

# nekst>>

vol. 29 no. 2 | winter 2021 | [nekst-online.nl](https://nekst-online.nl)

VOTE

## Special

Gerrymandering in the  
American District Elections



### Familiar Faces

T.S.Z.W.V. Avalon  
Joris te Booij



### Interview

Dassault Systèmes  
(3DS)



### Report

Cycling Dinner





## To New Beginnings

As we become older, time seems to move so much faster than when we were kids. Not long ago, I was writing my preface for the first edition, and now the second Nekst has already arrived. As of now, the first semester of the academic year has ended too. With the ending of this semester, a new year has started: 2021. For me, this new year means a fresh start! Therefore, Nekst is trying to avoid the infamous C-word as much as possible by focusing on the future rather than the past.

On March 17, the Parliamentary elections will take place in the Netherlands. Accordingly, this edition of Nekst is slightly politically oriented with a special about the American voting system. Additionally, we sent a questionnaire to our Active Members to see which parties they will vote for. You can read all about this in the section 'Let's Talk!'. Next to that, we interviewed Christel Opheij, a former active member of Asset|Econometrics, about her work at Dassault Systèmes. Furthermore, we cover events such as the Econometrics in Practice Day and the Cycling Dinner. For the students who are curious about which econometrics Master fits them best, we have also made a quiz that helps you to determine your preferences.

In short, whether you are interested in the events of our study association or in a scientific report, this edition has an article for everyone. However, if you cannot get enough of Nekst, I recommend visiting our brand new website: [Nekst-Online.nl](https://Nekst-Online.nl). The website has gotten an entire make-over (see page 6), so do not forget to check it out!

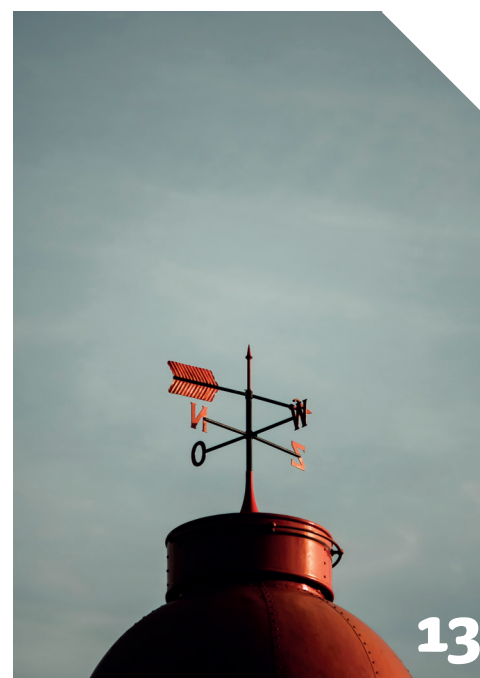
Yours sincerely,

**Mylan Tran**  
Editor-In-Chief

# Table of Contents



Triangle



Master Quiz



Ranking the Trists

## COLOPHON

Nekst is the quarterly magazine of Asset | Econometrics ©2021  
Insertion of an article does not mean that the opinion of the board of Asset | Econometrics or the editorial staff is verbalized.

## Correspondence

Asset | Econometrics  
Tilburg University  
Room E 1.10  
P.O.Box 90153  
5000 LE Tilburg  
Telephone: 013 466 27 47  
[info@Asset-Econometrics.nl](mailto:info@Asset-Econometrics.nl)  
[www.Asset-Econometrics.nl](http://www.Asset-Econometrics.nl)  
[www.Nekst-Online.nl](http://www.Nekst-Online.nl)

## Editorial staff

Tamara Dert  
Casper Heemskerk  
Troy de Juncker  
Nienke Kempers  
Nienke Keuning  
Michelle Luijten  
Jarno Ringhs  
Aimee Smarius  
Marijn Wolferink





The Teacher: Emiel Caron



Practical Report



Special: Gerrymandering



Familiar Faces: Joris te Booij

## Advertisements

- cover Flow Traders
- 3 Dassault Systèmes (3DS)
- 6 Nekst-Online
- 36 Study Support
- 41 Career Platform Tilburg

## Articles

- 4 Dear Members
- 5 Meet the Board 2.0
- 7 Members Day
- 8 Column: Kuno Huisman
- 9 Special: Gerrymandering
- 11 Practical Report
- 13 Master Quiz
- 15 Cycling Dinner
- 16 Column: Henk Norde
- 17 Interview: 3DS
- 20 Ranking the Trists
- 21 Where is Waldo?
- 23 Familiar Faces: Joris te Booij
- 25 Triangle
- 29 Econometrics in Practice Day
- 30 Column: Anne Balter
- 31 The Teacher: Emiel Caron
- 33 Let's Talk
- 37 Quatsch
- 38 Puzzle
- 39 Graduates
- 42 Agenda

**Editor-in-Chief**  
Mylan Tran

**Lay-out editor**  
Dahli Koskamp

**Nekst-Online**  
Patrick Floor  
Luuk Sommers

**Contributions**  
Anne Balter  
Dominique Bavelaar  
Marieke Derks  
Bregje van Dortmont  
Lotte Gerrits  
Kuno Huisman  
Christel Janssen  
Henk Norde  
Eva Schoenmakers  
Juul Schuurmans  
Valentijn Stienen

**Printing**  
Gildeprint

**Circulation**  
1025

**ASSET**  **Econometrics**



Working at DELMIA Quintiq,  
part of Dassault Systèmes, is all  
about puzzles – real-life puzzles  
that fundamentally change the  
way the world does business.

Join a dynamic team of people just as smart as you are.  
Apply your skills in the fields of econometrics, operations  
research and actuarial sciences to some of the toughest  
real-world planning puzzles. Greet every day with an  
exciting new challenge.

Learn how. Visit **[careers.3ds.com](http://careers.3ds.com)**



**3DEXPERIENCE®**





# Dear Members,

Now that you have this beautiful winter edition of Nekst in your hands, the first semester of this academic year is already finished. I hope that you have passed all of your exams and had a great start of the second semester. Even though I have no clue whether we will even be able to celebrate carnival in any way at the moment of writing, I do hope that you will enjoy the time off that comes with it. Additionally, with the vaccination program which started at the beginning of January, I have good hopes that next year, we will be able to celebrate carnival the normal way, since I am quite a fan of this yearly party.

Before I start talking about what the future holds for our association, I would like to look back at the past. A lot of things happened during the last few months, and I would like to highlight some of the most important ones. We had our second Department Members Meeting on January 25, in which we said goodbye to Tjum van Dijck and welcomed two new board members. Yes, you read it correctly: we are increasing the number of board members from five to six! Before I introduce the two new members of our team, I would like to thank Tjum van Dijck for all his hard work, enthusiasm, and efforts in the past half-year. Even though he will be missed, I have the fullest confidence in our two new board members: Constantijn Wessel, who is our new External Affairs officer, and Bram Marsman, who is the new Internal Affairs officer. I am very happy with them as my fellow board members and I am certain that we will make the rest of this academic year a big success!

Another great event that took place recently is the National Econometrics Day, better known as LED. On February 4, around 600 Econometrics students from all over the Netherlands could get in touch

with their future employees. The event was organized online for the first time. However, still around 90 students from Asset | Econometrics wanted to participate.

After looking back, it is now time to look forward. We have a lot of events coming up, both formal and informal. The first formal event that is coming up is the Econometrics Consultancy Tour, which is planned on March 1-3. During this event, you can get in touch with several consultancy companies! Another formal event is the Master Experience Day on March 2. During this day, all three Econometrics Masters will be introduced by their respective Academic Directors and alumni. For Bachelor students, this is the perfect opportunity to investigate what possibilities there are after graduation!

Besides these formal events, we will also have a lot of informal events in March! At the moment of writing, we do not know in which form these will take place, but we will do our utmost best to keep organizing some for you. You can show your siblings what it is like to study Econometrics on March 8, during our Brothers and Sisters evening. For all the Freshmen, we are organizing a Freshmen Information day on March 17, which is followed by a drink. One day later, we have an event for all our older members, the second Olden Goldies activity!

Finally, I would like to wish you the best of luck with the new semester and I hope you will enjoy reading this winter edition of Nekst!

