# The effects of birth month on academic performance

University of Stavanger

Morten Økland - 211819

Steffen Lie Pringle - 207336

Universitetet
i Stavanger

**FACULTY OF SOCIAL SCIENCES,**
**UIS BUSINESS SCHOOL**

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| AUTHORS | | ADVISOR: |
| --- | --- | --- |
| Student number: | Name: | Ingeborg Foldøy Solli |
| 211819 | Morten Økland | |
| 207336 | Steffen Lie Pringle | |


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# Preface

This thesis was written in cooperation with the Business School at the University of Stavanger (UiS), in the context of the completion of our master degrees. We have chosen to look for birth month effects at UiS, to see if academic performance could be related to month of birth. Thanks to the student administration at UiS, by Sara Nustad Mauland, for giving us data so we were able to do so. We will also like to give credits to the study administrations at NHH and NTNU for data from selected study programs at these schools, and Anne-Lin Brobakke for being most helpful in regards of data directly from the UiS Business School.

Working with our master thesis the spring of 2015 have been intensive, constructive and a very instructive period. The thesis has taught us a lot, for instance how to plan and conduct our work, and it has given us a better understanding of econometrics, how to create models and interpret the results.

After an educational process with completion of our master degrees, we would like to thank our supervisor, Ingeborg Foldøy Solli, for great help, feedback and support given to us during the whole period.

# Abstract

In this master thesis we are examining how birth months affect the exam grades for chosen students at the University of Stavanger (UiS). There is a lot of previous literature on birth month effects, and the phenomenon on being relatively oldest in a cohort and performing better is well established in the literature.

Our results, using academic performance as the dependent variable, indicate that there are no birth month effects among female students at UiS. Actually the January born female students within our sample perform worse compared to female students from other birth months. For the male students there is some pattern of higher academic performance with an early birth month, especially for the petroleum technology students.

We believe that extensive selection processes and the Norwegian education system can explain our findings. In order to apply for higher education, the applicant has to fulfill certain requirements making the students enrolling into higher education a selected group. It is likely that all of these are good performing students, which might explain why any potential birth month effects have been reduced. Whereas the Norwegian education system has strict rules regarding enrollment and deferment, combined with no ability or performance based group placement of children seem to provide a good learning environment for students with varying ability. The presence of birth month effects among male students is likely to arise from natural differences in developmental paths by gender. The late-born boys seems to still suffer from some of the disadvantages of being relative younger.

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# 1. Introduction

The Norwegian education system operates with a single cut-off date for school entry, which is a common practice in nearly all education systems. The cut-off date differs from country to country, and in Norway it is set to January 1st with children starting their first year of school in August. Operating with a single cut-off date results in relative age differences within each cohort, with a possible distinction of close to one year between the youngest and oldest pupils. In Norway children start school the year they turn six, the oldest pupils could then be approximately 17 percent older than the youngest at school entry. Numerous studies have documented significantly age-related differences within a given cohort or class, with the conclusion that older pupils typically outperform the younger pupils (Bedard & Duhey, 2006; Crawford, Dearden, & Greaves, 2011)[1]. If this relative age effect vanishes with age, these differences within class might not be of any importance. On the other hand, if the performance gaps created by relative age persist into later stages of life, this may have important consequences for long-term outcomes as their professional career and productivity.

Uncovering the causal impact of age related performance-differentials on later outcomes are problematic because age and educational decisions interfere with each other. Deferring school entry, repetition of a grade and ability or performance based group placement are all examples of educational decisions interfering with age. With this in mind, it is obvious that relative age observed in the educational pathway is endogenous, while the initial timing of births is arguably exogenous. Therefore, the possibility that individuals born at different times of the year perform differently is an interesting research question.

The purpose of this thesis is to examine the pattern of academic performance as a function of birth month to see whether there are any differences and, if there are, to see how we can explain this pattern. Thus, we use birth month as an instrument for age difference within the classroom and estimate effects for all twelve months. Our study uses data collected from five different study programs at the University of Stavanger (UiS) in our search for birth month effects.

[1] A summary of these papers, and others, can be found in chapter 2 of this thesis.

The literature of relative age effects states multiple reasons for why birth month may affect school performance. The cut-off date obviously leads to relative age differences within a class. Being the relative oldest student within the class at early stages could give advantages throughout life. If being some months older makes you more mature, and this has a positive effect on learning, the oldest in class have an advantage compared to the younger peers. According James Heckman and his skill accumulation-theories, the relative age-advantage will increase over time, since the most advantaged pupils are able to progress through the books faster (Heckman, 2006). Previous literature shows that relative older children are less exposed from bullying, have higher confident, higher ambitions and gets more monitoring by parents (Crawford, Dearden, & Greaves, 2011). This will affect school performance and personality in a positive way, and therefore early born children tend to achieve better academic results.

Most studies focus on differences at early ages when the relative age differences are bigger, for example by using data from elementary school. It is believed that such differences are more prominent at early ages and that they might fade away as children grow older, thereby not causing long-term effects (Bedard & Duhey, 2006). In this master thesis we are going to see if we can estimate the direct and long-term effect of relative age that stems from early childhood within a sample of university students.

In order to identify birth month effects on academic performance we use a unique database of students at UiS. The dataset provides information about the study program, course name, gender, exam grade and date of birth. Combining these variables allows us to run several regressions to look for potential patterns. The analysis are carried out by using the analytics software SPSS.

To do the study we need to overcome several methodical challenges, where the omitted variable bias might be the most prominent. The problem with omitted variable bias may occur if the regressors we use are correlated with unobserved variables that also affect students' academic performance. The omitted variable bias may be caused by such characteristics as how well educated their parents are, number of siblings and parental income. In order to reduce some of the problems caused by omitted variables, we include all the person-specific variables available from the dataset. Solli (2011) finds that her findings are robust to controlling for background characteristics and parental fixed effects. We therefore argue not being able to control for all the relevant characteristics do not matter, because if date of birth were randomly assigned, there would be no need to include such characteristics.

There are also potential problems regarding the interpretation of our results since we have a selected sample of students. When enrolling into higher education students have been involved in many selection processes throughout their educational pathway. Many potential students are eliminated from each process, for example by not reaching the necessary requirements qualifying for more education. Analyses done by Solli (2011) suggest students born late in the year are both delayed in finalizing upper secondary school and less likely to ever enroll into college than their peers born early in the year. With this in mind, from every selection process it is likely that we have an overrepresentation of students born early in the year and an underrepresentation of late born students. Since only the best late-born students enroll into further education, the selection processes will reduce birth month estimates and align some of the differences between early and late-born students making it harder for us to find significant effects.

The empirical results from our first analysis, where we use academic performance as the dependent variable, show no birth month effects. If anything, we see a pattern with almost only positive coefficients where January is the base category, suggesting a disadvantage of being born in January. However the coefficients are quite small making it hard for us to draw a conclusion based on these results. When dropping the dummy variable for gender in our second analysis and running the regressions separately for boys and girls, the results show a slight presence of birth month effects for male students. After carrying out subsample analyses on each of the chosen study programs and gender we find some different patterns, again the effects are more prominent for boys than girls among all the study programs. For every study program, except industrial economy, there seems to be a disadvantage of being born in January among girls. As mentioned the boys appear to suffer from the opposite and more expected effect, where being born early is an advantage. However, the results are somewhat ambiguous and vary over study program especially for male students, with the male business students having a totally opposite pattern than the rest. Still, it seems to be clear differences among gender, our findings suggest that the birth month effect is more pronounced for male students.

We also carried out subsample analysis by splitting the age variable into three different groups, using data from the study programs where the birth month effects was most prominent among boys. This analysis show that the effect of achieving better academically when born early in the year, seems to fade away as the students get older. Even though the birth month effects may seem to be reduced with age, these results are hard to interpret. In addition to the fact that the relative age gets smaller as the students get older, the reason for why they choose to study later in life could be many, making the cohort more various and the results harder to interpret. It is not very likely some students have used ten years on completing upper secondary school, but they could have come back to studies after years in the work force, or maybe they are taking their studies part time, using longer time than normed.

Overall, we believe that extensive selection processes and the Norwegian education system can explain our results. All students that are accepted for higher education are bright students, which might explain why any potential birth month effects have been reduced. The Norwegian education system has strict rules regarding enrollment and deferment, combined with no ability or performance based group placement of children provides a good learning environment for students with varying ability. The less able students may benefit from the presence of talented students, giving them the possibility to equalize the advantage. The presence of birth month effects among male students is likely to arise from natural differences in developmental paths by gender. The late-born boys may suffer more from being immature and insecure at early stages, making the effect last longer. On the other hand, it does not seem to be the case for girls, when enrolling into universities they may have equalized this relationship.

Our findings contribute to the existing literature in utilizing a unique database where we document the functioning of birth month effects among students at different study programs within the same university. In addition does our study consist of students within a wide range of age, making it possible for us to look for how birth month effects develops with age. However, it is likely to believe that the relationship between birth months and academic performance might be different for our selected sample of UiS students compared to the entire population. We compare birth month distributions from each study program to both the Norwegian population and similar study programs at other education institutions within the country. This comparison shows UiS-students to be more frequently born in the first four months relative to the population.

The master thesis is organized as follows. A brief overview of the Norwegian school system is given in chapter 2. Chapter 3 presents the existing literature concerning birth month effects on academic performance. In chapter 4 we present and discuss our empirical strategy, while chapter 5 describes our dataset. Our results are presented in chapter 6 and discussed in chapter 7. At the end of the thesis in chapter 8 we sum up with a conclusion.

## 2. Institutional background

In Norway children start at school in August at the age of six years, and finish the compulsory school at the age of 16 in lower secondary school[2]. Compulsory school consists of two parts; students attend primary school for the first seven years and then go on to lower secondary school for the last three years.

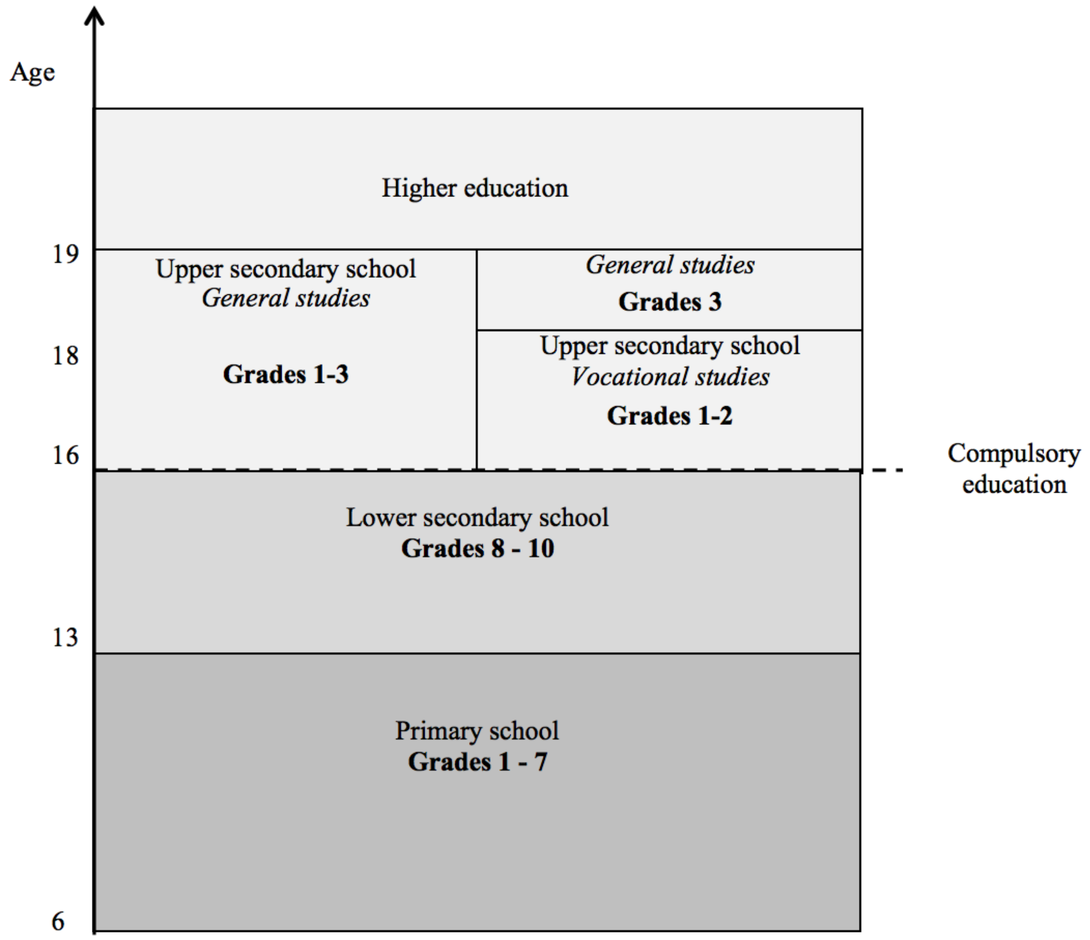
The administrative rule for enrollment into school changed in 1997, and in this study we have cohorts and students from both before and after the change. This should not affect our study, and thereby this will not be discussed further.

The Norwegian education system is known for trying to integrate children with different abilities and backgrounds throughout compulsory school. Therefore, children attending to the Norwegian education system are exposed to very strict rules regarding enrollment, it is required that every child born in a certain calendar year to start school at the same time. In relevance to this study, the possibility to deviate from the school entry rule is very limited. In order to deviate from the school entry rule it is required an assessment by an expert stating that the child is too immature to enter school. The parents of the child are the one applying for either late (older than six years old) or early (younger than six years old) school start. There are no national recommendations or guidelines of who could apply, but there are local policies from the municipality in cooperation with the Educational and Psychological Counseling Service (PPT). A previous study done by Solli (2011) has shown that the likelihood of being a deferred child is associated with birth month. Most deferred children are born in December, and it is a clear majority of deferred children born in December compared to the cohort at large.

In accordance with the strict enrollment rules, there is no ability or performance based group placement of children, and tracking of students does not occur before they enroll into upper secondary school. Therefore, pupils only advance to the next grade level when the school year finishes. Thus, the classes consist of children born within the same calendar year, with a possible age difference of nearly one year.

[2] In 1997 the enrollment age changed from 7 to 6 years old, and compulsory schooling was increased from 9 to 10 years.

**Figure 1: The Norwegian education system**




After ten years of schooling, as shown in the above figure[3], the students are free to choose either to stop their education or continue into three years at upper secondary school, almost equivalent to the American high school. In upper secondary school, they have two choices, either "general studies" or vocational studies. If the pupils complete the general studies they can apply to get into higher education, in the form of a university or university college. Some pupils take two years of vocational studies, then one year of general studies, and then they could also apply for higher education. Students are accepted into upper secondary school and higher education based on their grade point average from lower secondary school. Students proceeding directly through compulsory school and upper secondary school will enroll into higher education (such as a university) the year they turn 19 years old. Boys will often be one year older when enrolling into higher education because of military service.

[3] The figure is self-composed, similar figure can be found in the literature, for example in Zweimüller (2013).

Both compulsory and upper secondary schools are financed through public funds, making it free of charge for the students[4], while higher education requires small semester fees.

[4] They may be required to pay small fees to cover the costs of necessary equipment.

## 3. Existing evidence

Prior a hockey match in a junior league-game in Canada, Roger Barnsley and his wife Paula drew attention to the match program and noticed a pattern of the birth months among the players (Gladwell, 2008). This showed that the majority of the players were born within the first few months of the year. The pattern led to a paper published in 1985, together with A. H. Thompson, and the authors introduced the relative age effect-term. Based on this paper a wide specter of research has been done, and there has been found similar effects in multiple countries and circumstances.

Crawford, Dearden and Greaves (2011) look at birth months in relationship to school performance, experience of bullying, and behavior school. In this English study the findings indicate that August-born children are more likely to be unhappy or subject to bullying in primary school. In England the cut-off date to start school is 31$^{st}$ of August, so the oldest in class will be born on September 1$^{st}$. Crawford, Dearden and Greaves suggest that there is a big difference between August- and September-born children in terms of their cognitive skills, but also shows that the magnitude of these differences decrease as the children gets older. Self-esteem, ambitions and the child's social development may also be affected by older children's relative standing of being stronger and more mature. A bit similar to Crawford, Dearden and Greaves' research, Thompson, Barnsley and Battle (2004) did a study show that differences in performance lead to variation in self-esteem and confidence.

The study of Bedard and Dhuey (2006) find that the youngest pupils in class have a lower probability of participating in pre-university programs (Canada and US) and are underrepresented in accredited four-year college enrollments (US). Dhuey and Lipscomb (2006) find evidence for the oldest in a class being significantly more likely to participate in high school leadership activities. Crawford, Dearden and Greaves (2011) find the youngest in class being more likely to take vocational qualifications during college and are also less likely to enter a high status university. In their study the difference were mainly driven by individuals from low-income groups. Kawaguchi (2011) from Japan finds positive effects on relative age with respect to educational achievement on Japanese data, but no effect on labor market outcomes in terms of earnings. A German study tried to find out if actual age at school start had an impact on educational performance, but found no evidence of such effect (Fertig & Kluve, 2005). They used German survey data on the school entry cohorts 1966-1980. They reached the same conclusion when studying data from West Germany, where students were tracked at the age of 10, and when they used data from East Germany. Unlike Fertig and Kluve (2005), Dobkin and Ferreira (2010) found a positive effect on educational achievement of being oldest in class but no effects on labor market performance (wages) on US data.

In our study we are going to look for birth month effects at the university level. Most previous studies focus on younger children, while we are going to check for any potential long-term effects. There is less literature on long-term effects of relative age and it is also less conclusive. At Bocconi University in Italy Pellizzari and Billari (2011) investigated academic performance among students with different age, using data from their university. The findings are in contrast to most of previous literature. The authors found effects of the youngest students within a cohort outperform the oldest peer, which differs from research done on students at younger age. Pellizzari and Billari partly explain this by differences in cognitive ability, and also with differences in social activities. In Italy there is a degree of freedom to decide when your child should start primary school. At the start of their educational career the youngest within the cohort does it worse than their oldest peers. Although, as they get older and start at the University, Pellizzari and Billari suggests the youngest outperform the oldest peers. They reason this with a combination of early learning and progression over the age profile of cognitive development.

