purpose and limitations.

Chapter 2 discusses the choice of method and the general method of work. We will also give a brief description of the data used, and potential biases.

Chapter 3 starts with an introduction of the financial markets that we will study. Then, previous studies are discussed, as well as other topics of importance. The chapter ends with a description of the statistical measures used in this thesis.

Chapter 4 is divided into two parts; the first one presents the statistics briefly, and the second presents our result more thoroughly.

Chapter 5 states our conclusion about the results from the previous chapter, and the data used to calculate those results. Our recommendations for further studies are also presented.

1.2 BACKGROUND

First of all, we would like to explain our personal backgrounds in the field of finance.

Eric Olaison has been working as a professional day trader for the last 5 years, and is a major player in the ABB Ltd stock. He has on average represented approximately 10 % of the daily turnover in the stock, and he uses the OMX Stockholm 30 Index (OMX S30) and the Standard & Poor's 500 Index (S&P 500) as key market indicators. The past year (2008), Eric's trading in ABB Ltd has been very rewarding with only 10 losing days, and with the worst losing day not exceeding 100 basis points (1 %). His trading is extremely short-term, with trades lasting less than a second to several minutes. He does approximately between 250 and 750 trades a day (a trading session equals 500 minutes).

Eric Thorell has been employed by a derivatives trading hedge fund for the last three years. The hedge fund, with over SEK 1 billion under management, is a substantial player on the Swedish derivatives market. Its performance has been extraordinary; with only positive annual returns since its launch in 2003 and a ratio of approximately 85% positive return months during the same time period. The focus of trading is in index derivatives, with OMX S30 and Dow Jones EURO STOXX 50 (EURO STOXX 50) as underlying indexes.

Both our personal backgrounds have contributed to why we have chosen to study the probability distributions of ABB Ltd, S&P 500 Index, OMX S30 Index, and Dow Jones EURO STOXX 50 Index. We expect the thesis to assist in dealing with risk management in the selected markets. Calculating the probability distributions and presenting them in a readable way, will be a helpful trading tool to manage day to day risk for the short-term trader. Also, the characteristics of the results are similar to the Value at Risk (VaR) method in that both deal with the likelihood of bad outcomes. Considering that VaR is a standard throughout the world today, the results from this thesis will function as a good compliment in managing market risk.

The equity markets world wide has changed dramatically from the beginning of the 20th century till now. Online trading has made it easier and less expensive for individuals as well as for institutions to trade securities electronically (Shefrin, 2002). According to Borsellino (1999) the business of trading is changing, and in the last decade new technology has made its inroads into trading. Even though technology is leveling the playing field, the same conditions to succeed in the market still apply. Farell (1999, p. 2) describes the key to day trading as to trade only when the odds are in your favor. We have been inspired by Victor Sperandeo's ideas on how to use statistical profiles to tilt the odds even more in our favor.

Sperandeo (1991, p. 168) uses his distribution as a means to establish the base probability that a market movement will reach or go beyond a given extent and duration. This is the same way we aim to apply our distribution, but in other markets and with a slightly different approach. The secret to be successful in the stock market is not to buy at the bottom and sell at the top.

> "The idea is to buy when the probability is greatest that the market is going to advance" (Zweig, 1997, p. 5).

Link (2003) defines high probability trading as trades with low risk/reward ratio and with a positive expectancy. Because we already have a positive expectancy in our trading strategies, we hope this study will improve the expectancy even more.

According to Lukeman (2000), success in day trading is first defined as survival. Your ability to survive as a day trader depends on your money management techniques. Trading in the market is like playing poker, there is always a risk of failure, because it is a matter of probabilities (Sperandeo, 1991, p. 30). There are obvious similarities between gambling and trading, thus getting the *edge* is crucial for the individual's long-term success. In 1962, Edward O. Thorp wrote the book "Beat the Dealer" and Caplan (1996) shows the similarities in the following quote:

> "The skilled card counter (trader) is able to identify this situation where the deck (market) is rich in high cards (opportunities) which favor the player (trader). When this happens the skilled blackjack player (trader) increases his bet (positions)... Also, the skilled card counter (trader) is willing to wait for the deck (market) to become rich in high cards (opportunities) before making a big bet (position). He doesn't make his large bets just because he needs to get even, or because he has a hunch." (Caplan, 1996, p. 17)

The efficient market hypothesis (EMH) proposes that the prices of traded assets fully reflect all publicly available (and some private) information (Bodie & Merton, 2000, p. 209). With other words EMH states that investors cannot rationally expect to beat the market, except by taking on more systematic risk than the market. However active money managers disagree, and according to Shefrin (2002) the money manager David Dreman wrote in his book "Contrarian Investment Strategies: The Next Generation":

> "Nobody beats the market, they say. Except for those of us who do."

There are three price trends that exist simultaneously in all financial markets; the short-term trend, which lasts from days to weeks; the intermediate-term trend, which lasts from weeks to months; and the long-term trend, which lasts from months to years. For each price trend, there are different types of participants: traders, speculators, and investors (Sperandeo, 1991, p. 3).

In this thesis we will focus on the short-term trend, which is as described above the price trend that traders use. The theory itself can also be used in intermediate- and long-term speculation and investing, but because of certain limitations we will focus entirely on the intraday and short-term movements. We will develop this discussion further in section 1.4 Limitations.

1.3 PROBLEM SPECIFICATION

Fundamental analysis is a great tool analyzing the market, because it is governed by fundamental economic forces. Fundamental analysis alone, however, only gives you a broad preview of the future. It only tells you *what* is likely to happen, but not *when*. To be able to tell *when* a change will occur, technical analysis is a far better tool (Sperandeo, 1994). In section 3.3 the first hypothesis in Dow Theory states that manipulation is possible in the day to day movements, but the primary trend (i.e. in the long run) can never be manipulated. Consequently, a fundamental analysis would be more helpful if you are a long-term trader or investor, and if you are a very short-term trader, technical and statistical analysis will probably be more suitable. It is of course best to use a combination of both, because if the fundamentals are changing, the market will sooner or later change its course.

A change in the market is only possible when the predominant opinion of market participants believes a change is occurring or forthcoming. The predominant psychology of the market participants will determine the direction of price movements. By monitoring the placements of assets, which will be reflected in the price movements; there is a way to gauge the predominant opinion in the market. It is possible to correlate these patterns of economic behavior with patterns of price movements. A trend is established when a predominance of market participants pursue a similar course, which is measured by the cumulative placement of their assets (Sperandeo, 1994).

Fundamentalists and technicians both address issues of sentiment, but in quite different ways. Technicians are mainly betting on trends, which is why the predictions of technical analysts and those of fundamental analysts often conflict. Technical analysts seem to attribute sentiment a more important role in their predictions, than fundamental analysts (Shefrin, 2002).

No matter if you are fundamentalist or technician, there are two words that are probably the most ill-defined terms on Wall Street, yet widely used. The words are “risk” and “reward”. Risk is generally associated with losing money, and reward is associated with the opposite, i.e. making money. Instead of only defining the risk as the downside (the amount of money at stake) in any given trade, we want to take this a step further. We want to objectively and consistently define the odds of success versus the odds of failure, by determining the probabilities of a short-term trend going up versus going down, and also measuring the probability of how much it will go up versus down (Sperandeo, 1994).

We aim to build a profile of the different indexes life-expectancy, not that different from the ones insurance companies use. Sperandeo (1994) found concrete evidence that the market movements have statistically significant frequency distributions, in both extent and duration.

We will therefore calculate the distribution of the percentage move for each up and down day, respectively. To detect whether the distribution is skewed or not, we will do two separate studies, one for bull markets and one for bear markets. Finally, we will present a table that shows the probability of k % that a move on the ith day will not exceed x %.

1.4 PURPOSE

The purpose of this bachelor thesis is to measure probabilities in the equity markets in order to achieve higher success in trading. The results are not to be seen as a trading strategy of any kind, but as a tool in risk management in short-term trading in the studied markets.

1.5 LIMITATIONS

In this bachelor thesis we will study market data retrieved from Reuters, Infront's, and Six's database. The only stock market index with complete market data is the Dow Jones EURO STOXX 50. In the other two indexes, S&P 500 and OMX S30, we only have data starting at January 2, 1990 and October 6, 1987, respectively. The most limited sample-period is from January 2, 1997 to December, 2008, and it represents the ABB Ltd stock, listed in Stockholm, Zürich, and New York. The sample-period is about half the size of the indexes. But with approximately 252 trading days a year for the ABB Ltd stock, we will end up with more than 3000 observations (closing prices), which should be sufficient.

We will restrict our analysis to the distribution of the daily up and down movements in the three indexes and the chosen stock.

2. METHOD

In this chapter we aim to discuss our choice of method, and our general method of work. Because the data is of major importance in our calculations, we will also provide descriptions of the data collected and from where it originates.

2.1 MOTIVATION

The thesis is based on authentic empirical data which is used to calculate probabilities in the studied financial markets. Considering that our thesis is a branch of Dow Theory with only a slightly different point of application, we think it is suitable to have a deductive approach. A deductive approach is according to Patel & Davidson (2003) very common in scientific theses because the theoretical structure mostly already exists. We will use existing theories to draw conclusions about specific phenomena. The motivation is to calculate probabilities on the financial assets studied, and to present the results in a useful way for the short-term trader.

2.2 GENERAL METHOD OF WORK

As a first step, we collected data from our main three sources, Reuters, Infront and SIX. The amount of data was approximately between 3000 to 5500 observations for each study. We calculated the daily changes in percent, and made an algorithm to keep track of the character of the day (up or down) and to know the order (e.g. 4th up day in a row).

We also calculated the distribution of the percentage moves for each up and down day, respectively. The distributions were compared in two separate studies in order to examine whether the distributions were skewed or not. Finally, the results were presented in a table where it is possible to examine the probability that there is a k % chance that a move on the ith day will not exceed x %.

Table 2.1 illustrates the line of action in calculating the framework of the collected data. The first three columns are self-explanatory. We calculated the return using the equation in section 3.4.2. To differentiate between up days and down days, we wrote an algorithm in excel that reviewed the sign for each day t in the third column. The algorithms are listed in Appendix under Excel Algorithms.

Date	Close	Change %	Up	Down	# Up	# Down	Up II	Down II
2008-12-10	899,24	1,19%	1	0	1	0	0	0
2008-12-09	888,67	-2,31%	0	1	0	1	0	1
2008-12-08	909,70	3,84%	1	0	2	0	2	0
2008-12-05	876,07	3,65%	1	0	1	0	0	0
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
1990-01-08	353,79	0,45%	1	0	1	0	1	0
1990-01-05	352,20	-0,98%	0	1	0	3	0	3
1990-01-04	355,67	-0,86%	0	1	0	2	0	0
1990-01-03	358,76	-0,26%	0	1	0	1	0	0
1990-01-02	359,69							

Table 2.1 shows the structure of our analysis.

Our algorithm counts the number of up days separately, as well as down days. The results are shown in the distributions presented in section 4.2.

2.3 DATA

The data we collected was mainly retrieved through three different sources, Reuters, Infront and SIX. From the Reuters database we collected daily observations for the Dow Jones EURO STOXX 50 Index. Infront's Online Trader was used to retrieve daily observations for the Standard and Poor's 500 Index and the ABB Ltd stock. The OMX S30 Index was collected from SIX Pro Trader, and also contained daily observations for the whole time period.

The data used to explain the distributions of bull and bear markets, were based on Schannep's (2008) interpretation of the Dow Theory. The bell curves for the bull and bear markets describe the extent and duration of 25 bull markets and 24 bear markets in the S&P 500 Index. Sperandeo (1994) made an independent study of the bull markets in the Dow Jones Industrial Average (DJIA), and used data covering a time period of 100 years between 1900 and 1999 [sic!][1]. We use the mentioned studies and the underlying data as a measure of the markets long-term health. Combing these two studies with our own calculations, helps us make high probability decisions in the market place.

[1] Sperandeo has always used data from the start of the Dow Jones Industrial Average, i.e. from 1896.Therefore there is a possibility that the data used in this study of the bell curve may be offset by five years.

2.3.1 Potential biases

We found misguiding information in our data and therefore had to write an algorithm to correct our data sample. The data we used had occasionally closing prices for Saturdays and Sundays. This is of course incorrect, because the stock market is closed on the weekends. We created an algorithm that deleted every weekend and every holiday when the markets were closed. On weekends and holidays the closing prices are unchanged from the last trading day and using the unmodified data would lead to biased results.

