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Special
Data Science and Football

>> **Special**
Modern Art of Marketing

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Brink

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Dynamic Asset Allocation

ASSET Econometrics

On February 7 over 800 econometricians attended the LED 2019.
Read more about it on page 20!

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Eating Easter Eggs

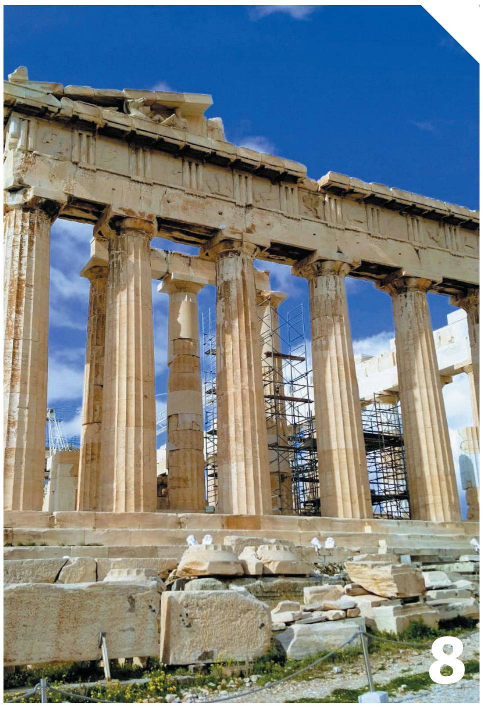
At the moment this issue of Nekst falls onto your doorstep, Easter lays just behind us and most likely, the sun is able to gently kiss your skin again as soon as you walk out the door. (If not: bad for you.) As Easter is a holiday, of which the true meaning is too multi-layered to elaborate on in my new smaller text box, I would just like to invite you to read this Nekst the way you eat chocolate Easter eggs. Some only like dark chocolate, others like crispy ones with nuts, salt and everything, whereas you would maybe simply eat the whole basket. A similar mindset is often found among Nekst readers: your most cherished econometrics buddy might be going crazy for interviews with teachers, whereas you yourself prefer reading a special and a practical report; and some diehards read everything.

For all kinds of readers, our editorial staff has prepared something nice. This edition contains three (!) specials! One is about the (in)effectiveness of advertisements and marketing campaigns and we have a piece about how mathematics and music are connected. Also, the triangle as well as our third special treat how econometrics can be used to evaluate sports performances.

Moreover, a report about a legendary lustrum trip and an introduction to the new members of Nekst's editorial staff can be found in this edition.
I wish you a wonderful read as always!

Yours cordially,

Dominique Bavelaar
Editor-in-Chief



COLOPHON

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ASSET Econometrics
The eighth wonder of the world

Dear Members,

When you are reading this, arguably the most beautiful season of the year has started: I am of course talking about spring. It is the time of the year during which the temperature gets comfortable again, the birds are singing and everything is turning green. But it is also a time for reflection leaving behind the winter in which much has happened. Our board year is well past halfway but it feels like we got the keys to this wonderful association yesterday. We have learned and laughed so much together.

All of this could not have been achieved if not for the great joy and mentality brought to us by my fellow board members: Wenxin, Jelle, Joris and Nina. Although I would love to spend another year with them we slowly are preparing the association for our successors. We are confident that they can ensure that the association can go to even greater heights.

Before this is happening, we do have a lot of activities. Think about the famous Active Members Weekend, the Astrics Cantus, the Freshmen activity (that is also open for second years), the Beer Games Drink and Brother and Sisters evening. But above all, we will, of course, have the Lustrum week in which we will celebrate together that Asset | Econometrics turned forty. It will be a mix of formal and informal events and it will be celebrated with both current members as alumni.

The pas few months, we experienced a lot. We started the year with the DMM in which we presented our progress on our policy and explained our future plans. Furthermore, over 140 members attended a very successful edition of the LED. Although one could arguably say that it can never beat LED 2018 as the greatest edition ever. I would love to tell you more about all our events, but the number of characters to which I am bound to forces me to keep it short. However, I do want to tell you at least a bit more about one other event that took place: the Lustrum Trip!

With 40 econometricians, we travelled from the Netherlands to Greece for a visit to Athens. Thinking of Greece, we expected lots of sun and beautiful beaches, but ironically, the weather was better at home in the Netherlands. However, none of this could spoil the fun. In just five days, we visited many highlights of Athens, went to karaoke bars, had a good party at a restaurant and enjoyed the view of the city. Many of you will also have celebrated another event that truly is part of studying in Brabant: Carnaval! I hope you all enjoyed it as much as we did.

We are looking forward to celebrate the forty years of Asset | Econometrics together with you during our Lustrum Week and wish you the best of luck in the upcoming months.

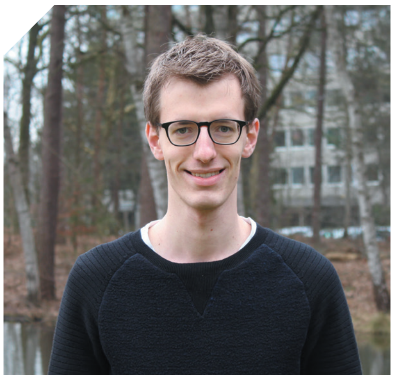
On behalf of the board,

Quirien Raat
Chairman Asset | Econometrics 2018-2019

New members!

Nekst Committee Spring 2018-2019

written by **Jeffrey Buijk**



Stefan ten Eikelder

PhD Candidate

Stefan is 25 years old and is currently in the first year of his PhD. He was born in Nuenen, which is a town near Eindhoven, but has been living in lodges since 2012. In the past he has been involved with the Nekst for a long time, both as Editor-in-Chief and Final Editor. He has also organized the Wie is de Mol Weekend last year. If Stefan would win 10 million euros in the lottery, he would travel and once possible buy a ticket for a space flight. When he was young, Stefan wanted to become an inventor, since he was inspired by Willie Wortel from the Donald Duck cartoons. In his spare time, Stefan likes to participate in pub quizzes, since he finds reading and hearing about all sorts of random facts interesting. Other hobbies of him are running and playing guitar.

Aurel Macias Minambres

Master QFAS

Aurel is a 25-year old Master student, who is born in Madrid, but has been living the rest of his live in Eindhoven. What he likes the most about our study is that many things do feel like a not-too-challenging puzzle. If he was able to join any TV show he wanted, he would join one where there is a lot of prize money to win. As a child, he wanted to do something with astronomics. Although it is something totally different from what he is doing currently, at least doing stuff with lots of data and large numbers is similar to what he initially wanted to do. His favorite food is pizza for the simple reason that it tastes good.

Jeffrey Buijk

Master EME

Jeffrey is a 22 years old master student, who is born in Roosendaal, but is currently living in lodges in Tilburg. Before he joined the Nekst committee, he was part of the Strategy Tour committee and the Education comittee. (Or also known as the Adtucation committee, because of the beer games) If he would be able to participate in a TV show, he would be part of "Wie is de Mol", since he would enjoy to try to mislead everyone by either being the mole or pretending to be the mole. When he was a child, his dream was to become a professional football player. His hobbies are therefore also sport related, namely running or watching sports, especially football and Formula 1.

Lucas Jacobs

Master QFAS

This 21-year old boy from Boxtel is currently on the first year of his master. As a true econometrician, he would invest his money in stocks and bonds if he would win 10 million euros in a lottery. If he would have to participate in a TV show, he would participate in "Hier zijn de van Rossems", partly because of the general lack of Dutch TV shows that he likes and partly because Maarten van Rossem is an amusing individual. His favorite food is spinach and "penne" with chicken and rasped cheese, because he likes the mix of vegetables, starch and meat, with the rasped cheese as finishing touch. His hobbies are athletics, music, history stuff and gaming, which also explains why he wanted to become a pro-gamer when he was a child.

Getting Insight into the World of Consultancy

Karlijn Koerts

Bachelor EOR

Age: 21

On February 21 we drove to Rotterdam together with students from both Maastricht and Tilburg. It was way too early in the morning to get dressed up, but luckily it got better when we received a delicious 'little' breakfast in our bus.

After a long drive, we arrived at the office of Pointlogic, where we first got some coffee and sweet yummy muffins. After that, received get a little tour through the company's office, where you could observe that all rooms in the company where named after a famous area or building in New York City. Even the Statue of Liberty was standing in central park, also known as the coffee corner. Here, I got a little flashback to my vacation of last summer and the many hours we walked to get to see the statue. I even felt my skin burning as if it was yesterday. Altogether, Pointlogic had a really nice office. We ended the tour with a presentation about the company, which was followed up by a case. The case was about finding out which components people link to ethics while buying or thinking about buying cosmetic products. We received some data from a survey and had to do some regressions in R. When we finished the case, we got a delicious lunch. Afterwards, we had to present and discuss our solutions. At the end of the day at Pointlogic, we had a small drink and the opportunity to talk with other employees.

Now that we finished our visit to Pointlogic, we had to drive to Alphen aan de Rijn, where our hotel was located. In ten minutes time, two accidents happened on the road we had to drive along. The second one took so much time to be cleaned up, that it resulted in the fact that half of the students in the bus, including myself, decided to walk the last three kilometres in the rain towards the hotel. At the hotel, everyone received their room and roommate and afterwards we had a dinner in the restaurant of the hotel.

The next morning, we drove to Utrecht where we had to visit Gupta Strategists in the morning and Capgemini in the afternoon. We almost lost all our luggage when driving away from the hotel since the bus driver had forgotten to close the backdoor. So the ones who weren't awake yet, were woken up now.

Gupta Strategists do not have their own office and therefore we had the company presentation, case and lunch at Villa Jongerius. The case was about an insurance company in Poland that wanted to know some reasons why their profit decreased a lot in the past year. We received several graphs and information about other insurance companies and hospitals in Poland. After working for a while on the case, we had the opportunity to do a "fake" interview with someone we could choose out of three persons, for example the director of one of the hospitals. Next, we had to present our findings and afterwards we got a lunch to end the morning.

Lastly, we travelled to the office of Capgemini, most of us by train, however I was lucky and could get a ride with someone's car. Here we again got a company presentation and did a case. This time the case was about finding out why a waste clean-up company did make a loss in the past year. We received some data and a diagram, not much but precisely enough according to the people of Capgemini. Here we also had to present our findings. Afterwards we had the opportunity to ask some questions about the company itself. We ended the day with a dinner at a restaurant in front of the office. Some employees of Capgemini and a recruiter joined our dinner.

It has been two nice and intensive days, which gave me more insight in the consultancy world. Thanks to the committee for organizing the event.

Acropolis, Gyros and Lots of Fun

Bas Ramaekers

Master BAOR

Age: 22

On Thursday February 14, we left Tilburg University to spend 5 days in the cultural capital of ancient Greek: Athens. I, some fool who studied ancient Greek back in high school, was very excited to finally visit the place I heard and learned so much about. Furthermore, the social activities with my fellow students would create the perfect setting for an awesome long weekend.

On Thursday, we arrived around 9.00 hours at our hostel Acropolis, and after all 41 participants settled for a bed, it was time to kick off the trip with a karaoke evening at a local bar. Many amazing classics came along, such as Bohemian Rhapsody by Queen and Angels by Robbie Williams. As much as we enjoyed ourselves, the neighbours could not appreciate our performances and the bar had to close. At this point, the group split up. Some went on the discover the night life in Athens a bit more, other called it a night to be able to catch a little bit more sleep.

The second day started with a walk along the highlights of Athens. The Acropolis with the Parthenon on it was the first on the list. The temple, while not entirely in one piece, did not fail to impress us all and it was certainly the right decision to start the day with such a highlight. Unfortunately, after we descended the hill, the weather changed for the worst and we had to abruptly put a stop to our tour. After a Greek lunch, we continued the now shortened tour and managed to see the Olympic stadium and the national gardens. We postponed a mountain climb for two days due to the bad weather. Therefore, everyone had some free time until the dinner started in the evening. During the dinner, more bad news arrived. The activity of the next day “canyoning” was cancelled due to the weather as well. ‘Every downside has an upside’, since this gave us a new opportunity to discover the nightlife in Athens.

We found out that the nightlife of Athens is a bit weird. Not all clubs were open that day (Friday evening) and some clubs had a limit on the amount of foreigners allowed in the club. This made it difficult for all of us to be in the same venue. Another thing of notice is that since Athens is quite big, one might want to take a taxi from one club to the other. However, some taxi drivers do not know their way around the city, so you always needed to be careful that you were actually driving in the correct direction.

After visiting several locations, I ended up with Robert, Quirien, Martijn and Joris at my last stop of the evening. After spending another hour or so there, we headed back to the hostel.

The next day, the committee put great effort into finding a replacement for the cancelled activity. Unfortunately, many attractions in a local theme park, which was their first back up plan, were closed. The second back up plan was a pinball museum. Due to horrendous traffic, not everyone was able to reach it. I was among the people that got stuck in traffic and I ended up making an extensive walk through the streets of Athens in combination with regular stops for a coffee and some food.

That evening, it was pub-crawl time! Our enthusiastic hosts first welcomed us with a local drink. It was a sort of sweet, but sharp at the same time. Although not everyone like it, I thought it was pretty nice. The first

bar, was a cocktail bar. Amongst others, it served some pretty good mojitos. The bar was rather small, which made it very cosy. We enjoyed ourselves for a while and then continued to the second bar. In this bar, we could order unlimited sangria and beer. It also had a lot of tables to sit at. Conveniently, Pierre brought some dice with him and we played some games while enjoying the beer and delicious sangria. The third location of the pub-crawl was a shisha lounge. Here, we had the first floor to ourselves. The music was not really fit for partying, so we rather spend the time telling stories to each other and getting to know our fellow students better. After the shisha lounge, the pub crawl was over. The group split up, again, in people that still wanted to go out and people that were still too tired from last night and went back to the hostel. I belonged to the second group, but Rein and I first wanted something to eat. We ended up in a place that served these Greek gyros sandwiches and buns. We both had one and it was absolutely delicious.

On Sunday, we had a change of weather. This time it changed for the better. Therefore, getting up early in order to see the change of guards at the Athens Parliament was a little less difficult . It was fun to see all the people in authentic clothing. Afterwards, we took another dive into the ancient Greek history and visited the agora of Athens. This place consisted of ancient building and ruins of a market place. It had a beautiful temple dedicated to Hephaistos. The best preserved building was the stoa of Attalos. Nowadays, this building also functions as a museum for the entire marketplace. The last stop of the day was the Lykavittós, This was a mountain in the middle of the city. Most people went to the top by foot, climbing all of the stairs. However, there were some people that willingly skipped the beautiful walk to the top and rather took the cable train. On top of the mountain was a white chapel and a restaurant. I spend the rest of the afternoon in the restaurant, enjoying the sun and the view of the city.

After we descended the mountain, it was time for dinner. The committee has arranged a dinner at the beach. The committee wanted to gather at the beach around six to still be able to see the sunset. Unfortunately, Quirien, Joris, Bas and I did not manage to get there in time because the tram did not show up. When we arrived, the view was still pretty good. We spent time on the beach until it was getting dark and our dinner started. The restaurant had a lot of salads as starters and most of us were not really hungry anymore, when the main dish was served. After dinner everyone was satisfied and we went to our next stop, another cocktail bar. This cocktail bar had these amazing cocktails. I, for example, had a preheated cognac with some added honey and cinnamon stick. After the cocktail bar, I went for another drink and went back to the hostel to already pack some of my stuff.
On Monday, we had to check out early. After everyone had left the hostel, we took the metro and a bus to our final activity the Attica Zoo. This zoo restful place with a lot of different animals. Everyone visited the residence of the animals at their own pace. My favourite animal was the Persian leopard. I also like the feeding of the orangutans, to see a baby orangutan gather all the food that the others left behind was very cute. Thanks to the good weather, even the people that were not so fond of animals enjoyed themselves.

After the zoo, it was eventually time to go home, so we took another bus and metro to the airport. As we were waiting at the airport, it became clear that the flight would have some delay. This meant that, back in Eindhoven, we had to hurry to catch the last bus through the train station. Fortunately, we catch the bus and could all still make it home and our trip came to an end.
A special thanks to the committee, who put in their everything to entertain us, even when changes in the planning had to be made. I also want to thank the entire group for making this trip awesome.

The Modern Art of Marketing

written by **Ridho Hidayat**

The digital advertising market is booming. During this century, Google's estimated ad revenue has increased year after year, more often than not with a double-digit percentage increase, resulting in a 116 billion dollar ad revenue in 2018. [7] What is more, worldwide spendings are estimated to surpass 300 billion dollars in 2019. [1,8] The revenue of Internet advertising already exceeds that of other advertising media, as can be seen in Figure 1. Have companies found the crucial key to success, or is reality not what it seems? In this article, I am going to take a closer look at the world of digital advertising. More specifically, I am going to present the conventional methodology that is used to measure advertising effects, and add some critical notes and alternatives to that.