Pellizzari and Billari had a selected data sample; the candidate must have some academic quality in regards of GPA and an admission test. Bocconi University also has higher tuition than most of the public universities in Italy. So the selected group of students at Bocconi is likely to have high academic ability, wealthy families and other family background than students at different universities. By taking robustness checks the authors find no major selection bias, and even if their results cannot be generalized, they are important in evidence of age effects.

A study from Norway investigates whether birth month effects leave a visible imprint on earnings throughout life (Solli & Larsen, 2012). Using data collected from Norway, they find significant birth month effects for all age levels, but their results show an unexpected pattern. They find that the youngest in a school cohort have a disadvantage in early labor market years and an advantage at older ages, compared to the oldest within a school cohort. Another Norwegian study based the work on OECD-PISA tests, and found similar effects with the youngest children within the cohort facing significant disadvantages in reading compared to their older classmates (Strøm, 2004). The author suggests more flexible enrollment rules (cut-off dates) to minimize the birth month effect.

Several studies that analyzed birth month effects also found that these effects tend to fade away as people get older. Bell, Massey and Dexter (1997) find it as a possible reason that "younger pupils may not have attained the same performance levels as their older classmates but they have the potential to match them in the future" (page 164). They further discuss that this could be hard to prove, partly because of huge variation in maturity in a group of pupils. Bedard and Dhuey (2006) also finds that the pupils oldest in their peers does it better, but the difference declines from $4^{th}$ to $8^{th}$ grade. Across gender empirical evidence by Elder and Lubotsky (2007) and Cascio and Schanzenbach (2007) suggests that birth month effects on school performance are more pronounced for boys.

From previous studies we can say if relative age has an impact on final grades from compulsory school, there is a great possibility for this relative difference to affect one's future career, firstly by performance based tracking into upper secondary schools (Solli, 2012). Bedard and Duhey (2006) also address the topic of tracking in the school system. Tracking is done when pupils are separated by their academic abilities, and distributed into groups. This separation doesn't exist formally in the Norwegian school, and the use of it has declined worldwide. Anyhow, studies show that the use of tracking may spread the maturity differences related to relative age.

# 4. Empirical strategy

In this chapter we will describe our models and discuss potential empirical challenges associated with this study. Our master thesis is motivated by earlier studies showing that relative older pupils outperform their peers in young ages. It is believed that such differences tend to fade away as children reach higher grades (Crosser, 1991; Sharp, Hutchison, & Whetton, 1994). Therefore, we intend to identify potential relative age effects among a sample of UiS-students. In order to do this we start with a simple model of the relationship between academic performance and observed age.

(1) $$Y_i = \alpha + \beta O_i + \delta G_i + \varepsilon_i$$

i The notation i refers to individual *i*

$Y_i$ The outcome for individual *i*

$O_i$ Observed age for individual *i*

$G_i$ Dummy variable taking value one if female, zero if male

$\varepsilon_i$ Error term

The parameter of interest is $\beta$, the causal impact of relative age. $Y_i$ denotes the outcome for individual *i*, which in this study is an exam grade. However, an obvious challenge by estimating age effects in school is that observed age may differ from the relative age at which a child should be observed, based on their birth date compared to school cut-off date. Deviations between observed age and the age that a child should be observed are due to non-compliance with enrollment policies. The causal interpretation of this model rests on the assumption that unobservables do not confound the observed age effect, which is clearly untrue due to our lack of information. Given that we are not able to control for all the relevant variables, this model is likely to cause biased estimates due to omitted variables. Omitted variable bias occurs if the regressors are correlated with a variable that has been omitted from the analysis, and that partly determines the dependent variable (Woolridge, 2009).

With this in mind, it is obvious that the observed relative age in the educational pathway is endogenous, while the initial timing of births is arguably exogenous. We therefore solve this problem by replacing observed age with birth month as an exogenous instrument of relative age.

However, we must still ensure that our model and the parameter of interest capture the wanted effect of relative age, and that it is not correlated with other characteristics affecting the outcome. Our dataset, and thereby our models, do not include any individual or family background characteristics and many of these omitted variables may affect student's school performance. Such as how well educated their parents are, number of siblings and parental income. In response to this, we also need to discuss whether date of birth relative to academic year cut-off is randomly assigned or if some parents target "old" relative ages? There is little or no evidence in Norwegian data of other differences between students born in January and December than the month they are born in. In comparison with USA, where Kasey Buckles and Daniel Hungerman (2013) show some signs of the women giving birth in the winter, intentional or unintentional, look different from other women; they are younger, less educated, and less likely to be married. Solli (2011) finds that her findings are robust to controlling for background characteristics and parental fixed effects. We therefore argue not being able to control for these characteristics do not matter, because if date of birth were randomly assigned, there would be no need to include such characteristics.

In chapter 2 we presented the institutional background for the relevant country of this study, which is Norway. We argue that it is possible to rely on a simple empirical strategy when using data from the Norwegian school system. First of all, there are very limited parental choices regarding enrollment date or year. In some countries parents have several alternatives when it comes to the enrollment date of their child. For example, the enrollment rule in the Netherlands is twofold. The parents have to send their children to school the year they turn five, but have the option to the enroll their kids when they are four years old (Leuven, M. Lindahl, & Webbink, 2003). The Norwegian school law states that children enroll in school the year they turn six, and needs to stay in school through compulsory school. As mentioned earlier, there are few deferred children and experts closely examine applications regarding exemption from this rule. Furthermore, in several countries grade retention is a quite common practice, while this practice is very rarely exerted within the Norwegian school system. Thus, all pupils that enroll in school at the same time while have identical length of schooling, assuming that they have only been exposed to the Norwegian school system. Third, only 3 percent attend to private schools instead of public compulsory schools, implying that for the majority of the population public compulsory school is the only realistic choice (The Norwegian Directorate for Education and Training). All the public schools use the same national standard curriculum and pupils are randomly allocated into different classes. Pupils usually attend to school based on where they live.

The institutional features described in this master thesis suggest that the variation in age within a Norwegian class stems from differences in birth date, thereby supporting our argument regarding use of a simple empirical strategy. Therefore, the Norwegian school system provides us with a good platform to identify potential relative age effects on academic performance, using birth month as an instrument for age differences.

Thereby, the following model will be used to identify the effect of birth month on academic performance:

(2) $$Y_i = \alpha + \sum_{m=2}^{12} \beta_m \cdot X_i + \delta G_i + \mu A_i + \varepsilon_i$$

| | |
|---|---|
| i | The notation i refers to individual *i* |
| $Y_i$ | The outcome for individual *i* |
| $X_i$ | Dummy variables taking value one for the month the child *i* belongs to |
| $G_i$ | Dummy variable taking value one if female, zero if male |
| $A_i$ | Age at exam |
| $\varepsilon_i$ | Error term |

Instead of using a linear variable to capture the outcome, we split the variable into dummies for each month. By doing this we allow for a possible non-linear relationship. The birth month dummies are our primary characteristics of interest. The coefficient $\beta_m$ measures the effect on $Y_i$ being born in month *m* compared to being born in our base category January. In this model we also include age at exam, which is constructed by taking exam year minus birth year. Our dataset contains of students within a wide range of age, therefore we would like to control for the effect of being one year older.

This model is built on a simple assumption that birth dates are randomly distributed within the year. In order to make this assumption we need to discuss the effects of non-compliance with enrollment regulations. Our model treats late-born students as the youngest within their class, although some may have deferred school entry and was the oldest. For our model to capture the wanted effect, we want age variation within a grade to be an exogenous variable. This would be violated if some of the earlier discussed possibilities of non-compliance with enrollment regulations were in place. But it is worth pointing out that even if some of these possibilities were violated it would not lead to biased results. The only consequence of late school entry is that some December born children was the oldest in the class, and thus it becomes more noise in our data than if all children born in December was the youngest. The same situation occurs if a January born children enrolls into school one year before scheduled. This will make it harder for us to find effects that are significant, but they will still be unbiased.

The late-born pupils who choose to defer school entry will as mentioned affect our results, but do they now perform best in class since they are the oldest? Probably not, since they are selected sample of weak pupils who defer school entry. The most likely effect is that a December born child, which defer school entry, will perform better than if the child had started school at the original enrollment date. Then what about the early starting children? These children are younger, and hence may score worse than if they had followed the original enrollment date. Again, both these situations create noise within our data, making it harder to find significant differences.

Another challenge when it comes to this study is the selection of students when it comes to higher education. No matter what university a student applies to, they have gone through many selection processes in order to get into the higher education, and many potential students are eliminated from the process. Analyses done by Solli (2011) suggest students born late in the year are both delayed in finalizing upper secondary school and less likely to ever enroll into college than their peers born early in the year. With this in mind, from every selection process it is likely that we have an overrepresentation of students born early in the year and an underrepresentation of late born students. When students enroll into compulsory school the early-born students will on average outperform the late-born students. As earlier mentioned compulsory school consists of two parts, primary school and lower secondary school, its unlikely to believe that the distribution of birth months change between these two stages. When students have completed compulsory school, they can apply for upper secondary school. GPA from compulsory school will probably affect student's motivation to proceed to and complete upper secondary school. Since the early-born students on average perform better than late-born students, we are likely to get an overrepresentation of early-born students enrolling into upper secondary school, and especially into general studies. This selection processes will reduce birth month estimates, since only the best late-born students enroll into general studies. The late-born students on average performance will rise, making the difference between early-born and late-born students smaller. The selection process into upper secondary school and general studies is probably the most vital, since it is the first in line. If the pupils complete the general studies they can apply to get into higher education, in the form of a university or university college. Enrollment into higher education will again lead to an overrepresentation of early-born students and an underrepresentation of late-born students. This selection process consists of several steps, first of all students need to decide whether or not to apply for higher education, then where and what to study. All these steps will reduce the birth month estimates, but probably to a lesser extent than the first selection process into upper secondary school. This should carefully be taken into account when interpreting the impact of birth month.

The students in our database have been through an extensive selection process where the birth month estimates have been reduced, which may make it harder for us to find significant differences. However, since the students in our dataset are from one specific university there is a last selection effect that we have not discussed. There is a selection effect on those students attending UiS; the data are not from a totally randomized group. None of the study programs we investigate in this study are the best alternative in Norway, i.e. the best business-students want to take their MBA at Norwegian School of Economics (NHH) in Bergen, and the best engineers take their masters at the Norwegian University of Science and Technology (NTNU) in Trondheim. The selection effect again occurs; the best pupils from upper secondary school may be underrepresented at UiS, and according previous literature those are most likely to be born early in the year. To sum up, it might be that the effect of the relative older students performing better does not show in our data because these students are underrepresented at UiS compared to other more acknowledged schools. Since this selection process is the last step when applying to higher education we believe that it will only have a minor effect on our birth month estimates, if any effect at all. However, to address this issue we graphically compare the distribution of birth months from the students in our dataset to the birth month distribution of the Norwegian population within the same cohorts. If the older students in each cohort are less likely to enroll into UiS, one should see a lower fraction of early-born students at UiS relative to the population.

Importantly, when we investigate the birth month effect on academic performance, the effects we estimate may reflect that January and December born children are systematically different from other causes than relative age. We have already discussed background and parental characteristics, but the estimates may reflect other differences that stem from their month of birth. It might be that children born early are biologically stronger than children born during autumn or winter. However, the two main months in this study is January and December, these should not be affected too much by season of births effects, since both are winter months. Nevertheless, it is plausible that our estimates reflect other differences than age associated with their month of birth.

$$Y_i = \alpha + \sum_{m=2}^{12} \beta_m \cdot X_i + \mu A_i + \varepsilon_i \quad (3)$$

In model 3 we have dropped the dummy for gender and analyze the data separately. Note that we then have to do two regressions, one with data only for males and one with the data for females only. For example, if females have a significantly different birth month pattern with respect to academic performance than males, this trend might disappear when these groups are combined. This phenomenon is called the Simpson’s paradox. The confounding variable, which is gender, should be controlled for by separately studying boys and girls. In theory, a confounding variable is a variable that produces mixed effects when combined with another variable, in contrast to when analyzing each separately (Pearl, 2009).

Further, the Simpson's paradox might also be present when we analyze the data from all the study programs together. In order to avoid this unwanted effect we also run regressions using a similar model for each study program separately, we will refer to this as model (4). The reason for this assumption is the different admission requirements for each study program. Since we have a selected sample of students from five different study programs at UiS, and the fact that early-born students tend to perform better the distribution of academic performance over birth month may vary within each study program. Hence, the composition of students can make it difficult for us to find a significant pattern within all the students. Therefore, we also look for patterns within each study program by running regression separately.

At last, if we are able to find some patterns that indicate birth month effects we will check if these effects last for every age level. Previous literature states that the relative age effects tend to fade out as individuals gets older. This literature is often based on young individuals, for example Bedard and Dhuey (2006) found birth month effects on both 9 and 14 year olds, but the magnitude of the effect was reduced when they got 14 years old. In our sample we are testing our youngest against the oldest, which will be from 18 to 37 years old (see chapter 5). When reaching this age the deviation in percent on being either 25 years and 4 month or 26 years are quite small, the relative age differences between the students have equalized, and birth month effects tend to fade away. If there is a trend for the effects to fade away in our sample, this trend could also be a result of something completely else. Many of our 30-year olds are most likely in a different life stage than the 20-year olds, and have other reasons to study. The 30-year olds could for example be taking single courses at the university, they could be individuals with very high academic abilities who wanted to get back to school after joining the work force "too early", or maybe they are just using very long time completing their education. Even though the potential weakening of the birth month effects could be result of many outlying variables, we are going to check if the birth month effects tend to fade away as the students get older, and how the different age groups reacts on actual age.

# 5. Data description

This chapter will present the data used for this study and the main descriptive statistics. First we will present the data in general, how it was collected and what we did to the dataset. Second we present descriptive statistics for our dataset, before we in the third part split the dataset into the different study programs, and present descriptive statistics for each study program. Fourth in this chapter we compare the chosen sample of UiS-students to the Norwegian population and see if there are any deviation in the birth month distribution. At last we take the birth month distributions from similar study programs at NHH and NTNU and compare them to the Norwegian population.

## 5.1 General data-description

The data for this study is collected by the student administration at the University of Stavanger, and contains information about exam grade, sex, month and year of birth, and comes from five different departments at UiS: UiS Business School, Department of Petroleum Technology, Department of Industrial Economics, Risk Management and Planning, Norwegian School of Hotel Management and the Department of Early Childhood Education. From each of these departments we got grades from all of the exams in a five-year period, from courses taken in the following study programs; Bachelor in Business and administration, Bachelor in Petroleum engineering, Master in Industrial Economics, Bachelor in Hotel Management, and Bachelor in Preschool teacher/Kindergarten teacher (in 2012 the name of the study changed from Preschool teacher to Kindergarten teacher. In this study we choose to use the name Preschool teacher). The student administration "cleaned" the dataset for personal sensitive information, such as national identity number of the exam candidate.

Our raw dataset from the study administration at UiS contained 44 973 exam grade observations with twelve variables shown in table 1 below, translated from Norwegian.

**Table 1: Variables in the dataset**

| *Norwegian* | *English* | *Explanation* |
|---|---|---|
| Institusjons-kode | Institution code | "UiS-code" 1160 for all observations. |
| Avdelingskode | Department code | Code for what department at UiS the candidate belongs to. |
| Arstall | Year | What year the exam was taken. |
| Semester | Semester | Taking either value 1 or 3, depending on spring- or fall-semester. |
| Studieprogram-kode | Study program code | Code for what study program at UiS the candidate belongs to. |
| Emnekode | Course code | Code for what course the candidate is taking. |
| Studiepoeng | Study points/Credits | How many credits the course is. |
| Studierett | Admission | Taking value 1 for all observations. Every student has the right to study at UiS. |
| Kjonn | Gender | Taking value 0 or 1 for male/female. |
| Fodselsdato | Birth date | When the candidate is born. |
| Karakter | Grade | What grade the candidate got. |
| Bestgjentak | Resit | Taking value 0 if it's the first time taking the exam, 1 if the student is taking it for the second time. |

The first variable in the dataset takes value 1160 for all observations, labeling all observations to be UiS students, while the second variable explains what department at UiS the individual belongs to. We get to know what year the exam was taken, and if the exam is taken in either the spring or fall semester. The study program code tells us which of the five chosen programs the exam candidate belongs to, and the course code what course it is. Credits are in the interval from 0-30, and every observation is taking the value 1 for *admission*, which tells us they all have the right to go to UiS. The gender-variable can take two values, 1 for female or 0 for male. Exam grades in the dataset take 10 different values; A-F is grades on a *normal* scale, G and H that are from courses with the grades *passed* or *not passed*. Withdrawal from exam takes the value T, while the value X symbolizes the persons that did not meet for exam, were sick or etc. The total of 5639 observations including either G or H were excluded from the dataset since they do not tell if being born early in the year is correlated with getting a better exam grade. The 6448 students that didn't meet up for the exam, were sick, or for some other reason did not meet up the exam day were also removed from the dataset. The last variable, *bestgjentak*, is a dummy variable taking value 0 if the exam candidate has not passed the course from previous year, and 1 if the exam candidate is taking the course to improve his/her grade. In total 1277 people are redoing their exam, but only 652 actually got a grade on their second (or $n^{th}$) exam. In this study we exclude the students taking the value 1 of this variable. Since they are taking the course for at least the second time, it is a possibility of this candidate to be counted twice and perhaps disturb the results.