There might be a potential bias on the results because we are restricted to the databases' limited samples, with exception for the data of Dow Jones EURO STOXX 50 which is complete. To eliminate another potential bias, we have divided the study of the distribution in three parts; the market as a whole and as a bull and bear market.

Another possible bias is the choice of using a moving average and its time frame. The longer the time frame, the more it will lag the market, but it will also more easily spot the overall trend (Borsellino, 2001, p. 64).

3. THEORETICAL FRAMEWORK

In the following section we will present the theoretical framework that is necessary for this thesis. The weighting methodology of the indexes will be discussed to enable the reader to be fully aware of the structure of the indexes. This will be followed by a brief presentation of each of the three indexes and the stock.

3.1 EQUITY MARKETS

3.1.1 Index Weighting Methodology

Because all three of the studied indexes are float adjusted and capitalization weighted we will give a brief explanation both intuitively and mathematically on how the indexes are weighted. The calculation formula of the index level (i.e. S&P 500 Index) is:

$$Index\ level = \frac{\sum_i P_i \times Q_i}{Divisor}, \qquad (1)$$

Index level is the price of the index and P_i is the price of $stock_i$ and Q_i is the quantity of the stock that is to be used in the calculations.

$$Q_i = (1 - IS_i) \times TS \qquad (2)$$

IS_i is the fraction of total shares to be excluded due to float adjustment[2], foreign ownership restrictions[3], and TS is the total number of outstanding shares in $stock_i$. The divisor represents the initial market value and sets the base value for the index. This is also known as scaling the portfolio market value. Thus, the divisor is adjusted to offset any change of the index level when components are added or removed. Adjustment to the divisor is also made to offset corporate actions that threaten to change the index level.

3.1.2 Standard & Poor's 500 Index

The S&P 500 Index was first set up in 1923, but with an expansion to include the current amount of 500 companies in 1957. By using the S&P 500 Index we will cover approximately 75 % of the equity markets in the United States of America. Standard & Poor's describes the index as focused on the large cap sector of the financial market in the U.S. They also refer to

[2] Float adjustment is according to *Index Mathematics Methodology* (2008, p. 7) the number of shares to exclude from the index calculations because they are not available to the public.

[3] Foreign ownership restrictions are according to *Float Adjustment Methodology* (2008, p. 9) applied when necessary, but does not have an explicit limit.

the index as a representation of the entire U.S. economy because of its relatively large market coverage (Standard & Poor's, 2008c).

The S&P 500 Index components and there individual market weights are chosen with a set of published guidelines and policies. Maintenance of this methodology is executed by the Standard & Poor's Index Committee[4] (Standard & Poor's, 2008c). Companies eligible for the S&P 500 Index need to have a minimum market capitalization[5] of $4 billion, adequate liquidity, be incorporated in the U.S. In addition to the criteria mentioned above, they must have a public float of minimum 50 %[6], and generally be financially viable (Standard & Poor's, 2008a) The Standard & Poor's U.S. Index Committee can change the components whenever needed, without any annual or semi-annual rebalancing which is usually the case in most indexes (Standard & Poor's, 2008c).

When choosing between DJIA and S&P 500 Index, the latter according to Schannep (2008) is more correct. The New York Stock Exchange (NYSE) represents 84 % of the U.S. stock market capitalization value as a whole, while NASDAQ represents 16 %. The DJIA has a representation of 93 % (28 out of 30) from the NYSE, and only 7 % (2 out of 30) from NASDAQ. This can be compared with the S&P 500 Index, which has 85 % (425 out of 500) from the NYSE and 15 % (75 out of 500) from NASDAQ (Schannep, 2008, p. 98).

Because the S&P 500 Index has the most accurate composition, we see it as the most appropriate index representing the U.S. stock market.

3.1.3 OMX Stockholm 30 Index

The OMX S30 Index was first set up in 2004, but with data going back to 1986 and a base value 125 also from 1986. A split of the index value by 4-1 was implemented 1998 (Bloomberg, 2008). By using the OMX S30 Index we get a large coverage of the equity markets in Sweden. OMX NASDAQ describes the index as focused on large cap sector stocks of the Swedish financial markets, but also refers to the index as a good representation of the entire Swedish economy because of its large market coverage (NASDAQ, 2008).

The OMX S30 Index components are chosen by turnover on the Stockolm Stock Exchange, which means that the 30 stocks with the largest turnover are selected into the index. This

[4] Standard & Poor's U.S. Index Committee is according to Standard & Poor's (2008b) a committee of eight full-time professional members of Standard & Poor's staff which meets monthly to review all the U.S. indexes that Standard & Poor's maintains.

[5] Market Capitalization is according to Bernhardsson (2005) the total market value of a company, which is the stock price multiplied with the number of outstanding stocks.

[6] Public float is according to Bernhardsson (2005) an American expression for the proportion of the total stock outstanding in a certain company which the public has a diversified ownership in.

process is done twice a year by the NASDAQ OMX Nordic Group. We have chosen to use the OMX S30 Index in this thesis because of its tradable nature and good representation of the Swedish financial markets (OMX, 2007).

The OMX S30 Index is float adjusted and market capitalization weighted. Further details of float adjustment and the market capitalization methodology is explained in section 3.1.1 Index Weighting Methodology.

3.1.4 Dow Jones EURO STOXX 50 Index

The Dow Jones EURO STOXX 50 was first set up in 1998, but with data going back to 1986 and a base value of 1000 from 1991 (Bloomberg, 2008). By using the EURO STOXX 50 we cover approximately 60% of the free float market capitalization of the Dow Jones EURO STOXX Total Market Index. A major difference between the EURO STOXX 50 and the Dow Jones EURO STOXX Total Market Index[7], is that the latter is a benchmark index which cannot be traded to the extent the Blue-Chip index of EURO STOXX 50 can. This is one of the main reasons why we have chosen the EURO STOXX 50 Index. According to STOXX the EURO STOXX 50 is the leading Blue-Chip index for the Eurozone and is licensed to over 800 financial institutions to serve as underlying for a wide range of investment and trading products (STOXX, 2008a).

The EURO STOXX 50 Index components, and the individual weights of each component, are chosen with a set of published guidelines and policies. Maintenance of this methodology is executed by the STOXX Supervisory Board[8] and they are in turn advised by the Advisory Committee[9]. Companies eligible for the EURO STOXX 50 Index are first of all the 40 largest stocks on the selection list[10]. There is a required minimum of 50 stocks, and any components currently on the EURO STOXX 50 Index ranked between 41 and 60 on the list are also then added to the index. Finally, when the component number is below 50 the largest stocks on the Selection List are added to the index until it contains 50 components. Index composition is reviewed annually every September (STOXX, 2008b).

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[7] The Dow Jones EURO STOXX Total Market Index is according to STOXX (2008c) a capitalization weighted index, which covers approximately 95% of the free float capitalization market in the Eurozone.

[8] The STOXX Supervisory Board is according to STOXX (2008) responsible for all decisions regarding composition of the EURO STOXX 50 Index. The board consists of one representative from each of the three joint venture partners, Deutsche Boerse Group, Dow Jones & Company and SIX Swiss Exchange.

[9] The STOXX Advisory Board is according to STOXX (2008) responsible for advising the Supervisory Board on composition decisions on the EURO STOXX 50 Index. The Committee is composed of third-party representatives from the financial services sector.

[10] The Selection List is according to STOXX (2008b) the largest stocks measured in free float market capitalization covering close to, but still less than, 60% of the free float market capitalization of the Dow Jones EURO STOXX Total Market Index.

The index is float adjusted and uses the market capitalization weighting methodology. Special for the EURO STOXX 50 Index is that each component's weight is capped[11] at 10% of the index's total free float market capitalization. The float adjustment and market capitalization weighting methodology is further discussed in section 3.1.1 Index Weighting Methodology (STOXX, 2008b).

3.1.5 ABB Ltd

ABB Ltd is a company in the Heavy Electrical Equipment sector. ABB Ltd was originally two companies (Asea[12] and Brown Boveri & Cie) that merged in 1989. The Swedish company Asea was founded in 1890, when Elektriska Aktiebolget merged with Wenströms & Granströms Elektriska Kraftbolag. Brown Boveri & Cie (BBC) was founded in 1891, in Baden, Switzerland. In the year prior to the merger, Asea had revenues of SEK 46 billion and SEK 2,6 billion in earnings, and 71,000 employees. The same year BBC had revenues of SEK 58 billion and SEK 900 million in earnings, and 97,000 employees. (ABB Ltd, 2009)

The ABB Ltd stock is traded on the Stockholm Stock Exchange, Swiss Exchange and the New York Stock Exchange. Within the Heavy Electrical Equipment sector ABB Ltd is specialized in power products, power systems, automation products, process automation and robotics automation (ABB Ltd, 2008).

3.2 PREVIOUS STUDIES

Sperandeo (1991) performed a study of the Industrial and Transportation averages from 1896 to 1985. He found that Dow Theory tactics accurately captured an average of 74.5 % of business expansion price movements, and 62 % of the price declines in recessions, from the confirmation date to market peaks or bottoms, respectively.

There is always confusion among traders, market analysts, and other market participants if the bull market top actually is a top or just a correction. There is no sure way of knowing this until either the corrections ends or a bear market is confirmed. These historical profiles of long-term trends can be very helpful in determining the probability if a bull market is due or not. Sperandeo (1994) has made extensive studies of the Dow Jones Industrial and Transportation Averages, and table 3.1 shows the extent and duration profiles for bull markets.

[11] A cap is according to Hull (2006) a limit that cannot be exceeded.
[12] Asea stands for Allmänna Svenska Elektriska Aktiebolaget.

Duration (Low-High Order)			Extent (Low-High Order)	
Period	Days	Years	Period	Percent
1939	164	0,45	1910-1912	22,9
1938	253	0,69	1960-1961	27,0
1960-1961	405	1,11	1947-1948	38,1
1947-1948	409	1,12	1939	38,6
1921-1922	452	1,24	1966-1968	42,0
1978-1981	472	1,29	1917-1919	49,0
1957-1959	606	1,66	1900-1902	51,7
1917-1919	670	1,84	1921-1922	52,7
1914-1916	674	1,85	1914-1916	67,8
1907-1909	684	1,87	1938-1939	70,4
1974-1976	684	1,87	1957-1959	71,5
1970-1972	686	1,88	1907-1909	77,5
1966-1968	787	2,16	1974-1976	78,6
1910-1912	799	2,19	1978-1981	81,3
1900-1902	813	2,23	1982-1983	87,7
1903-1906	844	2,31	1970-1972	95,1
1953-1956	952	2,61	1903-1906	100,1
1996-1999	967	2,65	1953-1956	102,0
1978-1981	1 144	3,13	1962-1966	110,1
1949-1953	1 295	3,55	1949-1952	128,1
1962-1966	1 328	3,64	1996-1999	139,8
1942-1946	1 482	4,06	1942-1946	160,9
1932-1937	1 710	4,68	1923-1929	242,5
1984-1989	1 923	5,26	1984-1989	245,7
1923-1929	2 224	6,09	1932-1937	379,4

Table 3.2 shows the extent and duration profiles for bull markets on the Dow Jones Industrial and Transportation averages. (Sperandeo, 1994, p. 135)

The main reason why Charles H. Dow developed his averages was as a guide to future economic activity. There is a distinct correlation between bull markets and economic expansion. With Schannep's (2008) definition of bull markets, i.e. a 19 % gain by DJIA and S&P 500, 100 % of those bull markets in the 20th century were accompanied by or followed shortly after their start by economic activity. The distribution of the different bull markets from the 20th and 21st is illustrated in figure 3.1. The bell curve in figure 2.1 shows that the most moderate gain was 22.3 % and that the most extreme gain was 371.6 %, and the shortest and longest bull markets were 5.9 months and 93.2 months respectively. The median of all bull markets lasted 25.9 months, and had a gain of 75.7 %.

