Master thesis

At University of Stavanger

av Jyri Egil Larikka

- Evaluation of different estimating techniques to generate best possible total return on investing on individual stocks on Oslo Stock Exchange -

Using Momentum strategy and Adaptive market hypothesis in a pair trading context.

Exam code and name:

MØA HOV Master Thesis

Spring 2010

Abstract

My intension with this thesis is to present three different kinds of models to analyze stock market and to find good buy candidates. They use different methodology as the first is using pair-trading, the second is using technical analysis and the third is using regression analysis.

The first model uses momentum strategy and adaptive market hypothesis in a pair trading context to dynamically generate good pairs of stocks based on their log return and correlation between each other. At first I generate a log return overview with a correlation matrix for all the stocks at Oslo Stock Exhange for a period of 3-12 months. Then I use the accumulated log return and correlation between the stocks in a sertain way to pick pairs of stocks and generate so called algo sheets. Both of the stocks must have higher log return than a user specified limit and on the other side I want the correlation to be lower than a user defined limit. I believe that this will give **good switching opportunities between the pair of stocks** since the individual stocks in the pair move differently from each other. This differs quite radically in the use of correlation compared to CAPM model where the beta represents correlation of the individual stocks return compared against the market return. In CAPM a high correlation with the market gives higher returns. This model has an order book-, order book history-, budget- and portfolio-sheet integrated in to it. While the benchmark (OSEAX index) has declined by 6.72% in the period from 14.5.2010 unntil 07.07.2010 has mine algorithm increased by 2.64%. This is 9,36% better than the benchmark in a period of 35 trading days. This is documented in the real time simulation logged in order book history.

The second model I use a technical analysis tool called Moving Average Convergence and Divergence to calculate Exponential Moving Average and to find stocks which have momentum to rise fastest based on the fastest increasing difference between MACD and 9-day EMA of MACD from the bottoming during the last three days. This model produces MACD sheets for all the stocks on Oslo stock exchange and summarizes it in a momentum sheet with Buy, Hold or Sell recommendations. This model does not have order book history jet and cannot therefore document its performance from real time simulation.

The third model which contains *five sub models* I use **regression analysis** to look at oil prices, S&P100, FTSE100 and GDAXI indexes descriptive power concerning the 10 year monthly development of ACY (Agercy) stock. I summarize the models performance at the end. This concludes that the DL model with all the four independent variables and their lagged values gives best $R^2_{adjusted.}$

Contents

Preface

This report is written under main profile of financial economy as last part of the Master in Economy and Administration study at University of Stavanger. The work with the study has been time consuming, exiting and not least a good learning process.

My focus has been to exploit the theory witch I can use to combine with algorithm- and quantitative trading models.

In the process I have got many new ideas but I have to limit myself to limited number of models.

My instructor has been Associate Professor of Finance Lorán G. Chollete at
Faculty of Social Sciences, Dept of Business Administration at University of Stavanger.
He has been an excellent support and I thank him for that.

Introduction

In my master thesis I was interested in studying different estimating techniques for the stock market which can be used in algorithm trading context. Therefore I have concentrated in studying different techniques for estimating stock prices and testing them through different excel models.

My goal is to get better understanding of different estimating techniques and try to develop some of my own techniques. It would be nice to make some models which I can use later on in trading stocks.

To make suitable for my investing goal I have concentrated on daily stock prices and intraday prices of the present day in model 1 and 2 while model 3 uses monthly prices in a ten year period.

Problem for discussion

Is it possible to generate better than benchmark profit due switching between different stocks based on algorithms?

This is tested in model 1 and 2.

Is it possible to generate better than benchmark profit by focusing on "smaller" companies (but still relatively liquid) because of the latency caused by slow reaction to price changes?

This is tested in model 1 and 2.

Can MACD histogram analysis give early signals for trading stocks?

This is tested in model 2.

Is it possible to use regression analysis to detect regime shifts in the long term trends?

This is tested in model 3.

This study is divided in two parts where in the **first part** I present some theories relevant to estimating stock prices "in the light of algorithm trading" and in the **second part** I present the models which I have made and describe them.

I have made **three models**:

1. My own pair trading strategy which uses momentum strategy and adaptive market hypothesis to choose between the stocks in a pair trading context based on 150 most liquid stocks on Oslo Stock Exchange.
2. Moving Average Convergence Divergence (MACD) model over 150 most liquid stocks at Oslo Stock Exchange where I use MACD histogram propose stocks which have are moving fastest upward during the past three days from the previous minimum point in the histogram. In this way I hope to give an early signal for potentially good investments even before the moving average crossing.
3. Five linear regression models where I use Oil price, S&P100, FTSE100 and GDAXI to study descriptive power of these for Agercy stock on Oslo Stock Exchange index.

The common thing with the two first models is that I use VBA (Visual Basic in Excel) and Access to daily retrieval and analyze of the data. Both of these models retrieve all the stocks in Oslo Stock Exchange as input.

Model 1

The main focus will be in presenting the model where I have used most of the time. In this model I use Excel, VBA and Access as development platform. In the process I have learned a lot of Visual Basic skills to make the model very flexible and automated.

I collect all the Oslo Stock Exchange for a selected period of daily prices normally between 3 and 12 months as Narasimhan Jegadeesh and Sheridan Titman is the optimal length for their Momentum strategy(N. Jegadeesh & Titman, 2001). In the analysis here I have used a period of approximately 10 months that will see from 7.8.2009 until today. In the period of order book history generation I have also recently looked at shorter time window starting from

01.01.2010 to experiment what effect it has when the prices has fallen exceptionally in the recent week (last week of June 2010). I calculate their log returns and produce a correlation matrix. Then I mark the combinations which I want to go further with based on their log return and correlation in the selected period. I want the pairs to have high log return and low correlation. It means also that the stocks in the pair move in a cointegrated fashion by ending up with a high log return in the selected period. I have chosen to use low correlation so that the stocks chosen in a pair move quite differently from each other giving good switching opportunities. For those pairs that satisfy the selection criteria I produce so called "algo sheets" where I can compare the two individual stocks and three other switching techniques. The last switching technique is what I focus on most because it produces the best results. It has build in "sensitivity simulation" based on recent day's correlation and log return development. This sensitivity limits the number of switching on the other hand but also gives good signals when to switch. In all the algo sheets there is a graph which shows the development of the two individual stocks and the three switching algorithms. The last switching technique also marks the switching points in the graph.

This is the basis for creating a sorting overview (NewOverviewSorted) with the best performing pairs at the top. The top ranged pairs are used further in order book generation. This procedure is run usually ones a day and the user can adjust the log return limit and the correlation limit. All input values are stored in order book for later references.

This algorithm shows through back testing that it performs quite well through switching and choosing the best candidate based on the previous days correlation and log return.

I also collect during the day intraday data every 15 minutes for the selected stocks which is being used for collecting the present prices. This automatic update can be turned off and run after user desired time by clicking the button "MakeIntraDaySheets".

I made it possible to choose between two methods in choosing between the stocks either based on the last "big" daily download or based on the newest prices from intraday sheets. There is no restriction on running the "big" daily download even more frequently. But after every "big" download one has to run log return sheet generation and algorithm sheet generation called "MakeMarkedCombinations". All this will take approximately five minutes. In both of the methods I have restrictions that the stock must have positive development today or else it will not generate a buy order.

The system generates sell orders in case of negative development. There are two exit strategies. If the stock is still a recommended stock but has negative development today it will sell gradually down the volume. In case it is not any more recommended it will sell down all the stocks on that stock in case the daily percentage change is more negative than the user defined limit for exit strategy. When the stock is not any more recommended it means that it is not included in any newly generated algo sheets.

I can generate order book at any time. It is based on the most resent "Make Marked Combinations" run. I can view the order book before I decide if I want to move it to order book history sheet (activating). Ones it is activated through moving it to order book history it maintains a portfolio and budget sheet. Budget sheet shows the available cash at any time and the portfolio shows how many stocks you have or have had and what gains or losses one have had with the individual stocks.

I wanted to make a model which made use of correlation between stocks and at the same time looks at their log returns. This leaded me to study pair trading strategy and momentum strategy on the other hand. This pair trading strategy generates pairs that have low correlation between the two stocks but at the same time have high log return on both of the stocks. This combined with momentum strategy in the last stage where I choose the best stock of the pair based on most recent development ("best intraday price gain" or "last line recommendation from algo sheet" depending on the user chosen method (Intraday- or History method)). And the same time have exit strategies to quickly exit the positions in case of negative development. I believe this combination of strategies can make a good strategy because it has a set of tools called correlation, log return and momentum strategy in a "pair trading context". This system also has an integrated budget sheet, order sheet, order history sheet, portfolio sheet, adjusted closing price history sheet, log return sheet, algo sheets (stock pairs), overview and sorted overview, a graphical presentation of sorted overview, new overview and new sorted overview and a new graphical presentation of sorted overview. The difference between the sheets using new prefix is that they use effective interest while the other sheets with similar names without new prefix use continuous compounding interest.

Model 2

I have made a MACD model which collects the 150 most liquid stocks from Oslo stock exchange and generates a MACD model for each of them. This model uses the **same input file as model 1** but does not cross tabulate the data. Then I look at the MACD histograms and

look at which of the stocks has bottomed (in the histogram) in the past days and which stock are increasing fastest from the "bottoming" during the past 5 days and generate a ranked list based on that in to the Momentum sheet. This column together with a column "last top/bottom indicator" and "number of days since last top/bottom" are inputs to generate the "Buy/Hold/Sell signal column". To give a buy signal the "last top/bottom indicator" must be bottom and the "number of days since last top/bottom" must be higher than 3 days. To give a sell signal the "last top/bottom indicator" must be a "top" and the "number of days since last top/bottom" must be higher than 3 days. Otherwise "hold" signal. I sort this group of columns in descending order by signal and ascending by the size of the accumulated change giving the best buy candidates on the top of the list and the best sell candidates on the bottom of the list.

MACD is a popular tool for technical analysis. In this model I show that it is possible to use VBA to analyze large number of stocks and rank the result afterwards therefore giving buy, sell or hold signals. To properly document the results for this model it should have integrated order book, order book history, budget and portfolio as in model 1. Then it could be possible to see if it performs good or bad in real time situations. This kind of calculation of signals may give many false signals since they are very early signals.

Model 3

In this model I make five different sub models where I look at different combinations of Oil price, S&P100, FTSE100, and GDAXI on Agercy stock on Oslo Stock Exchange. Both lagged and not lagged values. I use regression analysis and calculate t-tests and f-tests to determine the "descriptive power" of different independent variables on the dependent variable of Agercy.

In this type of models I see potential to utilize VBA too but because of the lack of time I have used just Excel. This kind of model could give indications on regime shifts. This could be an input to other models regarding if to use trending or mean-reverting models in estimating individual stock price changes.

The construction of this document

Concerning to construction of this document I have made **four different Appendixes** to make the main part easier to read and to make it possible for the reader to use the appendixes as "more detailed" lookup source in case needed:

1. **Installation instructions.** This Appendix tells you how to install the applications.

2. **Textual Appendix.** With more detailed information of theories in case the reader needs more information of specified subjects.

3. **Screenshot Appendix.** Here I have collected different screenshots from the applications to let the reader do lookup on the screen layouts to easier understand the text which describes the applications.

4. **VBA Appendix.** This includes the two parts of code in both model 1 and model 2. Model 3 does not have any VBA code at the moment.

I will start to go through some theories before I present the models in the method section.

Theory

In the following I will go through some theories that are relevant to predicting of stock market development and describe some systems of concepts.

Market trend

A market trend is a putative (presumed) tendency of a financial market to move in a particular direction over time (Fontanills & Gentile, 2001). These trends are classified as *secular* trends for long time frames, *primary* trends for medium time frames, and *secondary* trends lasting short times(Edwards, Magee, & Bassetti, 2007b). Traders identify market trends using technical analysis, a framework which characterizes market trends as a predictable price response of the market at levels of price support and price resistance, varying over time.

The terms bull market and bear market describe upward and downward market trends, respectively, and can be used to describe either the market as a whole or specific sectors and securities(Edwards, Magee, & Bassetti, 2007a).

Secular market trends

A secular market trend is a long-term trend that lasts 5 to 25 years and consists of a series of sequential primary trends. In a secular bull market the prevailing trend is bullish or upward moving. In a secular bear market, the prevailing trend is bearish or downward moving. (Wikipedia.org, 2010n)

Primary market trends

A primary trend has broad support throughout the entire market or market sector and lasts for a year or more.(Wikipedia.org, 2010n)

Bull market

A bull market is associated with increasing investor confidence, and increased investing in anticipation of future price increases (capital gains). A bullish trend in the stock market often begins before the general economy shows clear signs of recovery. It is a win win situation for the investors.(Wikipedia.org, 2010n)

Bear market

A bear market is a general decline in the stock market over a period of time(O'Sullivan & Sheffrin, 2007). It is a transition from high investor optimism to widespread investor fear and pessimism.(Wikipedia.org, 2010n)

Market top

A market top (or market high) is usually not a dramatic event. The market has simply reached the highest point that it will, for some time (usually a few years). It is, by definition, retroactively defined as market participants are not aware of it as it happens. A decline then follows, usually gradually at first and later with more rapidity.

Market bottom

A market bottom is a trend reversal, the end of a market downturn, and precedes the beginning of an upward moving trend (bull market). It is very difficult to identify a bottom (referred to by investors as "bottom picking") while it is occurring. The upturn following a decline is often short-lived and prices might resume their decline. This would bring a loss for the investor who purchased stock(s) during a misperceived or "false" market bottom.

Secondary market trends

Secondary trends are short-term changes in price direction within a primary trend. The duration is a few weeks or a few months. One type of secondary market trend is called a market correction. A correction is a short term price decline of 5% to 20% or so(Edwards, et al., 2007a). Another type of secondary trend is called a bear market rally which consists of a market price increase of 10% to 20%.

A **rally** is a period of sustained increases in the prices of stocks, bonds or indexes. This type of price movement can happen during either a bull or a bear market, when it is known as either a bull market rally or a bear market rally, respectively. However, a rally will generally follow a period of flat or declining prices.(investopedia.com, 2010)

Investor sentiment

Investor sentiment is a contrarian stock market indicator.

In science, the term "contrarian" is often applied to those who reject a general scientific consensus on some particular issue, as well as to scientists who pursue research strategies which are rejected by most researchers in the field.

By definition, the market balances buyers and sellers, so that there is a balance between positive and negative sentiment. Thus it is impossible for a high proportion of market participants to have negative or positive sentiment. However it is possible to argue that when a high proportion of *financial commentators and advisors* express a bearish sentiment, some people consider this as a strong signal that a market bottom may be near. The predictive capability of such a signal is thought to be highest when investor sentiment reaches extreme values(Hulbert, 2008). Indicators that measure investor sentiment may include:

- ***Investor Intelligence Sentiment Index***: *If the Bull-Bear spread (% of Bulls - % of Bears) is close to a historic low, it may signal a bottom*. If the % of Bulls is at an extreme high and the number of Bears is at an extreme low, historically, a market top may have occurred or close to occurring.
- ***American Association of Individual Investors (AAII) sentiment indicator***. It is reported *ones a week each Thursday morning by 9:00 AM EST*. They ask their membership where they think the market will be in six months, and group the responses into three categories: bullish, bearish or neutral. The *bull ratio* is calculated as follows: *AAII BULL RATIO = % BULLS / (% BULLS + % BEARS)* (Sundial Capital Research, 2007).
- Other sentiment indicators include the *Nova-Ursa ratio*, the *Short Interest/Total Market Float*, and the *Put/Call ratio*.

Market capitulation

Market capitulation refers to the threshold reached after a severe fall in the market, when large numbers of investors can no longer tolerate the financial losses incurred. This may trigger a further decline in the stock's price, if not already anticipated by the market.

The contrarians consider a capitulation a sign of a possible bottom in prices. This is because almost everyone who wanted (or was forced) to sell stock has already done so, leaving the buyers in the market, and they are expected to drive the prices up.

The peak in volume may precede an actual bottom.(Wikipedia.org, 2010n)

Quantitative trading

By some estimates, **quantitative or algorithmic trading** now accounts for over one-third of the trading volume in the United States (Chan, 2009). Chan presents ways for how an independent, retail trade can benefit from these algorithms. Normally is the arena for large hedge funds. He makes a point that it can be an advantage sometimes to be small to better gain profit from stock price movement.

Quantitative trading represents an investing technique typically employed by the most sophisticated, technically advanced hedge funds. These quant shops employ fast computers to find predictable patterns within financial data. Typically, quant investing is implemented by people who have spent time in the physics, math, computer science, or statistics disciplines.(Wikipedia.org, 2010u)

The process consists of thorough examination of vast databases searching for repeating patterns, typically positive or negative correlations among liquid assets ("statistical arbitrage" or "pairs trading"), or price-movement patterns ("trend following" or "mean reversion").(Wikipedia.org, 2010u)

In electronic financial markets algorithmic trading is the use of computer programs for entering trading orders with the computer algorithm deciding on aspects of the order such as the ***timing***, ***price***, or ***quantity*** of the order, or in many cases initiating the order without human intervention. In this "high frequency trading" (HFT) computers make the decision to initiate orders based on information that is received electronically, before human traders are even aware of the information.(Wikipedia.org, 2010b)

Algorithmic trading may be used in any investment strategy, including market making, inter-market spreading, arbitrage, or pure speculation (including trend following). The investment decision and implementation may be augmented at any stage with algorithmic support or may operate completely automatically ("on auto-pilot")(Wikipedia.org, 2010b).

As of 2009, high frequency trading firms account for 73% of all US equity trading volume(Lati, 2009). The foreign markets are following after.

One of the main issues regarding high frequency trading is the difficulty in determining just how profitable it is. A report released in August 2009 by the TABB Group, a financial

services industry research firm, estimated that the 300 securities firms and hedge funds that specialize in rapid fire algorithmic trading took in roughly $21 billion in profits in 2008 (Wikipedia.org, 2010b).

I believe that for a small investor there can be possible to make money in specific segments on volatility of stock prices. My model seems to pick stocks with relatively high volatility which is not the most popular stocks. I hope the big algo trader companies are not too much involved in that segment so that I can make money with fast reacting algorithms to give me signals on when to buy and sell.

Issues and developments

Financial market *news* is now being formatted by firms such as Thomson Reuters, Dow Jones, and Bloomberg, *to be read and traded on via algorithms*.

"Computers are now being used to generate news stories about company earnings results or economic statistics as they are released. And this almost instantaneous information forms a direct feed into other computers which trade on the news."(van Duyn, 2007)

I see a possibility to get recent news to my application trough a news portal called "Proff Forvalt" with a homepage called http://www.forvalt.no. I recently was receiving news on companies that I had as recommended stocks in my portfolio. This site gives information on the fundamental data and recent news connected to the company. This portal scans new from more than 1200 news sources. It categorizes the news on good, bad and neutral news. To be a member you have to pay a monthly fee around 500 NOK. This might be an idea for further development to receive information directly to my application and use it as decision basis to verify or decide order generation.

Effects

Competition is developing among exchanges for the fastest processing times for completing trades. For example the London Stock Exchange, in June 2007, started a new system called Trade Elect, which promises an average 10 millisecond turnaround time from placing an order to final confirmation, and can process 3,000 orders per second. (Wikipedia.org, 2010b)

Efficient Market Hypothesis

Efficient-market hypothesis claims that financial markets are "information ally efficient". The Efficient-market hypothesis claims one cannot consistently achieve returns in excess of

average market returns on a risk-adjusted basis. There are three major versions of the hypothesis: "weak", "semi-strong", and "strong".

1. **Weak** Efficient-market hypothesis claims that prices on traded assets already reflect all past publicly available information.
2. **Semi-strong** Efficient-market hypothesis claims both that prices reflect all publicly available information and those prices instantly change to reflect new public information.
3. **Strong** Efficient-market hypothesis additionally claims that prices instantly reflect even hidden or "insider" information.

There is evidence for and against the weak and semi-strong Efficient-market hypothesis, while there is powerful evidence against strong Efficient-market hypothesis.

Random walk hypothesis

The random walk hypothesis is a financial theory stating that stock market prices evolve according to a random walk and thus the prices of the stock market cannot be predicted. Economists have historically accepted the random walk hypothesis. They have run several tests and continue to believe that stock prices are completely random because of the efficiency of the market. This idea was first introduced by Paul Cootner in the book “The Random Character of Stock Market Prices” (Cootner, 1964) and later popularized by Burton Malkiel in his book “A Random Walk Down Wall Street” (Malkiel, 1973).

Random walk with drift (non-random walk hypothesis)

There are other economists, professors, and investors who believe that the market is predictable to some degree. These people believe that prices may move in trends and that the study of past prices can be used to forecast future price direction. There have been some economic studies that support this view, and a book has been written by two professors of economics that tries to prove the random walk hypothesis wrong.

Martin Weber(Glaser, Noeth, & Weber), a leading researcher in *behavioral finance*, has performed many tests and studies on finding trends in the stock market. In one of his key studies, he observed the stock market for ten years. Throughout that period, he looked at the market prices for noticeable trends and found *that stocks with high price increases in the first five years tended to become under-performers in the following five years*. Weber and other

believers in the non-random walk hypothesis cite this as a key contributor and contradictor to the random walk hypothesis.

Another test that Weber ran that contradicts the random walk hypothesis, was finding *stocks that have had an upward revision for earnings outperform other stocks in the forthcoming six months*. With this knowledge, investors can have an edge in predicting what stocks to pull out of the market and which stocks — the stocks with the upward revision — to leave in. Martin Weber's studies detract from the random walk hypothesis, because according to Weber, there are *trends and other tips to predicting the stock market*.

Professors Andrew W. Lo and Archie Craig MacKinlay, professors of Finance at the MIT Sloan School of Management and the University of Pennsylvania, respectively, have also tried to prove the random walk theory wrong. They wrote the book *A Non-Random Walk Down Wall Street (Andrew W. Lo & MacKinlay, 1999)*, which goes through a number of tests and studies that try to prove there are trends in the stock market and that they are somewhat predictable.

They prove it with what is called the simple volatility-based specification test, which is an equation that states:

$$X_t = \mu + X_{t-1} + \varepsilon_t$$

Where

X_t is the price of the stock at time t

μ is an arbitrary drift parameter

ε_t is a random disturbance term.

With this equation, they have been able to put in stock prices over the last number of years, and figure out the trends that have unfolded. They *have found small incremental changes in the stocks throughout the years*. Through these changes, Lo and MacKinlay believe that the stock market is predictable, thus *contradicting the random walk hypothesis*.

Adaptive market hypothesis

The Adaptive Market Hypothesis, as proposed by Andrew Lo(Andrew W. Lo, 2005), is an attempt to reconcile theories that imply that the markets are efficient with behavioral

alternatives, by applying the principles of evolution - competition, adaptation, and natural selection - to financial interactions(Cloves, 2005).

Under this approach the traditional models of modern financial economics can coexist alongside behavioral models. He argues that much of what behavioralists cite as counterexamples to economic rationality - loss aversion, overconfidence, overreaction, and other behavioral biases - are, in fact, consistent with an evolutionary model of individuals adapting to a changing environment using simple heuristics.(Cloves, 2005)

According to Lo, the Adaptive Markets Hypothesis can be viewed as a new version of the efficient market hypothesis, derived from evolutionary principles. "Prices reflect as much information as dictated by the combination of environmental conditions and the number and nature of "species" in the economy." By species, he means distinct groups of market participants, each behaving in a common manner (i.e. pension funds, retail investors, market makers, and hedge-fund managers, etc.). If multiple members of a single group are competing for rather scarce resources within a single market, that market is likely to be highly efficient, e.g., the market for 10-Year US Treasury Notes, which reflects most relevant information very quickly indeed. If, on the other hand, a small number of species are competing for rather abundant resources in a given market, that market will be less efficient, e.g., the market for oil paintings from the Italian Renaissance. Market efficiency cannot be evaluated in a vacuum, but is highly context-dependent and dynamic. *Shortly stated, the degree of market efficiency is related to environmental factors characterizing market ecology such as the number of competitors in the market, the magnitude of profit opportunities available, and the adaptability of the market participants* (Andrew W. Lo, 2005)

The Adaptive Market Hypothesis has several implications that differentiate it from the Efficient-market hypothesis such as:

1. To the extent that a relation between *risk* and *reward* exists, it is *unlikely to be stable over time.*
2. Contrary to the classical Efficient-market hypothesis, there are *arbitrage opportunities from time to time.*
3. *Investment strategies will also wax and wane, performing well in certain environments and performing poorly in other environments*. This includes quantitatively-, fundamentally- and technically-based methods.

4. Survival is the only objective that matters while profit and utility maximization are secondary relevant aspects.
5. *Innovation is the key to survival because as risk/reward relation varies through time,* the better way of achieving a consistent level of expected returns is to *adapt to changing market conditions.(Wikipedia.org, 2010a)*

In my model 1 and 2 I use daily updates of data and daily generation of best candidates for the portfolio. I claim that the models are therefore flexible over time and therefore adapt to changing market conditions.

Recent studies in behavioral finance - studies of how people make decisions involving money - show that in fact, investors are "often - if not always - irrational, exhibiting predictable and financially ruinous behavior," according to Andrew Lo.

Mr. Lo has proposed a different hypothesis, which incorporates the insights offered by behavioral finance into capital markets theory.

In effect, his hypothesis, which he calls the adaptive-market hypothesis, attempts to combine the concepts underlying the efficient-market hypothesis with behavioral-finance revelations about the way people behave.

Mr. Lo's hypothesis assumes that individuals make choices that are merely satisfactory, not necessarily optimal. That is, they are "satisfiers," not "optimizers." That's because "optimization is costly, and humans are naturally limited in their computational abilities."

He argued that individuals make choices based on past experience and their "best guess" as to what might be satisfactory for them. They use shortcuts based on experience to make decisions on the various economic challenges they face. As long as the challenges remain stable, these shortcuts will eventually adapt to yield approximately optimal solutions.

If the environment changes, however, the old decision rules may no longer work. They appear to be "behavioral biases."

If many of these groups compete for rather scarce resources within a single market, the market is likely to be highly efficient. *If a small number of groups compete for abundant resources, the market will be less efficient.*

Under his hypothesis, because people use shortcuts to help in decision making, behavioral biases abound.

The effect of these biases on the market is determined by the size of the group with a bias, relative to the sizes of groups using more-effective decision models. That is, any *relationship between risk and reward is unlikely to be stable* and is determined by the relative sizes and preferences of the various populations in the market.

Also under Mr. Lo's hypothesis, aggregate-risk preferences are not fixed but are shaped by forces of natural selection - as lack of success forces some groups of investors out of the market to be replaced by new groups with little or different experience.

Under his hypothesis, contrary to the efficient-market hypothesis, arbitrage opportunities exist from time to time. Also, investment strategies will surge as more and more investors adopt an apparently successful strategy. This will drive down the returns on the strategy, causing it to be unsuccessful and fall out of favor for a time, until returns grow again.

Perhaps the most important implication of Mr. Lo's adaptive-market hypothesis is: "Innovation is the key to survival." The efficient-market hypothesis assumes that a desired level of expected return can be achieved simply by bearing a sufficient level of risk.

Mr. Lo's hypothesis implies that the *risk-reward relationship varies through time* and that the way to achieve "a consistent level of expected returns is *to adapt to changing market conditions.*"

His hypothesis explains why so many investors continue to seek excess risk-adjusted returns from active management, which the efficient-market theory says is impossible.

Note, however, that Mr. Lo's *hypothesis doesn't say finding such returns are easy*.

“Critics of the Efficient Markets Hypothesis argue that investors are often—if not always—***irrational***, exhibiting predictable and financially ruinous biases such as ***overconfidence*** ((Barber & Odean, 1998); (Gervais & Odean, 1997)), ***overreaction*** (DeBond, 1986), ***loss aversion*** ((Odean, 1997);(M. Shefrin, & Statman, M., 1985);(Kahneman & Tversky, 1905)), ***herding*** (Huberman, 2001), ***psychological accounting*** (Tversky, 1981), ***miscalibration of***

probabilities (Lichtenstein, 1982), and ***regret*** ((Clarke, 1998);(Bell, 1982)).”(Andrew W. Lo & Repin, 2001)

The sources of these irrationalities are often attributed to psychological factors—*fear, greed*, and other emotional responses to price fluctuations and dramatic changes in an investor’s wealth. Although no clear alternative to the Efficient Markets Hypothesis has yet emerged, a growing number of economists, psychologists, and financial-industry professionals have begun to use the terms ‘‘behavioral economics’’ and ‘‘behavioral finance’’ to differentiate themselves from the standard orthodoxy (H. Shefrin, 2001). The fact that the current value of the *Nasdaq Composite Index*, a bellwether indicator of the technology sector, is 1646.34 (October 17, 2001)—only 32.6% of its historical high of 5048.62 (March 10, 2000), reached less than 2 years ago—lends credence to the critics of market rationality. Such critics argue that either the earlier run-up in the technology sector was driven by unbridled greed and optimism, or that the precipitous drop in value of such a significant portion of the U.S. economy must be due to irrational fears and pessimism.(Andrew W. Lo & Repin, 2001)

However, recent research in the cognitive sciences and financial economics suggest an *important link between* ***rationality*** *in decision making and* ***emotion*** ((Loewenstein, 2000; Peters, 2000); (A. W. Lo, 1999); (Elster, 1998); (Damasio, 1994); (Grossberg, 1987)), implying that *the two notions are* not antithetical but, in fact, ***complementary***”(Andrew W. Lo & Repin, 2001).

H. Peter Boswijk introduces a *switching model between mean reverting and trend following model* in a research paper named “Behavioral Heterogeneity in Stock Prices”. An evolutionary selection mechanism based on relative past profits governs the dynamics of the fractions and switching of agents between different beliefs or forecasting strategies. The estimation results support the existence of *two expectation regimes*. One regime can be characterized as a *fundamentalist’s regime*, because agents *believe in mean reversion of stock prices toward the benchmark fundamental value*. The second regime can be characterized as a chartist, *trend following regime because agents expect the deviations from the fundamental to trend*. The fractions of agents using the fundamentalists and trend following forecasting rules *show substantial time variation and switching between predictors*. The model offers an explanation for the recent stock prices run-up. Before the 90s the trend following regime was active only occasionally. However, in the late 90s the trend following regime persisted and

created an extraordinary deviation of stock prices from the fundamentals. Recently, the activation of the mean reversion regime has contributed to drive stock prices back towards their fundamental valuation.(Boswijk, Hommes, & Manzan, 2006)

Historical evidence indicates that stock prices fluctuate heavily compared to indicators of fundamental value. For example, the ***price to earnings ratio of the S&P500*** was around *5 at the beginning of the 20s*, but *more than 25 about nine years later* to *fall back to about 5 again by 1933*. In *1995* the price/earnings ratio of the S&P500 was close to *20*, went up to more than *40 at the beginning of 2000* and then quickly *declined again to about 20 by the end of 2003*. Ofek and Richardson (Ofek, 2003) estimated *that in 1999 the average price-earnings ratio for internet stocks was more than 600*.Why do prices fluctuate so much compared to economic fundamentals? (Boswijk, et al., 2006)

My belief

For me it the Adaptive Market Hypothesis makes sense. I think that the market is somewhat slow to react to god and bad news and that there exits arbitrage opportunities in the market if one is fast to react to news and stock price changes.

Therefore I became interested in making a model which uses log return and correlation in a pair trading context. I believe that the stocks in the pair move differently giving arbitrage opportunities by switching between them.

I also believe that my MACD model showing dynamically updated sorted overview of the best buy candidates (at the top of the sorted list) and short sell candidates (at bottom of the sorted list) can be used to successfully trade stocks. This makes use of using early signals based on 3 day fastest increasing /sinking MACD histogram from a bottoming/topping. On the other hand such early signals may also give false signals. If one is not sure one can wait for confirmation by the histogram crossing of the zero line. This would be the same as crossing of the 26 day and 12 day exponential moving average lines. In many cases this again would reduce the profit. I believe it can be more profitable to be aggressive an listen to the MACD histogram signals based on 3 day fastest increasing /sinking MACD histogram from a bottoming/topping.

I believe that trading in Oslo Stock Exchange with “smaller” but still “liquid” companies can give arbitrage opportunities because of the latency caused by slow reaction to news. I think

this is a "territory" that can give good opportunities for momentum strategies to success. I believe that many of the largest companies are followed up by so many professionals that it is propably not so easy to success with momentum strategies.

Momentum strategy

Jegadeesh and Titman (N. a. T. Jegadeesh, Sheridan, 1993) popularized the notion that the momentum strategy is profitable and dominates a buy and hold strategy. The momentum strategy is simple: it buys stocks with high returns over the ***three to twelve months*** and sells stocks with poor returns over the same past horizon (Han, 2004).

Momentum based strategies, in which we group both trend following and relative strength techniques have been applied as investment strategies for over a century. Momentum has been one of the most widely discussed and researched investment strategies (some academics would prefer the term "anomaly").(Faber, 2010)

For example, Jegadeesh and Titman (N. a. T. Jegadeesh, Sheridan, 1993) documented that over a horizon of three to twelve months, *past winners on average continue to outperform past losers by about one percent per month, showing that there is "momentum"* in stock prices. There are *two possible explanations for the momentum effect*. *First, stock prices* ***under react to information***. *Second,* ***investors tend to "flock" together***. The herding behavior is documented by several studies. For example, Grinblatt, Titman, and Wermers (Grinblatt, Titman, & Wermers, 1994) find that the majority of mutual funds purchase stocks based on their past returns, namely by buying past "winners", and that funds showing the greatest tendency to buy past winners also tend to invest more intensely "with the crowd" than other funds do. Also, Lakonishok, Shleifer, and Vishny (Lakonishok, Shleifer, & Vishny, 1992) find evidence of pension fund managers either buying or selling in herds, with slightly stronger evidence that they herd around small stocks.(Kalok, Allaudeen, & Wilson, 1999)

Momentum investing is an investment strategy that aims to capitalize on the continuance of existing trends in the market. The momentum investor believes that large increases in the price of a security will be followed by additional gains and vice versa for declining values.(investopedia.com, 2010)

This strategy looks to capture gains by riding "hot" stocks and selling "cold" ones. To participate in momentum investing, a trader will take a long position in an asset, which has shown an upward trending price, or short sell a security that has been in a downtrend. *The*

basic idea is that once a trend is established, it is more likely to continue in that direction than to move against the trend. (investopedia.com, 2010)

While no consensus exists about the validity of this claim, economists have trouble reconciling this phenomenon using the efficient-market hypothesis. Two main hypotheses have been submitted to explain the effect in terms of an efficient market. In the first, it is assumed that momentum investors bear significant risk for assuming this strategy, and thus the high returns are compensation for the risk. The second theory assumes that momentum investors are exploiting behavioral shortcomings in other investors, such as investor herding, investor over and under reaction and confirmation bias.

Seasonal effects may help to explain some of the reason for success in the momentum investing strategy. If a stock has performed poorly for months leading up to the end of the year, investors may decide to sell their holdings for tax purposes. Increased supply of shares in the market drive its price down, causing others to sell. Once the reason for tax selling is eliminated, the stock's price tends to recover.

Some investors may react to the inefficient pricing of a stock caused by momentum investing by using the tool of arbitrage.

"The existence of momentum is a market anomaly, which finance theory has been struggling to explain. The difficulty is that an increase in asset prices, in and of itself, should not warrant further increase. Such increase, according to the efficient-market hypothesis, is warranted only by changes in demand and supply or new information (cf. fundamental analysis). Students of financial economics have largely attributed the appearance of momentum to cognitive biases, which belong in the realm of behavioral economics. The explanation is that investors are irrational (Daniel, Hirshleifer, & Subrahmanyam, 1997) and (Barberis, Shleifer, & Vishny, 1998), in that they under react to new information by failing to incorporate news in their transaction prices. However, much as in the case of price bubbles, recent research has argued that momentum can be observed even with perfectly rational traders (Crombez, 2001)."(Wikipedia.org, 2010p)

Market anomaly

A market anomaly (or inefficiency) is a price and/or return distortion on a financial market.

It is usually related to:

- either structural factors (unfair competition, lack of market transparency, ...)
- or behavioral biases by economic agents (see behavioral economics)

It sometimes refers to phenomena contradicting the efficient market hypothesis. There are anomalies in relation to the economic fundamentals of the equity, technical trading rules, and economic calendar events.

Anomalies could be Fundamental, Technical or calendar related. Fundamental anomalies include value effect and small-cap effect (low P/E stocks and small cap companies do better than index on an average. Calendar anomalies involve patterns in stock returns from year to year or month to month, while technical anomalies include momentum effect. (Wikipedia.org, 2010l)

Trend following

Trend following is an investment strategy that *tries to take advantage of long-term moves that seem to play out in various markets*. The system aims to work on the market trend mechanism and take benefit from both sides of the market enjoying the profits from the *ups* and *downs* of the stock or futures markets. Traders who use this approach can use current market price calculation, moving averages and channel breakouts to determine the general direction of the market and to generate trade signals. Traders who subscribe to a trend following strategy do not aim to forecast or predict specific price levels; they simply jump on the trend and ride it.(Wikipedia.org, 2010w)

Definition

This trading method involves a *risk management component* that uses three elements: *number of shares held*; the current market *price*; and current market *volatility*. An initial risk rule determines position size at time of entry. Exactly how much to buy or sell is based on the size of the trading account and the volatility of the issue. Changes in price may lead to a gradual reduction or increase of the initial trade. On the other hand, adverse price movements may lead to an exit for the entire trade.(Wikipedia.org, 2010w)

These systems traders normally enter in the market after the trend properly establishes itself and for this reason, they ignore the initial turning point profit.(Wikipedia.org, 2010w)

If there is a turn contrary to the trend, these systems signal a pre-programmed exit or wait until the turn establishes itself as a trend in the opposite direction. In case the system signals an exit, the trader re-enters when the trend re-establishes.(Wikipedia.org, 2010w)

Considerations

Price: A trader need only be worried about what the market is doing, not what the market might do. The current price and only the price tells you what the market is doing.(Wikipedia.org, 2010w)

Money management: Another decisive factor of trend following is *not the timing* of the trade or the indicator, but *rather* the decision of *how much to trade* over the course of the trend.(Wikipedia.org, 2010w)

Risk control: Cut losses is the rule. This means that during periods of higher market volatility, the trading size is reduced. (Wikipedia.org, 2010w)

Rules: Trend following should be systematic. Price and time are pivotal at all times. This technique is not based on an analysis of fundamental supply or demand factors. (Wikipedia.org, 2010w)

Trend trading is most effective for a market that is quiet (relative low volatility) and trending. For this reason trend traders often focus on commodities which show a stronger tendency to trend than stocks which are more likely to be mean reverting (which favors swing traders)(Wikipedia.org, 2010w).

Swing trading

Swing trading is a style of trading that attempts to capture gains in a stock within one to four days. Swing traders use technical analysis to look for stocks with *short-term price momentum*. These traders aren't interested in the fundamental or intrinsic value of stocks, but rather in their price trends and patterns. *Swing trading is mainly used by at-home and day traders*. Large institutions trade in sizes too big to move in and out of stocks quickly.

Mean-reverting process (Ornstein–Uhlenbeck process)

The mean-reverting process is a stochastic process x_t given by the following stochastic differential equation:

$$dx_t = \theta (\mu - x_t)dt + \sigma dW_t$$

Where $\theta > 0$, μ and $\sigma > 0$ are parameters and W_t denotes the Wiener process.

Backtesting

Backtesting is the process of evaluating a strategy, theory, or model by applying it to historical data.

A key element of backtesting that differentiates it from other forms of historical testing is that backtesting calculates how a strategy would have performed if it had actually been applied in the past.

Backtesting is a common and methodologically accepted approach to research, however a high or successful correlation between a backtested strategy and historical results can never *prove* a theory correct, since past results do not necessarily indicate future results. In other words, things are always changing, but in a world where yesterday bears some resemblance to today, backtesting can be a useful tool of analysis and prediction (Wikipedia.org, 2010c).

I use backtesting in evaluating which stock pairs do perform well with my algorithm. This is done "from date" (user specified date) until today. The best performing pairs are candidates for order book generation. New candidates are generated normally ones a day. Which one of the stocks in the pair is recommended is based on either historical method based on last backtesting strategy (last row in algo sheet) or intraday method which chooses the stock in the pair based on today's best performer.

Presentation of CAPM, Fama-French three factor model and Carhart four-factor model

In the following pages I will present these three models which are very important economic theories. By presenting these theories I want to point out some shortcomings of CAPM. Especially it's weak ability to describe the short time frame variations in stock prices. This is one of the reasons I wanted to make an experimental model in model 1 which uses a switching technique quite successfully compared with the market index. I must point out that CAPM uses correlation between the individual stocks return against market return. In my model I compare the two individual stocks correlation in addition to the individual stocks log returns as "picking criteria". I believe that my model uses the momentum in a way where the stock in the pair is showing positive development in the recent days might have a good chance

to continue to do it good in the following days. When this momentum weakens or gets lower than the opposite stock it is time to switch to the other stock.

This technique is suitable for small investors as for big investors the switching would probably cause movements in the stock prices if the volume is big enough.

I think also an interesting point in presenting these three models is the important role of the momentum factor in the Four Factor model. This amplifies my belief on momentum as an important tool to utilize in my models. I believe this is specially the case in trading on daily basis.

My model also takes care of diversification in a way by having exposure on many stocks at the same time. And on the other side reduce the exposure to the stock market when the market is having hard times.

Capital asset pricing model

The capital asset pricing model (CAPM) is used to determine a theoretically appropriate required rate of return of an asset, if that asset is to be added to an already well-diversified portfolio, given that assets non-diversifiable. The model takes into account the asset's sensitivity to non-diversifiable risk, often represented by the quantity beta (β), as well as the expected return of the market and the expected return of a risk-free asset.

Capital asset pricing model is an economic theory that describes the relationship between risk and expected return, and serves as a model for the pricing of risky securities. The CAPM asserts that the only risk that is priced by rational investors is systematic risk, because that risk cannot be eliminated by diversification. The CAPM says that the expected return of a security or a portfolio is equal to the rate on a risk-free security plus a risk premium multiplied by the asset's systematic risk. (Harvey, 2010)

The CAPM is a model for pricing an individual security or a portfolio. For individual securities, we make use of the security market line (SML) and its relation to expected return and systematic risk (beta) to show how the market must price individual securities in relation to their security risk class. The SML enables us to calculate the reward-to-risk ratio for any security in relation to that of the overall market. Therefore, when the expected rate of return for any security is deflated by its beta coefficient, the reward-to-risk ratio for any individual security in the market is equal to the market reward-to-risk ratio, thus:

$$(E(R_i) - R_f)/\beta_i = E(R_m) - R_f$$

The market reward-to-risk ratio is effectively the market risk premium and by rearranging the above equation and solving for $E(R_i)$, we obtain the Capital Asset Pricing Model (CAPM).

$$E(R_i) = R_f + \beta_i(E(R_m) - R_f)$$

where:

- $E(R_i)$ is the expected return on the capital asset
- R_f is the risk-free rate of interest
- β_i (the *beta coefficient*) is the sensitivity of the expected excess asset returns to the expected excess market returns, or also $\beta_i = Cov(R_i, R_m)/ Var(R_m) = Cov(R_i, R_m)/(\sigma_i * \sigma_m)$
- $E(R_m)$ is the expected return of the market
- $E(R_m) - R_f$ is sometimes known as the *market premium* or *risk premium*.

Restated, in terms of risk premium, we find that:

$$E(R_i) - R_f = \beta_i(E(R_m) - R_f)$$

This states that the individual risk premium equals the market premium multiplied by β.(Wikipedia.org, 2010d)

Beta, compared with the equity risk premium, shows the amount of compensation equity investors need for taking on additional risk. If the stock's beta is 2.0, the risk-free rate is 3% and the market rate of return is 7%, the market's excess return is 4% (7% - 3%). Accordingly, the stock's excess return is 8% (2 X 4%, multiplying market return by the beta), and the stock's total required return is 11% (8% + 3%, the stock's excess return plus the risk-free rate).

Security market line (SML)

The SML graphs the results from the capital asset pricing model (CAPM) formula. The *x-axis* represents the *risk (beta)*, and the *y-axis* represents the *expected return*. The market *risk premium is determined from the slope* of the SML.(Wikipedia.org, 2010d)

The relationship between β and required return is plotted on the *securities market line* (SML) which shows expected return as a function of β. The *intercept is the nominal risk-free rate* available for the market, while the *slope is* $E(R_m - R_f)$. The securities market line can be

regarded as representing a single-factor model of the asset price, where *Beta is exposure to changes in value of the Market*. The equation of the SML is thus:

$$SML: E(R_i) = R_f + \beta_i(E(R_m) - R_f)$$

It is a useful tool in determining if an asset being considered for a portfolio offers a reasonable expected return for risk. Individual securities are plotted on the SML graph. *If the security's risk versus expected return is plotted above the SML, it is undervalued* since the investor can expect a greater return for the inherent risk. And a *security plotted below the SML is overvalued* since the investor would be accepting less return for the amount of risk assumed.(Wikipedia.org, 2010d)

Asset pricing

Once the expected/required rate of return, $E(R_i)$, is calculated using CAPM, we can compare this required rate of return to the asset's estimated rate of return over a specific investment horizon to determine whether it would be an appropriate investment.(Wikipedia.org, 2010d)

Asset-specific required return

The CAPM returns the asset-appropriate required return which future cash flows produced by the asset should be discounted given that asset's relative riskiness. Betas exceeding *one* signify more than average "riskiness"; betas below one indicate lower than average. Since beta reflects asset-specific sensitivity to non-diversifiable, i.e. market risk, *the market as a whole, by definition, has a beta of one.* (Wikipedia.org, 2010d)

Risk and diversification

The risk of a portfolio comprises systematic risk and unsystematic risk. Systematic risk refers to the risk common to all securities. Unsystematic risk is the risk associated with individual assets. Unsystematic risk can be diversified away to smaller levels by including a greater number of assets in the portfolio. The same is not possible for systematic risk.

The efficient frontier

The CAPM assumes that the risk-return profile of a portfolio can be optimized - an optimal portfolio displays the lowest possible level of risk for its level of return. Additionally, since each additional asset introduced into a portfolio further diversifies the portfolio, the optimal portfolio must comprise every asset, with each asset value-weighted to achieve the above. All such optimal portfolios, i.e., one for each level of return, comprise the efficient frontier.

Because the unsystematic risk is diversifiable, the total risk of a portfolio can be viewed as beta.(Wikipedia.org, 2010d)

The market portfolio

An investor might choose to invest a proportion of his or her wealth in a portfolio of risky assets with the remainder in cash - earning interest at the risk free rate. Here, the ratio of risky assets to risk free asset does not determine overall return - this relationship is clearly linear. It is thus possible to achieve a particular return in one of two ways:

1. By investing all of one's wealth in a risky portfolio,
2. Or by investing a proportion in a risky portfolio and the remainder in cash.

For a given level of return, however, only one of these portfolios will be optimal (in the sense of lowest risk). Since the risk free asset is, by definition, uncorrelated with any other asset, option 2 will generally have the lower variance and hence be the more efficient of the two.

Assumptions of CAPM

All investors:

1. Aim to maximize economic utility.
2. Are rational and risk-averse.
3. Are broadly diversified across a range of investments.
4. Are price takers, i.e., they cannot influence prices.
5. Can lend and borrow unlimited amounts under the risk free rate of interest.
6. Trade without transaction or taxation costs.
7. Deal with securities that are all highly divisible into small parcels.
8. Assume all information is available at the same time to all investors.
9. Perfect Competitive Markets(Wikipedia.org, 2010d)

Shortcomings of CAPM

- The model *assumes* that either asset returns are (jointly) *normally distributed* random variables or that investor's employ a quadratic form of utility. It is however frequently observed that returns in equity and other markets are not normally distributed. As a result, large swings (3 to 6 standard deviations from the mean) occur in the market more frequently than the normal distribution assumption would expect.(Mandelbrot, 2004)

- The model assumes that the *variance* of returns is an *adequate* measurement of risk.
- The model assumes that *all investors* have access to the *same information*.
- The model assumes that the probability beliefs of investors match the true distribution of returns. A different possibility is those *investors' expectations are biased*, causing market prices to be information ally inefficient. This possibility is studied in the field of behavioral finance, which uses psychological assumptions to provide alternatives to the CAPM such as the overconfidence-based asset pricing model of Kent Daniel, David Hirshleifer, and Avanidhar Subrahmanyam (2001)(Daniel, Hirshleifer, & Subrahmanyam, 2001)
- The model ***does not appear to adequately explain the variation in stock returns***. The model assumes that given a certain expected return investors will prefer lower risk (lower variance) to higher risk and conversely given a certain level of risk will prefer higher returns to lower ones.
- The model assumes that there are *no taxes or transaction costs*.
- The market portfolio consists of all assets in all markets, where each asset is weighted by its market capitalization.
- The market portfolio should in theory include all types of assets that are held by anyone as an investment.
- The model assumes just two dates, so that there is no opportunity to consume and rebalance portfolios repeatedly over time.
- CAPM assumes that all investors will consider all of their assets and optimize one portfolio. This is in sharp contradiction with portfolios that are held by investors: humans tend to have fragmented portfolios (or rather multiple portfolios: for each goal one portfolio - see behavioral portfolio theory (H. M. Shefrin & Statman, 2000) and Maslowian Portfolio Theory (Philippe, 2010).

I think it is interesting two observe the many shortcomings of CAPM. One of them being that it *does not appear to adequately explain the variation in stock returns.* Therefore I hope my switching strategy in model 1 can utilize the short variations in stock prices in an effective way and give good returns.

Fama–French three-factor model

In the portfolio management field, Eugene Fama and Kenneth French developed the Fama-French three factor model to describe market behavior.

CAPM uses a single factor, beta, to compare the excess returns of a portfolio with the excess returns of the market as a whole. But it oversimplifies the complex market. Fama and French started with the observation that two classes of stocks have tended to do better than the market as a whole: (i) small caps and (ii) stocks with a high book-to-market ratio. They then added two factors to CAPM to reflect a portfolio's exposure to these two classes (E. F. Fama & French, 1993):

$$r = R_f + \beta_3(K_m - R_f) + bs * SBM + bv * HML + \alpha$$

Here r is the portfolio's rate of return, R_f is the risk-free return rate, and K_m is the return of the whole stock market. The "three factor" β is analogous to the classical β but not equal to it, since there are now *two additional factors* to do some of the work. *SMB* stands for "*small* (market capitalization) *minus big*" and *HML* for "*high* (book-to-price ratio) *minus low*"; they measure the historic excess returns of small caps over big caps and of value stocks over growth stocks. These factors are calculated with combinations of portfolios composed by ranked stocks (Cap ranking, BM ranking) and available historical market data

Moreover, once SMB and HML are defined, the corresponding coefficients *bs* and *bv* are determined by linear regressions and can take negative values as well as positive values. The Fama-French Three Factor model explains over 90% of the diversified portfolios returns, compared with the average 80% given by the CAPM. The signs of the coefficients suggested that small cap and value portfolios have higher expected returns—and arguably higher expected risk—than those of large cap and growth portfolios.(E. F. F. Fama, Kenneth R. , 1992)

Carhart four-factor model (1997)

This model extends the Fama-French three-factor model with an additional factor called *momentum factor*.

"This paper tests the Fama-French three-factor pricing model augmented by a momentum factor on the Canadian stock market. *Using Fama-French's methodology to construct the risk factors, the average annual premium obtained for the market, size, book-to-market and momentum risk factors are respectively equal to 4.52%, 5.08%, 5.09% and 16.07%, over the July 1960-April 2001 period.* The results relative to the three zero-investment portfolios are in line with those obtained by Liew and Vassalou (2000) for the 1976-1996 period, even though

the authors use sequential sorts to construct the risk factors. The main evidence of regularities in factors' behavior is as follows: the size factor returns are substantially greater in January than in other months, whereas the *momentum factor returns are always significant, except in January*. Book-to-market factor returns are positive (negative) and highly (barely) significant in down-markets (up-markets). Lastly, regarding conditioning on the monetary policy environment, we find that the SMB and HML premiums are only significant in an expansive environment." (L'Her, Masmoudi, & Suret, 2003)

"The four-factor pricing model (*FFPM*) states that the excess return of a security is explained by the market portfolio and three factors designed to mimic risk variables related to size, book-to-market (*BM*) and momentum. According to the *FFPM*, stocks' excess returns are equal to:

$$E(R_{it}) - R_{ft} = b_i*(E(R_{mt})-R_{ft}) + s_i*E(SMB_t) + h_i*E(HML_t) + w_i*E(WML_t)$$

where the factor loadings are respectively b_i, s_i, h_i and w_i." (L'Her, et al., 2003)

In the citation above we can see that the momentum factor plays a significant role with its 16.7% compared with the others. Because of this observation I have used momentum in both of my two first models. In the first model as comparing the previous days and correlation between the two stocks in the pair and choosing the one with highest log return. In the second model as looking of the resent days MACD histograms speed of increasing from the recent bottoming. I use this information to recommend stocks from a pool of approximately 150 stocks. I consider the second model as a mean-reverting model as a whole but when I rank the stocks regarding to the speed of resent three day recovery from the histograms bottoming it can be looked at as momentum.

P/B ratio

The price-to-book ratio is a financial ratio used to compare a company's book value to its current market price. Book value is an accounting term denoting the portion of the company held by the shareholders; in other words, the *company's total tangible assets less its total liabilities*. The calculation can be performed in two ways, but the result should be the same each way.

In the *first way*, the company's market capitalization can be divided by the company's total book value from its balance sheet.

The *second way*, using per-share values, is to divide the company's current share price by the book value per share (i.e. its book value divided by the number of outstanding shares).(Wikipedia.org, 2010s)

Correlation

The stocks or indices that make good candidates for the pair's trade should have some measurable relationship. Ideally, the stocks or indices in the pair's trade should have a positive correlation and betas that are stable over time. Correlation is a statistical coefficient that measures the strength, within a range of +1 to -1, of the relationship between two variables.

In this case, the variables are stocks or indices. The idea of correlation as it relates to trading is best described by an example. If stock A and stock B both move up and down at the same time, then stock A and B have a high positive correlation (close to +1). If stock A moves up and stock B moves down at the same time, then stock A and B have a high negative correlation (close to -1). If the stock A and B move up and down completely randomly, then stock A and B have zero correlation. Correlation is calculated by dividing the covariance of the percentage changes of each stock or index divided by the product of the standard deviations for the two stocks. Covariance is a measure of the tendency of the two stocks or indices to move together, and dividing the covariance by the standard deviations sets the correlation between +1 and -1.(Preston, 2005)

Correlation in a pair of stocks: $Cov(R_i, R_j)/(\sigma_i * \sigma_j)$.

In my model 1 I pick pairs that have both high log return and low correlation at the same time. In this way I want to locate pairs that *move differently* but are *upward going trend at the same time*. This will pick stocks with quite high volatility but on the other hand can give good switching opportunities.

Cointegration

Cointegration arises when two variable shares a common stochastic trend, that is, when each variable contains a stochastic trend, but a weighted difference of the two variables does not.

Formulas that has been used

Rate of return

Rate of return is the ratio of money gained or lost on an investment relative to the amount of money invested.

The rate of return can be calculated over a single period, or expressed as an average over multiple periods.

Arithmetic return

The **arithmetic return** is:

$r_{arith} = (V_f - V_i)/V_i$

r_{arith} is sometimes referred to as the **yield**.

Logarithmic or continuously compounded return

The **logarithmic return** or continuously compounded return, also known as force of interest, is cleared as:

$r_{log} = \ln(V_f/V_i)$

It is the reciprocal (opposite) of the e-folding time. *e*-folding is the time interval in which an exponentially growing quantity increases by a factor of *e*.

Return of Investment might also be calculated as a *continuously compounded return* or *logarithmic return*. *Compound interest* arises when interest is added to the principal, so that from that moment on, the interest that has been added *also itself* earns interest. The effective continuously compounded rate of return is the natural log of the final investment value divided by the initial investment value:

- V_i is the *initial investment*
- V_f is the *final value*

Continuous compounding can be thought as making the compounding period infinitesimally small; therefore achieved by taking the limit of *n* to infinity.

It's simple: $P_1 = P_0 e^{rt}$ take t as 1 so

$ln(P_1 / P_0) = r = ln(1 + R)$

where *R is simple return* and *r is called log return* because it is the logarithm of normal return.

$$a(t) = \lim_{n \to \infty} \left(1 + \frac{r}{n}\right)^{nt}$$

$a(t) = e^{rt}$

The amount function is simply

$A(t) = A_0 e^{rt}$

The interest rate expressed as a continuously compounded rate is called the force of interest. The annual force of interest is simply 12 times the monthly force of interest.

The effective interest rate per year is

$i = e^r - 1$

Using this *i* the amount function can be written as:

$A(t) = A_0(1 + i)^t$

or

$A = P(1 + i)^t$

(Wikipedia.org, 2010f)

I have used the marked formula to compute the log returns into effective interest which is the usual method to present the stocks gains in a period.

I have used log returns in calculation to get the best basis for comparing the stock's performance. In model 1 I have used daily log returns and then summed them up to find log return for the period. *Then in the end I have used the "yellow formula" to show also the effective interest for both the two individual stocks and the three algorithms using pair switching technique. By doing this I get an effective interest for the three switching techniques which can be interesting to compare with the individual stocks.*

Arithmetic and logarithmic returns are not equal, but are approximately equal for small returns. The difference between them is large only when percent changes are high.

Description of some technical analysis tools used in model 2

Exponential Moving Average (EMA)

The Exponential Moving Average (EMA) weighs current prices more heavily than past prices. This gives the Exponential Moving Average the advantage of being *quicker to respond to price fluctuations* than a Simple Moving Average; however, that can also be viewed as a disadvantage because the EMA is more prone to give false signals.

An **exponential moving average** (EMA) applies weighting factors which decrease exponentially.

I use smoothing factor α which I calculate by the following formula:

$$\alpha = 2/(N+1)$$

Where N is the number of days used to calculate exponential moving average. In my model 2 the default values are 26 days for the long moving average, 12 days for the short moving average and 9 days for the exponential moving average of MACD. For the first observation I use normal average. The default values can be changed by the user by changing the values in the combo boxes.

Formula:

The formula for calculating the EMA at time periods $t > 2$ expressed in technical analysis terms is:

$$EMA_{today} = EMA_{yesterday} + \alpha * (price_{today} - EMA_{yesterday})$$

(Wikipedia.org, 2010j)

Price Oscillator

The Price Oscillator uses two moving averages, one shorter-period and one longer-period, and then *calculates the difference between the two moving averages*. The Price Oscillator technical indicator can be used to determine overbought and oversold conditions as well as to confirm bullish or bearish price moves.(OnlineTradingConcepts.com, 2008)

Price Oscillator Overbought & Oversold

The Price Oscillator can be used to detect when *a trend is slowing* down and potentially could reverse. This occurs when the Price Oscillator *moves back towards the zero line*. In contrast, when the Price Oscillator *is moving away from the zero line, the price trend is accelerating.* (OnlineTradingConcepts.com, 2008)

MACD uses price oscillator by calculating the difference between 12 and 26 day exponential moving averages.

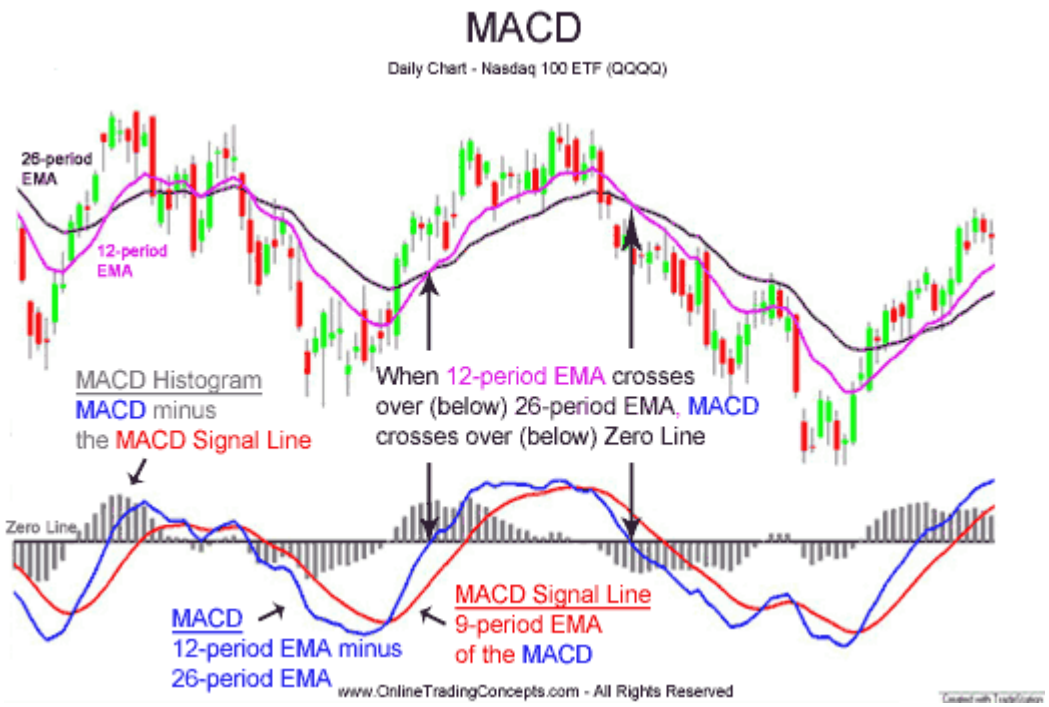
MACD

There are three main components of the MACD:

1. **MACD**: The 12-period exponential moving average (EMA) minus the 26-period EMA.
2. **MACD Signal Line**: A 9-period EMA of the MACD.
3. **MACD Histogram**: The MACD minus the MACD Signal Line.

MACD Moving Average Crossovers

The primary method of interpreting the MACD is with moving average crossovers. When the shorter-term 12-period exponential moving average (EMA) crosses over the longer-term 26-period EMA a buy signal is generated. (OnlineTradingConcepts.com, 2008)



When the shorter-term 12-period EMA crosses above the longer-term 26-period EMA, the MACD line crosses above the Zero line.

When the shorter-term 12-period EMA crosses below the 26-period EMA, the MACD line crosses below the Zero line.

Moving Average Crossover Buy Signal

A buy signal is generated when the MACD (blue line) crosses above the zero line. The same signal is given when the shorter-term 12-period EMA crosses above the longer-term 26-period EMA.

Moving Average Crossover Sell Signal

When the MACD crosses below the zero line, then a sell signal is generated. The same signal is given when the shorter-term 12-period EMA crosses below the 26-period EMA.

To get *even earlier signals* one can focus on the crossings of MACD and MACD signal line.

Most Common MACD Buy and Sell Signals

MACD Buy Signal

A buy signal is generated when the MACD (blue line) crosses above the MACD Signal Line (red line). The same signal is given when MACD histogram crosses above zero line.

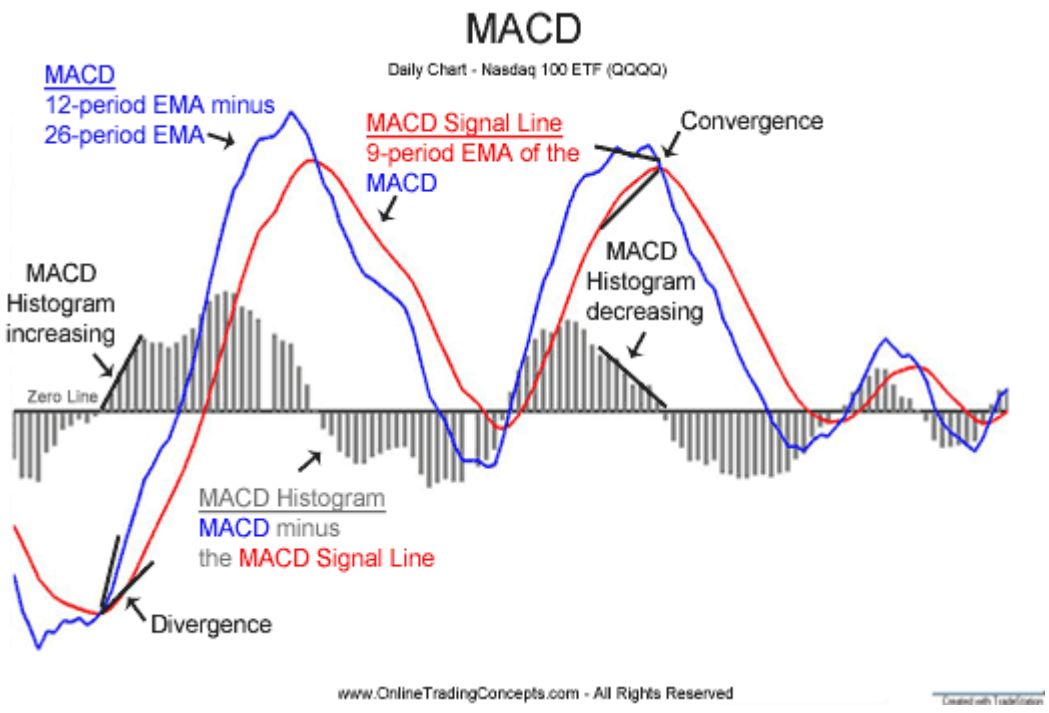
MACD Sell Signal

When the MACD crosses below the MACD Signal Line a sell signal is generated. The same signal is given when MACD histogram crosses below zero line.

