MASTER THESIS

Specialization: Applied Finance

"Do private investors understand diversification, and do they take advantage of diversification benefits in practice?"

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MASTEROPPGAVE

STUDIEPROGRAM: Master i økonomi og administrasjon	OPPGAVEN ER SKREVET INNEN FØLGENDE SPESIALISERINGSRETNING: Anvendt finans ER OPPGAVEN KONFIDENSIELL? Nei (**NB**! Bruk rødt skjema ved konfidensiell oppgave)

TITTEL: Forstår private investorer diversifisering, og benytter de seg av diversifiseringsfordeler i praksis?

ENGELSK TITTEL: Do private investors understand diversification, and do they take advantage of diversification benefits in practice?

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Summary

We found our Master thesis to be the optimal opportunity to examine the important phenomenon of diversification, but from a different angle than what earlier researchers have done. Diversification is a useful technique for reducing risk in a portfolio and several researches over the years have agreed on the importance of diversification. We observed that researchers tended to base their research on different stock exchanges or brokerage accounts, and put little emphasis on the motives behind private investors´ financial behavior. Our thesis differs from earlier research due to its focus on the theoretical and practical understanding that private investors possess. Based on the fact that several private investors seem to under-diversify, we wanted to investigate the reasons and eventual explanatory variables. After thorough research we decided on the following research question:

"Do private investors understand diversification, and do they take advantage of diversification benefits in practice?"

To best answer our research question we used both qualitative and quantitative methods. We chose to conduct an experiment, where the candidates consisted of undergraduate students studying Business Administration at the University of Stavanger. The experiment was divided into two parts. In part one we tested how the students behaved in a practical setting. We asked the students to make their individual investment decisions based on five stocks. We wanted to examine if they discovered and took advantage of the fact that two of the stocks had a high negative correlation, and thus gave the optimal diversification benefit. We divided the class into two treatment groups, where one group received an easy version, and the other group a more advanced. This made it possible for us to discover the students' degree of understanding. In part two we aimed at determining their risk preferences and theoretical knowledge about diversification. We had the students perform three different exercises, which were identical for the two treatment groups.

The main findings were that the students in both treatment groups seemed to have relatively high theoretical knowledge about diversification. However, in practice none of the treatment groups did seem to act according to their theoretical understanding. We found that both groups diversified to some degree by spreading their investments in several or all of the five stocks, but did not discover the correlation effect that lead to the highest diversification benefit. We found that less than 1/3 of the students invested in the two stocks that gave the highest risk reduction.

Our conclusion is that the private investors we studied understand diversification in theory, but they do not apply this knowledge in practice. We believe that this specific research area deserves further examination, especially when it comes to emphasize on the importance of linking psychological aspects with financial theory.

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1.0 Preface

Diversification is one of the fundamental theories in financial economics, and it was mentioned as early as 935 B.C. in the Ecclesiastes in the Bible.[1] Shakespeare also described diversification in "The Merchant of Venice" written approximately 1600 A.D; *My ventures are not in one bottom trusted, nor to one place; nor is my whole estate. Upon the fortune of this present year: Therefore, my merchandise makes me not sad.*[2]

Diversification is a method where investors hold several investments in order to reduce total portfolio risk. The subject is still of high relevance today, especially since we are introduced to an increasing amount of investment products. It is therefore interesting to investigate if private investors understand and take advantage of this risk reduction possibility.

We chose to focus on to what extent private investors understand diversification and also to examine whether they act according to theory in a practical experiment. In the preparation process of our thesis, we observed that the understanding of diversification among private investors has been devoted little attention. It was therefore very motivating to research this topic. We hope that our findings can contribute to valuable insight in private investors´ financial behavior.

We would like to thank our committed supervisor Bernt Arne Ødegaard for helpful advice and guidance. Another person we want to thank is Kristoffer W. Eriksen, lecturer at the University of Stavanger. He has experience with conducting experiments, and has been helpful with the experiment design and with advises on challenges that we faced in the early stages of our work process. We would also like to thank the Research Director Ragnhild Wiik at IRIS – International Research Institute of Stavanger for counseling regarding the data analysis. A special thank to "Stiftelsen for Anvendt finans" (SAFI) for the scholarship of 20 000 Norwegian kroner which made it possible for us to do a valid economic experiment. Last but not least, we will thank the participating students in the class of "Personlig økonomi" (personal economy) at University of Stavanger for their contribution.

[1] New Living Translation, *Ecclesiastes 11.2.* (n.d.) From:
http://www.newlivingtranslation.com/05discoverthenlt/ssresults.asp?txtSearchString=Ecclesiastes 11
[2] Christou, N. *Statistics C183/C283 (n.d.)* From:
http://www.stat.ucla.edu/~nchristo/statistics_c183_c283/statc183c283_introduction.pdf

2.0 Introduction

Diversification is a well-known term amongst economists, and several investment companies put diversification theory into practice when planning their investment strategy. On the other hand, what do *private investors* know about this theory, and how does it affect their investment decisions?

Investors invest in order to earn money, and it would be optimal if every asset they possessed had a positive pay-off. Unfortunately, it is often difficult to predict which assets will give a positive return, since there is uncertainty about what will happen in the future. Diversification is a method that investors can use to reduce the overall uncertainty of the portfolio. If an investor invests in different kinds of assets where some of the assets have positive returns and others negative returns, depending on the economic situation, these investments will neutralize each other and the total risk of the portfolio will be reduced. However, over time the investor will statistically have a higher accumulated return than he would have gotten by investing in only one of the assets.[3] This investment strategy is called diversification.

We have chosen to focus specifically on the correlation effect that arises from diversifying. This effect occurs when investors specifically and intentionally choose assets that are moving in different directions over time.[4] This is referred to as assets that are not perfectly correlated. Often investors achieve this effect by investing across countries, industries or in different types of securities.[5] In our thesis we want to examine whether private investors understand and take advantage of this correlation effect, and we have therefore given the investors in our experiment the possibility of choosing stocks that are close to moving in the opposite direction of each other (offsetting each other). This reveals if the investors are able to discover this diversification benefit.

Our thesis will therefore investigate whether private investors realize that having a combination of assets that offset each other will on average give a higher return and lower

[3] *Diversification* (n.d.). From: http://www.investopedia.com/terms/d/diversification.asp
[4] *Diversification* (n.d) From: http://homesteadfinancialllc.com/diversification.html
[5] *The Components of Risk* (n.d.) From:
http://pages.stern.nyu.edu/~adamodar/New_Home_Page/invfables/riskcomponents.htm

risk, and therefore is a valuable investment method that they should take advantage of. On basis of this we have chosen the following research question in this Master thesis:

"Do private investors understand diversification, and do they take advantage of diversification benefits in practice?"

We believe that examining this question will give us a good understanding of whether private investors understand diversification in theory and reveal whether they see the value of using diversification when creating their investment portfolio.

Finding the optimal number of stocks in a portfolio in order to get the optimal risk reduction has been a popular research area among researchers over the years. Statman (1987) found that 30 stocks is necessary in order to have a well diversified portfolio, while Evans and Archer (1968) and Wagner and Lau (1971) found respectively 10 and 15 stocks to be optimal in a portfolio. [6] These findings presuppose that there is not perfect correlation between the stocks. Despite that these numbers are considered optimal, Ødegaard (2009) found that private investors in Norway hold a portfolio of only three stocks on average.[7] The finding of Ødegaard strengthens our motivation to investigate how well informed private investors are when it comes to diversification.

In our thesis we will focus specifically on whether private investors in Norway have the necessary understanding of the correlation effect in order to use this in practice.

To best examine our research question we have chosen to do an experiment using both quantitative and qualitative methods. In the first part of the experiment we conducted a practical test (Exercise 1) to examine the students' investment behavior in practice. In the second part (Exercise 2, 3, 4) we mapped the students risk preferences and their theoretical level of knowledge concerning diversification

We divided the students into two treatment groups (treatment group 0 and 1) who received different versions of Exercise 1. One group got an easy version which clearly showed the

[6] Ødegaard, B.A. (2005) *Hvor mange aksjer skal til for å ha en veldiversifisert portefølje på Oslo børs?*
[7] Ødegaard, B.A. (2009) *The diversification cost of large, concentrated equity stakes. How big is it? Is it justified?*

correlation pattern between the stocks and the other group got a more advanced version where the correlation pattern was harder to spot. We expected that the students who received the easy version should see the correlation pattern and invest according to this, and that the students who received the advanced version would have more difficulties discovering and applying this.

The reason for having two treatment groups was to determine the level of understanding of diversification, and the ability to apply this in practice. Both treatment groups received the same version in part two of the experiment.

The thesis is from this point on divided into 8 main parts. The first part is a theoretical part where we discuss existing theory and relevant research on the subject of diversification. In the second part we explain the methods that have been used. The third and fourth part is an explanation of part one and part two of the experiment, respectively. The fifth part consists of an analysis of the experiment, performed using Excel and the statistical analysis program SPSS. This part also includes interpretation and discussion of the findings and a comparison to existing theories. Part six is a discussion of potential errors in the experiment. In part seven we discuss the implications of our findings in the analysis. In the last part we summarize our findings in a conclusion.

3.0 Theory and empirics

According to financial theory, choosing several stocks will lead to a reduction in overall portfolio risk, since the stocks are likely to move in different directions.[8]

Despite the theory, when looking at empirical studies of diversification we found a strong tendency of under-diversification among private investors. This tendency is mentioned by several researchers.

Ødegaard (2005), a Norwegian researcher, is one of the researchers that have examined this subject. He observed that Norwegian private investors seem to under-diversify, holding only three stocks on average.[9] This number is too small in order to fully exploit the risk reduction effect from diversifying by choosing several stocks.

Barber and Odean (2000) are other researchers who have examined this subject. From investments accounts at a brokerage firm they found that the mean broker account consists of 4,3 stocks.[10] These findings are also supported by Polkovnichenko (2006), who finds that in US, 80 % of the households hold five or less stocks.[11] The lack of diversification among private investors is regarded as an unresolved puzzle in financial economics.[12]

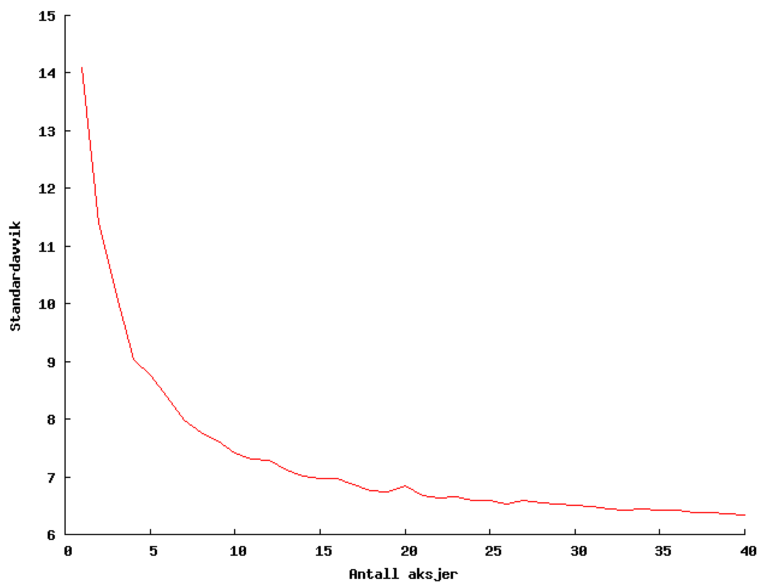
The tendency towards holding a small number of stocks, Statman (2004) called the "diversification puzzle". This trend has also been found in other countries, for example Finland (Grinblatt and Keloharju, 2001) and Sweden (Bodnaruk, Kandel, Massa, and Simonov ,2007). [13]

In the introduction we pointed out that researchers found that a number of stocks between 10 and 30 are necessary in order to achieve a situation of optimal risk reduction. A higher number of stocks will not lead to a remarkably higher risk reduction. Ødegaard (2005) has

[8] *The Dangers Of Over-Diversifying Your Portfolio* (2010) From:
http://www.investopedia.com/articles/01/051601.asp#axzz1Ozr9w9Zj
[9] Ødegaard, B.A. (2005) *Hvor mange aksjer skal til for å ha en veldiversifisert portefølje på Oslo børs?*
[10] Barber, B.M. & Odean, T. (2000) *Trading is hazardous to your wealth: The common stock investment performance of individual investors.*
[11] Døskeland, T. (2007) *Essays on Portfolio Choice*
[12] Døskeland, T. (2007) *Essays on Portfolio Choice*
[13] Døskeland, T. (2007) *Essays on Portfolio Choice*

shown this graphically,[14] where the curve for standard deviation is decreasing when the number of stocks is increasing. Standard deviation is used to measure risk of a stock or a stock portfolio.[15] After a certain number of stocks the curve flattens as shown in figure 1.

Figure 1 Optimal number of stocks in a portfolio



Ødegaard (2005) has used numbers from Oslo Stock Exchange (OSBX) to study the relationship between standard deviation and number of stocks held in a portfolio. Standard deviation is used to measure risk of a stock or a stock portfolio. The x-axis show the number of stocks, and the y-axis show the standard deviation in percentage. If an investor holds less than 5 stocks in his portfolio, the graph shows that he will achieve a noticeable risk reduction if he includes more stocks. The investor will also achieve some diversification benefit when holding 10-15 stocks. According to Ødegaard the curve flattens after this point. Further diversification will give low risk reduction effect.

The fact that several researchers finds a general lack of diversification among private investors, made us curious to investigate eventual explanations for this.

Goetzmann & Kumer provides some insights into this. They examined stock trading of 62 387 US individual investors from 1991 to 1996 concerning diversification. They found that investors under-diversify, but factors like age, wealth, experience, education and degree of financial sophistication influence their diversification decisions. Investors who hold mutual

[14] Ødegaard, B.A. (2005) *Hvor mange aksjer skal til for å ha en veldiversifisert portefølje på Oslo børs?*
[15] *How the RiskGrade Measure Differs from Traditional Risk Measures* (2000) From: http://www.riskgrades.com/retail/what_is/index.cgi?href=comparing_riskgrades.html

funds and foreign stocks are more diversified in their domestic portfolios. It is also shown that those who are more likely to act on behavioural biases under-diversify to a higher extent. [16] Behavioral biases might lead to unrational financial behavior, and this theme will be discussed further in section 3.3 *Behavioral biases.*

Despite the fact that the number of stocks that private investors hold in a portfolio is not optimal according to empirical studies, it is worth mentioning that they might be diversified in form of other assets. This could be through owning property, mutual funds, and also through having their pension savings placed in different savings schemes.[17]

John Y. Campbell argues that the risk reduction from diversification is a “free lunch”, despite that economists often claim that “there are no such thing as a free lunch”. Campbell states that an investor is able to reduce total portfolio risk if he invests in many investments that are not perfectly correlated. This risk reduction does not lead to a reduction on the average return over time.[18] Campbell emphasizes the importance of correlation when investors diversify, but in previous empirical research there seems to be little attention on studying specifically if investors actually are able to see the relation to the correlation effect.

3.1 How useful is diversification?

There are different opinions on the importance of diversification. The famous investor Warren Buffett argues that a broad diversification is only necessary when the investors have little knowledge of financial theories and the industries they invest in. He believes that a high level of diversification is not as necessary for experts in order to achieve a high return. According to Buffett, the experts have a deeper understanding of the financial markets, which makes it easier for them to identify attractive companies.[19]

[16] Goetzmann, W.N. & Kumar, A. (2008) *Equity Portfolio Diversification*
[17] *10 Different Ways to Diversify Your Investments* (2010) From: http://ezinearticles.com/?10-Different-Ways-to-Diversify-Your-Investments&id=3705229
[18] Campbell, J.Y (2000) *Diversification: A Bigger Free Lunch*
[19] Slettan, A. (2008) *Sats på det du ikke kan* From: http://www.na24.no/skribenter/article2020923.ece

Terrence Odean has a somewhat different view on this matter. He argues that one of the largest investment error private investors do is to under-diversify. He states that by diversifying it is possible to get a risk reduction without this leading to lower return. Odean emphasizes that most private investors do not understand why diversification is important.[20]

Døskeland and Hvide found that Norwegian private investors believe that they possess an expert knowledge about the industry they work in compared to other private investors. On average the Norwegian population invests 30 % of their savings in work-related industry, but research shows that this does not yield a higher return than investing in other industries. This implies that the average private investor might be flawed in his view thinking he will be better to predict the development of his own industry and therefore earn a higher profit compared to other investors. On the other hand, they found that a very small group of investors actually have a higher level of knowledge and more information about their own industry and are therefore able to achieve a higher return. [21] This supports Buffets theory of a small group of investors actually accomplishing a higher return.

There are two important variables that private investors need to take into consideration regarding diversification. These variables are the time horizon and the risk tolerance. [22] If an investor has a long time horizon he can tolerate a higher risk level, meaning higher volatility in his investments. On the opposite side, an investor with a short time horizon might try to avoid taking on too much risk, since he do not want to risk having to sell the stocks at a time when they have low value. An investor with high-risk tolerance will accept losing some of his invested money in the exchange for a better return in the future. An investor with low-risk tolerance will choose investments where there is a low possibility of losing his invested money. The level of risk tolerance and time horizon could influence to what extent the private investor choose to diversify.

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[20] Cecilie Langum Becker (2011) *Investorer er sin egen verste fiende.* From: http://www.dn.no/forsiden/borsMarked/article2059729.ece
[21] Slettan, A. (2008) *Sats på det du ikke kan* From: http://www.na24.no/skribenter/article2020923.ece
[22] U.S. Securities and Exchange Commission (2009) *Beginners´ guide to Asset Allocation, Diversification, and Rebalancing* From: http://www.sec.gov/investor/pubs/assetallocation.htm

Barber & Odean (2001) found that women are less risk seeking than men when it comes to investment behavior.[23] It is therefore interesting to investigate if the investment behavior in our experiment is consistent with these findings. We expect that the risk seeking students will have their main focus on total profit and therefore might associate reduced risk with reduced profits. Diversification could be a low priority among these individuals.