From Mad Men to Math Men

For centuries, the field of advertising had little to do with science. Mad Men ruled the business. These marketers could spend 3 million dollars on a Super Bowl advertisement without having a clue whether or not it was effective. In fact, they did not even care as long as their sales targets were hit. As William Bernbach, a famous American advertising creative director, stated in 1947: "Advertising is fundamentally persuasion and persuasion happens to be not a science, but an art". [4] However, with the rise of the Internet and the exponential growth of data, Mad Men made way for Math Men. These modern marketers, who may call themselves data consultants, aim to measure the effects of advertising by extracting information from data using mathematical models and other tools. According to a survey, which is illustrated in Figure 2, they mainly establish advertising effectiveness based on the sales uplift and the number of impressions they measure. This information is used to steer marketing campaigns and spend budgets more efficiently. So, does this mean that the field of advertising has shifted from art to science? Surprisingly, this does not appear to be the case. Marketers that study the effects of advertisements are often more interested in the results of a research than in the methodology. Here is the problem with that mindset: a flawed methodology leads to flawed results, and indeed it happens to be the case that the methodology is often flawed. Consequently, marketing analytics is often more a form of modern arts than a form of science.

Selection effect versus advertising effect

So what are these flaws that a lot of marketers neglect? We focus on one of the

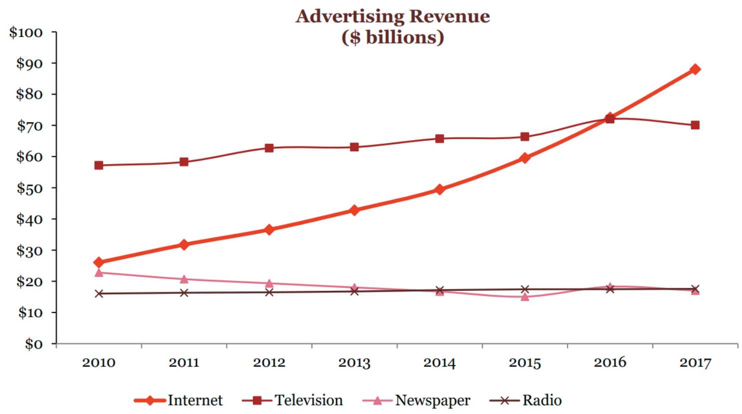


Figure 1

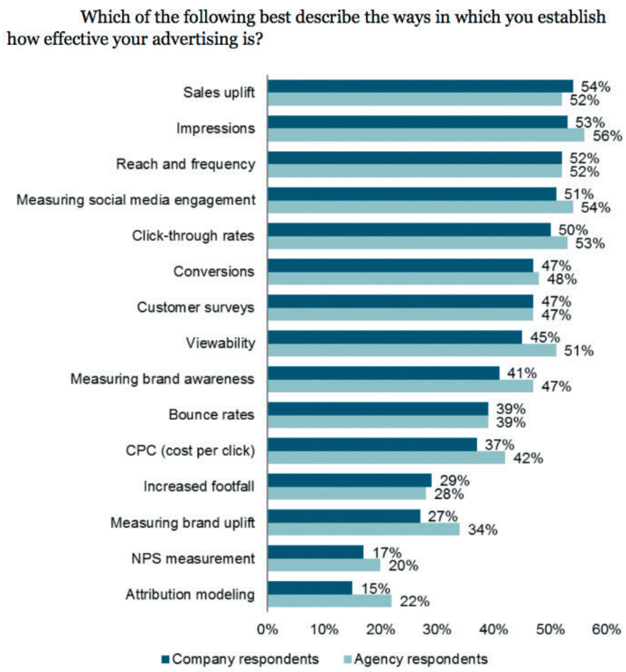


Figure 2

most important flaws: selection effects are often not distinguished from advertising effects. To explain what this means, we take a look at a simple example. Imagine that a restaurant hires two people, Alice and Bob, to hand out promotional coupons. After some time, it appears that Alice has a huge conversion rate; almost everyone who receives her coupons ends up eating at the restaurant. Bob on the other hand appears to be much less successful, his conversion rate is much lower. Does this mean that Alice is a much better salesperson and the entire marketing budget should go to her? Just from this information, it is impossible to draw this conclusion. Why is this the case? A possible explanation for the difference in conversion rates is that Alice was actually handing out her coupons in the lobby of the restaurant. So what appeared to be conversions that resulted from Alice's promotional efforts, were in fact conversions from people who would also eat at the restaurant without receiving her coupon. This is called the selection effect. Obviously, the selection effect should be distinguished from the advertising effect; the actual effect of exposure to an advertisement.

One may think that this is common sense, and big companies already do this. However, this is far from reality. Take eBay as an example. The most successful way of advertising that they use is brand keyword advertising. Anytime someone searches for the word 'eBay' on Google, eBay pays Google to make sure that the top result is a link to the website of eBay. Marketers from eBay showed that this resulted in a revenue of more than twelve dollars for each dollar that they spent. [2] However, they did not take the selection effect into account. So when eBay temporarily stopped advertising due to some circumstances, Steve Tadelis, a professor in Economics, got the opportunity to analyze the effect on the number of visitors of eBay. The result of his analysis can be seen in Figure 3. It turned out that people who normally visited eBay through the paid link now visited eBay through the regular link. Therefore, the true increase in revenues from advertising was not twelve dollars, but only 37 dollar cents. So in fact, eBay actually lost 63 cents on each dollar that it spent on advertising. Its "most successful way of advertising" did not yield a profit of 245 million dollars, it actually cost eBay 20 million dollars. This eBay-example also does not appear to be unique, it happens with a lot of companies. [2]

Randomly controlled trials

We discussed an important issue when measuring advertising effects. This raises the question: how should we measure online advertising effects? This does not necessarily require a highly sophisticated econometric model. Instead, all we need is a randomly controlled trial (RCT). To explain this methodology, we take Gordon, Zettelmeyer, Bhargava and Chapsky [3] as an example. In this study, big field experiments are conducted at Facebook to measure advertising effects. A randomly controlled trial is created by splitting up a group of people into a test group and a control group using random assignment. The control group is never exposed to the advertisement, while the test group is eligible to see the advertisement. However, some people in the test group may still not be exposed to the advertisement, for instance if they do not access Facebook during the study period. Therefore, three different groups are actually observed: control-unexposed, test-unexposed and test-exposed.

As can be seen in Figure 4, the conversion rate of the control group is 0.033%. The conversion rate of the entire test group is 0.045%, with the conversion rates of the test-unexposed group and test-exposed group being 0.025% and 0.079%, respectively . What we are mainly interested in, is the effect of the advertisement on the people who are exposed to it. This is called the average treatment effect on the treated (ATT). To estimate this effect, we first estimate the intention-to-treat (ITT) effect, the effect of the advertisement on the people who are eligible to see it. To do this, we simply subtract the conversion rate of the control group from the conversion rate of the test group, 0.045% - 0.033% = 0.012%. The ATT is then estimated by dividing the ITT (0.012%) by the percentage of consumers who were exposed to the advertisement (37%), resulting in an ATT of 0.033%.

While the theoretical framework behind this calculation is more elaborate, as can be seen in [3], it is clear that the calculation itself using a randomly controlled trial is not that complicated. So why is it that companies

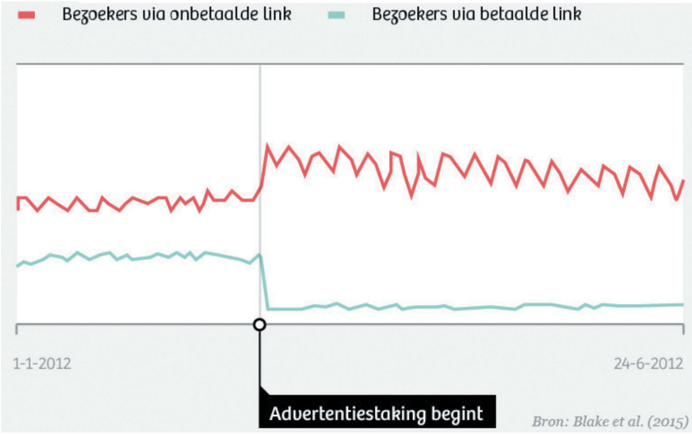


Figure 3

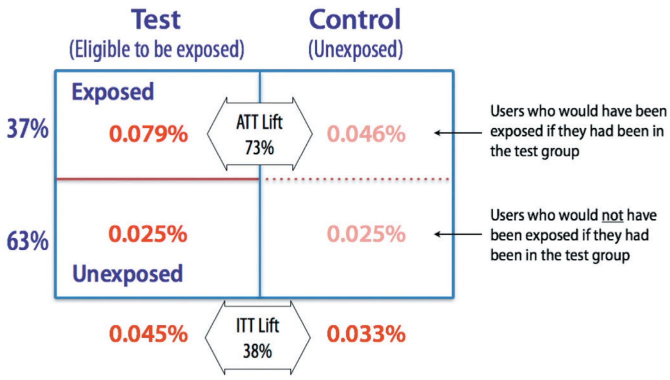


Figure 4

spend billions on online advertisements, but they do not seem to have an interest in thoroughly researching the effects of advertising? There are several reasons for this.

Results over reasoning

An important reason why companies often do not use randomly controlled trials to calculate advertising effects is, obviously, money. The opportunity costs of conducting such an experiment are large, since the company deliberately needs to exclude a part of their target group from exposure. Marketing teams need to hit their targets, so they are not eager to do these experiments.

Furthermore, the effect of advertising on sales is so small, that even with a huge sample it remains difficult to get conclusive results, the margin of error is simply too big. If we take the accuracy of these experiments into consideration, the conclusion is often: "the null hypothesis that exposure to an advertisement has no causal effect on the conversion rate cannot be rejected". Or bluntly stated: "it is unknown what the effect of this advertisement is". Even though such a conclusion is certainly not a matter of incompetence, it is often interpreted in that way. From a business perspective, these insights are not that valuable, because they do not tell whether or not a campaign is profitable. However, even if the effect of advertising is unknown, a company still needs to take action, one way or the other. Therefore, marketers might as well go for their gut feeling and take a guess which advertising campaigns are going to have a positive effect.

Lastly, there is a conflict of interest. Obviously, a company such as Nike benefits from knowing the profitability of its advertising campaigns. However, Nike's marketing division does not share that interest. This marketing division wants to have the largest possible budget, which is easier to obtain if it is "proven" that these advertising campaigns work wonders. Tadelis' research got a lot of a media attention when it was first published, however, only about ten percent of all marketers stopped using brand keyword advertising afterwards. They did not even start experimenting more to correctly measure advertising effects. Positive results make everyone happy, who cares how they are obtained, right?

Long live the Mad Men

All in all, it appears that despite the shift to internet advertising and the introduction of marketing analytics, marketing still maintains to be a form of art rather than science. As long as marketers are looking for results in their research that match their own view, the Math Men might as well be called Mad Men. Therefore, I would like to conclude this article with the following statement: the Mad Men are dead, long live the Mad Men. ●

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Bas Dietzenbacher
is a research fellow within the International Laboratory of Game Theory and Decision Making at HSE University in St. Petersburg, Russia. From 2010 to 2018, he studied at Tilburg University and finished the Bachelor Econometrics and Operations Research, the Master Operations Research and Management Science, and a research Master and PhD program in Business, Operations Research.

Living in the Russian Federation

Living abroad means being part of a different society, adapting to a different culture, and speaking another language. Of course, some countries are more similar than others, but there are always some minor differences. Although Saint Petersburg is located in the European part of Russia and is considered to be the most European city of Russia, living in this place is quite different from living in The Netherlands.

Russia is by far the largest country in the world in terms of area, almost twice as large as the subsequent country Canada. Saint Petersburg was established just over 300 years ago and is currently with more than 5 million inhabitants Russia's second largest city after Moscow. It was the governmental capital of Russia for a long time and still serves as its cultural capital. Saint Petersburg was founded to provide Russia access to the Baltic Sea via the Gulf of Finland and the design of its canals is based on the canal district of Amsterdam. This does not mean that Saint Petersburg is similar to any Dutch city.

The first obvious dissimilarities between Russia and The Netherlands are that Dutch people need a visa to enter the country and that the language uses the Cyrillic script instead of the Latin alphabet. A second observation reveals some minor distinctions: tea is the standard and coffee is the alternative, the social medium LinkedIn is blocked, and the ground floor is referred to as the first floor. Other differences only become clear when you stay somewhat longer or get to know the Russian people.

In line with what you might expect, Russia is a very bureaucratic and inefficiently organized country. Each time you enter the country you need to register yourself at your residence address, it takes a lot of time and effort to arrange your banking affairs, the heating is centrally controlled causing people having their windows opened all winter, you need to pay a fee when you take cash from an ATM of another bank, and there is a huge traffic chaos in the larger cities. Recently, they discovered that I had not yet signed a form declaring that I am not a terrorist, after living in their country for four months. I was locked up in a registration office on the other side of the city for four hours before I could sign such a form. Some argue that the country is actually very efficiently organized, but that the government pursues a different goal: controlling the citizens instead of serving them.

In contrast to what you might expect, Russian people do not drink vodka all day long, do not actively support Putin in public, and are not extremely unfriendly. Instead, they may as well drink beer, do not have a strong opinion about politics, and are actually quite nice to deal with. Moreover, they are generally very superstitious. Many statues and objects would bring good luck when you touch them, sitting on a stone would lead to cystitis, women sitting at the corner of a table would nevermore find a lover, and whistling at home would blow the money out. Furthermore, there is something peculiar with shaking hands. When a man enters or leaves the room, he normally only greets the other men by shaking hands, but skips the women. The first time my boss passed by my office, I opened the door and reached out my hand to meet him. He took my hand and literally pulled me out of my office to subsequently shake my hands in a gentle way. Shaking hands in doorways would namely bring bad luck… ●

Projecting the Future Performance of Professional Soccer Players

In the last few years there has been a major increase in the use of sports analytics. Especially in the domain of player recruitment, inspired by the 2003 book "Moneyball" by Michael Lewis [1], data science can have a big impact on multi-million dollar investment decisions. It in a sense all boils down to just one question: How well is a player going to perform in his future career? This information will ultimately decide which players are signed and determine the contract duration, salary and market value of the player. The answer lies in the field of data science!

Introduction

In sports such as baseball and basketball, data analysts and scientists have been at the cutting edge of data analytics technology for years and came up with some approaches to tackle this question. In football, however, data analytics seems to lag behind in this era of Moneyball. The main reason for this is the lack of data. There are simply less measurable events in football compared to other sports, making it harder to quantify success and skill and ultimately predict future performance. Also, luck seems to have a bigger impact on football. According to Garganta and Conçalves [3], football presents one of the lowest success rates in the ratio of goals scored over the number of attacking actions performed, increasing the difficulty in predictive analytics. Another shared opinion by experts is that the football community seems to have a somewhat conservative philosophy; they like to keep things the way it used to be. Investments in predictive data analytics technology are therefore less often seen in football. Based on this, the research I conducted in my thesis focused on introducing a predictive performance algorithm and making it understandable for the football community.

Ageing Curves

Many algorithms that involve a player's future performance projection use something that is known as an *ageing* curve as their foundation. An example is shown in the Figure 1 where EPI reflects a player's performance level. Such an ageing curve represents the average improvement or decline in performance a player has, based on his age. The curves can in fact have any shape, but in general follow a quadratic function where a player's top performance is most often seen around the age of 28. Simply put, human beings generally cannot run as fast at 36 as they can at 28.

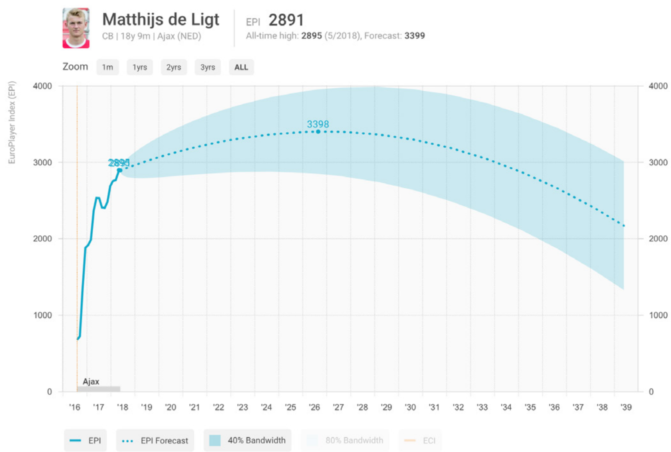


Figure 1: The ageing curve of Matthijs de Ligt that reflects his performance expectation for upcoming seasons.

Although ageing curves give reasonably good results for the majority of players, it lacks flexibility and therefore the ability to properly differentiate between players. It is quite rare for players to follow the smooth patterns of development that these curves imply; real ageing curves are noisy and in no sense identical between players[1]. As a result, this study finds its purpose in a different approach, inspired by the baseball projection system called PECOTA.

PECOTA

A baseball projection system developed amongst others by well-known American statistician Nate Silver, that uses a nearest neighborhood approach to project future performance. By doing this, it keeps the possibility for players to 'age' in a different way, while maintaining the idea of managing players' expectations using ageing curves.

[1] As stated in Silver [2]

A prediction done by PECOTA is based on two different things. It uses American statistician Bill James' similarity scores, also known as sabermetrics, and Gary Huckabay's work on Vlad, a different baseball projection svstem which tried to assign players to numerous different er paths. The combination of these two ideas makes it an effective and reliable algorithm, where the outcome is a future performance probability distribution rather than just one line of expected statistics.