The MACD moving average crossover is one of many ways to interpret the MACD technical indicator. Using the MACD histogram and MACD divergence warnings are two other important methods of using the MACD.

MACD Histogram

The MACD Histogram is simply the difference between the MACD line (blue line) and the MACD signal line (red line).

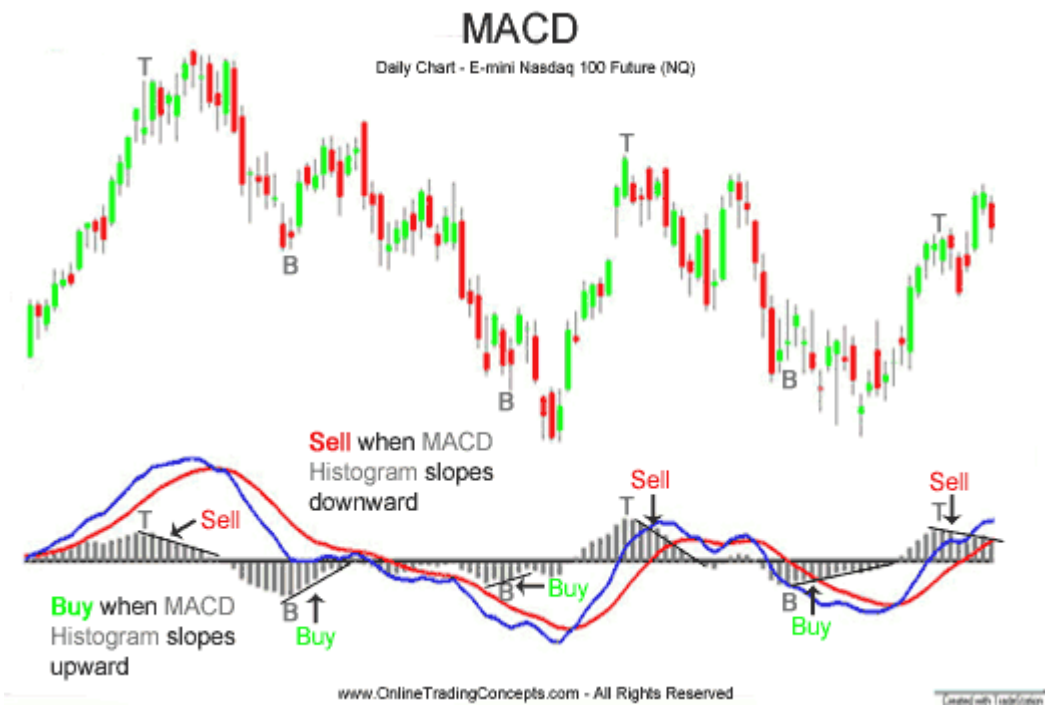


Two important terms are derived from the MACD histogram and are illustrated above.

- **Convergence**: The MACD histogram is *shrinking* in height. This occurs because there is a change in direction or a *slowdown in the stocks trend*. When that occurs, the MACD line is getting closer to the MACD signal line. (OnlineTradingConcepts.com, 2008)

- **Divergence**: The MACD histogram is *increasing* in height (either in the positive or negative direction). This occurs because the MACD is *accelerating faster in the direction of the prevailing market trend*. (OnlineTradingConcepts.com, 2008)

When a stock is moving strongly in a direction, the MACD histogram will increase in height. When the MACD histogram does not increase in height or begins to shrink, the market is slowing down and is a warning of a possible reversal. The graph below shows this phenomenon:



The letter **"T" represents when the top** or peak of the MACD histogram occurs. In contrast, the letter **"B" shows when the bottom** of the MACD histogram occurs. Notice how closely the tops and bottoms of the MACD histogram are to the tops of the Nasdaq 100 e-mini future. (OnlineTradingConcepts.com, 2008)

MACD Histogram Buy Signal

When the MACD histogram is below the zero line and begins to converge towards the zero line.

MACD Histogram Sell Signal

When the MACD histogram is above the zero line and begins to converge towards the zero line.

Note: In the example above, ***three consecutive days*** *of shrinking MACD histogram from top or bottom served as the* ***buy or sell signals shown with arrows****. This is an aggressive example. One could wait until the MACD histogram went to zero, but that would be the same signal as the MACD moving average crossover.* (OnlineTradingConcepts.com, 2008)

The MACD is not only good for buy and sell signals, the MACD can be used for warnings of potential change in the direction of stocks, futures, and currency pairs. (OnlineTradingConcepts.com, 2008)

I have used this technique described in above note in my model 2 to analyze all the stocks of Oslo stock Exchange ones a day and produce a so called momentum sheet where I rank the stock by how fast the histogram is increasing. This is again used to together with information of how many days since last top or bottom to generate buy or sell signal.

It may be somewhat misleading to call the summary sheet a momentum sheet since I consider this a mean-reverting strategy. But what I mean by momentum here is the strength of returning to the mean.

Special topics in Quantitative Trading

There are two basic categories of trading strategies: **mean-reverting** versus **momentum strategies**. Periods of mean-reverting and trending behaviors are examples of what some traders call regimes, and the switch between different regimes is a topic of discussion here. Mean-reverting strategies derive their mathematical justification from the concepts of stationarity and cointegration of time series.(Chan, 2009)

Trading strategies can be profitable only if securities prices are either mean-reverting or trending. Otherwise, they are random walking, and trading will be futile.

Academic research has indicated that stock prices are on average very close to random walking.

Many strategies based on moving averages are mean reverting strategies. In general terms the idea is that both a stock's high and low prices are temporary and that a stock's price will tend to have an average price over time. When the current market price is less than the average price, the stock is considered attractive for purchase, with the expectation that the price will rise. When the current market price is above the average price, the market price is expected to fall. In other words, deviations from the average price are expected to revert to the average.

The traditional pair trading strategy is mean-reverting also. When one stock in a pair outperforms the other, the poorer performing stock is bought long with the expectation that it will climb towards its outperforming partner, the other is sold short.

In my model 1 I have used a different approach where I use short term momentum.

Momentum can be generated by the slow diffusion of information – as more people become aware of certain news, more people decide to buy or sell a stock, thereby driving the price in

the same direction. Stock prices may exhibit momentum when the expected earnings have changed. This can happen when a company announces its quarterly earnings and investors gradually become aware of this announcement. This strategy recommends that you buy a stock when its earnings exceed expectations, and short a stock when it falls short. Many news announcements have the potential of altering expectations of a stock's future earnings, and therefore have the potential to trigger a trending period.

Momentum can also be generated by the herd like behavior of investors: investors interpret the (possible random and meaningless) buying or selling decisions of other as the sole justifications of their own trading decisions.

Unfortunately, momentum regimes generated by these two causes (private liquidity needs and herd like behavior) have highly unpredictable time horizons.

There is one last contrast between mean-reverting and momentum strategies that is worth pondering.

What are the effects of increasing competition from traders with the same strategies?

For mean-reverting strategies, the effect typically is the gradual elimination of any arbitrage opportunity, and thus gradually diminishing returns down to zero.

For momentum strategies, the effect of competition is often the diminishing of the time horizon over which the trend will continue. As news disseminates (spread) at a faster rate and as more traders take advantage of this trend earlier on, the equilibrium price will be reached sooner. Any trade entered after this equilibrium price is reached will be unprofitable.

Regime switching

The concept of regimes is most basic to financial markets. What else are "bull" and "bear" markets if not regimes? If our attempts to predict the switching from bull to a bear market were even slightly successful, we could focus our discussion to this one type of switching and call it a day. If only it were that easy. Regulatory changes can cause regime switching. They are often announced in beforehand but it is often not so easy to predict the effects.(Chan, 2009)

Some of the other most common financial or economic regimes studied are inflationary vs. recessionary regimes, high- vs. low volatility regimes and mean-reverting vs. trending regimes. Among these, volatility regime switching seems to be most amenable to classical

econometric tools such as the generalized autoregressive conditional heteroskedasticity (GARCH) model. Volatility regime switches can be of great value to options traders, but no help to stock traders. Markov regime switching or hidden Markov models can be used to estimate regime switching in stock prices. (Chan, 2009)

Academic attempts to model regime switches in stock prices generally proceed along these lines:

1. Propose that the two (or more) regimes are characterized by different probability distributions of the prices. In the simplest cases, the log of the prices of both regimes may be represented by normal distributions, except that they have different means and/or standard deviations.

2. Assume that there is some kind of transition probability among the regimes.

3. Determine the exact parameters that specify the regime probability distributions and the transition probabilities by fitting the model to past prices, using standard statistical methods such as maximum likelihood estimation.

4. Based on the fitted model above, find out the expected regime of the next time step and, more importantly, the expected stock price. (Chan, 2009)

Despite the elegant theoretical framework, such Markov regime switching models are generally useless for actual trading purposes. The reason for this weakness is that they assume constant transition probabilities among regimes at all times.(Chan, 2009)

According to Francis X. Dibolt in "Regime Switching with Time-Varying Transition Probabilities" the likelihood ratio *test clearly rejects the null of constant transition probabilities.(Diebold, 1994)* This is in contrast to Chan proposed above.

Marcelle Chauvet and Jeremy Piger used Markov switching model (regime-switching model) to predict GDP and employment in real time with great success in their papers: "Identifying business cycle turning points in real time" (M. P. Chauvet, Jeremy M., 2003) and "A Comparison of the real-Time Performance of Business Cycle Dating Methods"(M. Chauvet, Piger, & Federal Reserve Bank of St. Louis., 2005).

A stochastic process has the Markov property if the conditional probability distribution of future states of the process (conditional on both past and present values) depends only upon

the present state; that is, given the present, the future does not depend on the past. A process with this property is said to be Markov process. The Markov property states that the conditional probability distribution for the system at the next step (and in fact at all future steps) *given* its current state depends only on the current state of the system, and not additionally on the state of the system at previous steps:

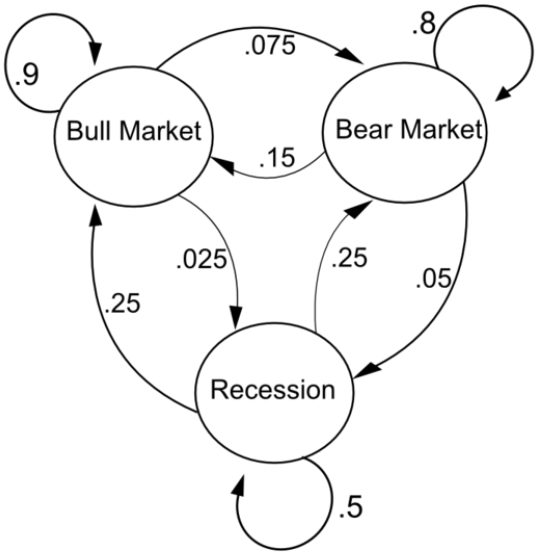
$$P(X_{n+1}|X_1,X_2,\ldots,X_n) = P(X_{n+1}|X_n).$$

Since the system changes randomly, it is generally impossible to predict the exact state of the system in the future. However, the statistical properties of the system's future can be predicted. In many applications it is these statistical properties that are important.(Wikipedia.org, 2010o)

The changes of state of the system are called transitions, and the probabilities associated with various state-changes are called transition probabilities. The set of all states and transition probabilities completely characterizes a Markov chain.(Wikipedia.org, 2010o)

The transition probabilities depend only on the current position, not on the way the position was reached. (Wikipedia.org, 2010o)

A simple example is shown in the figure below, using a directed graph to picture the state transitions. The states represent whether the economy is in a bull market, a bear market, or a recession, during a given week. According to the figure, a bull week is followed by another bull week 90% of the time, a bear market 7.5% of the time, and a recession the other 2.5%. From this figure it is possible to calculate, for example, the long-term fraction of time during which the economy is in a recession, or on average how long it will take to go from a recession to a bull market.(Wikipedia.org, 2010o)



This illustration is borrowed from Wikipedia.org to illustrate the above example (Wikipedia.org, 2010o)

Turning point models take a data mining approach(Soo, 2007). Enter all possible variables that might predict a turning point or regime switch. Variables such as current volatility; last-period return; or changes in macroeconomic numbers such as consumer confidence, oil price changes, bond price changes, and so on can all be part of this input. These can use major shifts of interest rates, a release of government macroeconomic data, earnings announcements or news data are likely trigger turning points (Chan, 2009).

An index called Leading Economic Indicators which is a weighted average of all leading indicators in US can be used to forecast turning point in economy. A rule often used to identify turning points in the index is the so-called three-consecutive-declines rule: three consecutive declines in the LEI Index signal a turning point, suggesting that a downturn in economic activity may be imminent. (Negro, 2002)

In my model 3 I will present a regression analysis model to see the descriptive power of some macroeconomic numbers for a single stock (Agercy)(monthly data over a 10 year period). This could be developed further to give the other two models input on regime shifts based on turning point models. Turning point models can identify primary and secondary trends. This can be interesting to know where one is in the trend development in a longer perspective.

Stationarity and cointegration

A time series is "stationary" if it never drifts father and father away from its initial value. In technical terms, stationary time series are "integrated of order zero," or I(0) (Alexander,

2001). It is obvious that if the price series of a security is stationary, it would be a great candidate for a mean-reversion strategy. Unfortunately, most stock price series are not stationary – they exhibit a geometric random walk that gets them farther and farther away from their starting values. However, you can often find a pair of stocks such that if you long one and short the other, the market value of the pair is stationary. I this is the case, then the two individual time series are said to be cointegrated. Traders have long been familiar with this so-called pair-trading strategy. They buy the pair portfolio when the spread of the stock prices formed by these pairs is low, and sell/short the pair when the spread is high – in other words, a classic mean-reverting strategy. (Chan, 2009)

If a price series (of a stock, a pair of stocks, or, in general, a portfolio of stocks) is stationary, then a mean-reverting strategy is guaranteed to be profitable, as long as the stationarity persist into the future (which is by no means guaranteed). *However, the converse is not true. You don't necessarily need a stationary price series in order to have a mean-reverting strategy. Even a non-stationary price series can have many short-term reversal opportunities that one can exploit, as many traders have discovered.* If two stocks were cointegrated and remain so in the future, their prices (weighted appropriately) will be unlikely to diverge. Yet their daily returns may be quite uncorrelated. (Chan, 2009)

What is your exit strategy?

While entry signals are very specific to each trading strategy, there isn't usually much variety in the way exit signals are generated. They are based on one of these:

- A fixed holding period
- A target price or profit cap
- The latest entry signals
- A stop price

A fixed holding period is the default exit strategy for any trading strategy, whether it is a momentum model or a reversal model, or some kind of seasonal trading strategy, which can be either momentum or reversal based.

The momentum strategies slow diffusion of information process has finite lifetime and therefore determining the optimal holding period which can usually be discovered in a

backtest. If increasing number of traders catch on this trading opportunity then the optimal holding period will be shorter or it can become unprofitable. (Chan, 2009)

I don't use optimal holding period in my model 1 since I create new pairs daily. But it could be archieved by using the "Number of Switches"-column in "New Overview sorted"-sheet by dividing number of days in the backtesting period with "Number of Switches" in the pair. I think that using this kind of exit strategy it would not exit as fast as it does now since now I have used 1% decline "today" as an exit signal.

The mean reversion of time series can be modeled by an equation called the Ornstein_Uhlenbeck formula (Uhlenbeck, 1930). Let's say we denote the mean-reverting spread (long market value minus short market value) of pair of stocks as *z(t)*. Then we can write

$$dz(t) = -\theta(z(t) - \mu)dt + dW$$

where μ is the mean value of the prices over time and *dW* is simply some random Gaussian noise. Given a time series of the daily spread values, we can easily find θ (and μ) by performing a linear regression fit of the daily change in the spread *dz* against the spread itself. Mathematicians tell us that the average value of *z(t)* follows an exponential decay to its mean μ, and the half-life of this exponential decay is equal *to ln(2)/*θ, which is the exponential time it takes for the spread to revert to half its initial deviation from the mean. *This half-life can be used to determine the optimal holding period for a mean-reverting position.* Since we can make use of the entire time series to find the best estimate of θ, and not just on the days where a trade was triggered, the estimate for the half-life is much more robust and can be obtained directly from a trading model. (Chan, 2009)

For mean-reverting securities you have a readymade target price – the mean value of the historical prices of the security, or μ in the Ornstein-Uhlenbeck formula. This *target price* can be used together with the half-life as exit signals (exit when either criterion is met).(Chan, 2009)

Target prices are not as easily justified in momentum models as in mean-reverting models because momentum models have to use fundamental valuation which is at best an inexact science. (Chan, 2009)

This strategy also tells us whether a stop-loss strategy is recommended. In a momentum model, when a more recent entry signal is opposite to an existing position, it means that the direction of momentum has changed, thus a loss (or more precisely, a drawdown) in your position has been incurred. Exiting based on the most recent entry signal is clearly justified based on the rationale for the momentum model.(Chan, 2009)

High-frequency trading strategies

In general, if a high Sharpe ratio is the goal of your trading strategy, then you should be trading at high frequencies, rather than holding stocks overnight (Chan, 2009).

The reason why these strategies have Sharpe ratio is simple: Based on the "law of large numbers," the more bets you can place, the smaller the percent deviation from the mean return you will experience. Of course, the law of large numbers does not explain why a particular high-frequency strategy has positive mean return in the first place. In fact, it is impossible to explain in general why high-frequency strategies are often profitable, as there are many such strategies as there are fund managers. Some of them are mean reverting, while others are trend following. Some are market-neutral pair traders, while others are long-only directional traders. In general, though, these strategies aim to exploit tiny inefficiencies in the market or to provide temporary liquidity needs for a small fee. High-frequency strategies typically trade securities in modest sizes. Without large positions to unwind, risk management for high-frequency portfolios is fairly easy: "Deleveraging" can be done very quickly in the face of losses, and certainly one can stop trading and be completely in cash when the going gets truly rough. Sudden drastic losses are not likely, nor are contagious losses across multiple accounts. (Chan, 2009)

Method

I wanted to focus on a trading area called statistical arbitrage used with trading stocks. I wanted to utilize my programming skills and interest on stocks at the same time. Therefore this area seemed to fit my interests well.

I become interested in ***algorithm trading*** and ***quantitative trading*** because I had read that Oslo Stock Exchange where going to start with a system which made it possible to send in orders electronically through a system called Trade Elect.

Later I have learned that this is open only for members which are broker houses. In a recent newspaper article I read that Sven Arild Andersen (earlier Stock Exchange Director) wrote that the broker houses have too much power by having a position between the investor and the stock exchange. He asks why not let the investors have direct access to the Stock Exchange broker system and by that saving a lot of transaction costs (Andersen, 2010). On the other hand I have not yet found any broker houses that offer API (Application Program Interface) to receive orders from investors program to their trading system. Therefore I have concentrated in making a semiautomatic system (Model 1) which produces a basket of orders which still has to be manually registered trough brokers orders system. On the other hand I want still to view the orders before they are executed.

I believe that there is a possibility to make extraordinary profit by switching between stocks at the right time because of the latency and the herding behavior of people. I want to try to exploit this in Model 1 and Model 2.

In Model 2 the MACD histogram analysis will give early signals of short term trend changes. This is also related to jump on an early momentum swing and riding it. The model generates daily new best candidates for momentum and will also show when the momentum weakens and therefore gives a signal of switching to a better candidate stock. This model could be developed further to propose these candidates by generating order book records and maintaining budget and portfolio sheet. But at time being it just generates a momentum overview with a sorted overview where the best buy candidates are at top and the “best sell candidates” at the bottom.

This technique could be considered as riding the stocks with best momentum and switching to candidates where you dynamically will get new candidates from the sorted list when the momentum reverses or weakens.

In both model 1 and model 2 it is important to diversify the risk by entering on several stocks at same time. This will reduce the risk in case the development does not go as expected. Model 1 reduces the risk by entering normally on several stocks at same time and having two different exit strategies.

To make models as the Model 1 and 2 one has to know how to exploit VBA programming in Excel and exploit Access query language when you want to make datasets for analyzing the data. I have always been interested in programming and I wanted to exploit this in my master thesis. I believe that programming skills can be an important skill when making models for algorithm- and quantitative trading.

I have included four appendixes in the thesis: Installation instructions, Textual appendix, Screenshot appendix and VBA appendix.

The normal steps in making a statistical arbitrage model is by

- Finding a viable trading strategy.
- Backtesting the strategy to ensure that it at least has good historical performance.
- Setting up the business and technological infrastructure.
- Building an automated trading system to execute your strategy.
- Managing the money and risks involved in holding positions generated by this strategy.

Quantitative trading, also known as algorithmic trading, is the trading of securities based strictly on the buy/sell decisions of computer algorithms. The computer algorithms are designed and perhaps programmed by the traders themselves, based on the historical performance of encoded strategy tested against historical financial data.

Technical analysis can be a part of quantitative trading if it can be fully encoded as computer programs. Certain chartist techniques as recognition of some formations might not be

included in a quantitative trader's arsenal because they are quite subjective and may not be quantifiable.

Yet quantitative trading includes more than just technical analysis. Many quantitative trading systems incorporate fundamental data in their inputs: numbers such as revenue, cash flow, debt-to-equity ratio, and others. Some advanced quantitative systems can even incorporate news events as inputs.(Chan, 2009)

As long as you can convert information into bits and bytes that the computer can understand, it can be regarded as part of quantitative trading.

Statistical arbitrage trading deals with the simplest financial instruments: stocks, futures, and sometimes currencies.

The ideal independent quantitative traders is therefore someone who has some prior experience with finance or computer programming, who has enough savings to withstand the inevitable losses and periods without income, and whose emotions has found the right balance between fear and greed.

Quantitative trading is very scalable and a highly automated business. You need to spend time doing research and backtesting on new strategies. You need to consider further automation of your processes as automatically starting programs, download data automatically and maybe even interpret the news items that come across the newswire and take appropriate actions, and shut themselves down automatically after the market closes.

Maximum long-term growth is achieved by *finding a strategy with the maximum Sharpe ratio*, provided that you have access to sufficiently high leverage. Therefore, comparing a short-term strategy with a very short holding period, small annual return, but very high Sharpe ratio, to a long-term strategy with a long holding period, high annual return, but lower Sharpe ratio, it is still preferable to choose the short-term strategy even if you goal is long-term growth, barring (except) tax considerations and the limitation on your margin borrowing. (Chan, 2009)

Even before doing an in-depth backtest of the strategy you can quickly filter out some unsuitable strategies if they fail on one or more of these tests:

- Does it outperform a benchmark?

- Does it have a high enough Sharpe ratio?
- Does it have small enough drawdown and short enough drawdown duration?
- Does the backtest suffer from survivorship bias?
- Does the strategy lose steam in recent years compared to its earlier years?
- Does the strategy have its own "niche" that protects it from intense competition from large institutional money managers? (Chan, 2009)

A key difference between a traditional investment management process and a quantitative investment process is the possibility of backtesting a quantitative investment strategy to see how it would have performed in the past. By doing the backtest yourself allows you to experiment with variations of the original strategy, thereby refining and improving the strategy.

Quantitative traders use a good variety of performance measures. Ernest Chan argue that the Sharpe ratio and drawdowns are the two most important. The maximum drawdown is the difference between the global maximum of the equity curve with the global minimum of the curve after the occurrence of the global maximum (time order matters here: The global minimum must occur later than the global maximum). The global maximum is called the "high watermark." The maximum drawdown duration is the longest it has taken for the equity curve to recover losses. You have to ask yourself, realistically, how deep and how long a drawdown will you be able to tolerate and not liquidate your portfolio and shut down your strategy? (Chan, 2009) I have looked at one of his models where he calculates hedged strategy based on two different stocks and calculates cumulative return, high water mark, drawdown and duration. I think it is interesting and it could be a basis for a different model. I have instead concentrated on the three models mentioned earlier.

He argues also that you need to subtract the risk-free rate from your strategy returns in calculating the Sharpe ratio only if your strategy incurs financing cost.

In Excel it is easy to avoid look-ahead bias by ensuring that the formula in each cell is computed based on the rows above the current row.

In Excel it is also relatively easy to make VBA programs to automate processes and utilize Access as a database query language to create cross tabulated views and portfolio summaries.

Design

In the following I will present *three models* as mentioned in abstract.

1. The first is the main model which uses adaptive market hypothesis and momentum strategy in a pair trading context. It also makes use of log return and correlation between the pairs of stocks. I utilize the anti-correlation in the pair in a "mean-reverting" way.

2. The second model uses MACD (Moving Average Convergence Divergence) model to show early and hopefully good buy opportunities based on the MACD histogram. The stocks that are increasing fastest from a minimum point the resent days are good candidates for buys. The stocks that are declining fastest from the maximum point the resent days are good sell candidates. I use this technique in my model.

3. The third model which uses linear regression to predict development of the Agercy stock on Oslo Stock Exchange with the help of different oil price and some foreign stock market indexes. I present 5 sub models and compare the results with each other.

By presenting of these three models I hope to demonstrate useful understanding of algorithm trading models and the many possibilities that can be exploited.

Model 1:

In this model my intension was to automatically pick stock pairs based on their log return and correlation with each other. I have used a time window from 07.08.2010 until today as basis to find the best pairs for investing. The starting point of the window can be adjusted in the menu. The ending point is always the latest stock price. The results of my algorithm compared to the individual stocks and the two other pair trading strategies (algorithms (in the model))) can be easily compared in a graph. The graph shows that the last algo trading strategy performs best based on this time window. This can be viewed as a backtesting of the strategy.

I have run this model on daily basis normally ones a day since 15.05.2010 until today (06.07.2010) and the transactions can be viewed at order book history. All the gains and losses during this period can be viewed at portfolio sheet.

I have to precise the difference how I have handled the correlation in my model compared to CAPM model. The CAPM model utilizes correlation between the individual stock and the market. My model utilizes the correlation between the two individual stocks in the pair. In

CAPM the β (beta) is the sensitivity of the expected excess asset returns to the expected excess market returns, or also

$$\beta_i = Cov(R_i, R_m)/ Var(R_m) = Cov(R_i, R_m)/(\sigma_i * \sigma_m).$$

This system makes use of Momentum strategy and Adaptive Market Hypothesis in a pair trading context buy choosing the best performing pairs for further analysis in the first phase and also in the second phase to decide which of the two stocks to recommend to buy. This model makes it possible to gain extra profit by switching between the stocks on the right moments based on their previous days log return and correlation.

At first it generates a log return overview with correlation matrix. I mark with green background the *log returns* that are *higher* than a user defined limit, which I call log return limit. In the correlation matrix I mark the pairs with green background that have *lower correlation* than a user defined "correlation limit" while at the same time the log return criteria must be satisfied for both companies. The companies included in the combination must satisfy the log return and correlation criteria to be included to further "algo sheet" generation. By utilizing high log returns and low correlation I hope to identify stocks that move quite differently from each other and therefore giving good switching opportunities.

These marked combinations are the basis for generation of "algo sheets" for the most interesting pairs with graphs to illustrate the performance of the two individual stocks and three different switching techniques. For the last switching technique I also show the proposed swithing points with dates marked in the graph.

These "algo sheets" are the basis of generating a sorted overview where the best performing pairs are at top.

The top performing pairs are again basis for generating order book. When the order book is transferred to order book history it maintains a budget sheet and a portfolio sheet.

When I generate the order book I use a 3-day window back from the most recent price to compare the accumulated 3-day log return of the two stocks in the pair together with the n-day (usually 5 day) correlation to decide which stock to buy.

After I made my model I found someone else who had done somewhat similar approach. In the paper called "Can We Learn to Beat the Best Stock" does Allan Borudin, Ran El-Yaniv

and Vincent Gohan utilize anti-correlation in a pair of stocks (Borudin, 2004). This papers approach relies on predictable statistical relations between all pairs of stocks in the market. It does not attempt to predict winners or trends. Their emprical results on historical markeds provide strong evidence that this type of technical trading can "beat the market" and moreover, can beat the best stock in the market. In doing so they utilize a new idea for smoothing critical parameters in the context of expert learning.

In my model I dynamically change the portofolio during trading period. This approach is often called "active trading". In the Anticor Algorithm of Borudin they take advantage of the price fluctuation by constantly transferring wealth from the high perfomring stock to the anti-correlated low performing stock in the pair. In contrast to my model I transfer wealth to the best performer of the present day. This is based on my reading of Momentum strategy (N. Jegadeesh & Titman, 2001) where you belive that if you are early to jump to a upward trend it is likely to go upward based on the latency of the market reactions.

In my resent months test runs of my system I experience that often the jumps happen in early hours of trading and when I run my update around noon I may be too late to ride the uptrend. It is interesting to see how Borudin uses anti-correlation in pair-trading context in opposite way. I belive that this could be an interesting to test opposite reaction in my application since I have the positive log return test in the pair selection algorithm also. In this way it could be likely that the bad performer of today will return to trend later on and therefor I could gain the uptrend later. Borudins method is quite different from mine by since his model is mean-reverting while mine is based on momentum strategy and adaptive market hypothesis. I try to utilize the latenzy in herding behavior of the groud.

I also observe that Brudin uses quite short time window (les than 50 days) in contrast to my approzimately 300 day window. My window size is based on Jegadeesh and Titmans momentum strategy where they found out that it performs best in 3 to 12 month time window.

I belive it is quite difficult to optimize the right size of time window. And on the other side the optimal size might vary from time to time.

In my model I have not taken the transaction costs in consideration yet. The transaction costs are represented by the provision and the difference between the bid and ask prices at the broker.

I belive that my model can be calibrated better to give a better performance. I would like to try some of the thoughts of the Anticor Algorithm of Borudin mentioned earlier.

I did experience that it performed much better in a strong upward trending period when I was developing it in March and April but had not yet developed the orderbook, orderbook history and portfolio part. It seems like Borudin has done some of the same conclusions in their algorithm conserning making money on upward trending market.

Model 2:

In this model I use MACD (Moving Average Convergence Divergence) to dynamically select good buy candidates based on the stock's recent days MACD histogram development. It collects data for approximately 150 mostly traded stocks at Oslo Stock Exchange. The histogram is referred as difference column in the following. It is the difference between MACD (which is the difference between 26 day and 12 day exponential moving average) and 9 day exponential moving average of the MACD (Signal line).

The user can decide how many days to use in long, short and signal line window.

The advantage by using difference column is that it can give early buy and sell signals, even before the crossing of the signal line and MACD line. See description of MACD in the theory part.

Model 3:

In this model I use regression analysis to determine the descripting power of oil price, S&P100, FTSE100 and GDAXI indexes on a singel stock which is Agercy. It is a study where I present five models and look which of them gives the best descriptive power to explain changes in Acercy share on montly basis from the star of 2000 until beginning of 2010. This illustrates the many possibilities with regression analysis and the relative easy way to compare the results with each other. This kind of models could be used to predict regime shifts and help to decide if it is wise to use momentum models or mean-reverting models. Momentum models work best on upward trending markets while mean-reverting models work best on sideways trending markets. I consider model 1 as momentum model while model 2 as mean reverting model. It could also be used to lower the exposition when things look bad and higher the exposition when things look good.

Sample

"There is substantial evidence that indicates that stocks that perform the best (worst) over a three to 12 month period tend to continue to perform well (poorly) over the subsequent three to 12 months." (N. Jegadeesh & Titman, 2001) According to Momentum strategy by Jegadeesh and Titman it can be a good idea to look at the good performing stock over three to 12 months and hope that they will continue to perform well in the future.

Therefore I have used daily prices from the Oslo Stock Exchange for all the stocks for a period of appropriately 10 months and choose good performing pairs. In my example I have used data from 07.08.2009 until today. When I say today I mean it is moving as time goes by. The last date I updated the model was 06.07.2010.

Collecting of data

Model 1 & 2:

I have collected data through two sources:

1. For the historical data I have used a tool called HSQuote which I call from excel with parameters to collect data in to my application. I collect data at least ones a day through this canal.

2. On the other hand I can collect intraday data to my model with 15 minute interval from dn.no (Dagens Næringsliv – a Norwegian business newspaper) if necessary. This is regulated by the connections refresh rate. But I normally the refresh rate turned off and generate intraday sheets "manually" by starting a "Make Intraday sheet" – subroutine which decides which companies to include in to the intraday generation routine. This decision is based on the best performing pairs over the whole period (and those stocks that have been included earlier in the order book) which is in my case from 07.08.2009 until today.

Model 3:

I this case I have collected monthly data for a 10 year period from January 2000 to January 2010. It does not have an automatic download routine yet.

Analyze of data

Model 1 - Short description of my own pair trading strategy

I wanted to make a model which made use of correlation between stocks and at the same time looks at their log returns. This leaded me to study pair trading strategy and momentum

strategy on the other hand. The kind of pair trading strategy I generate pairs that have low correlation but at the same time have high log returns. This combined with momentum strategy in the last stage where I choose the best stock of the pair based on most recent development (intraday price or yesterday closing price depending on the user chosen method) and the same time have exit strategies to quickly exit the positions in case of negative development. I believe this combination of strategies can make a good strategy because it has a set of tools called correlation, log return and momentum strategy in a "pair trading context".

This technique divides in two stages. The first stage is to choose the best candidates based on their historical trend (which has to be positive) and the stock pairs correlation (which has to be lower than a user specified limit). This combination of choosing criteria helps me to find stock pairs that have positive trend and at the same time move quite differently from each other. This gives me the possibility to switch between the stocks based on their resent development. This switching process in referred as the stage two above. This model produces a sorted overview with a graph with the best candidate pairs on top and shows the differences in performance between the two individual stocks(1 & 2), strategy based on yesterday and day before yesterday(3), strategy based on the last three day average(4) and "my algorithm strategy"(5). In many pairs the "algorithm strategy" can produce very good results. You can see it in the graph at enclosure S6 where the graph on the lower right corner represents the returns produced by "my algorithm strategy". It is significantly better than the others.

I wanted to use these best candidates in the ranked list to generate buy, sell and hold signals in to an order book. I can choose between two methods of generating order book records based on the top candidates in the sorted overview. The first I call "History method" which uses the most resent dates recommendation in algorithm sheets to generate a buy order in case it has been positive development now (today intraday price). The second method which I call "Intraday method" generates buy orders on the best performer stock of the pair today in case it is positive.

Both generate sell orders in case the stock has negative development in "stages" ("little by little"). Both also have an exit strategy to exit the stock position completely in case the stock goes down more than x% a day (user specified parameter). I have used 1% in the whole period which has leaded to sells quite often.

In the model I have made automatic generation of intraday sheets for all the companies that are recommended or are in my portfolio. In addition to most recent order book proposal the model saves all the order book records in an order book history sheet and maintains a budget sheet and a portfolio sheet.

This system also has an integrated budget sheet, order sheet, order history sheet, portfolio sheet in addition to the price history, log return sheet, algorithm sheets (stock pairs), overview and sorted overview of pair's graphical presentation of the different pair's performance.

Model 2 - Short description of MACD model

In this model I use the same input file (txt file from HSQuote) as for the model 1.

I use to different Access queries to produce "All stock"- sheet and "CompSymbols"-sheet where I add two columns for start row and end row for each ticker in the "All stock"-sheet.

These two sheets are input for generating all the company sheets with MACD calculations and graphs. In the company sheets I use color codes to show the development of the MACD histogram in the differance column. I greate a number of columns where the most important ones are:

- Change (in differanse column)
- Five day sum off change column
- Min/Max mark (shows -1 if minimum, 1 if maximum else 0.)
- Last mark (shows the last min/max mark until it changes.
- Cnt (number of days since last min or max)
- Signal (shows the Buy, Sell or Hold recommendation)

In the end of the same routine I generate a Momentum sheet which is an overview of the results where the best buy candidates are at the top and the best sell candidate at the bottom.

Model 3 - Short description of regression analysis model

Here I present five regression analysis models: (I must point out that when I refer ACY_t I mean $LN(ACY_t/ ACY_{t-1})$. The same for the dependent variables.)

1. $$ACY_t = \beta_0 + \beta_1 * ACY_{t-1} + U_t$$

2. $ACY_t = \beta_0 + \beta_1 * Oilprice_t + \beta_2 * Oilprice_{t-1} + U_t$

3. $ACY_t = \beta_0 + \beta_1 * Oilprice_t + \beta_2 * Oilprice_{t-1} + \beta_3 * S\&P100_t + \beta_4 * S\&P100_{t-1} + U_t$

4. $ACY_t = \beta_0 + \beta_1 * Oilprice_t + \beta_2 * Oilprice_{t-1} + \beta_3 * S\&P100_t + \beta 4 * S\&P100_{t-1} + \beta_5 * FTSE100_t + \beta_6 * FTSE100_{t-1} + \beta 7 * GDAXI_t + \beta_8 * GDAXI_{t-1} + U_t$

5. $ACY_t = \beta_0 + \beta_1 * Oilprice_t + \beta_2 * Oilprice_{t-1} + \beta_3 * S\&P100_t + \beta_4 * S\&P100_{t-1} + \beta_5 * K1_t + \beta_6 * K2_t + \beta_7 * K3_t + \beta_8 * K4_t + \beta_9 * K5_t + \beta_{10} * K6_t + \beta_{11} * K7_t + \beta_{12} * K8_t + \beta_{13} * K9_t + \beta_{14} * K10_t + \beta_{15} * K11_t$

Process and results

Model 1 - Process - Detailed description of my own pair trading strategy

In this description I want to illustrate and describe the menu and all the sheets. In addition I will describe some of the VBA-subroutines and functions. You can find all the VBA-code in a separate appendix.

In my application I have focused on daily downloads of data from HSQuote but it is possible to do this download many times a day since I take care of the time in addition to the date in order book and order book history. This download is the basis for the generation of algo sheets. In addition I do create so called intraday sheets for the stocks that are included in the portfolio or are included in the most resent algo sheet collection. I make use of intraday price development (daily % change) in generation of order book.

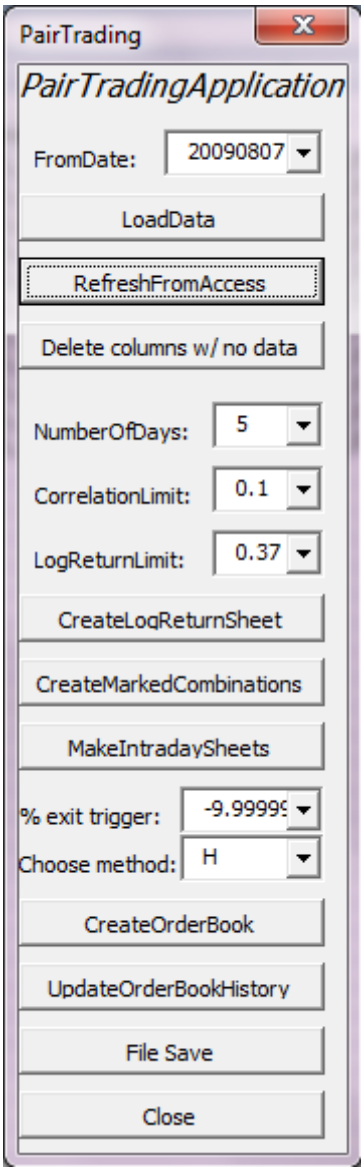
Menu

The application has a menu which can be opened by two ways.

- By clicking <ctrl>m or
- By clicking “Open Form” at the “FinalStockPriceQuery” sheet.

To close the menu you must push the “Close” button.

The menu looks like this:



From the "FromDate-combo box" you can choose how far back in time you want to use data from.

Load Data

The "LoadData" pushbuttom retrieves daily prices from HSQuote and places the data in to a semicolon separated txt file in a subdirectory called JyrisIndexM.

Refresh from Access

The "RefreshFromAccess" pushbuttom collects the adjusted close price from the txt file and uses Access to make a crosstabulated preview of the data and places it into the "FinalStockPriceQuery" sheet. The access queries do some selections based on daily changes and number of days with quotation. I want the stocks also to have a minimum of turnover (stock price * volume) in the selected period. This is mostly to ensure that I don't get the

stocks that are rarely quoted. These stocks would cause problems later in log return and correlation calculations. Therefore I exlude those companies that have log return like zero in *n* (the number of days parameter) subsequent days. Log return like zero means that there is no change from previous day in the stock price.

Delete columns

The "Delete Columns" button is to delete columns at the right of the "FinalStockPriceQuery" in case there are columns with heading like "ColumnX" where X is a number. This can happen if I run the download early after opening of the stock exchange because not all the stocks have been quoted yet for the day and therefore get les number of columns than the day before. Therefore I usually don't run the download between 09:00 and 11:00. I usually check for columns like this on the right hand side of the table and in case I see columns like that I run this routine. It does not harm anything in case one runs it if there is no columns like that.

Number of days combo box

The "NumberOfDays" combo box is to choose how many days back the "running look back window" for correlation calculation uses in algo sheet generation. This is also used in exluding companies with no change in price in n subsequent days as mentioned earlier.

Correlation limit and Log return limit combo box

The "Correlation Limit" and "Log Return Limit" are parameters which I use in selecting pairs for algo sheet generation. As earlier mentioned my intension is to concentrate about the stock pairs that have higher log return in the period than "Log Return Limit" and at the same time have lower correlation between the pair of stocks than "Correlation Limit". If the log return for both of the two companies are above the log return limit and at the same time the correlation between the two companies are below the "correlation limit" then the combination will be labeled with green background. My intension with the "Correlation Limit" was that this could be an indicator that the stocks move quite differently of each other giving good switching opportunities. But if it is desirable to downprioritize this selection option it is possible to select a high "Correlation Limit". This is to limit the number of combinations (algo sheets) generated. If I would create algo sheets for all possible combinations for 150+ stocks it would generate rather a large number of combinations. I have created combinations for about 250 stock pairs but then the spreadsheet is quite large. Normally I try to limit the number of combinations between 50 and 100.

Create Log Return Sheet

The "Create Log Return Sheet" push button creates the "Log Return" sheet which consists of two parts. On the top I create the log return table and on the bottom the correlation table. On top and on the right hand side of the correlation table I have put the log returns of each stock and marked the log returns which are higher than the log return limit. In the correlation table I marked the combinations that satisfy my selection criteria based on "Correlation Limit" and "Log Return Limit". The interesting combinations are marked with green background.

Create market combinations

The "Create Market Combinations" button starts creating of algo sheets based on the marked combinations in "Log Return" sheet. The workbook will be saved e.g. as "FSPQ_ 3_Day_ .1_CorrLim_ .5_LRLim_pr_07.04.2010_HBlendedStategy". Here the FSPQ is the fixed part and the rest is variable depending on the input parameter choices and the last date in the model. FSPQ is short name for "Final Stock Price Query" which is the name of the Access query and the name of the first worksheet.

Columns in algo sheet

The Algo sheets that consist of following columns:

1. Trade date
2. Log Return for stock 1.
3. Accumulated stock return for stock 1.
4. Log Return for stock 2.
5. Accumulated stock return for stock 2.
6. Correlation between the two stocks the previous parameter given days (referenced above as "number of look back days").
7. Accumulated three day log return for stock 1.
8. Accumulated three day log return for stock 2.
9. The ticker for best performer today (not in use further).
10. The ticker for best performer yesterday.
11. The ticker for best performer the day before yesterday.
12. If field 10 and 11 give same ticker then the ticker else "blank".
13. Recommendation ticker. =IF(L7=M6;M6;IF(L7="";M6;IF(L7=B$4;B$4;D$4))). If previous recommendation like field 12 then previous recommendation else if field 12 like blank then previous recommendation else if field 12 like the ticker in top of column 2 then ticker in top of column 2 else ticker in top of column 4.

14. Daily log return of the recommended stock.
15. Accumulated column 14 which I call **AcChY+YY** which uses the daily log return of yesterday and day before yesterday to decide which stock to recommend.
16. The ticker for best three day trend (inclusive today) of the two stocks.
17. The daily log returns for the ticker at column 16.
18. Accumulated column 17 which I call **AcCh3day**.
19. Recommendation ticker for so called algorithm trade where I look at both the trend and correlation. I use the columns 6, 7 and 8 to decide which stock to recommend. =IF(AND($H8>$G8;$F8<$S$3);$D$4;IF(AND($H8<$G8; $F8<$S$3);$B$4;$S7)). The company with best three day trend and at the same time n-day correlation in absolute value lower than correlation limit change to this stock else stay at the same position. The correlation limit here is based on comparing of different correlation limits which in sum generates best results done on the right hand side of the table. The result of this comparing is filled in the orange field which is used in this algorithm. This field is filled out by a VBA-routine which chooses the best performing "sensitivity" factor.
20. The daily log returns for the ticker at column 19.
21. Accumulated column 20 which I call **AcChAlg**.
22. Columns from columns 22 to 41 are used to find the most profitable correlation limit which is used in column 19.
23. Column 42 is a help field to generate the switching marks on the graph.

At top of each these daily log return columns I sum up the total log returns from day 4 to the end of period to make them comparable.

Comparison of the Overview sheets

I use the accumulated columns for each of the stocks and AcChY+YY, AcCh3day and AcChAlg to produce six worksheets called Overview, "Overview Sorted", "Overview Sorted Graph", "New Overview, "New Overview Sorted" and "New Overview Sorted Graph" which make it easy to compare the results of each strategy for each pair of stocks. The difference between the three sheets with "New"-prefix is that they use the effective interest while the ones without the "New"-prefix use continuous compounding return.

Overview and New Overview sheet

In Overview and New Overview the stock pairs are listed in the order they are generated.

Overview Sorted and New Overview sheet

In "Overview Sorted" and in "New Overview Sorted" then stock pairs are sorted descending by AcChAlg with the best performing stock at the top.

In both of these sheets I have color-code the rows where algo strategy has performed best. I have also indicator columns from column G to F which indicate which strategy is the best otherwise blank. At the top I show a percentage which shows the portion of each strategy's success. Column CntNotBlnk (L) shows for each row how many strategies have given the best result. It can happen that more than one strategy gives the best result. "Sensitivity % algo" (M) shows which sensitivity that has been used in the stock pair. This number can be a number between 0 and 0.9 with increments of 0.1. Low number means that it has been more profitable not to switch between the stocks often. High number means that it has been necessary to switch between the stocks quite frequently. The next three columns called "No of switches" tell how many times each of the tree "pair strategies" has had to switch between the stocks. As the last column I have calculated a percentage based on "Better than the best individual stock in the pair compared with algo strategy" for the whole period.

When choosing the best candidate it is probably best to choose one near the top of the sorted list and also take in consideration the number of switches between the stocks since each switch will add transaction costs.

In both overviews I have made a hyperlink to the individual algo sheet to give easy access to details. There is also a button in each algo sheet named "return to sorted overview" to give easy access back to the overview. In algo sheet I have also made two hyperlinks for each of the stocks to open stock "development" page from Dagens Næringsliv (dn.no). This is to give easy access to news and information about the individual stock. This gives also a possibility to double check the data.

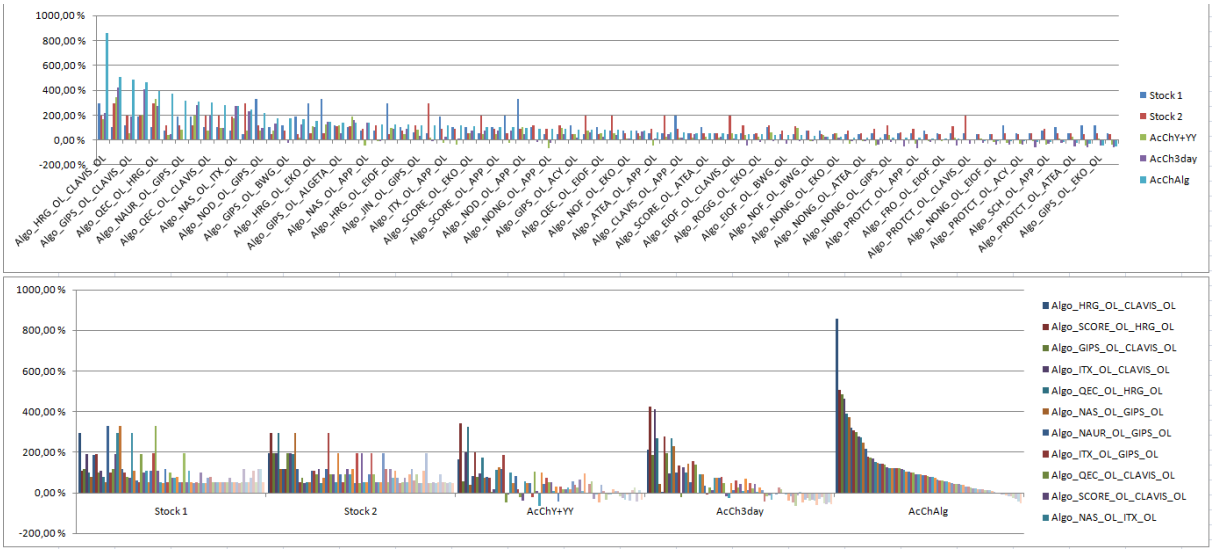
The "*New Overview Sorted*" which uses *effective interest* is based on the percentages on line **one** on every algo sheet (in *black*). This is calculated from the continuous compounding interest which is on the line 3 (in black). The black percentages on line one is comparable with the percentage changes referred at Dagens Næringsliv (dn.no).

The "*Overview Sorted*" which uses continuous compounding interest is based on the percentages on line **three** on every algo sheet (in *black*).

The *red* percentages on line **two** on algo sheet are effective interest based on the stock prices on sheet "Final Stock Price Query". I have kept this since it is good to have the possibility to double-check the calculation from continuous compounding interest rates to effective interests rates on line one.

I have calculated the log return percentage (continuous compounding interest) to an annual number in the algo sheet which is colored light *brown* through a formula =B3/($O$2/360) where b3 is log return for the whole period and $O$2 is number of days in the whole period (from day 4 to the end. I have to start from day 4 to make all the columns comparable with each other.)

Graphical presentation of the different algorithms performance



It shows two graphs where the top one has the strategies grouped by stock pair at x-axis. While the second graph has the strategies grouped along the x-axis. In the first graph we can see that the light blue bar is performing best the most times in the pairs. In the second graph we can see how "my pairs trading strategy" outperforms both the two independent stocks and the two other pair trading strategies.

When I choose pairs for the order book I pick the pairs with the highest performers on the bottom right graph. These graphs are based on the development of the pairs from the start of the period until today. The number of pairs which is picked further to the order book varies according to how many algo strategies are ranked at the top of the New Sorted Overview list.

The Lists sheets (are parameter and lookup sheets for doing different calculations)

I have also a worksheet called "Lists" which contains list of all the tickers, name of the company, sector code and sector name. The tickers are listed as the symbol in Norway and as HSQuote symbol with "_OL" extension to indicate that it is a Norwegian symbol in the international database where I retrieve the daily stock prices.

The "Lists" worksheet also contains the eligible values of the three input parameters and the current chosen ones just below.

The first one:

This is also referred as number of day's parameter. It is used in both create log return sheet as selection for number of zero change days following each other and in create marked combinations on correlation range calculation (number of look back days).

CorrLookUpRange
3
4
5
6
7
8
3

The second one:

This is also used in both "create log return sheet" and "create marked combinations" routines. In the first routine it is used to color code the combinations that are interesting. In the second routine the color coded combinations are used to generate algo sheets. Correlation limit (CorrLimit) I have decided to have a range from 0.1 to 0.5 because I want here to concentrate on the stock pairs with low correlation in absolute value to get best switching effect since the stocks move differently.

CorrLimit
0,1
0,2
0,3
0,4
0,5
0,1

The third one:

For the log return limit I have chosen a range of positive values from 0.1 up to 3.0 with 0.1 increments. It depends on the data what is most suitable log return limit. I have used limits between 0.2 and 0.5 for the data for a period between 7.8.2009 and 7.7.2010.

LogRetLimit
3
2,9
2,8
2,7
2,6
2,5
2,4
2,3
2,2
2,1
2
1,9
1,8
1,7
1,6
1,5
1,4
1,3
1,2
1,1
1
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0,5

It is possible to change the value proposed by the combo boxes by manually entering a value.

After I have greated log return sheet I look for how many green marked correlations I see in the correlation matrix. I normally want it to be a number between 50 and 150. If the number is less I adjust either “log return limit” down or “correlation limit” up. This way I wil get more companies marked in the correlation matrix. In case the number is larger than 150 I will adjust the parameters opposite way. But of course it is the user that decides that. I see that the size of

the spreadsheet increases as the number of companies increases. With 56 companies the size of file is apprimately 10 MB.

Xsheet names are templates used in generation of the actual sheet names

The workbook contains also three template sheets called XLogReturn, XAlgoTemplate and XOverview. I use them in some degree in generating the sheets with no X in front.

Make intraday sheets

Make intraday sheets creates sheets called I_<company ticker> for the companies that are included in the pairs of the resent run of "Create Market Combinations" and those tickers that exists in the portfolio from earlier runs. The daily percentage change is used in order book creation. I get these data from Dagens Næringsliv page (dn.no) through a web connection.

Create Order book

Create order book uses exit trigger and method parameters to create order book.

% exit trigger

This is the percentage limit which triggers sell order generation. I have used 1% decline as an exit trigger (which is displayed as -9.9999 in the combo box afterwards. But I can see it is stored correctly in to the Lists sheet where I pick it up for later use). There are two kinds of exit strategies: One is executed gradually by selling down gradually if the stock is still recommended but has a negative development greater than exit trigger today. The other sells down the whole position in case the stock is not any more recommended and has a negative development greater than exit trigger today. These lines get a little different layout in the order book. They are marked with a text: "Not more recommended".

Choose method

It is possible to choose between Historical (H) and Intraday (I) method.

Historical method uses algo sheet recommendation as basis for choosing between the two stocks in the pair. In case of possible development today it will recommend the stock from algo sheet.

Intraday method recommends the stock of the pair which has been best performer today based on percentage changes on intraday sheets.

Effect of using either History or Intraday method in order book generation

As earlier mentioned the History method recommends the stock on the last row of algo sheet for buying and the intraday method recommends the best performer of today based on

intraday sheets. To illustrate the difference I show two examples of order book which give quite different recommendations based on the choice of method:

Intraday method:

Order book ! today	Stock pairs	Best choice today	Cap.to use	b/s/h	price last	price now	calc gain/loss%	source gain/loss%	No of stock's	Cap.used/ realized	Parm used	Bad choice today	Bad choice today incr.	Average inc. all	Average inc. sel.	Accumu Balance	Run Counter	no of stock remaining	repeat controll
08.06.10 1:23	Algo_QEC_OL_HRG_OL	QEC_OL	956,47	Buy	19,8	19,8	0,00 %	2,59 %	48,31	956,47	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_I	HRG_OL	-4,38 %			18412,10		0,00	0,00
08.06.10 1:23	Algo_QEC_OL_CLAVIS_OL	QEC_OL	956,47	Buy	19,8	19,8	0,00 %	2,59 %	48,31	956,47	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_I	CLAVIS_OL	-5,38 %			17455,63		0,00	0,00
08.06.10 1:23	Algo_GIPS_OL_CLAVIS_OL	GIPS_OL	956,47	Buy	13,1	13,1	0,00 %	2,34 %	73,01	956,47	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_I	CLAVIS_OL	-5,38 %			16499,16		277,06	277,06
08.06.10 1:23	Algo_NAS_OL_GIPS_OL	GIPS_OL	956,47	Buy	13,1	13,1	0,00 %	2,34 %	73,01	956,47	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_I	NAS_OL	-4,84 %			15542,68		277,06	0,00
08.06.10 1:23	Algo_NAUR_OL_GIPS_OL	GIPS_OL	956,47	Buy	13,1	13,1	0,00 %	2,34 %	73,01	956,47	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_I	NAUR_OL	-4,49 %			14586,21		277,06	0,00
08.06.10 1:23	Algo_ITX_OL_GIPS_OL	GIPS_OL	956,47	Buy	13,1	13,1	0,00 %	2,34 %	73,01	956,47	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_I	ITX_OL	-1,26 %			13629,74		277,06	0,00
08.06.10 1:23	Algo_SCORE_OL_HRG_OL	SCORE_OL	956,47	Buy	40,3	40,3	0,00 %	0,25 %	23,73	956,47	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_I	HRG_OL	-4,38 %			12673,26		150,36	150,36
08.06.10 1:23	Algo_SCORE_OL_CLAVIS_OL	SCORE_OL	956,47	Buy	40,3	40,3	0,00 %	0,25 %	23,73	956,47	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_I	CLAVIS_OL	-5,38 %			11716,79		150,36	0,00
08.06.10 1:23	Algo_ITX_OL_CLAVIS_OL	ITX_OL	0,00	Hold	11,75	11,75	0,00 %	-1,26 %	0,00	0,00	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_I	CLAVIS_OL	-5,38 %			11716,79		0,00	0,00
08.06.10 1:23	Algo_NAS_OL_ITX_OL	ITX_OL	0,00	Hold	11,75	11,75	0,00 %	-1,26 %	0,00	0,00	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_I	NAS_OL	-4,84 %			11716,79		0,00	0,00
08.06.10 1:23	Algo_HRG_OL_CLAVIS_OL	HRG_OL	0,00	Hold	4,59	4,59	0,00 %	-4,38 %	0,00	0,00	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_I	CLAVIS_OL	-5,38 %			11716,79		0,00	0,00
								0,74 %					-4,64 %						

History method:

Order book ! today	Stock pairs	Best choice today	Cap.to use	b/s/h	price last	price now	calc gain/loss%	source gain/loss%	No of stock's	Cap.used/ realized	Parm used	Bad choice today	Bad choice today incr.	Average inc. all	Average inc. sel.	Accumu Balance	Run Counter	no of stock remaining	repeat controll
08.06.10 1:53	Algo_QEC_OL_CLAVIS_OL	QEC_OL	956,47	Buy	19,8	19,8	0,00 %	2,59 %	48,31	956,47	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_H	CLAVIS_OL	-5,38 %			18412,10		0,00	0,00
08.06.10 1:53	Algo_NAUR_OL_GIPS_OL	GIPS_OL	956,47	Buy	13,1	13,1	0,00 %	2,34 %	73,01	956,47	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_H	NAUR_OL	-4,49 %			17455,63		277,06	277,06
08.06.10 1:53	Algo_ITX_OL_GIPS_OL	GIPS_OL	956,47	Buy	13,1	13,1	0,00 %	2,34 %	73,01	956,47	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_H	ITX_OL	-1,26 %			16499,16		277,06	0,00
08.06.10 1:53	Algo_SCORE_OL_HRG_OL	SCORE_OL	956,47	Buy	40,3	40,3	0,00 %	0,25 %	23,73	956,47	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_H	HRG_OL	-4,38 %			15542,68		150,36	150,36
08.06.10 1:53	Algo_SCORE_OL_CLAVIS_OL	SCORE_OL	956,47	Buy	40,3	40,3	0,00 %	0,25 %	23,73	956,47	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_H	CLAVIS_OL	-5,38 %			14586,21		150,36	0,00
08.06.10 1:53	Algo_QEC_OL_HRG_OL	HRG_OL	0,00	Hold	4,59	4,59	0,00 %	-4,38 %	0,00	0,00	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_H	QEC_OL	2,59 %			14586,21		0,00	0,00
08.06.10 1:53	Algo_NAS_OL_GIPS_OL	NAS_OL	0,00	Hold	118	118	0,00 %	-4,84 %	0,00	0,00	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_H	GIPS_OL	-2,34 %			14586,21		0,00	0,00
08.06.10 1:53	Algo_NAS_OL_ITX_OL	NAS_OL	0,00	Hold	118	118	0,00 %	-4,84 %	0,00	0,00	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_H	ITX_OL	-1,26 %			14586,21		0,00	0,00
08.06.10 1:53	Algo_HRG_OL_CLAVIS_OL	CLAVIS_OL	0,00	Hold	44	44	0,00 %	-5,38 %	0,00	0,00	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_H	HRG_OL	-4,38 %			14586,21		0,00	0,00
08.06.10 1:53	Algo_GIPS_OL_CLAVIS_OL	CLAVIS_OL	0,00	Hold	44	44	0,00 %	-5,38 %	0,00	0,00	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_H	GIPS_OL	2,34 %			14586,21		0,00	0,00
08.06.10 1:53	Algo_ITX_OL_CLAVIS_OL	CLAVIS_OL	0,00	Hold	44	44	0,00 %	-5,38 %	0,00	0,00	FSPQ_5_Days_ 1_ConLim_ 37_LRLim_07.08.2009_07.06.2010_H	ITX_OL	-1,26 %			14586,21		0,00	0,00
								-2,04 %					-1,87 %						

Both of them have the same pairs as basis but choose often different stocks to buy. Historical method proposes buy based on the resent days development based on calculation done in algosheets. Intraday method proposes buy based on todays stock price development. In both cases there is a test that it will not propose a buy in case of negative development today.

The volume to buy or sell

The volume to buy or sell is based on how many stocks are recommended and how much cash available. In case as above there are 11 lines in the order book then the cash amount used to buy or sell on each stock is cash available (the last line in budget sheet) divided by 11. But as in the example above not all lines fill the requirements for buy or sell and get a “hold tag”. Therefore not all available cash is used in this run. Therefore the available cash varies according to development of the stock marked by being more strongly involved when positive development and less involved when negative development. This example does not show lines which recommends a sale of whole position, but you can find examples on order book history. When there is very strong negative development the system generates many exit orders based on “not recommended any more” and frees more cash. While in positive development larger portion of cash is used on the stocks.

Update order book history

This routine transfers the order book to order book history sheet and maintains the portfolio sheet with assistance of Access and maintains the budget sheet with available cash.