It is stated that the use of diversification can be taken too far, and lead to over-diversification. For instance, if a private investor tries to diversify by buying 10 – 20 different mutual funds where each fund has invested in 100 – 1000 different companies then the private investor becomes a victim of over-diversification. If an investor owns too many investments and is not able to analyze them carefully he might risk that a large part of the return from profitable investments will have to be used to cover the losses from bad investments.[24] A reason for over-diversifying could be that many investors seem to believe that they can diversify all of the risk away. This is not the case. By investing in a stock portfolio there will always be systematic risk that is impossible to remove by diversifying.[25]

3.2 Transaction costs

Transaction costs could be an explanation why private investors seem to under-diversify. Transaction costs are the price the private investor have to pay for each buy and sell. Mishkin (2007) found that high transaction costs could create a barrier for private investors, which resulted in private investors under-diversifying. Because of this barrier towards diversification the investors are exposed to unnecessary unsystematic risk.[26]

In table 1(see below) we have shown an example of how expensive transaction costs are for private investors using Nordnet.[27] We chose Nordnet because it is one of the most popular websites for trading stocks for Norwegian private investors.

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[23]Barber, B.M. & Odean, T. (2001) *Boys will be boys: Gender, Overconfidence, and Common Stock Investment*
[24] *Investment Portfolio Diversification Overload (n.d.) From:* http://www.stocks-simplified.com/Investment-Portfolio-Diversification.html
[25] *The Dangers of Over-Diversifying Your portfolio* (2010) From: http://www.investopedia.com/articles/01/051601.asp#axzz1Ozr9w9Zj
[26] Mishkin, F.S. (2007) *The Economics of Money, Banking and Financial Markets*, 8.th edition p.184 – 185
[27] *Kurtasje og fondsavgifter* From: https://www.nordnet.no/mux/web/nordnet/pricelist.html

Table 1 Transaction costs for private investors using Nordnet

Norwegian securities: Oslo Børs, Burgundy and Oslo Axess	Normal customer	Bonus customer	VIP customer	Mini customer
Stocks, warrants, equity certificates and listed funds	0,05% or Min.95 NOK	0,045% or Min.79 NOK	0,039% or Min.59 NOK	0,1% or Min.39 NOK

The table shows the transaction costs that private investors using Nordnet have to pay for each buy and sell. For a "normal customer" there are no requirements regarding deposits or number of trades. To become "bonus customer" the requirements are that you do at least 30 transactions with commissions per quarter. To become a "VIP customer" the requirements are that you do at least 100 transactions with commissions per quarter or have a minimum of 2 million NOK on your account/as equity. "Mini" is a brokerage model which is optional and is suitable for those who have a small number of trades and a small volume in each trade.

Depending on what kind of customer you are, these are the prices you have to pay for each buy and sell. The customers are divided into the four categories on basis of investment amount and number of trades. Table 1 shows that 39 NOK is the lowest transaction cost. For a small private investor, 39 NOK for each buy and sale could result in large amounts making diversification unprofitable.

Researchers seem to have different opinions on transaction costs and how it affects investors investment decisions. Goetzmann & Kumer found that small portfolioes and high transaction costs are not to a high degree correlated with under-diversification.[28] In our thesis we have chosen to exclude the transaction costs, because we wanted to investigate in isolation whether private investors discover the correlation between different stock investments.

3.3 Behavioral Biases

Over the last decades there has been an increased focus on psychological factors as explanatory variables for economical puzzles.[29] This thesis will also examine if behavioral biases can contribute with explanations to why private investors do not seem to diversify optimally.

[28] Goetzmann, W.N. & Kumar, A. (2008) *Equity Portfolio Diversification*
[29] Olsen, R.A. (1998) *Behavioral Finance and Its Implications for Stock-Price Volatility*

Economic theory assumes that the investor is rational and predictable, but this is not always the case. There are psychological and emotional aspects that need to be taken into consideration, because they affect the way investors behave.[30] Below we will describe two typical biases that we suspect the students in our experiment might be influenced by.

Familiarity Bias

Huberman (2001) found that investors often overweight familiar assets.[31] Coval and Moskowitz (1999) discovered that investors prefer to invest in local companies. This familiarity bias is called the "Local bias".[32] Foad (2010) points out that investing in domestic investments without including foreign investments are a common bias. This bias can make investors miss out on high diversification benefits from combining domestic and foreign investments. This familiarity bias is called the "Home bias".[33] We expect that some of the students may be influenced by the familiarity bias in the experiment, and as a consequence not diversify optimally.

Underconfidence Bias

Underconfidence makes investors afraid of being wrong and therefore unable to make decisions. This might lead to the investors "freezing" instead of taking necessary action, like choosing to sell or buy assets. Underconfidence can make investors easily influenced by other people. [34] We suspect that the students in our study might not believe that they have the required knowledge and capabilities to see the diversification possibilities. They might therefore choose a suboptimal approach because they are trying to find a way that they see as the safest option, despite the fact that they actually spot the correlation between the stocks included in our experiment.

[30] Phung, A. (2010) *Behavioral Finance* From: http://i.investopedia.com/inv/pdf/tutorials/BehavioralFinance.pdf
[31] Huberman, G. (2001) *Familiarity breeds investments*
[32] Coval, J.D. & Moskowitz, T.J. (1999) *Home Bias at Home: Local Equity Preference In Domestic Portfolios*
[33] Foad, H. (2010) *Familiarity Bias* From: http://www-rohan.sdsu.edu/~hfoad/FamBias_BF.pdf
[34] *Delusion, illusion, overconfidence, under-confidence (n.d.)* From: http://knol.google.com/k/delusion-illusion-overconfidence-under-confidence#C%2829%29_Underconfidence_bias

4.0 Method

4.1 Design

To investigate the research question it was useful to look at a sample of the population that we would expect to have some interest in the stock market. We therefore chose a class of undergraduate students studying Business Administration.

For the investigation of whether the Norwegian population, here represented by the class, understands diversification in theory and to see if they apply this in practice, the students had to perform 4 exercises. Exercise 1 (part one) was a practical test to see if they could discover how five stocks move in relation to each other, and also to study how they made investment decisions based on this discovery. Exercise 2, 3 and 4 (part two) was included to retrieve information about risk preferences and their theoretical knowledge and understanding of diversification. If the students showed a lack of theoretical knowledge and understanding of this topic, then this might explain why they acted in a certain way in Exercise 1. Also, their risk preferences might be an explanatory factor for their behavior in Exercise 1.

The experiment was designed in cooperation with our supervisor and a lecturer who has previous experience with designing experiments. In addition we used family and friends as dummies to test different versions of the experiment as we made improvements. We also used a method of trial and error for different exercises that we considered to include in our experiment. Improvements were made along the way and this was an important process with respect to optimizing the experimental design. Our main focus was to make sure that the experiment was designed in a way that made it easy to perform and would provide us with useful information as basis for our analysis.

The students received a Norwegian version of the experiment. The models and questions included in this thesis are translated into English. A motivation for the students to participate in the experiment was that one of the exercises in their final exam would be based on the exercises they underwent in this experiment.

4.2 Population

The experiment was conducted on a class consisting of undergraduate students enrolled in the module “Personlig økonomi” (personal economy). The number of enrolled students was approximately 150 persons, whereof 55 attended the experiment. The experiment was done anonymously, and the students were not allowed to communicate with each other. If the students had any questions they would raise their hands, and the questions were answered individually to the students by us or our two assistants. The reason why the students were not allowed to communicate or ask question in front of the class was to avoid students influencing each other’s mindset and decisions. The answers we gave were neutral and should not influence their investment decisions.

4.3 The use of treatment groups

We divided the class into two groups who received different versions of Exercise 1.[35] [36] The students were randomly assigned which group (i.e. group 0 or group 1) they would participate in. One of the groups were handed an easy version and the other group a more advanced version. Receiving different versions are referred to as being given different treatments. The two groups are called “treatment group 0” and “treatment group 1”. We expected to see differences between the groups. One of our expectations were that treatment group 0 (who got the easy version) would easily discover the correlation pattern and make investment decisions according to this. We also expected that some of the students from treatment group 1 (who got the advanced version) would discover the correlation pattern and take advantage of it. Receiving different levels of difficulty in Exercise 1 made it possible for us to examine to what extent the students understood the concept of diversification and took advantage of it.

In the second part we tested the students risk preferences (Exercise 2) and knowledge about diversification (Exercise 3 and 4). We anticipated that the students would have different risk preferences. We also anticipated that the students would understand the

[35] Appendix 1: Exercise 1 for treatment group 0
[36] Appendix 1: Exercise 1 for treatment group 1

theoretical questions regarding diversification and answer them to a satisfying degree, since they have background in economics.

In addition to conducting quantitative analysis, we found it useful to ask some qualitative questions, since this would give the students the opportunity to further explain the reasons behind their decisions.

5.0 Part one of the experiment (Exercise 1)

In Exercise 1 we included five different stocks, called stock 1-5, that the students could choose to invest in. Exercise 1 was conducted over five rounds, where the students had to make their individual investment decisions each round. The reason for running Exercise 1 over five rounds was because we wanted to include the time aspect, which made it possible for us to analyze how the students performed over time. Each round, there were six outcomes that could occur, and these were determined by rolling a dice. The reason for using a dice was to simulate the more or less random variations in the stock market.

The challenge for the students was to see that a combination of stock 1 and stock 5 would lower the standard deviation (portfolio risk) and consequently yield a higher return on average. This presupposes that there is an equal possibility of getting each of the six dice outcomes. The reason why the combination of stock 1 and 5 is beneficial is because the two stocks are offsetting each other. Stock 1 has a high return when stock 5 has a low return, and vice versa.

To avoid making the correlation between stock 1 and 5 too obvious for the students we included stock 2 which is the "safe" stock (low standard deviation) and stock 3 which is a "stable" stock with higher return and lower standard deviation than stock 1, which could make it look quite attractive. We also included stock 4 which is the "risky" stock (high standard deviation).

As mentioned, the students were divided into two treatment groups. After the selection of which group to participate in, the students were given calculators, their respective versions of Exercise 1 (easy or advanced) and five round tables where they reported their investment decisions for each of the five rounds (will be further explained on page 22). They were also given a receipt with an individual identification number. The students had to fill in their identification number on all papers that they handed in to allow us to link the performance of each student to the different exercises.

After the students were handed their respective versions of Exercise 1, we instructed them to answer the following question based on table 2 / table 3 (easy / advanced): *"Which of the* *five investments in the table do you find most attractive? State the reason for your choice."* The reason for asking this question was to test the students risk preferences and to get an idea of their way of thinking concerning stock investments.

Table 2 Expected annual return and standard deviation of the 5 stocks for treatment group 0

Investment	Expected annual return	Standard deviation of expected annual return
Stock 1	169.17%	134.43%
Stock 2	112.50%	26.10%
Stock 3	170.00%	127.41%
Stock 4	158.33%	244.64%
Stock 5	175.83%	142.14%

Table 3 Expected annual return and standard deviation of the 5 stocks for treatment group 1

Investment	Expected annual return	Standard deviation of expected annual return
Stock 1	169.17%	137.25%
Stock 2	112.50%	26.10%
Stock 3	170.50%	132.74%
Stock 4	158.33%	244.64%
Stock 5	175.83%	142.14%

Table 2 and 3 are calculated on basis of table 4 and 5 for the respective treatment groups 0 and 1. The expected return and standard deviation is approximately the same for both treatment groups.

After answering this question, the students were told to study their respective table of return which is shown in table 4 and 5. Table 4 was received by the students in treatment group 0 (easy) and table 5 was received by treatment group 1 (advanced). Table 4 and 5 displays the return that the students would achieve, depending on the different outcomes decided by the dice. The students' investments decisions in each of the five rounds were made on basis of these tables.

We chose to call the investment options; stock 1, stock 2, stock 3, stock 4 and stock 5, since this might lead the students into thinking in the direction of investing in real stocks. One of our lecturers, Kristoffer Eriksen, advised us to keep the experiment as neutral as possible and label the stocks "1-5" instead of for example five different company names.

Table 4 Table of return for treatment group 0

Outcome	Stock 1	Stock 2	Stock 3	Stock 4	Stock 5
1	3	0.95	0.8	0.2	0,05
2	3	1	1.3	0.3	0.1
3	3	1.7	4.5	0.1	1
4	0,05	1	0.9	1.0	2.9
5	1	1	1.2	7	3
6	0.1	1.1	1.5	0.9	3.5

Table 4 is received by treatment group 0 and is the table where the correlation between the five stocks should be relatively easy to discover. If the dice outcome is 1,2 or 3, stock 1 would have a high return, and stock 5 would have a low return. If the dice outcomes were 4, 5 or 6, stock 5 would have a high return, and stock 1 would have a low return. These two stocks would therefore to a large extent offset each other. The two stocks are almost perfect negatively correlated which will be shown later in table 6. To make the correlation pattern visible, numbers without decimals are chosen for outcome 1, 2 and 3 for stock 1. The numbers are also very much the same in stock 1 and 5. For example outcome 4, 5 and 6 for stock 1 is exactly the same as outcome 1,3 and 2 for stock 5. The highlighting of stock 1 and 5 are only to illustrate how these stocks offset each other and were not in the tables that the students received.

Table 5 Table of return for treatment group 1

Outcome	Stock 1	Stock 2	Stock 3	Stock 4	Stock 5
1	2.90	0.95	1.07	0.2	0.05
2	0.1	1	1.38	0.3	3.5
3	3	1.7	4.66	0.1	1
4	0.05	1	1.07	1.0	2.9
5	0.9	1	0.99	7	3
6	3.2	1.1	1.06	0.9	0.1

Table 5 is received by treatment group 1 and has a correlation pattern which is a bit more difficult to discover compared to table 4. What is similar between table 4 and 5 is that the correlation between the five stocks is approximately the same in both tables as shown later in table 6. Stock 1 and 5 should therefore be equally attractive both for treatment group 0 and 1. The difference is that the order of the numbers is swapped, and that most numbers have decimals. The highlighting of stock 1 and 5 are only to illustrate how these stocks offset each other and were not in the tables that the students received.

Our expectations would be met if more students in treatment group 0 than in treatment group 1 chose to invest in stock 1 and 5 in combination. At the same time we anticipated that a high number of students in both groups understood the optimal way to invest.

We also expected that the students´ risk preferences would partly explain their investment behavior. This means that if the majority of the students did not chose a combination of stock 1 and 5 then we might have to look at their risk preferences to explain why they found the other stocks more attractive. As mentioned earlier, choosing stock 2 involves little risk, but also leads to relatively low return. Stock 4 on the other hand is very volatile and has a reduced return in four of the six outcomes. Despite the possibility of getting a reduced return in four of the six outcomes, stock 4 has a return of 7 if outcome 5 occurs, which could make the stock tempting for the risk seeking students.

The way the five different stocks correlates are very similar for the two groups, as shown in table 6. The correlation table was not included in the exercise (Exercise 1) that was handed to the students, since we were testing whether they were able to discover this pattern based on the tables of return.

Table 6 Correlation matrix for treatment group 0 and 1

Correlation matrix for treatment group 0 (easy version)

Correlations	**Stock 1**	**Stock 2**	**Stock 3**	**Stock 4**
Stock 2	0,328			
Stock 3	0,383	0,995		
Stock 4	- 0,361	- 0,271	- 0,241	
Stock 5	- 0,951	- 0,122	- 0, 166	0,503

Correlation matrix for treatment group 1 (advanced version)

Correlations	**Stock 1**	**Stock 2**	**Stock 3**	**Stock 4**
Stock 2	0,468			
Stock 3	0,389	0,979		
Stock 4	- 0,294	- 0,271	- 0,247	
Stock 5	- 0,956	- 0,275	- 0,200	0,405

The tables show the correlations between the different stocks for the two treatment groups. As shown, stock 1 and stock 5 correlates most negatively with a correlation coefficient of approximately -0,95 in both versions of Exercise 1.

Stock 1 and stock 5 were the stocks that correlated most negatively, with a correlation coefficient of approximately -0,95 in both versions of Exercise 1. Choosing a combination of these two would give the highest benefit of diversification (highest risk reduction). This means that if the students understand how the stocks move in relation to each other, they are expected to choose the combination of stock 1 and 5. As seen from table 6 other combinations of stocks are also negatively correlated, but not nearly to the same extent. Because of this, we expected the students to overweight both stock 1 and stock 5.

The experiment was performed so that the students had to fill in one round table for each of the five rounds of investment decisions.[37] Their decisions were based upon the tables of return (table 4 and 5).

In table 7 the round table for round 1 is shown as an example. In the first row the students wrote the percentage of amount they would like to invest in each stock. In round 1, this meant that each student should invest their entire start value of 100 experimental kroner.

The students also had to hand in a note each round that showed their invested percentages. This was a control for us, to make sure no one was changing percentages in their round tables during the practical experiment.

Table 7 Round table for round 1

Start amount: 100 experimental kroner

Round 1	Stock 1	Stock 2	Stock 3	Stock 4	Stock 5	Total	Dice outcome
Percentage of amount						100 %	
Return							
Wealth						NOK	

After each student had reported the percentage of amount they wanted to invest, in this table and on the note, we rolled the dice to decide the outcome. Then the students had to fill in the return of the actual outcome in row 2 based on the tables of return (table 4 and 5). Having done this, the students calculated their wealth from that round. Wealth was calculated using this formula: **Wealth = Percentage of amount * Return*100 or remaining amount**. The new wealth for each stock was summarized to a total amount for all stocks. This was the amount the students had available for the next round.