Specific details about how PECOTA identifies the set of similar players are not publicly shared. Also, the literature leaves some loose ends about how such a set of similar players should be used to do a projection on. In my thesis, I came up with my own ideas how to do so and eventually incorporated it in an algorithm that can be used these days in the world of football.

Data

The data gathered to conduct my research is based on the following idea: each player has certain statistics, is sunt, features, over time, matching a certain age. An example is sketched below.

ID	Age	Features
470780	27.5	...
470780	28	...
470795	28	...

Table 1: The structure of the data set reflected by three data points.

By gathering these statistics on a half-yearly basis, the dataset will have sufficient information to create insights on, but also keeps being manageable with respect to its size. Moreover, a structure like this lists multiple rows of data, further referred to as data points, per player, all matching a unique age. In this way the Neighborhood Projection Algorithm (NPA) is able to track a player's performance over time, which is an important building block of NPAâĂŹs methodology.

The features to create insights on the potential future career of football players can roughly be separated into three levels. Basic features that represent a player's origin and position on the pitch, individual features that reflect a player's playing skill and its development over time, and team features that represent statistics that in some way involve a team performance. The company [2] developed most of these statistics and made them available for my research.

Neighborhood Projection Algorithm

[2] https://www.remiqz.com

The future performance of football players is projected using the NPA. The NPA uses neighbors, similarity scores and performance development over time to solve the problem. The idea is that a player follows the same performance development over time as his close neighbors, is sunt, similar players, showed in the past. How this is done is illustrated by the flowchart shown in Figure 2, where player x^* represents the player whose future performance is being predicted and k refers to a future point in time to do a projection for.

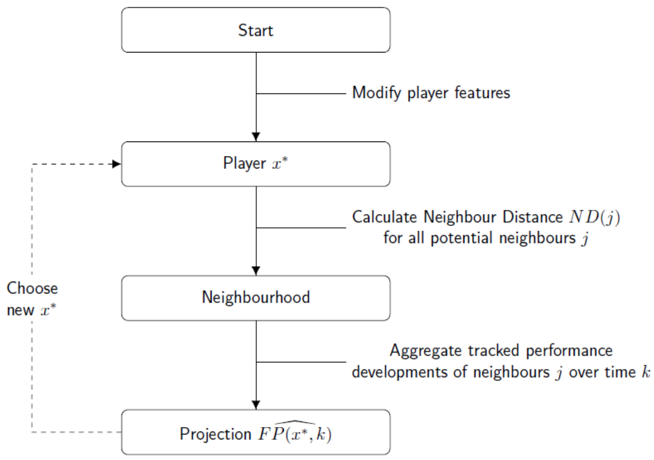


Figure 2: A flowchart reflecting the main path the NPA walks.

The three most important steps of the NPA are modifying features, calculating Neighbor Distance $ND(j)$ and aggregating tracked performance developments. Modifying player features is particularly important to do a fair comparison between different data points, such that $ND(j)$, for each neighbor j, can ultimately determine which data points are seen as player x^*'s neighbors. The function roughly looks as follows:

$$ND(j) = \sqrt{\sum_{f \in MNF(x^*)} w_f \cdot (\widetilde{x_f^j} - \widetilde{x_f^*})^2} \qquad \forall j \in G(x^*) \quad (1)$$

where $\widetilde{x_f^j}$ and $\widetilde{x_f^*}$ represent the modified feature value f of data point j and player x^*, respectively. The feature weights are represented by the vector w.

As one might recognise, $ND(j)$ calculates the weighted Euclidean distance between the modified features of two data points. The smaller this distance, the closer and more similar two data points are. The closest, unique data points ultimately determine player x^*'s neighborhood.

A future performance projection $\widehat{FP(x^*,k)}$ is calculated using a recursive formula which tracks the performance develop-

>>

ment of neighbors j over time. Subsequently, $FP(\widehat{x^*, k})$ will resemble the same performance development as the weighted average of player x^*'s neighborhood showed over time. That is

$$FP(\widehat{x^*, k}) = \begin{cases} x^*_{Current} & \text{if } k = 0, \\ FP(\widehat{x^*, k} - 0.5) + \\ \sum\limits_{j \in N^{\mathbf{k}}(x^*)} x^{j,\mathbf{k}}_{\Delta EPI} \cdot RSS(j,k) & \text{if } 0.5 \leq k \leq 10.0, \end{cases} \tag{2}$$

where k has increments of 0.5 years, $x^*_{Current}$ is player x^*'s current performance level and $x^{j,\mathbf{k}}_{\Delta EPI}$ and $RSS(j,k)$ denote neighbor j's half yearly performance development and assigned Relative Similarity Score for k years ahead, respectively. $RSS(j,k)$ can be seen as a function that creates a weighted average, rather than just an ordinary average. The idea is that there should be adjusted for differences in similarities between neighbors, measured in terms of $ND(j)$. Multiple $FP(\widehat{x^*, k})$ for increasing k will ultimately project player x^*'s future performance path.

Some of the difficulties faced while implementing the model is the fact that not all players have the same data available and players retire over time. Player x^*'s neighborhood is therefore made dynamic over time in combination with a stopping criterion.

Results

Figure 3 visualises the difference between a projection done by the NPA and an ageing curves algorithm as discussed previously. The NPA's level of flexibility, its uniqueness and the length of its projection is what separates the two approaches.

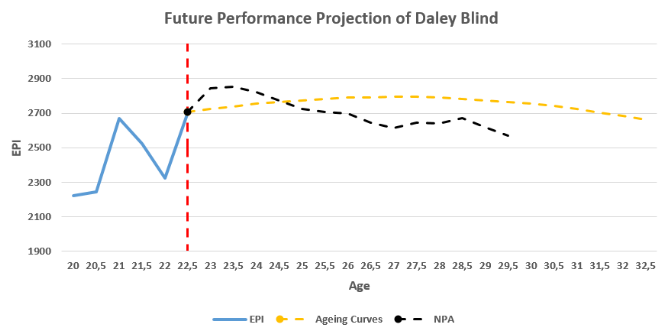


Figure 3: Future performance projections of Daley Blind at the age of 22.5.

When looking at the performance of both algorithms with respect to reality, one can conclude that the NPA is strong on predictions done on short to midterm length, which are those from one up to six years ahead. This, in particular, is a valuable result favoring the use of the NPA over the Ageing Curves algorithm, as professional football players usually get contracted by clubs for three up to five years. The NPA is also strong on predictions done for players having a defending role in the team. The biggest flaw of the NPA, however, is probably the lack in performance accuracy for players having a younger age (i.e. age $\leq$ 25). It seems that the NPA struggles to find a close neighborhood for those players and ultimately lacks upward potential in their future performance projection paths. So, based on these findings, there is still some research to do before a neighborhood projection approach can become the new standard in projecting the future performance of football players.

Internship

I conducted my research in combination with an internship at Hypercube Business Innovation that works closely together with start-up Remiqz, for whom I conducted the research. Remiqz is a young and energetic team of professionals, mostly econometricians, that do all kinds of data driven consulting for professional football clubs. If you are interested in doing a research in Sports Analytics, you should definitely have a look there. Feel free to contact me if you would like to be introduced by me.

References

[1] M. Lewis. *MoneyBall: The Art of Winning an Unfair Game*, W.W. Norton & Company, 2003.

[2] N. Silver. *The signal and the noise: why most predictions fail - but some don't*, The Penguin Press, 2012

[3] J. Garganta & Conçalves. *Comparison of Successful Attacking Play in Male and Female Portuguese National football Teams*, Notational Analysis of Sport -I & II, Cardiff: UWIC, 1997.

Maurice Peters
MSc BAOR Alumnus

The Perfect Opportunity to Connect with Different Companies

Marijn Paijmans

Bachelor EOR

Age: 21

On March 19, Asset | Econometrics organized the Connection Day. This day is all about meeting companies, talking to their representatives and orientating yourself about what your next step is going to be. The several cases that were held gave good insight in what these companies do in daily life and what you can expect once you choose to work at their firm.

The day started with a warm coffee and tea and a word of welcome by the chairman of the committee, Melissa van Wingerden. Soon after, we walked all the way through the Cobbenhagen building to our first case of the day, which was organized by ORTEC. ORTEC is one of the world's leading players in the field of optimization software and analytics solutions. They make businesses more efficient, more predictable and more effective, as they say themselves. After a short introduction about the ins and outs of ORTEC, we started working on a case. In this case, we took over the role of a task planner to link tasks to engineers with one goal: to minimize the distance traveled through the country. As soon as we started with the case, the competition between the teams began as well, since of course, only one team could win. In the second round, one of the engineers became ill and the scheduling had to be done all over again. In total we spent around 40 minutes on this case, and the results were not too bad, while we had a lot of fun also! After the case, the big red 'Solve' button in the ORTEC software was used to solve the problem. In seconds the machine found a solution that was better then our solution, while we spent quite a long time on it. Amazing how this kind of software works!

After the first case, we enjoyed lunch at Faculty Club with the company representatives. With fresh orange juice and tasty sandwiches, we obtained new energy for the next round of cases.

In this round, there were two more companies which introduced themselves: Willis Towers Watson and TBA. I attended the case of TBA. The company representatives told something about themselves and the background of their projects. TBA Group is a leading international provider of software and services for ports, terminals and warehouses. A fun fact about TBA is that the name does not stand for To Be Announced as one might expect but is simply a name. In the case we had to make several decisions on a new terminal that was going to be built: from the length of the quay to the number of and types of cranes. This all has to be done in order to handle an uncertain pattern of boats that arrives and needs to be helped. These boats had different sizes, different types and different priorities (and according to those penalties if a boat is not helped in time). The difficulty here was that you were not able to check your solutions immediately. You only had one chance to check the cost in the simulation via the software of TBA, before we had to give our final solution. Our results were very good: TBA had done this case at other universities as well, and Asset | Econometrics was the best performing association so far! We can be proud of ourselves. For my group, it became even better: we won the case and got a small present from TBA. My day could not have been better.

To conclude the day, there also was a networking drink. This gave us the possibility to reflect on the day and connect with the representatives of the company. All in all, the day gave me nice insights in the daily business of several companies related to our study fields. I would like to thank the committee and the participating companies for this nice edition of the Connection Day!

From Iran to Tilburg

written by **Aurel Macias Minambres**

On a Friday afternoon, Marieke and I went to the Prisma building offices to speak with Amin Khodabandeh Amiri. Amin is not yet that well-known for most of us econometrics students: he has been teaching the revised Computer Programming course in the second year since last fall and he has only been working in Tilburg since the beginning of last calendar year. This was a nice opportunity for us to get to know more about him.

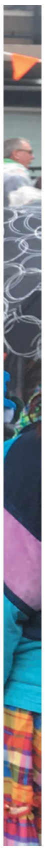
First, we talked about the roots of Amin. He was born in Iran, in a decently large city in the north: Babol, about the size of Tilburg. Contrary to what you would believe if one says Iran, it is a green city where rain fell quite occasionally like in the Netherlands. For his studies, he went to Teheran, the capital of his country, which is one of the largest cities in the entire world. He started a study in software engineering there. After this, he also did his Master in IT Management there. After some teaching in Iran, he went to Canada, where he did his Ph.D. on a subject related to Information System Management. After this, he finally came to the Netherlands in 2018 and started working at our university.

Amin enjoyed his study time, although he did not consider his transition from Babol to Teheran at the start of his Bachelor easy. Adapting to the new city, his studies and making friends at the same time was a tough experience, but he managed eventually. During this time, he was not active at any association, which they have in much the same way as we have the Netherlands, according to Amin. He preferred spending time with his own friends.
At the end of his Bachelor came a sudden change in pace. Amin got married at that time, so his experience in the Master was much different from his experience in the Bachelor. A married life is obviously completely different from the life of a single student. Amin also felt his philosophy in life changing during that time, reading into a lot of philosophy books.

Also, he had a part-time job related to his studies as a software developer. In that time, he really wanted a company for himself. It was the dream for everyone in the tech sector to be the next Bill Gates. To that extent, he ran a small website in which one could drop reviews for stores in his hometown. However, he did not have enough time to keep managing it and services like this were not very usable and profitable back in the day: it was not really the time for that early in the 21st century. However, "thinking big" is something most IT people do, according to Amin. At least, it reduced his stress level quite a lot to not run some company for himself.

In Iran, military service is still mandatory. Back in the day however, the top students were excluded from military service. Sadly for Amin, the law was changed and he had to do some community service. He could do this by means of teaching at an university instead of serving in the military: it was good enough as a substitute. In the meantime, he could also feed his family through his teaching job.

After a couple of years, he finally went to Canada. He had a great time there, in Vancouver, especially because the city is so international. There are all kinds of people



in Vancouver from all over the world and everyone enjoys life there, so it seems. There is a large Iranian community in Vancouver too, which really helped his cause there although Amin loves to get in touch with other cultures. His time as a Ph.D. student was very stressful but still quite rewarding. After that he went to us here in the Netherlands. As to why: Amin liked the idea of being in Europe, where many a civilization can be found in a small span of landmass with also a lot of different cultures. That, and traveling between the different countries is easy. In Vancouver, no Canadian cities were nearby and traveling to the US was not easy, especially due to an Iranian background. The Netherlands was interesting for Amin because he preferred a country where they speak English reasonably well and where speaking English at the University is all right. Fulfilling these two conditions, Tilburg University was the university where the research field felt most interesting to him. Hence, he applied and he indeed got in. The Netherlands is quite an interesting country for Amin. Contrary to what you would expect, the amount of bikes was not that staggering for him. He already saw many of them in Vancouver and they even have bikes at his Iranian hometown, as the landscape is reasonably flat there. One of the largest differences he observed in coming to the Netherlands is the interactivity in classes: in North America your class absolutely needs to be interactive. In the Netherlands, students rather sit back, relax and consume. Classes that are too interactive are not accepted all that well by the general public. This is actually easier for the teachers too. It is much less exhausting to have these kind of classes.

> “ I like making small trips. Exploring the world and its people. ”

Amin: “A day at the university usually just consists of a lot of PC work, reading and writing papers. It is very flexible, although it can also be quite stressful to write papers to meet up to the standards of top academic journals.” As long as those are met however, his job is fine and Amin does not mind working long days. Sometimes Amin also works in the weekends to manage this, but sometimes the weekends are used for his main hobby: traveling to different citie. Amin: “I like making small trips and explore the world and its people. Moreover, I love to learn about the history of the world and I consider Europe particularly interesting.”

Amin also likes the food from all over the world. Here in the Netherlands the “kroket” is his favorite, but also hamburgers with peanut sauce and chocolate sprinkles do him well. He does not miss the food of his country that much, as his wife is a good cook of Iranian food, even though there are not really many Iranian shops in the Netherlands. Delft, which has a larger Iranian community, has one. He has some friends there and sometimes visits them and goes to the Iranian shop there too. Eastern Asian food is much more common here: the Indonesian kitchen being particularly well-supplied. Amin also likes that much. He misses one particular food from Vancouver: poutine. This food is comparable, but not quite equal to our “kapsalon”: fries with cheese and gravy.
One thing Amin does not like too much about the Netherlands, and Northern Europe in general, is the climate. Even though his hometown is temperate, the sun is still coming up much more in his hometown than here. However, the weather is similar to that in Vancouver so Amin manages.

All in all, we learned a lot about Amin and his journey from Babol to Vancouver to Tilburg. It was a lot of fun talking about his experiences and the differences between all these countries. Before we leave, Amin shared some advice with us which we also want to share with you: have a vision about how your life looks like at age 40. Amin stated that many students do not have a clear vision about what they want in life when they are 40, not only in terms of a job but also in terms of being settled down, what you want to do next to your job and so on. Also, share this vision with people you know and discuss it. It will help you in life, according to Amin.. ●

dr. A. Khodabandeh Amiri

Bert & Ernie Questions

Bert/**Ernie**
Research/Teaching
Canada/Netherlands
Stress/Boredom
America/Asia
Using a calculator/Mental calculation

Learn, Experience, Dance

Today, the yearly National Econometricians Day takes place. This yearly event is the biggest career event in the econometrics sector in the Netherlands. (Every year, it takes place in Nieuwegein at the NBC business centre.) The event offers the ability for econometrics students to participate in a multitude of cases offered by various companies. In addition, this year, the LED also introduced the company fair. This fair offered stands from various companies allowing students to walk around and get introduced to multiple possible employers. The company fair enabled 150 more students than last year to participate. With a staggering total of 800 students, the event was bigger than ever.

This year, the LED was organized by students from the University of Groningen. The day started from 9.45 hours with the reception. Here everyone got to hear the companies and activities they would be visiting for the day. Everyone looked around, saw who had which company and if they were selected for the companies they aimed for. The good thing about the LED is that they offer a huge variety in companies. Every discipline in the field of our study is offered. There were companies present from the consultancy branch but also companies like Flowtraders and Optiver who specialize in trading. It does not stop there because econometrics is more than that and every possible branch was being represented. Another positive note on the LED is that the spectrum of companies was also very diverse. With a big career event like this often only big companies are represented, but not all students want to work at a big multinational organization. The LED really tackles this well by also letting small and new companies participate. In this way students also get the opportunity to meet companies they would normally never encounter.