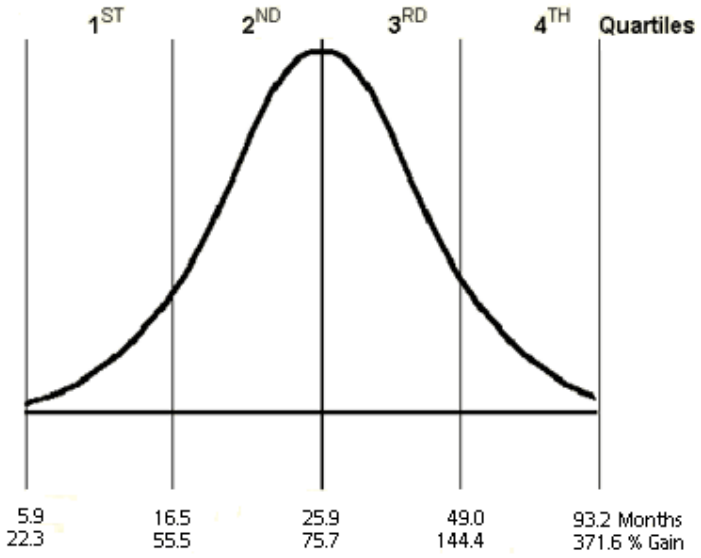

Figure 3.1 Bell Curve of the Length and Gain of Previous Bull Markets (25 Bull Markets). (Schannep, 2008, p. 58)

Schannep (2008) defines a bear market as a 16 % drop on both the DJIA and the S&P 500 over any time frame. The reason why Schannep uses a 16 % drop is because it takes a 19 % gain to come to break-even. To compare with Wall Street Journal's definition of a bull and bear market, i.e. a 20 % gain and drop respectively, Schannep's definition is, in our view, more logical. This because there needs to be a 25 % gain to restore a 20 % drop.

In figure 3.2 below, shows the distribution of bear markets. As you can see, the smallest decline was 16.4 % and the most gain was 89.2 %, and the shortest and longest bear markets were 1.5 months and 41.5 months respectively. The median of all bear markets lasted 18.4 months and declined 27.4 %.

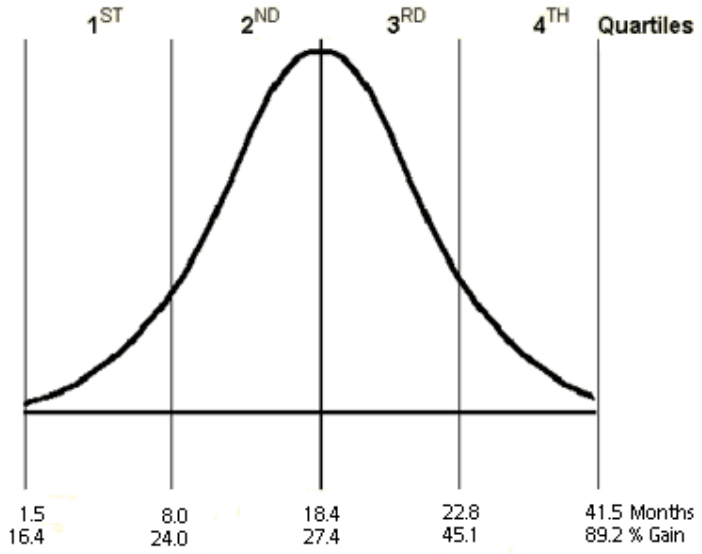

Figure 3.2 Bell Curve of the Length and Decline of Previous Bear Markets (24 Bear Markets). (Schannep, 2008, p. 65)

3.3 ASYMMETRIC VOLATILITY PHENOMENON

The asymmetric volatility phenomenon (AVP) refers to the fact that negative price shocks tend to have higher future volatility than positive price shocks. According to Dennis et al. (2005) the AVP may also be described as a negative correlation between stock returns and innovations in expected volatility.

According to Investopedia (2009) the factors causing this phenomenon are attributed to:

> "[…] the effects of leverage in the markets, volatility feedback and psychological investment factors related to the perceived risk/reward balance at different market levels."

Crashophobia is another concept that is discussed to explain the AVP. The concept explains the volatility skew in option pricing by the fear of a possibility of a new crash similar to October 1987. Hull (2008) refers to some empirical support for this concept. There tends to be a steepening of the volatility skew, when the S&P 500 declines. Hull (2008) also considers leverage to be a reason why volatility increases when a company's equity declines in value. This because their debt is fixed at least in the short term, thus their debt/equity ratio increases.

3.4 BOLLINGER BANDS

There are mainly two types of channels or envelopes, the first one deviates with a fixed amount or percentage points from a moving average (MA). The second envelope depends on the underlying volatility, and is usually referred to as Bollinger bands (Elder, 2002, p. 95).

The Bollinger bands keep changing in response to volatility, i.e. in a high volatility market the bands spread wide, and in a low volatility market the bands start to contract toward the MA. Bollinger bands are calculated with the following equation:

$$\text{Bollinger band} = MA(n) \pm MA(n) \cdot 1{,}96\sigma \qquad (3)$$

where MA(n) stands for a n-period moving average plus (or minus) 1,96 standard deviations. If the data is approximately normal 95 % of the values will be within 1,96 standard deviations (Elder, 2002, p. 95).

A trader can use this tool as an indicator if he or she is going to make a high probability decision. If the stock price is above the upper limit, there is only a 5 % chance that it should be there. This is not a high probability buying opportunity; the best thing to do is either to wait for a rebound or go short the stock. The latter can be dangerous; it is never clever to fight the trend unless you have proper risk control.

3.5 DOW THEORY

Charles Henry Dow was born in Sterling, Connecticut, and began his career at the age of 18, as a reporter with the *Springfield Republican* and moved on to the *Providence Journal* in 1875. Here he developed an interest in business, and after a couple of years he was hired in New York as a financial reporter for *The New York Mail and Express*. Later on, Charles H. Dow and his friend Edward Jones formed Dow Jones & Company and began publishing Customer's Afternoon Letter, precursor of the Wall Street Journal (Schannep, 2008).

In May 26, 1896 the DJIA was born, and a year later Dow Jones Transportation Average (DJTA) was started. Charles H. Dow died 51 years old, and unfortunately he never had time to write down his theory. It was his friend, A.J. Nelson, who dubbed Dow's methods Dow Theory in his book The ABC of Stock Speculation (Schannep, 2008).

The primary idea of the Dow Theory is that the two indexes (DJIA & DJTA) must confirm each other. The DJIA and DJTA were indicators for the two economic sectors, production and distribution, respectively (Sperandeo, 1991). Today, DJIA is the world's most famous stock

market index. It has gone from only including 12 large industrial corporations in 1897 to its present size of 30 industrials (Zweig, 1997).

The subsequent description is an exact excerpt from Sperandeo (1991) and it is describing Robert Rhea's three hypotheses from his book The Dow Theory.

> **Hypothesis number 1:**
>
> Manipulation: Manipulation is possible in the day to day movement of the averages, and secondary reactions are subject to such an influence to a more limited degree, but the primary trend can never be manipulated.
>
> **Hypothesis number 2:**
>
> The Averages Discount Everything: The fluctuations of the daily closing prices of the Dow-Jones rail and industrial averages afford a composite index of all hopes, disappointments, and knowledge of everyone who knows anything of financial matters, and for that reason the effects of coming events (excluding acts of God)13 are always properly anticipated in their movement. The averages quickly appraise such calamities as fire and earthquakes.
>
> **Hypothesis number 3:**
>
> The Theory Is Not Infallible: The Dow Theory is not an infallible system for beating the market. Its successful use as an aid in speculation requires serious study, and the summing up of evidence must be impartial. The wish must never be allowed to father the thought.

Professional traders have always had some system or other based on their experience and governed either by their attitude toward speculation or by their desires (Lefèvre, 1993, p. 128).

[13] Note: To Rhea's parenthetical observation "(excluding acts of God)," should be added "and excluding acts of government, especially acts of Federal Reserve Board."

According to Sperandeo (1991) there is a way to measure risk in the stock market in quantitative terms; there is a way to determine the probability of the market going up x % versus down y %. The next section will discuss a popular way to measure risk in the market, i.e. VaR.

3.6 VALUE AT RISK

3.6.1 Background of Value at Risk

VaR was first introduced by J.P. Morgan as an internal risk reporting metric. The purpose was to provide an aggregate value of maximum loss under a given confidence interval. This would help the senior management of the bank to asses the bank-wide risk for the next day, instead of looking at multiple charts and a lot of pages of figures. In 1994, J.P. Morgan started to distribute its risk valuation method for free, and has since then been adopted by the Bank of International Settlement (BIS). The VaR method is today a world-wide standard in risk management and required as a firm-wide risk management system (Reverre, 2001).

VaR has also become widely used by corporate treasurers and fund managers to summarize the total risk in a portfolio of financial assets. The essence of VaR can be described by the simple question "How bad can things get?" Whether this is the best method of measuring risk should be unsaid, but there are a couple of alternatives. According to Hull (2006, p. 436) some researchers have argued that VaR may tempt traders to choose a portfolio with a return distribution that is far from normally distributed. Two portfolios can have the same VaR, but the portfolio with a return distribution with fat tails is much riskier, because the potential losses are much larger. Conditional VaR (C-VaR) deals with this problem, i.e. it calculates the average amount we lose over a n-day period assuming that a $(1-\alpha)$ % event occurs.

There is always a likelihood of bad outcomes and banks and institutions in particular, are more concerned than others (Elton, et. al., 2007).

3.6.2 Methodology

Reverre (2001, p. 361) states that there are three main categories of VaR calculations: analytical method, historical method, and stochastic simulation. The analytical method makes the assumption that all assets have normally distributed returns. With this in mind, it is fairly easy to construct the distribution of returns on any portfolio because it is a linear combination of normal returns. The variance of a portfolio is given by:

$$\sigma_P^2 = \sum_i (\alpha_i \cdot \sigma_i)^2 + 2 \cdot \sum_i \sum_j \alpha_i \cdot \alpha_j \cdot \rho_{ij} \cdot \sigma_i \cdot \sigma_j \qquad (4)$$

where α_i is the weight of asset i, σ_i is the standard deviation of its return, and ρ_{ij} is the coefficient of correlation between assets *i* and *j*. With σ_i, σ_j, and ρ_{ij} known, the cumulative distribution is easily obtainable using the equation (4) above.

The historical method consists of collecting historical data over a relevant period for the portfolio under consideration, and basing the cumulative histogram on these observed data points. The advantage with the historical method compared to the analytical method, is that using real data removes the simplification of normality. Its principal drawback is that it does not properly incorporate sudden changes in the size of the portfolio. According to Reverre (2001, p.363) there is a solution to this problem, and it is called a historic simulation model. Historical market parameters are the foundation in the historical simulation model, rather than collecting only daily profit and losses for the portfolio. The VaR is the valuation of the portfolio based on this new set of parameters.

The stochastic simulation method is designed to stress test the risk management process. It is based on Monte Carlo simulation, which is a procedure of sampling random outcomes of a stochastic process (Hull, 2006, p.271). Reverre (2001) states that the past is usually not a reliable predictor of the future, and using known risk (historical data) in computing VaR is dangerous, because it is only based on things that have occurred. Using randomly generated scenarios instead, the VaR will truly reflect some unknown behavior, perhaps highly volatile.

These three methods all have their strengths and weaknesses, but the most important of these is probably the tradeoff; speed versus accuracy. Reverre (2001) states that VaR may be a great tool for upper management, but traders need a more thorough risk report that focuses primarily on the positions he or she is responsible for. This is why the purpose of risk analysis is highly dependent on the target audience. The calculation of VaR incorporates the randomness in the market because this is what the upper management need. On the other hand, the sole function of a trader is to manage the randomness in the market, because this is exactly how he or she makes money. Just because a trader and management have not the same needs regarding risk report, does not mean the two approaches are incompatible. Experienced traders are capable of estimating their VaR intuitively, which indicates how closely related the two information sets are.

3.7 STATISTICAL MEASURES

3.7.1 Mean Return

To calculate the average return we have used the following equation:

$$\overline{R_i} = \frac{1}{N}\sum_t R_{it} \tag{5}$$

3.7.2 Return

To calculate the daily return we have used the following equation:

$$R_t = \frac{P_t - P_{t-1}}{P_{t-1}} \tag{6}$$

where P_t is the closing price on day *t*, and P_{t-1} is the closing price the day before.

3.7.3 The Central Limit Theorem

The central limit theorem (CLT) states that if $X_1, X_2, ..., X_n$ is a random sample from any population (i.e., probability distribution) with mean μ_X and variance σ_X^2, the sample mean $\overline{X}$ tends to be normally distributed with mean μ_X and variance σ_X^2/n as the sample size increases indefinitely (technically, infinitely). In practice, no matter what the underlying probability distribution is, the sample mean of a sample size of at least 30 observations will be approximately normal (Gujarati, 2006).