Order book today	Stock pairs	Best choice today	CapTo use	b/s/h	price last	price now	calc gain/loss%	source gain/loss%	No of stock's	CapUsed realized	Parm used	Bad choice today	Bad choice today incr.	Average inc. all	Average inc. sel.	Accumu Balance	Run Coun	no of st remaini
15.05.2010 03:14	Algo_ITX_OL_GSF_OL	GSF_OL	6000,00	Buy	18	18,2	1,11 %	3,41 %	329,67	6000,00	FSPQ_6_Days_13_CorrLim_4_LRLim_pr_14.05.2010	ITX_OL	-3,79 %			24000,00	1	0,00
15.05.2010 03:14	Algo_ITX_OL_GIPS_OL	GIPS_OL	6000,00	Buy	10,2	10,2	0,00 %	2,00 %	588,24	6000,00	FSPQ_6_Days_13_CorrLim_4_LRLim_pr_14.05.2010	ITX_OL	-3,79 %			18000,00	1	0,00
15.05.2010 03:14	Algo_ITX_OL_BERGEN_OL	BERGEN_OL	6000,00	Buy	9,49	9,48	-0,11 %	0,85 %	632,91	6000,00	FSPQ_6_Days_13_CorrLim_4_LRLim_pr_14.05.2010	ITX_OL	-3,79 %			12000,00	1	0,00
15.05.2010 03:14	Algo_SIT_OL_ITX_OL	SIT_OL	0,00	Sell	8,18	8,18	0,00 %	-0,73 %	0,00	0,00	FSPQ_6_Days_13_CorrLim_4_LRLim_pr_14.05.2010	ITX_OL	-3,79 %			12000,00	1	0,00
15.05.2010 03:14	Algo_ITX_OL_DNO_OL	DNO_OL	0,00	Sell	8,125	8,13	0,06 %	-1,75 %	0,00	0,00	FSPQ_6_Days_13_CorrLim_4_LRLim_pr_14.05.2010	ITX_OL	-3,79 %	0,76 %	-3,79 %	12000,00	1	0,00
15.05.2010 13:56	Algo_KOG_OL_ITX_OL	ITX_OL	0,00	Hold	13,75	13,95	1,45 %	0,00 %	0,00	0,00	FSPQ_3_Days_2_CorrLim_4_LRLim_pr_14.05.2010	KOG_OL	0,00 %			12000,00	2	0,00
15.05.2010 13:56	Algo_NAUR_OL_ITX_OL	ITX_OL	0,00	Hold	13,75	13,95	1,45 %	0,00 %	0,00	0,00	FSPQ_3_Days_2_CorrLim_4_LRLim_pr_14.05.2010	NAUR_OL	0,00 %			12000,00	2	0,00
15.05.2010 13:56	Algo_SCORE_OL_ITX_OL	ITX_OL	0,00	Hold	13,75	13,95	1,45 %	0,00 %	0,00	0,00	FSPQ_3_Days_2_CorrLim_4_LRLim_pr_14.05.2010	SCORE_OL	0,00 %			12000,00	2	0,00
15.05.2010 13:56	Algo_ITX_OL_BERGEN_OL	BERGEN_OL	0,00	Hold	9,49	9,48	-0,11 %	0,00 %	0,00	0,00	FSPQ_3_Days_2_CorrLim_4_LRLim_pr_14.05.2010	ITX_OL	0,00 %			12000,00	2	632,91
15.05.2010 13:56	Algo_ITX_OL_DNO_OL	DNO_OL	0,00	Hold	8,125	8,13	0,06 %	0,00 %	0,00	0,00	FSPQ_3_Days_2_CorrLim_4_LRLim_pr_14.05.2010	ITX_OL	0,00 %			12000,00	2	0,00
15.05.2010 13:56	Algo_ITX_OL_FUNCOM_OL	FUNCOM_OL	0,00	Hold	6	5,9	-1,67 %	0,00 %	0,00	0,00	FSPQ_3_Days_2_CorrLim_4_LRLim_pr_14.05.2010	ITX_OL	0,00 %	0,00 %	0,00 %	12000,00	2	0,00
18.05.2010 13:20	Algo_HRG_OL_GIPS_OL	GIPS_OL	1786,99	Buy	12,9	12,9	0,00 %	26,47 %	138,53	1786,99	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I	HRG_OL	-4,88 %			10213,01	3	1030,21
18.05.2010 13:20	Algo_ITX_OL_GIPS_OL	GIPS_OL	1786,99	Buy	12,9	12,9	0,00 %	26,47 %	138,53	1786,99	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I	ITX_OL	-2,15 %			8426,02	3	1030,21
18.05.2010 13:20	Algo_NAUR_OL_GIPS_OL	GIPS_OL	1786,99	Buy	12,9	12,9	0,00 %	26,47 %	138,53	1786,99	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I	NAUR_OL	-1,76 %			6639,02	3	1030,21
18.05.2010 13:20	Algo_NAUR_OL_HRG_OL	NAUR_OL	0,00	Hold	16,7	16,7	0,00 %	-1,76 %	0,00	0,00	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I	HRG_OL	-4,88 %			6639,02	3	0,00
18.05.2010 13:20	Algo_QEC_OL_NAUR_OL	NAUR_OL	0,00	Hold	16,7	16,7	0,00 %	-1,76 %	0,00	0,00	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I	QEC_OL	-3,80 %			6639,02	3	0,00
18.05.2010 13:20	Algo_NAUR_OL_ITX_OL	NAUR_OL	0,00	Hold	16,7	16,7	0,00 %	-1,76 %	0,00	0,00	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I	ITX_OL	-2,15 %			6639,02	3	0,00
18.05.2010 13:20	Algo_ITX_OL_HRG_OL	ITX_OL	0,00	Hold	13,6	13,65	0,37 %	-2,15 %	0,00	0,00	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I	HRG_OL	-4,88 %			6639,02	3	-231,49
18.05.2010 13:20	Algo_QEC_OL_ITX_OL	ITX_OL	0,00	Hold	13,6	13,65	0,37 %	-2,15 %	0,00	0,00	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I	QEC_OL	-3,80 %			6639,02	3	-231,49
18.05.2010 13:20	Algo_QEC_OL_HRG_OL	QEC_OL	0,00	Hold	17,8	17,7	-0,56 %	-3,80 %	0,00	0,00	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I	HRG_OL	-4,88 %	7,34 %	-3,69 %	6639,02	3	0,00
18.05.2010 13:24	Algo_HRG_OL_GIPS_OL	GIPS_OL	737,67	Buy	12,9	12,9	0,00 %	26,47 %	57,18	737,67	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I	HRG_OL	-5,07 %			5901,35	4	1003,81
18.05.2010 13:24	Algo_ITX_OL_GIPS_OL	GIPS_OL	737,67	Buy	12,9	12,9	0,00 %	26,47 %	57,18	737,67	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I	ITX_OL	-2,15 %			5163,68	4	1003,81
18.05.2010 13:24	Algo_NAUR_OL_GIPS_OL	GIPS_OL	737,67	Buy	12,9	12,9	0,00 %	26,47 %	57,18	737,67	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I	NAUR_OL	-1,76 %			4426,02	4	1003,81
18.05.2010 13:24	Algo_NAUR_OL_HRG_OL	NAUR_OL	0,00	Hold	16,7	16,7	0,00 %	-1,76 %	0,00	0,00	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I	HRG_OL	-5,07 %			4426,02	4	0,00
18.05.2010 13:24	Algo_QEC_OL_NAUR_OL	NAUR_OL	0,00	Hold	16,7	16,7	0,00 %	-1,76 %	0,00	0,00	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I	QEC_OL	-3,26 %			4426,02	4	0,00
18.05.2010 13:24	Algo_NAUR_OL_ITX_OL	NAUR_OL	0,00	Hold	16,7	16,7	0,00 %	-1,76 %	0,00	0,00	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I	ITX_OL	-2,15 %			4426,02	4	0,00
18.05.2010 13:24	Algo_ITX_OL_HRG_OL	ITX_OL	0,00	Hold	13,6	13,65	0,37 %	-2,15 %	0,00	0,00	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I	HRG_OL	-5,07 %			4426,02	4	0,00
18.05.2010 13:24	Algo_QEC_OL_ITX_OL	ITX_OL	0,00	Hold	13,6	13,65	0,37 %	-2,15 %	0,00	0,00	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I	QEC_OL	-3,26 %			4426,02	4	0,00
18.05.2010 13:24	Algo_QEC_OL_HRG_OL	QEC_OL	0,00	Hold	17,8	17,8	0,00 %	-3,26 %	0,00	0,00	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I	HRG_OL	-5,07 %	6,34 %	-3,65 %	4426,02	4	0,00
18.05.2010 13:24	Sell, not recomended any more	BERGEN_OL	-5810,13	Sell	9,18	9,18	0,00 %	-3,16 %	-632,91	-5810,13	FSPQ_4_Days_25_CorrLim_7_LRLim_07.08.2009_18.05.2010_I					10236,14	4	632,91

Description of the columns:

1. *Date and time* for the generation of order book.
2. The *stock pair* recommended by the "New Overview sorted"
3. *Best choice today* based either on History or Intraday method.
4. *"Cap to use"* means how much money to spend on a buy or how much money to sell for.
5. Buy/Sell/Hold indicator.
6. *Price from the last "big" download* which was the basis for generating of algo sheets.
7. *Price now* is the price just collected from the updated intraday sheets.
8. *Calculated gain loss* is calculated based on the percentage change from last big download to price now.
9. *Source gain/loss* is retrieved from the intraday sheets which represents the *change in price today*. These fields are used in the exit strategies and buy recommendations.
10. *Number of stock to buy or sell* is calculated by Cap to use/price now.
11. *Capital used or realized* is calculated by Number of stock * price now. This is the same as column 4. Can be removed later no new information but at time being I don't consider it to be such an important task.
12. Parameters used and at the same time output file name. Notice that the last character indicates which method is used.

13. Bad choice today. It is the opposite position of the recommended stock in the pair.
14. Bad choice today increment is collected from the intraday sheets to show what the percentage change of this stock is for today.
15. Average "good" is a summary field for the current order book and shows the average gain for the recommended stock of the pair at order date.
16. Average "bad" is a summary field for the current order book and shows the average gain for the opposite stock of the pair at order date.
17. Accumulated balance shows the "running" available cash after this buy/sell.
18. Run counter is a field used in the order book history sheet to show a counter for each order book generation. This helps to see which transactions belong to which order book generation run.
19. Number of stocks remaining shows how many stocks one has after this transaction. =IF(ISERROR(VLOOKUP(C3;Table_JyriIndexM11;4;FALSE));0;(VLOOKUP(C3;Table_JyriIndexM11;4;FALSE))) looks up the number of stocks remaining from the portfolio sheet.
20. Repeat control is a help field used by VBA to calculate capital to use in some circumstances.

Update order book history maintains budget sheet (Enclosure S11) and portfolio sheet (Enclosure S12).

In addition I have something which I call news sheet (Enclosure S13) which shows OSEBX index, winners and losers of the day and some news headings. This is retrieved from dn.no.

At all times there is also maintained an index sheet as the last sheet which shows all the sheets included in the workbook (Enclosure S14).

File Save as

Saves the file in to filenames:

- Working Copy Blended Strategy. This is the file we open every time we start the program. Access refers to this file name through "Link Manager" when producing portfolio from order book history sheet.

- FSPQ_ 5_Days_ .1_CorrLim_ .37_LRLim_07.08.2009_09.06.2010_HBlendedStrategy. This filename is used in case it is interesting to study why the algorithm did certain decisions earlier. This is done because the algo sheets in Working Copy are overwritten in each run.

Initially I started to study the differanse in the performance of the two methods but because of maintanse needs in the code I had to consentrate to keep the Blended Strategy sheet up to date and leave the to other unchanged. But I have left the possibility to be open as I have Access queries which produce portfolio also for these sheets.

- WorkingCopyI – for Intraday runs. And then the parameterized filename had an "I" in the end instead of Blended Strategy.
- WorkingCopyH – for History method. And then the parameterized filename had an "H" in the end instead of Blended Strategy.
- But because of lack of time I haven't studied this thorough (in-depth). But my intuition tells me that maybe Intraday method would perform better on trending market (moving mostly on same direction) and History method better on trading markets (moving up and down).

Results – Model 1

I consider OSEAX as my benchmark since I collect stock pairs from this index. This is the index which includes all the stocks in Oslo Stock Exhange (209 stocks in dn.no list). I select approcimately 150 most liquid stocks on this index because I want the stocks to be traded daily. But still I think it is the closest benchmark I can compare my algorithm with.

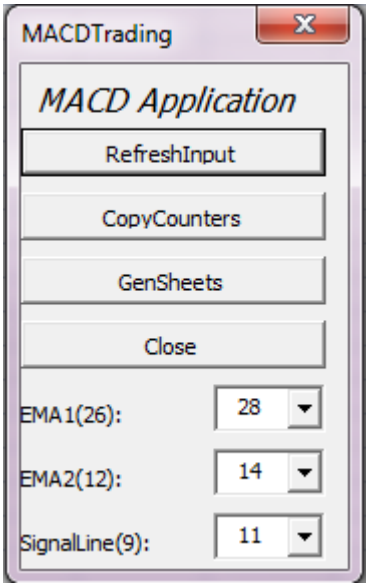
When I compare the period where I have collected data and generated order book history I can see that OSEAX index has declined from the 14.5.2010 when it was 412.82 until 07.07.2010 when it was 386.83. This is a decline of 6.72% against mine algorithm has increased by 2.64%. This is 6,72+2,64=9,36% better than the benchmark in that period which is 35 trading days.

On the other hand if I compare the best performing pair in the Enclosure S8 called "New Sorted Overview" for the period from 8.7.2009 until 25.06.2010 which is the best performing pair *in the backtest*. HRG (Hurtigruten) has gained 306.90%, CLAVIS (Clavis Pharma) has gained 197.67% and my algorithm has gained 867.37%. This is 560.47% better than the best individual stock.

Maybe on background of this I would have hoped for better results but I realize that the randomness of the market makes it not easy to retrieve that kind of results. But this can in some extend confirm that use of low correlation together with high log return can produce extraordinary results in some cases.

Model 2 - Process - Detailed description of MACD model/strategy

This model has a menu which can be opened from an "Open Form" button at "All Stock" sheet. The screenshots can be viewed at enclosure S15 to S19 in the screenshot appendix. The menu looks like this:



Refresh Input

This menu button retrieves data in to model from a common input file with model 1. While model 1 retrieves the data in a cross tabulated form this model retrieves the data in "list"-style form with columns: Symbol, Date, Open, High, Low, Volume, Close and Adj. Close.

The refresh input also makes a company symbol sheet where there are four columns: symbol, number of date rows, start row and end row. This is used to collect the data belonging to each stock in the MACD sheets named <company symbol>.OL.

I use Access queries to format and select data in access to generate desired output of data to the sheets on the basis of the txt file output imported by HSQuote application.

Copy Counters

The Copy Counters routine fills in the Comp Symbols sheet the starting and ending row positions of the data regarding each company.

Generate Sheets

This menu option generates all the 150 MACD sheets and the summary sheet called Momentum sheet.

In this sheet I use conditional color codes in the difference column to show following characteristics:

- Red fill means that the difference line crosses below zero. This gives a sell recommendation.
- Green fill means that the difference line crosses above zero. This gives a buy recommendation.
- Light green numbers means that the difference line is sloping up from the previous day.
- Pink numbers means that difference line is sloping down from the previous day.

To calculate the buy/hold/sell signal I make following columns.

- Change in the difference column from the day before. (M)
- 5-day sum of the difference. (N)
- 9-day maximum of the difference (not in use further).(O)
- 9-day minimum of the difference (not in use further).(P)
- 4-day sum of the difference.(Q)
- 3-day sum of the difference.(R)
- 2-day sum of the difference.(S)
- 1-day sum of the difference.(T)
- Mark the crossing of differance line down below the zero by “-1” and mark the crossing of differance line above the zero by “1”. This column is called “Min/Max Mark”.(U)
- Show the last crossing with the same “symbols as above” before the next crossing.(V)

- Count the same symbols following each other. When changed start to count from one. (W)

- The Buy, Hold or Sell signal (X) is calculated by the columns: V, W, and N. If last crossing down below the zero line and the downturn has lasted for more than three days and the 5-day sum of difference is greater than 0 then “Buy”. If last crossing up over the zero line and the downturn has lasted for more than three days and the 5-day sum of differences are less than 0 then “Sell”. Else “Hold”.

  =IF(AND(AND(V64=-1;W64>3);N64>0);"Buy";IF(AND(AND(V64=1;W64>3);N64<0);"Sell";"Hold"))

All these results are summarized in Momentum sheet. There are three groups of columns marked with different background color. In the first group I collect the results in alphabetical order. In the second group I sort the results descending by 5-day, 4-day, 3-day, 2-day and 1-day change. In the third group I collect symbol, “number of days since last crossing of zero line”, “last mark” and signal from the MACD sheets. I sort the third group by ascending signal and descending “5 day momentum” to get the best buy candidates on top and the best sell candidates on the bottom of the list. At this way I can see the best buy candidates based on the fastest increasing difference line during the last 5 days under condition that the last crossing was below the zero line and that it has been below the zero line for at least three days. The best sell candidates are the stocks that are declining fastest during the last 5 days and that the last crossing was above zero line and that it has been above the zero line for at least three days. Otherwise Hold.

All the MACD sheets have three graphical presentations of data. The first is showing the closing price together with the 26 and 12 day exponential moving averages. The second is showing MACD line together with the 9 day signal line which is 9 day exponential moving average of the MACD line. MACD line is calculated as the difference between 26 and 12 day exponential moving averages of the closing price.

The third graph shows the difference of MACD and signal line as a histogram. This is the data column I use in the analysis to find buy, sell or hold signals.

This model does not yet have any order book, order book history, budget or portfolio build in into it. But I believe I could quite easily convert some of the logic behind that in model 1 to this model. But because of the lack of time I have cannot do further work on this model regarding to my thesis.

The Exponential moving average long window size – combo box

This combo box is used to select the length of the long window. It is normal to use 26 day window but I have given the user the possibility to choose between 23 and 28 days.

The Exponential moving average short window size – combo box

This combo box is used to select the length of the short window. It is normal to use 12 day window but I have given the user the possibility to choose between 9 and 14 days.

The Signal line window size – combo box

This combo box is used to select the length of the signal line window. It is normal to use 9 day window but I have given the user the possibility to choose between 6 and 11 days.

Results – Model 2

As mentioned earlier I have no order book history on this model. But I think that it can be a useful tool to *detect early momentum* on stocks movements which have potential to rise/decline quite considerably on short term based on either buy or sell recommendation.

MACD is quite popular technical trading indicator as described in the theory part. It is often used in a way where one first looks for the early signals based on MACD histogram (topping or bottoming) and if desirable to wait for confirmation in form of a zero line crossing which comes later.

Model 3 - Process - Detailed description of regression analysis model

Regression models:

In the following I will present 5 regression analysis models to predict a single stock. I refer to the models as model 3.1, 3.2, 3.3, 3.4 and 3.5. I have picked Agercy (ACY) as the stock. I wanted to look if the stock price can be described by some independent variables which are:

- Oil price
- S&P100
- FTSE100
- GDAXI

I have also used lagged variables in some models. I wanted to show that regression analysis is a very useful tool to test relationships between different variables.

I collected the data for ACY, Oil price, S&P100, FTSE100 and GDAXI for the period from the beginning of 2000 until the beginning of 2010 on monthly basis.

Then I calculated LN changes from month to month and used these data in the regression analysis. This means that I calculate LN(ACYt/ACYt-1) for all the values. I refer to these columns in the following models as ACYt, but they mean actually the result of LN formula. This is done also for Oil price, S&P100, FTSE100 and GDAXI (German index).

At first I present a descriptive statistic of these data:

	ACYchange	*Opchange*	*laggedOPch*	*S&P100ch*	*laggedS&P100ch*	*FTSE100cha*	*lagedFTSE100cha*	*GDAXIcha*	*laggedGDAXIcha*
Mean	-0,00132	0,00824	0,00845	-0,00336	-0,00322	-0,00154	-0,00123	-0,00260	-0,00116
Standard Error	0,01711	0,00860	0,00862	0,00437	0,00436	0,00398	0,00397	0,00642	0,00647
Median	0,02294	0,02223	0,02223	0,00354	0,00354	0,00540	0,00540	0,00754	0,00950
Standard Deviation	0,18661	0,09387	0,09399	0,04769	0,04761	0,04343	0,04327	0,06999	0,07056
Sample Variance	0,03482	0,00881	0,00883	0,00227	0,00227	0,00189	0,00187	0,00490	0,00498
Kurtosis	2,91766	1,93812	1,92287	0,68111	0,71037	0,81163	0,88718	2,44770	2,39652
Skewness	-1,21888	-1,05044	-1,05058	-0,56867	-0,57767	-0,80338	-0,82691	-0,84060	-0,84133
Range	1,16990	0,53981	0,53981	0,26020	0,26020	0,22254	0,22254	0,48706	0,48706
Minimum	-0,78587	-0,33668	-0,33668	-0,15772	-0,15772	-0,13954	-0,13954	-0,29333	-0,29333
Maximum	0,38403	0,20313	0,20313	0,10248	0,10248	0,08300	0,08300	0,19374	0,19374
Sum	-0,15721	0,98023	1,00563	-0,40007	-0,38334	-0,18335	-0,14675	-0,30966	-0,13751
Count	119	119	119	119	119	119	119	119	119

For the second I want to percent the correlation between the variables:

	ACYchange	*Opchange*	*laggedOPch*	*S&P100ch*	*laggedS&P100ch*	*FTSE100cha*	*lagedFTSE100cha*	*GDAXIcha*	*laggedGDAXIcha*
ACYchange	1,0000								
Opchange	0,1464	1,0000							
laggedOPch	0,0451	0,2755	1,0000						
S&P100ch	0,4040	0,0979	0,1259	1,0000					
laggedS&P100ch	0,1814	0,2180	0,0985	0,1393	1,0000				
FTSE100cha	0,4936	0,0169	0,0763	0,8406	0,1429	1,0000			
lagedFTSE100cha	0,1526	0,3088	0,0200	0,1290	0,8396	0,0707	1,0000		
GDAXIcha	0,5107	-0,0277	0,0885	0,8370	0,1704	0,8621	0,1109	1,0000	
laggedGDAXIcha	0,2477	0,2748	-0,0143	0,1165	0,8215	0,1184	0,8503	0,0770	1,0000

Correlation between Oil price and S&P100 is 0,0979. This is not much and thus there is no problem with multicollinearity. Perfect positive multicollinearity is 1 and perfect negative multicollinearity is-1. On no multicollinearity is number 0.

Multicollinearity is a statistical phenomenon where two or more coefficients in a multiple regression model are much correlated. In such a situation can estimates to coefficients change unexpectedly after slight changes in the model or data. Multicollinearity reduces not

predictive power of the model as a whole. It affects only the individual coefficients. In multiple regression curve model correlated variable coefficients may indicate how well the overall model estimates, it affects the individual coefficients. Although it can predict good overall model it can affect the individual coefficients in the wrong direction.

It may be prudent to test the correlation between variable isolated seen such as with oil price and S&P100 to be sure it is not the case. If it had been the case one should to consider whether to exclude one from the model. Thus, to avoid that one or more of the coefficients will be also imprecise estimated. That will say that they would have won great sample variance.

I test five different models to see the descriptive power of them. I look at different above mentioned independent variables to describe the LN change of adjusted closing price of Agercy at Oslo Stock exchange.

Model 3.1: Regression statistics for AR (1) model (autoregressive model):

With autoregressive model estimates we the dependent variable (ACY_t) based on previous measurements of this variable (ACY_{t-1}). The autoregressive model with a layer, AR (1), will look like this:

$$ACY_t = \beta_0 + \beta_1 * ACY_{t-1} + U_t$$

Where ACY_{t-1} is the lagged value of the dependent variable. ACY_t is lagged and using it in the regression analysis as the dependent variable and ACY_{t-1} as the independent variable. This is called first ordinal autoregression, AR (1).

Modell 3.1:

ACY_t=	-0,00064	+	0,046378	* ACY_{t-1}	R^2=	0,002148	SER=	0,186542	R^2_{adj}=	-0,00631
	(	0,017029	)		(	0,092012179	)			

A test about $\beta_1 = 0$ vs. $\beta_1 \neq 0$ is a test about ACY_{t-1} can be used for making assumptions of ACY_t. Test will be: H_0: $\beta_1 = 0$ against H_1: $\beta_1 \neq 0$. It is checked whether the β_1 is significantly different from 0 and here I choose a 5% significance level and then the critical t-value is 1,96. That is, the test is sure of the 95% level. I choose here to look at the t-test for β_1.

T-test for β_1:

T-test tests observed t-value in the regression against a critical t-value. The formula for the t-statistic is: $T = \beta_1 - \beta_{1,0} / SE(\beta_1)$, where $SE(\beta_1)$ is the standard error of β_1 in this case: 0,504046.

It is believed then that distribution is normally distributed with continuous random variables. The test is then as follows: we reject H_0 of 5% significance level if the t-statistic in absolute value > critical t-value. At a 5% significance level: t-statistic > 1,96.

T-the statistic from regressions analyze equals (0,046378-0)/0,092012=0,504046 which is less than 1,96. The conclusion is therefore that we cannot reject H_0 and we can say that β_1 does not significantly differ from 0. Thus ACY_{t-1} does not have a significant impact on the dependent variable.

95% conf. interval for β1= β1± 1,96 * SE(β1)	**-0,13397**	=	0,046378	+1,96*	=0,092012
	0,226722	=	0,046378	-1,96*	=0,092012
	i.e. B1 coefficient			0,046378	lies innside the interval
	Therefore vi **cannot reject H_0** hypothesis.				

Model 3.2 - Distributed lag model (DL-model):

A distributed team model is a model where it is estimated the dependent variable Y (ACY_t) on lagged values of the independent variables X_i ($Oilprice_t$ and $Oilprice_{t-1}$). Dynamic causal effects can be estimated with the help of Distributed lag model.

DL model will look like this:

$$ACY_t = \beta_0 + \beta_1 * Oilprice_t + \beta_2 * Oilprice_{t-1} + U_t$$

Here is the regression analysis with ACY_t as dependent variable and $Oilprice_t$ and $Oilprice_{t-1}$ as independent variables. We make one lag of the Oil price variable and run the regression analysis.

Then we get the following regression model:

Modell 3.2:

ACY_t= -0,00378 + 0,288249 *β_1+ 0,010286823 *β_2 ,where R^2= 0,021463 SER= 0,186185 $R^2_{adjusted}$= 0,004591

(0,017174) (0,189945) (0,189686516)

Here tested β-values for statistical significance. The test in this task will have the same conditions as in model 1. Thus I reject H_0 at 5% significance level if the t-statistic in absolute value > critical t-value. At a 5% significance level, this is the case if the t-statistic > 1,96. In the opposite case I cannot reject H_0 and must in that case conclude that beta is not significantly different from 0.

T-test for β_1:

T-statistic = 1,517542. It is thus less than 1,96 and I cannot reject H_0. The conclusion is that the β1=0 and thus does not have a significant $OilPrice_t$ effect on ACY_t.

T-test for β_2:

T-statistic = 0,054231. Thus is the t-statistic less than 1,96 and I cannot reject H_0. β_2 is thus not significantly different from 0 and not saying something significant about the dependent variable.

Short-and long-term, and effects on ACY of a 1% increase in Oil Price:

The assumption is that the short-term effect on ACY depends on $OilPrice_{t-1}$ and expresses the ACY_t. I should then look at the change in ACY_t when $OilPrice_{t-1}$ increases by 1%. The model is thus as described earlier in this task.

Short-term effect:

This depends on null-period dynamic multiplier which is β1. The short-term effect is therefore β1= 0,28, that is a 1% increase in oil price will cause a 0,28% increase in ACY_t on short-term.

Long-term effect:

The sum of dynamic multipliers is the cumulative long-term effect on the dependent variable of a change in the independent variable. Therefore the long term effect is $\beta_1 + \beta_2$ in this case. The long-term effect is therefore: $\beta_1 + \beta_2 = 0,28 + 0,01 = 0,29$, this will say that a 1% increase in Oil price will cause a 0,29% increase on ACY_t on long-term.

Model 3.3: - Distributed lag model:

In this model I expand the previous model with two explanatory variables: $S\&P100_t$ and $S\&P100_{t-1}$. The model will then look like this on the general form:

$$ACY_t = \beta_0 + \beta_1 * OilPrice_t + \beta_2 * OilPrice_{t-1} + \beta_3 * S\&P100_t + \beta_4 * S\&P100_{t-1} + U_t$$

Regression curve analysis provides the following numbers for the model:

Modell 3.3:

ACY_t =0,004 + 0,19 * $OilPrice_t$ + (-0,08) * $OilPrice_{t-1}$ + 1,50 * $S\&P100_t$ + 0,434 * $S\&P100_{t-1}$

(0,015897073) (0,178322) (0,175359) (0,336081) (0,341708)

where R^2 = 0,187581 SER= 0,171129 $R^2_{adjusted}$ = 0,159075269

F-test to check whether $S\&P100_t$ and $S\&P100_{t-1}$ are significant:

F-test is used to test the significance to several beta coefficients at the same time. The null hypothesis is in this case: H0: β3 = 0 and β4 = 0. F-test statistic is calculated with the following formula:

$$F = \frac{(R^2_{unrestricted} - R^2_{restricted})/q}{(1 - R^2_{unrestricted})/(n - k_{unrestricted} - 1)}$$

- $R_{unrestricted}$ is R^2 for the regression where all variables are included: 0,187581
- Where $R^2_{restricted}$ *is* R^2 for the regression where the variables from H_0 are forced to be zero, meaning that they are removed from the regression: 0,021463
- q is the number of restrictions: 2
- $k_{unrestrted}$ is the number of regressors in the regression without restrictions: 4

Therefore F = ((0,187581-0,021463) / 2) / ((1-0,187581192) / (119-4-1)) = 11,655024

This value is compared with the critical F-value which in this case is 3.07 = $F_{2,120}$, for 5% significance level.

F-test statistic (11,65502)> the critical f-value (3,07) at 5% significance level.

Therefore **we can reject H0** and conclude with that β3 and/or β4 are significantly unlike from 0 and that these descriptive variables have significant effect on the dependent variable.

The same conclusion applies also for 1 % significance level where the critical value of F is F= 3,48.

Model 3.4 - Distributed lag model:

$ACY_t = \beta_0 + \beta_1 * OilPrice_t + \beta_2 * OilPrice_{t-1} + \beta_3 * S\&P100_t + \beta_4 * S\&P100_{t-1} + \beta_5 * FTSE100_t + \beta_6 * FTSE100_{t-1} + \beta_7 * GDAXI_t + \beta_8 * GDAXI_{t-1} + U_t$

I run a regression analysis and getting through to the following regression model:

Modell 3.4:

ACY_t = (-0,00368) + 0,312 *$OilPrice_t$ + (-0,0,00864) *$OilPrice_{t-i}$ + (-1,076) * $S\&P100_t$

(0,014372) (0,170495 (0,162524) (0,622775)

$+ (-0{,}598) * S\&P100_{t-1} + 0{,}8108 * FTSE100_t + (0{,}954) * FTSE100_{t-1} + 1{,}59 * GDAXI_t + 1{,}274 * GDAXI_{t-1}$

(0,6227) (0,742981) (0,462117) (0,433827)

Where R^2 0,367316 SER= 0,153738 $R^2_{adjusted}$ = 0,321303.

F-test to check if $FTSE100_t$, $FTS100_{t-1}$, $GDAXI_t$ and $GDAXI_{t-1}$ are significant:

F-test is used for testing the significance to several beta coefficients at the same time. The null hypothesis is in this case: H_0: β_5, β_6, β_7 and $\beta_8 = 0$ against H_1: β_5, β_6, β_7 and $\beta_8 \neq 0$.

- $R_{unrestricted}$ is R^2 for the regression where all variables are included: 0,367316
- Where $R^2_{restricted}$ *is* R^2 for the regression where the variables from H_0 are forced to be zero, meaning that they are removed from the regression: 0,187581
- q is the number of restrictions: 4
- $k_{unrestrted}$ is the number of regressors in the regression without restrictions: 8

Therefore is F = ((0,367316-0,187581) / 4) / ((1-0,367316) / (119-8-1)) = 7,812296 (F - test statistic)

Since 7,812296 > 1,99 it lies inside the confidence interval that is longer to the left. This value is compared with the critical F-value which in this case is 1.99 = $F_{4,120}$, for 10% significance level. As a result, we reject the null hypothesis that the β5, β6, β7 and β8 = 0 of 1, 5 or 10% significance level. This tells me that at least one of these explanatory variables have significant impact on the dependent variable.

Thus, it may seem as these variables help explain changes in ACY_t. Thus **we can reject H0** and conclude that β5, β6, β7 and β8 = 0 is significantly different from 0 and that these explanatory variables has significant impact on the dependent variable. The same conclusion applies to the 1% significance level where the critical value of F = 3,48.

Model 3.5 - Distributed layers model with binary variables:

By qualitative data, we can use binary variables. I want to test if the time of the year can help to explain variations of the ACY stock price. The variable is set to 1 if a given condition is met and 0 otherwise. If the right month the 1 otherwise 0:

In General, this model looks like this:

$ACY_t = \beta_0 + \beta_1 * OilPrice_t + \beta_2 * OilPrice_{t-1} + \beta_3 * S\&P100_t + \beta_4 * S\&P100_{t-1} + \beta_5 * K_{1t} + \beta_6 * K_{2t} + \beta_7 * K_{3t} + \beta_8 *$

$K_{4t}+ \beta_9 * K_{5t}+ \beta_{10} * K_{6t}+ \beta_{11} * K_{7t}+ \beta_{12} * K_{8t}+ \beta_{13} * K_{9t}+ \beta_{14} * K_{10t}+ \beta_{15} * K_{11t} + U_t$

I construct a model with these 11 dummy variables and run a regression analysis:

Model 3.5:

$ACY_t = 0{,}024 + 0{,}107 * OilPrice_t + (-0{,}08) * OilPrice_{t-1} + 1{,}497 * S\&P100_t + 0{,}587 * S\&P100_{t-1} + 0{,}003 * K_{1t} + 0{,}095 * K_{2t} + 0{,}011 * K_{3t}+$

(0,0546) (0,190863) (0,186311) (0,352565) (0,360705) (0,07763) (0,081318) (0,08078)

(-0,016) * K4t+ (-0,016) * K5t+ (-0,015) * K6t+ (-0,059) * K7t+ (-0,037) * K8t+ (-0,143) * K9t+ (-0,083) * K10t+ (-0,038) * K11t

(0,077659995) (0,077507) (0,078934) (0,07827) (0,077279) (0,077465) (0,076861) (0,07537)

Where $R^2 = 0{,}291228$ SER= 0,168159 $R^2_{adjusted} = 0{,}188009$.

T-test to check whether K_{1t}, K_{2t}, K_{3t}, K_{4t}, K_{5t}, K_{6t}, K_{7t}, K_{8t}, K_{9t}, K_{10t} or K_{11t} are significant:

None of the dummy variables is statistically significant according to t-test. T-statistics are respectively smaller. Thus, none of dummy variables are significant at the 1, 5 or 10% significance level.

F-test to check whether K_{1t}, K_{2t}, K_{3t}, K_{4t}, K_{5t}, K_{6t}, K_{7t}, K_{8t}, K_{9t}, K_{10t} or K_{11t} is significant:

F-test is used for testing significance to several beta coefficients at the same time. The null hypothesis is in this case: H_0: β_5, β_6, β_7, β_8, β_9, β_{10} ,β_{11} ,β_{12} ,β_{13} ,β_{14} and $\beta_{15} = 0$ and H_1: β_5, β_6, β_7, β_8, β_9, β_{10} ,β_{11} ,β_{12} ,β_{13} ,β_{14} and $\beta_{15} \neq 0$.

F-test statistic is calculated as in previous tasks:

- $R_{unrestricted}$ is R^2 for the regression where all variables are included: 0,291228
- Where $R^2_{restricted}$ *is* R^2 for the regression where the variables from H_0 are forced to be zero, meaning that they are removed from the regression: 0,187581
- q is the number of restrictions: 11
- $k_{unrestrted}$ is the number of regressors in the regression without restrictions: 15

Thus, F = ((0,291228- 0,187581) / 11) / ((1- 0,2912278) / (119-15-1)) = 1,369282 (F - test statistic)

F= 1,369282 <1,65 critical value on 10% significance level

Thus **cannot reject H0** and conclude that β_5, β_6, β_7, β_8, β_9, β_{10}, β_{11}, β_{12}, β_{13}, β_{14} and/or β_{15} are not significantly different from 0. Binary variables do not contribute to explaining the changes in stock price of ACY_t.

By test against the critical F-value it has emerged that H_0 cannot be discarded. By seeing this

along with T-statistics, it can be concluded that the binary variables does not contribute to explain the ACY_t fluctuations. They have thus not significantly influence for the dependent variable.

Compare models in tabular form:

Model 3.1:

ACY_t= -0,00064 + 0,046378 * ACY_{t-1} ,where R^2= 0,002148 SER= 0,186542 R^2_{adj}= -0,00631

(0,017029) (0,092012179)

Model 3.2:

ACY_t= -0,00378 + 0,288249 *β_1+ 0,010286823 *β_2 ,where R^2= 0,021463 SER= 0,186185 $R^2_{adjusted}$= 0,004591

(0,017174) (0,189945) (0,189686516)

Model 3.3:

ACY_t =0,004 + 0,19 * $OilPrice_t$ + (-0,08) * $OilPrice_{t-1}$ + 1,50 * $S\&P100_t$ + 0,434 * $S\&P100_{t-1}$

(0,015897073) (0,178322) (0,175359) (0,336081) (0,341708)

where R^2 = 0,187581 SER= 0,171129 $R^2_{adjusted}$ = 0,159075269

Model 3.4:

ACY_t = (-0,00368) + 0,312 *$OilPrice_t$ + (-0,00864) *$OilPrice_{t-i}$ + (-1,076) * $S\&P100_t$

(0,014372) (0,170495 (0,162524) (0,622775)

+ (-0,598) * $S\&P100_{t-1}$ +0,8108 * $FTSE100_t$ + (0,954) * $FTSE100_{t-1}$ + 1,59 * $GDAXI_t$ + 1,274 * $GDAXI_{t-1}$

(0,6227) (0,742981) (0,462117) (0,433827)

where R^2 0,367316 SER= 0,153738 $R^2_{adjusted}$ = 0,321303

Model 3.5:

ACY_t = 0,024 + 0,107 * $OilPrice_t$ + (-0,08) * $OilPrice_{t-1}$ + 1,497 * $S\&P100_t$ + 0,587 * $S\&P100_{t-1}$ + 0,003 * K_{1t} + 0,095 * K_{2t} + 0,011 * K_{3t}+

(0,0546) (0,190863) (0,186311) (0,352565) (0,360705) (0,07763) (0,081318) (0,08078)

(-0,016) * K_{4t}+ (-0,016) * K_{5t}+ (-0,015) * K_{6t}+ (-0,059) * K_{7t}+ (-0,037) * K_{8t}+ (-0,143) * K_{9t}+ (-0,083) * K_{10t}+ (-0,038) * K_{11t}

(0,077659995) (0,077507) (0,078934) (0,07827) (0,077279) (0,077465) (0,076861) (0,07537)

Where R^2 = 0,291228 SER= 0,168159 $R^2_{adjusted}$ = 0,188009

Test of autocorrelation in error term

I check here for auto correlation in the error term of regression in Model 3.4. Prerequisite for multi coefficient model is that there is no covariance between error terms (U_t) that will say no auto correlation in the regression. I check this by running a regression with U_t as the dependent variable and U_{t-1} as the independent variable. Moreover I test β1 for statistical

significance. I will do this by a T-test where H_0: $\beta_1 = 0$ against H_1: $\beta_1 \neq 0$. When I do this I get the following model:

$U_t = \beta_0 + \beta_1 * U_{t-1}$

$U_t = (-0{,}002094) + (-0{,}11165) * U_{t-1}$, where $R^2 = 0{,}012476$ SER= 0,170132 $R^2_{adjusted} = 0{,}003963$

(0,015664) (0,092226)

Where T-test statistic = -1,21059. There is thus no reason to reject H_0. It is also not a problem with auto correlation in the error term in the regression model.

Results – Model 3

Which model is best suited as forecast model?

R^2 is a measure of how much of the total variance in the dependent variable which is explained by the variance in it (or the) independent variable(s). An uncritical view of R^2 is not necessarily entirely flawlessly when R^2 may contain some errors. Among other things, R^2 is not strictly decreasing with increased number of explanatory variables. $R^2_{adjusted}$ accounts for this. This becomes evident if we look at the mathematical expressions.

Equations:

$R^2 = ESS / TSS = 1 - SSR / TSS$

$R^2_{adjusted} = 1 - (n - 1 / n – k - 1) * SSR / TSS$

Where ESS is model's variance, TSS is the total variance in the dependent variable and SSR is the variance of the error term.

The two measurements differ by $R^2_{adjusted}$ taking into account the number of degrees of freedom. $R^2_{adjusted}$ is a more secure measure of variance explained when the number of degrees of freedom vary.

Model 3.4 has the highest $R^2_{adjusted}$ and is therefore the model that works best as forecast model of the five regression models.

Interpretation and discussion

Is it possible to generate better than benchmark profit due switching between different stocks based on algorithms?

This is tested in model 1 and 2.

Is it possible to generate better than benchmark profit by focusing on "smaller" companies (but still relatively liquid) because of the latency caused by slow reaction to price changes?

This is tested in model 1 and 2.

Can MACD histogram analysis give early signals for trading stocks?

This is tested in model 2.

Is it possible to use regression analysis to detect regime shifts in the long term trends?

This is tested in model 3.

Model 1 – related to question 1:

Is it possible to generate better than benchmark profit due switching between different stocks based on algorithms?

I am quite happy with a result of 9,36% better than the benchmark on 35 days of trading. This means that the answer is **yes** to the first question.

I must say that I have sometimes chosen to use history method and sometimes intraday method. Intraday method chooses the best performer today from the two stocks in the pair while history method chooses the stock recommended in the last line of algosheet. This recommendation is again based on recent days accumulated log return and correlation. The chosen methods are logged in order book history in the "Parameters used" column. Therefore I have called this worksheet WorkingCopyBlendedStrategy.

Initially I was planning on using also two other worksheets where I only used one of the methods called: WorkingCopyI and WorkingCopyH. In that way I could have compared results between them. But it became difficult to maintain code in different worksheets while I still found things to adjust in the code. I did think about collecting all the code in to a common file called personal.xls which is the sheet every worksheet gets to access the code. But this code is quite application specific and I decided not to do that.

I believe that the history method is best of the two methods because it uses n-days (for the most I have used 5 days) accumulated log return and correlation to decide which stock to enter. The intraday in contrary uses today's price percentage change as decision basis for which stock to enter. I believe this can lead to unnecessary enters and exits. It is better to rely on n-day log return and n-day correlation to decide which stock to enter. It may be a good idea to use history method on relatively normal days but use intraday method when there is a

very strong recovery (upward trending). Then it may catch up and jump on the stocks that are increasing fastest "today".

I also experience that my algorithm will perform even better when the market is having a strong upward trend. Then it is easier to ride the good performing stocks with the help of momentum.

I have normally run the "big" upload at around 12:00 a' clock because earlier on the day I would not get enough updated data to the model. I want a reasonalble amount of different stocks to be traded by then. When I want to collect as many as 150 different stocks it looks like it is suitable to run the first update around 11:00 to 12:00 a clock because otherwise I might get errors in correlation matrix generation. On the other hand it is often in the morning that the stocks make the big moves based on news and announcements.

Another improvement could be to include news in the model in some manner. Maybe an idea would be to use a news provider as Proff Forvaltning which I have described in chapter of Quantitative trading with subchapter called "Issues of development". But this is by no means a simple task to let a computer decide if a news announcement is positive or negative.

I have made a momentum strategy where I get buy recommendations and at the same time have two exit strategies. But the normal approach in pair trading is to use mean reverting strategy. This could be an idea for an alternative model. That means that one chooses the stock which is going down in the pair hoping that it will reverse to the trend and short selling the other stock. The idea with that is to choose very positive correlated stocks and study the differences in their log return changes from day to day. When they divert from each other then it is time to buy the stock below the difference trend line and short sell the stock above the difference trend line. Here it is necessary to calculate the historical half-life of the diverting time to find the right timing for entering and exiting the trades. This half-life can be used to determine the optimal holding period for a mean-reverting position. (See page 55 on exit strategies for more details).

I am hoping for a more positive trend since it would be nice to test the model when trend is going up instead of down.

Model 2 – related to question 1:

Is it possible to generate better than benchmark profit due switching between different stocks based on algorithms?

As earlier mentioned I haven't generated any order book history for model 2 and cannot give a sure answer for that here. But since MACD is a popular tool I believe there is good potential to develop this model further and use it with success.

My plan is to develop this model further by creating order book, order book history, budget, portfolio in a similar way to model 1. Then it could be possible to see if it performs good or bad in real time situations. This kind of calculation of signals may give many false signals since they are very early signals.

Possible way to develop the order book generation could be by creating buy and short sell candidates based on the top 3 and bottom 3 candidates of the list on the right most group of momentum sheet. At the same time maintain budget (cash available), order book history and portfolio. I would develop a similar exit strategy as in model 1 in case of negative development. But also having an entry/exit strategy based on weighting the existing portfolio stocks against new candidate stocks based on their daily generated position in the ranked list (Momentum sheet). This will say that if a new candidate ranks higher than the worst ranked portfolio stock then switch to the new candidate. When choosing short sell candidates I would study the bottom of the list in opposite way.

In this case I would have to differentiate long and short positions in the portfolio in a way which would make it possible to decide which algorithm to use concerning weighting the new candidates on top or bottom of the "momentum"-list against portfolio.

I think this would be an interesting idea to test further.

Model 1 – related to question 2:

Is it possible to generate better than benchmark profit by focusing on "smaller" companies (but still relatively liquid) because of the latency caused by slow reaction to price changes?

It seems like my model automatically chooses relatively small companies as they vary more in the price than the large companies. This means that they are more volatile. On the other hand I collect data only for approximately 150 most liquid stocks in Oslo Stock Exchange. Dagens Næringsliv reports stocks for 209 companies. On the other hand the "CreateLogReturnSheet"-routine reduces the number of companies further by looking at the number of days with no change in price (i.e. zero log return). The number of *subsequent* days with zero log return higher than "number of days"-parameter excludes the company from

further analysis because it would get errors in log return calculations and/or correlation matrix generation. This means that the sample of companies is reduced further. This depends on the chosen number of day's parameter but when I counted the number of companies in the last log return sheet it was about 90 companies. Then I had used a 5-day look back parameter. The smaller the number of day's parameter is the smaller amount of companies is included. This helps me also to keep away from companies which are rarely traded.

I try to utilize this volatility to gain profit with help of momentum strategy in a pair trading context. The answer for this question 2 related to model 1 is **yes** based on the results of simulated trading which can be studied in order book history.

Model 2 – related to question 2:

Is it possible to generate better than benchmark profit by focusing on "smaller" companies (but still relatively liquid) because of the latency caused by slow reaction to price changes?

I think the answer is **yes** because this model is designed to listen to the early changes in stock prices and therefore would cause it to recommend changes in the portfolio if a signal of buy or sell is given. This model does not reduce the 150 companies in contrast to model 1. I believe that the relatively smaller companies are not so popular and therefore can give better possibilities to jump on a trend than with the big companies which are followed closely by many actors. The relatively smaller companies are often more volatile and therefore give good opportunities to change to other candidate stock. Volatility is a messure of risk where high volatility is considered as bad thing. I belive that it can be utilized in swithing techniques to gain better than benchmark return.

Model 2 – related to question 3:

Can MACD histogram analysis give early signals for trading stocks?

I think the answer is **yes** because this model is designed to listen to the early changes in stock prices and therefore would cause it to recommend changes in the portfolio if a signal of buy or sell is given. On the other hand with a three day accumulated change in difference curve might be quite short and give many false signals. But on the other hand this can be adjusted to a larger number of days.

As mentioned earlier this model needs order book history to really proof the results in real time.

It is possible to study the recommendations on all the individual sheets and study them in light of a backtest for the short period of data (6.5.2010-2.7.2010) where there are generated recommendations. For me it seems like in some cases it gives right signals while in other cases not so good signals.

We have to bear in mind that the market has declined 5,61% (from 408,54 to 386,83) in the same period which is a large decline for such a short period of time.

I would have liked to give success rate of the backtest based on all the companies over the time period but because of the lack of time I haven't had time to do that. The success rate could be calculated by comparing the following day's price with the signal day's price and counting the sucsessfull (buy/sell) recommendations agains the not sucsessfull (buy/sell) recommendations.

Model 3 – related to question 4:

Is it possible to use regression analysis to detect regime shifts in the long term trends?

I have tested 5 sub models for their descriptive power of a single stock called Agercy over a 10 year period. The model 3.4 gives an $R^2_{adjusted}$ = 0,321303 and F=7,812296>1,99 critical value on 10% significance level. The model tells me that at least one of these explanatory variables have significant impact on the dependent variable. Thus, it seem as these variables help explain changes in ACY_t.

Regression analysis is a good tool to analyze predictive power of different independent variables on the dependent variable. This could be used in this context to identify where the trend is heading and therefore give signals to the short term trading what kind of strategies to use. In case of upward trending markets it can be wise to use momentum strategies while on sideways trending markets it may be wise use mean-reverting strategies. Since I consider model 1 to be a type of momentum strategy and the model 2 a type of mean-reverting strategy it could be an idea to let model 3 decide some kind of *weigting regarding to how big share of the budget* each of the models have disposable.

Conclusion

I have presented tree different models.

The first model I have made a quite experimental model to trade stocks on daily basis based on dynamic pair trading strategy with use of short term momentum. I consider this as being a momentum model. This is the only model where I have made an order book history, budget

and portfolio. That makes it easy to follow its performance in time and compare it to benchmark in a way which simulates real trading. It has performed quite a lot better than the benchmark when the transaction costs are not taken in account. The stock market has been performing very poorly in the period since 15.04.2010 until today (07.07.2010) but still it has outperformed the benchmark. I am quite happy with a result of 9,36% better than the benchmark on 35 days of trading. I will continue to test this model and maybe start trading with it on real money when I start working.

The second model is based on technical analysis tool called MACD (Moving Average Convergence and Divergence). I consider this model as being a mean-reverting model. Here I wanted to use computers ability to look for the fastest increasing difference between MACD and 9-day exponential moving average from a minimum point. According to the literature (See MACD in theory-part) it could give a good and early buy signal.

This model summarizes these results in a so called momentum sheet where it is easy to get an overview of the best buy and sell candidates. The momentum sheet is generated daily. When I refer to momentum in this models context I mean the strength to revert to mean. Through studying the recommendations it seems that it works as expected giving god recommendations in many cases but in some cases it does give false recommendations. This is quite aggressive strategy to recommend stock on three day maximum rise from the bottoming of MACD histogram. I plan to add order book, order book history, budget and portfolio to this application as well to better simulate actual trading in a similar way as in model 1.

In the third model I have five sub models where I use regression analysis to test the prediction power of oil price, S&P100, FTSE100 and GDAXI (present and lagged values) on Agercy stock on monthly basis on a 10 year period. I find that model 3.4 which includes oil price, S&P100, FTSE100 and GDAXI and their lagged values as independent variables gives best results with $R^2_{adjusted}$ = 0,321303 and F=7,812296>1,99 critical value on 10% significance level. I believe that it could be possible to develop this model further in similar fashion as the two other models by using VBA to look for different combinations of independent and dependent variables to find combinations with high F-test values, high $R^2_{adjusted}$ values. And thereafter use the best combination to predict regime shifts.

It would be interesting to use (or weight them differently regarding use of budget) the third model as input for deciding whether to use momentum strategy in model 1 or use mean-

reverting strategy in model 2. In case the development is trending upwards then using momentum strategy in model 1, if not, using mean-reverting strategy in model 2. To decide which strategy to use could be done through regression analysis model similar to model 3.4. and comparing the trend line against actual performance. And let the recent months development of actual performance compared with the trend line give indications on where the prices are heading. In this case it would be best to use OSEAX index (Oslo all stock index) as the dependent variable to give more a general view of the market as whole.

Because of the randomness of the market I find it quite exiting to experiment with different kinds of models. It would be interesting to look at regime shift strategies based on regression analysis (turning point strategies) where the system automatically could choose either to use momentum or mean-reverting strategy.

My focus in this thesis has been to study possibilities in algorithm and quantitative trading to trade stocks with help of computer algorithms. I have presented two switching strategies to trade stocks on daily basis. I have shown a regression analysis model to use in analyzing data on longer perspective. And I have presented an idea to use longer perspective regression analysis as basis for weighting the investments differently on momentum strategy model (model 1) and mean-reverting model (model 2).

I also wanted to show that there exist possibilities to gain better than benchmark profit based on momentum and adaptive marked hypothesis mostly because of the herding behavior of people and the slow (not perfect) propagation of information.

References:

Alexander, C. (2001). *Market models : a guide to financial data analysis*. Chichester, UK ; New York, NY: Wiley.

Andersen, S. A. (2010, 05.07.2010). Aksjehandel må forenkles (Stock trading must be simplified). *Dagens Næringsliv*,

Barber, B. M., & Odean, T. (1998). Boys will be Boys: Gender, Overconfidence, and Common Stock Investment. *SSRN eLibrary*.

Barberis, N., Shleifer, A., & Vishny, R. W. (1998). A Model of Investor Sentiment. *SSRN eLibrary*.

Bell, D. (1982). Risk premiums for decision regret. *Management Science*(29), 1156- 1166.

Bensley, D. A. (1998). *Critical thinking in psychology: A unified skills approach*. Belmont, CA, US: Thomson Brooks/Cole Publishing Co.

Borudin, A. E.-Y., Ran & Gohan, Vincent (2004). *Can We Learn to Beat the Best Stock*. Toronto: Department of Computer Science at University of Toronto.

Boswijk, H. P., Hommes, C. H., & Manzan, S. (2006). Behavioral Heterogeneity in Stock Prices. *Journal of Economic Dynamics and Control, Vol. 31, 2007*.

Chan, E. P. (2006, 13.11.2006). Cointegration is not the same as correlation. *TradingMarkets.com* from http://www.tradingmarkets.com/.site/stocks/commentary/quantitative_trading/Cointegration-is-not-the-same-as-correlation.cfm

Chan, E. P. (2009). *Quantitative trading : how to build your own algorithmic trading business*. Hoboken, N.J.: John Wiley & Sons.

Chauvet, M., Piger, J. M., & Federal Reserve Bank of St. Louis. (2005). A comparison of the real-time performance of business cycle dating methods, Working paper 2005-021A Available from http://research.stlouisfed.org/wp/more/2005-021/

Chauvet, M. P., Jeremy M. (2003). Identifying Business Cycle Turning Points in Real Time. *Federal Reserve Bank of Atlanta, Working Paper Series*.

Clarke, R., Krase, S., & Statman, M. (1998). Tracking errors, regret, and tactical asset allocation. *Journal of Portfolio Management*(20), 16-24.

Cloves, M. (2005). Adaptive-market theory offers investor insights. *Investment news*.

Cootner, P. H. (1964). *The random character of stock market prices*. Cambridge, Mass.,: M.I.T. Press.

Crombez, J. (2001). Momentum, Rational Agents and Efficient Markets. *Journal of Behavioral Finance, 2*(4), 190-200.

Damasio, A. R. (1994). *Descartes' error: Emotion, reason and the human brain*. New York: Avon Books.

Daniel, K. D., Hirshleifer, D. A., & Subrahmanyam, A. (1997). A Theory of Overconfidence, Self-Attribution, and Security Market Under- and Over-reactions. *SSRN eLibrary*.

Daniel, K. D., Hirshleifer, D. A., & Subrahmanyam, A. (2001). Overconfidence, Arbitrage, and Equilibrium Asset Pricing. *Journal of Finance, Vol. 56, No. 3, pp. 921-965, June 2001*.

DeBond, W., & Thaler, R. (1986). Does the stock market overreact? *Journal of Finance*(40), 793-807.

Diebold, F. L., Jon Haeg & Weinback, Gretchen C. (1994). Regime Switching with Time-Varying Transition Probabilities. *Oxford University Press*.

Edwards, R. D., Magee, J., & Bassetti, W. H. C. (2007a). Technical analysis of stock trends Available from http://www.myilibrary.com?id=108189

Edwards, R. D., Magee, J., & Bassetti, W. H. C. (2007b). *Technical analysis of stock trends* (9th ed.). Boca Raton, FL

New York: CRC Press ;

AMACOM, American Management Association.

Elster, J. (1998). Emotions and economic theory. *Jou rnal of Economic Literature*(36), 47-74.

Faber, M. T. (2010). Relative Strength Strategies for Investing. *SSRN eLibrary*.

Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics, 33*(1), 3-56.

Fama, E. F. F., Kenneth R. (1992). The Cross-Section of Expected Stock Returns. *The Journal of Finance, 47*(2), 427-465.
Fontanills, G., & Gentile, T. (2001). *The stock market course*. New York: Wiley.
Gervais, S., & Odean, T. (1997). Learning To Be Overconfident. *SSRN eLibrary*.
Glaser, M., Noeth, M., & Weber, M. Behavioral Finance. *HANDBOOK OF JUDGMENT AND DECISION MAKING, D.J. Koehler, N. Harvey, eds., pp. 527-546, Blackwell Publishers, 2004*.
Grinblatt, M., Titman, S., & Wermers, R. R. (1994). Momentum Investment Strategies, Portfolio Performance, and Herding: A Study of Mutual Fund Behavior. *SSRN eLibrary*.
Grinold, R. C. K., Ronald N. (1999). *Active Portfolio Management* New York: McGraw-Hill.
Grossberg, S., & Gutowski, W. (1987). Neural dynamics of decision making under risk: Affective balance and cognitive emotional interactions. *Psychological Review*(94), 300-318.
Han, B. a. H., Jason (2004). *A Synthesis on Stock Momentum*: Han is with the Fisher College of Business at the Ohio State University. Hsu is with the Research Affiliates, LLC.
Harvey, C. R. (2010). Hypertextual Finance Glossary. *Hypertextual Finance Glossary*.
Holton, G. A. (2003). *Value-at-risk : theory and practice*. Amsterdam ; Boston: Academic Press.
Huberman, G., & Regev, T. (2001). Contagious speculation and a cure for cancer: A nonevent that made stock prices soar. *Journal of Finance*(56), 387- 396.
Hulbert, M. (2008). Trying to Plumb a Bottom - What sentiment data are saying about finding a bear-market low. Retrieved from http://online.barrons.com/article/SB122652105098621685.html
Hull, J. (2009). *Options, futures and other derivatives* (7th ed.). Upper Saddle River, NJ: Prentice Hall.
investopedia.com (2010). Momentum investing.
Jegadeesh, N., & Titman, S. (2001). Momentum. *SSRN eLibrary*.
Jegadeesh, N. a. T., Sheridan (1993). Returns to buying winners and selling losers: implications for stock market efficiency. *Journal of Finance*(48), 65-91.
Jorion, P. (2007). *Value at risk : the new benchmark for managing financial risk* (3rd ed.). New York: McGraw-Hill.
Kahneman, D., & Tversky, A. (1905). Prospect Theory: An Analysis of Decision Under Risk. *University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship*.
Kalok, C. a., Allaudeen, H. a., & Wilson, T. (1999). Profitability of Momentum Strategies in the International Equity Markets: a: Department of Finance
Hong Kong University of Science & Technology
Clearwater Bay, Hong Kong
b: Department of Finance and Banking
Faculty of Business Administration
National University of Singapore
Singapore 119260.
L'Her, J.-F. a., Masmoudi, T. a., & Suret, J.-M. (2003). Evidence to support the four-factor pricing model from the Canadian stock market. (2003 Issue).
Lakonishok, J., Shleifer, A., & Vishny, R. (1992). The impact of institutional trading on stock prices. *Journal of Financial Economics, 32*(1), 23-43.
Lati, R. (2009). The Real Story of Trading Software Espionage. *Advanced Trading*.
Lichtenstein, S., Fischoff, B., & Phillips, L. D. (1982). Calibration of probabilities: The state of the art to 1980. Retrieved from http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA101986&Location=U2&doc=GetTRDoc.pdf
Lo, A. W. (1999). The three P's of total risk management. *Financial Analysts Jou rnal*(55), 12-20.
Lo, A. W. (2005). Reconciling Efficient Markets with
Behavioral Finance:
The Adaptive Markets Hypothesis.
Lo, A. W., & MacKinlay, A. C. (1999). *A non-random walk down Wall Street*. Princeton, N.J.: Princeton University Press.

Lo, A. W., & Repin, D. V. (2001). The Psychophysiology of Real-Time Financial Risk Processing. *SSRN eLibrary*.
Loewenstein, G. (2000). Emotions in economic theory and economic behavior. *American Economic Review*(90), 426- 432.
Malkiel, B. G. (1973). *A random walk down Wall Street* ([1st ed.). New York,: Norton.
Mandelbrot, B., and Hudson, R. L. (2004). *The (Mis)Behaviour of Markets: A Fractal View of Risk, Ruin, and Reward*. London: Profile Books.
McNeil, A. J., Frey, R., & Embrechts, P. (2005). *Quantitative risk management : concepts, techniques, and tools*. Princeton, N.J.: Princeton University Press.
Negro, M. d. N. (2002). Turn, Turn, Turn:Predicting Turning Points in Economic Activity. *Federal Reserve Bank of Atlanta ECONOMIC REVIEW*(Second Quarter).
O'Sullivan, A., & Sheffrin, S. M. (2007). *Economics : principles in action* (California teacher's ed.). Boston, Mass.: Pearson/Prentice Hall.
Odean, T. (1997). Are Investors Reluctant to Realize Their Losses? *SSRN eLibrary*.
Ofek, E. (2003). The Valuation and Market Rationality of Internet Stock Prices. *SSRN eLibrary*.
OnlineTradingConcepts.com (2008). Description of different tecknical analysis tools.
Peters, E. S., P. (2000). The springs of action: Affective and analytical information processing in choice. *Personality and Social Psychology Bulletin*(26), 1465- 1475.
Philippe (2010). Maslowian Portfolio Theory: An alternative formulation of the Behavioural Portfolio Theory. *Journal of Asset Management*, *9*(6), 359-365.
Preston, T. (2005). Pairs Trading. Retrieved from http://mediaserver.thinkorswim.com/articles/TPPairsTradingArticle.pdf
Sharpe, W. (1994). The Sharpe Ratio. *The Journal of Portfolio Management*.
Sharpe, W. (2010). Linear Factor Models, from http://www.stanford.edu/~wfsharpe/mia/fac/mia_fac2.htm
Shefrin, H. (2001). *Behavioral finance*. Northampton, MA: Edward Elgar Pub.
Shefrin, H. M., & Statman, M. (2000). Behavioral Portfolio Theory. *SSRN eLibrary*.
Shefrin, M., & Statman, M. (1985). The disposition to sell winners too early and ride losers too long: Theory and evidence. *Jou rnal of Finance*(40), 777- 790.
Soo, C. L., Joon (2007). Economic Turning Point Forecasting Using Neural Network with Weighted Fuzzy Membership Functions Lecture Notes in Computer Science (Vol. 4570, Available from http://www.springerlink.com/content/r21534276gx1h752/
Stock, J. H., & Watson, M. W. (2007). *Introduction to econometrics* (2nd ed.). Boston: Pearson/Addison Wesley.
Stock, J. H. W., M. W. (2007). Introduction to Econometrics: Pearson Education Inc.
Sundial Capital Research, I. (2007). AAII Sentiment Survey. *Sentiment Trader*.
Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science*(211), 453- 458.
Uhlenbeck, G. O., Leonard (1930). On the Theory of Brownian Motion. *Physical Review*(36), 823-841.
van Duyn, A. (2007, 15.04.2007). Automatic news makes headlines and money. *Financial Times*, from http://www.ft.com/cms/s/2/e3988202-eb7c-11db-b290-000b5df10621.html
Wikipedia.org (2010a). Adaptive Market Hypothesis
Wikipedia.org (2010b). Algorithm trading.
Wikipedia.org (2010c). Backtesting.
Wikipedia.org (2010d). Capital asset pricing model.
Wikipedia.org (2010e). Cognitive bias.
Wikipedia.org (2010f). Contious Compounding.
Wikipedia.org (2010g). Deterministic system (mathematics).
wikipedia.org (2010h). Economic model.
Wikipedia.org (2010i). Exogenous.
Wikipedia.org (2010j). Exponential moving average.
Wikipedia.org (2010k). Margin buying.
Wikipedia.org (2010l). Market anomaly.

Wikipedia.org (2010m). Market capitalization.
Wikipedia.org (2010n). Market trend.
Wikipedia.org (2010o). Markov Chain.
Wikipedia.org (2010p). Momentum (finance).
Wikipedia.org (2010q). Multicollinearity.
Wikipedia.org (2010r). Ordinary least squares.
Wikipedia.org (2010s). P/B ratio.
Wikipedia.org (2010t). Program trading.
Wikipedia.org (2010u). Quantitative investing.
Wikipedia.org (2010v). Stochastic process.
Wikipedia.org (2010w). Trend following.
Zweig, J. (2009). How to Ignore the Yes-Man in Your Head. *Wall Street Journal*.

Appendix for Installation instructions

Installation instructions for Jyri's pair trading application:

Installation requirements:

- You must have Microsoft Excel
    - In Excel Options you must ensure that following add inns are installed:
        - Analysis Toolpak
        - Analysis Toolpak – VBA
        - Lookup Wizard
        - Conditional Sum Wizard
        - Solver Add-in
- You must have Microsoft Access
- HSQuote downloader V1.90 (can be downloaded free from http://www.1free-historical-stock-quotes-downloader.com/)

Installation procedure:

This system contains an exec application with VBA-code and it uses Access to in query purposes. There are some plases where one must change directory referances to you're your environment. I wrote this installation procedure a month ago while I installed it to my wifes pc to easier detect all the problems to be aware off. Therefore you must make sure that you do this.

The installation CD context of a directory called JyrisPairTradingAppl with some subdirectories:

1. Copy the contents of this CD with a subdirectory called JyrisPairTradingAppl under Documents. In that way you will get a subdirectory to Documents called JyrisPairTradingAppl.
2. An application called HSQuote, where I get my input data, can be downloaded for a one month free use from http://www.1free-historical-stock-quotes-downloader.com/. Install this application from this site by clicking free trial. It is not necessary to download Magnifier Software which it proposes to you afterwards. This application makes use of so called tic-files which contain a list of tickers which you are interested. I enclose the ticker file which I use which contains tickers from Oslo Stock Exchange. It is called: **JyrisIndexM.tic**.

   a. My application gives an input parameter which is "from date" to this system and retrieves data until the most recent data for the selected tickers.
   b. This system must be configured to output the data in right format (see Screen Shot Appendix **A1**). To ensure the right configuration of the output file I have described trough to screenshots how you can do it see (Screen Shot Appendix **A2**).

3. Start HSQuote for first time. Open preferences and
   a. Change the default directory to Documents\JyrisPairTradingAppl. In that way you will have all the files located at this directory.
   b. Answer "yes" to copy all the existing data to this location.
   c. Answer "yes" to delete all the data files from the old file location.
   d. Clear Columns. Click order: Symbol, date, open, high, low, volume, close, adj. close.
   e. Select semi-colon as column separator.
   f. Change file extension to .txt
   g. Unmark the "No message prompting during download.
   h. Mark the "Enable download of linked ticker files.
4. Check the following in the main window before pushing start button:
   a. Select JyriIndexM.tic from the portfolio list to test downloading.
   b. Server: As in Preference setting.
   c. Select form date 07.08.2009 mark daily and push start button.
   d. Check the output format part of window on has "Personalized format" checked.
   e. Push "Set as Default".
   f. Push the Start button to start the download.
5. Doble click the Access database called: JyriIndexM.accdb a Microsoft Office Access 2007 Database (.accdb).
   a. To correct the directory references in the "linked table manager" you have to right click the table
      i. JyrisIndexM in Access and choose Linked Table Manager. Mark the checkbox called JyrisIndexM. And find the file generated by HSQuote at a subdirectory called JyrisIndexM and choose the file JyrisIndexM.txt.
      ii. Order_bookHistRangeB has to point against WorkingCopyH.xlsm

iii. Order_bookHistRangeI has to point against WorkingCopyI.xlsm
iv. Order_bookHistRangeBlendedStrategy has to point against WorkingCopyBlendedStrategy.xlsm

b. To test the connections run following queries in Access:
i. FinalStockPriceQueryN which uses the JyrisIndexM.
ii. Order_bookHistRangeB Query Query Query which uses Order_bookHistRangeB.
iii. Order_bookHistRange Query Query Query which uses Order_bookHistRangeI.
iv. Order_bookHistRangeB Query Query Query which uses Order_bookHistRangeBlendedStrategy.
v. Close all the queries by right-clicking the "flipper" and choosing "Close all".
vi. Now you can exit Access.