[37] Appendix 2: Round tables for the five rounds

After completing five rounds of the quantitative experiment, the students were asked the question *"Why did you choose to set the percentage of amount the way you did?"* This question was included to see whether they recognized the fairly high negative correlation between stock 1 and 5, but also to check for other motives such as being a gambler, acting on behavioral biases etc. This question would therefore give a more thorough explanation of their decisions, which would give us an indication of whether they have understood the importance of diversification.

After the five rounds Exercise 1 was completed and handed in. Each student kept a receipt which included their identification number and their total amount/final wealth after round 5. The students were told to keep their receipt, and bring it to class at a later date when rewards would be paid.

Exercise 1 had to be conducted before determining the level of knowledge and understanding. Otherwise the students would have gotten clues and implications of the subject we were testing, and we might have received a falsely higher amount of candidates that invested in stock 1 and 5 in the Exercise 1.

5.1 Monetary reward

For this to be a valid economic experiment, the students were given the opportunity to earn money based upon their performance in Exercise 1. This gave students incentives to behave more realistically and also to think more thoroughly through their investment decisions. We applied to the "Stiftelsen for anvendt finans" (SAFI) for a scholarship and were granted 20 000 Norwegian kroner for use as reward. The final wealth in experimental kroner that each student had earned in Exercise 1 was multiplied by a factor of 0,5 to determine the amount they would receive into real Norwegian kroner. We decided an upper limit of 2000 kroner for each person to make sure we were not exceeding our budget.

5.2 Execution of Exercise 1

To give a better understanding of how Exercise 1 was executed we have included an example that show how one of the students did. This person, hereafter called person A, was in treatment group 0 which conducted the easier version of the experiment.[38] The tables we refer to in this example are shown in Appendix 1.[39]

The first step for the student was to study the first table in Exercise 1 and answer the first question "*Which of the five investments in the table above do you find most attractive? State the reason for your choice".* Person A chose stock 5, and gave the explanation that this stock had the highest expected annual return.

The next step for the student was to look at the second table (in addition to the first table), and make his investment decisions based on these. Person A chose to invest 50 % of his 100 available experimental kroner in stock 1, and the remaining 50 % in stock 5. The percentages was filled in on the students own sheets, as well as on the separate round table notes. We then collected the separate round table notes for round 1. Then the dice was rolled. The outcome of the dice for the first round was 5. By using the second table, person A saw that the return in stock 1 was 1 and the return in stock 5 was 3. He calculated his new wealth with the formula: Wealth = Percentage of amount * Return * 100 or remaining amount. For person A the calculation were the following: (0,5 * 1 * 100) + (0,5 * 3 * 100) = 50 + 150 = 200,00. Person A did not either loose or gain money on stock 1 (ended up with 50,00 experimental kroner), but gained money on stock 5 (ended up with 150,00 experimental kroner). In total his wealth before round 2 was 200,00. This was the amount person A should invest in round 2.

In the second round person A invested 45 % in stock 1 and 55 % in stock 5. After filling in his own sheet and handing in the separate round tables for round 2, the dice was rolled. The outcome in the second round was 6. Person A could see from the second table that the return for stock 1 was 0,1 and the return for stock 5 was 3,5. He used the same formula as before to calculate his new wealth: (0,45 * 0,1 * 200) + (0,55 * 3,5 * 200) = 9 + 385 = 394,00

[38] From PDF file on attached CD: Treatment group 0, part 1 of the experiment, ID nr.1
[39] Apenndix 1: Exercise 1 for treatment group 0

experimental kroner. Person A lost money in stock 1 (ended up with 9,00 experimental kroner), but gained in stock 5 (ended up with 385,00). The total wealth before round 3 was 394,00 experimental kroner. This amount was the amount person A should invest in round 3.

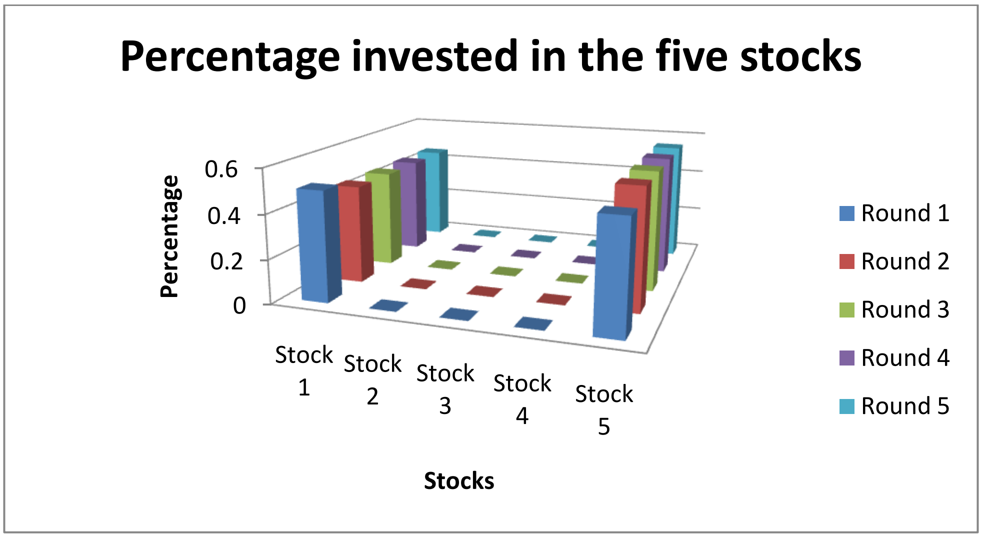
In the third round person A placed 45 % in stock 1 and 55 % in stock 5. He filled in the percentages on his sheet and on the separate round table for round 3. The separate round tables were collected. We rolled the dice and the outcome for the third round was 1. The second table showed that the return for stock 1 was 3, and the return for stock 5 was 0,05. Person A calculated his new wealth: (0,45 * 3 * 394) + (0,55* 0,05 * 394) = 531,9 + 10, 84 = 542,75. In this round, person A got a high positive return in stock 1 (ended up with 531,90) and lost money in stock 5 (ended up with 10,84). His total wealth to invest in round 4 was 542,75.

Person A chose the same percentages in the fourth round as he did for the two previous rounds, respectively 45 % in stock 1 and 55 % in stock 5. He filled in the percentages in his own sheet and on the separate round table for round 4, which was collected. The dice was rolled and showed that the outcome for the fourth round was 6. The second table showed that this gave a return of 0,1 for stock 1 and 3,5 for stock 5. Person A calculated his new total wealth: (0,45 * 0,1 * 542,75) + (0,55 * 3,5 * 542,75) = 24,42 + 1044, 79 = 1069,21 experimental kroner. Person A had 1069,21 experimental kroner to invest in the last round, round 5.

Person A continued his investment strategy of putting 45 % in stock 1 and 55 % in stock 5. After filling in the percentages in his own sheet he filled in the separate round table for round 5 and handed this in. The dice was rolled and showed that the outcome for the fifth round was 4. The second table showed that this gave a return of 0,05 for stock 1 and 2,9 for stock 5. Person A could now calculate his final wealth: (0,45 * 0,05 * 1069,21) + (0,45 * 2,9 * 1069,21) = 24,06 +1705,39 = 1729,45. Person A earned 1729,45 experimental kroner in total in Exercise 1. This amount was translated into real Norwegian kroner using the factor 0,5 which gave the amount of 864,73 NOK. This amount was rounded up to the nearest 50 (which gave him in total 900 NOK) and given to him in a later lecture.

Figure 2 shows person A´s investment decisions.

Figure 2 Example of person A´s investment decisions



The chart displays the investment decisions of person A. This student has clearly understood the diversification benefit that arises from negative correlation between stocks. Person A invested 50/50 in stock 1 and 5 in the first round, and changed to 45/55 over the next four rounds.

At the end of Exercise 1 the student were asked to answer the following question "*Why did you choose to set the percentages of amount the way you did?*" Person A explained that no matter the outcome of the dice he earned money. He stated that stock 1 and 5 had a "minimal" correlation which gave him high return and low risk.

Overall, it is clear that this student discovered the negative correlation between the two stocks from the beginning of Exercise 1, and we expected several students to invest similar to this.

6.0 Part two of the experiment (Exercises 2, 3 and 4)

The second part of the experiment was handed out to the students after part one had been collected. The second part was the same for both experiment groups, and consisted of Exercise 2, 3 and 4. The students had to fill in the same identification number as in part one, so that we could compare the results from the two parts. There was no monetary reward for this second part of the experiment.

Exercise 2

The purpose of Exercise 2 was to determine the students´ risk preferences (see Appendix 3).[40] In this exercise the students had to make ten different investment decisions, where they in each investment could choose between a "safe" investment and a "risky" investment. On the basis of their investment decisions, the students risk preferences were classified into the following categories: risk averse (-1), risk neutral (0) and risk seeking (1). This classification was based on Holt and Lori´s risk preference categorization.[41] It is likely that the students´ risk preferences could influence on their degree of diversification in Exercise 1.

According to research by Jianakoplos & Bernasek (2006), young people tend to take on more risk.[42] It is therefore worth noting that our sample consists of relatively young individuals, and that we could expect that they might be more risk seeking than the average population.

Exercise 3

Exercise 3 tested different diversification strategies (see Appendix 4).[43] The students could choose to diversify across countries, industries and number of companies based on 24 available companies. This exercise was conducted to see which stocks they chose to include in their portfolio, and also to see if the number of stocks they chose was in line with the findings of Ødegaard (2009) that private investors on average holds three stocks. Exercise 3 also included a qualitative question, purpose being to retrieve information about the students´ thoughts and reasoning when it comes to discovering any of the diversification possibilities.

[40] Appendix 3: Exercise 2 of the experiment
[41] Holt C.(2007) *Markets, Games & Strategic Behavior, p.50-54*
[42] Jianakoplos, N.A. & Bernasek, A. (2006) Financial Risk Taking by Age and Birth Cohort
[43] Appendix 4: Exercise 3 of the experiment

Exercise 4

Exercise 4 was a test of the students' level of knowledge regarding diversification (see Appendix 5).[44] There were 8 statements that the students would have to give their opinion about. We ranged the level of knowledge into the following categories -1, 0 and 1.

Categorization

0-2 correct answers = category -1, which means low level of knowledge

3-6 correct answers = category 0, which means medium level of knowledge

7-8 correct answers = category 1, which means high level of knowledge

6.1 Execution of Exercises 2, 3 and 4

We will now give an example of how Exercise 2,3 and 4 was executed. For this we chose to use the same person as we used in the example in part one (person A).[45]

In Exercise 2 we wanted to map the students´ risk preferences. Person A chose to invest in the "safe" investment (option A) in situation 1,2,3,4 and 5, then he changed to the "risky" investment (option B) in situation 6,7,8,9 and 10. Since person A chose this investment strategy we were able to categorize him as risk neutral, based on the Holt and Lori´s classification of risk preferences.[46]

In Exercise 3, the students should choose companies they wanted to invest in. Person A invested in all companies available. The qualitative question revealed that he had a profound understanding of diversification. He explained that he wanted to diversify, and since he did not have any information about correlation or risk he wanted to invest an equal amount in all companies.

In exercise 4 the students were asked to give their opinion regarding 8 statements (shown in appendix 5). Person A ticked of the correct answer on all 8 statements, and based on this we were able to place him in category 1, which means high level of knowledge.

[44] Appendix 5: Exercise 4 of the experiment

[45] From PDF file on attached CD: Treatment group 0, part 2 of the experiment, ID nr.1, exercise 2, 3 and 4.

[46] Holt C. (2009): Markets, Games and Strategic Behavior p.50-54

7.0 Analysis of the experiment (Exercises 1, 2, 3, 4)

The following analysis is divided into three main parts. To best answer our research question, we found the following structure to be the most appropriate:

The purpose of the first part (7.1) of this analysis is to examine whether the students understand diversification in theory. This part is based on exercise 3 and 4 (part two). Exploring the students' choice of companies (Exercise 3) and their theoretical level of knowledge (Exercise 4) will give an indication of whether they have the necessary knowledge on the subject of diversification.

In the second part (7.2) we want to examine if the students take advantage of the diversification benefit in practice. This part is based on Exercise 1 (part one). The results from Exercise 1 will provide information on how the students act in a practical setting.

The third part (7.3) is a mapping of the students risk preferences, which is included since we believe that this factor could affect the students' investment decisions. This part is based on Exercise 2 (part two). Risk preferences might help explaining the students´ actual investment decisions during Exercise 1.

In addition we have included some qualitative questions which will be used as supplements to examine the underlying motives for the students´ investment behavior.

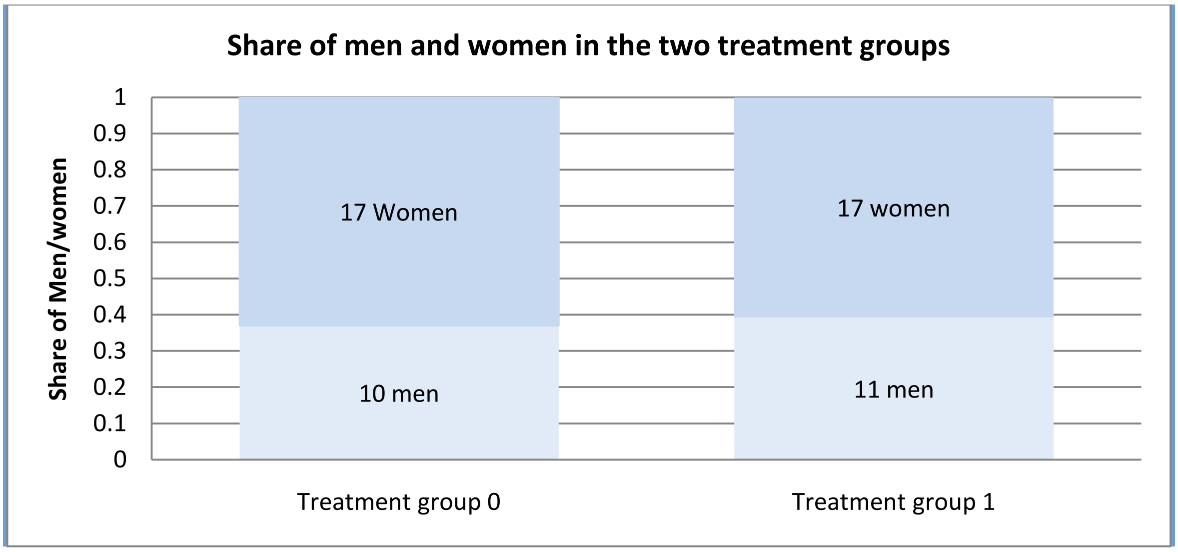
We have performed descriptive analyses to show graphically the students understanding of diversification. We have also conducted statistical analysis. In the statistical analysis we have chosen to primarily use nonparametric tests, such as the Mann-Whitney test and Kruskal-Wallis test[47] using the statistic program SPSS. These tests will reveal if there are significant differences between the students.

[47] *Nonparametric methods (n.d.)* From: http://www.stats.gla.ac.uk/steps/glossary/nonparametric.html#kwt

In the statistical analysis we have used a confidence level of 95 %, since this is a common confidence level used in economic researches. This means that if the significance level is < 0,05 there are significant differences between the variables tested.

In total 55 students participated in the experiment. As shown in the chart below there were 10 men and 17 women in treatment group 0, and 11 men and 17 women in treatment group 1, i.e. an approximately equal distribution of men and women in the two treatment groups.

Figure 3 Share of men and women in the two treatment groups



The chart shows the distribution of men and women in each of the two treatment groups. There were 10 men and 17 women in treatment group 0 and 11 men and 17 women in treatment group 1. The distribution of men and women between the two groups are approximately equal.

7.1 Do the students understand diversification in theory?

A certain academic knowledge is necessary for the students in order to be able to discover diversification possibilities. We have used the results from Exercise 3 (number of companies) and Exercise 4 (level of knowledge) to analyze if the students understand diversification in theory. In this section we will look at differences between the two treatment groups as well as differences between genders, both in relation to the two exercises.

7.1.1 Differences between treatment groups regarding theoretical understanding

We started with comparing the two treatment groups with number of companies they would prefer to invest in (Exercise 3)[48] and their level of knowledge of diversification (Exercise 4).[49]

Table 8 Treatment groups compared with number of companies and level of knowledge

Treatment group compared with:	Treatment group 0 Mean	Treatment group 1 Mean	Significance
Number of Companies	7,85	5,86	0,067
Level of knowledge	0,48	0,25	0,137

The table shows the mean and significance of treatment group 0 and 1 when comparing them with number of companies (Exercise 3) and level of knowledge of diversification (Exercise 4).

In Exercise 3, the students were asked to select companies they would invest in, from a list. The results regarding number of companies selected revealed no significant difference on 95% confidence level between the two treatment groups. We found that treatment group 0 on average chose to include more companies in their portfolio (7,85) compared to treatment group 1 (5,86).[50] Even though treatment group 1 invested in fewer companies than treatment group 0, both groups held a higher number than what Ødegaard (2009) found was the average number of companies in the Norwegian private investors portfolio.[51]

[48] Appendix 6: Treatment groups compared with number of companies
[49] Appendix 7: Treatment groups compared with level of knowledge
[50] Appendix 22: Calculations of the Mean for all students, treatment groups, gender and investment in stock 1 + stock 5
[51] Ødegaard, B.A. (2009) *The diversification cost of large, concentrated equity stakes. How big is it? Is it justified?*

This said, this result is no guarantee that the students understand the importance of correlation, only that they understand that there is some diversification effect from choosing several companies. It is also possible that the exclusion of transaction costs could partly explain the high number in our experiment.

After the selection of companies, the students answered the question *"State the reason for your choice of companies?"* Treatment group 0 and 1 answered this question with close to identical explanations. The answers showed that both groups tried to diversify by choosing companies across several industries. The students explained that they chose companies which they regarded as safe and stable. Some students also pointed out that they chose companies they are familiar with, thereby exposing themselves to the familiarity bias. Still, the overall impression is that most students chose to invest in both domestic and foreign companies and not only in local companies and are therefore not exposing themselves to the local / home bias. From this qualitative question we found that the students have a relatively high theoretical understanding, as they chose to invest in a high number of companies and across several industries. They also commented on the correlation effect indirectly in their explanations.