After everyone sorted out their program for the day, it was time for the opening of the day. The LED officially started off with an interesting seminar by dr. Caspar Chorus. Dr. Chorus specializes in choice theory and his seminar made use of this concept. The talk introduced the question whether econometricians are still needed in 10 years. Obviously the answer was: yes!

Now that the day was officially opened it was time for either the masterclass and the business fair or the company cases. I participated in the latter one. The company I was assigned to was Willis Towers Watson. The company was my first choice when I had to register in November, so I was happy with this selection. Willis Towers Watson is a company that is active in a lot of different industries. However, the case we got was about ‘retirement’ consultancy. Pensions, and pension consultancy, is the core business of Willis Towers Watson. For this reason I was very happy they used this topic as to get an insight of the company’s main business. We started off with a presentation to get an insight in the company’s every day activities. As mentioned previously, Willis Towers Watson specializes in pension consultancy, but this presentation taught me the company is much more. After the presentation, the case for the morning was presented. The case took place in a scenario where a pension policy was changed. As a pension consultantants, we had to determine what this policy change meant for the company, whether we had to compensate our employees and whether it will cost money or not. In the end we had to present our finding in front of the employees and a winner among the groups was selected. To our surprise our group had won the case! As a reward we got special Willis Towers Watson power banks. Overall, my image of the company was very positive. The people presenting the case and they were really friendly and always open to answer questions. The case really gave a good insight on what to expect if you would work at Willis Towers Watson. All in all, it was a very positive and nice experience. This was my first time participating in the LED, beforehand I did not know what to expect. Nevertheless I was pleasantly surprised by the case and the friendly and helpful people.

After the morning company cases it was time for lunch. The lunch was organized really well. It took place in a big open hall. Most companies had their own stand which gave people to opportunity to talk to their company of interest. If you did not feel like networking, there was also room to hang out with friends or other people and hear what other people had experienced in the morning. Here I heard from other people that they also won cases from other companies. Although I was very happy with my powerbank from Willis Towers Watson, I also heard people having won bottles of vodka and champagne and even a drive in a Tesla. Especially the bottle of vodka was a very surprising prize. The lunch took from 13.00 until 14.15 meaning you had a lot of time to catch up with people, talk with companies and eat your lunch.

Finally, after 14.15 hours it was time for the second round. This time, I had a case of PwC. This case had the same set up as Willis Towers Watson. First, they talked about the company itself and then their job specifically, leading in the end to the introduction of the case. The case was about a very relatable topic; namely football. With this case PwC wanted to show that the use of data can be applied in almost every field. Even some topics like, managing a football team can be simulated with data. As for us, we first got presented the data from the video game FIFA. They presented all data of every player and team in the database of FIFA. Meaning we got characteristics like age, club and many personal treats and their scores. As most people know there are a lot of players and teams in FIFA and the total data set we were given was rather large. For the case, we had to summarize data and do a presentation about this. After everyone presented their insights one of the employees of PwC gave his application of the data. He showed us that they had developed an application which would classify players. In the end this way a manager of a team could find a player with the same characteristics as a player that he was looking for. An example of that was shown using the French player Mbappé. He showed 4 players which had the same characteristics but no one had every heard of the players, meaning managers could get those players for cheaper and they would possibly become the new star in football. I think in this case the part the students had to do themselves was a bit less interesting. The final presentation by the employee of PwC was really interesting though and clearly showed the possibilities of working with data. Just like the first case , I really enjoyed the case and was happy with my choice of company.

Now that all the cases were over we moved to the more informal part of the day. We started off with magic show and which was followed by the networking drink. Here, everyone had the opportunity to talk with the company of their interest and take pictures for your LinkedIn. The networking drink ended soon enough and then it was time for the final official part of the LED, the business dinner. I was placed at the table of Deloitte. Each table consisted of 8 students and 2 company associates. The dinner that was served was delicious. To my surprise all people also got their dinner roughly at the same time, which is an incredible feat for 800 students and all the companies all with good quality of food.

After the dinner, the formal event was over. We all got a goodie bag from the LED with a lot of nifty stuff from companies. We went to the hostel and directly after, the (in)famous LED party started off at club BASIS. At this club most of the econometric students from the LED gathered and partied until late in the evening. All the beer was free for the evening so luckily the hostel was only 2 minutes away from the club, meaning we did not have to walk far.

Joost Broeders

Bachelor EOR

Age: 21

Altogether, I would highly recommend the LED to all students. The day really gives you an idea of what most companies do on a daily basis and what the options are for econometrics students both after and during their studies. The day was organized incredibly smoothly, meaning we never had to worry about anything and we could just enjoy the day as it was. For this I would like to thank to organization of the LED and all the companies participating.

Discovering Real Estate with Brink

written by **Lucas Jacobs**

On Thursday morning February 27 Dominique Bavelaar and I went to the office of *Brink Management / Advies,* part of Brink Groep, in Eindhoven, for an interview with Thijs Kramer about the pursuits of the company. Thijs studied econometrics with us at Tilburg University and was quite active at Asset | Econometrics during his studies. After having worked for Aorta Business Intelligence he was looking for something new. He joined Brink after contact with Joost van der Werf, who is department coordinator, and he has worked for Brink for one and a half year now.

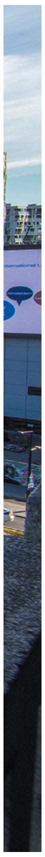
Apart from Thijs, two other people participated in this interview: Joost van der Werf – who was mentioned earlier- and Judith van Rijswick, both senior managers. Judith has studied Operations Research (OR) in Amsterdam after which she joined CQM B.V., a data science consultancy firm. After eighteen years of implementing decision support models in different industries, she was ready to take on a new challenge. She already knew Joost, who has worked almost twelve years for Brink, for some time, and she decided to join Brink last January. Joost has studied Economics and Business in Rotterdam and was always interested in real estate. Since the latter is the core business of Brink, you might not be too surprised to read that he enjoys working here.
Brink is a company that specializes in real estate. It is one of the biggest firms in the sector: many of the big and complex projects and assignments that concern real estate in the Netherlands are being handled by Brink. The company has offices in Rotterdam, Eindhoven and Groningen. Brink Groep consists of both Brink Management / Advies and Ibis, and employs 230 people. Ibis is a firm that makes calculation software for construction companies. The top ten contractor companies (at least) in the Netherlands use the software made by Ibis, which includes maintenance and inspection software.

Brink Management / Advies breaks down in two parts: management on one hand and the advisory/consultancy body on the other. Management arranges all the projects, advisory does the puzzle work. Within advisory, Brik distinguishes different departments. The first one is policy and organization, which focuses more on the "soft" side of the company. Secondly, development and investment, where they deal with business cases for new buildings and campuses. Lastly, the group of which Joost, Judith and Thijs are part of: portfolio management. They puzzle with large portfolios of real estate.

Brink has many clients and projects, for example: the ministry of Defense, the National Police, KLM, Schiphol real estate, Brightlands Chemelot Campus, P*aleis Het Loo*, the Kröller-Müller museums, *het Binnenhof*, the Leidsenhage mall, the government real estate company and a lot of municipalities. The clients are often relatively big with rather complex assignments.

One of the first things Joost did at Brink, with the development and investment group, was standardizing the land development (Dutch: grondexploitatie) model. Land development is the sum of all the costs that concern the purchasing, demolishing, remediation and building of houses and streets of a certain ground area. During the financial crisis of 2008, there was less land development work available than before so Joost started working on quality management which concerns the quality of the houses once delivered. This work concerned thousands or even tens of thousands of locations: it quickly turned unclear for the human mind. As the scale grew even more, programs like Excel did not work anymore and hence new technologies and methodologies were needed. Where scale increases, econometrics comes in.

This also became apparent with the "one million houses" project of Brink where data had to be analyzed in order to find suitable locations for building houses in



the upcoming years. Here, the input and know-how of Thijs was of great value, also during the process of putting algorithms from Excel to R. Even stronger, without the competence of Thijs the whole one million houses project would probably not have succeeded. The work done by data scientists at Brink require the company to consider the use of programming languages like R or Phyton. Econometricians bring another way of thinking to the company which can turn out to be extremely useful or sometimes even necessary for a project to succeed. New components can be added to the advice to the clients that someone with an engineering background would not be able to provide.

Originally, Brink mainly relied on knowledge and skills in the field of engineering. Students from universities of technology were the main group of people who started working at Brink. The majority of the people working at Brink still has such a background. However, with a growing database and more data becoming available, Brink now also sees the opportunities that lie in the field of data science and econometrics. That is why Thijs works at Brink and why there will be an expansion in the department of data science in the coming years.

It is the combination of knowledge in the field of engineering – about how to build and use buildings properly – and methodologies in the field of econometrics – numerical techniques to deal with all available data – that makes Brink powerful.

Thijs tells us that the current goal of Brink is mapping all of the real estate information onto the Netherlands as well as possible and to expand in this as much as possible. The information resulting from this mapping can subsequently be used in all kinds of projects. This information comes from the Brink Data Center which contains property info, energy labels, geo-information like roof orientation, but also prices from *Funda* for example. There are a lot of optimization problems as well that could be applied in the context of real estate.

Judith tells us about such a topic which keeps Brink busy: increasing the sustainability of houses in the Netherlands, mainly motivated by the government. The sustainability is measured with energy labels, it is not possible to give the highest label to all the houses. There are budget constraints, questions like simultaneously or sequentially increasing sustainability, a particular order of proceedings when making a house more sustainable. Potentially interesting questions, also for econometricians!

Striking was that during the interview, it became clear that a lot of real estate related data issues are not efficiently arranged in the Netherlands: a lot of municipalities do not know exactly how much real estate they actually possess. Also, a lot of energy label inspections are carried out house by house, instead of making use of sample experiments. Moreover, incomplete and unclear documentation of certain information of real estate – even concerning the location – or public institutions not knowing whether or not certain buildings are theirs.

In some administration databases, buildings of around 50 000 square meter are just saved as a small dot and therefore theoretically fit in a pixel of 100 by 100 meters. From all of this we can conclude that the way real estate data is registered in the Netherlands is not always such that it can be handled right away. Hence, regarding efficiency, improvements definitely need to be made in Dutch real estate databases.

Because many parties are involved with new real estate plans, there are a lot of restrictions Brink takes into account when advising clients on potential ground areas. Sometimes the combination of these restrictions makes it simply impossible to do anything, so one has to shuffle a bit with certain restrictions: find inconsistencies in what parties consider restrictions and what is actually already happening in practice. Sometimes, data tells that construction activities are going on at places where it is officially not allowed to build.

The culture of Brink is characterized by little hierarchy and focuses on the employee as a person: a kind of family-like idea. All shares of Brink are owned by employees and management; shares of Brink can be bought once one has worked a year for the company. Of course, Brink undertakes all kinds of fun activities with its employees. The portfolio management department really likes escape rooms (for whatever reason). As for Thijs, he really enjoys his work at Brink as Consultant although his interests go beyond the world of real estate. Brink also works with working students: currently three of them are employed.

Our final impression of Brink is that of a very specialized, professional real estate consultancy company with a friendly culture, which values hard-working employees.

We would like to thank Thijs, Judith and Joost for their time and the interesting insights they provided on how econometrics can be of value in the real estate sector. ●

Thijs Kramer
Age: 23
Function: Consultant
Alma Mater: Tilburg Universtiy
Study: MSc Strategic Management, BSc EOR

brink
management / advies

Lustrum Trip: Athens 2019


ASSET Econometrics
The eighth wonder of the world

Don’t Drink and Drive?

Bas Verkaik

Bachelor EOR

Age: 23

On February 5, this year’s male/female activity took place. As the name suggests, it consists of a separate program for male and female members of Asset | Econometrics. Both the activities started with a dinner. The broad intent was that we all needed a decently stuffed stomach to last for the rest of the night.

As meat is in general one of the best things to eat before going out, most male participants chose for either the mixed grill or the chicken nachos. The fish and vegetarian dishes were not popular at all among these men. After the dinner, the female participants headed to the Lollipop bar to sing karaoke. We could hear the music and the girls sing from far away and they probably had a lot of fun. The male part of participants went to the parking lot across the street from the Interpolis building to pick up the beer bikes. When we arrived, the two drivers had to sign a paper to ensure they would stay sober and would try to keep the bikes and the other participants safe. After this, it was time to leave and the beer tap was opened. When every cyclist had received a beer we could finally get into gear. The other team, however unlike my team, did not have a starting problem and it only took them until the end of the first street to dissappear out of sight. Meanwhile, the discussion about the music on the bikes started. Normally, everyone wants to be the DJ, but this time we struggled to even find one. After a while, Bernard finally put on some music and, as nobody else wanted to be the DJ, we could not really complain about his choice of music. As soon as the music volume was turned up, the bikes started to catch more attention of cyclists and pedestrians. Through the whole journey, people cheered at us, ran along and made pictures of the beer bikes. Also, cars were honking when they passed us was a recurring event during that evening. It took about two streets until the first beer had to be chucked by someone, followed by the first beer race. In the beginning, everyone was helping to keep the bikes running, however it did not take that long until we saw who were the real team players that just kept going and who were more attracted to standing behind the beer tap or sitting in the seats in the back. However, we still had a few big motors, so we kept going. After two rounds through the city center, a few beers and some races, it was time to take the journey to a less known part of Tilburg as we drove into Tilburg-East. As we were just over an hour into the activity at that moment, the first people started to have problems with their bladder and needed to pee. Being a man, it is very easy to step behind a tree somewhere, so this was not the biggest problem. However, in typical male fashion, every time someone stepped off the bike to have a pee the rest was shouting “Drive, drive!” before putting effort into raising the speed as much as possible. This meant we went at least three or four times the usual speed making it hard for our peeing counterparts to get back to the bikes. Most had to make a real run for it, and if the bikes would have had gears, we would have been able to give them an even harder time trying to get back. More and more men needed to get off to do their thing, so in our final round, continuing in this fashion, we went a lot faster than during the first two rounds. After about one hour and 35 minutes, all the beer that was present at the bike was consumed and we had to finish the route without this very much needed fuel for men. This led to a bit of disappointment among all men. However, after already quite some beers everyone still drove the beer bike with a smile on their face. All in all, it was a very fun activity to take part in, and I would advise everyone to jump on a beer bike for at least once, if they ever get the opportunity. ●

ASSET Econometrics
The eighth wonder of the world

Lustrum Activities

Reception

On Monday, April 29, we will open the Lustrum week with a formal reception! The Reception will start at 19.00 hours and it will take place at the Faculty Club. During the evening we will look back at the past five years and we will look forward to the upcoming week. Furthermore, the most import part of the reception will be the presentation of the almanac containing a lot of great memories.

Hangover Activity

After all the beers consumed at the Bollywood party, we have arranged an activity that will embrace your hangovers, let you regret the alcohol and gives you the opportunity to say: 'From now on, I will reduce my alcohol consumption'. With a lot of hangover food, the hangover movies and hangover members, this will be the best activity to recharge for the remaining part of the Lustrum week.

Company Day

During the Company Day you will have the opportunity to meet several different companies of your interest and maybe make the first steps to finding an internship or a possible employer. The program consists of cases, trainings, a business lunch and an informal dinner in the style of the Colosseum. The participating companies are Achmea, Capgemini, Deloitte, and Rabobank.

Active Members Day

After recharging, the Active Members' Day will take place on Friday. During this day the active members are thanked for their efforts in one of the committees of Asset | Econometrics. The activity for the Active Members' Day is still a secret, but it will be challenging and exciting.

Theme Party

The Theme Party will take place at De Heuvel Gallery. The wonder of the world is the Taj Mahal. To make it a little bit more festive, the theme of the party will be Bollywood. So, go to the store, find an amazing fabulous outfit and win the prize of best dressed Bollywood star. We have arranged a lot of free beers, amazing music and handmade decoration. Let yourself go into the world of Bollywood.

Gala

To end the Lustrum week in a spectacular way, the gala and dinner will take place on Saturday at the Villa de Vier Jaargetijden. Since Asset | Econometrics is the eighth wonder of the world, we assigned the Astrics theme to the most fabulous activity of the lustrum week: the gala. During the dinner and gala, active, passive and former members will be present.

Math & Music

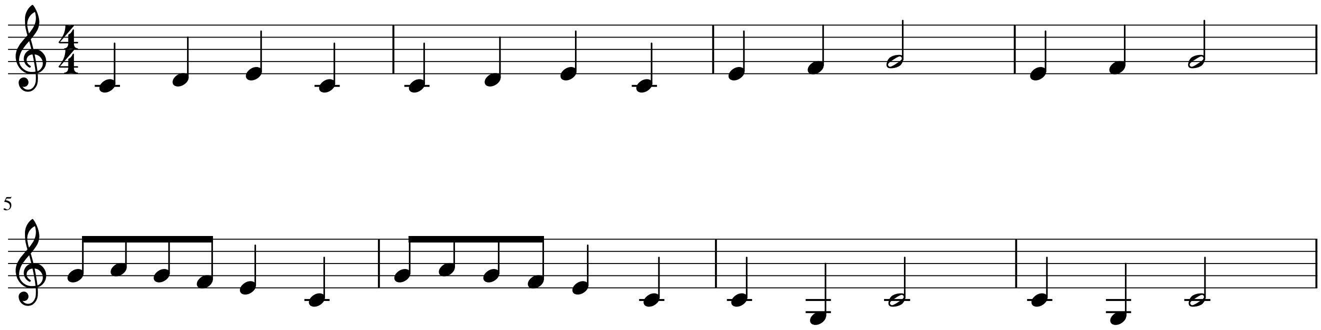
written by **Cas Slootweg**

Most people would consider music as an art and do not immediately associate mathematics with it. However, world-famous mathematicians like Euler and Pythagoras have studied music from a mathematical point of view. Musicians made the link as well: Mozart played a dice-game to come up with new pieces and Markov Chains are used in music education. Time to dive into the world of musical mathematics and mathematical music.