6. The directory contains an Excel file called WorkingCopyBlendedStrategy.xlsm a Microsoft Office Excel Macro-Enabled Worksheet (.xlsm). Dobleclick the excel file called WorkingCopyBlendedStrategy.xlsm to check that the connections point to right directories. Two connections files called: (These files have to be copied to a predefined directory called: C:\Users\Jyri\Documents\My Data Sources. Where "Jyri" has to be replaced with your username.)
a. JyriIndexM11 - Order_bookHistRangeB Query Query Query.odc a Microsoft Office Data Connection (.odc) file. This is used to access OrderBookHistory sheet when Portfolio sheet is updated. Check the directory reference through Data/Connections/Definition and make sure it point to ...\Documents\My Data Sources\ JyriIndexM11.odc.
b. JyriIndexM1 – FinalStockPriceQueryN.odc a Microsoft Office Data Connection (.odc) file. This is used to access an imported exec file from HSQuote to cross tabulate the data and do some selections. Check the directory reference through Data/Connections/Definition and make sure it point to ...\Documents\My Data Sources\ JyriIndexM1.odc.
c. In addition the system generates automatically web connections to Oslo Stock Exchange to retrieve data to the intraday sheets named with a prefix I_<comp ticker>.

   d. Now you can save and exit the WorkingCopyBlendedStrategy.xlsm file and follow the next instructions to test the functionality of the system.

7. The system also maintains two copies of the application because I want to keep copies of files after each run on a separate file which contains all the parameter in the filename but on the other hand I have to have same name on the file which I work with because of JyriIndexM1 connection file which refers to a fixed filename called WorkingCopyBlendedStrategy. This means that normally you open this file every time and run it. It makes copies for history purposes. I have made a location on the workbook on a sheet called **Lists2** where there is a **directory reference to the location** where you want to store these files.

To test the functionally of the system:

1. Open the excel sheet called "WorkingCopyBlendedStrategy".
2. In case you don't have the "Developer" tag enabled you must go to Start/Excel Options/Popular and mark the check box called "Show Developer tab in the Ribbon"
3. You can also check that you have enabled the following Add-inn's on options panel.
   a. Analysis Toolpak
   b. Analysis Toolpak – VBA
   c. Internet Assistant VBA
   d. Lookup wizard
4. Go to the Lists2 worksheet to change the directory settings to suit your environment on your pc. There are two directory references there. You probably have to change the first **from**:
   a. C:\Users\Jyri\Documents\Jyris etterutdanning 2\Masteroppgave\Regneark\Jyris Regresjon\ **to** C:\Users\<username>\Documents\ JyrisPairTradingAppl\
   b. And the second from: C:\Program Files (x86)\HSQuote V1\ **to** C:\HSQuote V1\
5. Select the sheet called "FinalStockPriceQuery" and push the button "Open Form".
6. Click the Load data button to retrieve data from 07.08.2009.
7. Click the Create Log Return Sheet button
   a. This sheet has two parts:
      i. Top: Which contains the log return data
      ii. Bottom: Which contains the correlation table

1. There is automatically marked according to your input parameters the stock pairs which we will take further in the analysis. The selection condition must satisfy to conditions:
    a. The stocks log return must be higher than the log return limit at menu.
    b. The correlation between the stock pair must be lower that the correlation limit at menu.

8. Click the Create Market Combinations button to create algo sheets for the selected stock pairs. This uses the number of day's parameter to calculate correlation between the stock pairs for the number of days. This is a switching parameter in addition to each of the stocks 3 day log return.
9. Click the Create intraday sheets to clean up irrelevant intraday sheets and to create new ones for the sheets that are potentially good new candidates and those stocks that are in the portfolio already with number of stock larger than zero.
10. Select the appropriate percent exit trigger which is used in Order book creation. I usually use 1% which is 0,01 at the combo box. It displays as -0.99999 of some strange cause, but the right value is stored in Lists!L53 as -1,00E-02 which means -0,01 which is being used in the algorithm.
11. Select the method which you want to base the buy order generation. Both methods get their candidates from the top of the sorted overview pairs. The number of pairs is based on the candidates which have "if algo greatest" or "count not blank not equal to 1". This means that the top group marked light blue is used in order book generation.
    a. I=Intraday method uses today's change in the stock price as the selection criteria between to two stocks in the pair. The most positive today will be the buy candidate. The size of the buy orders are based on the number of candidates in the order book generation and the number of available cash
    b. H=History method uses the recommended stock of the pair based on the latest algo sheet row (column S last row). It does not take in consideration the prices in the intraday sheets in selection of the "best" stock in the pair.
    c. Both methods have a second round after sorting the order book where I recommend a buy only in case the development today has been positive.
    d. Both of the methods have two common sell order generation methods.
        i. Sell gradually down if still in a recommended pair.

ii. Sell all the stocks in case not recommended and the stock has a negative development higher than "exit trigger".

12. Click the "Create Order Book" to make order book. You can use this recommendation or go back few steps to log return sheet generation and choose different input parameters.
13. Click "Update order book history" to copy the order book to order book history and maintain portfolio and budget sheet.
14. Click the File Save button. It will save to copies of the file: one with the name of WorkingCopyBlendedStrategy and the parameterized name for lookup later in history study purposes. The algo sheets are been overwritten every time we generate algo sheets therefore it can be interesting to collect sheets after each run.
15. Click the Close button when you want to close the menu form.

There are numerous subroutines and functions in the module which I don't bother to comment in detail. I feel that it is not interesting for my audience who reads this document. But they can be viewed via the Developer tag. I have commented the code mostly for myself to remember changes in the code. All the procedures that are in use are collected In Module 1. The rest of the modules are temporary collections of routines I have worked under the development phase but are not in use any more.

Installation instructions for MACD model (Model 2):

This application uses the same input file (txt-file) from HSQuote as model 1 does. Therefore it is nessary to install model 1 completely first because of the automated download process is located in Model 1 (1st. menu choice). This model uses also Access as query tool to retrieve data from the input file and to run two queries to make the "AllStock"-sheet and the "CompSymbols"-sheet.

When opening the worksheet called "MACD Generation" one has to enable the VBA at start.

To open the menu one goes to the top of "AllStock"-sheet and push the "Open Form"-button.

To ensure that the two queries run correctly do following:

1. Enter in to Access to test that the two queries are retrieving data from the txt file. (database called: JyriIndexM.accdb)
    a. To test the connections run following queries:

i. JyriIndexM Query1 which uses the JyrisIndexM as input to produce company history (Connection file: CompHist.odc).
ii. JyriIndexM Query which uses the JyrisIndexM as input to produce company symbol overview (Connection file: CompSymbols.odc)
iii. Now you can exit Access.

2. Enter into Exel to check that it is able to retrieve data. Open the data flip and the connections. Check the properties for the to connection files to ensure that they are pointing to right directory.
   a. Mark the CompHist connection and look at the properties/definition. It should point to the Access query called JyriIndexM Query1.
   b. Mark the CompSymbols connection and look at the properties/definition. It should point to the Access query called JyriIndexM Query.
   c. Now you can open the menu from "All Stock" sheet and start loading data and generating sheets.

Installation instructions for regression analysis model (Model 3):

This application does not use VBA and does not have data load functionality. It is just a standard excel workbook. To study the calculations it is just nessary to open the exel file and study the different worksheets.

Textual Appendix

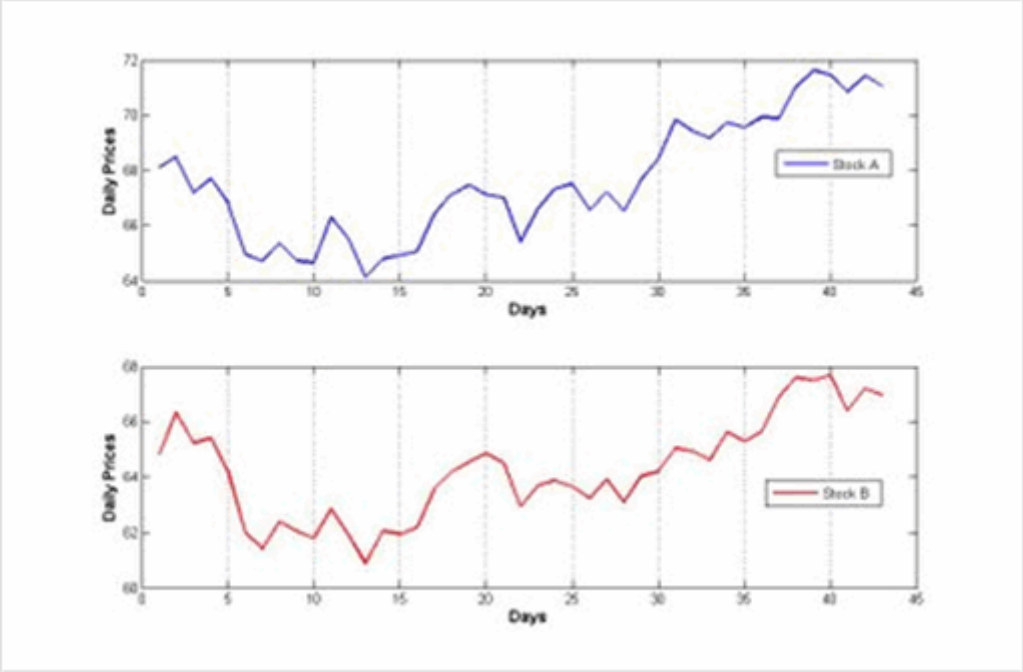
I have collected some descriptions and sitations which I provide as lookup resource and by that limiting the size of the main part of the thesis.

Cointegration is not the same as correlation

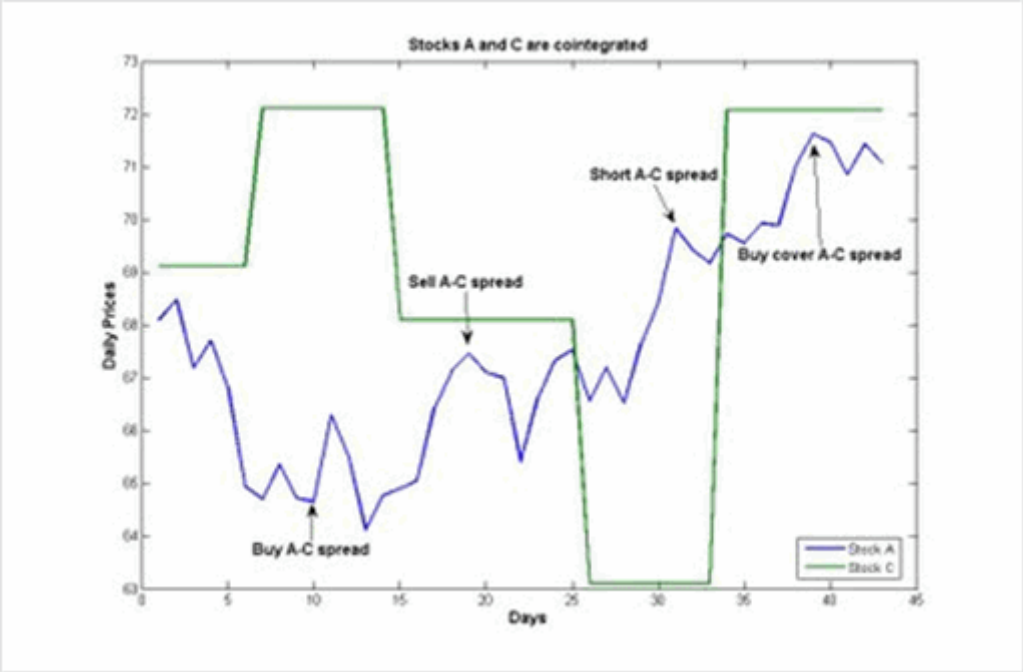
A reader asked me recently why I believe that energy stock prices (e.g. XLE) are correlated with crude oil futures front-month contract (QM). Actually I don't believe they are necessarily correlated I only think they are cointegrated.

What is the difference between correlation and cointegration? If XLE and QM were really correlated, when XLE goes up one day, QM would likely go up also on the same day, and vice versa. Their daily (or weekly, or monthly) returns would have risen or fallen in synchrony. But that's not what my analysis was about. I claim that XLE and QM are cointegrated; meaning that the two price series cannot wander off in opposite directions for very long without coming back to a mean distance eventually. But it doesn't mean that on a daily basis the two prices have to move in synchrony at all.

Two hypothetical graphs illustrate the differences. In the first graph, stock A and stock B are correlated. You can see that their prices move in the same direction almost every day.



Now consider stock A and stock C.



Stock C clearly doesn't move in any correlated fashion with stock A: some days they move in same direction, other days opposite. Most days stock C doesn't move at all! But notice that

the spread in stock prices between C and A always return to about $1 after a while. This is a manifestation of cointegration between A and C. In this instance, a profitable trade would be to buy A and short C at around day 10, then exit both positions at around day 19. Another profitable trade would be to buy C and short A at around day 31, then closing out the positions around day 40.
Cointegration is the foundation upon which pair trading (statistical arbitrage) is built. If two stocks simply move in a correlated manner, there may never be any widening of the spread. Without a temporary widening of the spread in either direction, there is no opportunity to short (or buy) the spread, and no reason to expect the spread to revert to the mean either.(Chan, 2006)

Program trading

Program trading is a generic term used to describe a type of trading in securities, usually consisting of baskets of fifteen stocks or more. It is loosely defined as an electronic transaction involving 15 or more stocks with a combined value of at least $1 million. Three factors help to explain the explosion in program trading. **First**, technological advances spawned the growth of electronic communication networks. These electronic exchanges, like Instinet and Archipelago, allow thousands of buy and sell orders to be matched at the speed of light without any human intervention. **Second**, the Securities and Exchange Commission mandated in 2001 that the major stock exchanges price stocks in dollars and cents instead of fractions. **Third**, and perhaps most significant, the proliferation of hedge funds with all their sophisticated trading strategies is driving program-trading volume(Wikipedia.org, 2010t).

Dark pool

Dark liquidity pools offer institutional investors many of the efficiencies associated with trading on the exchanges' public limit order books but without showing their actions to others. Dark liquidity pools avoid this risk because neither the price nor the identity of the trading company is displayed.(Wikipedia.org, 2010b)

Margin buying

Margin buying is buying securities with cash borrowed from a broker, using other securities as collateral (security/guaranty). This has the effect of magnifying any profit or loss made on the securities. The securities serve as collateral for the loan. The net value, i.e. the difference between the value of the securities and the loan, is initially equal to the amount of one's own cash used. This difference has to stay above a minimum margin requirement, the purpose of

which is to protect the broker against a fall in the value of the securities to the point that the investor can no longer cover the loan.(Wikipedia.org, 2010k)

Market capitalization

Market capitalization is a measurement of size of a business corporation equal to the share price times the number of shares outstanding of a public company. As owning stock represents ownership of the company, including all its equity, capitalization could represent the public opinion of a company's net worth and is a determining factor in stock valuation. (Wikipedia.org, 2010m)

Confirmation bias

Confirmation bias is a tendency for people to prefer information that confirms their preconceptions or hypotheses, independently of whether they are true (Bensley, 1998). People can reinforce their existing attitudes by selectively collecting new evidence, by interpreting evidence in a biased way, or by selectively recalling information from memory.(Zweig, 2009)

Cognitive bias

A cognitive bias is the human tendency to draw incorrect conclusions in certain circumstances based on cognitive factors rather than evidence. Such biases are thought to be a form of "cognitive shortcut", often based upon rules of thumb, and include errors in statistical judgment, social attribution, and memory. Cognitive biases are a common outcome of human thought, and often drastically skew the reliability of anecdotal and legal evidence. It is a phenomenon studied in cognitive science and social psychology.(Wikipedia.org, 2010e)

Active management

Active management refers to a portfolio management strategy where the manager makes specific investments with the goal of outperforming an investment benchmark index.

Slippage

The difference between the expected price of a trade, and the price the trade actually executes at. Slippage often occurs during periods of higher volatility, when market orders are used, and also when large orders are executed when there may not be enough interest at the desired price level to maintain the expected price of trade.

Sharpe ratio

The Sharpe ratio is a measure of the excess return per unit of risk in an investment asset or a trading strategy, named after William Forsyth Sharpe. Since its revision by the original author in 1994, it is defined as:

$$S = \frac{R - R_f}{\sigma} = \frac{E[R - R_f]}{\sqrt{\operatorname{var}[R - R_f]}},$$

where R is the asset return, R_f is the return on a benchmark asset, such as the risk free rate of return, $E[R - R_f]$ is the expected value of the excess of the asset return over the benchmark return, and σ is the standard deviation of the asset.(Sharpe, 1994)

Note, if R_f is a constant risk free return throughout the period,

$$\sqrt{\operatorname{var}[R - R_f]} = \sqrt{\operatorname{var}[R]}.$$

The Sharpe ratio is used to characterize how well the return of an asset compensates the investor for the risk taken, the higher the Sharpe ratio number the better. When comparing two assets each with the expected return $E[R]$ against the same benchmark with return R_f, the asset with the higher Sharpe ratio gives more return for the same risk. Investors are often advised to pick investments with high Sharpe ratios.

The Sharpe ratio has as its principal *advantage* that it is directly computable from any observed series of returns without need for additional information surrounding the source of profitability. The Sharpe ratio observes both systematic and idiosyncratic risks.

Kelly formula

Kelly formula gives the **optimal leverage.** It means how big share of your budget to invest.

$f_i = m_i / s_i^2$

where **m_i is mean return** and **s_i is standard deviation**.

Maximum compounded **growth rate**:

$g = r + S^2/2$

where **S is Sharpe ratio** of your portfolio and **r is the risk-free rate**.

The higher the Sharpe ratio of your portfolio (or strategy), the higher the maximum growth rate of your equity (or wealth), provided you use the optimal leverage recommended by the Kelly formula.(Chan, 2009)

Wiener process

A stochastic process where the change in a variable during each short period of time of length Δt has a normal distribution with a mean equal to zero and variance equal to Δt.(Hull, 2009)

Stochastic process

In probability theory, a stochastic process, or sometimes random process, is the counterpart to a deterministic process. Instead of dealing with only one possible reality of how the process might evolve under time (as is the case, for example, for solutions of an ordinary differential equation), in a stochastic or random process there is some indeterminacy in its future evolution described by probability distributions. This means that even if the initial condition (or starting point) is known, there are many possibilities the process might go to, but some paths may be more probable and others less.(Wikipedia.org, 2010v)

Deterministic system (mathematics)

In mathematics, a **deterministic system** is a system in which no randomness is involved in the development of future states of the system. Deterministic models thus produce the same output for a given starting condition.(Wikipedia.org, 2010g)

Volatility

Volatility is a measure of the uncertainty of the return realized on an asset.(Hull, 2009)

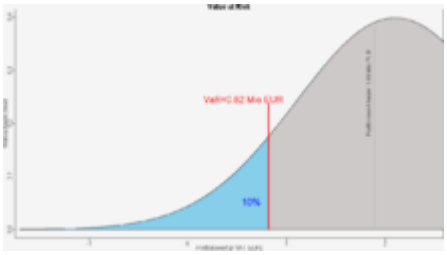
Value at risk

A loss that will not be exceeded at some specified confidence level.(Hull, 2009)

In financial mathematics and financial risk management, Value at Risk (VaR) is a widely used risk measure of the risk of loss on a specific portfolio of financial assets. For a given portfolio, probability and time horizon, VaR is defined as a threshold value such that the probability that the mark-to-market loss on the portfolio over the given time horizon exceeds this value (assuming normal markets and no trading in the portfolio) is the given probability level.(Jorion, 2007)

For example, if a portfolio of stocks has a one-day 5% VaR of $1 million, there is a 0.05 probability that the portfolio will fall in value by more than $1 million over a one day period,

assuming markets are normal and there is no trading. Informally, a loss of $1 million or more on this portfolio is expected on 1 day in 20. A loss which exceeds the VaR threshold is termed a "VaR break."(Holton, 2003)



The 10% Value at Risk of a normally distributed portfolio returns

VaR has five main uses in finance: risk management, risk measurement, financial control, financial reporting and computing regulatory capital. VaR is sometimes used in non-financial applications as well. (McNeil, Frey, & Embrechts, 2005)

Ordinary least squares

In statistics and econometrics, ordinary least squares (OLS) is a method for estimating the unknown parameters in a linear regression model. This method minimizes the sum of squared distances between the observed responses in the dataset, and the responses predicted by the linear approximation. The resulting estimator can be expressed by a simple formula, especially in the case of a single regressor on the right-hand side. The OLS estimator is consistent when the regressors are exogenous and there is no multicollinearity, and optimal in the class of linear unbiased estimators when the errors are homoscedastic and serially uncorrelated. OLS can be derived as a maximum likelihood estimator under the assumption that the errors are normally distributed.(Wikipedia.org, 2010r)

Multicollinearity

Multicollinearity is a statistical phenomenon in which two or more predictor variables in a multiple regression model are highly correlated. In this situation the coefficient estimates may change erratically in response to small changes in the model or the data. Multicollinearity does not reduce the predictive power or reliability of the model as a whole; it only affects calculations regarding individual predictors. That is, a multiple regression model with correlated predictors can indicate how well the entire bundle of predictors predicts the outcome variable, but it may not give valid results about any individual predictor, or about which predictors are redundant with others.(Wikipedia.org, 2010q)

Homoscedasticity

In statistics, a sequence or a vector of random variables is homoscedastic if all random variables in the sequence or vector have the same finite variance.

Heteroscedasticity

In statistics, a sequence of random variables is heteroscedastic, if the random variables have different variances.

Endogeneity

In an economic model, a parameter or variable is said to be endogenous when there is a correlation between the parameter or variable and the error term. Endogeneity can arise as a result of measurement error, autoregression with autocorrelated errors, simultaneity, omitted variables, and sample selection errors. Broadly, a loop of causality between the independent and dependent variables of a model leads to endogeneity.

Exogeny

Exogenous refers to an action or object coming from outside a system. It is the opposite of *endogenous*, something generated from within the system. In an economic model, an exogenous change is one that comes from outside the model and is unexplained by the model. In linear regression, it means that the variable is independent of all other response values.(Wikipedia.org, 2010i)

Economic model

In economics, a **model** is a theoretical construct that represents economic processes by a set of variables and a set of logical and/or quantitative relationships between them. The economic model is a simplified framework designed to illustrate complex processes, often but not always using mathematical techniques. A model may have various parameters and those parameters may change to create various properties.(wikipedia.org, 2010h)

In general terms, economic models have two functions: first as a simplification of an abstraction from observed data, and second as a means of selection of data based on a paradigm of econometric study.

Conclusions drawn from models will be approximate representations of economic facts. Properly constructed models can remove extraneous information and isolate useful approximations of key relationships. In this way more can be understood about the relationships in question than by trying to understand the entire economic process.

The details of model construction vary with type of model and its application, but a generic process can be identified. Generally any modeling process has two steps: generating a model, then checking the model for accuracy (sometimes called diagnostics). The diagnostic step is important because a model is only useful to the extent that it accurately mirrors the relationships that it purports to describe. Creating and diagnosing a model is frequently an iterative process in which the model is modified (and hopefully improved) with each iteration of diagnosis and respecification. Once a satisfactory model is found, it should be double checked by applying it to a different data set.

At a more practical level, quantitative modeling is applied to many areas of economics and several methodologies have evolved more or less independently of each other. As a result, no overall model taxonomy is naturally available.

Descriptive vs. Prescriptive/Normative model

A descriptive model focuses on whether it can make good predictions, while leaves the underlying dynamics unexplained. In the other hand, a prescriptive model focuses on whether it provides an explanation of the underlying dynamics while it might not be able to do a good job on fitting the empirical data, not to mention predictions.

Stationary process

A stationary process is a stochastic process whose joint probability distribution does not change when shifted in time or space. As a result, parameters such as the mean and variance, if they exist, also do not change over time or position.

Unit root

If an AR(p) has a root that equals to 1, the series is said to have a nit autoregressive root or, more simply, a unit root. I Y_t has a unit root, then it contains a stochastic trend. If Y_t is stationary (and thus does not have a unit root), it does not contain a stochastic trend (J. H. Stock & Watson, 2007).

If regression has a stochastic trend (has unit root), then the OLS estimator of its coefficient and its OLS t-statistic can have nonstandard distributions, even in large samples. (J. H. W. Stock, M. W., 2007)

Seasonal trading strategies

Seasonality in equity markets has wakened or even disappeared in recent years, perhaps due to the widespread knowledge of this trading opportunity, whereas some seasonal trades in commodity futures are still profitable. “January effect” is strategy that utilizes the tax effect of

buying losers in the end of December to because many want to benefit of the tax benefit of realizing looses. Often these stocks will go up in January because those equities are often underpriced. (Chan, 2009)

An another seasonal strategy is to buy stocks that have performed the best in the same month a year earlier, and short the same number of stocks that performed poorest in that month a year earlier. This strategy works well on commodity futures because the seasonal demand for certain commodities is driven by "real" economic needs rather than speculations.(Chan, 2009)

Factor models

There is a well-known framework in quantitative finance called factor models (also known as arbitrage pricing theory (APT)) that attempts to capture the different drivers of returns such as earnings growth rates, interest rate, or the market capitalization of a company. These drivers are called factors. Mathematically, we can write the *excess returns* (returns minus risk-free rate) R of N stocks as

$R = Xb + u$

Where X is an N x N matrix of factor exposures (also known as factor loadings), b is an N vector for factor returns, and U an N vector of specific returns. (Every one of these quantities is time dependent, but I suppress this explicit dependence for simplicity.) (Chan, 2009)

A linear factor model relates the return on an asset (be it a stock, bond, mutual fund or something else) to the values of a limited number of *factors*, with the relationship described by a linear equation. In its most generic form, such a model can be written as:

$r_i = b_{i1}*f_1 + b_{i2}*f_2 + ... + b_{im}*f_m + e_i$

where:

r_i = the return on asset i
b_{i1} = the change in the return on asset i per unit change in factor 1
f_1 = the value of factor 1
b_{i2} = the change in the return on asset i per unit change in factor 2
f_2 = the value of factor 2
... = terms of the form $b_{ij}*f_j$ with j going from 3 to m-1
f_m = the value of factor m

b_{im} = the change in the return on asset i per unit change in factor m

m = the number of factors

e_i = the portion of the return on asset i not related to the m factors (Sharpe, 2010)

The terms factor exposure, factor return, and specific return are commonly used in quantitative finance, and it is well worth our effort to understand their meanings. Factor returns are the common drivers of stock returns, and are therefore independent of a particular stock. Factor exposures are the sensitivities to each of these common drivers. Any part of a stock's return that cannot be explained by these common factor returns is deemed a specific return (i.e., specific to a stock and essentially regarded as just random noise within the APT framework). Each stock's specific return is assumed to be uncorrelated to another stock's.(Chan, 2009)

Let's illustrate these using a simple factor model called the Fama-French Three-Factor model (E. F. F. Fama, Kenneth R. , 1992). This model postulates that the excess return of stock depends linearly on only three factor exposures: its beta (i.e., its sensitivity to the market index), its market capitalization, and its book-to-price ratio. These factor exposures are obviously different for each stock and for each time period. (Factor exposures are often normalized such that the average of the factor exposures within a universe of stocks is zero, and the standard deviation is 1.)

Now that we know how to calculate the factor exposures, what about the factor returns and specific returns? We cannot directly compute the factor returns and specific returns – we have to infer their values by running a multivariate linear regression of the excess returns of stocks against the factor exposures. Note that each stock represents one data point in this linear regression, and have to either run a separate linear regression for each time period or, if we want an average value over many time periods, aggregate the values from all these time periods into one training set and run one regression against them all. (Chan, 2009)

If you perform this linear regression fit over many time periods for the Fama-French Three-Factor model, you will find that the market capitalization factor return is usually negative (meaning that small-cap stocks usually outperform large-cap stocks), and the book-to-price ration factor return is usually positive (meaning value stocks usually outperform growth stocks). And since most stocks are positively correlated with the market index, the beta factor return is positive as well.(Chan, 2009)

Whether the factor exposures you have chosen are sensible or not will determine whether the factor model explains the excess returns of the stocks adequately. If factor exposures (and consequently the model as a whole) are poorly chosen, the linear regression fit will produce specific returns of significant sizes, and the R^2 statistic of the fit will be small. According to experts (Grinold, 1999), the R^2 statistic of a good factor model with monthly returns of 1000 stocks and 50 factors is typically about 30 percent to 40 percent.(Chan, 2009)

It may appear that these factor models are only explanatory in retrospect (looking backwards) – that is, given historical returns and factor exposures, we can compute the factor returns of those historical periods. But what good are those historical factor returns for our trading? It turns out that often factor returns are more stable than individual stock returns. In other words, they have momentum. You can therefore assume that their values remain unchanged from the current period (known from the regression fit) to the next time period. If this is the case, then, of course, you can also predict the excess returns, as long as the factor exposures are well chosen and therefore the time-varying specific returns are not significant.(Chan, 2009)

Screen Shot Appendix

A1 – The output file format from HSQuote:

The output file from HSQuote is called: C:\Users\Jyri\Documents\Jyris etterutdanning 2\Masteroppgave\Regneark\Jyris Regresjon\JyrisIndexM.txt

The output format must look like this with semicolons as separators:

Symbol;Date;Open;High;Low;Volume;Close;Adj-Close

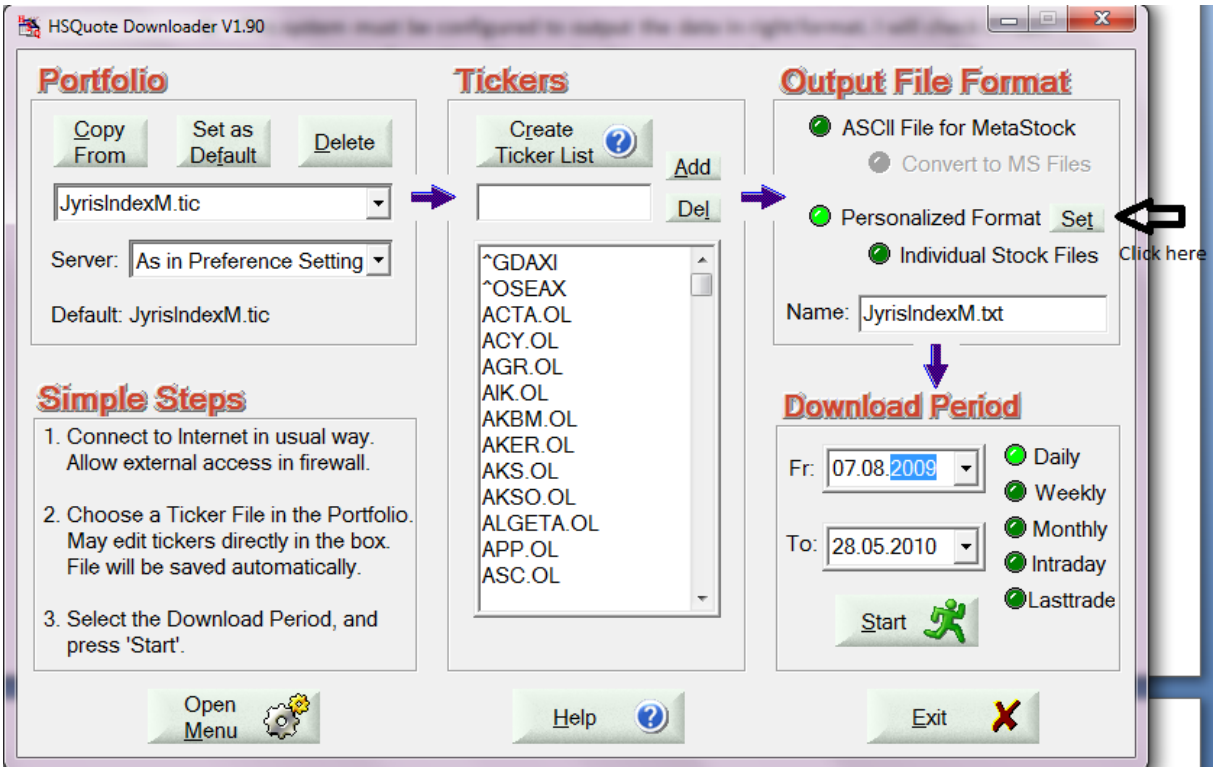
^GDAXI;07/08/2009;5366,38;5480,93;5312,78;31454900;5458,96;5458,96

^GDAXI;10/08/2009;5451,79;5452,20;5390,70;20204100;5418,12;5418,12

A2 – Screenshots from HSQuote to show the recommended settings:

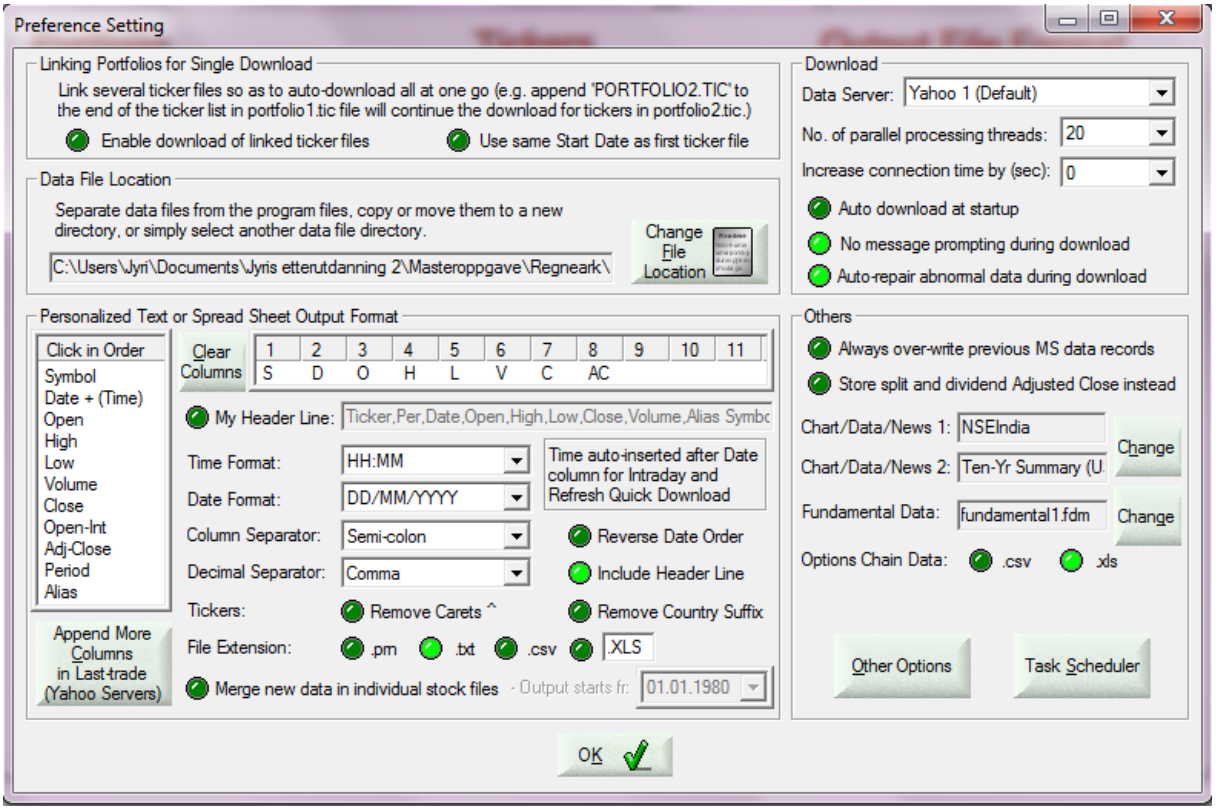
A2a – The download window

The "download window" looks like this and it is the first window that opens when you start the application. This window also opens when you run the first choice in the menu to load data and then it uses the date field from the application to put in to the field "From period".

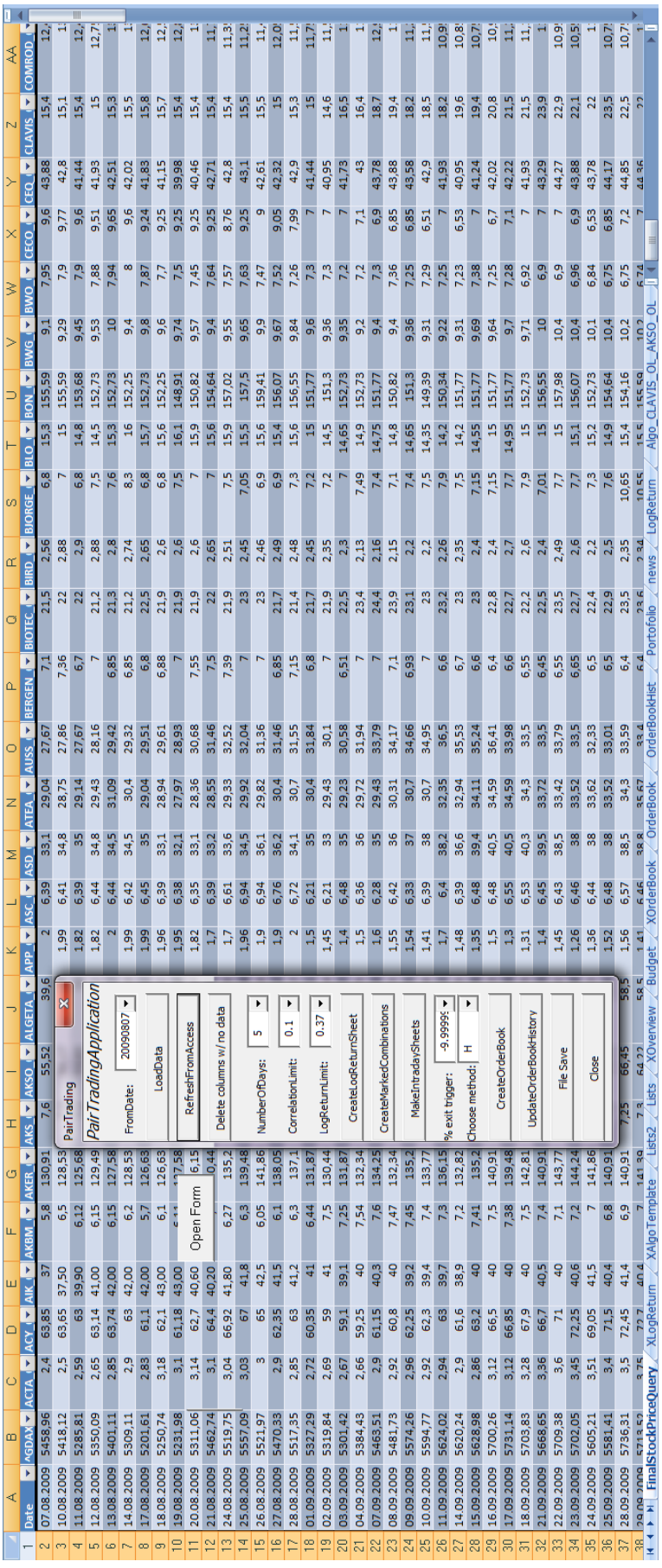


The configuration window looks like this. Notice that this describes the output format. It has to be like this to fit with my application.

A2b – The configuration window



S1 - Cross tabulated stock prices table in sheet 1:



S2 - Cross tabulated log returns table with correlation table in sheet 2:

S2a - Cross tabulated log returns table in sheet 2:

Date	^GDAXI	ACTA_OL	ACY_OL	AKBM_OL	AKER_OL	AKS_OL	AKSO_OL	ALGETA_OL	APP_OL	ATEA_OL	AUSS_OL	BERGEN_OL	BIOTEC_OL	BIRD_OL	BL
07.08.2009	^GDAXI	ACTA_OL	ACY_OL	AKBM_OL	AKER_OL	AKS_OL	AKSO_OL	ALGETA_OL	APP_OL	ATEA_OL	AUSS_OL	BERGEN_OL	BIOTEC_OL	BIRD_OL	BL
10.08.2009	-0,007509404	0,040821995	-0,003137257	0,113944259	-0,018347724	-0,040273899	0,01163949	-0,015267472	-0,005012542	-0,010036423	0,006843175	0,035965149	0,022989518	0,117783036	
11.08.2009	-0,02472302	0,035367144	-0,010264599	-0,06024008	-0,022423346	-0,013793322	-0,024145317	-0,025975486	-0,089298138	0,013474034	-0,006843175	-0,093952406	0	0,006920443	
12.08.2009	0,012087512	0,022901764	0,002219757	0,004889985	0,029864664	0,013793322	0,028586216	0,005249356	0	0,009902761	0,017553737	0,043802623	-0,037041272	-0,006920443	
13.08.2009	0,009491105	0,072759354	0,009457826	0	-0,014860039	0,013605652	-0,097279505	0	0,094310679	0,054871662	0,043772184	-0,021661497	0,004705891	-0,028170877	
14.08.2009	-0,017180275	0,017391743	-0,011677583	0,00809721	0,007418721	0,01342302	0,01203898	0,104312847	-0,005012542	-0,022443816	-0,003404838	0	-0,004705891	-0,021661497	
17.08.2009	-0,02045602	-0,024434025	-0,03062286	-0,084083117	-0,014892892	0,051959739	-0,052909814	-0,033576296	0	-0,045768418	0,006459312	-0,00732604	0,059514128	-0,03339828	
18.08.2009	0,009400826	0,116604485	0,016234123	0,067822596	0	-0,025642431	0,003859048	0,024097552	-0,015190165	-0,003449469	0,003382953	0,01169604	-0,027028672	-0,019048195	
19.08.2009	-0,003579228	-0,025479085	-0,01492565	0,001638002	0,00747417	-0,033006296	0,000202696	-0,004773279	-0,005115101	-0,034092214	-0,023233023	0,017291497	0	0	
20.08.2009	0,015001647	0,012820688	0,024541109	0,014622519	-0,011271944	0	0,011486272	0,018957914	-0,068992871	0,013847194	0,058731858	0,075637414	0	0	
21.08.2009	0,028159057	-0,012820688	0,026752185	0,016000341	0,033441676	-0,020339684	0,051733991	0,020906685	-0,068220825	0,006677234	0,025105921	-0,006644543	0,004555817	0,019048195	
24.08.2009	0,010382074	-0,019544596	0,038384243	-0,004773279	0,035841813	-0,006872879	0,058922036	-0,011580822	0	0,026953947	0,033138387	-0,014775286	-0,004555817	-0,054276887	
25.08.2009	0,006742021	-0,003294896	0,001794743	0,004773279	0,031166058	0,033901552	0,029341094	0,036533743	0,142316222	0,019916227	-0,014870162	-0,054217586	0,049007579	-0,024194729	
26.08.2009	-0,006339909	-0,009950331	-0,030305349	-0,040491361	0,016919434	-0,006688988	-0,006816421	0	-0,031090587	-0,003347844	-0,021451927	0	0	0,004073325	
27.08.2009	-0,009395737	-0,033901552	-0,041623598	0,008230499	-0,027224717	0	0,033117894	-0,009009907	0	0,019263299	0,003183702	-0,021661497	-0,058181955	0,012121361	
28.08.2009	0,008558729	-0,017391743	0,010371054	0,032260862	-0,006905352	0,006688988	0,029423721	0,002259888	0,051293294	0,009820046	0,002856691	0,042863704	-0,013921339	-0,00402415	
01.09.2009	-0,035055006	-0,046687114	-0,042973779	0,021978907	-0,038893998	-0,097980408	-0,05746857	-0,050936936	-0,287682072	-0,009820046	0,009149772	-0,050189745	0,028987537	0,013921339	
02.09.2009	-0,001399438	-0,011090687	-0,022623504	0,15237448	-0,010903238	-0,037457563	-0,020626558	-0,041217956	-0,033901552	-0,032428046	-0,056198189	0,028987537	0,009174376	-0,041672696	
03.09.2009	-0,003468519	-0,007462721	0,001693481	-0,033901552	0,010903238	0,007604599	0,008690309	0,344221483	-0,035091132	-0,006818983	0,015821029	-0,072570693	0,027028672	-0,021506205	
04.09.2009	0,015536746	-0,00375235	0,002534856	0,039220713	0,00355778	-0,038614836	0,022005778	-0,040273899	0,068992871	0,016624641	0,043512942	0,072570693	0,039220713	-0,076787143	
07.09.2009	0,014579985	0,086384614	0,031564082	0,007926065	0,014329365	-0,023905521	0,016617085	0,066249386	0,064538521	-0,009805658	0,056305758	0	0,04184711	0,013986242	
08.09.2009	0,003329304	0,006872879	-0,005740073	-0,017253248	-0,014329385	0	-0,004085808	-0,039220713	-0,031748698	0,029463129	0,011183165	0,014184635	-0,020704673	-0,00464038	
09.09.2009	0,016738829	0,013605652	0,023568746	-0,002680967	0,021380795	-0,032788823	0,036678314	-0,008928631	-0,006472515	0,012784964	0,014238218	-0,024234971	-0,034045841	0,022989518	
10.09.2009	0,00367266	-0,013605652	0,00080289	-0,006734032	-0,010633256	0,093793879	-0,025988469	0,00447428	-0,088192712	0	0,008332184	0,010050336	-0,004338402	0	
11.09.2009	0,005214478	0,006825965	0,011173301	-0,013605652	0,017635312	0,016554178	0,002528446	-0,00896867	0,187038547	0,052351366	0,043393792	-0,0568405	0,008658063	0,026907453	
14.09.2009	-0,000672343	-0,013698844	-0,022472856	-0,013793322	-0,024762391	0,029413885	-0,020752573	-0,022780028	-0,138586163	0,018073704	-0,026934851	0,015037877	-0,008658063	0,039050515	
15.09.2009	0,001553886	-0,013889112	0,025642431	0,028749413	0,017760335	-0,139761942	0,025622849	-0,018605188	-0,091937495	0,034902872	-0,008195609	-0,015037877	0	0,021053409	
16.09.2009	0,012583534	0,087011377	0,050897647	0,012072581	0,041366225	0,072320662	0,086606425	0,023202897	0,105360516	0,013974027	0,032661661	-0,030771659	-0,00873368	0	
17.09.2009	0,005402676	0	0,005249356	-0,016129382	-0,010200167	0,022989518	-0,031050158	0	-0,143100844	0	-0,069071346	0,030771659	-0,004395611	0,117783036	
18.09.2009	-0,004776585	0,050010421	0,015584731	0,016129382	0,023593854	0,037179003	-0,000792707	0,057922648	0,007662873	-0,008419269	-0,014226677	-0,007604599	-0,022272636	-0,037740328	
21.09.2009	-0,006186865	0,024097552	-0,017931082	-0,01342302	-0,013393687	0,021661497	-0,036173813	-0,004338402	0,066445099	-0,017054221	0	-0,015384919	0,01342302	-0,080042708	
22.09.2009	0,007159442	0,068992871	0,062474924	-0,041385216	0,020093412	0,075637414	0,043128164	0,075349437	0,035093132	-0,008931661	0,008619462	0,015384919	0,043485112	0,036813973	
23.09.2009	-0,001284677	-0,042559614	0,01745245	0,013986242	0,003263778	-0,033673215	0,02642367	-0,032789823	-0,140451835	0,002987752	-0,008619462	0,015151805	-0,034635497	0,043228735	
24.09.2009	-0,017129237	0,017241806	-0,045301447	-0,028170877	-0,016637923	-0,040536647	0,016280314	-0,025317808	0,076372979	0,002978852	-0,002978852	-0,035549847	-0,022814678	-0,013303966	-0,167054085
25.09.2009	-0,00425509	-0,031840606	0,03486657	-0,028987537	-0,006719267	0,040536647	0,001508068	0	0,111225635	-0,002978852	0,020814954	0	0,022075952	0,127833372	
28.09.2009	0,027374714	0,028987537	0,013199219	0,014598799	0	-0,006872879	0,00135532	0	0,025975486	0,023003079	0,017417858	-0,015504187	0,025863511	-0,061875404	
29.09.2009	-0,002398085	0,068992871	0,003444716	0,014308737	0,003400641	0,006872879	-0,013475096	0	-0,110109117	0,019916445	-0,005572504	0	0,004246291	-0,004264399	

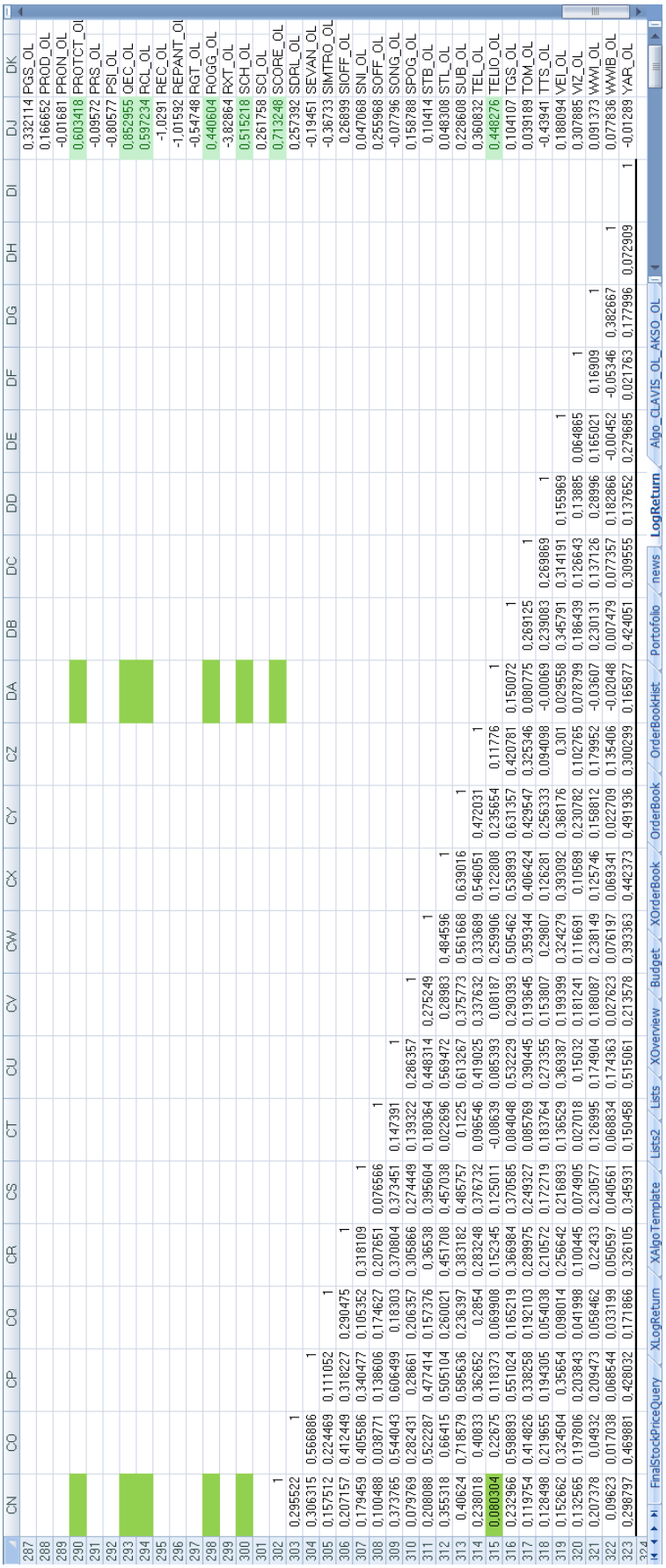
Page: 123

S2b - Correlation matrix in the bottom of sheet 2 (top left side):

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
209	**Sum**	**0,083239667**	**-0,04691692**	**0,35980239**	**-1,25708263**	**-0,050204348**	**-0,041644701**	**0,433525909**	**0,696927903**	**0,479334957**	**0,417785592**	**0,350875725**	**0,291197015**	**-1,363304843**	**-0,716863707**
210	**Correl. Limit:**	**0,1**	**CorrLookUpRange:**		**5 LogRetLimit:**	**0,37**									
211		*^GDAXI*	*ACTA_OL*	*ACY_OL*	*AKBM_OL*	*AKER_OL*	*AKS_OL*	*AKSO_OL*	*ALGETA_OL*	*APP_OL*	*ATEA_OL*	*AUSS_OL*	*BERGEN_OL*	*BIOTEC_OL*	*BIRD_OL*
212	^GDAXI	1													
213	ACTA_OL	0,338467367	1												
214	ACY_OL	0,710003755	0,332384163	1											
215	AKBM_OL	0,008445716	-0,01285723	-0,01522062	1										
216	AKER_OL	0,643001998	0,287216777	0,642339817	0,016795237	1									
217	AKS_OL	0,291531032	0,191050758	0,296664331	0,009724146	0,299468998	1								
218	AKSO_OL	0,652527466	0,237273375	0,713290918	0,041252195	0,69956659	0,25135789	1							
219	ALGETA_OL	0,3242315	0,201827522	0,431597364	-0,064396828	0,401448941	0,310075784	0,345912316	1						
220	APP_OL	0,204314841	0,176532293	0,156847476	0,025768593	0,252842557	0,182306055	0,214428586	0,153603668	1					
221	ATEA_OL	0,414101231	0,179729678	0,413144843	0,018389049	0,300751371	0,185797174	0,245344007	0,205646179	0,078979836	1				
222	AUSS_OL	0,291573335	0,209546258	0,359205004	-0,015040317	0,32997119	0,315877914	0,310662718	0,242960539	0,15583257	0,280252469	1			
223	BERGEN_OL	0,345602071	0,111716565	0,283480134	-0,056013794	0,312407235	0,11339478	0,309067673	0,134052569	0,068227915	0,003064041	0,200095207	1		
224	BIOTEC_OL	-0,04383917	0,062159371	-0,003036421	-0,057015666	-0,073131475	-0,050397644	-0,008505024	0,086215182	0,072727826	-0,061641317	0,03185845	0,036005888	1	
225	BIRD_OL	0,074735332	0,018297209	0,147817987	0,062984727	0,102757372	0,147731683	0,035845014	0,043281589	-0,122348279	0,024262771	-0,005468268	0,031057103	-0,039353397	1
226	BLO_OL	0,25644886	0,23547785	0,174222852	-0,002660475	0,191063793	0,040382433	0,07878263	0,10237365	0,060357544	0,131645769	0,168465696	0,08904662	0,028977698	-0,040574962
227	BON_OL	0,294801919	0,25193208	0,310572568	0,097591994	0,333468574	0,245195346	0,307740107	0,229336424	0,087345707	0,140920015	0,167623754	0,164058021	0,099037332	-0,01818376
228	BWO_OL	0,273313004	0,145935787	0,269901874	0,011401325	0,199375521	0,075169519	0,199750959	0,206840952	0,128040315	0,150739099	0,241346246	0,189218258	0,069578651	0,067067887
229	CEQ_OL	0,53428674	0,219250944	0,523897582	0,02733691	0,486427247	0,269695803	0,462065644	0,29660367	0,137049249	0,283992745	0,422780997	0,303449368	-0,133084917	-0,020929833
230	CLAVIS_OL	0,167803792	0,146951992	0,142801212	0,030177977	0,144423862	0,178653783	0,088570949	0,370944093	0,060758478	0,242983308	0,106215315	0,08896081	-0,082748787	0,049752808
231	COMROD_OL	0,024716273	0,073662954	0,011441502	-0,188604794	0,090746315	0,060312425	-0,005840018	0,071486467	-0,002091712	0,028934653	0,086694807	0,044728625	0,019272048	0,084409817
232	COP_OL	0,124125559	0,057573455	0,161073313	-0,009073479	0,144751376	0,147324983	0,204981043	0,113292183	-0,078686075	0,20573773	0,276478542	-0,016595319	-0,014075901	-0,073823488
233	DAT_OL	0,238864777	0,034355115	0,214047507	-0,045252359	0,057558196	0,05656949	0,113810259	0,237082508	-0,123038194	0,201838445	0,155202269	0,190208591	0,021724963	0,038814154
234	DESSC_OL	0,356004063	0,210200283	0,413033239	0,0559869	0,376475238	0,149783072	0,374955933	0,295898284	-0,003168709	0,246531239	0,250740356	0,256260849	0,051535593	0,129213071
235	DIAG_OL	0,240050329	0,118727171	0,256980511	0,063352538	0,24601645	0,089690313	0,231940465	0,294043778	0,176146223	0,095494241	0,142732526	0,00864136	0,014101634	0,068291652
236	DNBNOR_OL	0,616209721	0,228929076	0,597471805	-0,003709329	0,496936581	0,209778251	0,484799033	0,305910342	0,074077889	0,326766352	0,313661905	0,236081168	-0,040168454	0,151207579
237	DOF_OL	0,235221422	0,028664606	0,273180517	-0,110205343	0,348477328	0,178169595	0,280831675	0,204729232	0,058446457	0,288163812	0,222599732	0,195984133	-0,040132043	-0,020719626
238	EDBASA_OL	0,260937057	0,171638861	0,292367914	-0,012701647	0,234444689	0,142132752	0,234339806	0,194284439	0,10761734	0,167219333	0,122919738	0,199191783	-0,004618669	-0,133683614
239	EKO_OL	0,083388768	0,078786169	0,211360164	0,01838696	0,247781827	0,153125411	0,116915331	0,253987333	-0,047684455	0,091022537	0,177547942	-0,020038683	-0,033826579	0,026142151
240	ELT_OL	0,350364884	0,140259952	0,350785859	-0,03799305	0,386400901	0,175127512	0,313318007	0,256274207	0,097988003	0,285916601	0,191718569	0,226800229	0,040618202	0,000473717
241	EMGS_OL	0,288365411	0,244414649	0,319462339	-0,027689999	0,313568528	0,154214842	0,246473352	0,28126849	0,14186532	0,229649847	0,262113533	0,163215266	0,037503758	0,003950815
242	EMS_OL	0,279362519	0,107741895	0,237602345	0,057820314	0,158716019	0,185927937	0,192014464	0,126102914	0,056575969	0,159784834	0,25281336	0,214710748	0,029849726	0,120310352
243	FAIR_OL	0,25027157	0,110390952	0,188471093	0,027656738	0,126124177	0,1059475	0,147144062	0,124762812	0,094340273	0,187188773	0,087168173	0,240103198	0,030700678	-0,065722186
244	FBU_OL	0,234569857	0,068282793	0,224671379	0,154775992	0,242271006	0,089417071	0,254323978	0,171805788	0,096063323	0,077060925	0,22430135	0,25286041	0,03577848	0,008202056
245	FOE_OL	0,547840029	0,229743708	0,54748059	0,038483712	0,483111855	0,249994987	0,534665449	0,312825635	0,175881587	0,232177823	0,186192661	0,189264491	0,01796756	-0,044319971
246	FRO_OL	0,598218614	0,294488624	0,541857168	-0,062137355	0,478119313	0,351478606	0,478820006	0,31847874	0,151126554	0,318968888	0,243127546	0,219204656	0,021551592	0,123984729

FinalStockPriceQuery / XAlgoTemplate / Lists2 / XOverview / Buddet / XOrderBook / OrderBook / OrderBookHist / Portofolio / news / **LogReturn** / Algo CLAVIS_OL AKSO_OL

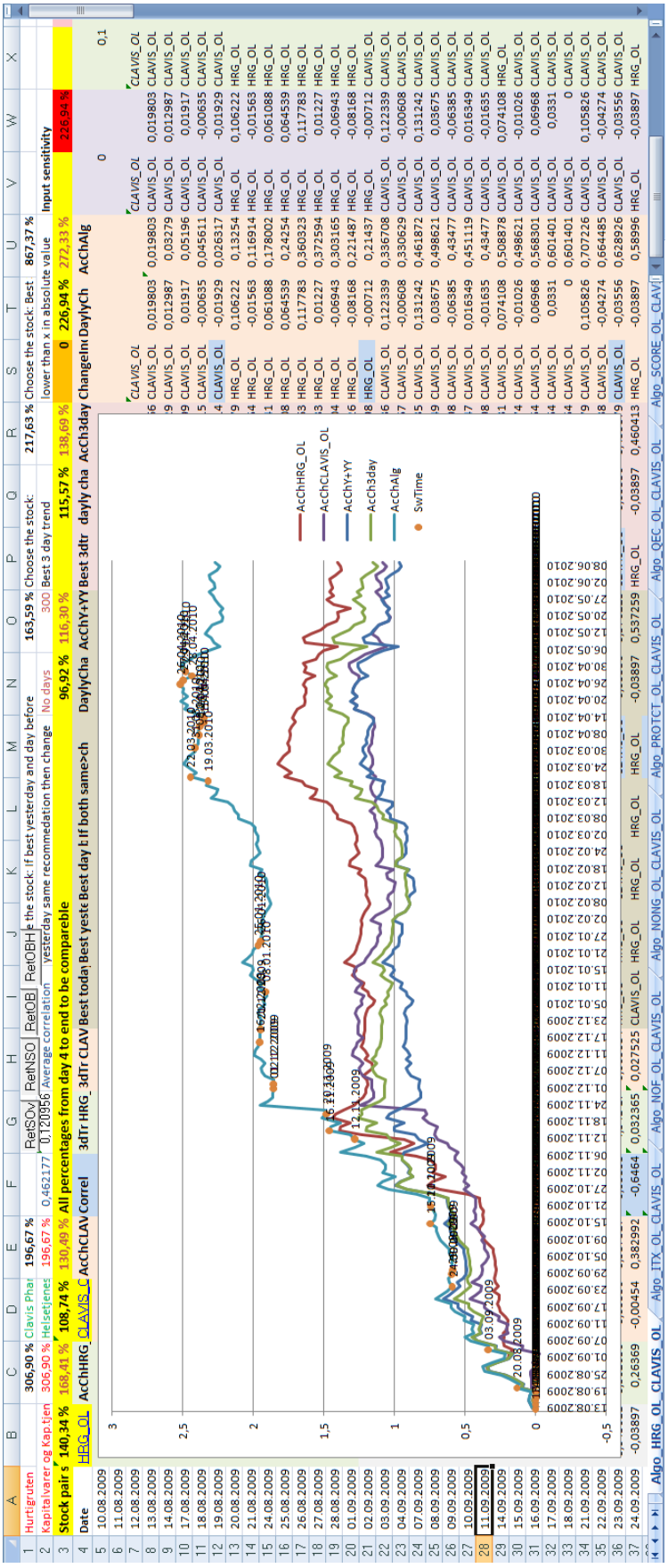
S2c - Correlation matrix in the bottom of sheet 2 (bottom right side):