In Exercise 4 we categorized the students according to level of knowledge into the following categories; low level of knowledge (-1), medium level of knowledge (0) and high level of knowledge (1). When comparing treatment groups we found no significant differences when it comes to the students' level of knowledge. The mean is however higher for treatment group 0, which means that this group have more correct answers with respect to level of knowledge regarding diversification (0,48 > versus 0,25).[52] We also found that the mean for both groups combined is 0,36 which is a number between medium and high level of knowledge. This indicates that the students in both groups have the necessary knowledge to understand diversification in theory.

A Kruskal-Wallis test revealed that there is a connection between level of knowledge and final wealth in Exercise 1, even though it was not significant. [53] Students with high level of knowledge had a higher final wealth on average in Exercise 1 compared to the rest of the students.

[52] Appendix 22: Calculations of the Mean for all students, treatment groups, gender and investment in stock 1 + stock 5
[53] Appendix 8: Level of knowledge compared with final wealth

7.1.2 Differences between men and women regarding theoretical understanding

We also wanted to investigate if there were any differences in the theoretical knowledge of diversification between the genders. In our sample there are 21 men and 34 women. Table 9 shows the mean and significance level when comparing men and women with number of companies (Exercise 3)[54] and level of knowledge of diversification (Exercise 4).[55]

Table 9 Gender compared with number of companies and level of knowledge

Gender compared with:	Men Mean	Women Mean	Significance
Number of Companies	7,10	6,68	0,958
Level of knowledge	0,57	0,24	0,045

The table shows the mean and significance of male and female students when comparing them with number of companies (Exercise 3) and level of knowledge of diversification (Exercise 4).

We found no significant differences in the number of companies the male and female students chose to hold in their portfolio. Both genders chose approximately equal number of companies, respectively 7,10 for men and 6,68 for women.[56] We did however find a significantly higher level of knowledge amongst the men. The mean shows that the men in our experiment have a higher percentage of correct answers than women regarding the subject of diversification (0,57 versus 0,24).[57]

7.1.3 Summary of the students' theoretical understanding of diversification

Overall, it seems like the students have the theoretical knowledge in order to understand diversification. Treatment group 0 exceeds treatment group 1 in their theoretical understanding, and men also outperforms women. As a consequence treatment group 0 and the male students achieved a higher final wealth in Exercise 1. This will be shown in section *7.2.5. Final Wealth.*

[54] Appendix 9: Gender compared with number of companies
[55] Appendix 10: Gender compared with level of knowledge
[56] Appendix 22: Calculations of the Mean for all students, treatment groups, gender and investment in stock 1 + stock 5
[57] Appendix 22: Calculations of the Mean for all students, treatment groups, gender and investment in stock 1 + stock 5

7.2 Do the students take advantage of diversification benefits in practice?

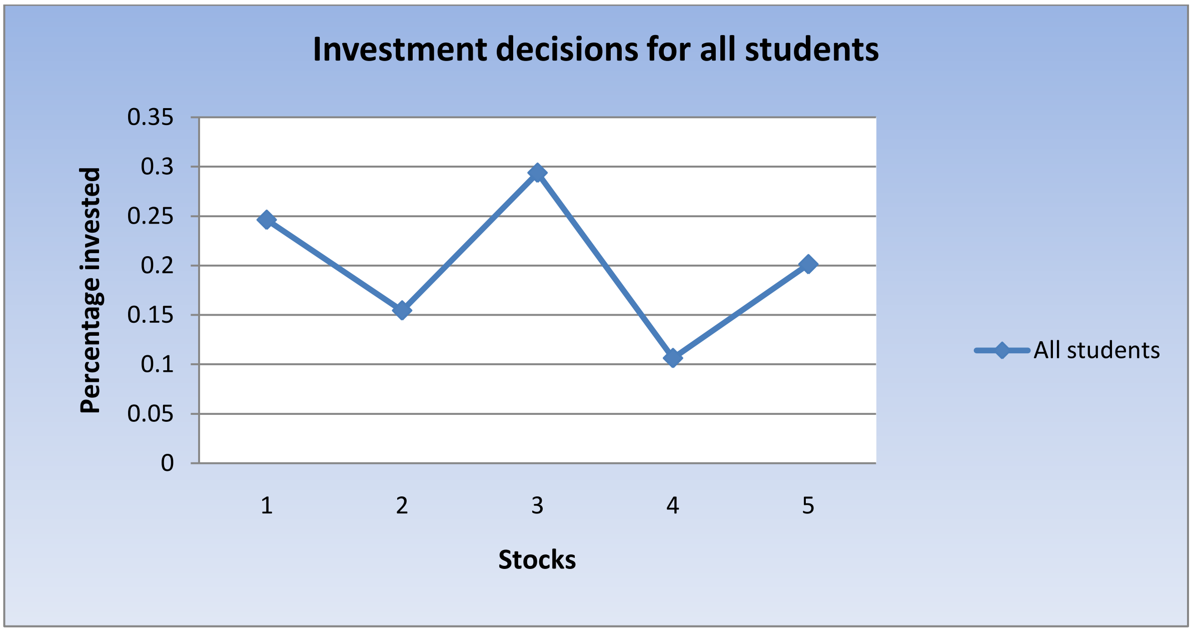
We examined if the students took advantage of diversification benefits in practice. To do this we analyzed Exercise 1 (part one). If the students understood the diversification benefit that arose from choosing uncorrelated assets, they would combine stock 1 and 5 and overweight these in their portfolio. We expected that for the students who did not understand the correlation effect, stock 2 might be the most attractive to risk averse students since it has the lowest standard deviation. For risk-seeking students who did not understand the benefit of the combination of stock 1 and 5, we expected that stock 4 might be the most attractive since the return is 7 if dice outcome 5 occurs. In addition, for the students who did not see the benefit of diversification from the beginning of Exercise 1, we anticipated a learning effect as they progressed through this experiment.

In this section we will look at the investment decisions of all students (treatment group 0 and 1 combined), but also examine if there are differences in how the two treatment groups invested. Possible differences between genders will also be examined. In addition, we will investigate if any of the two treatment groups had any learning effect during the five rounds. We will also look at the final wealth the students achieved in Exercise 1. The two treatment groups and genders will be compared to final wealth. At the end of this section we will examine the answers that the students gave to the qualitative question at the end of Exercise 1.

7.2.1 Investment decisions for all students

Figure 4 gives an overview of how the students altogether (group 0 and 1 combined) chose to invest on average in stock 1-5 over the five rounds.

Figure 4 Investment decisions for all students



Stock 1	Stock 2	Stock 3	Stock 4	Stock 5
24,62 %	15,44 %	29,38 %	10,62 %	20,12 %

The chart and table shows how the students on average invested in stock 1-5 over the five rounds. Stock 3 is the one the students on average invest the highest percentage in (29,38 %), followed by stock 1 (24,62 %) and stock 5 (20,12 %).

The chart shows that students invest in stock 1 and 5 to some degree, but they seem to overweight stock 3. This contradicts our expectations that the students would overweight stock 1 and 5. In line with our expectations, the safe stock (stock 2) and the risky stock (stock 4) seem to have been given low priority.

The table in figure 4[58] show that the average percentage invested in stock 3 was 29,38 %. Since the invested percentage in stock 1 and 5 are respectively 24,62 % and 20,12 % i.e. lower than what is invested in stock 3, we suspect that the students might have difficulties with discovering the diversification benefit in practice.

From a statistical point of view the expectations would be that each student would invest 20 % in each of the five stocks. A higher percentage invested in any stock means that the students overweight this stock. Since the students invested an average of 24,62 % in stock 1 and 20,12 % in stock 5, this show that they invest above what we expected using statistical reasoning. Still, this percentage is not high enough to draw the conclusion that the students prefer stock 1 and 5.

We counted the number of students that had invested more than the expected 20 % in *both* stock 1 and 5, and thus had seen the correlation effect. We found that 16 of the 55 students invested more than the expected 20 % in both stock 1 and stock 5. This gives a percentage of 29,09 %, which means that less than 1/3 of the students did see the correlation effect.[59] This percentage is lower than what we originally expected.

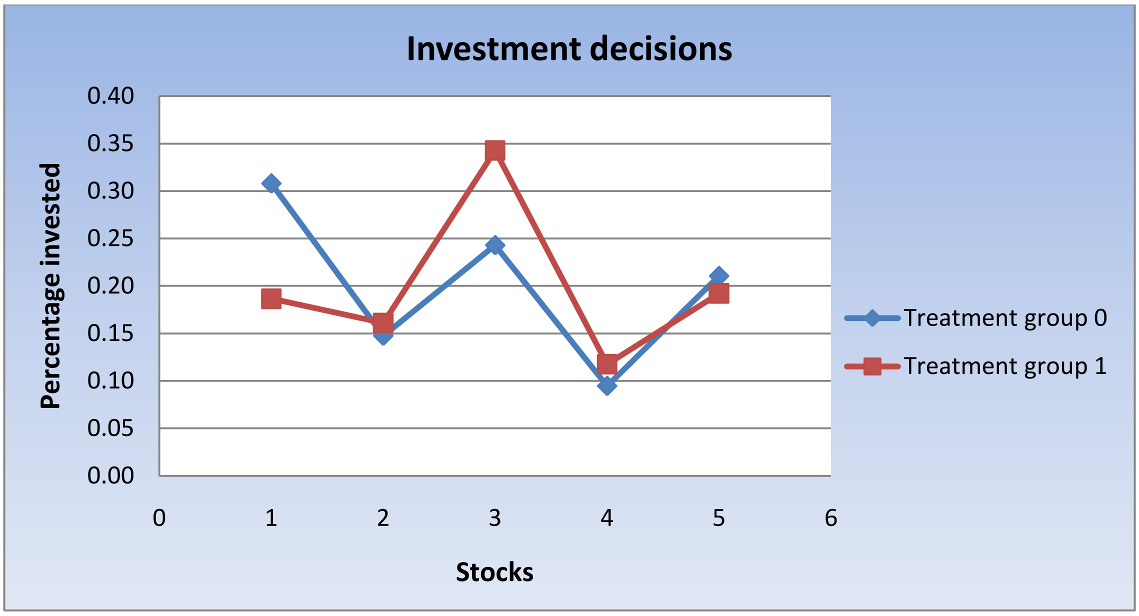
[58] From Excel-file on attached CD: Excel-variables
[59] Appendix 22: Calculations of the Mean for all students, treatment groups, gender and investment in stock 1 + stock 5

7.2.2 Differences between the investment decisions of treatment group 0 and 1

Earlier (in section 7.1.1), we found that treatment group 0 seemed to have a slightly better understanding of diversification in theory, and it was therefore interesting to investigate if there were differences between the two treatment groups´ behavior in practice.

Figure 5 shows the difference between how the two treatment groups invested on average in stock 1-5 during Exercise 1.

Figure 5 Investment decisions for the two treatment groups



	Stock 1	Stock 2	Stock 3	Stock 4	Stock 5
Treatment group 0	30,80 %	14,75 %	24,30 %	9,46 %	21,05 %
Treatment group 1	18,65 %	16,11 %	34,28 %	11,74 %	19,22 %

The chart and table shows how the two treatment groups on average invested in stock 1-5 during the five rounds. The relative rankings of the stocks are not the same for both treatment groups. Treatment group 0 invest the most in stock 1 (30,8%) and treatment group 1 invest the most in stock 3 (34,3%).

Treatment group 0 invested a higher percentage in stock 1 (30,80% versus 18,65%) and 5 (21,05% versus 19,22%) than treatment group 1.[60] This could mean that the easier version of Exercise 1, that were given to treatment group 0, made it easier for them to discover the

[60] From Excel-file on attached CD: Excel-variables

stocks that correlated most negatively and was optimal to choose in combination. However, the difference between the two treatment groups is significant for stock 1, but not for stock 5.[61] The finding that the differences between the two groups for stock 5 is not significant leads to uncertainty about whether treatment group 0 really did discover the correlation to a higher extent than treatment group 1 in Exercise 1.

Treatment group 1 which conducted the more advanced version of Exercise 1 chose to invest more in stock 3 (34,28% versus 24,30%) compared with treatment group 0. This could be because of the more confusing pattern in the advanced version of Exercise 1 (see table 5, page 20) and due to the fact that the lowest return on stock 3 was 0,99 (which is higher than the lowest return of the other stocks) and the highest return was 4,66 (which is higher than any of the returns of stock 1 and 5). Stock 3 could be interpreted as a stock with small downside, but also a distinctive upside compared to the other stocks.

There is only minor difference between the percentages the two groups invested in stock 2. For stock 4, treatment group 1 have a larger share than treatment group 0 (11,7 % versus 9,5 %). The reason for this difference could be that treatment group 1 chose to invest more risky in lack of a logical pattern since it was harder to spot the correlations between the stocks in their version.

We examined which group invested more than the statistical expectation of 20 % in both stock 1 and stock 5 in each of the treatment groups. Treatment group 0 invested more than the statistical expectation of 20 % in both stock 1 (30,80 %) and in stock 5 (21,05%) on average. For treatment group 1 the average percentage invested was just below 20 % for both stock 1 (18,65%) and stock 5 (19,21%).

To be able to draw a conclusion about whether the students in one of the treatment groups understand the correlation effect to a higher extent than the other, we counted how many students in each group invested more than the statistically expected 20 % in both stock 1 and stock 5. Of the 16 students we earlier found that seemed to have understood the correlation effect and invested more than 20 % in both stocks 1 and 5, 9 of those were in

[61] Appendix 11: Treatment groups compared with stock 1-5

treatment group 0 and 7 were in treatment group 1.[62] Despite that treatment group 0 understood more when testing their theoretical knowledge, these results are not clear enough to conclude that treatment group 0 do better in practice. This makes us believe that both treatment groups have problems with discovering and exploiting the correlation effect in practice.

7.2.3 Differences between the investment decisions of genders.

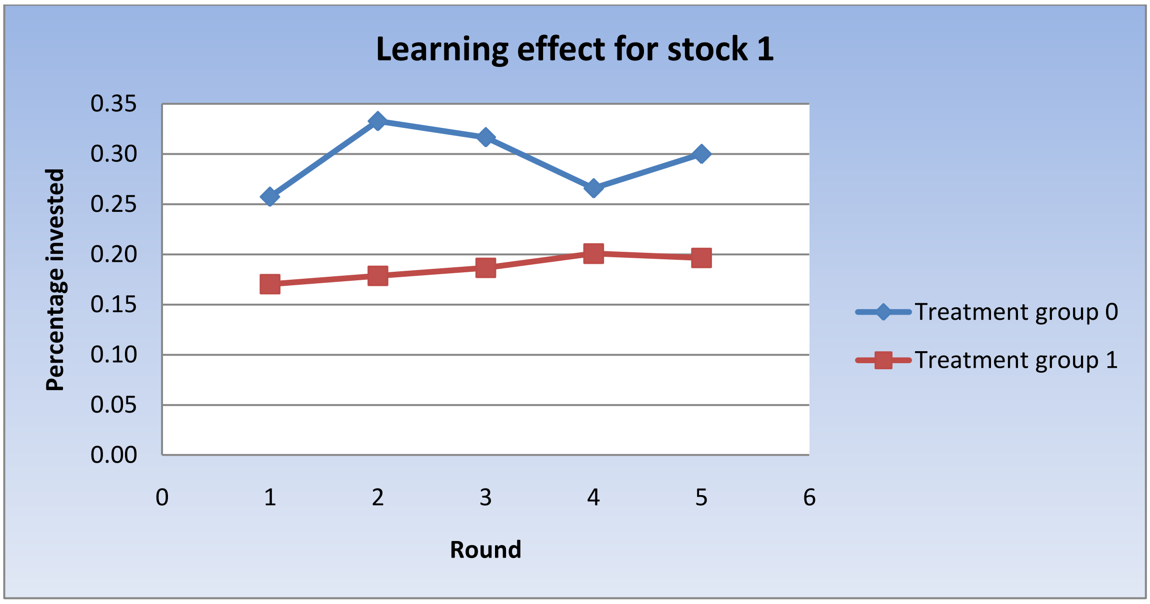
In addition to treatment groups we compared gender with stock 1 and 5 to see if there were difference between male and female students when it comes to discovering the correlation pattern between stock 1 and 5.[63] We found that there is a significant difference between how men and women invest in both stock 1 and 5. Men invest more than women in both stock 1 and 5 with respectively 27,75 % versus 22,68 % in stock 1 and 25,70 % versus 16,67 % for stock 5. A reason for this might be the finding that men possess a higher level of knowledge about diversification, which was shown in section 7.1.2. *Differences between men and women regarding theoretical understanding.*

7.2.4 Learning effect for treatment group 0 and 1

Another way to examine if the students were able to take advantage of diversification benefits in practice was to check if they had any learning effect over the five rounds in Exercise 1. We expected that the students would place an increasingly higher amount in stock 1 and 5 over the rounds as a result of more students discovering the negative correlation between them. As shown in figure 6 and 7 (see below) we have compared treatment group 0 and 1 with respect to how they invested over the five rounds. As a limitation we chose only to look at stock 1 and 5. The reason for comparing the two groups was to see if there were any differences in investment behavior since the two groups received different versions of Exercise 1.