Before we can go to the more in-depth analysis, we first need to discuss the basics of music theory. There are seven notes in music, A-B-C-D-E-F-G-A', here A' is just an A, but then an octave higher. These are the white keys on a piano. Between most notes, there is a full tone separating them, only between B-C and E-F the distance is a semitone (half a note). Therefore, when we go from A to A' there are six full notes. Every full note is subdivided in two half notes, getting a total of 12 'steps' in each octave. For instance, between A and B there is the note A# dividing the interval between A and B in half. These are the black keys on a piano. Another building block of music theory is the concept of intervals between two notes. These notes can be played together or in sequence. The simplest interval is the unison, which is just the same note played twice. Starting from the unison (the 1st) there are eight intervals in an octave (octave comes from octo, Latin for eight). However, since there are 12 steps in an octave, some of these intervals are divided themselves. There is, for instance, the major and the minor 3rd. As a rule of thumb, all the minor intervals sound sad and the major intervals sound happy. A complete list of the intervals and the distance separating the notes are given in Table 1.

As you might already know, sound is just air vibrating. The rate at which this happens, the frequency, determines the pitch of the sound. The amplitude the sound wave corresponds to its volume. For instance, A_4 has a frequency of 440 Hz (440 times per second). Originally, intervals in music were defined by its frequency ratio. An octave has a ratio of 1:2, meaning that if we double the frequency of a note, we obtain the octave. Therefore, if we have a frequency of 880 Hz, the note is an A again, now denoted by A_5. With the same reasoning, we know that A_7 has a frequency of $880*2^2=3520$ Hz. For every interval such a ratio is defined. For the 5^{th} this is 2:3. However, there is a problem with this and Pythagoras was one of the first who rigorously studied this. As mentioned, there are six tones in an octave and the 5th comprises three and a half tones. Therefore, if we take seven octaves and twelve times the 5th interval, we end up at the same note (since 7*6=12*3.5=42). However, based on the frequency ratios we should also have that $2^7=(3/2)^{12}$, but this is not the case. In fact, if we divide the octave into twelve equal steps (by taking $\sqrt[12]{2}$ as a ratio for each semitone) and use this to construct

Brother John (Vader Jacob)



the 5th, we end up at a ratio of approximately 1:1,498. This problem was solved by just defining the ratios in such a way that they did not interfere with our concepts of intervals and tones. The result is that music, as we know it, is just slightly out-of-tune, in the sense that it does not consist of the pure or natural ratios. However, since we are used to it, music sounds just fine and instead the original ratios sound a little bit off-key to us. A ratio of 400:599 is closer to modern day tuning than 2:3, so the first will sound better than the latter.

So far it was assumed that a note has a single frequency. However, when an A_4 is played on an instrument, there are in fact multiple sound waves having a frequency of 440 Hz, 880 Hz, 1320 Hz, and so on. These are called overtones and which overtones at what volumes are formed determine the timbre (sound or klankkleur in Dutch) of the instrument. This is why the same note sounds differently on a saxophone, piano or a guitar. Different types of guitars have different overtone schemes themselves, giving each instrument its characteristic sound. A tone without overtones can be generated by a computer and sounds very unnatural. This is also the reason why autotune sounds so fake, the overtones constructed by the autotune algorithm do not resemble the overtones of a human voice. Our brains are so used to hearing overtones that it works the other way around as well. If we hear a note with a frequency of 880 Hz and a note with a frequency of 1320 Hz together, our minds will construct a (lower) note of 440 Hz in our heads. Together with the fact that modern day music is a little off compared to the natural ratio's, this shows that music is not only interesting from a mathematical point of view, but also for different fields like psychology and culture studies. In this article, only Western music is considered. It is worth nothing that some isolated tribes in Africa have a completely different view on music. Sad songs sound happy to them and the other way around.

Coming back to intervals and frequencies, there is this concept of consonance and dissonance. This is basically about whether two tones sound good (consonant) or bad (dissonant) together. Originally, the intervals were divided between the two classes. The 1st, (major and minor) 3rd, 4th 5th, (major and minor) 6th and 8th are consonant and the other intervals are dissonant. However, Euler thought we could do better than this. Rather than a binary classifier he developed a formula to calculate the level of consonance between two tones. His motivation was that although the minor 3rd and the 8th are both consonant, the octave still sounds better than the minor 3rd. He came up with a concept called softness which he related to the frequencies of each interval. For instance, the 1st has a frequency ratio of 1:1, this was defined as the first order of softness. The 8th has a ratio of 1:2, the second order of softness and both the ratios 1:3 and 1:4 have an order of 3. The lower the order of softness, the better two tones sound together. Every time we double the frequency, the order goes up by one. Further, he defined that each prime ratio (e.g. 1:2, 1:3, 1:5, 1:7,…) has the order of softness of that prime. Euler combined these two rules and came up with the Euler Gradus Function using the prime factor decomposition of a frequency:

$$E(n) = 1 + \sum_{k=1}^{r} a_k(p_k - 1)$$

Here E(n) is the order of softness, pk are the prime factors of a frequency and ak are the exponents of these prime factors. For instance, take 1:12. As 12 can be written as 2^2*3^1, the parameters are $p_1=2$, $a_1=2$, $p_2=3$ and $a_2=1$. If we plug this into our formula, we end up with an order of softness of 5.

However, so far, we have only considered frequencies larger than an octave, what about the ones within? According to Euler, it does not matter in which order or direction you stack the frequencies. For instance, 1:12 can be built up by first doing 1:4 and then applying 1:3. But one can also do 1:3 first and then go down by 4:1, leaving us at 3:4. By Euler's theory, both 1:12 and 3:4 must have the same order of softness. Therefore, 3:4 (which is the 4th) has an order of softness of 5 as well.

Name	Distance	Cons/Diss	Softness
1st (Unison)	0 tones	Consonant	Order 1
Minor 2nd	½ tone	Dissonant	Order 11
Major 2nd	1 tone	Dissonant	Order 8
Minor 3rd	1 ½ tones	Consonant	Order 8
Major 3rd	2 tones	Consonant	Order 7
4th	2 ½ tones	Consonant	Order 5
Tritone	3 tones	Dissonant	Order 14
5th	3 ½ tones	Consonant	Order 4
Minor 6th	4 tones	Consonant	Order 8
Major 6th	4 ½ tones	Consonant	Order 7
Minor 7th	5 tones	Dissonant	Order 9
Major 7th	5 ½ tones	Dissonant	Order 10
8th (Octave)	6 tones	Consonant	Order 2

Table 1

	g	C	D	E	F	G	A
g		2					
C	2	3	2	1		1	
D				2			
E		4			2		
F				2		2	
G				1	2	1	2
A						2	

Table 2

If we do this calculation for every interval within an octave, we get a more ordered list using Euler's Gradus Function than the classical binary division as shown in Table 1.

He generalized this to chords as well. A major chord consists of three notes, namely the 1st, the major 3rd and the 5th. This can be written as the combination of ratio's 4:5:6, as 4:5 is the major 3rd frequency ratio and 4:6 is equivalent to 2:3, which is the 5th. To calculate the order of softness, we should plug in the least common multiple of these numbers, which is 60 in our case. If we run this through our formula, we have an order of softness of 9 for the major chord.

Although it may not seem obvious, statistics and probabilities appear in music as well. Some composers used random draws when they did not have much inspiration. Mozart, for instance, played a little game which is came to known as "Musikalisches Würfelspel" (the musical dice game). For this he used 176 precomposed bars to write new music. He listed these in a table of 11 by 16. Each bar of the new composition corresponded to a column and the row was selected by throwing two dice. If the first throw resulted in a 2 and a 4 for instance, he picked (5,1) as the first bar of the new composition. With a second throw of 4 and 5, the second bar would be (8,2). The idea was to do this for all 16 bars and glue them all together to form a new piece. This gives 11 possibilities for each bar and considering there are 16 bars in total, there are 1116≈4.5×1016 new compositions to be made using this method.

One way of learning to write music is to study the great composers. In higher music education, students often get the assignment to compose a music piece in the style of Bach for instance. But what exactly is the style of Bach? Amongst other methods, Markov Chains provide a good way of analysing this. Think of music as a long chain of notes where each note (state) is followed by a different note (state). If we list which notes are followed by which, we can create a transition matrix for our Markov Chain. Then we can use this transition matrix to compose new music that sounds alike. A small example for Brother John (Vader Jacob) is given in Table 2 (here g denotes a low G). If we start at C, we can go to G', C, D, E and G for our second note. They have different probabilities and we can use a random number generator to pick one. Let's say the second will be G. Then from G we can only go to C again for our third note. If we repeat this process, we have 'written' a new song in the style of Brother John. Of course you can make this more complicated, by taking strings of notes as states (instead of single ones) and by factoring in the length of each note. Some scholars have used this technique to write music in the style of various composers, and with success.

Although it may not seem obvious at first, mathematics and music are intertwined. It shows that mathematics is everywhere and is applied in the most surprising fields. ●

Investment Guarantees

Many people value guarantees. If you buy an expensive new iPhone, you want to be sure that it either works properly or that your money is returned. These guarantees are often even legally obliged. Investments are different though. Here as well people would like to have guarantees. In a recent survey among more than 200 first year Bachelor students in economics in Tilburg some 60% of them prefers riskless investing of their pension wealth. Only 10% prefers risk taking. In the same questionnaire though more than 50% indicates that they are not willing to work more than the current one day a week (20%) to pay the pension contributions . Only a minority is willing to pay more. This questionnaire shows that there is a lot to be learned for first year bachelor students. I fear though that many others make the same mistake (first year econometricians as well as more senior students). Please check what your answer would have been in that survey before you continue reading!

In valuing investment guarantees people tend to forget an essential basic economic insight. Of course people dislike risk as well as high contributions. However, the two are connected through a budget constraint. Lower risk taking implies higher contribution rates (unless one is willing to accept lower income level in retirement, but that is rather unlikely). Students will not pass the exams if they argue in favor of less risk taking as well as low contributions rates…

Guaranteed future income is also a key point in the reform discussion on supplementary pensions in many countries. The Dutch solvency framework for pension income is built on the notion of guaranteed pension income but does not consistently implement investment strategies to assure that benefits are never cut. Stock markets dropped significantly in December 2018 and interest rates dropped further since. Cuts in pension benefits are again a very real possibility for a very large fraction of the Dutch retirees. Lack of clarity and consistency in pension contracts can be observed in other countries as well. In Denmark there have been court cases to decide whether the return guarantee on pension wealth were to be interpreted as an annual guarantee or as an average rate guarantee over many years. The implications of these two are drastically different.

In the Netherlands a farewell to guarantees was proposed in 2011 in order to better exploit investment opportunities. The labor unions initially agreed, but later referred to the lack of guarantees as "casino pensions" and the proposed reform was cancelled. The irony of history is that this lack of any form of guarantees is now a corner stone in the contract for supplementary pensions that was recently proposed by the labor unions and employers. It is a challenge for econometricians to address the question whether this is really the pension that people prefer. The complete lack of any guarantee seems extreme and it is tempting to think of a guaranteed pension income as of a certain age. The drawback of solutions with age dependent guarantees according to some is that solidarity is lost: poor investment returns pension incomes are no longer adjusted with the same percentage for all participants in a pension fund. This aspect is not reflected in the criterion functions that are typically used in economics. Many people moreover are likely to value the guarantee. Societal preferences and sound econometrics meet.

The preference for guarantees poses interesting questions that can be investigated, e.g, in BSc and MSc theses. In standard utility functions there is no role for guarantees. Extensions are available but often technically more demanding. A vital issue is also that no investment strategy can deliver the first best product. Bond markets for long maturities are very thin and illiquid. The most relevant guarantees are in terms of purchasing power but no assets are traded that can directly hedge Dutch inflation risk. These so called incomplete markets pose a substantial additional challenge in finding adequate investment strategies. ●

Theo Nijman
is professor of Financial Econometrics in the EOR and Finance departments. Theo is Scientific Director of Netspar, a knowledge network with eight universities and many private partners from the pension industry. Besides his academic work, he is heavily involved in pension regulation and reform in the Netherlands.

The History of Asset | Econometrics

written by **Jeffrey Buijk**

One hour after the COdE Beer Cantus ended, on March 15 Asset | Econometrics celebrated their 8th Lustrum. In 40 years, a lot has changed within our study association, starting from TEV (Tilburgse Econometristen Vereniging) on in 1979 until where we are now. Therefore, this is a great moment to look what has happened in the time that Asset | Econometrics exists.

Asset | Econometrics is the second-oldest study association connected to the Tilburg School of Economics and Management (TiSEM) and was originally named Tilburgse Econometristen Vereniging (TEV). TEV was founded by four fourth-year students; Annemie van de Ven, Jan Bogers, John Smits and August Swanenberg, who believed the number of activities focused on students in econometrics were scarce. The initial goal was to improve communication between students and teachers, but soon after TEV was founded, companies joined as a third party. One year after the foundation of TEV, the amount of members of our study association already exceeded 100. This number increased even more in 1983, caused by the possibility to buy books at TEV. In 2008, TEV was renamed to Asset | Econometrics, which was preceded by a long process concerning the formation of the faculty association Asset.

Once started in the Koopmans building, Asset | Econometrics has been housed in many different locations at the university. Via the Olympia building and the Reitse Toren, Asset | Econometrics ended up in the Esplanade building, where it is still located today. In the Esplanade building, Asset | Econometrics has had many different locations before it ended up in the rooms E1.10 and E1.23 in the summer of 2003. Since the summer of 2009, Asset | Econometrics got her third room, namely E1.09. In 2009, the idea of flex rooms was introduced. A flex room is a room that is shared by multiple Asset associations and it should improve the contact between active members and board members of Asset associations. Asset | Econometrics used to have a flex room with Asset | Accounting & Finance (E1.09) and with Asset (E1.23). Since 2015-2016, the rooms E1.09, E1.10 and E1.23 are completely in possession of Asset | Econometrics.

Activities

When Asset | Econometrics was just founded, the study association only had a few committees, such as a committee for organizing excursions and a committee for the magazine 'Cirkel', which was a precursor of Nekst. In these years obviously a lot has changed in the activities of Asset | Econometrics. To give an example the Astrics Beer Cantus is a well-known yearly activity within Asset | Econometrics. But what a lot of members probably do not know is that this cantus has only been organized for four years now. Before 2014-2015, Asset | Econometrics did not have a beer cantus for Asset | Econometrics members only.

Nowadays there is a huge variety in the activities you can join as an Asset | Econometrics member. Students can join formal activities, such as the Connection Day and the Econometrics in Practice Day. But there are also plenty of informal activities, such as the Active Members Weekend and the many drinks that are organized by Asset | Econometrics. There are also a lot of activities organized between different study associations of Asset, such as the Finance Expedition, between Asset | Econometrics and Asset | Accounting & Finance, and the Economic Business weeks Tilburg, which is aimed all Asset associations. Also, there are activities that are organized by all different econometrics study associations, namely the Landelijke Econometristen Dag (LED) and the Landelijke Econometristen Sport Toernooi (LEST).

But over the past years there has been one activity where a lot of active member are

looking forward to a whole year long: The Active Members Weekend. This activity has been organized since the study 2008-2009 and is traditionally a weekend with a big competition between groups, that are typically formed in such a way that members are placed by others who they did not know that well. Since its existence Asset | Econometrics has a large amount of traditions, which have changed over time. In the earlier years there was always an activity around the camping farm on the Friday evening. Also the chairmen of each committee would be 'turned', which means their mattress would be flipped over, while the chairman is sleeping on it. A tradition that is still being used is that the Saturday contains one or two activities with a bit of a sportive character and ends with a barbecue. The night has to be ended in a 'wrong' bar, but not empty, with all participants that are present.

Study Trips

When TEV was only a few years old, trips to different countries were an important activity on the Asset | Econometrics' calendar. In 1983, 4 years after the foundation of our study association, the first excursion abroad was arranged to Germany. After this, many kinds of study tours have been organized. First, this business trip was known as the Business Research Program. In the Business Research Program we would visit one city in which we would visit one company and furthermore learn more about the culture of the country. During this concept, TEV has visited different locations, that were both in Europe (such as Istanbul and Dublin) and outside of Europe (such as New York and Atlanta). In 2008, there was a fear that it would not be possible to find a company for the Business Research Program under the current concept and as expected, one year later this concern actually changed into truth. In 2009 the committee was not succeeding in finding a company for the Business Research Program. There were two companies, who were not interested in the current idea, but were willing to discuss the concept. Out of these conversations a new concept arose, the International Business Tour, in which several companies were visited, which led to a less intensive program.