On behalf of the board,

**Juul Schuurmans**

*Chairman Asset | Econometrics 2020-2021*





# Meet the Board 2.0

Board of Asset | Econometrics 2021



## External Affairs

My name is Constantijn Wessel and I will be one of the External Affairs of Asset | Econometrics from February 2021 till February 2022. I was born in Hong Kong 22 years ago, raised in Arnhem, and happily moved to Tilburg four and a half years ago. As some of you may already know, I did not start studying the Bachelor Econometrics and Operations Research (EOR) but I actually did a Bachelor in Economics. However, I found out quickly that I missed the mathematics that I loved in high school. So, I decided to make the switch to EOR by doing a pre-Master. Currently, I am finishing my Master Quantitative Finance and Actuarial Science. Being this close to finishing my studies, I decided I was not yet done studying and decided to do a board year. As External Affairs, I am responsible for multiple things, among others the acquisition of Asset | Econometrics and managing company relations. Before doing this board year, I was a member of the Econometrics Business Dinner committee, the Quantitative Investment Group, and of course, the Nekst committee. Besides, being active at Asset | Econometrics, I have always been an eager sports player. Currently, I enjoy jogging and leading my field hockey team as captain at Studenten Hockeyvereniging Tilburg (SHOT) during the week and weekend days. In my free time, I take pleasure in learning about historical battles. I would even go as far as calling myself somewhat of a history buff.

## Internal Affairs

My name is Bram Marsman and I will be the new Internal Affairs of Asset | Econometrics. I was born and raised in Tilburg and I am proud to call myself a 'Tilburger' for 22 years now. I started studying Econometrics and Operations Research in 2017, and at the moment of writing, I am finishing my Bachelor's degree. I have been active at Asset | Econometrics ever since joining the ski trip committee in my first year. Now, I am very grateful for the opportunity to follow in Tjum's footsteps as the new Internal Affairs of Asset | Econometrics. As the Internal Affairs, I will be responsible for the Active Members Policy and all education-related matters. I will also take part in the Public Relations meeting and I will be the coordinator of many informal committees. My hobbies are watching Netflix, playing soccer, tennis, and squash, hanging out with friends, and attending all of our great events! At most of these events, I like to drink a beer or two. I am especially quite fond of the 'cantus'. Next to this, I also like to go to festivals. In 2019, I attended Sziget, Paaspop, and Awakenings. Finally, I love to go on holidays, both in the summer as in the winter. I look very much forward to meeting you all at our online, and hopefully soon offline, events!







Nekst online, **new** year, **new** design, **new** articles!

To get familiar with the new website we have hidden an easter egg.  
The first one to find it receives a prize, so go to our website right now!

[www.Nekst-Online.nl](http://www.Nekst-Online.nl)

ASSET



Econometrics



# Epic Bingo Night

**T**hursday November 5, it was finally time for the Epic Bingo Night of Asset | Econometrics. The excitement for this online event already began on the day before, when everyone received an envelope with bingo cards and a bingo dabber at their home address. After one look at my cards, I already knew enough: I had received the winning cards. After a night of restless sleep, it was finally time. Gathered with Nikita Veldhuis, Michelle Luijten, and Monique Groen at my place, we entered the Zoom session.

We played four bingo rounds in total. In every round, three prizes could be won. The third prize for being first with one row, the second prize for being first with having two full rows, and the first prize for having a full bingo card. In the first round, the prizes immediately hit our group. Monique was the first person to shout bingo! Unfortunately, after the committee checked her card, it was a false bingo. Monique had to sing a song and the game was continued. A short while after, someone else had bingo and the third prize was given away. Not much later, the second prize had also been won. Thereafter, it was time for the first grand prize, a specialty beer package with a personalized beer glass. This time I was the first one to yell bingo! I happily sent a photo to the bingo Whatsapp group so the committee could check it. Luckily, it was not a false bingo and I won the prize!

Not fully recovered from the adrenaline kick, we already started the second round. Now, the grand prize was a games package with Perudo and other small games. After a very thrilling round, the first person with a full bingo card was determined. It was Bente Stokebrand who won the grand prize this time. Afterwards, it was time to play the first epic minigame of the night. The committee made a very fun Kahoot quiz. In the end, it was Polle Dankers who had scored the most points in the quiz. So, he won the beloved Asset | Econometrics bathrobe.

After a short break, the third bingo round began. The second-last grand prize was a treat-yourself-package with a scented candle, a fleece blanket, a Pathé coupon to watch movies at home, tea, and much more. Again, it was a very exciting round. The second and third prizes were given out very fast. However, we were still in the game for the grand prize. I do not understand how, but again I was the first one having a full card. I felt a bit guilty but shouted bingo anyway. After a check from the committee, it was obvious that it was not a false bingo and I had won again.

After this, it was time for the second epic minigame: the story round. Everyone in the Zoom call was divided into breakout rooms. Every team got five words, mostly Asset | Econometrics related, and the names of two participants. You had to make a juicy gossip with these words and tell it to the rest of the players. Then, everyone



**Lotte Gerrits**

**Bachelor EOR**

Age: 21

had to vote in a poll which group had the most fun and juicy gossip. The winning team received chocolate letters for all team members.

When we finished listening to all the hilarious stories, it was already time for the very last bingo round. This time we were going to play for the biggest grand prize, a JBL box. The second and third prizes were given away and everyone was really excited for the grand prize. After a long intensive round, it was Myra Coppens who had the first full bingo card. After her card was checked, the party was over. Everybody could go back to breathing normally again. I really want to thank the Active Members Day committee for arranging this very exciting night. Everything was organized perfectly and the committee was even dressed up in the bingo theme! ●





# Ten Years at CQM and back to Tilburg University

**D**uring the last year of my PhD, I decided that I wanted to gain some practical work experience. Looking back, there were two main reasons for this shift from an academic career towards business life.

First, I wanted to see with my own eyes what could be achieved by mathematical modeling, or more specifically by operations research, in solving real world problems. This wish was fueled by my experience in the academic world where you make up your own problems. If you can solve these problems, you tell the whole world and go to nice places for conferences to present your results. If you cannot solve the problem, you will find another issue to solve. Do not get me wrong, I love doing theoretical research. However, I also believe that applied research is necessary to enable progress. Therefore, I was certain that I wanted to discover how to apply my knowledge in practice. Secondly, continuing in the academic world would have meant leaving Tilburg University for sure and most probably also leaving the Netherlands. My wife had a good job and a successful career in the Netherlands and both of us did not want to give that up for an uncertain academic future from my side. After some orientation, I concluded that I had the option to go for quantitative consultancy or apply for a job at a bank. I preferred consultancy and therefore, I sent an open letter to CQM in Eindhoven. After a few rounds of job interviews, they offered me a job and I started in September 2000.

On my second day, I drove to Germany to visit my first customer: Danzas Euronet. This company would later become a part of DHL. Funny thing is that ten years later, on my second to last day, I visited the same customer for my last meeting and said farewell. For DHL, we created software that helped the planners to make weekly timetables for the routes of their trucks throughout Europe. We used several operations research techniques for that, like short path algorithms, local search, and linear programming. The datasets started with 500 shipments every week and that number increased to around 100.000. The number of hubs started around 50 and ended around 500. With smarter algorithms and the increased computer speed, we were able to solve these problems in reasonable

time. Over these ten years, several projects were carried out. My biggest project took place in 2005. I still remember it very vividly as that is also the year that my first daughter was born. On the day that she was born, I was working on it in Brussels near the airport. As the delivery was not going too well, my wife asked me to come to the hospital as the doctor decided that my daughter should be born that day with a cesarean section. I had never driven and most probably will never drive that fast again from Brussels airport to the Maxima Medisch Centrum in Veldhoven, which is situated next to the ASML campus.

Another customer that I did many projects with, is ProRail. This company is responsible for the maintenance of the railway tracks of the Netherlands. The first project was a cooperation between ProRail, Tilburg University, and CQM. Therefore, I was back at the university once a week. During this time, I could meet with Peter Kort, my promotor, and some of his new PhD students to work on some research projects. The last project I did with ProRail was making the schedule for the 'videoschouwtrein' (video surveillance train). This train makes pictures of all track switches in the Netherlands that consequently can be checked on errors. Making an efficient schedule for detecting all switches in both directions (straight and deflecting) can be done by solving a mixed-integer programming model. The first inspections of the pictures were done by humans. Later on, CQM did a project to do this with machine learning, with which they won the 2018 Dutch Data Science award.