[62] Appendix 22: Calculations of the Mean for all students, treatment groups, gender and investment in stock 1 + stock 5
[63] Appendix 12: Gender compared with stock 1 and stock 5

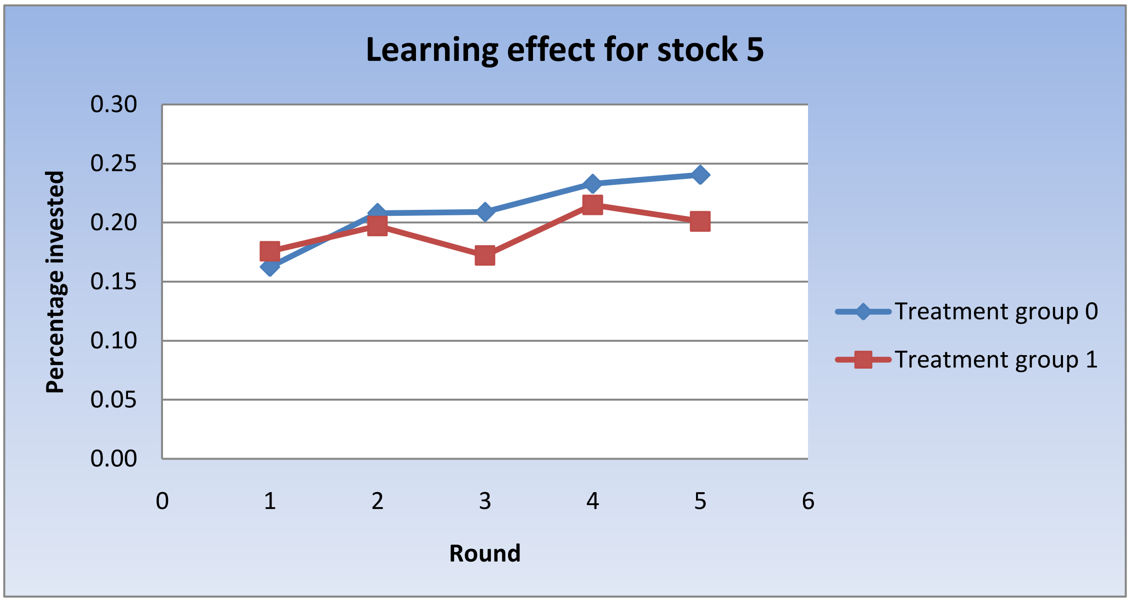
Figure 6 Learning effect for stock 1



The chart shows the percentage the two treatment groups invested in stock 1 over the five rounds. For there to be any learning effect the students should place an increasingly higher amount in stock 1 over the five rounds.

Figure 6 shows that for stock 1 neither of the groups seemed to have a distinct learning effect, since there is no clear increase in the curves over the five rounds. We expected that treatment group 0 (who were given the easier version of Exercise 1 where the high negative correlation should be easily spotted), to a higher extent than treatment group 1, should have invested an increasing percentage in stock 1 over the five rounds. Surprisingly, it looks like treatment group 1 have had some sort of learning effect over the first four rounds, but since there is a dip in round 5 there is no clear conclusion regarding the learning effect.

Figure 7 Learning effect for stock 5



The chart shows the percentage the two treatment groups invested in stock 5 over the five rounds. For there to be any learning effect the students should place an increasingly higher amount in stock 5 over the five rounds.

Unlike the findings for stock 1, figure 7 indicates that treatment group 0 has had a more clear learning effect than treatment group 1 regarding stock 5 over the five rounds. Treatment group 0 has an increasing amount each round, and therefore it seems like they have had a learning effect over the rounds. Treatment group 1 on the other hand, had a dip in round 3 and 5. We can therefore conclude that treatment group 1 did not have a learning effect.

Despite the fact that descriptive statistics indicated that the students did not have any clear learning effect it was relevant to do a Scheffe test to test statistically if there were any learning effect and also if these findings would be significant.[64] The Scheffe test displays which of the stocks the students invest the highest amount in for each of the 5 rounds. If the students actually had a learning effect over the rounds, the rounds should be listed in the following order; 1,2,3,4,5 and have a significantly increasing percentage invested over the five rounds.

[64] Appendix 13: Learning effect over the five rounds for treatment group 0 and 1 (for stock 1 and 5)

Table 10 Scheffe test to test learning effect over the five rounds for stock 1 and 5

Stocks	Treatment group	Ranking of the rounds	Sig.
Stock 1	0 1	1, 5, 3, 2, 4 1, 2, 3, 5, 4	0,585 0,913
Stock 5	0 1	1, 2, 3, 4, 5 3, 1, 2, 5, 4	0,468 0,764

The table shows the ranking of the rounds for stock 1 and 5 for each treatment group. The ranking is based on relative investment for each stock. If the students had any learning effect the rounds should be listed; 1,2,3,4,5, and have a significantly increasing percentage over the five rounds. In stock 1 the rounds are not ranked correctly for any of the treatment groups, meaning no learning effect. For stock 5 the rounds are ranked correctly for treatment group 0 but the increasing percentage over the five rounds are not high enough to state that this finding is significant.

Since the rounds for stock 1 does not follow this pattern for any of the treatment groups we can conclude that there is no learning effect. For treatment group 0 this conclusion is also supported by the significance level of 0,585. Treatment group 1 is also far from being significant with significance level of 0,913.

For treatment group 0, the ranking of the rounds for stock 5 have the correct pattern (1,2,3,4,5), which indicates some sort of learning effect, but the increasing amount in each round is not large enough to be significant (significance level of 0,468). For treatment group 1, there is clearly no learning effect since the rounds are not listed in the correct order. This is also supported by a significance level of 0,764.

We expected that both treatment groups would show a learning effect during the experiment. Both descriptive statistics and the Scheffe test rejected our expectations. The overall conclusion is that there seems to be no clear learning effect for any of the treatment groups.

7.2.5 Final wealth

We found it interesting to assess the monetary gain of the students during Exercise 1, and therefore examined their final wealth after the five rounds. We started with analyzing which one of the two treatment groups achieved the highest final wealth. The table below shows the mean for both groups, as well as the significance coefficient.

Table 11 Treatment groups compared with final wealth

Treatment group compared with:	Treatment group 0 Mean	Treatment group 1 Mean	Significance
Final wealth	590,19	460,15	0,474

The table shows the mean and significance of treatment group 0 and 1 when comparing them with final wealth.

The results from a Mann Whitney test[65] showed no significant difference between the two treatment groups when it comes to final wealth, but we observe that treatment group 0 had a higher final wealth on average (590,19) than treatment group 1 (460,15).[66] This could be due to the fact that they invested a higher percentage than treatment group 1 in stock 1 and 5 and thereby achieved a better diversification.

The Mann-Whitney test also showed that the minimum individual final wealth earned in the practical experiment was 16,32 experimental kroner, and the maximum was 1827,98 experimental kroner.

The discovery of men investing significantly more in both stock 1 and 5 (see section 7.2.3) in the practical experiment made it interesting to also check if male students achieved significantly higher final wealth compared to women.

[65] Appendix 14: Treatment groups compared with final wealth
[66] Appendix 22: Calculations of the Mean for all students, treatment groups, gender and investment in stock 1 + stock 5

Table 12 Gender compared with final wealth

Gender compared with:	Men Mean	Women Mean	Significance
Final wealth	571,25	494,79	0,579

The table shows the mean and significance of men and women when comparing them with final wealth.

The average final wealth of men (571,25) is higher than for women (494,79),[67] but a Mann-Whitney test revealed that the difference is not significant (0,579).[68]

Monetary reward

As mentioned in section 5.1. *Monetary Reward* we had 20 000 Norwegian kroner at our disposal, and we were able to hand out 16 300 real Norwegian kroner.[69] The amount earned by each student ranged from 50-950 Norwegian kroner (50 % of their earned final wealth in Exercise 1). To avoid handing out coins we gave the students an amount that was rounded up to the nearest 50 NOK.

7.2.6. Qualitative question that was asked at the end of exercise 1

At the end of part one of the experiment the students were asked to answer the following question: *"Why did you choose to set the percentage of amount the way you did?"*
For both treatment groups we found that a large part of the students answered that they spread the risk by investing in several or all of the stocks each round, assuming that this automatically led to a high degree of diversification. Several students answered that their investments decisions were chosen randomly. An interesting observation is that more students in treatment group 0 pointed out that investing in both stock 1 and 5 would give a guaranteed return. There were only one student in treatment group 1 who specifically mentioned the negative correlation between stock 1 and 5, while in group 0 there were seven students mentioning this. The answers to the qualitative question indicates that the students to a certain degree do understand how they should invest, but in practice their

[67] Appendix 22: Calculations of the Mean for all students, treatment groups, gender and investment in stock 1 + stock 5
[68] Appendix 15: Gender compared with final wealth
[69] Appendix 16: Reward handed out to the students

decisions might be affected by the underconfidence bias, as mentioned in section *3.3 Behavioral Biases*. This bias could make them invest more broadly, feeling that this will be safer, in lack of the confidence needed to invest in only a few stocks. It seems that women to a larger extent are affected by this bias because more female students split their investments almost equally in all of the stocks every round instead of daring to place the most in stock 1 and 5.

7.2.7 Summary of the students´ practical understanding

In practice, several students did not diversify optimally (stocks 1 and 5), but over weighted stock 3. Many students also chose a combination with several or all of the stocks in each round. Students who invested in all of the stocks in each round achieved some diversification benefit since the stocks are not perfectly correlated. Still, since only 16 of 55 students were able to spot that a combination of stock 1 and 5 led to a higher diversification benefit, it seems like they were not able to see the importance of correlation between stocks. In addition, the students did not show any learning effect.

7.3 Students´ risk preferences

We suspected that the risk preferences could be an influencing factor on the students´ investment decisions, and from Exercise 2[70] we were able to map whether the students were risk averse, risk neutral or risk seeking.[71]

In this section we will start with analyzing the general risk preferences of all students, before we compare risk preferences with investment decisions. Thereafter, we will examine whether risk preferences influence the final wealth achieved in Exercise 1. After this we will look at differences between treatment groups as well as differences between genders, both in relation to risk preferences.

In this part of the analysis we have excluded 7 students who have clearly not understood the risk preference exercise. The new number of students during the analysis of risk preferences is 48 (18 men and 30 women).

7.3.1 The general risk preferences of all students (groups 0 and 1 combined)

When analyzing Exercise 2 we observed that 20 students changed from the "safe option" (option A in Exercise 2) to the "risky option" (option B in Exercise 2) at an early stage, meaning that they ended up in the category of being risk seeking. 13 students ended up being categorized as risk neutral, and 15 being risk averse.[72] Because of their young age, and the fact that there was no real monetary reward in this exercise, the high number of risk seeking students was not extraordinary. Altogether the distribution was relatively even.

7.3.2. Risk preferences compared with investment decisions

We also wanted to investigate if the students risk preferences matched their investment decisions. It would be natural to expect that the risk seeking students would gamble more, and invest a high percentage in stock 4 which is the most risky stock (high standard deviation, but also a possibility of high return). If students are risk averse we would expect that they invest in stock 2 or a combination of stock 1 and 5. We also expected that there

[70] Appendix 3: Exercise 2 of the experiment
[71] Holt C.(2007) *Markets, Games & Strategic Behavior, p.50-54*
[72] Appendix 18: Risk preferences compared with final wealth

were no differences in risk preferences between the two treatment groups since the class is relatively homogeneous and the dividing into the two groups were made randomly.

Table 13 is based on a Kruskal-Wallis test that compared risk preferences with stocks 1-5.[73] The students risk preferences are categorized into respectively risk averse (-1), risk neutral (0) and risk seeking (1).[74]

Table 13 Risk preferences compared with stock 1-5

	Risk averse (-1)	Risk neutral (0)	Risk seeking (1)
Stock 1	2	2	4
Stock 2	3	5	3
Stock 3	5	1	1
Stock 4	4	3	2
Stock 5	1	4	5

The numbers in this table are based on the mean rank values in the Kruskal-Wallis test in appendix 17. This table show a ranking based on the amount placed in each stock in relation to the risk preferences. This table includes both treatment groups as one entity. According to the Kruskal-Wallis test, the risk averse investor (-1) place the highest amount in stock 5 on average over the five rounds , therefore the value of 1 in stock 5. The further ranking for the risk averse students are stock 1 in second place, stock 2 in third place, stock 4 in fourth place and then stock 3 as the least favorable. The same logic applies to the risk neutral (0) that chooses to put the highest amount in stock 3, and the lowest amount in stock 2. The risk seeking students (1) invest the most in stock 3 and the least in stock 5.

The most interesting findings from this table is that the risk averse students favor stock 5 and 1 as the top two stocks thereafter followed by stock 2. This is very much in line with what we had expected. Another important finding is that the risk seeking students chose to invest the least in stock 1 and 5. The most popular stock to invest in for the risk seeking students is stock 3, followed by stock 4, the gambler option. The high percentage invested in stock 4 also matches the risk preferences and is therefore a logical outcome. The risk neutral invests the most in stock 3 and the least in stock 2. The fact that both risk neutral and risk seeking students find stock 3 as the most attractive investment might be due to what we observed in the first question in Exercise 1; "*Which of the five investments in the table above do you find most attractive? State the reason for your choice"*, namely that many students regarded stock 3 as their number one investment choice if they were allowed to choose only

[73] Appendix 17: Risk preferences compared with stock 1-5.
[74] Appendix 3: Exercise 2 of the experiment

one stock to invest in. Stock 3 was also the favorite investment choice for all students when comparing the average invested in each stock over the five rounds. The reason for stock 3 being so attractive could be because this stock has a high expected annual return and a relatively low standard deviation compared to the other stocks (see table 2 and 3, page 19). It is a possibility that the students who regarded stock 3 as the most attractive stock in the first question in Exercise 1, placed an extra attention to this stock throughout Exercise 1. Those students might therefore have continued overweighting stock 3 in Exercise 1. This could have made them less aware of the correlation pattern between stocks 1 and 5.

The finding that students invest the most in stock 3, indicates that they have problems discovering the optimal investment behavior.

7.3.3 Risk preferences compared with final wealth

A further statistical analysis revealed that the students that were more risk averse achieved a higher final wealth.[75] This is consistent with the findings that the most risk averse students chose to invest the most in stock 1 and 5 (see table 13). Under the assumption that they chose stock 1 and 5 in combination, this is expected to give the highest final wealth on average, due to the almost perfect negative correlation between these two stocks.[76]

7.3.4 Differences between the two treatment groups in relation to risk preferences

When comparing risk preferences with treatment groups we found that there is no significant difference,[77] but the findings indicate that treatment group 1 is the most risk seeking of the two groups. This is also consistent with the behavior in Exercise 1, where treatment group 1 invested more in the risky stock (stock 4) than treatment group 0. Whether this is caused by the students in treatment group 1 originally being more risk seeking or if it is a consequence of the treatment they received in part one (e.g. that treatment group 1 received a more advanced version) is not possible to decide.

[75] Appendix 18: Risk preferences compared with final wealth
[76] Appendix 19: Calculations of final wealth
[77] Appendix 20: Risk preferences compared with treatment groups

7.3.5 Differences between the genders in relation to risk preferences

Barber & Odean (2001) found that women are less risk seeking.[78] Our results also pointed towards male students being slightly more risk seeking, although this was not significant.[79] On basis of this we find to some degree support for their theory in our experiment, with the male students showing tendencies towards being more risk seeking. We have stressed that risk averse students chose to invest a higher percentage in both stock 1 and 5, and also achieved a higher final wealth. Therefore, the findings that men are more risk seeking than women is conflicting with the findings from Exercise 1, that men invest more in stock 1 and 5 in combination and also achieves a higher final wealth. The reason for this contradiction could be that men behave differently in a practical setting (Exercise 1), than in a separate risk preference exercise. The behavior of men in Exercise 1, indicated that they are more risk averse than women.

7.3.6. Summary of the students´ risk preferences

A summary of the students risk preferences is that they are slightly more risk seeking than the average population. This statement is based on Holt and Lori´s classification of risk preferences.[80] We also found that the students´ investment decisions matched their risk preferences. By this we refer to the discovery that risk averse students invested the most in stock 1 and 5 as well as stock 2, while the risk seeking students invested the most in stock 3 and 4. In line with what we expected, risk averse students on average achieved a higher final wealth.

The risk preferences could explain why students did not invest in stock 1 and 5 in combination even though they are able to discover the covariance between these stocks. It is possible that risk seeking individuals focus more on the expected return, and less on reducing the risk by diversifying.

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[78] Barber, B.M. & Odean, T. (2001) *Boys will be boys: Gender, Overconfidence, and Common Stock Investment*
[79] Appendix 21: Risk preferences compared with gender
[80] Holt C. (2007) Markets Games & Strategic Behavior, p.50-54.

8.0 Potential errors

We have tried to critically identify and evaluate the factors that could lead to errors in our experiment.

The fact that the experiment is conducted in a classroom setting, which is an artificial setting compared to a "real world investment situation" could affect the results and to what extent the results are valid in the real world. The classroom setting is more of a laboratory experiment, and whether the same results had been found (reliability) if the experiment had been repeated with other students is worth discussing.

Since this was a hypothetical laboratory experiment we chose to exaggerate the numbers in table 4 and 5 to make the picture as clear as possible. Since table 2 and 3 are based on table 4 and 5, also table 2 and 3 would have extreme percentages when it comes to expected annual return and standard deviation. In a real world these percentages might be unrealistic, but we considered this to be the best way to show the differences between the stocks.

Another potential source of error in the design might be that our sample of students are a rather homogenous group compared to the Norwegian population since our sample consist of students only, and they also have the same academic background. Another potential error can be the sample size consisting of 55 individuals only, which might be a low number in order to state that the result can be applied to the entire Norwegian population.