3.7.4 Moving Averages

In determining bull and bear markets, we decided to use a 504-day moving average. The reason why, was because we wanted a method that was as objective as possible in generating the signals. It is always easy to spot tops and bottoms in the market in hindsight, but with a moving average you can define the trend today. Wall Street still does not have an *explicit definition* of either a bull or bear market, but the general opinion is a 20 percent advance or decline in the leading index in the economy of interest (Schannep, 2008).

A trading year has approximately 252 trading days according to Augen (2008), and that is why we have chosen to use a 2-year moving average, i.e. a 504-day moving average. The 504-day moving average (MA) is calculated with the following equation:

$$\text{MA}(504)_{504+t} = \frac{\sum_{n=1+t}^{504+t} P_i}{504} \tag{7}$$

where P_i is the closing price on day i, and t is the number of days after the first 504-day period. To make sure that the moving average will not generate false signals, we implemented a 5 % envelope (Borsellino, 2001). When a market is turning from up to down or vice versa, the market will cross the moving average. It is very common that the market will have some problem to break through and that is why we created an envelope around the moving average. If the last closing price was under the moving average (i.e. a bear market), then the next day had to close 5 % above the moving average to trigger a bull market and end the bear market. The opposite holds for a bull market, i.e. it takes a 5 % drop beneath the moving average before the market turns into a bear market. Everything less than 5 % is considered noise.

4. RESULTS AND DISCUSSION

In this section we will present the results from our calculations. The statistical measures used in the thesis will be discussed, followed by tables and graphs for each index and the stock. Each table and graph is accompanied by a detailed explanation of how to read them.

4.1 SUMMARY STATISTICS

4.1.1 Standard & Poor's 500 Index

The 504-day moving average resulted with following bull and bear markets, i.e. when the market was in an up or down trend, respectively. During the following period (YY/MM/DD) was S&P 500 Index in a trend according to the moving average calculations:

Bull: 91/12/30 – 00/12/18, 03/09/18-08/01/17

Bear: 00/12/19 – 03/09/17, 08/01/18 – to present

4.1.2 OMX Stockholm 30 Index

During the following period was OMX S30 in a trend according to the moving average calculations:

Bull: 89/10/10 – 90/09/20, 91/06/03 – 91/10/07, 93/01/05 – 98/09/30, 98/11/02 – 01/01/02, 03/12/23 – 08/01/02

Bear: 90/09/21 – 91/05/31, 91/10/08 – 93/01/04, 98/10/01 – 98/10/30, 01/01/03 – 03/12/22, 08/01/03 – to present

4.1.3 Dow Jones EURO STOXX 50 Index

During the following period was Dow Jones EURO STOXX 50 in a trend according to the moving average calculations:

Bull: 88/12/08 – 90/08/20, 92/01/15 – 92/08/24, 93/02/03 – 98/10/07, 98/10/14 – 01/02/22, 04/01/16 – 08/01/18

Bear: 90/08/21 – 92/01/14, 92/08/25 – 93/02/02, 98/10/08 – 98/10/13, 01/02/23 – 04/01/15, 08/01/21 – to present

4.1.4 ABB Ltd

During the following period was ABB LTD in a trend according to the moving average calculations:

Bull: 99/03/25 – 01/02/12, 04/01/13 – 08/09/10

Bear: 99/01/12 – 99/03/24, 01/02/13 – 04/01/12, 08/09/11 – to present

4.2 RESULTS

4.2.1 Standard & Poor's 500 Index

In our studies of the distribution of up and down days in the S&P 500, we calculated on how many occasions a short-term trend could last, i.e. how many days the market has gone up or down in a row.

Table 4.1 shows the difference in distributions between a bull market or a bear market or the market in general. The data sample consisted of 2516 up days and 2248 down days. The first column shows the number of days and the other columns shows the distribution of the S&P 500 as a whole, bull markets and bear markets, respectively. The shaded area illustrates down days.

	All	Bull	Bear	All	Bull	Bear
1	47,01%	44,98%	54,69%	52,42%	54,01%	50,20%
2	25,27%	24,79%	25,71%	24,82%	23,47%	27,13%
3	14,68%	15,58%	12,65%	14,17%	14,39%	13,77%
4	6,23%	6,97%	4,08%	5,00%	4,95%	5,26%
5	3,77%	3,90%	1,63%	2,54%	2,36%	2,83%
6	1,72%	2,36%	0,41%	0,82%	0,71%	0,40%
7	0,74%	0,94%	0,41%	0,00%	0,00%	0,00%
8	0,16%	0,12%	0,41%	0,25%	0,12%	0,40%
9	0,25%	0,24%	0,00%	0,00%	0,00%	0,00%
10	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
11	0,08%	0,00%	0,00%	0,00%	0,00%	0,00%
12	0,08%	0,12%	0,00%	0,00%	0,00%	0,00%
	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%

Table 4.1 shows the distribution for bull and bear markets and S&P 500 as a whole. The shaded area illustrates down days.

The first equation below can be used to calculate the probability that the S&P 500 will go up or down *n* days in a row, and the second equation shows an example of the probability that the S&P 500 will go up 4 days or more in a row.

$$P(k \geq n) = 1 - \sum_{1}^{n-1} i \tag{8}$$

$$P(k \geq 4) = 1 - \sum_{1}^{3} i = 1 - (0{,}4701 + 0{,}2527 + 0{,}1468) = 0{,}1304$$

There is 13,04 % probability that the S&P 500 will go up 4 days or more in a row, according to our empirical results.

Table 4.2 shows the daily advance and decline (shaded area) of the S&P 500. Each column illustrates the different types of data sample (S&P 500 as a whole, bull markets, and bear markets) and each row shows the ith consecutive up or down day.

	All	Bull	Bear	All	Bull	Bear
1	0,82%	0,67%	1,35%	-0,72%	-0,58%	-1,17%
2	0,76%	0,65%	1,18%	-0,80%	-0,64%	-1,36%
3	0,61%	0,57%	0,77%	-0,87%	-0,78%	-1,24%
4	0,63%	0,53%	1,38%	-0,95%	-0,85%	-1,25%
5	0,48%	0,42%	0,74%	-1,22%	-1,14%	-1,89%
6	0,67%	0,56%	1,29%	-0,58%	-0,56%	-1,07%
7	0,51%	0,55%	0,31%	-2,74%	-0,47%	-7,62%
8	0,68%	0,54%	2,29%	-0,74%	-0,02%	-1,18%
9	0,29%	0,22%	-	-	-	-
10	1,42%	0,45%	-	-	-	-
11	0,59%	0,39%	-	-	-	-
12	0,84%	0,84%	-	-	-	-

Table 4.2 shows the daily advance and decline, respectively for bull and bear markets and S&P 500 as a whole. The shaded area is on down days.

The equations[14] below demonstrate the procedure of how to calculate the expected ΔY in figure 4.1 and 4.2, i.e. the expected return from one day to another.

$$E(r_{\Delta n}) = \prod_{k=1}^{n}(1+r_i) - \prod_{k=1}^{n-1}(1+r_i) = \prod_{k=1}^{n-1}(1+r_i)\cdot r_n \qquad (9)$$

$$E(r_{\Delta n}) = e^{\sum_{k=1}^{n-1} r_i}\left[e^{r_n} - 1\right] \qquad (10)$$

The two equations above are almost identical, and when calculating the expected return in the short term, continuous compounding is trivial for the overall results.

As an example we will demonstrate how to calculate the expected increase in return between day 3 and 4. This presupposes that the next day (i.e. day no. 4) will be an up day. Equation (8)

[14] The proof of the equation (9):

$$E(r_{\Delta n}) = \prod_{k=1}^{n}(1+r_i) - \prod_{k=1}^{n-1}(1+r_i) = (1+r_1)(1+r_2)\ldots(1+r_n) - (1+r_1)(1+r_2)\ldots(1+r_{n-1})$$

$$= (1+r_1)(1+r_2)\ldots(1+r_{n-1})\left[(1+r_n)-1\right] = (1+r_1)(1+r_2)\ldots(1+r_{n-1})r_n = \prod_{k=1}^{n-1}(1+r_i)\cdot r_n$$

Q.E.D.

With continuous compounding the equation (10) is derived from:

$$E(r_{\Delta n}) = e^{(r_1+r_2+\ldots+r_n)} - e^{(r_1+r_2+\ldots+r_{n-1})} = e^{(r_1+r_2+\ldots+r_{n-1})}\left[e^{r_n} - 1\right] = e^{\sum_{k=1}^{n-1} r_i}\left[e^{r_n} - 1\right]$$

shows us the probability of the S&P 500 advancing for at least another day, which is 13,04%. By using equation (9) or (10) with parameter n as 4, we get the following results:

$$E(r_{\Delta n}) = \prod_{k=1}^{3}(1+r_i)\cdot r_4 = (1{,}0082)(1{,}0076)(1{,}0061)\cdot 0{,}0063 \approx 0{,}00644 = 0{,}644\ \%$$

$$E(r_{\Delta n}) = e^{\sum_{k=1}^{3} r_i}\left[e^{r_4} - 1\right] = e^{(0{,}0082+0{,}0076+0{,}0061)}\left[e^{0{,}0063} - 1\right] \approx 0{,}00646 = 0{,}646\ \%$$

Thus we have 4 results of great value:

1. The probability of an up move (13,04 %).
2. The probability of a down move (86,96 %).
3. The expected advance (0,64 %).
4. The expected decline (-0,72 %)[15].

Using these numbers we can calculate the expected return for the next day. The equations below should be used to calculate the expected return in up trends (11) and in down trends (12). In our example we will use (11), where $P(u)$ and $P(d)$ represents the probability that the next day will be an up or down day, respectively. The return on the ith up or down day is represented by $r_{u,i}$ and $r_{d,i}$, respectively.

$$E(r_{u,\Delta i}) = P(u)\cdot r_{u,i} + P(d)\cdot r_{d,1} \tag{11}$$

$$E(r_{d,\Delta i}) = P(u)\cdot r_{u,1} + P(d)\cdot r_{d,i} \tag{12}$$

The expected value of the return after a 3 day long up trend is:

$$E(r_{u,\Delta i}) = P(u)\cdot r_{u,4} + P(d)\cdot r_{d,1} = 0{,}1304\cdot 0{,}0064 + 0{,}8696\cdot(-0{,}0072) \approx -0{,}0054 = -0{,}54\ \%$$

With this knowledge a trader can prepare himself or herself for the next trading day by building a high probability trading range. This range will not be exceeded with a certain degree of confidence. We would like to emphasize that we are well aware of that there is no certainties in the market, and this range should be seen as a guideline instead of as a rigid set of rules. Before we can calculate this range we need to know the distributions of all up and down days. How to calculate these distributions will be discussed below.

After calculating the distributions of all up days and down days for the S&P 500 we have arranged the data of the ith day's percentage gain in low to high order. On the first up day

[15] See table 4.2.

there were 1219 observations, and this includes the percentage gain on the first day no matter the length of the trend. This means that the first day in e.g. a three day sequence will be included, just because we don't know if the trend will continue or not. We choose to differentiate between data samples with more than 100 observations and data samples with fewer than 100 observations. This because with a minimum of 100 observations there is a 99 % probability that an up move will not exceed the largest up day in the data sample (99 out of 100) if gains are sorted in low to high order. There will be fewer observations for each new up day, and we have decided to mark up days with observations fewer than 100 with a slightly shaded color. Up days with less than 30 observations are dark shaded, and this is because these results are not statistically significant according to Gujarati (2006).

We calculated the significance level α with the following equation:

$$N_{i,\alpha} = N_i \times \alpha \tag{13}$$

where N_i is the number of observations on day *i* and α is the significance level and $N_{i,\alpha}$ is the number of observations that are within the significance level. Taking the Nth return on the ith day gives us the following table below, see table 4.3. $N_{i,\alpha} \rightarrow R_{i,\alpha}$

Table 4.3 shows the significance level α for the S&P 500 on up movements, and we have used (13) to calculate the numbers.