In 2004, I got the opportunity to go back to the university with a one day per week contract. I was hired as a researcher and thereby my hobby, doing academic research, became my work again. Next to that, I supervised Master's and PhD students and did some teaching. In 2008, my second daughter was born. In that same year, my temporary contract at the university was made permanent and I was promoted to assistant professor. At CQM, I did projects for Philips, APX, Ineos, and other companies. In 2009, I was teaching Dynamic Real Investment to a part-time student that was also working at ASML. He contacted me in 2010 just after my son was born to have a talk. In the next column, I will tell you all about the conversation we had! ●

## Kuno Huisman

*is director of business control Twinscan Factory at ASML. Next to that, he is a part-time full professor of decision making under uncertainty at Tilburg University where he teaches courses on professional skills and investment under uncertainty.*





# Gerry + Salamander = Gerrymander

**W**hen the presidential election between Donald Trump and Joe Biden took place in the United States of America last November, the whole world seemed to be watching. Since this country has such a powerful position in the world, its political decisions are of great interest globally. Their political system differs quite a bit from the Dutch system: alongside a president, there is a congress that includes a Senate and a House. The United States is divided into 52 states and every state provides two senators and a proportional amount of representatives in the House. To determine the number of representatives per state, these states are divided into districts. The goal of these districts is to create an adequate representation of the population. However, how should these districts be distributed to ensure that this goal is reached?

written by **Patrick Floor** and **Nienke Keuning**

Every political party would want the upper hand within the district elections, as these determine the representation of one's party in the government. Hence, districts are often drawn in a way that is beneficial for the outcome of the district elections. The determination of such politically strategic boundaries is a phenomenon called gerrymandering. The term gerrymandering is named after the American politician Elbridge Gerry, who was the governor of Massachusetts from 1810 to 1812. He passed a bill that created a partisan district in the Boston area with a shape of a salamander [1]. The goal of gerrymandering is to get an advantage for your own party against the opposing party. How gerrymandering works best is explained with the following example.

Suppose we have a state with a total of fifty people, where five representatives will be chosen. Thirty people belong to party A (green) and the other twenty people belong to party B (yellow). This means that 60 percent of the state would choose for the green political party, while 40 percent of the state would choose for the yellow political party. Figure 1 shows three grids representing this state and its citizens. As can be seen in this figure, district boundaries can be drawn in several different ways. Consequently, this influences the outcome of the chosen state representatives. In the first grid, green gets three representatives and yellow gets two representatives. This is the fairest outcome since it exactly portrays the proportion between yellow and green. In the second grid, the green party obtains all five representatives as green has more votes than yellow in every district. It can be easily seen that this does not adequately represent the political beliefs of the citizens. In the third grid, yellow obtains three representatives and green only two. In this way, the yellow political party has the upper hand while having fewer members than the green party. This example perfectly portrays the influence that district boundaries have on the district elections [2].

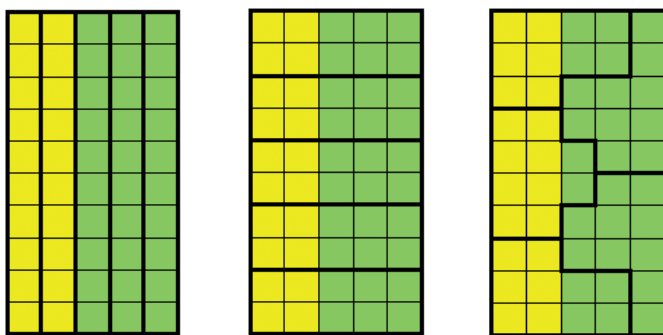


Figure 1

Congressional districts within states are being redrawn all the time. This also happened in Pennsylvania in 2018. Redrawing a congressional district only happens when the Supreme Court of the corresponding state convicted the current map to be invalid. Pennsylvania's Supreme Court found that the map constituted an illegal partisan gerrymander. To show the impact of redrawing such maps, we will take a look at the previous house elections of Pennsylvania. In Figure 2, you can find the congressional districts of Pennsylvania. In the top figure, you can find the newly drawn map and at the bottom, the old one.

Ballotpedia states the following about redistricting in Pennsylvania: "District locations and numbers differ between the two maps. The map adopted by the state supreme court split thirteen counties; the 2011 map split 28 counties. Had the 2018 map been in place during the 2016 presidential election, Donald Trump (R) would have won ten districts and Hillary Clinton (D) would have won eight. In 2016, at which time the 2011 map was in place, Trump carried twelve districts to Clinton's six." [3]

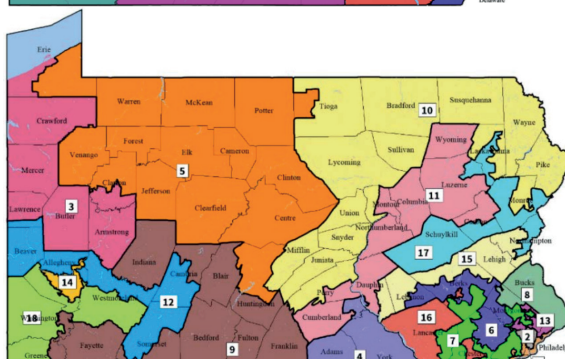
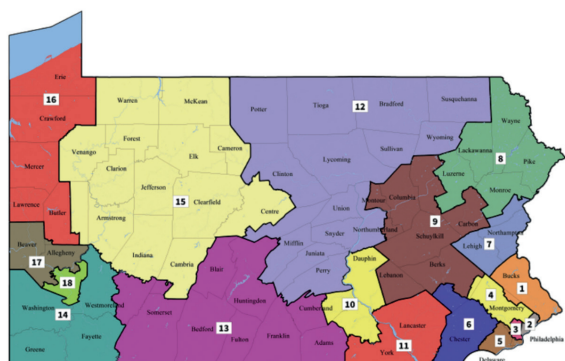


Figure 2



As a consequence of gerrymandering, there is a misrepresentation of the society in the House of representatives. Misrepresentation in the House means that, as explained before, the representatives chosen during the elections do not sufficiently portray the actual division between parties in the states. Figure 3 shows an extensive overview of the misrepresentation in 2016. It is evident that gerrymandering was used in both parties. Thus, the representation relatively evens out again, with a difference of approximately 5 percent [4].

Now that the way in which districts are drawn in America has been discussed, it is interesting to look at other possible ways of holding district elections. Take the system of 'Single Transferable Vote' (STV), for example. This system is used to elect several representatives rather than one leader, like the district representatives. On an STV ballot, the voter can put several candidates in the order of their preference. A voter usually has more than one candidate whose ideas are to their liking. One can vote for different people of the same party, or rather base their vote on the personal ideas and goals of the candidates. As soon as the first choice of the voter has enough votes, or on the other hand, has no perspective of winning, the vote will be used for the second choice candidate in the list of preferences. In this way, none of the votes are lost. With the current system, if it is known that a candidate has no chance of winning, it would be illogical to vote for this person. The vote would get lost. However, with the STV system, one does not have to worry about votes getting lost, and even less popular candidates have a bigger chance of being elected. Take for example citizen A who voted for candidates A, B, and C in this order. Since candidate A is very popular, no votes are needed anymore for him or her to become a representative. So, citizen A's vote is transferred to candidate B, who now has more chance of becoming a representative too. Another advantage of this system is that strategic voting is substantially more difficult to apply than the voting system currently used. This is due to the fact that the STV system is NP-complete [5]. The practical significance of the notion of an NP-complete problem lies in the belief that such problems are inherently intractable from the computational point of view. Meaning, NP-complete problems are not susceptible to efficient algorithms. Moreover, any algorithm that correctly solves an NP-complete problem will require, in a worst-case scenario, an exponential amount of time to solve. Hence, it will be impractical for all but very small instances. In other words, a researcher who faces such combinatorial optimization problems will not be able to find an efficient algorithm to solve the problem. Strategic voting is voting with the end result in mind, rather than voting for a certain candidate. What is happening in the current system is that the political campaign is aimed at certain areas to get more votes there in order to win the whole district. However, with the STV system, it is much more difficult to figure out which areas will be deciding factors in