The dataset does unfortunately not include how many semesters the candidate have studied, so we cannot tell if the candidate is a freshmen or graduate student. From the course code we get to know what course it is, and we can get an indication if the course are mainly meant for first- or second-graders. Though, it is a possibility of the candidate taking one course and not belonging to any class, or maybe the candidate belongs to another department at UiS, not belonging the class which the course are meant for. Since we cannot conclude with certainty what grade or semester the student is in, we will therefore ignore this variable.

After removing the students taking the exam for the $n^{th}$ time and those without any grade we have 32 234 remaining observations of exam grades. From the variables *birth date* and *year* (the year exam was taken), we can calculate how old the candidate was at exam time. The oldest students is 59 years old, while there are twelve students being 18 years old at the exam year; six of them business students the other six study petroleum technology. If a student enrolls directly into the university from the Norwegian upper secondary school, they are normally 19 years old. The 18-years old in our sample are most likely individuals born early in the year, and their parents applied for them starting at school as five-year olds. These twelve observations in our sample are the only individuals we can identify which started earlier than normal at compulsory school, according administrative statutes. Unfortunately we do not have this personal information of when they started compulsory school for the rest of our sample.

If a child is born before $1^{st}$ of April their parents can, according Norwegian rules, apply for them to start school as a five-year old. Then these twelve 18-year-olds in our dataset should be born in the first quarter of the year. But, there are always exceptions to the rule; half of the 18-year old observations are born in May and April (table 2 below).

**Table 2: Birth month distribution, 18-year olds**

| *Month* | *Frequency* | *Percent* | *Cumulative Percent* |
|---|---|---|---|
| January | 3 | 25 | 25 |
| February | 3 | 25 | 50 |
| April | 3 | 25 | 75 |
| May | 3 | 25 | 100 |
| Total | 12 | 100 | |

The birth month distribution of the twelve 18-year olds displays that every one of them is born before the summer holidays. Including these twelve individuals there are most likely other students in our sample that have either deferred or forwarded their school start, but they can unfortunately not be identified.

In the other end of the age-scale there is some potential outliers of the oldest individuals in the sample. Outliers is defined as "observations in a data set that are substantially different from the bulk of the data (Woolridge, 2009)", in our case the oldest students are 59 years old. We are excluding all 1641 students above 37 years old from the dataset, approximately 5% of the observations. Table 3 summarizes the process of trimming the raw dataset, and our final analytic sample has been cut to a total of 30 593 observations.

**Table 3: Sample trimming for final dataset**

| *Variable* | *Dropped from our dataset* | *Number* | *Net sample* |
|---|---|---|---|
| Raw dataset | | | 44973 |
| Grade | Observations without grades from A-F | 5639 | 39334 |
| Grade | Exam candidates who did not meet up for exam | 6448 | 32886 |
| Resit | Candidates taking exam for $n^{th}$ time | 652 | 32234 |
| Age at exam | Every student over 37 years | 1641 | 30593 |
| Final analytic sample | | | 30593 |

As reported in table 4, of the 30593 observations of different exam grades in the sample 61 percent are taking the value 1 for gender, indicating being a female student. The grading system is an ascending interval from 0-5, where 0 is an F (failed exam) and the best grade, 5, is an A. In total the mean grade is 2,92, converted to letter-grades that is almost a C with a standard deviation of 1,416. Table 4 also tells us the average student in the sample is 23,96 years old the year the exam was taken, with a standard deviation on 3,907.

**Table 4: Descriptive statistics for final dataset**

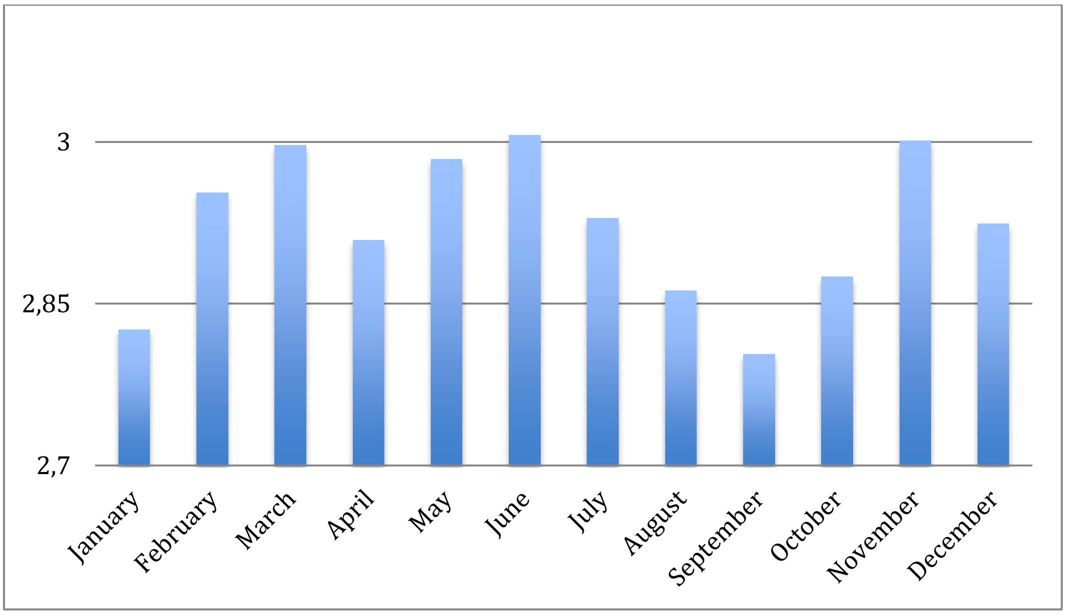
| | *Gender* | *Grade* | *Age at exam* |
|---|---|---|---|
| N | 30593 | 30593 | 30593 |
| Minimum | 0 | 0 | 18 |
| Maximum | 1 | 5 | 37 |
| Mean | .61 | 2.92 | 23.96 |
| Std. Deviation | .488 | 1.416 | 3.907 |

In table 5 we present the mean exam grade per birth month from our sample. These mean grades are illustrated in figure 2, and we easily see that June, March and November has the highest mean grades. All of these months are close up to 3, which indicates C as a grade. The birth month with the lowest grade on average is September, with January as a close runner-up. The columns in figure 2 are bouncing up and down, not depicting any particular pattern of birth months and associated exam grades.

**Table 5: Mean grades per month**

| *Month* | *Mean grade* |
|---|---|
| January | 2.826 |
| February | 2.953 |
| March | 2.997 |
| April | 2.909 |
| May | 2.984 |
| June | 3.006 |
| July | 2.929 |
| August | 2.862 |
| September | 2.803 |
| October | 2.875 |
| November | 3.001 |
| December | 2.924 |

**Figure 2: Mean grades by month illustrated**



## 5.2 Descriptive statistics by study program

In table 6 descriptive statistics from our dataset is presented, and split into the chosen study programs and again divided by gender. In total, our sample consists of 61,0% female students. The preschool teacher study program has the highest share of female students, with 90,6%, while Petroleum technology has the lowest share of female students; 28,3%. Industrial economy also have a low female share with 31,5% female, the last two study programs are most represented by female students, around 60%.

**Table 6: Descriptive statistics by study program**

| Gender | | *Study program* | | | | | |
|---|---|---|---|---|---|---|---|
| | | *ALL STUDIES* | *PRESCHOOL* | *HTLMNGT* | *PETROL* | *ECON* | *INDECON* |
| Male | Share male | 0.390 | 0.094 | 0.384 | 0.717 | 0.414 | 0.685 |
| | Mean grade | 2.94 | 2.47 | 2.51 | 2.77 | 3.05 | 3.62 |
| | | (1.484) | (1.313) | (1.608) | (1.516) | (1.417) | (1.251) |
| | Mean age | 23.76 | 24.54 | 25.18 | 23.91 | 23.15 | 23.32 |
| | | (3.48) | (3.486) | (3.345) | (3.753) | (3.198) | (3.221) |
| | Share students 30+ | 0.078 | 0.12 | 0.114 | 0.085 | 0.059 | 0.058 |
| | N | 11938 | 826 | 1534 | 3524 | 4253 | 1801 |

| Gender | | *Study program* | | | | | |
|---|---|---|---|---|---|---|---|
| | | *ALL STUDIES* | *PRESCHOOL* | *HTLMNGT* | *PETROL* | *ECON* | *INDECON* |
| Female | Share female | 0.61 | 0.906 | 0.616 | 0.282 | 0.586 | 0.315 |
| | Mean grade | 2.91 | 2.94 | 2.69 | 2.72 | 2.91 | 3.54 |
| | | (1.37) | (1.229) | (1.588) | (1.550) | (1.398) | (1.208) |
| | Mean age | 24.09 | 24.91 | 24.04 | 23.31 | 23.38 | 22.77 |
| | | (4.152) | (4.752( | (2.979) | (3.867) | (3.647) | (3.189) |
| | Share students 30+ | 0.126 | 0.191 | 0.057 | 0.089 | 0.084 | 0.07 |
| | N | 18655 | 7959 | 2464 | 1393 | 6010 | 829 |

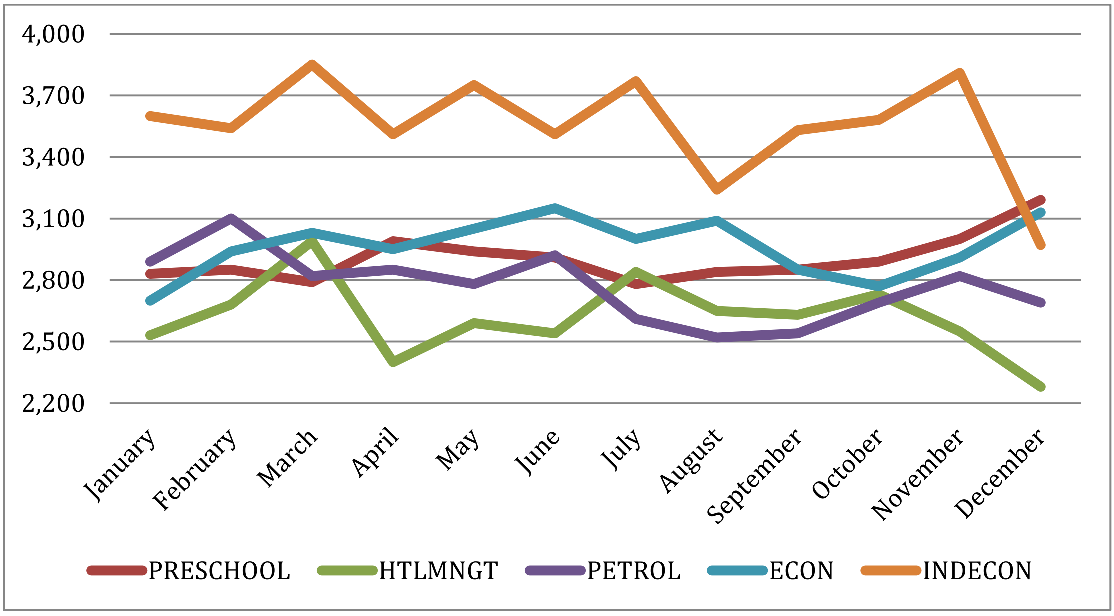
Note: Standard deviations are reported in parenthesis

In total the average grade is, as stated in table 4, just below a C. For male students the mean grade is 2,94, and for the female students 2,91 with standard deviations on respectively 1,484 and 1,37. The study program with the lowest mean grade of the total sample is the male preschool teacher-students. They have a mean of 2,47, with the female counterpart almost a half grade higher (0,47) on average. The industrial economy students have the highest mean grades. The males mean grade is 3,62 and the females have a mean grade is 3,54. These two, are together with the male business students (ECON) the only students getting a mean grade over C.

Figure 3 below illustrates the mean exam grades for each month, and divided into the five different study programs we analyze. The orange line, illustrating the individuals studying industrial economy, has the highest mean grades of the selected students at UiS, with the March- and November-students being those with the best grades from this study program.

January do not have, as illustrated in figure 3, the highest mean grade for any of the study programs, if you look at the business students (light blue line) January is actually the worst month. Even though January is not the best month, there are patterns showing that it could be beneficial to be born before the summer holidays. For the petroleum technology and industrial economy students there is a trend of the students born early in the year having higher average grades than students born later in the year. Among the preschool teacher students we can see an opposite pattern, with low average grades in the start of the year and a slightly increasing average, as we are getting closer to December. Hotel management and the business students do not give us a certain pattern of birth month and mean grade.

**Figure 3: Mean grade by month, sorted by study program**




From table 6 we see that the oldest students on average are the male hotel management students (25,18 years), with preschool teacher students of both genders close behind. For the three last study programs the mean age is around 23-24 years old. Even though the male hotel management students are on average the oldest students, the preschool teacher study program got the largest share of students over 30 years, both for the male and female students with respectively 12 and 19,1 percent share of the students. In total the share of students between 30-37 years is respectively 7,8 and 12,6 percent for male and female students in our sample.

## 5.3 UiS students compared to Norwegian population

In this part of the chapter we will compare the chosen UiS-students with the Norwegian population in regards of birth months, and check for differences in the birth month distribution. Table 7 displays the Norwegian population's birth month distribution, and compares it with the UiS-students' birth months. From Statistics Norway we acquired aggregated birth data of 607 816 persons from the Norwegian population born in the period 1982-1992. From table 7 we can see that the most frequent birth months from our data sample are March, April and October, while the least frequent birth months are June, August, November and December. The distribution is anyhow quite evenly distributed, and the majority of both the Norwegians and the UiS-students are born within the first six months.

**Table 7: UiS-birth months, compared with population**

| | *Norwegian population* | *Cumulative share* | *UiS total* | *Cumulative share* | *Deviation* |
|---|---|---|---|---|---|
| January | 0.081 | 0.081 | 0.088 | 0.088 | 0.007 |
| February | 0.080 | 0.161 | 0.085 | 0.173 | 0.005 |
| March | 0.091 | 0.252 | 0.097 | 0.27 | 0.006 |
| April | 0.091 | 0.343 | 0.093 | 0.363 | 0.002 |
| May | 0.088 | 0.431 | 0.081 | 0.444 | -0.007 |
| June | 0.084 | 0.515 | 0.074 | 0.518 | -0.010 |
| July | 0.086 | 0.601 | 0.088 | 0.606 | 0.002 |
| August | 0.084 | 0.685 | 0.074 | 0.68 | -0.010 |
| September | 0.083 | 0.768 | 0.083 | 0.763 | 0.000 |
| October | 0.079 | 0.847 | 0.092 | 0.855 | 0.013 |
| November | 0.075 | 0.922 | 0.072 | 0.927 | -0.003 |
| December | 0.077 | 1.00 | 0.074 | 1.00 | -0.003 |

**Figure 4: Birth months to chosen UiS-students relative to the population**

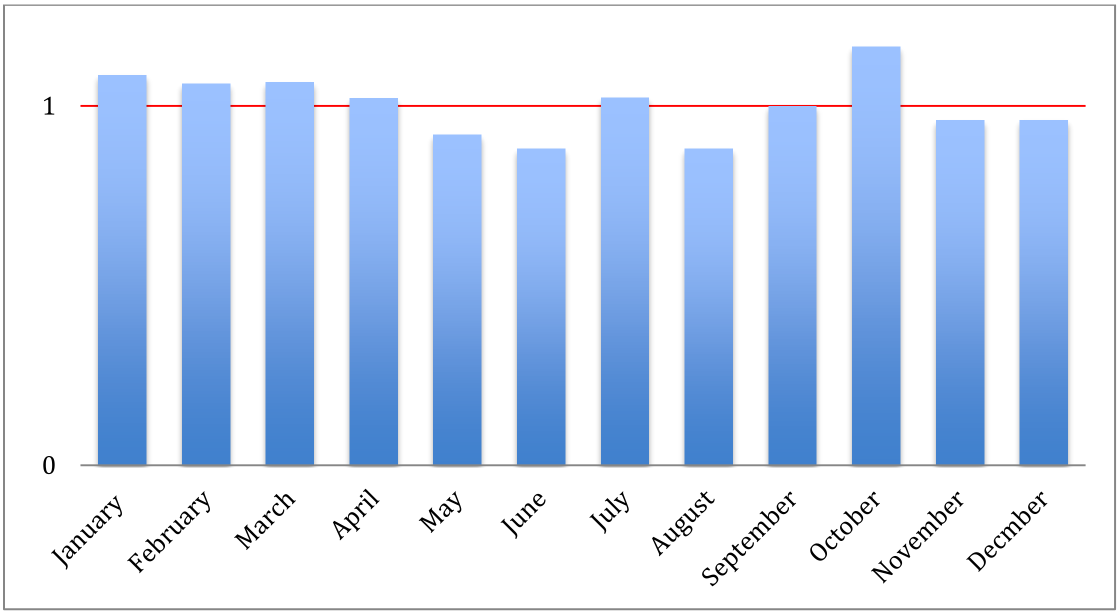



Figure 4 illustrates the birth month distribution for the chosen UiS students relative to the Norwegian population. The red line illustrates the population and the blue columns are representing the UiS students. Even though the students at UiS deviate from the population, the differences are not that large; the largest deviation is in October. 9,2 percent of the chosen UiS-students are born in October, 1,3 percent more than the Norwegian average. In figure 4 we also see that the UiS students are more frequently born in the first four months relatively to the Norwegian population, and in the end of the year we see, apart from October, a trend of less birth months relatively to the population.

With figure 4 showing us that the UiS students maybe are a bit underrepresented in May, June and August, and maybe a bit overrepresented in October, it also shows that our sample of students are more frequently born in the beginning of the year relative to the Norwegian population. We are going to check these deviations from the population to find potential patterns from each of the chosen study programs in part 5.3.1 to 5.3.5.