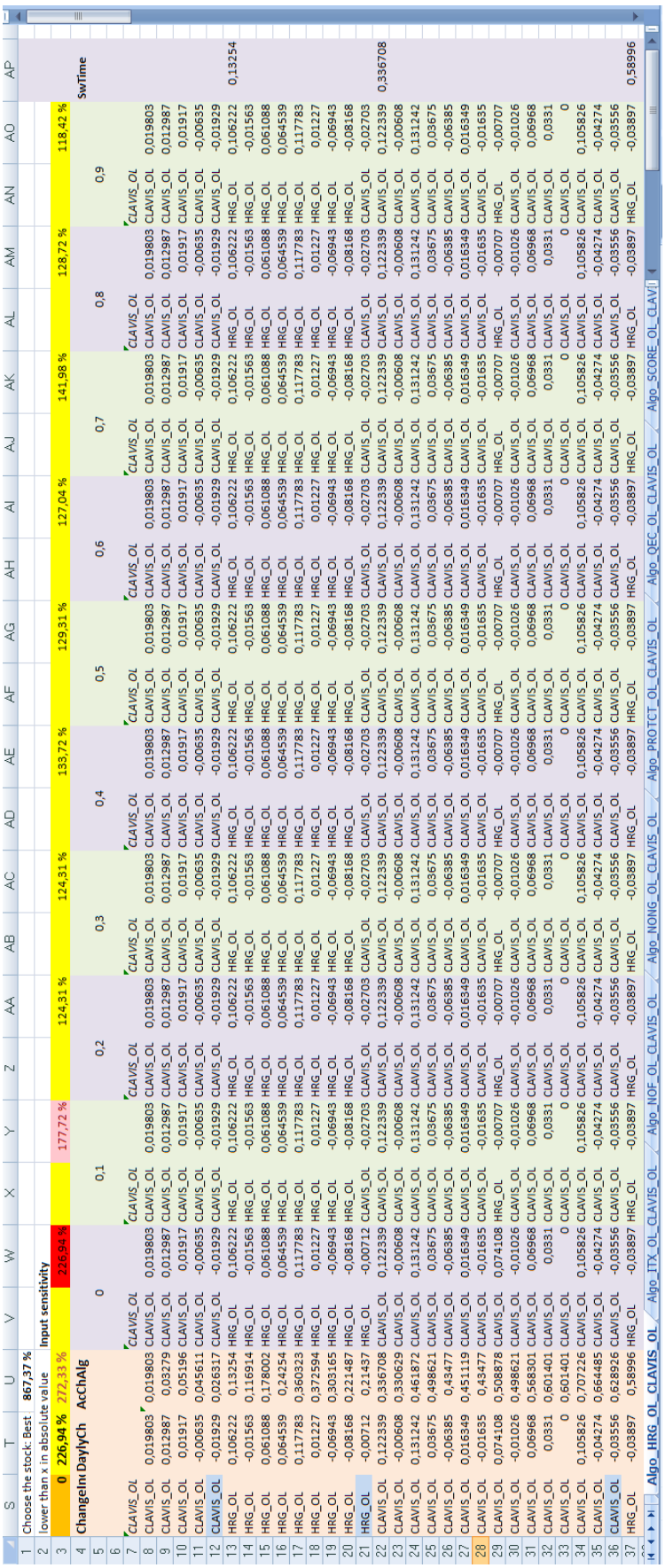
	CN	CO	CP	CQ	CR	CS	CT	CU	CV	CW	CX	CY	CZ	DA	DB	DC	DD	DE	DF	DG	DH	DI	DJ	DK
287																							0,332114	PGS_OL
288																							0,166652	PROD_OL
289																							-0,01681	PRON_OL
290																							0,603418	PROTCT_OL
291																							-0,09572	PRS_OL
292																							-0,80577	PSL_OL
293																							0,852955	QEC_OL
294																							0,597234	RCL_OL
295																							-1,0291	REC_OL
296																							-1,01592	REPANT_OL
297																							-0,54748	RGT_OL
298																							0,440604	ROGG_OL
299																							-3,82864	RXT_OL
300																							0,515218	SCH_OL
301																							0,261758	SCL_OL
302	1																						0,713248	SCORE_OL
303	0,295522	1																					0,257392	SDRL_OL
304	0,306315	0,566886	1																				-0,19451	SEVAN_OL
305	0,157512	0,224469	0,111052	1																			-0,36733	SIMTRO_OL
306	0,207157	0,412449	0,318227	0,290475	1																		0,26899	SIOFF_OL
307	0,179459	0,405586	0,340477	0,105352	0,318109	1																	0,047068	SNI_OL
308	0,100488	0,038771	0,138606	0,174627	0,207651	0,076566	1																0,255968	SOFF_OL
309	0,373765	0,544043	0,606499	0,18303	0,370804	0,373451	0,147391	1															-0,07796	SONG_OL
310	0,079769	0,282431	0,28661	0,206357	0,305866	0,274449	0,139322	0,286357	1														0,158788	SPOG_OL
311	0,208088	0,522287	0,477414	0,157376	0,36538	0,395604	0,180364	0,448314	0,275249	1													0,10414	STB_OL
312	0,355318	0,66415	0,505104	0,260021	0,451708	0,457038	0,022696	0,569472	0,28983	0,484596	1												0,048308	STL_OL
313	0,40624	0,718579	0,585636	0,236397	0,383182	0,485757	0,1225	0,613267	0,375773	0,561668	0,639016	1											0,228608	SUB_OL
314	0,238018	0,40833	0,362652	0,2854	0,283246	0,376732	0,096546	0,419025	0,337632	0,333689	0,546051	0,472031	1										0,360832	TEL_OL
315	0,080304	0,22675	0,118373	0,069908	0,152345	0,125011	-0,08639	0,085393	0,08187	0,259906	0,122808	0,235654	0,11776	1									0,448276	TELIO_OL
316	0,232966	0,598893	0,551024	0,165219	0,366984	0,370585	0,084048	0,532229	0,290393	0,505462	0,538993	0,631357	0,420781	0,150072	1								0,104107	TGS_OL
317	0,119754	0,414826	0,338258	0,192103	0,289975	0,249327	0,085769	0,390445	0,193645	0,359344	0,406424	0,429547	0,325346	0,080775	0,269125	1							0,039189	TOM_OL
318	0,128498	0,219655	0,194305	0,054038	0,210572	0,172719	0,183764	0,273355	0,153807	0,29807	0,126281	0,256333	0,094098	-0,00069	0,239083	0,269869	1						-0,43941	TTS_OL
319	0,152662	0,324504	0,35654	0,098014	0,256642	0,216893	0,136529	0,369387	0,199399	0,324279	0,393092	0,368176	0,301	0,029558	0,345791	0,314191	0,155969	1					0,188094	YEL_OL
320	0,132565	0,197806	0,203843	0,041998	0,100445	0,074905	0,027018	0,15032	0,181241	0,116691	0,10589	0,230782	0,102765	0,078799	0,186439	0,126643	0,13885	0,064865	1				0,307885	YIZ_OL
321	0,207378	0,04932	0,209473	0,058462	0,22433	0,230577	0,126995	0,174904	0,188087	0,238149	0,125746	0,158812	0,179952	-0,03607	0,230131	0,137126	0,28996	0,165021	0,16909	1			0,091373	WWI_OL
322	0,09623	0,017038	0,068544	0,033199	0,050597	0,040561	0,068834	0,174363	0,027623	0,076197	0,069341	0,022709	0,135406	-0,02048	0,007479	0,077357	0,182866	-0,00452	-0,05346	0,382667	1		0,077836	WWIB_OL
323	0,298797	0,469881	0,428032	0,171866	0,326105	0,345931	0,150458	0,515061	0,213578	0,393363	0,442373	0,491936	0,300299	0,165877	0,424051	0,309555	0,137652	0,279685	0,021763	0,177996	0,072909	1	-0,01289	YAR_OL
324																								

S3 - An example of an Algo sheet representing a stock pair:

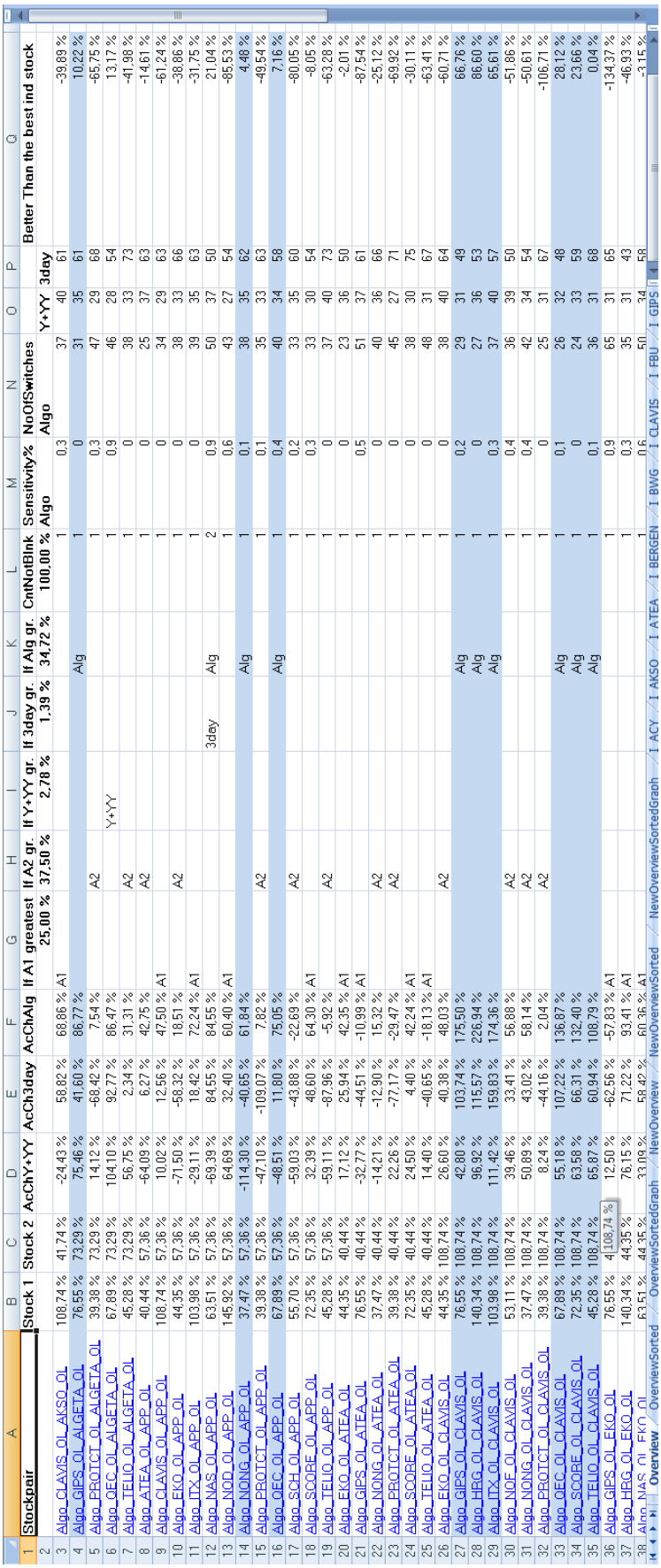
S3a - First part of the sheet:



S3b - Second part of the sheet:

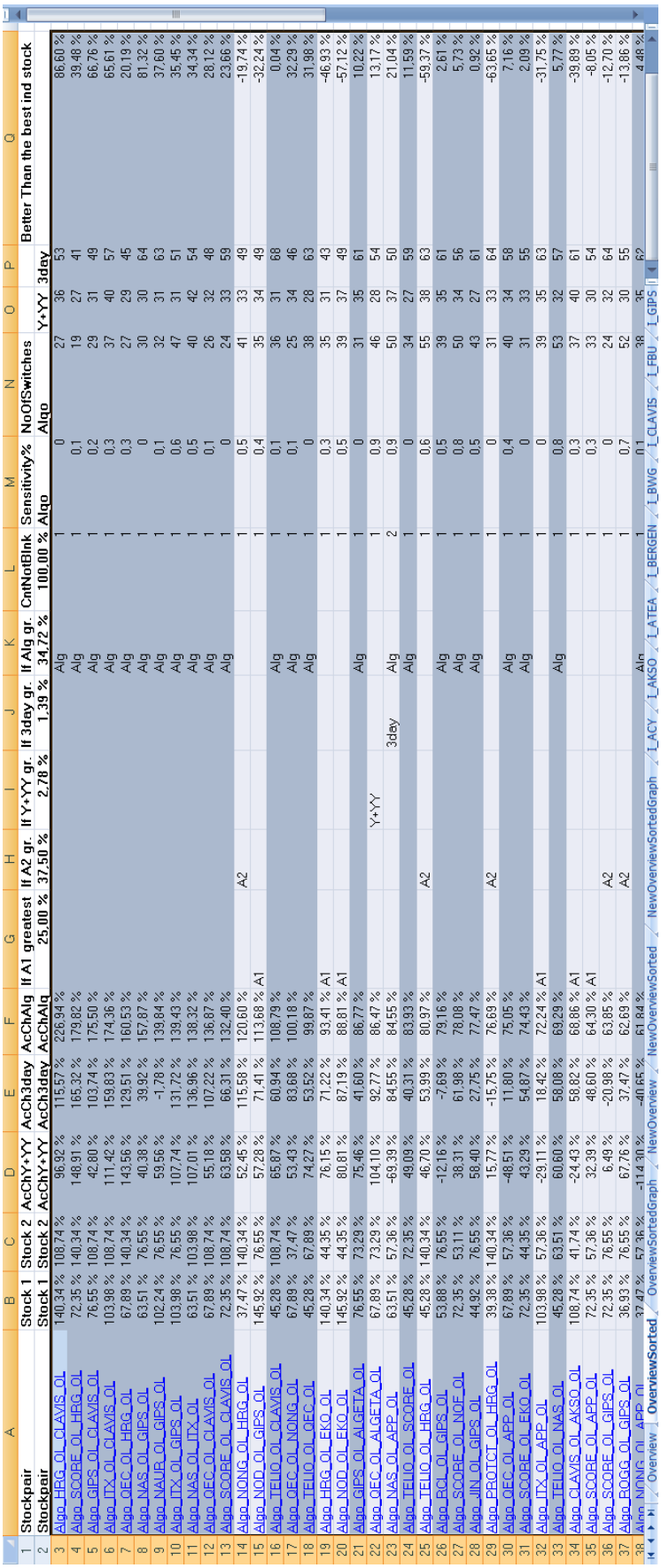


S4 - Overview sheet (using continuous compounding interest):



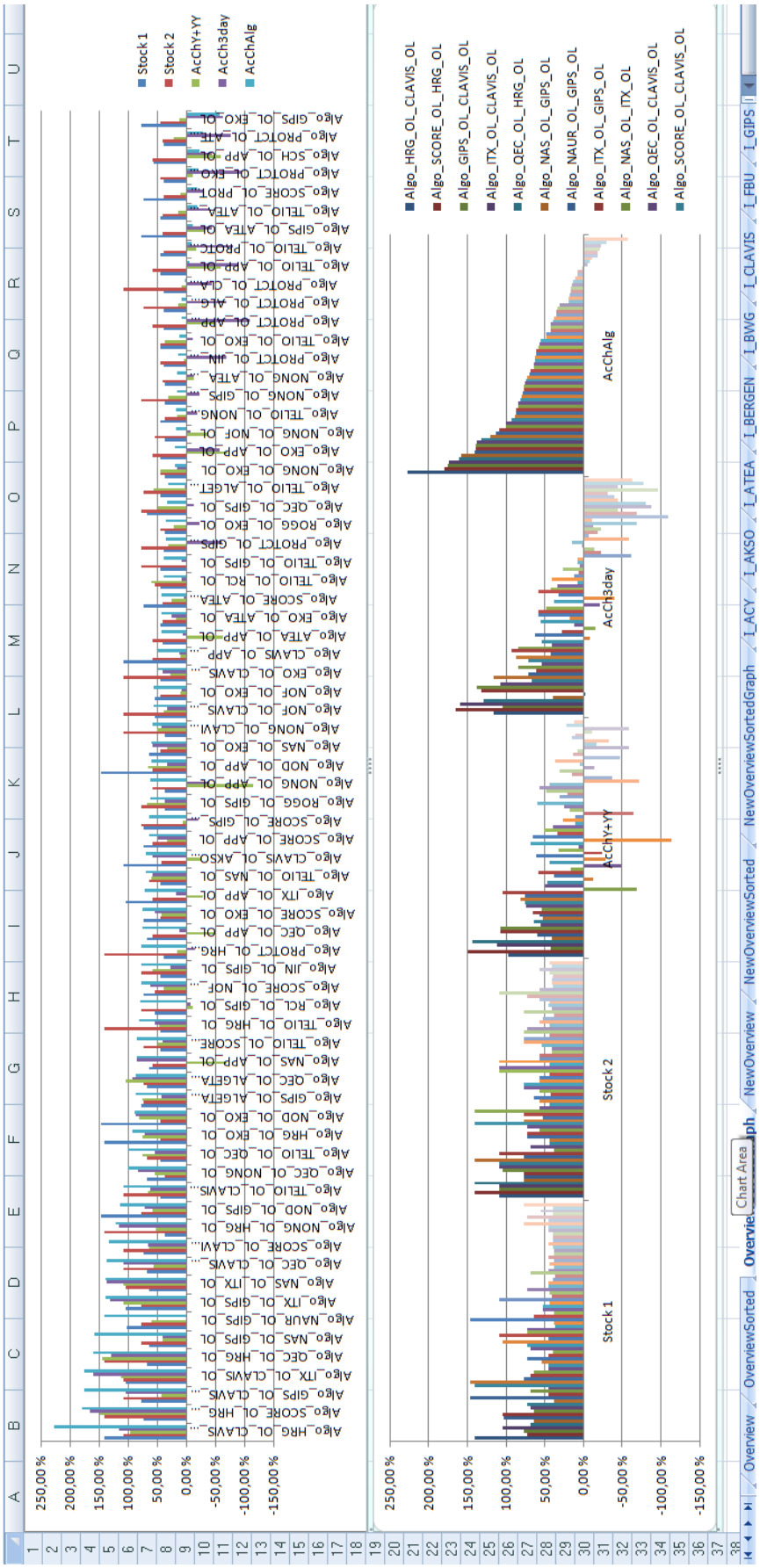
Stockpair	Stock 1	Stock 2	AcChY+YY	AcCh3day	AcChAlg	If A1 greatest 25,00 %	If A2 gr. 37,50 %	If Y+YY gr. 2,78 %	If 3day gr. 1,39 %	If Alg gr. 34,72 %	CatNotBlnk 100,00 %	Sensitivity% Algo	NoOfSwitches Algo	Y+YY	3day	Better Than the best ind stock
Algo_CLAVIS_OL_AKSO_OL	108,74 %	41,74 %	-24,43 %	58,82 %	68,86 %	A1					1	0,3	37	40	61	-39,89 %
Algo_GIPS_OL_ALGETA_OL	76,55 %	73,29 %	75,46 %	41,60 %	86,77 %					Alg	1	0	31	35	61	10,22 %
Algo_PROTCT_OL_ALGETA_OL	39,38 %	73,29 %	14,12 %	-68,42 %	7,54 %		A2				1	0,3	47	29	68	-65,75 %
Algo_QEC_OL_ALGETA_OL	67,89 %	73,29 %	104,10 %	92,77 %	86,47 %			Y+YY			1	0,9	46	28	54	13,17 %
Algo_TELIO_OL_ALGETA_OL	45,28 %	73,29 %	56,75 %	2,34 %	31,31 %		A2				1	0	38	33	73	-41,98 %
Algo_ATEA_OL_APP_OL	40,44 %	57,36 %	-64,09 %	6,27 %	42,75 %		A2				1	0	25	37	63	-14,61 %
Algo_CLAVIS_OL_APP_OL	108,74 %	57,36 %	10,02 %	12,56 %	47,50 %	A1					1	0	34	29	63	-61,24 %
Algo_EKO_OL_APP_OL	44,35 %	57,36 %	-71,50 %	-58,32 %	18,51 %		A2				1	0	38	33	66	-38,86 %
Algo_ITX_OL_APP_OL	103,98 %	57,36 %	-29,11 %	18,42 %	72,24 %	A1					1	0	39	35	63	-31,75 %
Algo_NAS_OL_APP_OL	63,51 %	57,36 %	-69,39 %	84,55 %	84,55 %				3day	Alg	2	0,9	50	37	50	21,04 %
Algo_NOD_OL_APP_OL	145,92 %	57,36 %	64,69 %	32,40 %	60,40 %	A1					1	0,6	43	27	54	-85,53 %
Algo_NONG_OL_APP_OL	37,47 %	57,36 %	-114,30 %	-40,65 %	61,84 %					Alg	1	0,1	38	35	62	4,48 %
Algo_PROTCT_OL_APP_OL	39,38 %	57,36 %	-47,10 %	-109,07 %	7,82 %		A2				1	0,1	35	33	63	-49,54 %
Algo_QEC_OL_APP_OL	67,89 %	57,36 %	-48,51 %	11,80 %	75,05 %					Alg	1	0,4	40	34	58	7,16 %
Algo_SCH_OL_APP_OL	55,70 %	57,36 %	-59,03 %	-43,88 %	-22,69 %		A2				1	0,2	33	35	60	-80,05 %
Algo_SCOBE_OL_APP_OL	72,35 %	57,36 %	32,39 %	48,60 %	64,30 %	A1					1	0,3	33	30	54	-8,05 %
Algo_TELIO_OL_APP_OL	45,28 %	57,36 %	-59,11 %	-87,96 %	-5,92 %		A2				1	0	37	40	73	-63,28 %
Algo_EKO_OL_ATEA_OL	44,35 %	40,44 %	17,12 %	25,94 %	42,35 %	A1					1	0	23	36	50	-2,01 %
Algo_GIPS_OL_ATEA_OL	76,55 %	40,44 %	-32,77 %	-44,51 %	-10,99 %	A1					1	0,5	51	37	61	-87,54 %
Algo_NONG_OL_ATEA_OL	37,47 %	40,44 %	-14,21 %	-12,90 %	15,32 %		A2				1	0	40	36	66	-25,12 %
Algo_PROTCT_OL_ATEA_OL	39,38 %	40,44 %	22,26 %	-77,17 %	-29,47 %		A2				1	0	45	27	71	-69,92 %
Algo_SCOBE_OL_ATEA_OL	72,35 %	40,44 %	24,50 %	4,40 %	42,24 %	A1					1	0	38	30	75	-30,11 %
Algo_TELIO_OL_ATEA_OL	45,28 %	40,44 %	14,40 %	-40,65 %	-18,13 %	A1					1	0	48	31	67	-63,41 %
Algo_EKO_OL_CLAVIS_OL	44,35 %	108,74 %	26,60 %	40,38 %	48,03 %		A2				1	0	38	40	64	-60,71 %
Algo_GIPS_OL_CLAVIS_OL	76,55 %	108,74 %	42,80 %	103,74 %	175,50 %					Alg	1	0,2	29	31	49	66,76 %
Algo_HBG_OL_CLAVIS_OL	140,34 %	108,74 %	96,92 %	115,57 %	226,94 %					Alg	1	0	27	36	53	86,60 %
Algo_ITX_OL_CLAVIS_OL	103,98 %	108,74 %	111,42 %	159,83 %	174,36 %					Alg	1	0,3	37	40	57	65,61 %
Algo_NOF_OL_CLAVIS_OL	53,11 %	108,74 %	39,46 %	33,41 %	56,88 %		A2				1	0,4	36	39	50	-51,86 %
Algo_NONG_OL_CLAVIS_OL	37,47 %	108,74 %	50,89 %	43,02 %	58,14 %		A2				1	0,4	42	34	54	-50,61 %
Algo_PROTCT_OL_CLAVIS_OL	39,38 %	108,74 %	8,24 %	-44,16 %	2,04 %		A2				1	0	25	31	67	-106,71 %
Algo_QEC_OL_CLAVIS_OL	67,89 %	108,74 %	55,18 %	107,22 %	136,87 %					Alg	1	0,1	26	32	48	28,12 %
Algo_SCOBE_OL_CLAVIS_OL	72,35 %	108,74 %	63,58 %	66,31 %	132,40 %					Alg	1	0	24	33	59	23,66 %
Algo_TELIO_OL_CLAVIS_OL	45,28 %	108,74 %	65,87 %	60,94 %	108,79 %					Alg	1	0,1	36	31	68	0,04 %
Algo_GIPS_OL_EKO_OL	76,55 %	41 108,74 %	12,50 %	-62,56 %	-57,83 %	A1					1	0,9	65	31	65	-134,37 %
Algo_HBG_OL_EKO_OL	140,34 %	44,35 %	76,15 %	71,22 %	93,41 %	A1					1	0,3	35	31	43	-46,93 %
Algo_NAS_OL_EKO_OL	63,51 %	44,35 %	33,09 %	58,42 %	60,36 %	A1					1	0,6	50	34	58	-3,15 %

S5 - Sorted Overview Sheet (using continuous compounding interest):

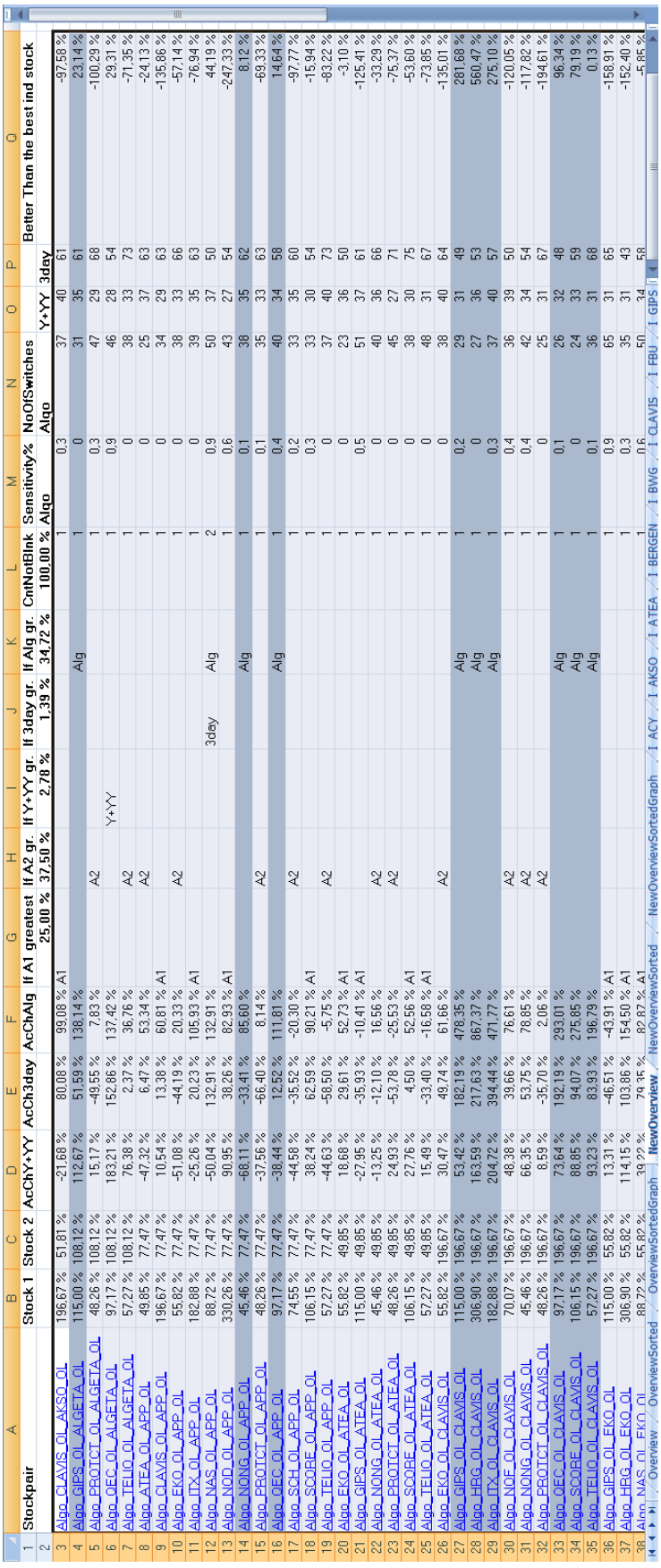


	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Stockpair	Stock 1	Stock 2	AcChY+YY	AcCh3day	AcChAlg	If A1 greatest	If A2 gr.	If Y+YY gr.	If 3day gr.	If Alg gr.	CntNotBlnk	Sensitivity%	NoOfSwitches			Better Than the best ind stock
2	Stockpair	Stock 1	Stock 2	AcChY+YY	AcCh3day	AcChAlg	25,00 %	37,50 %	2,78 %	1,39 %	34,72 %	100,00 %	Algo	Algo	Y+YY	3day	
3	Algo_HRG_OL_CLAVIS_OL	140,34 %	108,74 %	96,92 %	115,57 %	226,94 %					Alg	1	0	27	36	53	86,60 %
4	Algo_SCORE_OL_HRG_OL	72,35 %	140,34 %	148,91 %	165,32 %	179,82 %					Alg	1	0,1	19	27	41	39,48 %
5	Algo_GIPS_OL_CLAVIS_OL	76,55 %	108,74 %	42,80 %	103,74 %	175,50 %					Alg	1	0,2	29	31	49	66,76 %
6	Algo_ITX_OL_CLAVIS_OL	103,98 %	108,74 %	111,42 %	159,83 %	174,36 %					Alg	1	0,3	37	40	57	65,61 %
7	Algo_QEC_OL_HRG_OL	67,89 %	140,34 %	143,56 %	129,51 %	160,53 %					Alg	1	0,3	27	29	45	20,19 %
8	Algo_NAS_OL_GIPS_OL	63,51 %	76,55 %	40,38 %	39,92 %	157,87 %					Alg	1	0	30	30	64	81,32 %
9	Algo_NAUR_OL_GIPS_OL	102,24 %	76,55 %	59,56 %	-1,78 %	139,84 %					Alg	1	0,1	32	31	63	37,60 %
10	Algo_ITX_OL_GIPS_OL	103,98 %	76,55 %	107,74 %	131,72 %	139,43 %					Alg	1	0,6	47	31	51	35,45 %
11	Algo_NAS_OL_ITX_OL	63,51 %	103,98 %	107,01 %	136,96 %	138,32 %					Alg	1	0,5	40	42	54	34,34 %
12	Algo_QEC_OL_CLAVIS_OL	67,89 %	108,74 %	55,18 %	107,22 %	136,87 %					Alg	1	0,1	26	32	48	28,12 %
13	Algo_SCORE_OL_CLAVIS_OL	72,35 %	108,74 %	63,58 %	66,31 %	132,40 %					Alg	1	0	24	33	59	23,66 %
14	Algo_NONG_OL_HRG_OL	37,47 %	140,34 %	52,45 %	115,58 %	120,60 %		A2				1	0,5	41	33	49	-19,74 %
15	Algo_NOD_OL_GIPS_OL	145,92 %	76,55 %	57,28 %	71,41 %	113,68 %	A1					1	0,4	35	34	49	-32,24 %
16	Algo_TELIO_OL_CLAVIS_OL	45,28 %	108,74 %	65,87 %	60,94 %	108,79 %					Alg	1	0,1	36	31	68	0,04 %
17	Algo_QEC_OL_NONG_OL	67,89 %	37,47 %	53,43 %	83,68 %	100,18 %					Alg	1	0,1	25	34	46	32,29 %
18	Algo_TELIO_OL_QEC_OL	45,28 %	67,89 %	74,27 %	53,52 %	99,87 %					Alg	1	0	38	28	63	31,98 %
19	Algo_HRG_OL_EKO_OL	140,34 %	44,35 %	76,15 %	71,22 %	93,41 %	A1					1	0,3	35	31	43	-46,93 %
20	Algo_NOD_OL_EKO_OL	145,92 %	44,35 %	80,81 %	87,19 %	88,81 %	A1					1	0,5	39	37	49	-57,12 %
21	Algo_GIPS_OL_ALGETA_OL	76,55 %	73,29 %	75,46 %	41,60 %	86,77 %					Alg	1	0	31	35	61	10,22 %
22	Algo_QEC_OL_ALGETA_OL	67,89 %	73,29 %	104,10 %	92,77 %	86,47 %			Y+YY			1	0,9	46	28	54	13,17 %
23	Algo_NAS_OL_APP_OL	63,51 %	57,36 %	-69,39 %	84,55 %	84,55 %				3day	Alg	2	0,9	50	37	50	21,04 %
24	Algo_TELIO_OL_SCORE_OL	45,28 %	72,35 %	49,09 %	40,31 %	83,93 %					Alg	1	0	34	27	59	11,59 %
25	Algo_TELIO_OL_HRG_OL	45,28 %	140,34 %	46,70 %	53,99 %	80,97 %		A2				1	0,6	55	38	63	-59,37 %
26	Algo_RCL_OL_GIPS_OL	53,88 %	76,55 %	-12,16 %	-7,69 %	79,16 %					Alg	1	0,5	39	35	61	2,61 %
27	Algo_SCORE_OL_NOF_OL	72,35 %	53,11 %	38,31 %	61,98 %	78,08 %					Alg	1	0,8	50	34	56	5,73 %
28	Algo_JIN_OL_GIPS_OL	44,92 %	76,55 %	58,40 %	27,75 %	77,47 %					Alg	1	0,5	43	27	61	0,92 %
29	Algo_PROTCT_OL_HRG_OL	39,38 %	140,34 %	15,77 %	-15,75 %	76,69 %		A2				1	0	31	33	64	-63,65 %
30	Algo_QEC_OL_APP_OL	67,89 %	57,36 %	-48,51 %	11,80 %	75,05 %					Alg	1	0,4	40	34	58	7,16 %
31	Algo_SCORE_OL_EKO_OL	72,35 %	44,35 %	43,29 %	54,87 %	74,43 %					Alg	1	0	31	33	55	2,09 %
32	Algo_ITX_OL_APP_OL	103,98 %	57,36 %	-29,11 %	18,42 %	72,24 %	A1					1	0	39	35	63	-31,75 %
33	Algo_TELIO_OL_NAS_OL	45,28 %	63,51 %	60,60 %	58,08 %	69,29 %					Alg	1	0,8	53	32	57	5,77 %
34	Algo_CLAVIS_OL_AKSO_OL	108,74 %	41,74 %	-24,43 %	58,82 %	68,86 %	A1					1	0,3	37	40	61	-39,89 %
35	Algo_SCORE_OL_APP_OL	72,35 %	57,36 %	32,39 %	48,60 %	64,30 %	A1					1	0,3	33	30	54	-8,05 %
36	Algo_SCORE_OL_GIPS_OL	72,35 %	76,55 %	6,49 %	-20,98 %	63,85 %		A2				1	0	24	32	64	-12,70 %
37	Algo_ROGG_OL_GIPS_OL	36,93 %	76,55 %	67,76 %	37,47 %	62,69 %		A2				1	0,7	52	30	55	-13,86 %
38	Algo_NONG_OL_APP_OL	37,47 %	57,36 %	-114,30 %	-40,65 %	61,84 %					Alg	1	0,1	38	35	62	4,48 %

S6 - Overview Sorted Graph (using continuous compounding interest):

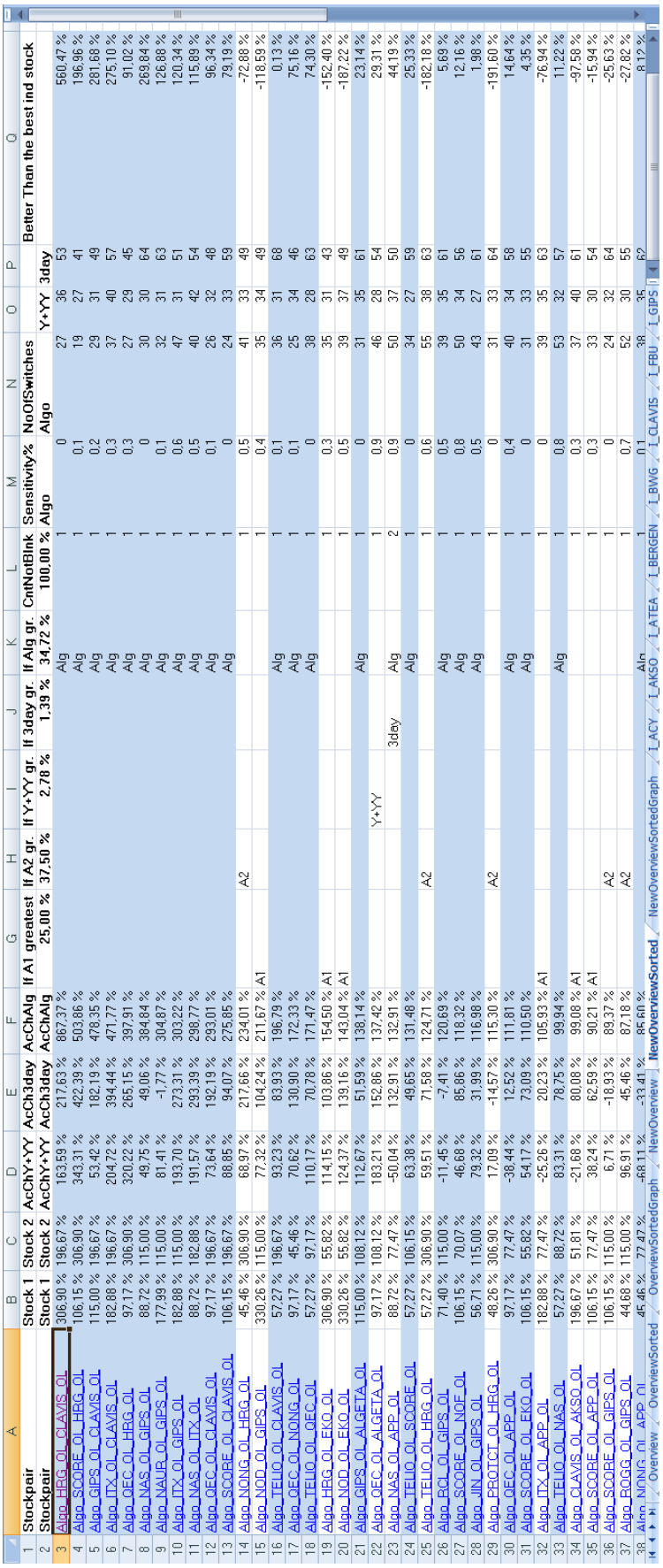


S7 – NewOverview (effective interest):



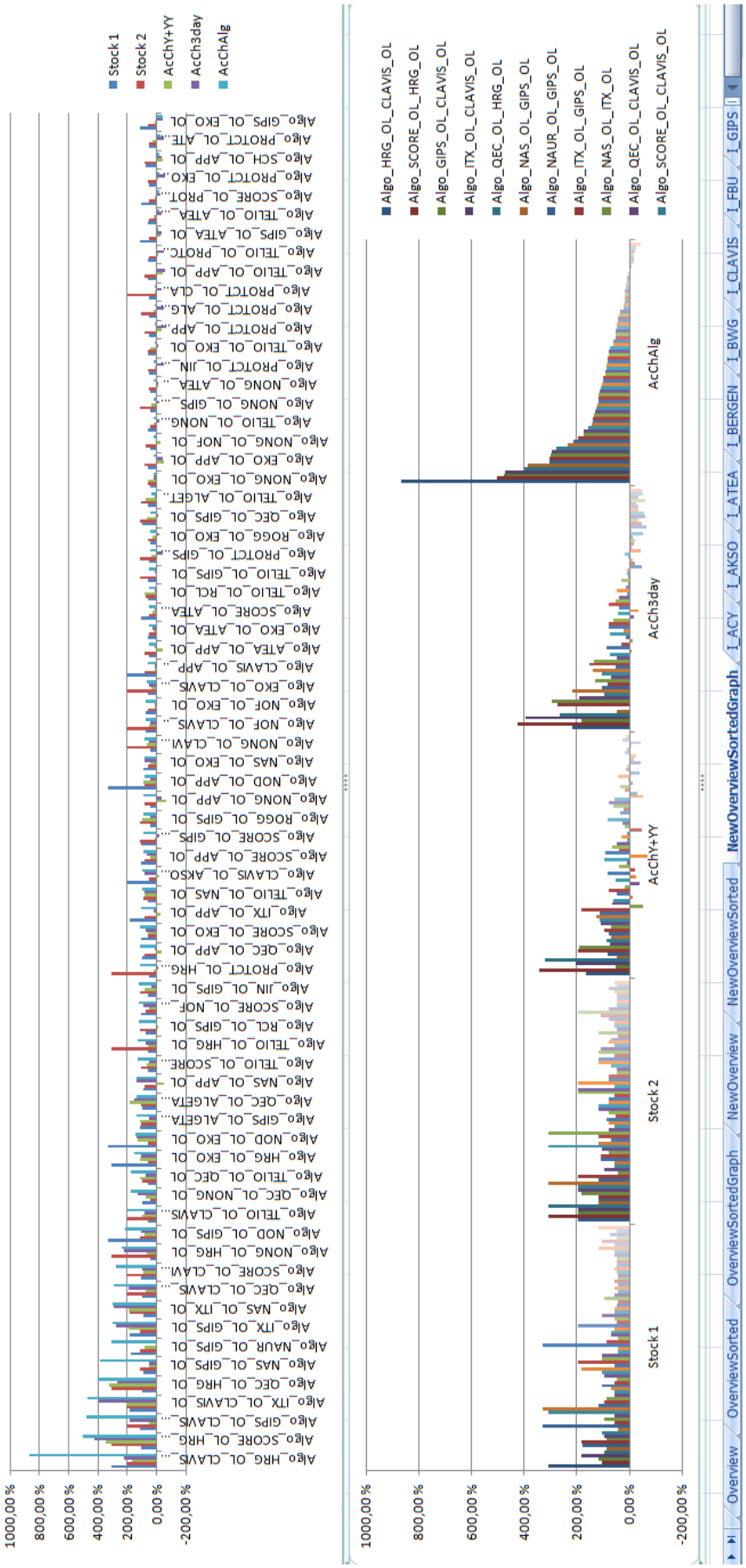
Stockpair	Stock 1	Stock 2	AcChY+YY	AcCh3day	AcChAlg	If A1 greatest 25,00 %	If A2 gr. 37,50 %	If Y+YY gr. 2,78 %	If 3day gr. 1,39 %	If Alg gr. 34,72 %	CntNotBlnk 100,00 %	Sensitivity% Algo	NoOfSwitches Algo	Y+YY	3day	Better Than the best ind stock
Algo_CLAVIS_OL_AKSO_OL	196,67 %	51,81 %	-21,68 %	80,08 %	99,08 %	A1					1	0,3	0	37	40	61	-97,58 %
Algo_GIPS_OL_ALGETA_OL	115,00 %	108,12 %	112,67 %	51,59 %	138,14 %					Alg	1	0	0	31	35	61	23,14 %
Algo_PROTCT_OL_ALGETA_OL	48,26 %	108,12 %	15,17 %	-49,55 %	7,83 %		A2				1	0,3	0	47	29	68	-100,29 %
Algo_QEC_OL_ALGETA_OL	97,17 %	108,12 %	183,21 %	152,86 %	137,42 %			Y+YY			1	0,9	0	46	28	54	29,31 %
Algo_TELIO_OL_ALGETA_OL	57,27 %	108,12 %	76,38 %	2,37 %	36,76 %		A2				1		0	38	33	73	-71,35 %
Algo_ATEA_OL_APP_OL	49,85 %	77,47 %	-47,32 %	6,47 %	53,34 %		A2				1		0	25	37	63	-24,13 %
Algo_CLAVIS_OL_APP_OL	196,67 %	77,47 %	10,54 %	13,38 %	60,81 %	A1					1		0	34	29	63	-135,88 %
Algo_EKO_OL_APP_OL	55,82 %	77,47 %	-51,08 %	-44,19 %	20,33 %		A2				1		0	38	33	66	-57,14 %
Algo_ITX_OL_APP_OL	182,88 %	77,47 %	-25,26 %	20,23 %	105,93 %	A1					1		0	39	35	63	-76,94 %
Algo_NAS_OL_APP_OL	88,72 %	77,47 %	-50,04 %	132,91 %	132,91 %				3day	Alg	2	0,9	0,6	50	37	50	44,19 %
Algo_NOD_OL_APP_OL	330,26 %	77,47 %	90,95 %	38,26 %	82,93 %	A1					1	0,6		43	27	54	-247,33 %
Algo_NONG_OL_APP_OL	45,46 %	77,47 %	-68,11 %	-33,41 %	85,60 %					Alg	1	0,1		38	35	62	8,12 %
Algo_PROTCT_OL_APP_OL	48,26 %	77,47 %	-37,56 %	-66,40 %	8,14 %		A2				1	0,1		35	33	63	-69,33 %
Algo_QEC_OL_APP_OL	97,17 %	77,47 %	-38,44 %	12,52 %	111,81 %					Alg	1	0,4		40	34	58	14,64 %
Algo_SCH_OL_APP_OL	74,55 %	77,47 %	-44,58 %	-35,52 %	-20,30 %		A2				1	0,2		33	35	60	-97,77 %
Algo_SCORE_OL_APP_OL	106,15 %	77,47 %	38,24 %	62,59 %	90,21 %	A1					1	0,3		33	30	54	-15,94 %
Algo_TELIO_OL_APP_OL	57,27 %	77,47 %	-44,63 %	-58,50 %	-5,75 %		A2				1		0	37	40	73	-83,22 %
Algo_EKO_OL_ATEA_OL	55,82 %	49,85 %	18,68 %	29,61 %	52,73 %	A1					1		0	23	36	50	-3,10 %
Algo_GIPS_OL_ATEA_OL	115,00 %	49,85 %	-27,95 %	-35,93 %	-10,41 %	A1					1	0,5		51	37	61	-125,41 %
Algo_NONG_OL_ATEA_OL	45,46 %	49,85 %	-13,25 %	-12,10 %	16,56 %		A2				1		0	40	36	66	-33,29 %
Algo_PROTCT_OL_ATEA_OL	48,26 %	49,85 %	24,93 %	-53,78 %	-25,53 %		A2				1		0	45	27	71	-75,37 %
Algo_SCORE_OL_ATEA_OL	106,15 %	49,85 %	27,76 %	4,50 %	52,56 %	A1					1		0	38	30	75	-53,60 %
Algo_TELIO_OL_ATEA_OL	57,27 %	49,85 %	15,49 %	-33,40 %	-16,58 %	A1					1		0	48	31	67	-73,85 %
Algo_EKO_OL_CLAVIS_OL	55,82 %	196,67 %	30,47 %	49,74 %	61,66 %		A2				1		0	38	40	64	-135,01 %
Algo_GIPS_OL_CLAVIS_OL	115,00 %	196,67 %	53,42 %	182,19 %	478,35 %					Alg	1	0,2		29	31	49	281,68 %
Algo_HEG_OL_CLAVIS_OL	306,90 %	196,67 %	163,59 %	217,63 %	887,37 %					Alg	1	0		27	36	53	560,47 %
Algo_ITX_OL_CLAVIS_OL	182,88 %	196,67 %	204,72 %	394,44 %	471,77 %					Alg	1	0,3		37	40	57	275,10 %
Algo_NOE_OL_CLAVIS_OL	70,07 %	196,67 %	48,38 %	39,66 %	76,61 %		A2				1	0,4		36	39	50	-120,05 %
Algo_NONG_OL_CLAVIS_OL	45,46 %	196,67 %	66,35 %	53,75 %	78,85 %		A2				1	0,4		42	34	54	-117,82 %
Algo_PROTCT_OL_CLAVIS_OL	48,26 %	196,67 %	8,59 %	-35,70 %	2,06 %		A2				1		0	25	31	67	-194,61 %
Algo_QEC_OL_CLAVIS_OL	97,17 %	196,67 %	73,64 %	192,19 %	293,01 %					Alg	1	0,1		26	32	48	96,34 %
Algo_SCORE_OL_CLAVIS_OL	106,15 %	196,67 %	88,85 %	94,07 %	275,85 %					Alg	1	0		24	33	59	79,19 %
Algo_TELIO_OL_CLAVIS_OL	57,27 %	196,67 %	93,23 %	83,93 %	196,79 %					Alg	1	0,1		36	31	68	0,13 %
Algo_GIPS_OL_EKO_OL	115,00 %	55,82 %	13,31 %	-46,51 %	-43,91 %	A1					1	0,9		65	31	65	-158,91 %
Algo_HEG_OL_EKO_OL	306,90 %	55,82 %	114,15 %	103,86 %	154,50 %	A1					1	0,3		35	31	43	-152,40 %
Algo_NAS_OL_EKO_OL	88,72 %	55,82 %	39,99 %	74,36 %	82,87 %	A1					1	0,6		50	34	58	-5,85 %

S8 – NewOverviewSorted (effective interest):



Stockpair	Stock 1	Stock 2	AcChY+YY	AcCh3day	AcChAlg	If A1 greatest	If A2 gr.	If Y+YY gr.	If 3day gr.	If Alg gr.	CntNotBlink	Sensitivity%	NoOfSwitches				Better Than the best ind stock
Stockpair	Stock 1	Stock 2	AcChY+YY	AcCh3day	AcChAlg	25,00 %	37,50 %	2,78 %	1,39 %	34,72 %	100,00 %	Algo	Algo		Y+YY	3day	
Algo_HRG_OL_CLAVIS_OL	306,90 %	196,67 %	163,59 %	217,63 %	867,37 %					Alg	1	0	0		27	36	53	560,47 %
Algo_SCORE_OL_HRG_OL	106,15 %	306,90 %	343,31 %	422,39 %	503,86 %					Alg	1	0,1	1		19	27	41	196,96 %
Algo_GIPS_OL_CLAVIS_OL	115,00 %	196,67 %	53,42 %	182,19 %	478,35 %					Alg	1	0,2	1		29	31	49	281,68 %
Algo_ITX_OL_CLAVIS_OL	182,88 %	196,67 %	204,72 %	394,44 %	471,77 %					Alg	1	0,3	1		37	40	57	275,10 %
Algo_OEC_OL_HRG_OL	97,17 %	306,90 %	320,22 %	265,15 %	397,91 %					Alg	1	0,3	1		27	29	45	91,02 %
Algo_NAS_OL_GIPS_OL	88,72 %	115,00 %	49,75 %	49,06 %	384,84 %					Alg	1	0	0		30	30	64	269,84 %
Algo_NAUR_OL_GIPS_OL	177,99 %	115,00 %	81,41 %	-1,77 %	304,87 %					Alg	1	0,1	1		32	31	63	126,88 %
Algo_ITX_OL_GIPS_OL	182,88 %	115,00 %	193,70 %	273,31 %	303,22 %					Alg	1	0,6	1		47	31	51	120,34 %
Algo_NAS_OL_ITX_OL	88,72 %	182,88 %	191,57 %	293,39 %	298,77 %					Alg	1	0,5	1		40	42	54	115,89 %
Algo_OEC_OL_CLAVIS_OL	97,17 %	196,67 %	73,64 %	192,19 %	293,01 %					Alg	1	0,1	1		26	32	48	96,34 %
Algo_SCORE_OL_CLAVIS_OL	106,15 %	196,67 %	88,85 %	94,07 %	275,85 %					Alg	1	0	0		24	33	59	79,19 %
Algo_NONG_OL_HRG_OL	45,46 %	306,90 %	68,97 %	217,66 %	234,01 %		A2				1	0,5	1		41	33	49	-72,88 %
Algo_NOD_OL_GIPS_OL	330,26 %	115,00 %	77,32 %	104,24 %	211,67 %	A1					1	0,4	1		35	34	49	-118,59 %
Algo_TELIO_OL_CLAVIS_OL	57,27 %	196,67 %	93,23 %	83,93 %	196,79 %					Alg	1	0,1	1		36	31	68	0,13 %
Algo_OEC_OL_NONG_OL	97,17 %	45,46 %	70,62 %	130,90 %	172,33 %					Alg	1	0,1	1		25	34	46	75,16 %
Algo_TELIO_OL_OEC_OL	57,27 %	97,17 %	110,17 %	70,78 %	171,47 %					Alg	1	0	0		38	28	63	74,30 %
Algo_HRG_OL_EKO_OL	306,90 %	55,82 %	114,15 %	103,86 %	154,50 %	A1					1	0,3	1		35	31	43	-152,40 %
Algo_NOD_OL_EKO_OL	330,26 %	55,82 %	124,37 %	139,16 %	143,04 %	A1					1	0,5	1		39	37	49	-187,22 %
Algo_GIPS_OL_ALGETA_OL	115,00 %	108,12 %	112,67 %	51,59 %	138,14 %					Alg	1	0	1		31	35	61	23,14 %
Algo_OEC_OL_ALGETA_OL	97,17 %	108,12 %	183,21 %	152,86 %	137,42 %			Y+YY			1	0,9	1		46	28	54	29,31 %
Algo_NAS_OL_APP_OL	88,72 %	77,47 %	-50,04 %	132,91 %	132,91 %				3day	Alg	2	0,9	1		50	37	50	44,19 %
Algo_TELIO_OL_SCORE_OL	57,27 %	106,15 %	63,38 %	49,65 %	131,48 %					Alg	1	0	1		34	27	59	25,33 %
Algo_TELIO_OL_HRG_OL	57,27 %	306,90 %	59,51 %	71,58 %	124,71 %		A2				1	0,6	1		55	38	63	-182,18 %
Algo_RCL_OL_GIPS_OL	71,40 %	115,00 %	-11,45 %	-7,41 %	120,69 %					Alg	1	0,5	1		39	35	61	5,69 %
Algo_SCORE_OL_NOF_OL	106,15 %	70,07 %	46,68 %	85,86 %	118,32 %					Alg	1	0,8	1		50	34	56	12,16 %
Algo_JIN_OL_GIPS_OL	56,71 %	115,00 %	79,32 %	31,99 %	116,98 %					Alg	1	0,5	1		43	27	61	1,98 %
Algo_PROTCT_OL_HRG_OL	48,28 %	306,90 %	17,09 %	-14,57 %	115,30 %		A2				1	0	1		31	33	64	-191,60 %
Algo_OEC_OL_APP_OL	97,17 %	77,47 %	-38,44 %	12,52 %	111,81 %					Alg	1	0,4	1		40	34	58	14,64 %
Algo_SCORE_OL_EKO_OL	106,15 %	55,82 %	54,17 %	73,09 %	110,50 %					Alg	1	0	1		31	33	55	4,35 %
Algo_ITX_OL_APP_OL	182,88 %	77,47 %	-25,26 %	20,23 %	105,93 %	A1					1	0	0		39	35	63	-76,94 %
Algo_TELIO_OL_NAS_OL	57,27 %	88,72 %	83,31 %	78,75 %	99,94 %					Alg	1	0,8	1		53	32	57	11,22 %
Algo_CLAVIS_OL_AKSO_OL	196,67 %	51,81 %	-21,68 %	80,08 %	99,08 %	A1					1	0,3	1		37	40	61	-97,58 %
Algo_SCORE_OL_APP_OL	106,15 %	77,47 %	38,24 %	62,59 %	90,21 %	A1					1	0,3	1		33	30	54	-15,94 %
Algo_SCORE_OL_GIPS_OL	106,15 %	115,00 %	6,71 %	-18,93 %	89,37 %		A2				1	0	1		24	32	64	-25,63 %
Algo_ROGG_OL_GIPS_OL	44,68 %	115,00 %	96,91 %	45,46 %	87,18 %		A2				1	0,7	1		52	30	55	-27,82 %
Algo_NONG_OL_APP_OL	45,46 %	77,47 %	69,11 %	-33,41 %	85,60 %					Alg	1	0,1	1		38	35	62	8,12 %

S9 – New Overview Sorted Graph (effective interest):



S10 – An example of an intraday sheet

	A	B	C	D	E	F	G	H	I	J
1	ACY									
2	Intraday:									
3	Info		Kjøper	Selger	Siste	Tid	Høy	Lav	Avk. % i dag	Markedsverdi (MNOK)
4			91,8	91,95	91,95	15:04	92,4	89,2	2,17 %	16 712,77
5										
6	Last movements:									
7	Dato	Pris	Volum	Kjøper	Selger					
8	15:04	91,95	400	CSB	ESO					
9	15:04	91,95	1 299	CSB	BPP					
10	15:03	91,9	543	PAS	MSI					
11	15:03	91,9	500	PAS	TMB					
12	15:03	91,9	2 176	PAS	CSB					
13	15:03	91,9	1 781	PAS	CSB					
14	15:03	91,75	435	ESO	BPP					
15	15:03	91,7	76	SGP	HQB					
16	15:03	91,7	100	SGP	HQB					
17	15:03	91,7	100	SGP	HQB					
18	15:01	91,7	700	NON	ESO					
19	15:01	91,7	100	NON	HQB					
20	15:01	91,7	572	CDV	CSB					
21	15:01	91,7	100	CDV	HQB					
22	15:01	91,7	68	NIP	UBS					
23										
24										
25										
26										
27										
28										
29										
30										
31										
32										
33										
34										
35										
36										
37										
38										

NewOverviewSorted | NewOverviewSortedGraph | I_ACY | I_AKSO | I_ATEA | I_BERGEN

S11 – Budget sheet

	A	B	C
1	Budget		
2	Total capital:		60000
3	Dayly cap to use:		30000
4	Accumulated buys:		5
5	Capital for each buy:		4075,63
6	Balance to use:		20378,16

S12 – Portfolio sheet

	A	B	C	D	E	F	G
1	Symbol	Cost	CurrentPrice	NoOfStocks	ValueNow	Gain	Column1
2	ACY_OL	234,58	108,60	0,00	0,00	-234,58	
3	AKSO_OL	56,94	91,05	0,00	0,00	-56,94	
4	ATEA_OL	12,94	46,40	0,00	0,00	-12,94	
5	BERGEN_OL	189,87	9,18	0,00	0,00	-189,87	
6	BWG_OL	157,53	16,30	0,00	0,00	-157,53	
7	CLAVIS_OL	-424,43	49,00	0,00	0,00	424,43	
8	COP_OL	20,26	39,50	0,00	0,00	-20,26	
9	EKO_OL	449,05	139,50	3,22	449,05	0,00	
10	EMGS_OL	220,38	6,48	0,00	0,00	-220,38	
11	FBU_OL	1,46	2,00	0,00	0,00	-1,46	
12	GIPS_OL	-1611,56	13,00	0,00	0,00	1611,56	
13	GSF_OL	131,87	17,80	0,00	0,00	-131,87	
14	HRG_OL	275,63	4,75	0,00	0,00	-275,63	
15	ITX_OL	-228,43	12,60	0,00	0,00	228,43	
16	NAS_OL	163,42	127,50	0,00	0,00	-163,42	
17	NAUR_OL	-184,44	14,75	0,00	0,00	184,44	
18	NOF_OL	7,00	11,80	0,00	0,00	-7,00	
19	NONG_OL	449,05	108,00	4,16	449,05	-0,00	
20	PGS_OL	27,48	64,50	0,00	0,00	-27,48	
21	QEC_OL	-91,29	22,33	0,00	0,00	91,29	
22	RCL_OL	122,75	187,00	0,00	0,00	-122,75	
23	SCORE_OL	7967,11	40,20	197,83	7952,67	-14,44	
24	SIT_OL	1604,84	8,18	195,22	1596,91	-7,94	
25	SUB_OL	69,83	111,50	0,00	0,00	-69,83	
26		**9621,84**			**10447,68**	**825,83**	**2,75 %**
27	Cash	20378,16					
28	Sum	30000,00					

S13 – News sheet

	A	B	C	D	E	F	G	H	I	J	K
1	Nøkkeltall / Valuta				Percentage changes in the perio		Gain from line 5 until today	Start	End	Yesterday	Gain today
2	OSEBX	351,1	-2,10 %		All shares	^OSEAX	14,88 %	350,8	403,01	410,47	-1,82 %
3	Dow Jones	10 203,36	-0,92 %		58 shares	^OSEBX					
4	Nasdaq	2 229,07	-1,12 %								
5											
6	Vinnere / Tapere										
7	NAM	11,84 %									
8	Navamedic	6,21 %									
9	Inmeta	4,91 %									
10	Codfarmers	4,55 %									
11											
12											
13	USD	6,47	-0,23 %								
14	EUR	7,998	0,33 %								
15	GBP	9,703	0,06 %								
16	SEK	83,35	-0,17 %								
17											
18											
19	MIS	-18,22 %									
20	Birdstep Technology	-10,77 %									
21	Polaris Media	-10,64 %									
22	Global IP Solutions	-10,34 %									
23											
24	- Må snart slippe penger fra helikopter										

S14 – The dynamically generated sheet index

There is a sheet index in both model 1 and model2 with hyperlinks to all the sheets on the workbook.