U/1-α	75%	80%	85%	90%	95%	99%
1	1,08%	1,21%	1,40%	1,71%	2,30%	4,25%
2	1,03%	1,20%	1,38%	1,67%	2,20%	3,89%
3	0,83%	0,95%	1,15%	1,47%	1,92%	3,27%
4	0,85%	0,96%	1,17%	1,38%	1,81%	3,54%
5	0,71%	0,77%	0,94%	1,00%	1,17%	2,07%
6	0,89%	1,00%	1,12%	1,40%	1,62%	2,14%
7	0,80%	0,80%	1,11%	1,12%	2,12%	2,12%
8	1,62%	1,62%	2,29%	2,29%	2,29%	2,29%
9	0,39%	0,50%	0,50%	0,50%	0,50%	0,50%
10	2,38%	2,38%	2,38%	2,38%	2,38%	2,38%
11	0,78%	0,78%	0,78%	0,78%	0,78%	0,78%
12	0,84%	0,84%	0,84%	0,84%	0,84%	0,84%

Table 4.3 shows the significance level α on the x-axis and the ith up day on the y-axis for the S&P 500.

The following example shows the procedure of calculating the gain that will not be exceeded with a probability of 99 %. In this case we have $i = 1, \alpha = 0{,}99$ and $N_1 = 1219$, thus

$1219 \times 0{,}99 = 1206{,}81$. To be certain that there will be no more gain than the specified level $R_{1,0.99}$, we will always use the integer larger than $N_{i,\alpha}$ to receive the correct value. Hence, the 13th largest gain on the first up day was 4,25 % and will not exceed this limit with a probability of 99 %.

Table 4.4 shows the significance level α for the S&P 500 on down movements. As we stated before, the slightly shaded area has observations between 30 and 100 (thus, not as reliable as the white area in determining the significance levels in an up or down movement). The dark shaded area is very unreliable, and we will not put any significant importance to it.

D/1-α	75%	80%	85%	90%	95%	99%
1	-0,97%	-1,13%	-1,36%	-1,67%	-2,22%	-3,23%
2	-1,05%	-1,19%	-1,42%	-1,68%	-2,27%	-4,03%
3	-1,26%	-1,45%	-1,63%	-1,93%	-2,36%	-3,43%
4	-1,35%	-1,70%	-1,80%	-2,15%	-2,99%	-6,80%
5	-1,39%	-1,90%	-2,24%	-2,81%	-4,15%	-5,83%
6	-1,01%	-1,08%	-1,13%	-1,13%	-1,53%	-1,53%
7	-7,62%	-7,62%	-7,62%	-7,62%	-7,62%	-7,62%
8	-1,18%	-1,18%	-1,18%	-1,18%	-1,18%	-1,18%

Table 4.4 shows the significance level α on the x-axis and the ith down day on the y-axis for the S&P 500

Utilizing the numbers from table 4.3 and 4.4 above, will help us build the trading range mentioned earlier. Equation (14) and (15) below show the probability that the index will stay within the range.

Upper limit: $P(r_{u,i} < r_{u,\alpha}) = 1 - \alpha$ (14)

Lower limit: $P(r_{d,i} > r_{d,\alpha}) = 1 - \alpha$ (15)

Where $r_{u,i}$ and $r_{d,i}$ represent the return on the ith up or down day, respectively. The critical values we are looking for is $r_{u,\alpha}$ and $r_{d,\alpha}$, which is the upper limit and lower limit, respectively, given a certain significance level. In our example on page 26 and on, we calculated the expected value of the return after a three day long up trend to -0,54 %. After a three day long up trend there is two[16] possibilities, either it will continue to go up or start to retrace. From table 4.3 and 4.4 above, the upper (14) and lower (15) limit $r_{u,0,05}$ and $r_{d,0,05}$ will

[16] The index can stay unchanged, but in our sample it never occurred, i.e. the closing prices were never exactly the same. It happened for the stock a couple of times, because it is trading with increments of SEK 0,25 or SEK 0,50 depending on the price.

be obtained. With $\alpha = 5\%$ and knowing that our two possible outcomes are either $r_{u,4}$ or $r_{d,1}$, the upper and lower limit will be 1,81 % and -2,22 %, respectively.

Now we have attained a valuable set of parameters, i.e. we know the historical profile of a three day long up trend. We know that it is negatively biased with an expected return of -0,54 % on day 4, and with a 95 % probability that the index will stay within the range (-2,22;1,81).

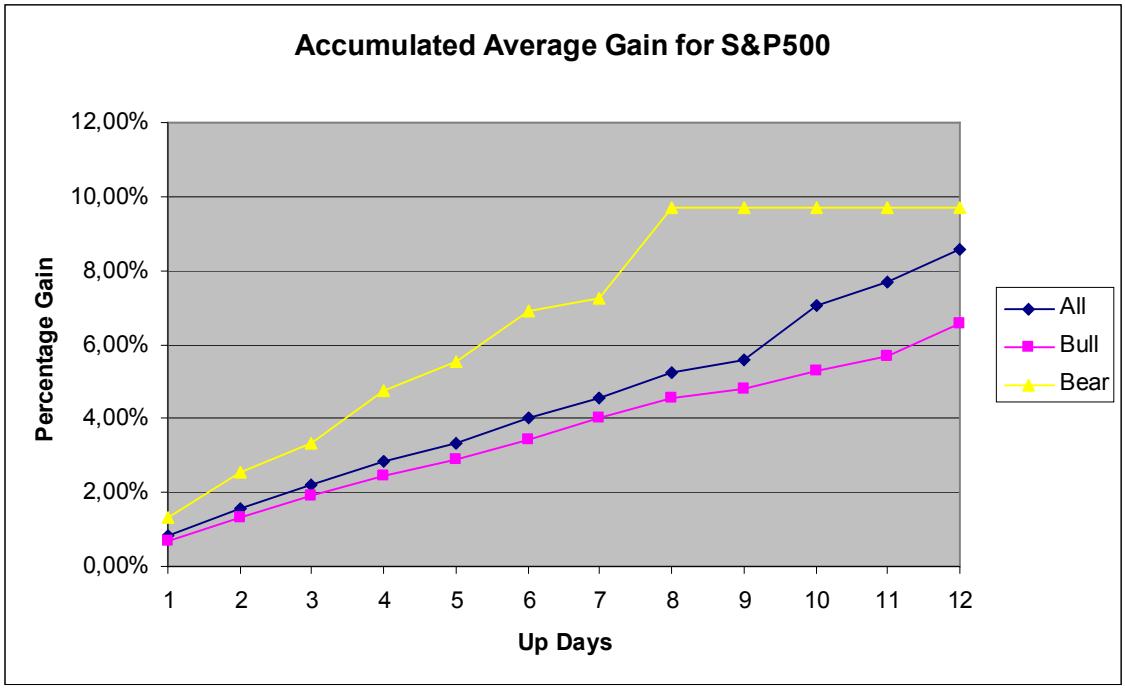

Figure 4.1 shows the accumulated average advance for S&P 500.

Figure 4.1 and 4.2 (see page 32) illustrates the accumulated average advance and decline for S&P 500, respectively. As we can tell from the figures above and below, the accumulated gain and decline for bear markets is larger than in bull markets, which can be explained by the higher volatility in bear markets.

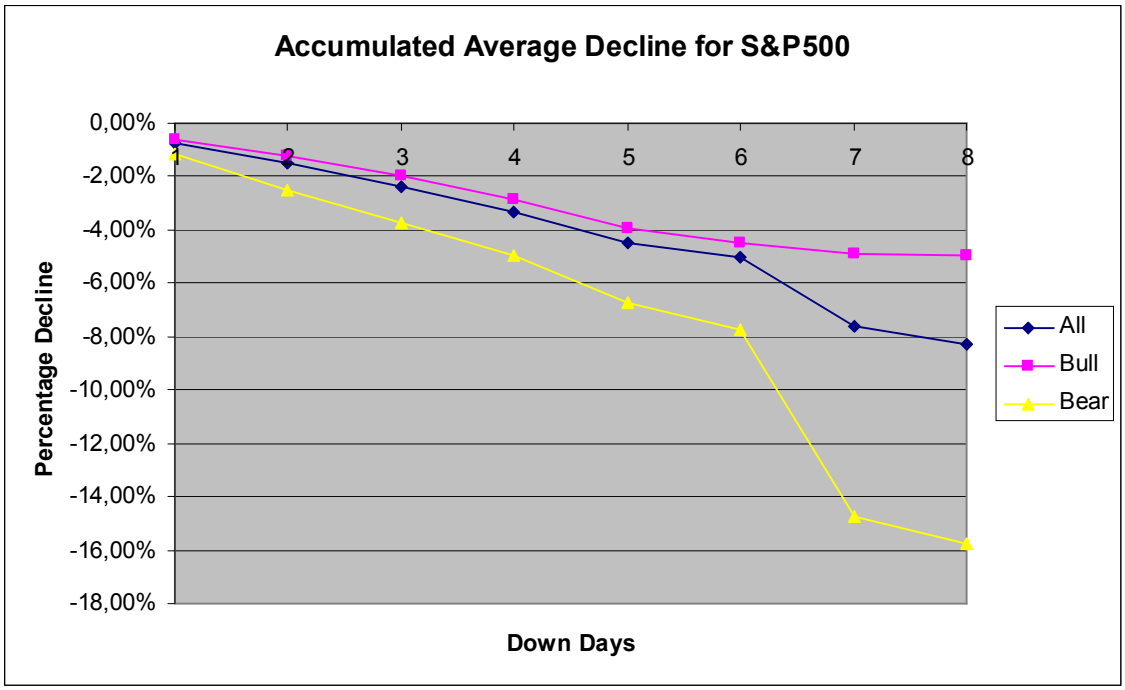

Figure 4.2 shows the accumulated average decline for S&P 500.

4.2.2 OMX Stockholm 30 Index

Table 4.5 shows the difference in distributions between a bull market or a bear market or the market in general. The data sample consisted of 2800 up days and 2512 down days. The first column shows the number of days and the other columns shows the distribution of the OMX S30 as a whole, bull markets and bear markets, respectively. The shaded area illustrates down days.

	All	Bull	Bear	All	Bull	Bear
1	44,10%	44,82%	45,00%	49,16%	52,99%	42,18%
2	25,12%	23,97%	28,53%	25,34%	24,25%	26,55%
3	14,99%	14,23%	14,41%	13,78%	12,69%	15,34%
4	6,78%	7,49%	6,18%	5,42%	5,10%	6,19%
5	3,83%	4,00%	3,24%	3,59%	3,11%	4,42%
6	1,91%	2,12%	1,76%	1,27%	1,24%	1,77%
7	1,20%	1,12%	0,88%	0,80%	0,25%	2,06%
8	1,44%	1,37%	0,00%	0,24%	0,12%	0,59%
9	0,32%	0,37%	0,00%	0,16%	0,12%	0,29%
10	0,24%	0,37%	0,00%	0,00%	0,00%	0,00%
11	0,08%	0,12%	0,00%	0,08%	0,00%	0,29%
12	0,00%	0,00%	0,00%	0,16%	0,12%	0,29%
	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%

Table 4.5 shows the distribution for bull and bear markets and OMX S30 as a whole. The shaded area is on down days.

Table 4.6 shows the daily advance and decline (shaded area) of the OMX S30. Each column illustrates the different types of data sample (OMX S30 as a whole, bull markets, and bear markets) and each row shows the ith consecutive up or down day.

	All	Bull	Bear	All	Bull	Bear
1	1,12%	0,97%	1,53%	-0,94%	-0,84%	-1,25%
2	1,11%	0,92%	1,65%	-1,12%	-0,96%	-1,47%
3	0,95%	0,83%	1,33%	-1,40%	-1,20%	-1,63%
4	0,96%	0,91%	1,28%	-1,34%	-1,30%	-1,36%
5	0,82%	0,77%	1,16%	-1,39%	-1,01%	-1,95%
6	0,77%	0,78%	0,78%	-1,17%	-1,17%	-1,11%
7	0,98%	0,99%	1,71%	-1,20%	-0,83%	-1,09%
8	0,68%	0,70%	-	-1,86%	-2,10%	-1,71%
9	0,69%	0,61%	-	-1,35%	-1,28%	-1,40%
10	0,53%	0,53%	-	-1,60%	-1,23%	-1,79%
11	0,25%	0,25%	-	-0,19%	-0,34%	-0,11%
12	-	-	-	-4,48%	-0,80%	-8,17%

Table 4.6 shows the daily advance and decline, respectively for bull and bear markets and OMX S30 as a whole. The shaded area is on down days.