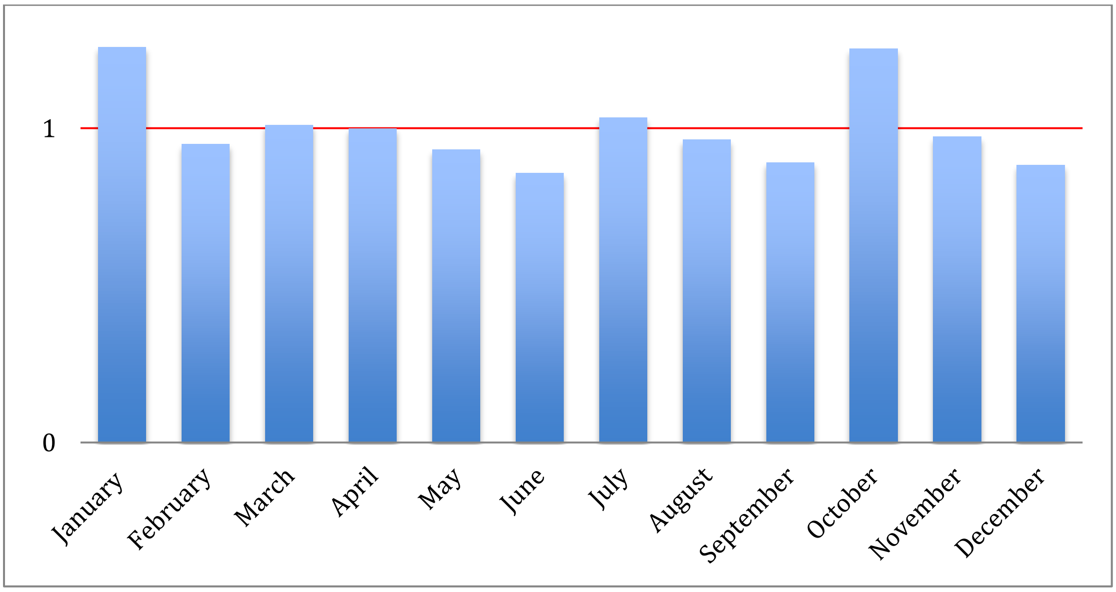
### 5.3.1 Preschool teacher study

In table 8 we are presenting the preschool teacher students' birth distribution compared to the Norwegian population. It tells us that January and October deviates most from the national average, with respectively 2,1 and 2 percent. Except these two months, the birth month distribution for the chosen preschool teacher students at UiS is quite similar the Norwegian population, as illustrated in figure 5.

**Table 8: Birth months for preschool teacher students at UiS, compared with population**

| | *Norwegian population* | *Cumulative share* | *Preschool teacher* | *Cumulative share* | *Deviaton* |
|---|---|---|---|---|---|
| January | 0.081 | 0.081 | 0.102 | 0.102 | 0.021 |
| February | 0.080 | 0.161 | 0.076 | 0.178 | -0.004 |
| March | 0.091 | 0.252 | 0.092 | 0.27 | 0.001 |
| April | 0.091 | 0.343 | 0.091 | 0.361 | 0.000 |
| May | 0.088 | 0.431 | 0.082 | 0.443 | -0.006 |
| June | 0.084 | 0.515 | 0.072 | 0.515 | -0.012 |
| July | 0.086 | 0.601 | 0.089 | 0.604 | 0.003 |
| August | 0.084 | 0.685 | 0.081 | 0.685 | -0.003 |
| September | 0.083 | 0.768 | 0.074 | 0.759 | -0.009 |
| October | 0.079 | 0.847 | 0.099 | 0.858 | 0.020 |
| November | 0.075 | 0.922 | 0.073 | 0.931 | -0.002 |
| December | 0.077 | 1.00 | 0.068 | 1.00 | -0.009 |

**Figure 5: Birth months, preschool teacher students at UiS, relative to population**



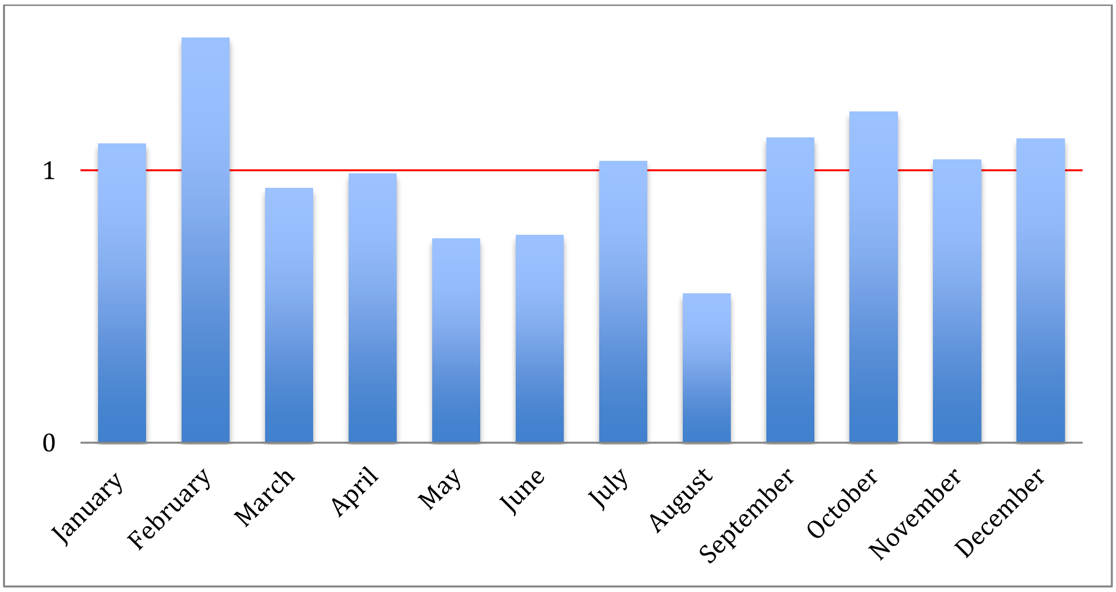
### 5.3.2 Hotel management

3 998 of the students in our trimmed dataset are studying hotel management. The birth month distribution of these students, compared to the Norwegian population, is depicted in the table and figure below. Here we see that February and August are the outliers, with respectively +3,9 and -3,8 percent deviation from the average birth month. There is not enough students applying for this study program compared to how many vacant open study places it is, and this leads to no grade requirement for the pupils from upper secondary school (Samordna Opptak).

**Table 9: Birth months, hotel management, compared with population**

| | *Norwegian population* | *Cumulative share* | *Hotel management* | *Cumulative share* | *Deviation* |
|---|---|---|---|---|---|
| January | 0.081 | 0.081 | 0.089 | 0.089 | 0.008 |
| February | 0.08 | 0.161 | 0.119 | 0.208 | 0.039 |
| March | 0.091 | 0.252 | 0.085 | 0.293 | -0.006 |
| April | 0.091 | 0.343 | 0.09 | 0.383 | -0.001 |
| May | 0.088 | 0.431 | 0.066 | 0.449 | -0.022 |
| June | 0.084 | 0.515 | 0.064 | 0.513 | -0.020 |
| July | 0.086 | 0.601 | 0.089 | 0.602 | 0.003 |
| August | 0.084 | 0.685 | 0.046 | 0.648 | -0.038 |
| September | 0.083 | 0.768 | 0.093 | 0.741 | 0.010 |
| October | 0.079 | 0.847 | 0.096 | 0.837 | 0.017 |
| November | 0.075 | 0.922 | 0.078 | 0.915 | 0.003 |
| December | 0.077 | 0.999 | 0.086 | 1.001 | 0.009 |

**Figure 6: Birth months, hotel management students at UiS, relative to population**



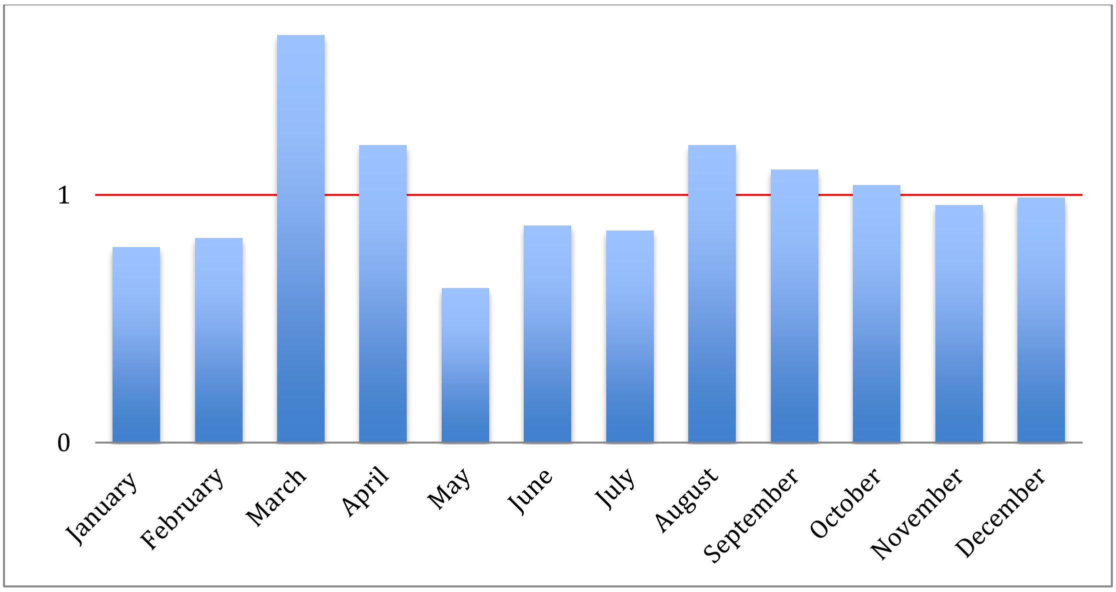
### 5.3.3 Petroleum technology

In the trimmed sample dataset we have 4 917 students from the bachelor program in petroleum technology UiS. As illustrated in table 10 and figure 7, we observe something strange in March and April; 38,5 percent of the students are born within the first four months, with March and April alone got 25,6 percent. Figure 7 illustrates table 10, and as we can see the UiS petroleum technology students are overrepresented in March and April, and May having the largest deviation relative to the population, with an underrepresentation of 3,4 percent.

**Table 10: Birth months, petroleum technology, compared with population**

| | *Norwegian population* | *Cumulative share* | *Petroleum technology* | *Cumulative share* | *Deviation* |
|---|---|---|---|---|---|
| January | 0.08 | 0.08 | 0.063 | 0.063 | -0.017 |
| February | 0.08 | 0.16 | 0.066 | 0.129 | -0.014 |
| March | 0.09 | 0.25 | 0.148 | 0.277 | 0.058 |
| April | 0.09 | 0.34 | 0.108 | 0.385 | 0.018 |
| May | 0.09 | 0.43 | 0.056 | 0.441 | -0.034 |
| June | 0.08 | 0.51 | 0.07 | 0.511 | -0.01 |
| July | 0.09 | 0.6 | 0.077 | 0.588 | -0.013 |
| August | 0.08 | 0.68 | 0.096 | 0.684 | 0.016 |
| September | 0.08 | 0.76 | 0.088 | 0.772 | 0.008 |
| October | 0.08 | 0.84 | 0.083 | 0.855 | 0.00 |
| November | 0.07 | 0.91 | 0.067 | 0.922 | 0.00 |
| December | 0.08 | 1.0 | 0.079 | 1.0 | 0.00 |

**Figure 7: Birth months, petroleum students at UiS, relative to population**



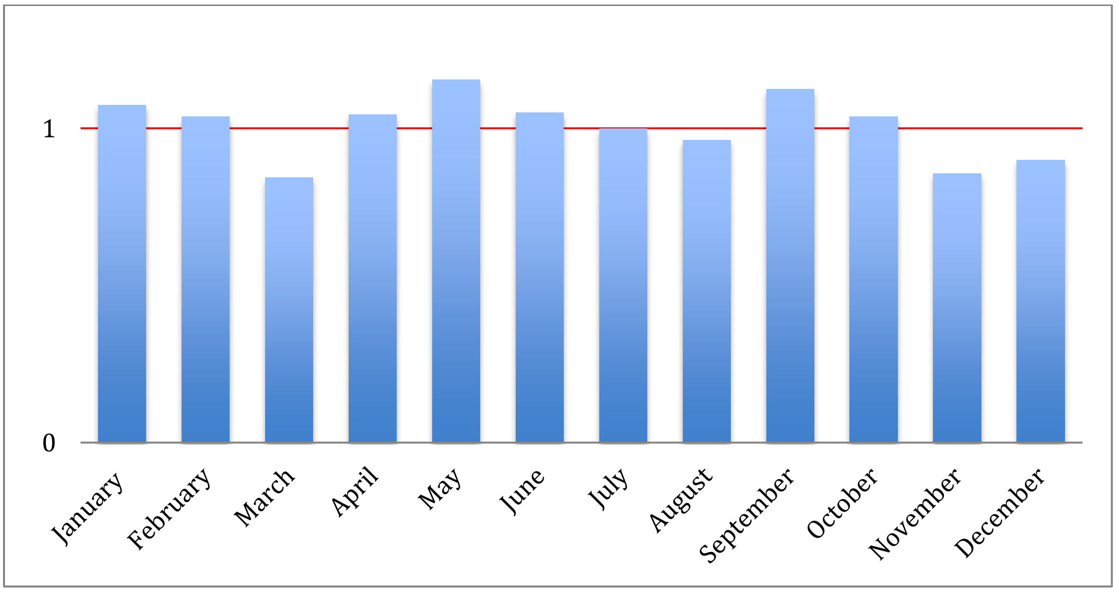
### 5.3.4 Business and administration students

In the trimmed dataset 10263 observations are studying at the UiS Business School. The birth month distribution of the chosen business students at UiS compared to the Norwegian population is presented in table 11. As illustrated in figure 8 below, there are very small deviations from the national average in birth month distribution of these students. From the chosen study programs, the birth month distribution from the business students is the one with least deviations from the Norwegian population.

**Table 11: Birth months business students, compared with population**

| | *Norwegian population* | *Cumulative share* | *Business* | *Cumulative share* | *Deviation* |
|---|---|---|---|---|---|
| January | 0.08 | 0.08 | 0.086 | 0.086 | 0.006 |
| February | 0.08 | 0.16 | 0.083 | 0.169 | 0.003 |
| March | 0.09 | 0.25 | 0.076 | 0.245 | -0.014 |
| April | 0.09 | 0.34 | 0.094 | 0.339 | 0.004 |
| May | 0.09 | 0.43 | 0.104 | 0.443 | 0.014 |
| June | 0.08 | 0.51 | 0.084 | 0.527 | 0.004 |
| July | 0.09 | 0.6 | 0.090 | 0.617 | 0 |
| August | 0.08 | 0.68 | 0.077 | 0.694 | -0.003 |
| September | 0.08 | 0.76 | 0.090 | 0.784 | 0.01 |
| October | 0.08 | 0.84 | 0.083 | 0.867 | 0.003 |
| November | 0.07 | 0.91 | 0.060 | 0.927 | -0.01 |
| December | 0.08 | 1.0 | 0.072 | 1.0 | -0.008 |

**Figure 8: Birth months for business students at UiS, relative to population**



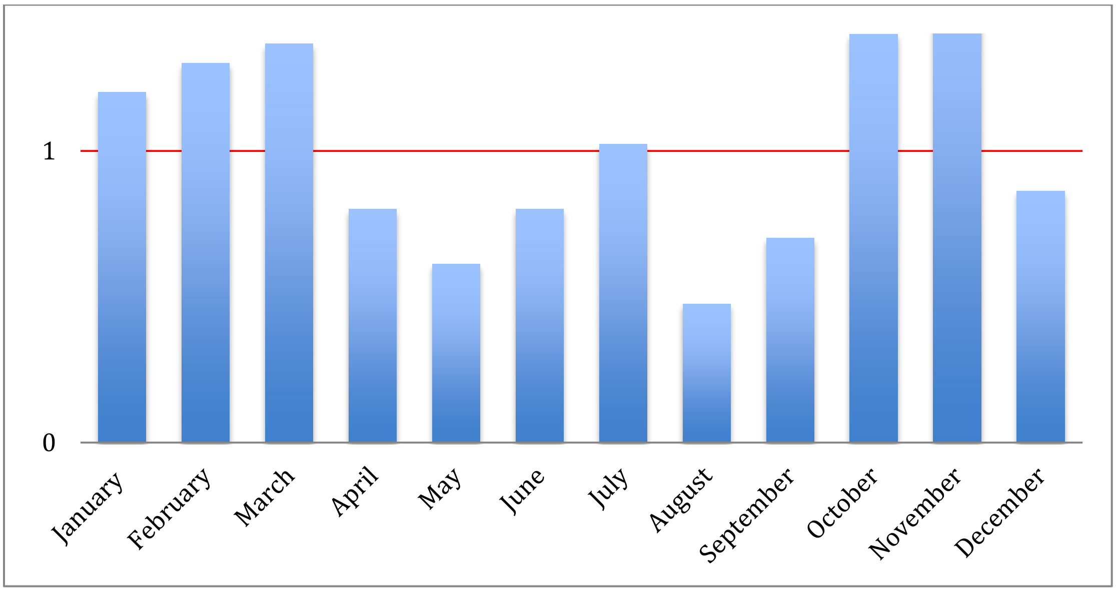
### 5.3.5 Industrial economics

Table 12, and the related figure 9, shows the birth month distribution of the 2630 master students in industrial economy students from our sample, compared with the Norwegian population. Figure 9 easily illustrates a trend for the chosen master students in industrial economies students to be more often born in the first and last quarter of the year, relative to the national average.