The average age for the students in our experiment is 23,5 years. This is relatively young compared to the average Norwegian who is 37,7 years.[81] The results might therefore not be very representative for the entire Norwegian population. In the experiment there are 21 men and 34 women. Our analysis has shown that men and women invest differently. Consequently the results of the experiment would likely have been different had the distribution of men and women been 50/50, which was the approximate distribution in Norway at the beginning of this year (2011).[82]

[81] *Fakta om Norge* (2010) From: www.fjordnorge.dk/norsk/fakta_om_norge_no.htm
[82] *Befolkning* (2011) From: http://www.ssb.no/befolkning/

The experiment was performed in a 2 hour lecture without any breaks. This duration might have led the students to become impatient. Lack of concentration might have affected the effort and their answers especially towards the end of the experiment.
Since the lecture was not mandatory, the students who participated might not have been a representative selection of the entire class in “Personlig økonomi” (personal economy). The ones who participated might be the ones who usually attend the lectures and might therefore have a better foundation for performing well in the experiment. The topic of diversification has been covered in a previous lecture, and the students who attended this lecture should have a better base for understanding our researched topic.

Even though we were not able to create a real world investment situation, we believe that the experiment and the following analysis led to valuable insight in benefits of diversification and investment behavior. Since we excluded transaction costs and also the fact that the students did not have to worry about losing “real” money, mean that we were able to study the understanding of diversification more thoroughly and undisturbed as a phenomenon.

9.0 Implications of the findings in the analysis

Our findings showed a tendency towards people understanding diversification in theory, but might have problems with transferring this knowledge into practice. This may be even more difficult in the real world since there are many factors of "noise" in the real financial market. Despite that we gave one treatment group (group 1) a more advanced version of Exercise 1, this exercise was still quite simple compared to the real world. We only had five stocks that the students could choose from, but in the real financial market there are numerous stocks and other types of investments. Investors also have access to overwhelming technical and fundamental information, which makes the investment decisions even more complex.

To better teach the next generation of investors the importance of diversification and its risk reducing effect it might be beneficial to include practical experiments in the lectures in addition to the theoretical perspective. The students could for example manage a fictive portfolio, or participate in investment groups. Such groups exist at some Norwegian schools and universities and there is also an annual competition between them to see who can achieve the highest return during a certain time period. Starting and running these groups may be dependent on individual initiatives, but could provide unique and valuable insights to the functions of the stock market.

Dean P. Foster and Robert A. Stine at the University of Pennsylvania have developed a classroom simulation program in order to make students who are relatively new to statistics and finance aware of the connection between variance and risk.[83] They found that it was easier to remember and more motivating to let the students discover the connections themselves. A good way of teaching the Norwegian students the connection between correlation and return could be to run a similar experiment as the one described in this master thesis.

Based on our findings, we can speculate whether private investors are aware of the diversification benefit at all, when discovering that even students with background in economics do not realize the diversification benefits. Goetzmann & Kumer found that

[83] Foster, D.P & Stine, R.A. (2005) *Being Warren Buffett: A Classroom Simulation of Risk and Wealth when Investing in the Stock Market*

factors like age, wealth, experience, education and degree of financial sophistication influence diversification decisions.[84] The relatively young average age of the students in our experiment, as well as little personal experience with investments, might be important explanations for this. When being in the process of developing our experiment design, we discovered that age seemed to impact on the investment decisions. When using families and friends as test dummies we were surprised that despite not having any background in economics, several of them were able to think logically and choose the combination of stock 1 and 5. All of these people were older than the average age of our students (23,5 years). This could support the theory of age influencing the decisions.

Døskeland (2007) pointed out that in the last few decades there has been a development towards people having to take more responsibility for what kind of assets they want to include in their retirement portfolio. This development together with a financial market that is continuously changing makes it necessary to have a higher competence on financial matters in order to make clever investment decisions.[85] This implies that in today´s market it is crucial to have knowledge of recognized financial theories, there among diversification, in order to make optimal portfolio decisions.

Overall, it seems that the common Norwegian private investor has problems with discovering diversification benefits. A question that arises from this is, "*Should private investors even enter the stock market when they do not have the necessary knowledge?"* Investing in mutual funds or index funds could be a better solution for a lot of investors instead of entering into a highly advanced financial system.

[84] Goetzmann, W.N. & Kumar, A. (2008) *Equity Portfolio Diversification*
[85] Døskeland, T.M.(2007) *Essays on Portfolio Choice*

10.0 Conclusion

In this thesis we wanted to study private investors' general level of knowledge regarding diversification, and to examine whether they took advantage of this in practice. For investigating this, a sample of students has been used.

When testing the students' theoretical knowledge, an overall impression is that they have the necessary knowledge to understand the benefits of diversification. This is based on the observation that they chose a relatively high number of companies on average (6,84) (Exercise 3) and that their investment decisions were a mix of local, domestic and foreign companies. In addition, the average score for all students in the experiment indicated a relatively high theoretical level of knowledge (0,36) (Exercise 4). This indicates that both treatment groups understand diversification in theory.

In practice the students did not seem to act according to their theoretical understanding of diversification. In both treatment groups we found that a large part of the students answered that they tried to spread the risk by investing in several or all of the stocks in combination, and that this automatically led to diversification. This suggests that many students understood that there is some diversification benefit from investing in several stocks. However, they tended to underestimate the importance of the correlation effect. This effect is in our case the correlation between stock 1 and 5. Less than 1/3 of the students invested more than 20 % in each of stock 1 and 5 in each round. This is fewer students than what we expected. The difference in the two treatment groups was small; 9 of the 16 students who over weighted stock 1 and 5 were in treatment group 0, and 7 were in treatment group 1.

If the students did not notice the correlation between stock 1 and 5 from the beginning we expected that they would learn this gradually over the five rounds. Surprisingly, this development did not take place for any of the treatment groups.

The finding that our students were relatively risk seeking can be the explanation for why they did not diversify. Risk seeking students might have focused on maximizing profit and neglected the risk reduction opportunity.

Overall our findings suggests that both treatment groups seems to understand diversification in theory, but do not apply this understanding in practice.

Further it seems that men, to a higher extent than women, discovered the correlation pattern between stock 1 and 5, since they choose these two stocks to a significantly higher extent. It would be interesting to see if the conclusion would be different if the experiment were conducted on the genders separately.

When looking into earlier research on our topic we noticed that there was very little research on the reasons *why* private investors seems to under-diversify. Most research focus on the optimal number of stocks, without investigating whether investors are aware of the correlation effect. There is also very little research on the consistency or lack of such, between the understanding of diversification in theory compared to how private investors behave in practice. We believe that this subject deserves further research, and hope our thesis can contribute to enlighten important aspects in this regard.

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Attachments

CD-rom:

Excel variables

PDF-file: Treatment group 0 part1

PDF-file: Treatment group 0 part2

PDF-file: Treatment group 1 part1

PDF-file: Treatment group 1 part2

SPSS variables

12.0 Appendixes

Appendix 1 Exercise 1 for treatment group 0

Eksperiment

Kjønn: Mann ☐ Kvinne ☐ Alder: ______ ID-nummer:______

Oppgave 1)

TABELL 1

Investering	Forventet avkastning	Standard avvik av forventet avkastning
Aksje 1	169,17 %	134,43 %
Aksje 2	112,50 %	26,10 %
Aksje 3	170,00 %	127,41 %
Aksje 4	158,33 %	244,64 %
Aksje 5	175,83 %	142,14 %

Hvilken av de fem investeringene i tabellen ovenfor synes du er mest attraktiv? Begrunn valget:

Du har 100 eksperimentelle kroner til disposisjon. Disse skal fordeles med prosentsats (vektes) på hver av enkeltaksjene. Du står fritt til å velge sammensetning og kan fordele pengene på aksje 1, 2, 3, 4 eller alle aksjene.

TABELL 2: Avkastningstabell

Utfall	Aksje 1	Aksje 2	Aksje 3	Aksje 4	Aksje 5
1	3	0,95	0,8	0,2	0,05
2	3	1	1,3	0,3	0,1
3	3	1,7	4,5	0,1	1
4	0,05	1	0,9	1,0	2,9
5	1	1	1,2	7,0	3
6	0,1	1,1	1,5	0,9	3,5

Eksperiment

Kjønn: Mann ☐ Kvinne ☐ Alder: ______ ID-nummer:______

Oppgave 1)

TABELL 1

Investering	Forventet avkastning	Standard avvik av forventet avkastning
Aksje 1	169,17 %	137,25 %
Aksje 2	112,50 %	26,10 %
Aksje 3	170,50 %	132,74 %
Aksje 4	158,33 %	244,64 %
Aksje 5	175,83 %	142,14 %

Hvilken av de fem investeringene i tabellen ovenfor synes du er mest attraktiv? Begrunn valget:

Du har 100 eksperimentelle kroner til disposisjon. Disse skal fordeles med prosentsats (vektes) på hver av enkeltaksjene. Du står fritt til å velge sammensetning og kan fordele pengene på aksje 1, 2, 3, 4 eller alle aksjene.

TABELL 2: Avkastningstabell

Utfall	Aksje 1	Aksje 2	Aksje 3	Aksje 4	Aksje 5
1	2,90	0,95	1,07	0,20	0,05
2	0,10	1,00	1,38	0,30	3,50
3	3,00	1,70	4,66	0,10	1,00
4	0,05	1,00	1,07	1,00	2,90
5	0,90	1,00	0,99	7,00	3,00
6	3,20	1,10	1,06	0,90	0,10

We divided the students into two treatment groups. Treatment group 0 and 1 received different experiments. All students were told to fill in gender, age and their individual ID-number which was handed out in the beginning of the experiment. In both experiments we tested whether the treatment groups discovered the benefit of choosing stock 1 and 5 in combination. The benefit occurs because of the high negative correlation between these two stocks. The experiment that treatment group 0 got was considered a quite simple experiment, where the correlation between stock 1 and 5 was easy to observe. The experiment that treatment group 1 received had more confusing pattern, making it more difficult to discover this benefit.

“Tabell 2” (table of return) in both experiments shows the different return for each stock depending on the outcome, which were decided by rolling a dice. In table 2 for treatment group 0 we observe that if the dice outcome is 1, 2 or 3, stock 1 would have a high return and stock 5 a low return. If the dice outcome is 4, 5 or 6 then stock 5 have a high return and stock 1 a low return. Therefore, these stocks offset each other. In table 2 for treatment group 1 we observe that this correlation pattern is more difficult to discover, because the order of the numbers are swapped and that most numbers have decimals. Stock 2, 3 and 4 are included to avoid making the covariance between stock 1 and 5 too obvious. Stock 2 can be seen as a “safe” stock because of the low standard deviation, stock 3 as a “stable” stock with higher return and lower standard deviation than stock 1 and could therefore look quite attractive. Stock 4 are considered a “risky” stock because of its high volatility.

“Tabell 1” (expected annual return and standard deviation) is based on table 2 and shows the expected annual return and standard deviation for each stock. First, the students were asked to answer the qualitative question; “Which of the five investments in the table below do you find most attractive? State the reason for your choice” based on table 1. After answering this question the students were told that they have 100 experimental kroner at their disposal, which they should invest in the stocks. The composition was optional. The percentage they wanted to invest was filled out in the round table, which will be described in Appendix 2. The experiment was conducted over five rounds.

Appendix 2 Round tables for the five rounds

Verdi = prosent av beløp * avkastning*100 eller resterende beløp.

Husk når du velger *prosentandel av beløp* at 50 % = 0,5.
Avkastning er gitt ved tallet i tabellen ovenfor. Føres direkte over i rad 2.

Beløp til disposisjon: 100 eksperimentelle kroner

Runde 1	Aksje 1	Aksje 2	Aksje 3	Aksje 4	Aksje 5	Sum	Terningutfall
Prosentandel av beløp						100 %	
Avkastning (se tabell)							
Verdi						KR	

Beløp til disposisjon før neste runde: ________

Runde 2	Aksje 1	Aksje 2	Aksje 3	Aksje 4	Aksje 5	Sum	Terningutfall
Prosentandel av beløp						100 %	
Avkastning (se tabell)							
Verdi						KR	

Beløp til disposisjon før neste runde: ________

Runde 3	Aksje 1	Aksje 2	Aksje 3	Aksje 4	Aksje 5	Sum	Terningutfall
Prosentandel av beløp						100 %	
Avkastning (se tabell)							
Verdi						KR	

Beløp til disposisjon før neste runde: ________

Runde 4	Aksje 1	Aksje 2	Aksje 3	Aksje 4	Aksje 5	Sum	Terningutfall
Prosentandel av beløp						100 %	
Avkastning (se tabell)							
Verdi						KR	

Beløp til disposisjon før neste runde: ________

Runde 5	Aksje 1	Aksje 2	Aksje 3	Aksje 4	Aksje 5	Totalsum	Terningutfall
Prosentandel av beløp						100 %	
Avkastning (se tabell)							
Verdi						KR	

Hvorfor valgte du den vektingen som du gjorde?

The 5 tables above are the round tables that were used in order to calculate the wealth during the practical experiment. All students start with a fictive amount of NOK 100, which will grow or decrease depending on students investment decisions and the outcomes from the dice. In the beginning of each round the students are told to distribute their current wealth into 5 stocks using percentages. They are also told that they are free to choose the distribution between the stocks. After row one is filled in, the dice will be rolled and a random outcome between one to six will occur. The students now have to fill in their return (avkastning) based on the table of return which is shown in appendix 1. After filling out the return in row 2 in the round table, the students are able to calculate the wealth from this round in row 3(Verdi). The amount from each round is used as a basis for the next round, as shown in the tables above "beløp til disposisjon før neste runde". The wealth is calculated using the following formula: **Wealth = Percentage of amount * Return*100 or remaining amount**.

In addition to the practical experiment we asked the question: Why did you choose to set the percentage of amount the way you did? We included this question with the intention of getting a better understanding of students´ investment behavior and to study the factors that were actually affecting their decisions.

Appendix 3 Exercise 2 of the experiment (which is identical for both treatment groups)

ID-nummer: _______

Oppgave 2)

Tenk deg at du skal foreta reelle valg. Du skal velge mellom valg A eller valg B for hver situasjon. Utfallene er tilfeldige og er like sannsynlige. Du kan tenke på utfallet som en terning med 10 sider.

	Valg A	Valg B	Ditt valg A eller B
Situasjon 1	$40 dersom utfallet blir 1 $32 dersom utfallet blir 2-10	$77 dersom utfallet blir 1 $2 dersom utfallet blir 2-10	
Situasjon 2	$40 dersom utfallet blir 1-2 $32 dersom utfallet blir 3-10	$77 dersom utfallet blir 1-2 $2 dersom utfallet blir 3-10	
Situasjon 3	$40 dersom utfallet blir 1-3 $32 dersom utfallet blir 4-10	$77 dersom utfallet blir 1-3 $2 dersom utfallet blir 4-10	
Situasjon 4	$40 dersom utfallet blir 1-4 $32 dersom utfallet blir 5-10	$77 dersom utfallet blir 1-4 $2 dersom utfallet blir 5-10	
Situasjon 5	$40 dersom utfallet blir 1-5 $32 dersom utfallet blir 6-10	$77 dersom utfallet blir 1-5 $2 dersom utfallet blir 6-10	
Situasjon 6	$40 dersom utfallet blir 1-6 $32 dersom utfallet blir 7-10	$77 dersom utfallet blir 1-6 $2 dersom utfallet blir 7-10	
Situasjon 7	$40 dersom utfallet blir 1-7 $32 dersom utfallet blir 8-10	$77 dersom utfallet blir 1-7 $2 dersom utfallet blir 8-10	
Situasjon 8	$40 dersom utfallet blir 1-8 $32 dersom utfallet blir 9-10	$77 dersom utfallet blir 1-8 $2 dersom utfallet blir 9-10	
Situasjon 9	$40 dersom utfallet blir 1-9 $32 dersom utfallet blir 10	$77 dersom utfallet blir 1-9 $2 dersom utfallet blir 10	
Situasjon 10	$40 dersom utfallet blir 1-10	$77 dersom utfallet blir 1-10	

This figure determines the categorization of the students into three risk classes. The students risk preferences were categorized into respectively risk averse (-1), risk neutral (0) and risk seeking (1). The figure is based on Holt & Lori´s classification of risk preferences.[86] If students were risk-seeking they should change from option A to option B earlier than decision 4 (“situasjon 4”) in the figure above. If the students were risk neutral they should act the way the figure shows, and change from option A to option B in decision 5 (“situasjon 5”). This means that the students would have 4 option A, then 6 option B. Students who change from option A to option B in decision 6 (“situasjon 6”) or later is considered risk averse.

The logic is calculating the expected payoffs from each option; in decision 1-4, the payoff is highest when choosing option A, but in decision 5-10, the expected payoff is highest when choosing option B. Option A is called the safe choice, and option B the risky choice. Holt and Lori also found a tendency towards less risk aversion when the payoffs were hypothetical, where test subjects chose 5 A on average, compared to 6 A when real payments.

[86] Holt, C. (2007) Markets, Games & Strategic Behavior, page 50-54

Appendix 4 Exercise 3 of the experiment (which is identical for both treatment groups)

Oppgave 3)

Sett sammen portefølje av selskapene nedenfor ved å krysse av valgte selskaper. Sammensetningen er valgfri. Vekting trengs ikke tas hensyn til.

	Yara International
	Toyota
	Thai Airways International
	Telenor
	Subsea 7
	Storebrand
	Amerikanske statsobligasjoner
	Statoil
	Seadrill
	Panasonic Corp.
	Orkla
	Olav Thon Eiendomsselskap
	Norsk Hydro
	Norgesgruppen ASA
	Microsoft Corperation
	Gjensidige Forsikring
	General Motors
	Norske statsobligasjoner
	DnB NOR
	Apple Inc.
	Amazon
	Aker Solutions
	Acergy
	Google Inc.

Hva var bakgrunnen for at du valgte som du gjorde? Utdyp.

Exercise 3 was a test to see if the students showed a tendency of under-diversification and therefore chose a low number of stocks. In this exercise we also wanted to study if the students chose to combine both local, domestic and foreign stocks, and whether they chose stocks across different industries. In exercise 3 we also included the question "State the reason for your choice of companies?" The answers from this question would possibly give us a broader perspective on the students opinions and understanding of diversification and also to check for any psychological biases.