The year after this new concept arose, it actually was not used straight away. In 2010 the choice was made to plan a normal study tour to a nice city: Moscow. But one year later, the new IBT concept was actually implemented and would not be deviated from until the day of today. Besides implementing the new concept, in 2011 also the amount of participants raised from 18 to 24. This was quite an important change, since in the upcoming years the amount of subscriptions would turn out to be quite high. The International Business Tour has visited many different cities since his foundation, of which most recently the most were East-Asian located cities, such as Tokyo, Hong Kong and Seoul.

Since the IBT became more popular and expensive over the years, which was mainly caused by the fact that the destinations became further away, not all students were able to join the trip. Therefore Asset | Econometrics decided to introduce the Lustrum Trip in the year 2013-2014. This Lustrum Trip, that would celebrate the 7th lustrum of Asset | Econometrics, would be a nice, cheaper and more accessible alternative, which is also open for first and second year students. At the start of the organization, two alternatives were considered, which were a ski-trip and a city-trip. Since it was only possible to let the Lustrum Trip last one weekend and this would be too short for a ski-trip, the first Lustrum Trip became a city-trip to Hamburg. Since the Lustrum Trip was really successful, it became a yearly trip to a destination in Europe. After hitch-hiking and visiting Ghent and Brussels,the board decided to make the Europe Trip bigger in the year 2017-2018. They decided to choose a destination further away, which was Prague and make the Trip 5 days instead of one weekend. Since this concept also was very successful, one year later, i.e., last February, the second Lustrum Trip went to Athens.

Nekst

Asset | Econometrics has already had their own magazine since their foundation, which was then named 'Cirkel'. After being renamed in 1988 to 'Tristichon', four years later the magazine did get the name we still know today, het Nieuw EKonometriSch Tijdschrift, or abbreviated as 'Nekst'. Nekst consists of a mixture of different articles of whom some have been the same for a long time and some are more changing over the time. Since a long time every edition includes an interview with a teacher, a present day issue or research that has something to do with Econometrics and reports of different activities within Asset | Econometrics, but there are also subjects that change over time such as "The parents of" and "Living in Lodges". Since the start of 'Cirkel' until the study year 2007-2008, the magazine of Asset | Econometrics has always been written in Dutch. This is caused by the fact that our study became more international, hence there were also more international members of Asset | Econometrics, who should also have the opportunity to read the Nekst. In 2016-2017 Nekst celebrated the 25th anniversary. Therefore in this year a special theme was made that was used at the frontpage of the Nekst as well as at every old articles in these Neksts.

In the year 2008-2009, Nekst was trying to get an interview with a famous or important person in every new edition. Since this was a success, Nekst continued with this concept in the upcoming years managing a lot of famous people. In the year 2010-2011, Nekst could interview Robert C. Merton, who is an American economist that has won the Nobel Prize in the field of economics. One year later Nassim Taleb, who is the writer of the well-known book Black Swan, which is about the impact of rare and unpredictable outlier events and the human tendency to find simplistic explanations for these events. In 2014 Eva K. Lee, who is the director of the Center for Operations Research in Medicine and Heathcare in the US, was interviewed.

LaTeX for Dummies

written by **Guus Vlaskamp**

When writing any kind of mathematical or scientific document the econometrician usually encounters a rather time-consuming problem: getting your derivations and equations from your handwritten paper to the computer. Microsoft Word and most other text processors designed for the general public are quite ill-equipped for these specific tasks and probably around 90 percent of econometrics students have cursed at their computer more than once for outlining their equation precisely not where they intended it to go. That is, if they are not already using LaTeX.

LaTeX, pronounced <<Lah-tech>>, is a document layout system designed specifically with technical and scientific documents in mind. It is however not a word processor, meaning you do not always write what you want to see. In WYSIWYG ("What you see is what you get") processors such as Microsoft Word you would first select the desired layout and start typing, whereas in LaTeX we use commands to define the layout and behaviour of specific pieces of information. However, before we get to the actual functionalities of LaTeX, we first need to find a program that translates our LaTeX code into actual documents. A widely used program for this is Overleaf. When using LaTeX, Overleaf can be of great help by continually pre-processing and displaying the work we have done. When first embarking on a document-creating adventure any existing code might seem a bit alien, and hard to interpret to the uninitiated. Documents are usually filled with commands and environments, so let's explain these concepts.

Commands

Whenever we want to tell the program to change the layout of any text, create special objects such as small pieces of mathematics, or format information such as the title of the document or its author we use commands. All commands start with a \, and apply to everything within { }. So if we want to make a word bold, we use the command \textbf{word}.

LaTeX is somewhat like a programming language in these regards. Do not get discouraged by the use of commands in documents,it will become second nature to quickly define what you want the text you are writing to look like in no time.

Environments

To define longer objects in your documents such as figures, tables, or multiline equations, we use environments. An environment starts with \begin{name of environment} and ends with \end{name of environments}, the environment we use defines the behaviour and layout of the information that is used as input. In this way we are able to create many layouts and objects, other than plain text.

Getting started

Using LaTeX over the usual word processors is of definite value for all econometrics students, however starting off might seem a bit daunting. Do not let the multitude of applications and possibilities scare you away. Start using it with simple plain text, use Google and StackExchange to research problems you encounter, since you will never be the first one needing a solution for it. Learn while doing, and in no time you will be creating the neatest of documents.

Useful concepts:
The following examples display the endless possibilities of LaTeX, along with the code needed to create these pieces of information. There are many more commands and environments in addition to these, this is just a small insight into the capabilities of LaTeX.

Basic Mathematics

```
\[\sum_{i=1}^n x^2_i = x \left( \frac{\log_3(x^2)}{\int_{-\infty}^6
e^{2x+3}} \right)\]
```

$$\sum_{i=1}^n x^2_i = x \left(\frac{\log_3(x^2)}{\int_{-\infty}^6 e^{2x+3}} \right)$$

Graphs and figures

```
\begin{figure}[b]
\begin{center}
\includegraphics[width = 0.3\textwidth]{latex_course_
graph.eps}
\caption{A matlab-generated graph}
\end{center}
\end{figure}
```

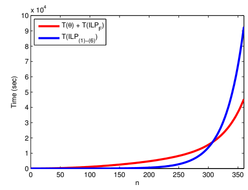


Figure 2: A matlab-generated graph

Equations

```
\begin{figure}[b]
\begin{center}
\includegraphics[width = 0.3\textwidth]{latex_course_
graph.eps}
\caption{A matlab-generated graph}
\end{center}
\end{figure}
```

$$\begin{aligned} \max\ & 3x_1 + 2x_2 - x_3 \\ \text{s.t. } & 2x_1 \leq x_3 \\ & x_2 + x_3 \leq 5 \\ & x \geq 0 \end{aligned}$$

Tables

```
\begin{table}[b]
\begin{center}
\begin{tabular}{c|cc}
Test & \(\mu\) & \(\sigma\)\\ \hline
1 & 4.00 & 0.23 \\
2 & 4.21 & 0.21 \\
3 & 3.98 & 0.24 \\
\end{tabular}
\caption{\label{table 2}Use \textbackslash hline and "\(|\)" to
add lines}
\end{center}
\end{table}
```

Test	μ	σ
1	4.00	0.23
2	4.21	0.21
3	3.98	0.24

Table 2: Use \hline and "|" to add lines

Matrices

```
\begin{equation}
\label{eq with matrix}
\begin{bmatrix} 1& 4& 3\\
0& 12& 2\\
14& 2& 0 \end{bmatrix} \begin{bmatrix}x_1 \\ x_2 \\ x_3\
end{bmatrix} = \begin{bmatrix}
3 \\ 2 \\ 0
\end{bmatrix}
\end{equation}
```

$$\begin{bmatrix} 1 & 4 & 3 \\ 0 & 12 & 2 \\ 14 & 2 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 3 \\ 2 \\ 0 \end{bmatrix}$$

Dynamic Asset Allocation and Consumption under Time-inconsistent Preferences

The exponential discounted-utility model has been subject to considerable criticism, since it induces time-consistent behaviour. A substantial body of experimental evidence suggests that time inconsistency is standard in human nature. We examine optimal life-cycle behaviour under time-inconsistent preferences. The results show that a timeinconsistent individual consumes and invests differently than an individual with time-consistent preferences.

written by **Jorgo Goossens**

Since its introduction by Samuelson in 1937, the exponential discounted-utility model has dominated economic and financial analyses. However, over the last two decades, experiments have uncovered a wide range of phenomena that violate the assumptions of the discounted-utility model. The key assumption underlying the discounted-utility model is that a person's preference for consumption at an earlier date over a later date remains the same no matter when he is asked. Formally, this is time-consistent behaviour and, mathematically, we capture this by exponential discounting.

But, the example of Nobel laureate R. Thaler (2017) demonstrates that this assumption may be easily violated:

(A)	Choose between:	(A.1)	One apple today
		(A.2)	Two apples tomorrow
(B)	Choose between:	(B.1)	One apple in 50 days
		(B.2)	Two apples in 51 days

Experimental evidence finds that people tend to prefer (A.1) over (A.2), but at the same time they prefer (B.2) over (B.1). While if people reconsider their choice at day 50, then they prefer (B.1) over (B.2). That is, people behave time inconsistent, because they pursue immediate gratification and they are unable to stick to their initial plan. If one would believe the exponential discounted-utility model, then individuals are rational and consider the choices (A) and (B) identical at each point in time.

The example provides three observations. Firstly, preferences between two delayed rewards reverse. The key driver is immediate gratification, also known as present bias. Secondly, to capture this reversal, discount rates have to depend on time. Namely, the discount rate in the short run is larger than the discount rate in the long run (Thaler, 1981). Thirdly, when we fit mathematical functions to such experimental data, a hyperbolic discount function provides a better fit than exponential discount functions. The reason is that hyperbolic functional forms impose declining discount rates, rather than constant discount rates from the exponential discounted-utility model (Frederick et al., 2002).

Formalisations

These observations lead to the following proposition.

Proposition 1. *Preferences are time consistent if and only if the discount function is exponential, implying that the (instantaneous) discount rate is independent of time t.*

Proof. Along the lines of Loewenstein and Prelec (1992), available upon request. □

Any other discounting pattern leads to time-inconsistent preferences. The hyperbolic discounting model has become the most widely accepted framework for modelling time-inconsistent preferences. But, how to maintain analytical tractability and interpretability? To this end, we introduce a quasi-hyperbolic discount structure that mimics the properties of generalised hyperbolic discount functions, but maintains the tractability and interpretability of exponential discount functions.

Definition 1. *A discount function $\phi_t(s)$, with current time s and future consumption time $t \geq s$, represents quasi-hyperbolic time discounting if*

$$\begin{aligned} \phi_t(s) &= e^{-\delta(t-s)} \text{ if } t \in [s, s+\tau) \\ \phi_t(s) &= \beta e^{-\delta(t-s)} \text{ if } t \in [s+\tau, \infty), \end{aligned} \tag{1}$$

with $\beta \in (0,1]$ and $\delta \in (0,1]$.

The parameter δ is the standard exponential discount factor and captures the long-run time-consistent impatience. The parameter β is the present-bias factor and captures the time-inconsistent preference for immediate gratification. This quasi-hyperbolic discount structure compares future periods with each other using exponential discounting, but hits all future periods with an additional β. This structure nests the exponential discounted-utility model, namely if $\beta = 1$. Here, $[s, s+\tau)$ is the present interval and $[s+\tau, \infty)$ is the future interval. The duration of the present interval is τ and, for now, is taken to be 1 (Laibson, 1997).[1] Figure 1 shows

[1] τ may be stochastic and exponentially distributed with arrival rate parameter λ, also known as stochastic hyperbolic discounting (Harris and Laibson, 2013).

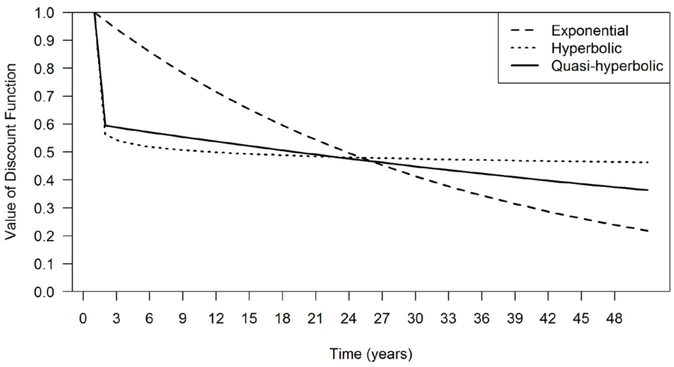


Figure 1: Three discount functions for a period of 50 years.

the three discount structures: exponential discounting is constant, while (quasi-)hyperbolic discounting declines faster in the short run, but remains constant thereafter.

The problem

We now show how in general time preferences can be incorporated into a traditional life-cycle framework. We treat exponential and hyperbolic discounting as special cases. We take the dynamic asset-pricing framework of Merton (1969), whereby the dynamics of the interest rate are governed by a Vasicek (1977) one-factor model. For this reason, we have two sources of risk in the economy. Consequently, there are three available asset classes: stocks, bonds and cash. The goal is to solve for the optimal consumption path and the optimal investment strategy for a retiree. The solution technique is the martingale method from Cox and Huang (1989).

The idea is to allocate total initial pension wealth W_t to n individual pension pots during the retirement phase of length T_n. The individual reserves money for each pension pot j such that his utility is maximised. To achieve the optimal pension pot amount $W^*_{t,T_j,t+h}$ at time t under pension payment $T_j \geq t$ for future date $t+h$, the individual uses an optimal individual investment strategy $\pi^*_{t,T_j,t+h}$ to finance his pension pots throughout retirement. The individual solves the following problem at each time t for every pension payment T_j and for every in between future date $t+h$:[2]

$$\max_{W_{t,T_j,T_j}\, j=1,\ldots,n} \mathbb{E}_t \left[\sum_{j=1, t\leq T_j}^{n} \phi_{T_j}(t) u(W_{t,T_j,T_j}) \right], \tag{2}$$

[2] Note that $h = 0, \ldots, T_j - t$ is the planning horizon and $j = 1, \ldots, n$ indicates the pension payment date T_j.

subject to his budget constraint

$$\mathbb{E}_t \left[\sum_{j=1, t\leq T_j}^{n} W_{t,T_j,T_j} M_{T_j} \right] = W_t M_t. \tag{3}$$

Here, W_t equals wealth from the previous period including returns on optimal investment in the three assets, minus consumption. Please notice that if $j = 1$, we solve a simple one-period terminal wealth problem.

The instantaneous interest rate r_t evolves according to an Ornstein-Uhlenbeck process

$$dr_t = \kappa(\theta - r_t)dt + \sigma_r dZ_{r,t}, \quad r_0 = 1.7\% \tag{4}$$

where the parameter θ describes the long-run mean of the instantaneous interest rate r_t, κ describes the degree of mean reversion, σ_r is the instantaneous interest rate volatility and $Z_{r,t}$ is a standard Brownian motion. Since we adopt the martingale method, we assume throughout the absence of arbitrage and, thus, the existence of a stochastic discount factor process M_t. The dynamics follow from the stochastic differential equation:

$$\frac{dM_t}{M_t} = -r_t dt - \lambda_S dZ_{S,t} - \lambda_r dZ_{r,t}, \quad M_0 = 1 \tag{5}$$

where λ_S and λ_r are the prices of risk for equity and interest rate exposure, respectively. To find explicit results for the optimal consumption path and the optimal investment strategy, we need an intermediate lemma.

Lemma 1. *The conditional expectation at time t of the stochastic discount factor at time $T > t$ for positive α is*

$$E_t\left[M_T^\alpha\right] = M_t^\alpha e^{\frac{1}{2}\alpha(\alpha-1)v^2(t,T)} \left(P(r_t; t, T)\right)^\alpha, \tag{6}$$

where

$$P(r_t; t, T) = \exp\left(A(\tau) - B(\tau) r_t\right), \quad \text{with } \tau = T - t \tag{7}$$

$$A(\tau) = (B(\tau) - \tau) R_\infty - \frac{\sigma_r^2}{4\kappa} B(\tau)^2, \tag{8}$$

$$\text{with } R_\infty = \theta - \frac{\lambda_r \sigma_r}{\kappa} - \frac{1}{2}\frac{\sigma_r^2}{\kappa^2}, \tag{9}$$

$$B(\tau) = \frac{1}{\kappa}\left(1 - \exp(-\kappa\tau)\right), \tag{10}$$

and where

$$v^2(t,T) = \frac{\sigma_r^2}{\kappa^2}\left[\tau - B(\tau) - \frac{\kappa}{2} B(\tau)^2\right] + (\lambda_S^2 + \lambda_r^2)\tau + \frac{2\sigma_r}{\kappa}\lambda_r\left[\tau - B(\tau)\right]. \tag{11}$$

Proof. Available upon request. □

At a less formal level, equation (6) follows directly from the properties of a log-normal distribution, by using the expectation and variance over $\int_t^T r_u du$. $P(r_t; t, T)$ is just the price at time t of a zero-coupon bond with maturity T. Moreover, R_∞ is the limit of the term structure as T approaches infinity, such that this term describes the yield to maturity for a very long bond. Besides, $v^2(t, T)$ is the variance of the logarithm of the stochastic discount factor.