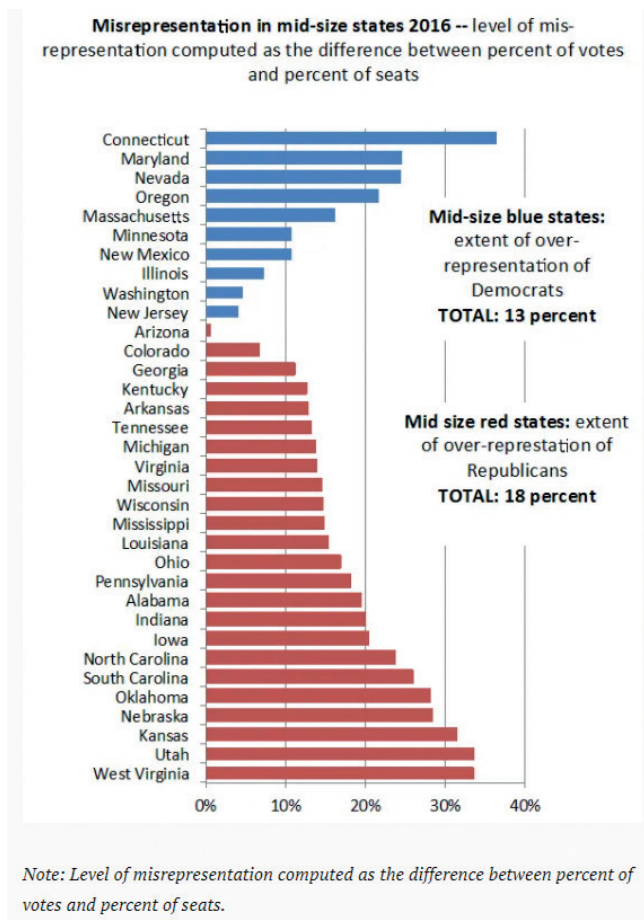


Figure 3

the election. Hence, it is nearly impossible to implement strategic voting in this case. Nevertheless, a downside to using the 'Single Transferable Vote' system is that it is harder to carry out on a large scale since the counting of the votes is more complicated than with the current system. In addition, more candidates have to be chosen, which requires more time and effort from the voter [5].

Understandably, gerrymandering is the preferred method when it comes to the state elections in the United States. Since it is used for the benefit of both parties, it is not very likely that other methods will be implemented very soon. Even when it is so evident that this phenomenon causes misrepresentation, it is a process that will take years before anything changes. So, for now, the United States will keep on 'gerrymandering'.

## References

- [1] <https://www.ahdictionary.com/word/search.html?q=gerrymander> (n.d.) The American Heritage Dictionary of the English Language (5th ed.) (n.d.)
- [2] Ingraham, C. (2015). This is the best explanation of gerrymandering you will ever see. Retrieved from: <https://www.washingtonpost.com/news/wonk/wp/2015/03/01/this-is-the-best-explanation-of-gerrymandering-you-will-ever-see/>
- [3] [https://ballotpedia.org/Redistricting\\_in\\_Pennsylvania](https://ballotpedia.org/Redistricting_in_Pennsylvania) (n.d.). Redistricting in Pennsylvania.
- [4] Ingram, G., Wils, A. (2017). Misrepresentation in the House of Representatives.
- [5] Bartholdi III, J.J., Orlin, J.B. (1991). Single transferable vote resists strategic voting. *Social Choice and Welfare* (1991), 8, 341-354.



## Solidarity Within The New Dutch Pension Deal

2020 has been a year like no other. One can safely say that the concentration of events with a lasting long term impact on the whole society is unprecedented. Obviously, the first development that comes to mind in this respect, is the formalization of the new pension deal in the Netherlands (Dutch: nieuw contract).

### Introduction

Well, actually, most of you will not mention the signature of the Dutch minister of Social Affairs when asked for the most impactful moment of 2020. This is, of course, understandable. However, I would like to draw your attention to some elements of this legislative package, which fundamentally affect the nature of employer-funded retirement schemes in the Netherlands. As a result, pension funds, their executives, and service providers face major challenges in terms of implementation in the upcoming years. Especially for us econometricians, there is a lot of work to do in this respect. That is why the Nekst committee very kindly asked me to talk you through some developments and also zoom in on the research that I carried out in the context of my thesis last year. This was carried out in combination with an internship at APG. APG is the largest Dutch pension service provider, serving pension funds of various sizes, for which we carry out pension administration, asset management, and management advisory.

### Pension system reform

The change in pension system design is, laying mainly within the domain of employer-funded pension schemes, characterized by a shift from collective risk-sharing towards more risk-taking on an individual level. However, policymakers do not entirely part from the solidarity-based nature of the initial system. In short, solidarity in this context boils down to risk sharing among pension fund participants.

When mentioning solidarity and risk-sharing, it is also important to actually specify which risks are faced by pension funds and their participants. Fund members put in a so called premium, which is in fact a part of labor income, in a pension fund for each period of their working life. These premia are invested in order to generate returns. The basic idea is that the asset value in the fund matches the present value of all promised pension provisions. The returns on investment are in general not guaranteed and there exists a potential that this return does not match its expectation for the period of interest. This potential is referred to as investment risk. If this risk materializes, a pension fund's asset value is not at the level it was expected to be, causing possible challenges to

keep up with the promises made to individual fund members. This ratio between asset and liability value is referred to as 'the funding rate' (Dutch: dekkingsgraad).

Before the reforms I referred to earlier, pension cut or indexation decisions were almost solely dependent on the level of the funding rate at the end of a calendar year. In the new contract, individual pension benefit level adaptations are more directly linked to the outcome of risk factors in a specific year. Note, however, that such a design change does not necessarily increase nor decrease the total amount of risk a fund is exposed to. However, individual pension benefit levels will tend to move quicker along the lines of investment outcomes, but the total risk magnitude does not change if the investment policy does not change either. Muns and Werker (2019) propose a return allocation mechanism for returns on financial risk exposure within this pension contract [1]. The developed procedure yields an increase in perceived welfare compared to the 'status quo' using intergenerational risk-sharing.



Figure 1: Retirees

### Longevity risk exposure

Longevity risk is fundamentally different from investment risk and can be split into two parts: micro-longevity and macro-longevity risk. A pension fund determines the price of a pension right depending on its beliefs with respect to the remaining life expectancies of its fund members. This, namely, determines for what time a pension fund expects to pay out pension payments to its pension right holders. The concept of longevity risk refers to the potential that the fund ex-ante



expectations regarding mortality of fund participants are not matched in reality.

Micro-longevity risk refers to the potential that in a specific year, less (or more) people pass away than expected. This impacts a pension fund's liability value as the number of members that are entitled to a pension benefit to be paid out, is higher (or lower). Macro-longevity risk refers to the potential that ex-ante beliefs regarding mortality distributions over time happen to be breached by reality. In other words, if the change in life expectancy over time of fund members is more (or less) severe than expected, this impacts the liability value as well. Namely, if an individual's life expectancy increases more rapidly than expected, so does the present value of his or her pension rights, as the expected payout period has gone up. In other words, 'the present price of a pension' goes up. De Waegenaere, Joseph, Janssen, and Vellekoop (2018) propose approaches to share longevity risk in a pension fund, allowing for age-specific risk exposure [2].

### Solidarity buffer

However, for longevity risk, allocation mechanisms are not yet formalized and developed to the extent as they are for investment-related risk within a pension contract. In addition to risk-sharing mechanisms, also the so called 'solidarity buffer' (Dutch: solidariteitsbuffer) is established. The CPB (Central Planning Bureau) has proposed a formalization of regulations with respect to buffer dynamics [3]. The idea behind this buffer is that in years in which financial returns are better than expected, part of this excess return is used to fill the buffer. On the other hand, in years of underperformance, this buffer is used to mitigate some of the impacts this would have on pension benefit levels.