Appendix 5 Exercise 4 of the experiment (which is identical for both treatment groups)

Oppgave 4)

Spørsmål. Kryss av for riktig svar.

Spørsmål 1: Å ha 3 aksjer i en portefølje er nok til å få optimal diversifiseringsgevinst.

Sant ☐ Ingen formening ☐ Usant ☐

Spørsmål 2: Dersom du hadde valget mellom to porteføljer som hadde samme avkastning, ville du valgt det med høyeste eller lavest standardavvik? Høyest ☐ Lavest ☐

Spørsmål 3: Ville du valgt å investere både i Norge og i utlandet dersom du har mulighet?

Norge ☐ Norge & utland ☐

Spørsmål 4: Ville du valgt å investere i en eller flere bransjer dersom du har mulighet?

En ☐ Flere ☐

Spørsmål 5: Kan man redusere risikoen i en portefølje ved å investere i flere typer verdipapirer?

Ja ☐ Nei ☐ Ingen formening ☐

Spørsmål 6: Har korrelasjon mellom aksjer noe å si for hvordan du ville investert?

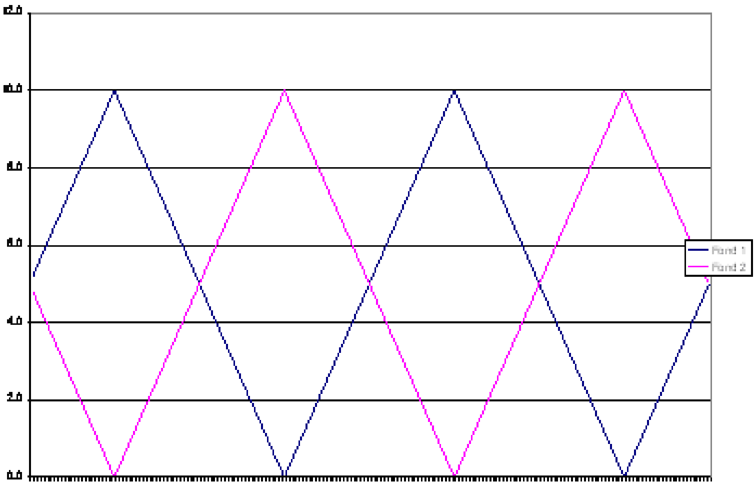
Ja ☐ Nei ☐ Ingen formening ☐

Spørsmål 7: Hvilken korrelasjon gir høyest diversifisering?

Positiv ☐ Negativ ☐ Ingen betydning ☐

HUSK SPØRSMÅL 8 PÅ NESTE SIDE...

Spørsmål 8:



I figuren over ser du to aksjer. Vil en sammensetning av rosa og blå medføre diversifisering?

Ja ☐ Nei ☐ Vet ikke ☐

Exercise 4 was a test of the students´ general level of knowledge when answering 8 statements related to diversification. The students were categorized according to their level of knowledge. If the students had 0 – 2 correct answers they are in the category -1; which means low level of knowledge. If they had 3 – 6 correct answers they were in category 0; which means medium level of knowledge. Having 7 – 8 correct answers, they are in category 1, which means high level of knowledge.

Appendix 6 Treatment groups compared with number of companies

NPar Tests

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
NumberOfCompanies	55	6.84	3.833	2	24	4.00	6.00	8.00
Treatment	55	.51	.505	0	1	.00	1.00	1.00

Mann-Whitney Test

Ranks

	Treatment	N	Mean Rank	Sum of Ranks
NumberOfCompanies	0	27	32.00	864.00
	1	28	24.14	676.00
	Total	55		

Test Statistics[a]

	NumberOfCompanies
Mann-Whitney U	270.000
Wilcoxon W	676.000
Z	-1.829
Asymp. Sig. (2-tailed)	.067

a. Grouping Variable: Treatment

We performed a Mann-Whitney test to study differences between the two treatment groups with respect to number of companies they chose to invest in when creating their own portfolio. The N is the number of students, which in our experiment were 55. The minimum show that the minimum number of companies the students chose to invest in was 2, and the maximum tells us that the maximum number of companies that the students invested in was 24. This is a relatively broad spread, and could mean that there are differences in the level of understanding of diversification among students. As the N in the “Rank” table show, there are 27 students in treatment group 0 and 28 students in treatment group 1. The process of ranking the scores for the different groups (from highest to lowest), and finding the mean of the ranks gives us the Mean Rank. The mean ranks are numbers that we can compare to see which group have the highest/lowest score. The mean rank shows that treatment group 0 seems to chose on average a higher number of companies (mean rank: 32,00) than treatment group 1 (mean rank: 24,14). The Asymp. Sig shows that there are no significant differences in the two treatment groups when examining the number of companies they choose to invest in (Asymp. Sig: 0,067 > 0,05), but the significance level are not very far from being significant.

Appendix 7 Treatment groups compared with level of knowledge

NPar Tests

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
LevelOfKnowledge	55	.36	.589	-1	1	.00	.00	1.00
Treatment	55	.51	.505	0	1	.00	1.00	1.00

Mann-Whitney Test

Ranks

	Treatment	N	Mean Rank	Sum of Ranks
LevelOfKnowledge	0	27	30.89	834.00
	1	28	25.21	706.00
	Total	55		

Test Statistics[a]

	LevelOfKnowledge
Mann-Whitney U	300.000
Wilcoxon W	706.000
Z	-1.487
Asymp. Sig. (2-tailed)	.137

a. Grouping Variable: Treatment

This Mann-Whitney test was conducted to see if there were any relationship between the treatment groups and their level of knowledge regarding diversification. The N is the number of students, which in our experiment were 55. As the N in the “Rank” table show, there are 27 students in treatment group 0 and 28 students in treatment group 1. The process of ranking the scores for the different groups (from highest to lowest), and finding the mean of the ranks gives us the Mean Rank. The mean ranks are numbers that we can compare to see which group have the highest/lowest score. The mean rank shows that treatment group 0 have a tendency towards having a higher level of knowledge (mean rank: 30,89) than treatment group 1 (mean rank: 25,21). The Asymp. Sig shows that there are no significant differences in the two treatment groups when comparing them to their level of knowledge. (Asymp. Sig: 0,137 > 0,05)

Appendix 8 Final wealth compared with level of knowledge

NPar Tests

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles 25th	Percentiles 50th (Median)	Percentiles 75th
FinalWealth	55	523.98673	376.052225	16.320	1827.980	304.50000	455.99000	608.00000
LevelOfKnowledge	55	.36	.589	-1	1	.00	.00	1.00

Kruskal-Wallis Test

Ranks

	LevelOfKnowledge	N	Mean Rank
FinalWealth	-1	3	17.33
	0	29	28.14
	1	23	29.22
	Total	55	

Test Statistics[a,b]

	FinalWealth
Chi-square	1.465
Df	2
Asymp. Sig.	.481

a. Kruskal Wallis Test

b. Grouping Variable: LevelOfKnowledge

This Kruskal-Wallis test was conducted to check for relationship between final wealth and the students level of knowledge. The number of students examined is 55 students. The lowest final wealth achieved is 16 and the highest is 1828 according to minimum and maximum values as shown in the table above. The average final wealth is 524. Final wealth is compared with the level of knowledge, respectively -1=low level, 0=medium level and 1=high level. As shown by the mean rank values, the students with a low level of knowledge earns the lowest final wealth (17,33), and the students with the highest level of knowledge achieves the highest final wealth (29,22). The process of ranking the scores for the different groups (from highest to lowest), and finding the mean of the ranks gives us the Mean Rank. The mean ranks are numbers that we can compare to see which group have the highest/lowest score Despite the indications of the mean rank, the result is not significant (sig.0,481). Another interesting value is the average (mean) level of knowledge, being 0,36. This is a number between a medium to a high level of knowledge, and indicates that the students should have a sufficient level of knowledge regarding diversification.

Appendix 9 Gender compared with number of companies

NPar Tests

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
NumberOfCompanies	55	6.84	3.833	2	24	4.00	6.00	8.00
Gender	55	.62	.490	0	1	.00	1.00	1.00

Mann-Whitney Test

Ranks

	Gender	N	Mean Rank	Sum of Ranks
NumberOfCompanies	0	21	28.14	591.00
	1	34	27.91	949.00
	Total	55		

Test Statistics[a]

	NumberOfCompanies
Mann-Whitney U	354.000
Wilcoxon W	949.000
Z	-.052
Asymp. Sig. (2-tailed)	.958

a. Grouping Variable: Gender

This Mann-Whitney test was performed to see if there were any differences between men and women when it comes to how many stocks they wanted to include in their portfolio. This test is based on an exercise where the students were told to choose voluntarily from a pool of 24 stocks. Ødegaard (2005) found that the average investor invests in approximately 3 stocks when making a stock portfolio, and we wanted to see if our students in a laboratory setting would act similarly. As the first table above shows, both men and women together choose on average almost 7 companies in their portfolio (6,84). In this test there are 21 men and 34 women as shown in the second table. The process of ranking the scores for the different groups (from highest to lowest), and finding the mean of the ranks gives us the Mean Rank. The mean ranks are numbers that we can compare to see which group have the highest/lowest score. The mean rank reveal that men chose to invest in a slightly higher number of stocks (28,14>27,91). However, this result is not significant (sig.0.958).

Appendix 10 Gender compared with level of knowledge

NPar Tests

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
LevelOfKnowledge	55	.36	.589	-1	1	.00	.00	1.00
Gender	55	.62	.490	0	1	.00	1.00	1.00

Mann-Whitney Test

Ranks

	Gender	N	Mean Rank	Sum of Ranks
LevelOfKnowledge	0	21	32.86	690.00
	1	34	25.00	850.00
	Total	55		

Test Statistics[a]

	LevelOfKnowledge
Mann-Whitney U	255.000
Wilcoxon W	850.000
Z	-2.000
Asymp. Sig. (2-tailed)	.045

a. Grouping Variable: Gender

We conducted a Mann-Whitney test to check for differences between men and women regarding their level of knowledge concerning diversification. This Mann-Whitney test is based on a test of the students´ level of knowledge regarding diversification, where students are categorized into 3 groups: high level of knowledge, medium level of knowledge and low level of knowledge. The results from this Mann-Whitney test shows that the mean level of knowledge for both men and women is 0,36, which means a medium to a high level of knowledge on average. The process of ranking the scores for the different groups (from highest to lowest), and finding the mean of the ranks gives us the Mean Rank. The mean ranks are numbers that we can compare to see which group have the highest/lowest score. The second table shows that the distribution of men and women are unequal, consisting of 21 men(0) and 34 women (1). The table also show that men have a higher level of knowledge (32,86) than women(25,00). This is also a significant difference (sig.0.045).

Appendix 11 Treatment groups compared with stock 1-5

NPar Tests

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
Stock1	275	.2462	.15382	.00	1.00	.1500	.2000	.3000
Stock2	275	.1544	.13533	.00	1.00	.0000	.1700	.2000
Stock3	275	.2938	.20314	.00	1.00	.2000	.3000	.3500
Stock4	275	.1062	.12505	.00	1.00	.0000	.1000	.2000
Stock5	275	.2012	.13521	.00	.60	.1000	.2000	.3000
Treatment	275	.51	.501	0	1	.00	1.00	1.00

Mann-Whitney Test

Ranks

	Treatment	N	Mean Rank	Sum of Ranks
Stock1	0	135	171.26	23120.00
	1	140	105.93	14830.00
	Total	275		
Stock2	0	135	130.90	17672.00
	1	140	144.84	20278.00
	Total	275		
Stock3	0	135	120.27	16237.00
	1	140	155.09	21713.00
	Total	275		
Stock4	0	135	128.10	17293.00
	1	140	147.55	20657.00
	Total	275		
Stock5	0	135	139.34	18811.00
	1	140	136.71	19139.00
	Total	275		

Test Statistics[a]

	Stock1	Stock2	Stock3	Stock4	Stock5
Mann-Whitney U	4960.000	8492.000	7057.000	8113.000	9269.000
Wilcoxon W	14830.000	17672.000	16237.000	17293.000	19139.000
Z	-6.903	-1.490	-3.683	-2.104	-.278
Asymp. Sig. (2-tailed)	.000	.136	.000	.035	.781

a. Grouping Variable: Treatment

This Mann-Whitney test was conducted to examine if there were differences between treatment group 0 and treatment group 1 with respect to how they chose to invest in stock 1, 2, 3, 4 and 5. The test is to see whether the students choose the optimal investment solution which is a combination of stock 1 and stock 5. The way we designed the five stocks and their correlation pattern, a combination of stock 1 and stock 5 in all of the five rounds will lead exclusively to a positive return.

The descriptive statistics show that the N is 275, which means 55 students in total multiplied by 5 rounds. The mean is telling us that stock 3 is the favorite for all students with 29% invested on average during the five rounds. In second and third place we have stock 1 and stock 5. The process of ranking the scores for the different groups (from highest to lowest), and finding the mean of the ranks gives us the Mean Rank. The mean ranks are numbers that we can compare to see which group have the highest/lowest score. The second table show that the N is 135 and 140 observations. This is because treatment group 0 consist of 27 students*5 rounds, and treatment group 1 consists of 28 students * 5 rounds. The most important finding is that treatment group 0 seems to choose stock 1 and stock 5 to a larger extent than treatment group 1 according to the mean rank. (171,3>105,9). Treatment group 0 also chooses to invest less in stock 2, stock 3 and stock 4 compared to treatment group 1. The difference between the two treatment groups is significant for stock 1 (sig. 0,00) stock 3 (sig.0.00) and stock 4 (sig.0.035) .

Appendix 12 Gender compared with stock 1 and stock 5

NPar Tests

Mann-Whitney Test

Ranks

	Gender	N	Mean Rank	Sum of Ranks
Stock1	0	105	153.27	16093.00
	1	170	128.57	21857.00
	Total	275		
Stock5	0	105	167.67	17605.50
	1	170	119.67	20344.50
	Total	275		

Test Statistics[a]

	Stock1	Stock5
Mann-Whitney U	7322.000	5809.500
Wilcoxon W	21857.000	20344.500
Z	-2.536	-4.923
Asymp. Sig. (2-tailed)	.011	.000

a. Grouping Variable: Gender

This Mann-Whitney test was conducted to check for differences between men and women regarding their investment percentages in stock 1 and stock 5. We are specifically studying these two stocks since they are the two stocks that it would be optimal to combine because of their correlation. If students chose to invest in both stock 1 and stock 5 in each of the five rounds their wealth would grow steadily. This is due to the almost perfect negative correlation causing the stocks to give a positive return when the other one gives a negative return, and will on average give the highest final wealth. The process of ranking the scores for the different groups (from highest to lowest), and finding the mean of the ranks gives us the Mean Rank. The mean ranks are numbers that we can compare to see which group have the highest/lowest score. According to the mean rank, men (0) invest a higher percentage in stock 1 (153,27>128,57) and stock 5 (167,67>119,67) over the 5 rounds compared to women (1). This difference is also significant for both stock 1(sig.0,011) and stock 5(sig.0,00). From this result is seems that men to a higher extent saw the correlation pattern between the stocks, and invested more rationally.

Appendix 13 Learning effect over the five rounds for treatment group 0 and 1 (for stock 1 and 5)

Treatment group 0 for stock 1:

Homogeneous Subsets

Stock1

Scheffe[a]

Round	N	Subset for alpha = 0.05
		1
1	27	.2574
5	27	.3000
3	27	.3167
2	27	.3327
4	27	.3333
Sig.		.585

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 27.000.

Treatment group 1 for stock 1:

Homogeneous Subsets

Stock1

Scheffe[a]

Round	N	Subset for alpha = 0.05
		1
1	28	.1704
2	28	.1786
3	28	.1864
5	28	.1964
4	28	.2007
Sig.		.913

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 28.000.
b.

Treatment group 0 for stock 5:

Homogeneous Subsets

Stock5

Scheffe[a]

Round	N	Subset for alpha = 0.05
		1
1	27	.1625
2	27	.2080
3	27	.2089
4	27	.2327
5	27	.2404
Sig.		.468

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 27.000.

Treatment group 1 for stock 5:

Homogeneous Subsets

Stock5

Scheffe[a]

Round	N	Subset for alpha = 0.05
		1
3	28	.1721
1	28	.1757
2	28	.1971
5	28	.2011
4	28	.2150
Sig.		.764

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 28.000.