Optimal consumption

Now, we have all the ingredients in place. Standard calculations using the Langrange method, and the fundamental pricing equation, lead to the optimal consumption path. We assume an investor with CRRA utility and risk aversion parameter γ.

Theorem 1. *The optimal allocation of wealth over the pension pots for a general discount function $\phi_{T_j}(t)$ equals*

$$W^*_{t,T_j,t+h} = \frac{1}{M_{t+h}} \mathbb{E}_{t+h}\left[W^*_{t,T_j,T_j} M_{T_j}\right]$$
$$\propto \phi_{T_j}(t)^{1/\gamma} \exp\left(-\frac{1}{2}\frac{\gamma-1}{\gamma^2} v^2(t+h, T_j)\right)$$
$$\cdot \left(P(r_{t+h}; t+h, T_j)\right)^{1-1/\gamma}.$$

Proof. Along the lines of Balter and Werker (2016), and Grebenchtchikova et al. (2017); available upon request. □

The optimal consumption path $W^*_{t,T_j,t+h}$ depends on three terms: the general discount function (i.e. exponential or hyperbolic), the variance of the stochastic discount factor and the bond prices in the financial market.

Figure 2 presents the optimal consumption rate (i.e. consumption divided by total wealth) during each year t in retirement for four types of individuals. We make two observations. Firstly, hyperbolic discounters have a higher consumption rate than time-consistent exponential discounters.[3] Namely, due to the present bias, hyperbolic discounters always prefer current consumption over delayed future consumption by means of their preference for immediate gratification. Hyperbolic discounters finance current consumption by extracting money from later pension pots and, thereby, saving less for the future. As a result, their (early current) consumption levels are high, while remaining wealth levels continue to deplete due to the present bias. As such, present-biased individuals have substantially lower consumption levels at higher ages than their time-consistent counterparts.

Secondly, a present-biased risk averse individual has the lowest consumption rate. Although this individual is present biased, the risk aversion dominates by means of a strong preference for a smooth consumption path. As a result, this individual consumes less today, but saves more for the future.

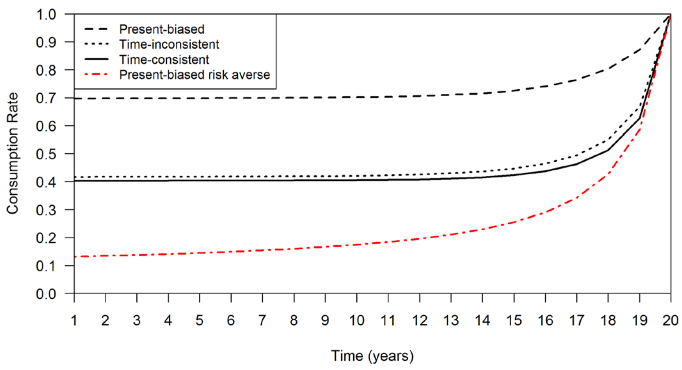


Figure 2: Consumption rate during retirement.

Optimal asset allocation

To finance its consumption, the individual follows an investment strategy. He bases his investment strategy on the available assets in the financial market. The menu of assets consists of stocks, bonds and cash. Mathematically, the dynamics of the three assets are, respectively:[4]

$$\frac{dS_t}{S_t} = (r_t + \lambda_S \sigma_S)dt + \sigma_S\left(\rho dZ_{r,t} + \sqrt{1-\rho^2} dZ_{S,t}\right),$$
$$\frac{dP(r_t; t, T)}{P(r_t; t, T)} = (r_t - \lambda_r \sigma_r B(T-t))dt - \sigma_r B(T-t) dZ_{r,t},$$
$$\frac{dB_t}{B_t} = r_t dt, \tag{12}$$

where Z_S and Z_r are standard Brownian motions, σ_S is the stock volatility and ρ determines the degree of correlation between both shocks in the economy.[5,6,7]

Now, we can construct an individual wealth process that evolves according to an investment strategy $\pi_{t,T_j,t+h}$ based on the three assets. By equating the exposures to the diffusion

[3] Hyperbolic discounters are those who are time inconsistent, and if they behave highly time inconsistent, then we call them present-biased individuals.

[4] We need some starting values: $S_0 = 1$, $P(r_0; 0, h) = 1 \forall h$, $B_0 = 1$.

[5] Dividends from the risky investment are assumed to be reinvested.

[6] One could also use constant maturity bonds in the analysis.

[7] The processes have an interpretation which is sometimes referred to as factor investing or beta pricing.

terms in the optimal consumption path with the individual wealth process, we find the optimal investment strategy per pot.[8]

Theorem 2. *The optimal portfolio weights per pension pot at time t for a stock and a bond, with maturity h under investment horizon T, equals*

$$\pi_S^* = \frac{\lambda_S}{\gamma\sigma_S\sqrt{1-\rho^2}},$$
$$\pi_P^*(t,T,h) = \left(1-\frac{1}{\gamma}\right)\frac{B(T-t)}{B(h-t)} - \frac{\lambda_r}{\gamma\sigma_r B(h-t)} + \frac{\rho}{\sqrt{1-\rho^2}}\frac{\lambda_S}{\gamma\sigma_r B(h-t)},$$

while the remainder is invested in the risk-free asset

$$\pi_B^*(t,T,h) = 1 - \pi_S^* - \pi_P^*(t,T,h).$$

The result is identical to the findings of Sorensen (1999), and Brennan and Xia (2002). The optimal stock allocation is independent of time, while the optimal bond allocation depends on the remaining investment horizon $T-t$. Moreover, notice that the speculative part of the portfolio is

$$\frac{\lambda_S}{\gamma\sigma_S\sqrt{1-\rho^2}} - \frac{\lambda_r}{\gamma\sigma_r B(h-t)} + \frac{\rho}{\sqrt{1-\rho^2}}\frac{\lambda_S}{\gamma\sigma_r B(h-t)}, \tag{13}$$

while the hedging term equals

$$\left(1-\frac{1}{\gamma}\right)\frac{B(T-t)}{B(h-t)}. \tag{14}$$

There are two special types of investor. Firstly, an investor with log-utility preferences that arises if $\gamma = 1$. A log-investor has no hedging demand, but only speculative demands. Secondly, an extreme risk-averse investor that arises if $\gamma \to \infty$. This investor follows a a simple investment strategy: hedge all risks by investing 100% in a bond equal to the remaining investment horizon, and stay out of risky stocks.

Theorem 2 is the optimal investment strategy per pension pot and, clearly, is independent of time preferences (i.e. no discount function nor β, δ in the results). To see the effect(s) of time-preferences, we are currently researching the aggregated investment strategy over all pension pots. Preliminary results show that time-inconsistent, or present-biased, investors also invest differently than time-consistent individuals. More specifically, hyperbolic discounters seem to demand less interest rate exposure, or invest more in short-term bonds or cash. The reason would be that time-inconsistent individuals have subjective small investment horizons and, therefore, prefer more short-term investments. For this reason, time-inconsistent preferences may be an explanation for the risk-free rate puzzle prevailing in the asset-pricing literature.

[8] Please note that the maturity h, previously introduced as the future date in consumption, not necessarily equals the investment horizon. Therefore, it should not be confused with the investment horizon T.

Conclusion

A substantial body of experimental evidence suggests that time-inconsistent preferences play an important role in determining how people evaluate intertemporal decisions. We incorporate this idea into a behavioural life-cycle framework to improve our understanding of consumption and investment behaviours by refining the way we model time preferences in general. In particular, we consider two special cases: exponential discounting for time-consistent preferences and (quasi-)hyperbolic discounting for time-inconsistent preferences. Due to a present bias, time-inconsistent individuals have a higher consumption rate. Consequently, they also tailor their investment strategy towards this consumption pattern.

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Data Science and Football

Sports helps us stay in shape and clear our minds, and we simply love it for the excitement. A win feels great, and we can just blame a loss on the referee or the field, or blame it on bad luck. Or, perhaps, your opponent turned to math, and you did not. Has data analytics got a hold of the chaotic nature of sports? We lift the corner of the veil by presenting two examples of data analytics in football.

written by **Stefan ten Eikelder**

The Moneyball story (a 2003 book and 2011 movie) is credited with bringing attention to the potential of math and statistics in sports. It describes the real-life story of how the Oakland Athletics baseball team used a data-driven approach to player selection in their 2002 season. They continued to win 20 consecutive games, a record broken only in 2017.

Since then, an enormous progress in the field of sports analytics has been made. Most of this was in the typical US sports such as baseball and American football. The main reason for this is probably that these sports are relativly closed, consisting of individual events, making them more suitable for data analytics. However, we will leave the US sports for what they are, and focus on data analytics in the most popular sports in the world: football. Elsewhere in this magazine you will find Maurice Peters' Practical Report on the use of data analytics to predict the future performance of individual football players. Here we take an alternative approach, and try to determine how passes and shots contribute to the outcome of a game.

Let us start with pointing out the main challenge in data analytics for football: the events we are interested in, goals, typically happen very rarely. Hence, it is hard to see how other, more frequently occurring, events such as passes relate to goals. For example: how do we quantify any player's performance if a game ends in 0-0?

Many currently used metrics are flawed. For instance, an assist credits the player who gave the final pass before a goal is made. However, a successful attack that leads to a goal may consist of multiple passes, and the last passes is not necessarily the most important one. Also, whether or not an excellent pass is turned into an assist depends on the quality of the shot and the quality of the goalkeeper as well.

Quantifying pass quality

A model that quantifies the quality of a pass by estimating the influence it has on the likelihood of a shot is developed in [1]. As shots are typically seen as favorable outcomes, one could hypothesize that passes that lead to shots are 'good' passes. They focus on the locations (origin and destination) of passes, to identify what types of passes tend to lead to shots. Figure 1 shows their discretization of the pitch.

A pass location is represented by a vector indicating the closeness of the location to each zone in Figure 1. Let $d(l, z_i)$ denote the Euclidean distance between the pass location l and the center of zone i, denoted z_i. The closeness of pass location l to zone i is defined as

$$r_i^l = \frac{c_i}{\max\{d(l, z_i), 1\}}, \tag{1}$$

where c_i is a binary parameter indicating whether zone i is one of the N closest zones. A value $N = 2$ turns out to work best. The lower bound of 1 in the denominator avoids very high closeness values. Now, any pass can be represented by two vectors $\boldsymbol{r}^{l_o}$ and $\boldsymbol{r}^{l_d}$ for the origin and destination location, respectively. The next step is to construct a matrix $R^{l_{od}}$, which is the outer product of vectors $\boldsymbol{r}^{l_o}$ and $\boldsymbol{r}^{l_d}$. This matrix describes the pass from origin l_o to destination l_d. Subsequently, we construct a feature vector for this pass. This vector contains the origin and destination vectors and a vectorized version of the matrix $R^{l_{od}}$.

Now, what is the value of this pass? We wish to relate this feature vector to some quantifyable outcome. In order to answer this question, we assign the pass to a *possession*. A possession is a period of time in which one team controls the ball, without losing it to the other team or the play being interrupted. A possession contains a number of passes; only possessions of at least three passes are taken into account. Any possession ends at some point; it ends either with a shot $(y = 1)$ by the offensive team or not $(y = -1)$. The feature

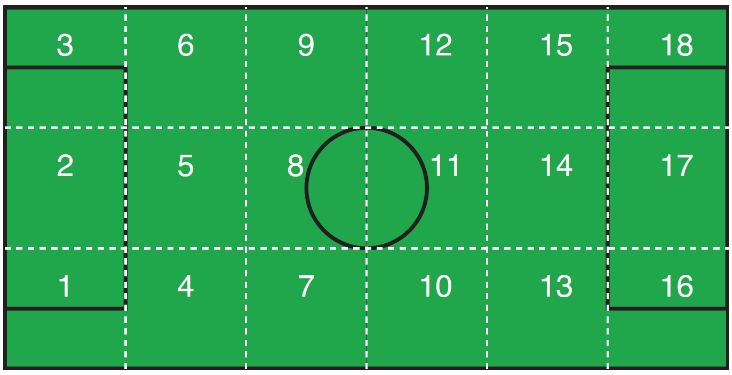


Figure 1: Pitch discretization used in [1].

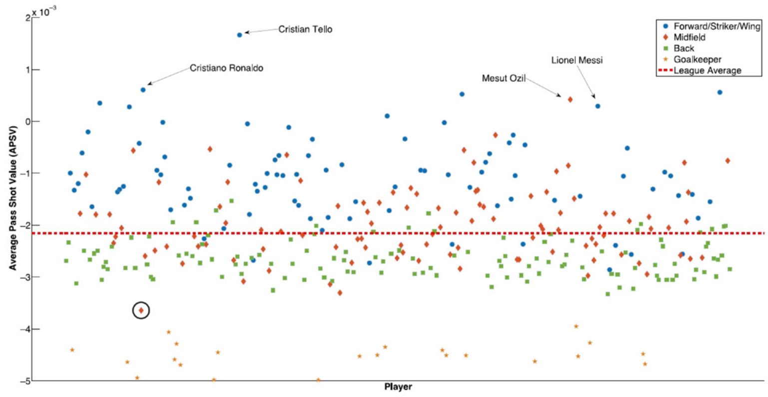


Figure 2: Average Pass Shot Value of Spanish La Liga Players 2012-2013

vector of the possession is defined as the average of the feature vectors of all passes in this possession.

Using this data set, [1] trained a linear support vector machine (SVM) to predict whether a possession ends in a shot or not. Ball-event data from the 2012-2013 season of the Spanish La Liga is used. On average, teams made 18,000 passes and attempted 500 shots in the entire season. The result are weights for all input features: a vector $\boldsymbol{w}^o$ for the pass origin locations, a vector $\boldsymbol{w}^d$ for pass destination locations and a vector $\boldsymbol{w}^{od}$ for the origin-destination pairs.

Now, what insights does this give us? First of all, we can see what features are most influential in shot predictions. It turns out that of the ten most influential features (positive or negative), eight are related to zone 14, which is the center zone right outside the penalty area. Six of these have a positive influence: origin-destination pairs (14-18), (16-14), (15-14), (18-14), (14-13), and the destination feature "14". Relating this back to Figure 1, we learn that getting the ball near the center area in front of the penalty area may lead to shot opportunities. However, pairs (9-14) and (5-14) have negative weight, implying that long passes to area 14 tend not to lead to shot opportunities.

What else can we do? In [1], the model weights are used to compute a Pass Shot Value (PSV, acronym unrelated to the Dutch club). The PSV of a pass with an origin in zone i and a destination in zone j is computed as

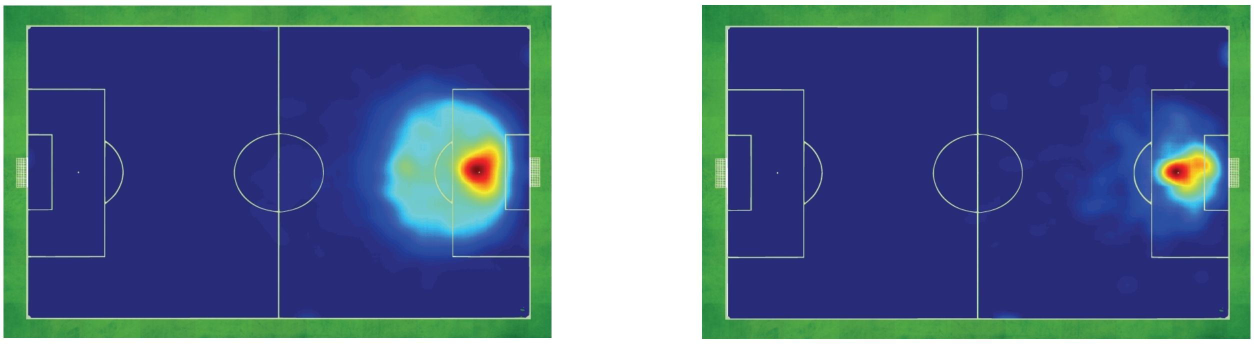
$$\text{PSV}(i,j) = w_i^0 + w_j^d + w_{ij}^{od}. \tag{2}$$

Subsequently, averaging this over all passes an individual player has given, gives an understanding of how the passes of this player contribute to creating shot opportunities. Figure 2 gives the average PSV for all players in the data set who completed at least 200 passes. First of all, average PSV is negative for most players. This is as expected, as most possessions do not lead to shots. We see that indeed players in offensive positions more often make passes that are associated with shots. Moreover, a few well renowned players such as Ronaldo and Messi indeed score well on this indicator. Furthermore, at the bottom-left we see a midfielder (circled diamond), whose passes turn out to have an extremely poor contribution to shot creation. Perhaps its simply due to his playing style or particular role in the team, but this is surely interesting information for his coach.

From shot to goal

Although shots are generally perceived as being an indicator of dominance in the game, its not quite that simple. Any (self proclaimed) football expert will agree that not all shots are equal. In [4] the factors that influence the probability of a shot resulting in a goal are studied. Figure 3 nicely demonstrates that the location of the shot plays a major role. Secondly, Table 1 shows that the game context is important.