Solidarity is quite an abstract concept and often used in a shallow context. So, it might not come as a surprise that those whom it should concern most, the Dutch pension fund participants, are not likely to come up with the above explanation of this buffer. Most of the fund members would think of a kind of 'piggy bank' which can be used for low-income groups to cover pension premia, or as a pot of money such that those who have less wealth can also afford retirement. This is, as may have become clear, a fundamentally different and, in essence, wrong interpretation. It is worth mentioning, though, that implicit wealth transfer effects when employing such a buffer cannot be fully excluded and, to be honest, I personally do not know to what extent this will turn out to be the case. However, the point is that the main goal of employment of this buffer is to avoid too severe year-to-year adaptations in pension income. As becomes clear from this little paragraph already, this element of the pension contract poses not only

mathematical challenges for us econometricians, but also in terms of communication with the fund members, there is work to do to ensure trust and systemic sustainability.

So, as said, for investment-related risks, this mechanism is already proposed and formalized. In terms of longevity risk, this is not yet the case. In my research, I looked into how this solidarity buffer can be employed, such that it can be used to cover financial implications of materializing longevity risk.

Major design challenges lie within the domain of linking a specific outcome of mortality events within a population to a market-consistent monetary equivalent, which can be extracted from the buffer if the price of an individual's pension goes up. Valuation hereof is not straightforward, as there is not really an efficient market for longevity risk to the extent there is one for financial risks. Also, the tradeoff between paying out pension provisions and filling the buffer needs to be made by policymakers. So, in case you were wondering whether 2021 will be more challenging for econometricians than 2020 has been: I guarantee you that the implementation of the new pension deal will be an exciting ride! ●

## References

- [1] Muns, Sander, and Werker (2019). "Baten van slimme toedeling rendementen hoger dan van intergenerationele risicodeling." *Economisch Statistische Berichten* 4777, 427-429.
- [2] De Waegenaere, A., Joseph, A., Janssen, P., and Vellekoop, M. (2018). *Het delen van langlevensrisico*. Netspar Industry Paper, 4.
- [3] Metselaar, Nibbelink, and Zwaneveld (2020). CPB achtergronddocument. *Het doorontwikkelde contract: uitdeel- en vulopties voor de solidariteitsreserve*.

*Views expressed in this article are not necessarily coinciding with those of APG or its legal subsidiaries.*



**Dominique Bavelaar**  
Graduated Master QFAS (2020)



# Master Your Future

**A**re you still doing your Bachelor's or are you currently doing your pre-Master's? Do you have doubts about your next step in your academic career? Are you not sure about your field of interest? Then, this quiz can help you in making the right choice. Tilburg University offers three different Masters in the field of econometrics: Business Analytics and Operations Research, Econometrics and Mathematical Economics, and Quantitative Finance and Actuarial Sciences. All these programs will guarantee you a bright future, but which one will make you the happiest? For every question in this quiz, you have to circle the answer that resembles you the most. As you might remember from your childhood magazines, the answer that occurs most often will determine your final Master's choice. Good luck!

written by **Michelle Luijten** and **Mylan Tran**

## 1. What were your favorite courses in the Bachelor?

A. Combinatorial Optimization, Inventory and Production Management, Linear Optimization, Operations Research Methods, Stochastic Operations Research Models

B. Introduction Asset Pricing, Introduction to Finance and Actuarial Sciences, Life Insurance, Quantitative Finance, Risk Theory

C. Econometrics, Games and Economic Behavior, Introduction Econometrics, Introduction Mathematical Economics, Auctions, Bargaining, and Networks

## 2. To be able to make a well-thought decision about your Master's, it is important to take a close look at the fields of interest of each Master. So, what field of interest is most to your liking?

A. Finance and Actuarial Sciences. Apply and develop advanced new mathematical or statistical tools to tackle a wide range of financial and actuarial challenges, ranging from price setting to risk management and policy advice.

B. Optimization. The field of optimization is mainly about optimizing supply chains, vehicle planning, and inventory management. But also about optimizing medical treatment plans, determining the optimal dike height, and making schedules more efficient.

C. Analyses. The field of analysis is very broad. This means that you can end up in many different places when finishing your Master's. You can thus end up exactly where you like, because analyses are needed almost everywhere.

## 3. Which company has your interest?

A. Delmia Quintiq

B. Flow Traders

C. Ab Ovo

## 4. In what kind of organization would you like to work?

A. Working in a hierarchical organization with a strict level structure

B. Working mainly in teams without having a strict hierarchical structure

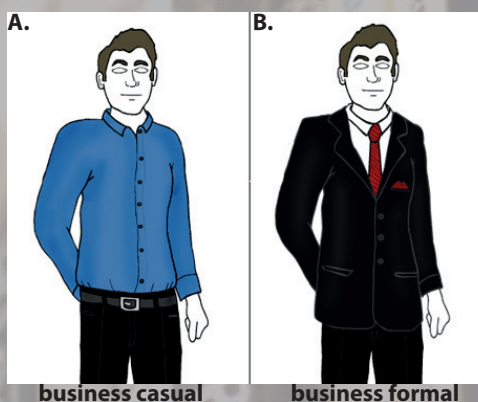
## 5. What kind of working field do you prefer?

A. Banks, insurance companies, actuaries, trading companies

B. Data scientist, Consultancy and Business Analytics, IT consultancy

C. Governmental issues and policies, Consultancy and Data Analytics, Market Analytics

## 6. What kind of dress code do you prefer?



## 7. Which Master's courses seem the most interesting to you?

A. Data Science Methods, Decision Making under Uncertainty, Decision Making with Business Analytics, Optimization, Supply Chain Analytics

B. Data Science Methods, Games and Economic Models, Micro-econometrics, Panel Data Analysis of Microeconomic Decisions, Time Series and their Applications

C. Asset Liability Management, Dynamic Real Investment, Empirical Finance, The Economics and Finance of Pensions, Valuation and Risk Management

## 8. What kind of topic would you like to investigate?

A. Analyzing equity-linked life insurance products

B. Optimizing the number of vehicles that are needed for the transport of products

C. Calculating the probability of winning a game of cards



Now, fill in your answers in the table below. If most of your answers coincide with the row 'BAOR', for example, then your ideal Master will be BAOR.

Question	1	2	3	4	5	6	7	8
BAOR	A	B	C	B	B	A	A	B
EME	C	C	A	B	C	A	B	C
QFAS	B	A	B	A	A	B	C	A
Your answer								

## BAOR

### Most answers BAOR

It seems that you are extremely interested in optimizing processes and analyzing data. The Master Business Analytics and Operations Research (BAOR) is therefore a perfect match for you. In this world, you will be surrounded by data scientists and business consultants who are interested in translating 'big data' into useful management insights. You can, for example, go into the logistics of supply chains or jump into the medical world of optimizing cancer treatment plans after finishing your Master's. By choosing BAOR, you will learn to take a practical approach to solve the problems while working in small groups

### Most answers EME

You do not mind to learn many theorems to build the perfect model. The theoretical side of mathematics appeals to you the most. Solving difficult real-life 'games' and investigating networks are no problem for you either. Hence, there is no doubt that the Master Econometrics and Mathematical Economics (EME) will be the best fit. With EME, you will be able to use your mathematical and statistical knowledge to solve economic and business-related problems. Additionally, by analyzing your data, you can determine whether certain policies will affect your variable of interest significantly.

## EME

## QFAS

### Most answers QFAS

You are ambitious and you do not mind to work overtime to achieve your goal. The most difficult subjects like finance and actuarial sciences keep your mind busy. Working in one of the largest and prestigious companies in the Randstad is your biggest dream. The rumor that one out of three econometricians will become a millionaire might apply to you when you choose the Master Quantitative Finance and Actuarial Science (QFAS). This Master's might be the first step on your way to becoming a highly successful trader, banker, or actuary.

## Tips

It is possible that you have as many answers in the BAOR category as in the EME category. There is no need to worry. In this case, you just have a broader field of interest. You can consider combining the two Masters BAOR and EME. This will take up two years in which you have to do ten courses and two Master theses. Furthermore, every Master's requires you to follow core courses and elective courses. For the latter, you can choose courses from one of the two other Masters. This way, you can still follow most of your subjects of interest. On the other hand, doing your Master's at another university is also possible, but we would be really sad to see you go. However, whatever choice you make, we do not think you can make the wrong one as long as you do what makes you happy.