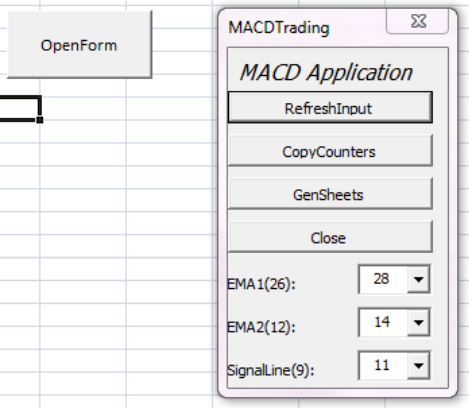
	A
1	HyperLink:FinalStockPriceQuery
2	HyperLink:XLogReturn
3	HyperLink:XAlgoTemplate
4	HyperLink:Lists2
5	HyperLink:Lists
6	HyperLink:XOverview
7	HyperLink:Budget
8	HyperLink:XOrderBook
9	HyperLink:OrderBook
10	HyperLink:OrderBookHist
11	HyperLink:Portofolio
12	HyperLink:news
13	HyperLink:LogReturn
14	HyperLink:Algo_CLAVIS_OL_AKSO_OL
15	HyperLink:Algo_GIPS_OL_ALGETA_OL
16	HyperLink:Algo_PROTCT_OL_ALGETA_OL
17	HyperLink:Algo_QEC_OL_ALGETA_OL
18	HyperLink:Algo_TELIO_OL_ALGETA_OL
19	HyperLink:Algo_ATEA_OL_APP_OL
20	HyperLink:Algo_CLAVIS_OL_APP_OL
21	HyperLink:Algo_EKO_OL_APP_OL
22	HyperLink:Algo_ITX_OL_APP_OL
23	HyperLink:Algo_NAS_OL_APP_OL
24	HyperLink:Algo_NOD_OL_APP_OL
25	HyperLink:Algo_NONG_OL_APP_OL
26	HyperLink:Algo_PROTCT_OL_APP_OL
27	HyperLink:Algo_QEC_OL_APP_OL
28	HyperLink:Algo_SCH_OL_APP_OL
29	HyperLink:Algo_SCORE_OL_APP_OL
30	HyperLink:Algo_TELIO_OL_APP_OL
31	HyperLink:Algo_EKO_OL_ATEA_OL
32	HyperLink:Algo_GIPS_OL_ATEA_OL
33	HyperLink:Algo_NONG_OL_ATEA_OL
34	HyperLink:Algo_PROTCT_OL_ATEA_OL
35	HyperLink:Algo_SCORE_OL_ATEA_OL
36	HyperLink:Algo_TELIO_OL_ATEA_OL
37	HyperLink:Algo_EKO_OL_CLAVIS_OL

38	HyperLink:Algo_GIPS_OL_CLAVIS_OL
39	HyperLink:Algo_HRG_OL_CLAVIS_OL
40	HyperLink:Algo_ITX_OL_CLAVIS_OL
41	HyperLink:Algo_NOF_OL_CLAVIS_OL
42	HyperLink:Algo_NONG_OL_CLAVIS_OL
43	HyperLink:Algo_PROTCT_OL_CLAVIS_OL
44	HyperLink:Algo_QEC_OL_CLAVIS_OL
45	HyperLink:Algo_SCORE_OL_CLAVIS_OL
46	HyperLink:Algo_TELIO_OL_CLAVIS_OL
47	HyperLink:Algo_GIPS_OL_EKO_OL
48	HyperLink:Algo_HRG_OL_EKO_OL
49	HyperLink:Algo_NAS_OL_EKO_OL
50	HyperLink:Algo_NOD_OL_EKO_OL
51	HyperLink:Algo_NOF_OL_EKO_OL
52	HyperLink:Algo_NONG_OL_EKO_OL
53	HyperLink:Algo_PROTCT_OL_EKO_OL
54	HyperLink:Algo_ROGG_OL_EKO_OL
55	HyperLink:Algo_SCORE_OL_EKO_OL
56	HyperLink:Algo_TELIO_OL_EKO_OL
57	HyperLink:Algo_ITX_OL_GIPS_OL
58	HyperLink:Algo_JIN_OL_GIPS_OL
59	HyperLink:Algo_NAS_OL_GIPS_OL
60	HyperLink:Algo_NAUR_OL_GIPS_OL
61	HyperLink:Algo_NOD_OL_GIPS_OL
62	HyperLink:Algo_NONG_OL_GIPS_OL
63	HyperLink:Algo_PROTCT_OL_GIPS_OL
64	HyperLink:Algo_QEC_OL_GIPS_OL
65	HyperLink:Algo_RCL_OL_GIPS_OL
66	HyperLink:Algo_ROGG_OL_GIPS_OL
67	HyperLink:Algo_SCORE_OL_GIPS_OL
68	HyperLink:Algo_TELIO_OL_GIPS_OL
69	HyperLink:Algo_NONG_OL_HRG_OL
70	HyperLink:Algo_PROTCT_OL_HRG_OL
71	HyperLink:Algo_QEC_OL_HRG_OL
72	HyperLink:Algo_SCORE_OL_HRG_OL
73	HyperLink:Algo_TELIO_OL_HRG_OL
74	HyperLink:Algo_NAS_OL_ITX_OL

75	HyperLink:Algo_PROTCT_OL_JIN_OL
76	HyperLink:Algo_TELIO_OL_NAS_OL
77	HyperLink:Algo_NONG_OL_NOF_OL
78	HyperLink:Algo_SCORE_OL_NOF_OL
79	HyperLink:Algo_QEC_OL_NONG_OL
80	HyperLink:Algo_TELIO_OL_NONG_OL
81	HyperLink:Algo_SCORE_OL_PROTCT_OL
82	HyperLink:Algo_TELIO_OL_PROTCT_OL
83	HyperLink:Algo_TELIO_OL_QEC_OL
84	HyperLink:Algo_TELIO_OL_RCL_OL
85	HyperLink:Algo_TELIO_OL_SCORE_OL
86	HyperLink:Overview
87	HyperLink:OverviewSorted
88	HyperLink:OverviewSortedGraph
89	HyperLink:NewOverview
90	HyperLink:NewOverviewSorted
91	HyperLink:NewOverviewSortedGraph
92	HyperLink:I_ACY
93	HyperLink:I_AKSO
94	HyperLink:I_ATEA
95	HyperLink:I_BERGEN
96	HyperLink:I_BWG
97	HyperLink:I_CLAVIS
98	HyperLink:I_FBU
99	HyperLink:I_GIPS
100	HyperLink:I_GSF
101	HyperLink:I_HRG
102	HyperLink:I_ITX
103	HyperLink:I_NAS
104	HyperLink:I_NAUR
105	HyperLink:I_NOF
106	HyperLink:I_PGS
107	HyperLink:I_QEC
108	HyperLink:I_RCL
109	HyperLink:I_SCORE
110	HyperLink:I_SIT
111	HyperLink:SheetIndex
112	

S15 – MACD – All stock sheet with menu

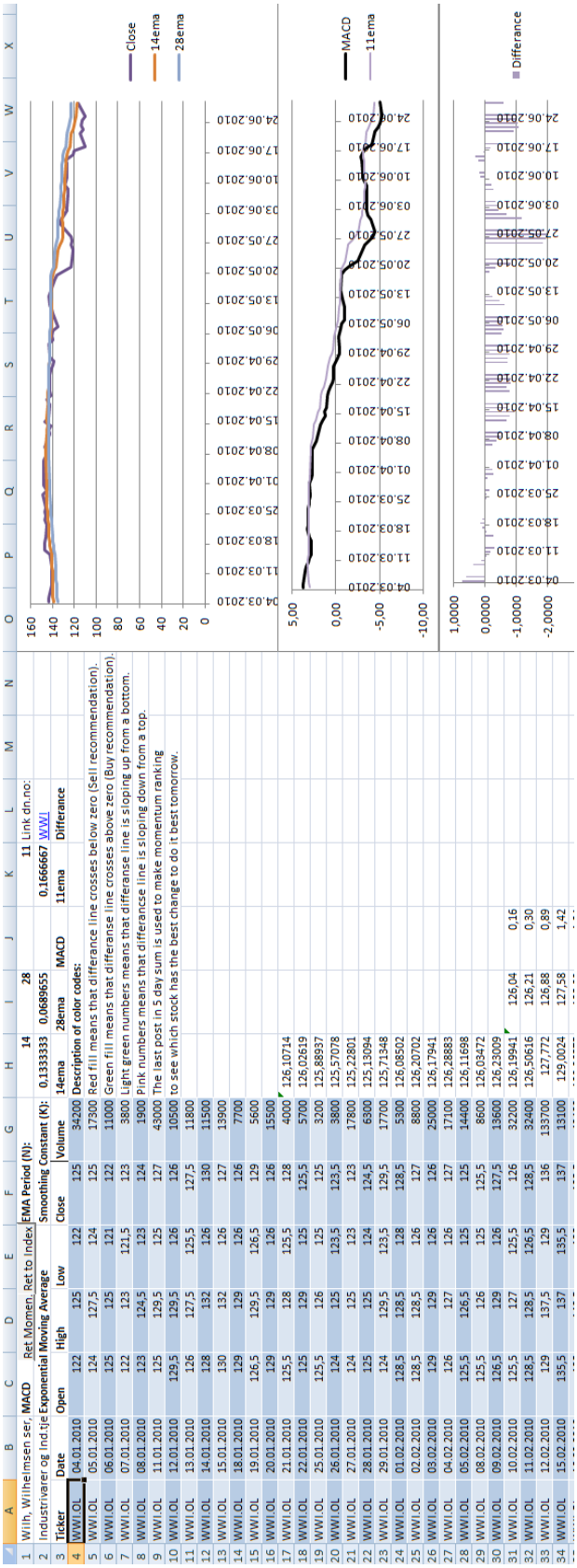
	A	B	C	D	E	F	G	H
1	Symbol	Date	Open	High	Low	Volume	Close	Adj-Close
2	ACTA.OL	04.01.2010	4,15	4,16	4,04	1169000	4,04	4,04
3	ACTA.OL	05.01.2010	4,11	4,12	3,96	1396400	4,05	4,05
4	ACTA.OL	06.01.2010	4,05	4,05	3,87	993800	3,99	3,99
5	ACTA.OL	07.01.2010	3,97	4,04	3,9	1154700	4,03	4,03
6	ACTA.OL	08.01.2010	4,04	4,09	4	1513000	4,03	4,03
7	ACTA.OL	11.01.2010	4,03	4,11	4	1565400	4,04	4,04
8	ACTA.OL	12.01.2010	4,05	4,05	3,85	1070200	3,9	3,9
9	ACTA.OL	13.01.2010	3,91	3,98	3,85	488200	3,87	3,87
10	ACTA.OL	14.01.2010	3,9	3,97	3,62	1905500	3,77	3,77
11	ACTA.OL	15.01.2010	3,77	3,8	3,7	1065500	3,7	3,7
12	ACTA.OL	18.01.2010	3,71	3,75	3,55	1203500	3,58	3,58
13	ACTA.OL	19.01.2010	3,6	3,6	3,43	1634500	3,58	3,58
14	ACTA.OL	20.01.2010	3,49	3,67	3,48	860500	3,5	3,5
15	ACTA.OL	21.01.2010	3,51	3,55	3,4	952100	3,48	3,48
16	ACTA.OL	22.01.2010	3,53	3,53	3,38	1176400	3,45	3,45
17	ACTA.OL	25.01.2010	3,42	3,8	3,35	1798300	3,78	3,78
18	ACTA.OL	26.01.2010	3,69	3,8	3,55	1449800	3,78	3,78
19	ACTA.OL	27.01.2010	3,7	3,82	3,65	682000	3,7	3,7
20	ACTA.OL	28.01.2010	3,83	3,83	3,56	708000	3,6	3,6
21	ACTA.OL	29.01.2010	3,58	3,64	3,48	1124000	3,63	3,63
22	ACTA.OL	01.02.2010	3,63	3,63	3,52	358000	3,63	3,63
23	ACTA.OL	02.02.2010	3,6	3,79	3,6	668000	3,73	3,73
24	ACTA.OL	03.02.2010	3,75	3,8	3,62	574100	3,69	3,69
25	ACTA.OL	04.02.2010	3,63	3,74	3,55	231500	3,55	3,55
26	ACTA.OL	05.02.2010	3,58	3,58	3,3	943900	3,41	3,41
27	ACTA.OL	08.02.2010	3,4	3,44	3,2	782900	3,3	3,3
28	ACTA.OL	09.02.2010	3,28	3,65	3,28	1380500	3,53	3,53
29	ACTA.OL	10.02.2010	3,59	3,59	3,4	403200	3,43	3,43
30	ACTA.OL	11.02.2010	3,48	3,64	3,48	428000	3,48	3,48
31	ACTA.OL	12.02.2010	3,5	3,5	3,35	183400	3,35	3,35
32	ACTA.OL	15.02.2010	3,35	3,5	3,25	211600	3,42	3,42
33	ACTA.OL	16.02.2010	3,49	3,52	3,36	283100	3,46	3,46
34	ACTA.OL	17.02.2010	3,46	3,46	3,15	1608400	3,22	3,22
35	ACTA.OL	18.02.2010	3,15	3,2	3,06	671500	3,1	3,1
36	ACTA.OL	19.02.2010	3,08	3,1	2,93	589000	3,1	3,1
37	ACTA.OL	22.02.2010	3,12	3,3	3	540000	3,23	3,23



S16 – MACD – Company Symbols sheet with start and end row numbers in the all stock sheet

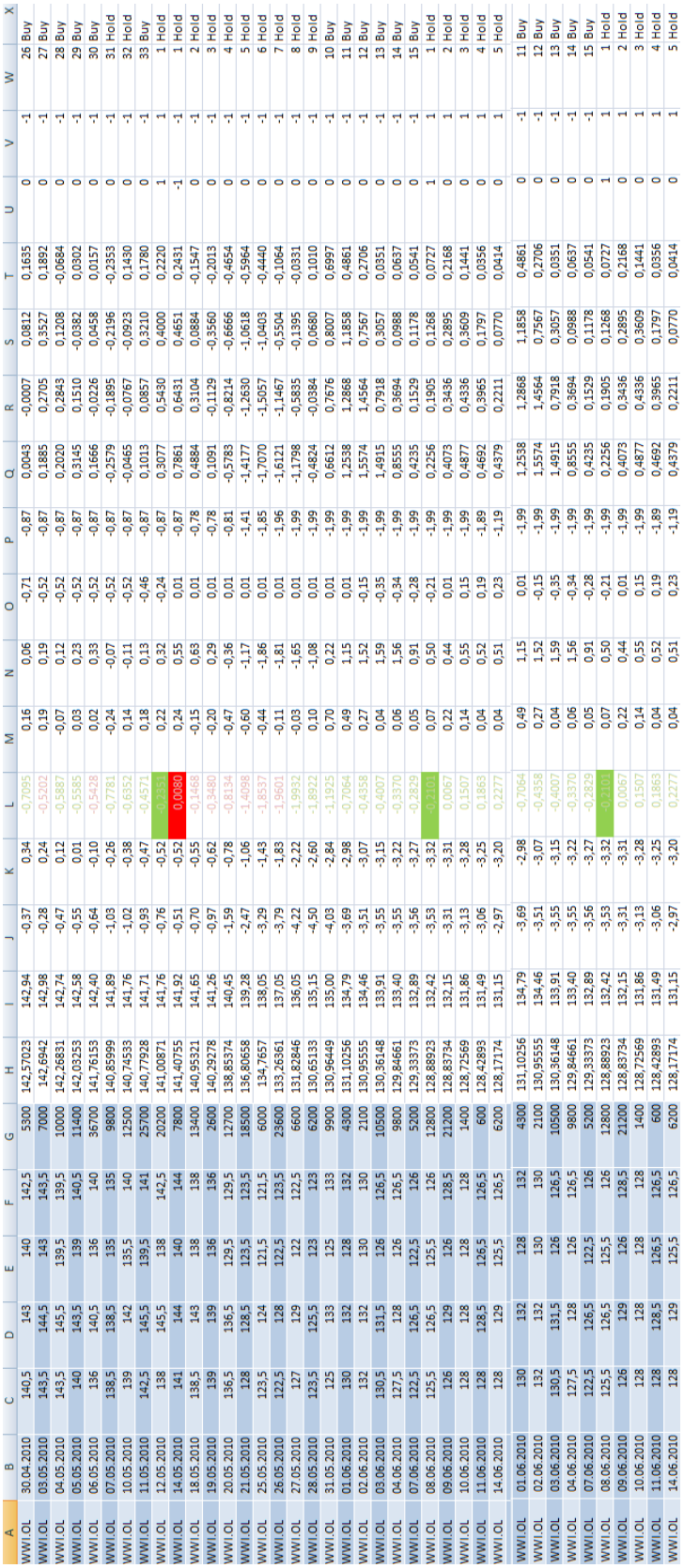
	A	B	C	D
1	Symbol	Cnt	StartRo	EndRo
2	ACTA.OL	120	2	121
3	ACY.OL	120	122	241
4	AGR.OL	120	242	361
5	AIK.OL	119	362	480
6	AKBM.OL	120	481	600
7	AKER.OL	120	601	720
8	AKS.OL	120	721	840
9	AKSO.OL	120	841	960
10	ALGETA.OL	120	961	1080
11	APP.OL	120	1081	1200
12	ASC.OL	120	1201	1320
13	ASD.OL	119	1321	1439
14	ATEA.OL	120	1440	1559
15	AUSS.OL	120	1560	1679
16	BERGEN.OL	120	1680	1799
17	BIONOR.OL	120	1800	1919
18	BIOTEC.OL	120	1920	2039
19	BIRD.OL	120	2040	2159
20	BLO.OL	120	2160	2279
21	BON.OL	120	2280	2399
22	BWG.OL	120	2400	2519
23	BWO.OL	120	2520	2639
24	CECO.OL	119	2640	2758

S17 – MACD – Example of one MACD (company) sheet – top part



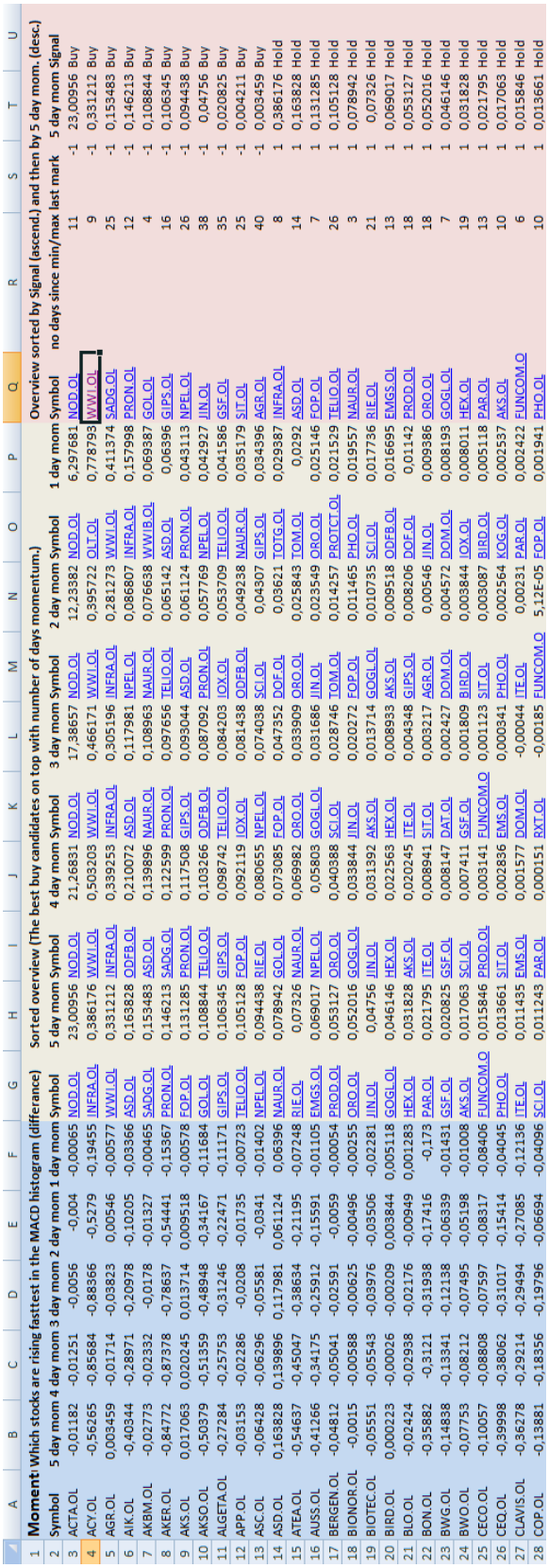
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Wilh. Wilhelmsen ser.	MACD	Ret Momen.	Ret to Index	EMA Period (N):		14		28			11	Link dn.no:	
2	Industrivarer og Ind.tje	Exponential Moving Average			Smoothing Constant (K):		0,1333333		0,0689655		0,1666667	WWI		
3	Ticker	Date	Open	High	Low	Close	Volume	14ema	28ema	MACD	11ema	Differance		
4	WWI.OL	04.01.2010	122	125	122	125	34200	Description of color codes:						
5	WWI.OL	05.01.2010	124	127,5	124	125	17300	Red fill means that differance line crosses below zero (Sell recommendation).						
6	WWI.OL	06.01.2010	125	125	121	122	11000	Green fill means that differanse line crosses above zero (Buy recommendation).						
7	WWI.OL	07.01.2010	122	123	121,5	123	3800	Light green numbers means that differanse line is sloping up from a bottom.						
8	WWI.OL	08.01.2010	123	124,5	123	124	1900	Pink numbers means that differanse line is sloping down from a top.						
9	WWI.OL	11.01.2010	125	129,5	125	127	43000	The last post in 5 day sum is used to make momentum ranking						
10	WWI.OL	12.01.2010	129,5	129,5	126	126	10500	to see which stock has the best change to do it best tomorrow.						
11	WWI.OL	13.01.2010	126	127,5	125,5	127,5	11800							
12	WWI.OL	14.01.2010	128	132	126	130	11500							
13	WWI.OL	15.01.2010	130	132	126	127	13900							
14	WWI.OL	18.01.2010	129	129	126	126	7700							
15	WWI.OL	19.01.2010	126,5	129,5	126,5	129	5600							
16	WWI.OL	20.01.2010	129	129	126	126	15500							
17	WWI.OL	21.01.2010	125,5	128	125,5	128	4000	126,10714						
18	WWI.OL	22.01.2010	125	129	125	125,5	5700	126,02619						
19	WWI.OL	25.01.2010	125,5	126	125	125	3200	125,88937						
20	WWI.OL	26.01.2010	124	125	123,5	123,5	3800	125,57078						
21	WWI.OL	27.01.2010	124	125	123	123	17800	125,22801						
22	WWI.OL	28.01.2010	125	125	124	124,5	6300	125,13094						
23	WWI.OL	29.01.2010	124	129,5	123,5	129,5	17700	125,71348						
24	WWI.OL	01.02.2010	128,5	128,5	128,5	128,5	5300	126,08502						
25	WWI.OL	02.02.2010	128,5	128,5	126	127	8800	126,20702						
26	WWI.OL	03.02.2010	129	129	126	126	25000	126,17941						
27	WWI.OL	04.02.2010	126	127	126	127	17100	126,28883						
28	WWI.OL	05.02.2010	125,5	126,5	125	125	14400	126,11698						
29	WWI.OL	08.02.2010	125,5	126	125	125,5	8600	126,03472						
30	WWI.OL	09.02.2010	126,5	129	126	127,5	13600	126,23009						
31	WWI.OL	10.02.2010	125,5	127	125,5	126	32200	126,19941	126,04	0,16				
32	WWI.OL	11.02.2010	128,5	128,5	126,5	128,5	32400	126,50616	126,21	0,30				
33	WWI.OL	12.02.2010	129	137,5	129	136	133700	127,772	126,88	0,89				
34	WWI.OL	15.02.2010	135,5	137	135,5	137	13100	129,0024	127,58	1,42				

S18 – MACD – Example of one MACD (company) sheet – bottom part



A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
WWI.OL	30.04.2010	140,5	143	140	142,5	5300	142,57023	142,94	-0,37	0,34	-0,7095	0,16	0,06	-0,71	-0,87	0,0043	-0,0007	0,0812	0,1635	0	-1	26	Buy
WWI.OL	03.05.2010	143,5	144,5	143	143,5	7000	142,6942	142,98	-0,28	0,24	-0,5202	0,19	0,19	-0,52	-0,87	0,1885	0,2705	0,3527	0,1892	0	-1	27	Buy
WWI.OL	04.05.2010	143,5	145,5	139,5	139,5	10000	142,26831	142,74	-0,47	0,12	-0,5887	-0,07	0,12	-0,52	-0,87	0,2020	0,2843	0,1208	-0,0684	0	-1	28	Buy
WWI.OL	05.05.2010	140	143,5	139	140,5	11400	142,03253	142,58	-0,55	0,01	-0,5585	0,03	0,23	-0,52	-0,87	0,3145	0,1510	-0,0382	0,0302	0	-1	29	Buy
WWI.OL	06.05.2010	136	140,5	136	140	36700	141,76153	142,40	-0,64	-0,10	-0,5428	0,02	0,33	-0,52	-0,87	0,1666	-0,0226	0,0458	0,0157	0	-1	30	Buy
WWI.OL	07.05.2010	138,5	138,5	135	135	9800	140,85999	141,89	-1,03	-0,26	-0,7781	-0,24	-0,07	-0,52	-0,87	-0,2579	-0,1895	-0,2196	-0,2353	0	-1	31	Hold
WWI.OL	10.05.2010	139	142	135,5	140	12500	140,74533	141,76	-1,02	-0,38	-0,6352	0,14	-0,11	-0,52	-0,87	-0,0465	-0,0767	-0,0923	0,1430	0	-1	32	Hold
WWI.OL	11.05.2010	142,5	145,5	139,5	141	25700	140,77928	141,71	-0,93	-0,47	-0,4571	0,18	0,13	-0,46	-0,87	0,1013	0,0857	0,3210	0,1780	0	-1	33	Buy
WWI.OL	12.05.2010	138	145,5	138	142,5	20200	141,00871	141,76	-0,76	-0,52	-0,2351	0,22	0,32	-0,24	-0,87	0,3077	0,5430	0,4000	0,2220	1	1	1	Hold
WWI.OL	14.05.2010	141	144	140	144	7800	141,40755	141,92	-0,51	-0,52	0,0080	0,24	0,55	0,01	-0,87	0,7861	0,6431	0,4651	0,2431	-1	-1	1	Hold
WWI.OL	18.05.2010	138,5	143	138	138	13400	140,95321	141,65	-0,70	-0,55	-0,1468	-0,15	0,63	0,01	-0,78	0,4884	0,3104	0,0884	-0,1547	0	-1	2	Hold
WWI.OL	19.05.2010	139	139	136	136	2600	140,29278	141,26	-0,97	-0,62	-0,3480	-0,20	0,29	0,01	-0,78	0,1091	-0,1129	-0,3560	-0,2013	0	-1	3	Hold
WWI.OL	20.05.2010	136,5	136,5	129,5	129,5	12700	138,85374	140,45	-1,59	-0,78	-0,8134	-0,47	-0,36	0,01	-0,81	-0,5783	-0,8214	-0,6666	-0,4654	0	-1	4	Hold
WWI.OL	21.05.2010	128	128,5	123,5	123,5	18500	136,80658	139,28	-2,47	-1,06	-1,4098	-0,60	-1,17	0,01	-1,41	-1,4177	-1,2630	-1,0618	-0,5964	0	-1	5	Hold
WWI.OL	25.05.2010	123,5	124	121,5	121,5	6000	134,7657	138,05	-3,29	-1,43	-1,8537	-0,44	-1,86	0,01	-1,85	-1,7070	-1,5057	-1,0403	-0,4440	0	-1	6	Hold
WWI.OL	26.05.2010	122,5	128	122,5	123,5	23600	133,26361	137,05	-3,79	-1,83	-1,9601	-0,11	-1,81	0,01	-1,96	-1,6121	-1,1467	-0,5504	-0,1064	0	-1	7	Hold
WWI.OL	27.05.2010	127	129	122	122,5	6600	131,82846	136,05	-4,22	-2,22	-1,9932	-0,03	-1,65	0,01	-1,99	-1,1798	-0,5835	-0,1395	-0,0331	0	-1	8	Hold
WWI.OL	28.05.2010	123,5	125,5	123	123	6200	130,65133	135,15	-4,50	-2,60	-1,8922	0,10	-1,08	0,01	-1,99	-0,4824	-0,0384	0,0680	0,1010	0	-1	9	Hold
WWI.OL	31.05.2010	125	133	125	133	9900	130,96449	135,00	-4,03	-2,84	-1,1925	0,70	0,22	0,01	-1,99	0,6612	0,7676	0,8007	0,6997	0	-1	10	Buy
WWI.OL	01.06.2010	130	132	128	132	4300	131,10256	134,79	-3,69	-2,98	-0,7064	0,49	1,15	0,01	-1,99	1,2538	1,2868	1,1858	0,4861	0	-1	11	Buy
WWI.OL	02.06.2010	132	132	130	130	2100	130,95555	134,46	-3,51	-3,07	-0,4358	0,27	1,52	-0,15	-1,99	1,5574	1,4564	1,3609	0,1441	0	1	3	Hold
WWI.OL	03.06.2010	130,5	131,5	126	126,5	10500	130,36148	133,91	-3,55	-3,15	-0,4007	0,04	1,59	-0,35	-1,99	1,4915	1,3694	0,0988	0,0637	0	-1	14	Buy
WWI.OL	04.06.2010	127,5	128	126	126,5	9800	129,84661	133,40	-3,55	-3,22	-0,3370	0,06	1,56	-0,34	-1,99	0,8555	0,3694	0,0988	0,0637	0	-1	14	Buy
WWI.OL	07.06.2010	122,5	126,5	122,5	126	5200	129,33373	132,89	-3,56	-3,27	-0,2829	0,05	0,91	-0,28	-1,99	0,4235	0,1529	0,1178	0,0541	0	-1	15	Buy
WWI.OL	08.06.2010	125,5	126,5	125,5	126	12800	128,88923	132,42	-3,53	-3,32	-0,2103	0,07	0,50	-0,21	-1,99	0,2256	0,1905	0,1268	0,0727	1	1	1	Hold
WWI.OL	09.06.2010	126	129	126	128,5	21200	128,83734	132,15	-3,31	-3,31	0,0067	0,22	0,44	0,01	-1,99	0,4073	0,3436	0,2895	0,2168	0	1	2	Hold
WWI.OL	10.06.2010	128	128	128	128	1400	128,72569	131,86	-3,13	-3,28	0,1507	0,14	0,55	0,15	-1,99	0,4877	0,4336	0,3609	0,1441	0	1	3	Hold
WWI.OL	11.06.2010	128	128,5	126,5	126,5	600	128,42893	131,49	-3,06	-3,25	0,1863	0,04	0,52	0,19	-1,89	0,4692	0,3965	0,1797	0,0356	0	1	4	Hold
WWI.OL	14.06.2010	128	129	125,5	126,5	6200	128,17174	131,15	-2,97	-3,20	0,2277	0,04	0,51	0,23	-1,19	0,4379	0,2211	0,0770	0,0414	0	1	5	Hold

S19 – MACD – Momentum sheet (Overview sheet)



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	**Moment**	**Which stocks are rising fasttest in the MACD histogram (differance)**						**Sorted overview (The best buy candidates on top with number of days momentum.)**									**Overview sorted by Signal (ascend.) and then by 5 day mom. (desc.)**				
2	**Symbol**	**5 day mom**	**4 day mom**	**3 day mom**	**2 day mom**	**1 day mom**	**Symbol**	**5 day mom**	**Symbol**	**4 day mom**	**Symbol**	**3 day mom**	**Symbol**	**2 day mom**	**Symbol**	**1 day mom**	**Symbol**	**no days since min/max**	**last mark**	**5 day mom**	**Signal**
3	ACTA.OL	-0,01182	-0,01251	-0,0056	-0,004	-0,00065	NOD.OL	23,00956	NOD.OL	21,26831	NOD.OL	17,38657	NOD.OL	12,23382	NOD.OL	6,297681	NOD.OL	11	-1	23,00956	Buy
4	ACY.OL	-0,56265	-0,85684	-0,88366	-0,5279	-0,19455	INFRA.OL	0,386176	WWI.OL	0,503203	WWI.OL	0,466171	WWI.OL	0,395722	OLT.OL	0,778793	WWI.OL	9	-1	0,3312212	Buy
5	AGR.OL	0,003459	-0,01714	-0,03823	0,00546	-0,00577	WWI.OL	0,331212	INFRA.OL	0,339253	INFRA.OL	0,305196	INFRA.OL	0,281273	WWI.OL	0,411374	SADG.OL	25	-1	0,1534833	Buy
6	AIK.OL	-0,40344	-0,28971	-0,20978	-0,10205	-0,03366	ASD.OL	0,163828	ODFB.OL	0,210072	ASD.OL	0,117981	NPEL.OL	0,086807	INFRA.OL	0,157998	PRON.OL	12	-1	0,1462133	Buy
7	AKBM.OL	-0,02773	-0,02332	-0,0178	-0,01327	-0,00465	SADG.OL	0,153483	ASD.OL	0,139896	NAUR.OL	0,108963	NAUR.OL	0,076638	WWIB.OL	0,069387	GOL.OL	4	-1	0,1088444	Buy
8	AKER.OL	-0,84772	-0,87378	-0,78637	-0,54441	-0,15367	PRON.OL	0,146213	SADG.OL	0,122599	PRON.OL	0,097656	TELIO.OL	0,065142	ASD.OL	0,06396	GIPS.OL	16	-1	0,1063453	Buy
9	AKS.OL	0,017063	0,020245	0,013714	0,009518	-0,00578	FOP.OL	0,131285	PRON.OL	0,117508	GIPS.OL	0,093044	ASD.OL	0,061124	PRON.OL	0,043113	NPEL.OL	26	-1	0,0944382	Buy
10	AKSO.OL	-0,50379	-0,51359	-0,48948	-0,34167	-0,11684	GOL.OL	0,108844	TELIO.OL	0,103266	ODFB.OL	0,087092	PRON.OL	0,057769	NPEL.OL	0,042927	JIN.OL	38	-1	0,04756	Buy
11	ALGETA.OL	-0,27284	-0,25753	-0,31246	-0,22471	-0,11171	GIPS.OL	0,106345	GIPS.OL	0,098742	TELIO.OL	0,084203	IOX.OL	0,053709	TELIO.OL	0,041586	GSF.OL	35	-1	0,0208253	Buy
12	APP.OL	-0,03153	-0,02286	-0,0208	-0,01735	-0,00723	TELIO.OL	0,105128	FOP.OL	0,092119	IOX.OL	0,081438	ODFB.OL	0,049238	NAUR.OL	0,035179	SIT.OL	25	-1	0,0042113	Buy
13	ASC.OL	-0,06428	-0,06296	-0,05581	-0,0341	-0,01402	NPEL.OL	0,094438	RIE.OL	0,080655	NPEL.OL	0,074038	SCI.OL	0,04307	GIPS.OL	0,034396	AGR.OL	40	-1	0,0034593	Buy
14	ASD.OL	0,163828	0,139896	0,117981	0,061124	0,06396	NAUR.OL	0,078942	GOL.OL	0,073085	FOP.OL	0,047352	DOF.OL	0,03621	TOTG.OL	0,029387	INFRA.OL	8	1	0,3861763	Hold
15	ATEA.OL	-0,54637	-0,45047	-0,38634	-0,21195	-0,07248	RIE.OL	0,07326	NAUR.OL	0,069982	ORO.OL	0,033909	ORO.OL	0,025843	TOM.OL	0,0292	ASD.OL	14	1	0,1638284	Hold
16	AUSS.OL	-0,41266	-0,34175	-0,25912	-0,15591	-0,01105	EMGS.OL	0,069017	NPEL.OL	0,05803	GOGL.OL	0,031686	JIN.OL	0,023549	ORO.OL	0,025146	FOP.OL	7	1	0,1312851	Hold
17	BERGEN.OL	-0,04812	-0,05041	-0,02591	-0,0059	-0,00054	PROD.OL	0,053127	ORO.OL	0,040388	SCI.OL	0,028746	TOM.OL	0,014257	PROTCT.OL	0,021529	TELIO.OL	26	1	0,1051284	Hold
18	BIONOR.OL	-0,0015	-0,00588	-0,00625	-0,00496	-0,00255	ORO.OL	0,052016	GOGL.OL	0,033844	JIN.OL	0,020272	FOP.OL	0,011465	PHO.OL	0,019557	NAUR.OL	3	1	0,0789422	Hold
19	BIOTEC.OL	-0,05551	-0,05543	-0,03976	-0,03506	-0,02281	JIN.OL	0,04756	JIN.OL	0,031392	AKS.OL	0,013714	GOGL.OL	0,010735	SCI.OL	0,017736	RIE.OL	21	1	0,07326	Hold
20	BIRD.OL	0,000223	-0,00026	-0,00209	0,003844	0,005118	GOGL.OL	0,046146	HEX.OL	0,022563	HEX.OL	0,008933	AKS.OL	0,009518	ODFB.OL	0,016695	EMGS.OL	13	1	0,0690172	Hold
21	BLO.OL	-0,02424	-0,02938	-0,02176	-0,00949	0,001283	HEX.OL	0,031828	AKS.OL	0,020245	ITE.OL	0,004348	GIPS.OL	0,008206	DOF.OL	0,01142	PROD.OL	18	1	0,0531272	Hold
22	BON.OL	-0,35882	-0,3121	-0,31938	-0,17416	-0,173	PAR.OL	0,021795	ITE.OL	0,008941	SIT.OL	0,003217	AGR.OL	0,00546	JIN.OL	0,009386	ORO.OL	18	1	0,0520161	Hold
23	BWG.OL	-0,14838	-0,13341	-0,12138	-0,06339	-0,01431	GSF.OL	0,020825	GSF.OL	0,008147	DAT.OL	0,002427	DOM.OL	0,004572	DOM.OL	0,008193	GOGL.OL	7	1	0,0461463	Hold
24	BWO.OL	-0,07753	-0,08212	-0,07495	-0,05198	-0,01008	AKS.OL	0,017063	SCI.OL	0,007411	GSF.OL	0,001809	BIRD.OL	0,003844	IOX.OL	0,008011	HEX.OL	19	1	0,0318283	Hold
25	CECO.OL	-0,10057	-0,08808	-0,07597	-0,08317	-0,08406	FUNCOM.O	0,015846	PROD.OL	0,003141	FUNCOM.O	0,001123	SIT.OL	0,003087	BIRD.OL	0,005118	PAR.OL	13	1	0,0217952	Hold
26	CEQ.OL	-0,39998	-0,38062	-0,31017	-0,15414	-0,04045	PHO.OL	0,013661	SIT.OL	0,002836	EMS.OL	0,000341	PHO.OL	0,002564	KOG.OL	0,002537	AKS.OL	10	1	0,0170631	Hold
27	CLAVIS.OL	-0,36278	-0,29214	-0,29494	-0,27085	-0,12136	ITE.OL	0,011435	EMS.OL	0,001577	DOM.OL	-0,00044	ITE.OL	0,00231	PAR.OL	0,002422	FUNCOM.O	6	1	0,0158463	Hold
28	COP.OL	-0,13881	-0,18356	-0,19796	-0,06694	-0,04096	SCI.OL	0,011243	PAR.OL	0,000151	RXT.OL	-0,00185	FUNCOM.O	5,12E-05	FOP.OL	0,001941	PHO.OL	10	1	0,0136611	Hold

VBA-code Appendix:

V1 - VBA – code behind the form of Jyri's pair trading application

```
Private Sub DeleteColumnsButton_Click()
   Call DeleteColumns
End Sub
Private Sub FileSaveButton_Click()
   Call fileSave
End Sub
Private Sub LoadDataButton_Click()
   Call LoadData
End Sub
Private Sub RefreshFromAccessButton_Click()
   Call RefreshFromAccess
End Sub
Private Sub CreateLogReturnSheetButton_Click()
   Call CreateLogReturnSheet
End Sub
Private Sub CreateMarkedCombinationsButton_Click()
   Call ShowMarkedCombinations
End Sub
Private Sub MakeIntradaySheetsButton_Click()
   Call MakeIntradaySheets
End Sub
Private Sub CreateOrderBookButton_Click()
   Call CreateOrderBook
End Sub
Private Sub UpdateOrderBookHistoryButton_Click()
   Call UpdateOrderBookHistory
End Sub
Private Sub CloseButton_Click()
   Unload Me
End Sub
Private Sub UserForm_QueryClose(Cancel As Integer, _
   CloseMode As Integer)
   If CloseMode = vbFormControlMenu Then
     Cancel = True
     MsgBox "Please use the button!"
   End If
End Sub
```