**Table 12: Birth month industrial economy, compared with population**

| | *Norwegian population* | *Cumulative share* | *Industrial economy* | *Cumulative share* | *Deviation* |
|---|---|---|---|---|---|
| January | 0.08 | 0.08 | 0.096 | 0.096 | 0.016 |
| February | 0.08 | 0.16 | 0.104 | 0.200 | 0.024 |
| March | 0.09 | 0.25 | 0.123 | 0.323 | 0.033 |
| April | 0.09 | 0.34 | 0.072 | 0.395 | -0.018 |
| May | 0.09 | 0.43 | 0.055 | 0.450 | -0.035 |
| June | 0.08 | 0.51 | 0.064 | 0.514 | -0.016 |
| July | 0.09 | 0.6 | 0.092 | 0.606 | 0.002 |
| August | 0.08 | 0.68 | 0.038 | 0.644 | -0.042 |
| September | 0.08 | 0.76 | 0.056 | 0.700 | -0.024 |
| October | 0.08 | 0.84 | 0.112 | 0.812 | 0.032 |
| November | 0.07 | 0.91 | 0.119 | 0.931 | 0.049 |
| December | 0.08 | 1.0 | 0.069 | 1.000 | -0.011 |

**Figure 9: Birth months, ind.econ students at UiS, relative to population**



## 5.4 UiS students compared to similar students

To see if the UiS students are somewhat different from other students in Norway we compared some selected study programs with similar studies in Norway. We received birth month data from the Norwegian School of Economics (NHH) for comparison with the business students at UiS, and from The Norwegian University of Science and Technology (NTNU) we received data with regards to the petroleum technology and the industrial economy students. These two schools are the assumed to be best schools for the three mentioned study programs, and have the highest grade requirements in Norway to get enrolled. In table 13 we show the difference in the grade requirements from UiS to the chosen comparison schools in the period 2010-2014 (Samordna Opptak). These requirements are based on pupils' GPA from upper secondary school, with 60 as a max score before extra credits.

**Table 13: Grade requirements to get into the chosen study programs**

| | | *2010* | *2011* | *2012* | *2013* | *2014* |
|---|---|---|---|---|---|---|
| Business | | | | | | |
| | NHH | 52.70 | 53.0 | 52.9 | 52.9 | 53.0 |
| | UiS | 42.5 | 44.0 | 46.3 | 49.3 | 48.8 |
| | Difference | 10.2 | 9.0 | 6.6 | 3.6 | 4.2 |
| Petroleum technology | | | | | | |
| | NTNU | 51.8 | 51.9 | 54.8 | 57.2 | 56.9 |
| | UiS | 42.5 | 44.0 | 46.3 | 49.3 | 48.8 |
| | Difference | 9.3 | 7.9 | 8.5 | 7.9 | 8.1 |
| Industrial economy | | | | | | |
| | NTNU | 58.2 | 58.9 | 59.5 | 59.8 | 60.2 |
| | UiS | 50.0 | 49.9 | 50.4 | 51.4 | 53.1 |
| | Difference | 8.2 | 9.0 | 9.1 | 8.4 | 7.1 |

With the data received from NTNU and NHH we could compare the birth month distribution for the UiS students to other students in Norway to find out if there are any differences. Since there are higher grade-requirements to get into NHH and NTNU relative to UiS, it makes sense that those students have to be academically stronger from upper secondary school, and are therefore more likely to be born early in the year. As in the rest of Norway, the majority of the business students are born in the first six months at both of the schools. In table 14 we compare the NHH-students to the Norwegian population to see if there are any differences, and in figure 10 they are illustrated relative to the population.

**Table 14: NHH birth months, compared with population**

| | *Norwegian population* | *Cumulative share* | *NHH* | *Cumulative share* | *Deviation* |
|---|---|---|---|---|---|
| January | 0.081 | 0.081 | 0.088 | 0.088 | 0.007 |
| February | 0.080 | 0.161 | 0.074 | 0.162 | -0.006 |
| March | 0.091 | 0.252 | 0.091 | 0.253 | 0.000 |
| April | 0.091 | 0.343 | 0.109 | 0.363 | 0.018 |
| May | 0.088 | 0.431 | 0.096 | 0.459 | 0.008 |
| June | 0.084 | 0.515 | 0.078 | 0.537 | -0.006 |
| July | 0.086 | 0.601 | 0.092 | 0.628 | 0.006 |
| August | 0.084 | 0.685 | 0.087 | 0.716 | 0.003 |
| September | 0.083 | 0.768 | 0.078 | 0.794 | -0.005 |
| October | 0.079 | 0.847 | 0.071 | 0.865 | -0.008 |
| November | 0.075 | 0.922 | 0.068 | 0.933 | -0.007 |
| December | 0.077 | 1.00 | 0.067 | 1.000 | -0.010 |

From NTNU we received data containing birth months from 355 students enrolled for the five-year long master degree in Petroleum, and in Geoscience and Petroleum technology. With this data we could test if the Petroleum-students at UiS differ from other Petroleum-students. Through Norwegian official websites (Samordna Opptak) we know that this study program is the hardest petroleum-engineering program in Norway to get enrolled to from upper secondary school. Using this data we can compare students' birth month distribution with the population. As we saw in table 10, the UiS petroleum technology students were more frequently born in March and April, and we see the same tendency at NTNU with April being the most frequent birth month as depicted in table 15.

**Table 15: NTNU petroleum students' birth months, compared with population**

| | *Norwegian population* | *Cumulative share* | *NTNU, petroleum* | *Cumulative share* | *Deviation* |
|---|---|---|---|---|---|
| January | 0.081 | 0.081 | 0.068 | 0.068 | -0.013 |
| February | 0.080 | 0.161 | 0.068 | 0.135 | -0.012 |
| March | 0.091 | 0.252 | 0.068 | 0.203 | -0.023 |
| April | 0.091 | 0.343 | 0.132 | 0.335 | 0.041 |
| May | 0.088 | 0.431 | 0.096 | 0.431 | 0.008 |
| June | 0.084 | 0.515 | 0.082 | 0.513 | -0.002 |
| July | 0.086 | 0.601 | 0.093 | 0.606 | 0.007 |
| August | 0.084 | 0.685 | 0.079 | 0.685 | -0.005 |
| September | 0.083 | 0.768 | 0.085 | 0.769 | 0.002 |
| October | 0.079 | 0.847 | 0.073 | 0.842 | -0.006 |
| November | 0.075 | 0.922 | 0.070 | 0.913 | -0.005 |
| December | 0.077 | 1.00 | 0.087 | 1.000 | 0.010 |

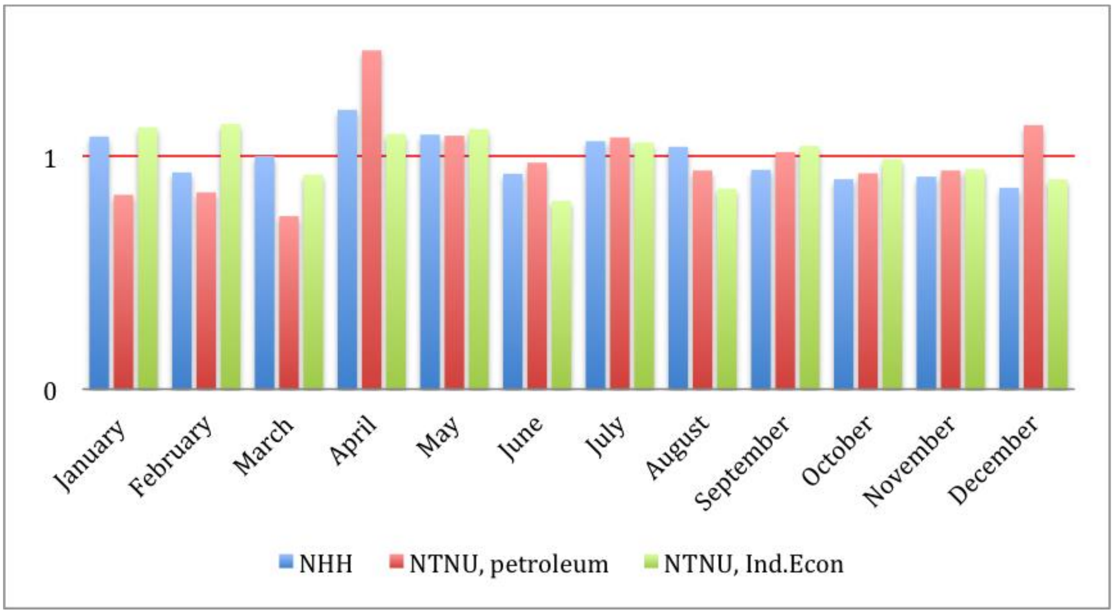
As for the business and petroleum technology students, we got data to compare the chosen industrial economy students at UiS. From NTNU we got data containing birth months for 692 students enrolled to their industrial economy program in the period 2010-2014. The evenly birth month distribution for the industrial economy students compared to the Norwegian population is presented in table 16.

**Table 16: NTNU ind.econ students' birth months, compared with population**

| | *Norwegian population* | *Cumulative share* | *NTNU, Ind.econ* | *Cumulative share* | *Deviation* |
|---|---|---|---|---|---|
| January | 0.081 | 0.081 | 0.091 | 0.091 | 0.010 |
| February | 0.080 | 0.161 | 0.091 | 0.182 | 0.011 |
| March | 0.091 | 0.252 | 0.084 | 0.266 | -0.007 |
| April | 0.091 | 0.343 | 0.100 | 0.366 | 0.009 |
| May | 0.088 | 0.431 | 0.098 | 0.464 | 0.010 |
| June | 0.084 | 0.515 | 0.068 | 0.532 | -0.016 |
| July | 0.086 | 0.601 | 0.091 | 0.623 | 0.005 |
| August | 0.084 | 0.685 | 0.072 | 0.695 | -0.012 |
| September | 0.083 | 0.768 | 0.087 | 0.782 | 0.004 |
| October | 0.079 | 0.847 | 0.078 | 0.860 | -0.001 |
| November | 0.075 | 0.922 | 0.071 | 0.931 | -0.004 |
| December | 0.077 | 1.00 | 0.069 | 1.000 | -0.008 |

The deviation between the birth months at NHH and NTNU and the Norwegian population for the three study programs are illustrated and summarized in figure 10. Here we see that petroleum students enrolled at NTNU varies more in their birth months, relative to the Norwegian population, than the business students at NHH and the industrial economics students at NTNU do.

**Figure 10: Birth months of students at other universities, relative to population**




Even though there are higher grade requirements for the upper secondary school pupils to get enrolled into these chosen study programs, we do not find any large deviations from the populations birth month distribution, except for the industrial economy students at NTNU. The green columns in figure 10 are illustrating the birth month distribution for these students. As earlier described, this study has the highest grade requirement to get enrolled into from all of the chosen study programs. Since the red line is illustrating the Norwegian population, we see that the industrial economy students are more frequently born in the first months relative to the population. For the petroleum technology students at NTNU there is a large deviation relative to the population in April, but we see the same tendency for the similar chosen students at UiS.

# 6. Results

In this section of the thesis we are going to present our findings after running regressions from models 2-4[5], and also present the results from the subsample analysis.

## 6.1 How birth month affect exam grade at UiS

In table 17 we present the unstandardized beta coefficients after running the equation from model 2 as described in chapter 4. The dependent variable is set to exam grade, while all months are dummy variables, with January as base month. We also include age at exam and gender as variables for all 30 593 observations.

The ordinary least square estimates from model 2 indicates that the January-born UiS students are performing academically weaker than all other birth month, except for September. These results are significant on a five percent level for every month except for August, September and October. The coefficient for age at exam is negative, which indicates becoming a year older responds negatively on the dependent variable, exam grade. Even though it responds negatively, the coefficient is so small that a change in ten years would only decrease the exam grade by 0,14. The gender variable are significant on a ten percent level, and tells us that male students are getting better grades than female students (since the variable is a dummy variable, and 1 indicates female). This is also a very small negative coefficient, so the gender-differences are more explained in model 3.

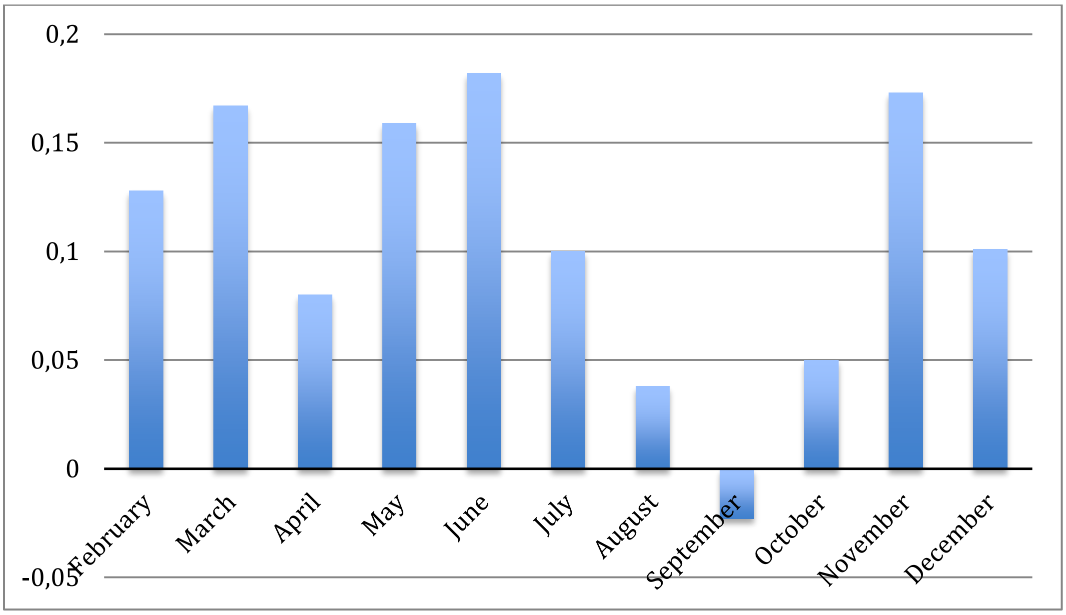
[5] In regressions not reported, we ran these models without the age at exam-variable, yielding same results.

**Table 17: Results model 2, how birth month affect exam grade**

| | *Unstandardized Coefficients* |
|---|---|
| | *B* |
| (Constant) | 3.192*** |
| February | 0.128*** |
| March | 0.167*** |
| April | 0.08** |
| May | 0.159*** |
| June | 0.182*** |
| July | 0.1*** |
| August | 0.038 |
| September | -0.023 |
| October | 0.05 |
| November | 0.173*** |
| December | 0.101** |
| Standard error birth months | 0.036 |
| Age at exam | -0.014*** |
| | (0.002) |
| Gender | -0.03* |
| | (0.017) |
| Mean grade | 2.92 |
| Standard deviation | 1.416 |
| Observations | 30593 |
| $R^2$ | 0.004 |

Notes: Dependent Variable: Grade. Reported standard error is approximately constant across birth month coefficients. For other variables they are reported in parenthesis. *, ** and *** significance at the 10, 5, and 1 % levels, respectively

**Figure 11: Model 2 beta coefficients illustrated**




The unstandardized coefficients from table 17 are illustrated in figure 11. The chosen UiS-students born in January are at level 0, and as depicted, every month except the insignificant September, are above 0 outperforming the January-born. The figure also illustrates the March-, June- and November-born students at UiS are getting the best exam grades. Even though these are the "best months" the coefficients are very small, and the differences between birth months are not large. The blue columns in figure 11 are bouncing up and down, and do not indicate a certain pattern of being born in any part of the year and benefitting the exam grades at UiS. In other words, we do not find any certain birth month effect from model 2.

## 6.2 Results by gender

As described in empirical strategy when model 3 was introduced, we drop the dummy for gender and analyze the gender data separately. From the descriptive statistics we see that the mean grade is higher for the male students compared to the female students, and the male students are also, on average, younger at the exam time. After running the regression we see a tendency of the male students born in January outperform the students born in the third and fourth quarters. The male students have higher mean grade and are on average a bit younger than the female students. For the female students we see the same pattern as we did for the whole sample with every month being better than January. The columns in figure 12 are indicating this better for us; we see that the male students are below 0 (which is the reference group January) for six of the months, while every month is positive for the female students.

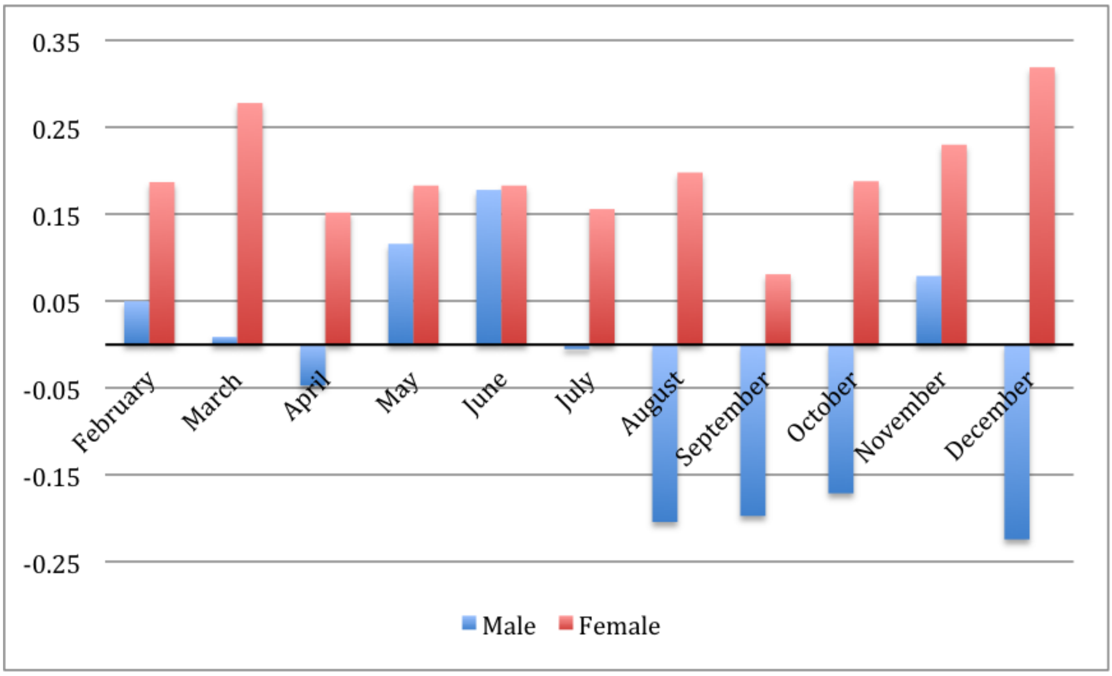
Males and females react differently on actual age; the age-variable from the table 18 indicates that a younger male student does it better than the older, but for the female students it is opposite. As for model 2, this age at exam-variable is very small, so even a ten-year increase will not have a huge impact on exam grade.