# Cycling Dinner Without Cycling

**O**n November 19, the Cycling Dinner took place. During this activity, we had a three-course meal with two or three other members. Everyone had to cook one meal. Normally, you would register as a couple and together cook one course for four other people. For the other two courses, you would go to another house. So, you really have to cycle from place to place. Due to the coronavirus, this was not possible since you would then meet too many people at once. Luckily, the new setup for the event was still a lot of fun.

The theme of the Cycling Dinner this year was 'colors'. This meant that you had to cook your dinner in a specific color. The committee had chosen the colors of all Asset departments, but those colors are not the easiest for a three-course meal. However, it was really fun to see all the pictures of the dishes that every group made. Some looked delicious, while others were really 'creative' with their color.

Our color was dark green. For the entree and the main dish, you can use simple vegetables, but unfortunately, I got the dessert. I really did not know what I could make for a dark green dessert. After a lot of thinking and asking around, I decided to

make something with pistachio. I bought some ice cream, but was not satisfied yet. So, I decided to buy some macarons too (and use the green ones of course).

One hour before I had to go, I was still not satisfied with my dessert. Luckily, I found some mint in our garden and some pistachio nuts. I immediately knew what I wanted to do with it. I decided to crumble the pistachio nuts and put them on top of the ice cream. I also added a little bit of mint and a macaron, and my dessert was ready. I was really happy how it turned out and everyone thought it was delicious.

This year, the Cycling Dinner was still a competition. Everyone had to take a picture of their course and send it to the committee. Then, they would pick a winner for every course. We were joking around about the prize all evening, and were very impressed with the pictures of all the other groups. After dinner, we started playing games and waited for the award ceremony. It turned out that we were so focused on the game that we missed the entire award ceremony. Apparently, also my internet was not working, but when I opened my phone I received many messages. We immediately started reading, but as I am not an



**Eva Schoenmakers**

**Bachelor EOR**

Age: 19

extremely fast reader, Juul was the one who saw that my dessert had won. I could not believe it until I saw it myself, but he was right! I won a blue face mask with the words 'MasterChef' on one side and 'Asset | Econometrics 2020/2021' on the other side. I loved it of course. All in all, it was an amazing evening. I had a lot of fun and the three-course meal was delicious!

Since this is my first year as a university student, I was really happy that I immediately won and got the opportunity to write an article for Nekst. This year is obviously not the best year to be a first-year student. Nevertheless, with all the events Asset | Econometrics organizes, I still get to meet new people and have fun. Hopefully, I still get the opportunity to have a normal life as a student with all the parties and other fun stuff. Until then, you will probably see me at almost every event. Finally, I want to thank the Drinks & Activities committee for organizing this amazing event and I am sure that I will participate again next year! ●





# My Old Gadgets

These days, I am spending a lot of time in my attic. Not really a surprise, there is my desk, it is my mini-classroom. Usually, attics act as storage rooms for things that we do not want to throw away: objects with memories. Our attic is no exception to this. Therefore, when I am teaching, my old gadgets surround me. For example, here is my good old Rubik's cube:



After 40 years, I tried to solve it again. I succeeded, but it took me two hours! In high school, I was able to do so in 90 seconds, at least, that is what I wish to remember. Still far away from the world record of 3.47 seconds. I thought that the Rubik's cube would be dead by now, but the contrary is true. There are world championships of speedcubing in many categories: 3x3x3 (classic) up to 7x7x7, with one hand, only with your toes, blindfolded, etcetera. Last year, even a documentary appeared on Netflix: The Speed Cubers. It is worthwhile to watch. Let me have a look, what do I preserve more in my attic? Ah, there is my slide-rule, in Dutch 'rekenliniaal'. Maybe, this translation does not ring a bell to you as well, so I added a picture of my slide-rule below.

Yes, I still have mine and treasure it. It is really a nice piece of art! You can carry out addition, subtraction, multiplication, division, and more with it, just like with a

normal calculator. Let me check whether it still works: I am going to compute 17 times 23. First, we put the 1 of scale C on the 1.7 of scale D. There is no 17 on it, so we have to correct with a factor 10. See here:



Second, we move the slider to the 2.3 of scale C (again, correct with a factor 10). Now, we read the outcome on scale D: just between 3.9 and 3.92, so that must be 3.91. Of course, we have to correct with a factor  $10 \times 10 = 100$  and we get the outcome 391. Check it, with your new-fashioned calculator. Nice, is it not? Slide-rulers have a great didactical advantage in comparison with calculators: you have to think carefully first about what actions to undertake before computing some outcome. When pushing the buttons of a calculator you are not thinking, right? Another nice feature of a slide-rule is that the scale is only running from 1 to 10. Otherwise, it would not fit on your desk, of course. If your slide rule produces for example 2.6 as an outcome, it is up to you to correct: is it really 2.6, or maybe 260, or 0.000026, or 2.6 million, or ...? It is good to have some training in estimating the magnitude of an outcome. Calculators made us lazy and destroyed many of our valuable quantitative skills.

You can still buy a slide-rule on Marktplaats, for about 10-15 euros. Be quick, retro objects are very popular these days. I will be happy to demonstrate my slide-rule to you in class, on campus. I hope that this is possible soon and I am looking forward to it. We miss you, we hope you miss us as well. ●



## Henk Norde

is a full professor in Mathematics and Game Theory at Tilburg University. His research interests are cooperative and non-cooperative game theory. He has won our own award for Lecturer of the year seven times!



# Optimize Your Future With 3DS

For this edition of Nekst, we interviewed a former active member of Asset | Econometrics: Christel Opheij. She has always wanted to do something with optimization and consulting. With this in mind, she ended up at Dassault Systèmes where she started working in January 2020 as part of the Delmia Quintiq domain. Dassault Systèmes (3DS) is the 3DEXPERIENCE company that provides world-leading solutions to transform the way products are designed, produced, and supported. In other words, it develops software for 3D product design, scientific simulation, production, but also for logistics optimization. Their software is applicable in all kinds of fields such as natural resources, cities, transportation, and even biological systems and chemistry. 3DS has more than 180 offices in 42 countries worldwide. Furthermore, it has approximately 20000 employees originating from 140 different nationalities. It was founded in 1981 and has become a big multinational. Its headquarters are in Paris, but besides holding an office in 's-Hertogenbosch, 3DS is also located in Boston, Shanghai, Los Angeles, Sydney, Dubai, Tokyo, and many other cities.

written by Jarno Ringhs, Mylan Tran, and Marijn Wolferink

## Why did you choose to study econometrics and how did you experience your time with Asset | Econometrics?

"During the last years of high school, I had considered almost every study. One of my teachers advised me to go to med school, because he thought I was social and smart. I went to a few open days to see if it would suit me, but it did not. My dad then advised me to go to as many open days as possible. I followed his advice and at some point, I just started by crossing out all the studies that were not a good fit for me. At first, I wanted to go to a university of technology to study industrial engineering. However, someone there asked me: 'Have you ever considered econometrics?' So, I went to an open day of the Bachelor Econometrics and Operational Research in Tilburg and I stuck with it. On that first open day, it was already clear to me that I was not interested in finance. Thus, I eventually chose the Master Business Analytics and Operations Research after finishing my Bachelor's." Christel also tells us that during her time in Tilburg, she has been in the Freshmen, Promotion, Orientation & Connection Day, and the LED committee. Therefore, she might be a familiar face for some of you. Furthermore, she has been part of De Kleine Consultant and an active member of the student korfbal society for a brief period.

## Have you ever been on exchange?

Christel tells us that she has been on exchange but not in her Bachelor's phase but during her Master's. At that time, she was thinking about doing a board year at Asset | Econometrics. However, she eventually decided to go on exchange to Peru

and she did not regret this decision at all. She adds: "Since this was an extra half-year on top of my Master's, I could choose any course that I wanted without any constraints. Peru appealed to me, because it has an authentic culture that is completely different from what we are used to and its nature is beautiful too. All in all, it was an extremely fun period."