V2 - VBA – code in Module 1 of Jyri's pair trading application

```
'Collection of subrutines and functions to make dataanalysis more effecient
'You start with a sheet imported from Access with crosstabulated data
'You must manually make the LogReturn sheet or you can copy a "template" from an other
'You must also have to templates called XAlgoTemplate and XOverview at this workbook
'
'The main routine for analysis is ShowMarkedCombinations which call a number of other subroutines and
functions
'Before you run it you must make a LogReturn sheet based on DataInputSheet whith a correlation table below
'In between logreturn table and correlation table there must be following field and groups of fields
'   Sum logreturn for the data with a "lower limit" logreturn field (input-field) at the right hand side
'   Just below that on the left side you must have a field called correlation limit (input-field).
'Both of these fields are used in this subroutine called ShowMarkedCombinations which goes through the
'colorcoded fields and produses an so called Algo-sheet for each of them.
'At the end it produses an Overview sheet and an Sorted Overview to make it possible to compare the different
```

```
'results from all the Algo-sheets.
'
'Writen by Jyri Egil Larikka in Stavanger, Norway in Feb-May 2010
'
Option Explicit
Option Base 1

Dim logretrange As Variant, corrstartpos  As Variant, corrrange As Variant
Dim sumlogretlim As Variant
Dim corrfield As Variant, corrlim As Variant
Dim sumcol As Variant, compcol As Variant, corrlastcol As Variant
Dim corrstartnoH As Integer, corrstartnoD As Integer, correndno As Integer
Dim sumrow As Variant, maxalgosheetrow As Integer
Dim combcounter As Integer, maxdatacol As Variant
Dim IMPnorows As Integer, IMPnocols As Integer
Dim IMPnocolsLR As Integer
Dim zerorowno As Integer, sumrowno As Integer, corrlimno As Integer
Dim RunIndicator As Integer 'Used to make sure that countrowsandcolumnsLR only counts the columns first
time with initial logretdata
Dim MaxNoOfFollowingDaysZeroChange As Integer
'Private Declare Sub Sleep Lib "kernel32" (ByVal dwMilliseconds As Long)
'Private Declare Sub AppSleep Lib "kernel32" Alias "Sleep" (ByVal dwMilliseconds As Long)

Sub countrowsandcolumns()
   Dim i As Integer, j As Integer, areaCount As Integer, a As Areas
   Sheets("FinalStockPriceQuery").Select
   Range("Table_JyriIndexM.accdb3").Select
   'Range("D34").Activate
   areaCount = Selection.Areas.Count
   If areaCount <= 1 Then
   '    MsgBox "The selection contains " & _
   '       Selection.Rows.Count & " rows."
   '    MsgBox "The selection contains " & _
   '       Selection.Columns.Count & " columns."
         IMPnorows = Selection.Rows.Count
         IMPnocols = Selection.Columns.Count
   Else
      i = 1
      For Each a In Selection.Areas
         MsgBox "Area " & i & " of the selection contains " & _
            a.Rows.Count & " rows."
         i = i + 1
      Next a
   End If
End Sub
Sub countrowsandcolumnsLR()
   Dim i As Integer, j As Integer, areaCount As Integer, a As Areas
   Sheets("LogReturn").Select
   Range("A3").Select
   Range("A3").Activate
   Range(Selection, Selection.End(xlToRight)).Select
   areaCount = Selection.Areas.Count
   If areaCount <= 1 Then
    '   MsgBox "The selection contains " & _
   '       Selection.Rows.Count & " rows."
    '   MsgBox "The selection contains " & _
```

```
    '      Selection.Columns.Count & " columns."
           IMPnocolsLR = Selection.Columns.Count
    Else
       i = 1
       For Each a In Selection.Areas
          MsgBox "Area " & i & " of the selection contains " & _
             a.Rows.Count & " rows."
          i = i + 1
       Next a
    End If
End Sub
Sub start()
    Call countrowsandcolumns
    Application.OnKey "^m", "StartFormButton_Click"
    'Gives values to global variables
    If RunIndicator = 0 Then
       Call countrowsandcolumnsLR
       RunIndicator = 1
       combcounter = 0
    End If
    MaxNoOfFollowingDaysZeroChange = Range("Lists!g9") ' Used by eliminating process
    zerorowno = IMPnorows + 2
    maxalgosheetrow = IMPnorows + 3 'Tre større i forhold til datasheet ikke logreturnsheet
    sumrowno = IMPnorows + 3
    corrlimno = IMPnorows + 4
    corrstartnoH = IMPnorows + 5
    corrstartnoD = IMPnorows + 6
    corrlim = "B" & corrlimno
    sumrow = "A" & sumrowno                    'Used in giving bold formatting to sum row
    correndno = corrstartnoD + IMPnocolsLR - 2
    sumcol = ColNo2ColRef(IMPnocolsLR + 1)
    compcol = ColNo2ColRef(IMPnocolsLR + 2) 'refers to the column right most with the tickernames
    corrlastcol = ColNo2ColRef(IMPnocolsLR)
    corrstartpos = "LogReturn!$A$" & corrstartnoH          'Used in correlation table creation
    logretrange = "LogReturn!$B$2:$" & corrlastcol & "$" & corrstartnoH - 4 'Used in correlation table creation
    corrfield = "B" & corrstartnoD                  'Used in conditional formatting
    corrrange = corrfield & ":" & corrlastcol & correndno   'Used in conditional formatting
    maxdatacol = ColNo2ColRef(IMPnocols)                'Used in eliminating columns
    sumlogretlim = "$" & sumcol & "$" & sumrowno       'Used in conditional formatting and marked
combinations
    combcounter = Range("Lists!m2") 'new test how this works
End Sub
Sub MakeBatFile()
'Makes a bat file to run to different dos commands i one sheell session
    Dim Myfile As Variant, fnum As Variant
    Dim FromDate As Double
    Dim ProgLocation As Variant
    FromDate = Range("Lists!n36").Value
'    MyFile = "C:\Users\Jyri\Documents\Jyris etterutdanning 2\Masteroppgave\Regneark\Jyris Regresjon\" &
"HSQcall.bat"
    Myfile = Range("Lists2!c7").Value & "HSQcall.bat"
    ProgLocation = Range("Lists2!c11").Value
    fnum = FreeFile()

    Open Myfile For Output As fnum
'    Print #fnum, "cd C:\Program Files (x86)\HSQuote V1"
```

```
    Print #fnum, "cd " & ProgLocation
    Print #fnum, "Quote.exe -t JyrisIndexM.tic -d -a -ns -nc -from " & FromDate
    Close #fnum
End Sub
Sub LoadData()
'Calls HSQuote application to collect data to text file
    Dim RetVal
    Dim FromDate As Double
    Dim Myfile As Variant
    Call MakeBatFile
    Myfile = Range("Lists2!c7").Value & "HSQcall.bat"
   ' RetVal = Shell("C:\Users\Jyri\Documents\Jyris etterutdanning 2\Masteroppgave\Regneark\Jyris
Regresjon\HSQcall.bat")
    RetVal = Shell(Myfile)
End Sub
Sub ShowMarkedCombinations()
If Range("Lists!m2") < 5 Then
    MsgBox ("Too few combinations with " & Range("Lists!m2") & " combinations. It has to be higher than 5.")
   Else
    Call start
    MsgBox "This procedure takes few minutes. Finish message at end."
    Call listworksheetsOnlyAlgoToDeleteSheets 'Rydder vekk før den lager nye
    Call JustifyCorrelationFormulas 'Prepares XAlgoTemplate for the number of lookbackdays

    Sheets("LogReturn").Select
    Dim rowrng As Range, colrng As Range, compNameRowRng As Range, compNameColRng As Range, corrrng
As Range
    Dim i As Integer, j As Integer  'rowcounter and columncounter
    Dim col1 As String, col2 As String ' column letter
    Dim Comp1 As String, Comp2 As String 'cell value
    Dim SumReturnLimit As Double, CorrLimit As Double, RcD As Double
    'combcounter As Integer

    SumReturnLimit = Range(sumlogretlim).Value
    CorrLimit = Range(corrlim).Value

    Set rowrng = Range("B" & sumrowno & ":" & corrlastcol & sumrowno)
    Set compNameRowRng = Range("B" & corrstartnoH & ":" & corrlastcol & corrstartnoH)

    Set colrng = Range(sumcol & corrstartnoD & ":" & sumcol & correndno)
    Set compNameColRng = Range(compcol & corrstartnoD & ":" & compcol & correndno)

    Set corrrng = Range("B" & corrstartnoD & ":" & corrlastcol & correndno)

    combcounter = 0
    'i is rowcounter and
    'j is colcounter

     For i = 1 To IMPnocolsLR - 1 'En mindre for å ikke telle med tickerkolonnen
       For j = 1 To IMPnocolsLR - 1
          If rowrng(i) > Range(sumlogretlim).Value Then
             If colrng(j) > Range(sumlogretlim).Value Then
'               If Abs(corrrng(j, i)) < Range(corrlim).Value Then
                If corrrng(j, i) < Range(corrlim).Value Then
'                  If Abs(corrrng(j, i)) <> 0 Then
                   If corrrng(j, i) <> 0 Then
```

```
'                   If Abs(corrrng(j, i)) <> "" Then
                    If corrrng(j, i) <> "" Then
'                     If Abs(corrrng(j, i)) <> 1 Then
                      If corrrng(j, i) <> 1 Then
                            Comp1 = compNameRowRng(i).Value
                            Comp2 = compNameColRng(j).Value
                            col1 = ColNo2ColRef(i + 1)
                            col2 = ColNo2ColRef(j + 1)
                            RcD = corrrng(j, i)

                           ' Range(ColNo2ColRef(i + 1) & j + corrstartnoH).Select

                            combcounter = combcounter + 1
                           ' MsgBox "Comp1: " & Comp1 & " Comp2: " & Comp2 & _
                           ' " col1: " & col1 & " col2: " & col2 & _
                           ' " Rcd: " & RcD & " i: " & i & " j: " & j

                            Call CopyAlgoSheet(col1, col2, Comp1, Comp2)
                            Calculate
                             'Må aktivere LogReturn sheeten før den begynner på neste loop med
korrelasjonstabellen som utgangspunkt.
                            Sheets("LogReturn").Select
                      End If
                    End If
                  End If
                End If
              End If
            End If
          Next j
        Next i
       'MsgBox "Teller etterpa: " & combcounter
       Range("LogReturn!$" & sumcol & "$" & corrlimno) = combcounter
       Range("Lists!m2") = combcounter
       Range("LogReturn!$" & compcol & "$" & corrlimno) = "Number of combinations"
       'Makes them bold
       Range("LogReturn!$" & sumcol & "$" & corrlimno).Select
       Selection.Font.Bold = True
       Range("LogReturn!$" & compcol & "$" & corrlimno).Select
       Selection.Font.Bold = True
'      Calculate
       Call listworksheetsOnlyAlgoToMakeCopyDates   'Kopierer datokolonnen fra logreturn sheet til algosheet
'      Calculate
       Call listworksheetsOnlyAlgoToCorrectSumming  'Corrects the summing according to number of daterows
       Calculate
       Call listworksheetsOnlyAlgoToMakeCorrLimit   'Finner optimale korrelation limit til hver worksheet
'      Calculate
       Call listworksheetsOnlyAlgoToMakeGraph       'Lager grapher
      ' Calculate
       Call listworksheetsOnlyAlgoToMakeOverview    'Makes overview sheet at the end
     '  Calculate
       Call OverviewPrepare
'      Calculate
       Call newListworksheetsOnlyAlgoToMakeOverview    'Makes overview sheet at the end
'      Calculate
       Call newOverviewPrepare
       Calculate
```

```
    Call listworksheetsToCleanup
    Call MakeSheetIndex
  '  Call FileSaveAsParameters
  '  Call FileSaveAsWorkingCopy
    MsgBox "Procedure finished"
   End If
End Sub
Sub Corr_Styling(shname As Variant)
    Range(shname & "!A21:B21").Select
    Range(Selection, Selection.End(xlDown)).Select
    With Selection.Font
        .Name = "Calibri"
        .Size = 10
        .Strikethrough = False
        .Superscript = False
        .Subscript = False
        .OutlineFont = False
        .Shadow = False
        .Underline = xlUnderlineStyleNone
        .ColorIndex = xlAutomatic
        .TintAndShade = 0
        .ThemeFont = xlThemeFontMinor
    End With
    Range(shname & "!D21").Select
    Range(Selection, Selection.End(xlDown)).Select
    With Selection.Font
        .Name = "Calibri"
        .Size = 10
        .Strikethrough = False
        .Superscript = False
        .Subscript = False
        .OutlineFont = False
        .Shadow = False
        .Underline = xlUnderlineStyleNone
        .ColorIndex = xlAutomatic
        .TintAndShade = 0
        .ThemeFont = xlThemeFontMinor
    End With
    With Selection.Interior
        .Pattern = xlSolid
        .PatternColorIndex = xlAutomatic
        .Color = 11387121
        .TintAndShade = 0
        .PatternTintAndShade = 0
    End With
    Range(shname & "!D21").Select
    Range(Selection, Selection.End(xlDown)).Select
    With Selection.Interior
        .Pattern = xlSolid
        .PatternColorIndex = xlAutomatic
        .ThemeColor = xlThemeColorAccent6
        .TintAndShade = 0.799981688894314
        .PatternTintAndShade = 0
    End With
    Range(shname & "!C20").Select
'    ActiveSheet.ChartObjects("Chart 1").Activate
```

```
    Range("B21").Select
    Range(Selection, Selection.End(xlDown)).Select
    With Selection.Interior
        .Pattern = xlSolid
        .PatternColorIndex = xlAutomatic
        .ThemeColor = xlThemeColorDark1
        .TintAndShade = -4.99893185216834E-02
        .PatternTintAndShade = 0
    End With
    Range(shname & "!C21").Select
End Sub
Sub CopyAlgoSheet(col1 As String, col2 As String, Comp1 As String, Comp2 As String)
    'Kalles av ShowMarkedCombinations
    'Kopierer algoarkene og modifiserer de ved hjelp av subrutiner
    Dim FraDatoRange As Range, TilDatoRange As Range
    Dim FraS1Range As Range, TilS1Range As Range
    Dim FraS2Range As Range, TilS2Range As Range
    Dim FS1R As Variant, TS1R As Variant
    Dim FS2R As Variant, TS2R As Variant
    Dim FDR As Variant, TDR As Variant
    Dim shname As Variant
    Dim DNlink2 As String, DNlink1 As String
    'Lager ny tom worksheet
    Sheets.Add After:=Sheets(Sheets.Count)
    'Renamer den til rett algo filnavn
    shname = "Algo_" & Comp2 & "_" & Comp1  'Switched between the tickers in order to correspond better
with output
    Sheets(Sheets(Sheets.Count).Name).Select
    Sheets(Sheets(Sheets.Count).Name).Name = shname
    'Kopierer malen lokalt
    Sheets("XAlgoTemplate").Select
    Range("XAlgoTemplate!A1:ap20").Select 'Rettet bg->ao
    Selection.Copy
    Sheets(shname).Select
    ActiveSheet.Paste
    Columns("A:A").ColumnWidth = 9.43
    'Copies the tickers to the sheet as a hyperlink to Dagens næringslivs website - new from 1.4.2010
    DNlink2 = "http://www.dn.no/finans/portal/stock-oslo?newt__ticker=" & StripSymbol(Comp2) &
"&newt__context=oslo"
    DNlink1 = "http://www.dn.no/finans/portal/stock-oslo?newt__ticker=" & StripSymbol(Comp1) &
"&newt__context=oslo"
    Call MakeLink(Range("b4"), DNlink2, Comp2, Comp2)
    Call MakeLink(Range("d4"), DNlink1, Comp1, Comp1)
    'Kopierer rett logreturn kolonne avhengig av selskap til algoarket
    FDR = "LogReturn!A3:A" & IMPnorows + 1
    TDR = "Algo_" & Comp2 & "_" & Comp1 & "!" & "A5:A" & maxalgosheetrow

    FS1R = "LogReturn!" & col2 & "3:" & col2 & IMPnorows + 1
    TS1R = "Algo_" & Comp2 & "_" & Comp1 & "!" & "B5:" & "B" & maxalgosheetrow
    FS2R = "LogReturn!" & col1 & "3:" & col1 & IMPnorows + 1
    TS2R = "Algo_" & Comp2 & "_" & Comp1 & "!" & "D5:" & "D" & maxalgosheetrow

    Range(TDR).Value = Range(FDR).Value ' copy dates
    Range(TS1R).Value = Range(FS1R).Value
    Range(TS2R).Value = Range(FS2R).Value
'   MsgBox "TS1R:" & TS1R & " - FS1R:" & FS1R & "TS2R:" & TS2R & " - FS2R:" & FS2R
```

```
    'count number of days included in the accumulated log return
    Range("O2").Formula = "=A" & maxalgosheetrow & " - A8"

    Range("F2").Select
    Selection.FormulaArray = "=AVERAGE(ABS(R[6]C:R[" & maxalgosheetrow - 2 & "]C))"

    Call PopulateColumnsInAlgo(shname) 'Lagt til parameter 30.3.2010
End Sub
Sub PopulateColumnsInAlgo(shname As Variant)
    Range("C11").Select
    Selection.AutoFill Destination:=Range("C11:C" & maxalgosheetrow), Type:=xlFillDefault
    Range("C11:C" & maxalgosheetrow).Select
    Range("E11").Select
    Range(Selection, Selection.End(xlToRight)).Select
    Selection.Copy
    Application.CutCopyMode = False
    Selection.AutoFill Destination:=Range("E11:ap" & maxalgosheetrow), Type:=xlFillDefault 'Rettet bg -> ap
***nytt***
    Range("E11:ap" & maxalgosheetrow).Select 'Rettet bg -> ap ***nytt***
    Calculate '-new
    'Justifify correlation formula according to zerocount - LAGT TIL 30.2.2010
    Sheets("XAlgoTemplate").Select
    Range("F8:F20").Select
    Selection.Copy
    Sheets(shname).Select
    Range("F8").Select
    ActiveSheet.Paste
    Range("F20").Select
    Application.CutCopyMode = False
    Selection.AutoFill Destination:=Range("F20:F" & maxalgosheetrow), Type:=xlFillDefault
    Range("F20:F" & maxalgosheetrow).Select
    Calculate
End Sub
Sub listworksheetsOnlyAlgoToMakeCopyDates()
    Call start
    Dim NewSheet As Worksheet, i As Integer 'Lagt til av Jyri den 16.3.2010
    'Denne lager liste over Algo* worksheetene og benytter den sammen med subrutinene CopyDates til å
    'Fylle ut rette datoene
    Set NewSheet = Sheets.Add(Type:=xlWorksheet)
    Dim j As Integer
    j = 0
    For i = 1 To Sheets.Count
        If Sheets(i).Name Like "Algo*" Then
            j = j + 1
            NewSheet.Cells(j, 1).Value = Sheets(i).Name
            CopyDates (Cells(j, 1).Value)
        End If
    Next i
End Sub
Sub CopyDates(shname As Variant)
    'Copies the dates from LogReturn sheet into AlgoSheets
    Sheets(shname).Range("A5:A" & maxalgosheetrow).Value = Sheets("LogReturn").Range("A3:A" & IMPnorows
+ 1).Value

    'Added 2.5.2010 - Calculates normal percentage in top of algosheets
    Range(shname & "!c2").Formula = Replace(Range("Lists2!c2").Formula, "XAlgoTemplate", shname)
```

```
    Range(shname & "!e2").Formula = Replace(Range("Lists2!e2").Formula, "XAlgoTemplate", shname)
End Sub
Sub listworksheetsOnlyAlgoToCorrectSumming()
    Dim NewSheet As Worksheet, i As Integer, j As Integer, shname As Variant, shteller As Integer,
shnamarr(500) As String
    Set NewSheet = Sheets.Add(Type:=xlWorksheet)
    shteller = Sheets.Count 'Totalt antall sheet'er tas vare på i en variabel som er fast og ikke endrer seg under
veis
    j = 0
    For i = 1 To shteller
      If Sheets(i).Name Like "Algo*" Then
          j = j + 1 'Legger første forekomsten på første linjen osv.
          NewSheet.Cells(j, 1).Value = Sheets(i).Name
          shname = Sheets(i).Name
          shnamarr(j) = shname
      End If
    Next i
    For i = 1 To j
      shname = shnamarr(i)
      Call CorrectSummingInAlgoSheets(shname)
    Next i
End Sub
Sub CorrectSummingInAlgoSheets(shname As Variant)
    Call start
    'Corrects the sums at the top of algosheets
    Sheets(shname).Select
    Worksheets(shname).Range("B3").Formula = "=SUM(B8:B" & maxalgosheetrow & ")"
    Worksheets(shname).Range("D3").Formula = "=SUM(D8:D" & maxalgosheetrow & ")"
    Worksheets(shname).Range("N3").Formula = "=SUM(N8:N" & maxalgosheetrow & ")"
    Worksheets(shname).Range("Q3").Formula = "=SUM(Q8:Q" & maxalgosheetrow & ")"
    Worksheets(shname).Range("T3").Formula = "=SUM(T8:T" & maxalgosheetrow & ")"
    Worksheets(shname).Range("W3").Formula = "=SUM(W8:W" & maxalgosheetrow & ")"
    Worksheets(shname).Range("Y3").Formula = "=SUM(Y8:Y" & maxalgosheetrow & ")"
    Worksheets(shname).Range("AA3").Formula = "=SUM(AA8:AA" & maxalgosheetrow & ")"
    Worksheets(shname).Range("AC3").Formula = "=SUM(AC8:AC" & maxalgosheetrow & ")"
    Worksheets(shname).Range("AE3").Formula = "=SUM(AE8:AE" & maxalgosheetrow & ")"
    Worksheets(shname).Range("AG3").Formula = "=SUM(AG8:AG" & maxalgosheetrow & ")"
    Worksheets(shname).Range("AI3").Formula = "=SUM(AI8:AI" & maxalgosheetrow & ")"
    Worksheets(shname).Range("AK3").Formula = "=SUM(AK8:AK" & maxalgosheetrow & ")"
    Worksheets(shname).Range("AM3").Formula = "=SUM(AM8:AM" & maxalgosheetrow & ")"
    Worksheets(shname).Range("AO3").Formula = "=SUM(AO8:AO" & maxalgosheetrow & ")"
'   Calculate
    Call Corr_Styling(shname) 'new
End Sub
Sub listworksheetsOnlyAlgoToMakeCorrLimit()
    'Denne lager liste over Algo* worksheetene og benytter den sammen med subrutinene GetMax og FindNum
til å
    'Fylle ut optimale korrelasjonslimitten til hver worksheet
    Dim NewSheet As Worksheet, i As Integer 'Lagt til av Jyri den 16.3.2010
    Set NewSheet = Sheets.Add(Type:=xlWorksheet)
    Dim j As Integer
    j = 0
    For i = 1 To Sheets.Count
       If Sheets(i).Name Like "Algo*" Then
          j = j + 1
          NewSheet.Cells(j, 1).Value = Sheets(i).Name
```

```
        GetMax (Cells(j, 1).Value)
        Calculate
      End If
   Next i
End Sub
Sub GetMax(shname As Variant)
'Finner maksimale returnverdien ved varierende correlation limit
   Dim lMax As Double
   Dim pos As Variant, fnd As Variant
   lMax = WorksheetFunction.Max(Range(shname & "!W3:ao3")) 'Rettet fra bg til ao etter å ha fjernet kol for
neg tall
   fnd = lMax
   pos = FindNum(fnd, Range(shname & "!W3:ao3")) 'Rettet fra bg til ao etter å ha fjernet kol for neg tall
   Sheets(shname).Range("S3").Value = Sheets(shname).Range(pos).Offset(2, -1).Value
  ' MsgBox "Max: " & lMax & " MaxPosisjon: " & pos & " LimitPos: " & Sheets(shname).Range(pos).Offset(2, -
1).Value
   End Sub
Function FindNum(tall As Variant, rng As Range) As Variant
   'Finner posisjonen for den maksimale verdien for å benytte den til å finne optimale korrelation limitten.
   Dim tel As Integer, c1 As Range, adr As Variant
   For Each c1 In rng
      If c1.Value = tall Then
         tel = tel + 1
         adr = c1.Address
      End If
   Next c1
   FindNum = adr
End Function
Sub listworksheetsOnlyAlgoToMakeGraph()
   Call start
   'Denne lager liste over Algo* worksheetene og benytter den sammen med subrutinene GetMax og FindNum
til å
   'Fylle ut optimale korrelasjonslimitten til hver worksheet
   Dim NewSheet As Worksheet, i As Integer 'Lagt til av Jyri den 16.3.2010
   Set NewSheet = Sheets.Add(Type:=xlWorksheet)
   Dim j As Integer, shname As Variant
   j = 0
   For i = 1 To Sheets.Count
      If Sheets(i).Name Like "Algo*" Then
         j = j + 1
         NewSheet.Cells(j, 1).Value = Sheets(i).Name
         shname = Sheets(i).Name
         MakeGraphGenerel (shname)
      End If
   Next i
End Sub
Sub MakeGraphGenerel(shname As Variant)
'Lager graph til hver enkelt algosheet
   Dim sharea As Variant
   sharea = shname & "!$A$4:$E$" & maxalgosheetrow
   Sheets(shname).Select 'Aktiverer shname sheet
   Range("A4:E" & maxalgosheetrow).Select
   ActiveSheet.Shapes.AddChart.Select
   With ActiveSheet.Shapes("Chart 1") 'resizes the graph
      .Top = 60
      .Left = 60
```

```
    .Height = 400
    .Width = 800
  End With
  ActiveChart.SetSourceData Source:=Range(sharea)
  ActiveChart.ChartType = xlLine
  ActiveChart.Axes(xlCategory).Select
  ActiveChart.SeriesCollection(1).Delete
  ActiveChart.SeriesCollection(2).Delete
  ActiveChart.SeriesCollection.NewSeries
  ActiveChart.SeriesCollection(3).Name = shname & "!$O$4"
  ActiveChart.SeriesCollection(3).Values = shname & "!$O$8:$O$" & maxalgosheetrow
  ActiveChart.SeriesCollection.NewSeries
  ActiveChart.SeriesCollection(4).Name = shname & "!$R$4"
  ActiveChart.SeriesCollection(4).Values = shname & "!$R$8:$R$" & maxalgosheetrow
  ActiveChart.SeriesCollection.NewSeries
  ActiveChart.SeriesCollection(5).Name = shname & "!$U$4"
  ActiveChart.SeriesCollection(5).Values = shname & "!$U$8:$U$" & maxalgosheetrow
  ActiveChart.SeriesCollection(5).XValues = shname & "!$A$8:$A$" & maxalgosheetrow 'date
  ActiveChart.SeriesCollection.NewSeries
  ActiveChart.SeriesCollection(6).Name = shname & "!$ap$4"
  ActiveChart.SeriesCollection(6).Values = shname & "!$ap$8:$ap$" & maxalgosheetrow
  ActiveChart.ChartArea.Select
  'new
  ActiveSheet.ChartObjects("Chart 1").Activate
  ActiveChart.PlotArea.Select
  ActiveChart.SeriesCollection(3).Name = "=" & shname & "!$O$4"
  ActiveChart.SeriesCollection(4).Name = "=" & shname & "!$R$4"
  ActiveChart.SeriesCollection(5).Name = "=" & shname & "!$U$4"
  ActiveChart.SeriesCollection(6).Name = "=" & shname & "!$ap$4" 'new
  'new 2
  ActiveSheet.ChartObjects("Chart 1").Activate
  ActiveChart.SeriesCollection(3).Select
  ActiveChart.SeriesCollection(1).XValues = "=" & shname & "!$A$8:$A$" & maxalgosheetrow
  ActiveChart.SeriesCollection(1).Values = "=" & shname & "!$C$8:$C$" & maxalgosheetrow
  ActiveChart.SeriesCollection(2).Values = "=" & shname & "!$E$8:$E$" & maxalgosheetrow

  ActiveChart.SeriesCollection(6).Select
  ActiveChart.SeriesCollection(6).ApplyDataLabels
  ActiveChart.SeriesCollection(6).DataLabels.Select

  Selection.ShowCategoryName = True
  Selection.ShowValue = False
  ActiveChart.PlotArea.Select
  ActiveChart.Axes(xlCategory).Select
  ActiveChart.SeriesCollection(6).Select
  With Selection
    .MarkerSize = 5
    .Border.LineStyle = xlNone  'makes the line invisible
    .MarkerStyle = xlNone       'makes the line invisible
  End With
  Selection.MarkerStyle = 8
'   Calculate
End Sub
Sub RefreshFromAccess()
  'Uses connections to refresh data from the Access database.
  'To update run CreateLogReturnSheet and ShowMarkedCombinations
```

```
'   Call LoadData 'It is run separately on menychoice above this because it has to finish befor this starts.
    Call start
    Sheets("FinalStockPriceQuery").Select 'Refererer til sheet name
    Range("Table_JyriIndexM.accdb3").Select 'Refererer til range name
    Selection.ClearContents
    ActiveWorkbook.Connections("JyriIndexM1").Refresh
    Range("Table_JyriIndexM.accdb3[Date]").Select
    Selection.NumberFormat = "m/d/yyyy"
  ' MsgBox "Finished with loading, starts with deleting blanks columns on the right hand side"
    'Call DeleteColumns
    MsgBox "When Finished, check for blank columns on the right end of the matrix, if so run DeleteColumns
routine"
End Sub
Sub DeleteColumns()
    'Deletes empty columns with title like column*
    Dim i As Integer, rng As Range, colend As Variant, col As Variant
    Call start
    Sheets("FinalStockPriceQuery").Select
    colend = ColNo2ColRef(IMPnocols)
    Set rng = Range("a1:" & colend & 1)
    For i = IMPnocols To 2 Step -1 'Deletion must be done from right to left because otherwise it will jumb over
some columns
        If rng(1, i) Like "Column*" Then
            col = ColNo2ColRef(i)
            Columns(col).Select
            Selection.Delete Shift:=xlToLeft
            'MsgBox "ColRef: " & col & "ColNr: " & i
        End If
    Next i
End Sub
Sub RefreshFromAccessPortofolio()
    'Saves the workbook since Access retrieves data from a linked tabel from harddisk. Therefor this must be
saved to the name as
    'the connection refers to
    Dim lastrowP As Integer
    ActiveWorkbook.Save
    Call start
    Sheets("Portofolio").Select 'Refererer til sheet name
    Range("Table_JyriIndexM11").Select 'Refererer til range name
    Selection.ClearContents
    On Error Resume Next ' in case history is empty then continue
    ActiveWorkbook.Connections("JyriIndexM11").Refresh
    Range("Table_JyriIndexM11[[Cost]:[Gain]]").Select
    Selection.NumberFormat = "0.00_ ;[Red]-0.00 "
    Range("Lists!m8") = Selection.Rows.Count

    Sheets("Portofolio").Select
    Range("a1").Select
    lastrowP = ActiveSheet.Range("A65536").End(xlUp).Row
  ' lastrowP = ActiveSheet.Range("A65536").End(xlUp).Row - 3 '27.5.2010 added -3 since sum fields at the
bottom
    Range("B" & lastrowP).Select
    Calculate
    MsgBox "Rebember to push F9 to refresh calculation in portofoliosheet after access retrieval"
    Calculate
End Sub
```

```
Sub CreateLogReturnSheet()
   'Cleanups sheets that reflect from LogReturnSheet
   Call listworksheetsOnlyAlgoToDeleteSheets
'  Calculate
   'This routine makes komplett LogReturn sheet
   MaxNoOfFollowingDaysZeroChange = Range("Lists!g9").Value
   RunIndicator = 0
   Call CreateLogReturnTop
   Call CountZeros
   Call MakeSumLogReturn
   Call AddCondStylingToCountZeros
   Call AddCondStylingToSumLine
   Call EliminateColumns
   Call MakeCorrLimitAndLogRetLimit
   Call MakeCorrTable
   Call RowToCol
   Call AddCondStCorrTab
   Call BoldHeader
   Call BoldSum
   Call AddBoldAndColorCodes
   Sheets("LogReturn").Select
   Worksheets("LogReturn").Columns("A:AW").AutoFit

   Call listworksheetsToCleanup
   Call MakeSheetIndex
End Sub
Sub CreateLogReturnTop()
   Call start
   Sheets("LogReturn").Select
   'ActiveWindow.SelectedSheets.Delete
   Call DeleteSheet("LogReturn")
   'Lager ny tom worksheet etter den siste
   Sheets.Add After:=Sheets(Sheets.Count)
   'Renamer den til LogReturn filnavn
   Sheets(Sheets(Sheets.Count).Name).Select
   Sheets(Sheets(Sheets.Count).Name).Name = "LogReturn"
   Sheets("LogReturn").Select
   Range("LogReturn!A1:C3").Formula = Range("XLogReturn!A1:C3").Formula
   Range("LogReturn!a3:c" & IMPnorows + 1).Formula = Range("LogReturn!a3:c3").Formula
   Range("LogReturn!$c1:" & maxdatacol & "$" & IMPnorows + 1).Formula = Range("LogReturn!$c1:c" &
IMPnorows + 1).Formula
End Sub
Sub CountZeros()
   Call start
   Sheets("LogReturn").Select

   Range("A" & zerorowno).Select
   ActiveCell.FormulaR1C1 = "Count zeros"
   With ActiveCell.Characters(start:=1, Length:=11).Font
      .Name = "MS Sans Serif"
      .FontStyle = "Regular"
      .Size = 10
      .Strikethrough = False
      .Superscript = False
      .Subscript = False
      .OutlineFont = False
```

```
        .Shadow = False
        .Underline = xlUnderlineStyleNone
        .ColorIndex = xlAutomatic
        .TintAndShade = 0
        .ThemeFont = xlThemeFontNone
    End With
    Range("B" & zerorowno).Select
    ActiveCell.FormulaR1C1 = "=COUNTIF(R[-" & IMPnorows - 1 & "]C:R[-1]C,0)"
    Range("B" & zerorowno).Select
    Selection.AutoFill Destination:=Range("B" & zerorowno & ":" & maxdatacol & zerorowno), Type:=xlFillDefault
    Range("B" & zerorowno & ":" & maxdatacol & zerorowno).Select
    'Nytt
    'Worksheets("LogReturn").Range(ColNo2ColRef(IMPnocols + 2) & corrlimno).Formula = "=Average(B" &
zerorowno & ":" & maxdatacol & zerorowno & ")"
    'Worksheets("LogReturn").Range(ColNo2ColRef(IMPnocols + 3) & corrlimno).Formula = "ZeroCountLimit"
End Sub
Sub MakeSumLogReturn()
    Call start
    Sheets("LogReturn").Select
    Range("A" & sumrowno).Select
    ActiveCell.FormulaR1C1 = "Sum"
    With ActiveCell.Characters(start:=1, Length:=3).Font
        .Name = "MS Sans Serif"
        .FontStyle = "Regular"
        .Size = 10
        .Strikethrough = False
        .Superscript = False
        .Subscript = False
        .OutlineFont = False
        .Shadow = False
        .Underline = xlUnderlineStyleNone
        .ColorIndex = xlAutomatic
        .TintAndShade = 0
        .ThemeFont = xlThemeFontNone
    End With

    Range("B" & sumrowno).Select
    ActiveCell.FormulaR1C1 = "=SUM(R[-" & IMPnorows + 0 & "]C:R[-2]C,0)"
    Range("B" & sumrowno).Select
    Selection.AutoFill Destination:=Range("B" & sumrowno & ":" & maxdatacol & sumrowno), Type:=xlFillDefault
    Range("B" & sumrowno & ":" & maxdatacol & sumrowno).Select
    Calculate
End Sub
Sub AddCondStylingToCountZeros()
'Used to find which columns to eliminate
    Call start
    Sheets("LogReturn").Select

    Range("B" & zerorowno).Select
    Range(Selection, Selection.End(xlToRight)).Select
    Selection.FormatConditions.Add Type:=xlCellValue, Operator:=xlGreater, _
        Formula1:="=100"
    Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
    With Selection.FormatConditions(1).Font
        .Color = -16383844
        .TintAndShade = 0
```

```
    End With
    With Selection.FormatConditions(1).Interior
        .PatternColorIndex = xlAutomatic
        .Color = 13551615
        .TintAndShade = 0
    End With
    Selection.FormatConditions(1).StopIfTrue = False
End Sub
Sub AddCondStylingToSumLine()
    Call start
    Sheets("LogReturn").Select

    Range("B" & sumrowno).Select
    Range(Selection, Selection.End(xlToRight)).Select
    Selection.FormatConditions.Add Type:=xlExpression, Formula1:= _
        "=ISERROR(B" & sumrowno & ")"
    Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
    With Selection.FormatConditions(1).Interior
        .PatternColorIndex = xlAutomatic
        .ThemeColor = xlThemeColorAccent2
        .TintAndShade = 0.599963377788629
    End With
    Selection.FormatConditions(1).StopIfTrue = False
End Sub
Function ColNo2ColRef(ColNo As Integer) As String
'The function below converts column number between 1 and 256 a to a column reference (A - IV) :
    If ColNo < 1 Or ColNo > 256 Then
        ColNo2ColRef = "#VALUE!"
        Exit Function
    End If
    ColNo2ColRef = Cells(1, ColNo).Address(True, False, xlA1)
    ColNo2ColRef = Left(ColNo2ColRef, InStr(1, ColNo2ColRef, "$") - 1)
End Function
Function ColRef2ColNo(colref As String) As Integer
'The function below converts a column reference (A - IV) to a column number between 1 and 256:
    ColRef2ColNo = 0
    On Error Resume Next
    ColRef2ColNo = Range(colref & "1").Column
End Function
Function CntMaxFollowingZeros(colref As Variant) As Integer
    Call start
    Sheets("LogReturn").Select
    Worksheets(1).EnableCalculation = True
    Dim i As Integer, tstrng As Range, zerocnt As Integer, maxcnt As Integer
    'Set tstrng = Range("Bu3:Bu200")
    Set tstrng = Range(colref & "3:" & colref & IMPnorows + 1)
    For i = 3 To IMPnorows + 1
        If tstrng.Cells(i).Value = 0 Then
            zerocnt = zerocnt + 1
            Else
                If maxcnt < zerocnt Then
                    maxcnt = zerocnt
                End If
                zerocnt = 0
            End If
    Next i
```

```
    'MsgBox "Maximum number of LogReturnValues like zero following each other: " & maxcnt
    CntMaxFollowingZeros = maxcnt + 1 'added +1 in the formula 14.5.2010
End Function
Sub EliminateColumns()
    Call start
    Sheets("LogReturn").Select

    Worksheets(1).EnableCalculation = True
    Dim i As Integer, col As Variant, nocols As Integer
    Dim zerocntrng As Range, zerocount As Variant
    Dim lgsumrng As Range, lgsum As Variant

    Set zerocntrng = Range("B" & zerorowno & ":" & maxdatacol & zerorowno)
    Set lgsumrng = Range("B" & sumrowno & ":" & maxdatacol & sumrowno)

    nocols = IMPnocols - ColRef2ColNo("B")

    For i = nocols To 2 Step -1
        zerocount = zerocntrng.Cells(i).Value
        lgsum = lgsumrng.Cells(i).Value
        col = ColNo2ColRef(i + 1)
        If IsError(lgsum) Then
'           MsgBox "col:" & col & " zerocount: " & zerocount
            Columns(col).Select
            Range(col & IMPnorows).Activate
            Selection.Delete Shift:=xlToLeft
            nocols = nocols - 1
        End If
    Next i
    For i = nocols To 2 Step -1
        zerocount = zerocntrng.Cells(i).Value
        lgsum = lgsumrng.Cells(i).Value
        col = ColNo2ColRef(i + 1)
        If CntMaxFollowingZeros(col) + 1 > MaxNoOfFollowingDaysZeroChange Or IsError(lgsum) Then
          '+1 since f.eks. if MaxNoOfFollowingDaysZeroChange is 3 then EliminateColumns must remove
          'stocks whith no change in the timeperiod with 3+1 following days. This because the
          'lookupprocedure based on xalgosheet prepare will get an division by 0 error in case 3 following says
have
          'zero change. Therefor it must be one higher.
'           MsgBox "col:" & col & " zerocount: " & zerocount
            Columns(col).Select
            Range(col & IMPnorows).Activate
            Selection.Delete Shift:=xlToLeft
        End If
    Next i
    Sheets("LogReturn").Select
End Sub
Sub JustifyCorrelationFormulas()
    Dim rng As Variant
    Call start
    rng = "F" & MaxNoOfFollowingDaysZeroChange + 5 & ":F20"
    Sheets("XAlgoTemplate").Select
    Range("F8").Select
    ActiveCell.FormulaR1C1 = "=CORREL(R[-3]C[-4]:R[-1]C[-4],R[-3]C[-2]:R[-1]C[-2])" '3 day lookup
    Range("F9").Select
    ActiveCell.FormulaR1C1 = "=CORREL(R[-4]C[-4]:R[-1]C[-4],R[-4]C[-2]:R[-1]C[-2])" '4 day lookup
```

```
    Range("F10").Select
    ActiveCell.FormulaR1C1 = "=CORREL(R[-5]C[-4]:R[-1]C[-4],R[-5]C[-2]:R[-1]C[-2])" '5 day lookup
    Range("F11").Select
    ActiveCell.FormulaR1C1 = "=CORREL(R[-6]C[-4]:R[-1]C[-4],R[-6]C[-2]:R[-1]C[-2])" '6 day lookup
    Range("F12").Select
    ActiveCell.FormulaR1C1 = "=CORREL(R[-7]C[-4]:R[-1]C[-4],R[-7]C[-2]:R[-1]C[-2])" '7 day lookup
    Range("F13").Select
    ActiveCell.FormulaR1C1 = "=CORREL(R[-8]C[-4]:R[-1]C[-4],R[-8]C[-2]:R[-1]C[-2])" '8 day lookup
    Range("F" & MaxNoOfFollowingDaysZeroChange + 5).Select
    '5 is fixed number of rows down - do not change
    Selection.AutoFill Destination:=Range(rng), Type:=xlFillDefault
    Calculate
End Sub
Sub MakeCorrLimitAndLogRetLimit()
    Call start
    Sheets("LogReturn").Select
    Call countrowsandcolumnsLR

    Range("A" & corrlimno).Select
    ActiveCell.FormulaR1C1 = "Correl. Limit:"
    Selection.Font.Bold = True

    Range("B" & corrlimno).Select
'   ActiveCell.FormulaR1C1 = "0.1"
    ActiveCell.FormulaR1C1 = Range("Lists!i8").Value
    Selection.Font.Bold = True

    Range("C" & corrlimno).Select
    ActiveCell.FormulaR1C1 = "CorrLookUpRange:"
    Selection.Font.Bold = True

    Range("D" & corrlimno).Select 'ny midlertidig
    ActiveCell.FormulaR1C1 = Range("Lists!g9").Value
    Selection.Font.Bold = True

    Range("E" & corrlimno).Select
    ActiveCell.FormulaR1C1 = "LogRetLimit:"
    Selection.Font.Bold = True

    Range("F" & corrlimno).Select 'ny midlertidig
    ActiveCell.FormulaR1C1 = Range("Lists!k33").Value
    Selection.Font.Bold = True

    Dim col1 As String, col2 As String
    col1 = ColNo2ColRef(IMPnocolsLR + 1)
    Range(col1 & sumrowno).Select
    ActiveCell.FormulaR1C1 = Range("Lists!k33").Value
    Selection.Font.Bold = True

    col2 = ColNo2ColRef(IMPnocolsLR + 2)
    Range(col2 & sumrowno).Select
    ActiveCell.FormulaR1C1 = "LogRetLimit"
    Selection.Font.Bold = True
End Sub
Sub MakeCorrTable()
    Call start
```

```
    Sheets("LogReturn").Select
    Application.Calculation = xlManual
    Application.CalculateBeforeSave = True
    Application.Run "ATPVBAEN.XLAM!Mcorrel", ActiveSheet.Range(logretrange), _
                                ActiveSheet.Range(corrstartpos), "C", True
End Sub
Sub RowToCol()
    Call start
    Sheets("LogReturn").Select
    'RowToCol Macro - Lager sumlogreturns i kolonneformasjon på høyre side av korrelasjonstabellen
    'Den er ikke nødvendig å gjøres i forhold til ShowMarkedCombinations; Den tar bare hensyn til
radformasjonen
    Dim Rc As Variant, i As Integer, st As String, noOfCol As Integer
    Dim inputRng As Range, outputRng As Range
    Dim inputRng2 As Range, outputRng2 As Range
    Set inputRng = Range("b" & sumrowno & ":" & ColNo2ColRef(IMPnocolsLR) & sumrowno + 1)
    Set outputRng = Range(ColNo2ColRef(IMPnocolsLR + 1) & corrstartnoD & ":" & _
            ColNo2ColRef(IMPnocolsLR + 1) & sumrowno + IMPnocolsLR)
    Set inputRng2 = Range("A" & corrstartnoD & ":" & "A" & corrstartnoD + IMPnocolsLR - 1)
    Set outputRng2 = Range(ColNo2ColRef(IMPnocolsLR + 2) & corrstartnoD & ":" & _
            ColNo2ColRef(IMPnocolsLR + 2) & corrstartnoD + IMPnocolsLR - 1)
    For i = 1 To IMPnocolsLR - 1
        outputRng(i).Cells.Value = inputRng(i).Cells.Value
        outputRng2(i).Cells.Value = inputRng2(i).Cells.Value
    Next i
    Calculate
End Sub
Sub AddCondStCorrTab()
    Call start
    Sheets("LogReturn").Select
'Add conditional styling to logreturn row and column
'row
    Range("B" & sumrowno & ":" & corrlastcol & sumrowno).Select
    Selection.FormatConditions.Add Type:=xlCellValue, Operator:=xlGreater, _
        Formula1:="=$" & sumcol & "$" & sumrowno
    Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
    With Selection.FormatConditions(1).Font
        .Color = -16752384
        .TintAndShade = 0
    End With
    With Selection.FormatConditions(1).Interior
        .PatternColorIndex = xlAutomatic
        .Color = 13561798
        .TintAndShade = 0
    End With
    Selection.FormatConditions(1).StopIfTrue = False

'column
    Range(sumcol & corrstartnoH & ":" & sumcol & correndno).Select
    Selection.FormatConditions.Add Type:=xlCellValue, Operator:=xlGreater, _
        Formula1:="=$" & sumcol & "$" & sumrowno
    Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
    With Selection.FormatConditions(1).Font
        .Color = -16752384
        .TintAndShade = 0
    End With
```

```
    With Selection.FormatConditions(1).Interior
        .PatternColorIndex = xlAutomatic
        .Color = 13561798
        .TintAndShade = 0
    End With
    Selection.FormatConditions(1).StopIfTrue = False

'correlation table
    Range("B" & corrstartnoD).Select
    Range(Selection, Selection.End(xlDown)).Select
    Range(Selection, Selection.End(xlToRight)).Select
    Range("B" & corrstartnoD & ":" & corrlastcol & correndno).Select
  '  Range("B" & corrstartnoD ":" & CP870").Select
    Selection.FormatConditions.Add Type:=xlExpression, Formula1:= _
        "=AND(AND(B$" & sumrowno & ">$" & sumcol & "$" & sumrowno & ";(B" & corrstartnoD & ")<$B$" &
corrlimno & ");$" & sumcol & corrstartnoD & ">$" & sumcol & "$" & sumrowno & ")"
'       "=AND(AND(B$" & sumrowno & ">$" & sumcol & "$" & sumrowno & ";ABS(B" & corrstartnoD & ")<$B$" &
corrlimno & ");$" & sumcol & corrstartnoD & ">$" & sumcol & "$" & sumrowno & ")" 'Taken away ABS() in the
formula 27.5.2010
        '=AND(AND(B$203>$AO$203;ABS(B206)<$B$204);$AO206>$AO$203)
    Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
    With Selection.FormatConditions(1).Interior
        .PatternColorIndex = xlAutomatic
        .Color = 5296274
        .TintAndShade = 0
    End With
    Selection.FormatConditions(1).StopIfTrue = False
 End Sub
Sub BoldHeader()
'Lager bold header for hele topraden
    Call start
    Sheets("LogReturn").Select

    Range("A1").Select
    Range(Selection, Selection.End(xlToRight)).Select
    Selection.Font.Bold = True
End Sub
Sub BoldSum()
'Lager bold header for hele topraden
    Call start
    Sheets("LogReturn").Select

    Range(sumrow).Select
    Range(Selection, Selection.End(xlToRight)).Select
    Selection.Font.Bold = True

    Range(sumcol & corrstartnoH).Select
    Range(Selection, Selection.End(xlDown)).Select
    Selection.Font.Bold = True
End Sub
Sub AddBoldAndColorCodes()
    Call start
    Sheets("LogReturn").Select
    Range("b1:b2").Select
    Range(Selection, Selection.End(xlToRight)).Select
    Selection.Font.Bold = True
```

```
    Range(sumcol & corrstartnoH).Select
    Range(Selection, Selection.End(xlDown)).Select
    Selection.Font.Bold = True
    Range(sumcol & sumrowno).Select
    With Selection.Interior
        .Pattern = xlSolid
        .PatternColorIndex = xlAutomatic
        .Color = 65535
        .TintAndShade = 0
        .PatternTintAndShade = 0
    End With
    Range("B" & corrstartnoH - 1).Select
    With Selection.Interior
        .Pattern = xlSolid
        .PatternColorIndex = xlAutomatic
        .Color = 65535
        .TintAndShade = 0
        .PatternTintAndShade = 0
    End With
End Sub
Sub MakeLink(ByVal cell As Range, ByVal url As String, ByVal txt As String, ByVal tooltip_text As String)
    'Subroutine MakeLink adds a hyperlink to the active worksheet. It calls the Hyperlinks collection's Add
method,
    'passing it the link's cell, URL, tooltip text, and display text.
    ActiveSheet.Hyperlinks.Add _
        Anchor:=cell, _
        Address:=url, _
        ScreenTip:=tooltip_text, _
        TextToDisplay:=txt
End Sub
Sub RemoveLink(ByVal cell As Range)
    'Subroutine RemoveLink removes the hylerlink from a cell. Note that this does not erase the cell's text. To do
that, call the cell's Clear method.
    cell.Hyperlinks.Delete
End Sub
Sub listworksheetsOnlyAlgoToMakeOverview()
    'Denne lager liste over Algo* worksheetene og benytter den sammen med subrutinene GetMax og FindNum
til å
    Dim NewSheet As Worksheet, i As Integer 'Lagt til av Jyri den 16.3.2010
    'Lager midlertidig worksheet med liste over alle algosheeten, refereres videre som New.Sheet
    Set NewSheet = Sheets.Add(Type:=xlWorksheet)
    'Lager ny tom worksheet etter den siste
    Sheets.Add After:=Sheets(Sheets.Count)
    'Renamer den til rett algo filnavn
    Sheets(Sheets(Sheets.Count).Name).Select
    Sheets(Sheets(Sheets.Count).Name).Name = "Overview"
    Dim j As Integer, shname As Variant
    j = 0
    For i = 1 To Sheets.Count
    'For i = 1 To 15 'Gjør begrenset loop
        If Sheets(i).Name Like "Algo*" Then
            j = j + 1
            If j = 1 Then
                NewSheet.Cells(j, 1).Value = Sheets(i).Name 'NewSheet sin celle An får verdien av Algosheetnavnet
                shname = Sheets(i).Name 'Tilordner verdien til en variabel som brukes videre
                Sheets(shname).Select 'Aktiverer shname sheet
```

```
            'Headingen bruker første linjen
            Sheets("Overview").Range("A1").Value = "Aksjepar"
            Sheets("Overview").Range("B1").Value = "Aksje 1"
            Sheets("Overview").Range("C1").Value = "Aksje 2"
            Sheets("Overview").Range("D1").Value = "AcChY+YY"
            Sheets("Overview").Range("E1").Value = "AcCh3day"
            Sheets("Overview").Range("F1").Value = "AcChAlg"
            Sheets("Overview").Range("M1").Value = "Sensitivity%"
            Sheets("Overview").Range("N1").Value = "NoOfSwitches"
            Sheets("Overview").Range("Q1").Value = "Better Than the best ind stock"
            j = j + 2 'Legger til en slik at første datalinjen kommer på linje 2 -   endret fra 1 til 2 17.3.2010
            Call fillOverview(shname, j)
          Else
          If j > 1 Then
            NewSheet.Cells(j, 1).Value = Sheets(i).Name 'NewSheet sin celle An får verdien av Algosheetnavnet
            shname = Sheets(i).Name 'Tilordner verdien til en variabel som brukes videre
            Sheets(shname).Select 'Aktiverer shname sheet
            Call fillOverview(shname, j)
          End If
          End If
        End If
    Next i
    Sheets("Overview").Select
    Call Adjust_column_widht_to_data_Overview
    Calculate
End Sub
Sub fillOverview(shname As Variant, radnr As Integer)
    'Dim rng As Range
    Dim rng As Variant
    rng = Range("A" & radnr)
    Call MakeLink(Range("Overview!A" & radnr), "#" & shname & "!A" & radnr, shname, shname)

    Sheets("Overview").Range("B" & radnr).Value = Sheets(shname).Range("B3").Value
    Sheets("Overview").Range("C" & radnr).Value = Sheets(shname).Range("D3").Value
    Sheets("Overview").Range("D" & radnr).Value = Sheets(shname).Range("N3").Value
    Sheets("Overview").Range("E" & radnr).Value = Sheets(shname).Range("Q3").Value
    Sheets("Overview").Range("F" & radnr).Value = Sheets(shname).Range("T3").Value

    Sheets("Overview").Range("M" & radnr).Value = Sheets(shname).Range("S3").Value 'Sensitivity% used in
Algo
    Sheets("Overview").Range("N" & radnr).Value = NoOfSwitches(shname, "S") 'Algo
    Sheets("Overview").Range("O" & radnr).Value = NoOfSwitches(shname, "M")  'Y+YY
    Sheets("Overview").Range("P" & radnr).Value = NoOfSwitches(shname, "P")  '3day
    Sheets("Overview").Range("Q" & radnr).Formula = Sheets("XOverview").Range("Q" & radnr).Formula  'Better
Than the best ind stock
End Sub
Sub OverviewPrepare()
    'Makes summing fields to Overview sheet and makes a new sheet with sorted results
    'Template Overview called XOverview has to have equal number of rows as Overview to make the copy
    'process to work properly
    Call start
    Dim rng As Variant
    Dim i As Integer, j As Integer
    combcounter = Range("LogReturn!$" & sumcol & "$" & corrlimno)
```

```
   Worksheets("Overview").Range("A1:L1").Formula = Worksheets("XOverview").Range("A1:L1").Formula  'Txt
header
   Worksheets("Overview").Range("G2").Formula = "=(COUNTA(G3:G" & combcounter + 2 & ")-
COUNTBLANK(G3:G" & combcounter + 2 & "))/COUNTA(G3:G" & combcounter + 2 & ")"
   Worksheets("Overview").Range("H2").Formula = "=(COUNTA(H3:H" & combcounter + 2 & ")-
COUNTBLANK(H3:H" & combcounter + 2 & "))/COUNTA(H3:H" & combcounter + 2 & ")"
   Worksheets("Overview").Range("I2").Formula = "=(COUNTA(I3:I" & combcounter + 2 & ")-COUNTBLANK(I3:I"
& combcounter + 2 & "))/COUNTA(I3:I" & combcounter + 2 & ")"
   Worksheets("Overview").Range("J2").Formula = "=(COUNTA(J3:J" & combcounter + 2 & ")-
COUNTBLANK(J3:J" & combcounter + 2 & "))/COUNTA(J3:J" & combcounter + 2 & ")"
   Worksheets("Overview").Range("K2").Formula = "=(COUNTA(K3:K" & combcounter + 2 & ")-
COUNTBLANK(K3:K" & combcounter + 2 & "))/COUNTA(K3:K" & combcounter + 2 & ")"
   Worksheets("Overview").Range("L2").Formula = "=(COUNTA(L3:L" & combcounter + 2 & ")-
COUNTBLANK(L3:L" & combcounter + 2 & "))/COUNTA(L3:L" & combcounter + 2 & ")"

   j = 2
   For i = 1 To combcounter
     j = j + 1
     Worksheets("Overview").Range("G" & j).Formula = Worksheets("XOverview").Range("G" & j).Formula
     Worksheets("Overview").Range("H" & j).Formula = Worksheets("XOverview").Range("H" & j).Formula
     Worksheets("Overview").Range("I" & j).Formula = Worksheets("XOverview").Range("I" & j).Formula
     Worksheets("Overview").Range("J" & j).Formula = Worksheets("XOverview").Range("J" & j).Formula
     Worksheets("Overview").Range("K" & j).Formula = Worksheets("XOverview").Range("K" & j).Formula
     Worksheets("Overview").Range("L" & j).Formula = "=5-COUNTBLANK(G" & j & ":K" & j & ")"
   Next i

   'Create empty OverviewSorted sheet
   Sheets.Add After:=Sheets(Sheets.Count)

   'Renames it to OverviewSorted
   Sheets(Sheets(Sheets.Count).Name).Select
   Sheets(Sheets(Sheets.Count).Name).Name = "OverviewSorted"

   'Create empty OverviewSortedGraph sheet
   Sheets.Add After:=Sheets(Sheets.Count)

   'Renames it to OverviewSortedGraph
   Sheets(Sheets(Sheets.Count).Name).Select
   Sheets(Sheets(Sheets.Count).Name).Name = "OverviewSortedGraph"

   'Copy data from Overview to OverviewSorted
   Application.CutCopyMode = False
   Sheets("Overview").Select

   'Creates some headings
   Range("M2").Select
   ActiveCell.FormulaR1C1 = "Algo"
   Range("N2").Select
   ActiveCell.FormulaR1C1 = "Algo"
   Range("O2").Select
   ActiveCell.FormulaR1C1 = "Y+YY"
   Range("P2").Select
   ActiveCell.FormulaR1C1 = "3day"
   Range("M3").Select
   Calculate
```

```
'Makes header bold in overview
Range("A1:Q2").Select
Selection.Font.Bold = True

Range("A1:Q" & combcounter + 2).Select
Selection.Copy

Sheets("OverviewSorted").Select
Range("A1").Select
ActiveSheet.Paste

'Makes header bold in sorted overview
Range("A1:Q2").Select
Selection.Font.Bold = True

'Sorterer
Range("A3:Q" & combcounter + 2).Select
ActiveWorkbook.Worksheets("OverviewSorted").Sort.SortFields.Clear
ActiveWorkbook.Worksheets("OverviewSorted").Sort.SortFields.Add Key:=Range( _
    "F3:F" & combcounter + 2), SortOn:=xlSortOnValues, Order:=xlDescending, DataOption:= _
    xlSortNormal
  With ActiveWorkbook.Worksheets("OverviewSorted").Sort
    .SetRange Range("A3:P" & combcounter + 2)
    .Header = xlGuess
    .MatchCase = False
    .Orientation = xlTopToBottom
    .SortMethod = xlPinYin
    .Apply
  End With

'Present the numbers in persentage
Sheets("Overview").Select
Range("B3:F" & combcounter + 2).Select
Selection.NumberFormat = "0.00%"
Range("G2:L2").Select
Selection.NumberFormat = "0.00%"
Range("q2:q" & combcounter + 2).Select 'new
Selection.NumberFormat = "0.00%"    'new
Call Adjust_column_widht_to_data_Overview

Sheets("OverviewSorted").Select
Range("B3:F" & combcounter + 2).Select
Selection.NumberFormat = "0.00%"
Range("G2:L2").Select
Selection.NumberFormat = "0.00%"
Range("q2:q" & combcounter + 2).Select 'new
Selection.NumberFormat = "0.00%"    'new
Call Adjust_column_widht_to_data_Overview
Calculate

Range("A2").Select
ActiveCell.FormulaR1C1 = "=R[-1]C"
Range("A2").Select
Selection.AutoFill Destination:=Range("A2:F2"), Type:=xlFillDefault
Range("OverviewSorted!A2:F2").Select
Calculate
```

```
    'Makes the first graph
    Range("OverviewSorted!A2:F" & combcounter + 2).Select
    Sheets("OverviewSortedGraph").Select
    ActiveSheet.Shapes.AddChart.Select 'Makes the graph
    ActiveChart.SetSourceData Source:=Range("'OverviewSorted'!$A$2:$F$" & combcounter + 2)
    Worksheets("OverviewSortedGraph").ChartObjects(1).Chart.PlotBy = xlColumns ' Notice PlotBy=xlColumns
    Worksheets("OverviewSortedGraph").ChartObjects(1).Left = 1
    Worksheets("OverviewSortedGraph").ChartObjects(1).Top = 1
    Worksheets("OverviewSortedGraph").ChartObjects(1).Height = 230
    Worksheets("OverviewSortedGraph").ChartObjects(1).Width = 1030
    ActiveChart.ChartType = xlColumnClustered

    'Makes the second graph
    Sheets("OverviewSortedGraph").Select
    ActiveSheet.Shapes.AddChart.Select 'Makes the graph
    ActiveChart.SetSourceData Source:=Range("'OverviewSorted'!$A$2:$F$" & combcounter + 2)
    Worksheets("OverviewSortedGraph").ChartObjects(2).Chart.PlotBy = xlRows ' Notice PlotBy=x1Rows
    Worksheets("OverviewSortedGraph").ChartObjects(2).Left = 1
    Worksheets("OverviewSortedGraph").ChartObjects(2).Top = 235
    Worksheets("OverviewSortedGraph").ChartObjects(2).Height = 230
    Worksheets("OverviewSortedGraph").ChartObjects(2).Width = 1030
    ActiveChart.ChartType = xlColumnClustered
    'Adds conditional styling to Overview to mark the good combinations
    Dim ovname As Variant
    ovname = "Overview"
    Call MarkGoodCombinations(ovname)
    ovname = "OverviewSorted"
    Call MarkGoodCombinations(ovname)
End Sub
Sub newListworksheetsOnlyAlgoToMakeOverview() 'New extra version to present Effective interest rate
instead of log return interest rate
    'Denne lager liste over Algo* worksheetene og benytter den sammen med subrutinene GetMax og FindNum
til å
    Dim NewSheet As Worksheet, i As Integer 'Lagt til av Jyri den 16.3.2010
    'Lager midlertidig worksheet med liste over alle algosheeten, refereres videre som New.Sheet
    Set NewSheet = Sheets.Add(Type:=xlWorksheet)
    'Lager ny tom worksheet etter den siste
    Sheets.Add After:=Sheets(Sheets.Count)
    'Renamer den til rett algo filnavn
    Sheets(Sheets(Sheets.Count).Name).Select
    Sheets(Sheets(Sheets.Count).Name).Name = "NewOverview"
    Dim j As Integer, shname As Variant
    j = 0
    For i = 1 To Sheets.Count
        If Sheets(i).Name Like "Algo*" Then
            j = j + 1
            If j = 1 Then
                NewSheet.Cells(j, 1).Value = Sheets(i).Name 'NewSheet sin celle An får verdien av Algosheetnavnet
                shname = Sheets(i).Name 'Tilordner verdien til en variabel som brukes videre
                Sheets(shname).Select 'Aktiverer shname sheet
                'Headingen bruker første linjen
                Sheets("NewOverview").Range("A1").Value = "Aksjepar"
                Sheets("NewOverview").Range("B1").Value = "Aksje 1"
                Sheets("NewOverview").Range("C1").Value = "Aksje 2"
                Sheets("NewOverview").Range("D1").Value = "AcChY+YY"
```

```
            Sheets("NewOverview").Range("E1").Value = "AcCh3day"
            Sheets("NewOverview").Range("F1").Value = "AcChAlg"
            Sheets("NewOverview").Range("M1").Value = "Sensitivity%"
            Sheets("NewOverview").Range("N1").Value = "NoOfSwitches"
            Sheets("NewOverview").Range("Q1").Value = "Better Than the best ind stock"
            j = j + 2 'Legger til en slik at første datalinjen kommer på linje 2 -   endret fra 1 til 2 17.3.2010
            Call newFillOverview(shname, j)
          Else
          If j > 1 Then
            NewSheet.Cells(j, 1).Value = Sheets(i).Name 'NewSheet sin celle An får verdien av Algosheetnavnet
            shname = Sheets(i).Name 'Tilordner verdien til en variabel som brukes videre
            Sheets(shname).Select 'Aktiverer shname sheet
            Call newFillOverview(shname, j)
          End If
          End If
        End If
    Next i
    Sheets("NewOverview").Select
    Call Adjust_column_widht_to_data_Overview
    Calculate
End Sub
Sub newFillOverview(shname As Variant, radnr As Integer) 'New extra version to present Effective interest rate
instead of log return interest rate
    Dim rng As Variant
    rng = Range("A" & radnr)
    Call MakeLink(Range("NewOverview!A" & radnr), "#" & shname & "!A" & radnr, shname, shname)

    Sheets("NewOverview").Range("B" & radnr).Value = Sheets(shname).Range("C1").Value
    Sheets("NewOverview").Range("C" & radnr).Value = Sheets(shname).Range("E1").Value
    Sheets("NewOverview").Range("D" & radnr).Value = Sheets(shname).Range("O1").Value
    Sheets("NewOverview").Range("E" & radnr).Value = Sheets(shname).Range("R1").Value
    Sheets("NewOverview").Range("F" & radnr).Value = Sheets(shname).Range("U1").Value

    Sheets("NewOverview").Range("M" & radnr).Value = Sheets(shname).Range("S3").Value 'Sensitivity% used in
Algo
    Sheets("NewOverview").Range("N" & radnr).Value = NoOfSwitches(shname, "S") 'Algo
    Sheets("NewOverview").Range("O" & radnr).Value = NoOfSwitches(shname, "M")  'Y+YY
    Sheets("NewOverview").Range("P" & radnr).Value = NoOfSwitches(shname, "P")  '3day
    Sheets("NewOverview").Range("Q" & radnr).Formula = Sheets("XOverview").Range("Q" & radnr).Formula
'Better Than the best ind stock
End Sub
Sub newOverviewPrepare() 'New extra version to present Effective interest rate instead of log return interest
rate
    'Makes summing fields to Overview sheet and makes a new sheet with sorted results
    'Template Overview called XOverview has to have equal number of rows as Overview to make the copy
    'process to work properly
    Call start
    Dim rng As Variant
    Dim i As Integer, j As Integer
    combcounter = Range("LogReturn!$" & sumcol & "$" & corrlimno)

    Worksheets("NewOverview").Range("A1:L1").Formula = Worksheets("XOverview").Range("A1:L1").Formula
'Txt header
    Worksheets("NewOverview").Range("G2").Formula = "=(COUNTA(G3:G" & combcounter + 2 & ")-
COUNTBLANK(G3:G" & combcounter + 2 & "))/COUNTA(G3:G" & combcounter + 2 & ")"
```

```
    Worksheets("NewOverview").Range("H2").Formula = "=(COUNTA(H3:H" & combcounter + 2 & ")-
COUNTBLANK(H3:H" & combcounter + 2 & "))/COUNTA(H3:H" & combcounter + 2 & ")"
    Worksheets("NewOverview").Range("I2").Formula = "=(COUNTA(I3:I" & combcounter + 2 & ")-
COUNTBLANK(I3:I" & combcounter + 2 & "))/COUNTA(I3:I" & combcounter + 2 & ")"
    Worksheets("NewOverview").Range("J2").Formula = "=(COUNTA(J3:J" & combcounter + 2 & ")-
COUNTBLANK(J3:J" & combcounter + 2 & "))/COUNTA(J3:J" & combcounter + 2 & ")"
    Worksheets("NewOverview").Range("K2").Formula = "=(COUNTA(K3:K" & combcounter + 2 & ")-
COUNTBLANK(K3:K" & combcounter + 2 & "))/COUNTA(K3:K" & combcounter + 2 & ")"
    Worksheets("NewOverview").Range("L2").Formula = "=(COUNTA(L3:L" & combcounter + 2 & ")-
COUNTBLANK(L3:L" & combcounter + 2 & "))/COUNTA(L3:L" & combcounter + 2 & ")"

    j = 2
    For i = 1 To combcounter
     j = j + 1
      Worksheets("NewOverview").Range("G" & j).Formula = Worksheets("XOverview").Range("G" & j).Formula
      Worksheets("NewOverview").Range("H" & j).Formula = Worksheets("XOverview").Range("H" & j).Formula
      Worksheets("NewOverview").Range("I" & j).Formula = Worksheets("XOverview").Range("I" & j).Formula
      Worksheets("NewOverview").Range("J" & j).Formula = Worksheets("XOverview").Range("J" & j).Formula
      Worksheets("NewOverview").Range("K" & j).Formula = Worksheets("XOverview").Range("K" & j).Formula
      Worksheets("NewOverview").Range("L" & j).Formula = "=5-COUNTBLANK(G" & j & ":K" & j & ")"
    Next i

    'Create empty NewOverviewSorted sheet
    Sheets.Add After:=Sheets(Sheets.Count)

    'Renames it to NewOverviewSorted
    Sheets(Sheets(Sheets.Count).Name).Select
    Sheets(Sheets(Sheets.Count).Name).Name = "NewOverviewSorted"

    'Create empty NewOverviewSortedGraph sheet
    Sheets.Add After:=Sheets(Sheets.Count)

    'Renames it to NewOverviewSortedGraph
    Sheets(Sheets(Sheets.Count).Name).Select
    Sheets(Sheets(Sheets.Count).Name).Name = "NewOverviewSortedGraph"

    'Copy data from NewOverview to NewOverviewSorted
    Application.CutCopyMode = False
    Sheets("NewOverview").Select

    'Creates some headings
    Range("M2").Select
    ActiveCell.FormulaR1C1 = "Algo"
    Range("N2").Select
    ActiveCell.FormulaR1C1 = "Algo"
    Range("O2").Select
    ActiveCell.FormulaR1C1 = "Y+YY"
    Range("P2").Select
    ActiveCell.FormulaR1C1 = "3day"
    Range("M3").Select
    Calculate

    'Makes header bold in NewOverview
    Range("A1:Q2").Select
    Selection.Font.Bold = True
```

```
Range("A1:Q" & combcounter + 2).Select
Selection.Copy

Sheets("NewOverviewSorted").Select
Range("A1").Select
ActiveSheet.Paste

'Makes header bold in sorted NewOverview
Range("A1:Q2").Select
Selection.Font.Bold = True

'Sorterer
Range("A3:Q" & combcounter + 2).Select
ActiveWorkbook.Worksheets("NewOverviewSorted").Sort.SortFields.Clear
ActiveWorkbook.Worksheets("NewOverviewSorted").Sort.SortFields.Add Key:=Range( _
    "F3:F" & combcounter + 2), SortOn:=xlSortOnValues, Order:=xlDescending, DataOption:= _
    xlSortNormal
  With ActiveWorkbook.Worksheets("NewOverviewSorted").Sort
    .SetRange Range("A3:P" & combcounter + 2)
    .Header = xlGuess
    .MatchCase = False
    .Orientation = xlTopToBottom
    .SortMethod = xlPinYin
    .Apply
  End With

'Present the numbers in persentage
Sheets("NewOverview").Select
Range("B3:F" & combcounter + 2).Select
Selection.NumberFormat = "0.00%"
Range("G2:L2").Select
Selection.NumberFormat = "0.00%"
Range("q2:q" & combcounter + 2).Select 'new
Selection.NumberFormat = "0.00%"    'new
Call Adjust_column_widht_to_data_Overview

Sheets("NewOverviewSorted").Select
Range("B3:F" & combcounter + 2).Select
Selection.NumberFormat = "0.00%"
Range("G2:L2").Select
Selection.NumberFormat = "0.00%"
Range("q2:q" & combcounter + 2).Select 'new
Selection.NumberFormat = "0.00%"    'new
Call Adjust_column_widht_to_data_Overview
Calculate

Range("A2").Select
ActiveCell.FormulaR1C1 = "=R[-1]C"
Range("A2").Select
Selection.AutoFill Destination:=Range("A2:F2"), Type:=xlFillDefault
Range("NewOverviewSorted!A2:F2").Select
Calculate

'Makes the first graph
Range("NewOverviewSorted!A2:F" & combcounter + 2).Select
Sheets("NewOverviewSortedGraph").Select
```

```
    ActiveSheet.Shapes.AddChart.Select 'Makes the graph
    ActiveChart.SetSourceData Source:=Range("'NewOverviewSorted'!$A$2:$F$" & combcounter + 2)
    Worksheets("NewOverviewSortedGraph").ChartObjects(1).Chart.PlotBy = xlColumns ' Notice
PlotBy=xlColumns
    Worksheets("NewOverviewSortedGraph").ChartObjects(1).Left = 1
    Worksheets("NewOverviewSortedGraph").ChartObjects(1).Top = 1
    Worksheets("NewOverviewSortedGraph").ChartObjects(1).Height = 230
    Worksheets("NewOverviewSortedGraph").ChartObjects(1).Width = 1030
    ActiveChart.ChartType = xlColumnClustered

    'Makes the second graph
    Sheets("NewOverviewSortedGraph").Select
    ActiveSheet.Shapes.AddChart.Select 'Makes the graph
    ActiveChart.SetSourceData Source:=Range("'NewOverviewSorted'!$A$2:$F$" & combcounter + 2)
    Worksheets("NewOverviewSortedGraph").ChartObjects(2).Chart.PlotBy = xlRows ' Notice PlotBy=x1Rows
    Worksheets("NewOverviewSortedGraph").ChartObjects(2).Left = 1
    Worksheets("NewOverviewSortedGraph").ChartObjects(2).Top = 235
    Worksheets("NewOverviewSortedGraph").ChartObjects(2).Height = 230
    Worksheets("NewOverviewSortedGraph").ChartObjects(2).Width = 1030
    ActiveChart.ChartType = xlColumnClustered
    'Adds conditional styling to NewOverview to mark the good combinations
    Dim ovname As Variant
    ovname = "NewOverview"
    Call MarkGoodCombinations(ovname)
    ovname = "NewOverviewSorted"
    Call MarkGoodCombinations(ovname)
End Sub
Function NoOfSwitches(shname As Variant, col As Variant) As Integer
    Dim i As Integer, cnt As Integer, rng As Range, pastval As String
    Sheets(shname).Select
   ' Sheets("Algo_HRG_OL_CLAVIS_OL").Select '                    Husk å kommentere vekk!!!!
   ' maxalgosheetrow = 222    '                    Husk å kommentere vekk!!!!
    Set rng = Range(col & "8:" & col & maxalgosheetrow)
    cnt = 0
    pastval = ""
    For i = 8 To maxalgosheetrow
     If pastval <> rng(i) Then
       cnt = cnt + 1
       pastval = rng(i)
     End If
    Next i
    'MsgBox "Count of changes: " & cnt - 2
    NoOfSwitches = cnt - 2
End Function
Sub MarkGoodCombinations(ovname As Variant)
    Sheets(ovname).Select
    Range(ovname & "!$A$3:$q$" & combcounter + 2).Select
    Selection.FormatConditions.Add Type:=xlExpression, Formula1:= _
       "=AND($K3=""Alg""; $L3=1)"
    Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
    With Selection.FormatConditions(1).Interior
       .PatternColorIndex = xlAutomatic
       .ThemeColor = xlThemeColorLight2
       .TintAndShade = 0.799981688894314
    End With
    Selection.FormatConditions(1).StopIfTrue = False
```

```
End Sub
Sub Adjust_column_widht_to_data()
   Columns("A:A").Select
   Range("A2").Activate
   Selection.Columns.AutoFit
End Sub
Sub Adjust_column_widht_to_data_Overview()
'   Columns("A:P").Select
   Columns("A:t").Select
   Selection.Columns.AutoFit
End Sub
Sub StartFormButton_Click()
   'Opens the form window
   PairTradingForm.Show False
End Sub
Sub MakeButtonForStartForm()
'Not in use at the moment
   Call start
   Sheets("FinalStockPriceQuery").Select
   ActiveSheet.Buttons.Add(232.5, 743.25, 86.25, 36).Select
   Selection.OnAction = "OpenForm"
   Selection.Characters.text = "OpenForm"
   With Selection.Characters(start:=1, Length:=16).Font
      .Name = "MS Sans Serif"
      .FontStyle = "Regular"
      .Size = 10
      .Strikethrough = False
      .Superscript = False
      .Subscript = False
      .OutlineFont = False
      .Shadow = False
      .Underline = xlUnderlineStyleNone
      .ColorIndex = xlAutomatic
   End With
   Selection.ShapeRange.ScaleWidth 1.23, msoFalse, msoScaleFromTopLeft
   Selection.ShapeRange.ScaleHeight 1.12, msoFalse, msoScaleFromTopLeft
End Sub
Sub HyperLink_SheetsToIndex()
    '  Local  Variables
   Dim wks              As Worksheet
   Dim rngLinkCell      As Range
   Dim strSubAddress    As String, strDisplayText    As String
    '   Step 1 :  Loop through all worksheets
    ' 1a : Clear all current  hyperlinks
   Worksheets("Sheet Index").Range("A:A").ClearContents
    ' 1b : Create Linked index list
   For Each wks In ActiveWorkbook.Worksheets
      Set rngLinkCell = Worksheets("Sheet Index").Range("A65536").End(xlUp)
      If rngLinkCell <> "" Then Set rngLinkCell = rngLinkCell.Offset(1, 0)
      strSubAddress = "'" & wks.Name & "'!A1"
      strDisplayText = "HyperLink : " & wks.Name
      Worksheets("Sheet Index").Hyperlinks.Add Anchor:=rngLinkCell, Address:="", SubAddress:=strSubAddress,
TextToDisplay:=strDisplayText
   Next wks
End Sub
Sub MakeSheetIndex()
```

```
    Sheets.Add After:=Sheets(Sheets.Count)
    Sheets(Sheets(Sheets.Count).Name).Select
    Sheets(Sheets(Sheets.Count).Name).Name = "Sheet Index"
    Call HyperLink_SheetsToIndex
    Sheets("Sheet Index").Select
    Worksheets("Sheet Index").Columns("A:A").AutoFit
End Sub
Function lookupLastPrice(compname As Variant) As Double
    Dim i As Integer, rng As Range, cn As Variant, price As Double
    Dim cns As String
    cns = compname
    Set rng = Sheets("FinalStockPriceQuery").Range("b1:" & ColNo2ColRef(IMPnocols) & "1")
    For i = 1 To IMPnocols
      cn = Sheets("FinalStockPriceQuery").Range(ColNo2ColRef(i) & "1").Value
      If compname = cn Then
        price = Sheets("FinalStockPriceQuery").Range(ColNo2ColRef(i) & IMPnorows + 1).Value 'add +1 in the
formula to get the last row
        If price = 0 Then
          price = Sheets("I_" & StripSymbol(cns)).Range("e4") 'Added 22.6.2010 since it happens that the data
from HSQuote is missing latest quotes, retrieves from intraday sheets instead.
        End If
        lookupLastPrice = price
        Exit For 'added 11.5.2010
      End If
    Next i
End Function
Sub CreateOrderBook()
    Dim NewSheet As Worksheet, i As Integer, shname As Variant, compname As Variant, compnamestr As
String, compnamestr2 As String, newrows As Integer, j As Integer
    Dim LastRowH As Integer, lastrowP As Integer, OBLinCnt As Integer
    Dim c11 As String, c12 As String, c21 As String, c22 As String, v1 As Double, v2 As Double
    Dim cap As Double, MethodInd As String
    Call start
    Sheets("OrderBookHist").Select
    Range("a1").Select
    LastRowH = ActiveSheet.Range("A65536").End(xlUp).Row

    Sheets("Portofolio").Select
    If LastRowH <= 2 Then 'If history empty
          Range("B2").Select
          ActiveCell.FormulaR1C1 = "0"
          Range("C2").Select
          ActiveCell.FormulaR1C1 = "0"
          Range("D2").Select
          ActiveCell.FormulaR1C1 = "0"
          Range("E2").Select
          ActiveCell.FormulaR1C1 = "0"
          Range("F2").Select
          ActiveCell.FormulaR1C1 = "0"
          Range("B2:F2").Select
          Range("Table_JyriIndexM11[[Cost]:[Gain]]").Select
          Range("Budget!c6") = Range("Budget!c3") 'Initializes the budget
       Else
          Call CorrAccBal 'Added 12.5.2010
        '  ActiveWorkbook.Save
        '  Call RefreshFromAccessPortofolio 'Cannot be here sice it is delayed for commands comming after
```

```
        Range("Budget!c6") = Range("OrderBookHist!q" & LastRowH) 'Updates the available balanse on budget
sheet
   End If

   Sheets("OrderBook").Select
   newrows = findMaxRowForOrderBookSelection()
   Range("Budget!C4").Value = newrows - 1 'Updates budsjett value with
   'Clear the contenst of orderbook and copies the headings from the template
   Sheets("OrderBook").Select
   Cells.Select
   Selection.ClearContents
   Range("A1").Select
   Sheets("XOrderBook").Select
   Range("A1:u2").Select
   Selection.Copy
   Sheets("OrderBook").Select
   Range("A1").Select
   ActiveSheet.Paste
   Range("A3").Select

   Sheets("OrderBook").Range("b3:b" & newrows + 1).Value = Sheets("NewOverviewSorted").Range("a3:a" &
newrows + 1).Value

   cap = Range("Budget!c6") 'To remember orginal balance

   For i = 3 + OBLinCnt To newrows + 1

      Sheets("OrderBook").Range("a" & i).Value = Now()

      MethodInd = Range("Lists!j5")
      'If Time() < "07:05" And Time() > "07:00" Then 'In the morning uses the best candidate from yesterday or
more correctly the cand in algosheets
      If MethodInd = "H" Then 'uses the last value in algosheetrecommendation to buy
            compnamestr = Sheets(Sheets("OrderBook").Range("b" & i).Value).Range("S" &
maxalgosheetrow).Value
            compnamestr = StripSymbol(compnamestr)
            shname = Sheets("OrderBook").Range("b" & i).Value
            Call MakeLink(Range("OrderBook!b" & i), "#" & shname & "!A" & i, shname, shname) 'new 3.5.2010
            compname = Sheets(shname).Range("S" & maxalgosheetrow).Value
            Sheets("OrderBook").Range("c" & i).Value = Sheets(shname).Range("S" & maxalgosheetrow).Value
            Sheets("OrderBook").Range("f" & i).Value = lookupLastPrice(compname)    'The closing price for
yesterday, latest price in the FinalStockPriceQuery
            If Sheets(shname).Range("b4") = Sheets("OrderBook").Range("c" & i).Value Then 'Displays the
opposite bad position on the last column
               Sheets("OrderBook").Range("m" & i).Value = Sheets(shname).Range("d4")
               compnamestr2 = Sheets("OrderBook").Range("m" & i).Value
               compnamestr2 = StripSymbol(compnamestr2)
               Sheets("OrderBook").Range("n" & i).Value = Sheets("I_" & compnamestr2).Range("i4").Value
             Else
               Sheets("OrderBook").Range("m" & i).Value = Sheets(shname).Range("b4")
               compnamestr2 = Sheets("OrderBook").Range("m" & i).Value
               compnamestr2 = StripSymbol(compnamestr2)
               Sheets("OrderBook").Range("n" & i).Value = Sheets("I_" & compnamestr2).Range("i4").Value
             End If
            Sheets("OrderBook").Range("g" & i).Value = Sheets("I_" & compnamestr).Range("e4").Value 'The
latest price from intradaysheets
```

```
            Sheets("OrderBook").Range("h" & i).Value = (Sheets("OrderBook").Range("g" & i).Value -
Sheets("OrderBook").Range("f" & i).Value) / Sheets("OrderBook").Range("f" & i).Value 'The calculated %
change
            Sheets("OrderBook").Range("i" & i).Formula = Sheets("I_" & compnamestr).Range("i4").Value 'The
source % change
            Sheets("OrderBook").Range("L" & i).Value = FileSaveAsParametersP()

         Else 'If method ="I" Compares the pair and uses the best of the day - USES THE MOST RESENT PRICES
from I-sheets

            shname = Sheets("OrderBook").Range("b" & i).Value
            c11 = Sheets(shname).Range("b4")
            c12 = StripSymbol(c11)
            If Sheets("I_" & c12).Range("i4").Value = "-" Then 'It happens that the intradaysheets contains a - sign
when no change. This inteprets it as 0.
               v1 = 0
               Sheets("I_" & c12).Range("i4").Value = 0
            Else
               v1 = Sheets("I_" & c12).Range("i4").Value
            End If

            c21 = Sheets(shname).Range("d4")
            c22 = StripSymbol(c21)
            If Sheets("I_" & c22).Range("i4").Value = "-" Then 'It happens that the intradaysheets contains a - sign
when no change. This inteprets it as 0.
               v2 = 0
               Sheets("I_" & c22).Range("i4").Value = 0
            Else
               v2 = Sheets("I_" & c22).Range("i4").Value
            End If

            If v1 > v2 Then
               compname = c11
               compnamestr = c12
            Else
               compname = c21
               compnamestr = c22
            End If

            shname = Sheets("OrderBook").Range("b" & i).Value
            Call MakeLink(Range("OrderBook!b" & i), "#" & shname & "!A" & i, shname, shname) 'new 3.5.2010 -
Makes a link to algosheet
            Sheets("OrderBook").Range("c" & i).Value = compname
            Sheets("OrderBook").Range("f" & i).Value = lookupLastPrice(compname) 'The closing price latest price
in the FinalStockPriceQuery

            If Sheets(shname).Range("b4") = Sheets("OrderBook").Range("c" & i).Value Then 'Displays the opposite
bad position on the last column
               Sheets("OrderBook").Range("m" & i).Value = Sheets(shname).Range("d4")
               compnamestr2 = Sheets("OrderBook").Range("m" & i).Value
               compnamestr2 = StripSymbol(compnamestr2)
               Sheets("OrderBook").Range("n" & i).Value = Sheets("I_" & compnamestr2).Range("i4").Value
            Else
               Sheets("OrderBook").Range("m" & i).Value = Sheets(shname).Range("b4")
               compnamestr2 = Sheets("OrderBook").Range("m" & i).Value
               compnamestr2 = StripSymbol(compnamestr2)
```

```
            Sheets("OrderBook").Range("n" & i).Value = Sheets("I_" & compnamestr2).Range("i4").Value
          End If

          Sheets("OrderBook").Range("g" & i).Value = Sheets("I_" & compnamestr).Range("e4").Value 'The latest
price from intradaysheets
          Sheets("OrderBook").Range("h" & i).Value = (Sheets("OrderBook").Range("g" & i).Value -
Sheets("OrderBook").Range("f" & i).Value) / Sheets("OrderBook").Range("f" & i).Value 'The calculated %
change
          Sheets("OrderBook").Range("i" & i).Formula = Sheets("I_" & compnamestr).Range("i4").Value 'The
source % change
          Sheets("OrderBook").Range("L" & i).Value = FileSaveAsParametersP()
        End If
    Next i
    'Sorts the table
    Sheets("OrderBook").Select

    Range("A3:S" & newrows + 1).Select
    ActiveWorkbook.Worksheets("OrderBook").Sort.SortFields.Clear
    ActiveWorkbook.Worksheets("OrderBook").Sort.SortFields.Add Key:=Range( _
      "i3:i" & newrows + 1), SortOn:=xlSortOnValues, Order:=xlDescending, DataOption:= _
      xlSortNormal
    With ActiveWorkbook.Worksheets("OrderBook").Sort
      .SetRange Range("A3:S" & newrows + 1)
      .Header = xlGuess
      .MatchCase = False
      .Orientation = xlTopToBottom
      .SortMethod = xlPinYin
      .Apply
    End With

    'Different loop to give the first row for these two columns a different formula from XOrderBook
    For i = 3 To newrows + 1 '+2 if not first time generation otherwise 2
        If Range("OrderBook!I" & i).Value > 0 And Range("Budget!$C$6") > 0 And Range("Budget!$C$5") >
Range("Budget!$C$6") Then 'buy
          Range("OrderBook!d" & i).Value = Range("Budget!$C$6")
          Range("Budget!$C$6") = Range("Budget!$C$6") - Range("OrderBook!d" & i).Value
          Range("OrderBook!q" & i) = Range("Budget!$C$6")
          Sheets("OrderBook").Range("e" & i).Formula = "Buy"
        Else
          If Range("OrderBook!I" & i).Value > 0 And Range("Budget!$C$6") > 0 And Range("Budget!$C$5") <=
Range("Budget!$C$6") Then 'buy
            Range("OrderBook!d" & i).Value = Range("Budget!$C$5")
            Range("Budget!$C$6") = Range("Budget!$C$6") - Range("OrderBook!d" & i).Value
            Sheets("OrderBook").Range("e" & i).Formula = "Buy"
          Else
            If Range("OrderBook!I" & i).Value > 0 And Range("Budget!$C$6") > 0 Then 'buy
              Range("OrderBook!d" & i).Value = Range("OrderBook!t3") * Range("OrderBook!g3")
              Range("Budget!$C$6") = Range("Budget!$C$6") - Range("OrderBook!d" & i).Value
              Sheets("OrderBook").Range("e" & i).Formula = "Buy"
            Else
              If Range("OrderBook!I" & i).Value < 0 And Range("OrderBook!t3") > 0 And _
                FindNoOfStock(Range("OrderBook!c" & i)) > 0 And _
                Range("I_" & compnamestr & "!i4") < Range("Lists!L53") Then 'sell if value depricated
                Range("OrderBook!d" & i).Value = Range("OrderBook!t3") * Range("OrderBook!g3") * -1
                Range("Budget!$C$6") = Range("Budget!$C$6") - Range("OrderBook!d" & i).Value
                Sheets("OrderBook").Range("e" & i).Formula = "Sell"
```

```
                Else
                  Range("OrderBook!d" & i).Value = 0
                  Sheets("OrderBook").Range("e" & i).Formula = "Hold"
                End If
              End If
            End If
          End If
    '   Sheets("OrderBook").Range("e" & i).Formula = Sheets("XOrderBook").Range("e" & i).Formula 'Buy, Sell or
Hold
      Sheets("OrderBook").Range("j" & i).Formula = "=D" & i & "/G" & i 'Number of stocks to invest xxxxx
      Sheets("OrderBook").Range("k" & i).Formula = "=J" & i & "*G" & i  'Capital used or relized
      Sheets("OrderBook").Range("q" & i).Formula = Range("Budget!$C$6") 'Accumulated balanse
      Sheets("OrderBook").Range("s" & i).Formula = Sheets("XOrderBook").Range("s" & i).Formula 'Number of
stock remaining
      Sheets("OrderBook").Range("t" & i).Formula = Sheets("XOrderBook").Range("t" & i).Formula 'Repeat
controll
    Next i

    Range("Budget!c6") = cap 'To put the balance back to orginal since it actually is updated later when
transfering to history
    Worksheets("OrderBook").Calculate
'   Calculate

    'The sellorders has to be done after the ordinary orderbookgeneration since CreateSellOrders looks for
portofoliolines that are not any more
    'recommended. That means that they are missing in resently generated orderbook (recommendations)
    Sheets("Lists").Range("m11") = i
    OBLinCnt = 0
    Sheets("Portofolio").Select
    Range("a1").Select
    'lastrowP = ActiveSheet.Range("A65536").End(xlUp).Row
    lastrowP = ActiveSheet.Range("A65536").End(xlUp).Row - 3 '27.5.2010 added -3 since sum fields at the
bottom
    If lastrowP > 2 Then
       Call CreateSellOrders(lastrowP)
       OBLinCnt = Sheets("Lists").Range("m11")
    End If
    Range("OrderBook!i" & OBLinCnt + newrows + 2).Formula = "=AVERAGE(I3:I" & OBLinCnt + newrows + 1 &
")"
    Range("OrderBook!n" & OBLinCnt + newrows + 2).Formula = "=AVERAGE(n3:n" & OBLinCnt + newrows + 1 &
")"

    Sheets("OrderBook").Select

    Range("A1").CurrentRegion.Name = "BestChoice"  'Adjust BestChoiceH as the list gets longer
    Range("BestChoice").FormatConditions.Delete
    Range("C3:C" & OBLinCnt + newrows + 1).Select
    Selection.FormatConditions.Delete

    'Conditional styling rules for BUY column - Green for BUY
    Sheets("OrderBook").Range("C3:C" & OBLinCnt + newrows + 1).Select
    Selection.FormatConditions.Add Type:=xlExpression, Formula1:="=$I3>0"
    Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
    With Selection.FormatConditions(1).Interior
      .PatternColorIndex = xlAutomatic
      .Color = 5296274
```

```
    .TintAndShade = 0
End With
Selection.FormatConditions(1).StopIfTrue = False

'Conditional styling rules for BUY column - Pink for SELL
Sheets("OrderBook").Range("C3:C" & OBLinCnt + newrows + 1).Select
Selection.FormatConditions.Add Type:=xlExpression, Formula1:="=$I3<0"
Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
With Selection.FormatConditions(1).Interior
    .PatternColorIndex = xlAutomatic
    .Color = RGB(241, 192, 173)
    .TintAndShade = 0
End With
Selection.FormatConditions(1).StopIfTrue = False

Selection.FormatConditions.Add Type:=xlExpression, Formula1:="=$Q3<0"
Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
With Selection.FormatConditions(1).Font
    .Color = -16776961
    .TintAndShade = 0
End With
Selection.FormatConditions(1).StopIfTrue = False

'Conditional styling rules for Balance column
Sheets("OrderBook").Range("Q3:Q" & OBLinCnt + newrows + 1).Select
Selection.NumberFormat = "0.00_ ;[Red]-0.00 "
Selection.FormatConditions.Add Type:=xlExpression, Formula1:="=$Q3<0"
Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
Selection.FormatConditions(1).StopIfTrue = False

Sheets("OrderBook").Select
Range("A1:Q2").Select
Selection.Font.Bold = True
Range("OrderBook!H3:I" & newrows + 3).NumberFormat = "0.00%"
Range("OrderBook!N3:N" & newrows + 3).NumberFormat = "0.00%"
Range("OrderBook!J3:J" & newrows + 3).NumberFormat = "0.00"
Range("OrderBook!d3:d" & newrows + 3).NumberFormat = "0.00"
Range("OrderBook!k3:k" & newrows + 3).NumberFormat = "0.00"
Range("OrderBook!s3:t" & newrows + 3).NumberFormat = "0.00"

'Select a smaller font to make room for all the columns
Cells.Select
With Selection.Font
    .Name = "MS Sans Serif"
    .Size = 8.5
    .Strikethrough = False
    .Superscript = False
    .Subscript = False
    .OutlineFont = False
    .Shadow = False
    .Underline = xlUnderlineStyleNone
    .ColorIndex = xlAutomatic
    .TintAndShade = 0
    .ThemeFont = xlThemeFontNone
End With
Call Adjust_column_widht_to_data_Overview
```

```
   Sheets("OrderBook").Select
   Range("A1").Select
   Worksheets("OrderBook").Calculate

   Call listworksheetsToCleanup 'Temperarely commented away
   Call MakeSheetIndex 'Temperarely commented away
 '  Call FileSaveAsParameters 'Temperarely commented away
 '  Call FileSaveAsWorkingCopy 'Temperarely commented away
   End Sub
Sub CreateSellOrders(lastrowP As Integer)
'Creates sellorders in case negativ development greater than exit limit (negativ value for the day)
'Checks if we have stocks in that equity in portofolio and finds out how many stocks we have
'And makes a sell order based on the number of stocks and the recent price awailable
'Creates extra sell orderlines to orderbook
'It is possible to run the orderbook ones more afterwards to use the awailable capital releaved after sellorders.
   Dim i As Integer, LastRowO As Integer, shname As Variant, compname As Variant, compnamestr As String,
nostock As Double
   Dim OBLinCnt As Integer, lrc As Integer
   Sheets("Orderbook").Select
   Range("a1").Select
   LastRowO = ActiveSheet.Range("A65536").End(xlUp).Row
   lrc = LastRowO
   For i = 2 To lastrowP
      compname = Range("Portofolio!A" & i).Value
      compnamestr = Range("Portofolio!A" & i).Value
      compnamestr = StripSymbol(compnamestr)
    '  MsgBox "Compname: " & compnamestr
      If Range("Portofolio!d" & i) > 0 And Range("I_" & compnamestr & "!i4") < Range("Lists!L53") Then
'Compare with exitTrigger
         lrc = lrc + 1
         shname = "Sell, not recomended any more"
         Range("OrderBook!b" & lrc) = shname
         Sheets("OrderBook").Range("c" & lrc).Value = compname
         Sheets("OrderBook").Range("f" & lrc).Value = lookupLastPrice(compname)  'The closing price for
yesterday, latest price in the FinalStockPriceQuery
         Sheets("OrderBook").Range("g" & lrc).Value = Sheets("I_" & compnamestr).Range("e4").Value 'The
latest price from intradaysheets
         Sheets("OrderBook").Range("j" & lrc).Value = Range("Portofolio!d" & i).Value * -1 'lookup number of
stock in portofolio

         Sheets("OrderBook").Range("h" & lrc).Value = (Sheets("OrderBook").Range("g" & lrc).Value -
Sheets("OrderBook").Range("f" & lrc).Value) / Sheets("OrderBook").Range("f" & lrc).Value 'The calculated %
change

         Sheets("OrderBook").Range("d" & lrc).Value = Sheets("OrderBook").Range("j" & lrc).Value *
Sheets("OrderBook").Range("g" & lrc).Value
         Sheets("OrderBook").Range("a" & lrc).Value = Now()
         Sheets("OrderBook").Range("e" & lrc).Value = "Sell"
         Sheets("OrderBook").Range("i" & lrc).Value = Sheets("I_" & compnamestr).Range("i4").Value 'The source
% change
         Sheets("OrderBook").Range("L" & lrc).Value = FileSaveAsParametersP()
         Sheets("OrderBook").Range("k" & lrc).Formula = Sheets("OrderBook").Range("d" & lrc).Value

         'new
         Sheets("OrderBook").Range("q" & lrc).Formula = Sheets("XOrderBook").Range("q" & lrc).Formula
```

```
        Sheets("OrderBook").Range("s" & lrc).Formula = Sheets("XOrderBook").Range("s" & lrc).Formula
        Sheets("OrderBook").Range("t" & lrc).Formula = Sheets("XOrderBook").Range("t" & lrc).Formula
        OBLinCnt = OBLinCnt + 1
      End If
    Next i
    Sheets("Lists").Range("m11") = OBLinCnt
End Sub
Sub UpdateOrderBookHistory()
    Call start
    Dim NewSheet As Worksheet, i As Integer, compnamestr As String, LastRow As Long, LastRowH As Long,
newrows As Integer, j As Integer
    Dim shname As Variant 'new 3.5.2010
    newrows = findMaxRowForOrderBookSelection - 1
    Sheets("OrderBook").Select
    Range("a1").Select
    LastRow = ActiveSheet.Range("A65536").End(xlUp).Row

    Sheets("OrderBook").Select
    Range("a1").Select
    Calculate 'To be sure that the right most columns are calculated before copying data to history
    LastRow = ActiveSheet.Range("A65536").End(xlUp).Row

    Sheets("OrderBookHist").Select
    Range("a1").Select
    LastRowH = ActiveSheet.Range("A65536").End(xlUp).Row

    For i = 3 To LastRow
      If LastRowH = 2 Then
        j = i
        Else
        j = i + LastRowH - 2
      End If
      Sheets("OrderBookHist").Range("a" & j).Value = Sheets("OrderBook").Range("a" & i).Value
      Sheets("OrderBookHist").Range("b" & j).Value = Sheets("OrderBook").Range("b" & i).Value
      shname = Sheets("OrderBookHist").Range("b" & j).Value 'new 3.5.2010
      Call MakeLink(Range("OrderBookHist!b" & j), "#" & shname & "!A" & i, shname, shname) 'new 3.5.2010

      Sheets("OrderBookHist").Range("c" & j).Value = Sheets("OrderBook").Range("c" & i).Value
      Sheets("OrderBookHist").Range("g" & j).Value = Sheets("OrderBook").Range("g" & i).Value
      Sheets("OrderBookHist").Range("h" & j).Value = Sheets("OrderBook").Range("h" & i).Value
      Sheets("OrderBookHist").Range("i" & j).Value = Sheets("OrderBook").Range("i" & i).Value
      Sheets("OrderBookHist").Range("t" & j).Value = Sheets("OrderBook").Range("t" & i).Value
      Sheets("OrderBookHist").Range("l" & j).Value = Sheets("OrderBook").Range("l" & i).Value
      Sheets("OrderBookHist").Range("m" & j).Value = Sheets("OrderBook").Range("m" & i).Value
      Sheets("OrderBookHist").Range("n" & j).Value = Sheets("OrderBook").Range("n" & i).Value
      Sheets("OrderBookHist").Range("f" & j).Value = Sheets("OrderBook").Range("f" & i).Value
      Sheets("OrderBookHist").Range("s" & j).Value = Sheets("OrderBook").Range("s" & i).Value
      Sheets("OrderBookHist").Range("t" & j).Value = Sheets("OrderBook").Range("t" & i).Value 'Number of
stock remaining

      Sheets("OrderBookHist").Range("d" & j).Value = Sheets("OrderBook").Range("d" & i).Value 'Cap. to use
xxxxxxxxx
      Sheets("OrderBookHist").Range("e" & j).Value = Sheets("OrderBook").Range("e" & i).Value 'Buy, Sell or
Hold

      Sheets("OrderBookHist").Range("j" & j).Value = "=D" & j & "/G" & j 'Number of stocks to invest xxxxx
```

```
    Sheets("OrderBookHist").Range("k" & j).Value = "=J" & j & "*G" & j  'Capital used or relized

    Sheets("OrderBookHist").Range("q" & j).Value = Sheets("OrderBook").Range("q" & i).Value 'Accumulated
balanse
  Next i

  'Takes average to the history
  Range("OrderBookHist!o" & LastRowH + newrows).Value = Range("OrderBook!i" & LastRow + 1)
  Range("OrderBookHist!p" & LastRowH + newrows).Value = Range("OrderBook!n" & LastRow + 1)

  'Copies the headings for sum percentage columns
  Sheets("OrderBook").Select
  Range("M1:P2").Select
  Application.CutCopyMode = False
  Selection.Copy
  Sheets("OrderBookHist").Select
  Range("M1").Select
  ActiveSheet.Paste

  'Formats the sum percentage fields
  Range("O3:P" & LastRowH + newrows).Select
  Application.CutCopyMode = False
  Selection.NumberFormat = "0.00%"

  Range("OrderBookHist!H3:I" & LastRowH + newrows).NumberFormat = "0.00%"
  Range("OrderBookHist!N3:N" & LastRowH + newrows).NumberFormat = "0.00%"
  Range("OrderBookHist!J3:J" & LastRowH + newrows).NumberFormat = "0.00"
  Range("OrderBookHist!d3:d" & LastRowH + newrows).NumberFormat = "0.00"
  Range("OrderBookHist!k3:k" & LastRowH + newrows).NumberFormat = "0.00"
  Range("OrderBookHist!s3:t" & LastRowH + newrows).NumberFormat = "0.00"

  'Select a smaller font to make room for all the columns
  Cells.Select
  With Selection.Font
    .Name = "MS Sans Serif"
    .Size = 8.5
    .Strikethrough = False
    .Superscript = False
    .Subscript = False
    .OutlineFont = False
    .Shadow = False
    .Underline = xlUnderlineStyleNone
    .ColorIndex = xlAutomatic
    .TintAndShade = 0
    .ThemeFont = xlThemeFontNone
  End With
  Call Adjust_column_widht_to_data_Overview
  Range("A1").CurrentRegion.Name = "Order_BookHistRange"  'Adjust Order_BookHistRange as the list gets
longer
  Range("A1").CurrentRegion.Name = "BestChoiceH"  'Adjust BestChoiceH as the list gets longer
  Range("BestChoiceH").FormatConditions.Delete

  Sheets("OrderBookHist").Select
  Sheets("OrderBookHist").Range("C3:C" & LastRowH + newrows).Select
  Selection.FormatConditions.Add Type:=xlExpression, Formula1:="=$i3>0"
  Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
```

```
    With Selection.FormatConditions(1).Interior
        .PatternColorIndex = xlAutomatic
        .Color = 5296274
        .TintAndShade = 0
    End With
    Selection.FormatConditions(1).StopIfTrue = False

    Sheets("OrderBookHist").Range("C3:C" & LastRowH + newrows).Select
    Selection.FormatConditions.Add Type:=xlExpression, Formula1:="=$i3<0"
    Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
    With Selection.FormatConditions(1).Interior
        .PatternColorIndex = xlAutomatic
        .Color = RGB(241, 192, 173)
        .TintAndShade = 0
    End With
    Selection.FormatConditions(1).StopIfTrue = False

    Selection.FormatConditions.Add Type:=xlExpression, Formula1:="=$Q3<0"
    Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
    With Selection.FormatConditions(1).Font
        .Color = -16776961
        .TintAndShade = 0
    End With
    Selection.FormatConditions(1).StopIfTrue = False

    'Conditional styling rules for Balance column
    Sheets("OrderBookHist").Range("Q3:Q" & LastRowH + newrows).Select
    Selection.NumberFormat = "0.00_ ;[Red]-0.00 "
    Selection.FormatConditions.Add Type:=xlExpression, Formula1:="=$Q3<0"
    Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
    Selection.FormatConditions(1).StopIfTrue = False

    'If no history then first run otherwise add one for the run counter
    If LastRowH = 2 Then
        Range("Lists!m5") = 1
     Else
        Range("Lists!m5") = Range("OrderBookHist!r" & LastRowH) + 1
    End If

'Maintains the run counter
    For i = LastRowH To j - 1
        Range("OrderBookHist!r" & i + 1) = Range("Lists!m5")
    Next i

    Range("A3:B" & LastRowH + newrows).Select
    Selection.FormatConditions.Add Type:=xlExpression, Formula1:="=$p3<>0"
    Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
    With Selection.FormatConditions(1).Interior
        .PatternColorIndex = xlAutomatic
        .ThemeColor = xlThemeColorAccent5
        .TintAndShade = 0.799981688894314
    End With
    Selection.FormatConditions(1).StopIfTrue = False

    Range("d3:r" & LastRowH + newrows).Select
    Selection.FormatConditions.Add Type:=xlExpression, Formula1:="=$p3<>0"
```

```
    Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
    With Selection.FormatConditions(1).Interior
        .PatternColorIndex = xlAutomatic
        .ThemeColor = xlThemeColorAccent5
        .TintAndShade = 0.799981688894314
    End With
    Selection.FormatConditions(1).StopIfTrue = False

    'Checks if the OrderBookHist is empty. If so do not run RefreshFromAccessPortofolio.
    Sheets("OrderBookHist").Select
    Range("a1").Select
    LastRowH = ActiveSheet.Range("A65536").End(xlUp).Row
    Sheets("OrderBook").Select
    Call listworksheetsToCleanup 'moved these 4 lines over the refresh from accessportofilio command to awoid
warning
    Call MakeSheetIndex
  '  Call FileSaveAsParameters
  '  Call FileSaveAsWorkingCopy

    If LastRowH > 2 Then
        Call CorrAccBal 'Added 12.5.2010
        Call RefreshFromAccessPortofolio 'Added here to get a fresh number of stocks in hand
        'Updates the available balanse on budget sheet
        Range("Budget!c6") = Range("OrderBookHist!q" & LastRowH)
    End If

End Sub
Sub fileSave()
    Call FileSaveAsParameters
    Call FileSaveAsWorkingCopy
End Sub
Sub CorrAccBal()
Dim i As Integer, LastRowH As Integer
    Sheets("OrderBookHist").Select
    Range("a1").Select
    LastRowH = ActiveSheet.Range("A65536").End(xlUp).Row
    Range("Budget!c6") = Range("Budget!c3")
    For i = 3 To LastRowH
      If i = 3 Then
        Range("OrderBookHist!q" & i) = Range("Budget!c6") - Range("OrderBookHist!d" & i)
        Else
        Range("OrderBookHist!q" & i) = Range("OrderBookHist!q" & i - 1) - Range("OrderBookHist!d" & i)
      End If
    Next i
    If Range("OrderBookHist!q" & LastRowH).Value = "Balance" Then
        Range("Budget!c6") = Range("Budget!c3")
        Else
        Range("Budget!c6") = Range("OrderBookHist!q" & LastRowH)
        End If
End Sub
Sub AutoOrder()
'Do While Time() < "9:00:00" And Time() < "16:00:00"
Dim i As Integer
For i = 1 To 2
    Call CreateOrderBook
  '  Call UpdateOrderBookHistory
```

```
    Call MakeIntradaySheets
'   Call RefreshFromAccessPortofolio
'   Application.Wait (Now() + TimeValue("0:06:00")) 'Delay to let the webqueries run before continuing
Next i
'Loop
End Sub
Sub MakeCompListAll()
Dim NewSheet As Worksheet, i As Integer, compname As Variant, compnamestr As String, newrows As Integer,
j As Integer
Dim v1 As String, v2 As String, w2 As String, v3 As String, w3 As String, prev As String, totrows As Integer
Dim lastrowP As Integer, k As Integer
newrows = findMaxRowForOrderBookSelection
'totrows = newrows * 2
Sheets("Lists2").Select
j = 2
For i = 3 To newrows + 1
    v1 = Range("Lists!o" & i).Value

    Range("Lists!p" & i).Value = Range(v1 & "!b4")
    v2 = Range(v1 & "!b4")
    Range("Lists!q" & i).Value = StripSymbol(v2)
    v3 = StripSymbol(v2)

    Range("Lists!r" & i).Value = Range(v1 & "!d4")
    w2 = Range(v1 & "!d4")
    Range("Lists!s" & i).Value = StripSymbol(w2)
    w3 = StripSymbol(w2)
    j = j + 1
    Range("Lists2!a" & j).Value = v3
    Range("Lists!t" & j).Value = v3

    j = j + 1
    Range("Lists2!a" & j).Value = w3
    Range("Lists!t" & j).Value = w3
Next i

'Adds stocks from portofolio since I want them also to be refreshed

'   Dim compname As Variant, compnamestr As String, i As Integer, lastrowP As Integer
    Sheets("Portofolio").Select
    Range("a1").Select
    'lastrowP = ActiveSheet.Range("A65536").End(xlUp).Row
    lastrowP = ActiveSheet.Range("A65536").End(xlUp).Row - 3 '27.5.2010 added -3 since sum fields at the
bottom
    For k = 2 To lastrowP
        Range("Lists2!a" & j + k - 1) = StripSymbol(Range("Portofolio!a" & k))
    '   MsgBox "Compname: " & Range("Portofolio!a" & k)
    Next k
totrows = newrows * 2 + lastrowP - 1

'Range("Lists2!a" & j + 1 & ":a" & j + 1 + lastrowP - 1) = Range("Portofolio!a2:a" & lastrowP)

Calculate


'Sorts the column
```

```
Sheets("Lists2").Select
   Columns("A:A").Select
   ActiveWorkbook.Worksheets("Lists2").Sort.SortFields.Clear
   ActiveWorkbook.Worksheets("Lists2").Sort.SortFields.Add Key:=Range("A1"), _
      SortOn:=xlSortOnValues, Order:=xlAscending, DataOption:=xlSortNormal
   With ActiveWorkbook.Worksheets("Lists2").Sort
      .SetRange Range("A1:A" & totrows)
      .Header = xlNo
      .MatchCase = False
      .Orientation = xlTopToBottom
      .SortMethod = xlPinYin
      .Apply
   End With
'Removes duplicates from the list
Call RemoveDupes
End Sub
Sub RemoveDupes()
   'Add extra Column, "A" becomes "B"
   Columns(1).EntireColumn.Insert
   'Filter out duplicates and copy unique list to "A"
   Range("B1", Range("B65536").End(xlUp)).AdvancedFilter _
      Action:=xlFilterCopy, CopyToRange:=Range("A1"), Unique:=True
   'Add extra Column, "B" becomes "A"
   Columns(2).EntireColumn.Delete
End Sub
Function FindNoOfStock(compname As Variant) As Double
   Dim i As Integer, lastrowP As Integer
   Sheets("Portofolio").Select
   Range("a1").Select
   'lastrowP = ActiveSheet.Range("A65536").End(xlUp).Row
   lastrowP = ActiveSheet.Range("A65536").End(xlUp).Row - 3 '27.5.2010 added -3 since sum fields at the
bottom
   For i = 2 To lastrowP
      If Sheets("Portofolio").Range("d" & i).Value = compname Then
      FindNoOfStock = Sheets("Portofolio").Range("d" & i).Value
      ' MsgBox "noOfStock: " & noOfStock
      Exit For
      End If
   Next i
End Function
Function StripSymbol(compnamestr As String) As String
      StripSymbol = Left(compnamestr, Len(compnamestr) - 3)
End Function
Function findMaxRowForOrderBookSelection() As Integer
   Call start
   Dim i As Integer, rng As Range, rng2 As Range, maxrow As Integer
   combcounter = Range("Lists!m2")
   Set rng = Sheets("NewOverviewSorted").Range("L3:L" & combcounter)
   Set rng2 = Sheets("NewOverviewSorted").Range("K3:K" & combcounter)
   For i = 1 To combcounter
     If rng(i) <> 1 Or rng2(i) <> "Alg" Then
       findMaxRowForOrderBookSelection = i
       Exit For
     End If
   Next i
End Function
```

```
Function findMaxRowForOrderBookSelectionAlt() As Integer
'Alternative approach - if used the sorted overview must be sorted by the "better than the best column"
'It can be done by changing sort column i overview prepare subroutine
   Call start
   Dim i As Integer, rng As Range, maxrow As Integer
   combcounter = Range("Lists!m2")
   Set rng = Sheets("NewOverviewSorted").Range("q3:q" & combcounter)
   For i = 1 To combcounter
     If rng(i) <= 0 Then 'Exits reading through combinations when it hits 0 or less than 0
       findMaxRowForOrderBookSelection = i + 3 'Added +3 to get some ekstra combinations
       Exit For
     End If
   Next i
End Function
Sub ReturnToSortedOverview()
   'ReturnToSortedOverview Macro
   'Keyboard Shortcut: Ctrl+Shift+R
   ActiveWindow.ScrollWorkbookTabs Position:=xlLast
   Sheets("OverviewSorted").Select
End Sub
Sub ReturnToNewSortedOverview()
   ActiveWindow.ScrollWorkbookTabs Position:=xlLast
   Sheets("NewOverviewSorted").Select
End Sub
Sub ReturnToOrderBook()
   ActiveWindow.ScrollWorkbookTabs Position:=xlLast
   Sheets("OrderBook").Select
End Sub
Sub ReturnToOrderBookHist()
   ActiveWindow.ScrollWorkbookTabs Position:=xlLast
   Sheets("OrderBookHist").Select
End Sub
Sub MakeIntradaySheets()
   Dim NewSheet As Worksheet, i As Integer, compname As Variant, compnamestr As String, newrows As
Integer, DNLink As String
   Call listworksheetsOnlyIntraToDeleteSheets 'new

   'Clears the working areas ---- new
   Sheets("Lists2").Select
   Range("a1:a200").Select
   Selection.ClearContents
   Sheets("Lists").Select
   Range("O3:W200").Select
   Selection.ClearContents

   newrows = findMaxRowForOrderBookSelection
   Sheets("Lists").Range("o3:o" & newrows + 1).Value = Sheets("NewOverviewSorted").Range("a3:a" &
newrows + 1).Value
   Call MakeCompListAll
   For i = 1 To 99
      If IsEmpty(Range("Lists2!a" & i)) = True Then Exit For
      compnamestr = Range("Lists2!a" & i)
      Call DeleteSheet("I_" & compnamestr)
      Set NewSheet = Sheets.Add(Type:=xlWorksheet)
      Sheets.Add After:=Sheets(Sheets.Count)
      Sheets(Sheets(Sheets.Count).Name).Select
```

```
    Sheets(Sheets(Sheets.Count).Name).Name = "I_" & compnamestr

    DNLink = "http://www.dn.no/finans/portal/stock-oslo?newt__ticker=" & compnamestr &
"&newt__context=oslo"
    Call MakeLink(Range("a1"), DNLink, compnamestr, compnamestr)

    Range("A2").Value = "Intraday:"
    Range("A3").Select
    With ActiveSheet.QueryTables.Add(Connection:= _
      "URL;http://www.oslobors.no/markedsaktivitet/stockOverview?newt__ticker=" & compnamestr _
      , Destination:=Range("$A$3"))
      .Name = "stockOverview?newt__ticker=" & compnamestr
      .FieldNames = True
      .RowNumbers = False
      .FillAdjacentFormulas = False
      .PreserveFormatting = True
      .RefreshOnFileOpen = False
      .BackgroundQuery = True
      .RefreshStyle = xlInsertDeleteCells
      .SavePassword = False
      .SaveData = True
      .AdjustColumnWidth = True
      .RefreshPeriod = 90 'Number of minutes between automatic refresh, initially 15 minutes
      .WebSelectionType = xlSpecifiedTables
      .WebFormatting = xlWebFormattingNone
      .WebTables = "3"
      .WebPreFormattedTextToColumns = True
      .WebConsecutiveDelimitersAsOne = True
      .WebSingleBlockTextImport = False
      .WebDisableDateRecognition = False
      .WebDisableRedirections = False
      .Refresh BackgroundQuery:=True
    End With

    'Makes heading bold for this section
    Range("A1:J3").Select
    Selection.Font.Bold = True
    Range("A6").Select
    ActiveCell.FormulaR1C1 = "Last movements:"
    Selection.Font.Bold = True

    Range("A7").Select
    With ActiveSheet.QueryTables.Add(Connection:= _
      "URL;http://www.oslobors.no/markedsaktivitet/stockOverview?newt__ticker=" & compnamestr _
      , Destination:=Range("$A$7"))
      .Name = "stockOverview?newt__ticker=" & compnamestr
      .FieldNames = True
      .RowNumbers = False
      .FillAdjacentFormulas = True
      .PreserveFormatting = True
      .RefreshOnFileOpen = False
      .BackgroundQuery = True
      .RefreshStyle = xlInsertDeleteCells
      .SavePassword = False
      .SaveData = True
      .AdjustColumnWidth = True
```

```
        .RefreshPeriod = 90 'Number of minutes between automatic refresh, initially 15 minutes
        .WebSelectionType = xlSpecifiedTables
        .WebFormatting = xlWebFormattingNone
        .WebTables = "9"
        .WebPreFormattedTextToColumns = True
        .WebConsecutiveDelimitersAsOne = True
        .WebSingleBlockTextImport = False
        .WebDisableDateRecognition = False
        .WebDisableRedirections = False
        .Refresh BackgroundQuery:=True
      End With

      'Makes heading bold for this section
      Range("A7:E7").Select
      Selection.Font.Bold = True
      'Adjust columnwith for first column
      Columns("A:A").ColumnWidth = 6.29
    Next i
    Call RefreshNews
    Call listworksheetsToCleanup
    Call MakeSheetIndex
End Sub
Sub RefreshNews()
' Updates the news sheet
' RefreshNews Macro
    ActiveWorkbook.Connections("Connection2").Refresh
End Sub
Sub FileSaveAsParameters()
'       "C:\Users\Jyri\Documents\Jyris etterutdanning 2\Masteroppgave\Regneark\Jyris Regresjon\" &
FileSaveAsParametersP & "BlendedStrategy.xlsm"
    MsgBox "File is beeing saved as: " & Range("Lists2!c7").Value & FileSaveAsParametersP &
"BlendedStrategy.xlsm"
    ActiveWorkbook.SaveAs Filename:= _
        Range("Lists2!c7").Value & FileSaveAsParametersP & "BlendedStrategy.xlsm" _
        , FileFormat:=xlOpenXMLWorkbookMacroEnabled, CreateBackup:=True
End Sub
Sub FileSaveAsWorkingCopy()
'       "C:\Users\Jyri\Documents\Jyris etterutdanning 2\Masteroppgave\Regneark\Jyris
Regresjon\WorkingCopyBlendedStrategy.xlsm"
    Dim MethodInd As String
    MethodInd = Range("Lists!j5")
    MsgBox "File is beeing saved as:" & Range("Lists2!c7").Value & "WorkingCopyBlendedStrategy.xlsm"
    ActiveWorkbook.SaveAs Filename:= _
        Range("Lists2!c7").Value & "WorkingCopyBlendedStrategy.xlsm" _
        , FileFormat:=xlOpenXMLWorkbookMacroEnabled, CreateBackup:=True
End Sub
Function FileSaveAsParametersP()
    Call start
    Dim days As Integer, colim As Double, lrlim As Double, sdays As String, cl As String, lrl As String
    Dim lastdate As String, firstdate As String, MethodInd As String
    days = Range("Lists!g9").Value
    colim = Round(Range("Lists!i8").Value, 2)
    lrlim = Round(Range("Lists!k33").Value, 2)
    sdays = str(days)
    cl = str(colim)
    lrl = str(lrlim)
```

```
    MethodInd = Range("Lists!j5")
    firstdate = Range("FinalStockPriceQuery!A2").Value
    lastdate = Range("FinalStockPriceQuery!A" & IMPnorows + 1).Value
    FileSaveAsParametersP = "FSPQ_" & sdays & "_Days_" & cl & "_CorrLim_" & lrl & "_LRLim_" & firstdate & "_"
& lastdate & "_" & MethodInd
End Function
Sub DeleteSheet(strSheetName As String)
    'Deletes a sheet named strSheetName in the active workbook
    Application.DisplayAlerts = False
    On Error Resume Next 'new
    Sheets(strSheetName).Delete
    Application.DisplayAlerts = True
End Sub
Sub listworksheetsOnlyAlgoToDeleteSheets()
    'Deletes sheets with names like Algo* and Sheet*
    Dim NewSheet As Worksheet, i As Integer, j As Integer, shname As Variant, shteller As Integer,
shnamarr(500) As String
    Dim shnamstr As String
    Set NewSheet = Sheets.Add(Type:=xlWorksheet)
    shteller = Sheets.Count 'Totalt antall sheet'er tas vare på i en variabel som er fast og ikke endrer seg under
veis
    j = 0
    For i = 1 To shteller
'       If Sheets(i).Name Like "Algo*" Or Sheets(i).Name Like "Sheet*" Or Sheets(i).Name Like "Overview*" Or
Sheets(i).Name Like "NewOverview*" Or Sheets(i).Name Like "I_*" Then
      If Sheets(i).Name Like "Algo*" Or Sheets(i).Name Like "Sheet*" Or Sheets(i).Name Like "Overview*" Or
Sheets(i).Name Like "NewOverview*" Then 'I want to keep the i_*-sheets used in history
          j = j + 1 'Legger første forekomsten på første linjen osv.
          NewSheet.Cells(j, 1).Value = Sheets(i).Name
          shname = Sheets(i).Name
          shnamarr(j) = shname
      End If
    Next i
    For i = 1 To j
          shname = shnamarr(i)
          shnamstr = shname
          Call DeleteSheet(shnamstr)
    Next i
    End Sub
Sub listworksheetsOnlyIntraToDeleteSheets()
    'Deletes sheets with names like Algo* and Sheet*
    Dim NewSheet As Worksheet, i As Integer, j As Integer, shname As Variant, shteller As Integer,
shnamarr(500) As String
    Dim shnamstr As String
    Set NewSheet = Sheets.Add(Type:=xlWorksheet)
    shteller = Sheets.Count 'Totalt antall sheet'er tas vare på i en variabel som er fast og ikke endrer seg under
veis
    j = 0
    For i = 1 To shteller
      If Sheets(i).Name Like "I*" Then 'I want to keep the i_*-sheets used in history
          j = j + 1 'Legger første forekomsten på første linjen osv.
          NewSheet.Cells(j, 1).Value = Sheets(i).Name
          shname = Sheets(i).Name
          shnamarr(j) = shname
      End If
    Next i
```

```
   For i = 1 To j
         shname = shnamarr(i)
         shnamstr = shname
         Call DeleteSheet(shnamstr)
   Next i
   End Sub
Sub listworksheetsToCleanup()
   'Deletes sheets with names like Algo* and Sheet*
   Dim NewSheet As Worksheet, i As Integer, j As Integer, shname As Variant, shteller As Integer,
shnamarr(500) As String
   Dim shnamstr As String
   Set NewSheet = Sheets.Add(Type:=xlWorksheet)
   shteller = Sheets.Count 'Totalt antall sheet'er tas vare på i en variabel som er fast og ikke endrer seg under
veis
   j = 0
   For i = 1 To shteller
     If Sheets(i).Name Like "Sheet*" Then
         j = j + 1 'Legger første forekomsten på første linjen osv.
         NewSheet.Cells(j, 1).Value = Sheets(i).Name
         shname = Sheets(i).Name
         shnamarr(j) = shname
        'MsgBox shname & "First round" & j
     End If
   Next i
   For i = 1 To j
         shname = shnamarr(i)
        'MsgBox shname & "Second round" & i
         'Sheets(shname).Select
         'ActiveWindow.SelectedSheets.Delete
         shnamstr = shname
         Call DeleteSheet(shnamstr)
   Next i
End Sub
```