We conducted a Scheffe test to examine if the students had any learning effect over the five rounds of the experiment. As a limitation we chose to only look at stock 1 and 5 for each of the two treatment groups. The Scheffe test displays which of the stocks the students invest the highest amount in for each of the five rounds. If the students actually had a learning effect over the rounds, the rounds should be listed in the following order; 1,2,3,4,5 and have significantly increasing percentage over the five rounds. The first table show how treatment group 0 invested in stock 1. The ranking of the rounds are; 1,5,3,2,4 which indicates no learning effect. The significance also supports this finding (Sig. 0,585 > 0,05). The second table show how treatment group 1 invested in stock 1. The ranking is; 1,2,3,5,4 which could seem like there has been a learning effect to begin with, but because of the deviation in round 4 and 5 this is not likely. Also the significance discard any learning effect (Sig. 0,913 > 0,05). In table 3 we observe that for stock 5 it seems like treatment group 0 have had learning effect, since the ranking of the rounds are; 1,2,3,4,5, but the significance tells us that the increasing amount in each round is not large enough to make this finding significant (Sig. 0,468 > 0,05). For treatment group 1 regarding stock 5 there is clearly no learning effect because the rounds are listed: 3,1,2,5,4. The significance supports this (Sig. 0,764 > 0,05). Conclusion of the Scheffe test is that there seems to be no clear learning effect for any of the treatment groups

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Appendix 14 Treatment groups compared with final wealth

NPar Tests

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
FinalWealth	55	523.98673	376.052225	16.320	1827.980	304.50000	455.99000	608.00000
Treatment	55	.51	.505	0	1	.00	1.00	1.00

Mann-Whitney Test

Ranks

	Treatment	N	Mean Rank	Sum of Ranks
FinalWealth	0	27	29.57	798.50
	1	28	26.48	741.50
	Total	55		

Test Statistics[a]

	FinalWealth
Mann-Whitney U	335.500
Wilcoxon W	741.500
Z	-.716
Asymp. Sig. (2-tailed)	.474

a. Grouping Variable: Treatment

We conducted a Mann-Whitney test to discover if there was a relationship between what treatment group the students were in and the final wealth they achieved. The N is the number of students, which in our experiment were 55. The minimum and maximum final wealth is respectively 16,320 and 1827,980 which tells us that there is a wide range of the final wealth the students achieved. As shown in the “Ranks” table there is 27 students in treatment group 0 and 28 students in treatment group 1. The process of ranking the scores for the different groups (from highest to lowest), and finding the mean of the ranks gives us the Mean Rank. The mean ranks are numbers that we can compare to see which group have the highest/lowest score. The mean rank shows that treatment group 0 seems to have a higher final wealth (mean rank: 29,57) than treatment group 1 (mean rank: 26,48). However, the Asymp. Sig shows that there are no significant differences in the final wealth when comparing the two treatment groups (Asymp. Sig: 0,474 > 0,05)

Appendix 15 Gender compared with final wealth

NPar Tests

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
FinalWealth	55	523.98673	376.052225	16.320	1827.980	304.50000	455.99000	608.00000
Gender	55	.62	.490	0	1	.00	1.00	1.00

Mann-Whitney Test

Ranks

	Gender	N	Mean Rank	Sum of Ranks
FinalWealth	0	21	29.52	620.00
	1	34	27.06	920.00
	Total	55		

Test Statistics[a]

	FinalWealth
Mann-Whitney U	325.000
Wilcoxon W	920.000
Z	-.554
Asymp. Sig. (2-tailed)	.579

a. Grouping Variable: Gender

In order to see if there were any differences between men and women when it comes to final wealth, we performed a Mann-Whitney test. The minimum final wealth achieved is 16, and the highest final wealth is 1827 experimental kroner. As shown in the second table, there are 21 men (0), and 34 women (1). The process of ranking the scores for the different groups (from highest to lowest), and finding the mean of the ranks gives us the Mean Rank. The mean ranks are numbers that we can compare to see which group have the highest/lowest score. According to the mean rank, men earns a higher final wealth (29,52) than women(27,06). However, this result is not significant (0,579).

Apendix 16 Reward handed out to the students

ID	Eksperimentelle penger	Virkelige penger (Eksperimentelle*0,5)	Rundet opp til nærmeste 50
1	1729,45	864,725	900
2	372,49	186,245	200
3	333,94	166,97	200
4	1226,25	613,125	650
5	1058,08	529,04	550
6	1827,98	913,99	950
7	533,58	266,79	300
8	200,34	100,17	150
9	837,6	418,8	450
10	262	131	150
11	413,49	206,745	250
12	211,79	105,895	150
13	705,6	352,8	400
14	534,55	267,275	300
15	102	51	100
16	95,6	47,8	50
17	16,32	8,16	50
18	685,56	342,78	350
19	445,8	222,9	250
20	128,47	64,235	100
21	608	304	350
23	367,34	183,67	200
24	450,73	225,365	250
25	531,08	265,54	300
27	603,66	301,83	350
28	1145,75	572,875	600
29	507,73	253,865	300
96	455,99	227,995	250
97	463,7	231,85	250
98	592,87	296,435	300
99	509,1	254,55	300
100	306,4	153,2	200
101	211,37	105,685	150
102	403,56	201,78	250
103	701,24	350,62	400
104	519,32	259,66	300
105	125,12	62,56	100
106	560,98	280,49	300
107	389,43	194,715	200
108	505	252,5	300
109	405	202,5	250
110	519,3	259,65	300

111	415,5	207,75	250
112	663	331,5	350
113	608	304	350
114	610	305	350
115	400,6	200,3	250
116	121,3	60,65	100
118	121,8	60,9	100
119	780	390	400
120	127,36	63,68	100
121	204,55	102,275	150
123	304,5	152,25	200
124	1433,8	716,9	750
125	425,3	212,65	250
		Sum totalt utbetalt	16300

The list above shows the students ID number in the first column (to the left), the second column show their final wealth in experimental kroner from the experiment, and the third column show experimental amount multiplied with the converting factor of 0,5 to make sure the budget of NOK 20 000 was not exceeded. In the fourth column the amount from the third column was rounded upwards to the nearest NOK 50 and is the amount in Norwegian kroner that the individual student was paid, making it easy to deliver the amounts to the students. In total, NOK 16 300 was paid to the students.

The ID numbers of 1-29 is treatment group 0, and ID numbers from 96-125 belongs to treatment group 1. Number 22, 26, 117 and 122 is lacking, these students probably decided to leave during the experiment. The number of students attending and registered with an ID number are 55. The reason for the gap between ID number 29 and ID number 96 is that we had to take into account the possibility of a larger number of students showing up. Therefore we had several additional sets of the experiment printed.

Appendix 17 Risk preferences compared with stock 1-5

Kruskal-Wallis Test

Ranks

	RiskPreferences	N	Mean Rank
Stock1	-1	75	135.48
	0	65	128.95
	1	100	103.77
	Total	240	
Stock2	-1	75	115.77
	0	65	113.52
	1	100	128.59
	Total	240	
Stock3	-1	75	90.57
	0	65	134.02
	1	100	134.16
	Total	240	
Stock4	-1	75	112.44
	0	65	116.68
	1	100	129.03
	Total	240	
Stock5	-1	75	146.93
	0	65	116.16
	1	100	103.50
	Total	240	

Test Statistics[a,b]

	Stock1	Stock2	Stock3	Stock4	Stock5
Chi-Square	10.541	2.493	20.928	2.956	17.517
Df	2	2	2	2	2
Asymp. Sig.	.005	.287	.000	.228	.000

a. Kruskal Wallis Test

b. Grouping Variable: RiskPreferences

This Kruskal-Wallis test was conducted to examine if there were a relationship between the students risk preferences and their investment decisions. As shown in the “Ranks” table the risk preferences are divided into the categories; -1, 0 and 1. -1 is the group of students that are risk averse, 0 is the groups of students that are risk neutral and 1 is the group of students that are risk seeking. The process of ranking the scores for the different groups (from highest to lowest), and finding the mean of the ranks gives us the Mean Rank. The mean ranks are numbers that we can compare to see which group have the highest/lowest score. The most important finding is that risk averse students seem to favor stock 1 (mean rank: 135,48) and stock 5 (mean rank: 146,93) thereby followed by stock 2 (mean rank: 115,77). It is also interesting to notice that risk seeking students invest the least in stock 1 (mean rank: 103,77) and stock 5 (mean rank: 103,50). Risk seeking students seem to prefer stock 3 (mean rank: 134,16) and stock 4 (mean rank: 129,03). Also, the risk neutral students invest the most in stock 3 (mean rank: 134,02) and invest the least in stock 2 (mean rank: 113,52). For stock 1 there are significant differences when comparing it to risk preference groups (Asymp. Sig: 0,005 < 0,05). For stock 2 there is no significant difference (Asymp. Sig: 0,287 > 0,05). For stock 3 there is clearly significant difference (Asymp. Sig: 0,000 < 0,05). For stock 4 there is no significant difference (Asymp. Sig: 0,228 > 0,05), but for stock 5 there is significant differences (Asymp. Sig. 0,000 < 0,05). Summarized the Kruskal-Wallis test show significant differences between the risk preference groups when it comes to stock 1,3 and 5.

Appendix 18 Risk preferences compared final wealth

NPar Tests

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
FinalWealth	48	535.2288	398.19255	16.32	1827.98
RiskPreferences	48	.10	.857	-1	1

Kruskal-Wallis Test

Ranks

	RiskPreferences	N	Mean Rank
FinalWealth	-1	15	28.33
	0	13	22.85
	1	20	22.70
	Total	48	

Test Statistics[a,b]

	FinalWealth
Chi-square	1.637
Df	2
Asymp. Sig.	.441

a. Kruskal Wallis Test

b. Grouping Variable: RiskPreferences

This Kruskal-Wallis test was conducted to see if there were a relationship between the students risk preferences and final wealth. The N is the number of students, in this case 48. The reason why not all the 55 students was included was because 7 of the students had clearly not understood the risk preference test and was therefore excluded from this particular test. The minimum and maximum final wealth is respectively 16,320 and 1827,980 which tells us that there is a wide range of the final wealth the students achieved during the experiment. As shown in the "Ranks" table the risk preferences are divided into -1, 0 and 1. -1 is the group of students that are risk averse, 0 is the groups of students that are risk neutral and 1 is the group of students that are risk seeking. As the N in the "Rank" table show, 15 of the students are risk averse, 13 students are risk neutral and 20 students are risk seeking. The process of ranking the scores for the different groups (from highest to lowest), and finding the mean of the ranks gives us the Mean Rank. The mean ranks are numbers that we can compare to see which group have the highest/lowest score. The mean rank shows that the risk averse group have the highest final wealth (mean rank 25,86) and the risk neutral group have the second highest final wealth (mean rank 22,58). The students who are risk seeking have the lowest final wealth (mean rank: 22,14). However, the Asymp. Sig shows that there are no significant differences in the students' final wealth when comparing them to their risk preferences. (Asymp. Sig: 0,705 > 0,05)

Appendix 19 Calculations of final wealth

	Return Stock 1	Return Stock 2	Return Stock 3	Return Stock 4	Return Stock 5	Dice outcome
Round 1	1	1	1,2	7	3	5
Round 2	0,1	1,1	1,5	0,9	3,5	6
Round 3	3	0,95	0,8	0,2	0,05	1
Round 4	0,1	1,1	1,5	0,9	3,5	6
Round 5	0,05	1	0,9	1	2,9	4

The table above shows the return in the 5 different stocks from part one of the experiment depending on the dice outcome. The dice outcome was the outcomes that actually occurred in the practical experiment. We have chosen to use experiment 0 to calculate the final wealth below.

If a student chose to put 50% in stock 1 and 50% in stock 5, given these dice outcomes, his final wealth would be 1457,6 experimental kroner:
Round 1: 100*0,5*1+100*0,5*3= 200
Round 2: 200*0,5*0,1+200*0,5*3,5= 360
Round 3: 360*0,5*3+360*0,5*0,05= 549
Round 4: 549*0,5*0,1+549*0,5*3,5= 988,2
Round 5: 988,2*0,5*0,05+988,2*0,5*2,9= <u>1457,6</u>

If a student chose to place 20% in each stock for each round, his final wealth would be 622,9 experimental kroner:
Round 1: 100*0,2*1+100*0,2*1+100*0,2*1,2+100*0,2*7+100*0,2*3= 264
Round 2: 264*0,2*0,1+264*0,2*1,1+264*0,2*1,5+264*0,2*0,9+264*0,2*3,5=374,9
Round 3: 374,9*0,2*3+374,9*0,2*0,95+374,9*0,2*0,8+374,9*0,2*0,2+374,9*0,2*0,05=374,9
Round 4: 374,9*0,2*0,1+374,9*0,2*1,1+374,9*0,2*1,5+374,9*0,2*0,9+374,9*0,2*3,5=532,4
Round 5: 532,4*0,2*0,05+532,4*0,2*1+532,4*0,2*0,9+532,4*0,2*1+532,4*0,2*2,9= <u>622,9</u>

If against all odds the dice outcome was 5 in each round and a student had placed 100% in stock 4 in each round, then his final wealth would be 1 680 700 experimental kroner.
100*1*7^5=1 680 700

The last calculation demonstrates that it was necessary to decide a maximum limit of amount that would be paid to each student. The maximum limit was set to 2000 NOK per student. As shown from calculations above, the students get a higher final wealth from investing in stock 1 and 5 in combination compared to distributing the amount equally(20%) in all the five stocks.

Appendix 20 Risk preferences compared with treatment

NPar Tests

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
RiskPreferences	48	-.46	.743	-1	1	-1.00	-1.00	.00
Treatment	48	.50	.505	0	1	.00	.50	1.00

Mann-Whitney Test

Ranks

	Treatment	N	Mean Rank	Sum of Ranks
RiskPreferences	0	24	21.38	513.00
	1	24	27.63	663.00
	Total	48		

Test Statistics[a]

	RiskPreferences
Mann-Whitney U	213.000
Wilcoxon W	513.000
Z	-1.773
Asymp. Sig. (2-tailed)	.076

a. Grouping Variable: Treatment

This Mann-Whitney test was conducted to see if there were a relationship between the students risk preferences and the treatment group they are in. The N is the number of students, in this case 48. The reason why not all the 55 students was included was because 7 of the students had clearly not understood the risk preference test and was therefore excluded from this particular test. As shown in the “Ranks” table the risk preferences are divided into the categories; -1, 0 and 1. -1 is the group of students that are risk averse, 0 is the groups of students that are risk neutral and 1 is the group of students that are risk seeking. As the N in the “Rank” table show, there were 24 students in treatment group 0 and 24 students in treatment group 1 which conducted this test. The process of ranking the scores for the different groups (from highest to lowest), and finding the mean of the ranks gives us the Mean Rank. The mean ranks are numbers that we can compare to see which group have the highest/lowest score. The mean rank shows that treatment group 1 has a tendency towards being more risk seeking (mean rank: 27,63) than treatment group 0 (mean rank: 21,38). The Asymp. Sig shows that there are no significant differences in the two treatment groups when comparing them to their risk preferences (Asymp. Sig: 0,076 > 0,05)

Appendix 21 Risk preferences compared with gender

NPar Tests

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
RiskPreferences	48	-.46	.743	-1	1	-1.00	-1.00	.00
Gender	48	.63	.489	0	1	.00	1.00	1.00

Mann-Whitney Test

Ranks

	Gender	N	Mean Rank	Sum of Ranks
RiskPreferences	0	18	27.36	492.50
	1	30	22.78	683.50
	Total	48		

Test Statistics[a]

	RiskPreferences
Mann-Whitney U	218.500
Wilcoxon W	683.500
Z	-1.257
Asymp. Sig. (2-tailed)	.209

a. Grouping Variable: Gender

This Mann-Whitney test was conducted to see if there was a relationship between gender and risk preferences. The N is the number of students, in this case 48. The reason why not all the 55 students was included was because 7 of the students had clearly not understood the risk preference test and was therefore excluded from this particular test. As the “Rank” table show gender is divided into 0 and 1. 0 is men and 1 is women. The N in the “Rank” table shows that there are 18 men and 30 women. The process of ranking the scores for the different groups (from highest to lowest), and finding the mean of the ranks gives us the Mean Rank. The mean ranks are numbers that we can compare to see which group have the highest/lowest score. The mean rank shows that men seems to be more risk seeking (mean rank: 27,36) than women (mean rank: 22,78). Despite this tendency, the Asymp. Sig concludes that there are no significant differences between gender and risk preferences (Asymp. Sig: 0,209 > 0,05)

Appendix 22 Calculations of the Mean for all students, treatment groups, gender and investment in stock 1 + stock 5

Mean number of companies group 0	7.852
Mean number of companies group 1	5.857

Mean level of knowledge group 0	0.481
Mean level of knowledge group 1	0.250

Mean number of companies men	7.095
Mean number of companies women	6.676

Mean level of knowledge men	0.571
Mean level of knowledge women	0.235

	Stock 1	Stock 2	Stock 3	Stock 4	Stock 5
Mean all students	0.2462	0.1544	0.2938	0.1062	0.2012

Mean treatment group 0	0.3080	0.1475	0.2430	0.0946	0.2105
Mean treatment group 1	0.1865	0.1611	0.3428	0.1174	0.1922

Number of students investing above 20 % in both stock 1 and stock 5	16	Tr.gr 0:	Tr.gr. 1:
16 of 55 have more than 20 % invested in both stock 1 and stock 5.	29.09%	9	7

Mean final wealth group 0	590.192
Mean final wealth group 1	460.146

Mean final wealth men	571.250
Mean final wealth women	494.794

We calculated the mean of how many companies each treatment group chose to invest in (exercise 3). Treatment group 0 invested in 7,852 companies on average and treatment group 1 invested in 5,857 companies on average. We also calculated the mean level of knowledge for the two groups (exercise 4). The categorization of level of knowledge ranged from -1 to 1. Treatment group 0 had a mean of 0,481, and treatment group 1 a mean of 0,250. Both groups are above 0 (medium level of knowledge), which indicates that the groups have a relatively high level of knowledge. The mean for genders were also calculated. Men invested in more companies than women (mean: 7,095 > 6,676). Men also had a higher level of knowledge than women (mean: 0,571 > 0,235).

We also calculated the mean for all students to be able to see the average invested in each of the five stocks. The mean revealed that the students on average favors stock 3 (29,4 %). Stock 1 is the second most popular (24,6%), and stock 5 the third most popular (20, 1%). In addition we calculated the mean for the two groups separately. Treatment group 0 invests the most in stock 1 (30,8%) and treatment group 1 the most in stock 3 (34,3%). When examining if the students invested in both stock 1 and 5 we found that 16 of 55 (29,09%) students invested more than 20 % in both stock 1 and stock 5. 9 of these 16 students were in treatment group 0, and the remaining 7 in treatment group 1. The final wealth on average for the two groups were 590,192 for group 0 and 460,146 for group 1. This means that treatment group 0 on average performed better than treatment group 1 in the practical experiment. Men also performed better than women on average (mean: 571,250 > 494,794).

Attached CD-rom contains:

Excel variables

PDF-file: Treatment group 0 part1

PDF-file: Treatment group 0 part2

PDF-file: Treatment group 1 part1

PDF-file: Treatment group 1 part2

SPSS variables