## How did you come in contact with 3DS?

"After finishing my Master's in 2019, I was looking for a challenging job in Brabant and I was especially curious about 3DS. So, I sent a message to Eline, a fellow econometrician from Tilburg working at 3DS. She replied enthusiastically and she asked me to have a cup of coffee with her to talk about the company. Her positive story convinced me that I wanted to work at 3DS immediately. On top of that, I found the perfect combination of a quantitative and consulting position at 3DS. Another advantage of 3DS is that its office is in 's-Hertogenbosch, close to home."

## Why have you chosen to work at 3DS?

Christel tells us with a big smile why she enjoys her time at 3DS so much: "The average age of employees at 3DS in the Netherlands is approximately 40. However, I have a lot of young colleagues with whom I participate in fun activities. We are a close-knit group of colleagues who see each other very often. I have always enjoyed organizing activities. So it is no surprise that I instantly joined the staff association in my first month. Before the pandemic, we had a Friday afternoon drink every week." Or as we know it in student 'language': de Vrijdag-



**Christel Opheij**

**Industry Process Consultant**

Graduated Master BAOR (2019)

Middag Borrel. She continues: "Next to that, we rent a sports hall every Tuesday evening to sport together. We play various sports like badminton or football. Moreover, we have multiple board game nights and we celebrate birthdays together. Now, during the pandemic, we still organize online escape rooms and pub quizzes, or we have coffee calls. In short, the social aspects of working at 3DS is also one of the main reasons why I wanted to work here."

When we asked her how 3DS differs from other companies in its sector, she replied: "I think 3DS differentiates itself from others by creating custom-made applications. Our





products are unique, because 3DS has its own software. For every problem, we have a special solution. You can compare it to a pie. The base consists of our base software. On top of that, you have a specific part related to the industry and the kind of problem you need to solve. As decoration, we build a customer-specific solution. In conclusion, there are a couple of other companies that offer more standardized solutions but we create a lot of custom-made solutions."

#### Can you tell us something about your role within 3DS?

Christel works in the DELMIA Quintiq department of 3DS. DELMIA Quintiq is one of the domains of Dassault Systèmes, which focuses on Supply Chain scheduling and optimization. Within services, there are three different functions: the Software Expert who specializes in building the applications for the customers, and the Operations Research (OR) Scientist who is even more related to econometrics, because he works on building the optimizers to find the best solutions. Finally, there is the Industry Process Consultant. Christel deliberately chose the last function because of the contact with the customers, stating: "I wanted to be an Industry Process Consultant, because this function requires a lot of social interaction and I enjoy working with many people. Moreover, I am an intermediary between the customer, the Software Expert, and the OR Scientist." Christel elaborates by guiding us through her working process: "First, I do analysis sessions with the customers to understand their requirements for the system. Then, I think about the best solutions for the applications and document this. Hence, it is important for a consultant to also know the possibilities of the software. Then, I will work together with our Software Expert, who will create the software code. The Software Expert does not focus on the presentation of the application itself. This is where I come in.

I will check in the application if the system that is built by the Software Expert works by testing all corner cases. In the end, I will train the customers in using the application."

#### Could you tell us something about your projects?

"Until now, I have only worked on one project. This is a workforce planning project for a Spanish client, which takes around two years. Thus, it is not the case that we do a lot of different projects in a year. 3DS has a standard application that can make schedules and planning, but every customer has particular needs." Christel gives us a more extensive explanation of the project: "A lot of business rules are already in place by our standard workforce planning functionality, such as, that an employee can only work two nights shifts in a row or a maximum of 50 hours a week. The sector in which my customer is working is very strictly regulated. Hence, we needed to build many additional rules, for example, that an instructor can work maximally 25% of his time as an instructor. Strict competencies are another

example of these rules. To keep your competency for a certain task A, you need to work at least a certain amount of time on task A during for example the last 60 days. Hence, we needed to track all the time worked on specific tasks and build extra warnings that help the planner. Moreover, we also need to steer the optimizer so that it makes sure employees keep their competencies. These kinds of restrictions are all custom-made for each client. Hence, it is important to remain in close contact with them and to test it together with the customer afterwards."

#### Can you choose the projects you have to work on, or are they just assigned to you?

"You are able to let your manager know your preferences. Of course, they then have to take a look at what projects are available. When a new project comes up, it gets forwarded to everyone and you can respond and let them know that you want to do it. For example, I have studied in Peru. So, I speak Spanish which leads to the fact that I am currently working on a Spanish project."



**How does a working week look for you?**

Christel gives us an example of an ordinary day at work: "This morning, we had a daily standup with everyone. Thereafter, I had contact with a customer who had questions about the program that we developed for them. Then, a customer with an important data issue contacted me. I had no idea how to solve the problem, so I contacted the Software experts. This was followed by a customer meeting of a couple of hours during which we discussed and tested the Key Performance Indicators (KPI) that we use for optimization. Afterwards, I had a call with two colleagues to discuss the approach of another topic that we are working on and I had another short call with a customer. As you can see by looking at my schedule, I have worked a bit on my own to prepare everything, but I have mostly been in contact with everybody else."

**Does the current situation with COVID-19 hinder you in your work?**

After a little bit of thinking, she comes to the conclusion that the coronavirus does have a significant influence on her job. She says: "Normally I would have been in Spain a lot for my project. However, when I started on this project back in March, travel restrictions were already imposed. Particularly during the beginning and the end of the project, it is really helpful to sit next to the client and take a look at the screen together. We usually visit them once every three weeks. Nowadays, this is of course not possible and we have to do this digitally. This makes the work more difficult sometimes. I also really miss the coffee and spontaneous moments with my colleagues at the office a lot. Nevertheless, the consultation with my colleagues does not differ from the normal situation. Our team is very international consisting of a Dutch consultant, two French ones, a German one, and a Spanish one. If I wanted to speak to them before COVID, this had to be done through Skype anyway."

**Does 3DS provide training or courses to develop yourself even further?**

"When I started at 3DS, the first five weeks were an onboarding process. In the first two weeks, I worked through many e-learning courses to learn the DELMIA Quintiq software. This software is object-oriented, so I had to discover how to work with object-oriented programming (OOP). I learned how to create, drag, and drop things into the application to make it attractive and user friendly. In the third week, I participated in a highly



interesting and exciting programming challenge where I was placed in a team with other colleagues. It was quite stressful, to be honest, because we had to build an entire application in one week. Nevertheless, at the end of the week, we were all very satisfied that we had succeeded in building a working application. In week five, I also did a similar challenge, but this one was in the consultancy branch. This time the emphasis was on properly presenting everything. As a consultant, it is important to deliver clear and engaging advice to your client to make the technical side of the software easier to understand. 3DS really accentuates the importance of continuous learning. We have a 3DS University with a wide variety of training offerings, both job-specific and related to soft skills. On top of that, every year, the Development Week is organized. This is a week full of trainings that you can choose from to stimulate your personal development. This year, I followed courses on workforce planning since it was the subject of my first project. However, I also want to learn more about logistic planning in order to start working on those kinds of projects. Finally, receiving and giving feedback is also very important within the company to lift each other to a higher level."

**Are there many different career opportunities within 3DS?**

"3DS works in a level structure. In my department, you start at consultant level 0, from which you can grow to consultant level 1 and 2. Ultimately, you can take up more responsibility by becoming a lead consultant who supervises an entire team. You can also become a consultant who looks after multiple teams and projects and only

interferes with problems of high difficulty. Next to consulting, you can go to the sales department or work your way up to management." Christel reaches a conclusion by adding: "So, you can see that there are endless possibilities within 3DS depending on your preferences."

**Did you have to learn new things for your job?**

"In the EOR program, we learn a couple of different programming languages and this gives you the ability to learn other programming languages and ways of thinking quite easily. Nevertheless, you still need a short course to learn the language of the 3DS systems. The study connected very well with the technical part of my work, but not with the consultancy part. We only had one course in the whole program that focused on improving your soft skills. Therefore, I also joined De Kleine Consultant. The skills that I developed while working there were very useful for my current job. I had to do a lot of interviews and other consultancy related work which gave me a big advantage."

**What kind of advice would you give to the econometricians in Tilburg who are about to enter the labor market, based on your experiences?**

Christel thinks this is a difficult question, which it is for anyone who just graduated not long ago. After a moment of thought, she says: "I think it is important to dive deeply into the matter, think about your interests and skills. Talk to people who are already working at the company of your interest to get a better idea of the company's activities and working atmosphere." ●



# Ranking the Trists

**W**hen I saw the announcement of this event, I immediately registered. First of all, for me, it was clear from the title that this was going to be an evening full of laughter. Second of all, an event organized by the Olden Goldies committee can never disappoint.