V3 - VBA – code behind the form of MACD application

```
Private Sub GenerateSheetsButton_Click()
   Call GenSheets
End Sub
Private Sub RefreshInputButton_Click()
   Call RefreshInput
End Sub
Private Sub CopyCountersButton_Click()
   Call CopyCounters
End Sub
Private Sub CloseButton_Click()
   Unload Me
End Sub
Private Sub UserForm_QueryClose(Cancel As Integer, _
   CloseMode As Integer)
   If CloseMode = vbFormControlMenu Then
     Cancel = True
     MsgBox "Please use the button!"
   End If
End Sub
```

V4 - VBA – code in Module 1 of MACD application

```
'This application produces MACD sheets for all the stocks at Oslo Stock Exhange.
'It uses the MACD histogram (differanse line) to give buy, hold or sell recommendations
'It produces a Momentum sheet where the previos days (5, 4, 3, 2 and 1 day)change is sorted in desending
order
'The stocks with highest momentum is ranked on top.
'This must be viewed together with the individual MACD sheets for each stock to see the graphical presentation
and to view the recommendations.
'
'This application was written by Jyri Egil Larikka on the spring of 2010
'to be a part of his master thesis
'where he studies different algorithm trading strategies.

Sub RefreshInput()
   'Refreshes both queries - one to get the stock prices and one to get symbols with the number of lines pr
symbol
   ActiveWorkbook.RefreshAll
   Sheets("CompSymbols").Select
   Columns("C:C").Select
   Selection.Delete Shift:=xlToLeft
   Selection.Delete Shift:=xlToLeft
   'Deletes Momentum sheet and all the MACD sheets to make ready for new generation
   Call listworksheetsToCleanup
   Sheets("CompSymbols").Select
   Range("a1").Select
End Sub
Sub CopyCounters()
Dim CSnorows As Long
   'Count number of rows an use it below
   Sheets("CompSymbols").Select
   Range("a1").Select
   Range(Selection, Selection.End(xlDown)).Select
   CSnorows = Selection.Rows.Count

   'Generates to help columns out of the template
   Range("C1").Select
   Sheets("CompSymbTempl").Select
   Range("C1:D7").Select
   Selection.Copy
   Sheets("CompSymbols").Select
   Range("C1").Select
   ActiveSheet.Paste
   Range("C7:D7").Select
   Application.CutCopyMode = False
   Selection.AutoFill Destination:=Range("C7:D" & CSnorows), Type:=xlFillDefault
   Range("C7:D" & CSnorows).Select
   Calculate
End Sub
Sub ClearContTempl()
'Clears the contest of the MACD template from columns h to z
   Sheets("MACDTemplate").Select
   Range("H4:z235").Select 'changed from z to p
   Selection.ClearContents
End Sub
Sub ParmChanges()
'Prepares the MACD template sheet before it is used in copying to the individual MACD sheets
```

```
    Dim firRowS As Integer, secRowS As Integer
    Dim firRowL As Integer, secRowL As Integer
    Dim firRowSL As Integer, secRowSL As Integer
    Dim maxRowH As Integer, maxRow As Integer
    Dim Mnorows As Integer
    Dim ConsStParm1 As Integer, ConsStParm2 As Integer
    Call ClearContTempl
    Call EmaShort_Change
    Call EmaLong_Change
    Call SignalDays_Change
    firRowS = Range("Lists!i9").Value + 3
    secRowS = firRowS + 1
    firRowL = Range("Lists!g9").Value + 3
    secRowL = firRowL + 1
    firRowSL = Range("Lists!k9").Value + firRowL - 1
    secRowSL = firRowSL + 1
    maxRowH = firRowSL + Range("Lists!k9").Value - 2
    maxRow = maxRowH + 1

    ConsStParm1 = firRowSL
    ConsStParm2 = maxRowH

    '1. column
    Range("MACDTemplate!H" & firRowS).Formula = "=AVERAGE(F4:F" & firRowS & ")"
    Range("MACDTemplate!H" & secRowS).Formula = "=(($H$2*(F" & secRowS & "-H" & firRowS & "))+H" &
firRowS & ")"

    '2. column
    Range("MACDTemplate!i" & firRowL).Formula = "=AVERAGE(F4:F" & firRowL & ")"
    Range("MACDTemplate!i" & secRowL).Formula = "=(($i$2*(F" & secRowL & "-i" & firRowL & "))+i" & firRowL
& ")"

    '3. column
    '=H29-I29
    Range("MACDTemplate!j" & firRowL).Formula = "=H" & firRowL & "-I" & firRowL

    '4. column
    Range("MACDTemplate!k" & firRowSL).Formula = "=AVERAGE(j" & firRowL & ":j" & firRowSL & ")"
    Range("MACDTemplate!k" & secRowSL).Formula = "=(($k$2*(j" & secRowSL & "-k" & firRowSL & "))+k" &
firRowSL & ")"

    '5. column
    Range("MACDTemplate!L" & firRowSL).Formula = "=J" & firRowSL & "-K" & firRowSL

    '6. column
    Range("MACDTemplate!m" & maxRow).Formula = "=L" & maxRow & "-L" & maxRow - 1

    '7. column
    Range("MACDTemplate!n" & maxRow + 4).Formula = "=SUM(M" & maxRow & ":M" & maxRow + 4 & ")"

    '8. column
    Range("MACDTemplate!o" & maxRowH).Formula = Range("Lists!k9").Value & "-DAYMAX"
    Range("MACDTemplate!o" & maxRow).Formula = "=MAX(L" & firRowSL & ":L" & maxRow & ")"

    '9. column
    Range("MACDTemplate!p" & maxRowH).Formula = Range("Lists!k9").Value & "-DAYMIN"
```

```
Range("MACDTemplate!p" & maxRow).Formula = "=MIN(L" & firRowSL & ":L" & maxRow & ")"


'Finds total number of rows in the template
Sheets("MACDTemplate").Select
Range("a1").Select
Range(Selection, Selection.End(xlDown)).Select
Mnorows = Selection.Rows.Count


'Autofills formulas downwords
Range("H" & secRowS).Select
Selection.AutoFill Destination:=Range("H" & secRowS & ":H" & secRowSL), Type:=xlFillDefault
Range("H" & secRowS & ":H" & secRowSL).Select
Range("I" & secRowL).Select
Selection.AutoFill Destination:=Range("I" & secRowL & ":I" & secRowSL), Type:=xlFillDefault
Range("I" & secRowL & ":I" & secRowSL).Select
Range("J" & firRowL).Select
Selection.AutoFill Destination:=Range("J" & firRowL & ":J" & secRowSL), Type:=xlFillDefault
Range("J" & firRowL & ":J" & secRowSL).Select
Range("L" & firRowSL).Select
Selection.AutoFill Destination:=Range("L" & firRowSL & ":L" & secRowSL), Type:=xlFillDefault
Range("L" & firRowSL & ":L" & secRowSL).Select
Range("H" & secRowSL & ":L" & secRowSL).Select
Selection.AutoFill Destination:=Range("H" & secRowSL & ":L" & Mnorows), Type:=xlFillDefault
Range("H" & secRowSL & ":L" & Mnorows).Select

Range("O" & maxRowH & ":P" & maxRowH).Select
Selection.Font.Bold = True
Range("O" & maxRow & ":P" & maxRow).Select
Selection.AutoFill Destination:=Range("O" & maxRow & ":P" & Mnorows), Type:=xlFillDefault
Range("O" & maxRow & ":P" & Mnorows).Select

Range("M" & maxRow).Select
Selection.AutoFill Destination:=Range("M" & maxRow & ":M" & maxRow + 4), Type:=xlFillDefault
Range("M" & maxRow + 4 & ":N" & maxRow + 4).Select
Selection.AutoFill Destination:=Range("M" & maxRow + 4 & ":N" & Mnorows), Type:=xlFillDefault
Range("M" & maxRow + 4 & ":N" & Mnorows).Select
Calculate

Range("m" & maxRow - 1) = "Change"
Range("m" & maxRow - 1).Select
Selection.Font.Bold = True
Range("n" & maxRow - 1) = "5d sum"
Range("n" & maxRow - 1).Select
Selection.Font.Bold = True
Range("h4") = "Description of color codes:"
Range("h4").Select
Selection.Font.Bold = True
Range("h5") = "Red fill means that differance line crosses below zero (Sell recommendation)."
Range("h6") = "Green fill means that differanse line crosses above zero (Buy recommendation)."
Range("h7") = "Light green numbers means that differanse line is sloping up from a bottom."
Range("h8") = "Pink numbers means that differancse line is sloping down from a top."
Range("h9") = "The last post in 5 day sum is used to make momentum ranking"
Range("h10") = "to see which stock has the best change to do it best tomorrow."
```

```
    Call AdjNewColumnsToRightStartLine(ConsStParm2, Mnorows)
    Call FormatDiffField(ConsStParm1)
    Call ClearCondStylingRulesOnTemplate(ConsStParm1)
    Call RedFill(ConsStParm1)
    Call GreenFill(ConsStParm1)
    Call LightGreenText(ConsStParm1, ConsStParm2)
    Call PinkText(ConsStParm1, ConsStParm2)
End Sub
Sub AdjNewColumnsToRightStartLine(ConsStParm2 As Integer, Mnorows As Integer)
    Sheets("MACDTemplate2").Select
    Range("Q44:X49").Select
    Selection.Copy
    Sheets("MACDTemplate").Select
    Range("Q" & ConsStParm2).Select
    ActiveSheet.Paste
    Range("Q" & ConsStParm2 + 5).Select
    Range(Selection, Selection.End(xlToRight)).Select
    Selection.AutoFill Destination:=Range("Q" & ConsStParm2 + 5 & ":X" & Mnorows), Type:=xlFillDefault
    Range("Q" & ConsStParm2 + 5 & ":X" & Mnorows).Select
    Calculate
End Sub
Sub FormatDiffField(ConsStParm1 As Integer)
'Format the differance field with more decimal places
    Range("L" & ConsStParm1).Select
    Range(Selection, Selection.End(xlDown)).Select
    Selection.NumberFormat = "#,##0.0000"
End Sub
Sub ClearCondStylingRulesOnTemplate(ConsStParm1 As Integer)
'Clears conditional styling rules on template
    Range("L" & ConsStParm1).Select
    Range(Selection, Selection.End(xlDown)).Select
    Selection.FormatConditions.Delete
End Sub
Sub RedFill(ConsStParm1 As Integer)
'Creates conditional styling rule for the differanse column - RedFill
    Range("L" & ConsStParm1).Select
    Range(Selection, Selection.End(xlDown)).Select
    Selection.FormatConditions.Add Type:=xlExpression, Formula1:= _
        "=AND($L" & ConsStParm1 & ">0;$L" & ConsStParm1 + 1 & "<0)"
    Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
    With Selection.FormatConditions(1).Interior
        .PatternColorIndex = xlAutomatic
        .Color = 255
        .TintAndShade = 0
    End With
    Selection.FormatConditions(1).StopIfTrue = False
End Sub
Sub GreenFill(ConsStParm1 As Integer)
'Creates conditional styling rule for the differanse column - GreenFill
    Selection.FormatConditions.Add Type:=xlExpression, Formula1:= _
        "=AND($L" & ConsStParm1 & "<0;$L" & ConsStParm1 + 1 & ">0)"
    Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
    With Selection.FormatConditions(1).Interior
        .PatternColorIndex = xlAutomatic
        .Color = 5296274
        .TintAndShade = 0
```

```
    End With
    Selection.FormatConditions(1).StopIfTrue = False
End Sub
Sub LightGreenText(ConsStParm1 As Integer, ConsStParm2 As Integer)
'Creates conditional styling rule for the differanse column - LightGreenText
    Selection.FormatConditions.Add Type:=xlExpression, Formula1:="=$L" & ConsStParm1 + 1 & ">$L" &
ConsStParm1 & ""
    Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
    With Selection.FormatConditions(1).Font
        .ThemeColor = xlThemeColorAccent3
        .TintAndShade = 0.399945066682943
    End With
    Selection.FormatConditions(1).StopIfTrue = False
End Sub
Sub PinkText(ConsStParm1 As Integer, ConsStParm2 As Integer)
'Creates conditional styling rule for the differanse column - PinkText
    Selection.FormatConditions.Add Type:=xlExpression, Formula1:="=$L" & ConsStParm1 + 1 & "<$L" &
ConsStParm1 & ""
    Selection.FormatConditions(Selection.FormatConditions.Count).SetFirstPriority
    With Selection.FormatConditions(1).Font
        .ThemeColor = xlThemeColorAccent2
        .TintAndShade = 0.599963377788629
    End With
    Selection.FormatConditions(1).StopIfTrue = False
End Sub
Private Sub EmaShort_Change()
'Updates the header on template sheet with the EMAShort value chosen by user
    Range("MACDTemplate!h1").Value = Range("Lists!i9").Value
    Range("MACDTemplate!h3").Value = Range("Lists!i9").Value & "ema"
End Sub
Private Sub EmaLong_Change()
'Updates the header on template sheet with the EmaLong value chosen by user
    Range("MACDTemplate!i1").Value = Range("Lists!g9").Value
    Range("MACDTemplate!i3").Value = Range("Lists!g9").Value & "ema"
End Sub
Private Sub SignalDays_Change()
'Updates the header on template sheet with the SignalDays value chosen by user
    Range("MACDTemplate!k1").Value = Range("Lists!k9").Value
    Range("MACDTemplate!k3").Value = Range("Lists!k9").Value & "ema"
End Sub
Sub GenSheets()
'Creates the indivudual MACD sheets (company sheets)
Dim i As Integer, j As Integer, comp As String, rng As Range, CSrng As Range, startpos As Integer
Call listworksheetsToCleanup
Call ParmChanges
Sheets("CompSymbols").Select
Range("a1").Select
Range(Selection, Selection.End(xlDown)).Select
CSnorows = Selection.Rows.Count
Set CSrng = Range("CompSymbols!a2:" & "d" & CSnorows)
Call MakeMomentumSheet 'Makes the headings on momentum sheet

For i = 1 To CSnorows
'For i = 1 To 4 'Temperary short loop to test functionality instead of the above complet loop

    'Makes companysheet
```

```
    comp = Range("CompSymbols!a" & i + 1)
    If comp <> "" Then
      Sheets.Add After:=Sheets(Sheets.Count)
      Sheets(Sheets(Sheets.Count).Name).Select
      Call DeleteSheet(comp)
      Sheets(Sheets(Sheets.Count).Name).Name = comp

      'Fills data in to companysheet
      Sheets("MACDTemplate").Select
      Range("A1:z235").Select
      Selection.Copy
      Sheets(comp).Select
      Range("A1").Activate
      ActiveSheet.Paste
      Columns("B:B").ColumnWidth = 10.14

      Call ClearTooMany(comp, CSrng(i, 2))
      Calculate
      Call CopyData(comp, CSrng(i, 3), CSrng(i, 4))
      Calculate
      Call Adjust_column_widht_to_data_Overview(comp, CSrng(i, 4))

      startpos = Range("Lists!g9").Value + Range("Lists!k9").Value + 8 'Added 28.6.2010
      Call CopyGraph(comp, startpos, CSrng(i, 2) + 3) ' Changed 28.6.2010 to input number of data rows - now
more flexible
      Call AdjFirstGraph(comp, startpos, CSrng(i, 2) + 3) 'Added 28.6.2010
      Call AdjSecondGraph(comp, startpos, CSrng(i, 2) + 3) 'Added 28.6.2010
      Call AdjThirdGraph(comp, startpos, CSrng(i, 2) + 3) 'Added 28.6.2010

      Range("A1").Activate
      Calculate
      Call BestMomentum(comp, CSrng(i, 2), i)
      Calculate
      Call MakeSignals(comp, CSrng(i, 2), i)
      Calculate
      Range("n" & CSrng(i, 2) + 3).Select 'new
      Selection.Font.Bold = True
    End If
Next i
Call SortMomentum
Call GiveBackGroundColor(CSnorows + 1)
Call MakeSheetIndex
Calculate
End Sub
Sub GiveBackGroundColor(CSnorowsH As Integer)
'Gives different background color in momentum sheet to distinct the three groups of data from each other
    Sheets("Momentum").Select
    Range("A1:F" & CSnorowsH).Select
    With Selection.Interior
        .Pattern = xlSolid
        .PatternColorIndex = xlAutomatic
        .ThemeColor = xlThemeColorLight2
        .TintAndShade = 0.799981688894314
        .PatternTintAndShade = 0
    End With
    Range("G1:P" & CSnorowsH).Select
```

```
    With Selection.Interior
        .Pattern = xlSolid
        .PatternColorIndex = xlAutomatic
        .ThemeColor = xlThemeColorDark2
        .TintAndShade = 0
        .PatternTintAndShade = 0
    End With
    Range("Q1:U" & CSnorowsH).Select
    With Selection.Interior
        .Pattern = xlSolid
        .PatternColorIndex = xlAutomatic
        .ThemeColor = xlThemeColorAccent2
        .TintAndShade = 0.799981688894314
        .PatternTintAndShade = 0
    End With
    Range("T9").Select
End Sub
Sub AdjFirstGraph(comp As String, startpos As Integer, norows As Integer)
'Added 28.6.2010 to syncronise the right data in the graph
    ActiveSheet.ChartObjects("Chart 4").Activate
    ActiveChart.PlotArea.Select
    ActiveChart.SeriesCollection(1).XValues = "=" & comp & "!$B$" & startpos & ":$B$" & norows
    ActiveChart.SeriesCollection(1).Name = "=" & comp & "!$F$3"
    ActiveChart.SeriesCollection(1).Values = "=" & comp & "!$F$" & startpos & ":$F$" & norows
    ActiveChart.SeriesCollection(2).Name = "=" & comp & "!$H$3"
    ActiveChart.SeriesCollection(2).Values = "=" & comp & "!$H$" & startpos & ":$H$" & norows
    ActiveChart.SeriesCollection(3).Name = "=" & comp & "!$I$3"
    ActiveChart.SeriesCollection(3).Values = "=" & comp & "!$I$" & startpos & ":$I$" & norows
    ActiveChart.SeriesCollection(3).XValues = "=" & comp & "!$B$" & startpos & ":$B$" & norows
End Sub
Sub AdjSecondGraph(comp As String, startpos As Integer, norows As Integer)
'Added 28.6.2010 to syncronise the right data in the graph
    ActiveSheet.ChartObjects("Chart 5").Activate
    ActiveChart.SeriesCollection(1).XValues = "=" & comp & "!$B$" & startpos & ":$B$" & norows
    ActiveChart.SeriesCollection(1).Name = "=" & comp & "!$J$3"
    ActiveChart.SeriesCollection(1).Values = "=" & comp & "!$J$" & startpos & ":$J$" & norows
    ActiveChart.SeriesCollection(2).Name = "=" & comp & "!$K$3"
    ActiveChart.SeriesCollection(2).Values = "=" & comp & "!$K$" & startpos & ":$K$" & norows
End Sub
Sub AdjThirdGraph(comp As String, startpos As Integer, norows As Integer)
'Added 28.6.2010 to syncronise the right data in the graph
    ActiveSheet.ChartObjects("Chart 6").Activate
    ActiveChart.PlotArea.Select
    ActiveChart.SeriesCollection(1).XValues = "=" & comp & "!$B$" & startpos & ":$B$" & norows
    ActiveChart.SeriesCollection(1).Name = "=" & comp & "!$L$3"
    ActiveChart.SeriesCollection(1).Values = "=" & comp & "!$L$" & startpos & ":$L$" & norows
End Sub
Sub CopyData(comp As String, StartRow As Long, EndRow As Long)
'Copy data from AllStock sheet to the individual MACD sheets.
'The StartRow and EndRow are the rownumbers where to locate company data from the AllStock sheet.
    Dim DNLink As String, compshort As String
    Sheets("AllStock").Select
    Range("A" & StartRow & ":E" & EndRow).Select
    Selection.Copy
    Sheets(comp).Select
    Range("A4").Select
```

```
    ActiveSheet.Paste

    Sheets("AllStock").Select
    Range("G" & StartRow & ":G" & EndRow).Select
    Range("G" & EndRow & "").Activate
    Application.CutCopyMode = False
    Selection.Copy
    Sheets(comp).Select
    Range("F4").Select
    ActiveSheet.Paste

    Sheets("AllStock").Select
    Range("F" & StartRow & ":F" & EndRow).Select
    Application.CutCopyMode = False
    Selection.Copy
    Sheets(comp).Select
    Range("G4").Select
    ActiveSheet.Paste

    compshort = Left(Range("a4"), Len(Range("a4")) - 3)
    'Makes a link to internet newspaper
    DNLink = "http://www.dn.no/finans/portal/stock-oslo?newt__ticker=" & compshort &
"&newt__context=oslo"
    Call MakeLink(Range("L2"), DNLink, compshort, compshort)
    Range("L1") = "Link dn.no:"
End Sub
Sub MakeMomentumSheet()
'Makes momentum sheet headings
    Call DeleteSheet("Momentum")
    Sheets.Add After:=Sheets(Sheets.Count)
    Sheets(Sheets(Sheets.Count).Name).Select
    Sheets(Sheets(Sheets.Count).Name).Name = "Momentum"
    Range("A1").Select
    ActiveCell.FormulaR1C1 = "Momentum"

    Range("B1").Select
    ActiveCell.FormulaR1C1 = "Which stocks are rising fasttest in the MACD histogram (differance)"

'new 29.6.2010
    Range("H1").Select
    ActiveCell.FormulaR1C1 = "Sorted overview (The best buy candidates on top with number of days
momentum.)"

    Range("Q1").Select
    ActiveCell.FormulaR1C1 = "Overview sorted by Signal (ascend.) and then by 5 day mom. (desc.)"
'end new

    Range("A2").Select
    ActiveCell.FormulaR1C1 = "Symbol"

    Range("B2").Select
    ActiveCell.FormulaR1C1 = "5 day mom"
    Range("c2").Select
    ActiveCell.FormulaR1C1 = "4 day mom"
    Range("d2").Select
    ActiveCell.FormulaR1C1 = "3 day mom"
```

```
    Range("e2").Select
    ActiveCell.FormulaR1C1 = "2 day mom"
    Range("f2").Select
    ActiveCell.FormulaR1C1 = "1 day mom"

    Range("g2").Select
    ActiveCell.FormulaR1C1 = "Symbol"

    Range("h2").Select
    ActiveCell.FormulaR1C1 = "5 day mom"

    Range("i2").Select
    ActiveCell.FormulaR1C1 = "Symbol"

    Range("j2").Select
    ActiveCell.FormulaR1C1 = "4 day mom"

    Range("k2").Select
    ActiveCell.FormulaR1C1 = "Symbol"

    Range("l2").Select
    ActiveCell.FormulaR1C1 = "3 day mom"

    Range("m2").Select
    ActiveCell.FormulaR1C1 = "Symbol"

    Range("n2").Select
    ActiveCell.FormulaR1C1 = "2 day mom"

    Range("o2").Select
    ActiveCell.FormulaR1C1 = "Symbol"

    Range("p2").Select
    ActiveCell.FormulaR1C1 = "1 day mom"

'new 29.6.2010
    Range("q2").Select
    ActiveCell.FormulaR1C1 = "Symbol"

    Range("r2").Select
    ActiveCell.FormulaR1C1 = "no days since min/max"

    Range("s2").Select
    ActiveCell.FormulaR1C1 = "last mark"

    Range("t2").Select
    ActiveCell.FormulaR1C1 = "5 day mom"

    Range("u2").Select
    ActiveCell.FormulaR1C1 = "Signal"
'new end

    Range("A1:z2").Select 'Changed to Z
    Selection.Font.Bold = True
    Range("A1").Select
    Selection.Font.Size = 12
```

```
End Sub
Sub BestMomentum(comp As String, numrows As Integer, i As Integer)
'Collects the momentum data in to an array - row by row - Called by the loop of GenSheets subroutine.
   Dim momrng As Range
   Set momrng = Range("Momentum!a3:f" & numrows + 3)
   momrng(i, 1) = comp
   momrng(i, 2) = Range(comp & "!n" & numrows + 3)
   momrng(i, 3) = Range(comp & "!q" & numrows + 3)
   momrng(i, 4) = Range(comp & "!r" & numrows + 3)
   momrng(i, 5) = Range(comp & "!s" & numrows + 3)
   momrng(i, 6) = Range(comp & "!t" & numrows + 3)
End Sub
Sub MakeSignals(comp As String, numrows As Integer, i As Integer)
'Collects the momentum data in to an array - row by row - Called by the loop of GenSheets subroutine.
   Dim signrng As Range
   Set signrng = Range("Momentum!q3:u" & numrows + 3)
   signrng(i, 1) = comp
   signrng(i, 2) = Range(comp & "!w" & numrows + 3)
   signrng(i, 3) = Range(comp & "!v" & numrows + 3)
   signrng(i, 4) = Range(comp & "!n" & numrows + 3)
   signrng(i, 5) = Range(comp & "!x" & numrows + 3)
End Sub
Sub SortMomentum()
'Collects the different number of days symbol and momentum on the right side to sort them.
'Sorts the different momentum symbol, momentum pairs in descending momentum order.
'and makes link to the individual MACD sheets from all the symbols.
   Dim norows As Integer, i As Integer
   Sheets("Momentum").Select
   Range("A3:B3").Select
   Range(Selection, Selection.End(xlDown)).Select
   norows = Selection.Rows.Count
   Application.CutCopyMode = False
   Selection.Copy

   Range("g3").Select
   ActiveSheet.Paste

   Range("A3:a" & norows + 2).Select
   Selection.Copy
   Range("i3").Select
   ActiveSheet.Paste
   Range("k3").Select
   ActiveSheet.Paste
   Range("m3").Select
   ActiveSheet.Paste
   Range("o3").Select
   ActiveSheet.Paste

   Range("c3:c" & norows + 2).Select
   Selection.Copy
   Range("j3").Select
   ActiveSheet.Paste

   Range("d3:d" & norows + 2).Select
   Selection.Copy
   Range("l3").Select
```

```
    ActiveSheet.Paste

    Range("e3:e" & norows + 2).Select
    Selection.Copy
    Range("n3").Select
    ActiveSheet.Paste

    Range("f3:f" & norows + 2).Select
    Selection.Copy
    Range("p3").Select
    ActiveSheet.Paste

    'Sorts 1. group
    ActiveWorkbook.Worksheets("Momentum").Sort.SortFields.Clear
    ActiveWorkbook.Worksheets("Momentum").Sort.SortFields.Add Key:=Range( _
        "h3:h" & norows + 3), SortOn:=xlSortOnValues, Order:=xlDescending, DataOption:= _
        xlSortNormal
    With ActiveWorkbook.Worksheets("Momentum").Sort
        .SetRange Range("h2:g" & norows + 3)
        .Header = xlYes
        .MatchCase = False
        .Orientation = xlTopToBottom
        .SortMethod = xlPinYin
        .Apply
    End With
    'Makes link to the individual MACD sheets
    For i = 3 To norows + 2
        Call MakeLink(Range("Momentum!g" & i), "#" & Range("Momentum!g" & i) & "!A" & i,
Range("Momentum!g" & i), Range("Momentum!g" & i))
    Next i

    'Sorts 2. group
    ActiveWorkbook.Worksheets("Momentum").Sort.SortFields.Clear
    ActiveWorkbook.Worksheets("Momentum").Sort.SortFields.Add Key:=Range( _
        "j3:j" & norows + 3), SortOn:=xlSortOnValues, Order:=xlDescending, DataOption:= _
        xlSortNormal
    With ActiveWorkbook.Worksheets("Momentum").Sort
        .SetRange Range("i2:j" & norows + 3)
        .Header = xlYes
        .MatchCase = False
        .Orientation = xlTopToBottom
        .SortMethod = xlPinYin
        .Apply
    End With
    'Makes link to the individual MACD sheets
    For i = 3 To norows + 2
        Call MakeLink(Range("Momentum!i" & i), "#" & Range("Momentum!i" & i) & "!A" & i,
Range("Momentum!i" & i), Range("Momentum!i" & i))
    Next i

    'Sorts 3. group
    ActiveWorkbook.Worksheets("Momentum").Sort.SortFields.Clear
    ActiveWorkbook.Worksheets("Momentum").Sort.SortFields.Add Key:=Range( _
        "l3:l" & norows + 3), SortOn:=xlSortOnValues, Order:=xlDescending, DataOption:= _
        xlSortNormal
    With ActiveWorkbook.Worksheets("Momentum").Sort
```

```
        .SetRange Range("k2:l" & norows + 3)
        .Header = xlYes
        .MatchCase = False
        .Orientation = xlTopToBottom
        .SortMethod = xlPinYin
        .Apply
    End With
    'Makes link to the individual MACD sheets
    For i = 3 To norows + 2
        Call MakeLink(Range("Momentum!k" & i), "#" & Range("Momentum!k" & i) & "!A" & i,
Range("Momentum!k" & i), Range("Momentum!k" & i))
    Next i

    'Sorts 4. group
    ActiveWorkbook.Worksheets("Momentum").Sort.SortFields.Clear
    ActiveWorkbook.Worksheets("Momentum").Sort.SortFields.Add Key:=Range( _
        "n3:n" & norows + 3), SortOn:=xlSortOnValues, Order:=xlDescending, DataOption:= _
        xlSortNormal
    With ActiveWorkbook.Worksheets("Momentum").Sort
        .SetRange Range("m2:n" & norows + 3)
        .Header = xlYes
        .MatchCase = False
        .Orientation = xlTopToBottom
        .SortMethod = xlPinYin
        .Apply
    End With
    'Makes link to the individual MACD sheets
    For i = 3 To norows + 2
        Call MakeLink(Range("Momentum!m" & i), "#" & Range("Momentum!m" & i) & "!A" & i,
Range("Momentum!m" & i), Range("Momentum!m" & i))
    Next i

    'Sorts 5. group
    ActiveWorkbook.Worksheets("Momentum").Sort.SortFields.Clear
    ActiveWorkbook.Worksheets("Momentum").Sort.SortFields.Add Key:=Range( _
        "p3:p" & norows + 3), SortOn:=xlSortOnValues, Order:=xlDescending, DataOption:= _
        xlSortNormal
    With ActiveWorkbook.Worksheets("Momentum").Sort
        .SetRange Range("o2:p" & norows + 3)
        .Header = xlYes
        .MatchCase = False
        .Orientation = xlTopToBottom
        .SortMethod = xlPinYin
        .Apply
    End With
    'Makes link to the individual MACD sheets
    For i = 3 To norows + 2
        Call MakeLink(Range("Momentum!o" & i), "#" & Range("Momentum!o" & i) & "!A" & i,
Range("Momentum!o" & i), Range("Momentum!o" & i))
    Next i

    'Sorts 6. group
    'Sorts first by signal (ascending) and the by 5 day momentum value (descending)
    ActiveWorkbook.Worksheets("Momentum").Sort.SortFields.Clear
    ActiveWorkbook.Worksheets("Momentum").Sort.SortFields.Add Key:=Range( _
        "u3:u" & norows + 3), SortOn:=xlSortOnValues, Order:=xlAscending, DataOption:= _
```

```
      xlSortNormal
   ActiveWorkbook.Worksheets("Momentum").Sort.SortFields.Add Key:=Range( _
      "T3:T146"), SortOn:=xlSortOnValues, Order:=xlDescending, DataOption:= _
      xlSortNormal
   With ActiveWorkbook.Worksheets("Momentum").Sort
      .SetRange Range("q2:u" & norows + 3)
      .Header = xlYes
      .MatchCase = False
      .Orientation = xlTopToBottom
      .SortMethod = xlPinYin
      .Apply
   End With
   'Makes link to the individual MACD sheets
   For i = 3 To norows + 2
      Call MakeLink(Range("Momentum!q" & i), "#" & Range("Momentum!q" & i) & "!A" & i,
Range("Momentum!q" & i), Range("Momentum!q" & i))
   Next i
End Sub
Sub ReturnToIndexButton_Click()
'Performs the action connected to the ReturnToIndexButton_Click
   Sheets("Sheet Index").Select
   Range("a1").Select
End Sub
Sub ReturnToMomentumButton_Click()
'Performs the action connected to the ReturnToMomentumButton_Click
   Sheets("Momentum").Select
   Range("a1").Select
End Sub
Sub MakeLink(ByVal cell As Range, ByVal url As String, ByVal txt As String, ByVal tooltip_text As String)
'Subroutine MakeLink adds a hyperlink to the active worksheet. It calls the Hyperlinks collection's Add method,
'passing it the link's cell, URL, tooltip text, and display text.
   ActiveSheet.Hyperlinks.Add _
      Anchor:=cell, _
      Address:=url, _
      ScreenTip:=tooltip_text, _
      TextToDisplay:=txt
End Sub
Sub CopyGraph(comp As String, startpos As Integer, norows As Integer)
'Copies the three graphs from from the template to each individual MACD sheet (companysheet)
   Sheets("MACDTemplate").Select
   ActiveSheet.ChartObjects("Chart 2").Activate 'ChartName source
   ActiveChart.ChartArea.Copy
   Sheets(comp).Select
   Range("o1").Select
   ActiveSheet.Paste

   Sheets("MACDTemplate").Select
   ActiveSheet.ChartObjects("Chart 4").Activate 'ChartName source
   ActiveChart.ChartArea.Copy
   Sheets(comp).Select
   Range("o17").Select
   ActiveSheet.Paste

   Sheets("MACDTemplate").Select
   ActiveSheet.ChartObjects("Chart 5").Activate 'ChartName source
   ActiveChart.ChartArea.Copy
```

```
    Sheets(comp).Select
    Range("o27").Select
    ActiveSheet.Paste

    ActiveSheet.ChartObjects("Chart 1").Activate 'ChartName destination
    ActiveChart.PlotArea.Select
    ActiveChart.SeriesCollection(1).XValues = comp & "!$B$" & startpos & ":$B$" & norows + 3
    ActiveChart.SeriesCollection(1).Name = "=" & comp & "!$F$3"
    ActiveChart.SeriesCollection(1).Values = comp & "!$F$" & startpos & ":$F$" & norows + 3
    ActiveChart.SeriesCollection(2).Name = "=" & comp & "!$H$3"
    ActiveChart.SeriesCollection(2).Values = comp & "!$H$" & startpos & ":$H$" & norows + 3
    ActiveChart.SeriesCollection(3).Name = "=" & comp & "!$I$3"
    ActiveChart.SeriesCollection(3).Values = comp & "!$I$" & startpos & ":$I$" & norows + 3

    ActiveSheet.ChartObjects("Chart 2").Activate  'ChartName destination
    ActiveChart.PlotArea.Select
    ActiveChart.SeriesCollection(1).XValues = comp & "!$B$" & startpos & ":$B$" & norows + 3
    ActiveChart.SeriesCollection(1).Name = "=" & comp & "!$J$3"
    ActiveChart.SeriesCollection(1).Values = comp & "!$J$" & startpos & ":$J$" & norows + 3
    ActiveChart.SeriesCollection(2).Name = "=" & comp & "!$K$3"
    ActiveChart.SeriesCollection(2).Values = comp & "!$K$" & startpos & ":$K$" & norows + 3

    ActiveSheet.ChartObjects("Chart 3").Activate 'ChartName destination
    ActiveChart.PlotArea.Select
    ActiveChart.SeriesCollection(1).XValues = comp & "!$B$" & startpos & ":$B$" & norows + 3
    ActiveChart.SeriesCollection(1).Name = "=" & comp & "!$L$3"
    ActiveChart.SeriesCollection(1).Values = comp & "!$L$" & startpos & ":$L$" & norows + 3
End Sub
Sub Adjust_column_widht_to_data_Overview(comp As String, EndRow As Long)
'Adjust column width to data
    Sheets(comp).Select
    Rows("4:" & EndRow).Select
    Selection.RowHeight = 12
    Selection.Font.Size = 9
    Columns("A:z").Select
    Selection.ColumnWidth = 8.29
End Sub
Sub ClearTooMany(comp As String, numrows As Long)
'Clears too many rows on the individual MACD sheets
    Range("A" & numrows + 4 & ":z241").Select
    Application.CutCopyMode = False
    Selection.ClearContents
End Sub
Sub listworksheetsToCleanup()
    'Deletes sheets with names like Sheet* and *.OL and Momentum
    Dim NewSheet As Worksheet, i As Integer, j As Integer, shname As Variant, shteller As Integer,
shnamarr(500) As String
    Dim shnamstr As String
    Set NewSheet = Sheets.Add(Type:=xlWorksheet)
    shteller = Sheets.Count 'Totalt antall sheet'er tas vare på i en variabel som er fast og ikke endrer seg under
veis
    j = 0
    For i = 1 To shteller
      If Sheets(i).Name Like "Sheet*" Or Sheets(i).Name Like "*.OL" Or Sheets(i).Name Like "Momentum" Then
        j = j + 1 'Legger første forekomsten på første linjen osv.
        NewSheet.Cells(j, 1).Value = Sheets(i).Name
```

```
      shname = Sheets(i).Name
      shnamarr(j) = shname
     End If
   Next i
   For i = 1 To j
      shname = shnamarr(i)
      shnamstr = shname
      Call DeleteSheet(shnamstr)
   Next i
End Sub
Sub DeleteSheet(strSheetName As String)
'Deletes the sheet spesified as input parameter
   Application.DisplayAlerts = False
   On Error Resume Next 'new
   Sheets(strSheetName).Delete
   Application.DisplayAlerts = True
End Sub
Sub MakeSheetIndex()
'Makes Sheet index as the last sheet on workbook
   DeleteSheet ("Sheet Index")
   Sheets.Add After:=Sheets(Sheets.Count)
   Sheets(Sheets(Sheets.Count).Name).Select
   Sheets(Sheets(Sheets.Count).Name).Name = "Sheet Index"
   Call HyperLink_SheetsToIndex
   Sheets("Sheet Index").Select
   Worksheets("Sheet Index").Columns("A:A").AutoFit
End Sub
Sub HyperLink_SheetsToIndex()
'Fills the sheet index with hyperlinks to all the sheets
   Dim wks              As Worksheet
   Dim rngLinkCell      As Range
   Dim strSubAddress    As String, strDisplayText    As String
   Worksheets("Sheet Index").Range("A:A").ClearContents
   For Each wks In ActiveWorkbook.Worksheets
      Set rngLinkCell = Worksheets("Sheet Index").Range("A65536").End(xlUp)
      If rngLinkCell <> "" Then Set rngLinkCell = rngLinkCell.Offset(1, 0)
      strSubAddress = "'" & wks.Name & "'!A1"
      strDisplayText = "HyperLink : " & wks.Name
      Worksheets("Sheet Index").Hyperlinks.Add Anchor:=rngLinkCell, Address:="", SubAddress:=strSubAddress,
TextToDisplay:=strDisplayText
   Next wks
End Sub
Sub StartFormButton_Click()
   'Opens the form window - This button is placed on top of all stock sheet and is named "Open form".
   MACDTradingForm.Show False
End Sub
```