**Table 18: Main results model 3, divided by gender**

| | *Gender* | |
|---|---|---|
| | *Male* | *Female* |
| | *B* | *B* |
| (Constant) | 4.302*** | 2.618*** |
| February | 0.05 | 0.187*** |
| March | 0.009 | 0.278*** |
| April | -0.047 | 0.152*** |
| May | 0.116* | 0.183*** |
| June | 0.178*** | 0.183*** |
| July | -0.005 | 0.156*** |
| August | -0.204*** | 0.198*** |
| September | -0.197*** | 0.081* |
| October | -0.171*** | 0.188*** |
| November | 0.079 | 0.23*** |
| December | -0.224*** | 0.319*** |
| Std.error birth months | 0.0688 | 0.0500 |
| Age at exam | -0.056*** | 0.005* |
| | (0.004) | (0.002) |
| Mean grade | 2.94 | 2.91 |
| Standard deviation | 1.48 | 1.37 |
| Observations | 11938 | 18655 |
| $R^2$ | 0.025 | 0.004 |

Notes: Reported standard error is approximately constant across birth month coefficients. For other variables they are reported in parenthesis. *, ** and *** significance at the 10, 5, and 1 % levels, respectively.

**Figure 12: Model 3 unstandardized beta coefficients illustrated**




The red columns in figure 12, representing the female students at UiS, depicts some of the same pattern as for the whole sample in model 2, with January being the worst birth month in regards of exam grades. The male students born in the first two quarters from our sample at UiS outperform the last two birth quarters, except the insignificant coefficient representing November. In other words, there is a pattern suggesting that the male students born early in the year perform better academically than those born late in the year. For example, the exam grade of a male student born in December is about 0,224 lower than the exam grade of male students born in January. On the other hand, December is the best achieving birth month with 0,319 higher exam grades compared to the January born female students.

## 6.3 Results by study program

Since the chosen study programs have different admission requirements, we want to run regressions separately to see if there are differences between the study programs. We will then find out if the January-born, or the students born early in the year, does it better in study programs where it is higher requirements to get enrolled into.

As described in empirical evidence, model 4 split the results into subsamples of gender and study program. Table 19 summarizes the results from this regression, and we identify opposite patterns between male and female for the preschool teacher students. Even though not every coefficient is significant, the male preschool teacher students benefits from being born early in the year, while the female students do not. December month for the male student differs quite from the rest with a very high positive, insignificant, coefficient. But, there is still a pattern of being born early in the year benefits academic performance for male preschool teacher students. The petroleum students are also showing opposite results between the genders; the male students benefits from being born early in the year, while the female petroleum technology students born in January are getting the worst exam grades. This is also showed in figure 13 and figure 14. The blue columns (ECON) are indicating that neither the male nor the female business students benefits from being born early in the year, and especially not January. For the 6010 female business students it is statistically significant that if the student is born in January, the student get worse grades than all other birth months. The 1801 male industrial economy students are showing a slight trend, as illustrated in figure 13, of being born early in the year is beneficial for academic performance. For the male hotel management students it is also a slight trend of being born early in the year gets better exam grades, but this pattern does not exist for the female students.

When it comes to the age at exam variable, it is only the preschool teacher-students that benefits from getting older by years. In all of the other chosen study programs the coefficient is negative, indicating the actual youngest students get better exam grades.

**Table 19: Model 4 unstandardized beta coefficient summary**

| Gender | | | | *StudyProgram* | | |
|---|---|---|---|---|---|---|
| | | *PRESCHOOL* | *HTLMNGT* | *PETROL* | *ECON* | *INDECON* |
| | | *B* | *B* | *B* | *B* | *B* |
| Male | (Constant) | 1.005*** | 2.851*** | 4.793*** | 3.373*** | 5.701*** |
| | February | -0.239 | 0.118 | 0.041 | 0.101 | -0.121 |
| | March | 0.061 | 0.523*** | -0.427*** | 0.292*** | -0.016 |
| | April | -0.346* | 0.037 | -0.179 | 0.176* | 0.101 |
| | May | -0.348 | -0.134 | -0.278* | 0.492*** | 0.312** |
| | June | -0.398 | -0.331 | -0.231* | 0.715*** | -0.013 |
| | July | -0.571*** | 0.009 | -0.699*** | 0.413*** | 0.061 |
| | August | -0.375* | -0.48** | -0.537*** | 0.346*** | -0.529*** |
| | September | -0.522** | 0.515** | -0.507*** | 0.076 | -0.31** |
| | October | -0.036 | -0.05 | -0.445*** | -0.121 | -0.182 |
| | November | -0.106 | -0.092 | -0.279** | 0.029 | 0.298*** |
| | December | 0.913 | -0.609*** | -0.586*** | 0.376*** | -0.879*** |
| | Std.error birth months | 0.272 | 0.192 | 0.131 | 0.108 | 0.135 |
| | Age at exam | 0.07*** | -0.013 | -0.07*** | -0.025*** | -0.086*** |
| | | (0.014) | (0.012) | (0.007) | (0.007) | (0.009) |
| | Mean grade | 2.47 | 2.51 | 2.77 | 3.05 | 3.62 |
| | Std. Dev. Grade | 1.313 | 1.608 | 1.516 | 1.417 | 1.251 |
| | Observations | 826 | 1534 | 3524 | 4253 | 1801 |
| | $R^2$ | 0.061 | 0.037 | 0.051 | 0.03 | 0.106 |

| Gender | | *PRESCHOOL* | *HTLMNGT* | *StudyProgram* *PETROL* | *ECON* | *INDECON* |
|---|---|---|---|---|---|---|
| | | *B* | *B* | *B* | *B* | *B* |
| Female | (Constant) | 2.001*** | 3.333*** | 4.023*** | 3.111*** | 4.65*** |
| | February | 0.013 | 0.19 | 0.775*** | 0.381*** | -0.113 |
| | March | -0.024 | 0.426** | 0.981*** | 0.386*** | 0.392** |
| | April | 0.245*** | -0.282* | 0.151 | 0.314*** | -0.359* |
| | May | 0.187*** | 0.248 | 0.48* | 0.256*** | 0.034 |
| | June | 0.098 | 0.161 | 1.272*** | 0.285*** | -0.104 |
| | July | 0.05 | 0.433*** | 0.723*** | 0.246*** | -0.215 |
| | August | 0.072 | 0.457** | 0.36* | 0.431*** | -0.162 |
| | September | 0.075 | -0.038 | 0.177 | 0.22*** | 0.149 |
| | October | 0.077 | 0.392** | 0.597*** | 0.243*** | 0.122 |
| | November | 0.25*** | 0.1 | 0.571** | 0.346*** | -0.286 |
| | December | 0.353*** | -0.046 | 0.892*** | 0.492*** | 0.284 |
| | Std.error birth months | 0.064 | 0.162 | 0.233 | 0.087 | 0.232 |
| | Age at exam | 0.353*** (0.003) | -0.033*** (0.011) | -0.082*** (0.011) | -0.021*** (0.005) | -0.049*** (0.014) |
| | Mean grade | 2.94 | 2.69 | 2.72 | 2.91 | 3.54 |
| | Std. Dev. Grade | 1.229 | 1.588 | 1.55 | 1.398 | 1.208 |
| | Observations | 7959 | 2464 | 1393 | 6010 | 829 |
| | $R^2$ | 0.025 | 0.022 | 0.086 | 0.01 | 0.07 |

Notes: Reported standard error is approximately constant across birth month coefficients. For other variables they are reported in parenthesis. *, ** and *** significance at the 10, 5, and 1 % levels, respectively. Reported coefficients are unstandardized.

**Figure 13: Model 4 coefficients, male**

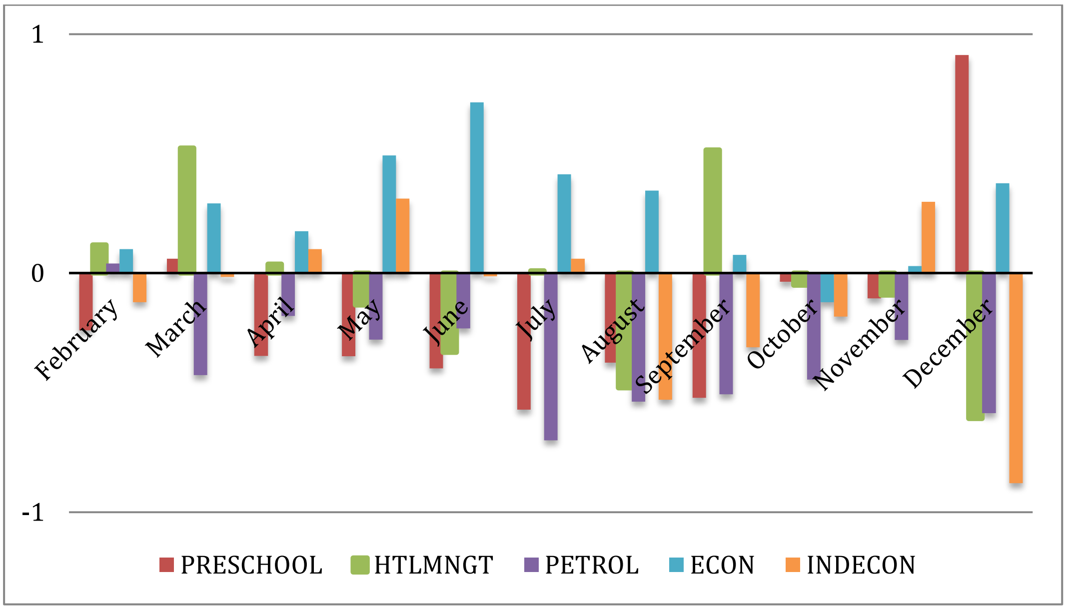
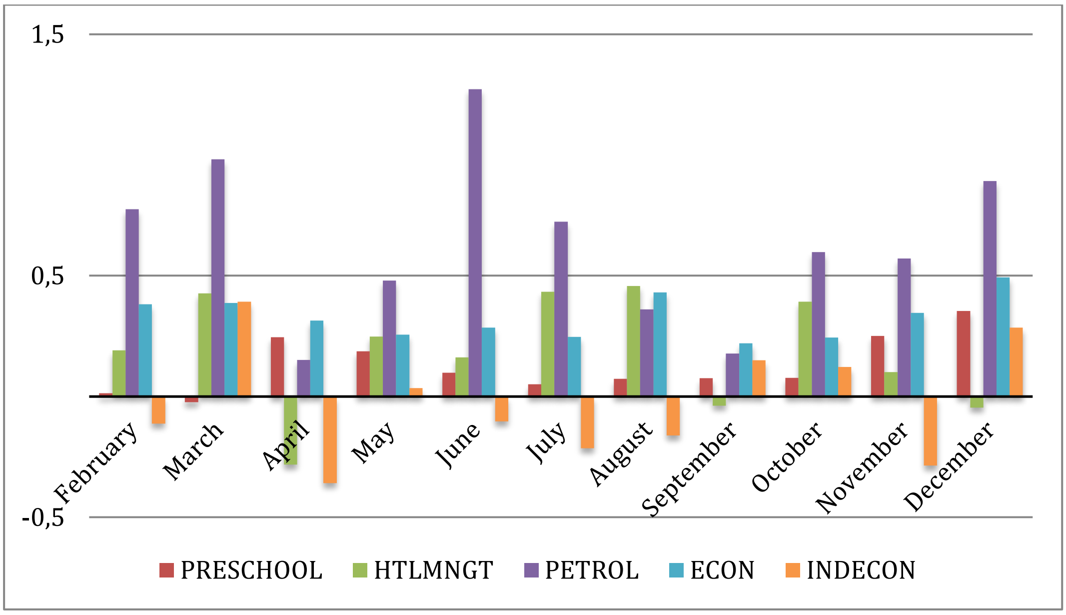



**Figure 14: Model 4 coefficients, female**



## 6.4 Results by age groups

The results from model 4 indicates that the male preschool teacher-, petroleum- and industrial economics-students benefit most from being born early in the year. As explained in empirical strategy the effect could tend to fade away as the students get older. To see if there is a tendency of the birth month effect weakens as the students get older, we are going to run model 4 only for the male students on the mentioned study programs, and split the results by age groups. Table 20 is a summary of the unstandardized beta coefficients and significance from tables presented in its full version in appendix I.

As depicted in table 20 these results are not very significant, but give us some indications, as illustrated in figures 15-17. The petroleum technology gives an indication of the birth month effect to weaken as the student gets older. For these students it is significant on a five percent level for every month, except August, that the January-born from 18-23 years achieve the best academic results. We see from the age at exam-variable for the same students the coefficient is negative (but insignificant), indicating the youngest students in the age interval 18-23 performing best. For the 1230 individuals in the age interval 24-29, the oldest students are getting better grades than the youngest. In the last age interval, 30-37, it has turned again with the youngest students performing best. Becoming a year older in this group has a huge impact on the exam grade.

For the industrial economy students the age at exam-variable is negative for the first two age intervals, and positive for the last. This implies getting older is negative in regards of academic performance up till 29 years old, but after the students passes 30 it is actually beneficial for exam grades. The coefficient is though small, insignificant, have a high standard error, and only for 105 observations so it is not very trustworthy.

**Table 20: Birth month effects for chosen study programs and age groups**

| | *PRESCHOOL* | | | *PETROL* | | | *INDECON* | | |
|---|---|---|---|---|---|---|---|---|---|
| | *18-23* | *24-29* | *30+* | *18-23* | *24-29* | *30+* | *18-23* | *24-29* | *30+* |
| (Constant) | 1.023 | 7.677*** | 3.758 | 5.79*** | 2.825*** | 2.238 | 6.174*** | 4.241*** | 1.597 |
| February | -1.082** | -0.156 | | -0.362** | 0.338 | 0.984 | -0.069 | -0.101 | -0.89 |
| March | 0.031 | -0.097 | 0.499 | -0.653*** | -0.468** | 1.069* | -0.159 | 0.362* | -2.564** |
| April | 0.359 | -0.894*** | -0.675* | -0.501*** | -0.016 | 1.896** | -0.109 | 0.486* | 0.315 |
| May | -0.236 | -0.36 | -0.481 | -0.558*** | -0.131 | 0.57 | -0.07 | 0.026 | 0.573 |
| June | -0.282 | -0.951* | | -0.415** | -0.415** | 1.119* | 0.154 | -0.066 | -0.236 |
| July | -0.337 | -0.59** | -2.048*** | -1.182*** | -0.425** | 1.647** | 0.017 | -0.228 | |
| August | -0.118 | -0.915*** | 0.651 | -0.229 | -0.956*** | -1.026* | -0.37 | -0.481* | -0.236 |
| September | -0.598* | -1.011*** | -0.085 | -0.704*** | -0.662*** | 1.043* | -0.574*** | 0.337 | 0.709 |
| October | -0.499 | 0.123 | 0.487 | -0.728*** | -0.466* | 0.782 | -0.171 | -0.057 | -1.631** |
| November | 0.206 | -0.103 | -1.386 | -0.754*** | 0.155 | 1.404** | 0.299* | 0.446** | -0.236 |
| December | 1.16* | | | -0.829*** | -0.731*** | 1.277** | -0.717*** | -1.143*** | 0.764 |
| | | | | | | | | | |
| Std.error birth months | 0.3843 | 0.3333 | 0.5891 | 0.1727 | 0.2135 | 0.6445 | 0.1724 | 0.2574 | 1.0816 |
| Age at exam | 0.059 | -0.183*** | -0.012 | -0.159 | 0.362* | -2.564** | -0.104*** | -0.037 | 0.055 |
| | (0.064) | (0.053) | (0.104) | (0.026) | (0.029) | (0.048) | (0.025) | (0.039) | (0.136) |
| Mean grade | 2.25 | 2.56 | 3.13 | 3.06 | 2.38 | 2.47 | 3.83 | 3.29 | 3.33 |
| Std. Dev. Grade | 1.272 | 1.293 | 1.299 | 1.427 | 1.546 | 1.546 | 1.129 | 1.371 | 1.298 |
| | | | | | | | | | |
| Observations | 409 | 318 | 99 | 1996 | 1230 | 298 | 1099 | 597 | 105 |
| $R^2$ | 0.074 | 0.135 | 0.24 | 0.038 | 0.054 | 0.199 | 0.076 | 0.12 | 0.328 |

Notes: Selecting only cases for which Study programs = PRESCHOOL, PETROL, INDECON. Reported standard error is approximately constant across birth month coefficients. For other variables they are reported in parenthesis. *, ** and *** significance at the 10, 5, and 1 % levels, respectively