Table 4.7 shows the significance level α for the OMX S30 on up movements. What we can tell from table 4.7 is that the average advance in OMX S30 tends to decrease after each up day in a row. One explanation can be that the move loses some momentum for each new up day, another can be that for each new up day there is fewer observations, thus less chance of a large move.

U/1-α	75%	80%	85%	90%	95%	99%
1	1,47%	1,67%	1,92%	2,38%	3,30%	5,50%
2	1,45%	1,66%	1,90%	2,39%	3,19%	5,69%
3	1,30%	1,49%	1,69%	2,00%	2,60%	4,34%
4	1,33%	1,49%	1,68%	2,01%	2,51%	4,74%
5	1,07%	1,20%	1,34%	1,56%	2,30%	4,16%
6	1,02%	1,12%	1,27%	1,39%	1,79%	5,78%
7	1,18%	1,40%	1,59%	1,94%	2,35%	3,96%
8	1,00%	1,02%	1,10%	1,13%	1,47%	1,51%
9	1,14%	1,14%	1,14%	1,26%	1,26%	1,26%
10	0,95%	0,95%	0,95%	0,95%	0,95%	0,95%
11	0,25%	0,25%	0,25%	0,25%	0,25%	0,25%

Table 4.7 shows the significance level α on the x-axis and the ith up day on the y-axis for the OMX S30.

Table 4.8 shows the significance level α for the OMX S30 on down movements. In this case the table shows an increase in the downward movement with a peak on day 3 (the dark shaded area is not considered).

D/1-α	75%	80%	85%	90%	95%	99%
1	-1,27%	-1,46%	-1,71%	-2,07%	-2,70%	-4,41%
2	-1,49%	-1,71%	-1,98%	-2,46%	-3,14%	-5,40%
3	-1,85%	-2,06%	-2,56%	-3,42%	-4,31%	-6,27%
4	-1,89%	-2,18%	-2,33%	-2,69%	-3,06%	-4,70%
5	-2,04%	-2,51%	-2,61%	-3,41%	-3,91%	-5,48%
6	-1,43%	-1,83%	-1,92%	-2,41%	-3,83%	-4,17%
7	-1,42%	-1,92%	-2,39%	-2,72%	-4,35%	-4,35%
8	-2,99%	-2,99%	-2,99%	-4,15%	-4,15%	-4,15%
9	-1,88%	-2,19%	-2,19%	-2,19%	-2,19%	-2,19%
10	-2,07%	-2,07%	-2,07%	-2,07%	-2,07%	-2,07%
11	-0,34%	-0,34%	-0,34%	-0,34%	-0,34%	-0,34%
12	-8,17%	-8,17%	-8,17%	-8,17%	-8,17%	-8,17%

Table 4.8 shows the significance level α on the x-axis and the ith down day on the y-axis for the OMX S30.

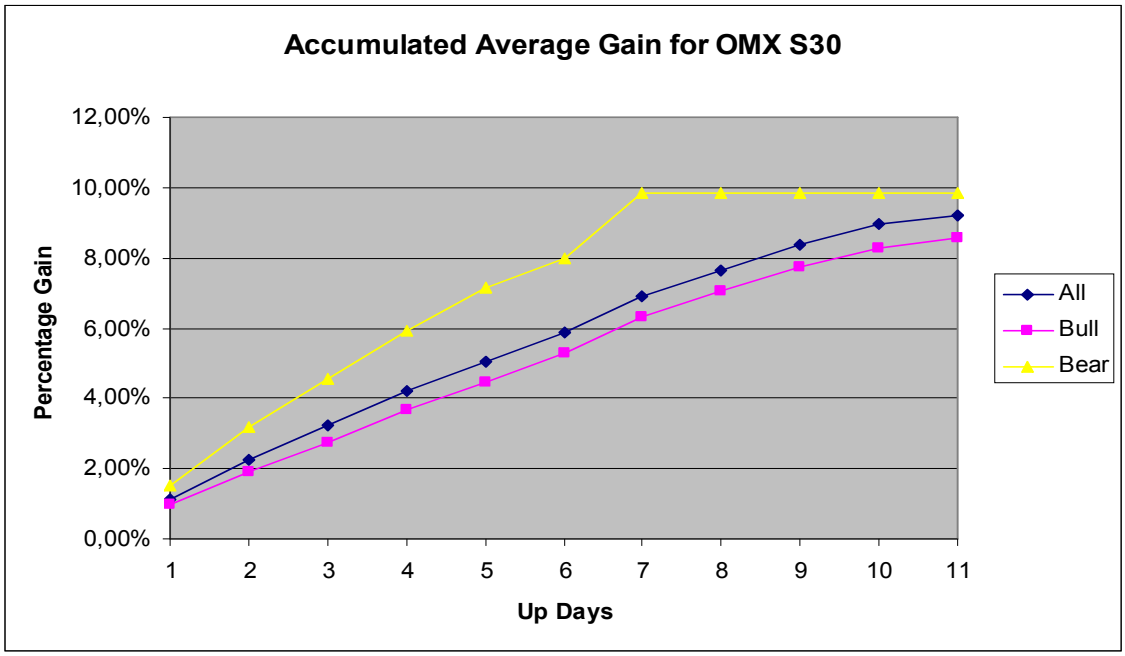

Figure 4.3 shows the accumulated average advance for OMX S30.

Figure 4.3 and 4.4 (see page 35) illustrates the accumulated average advance and decline for OMX S30, respectively. As we can tell from the figures below, the accumulated advance and decline for bear markets is larger than in bull markets, which can be explained by the higher volatility in bear markets.

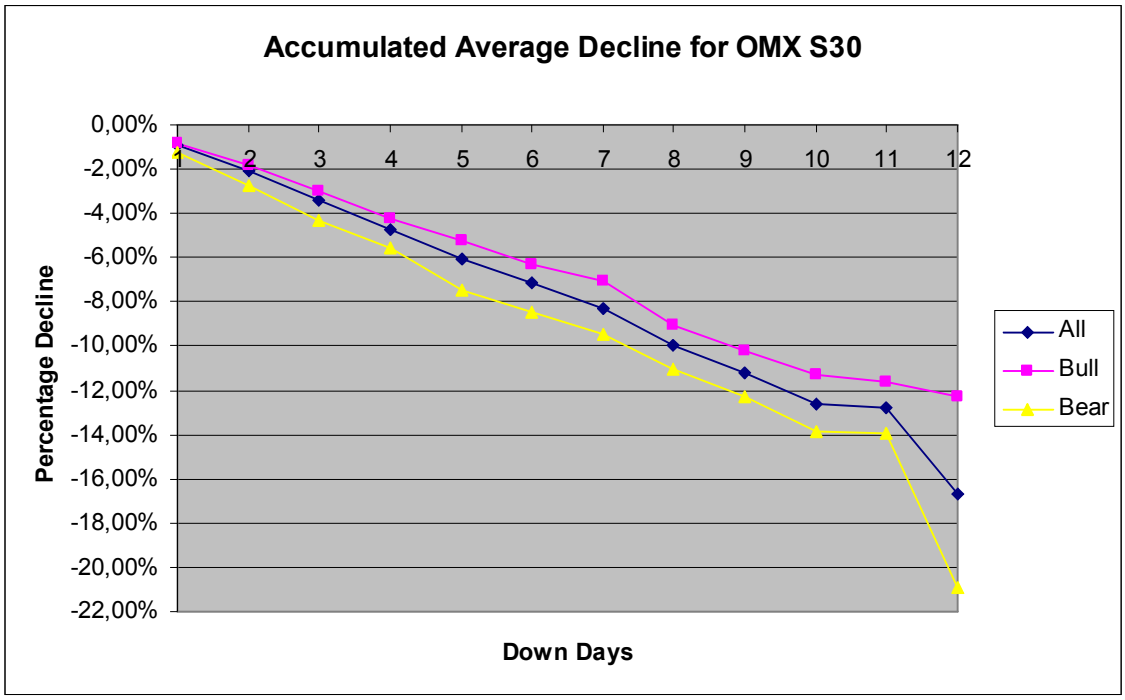

Figure 4.4 shows the accumulated average decline for OMX S30.

4.2.3 Dow Jones EURO STOXX 50 Index

Table 4.9 shows the difference in distributions between a bull market or a bear market or the market in general. The data sample consisted of 2984 up days and 2642 down days. The first column shows the number of days and the other columns shows the distribution of the Dow Jones EURO STOXX 50 as a whole, bull markets and bear markets, respectively. The shaded area illustrates down days.

	All	Bull	Bear	All	Bull	Bear
1	42,47%	43,67%	52,21%	51,65%	52,16%	48,61%
2	24,10%	25,78%	23,76%	25,61%	26,86%	27,22%
3	13,63%	12,89%	12,98%	12,16%	11,43%	12,22%
4	8,61%	7,44%	4,97%	4,72%	4,22%	5,83%
5	5,60%	6,00%	2,76%	3,58%	3,55%	3,61%
6	2,73%	2,11%	2,21%	1,29%	1,11%	1,11%
7	1,58%	1,11%	0,83%	0,57%	0,44%	0,28%
8	0,72%	0,56%	0,28%	0,14%	0,11%	0,28%
9	0,00%	0,00%	0,00%	0,14%	0,00%	0,83%
10	0,14%	0,11%	0,00%	0,14%	0,11%	0,00%
11	0,14%	0,11%	0,00%	-	-	-
12	0,14%	0,11%	0,00%	-	-	-
13	0,14%	0,11%	0,00%	-	-	-
	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%

Table 4.9 shows the distribution for bull and bear markets and the Dow Jones EURO STOXX 50 as a whole. The shaded area is on down days.

Table 4.10 shows the daily advance and decline (shaded area) of the Dow Jones EURO STOXX 50. Each column illustrates the different types of data sample (Dow Jones EURO STOXX 50 as a whole, bull markets, and bear markets) and each row shows the ith consecutive up or down day.

	All	Bull	Bear	All	Bull	Bear
1	0,67%	0,75%	1,35%	-0,62%	-0,68%	-1,15%
2	0,68%	0,72%	1,30%	-0,69%	-0,79%	-1,32%
3	0,65%	0,69%	1,07%	-0,76%	-0,77%	-1,42%
4	0,57%	0,59%	0,63%	-0,80%	-0,85%	-1,12%
5	0,59%	0,60%	1,03%	-1,06%	-1,06%	-1,64%
6	0,63%	0,67%	1,21%	-0,76%	-0,80%	-1,01%
7	0,51%	0,62%	0,42%	-0,36%	-0,51%	-1,29%
8	0,53%	0,68%	0,20%	-0,66%	-0,14%	-2,24%
9	0,42%	0,42%	0,00%	-1,34%	-0,33%	-2,43%
10	0,27%	0,27%	0,00%	-0,77%	-0,77%	0,00%
11	0,29%	0,29%	0,00%	-	-	-
12	0,20%	0,20%	0,00%	-	-	-
13	0,47%	0,47%	0,00%	-	-	-

Table 4.10 shows the daily advance and decline, respectively for bull and bear markets and the Dow Jones EURO STOXX 50 as a whole. The shaded area is on down days.

Table 4.11 shows the significance level α for the Dow Jones EURO STOXX 50 on up movements. What we can tell from table 4.11 is that the average advance in Dow Jones EURO STOXX 50 tends to decrease after each up day in a row. One explanation can be that the move loses some momentum for each new up day, another can be that for each new up day there is fewer observations, thus less chance of a large move.

U/1-α	75%	80%	85%	90%	95%	99%
1	1,16%	1,34%	1,61%	1,98%	2,76%	5,18%
2	1,12%	1,26%	1,45%	1,78%	2,43%	5,03%
3	1,05%	1,14%	1,31%	1,74%	2,04%	3,76%
4	0,89%	1,04%	1,18%	1,33%	1,73%	2,53%
5	0,91%	1,00%	1,18%	1,40%	2,09%	3,06%
6	0,92%	1,00%	1,22%	1,70%	2,20%	5,56%
7	1,06%	1,32%	1,62%	1,64%	1,77%	2,03%
8	0,95%	0,95%	0,96%	0,96%	1,56%	1,56%
9	0,33%	0,33%	0,33%	0,33%	0,33%	0,33%
10	0,79%	0,79%	0,79%	0,79%	0,79%	0,79%
11	0,44%	0,44%	0,44%	0,44%	0,44%	0,44%
12	0,25%	0,25%	0,25%	0,25%	0,25%	0,25%
13	0,47%	0,47%	0,47%	0,47%	0,47%	0,47%

Table 4.11 shows the significance level α on the x-axis and the ith up day on the y-axis for the EURO STOXX 50.