Next to these two factors, they consider various spatiotemporal factors. These are more and more available for sports



(a) All shots

(b) Shots that resulted in a goal

Figure 3: Location distribution of shots

Context	Shots (goals)	Percentage
Open play	6467 (534)	8.3%
Counter attack	1116 (166)	14.9%
Corners	1115 (100)	9.0%
Penalties	94 (67)	71.3%
Direct free kick	539 (26)	4.8%
Indirect free kick	388 (39)	10.1%

Table 1: Shots and goals per game context

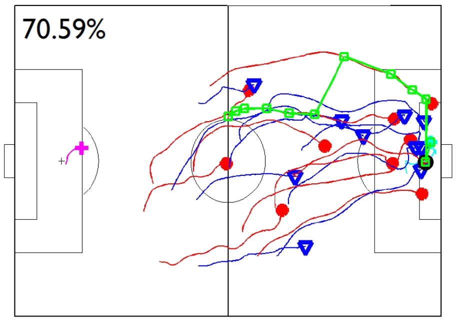


Figure 4: Team red is attacking from left to right, team blue defending, ball in green. EGV = 70.59%.

analytics due to advanced player and ball tracking methods. At any point in time during the game, the position of the ball and all players is registered. This allows [4] to take into account whether for a particular shot there were any defenders between the ball and the goal. If so, their Euclidean distance from the ball is taken into account. Lastly, various features that capture the structure of the defensive and offensive team are constructed from the spatiotemporal data. For instance, the pace of moving offensive players is added as a feature.

Using logistic regression, the likelihood of a shot resulting in a goal is estimated. This estimate is named the Expected Goal Value (EGV). Figure 4 shows an example with an EGV of 70.59%. A left-wing player controls the ball, with no defender close by. The ball is passed in the penalty area behind the 4 defenders. On average, approximately 7 out of 10 of shots attempted under those circumstances result in a goal. Next to analyzing individual goal attempts, in [4] the EGV is also used to estimate the expected number of goals of a team in an individual match and in an entire season.

Tip of the iceberg

There is a wealth of recent data analytics applications to football (and sports in general). In [2], a K-means algorithm is used to cluster teams based on their use of various passing styles. In [3], deep imitation learning is used to predict what a defensive player should have done in a particular situation, instead of what they actually did.

At this point you may wonder whether these methods are actually used, or are merely an academic exercise. To give you some clues: data analytics companies like 21st Club and SciSports are assisting both clubs and individual players in gaining a competitive edge. For instance, the latter company played a crucial role in the transfer of the Dutch star Memphis Depay to the French club Olympique Lyon. Another example: the Danish club FC Midtjylland installed an analyst as chairman in 2014, and proceeded to win their first ever Danish league title within one year. Remarkable, to say the least.

References

[1] Brooks et al. Developing a data-driven player ranking in soccer using predictive model weights. In: Proc. 22nd ACM SIGKDD International conference on knowledge discovery and data mining

[2] Gyarmati et al (2014) Searching for a unique style in soccer. In: Proc. 2014 KDD workshop on large-scale sports analytics

[3] Le et al. (2017) Data-driven ghosting using deep imitation learning. In: Proc. 11th Annual MIT Sloan sports analytics conference

[4] Lucey et al. (2015) "Quality vs Quantity": Improved shot prediction in soccer using strategic features from spatiotemporal data. In: Proc. 8th Annual MIT Sloan sports analytics conference

The Committee That Helps You Lose Your Beer Belly

Luuk Sommers

Bachelor EOR

Age: 20

For those of you trying to lose their beer belly and for those still trying to conceal it, we are here to help you out! As the new sport committee for 2019, we are going to make sure every econometrician in Tilburg stays in good shape.

For this important task a team of 5 was assembled. Our chairman Lotte, who is also the only woman on the team, will lead us through a successful year. This year's treasurer is Hugo and Luuk is our secretary. Last but not least, the two Jorisses complete our team. Together we form the second sport committee. If we are not at the rooms in E, we are probably lifting weights or doing other sporty business.

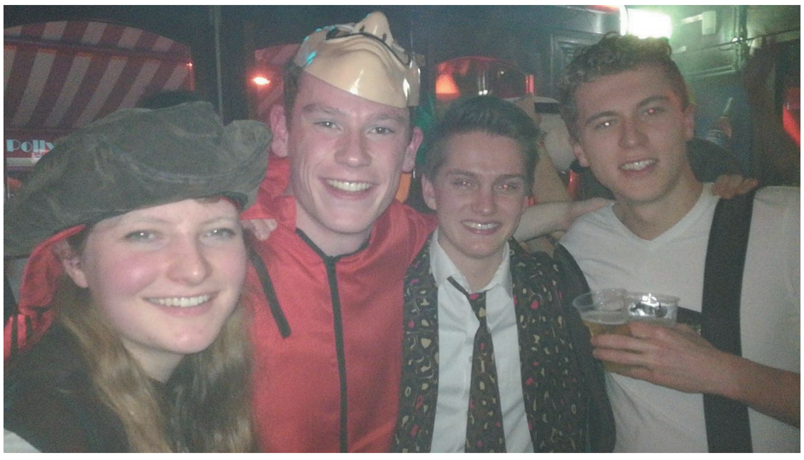
After the committee switch last February, we took on all sport tasks of the previous committee, starting with the squash ladder. This is a squash competition for all (former) econometrics students, set up by the previous committee. In this competition you play a squash match once every two weeks against someone that has the same squash skill level as you. By winning games, one can climb the ladder and ultimately become the new squash ladder champion! The ladder is an ever-growing competition, welcoming all econometricians (even the ones that have never held a squash racket before). Of course, we, as the new sport committee, also participate in the squash ladder. We think it is a fantastic way to stay in contact with fellow students and to working on your summer body at the same time. If you are interested, you can always subscribe on the Asset | Econometrics website.

We are very excited about this year's first large event that we will organize for Asset. This will be the Batavierenrace, a yearly event that will be organized for the 47th time upcoming May. The Batavierenrace is a relay race with over 350 teams running from Nijmegen to Enschede. The roughly 8,000 participating students, including a team of 25 Asset members divided over the Econometrics and IBA departments, will run in stages over 175 kilometers. After the heroic finish, everyone gets their well-deserved pint at the huge afterparty that will take place at the University of Twente amongst 13,000 other students. We will do our best to arrange everything as smooth as possible and to make this a weekend to remember.

At the end of the semester another yearly event takes place: the Asset | Econometrics Sport Tournament! The sport committee will organize a soccer and beach volleyball tournament for all econometrics students, which is an opportunity for you to show everyone how fit you have become after all the squash matches you won. Furthermore, upcoming autumn and winter we will organize a few more events to keep everyone healthy and off the streets.

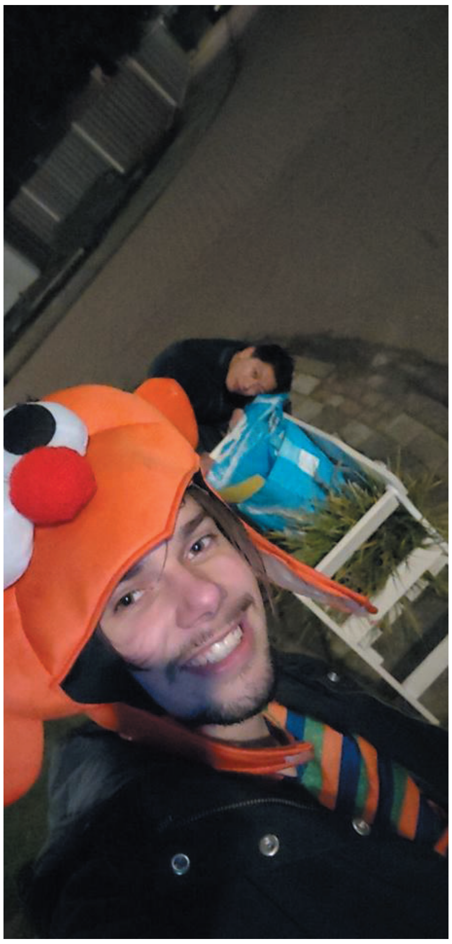
Aláááááf!
Winner Photo Contest

In the last issue of Nekst, a carnaval themed photo contest was hosted and we received a lot of joyful pictures. Some even from parts of the country from which it is often disputed whether or not it should even be a part of the Kingdom of The Netherlands. Anyway, there can only be one winning picture! If you can recognize yourself on the picture above, then one of you is invited to drop by at E1.10 to collect a crate of beer or a pie for you!




55
JAGRIP


Tilburg
ZONE
Naar de overkant?
Graag met de fiets
aan de hand!



Quatsch!

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Quatsch?

Over the past few months, the editorial staff of Nekst received many quotes that relate to the study of Econometrics and to the activities organized by Asset | Econometrics. Hereby, we present to you a selection of some striking and funny quotes!
Please mail all remarkable quotes you have heard to Nekst@Asset-Econometrics.nl!

Melissa van Wingerden (tijdens LED)
Oh, daar zie ik mensen van Econometrie!

Bernard van den Broek (wachtend op de bus)
Het is net als met pissen. De heren moeten staan; de meiden moeten zitten.

Job Hoven
Surinaams eten houd ik niet van.
Ik ga sowieso niet goed op Aziatisch eten.

Jochem Bruijninckx
Als je je vriendin uitscheldt, zorg dan in ieder geval dat je dat grammaticaal correct doet.

Guus Vlaskamp
Wat zie jij er netjes uit!
Ga je naar de begrafenis van de Nederlandse democratie?

Joris Pirée (over nicotinepleisters)
Dat werkt alleen vanwege het placenta-effect.

Rick Greeber
Vroeger hadden we nog geen robots, toen deden we het nog gewoon met elkaar.

Puzzle

Draw one straight line to make the following equation correct:

$$5+5+5=550$$

Can you figure out the puzzle?
Please enter your solutions at www.Nekst-Online.nl/Puzzle. A crate of beer or a delicious pie, whichever the winner prefers, will be waiting for whoever has sent the best (partial) solutions. Please note that, as before, every recipient of this magazine is eligible to send in their solutions, so members of the department are invited to participate as well. Note that there are multiple possible correct solutions to this puzzle. The more correct answers you send in, the higher your chances of winning. Good luck!

Martijn Oerlemans is the winner of the previous puzzle. As a reward, he can come and pick up a crate of beer or a pie at room E1.10. The solution can be found at www.nekst-online.nl

Asset | Econometrics congratulates…

Name **Christos Karamanlis**
Title Combined Production and Distribution Scheduling at Fransen Gerrits
MSc BAOR
Supervisors Prof.dr.ir. H.A. Fleuren, Dr.ir.ing. M.J.P. Peeters

Name **Vasileios Ravazoulas**
Title Empirical Comparison of machine learning and statistical techniques for forecasting at Cmotions
MSc BAOR
Supervisors Prof.dr.ir. H.A.M. Daniels, Dr. R.C.M. Brekelmans

Name **Marco Rodriguez Romero**
Title Structural Analysis: A Dynamic Factor Model Approach
MSc EME
Supervisors Prof.dr. B.J.M. Werker, Prof.dr. B. Melenberg

Name **Ginonne Severina**
Title A Genetic Algorithm for the Sprint Planning Scheduling Problem
MSc BAOR
Supervisors Dr. R.C.M. Brekelmans, Dr.ir.ing. M.J.P. Peeters

Name **Martijn Ketelaars**
Title A new approach to mutual liability problems: the Individual Settlement Allocation Procedure
MSc EME
Supervisors Prof.dr. P.E.M. Borm, Prof.dr. M.Quant

Name **Yordan Boychev**
Title Real Options: Timing and capacity choice in an imperfect information setting.
MSc EME
Supervisors Prof.dr. P.M. Kort, Prof.dr. K.J.M. Huisman

Name **Peggy Bor**
Title The Effect and Impact of Climate Change Scenarios: a Top-Down Approach for Asset Allocation
MSc QFAS
Supervisors Prof.dr. B. Melenberg, Prof.dr. B.J.M. Werker

Name **Daan Jansen**
Title Seriation in the Presence of Errors: New E cient Bounds
MSc BAOR
Supervisors Prof.dr. M. Laurent, Dr.ir.ing. M.J.P. Peeters

Name **Iosif Kyriazis**
Title Forecasting Danone's material requests and analysis of factors that lead to workflows rejection
MSc BAOR
Supervisors Dr. M. Rothfelder, Dr. C.B.T. Walsh

Name **Jiyuan Huang**
Title Share Pledge Loans and Corporate Strategic actions
MSc QFAS
Supervisors Prof.dr. B.J.M. Werker, Prof.dr. B. Melenberg

Name **Yue Hu**
Title Risk Averse Optimal Procurement Strategy with Supply, Demand, and Spot Market Volatility
MSc BAOR
Supervisors Dr. Y. Merzifonluoglu, Dr. R.C.M. Brekelmans

Name **Tom Steenbergen**
Title Predicting service completion times for Picnic's distribution system using deep learning methods
MSc BAOR
Supervisors Dr. R.C.M. Brekelmans, Prof.dr.ir. H.A. Fleuren

Name **Sjoerd Keijsers**
Title Loss Given Default modelling: A Comparison of Machine Learning Ensemble Methods
MSc QFAS
Supervisors Dr.ir. G.W.P. Charlier, Dr. O. Boldea

Name **Jim Peeten**
Title Using open text entries of questionnaires as meta-data to predict NPS
MSc BAOR
Supervisors Dr. J.C. Vera, Dr. C. Dobre

Name **Zoë Connell**
Title The effect of consumer valuation uncertainty on investment timing and investment size in a circular city model
MSc BAOR
Supervisors Prof.dr. P.M. Kort, Prof.dr. K.J.M. Huisman

Name **Joep van Kroonenburg**
Title Value Drivers of European IPOs
MSc QFAS
Supervisors Dr. P. Cizek, Dr. F.C. Drost

Name **Evrim Engin**
Title Contextual Bandits in the search for Recommender System Optimization
MSc EME
Supervisors Dr. O. Boldea, Dr. C.B.T. Walsh

…on obtaining their Master's degree

Agenda

MON 29 APR – SAT 4 MAY
Lustrum Week
Celebrate our 40th birthday with us during the lustrum week! This week will consist of all kinds of activities including a company day, a theme party and a gala. You can read all about the program in the article on page 27

WED 08 MAY
Optiver QIG Masterclass
Are you interested in trading and quantitative investment? Then this event is perfect for you! For this Masterclass we will visit the office of Optiver in Amsterdam. Here you will be taught about different trading strategies used at Optiver whilst getting to know the company better.

WED 15 MAY
Beer Games Drink
Find out which econometrician has the best beer drinking skills at the Beer Games Drink! During this drink you can team up and compete against other teams in all kinds of beer games such as beer races and beer pong. Will eternal glory be yours?

SAT 18 MAY
(A)FAM Dinner
During the (A)FAM Dinner, all (Aspirant) Former Active Members are invited to have a lovely dinner together in Utrecht. Here they can catch up with old friends and retrieve good memories of their student times in Tilburg together.

MON 20 MAY
Brothers and Sisters Evening
Call your brothers and sisters now and make sure they come to Tilburg for the Brothers and Sisters Evening! The committee has arranged a fun evening of games which will we end with a lovely barbecue together.

TUE 21 MAY
Monthly Afternoon
During those busy weeks of studying for your exams, it might be a relief to take a break once in a while… The perfect opportunity to catch up with your fellow econometricians at the Monthly Afternoon! We will have some games and drinks available and you can have dinner with us.

TUE 04 JUN
Sports Tournament
Who will be the new owner of the legendary Astrics Sports Tournament cup? We will find out at the Sports Tournament! Make sure to sign up with your team, compete in a game of soccer or beach volleyball and conquer that cup!

TUE 04 JUN
Announcement Drink
After showing off your soccer or volleyball skills at the Sports Tournament, make sure to come to the Heuvel Gallery where the candidate board of Asset | Econometrics 2019-2020 will be announced!

WED 12 JUN
Monthly Afternoon
Have a beer and snack together with your fellow econometricians at the last Monthly Afternoon of this academic year.

FRI 15 MAR
Asset Champions League
Not satisfied with your results at the Sports Tournament on June 4? Sign your team up for a rematch and represent Astrics against other Asset departments at the Asset Champions League! After the match we will have a party at café Polly Maggoo to celebrate our victory!

THU 04 JUL
Summer Activity
Unfortunately this year has almost come to an end, but don't be too sad because we still have the Summer Activity in store for you! The activity itself is still a secret, but stay tuned for more information!

Register and find more information about our events at ***www.Asset-Econometrics.nl/events***

[redacted]

[redacted]

[redacted]

You've nearly completed your degree, and you're ready for what's next: a job that will inspire you, make you think and put your skills to the best use.

Our unique perspective allows us to see the connections between talent, assets and ideas that can drive performance and growth. Powered by market analytics, behavioral insight and a culture of seamless execution, our colleagues work with you to design and implement lasting solutions that turn risk into a path to growth.

Together, we unlock potential.

[redacted]

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