**Figure 15: Coefficients from table 20, preschool teacher students**

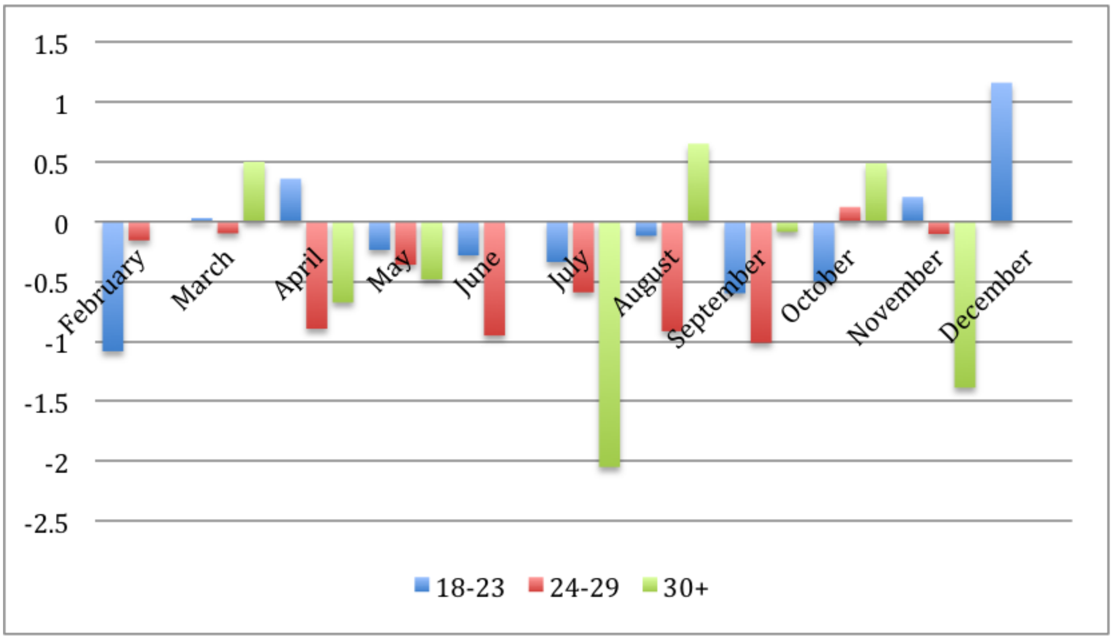



**Figure 16: Coefficients from table 20, petroleum technology students**

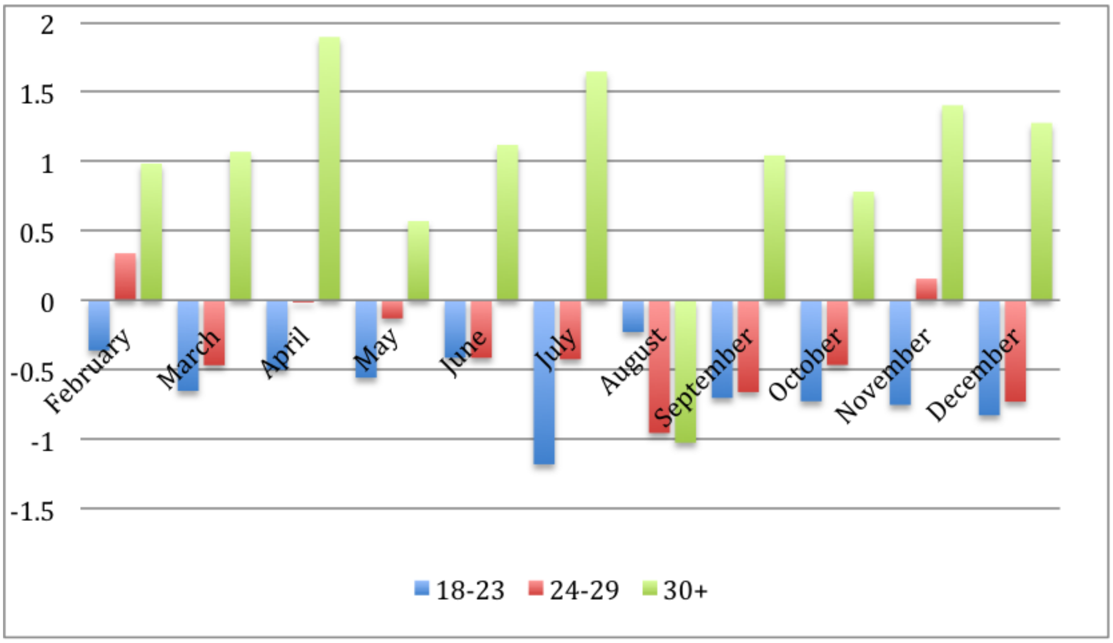


**Figure 17: Coefficients from table 20, industrial economy students**

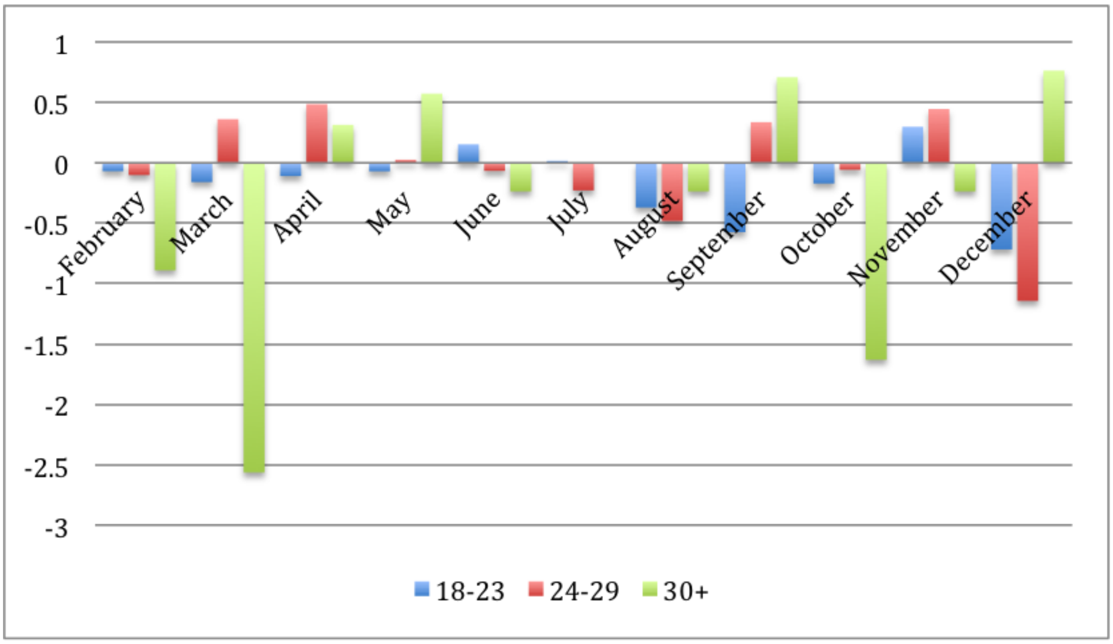



Figure 15 illustrates the standardized beta coefficients for the male preschool teacher students, and is divided into three age groups. There is a small birth effect for the first two age groups, but we actually see it best for the students between 24-29 years. For the students over 30 years we see no pattern. The petroleum technology students, depicted in figure 16, show a pattern for the students born early in the year in the age interval 18-23 performing best. We see the same tendency for the group from 24-29, though the effect has faded a bit away. For the students between 30-37 years there is no longer an effect of being born early in the year and achieving good grades.

Figure 17 illustrates the coefficients for the industrial economy students. Here the students born early in the year in the age group 18-23, does it better than the students born after the summer holidays. We see a tendency of the same pattern for the students between 24-29 years old, but for the industrial economy students over 30 years there is actually no systematic or significant pattern of when you are born and the exam grades.

# 7. Discussion

As discussed throughout this thesis, our primary objective is to estimate potential relative age effects among a sample of UiS-students, using birth month as an instrument for differences in age within a class. The results from chapter 6 imply that we are not able to see any trends that indicate the existence of any birth month effect at UiS when testing the whole sample simultaneously. After dividing the sample into different subsamples, like gender and study program, we find a pattern suggesting a weak presence of birth month effects among male students, and then especially petroleum technology students, and a small effect for male preschool teacher- and industrial economy-students.

The evidence presented differs somewhat from what many other researchers have found when focusing on birth month effects. As earlier described in the existing evidence chapter, Bedard and Dhuey (2006) found that older pupils typically outperform the younger pupils among $8^{th}$ graders. Our results indicate that the late-born students in our sample have equalized some of the potential benefits of being born early, making it difficult to find any significant patterns. In this section we will discuss potential explanations for why our results vary from other similar studies.

First we will consider if the Norwegian educational system may have had an influence on our results. Bedard and Dhuey (2006) found robust effects for almost every country they examined, but were not able to find significant relative age effects for children in Denmark and Finland. Bedard and Dhuey explain the absence of relative age effects on $8^{th}$ graders in Denmark and Finland by pointing to the educational systems. In Finland, children enroll into school at the age of 7 and the focus is on play and personal development rather than a formal curriculum through the initial grades. In Denmark children start at school the year they turn six, and differentiation of students based on ability is not present until the age of 16 (OFSTED, 2003). Bedard and Dhuey suggest that relative age effects might be less present in countries with educational system similar to these. The Norwegian educational system is most definitely quite similar to at least Denmark; therefore it might not be surprising that we fail to find any clear pattern of birth month effects. Even though they use "assigned relative age"[6] in their research, where we use birth months, the comparison is still valid. The educational features in Norway may benefit less talented students because of the presence of more talented classmates. The delay of tracking students after ability may be an efficient educational feature, which leads to less difference between the pupils born early and late in the year. These educational features do not rule out the presence of birth month effects, but it is a possible explanation to why we are only able to find some weak patterns among boys.

As earlier discussed the students in our dataset have been through extensive selection processes. We argue that the relationship between birth months and academic performance found in this study could be due to the selection processes. Our findings could represent an underrepresentation of late-born students and an overrepresentation of early-born students, where the late-born students who are accepted for higher education may be more talented than their early-born peers. It has also been argued this selection process is not only driven by the difference in academic performance between early and late-born students, social factors might also have an impact. Crawford, Dearden and Greaves (2011) find that late-born children are more likely to be unhappy or subject to bullying in primary school. If what they experience in the early stages of life affects their self-esteem, ambitions and the child's social development this might have an effect on their willingness to apply for higher education. Thus, the late-born students that are accepted for higher education might be top motivated, and thereby manage to equalize some of the advantage the early-born students have.

When it comes to gender our results from model 3 indicates that males and females within our dataset have a significantly different birth month pattern with respect to academic performance. Our results from model 2 seem to produce a mixed effect (Simpson's paradox) of both genders, which we are able to control for when separating the genders in model 3. We are now able to see some pattern among male students. Where the two last quarters perform significantly weaker, these findings are consistent with empirical evidence found by Elder and Lubotsky (2007) and Cascio and Schanzenbach (2007), they suggest that the effect is stronger for boys. We believe

[6] Assigned relative age refers to the relative age at which a child should be observed, based on their birth date relative to the school cut-off date.

that this might be a reflection of differences across gender regarding social development. The late-born boys suffer more from being immature and less confident at early stages, making the effect last longer. On the other hand, it does not seem to be the case for girls, when enrolling into universities they may have equalized this relationship.

Our results from model 4 indicate some differences between the study programs and gender, again we were able to see a pattern that indicates stronger birth month effects for male students. By stronger birth month effects, we refer to the alleged advantage of being born early in the year. That the results coincide with the results from model 3 is as expected, but we are now able to draw some different conclusion based on study programs. Among the students attending to preschool teacher, hotel management or petroleum technology there is a pattern indicating that the male students benefit from being born in January or within the first quarter. Though the effects appears to be opposite for the females students within these three study programs. For the female preschool teacher students the pattern indicates a disadvantage of being born within the first quarter, and for the female students attending to hotel management or petroleum technology the coefficients are mainly positive indicating a disadvantage of being born in January.

When looking at the output from regressions run on the business students we see, at least for boys, that the pattern differs from the earlier discussed study programs. The analyses indicate that neither the male nor the female business students benefits from being born in January. A potential explanation for this is that the very best students choose not to apply for higher education at UiS. They would probably prefer schools such as NHH, BI or Copenhagen Business School, while schools in bigger cities like Trondheim and Oslo, are also likely to offer more popular business studies than Stavanger. In Norway there is also over 20 different higher education institutions offering a bachelors program in business and administration (Samordna Opptak). Referring to earlier studies the very best students are likely to be born in the early months of the year, there might be an under-representation of good early-born students within the business study program. Even though we believe that the last selection process where a student decides where to apply for higher education will only have a minor effect on our birth month estimates, if any effect at all, it seems like a possible explanation that there is a under-representation of good January students in our selected sample of business students.

From the last study program, industrial economics, we see that the male students do not exert any clear pattern, but we note us large, negative and significant at the 1% level coefficients for August and October. This is also the conclusion for the female students, no clear pattern and very few significant coefficients. Industrial economics is the study program at UiS with the highest admission requirements, indicating that only high-leveled students enter. The lack of any pattern within this study program might be due to composition of students. Attracting only high-level students will probably make it hard for us to find any patterns over birth months.

This study differs from many others within the same topic, as we do not merge observed age and birth month into one coefficient. Our study is based on the hypothesis that being the relative oldest student within class at early stages could give advantages throughout life, where we use the birth months as an instrument for relative age. There could be a lot of noise in our data, because of the varying age of students taking the same exam. The relative age effect might dissipate with age or the older students may have a significantly different birth month pattern with respect to academic performance, and thereby it is possible that our oldest students complicate our study. When we split some selected study programs from our dataset into different age intervals, it is possible to see a pattern that indicates birth month effects in our dataset. The tendency is that birth month effects fade away with age, even though the patterns are not very significant. These findings are consistent with previous research done by Bedard and Dhuey (2006) and others, where they show that initial relative age effects reduce its magnitude with age. However, the pattern of our oldest peers not performing better by being born early in the year, could again be a result of some selection. The youngest students in our sample are coming directly from upper secondary school with bright minds, and being more alike each other relative to the oldest students in the sample. The oldest students have multiple reasons to enroll at the university, for instance returning to school after years in the work force, taking single courses, and then try to balance studies with work and family commitments. These differences between the age groups are making the results from the subsample analysis harder to interpret.

There is a trend of actual age having a negative effect on academic performance. From the age at exam-variable in model 4 every study program has a negative coefficient, both for the male and female students, except for those studying to become preschool teachers. This means that every student, except the preschool teacher students, is worse off becoming a year older and then getting lower grades. The age at exam-coefficients for both male and female preschool teacher students in table 19 are positive, indicating these students benefits from having an actual higher age at the exam time leads to better exam grades. This can be explained by the preschool teacher students are the study program with the largest sample of students between 30 and 37 years old. Combining this explanation with the fact that there is over 90 percent of females in this study program, there is a larger possibility of these students either being parents or at least have some kind of family relationship with young kids compared to students being in their early 20s. One of the courses in their curriculum is “Children’s development, play and teaching” (University of Stavanger), and being older with higher possibility of having raised a child would then lead to an advantage in courses like these. The pattern for preschool teacher students getting better exam grades as they get older is also showed in table 20, after dividing the male students into three age groups we see the mean grade increases from 2,25 to 3,13 from the youngest to oldest age group.

Our results are probably not representative for Norwegian students, and may not either be representative for UiS students because of our selected sample. Even though the UiS students are more frequently born in the first four months of the year relative to the Norwegian population, which could be an indication for birth month effects to exist, we are not able to find any clear evidence of birth month effects among the whole sample. Another indication suggesting less difference between early and late born students could be the birth month distribution at similar education institutions like NHH and NTNU. The study programs we compared from NHH and NTNU are the study programs with the highest admission requirements in Norway within their subjects. If birth month effects are present at university level in Norway, then we should find a pattern of overrepresentation for the first birth months. We find no clear overrepresentation of students being born early in the year at NHH or NTNU. This could indicate potential birth month effects being hard to find at universities, and the effects are equalized with age.

# 8. Conclusion

There is a lot of existing literature on the subject of relative age effects, and findings suggest that being born early in the year benefits both school and sports performances, especially during early stages of life. If being some months older makes you more mature, and this has a positive effect on learning, the oldest in class have an advantage compared to the younger peers. In this thesis we explore birth month effects on academic performance using data from five different study programs at the University of Stavanger.

Although one might expect that some months of relative maturity have an impact on performance during the primary grades, it is less clear how significant this might be at older ages. The magnitude might be dependent of several conditions such as the interaction between the educational structure and relative age, to what extent human capital accumulated in early ages is representative for later human capital accumulation, and the amount of effort teachers and young students exert to equalize the relationship between the young students and their older peers.

We were not able to see any trends that indicate the existence of any birth month effect at UiS when testing the whole sample simultaneously. If anything, we see a pattern with almost only positive coefficients where January represents the base category. Even though the results are suggesting a disadvantage of being born in January, the coefficients are quite small making it hard for us to draw a conclusion based on these results. However, when conducting analyses for males and females separately, the results suggest some pattern of birth month effects among male students at university level. Male students benefits from being born within the two first quarters of the year, while the female students seems to suffer from being born in January. The results from our first analysis seem to produce a mixed effect of both genders, which we are able to control for when separating the genders.

That birth month effects are more pronounced among male students are consistent with previous findings by Elder and Lubotsky (2007) and Cascio and Schanzenbach (2007). We believe that these differences stem from being relatively younger at early life, reflecting differences regarding social development. The late-born boys may suffer from being more immature and less confident at early stages in life and have not been able to equalize these effects, making the relative age effects to last longer. On the other hand, this does not seem to be the case for girls, when enrolling into universities they may have equalized this relationship.

When examining our results closely, and running regressions for each study program separately, we again see the effect being more pronounced among males. For the male students attending the study programs preschool teacher, hotel management or petroleum technology we find a pattern suggesting that it is beneficial to be born in January, or early in the year. The female students at these study programs seem to have opposite patterns compared with the males, with a disadvantage of being born in January. Further analysis indicates that neither the male nor the female business students benefits from being born in January. An explanation for this could be that there is an underrepresentation of good January-students within the business program at UiS; they could be enrolled into one of the many other universities offering bachelors in business and administration. For the last study program, the industrial economy students, we are not being able to find any clear pattern between birth month and exam grade.

For the three study programs where we found some pattern indicating birth month effects among male students, we carried out subsample analysis by splitting the data into three age intervals. These analyses indicate that the magnitude of the effect seem to weaken as the students get older. This is somehow consistent with previous literature, but our findings may not be comparable with this literature. Our sample has an age difference on 19 years from the oldest to the youngest, making the results hard to interpret. The youngest students could be more streamlined coming directly from upper secondary school, but it could be multiple reasons for why the oldest students are enrolled at the university. They could for instance have returned to school after years in the work force, or maybe struggling to complete their studies.