Table 4.12 shows the significance level α for the Dow Jones EURO STOXX 50 on down movements. In this case the table shows an increase in the downward movement with a peak on day 2 (the shaded area is not considered). If we consider the light shaded area, it seems that there tend to be larger than normal movements.

D/1-α	75%	80%	85%	90%	95%	99%
1	-1,11%	-1,26%	-1,48%	-1,78%	-2,40%	-4,88%
2	-1,21%	-1,42%	-1,69%	-2,20%	-2,97%	-5,43%
3	-1,38%	-1,63%	-2,08%	-2,32%	-2,89%	-4,76%
4	-1,36%	-1,52%	-1,74%	-1,93%	-2,60%	-4,84%
5	-1,53%	-1,72%	-2,26%	-3,56%	-4,86%	-7,31%
6	-1,48%	-1,74%	-1,76%	-2,28%	-2,49%	-2,83%
7	-0,87%	-0,87%	-1,25%	-1,25%	-4,38%	-4,38%
8	-1,81%	-1,81%	-3,92%	-3,92%	-3,92%	-3,92%
9	-3,58%	-3,58%	-3,58%	-3,58%	-3,58%	-3,58%
10	-0,77%	-0,77%	-0,77%	-0,77%	-0,77%	-0,77%

Table 4.12 shows the significance level α on the x-axis and the ith up day on the y-axis for the EURO STOXX 50.

Figure 4.5 and 4.6 (see page 38) illustrates the accumulated average advance and decline for Dow Jones EURO STOXX 50, respectively. As we can tell from the figures below, the accumulated advance and decline for bear markets is larger than in bull markets, which can be explained by the higher volatility in bear markets.

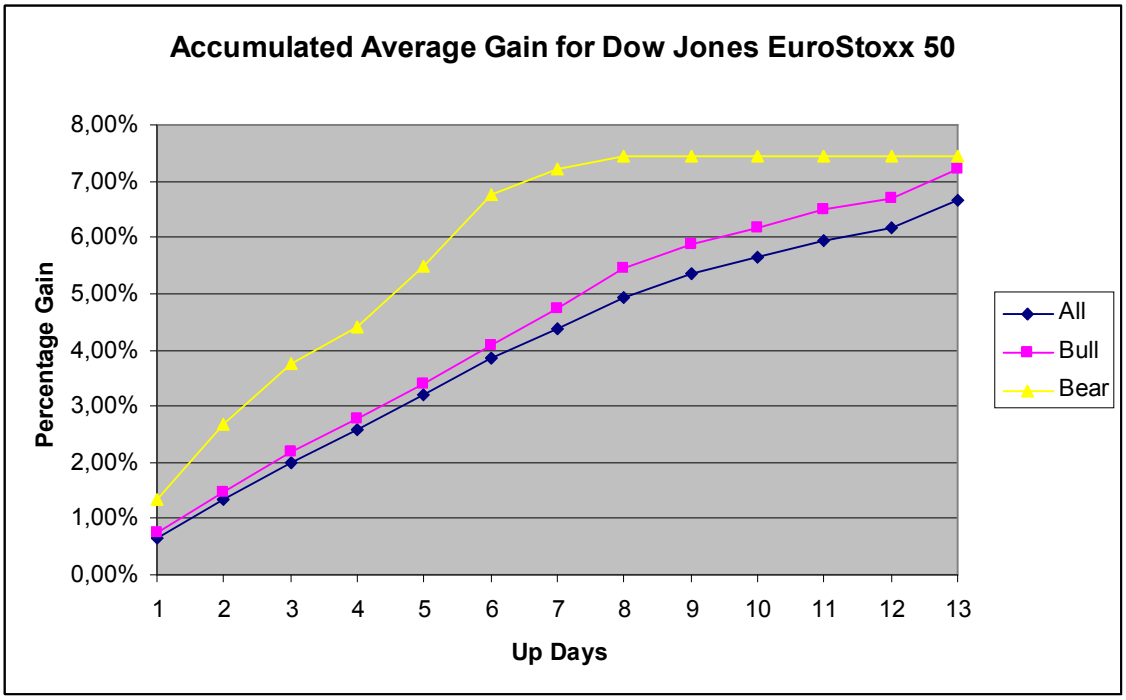

Figure 4.5 shows the accumulated average advance for EURO STOXX 50.

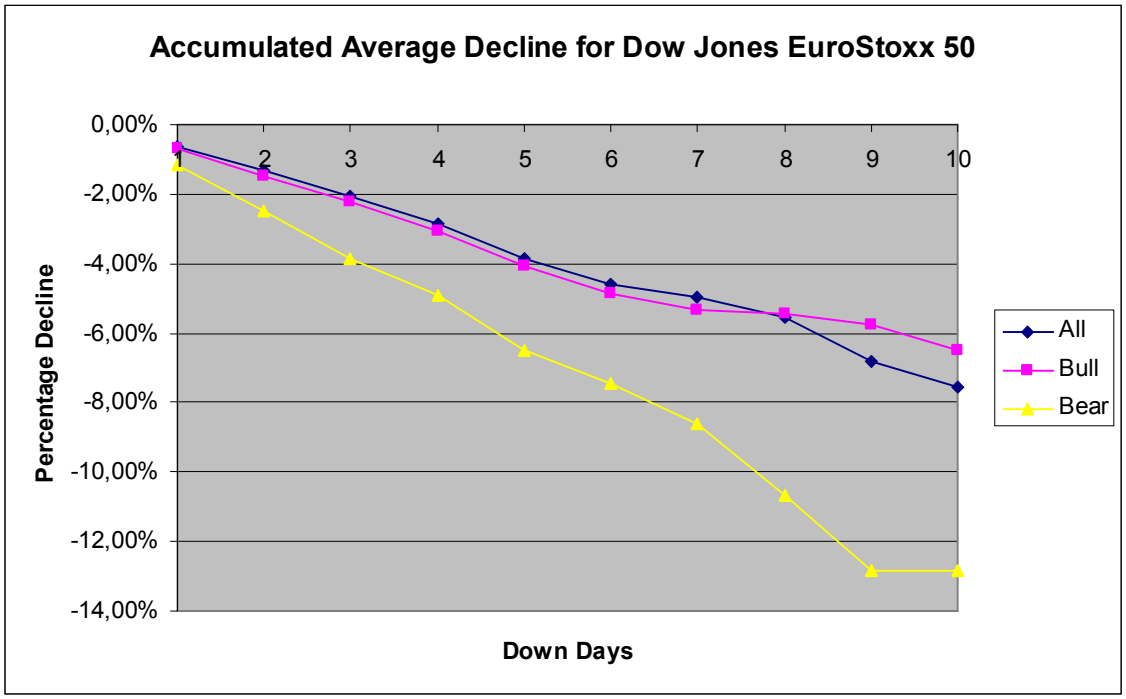

Figure 4.6 shows the accumulated average decline for EURO STOXX 50.

4.2.4 ABB Ltd

Table 4.13 shows the difference in distributions between a bull market or a bear market or the market in general. The data sample consisted of 1434 up days and 1374 down days. The first column shows the number of days and the other columns shows the distribution of the ABB Ltd as a whole, bull markets and bear markets, respectively. The shaded area illustrates down days.

	All	Bull	Bear	All	Bull	Bear
1	48,95%	47,22%	54,92%	51,27%	54,07%	44,16%
2	26,50%	29,78%	22,80%	23,24%	25,68%	22,34%
3	11,44%	10,41%	10,88%	14,23%	11,85%	19,80%
4	6,83%	6,30%	4,66%	6,62%	4,94%	8,63%
5	3,35%	3,39%	4,15%	2,82%	2,22%	2,54%
6	1,81%	1,69%	1,55%	1,27%	0,74%	2,03%
7	0,56%	0,73%	0,52%	0,14%	0,25%	0,00%
8	0,56%	0,48%	0,52%	0,14%	0,00%	0,51%
9	-	-	-	0,00%	0,00%	0,00%
10	-	-	-	0,28%	0,25%	0,00%
	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%

Table 4.13 shows the distribution for bull and bear markets and ABB Ltd as a whole. The shaded area is on down days.

Table 4.14 shows the daily advance and decline (shaded area) of the ABB Ltd. Each column illustrates the different types of data sample (ABB Ltd as a whole, bull markets, and bear markets) and each row shows the ith consecutive up or down day.

	All	Bull	Bear	All	Bull	Bear
1	2,22%	1,62%	3,63%	-2,04%	-1,49%	-3,33%
2	2,25%	1,56%	4,07%	-1,97%	-1,38%	-3,06%
3	2,06%	1,52%	3,79%	-2,50%	-1,68%	-3,64%
4	1,92%	1,28%	3,61%	-2,35%	-1,60%	-3,50%
5	1,84%	1,28%	3,15%	-2,27%	-1,84%	-3,13%
6	2,34%	1,36%	4,95%	-2,73%	-1,26%	-4,58%
7	2,24%	1,14%	5,42%	-1,96%	-0,52%	-4,21%
8	1,76%	3,03%	0,53%	-5,15%	-1,76%	-12,64%
9	-	-	-	-1,68%	-0,12%	-
10	-	-	-	-5,26%	-2,15%	-

Table 4.14 shows the daily advance and decline, respectively for bull and bear markets and ABB Ltd as a whole. The shaded area is on down days.

Table 4.15 shows the significance level α for the ABB Ltd on up movements.

U/1-α	75%	80%	85%	90%	95%	99%
1	2,66%	3,03%	3,77%	4,62%	7,19%	13,17%
2	2,87%	3,32%	3,95%	4,87%	6,42%	11,08%
3	2,26%	2,60%	3,18%	3,80%	8,82%	13,73%
4	2,48%	2,94%	3,43%	4,13%	5,77%	14,74%
5	2,21%	2,78%	3,45%	4,00%	5,63%	11,17%
6	3,45%	3,48%	3,96%	5,54%	5,68%	7,88%
7	5,22%	5,22%	5,22%	5,62%	5,62%	5,62%
8	4,20%	4,20%	4,20%	4,20%	4,20%	4,20%

Table 4.15 shows the significance level α on the x-axis and the ith up day on the y-axis for the ABB Ltd.

Table 4.16 shows the significance level α for the ABB Ltd on down movements. In this case the table shows an increase in the downward movement with a peak on day 4. One explanation why this happens is because when fear is driving the market, it tends to turn into panic after a couple of down days.

D/1-α	75%	80%	85%	90%	95%	99%
1	-2,48%	-2,86%	-3,43%	-4,17%	-5,83%	-9,80%
2	-2,51%	-2,98%	-3,48%	-4,40%	-5,81%	-9,58%
3	-3,51%	-3,87%	-4,55%	-4,98%	-6,04%	-14,75%
4	-2,78%	-3,37%	-3,74%	-5,08%	-7,03%	-22,86%
5	-3,58%	-3,94%	-4,19%	-4,23%	-6,49%	-7,22%
6	-3,90%	-4,63%	-6,69%	-6,69%	-6,86%	-6,86%
7	-4,21%	-4,21%	-4,21%	-4,21%	-4,21%	-4,21%
8	-12,64%	-12,64%	-12,64%	-12,64%	-12,64%	-12,64%
9	-3,24%	-3,24%	-3,24%	-3,24%	-3,24%	-3,24%
10	-8,38%	-8,38%	-8,38%	-8,38%	-8,38%	-8,38%

Table 4.16 shows the significance level α on the x-axis and the ith down day on the y-axis for the ABB Ltd.

Figure 4.7 and 4.8 illustrates the accumulated average advance and decline for ABB Ltd, respectively. As we can tell from the figures below, the accumulated advance and decline for bear markets is larger than in bull markets, which can partly be explained by extreme volatility during the end of 2002 (bear market) when ABB struggled with the asbestos scandal, but also because of the AVP.