Even though our results suggest a pattern of birth month effects for male students enrolled at UiS, we do not find a clear significant birth month pattern for the whole sample. This could be true for our study, but the results are most likely not universal for every educational institution, and maybe not either for UiS. Since our measure might not capture the true birth month effect for the student population of Norway, it would be interesting to compare Norwegian higher education institutions against each other to look for patterns between different universities. It would also be of interest to control for all fixed unobservable background characteristics that possibly generate a birth month effect. Data containing both exam grades and background characteristics could be hard to obtain since the universities do not hold this information. An alternative could be collecting own data, like doing a survey, but then there is a larger potential for errors, with the respondents raising their exam grades. By studying this more thorough, one will be able to find a more representative conclusion regarding the relative age effects among Norwegian university students.

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# Appendix

## I. Age levels, full regression results

*Coefficients*[a,b,c]

| | | | *Age_levels* | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *18-23* | | | | | *24-29* | | | | | *30+* | | | | |
| Gender | Study-Program | | *Unstandardized Coefficients* | | *Standardized Coefficients* | *t* | *Sig.* | *Unstandardized Coefficients* | | *Standardized Coefficients* | *t* | *Sig.* | *Unstandardized Coefficients* | | *Standardized Coefficients* | *t* | *Sig.* |
| | | | *B* | *Std. Error* | *Beta* | | | *B* | *Std. Error* | *Beta* | | | *B* | *Std. Error* | *Beta* | | |
| Male | PRE-SCHOOL | (Constant) | 1.023 | 1.4 | | 0.731 | 0.465 | 7.677 | 1.349 | | 5.69 | 0 | 3.758 | 3.452 | | 1.089 | 0.279 |
| | | February | -1.082 | 0.457 | -0.125 | -2.369 | 0.018 | -0.156 | 0.31 | -0.035 | -0.505 | 0.614 | | | | | |
| | | March | 0.031 | 0.269 | 0.008 | 0.117 | 0.907 | -0.097 | 0.355 | -0.017 | -0.272 | 0.786 | 0.499 | 0.407 | 0.135 | 1.227 | 0.223 |
| | | April | 0.359 | 0.243 | 0.106 | 1.478 | 0.14 | -0.894 | 0.288 | -0.237 | -3.104 | 0.002 | -0.675 | 0.376 | -0.206 | -1.797 | 0.076 |
| | | May | -0.236 | 0.287 | -0.051 | -0.825 | 0.41 | -0.36 | 0.313 | -0.078 | -1.148 | 0.252 | -0.481 | 0.529 | -0.112 | -0.91 | 0.365 |
| | | June | -0.282 | 0.899 | -0.015 | -0.313 | 0.754 | -0.951 | 0.544 | -0.1 | -1.748 | 0.081 | | | | | |
| | | July | -0.337 | 0.265 | -0.085 | -1.272 | 0.204 | -0.59 | 0.287 | -0.146 | -2.056 | 0.041 | -2.048 | 0.614 | -0.378 | -3.334 | 0.001 |
| | | August | -0.118 | 0.271 | -0.029 | -0.436 | 0.663 | -0.915 | 0.291 | -0.225 | -3.141 | 0.002 | 0.651 | 0.872 | 0.071 | 0.747 | 0.457 |
| | | September | -0.598 | 0.311 | -0.119 | -1.925 | 0.055 | -1.011 | 0.312 | -0.222 | -3.236 | 0.001 | -0.085 | 0.444 | -0.023 | -0.191 | 0.849 |
| | | October | -0.499 | 0.322 | -0.092 | -1.551 | 0.122 | 0.123 | 0.287 | 0.031 | 0.428 | 0.669 | 0.487 | 0.538 | 0.09 | 0.905 | 0.368 |
| | | November | 0.206 | 0.25 | 0.057 | 0.823 | 0.411 | -0.103 | 0.346 | -0.02 | -0.299 | 0.765 | -1.386 | 0.933 | -0.151 | -1.486 | 0.141 |
| | | December | 1.16 | 0.653 | 0.09 | 1.777 | 0.076 | | | | | | | | | | |
| | | Age at exam | 0.059 | 0.064 | 0.046 | 0.91 | 0.363 | -0.183 | 0.053 | -0.219 | -3.465 | 0.001 | -0.012 | 0.104 | -0.015 | -0.12 | 0.905 |
| | PETROL | (Constant) | 5.79 | 0.573 | | 10.109 | 0 | 2.825 | 0.741 | | 3.814 | 0 | 2.238 | 1.774 | | 1.262 | 0.208 |
| | | February | -0.362 | 0.176 | -0.064 | -2.056 | 0.04 | 0.338 | 0.233 | 0.053 | 1.449 | 0.148 | 0.984 | 0.621 | 0.242 | 1.583 | 0.115 |
| | | March | -0.653 | 0.151 | -0.166 | -4.339 | 0 | -0.468 | 0.183 | -0.109 | -2.552 | 0.011 | 1.069 | 0.597 | 0.208 | 1.791 | 0.074 |
| | | April | -0.501 | 0.151 | -0.125 | -3.308 | 0.001 | -0.016 | 0.202 | -0.003 | -0.078 | 0.938 | 1.896 | 0.8 | 0.186 | 2.369 | 0.019 |
| | | May | -0.558 | 0.19 | -0.086 | -2.938 | 0.003 | -0.131 | 0.224 | -0.021 | -0.583 | 0.56 | 0.57 | 0.663 | 0.081 | 0.86 | 0.391 |
| | | June | -0.415 | 0.169 | -0.079 | -2.45 | 0.014 | -0.415 | 0.209 | -0.073 | -1.983 | 0.048 | 1.119 | 0.583 | 0.242 | 1.917 | 0.056 |
| | | July | -1.182 | 0.208 | -0.156 | -5.682 | 0 | -0.425 | 0.214 | -0.072 | -1.991 | 0.047 | 1.647 | 0.736 | 0.172 | 2.239 | 0.026 |
| | | August | -0.229 | 0.169 | -0.044 | -1.355 | 0.175 | -0.956 | 0.215 | -0.169 | -4.445 | 0 | -1.026 | 0.609 | -0.2 | -1.685 | 0.093 |
| | | September | -0.704 | 0.17 | -0.133 | -4.145 | 0 | -0.662 | 0.2 | -0.128 | -3.311 | 0.001 | 1.043 | 0.6 | 0.24 | 1.737 | 0.083 |
| | | October | -0.728 | 0.16 | -0.158 | -4.557 | 0 | -0.466 | 0.244 | -0.064 | -1.91 | 0.056 | 0.782 | 0.629 | 0.132 | 1.242 | 0.215 |
| | | November | -0.754 | 0.168 | -0.145 | -4.476 | 0 | 0.155 | 0.215 | 0.026 | 0.719 | 0.472 | 1.404 | 0.657 | 0.192 | 2.138 | 0.033 |
| | | December | -0.829 | 0.188 | -0.129 | -4.407 | 0 | -0.731 | 0.209 | -0.129 | -3.498 | 0 | 1.277 | 0.594 | 0.252 | 2.149 | 0.032 |
| | | Age at exam | -0.102 | 0.026 | -0.087 | -3.887 | 0 | -0.004 | 0.029 | -0.004 | -0.14 | 0.888 | -0.019 | 0.048 | -0.028 | -0.394 | 0.694 |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Constant) | 6.174 | 0.542 | | 11.381 | 0 | 4.241 | 0.992 | | 4.277 | 0 | 1.597 | 4.922 | | 0.324 | 0.746 |
| | February | -0.069 | 0.151 | -0.02 | -0.461 | 0.645 | -0.101 | 0.235 | -0.02 | -0.431 | 0.667 | -0.89 | 0.76 | -0.265 | -1.17 | 0.245 |
| | March | -0.159 | 0.155 | -0.042 | -1.022 | 0.307 | 0.362 | 0.216 | 0.078 | 1.677 | 0.094 | -2.564 | 1.165 | -0.193 | -2.201 | 0.03 |
| | April | -0.109 | 0.174 | -0.024 | -0.628 | 0.53 | 0.486 | 0.281 | 0.075 | 1.73 | 0.084 | 0.315 | 0.729 | 0.068 | 0.433 | 0.666 |
| | May | -0.07 | 0.185 | -0.014 | -0.375 | 0.707 | 0.026 | 0.32 | 0.003 | 0.08 | 0.936 | 0.573 | 0.718 | 0.22 | 0.798 | 0.427 |
| | June | 0.154 | 0.189 | 0.029 | 0.815 | 0.415 | -0.066 | 0.222 | -0.014 | -0.299 | 0.765 | -0.236 | 1.02 | -0.039 | -0.231 | 0.818 |
| INDECON | July | 0.017 | 0.143 | 0.005 | 0.12 | 0.905 | -0.228 | 0.371 | -0.025 | -0.613 | 0.54 | | | | | |
| | August | -0.37 | 0.255 | -0.047 | -1.45 | 0.147 | -0.481 | 0.272 | -0.077 | -1.771 | 0.077 | -0.236 | 1.433 | -0.018 | -0.165 | 0.87 |
| | September | -0.574 | 0.183 | -0.116 | -3.133 | 0.002 | 0.337 | 0.287 | 0.05 | 1.172 | 0.242 | 0.709 | 1.358 | 0.053 | 0.522 | 0.603 |
| | October | -0.171 | 0.15 | -0.049 | -1.146 | 0.252 | -0.057 | 0.231 | -0.011 | -0.245 | 0.806 | -1.631 | 0.767 | -0.315 | -2.126 | 0.036 |
| | November | 0.299 | 0.152 | 0.082 | 1.962 | 0.05 | 0.446 | 0.178 | 0.13 | 2.504 | 0.013 | -0.236 | 1.433 | -0.018 | -0.165 | 0.87 |
| | December | -0.717 | 0.159 | -0.182 | -4.522 | 0 | -1.143 | 0.218 | -0.249 | -5.245 | 0 | 0.764 | 1.433 | 0.057 | 0.533 | 0.595 |
| | Age at exam | -0.104 | 0.025 | -0.124 | -4.141 | 0 | -0.037 | 0.039 | -0.04 | -0.958 | 0.338 | 0.055 | 0.136 | 0.08 | 0.402 | 0.689 |

a. Dependent Variable: Grade

b. Selecting only cases for which StudyProgram= PRESCHOOL, PETROL, INDECON, and gender = male

c. There are no valid cases in one or more split files. Statistics cannot be computed.

*Model Summary*[b]

| Gender | Age_levels | StudyProgram | Model | *R* *Programs = 1.00 (Selected)* | *R Square* | *Adjusted R Square* | *Std. Error of the Estimate* |
|---|---|---|---|---|---|---|---|
| | | PRESCHOOL | 1 | .272[a] | .074 | .046 | 1.242 |
| | 18-23 | PETROL | 1 | .195[c] | .038 | .032 | 1.404 |
| | | INDECON | 1 | .275[d] | .076 | .066 | 1.092 |
| | | PRESCHOOL | 1 | .367[e] | .135 | .103 | 1.225 |
| Male | 24-29 | PETROL | 1 | .231[f] | .054 | .044 | 1.512 |
| | | INDECON | 1 | .347[g] | .120 | .102 | 1.299 |
| | | PRESCHOOL | 1 | .490[h] | .240 | .163 | 1.188 |
| | 30+ | PETROL | 1 | .446[i] | .199 | .165 | 1.413 |
| | | INDECON | 1 | .573[j] | .328 | .249 | 1.125 |

a. Predictors: (Constant), Age at exam, March, June, February, December, May, October, July, September, August, November, April

b. There are no valid cases in one or more split files. Statistics cannot be computed.

c. Predictors: (Constant), Age at exam, March, July, December, September, May, February, June, August, November, October, April

d. Predictors: (Constant), Age at exam, April, August, June, May, December, September, March, November, February, October, July

e. Predictors: (Constant), Age at exam, October, May, June, March, July, February, November, September, August, April

f. Predictors: (Constant), Age at exam, September, October, May, December, November, July, June, February, April, August, March

g. Predictors: (Constant), Age at exam, July, October, May, September, August, February, April, March, June, December, November

h. Predictors: (Constant), Age at exam, April, August, November, March, October, July, September, May

i. Predictors: (Constant), Age at exam, August, May, July, October, November, April, March, September, December, June, February

j. Predictors: (Constant), Age at exam, April, September, October, December, November, August, March, June, February, May

*Descriptive Statistics*[a]

| Gender | StudyProgram | | *Age_levels* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | *18-23* | | | *24-29* | | | *30+* | | |
| | | | *Mean* | *Std. Deviation* | *N* | *Mean* | *Std. Deviation* | *N* | *Mean* | *Std. Deviation* | *N* |
| Male | PRE-SCHOOL | Grade | 2.25 | 1.272 | 409 | 2.56 | 1.293 | 318 | 3.13 | 1.299 | 99 |
| | | February | 0.02 | 0.147 | 409 | 0.09 | 0.288 | 318 | 0.26 | 0.442 | 99 |
| | | March | 0.11 | 0.31 | 409 | 0.06 | 0.231 | 318 | 0.14 | 0.35 | 99 |
| | | April | 0.17 | 0.377 | 409 | 0.14 | 0.342 | 318 | 0.19 | 0.396 | 99 |
| | | May | 0.08 | 0.276 | 409 | 0.08 | 0.279 | 318 | 0.1 | 0.303 | 99 |
| | | June | 0 | 0.07 | 409 | 0.02 | 0.136 | 318 | 0 | 0 | 99 |
| | | July | 0.12 | 0.322 | 409 | 0.12 | 0.321 | 318 | 0.06 | 0.24 | 99 |
| | | August | 0.11 | 0.31 | 409 | 0.11 | 0.317 | 318 | 0.02 | 0.141 | 99 |
| | | September | 0.07 | 0.253 | 409 | 0.09 | 0.284 | 318 | 0.14 | 0.35 | 99 |
| | | October | 0.06 | 0.235 | 409 | 0.12 | 0.321 | 318 | 0.06 | 0.24 | 99 |
| | | November | 0.15 | 0.354 | 409 | 0.07 | 0.249 | 318 | 0.02 | 0.141 | 99 |
| | | December | 0.01 | 0.099 | 409 | 0 | 0 | 318 | 0 | 0 | 99 |
| | | Age at exam | 21.95 | 1.001 | 409 | 25.52 | 1.55 | 318 | 32.04 | 1.558 | 99 |
| | PETROL | Grade | 3.06 | 1.427 | 1996 | 2.38 | 1.546 | 1230 | 2.47 | 1.546 | 298 |
| | | February | 0.07 | 0.251 | 1996 | 0.06 | 0.244 | 1230 | 0.17 | 0.38 | 298 |
| | | March | 0.15 | 0.362 | 1996 | 0.15 | 0.359 | 1230 | 0.1 | 0.301 | 298 |
| | | April | 0.15 | 0.356 | 1996 | 0.09 | 0.291 | 1230 | 0.02 | 0.152 | 298 |
| | | May | 0.05 | 0.219 | 1996 | 0.07 | 0.247 | 1230 | 0.05 | 0.219 | 298 |
| | | June | 0.08 | 0.272 | 1996 | 0.08 | 0.271 | 1230 | 0.13 | 0.334 | 298 |
| | | July | 0.04 | 0.188 | 1996 | 0.07 | 0.262 | 1230 | 0.03 | 0.162 | 298 |
| | | August | 0.08 | 0.272 | 1996 | 0.08 | 0.273 | 1230 | 0.1 | 0.301 | 298 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | September | 0.08 | 0.269 | 1996 | 0.1 | 0.298 | 1230 | 0.15 | 0.355 | 298 |
| | October | 0.11 | 0.309 | 1996 | 0.05 | 0.214 | 1230 | 0.07 | 0.262 | 298 |
| | November | 0.08 | 0.275 | 1996 | 0.07 | 0.259 | 1230 | 0.05 | 0.212 | 298 |
| | December | 0.05 | 0.222 | 1996 | 0.08 | 0.273 | 1230 | 0.1 | 0.306 | 298 |
| | Age at exam | 21.33 | 1.227 | 1996 | 25.92 | 1.605 | 1230 | 32.81 | 2.34 | 298 |
| | Grade | 3.83 | 1.129 | 1099 | 3.29 | 1.371 | 597 | 3.33 | 1.298 | 105 |
| | February | 0.11 | 0.318 | 1099 | 0.08 | 0.264 | 597 | 0.18 | 0.387 | 105 |
| | March | 0.1 | 0.298 | 1099 | 0.1 | 0.296 | 597 | 0.01 | 0.098 | 105 |
| | April | 0.06 | 0.243 | 1099 | 0.05 | 0.212 | 597 | 0.09 | 0.281 | 105 |
| | May | 0.05 | 0.222 | 1099 | 0.03 | 0.18 | 597 | 0.44 | 0.499 | 105 |
| | June | 0.05 | 0.214 | 1099 | 0.09 | 0.289 | 597 | 0.05 | 0.214 | 105 |
| INDECON | July | 0.15 | 0.356 | 1099 | 0.02 | 0.151 | 597 | 0 | 0 | 105 |
| | August | 0.02 | 0.143 | 1099 | 0.05 | 0.219 | 597 | 0.01 | 0.098 | 105 |
| | September | 0.05 | 0.227 | 1099 | 0.04 | 0.204 | 597 | 0.01 | 0.098 | 105 |
| | October | 0.12 | 0.325 | 1099 | 0.08 | 0.27 | 597 | 0.07 | 0.251 | 105 |
| | November | 0.11 | 0.311 | 1099 | 0.2 | 0.399 | 597 | 0.01 | 0.098 | 105 |
| | December | 0.09 | 0.286 | 1099 | 0.1 | 0.299 | 597 | 0.01 | 0.098 | 105 |
| | Age at exam | 21.34 | 1.338 | 1099 | 25.43 | 1.462 | 597 | 32.1 | 1.901 | 105 |

a. Selecting only cases for which StudyPrograms =  PRESCHOOL, PETROL, INDECON, and gender = male