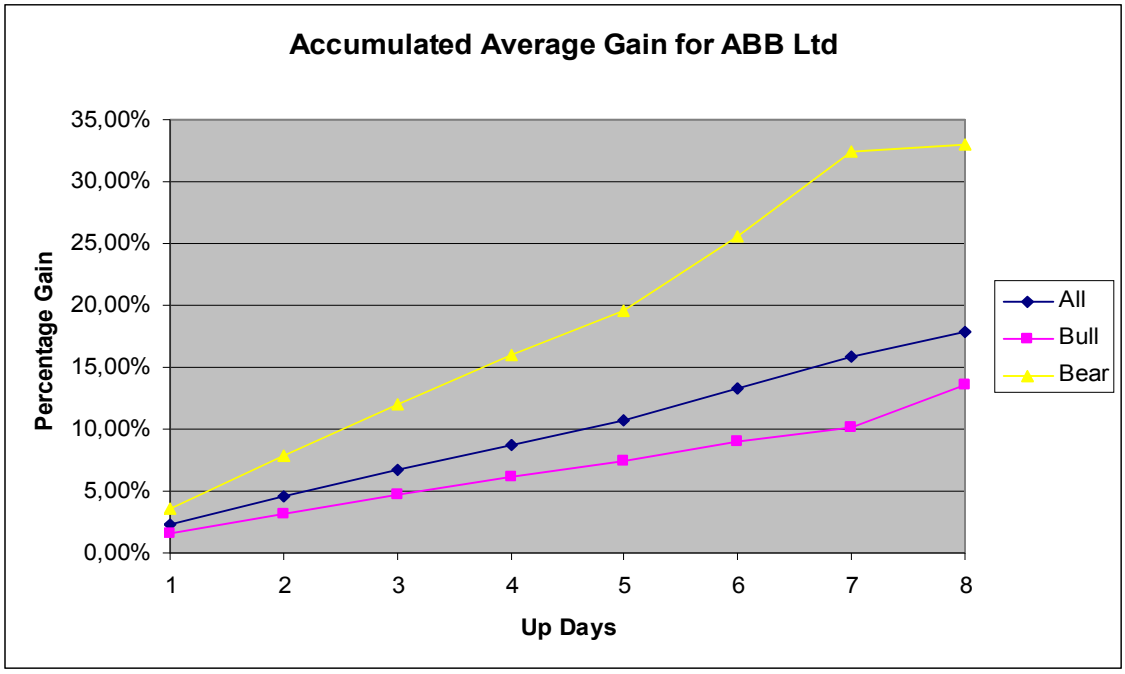

Figure 4.7 shows the accumulated average advance for ABB Ltd.

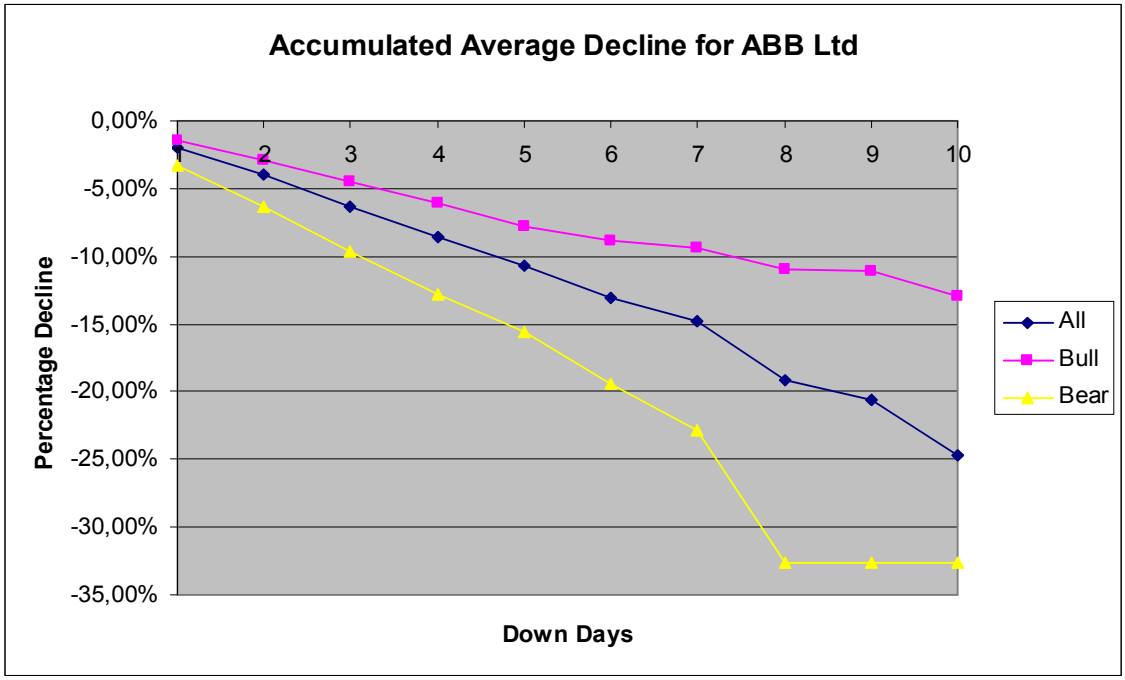

Figure 4.8 shows the accumulated average decline for ABB Ltd.

5. CONCLUSION

In this chapter, we will summarize the result from the previous chapter and draw conclusions regarding them. Finally, we will present suggestions for further studies.

5.1 CONCLUSION

The results regarding the indexes show that they share similar characteristics; we will therefore mainly discuss them as one entity. Our first thoughts concern the calculated distributions for bull and bear markets. When we are drawing our conclusions we are comparing the bull and bear markets relative to one another.

In up trends, the bull market has a larger proportion (relatively to the bear market) of long series of up days, and the bear market has a larger proportion (relatively to the bull market) of short series of up days. Down trends show the opposite results, where bear markets have long series of down days and bull markets tend to have short series of down days.

From table 4.2, 4.6 and 4.10 we can observe the daily average advance and decline on bull and bear markets. The values show that bear markets have higher daily advances/declines than bull markets, which can be explained by higher volatility in bear markets, mainly caused by fear and risk aversion, but also by the asymmetric volatility phenomenon (see section 3.4 or three paragraphs below). This can easily be observed in the graphs where the accumulated average gains/losses are presented.

Furthermore the probability calculations estimate the closing prices for the indexes and the stock for the following day. We have received significant results and the probabilities should be an excellent tool for the short-term trader. The results can be translated in two practical ways.

First, by examining the tables the typical trader can get an estimate of how likely it is that the following day will be an up day or down day. He or she can also examine the accumulated gain and decline tables and there receive and estimate of how much potential there is left in index or stock after a certain amount of up or down days. The second way is to create a trading range with a confidence level between 75 to 99 %. Using our trading range in conjunction with Bollinger bands (see section 3.4), which is normally distributed, will improve the odds significantly.

As expected, the results also confirm the asymmetric volatility phenomenon that we discussed in the Chapter 3. All 3 indexes and the stock show a more volatile price movement in bear markets. The asymmetrical volatility phenomenon is often assumed to be the result of a high

amount of fear of potential losses in bear markets, which is not matched by an equal amount of greed in bull markets.

We conclude that a combination of our life-expectancy distributions for the short-term trend, and VaR, will improve the risk control for market participants. E.g. if the market has fallen for three days in a row, and according to our distribution there is 10 % probability that tomorrow will be a negative day. Using our tables (4.4, 4.8, 4.12 or 4,16) we know that with 99 % confidence the market will not decline more than 4,5 %. If the VaR calculations suggest a 1 % risk of loosing not more than 4 %, we would recommend using our numbers instead, because it is the worst case scenario. Some other time, it may be the other way around. We do not suggest that our historical data should replace Monte Carlo simulation, but to be used in conjunction with it. It can be dangerous to base risk control solely on historic data, because it only measures known risk. Unexpected things do happen, but as a counterargument, history tends to repeat itself. As Jesse Livermore said in his book "How to Trade in Stocks"[17]:

> "Nothing ever changes in the market, the only things that changes are the players, and the new players have no financial memory of the previous major cycles […], because they have not experienced them. It may be new to the speculator – but it's not new to the market."

Once again, we would like to point out that the results and conclusion are in no way the foundation of a trading strategy, but a tool for the short-term trader to use in managing risk and calculating odds.

5.2 FURTHER STUDIES

The number of possibilities of calculating probabilities in the financial market is infinite. Further studies in calculating probabilities could easily be expanded from this thesis into a vast amount of different markets using similar techniques.

An interesting, and to this thesis complementary, approach would be to calculate probability distributions on seasonal indicators. Previous studies have found significant results when calculating the probabilities of direction of the market for weekdays and for the immediate days previous to a holiday. According to Zweig (1997, p. 162) the days around holidays have extraordinarily strong seasonal tendencies and one can also find strong seasonal indicators between weekdays.

[17] Smitten ed. (2001, p. 175) has reprinted the book, but it is a word for word transcription of the original "How to Trade in Stocks" from 1940.

> "But even if you do not trade stocks actively around the holidays, it must be acknowledged that the price behavior at these times is truly extraordinary and anything but random." (Zweig, 1997, p. 162)

Another interesting approach would be to perform a statistical test on the historical data, to see whether if it has correlation between the members of observations (ordered in time) or not. This phenomenon is also known as autocorrelation and if detected could show that the estimated variances are potentially biased (Gujarati, 2006, p. 428)

Finally, we would like to end the thesis with the same quote we included in the introduction:

> "Nobody beats the market, they say. Except for those of us who do."

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APPENDIX

A. EXCEL ALGORITHMS USED

4th Column

We wanted to determine if the return on day *t* was positive, and if it was true, it will return the number one, and if it was false it will return the number zero. The number will be put in the fourth column for day *t*.

$\text{IF}\,(return_t > 0;1;0)$

5th Column

We wanted to determine if the return on day *t* is negative, and if it was true, it will return the number 1, and if it was false it will return the number 0. The number will be put in the fifth column for day *t*.

$\text{IF}\,(return_t < 0;1;0)$

6th Column

We wanted to determine if the fourth column (i.e. up day) on day *t* was equal to 1. If it was true, it will return the number from day $t+1$, and if it was false it will return the number zero. The number will be put in the fifth column for day *t*.

$\text{IF}\,(up_t = 1; up_{t-1} + 1;0)$

7th Column

We wanted to determine if the fifth column (i.e. down day) on day *t* was equal to 1. If it was true, it will return the number from day $t+1$, and if it was false it will return the number zero. The number will be put in the fifth column for day *t*.

$\text{IF}\,(down_t = 1; down_{t-1} + 1;0)$

8th Column

We wanted to determine if the sixth column (i.e. the number of the up day) on day $t+1$ was equal to 0. If it was true, it will return the number from day *t* from the sixth column, and if it was false it will return the number zero. The number will be put in the eighth column for day *t*.

$\text{IF}\,(\#up_{t+1} = 0; \#up_t;0)$

9th Column

We wanted to determine if the seventh column (i.e. the number of the down day) on day $t+1$ was equal to 0. If it was true, it will return the number from day *t* from the seventh column, and if it was false it will return the number zero. The number will be put in the ninth column for day *t*.

IF $(\#down_{t+1} = 0; \#down_t; 0)$

10th to 23th Column

We wanted to determine the number of the maximum number of up days in a row for each up-trend, and put the number in right place. We had 14 columns, ranging from 1 up day to 14 up days. If the value of day *t* equals to the column number *N* minus 9, where *N* is between 10 and 23. If it was true, it will return the number 1 in column *N* (i.e. $\#up_t + 9$), and if it was false it will return the number zero. The number will be put in the Nth column for day *t*.

IF $(\#up_t = N - 9; 1; 0)$

24th to 37th Column

We wanted to determine the number of the maximum number of down days in a row for each down-trend, and put the number in right place. We had 14 columns, ranging from 1 down day to 14 down days. If the value of day *t* equals to the column number *N* minus 23, where *N* is between 24 and 37. If it was true, it will return the number 1 in column *N* (i.e. $\#down_t + 23$), and if it was false it will return the number zero. The number will be put in the Nth column for day *t*.

IF $(\#down_t = N - 23; 1; 0)$

38th to 51st Column

We wanted to determine if the number in the sixth column on day *t* was equal to the column number *N* (where *N* is between 10 and 23) minus 9. If it was true, it will return the return (yield) for day *t* in column *N* (i.e. $\#up_t + 9$), and if it was false it will return the number zero. The number will be put in the Nth column for day *t*.

IF $(\#up_t = N - 9; return_t; 0)$

52nd to 65th Column

We wanted to determine if the number in the seventh column on day *t* was equal to the column number *N* (where *N* is between 24 and 37) minus 23. If it was true, it will return the return (yield) for day *t* in column *N* (i.e. $\#down_t + 23$), and if it was false it will return the number zero. The number will be put in the Nth column for day *t*.

IF $(\#down_t = N - 23; return_t; 0)$