For those who have never heard of the tv-show 'Ranking the Stars', the name and concept of this event need some explanation. Shortly, before the event you are asked to give a top three ranking and a bottom three ranking for certain statements, choosing from the participants. Besides, you have to state whether you suspect yourself to be ranked in the top three, bottom three, or to not be ranked at all. You earn points if you have the right people in your ranking, which is determined by the ultimate top and bottom ranking. The outcomes are based on the answers from all the participants. In our case, the participants were obviously the participating econometricians from our lovely association, also known as 'Trists' (Dutch abbreviation)! Moreover, you could add some notes and stories to your rankings to explain your choices. Then, you wait for the moment of truth to hear about the result.



On December 1, it was finally time to sit together with some friends while of course adhering to the COVID-19 rules. We also bought some drinks, because we thought that those might be needed. Then, we sat down before a large TV screen. I loved seeing everyone on screen in the Zoom call, because we were all very excited to see what was going to happen. We quickly understood that the Olden Goldies committee had changed the original tv-show into a student version. This meant that there were several drinking rules for when one appeared in the ultimate ranking list. Additionally, they really put a lot of effort into the event and made a spinning wheel with ugly pictures of the participants' faces. In between questions, the wheel was spun and someone had to do a task (i.e., someone had to drink).

The part which made me really excited was when they told us we could order 'bitterballen' (my favorite snack) during the event. These would then be delivered to our home if we would call a certain number. As I typed in the number on my phone, I saw that this was the number of our Internal Affairs, Tjum van Dijck. I tried to order several times but I am unfortunately still waiting for my snacks...

*"An event organized by the Olden Goldies committee can never disappoint."*

Now it was finally time to hear the results. For every question, the people who had an interesting top and bottom three first had to explain their ranking. This resulted in some very funny stories that are not all repeatable here. After each speech, we saw the actual ranking. Some examples of questions were: 'Who could be the prime minister?', 'Who is a typical Econometrician?', 'Who is the first one to have children?' and 'Who often looks at themselves in the mirror naked?'. Some of the results were expected, but others were more surprising and I definitely



was very bad at guessing my position in the ranking. Nevertheless, it was at least very interesting to hear about everyone's unfiltered opinion!

At the end of the evening, the winners got surprised with a gift, which was delivered at their door at that moment! Via a

live stream, we were able to see some of the committee members showing up at the front door of the winners. One of the winners, for example, received a real-life Christmas tree. They also delivered a huge and in my opinion awful painting (see picture) on the doorstep of Denise Jacobs. Maybe not that bad that I did not win after all. All in all, I really had a good time joining this event and I hope the Olden Goldies committee will continue organizing their events as well as they did this time! ●



Where are the new





ew board Waldos?





# The Perfect Combination: Swimming and Econometrics

written by **Troy de Juncker** and **Jarno Ringhs**

**N**owadays, doing sports is even more important than ever before. After all those endless days of watching lectures from behind your laptop, you want to get out and stay fit. As a student, there is no better place than a student sports association to practice your favorite sport. Therefore, we thought it was a good idea to take a look at Avalon: the student swimming and water polo association of Tilburg. We spoke with Joris te Booij, the sports commissioner of Avalon and a fellow active member of Asset|Econometrics. He gave us an insight into his board life and how they, as a board, are dealing with the current situation.

Growing up in Vught, Joris decided to make more of his student life and move to Tilburg in his second year. A decision he is still very happy with. While being a passive member of Asset|Econometrics in his first year, his student life really got going when he decided to become active and join a committee. Joris decided to study at Tilburg University because Econometrics was highly regarded here. Also, the distance from Vught to the university was

easily traveled by a short train journey. While he thinks he maybe should have looked better at the universities of Rotterdam and Groningen, he is still very happy with his decision to choose for the program in Tilburg. The highlight of his student time should have been his exchange to Seattle. Due to COVID-19, he, unfortunately, had to come back home after only a little more than two months abroad. Even though it was only a short period there, he really enjoyed it.

*“Just come for a swim sometime”*

Of course, it is already really different being so far away from home, and that alone is a whole experience in itself. But the subjects he followed there were also enjoyable. Learning about Data science and improving his R skills made some of the courses easier. Moreover, the things he learned in Seattle were also applicable at Tilburg University.

While starting his second year at the university, he also joined Avalon, the student swimming and water polo asso-



ciation. At that time, the association recently added competition swimming, as it was only a water polo club before. Since he has been swimming his whole life and he knows people who are also part of the swimming organization, he knew this was the right step to take. What he especially likes about Avalon being a student association, is that he gets to visit a lot of student cities for his competitions and for the parties. At the races, he gets to see some familiar faces from his earlier swimming career and the fact that all of the participants are students is something he finds really enjoyable.

When we asked Joris to describe the club, he told us the following: “Avalon is a sociable association where people from every level are welcome. I am probably one of the members who take swimming and racing a bit more seriously. However, most of the members are here





because they enjoy swimming and like to stay in shape. Also, the monthly activities and the nights at Café Bolle with free beers are great reasons to become a member at Avalon."

We also asked Joris why he decided to become part of the board at Avalon. He replied: "I had been thinking about it for a long time, but because of my exchange, it was not possible yet. When I had to go home during my exchange, I took the opportunity. Also, I only heard positive stories from friends that were part of the board at their association in another city. Besides this, I already knew the members of the board and I also knew that they all signed up. So, nothing was going to stop me from joining."

Joris explained that the main target of the board is to promote the association as much as possible. He said: "We have set a couple of objectives for ourselves. We are a pretty small association and Tilburg is a big city that should have enough students who want to swim. So, we try to make more students aware of the fact that we exist. In addition, we have become more active on social media. Earlier this year we also created a promotional video in the Sports Center."

The coronavirus has also had an impact on this association. According to Joris, it had a small advantage, but mainly a lot of disadvantages. Joris said: "We have seen an increase in members due to the situation with the coronavirus because people do not want to sit in their room all day. On the other hand, there is still no advantage when the government has to close all the swimming pools. This is very difficult for people who want to become a member. When the pools have to close, you will lose the people who still have doubts about joining. Moreover, we had to cancel some activities. This year, we were going to organize the national students' championship for swimming (NSZK). It was planned for December 5. As the newest swimming association in the country, this was the first competition we were going to organize. Being a swimming coordinator you are mainly responsible for this event. So, I was very excited about it from the moment that I applied for this role as a member of the board. The event was moved to February, but now it is not happening at all. You are very hopeful at



*"I already knew the members of the board and I also knew that they all signed up. So, nothing was going to stop me from joining"*

the start, but everything is not like you had in mind. In 2022, it will be again our turn to organize the swimming championship. During the introduction week, we wanted to organize a cantus with T.S.H.V. Melmac and S.K.V. Camelot, but also this was unfortunately not possible."

We also asked Joris if he already knows what the rest of his student life will look like. He replied: "I will be on the board of Avalon until the end of the academic year. After that, I will probably start with the Master Business Analytics and Operations Research in Tilburg. I am still thinking about doing something extra besides my Master's, because I want to

get the most out of my student life. I will certainly remain a member of Avalon and I will probably join a committee too. Additionally, I still want to organize the NSZK in Tilburg."

Lastly, we asked Joris what we can expect from Avalon during the rest of the year. He enthusiastically replied: "In the summer, we will have our lustrum. It is our second lustrum and it is going to be legendary! The lustrum committee is very busy at the moment to make it an unforgettable experience. We hope that it can take place, because it will be at the end of June."

His last advice for the readers of Nekst is: "Just come for a swim sometime." ●

# Create and Enrich Road Networks for Optimization Using OpenStreetMap and GPS Traces

One of the prerequisites of successfully applying Operations Research techniques is having the right data available. As an example, when applying a shortest path algorithm, we need to know the underlying graph network for the results to make sense. If not all edges are present in this graph, the shortest path may not be as optimal as we would think or hope. In this article, we focus on finding an accurate representation of a road network, which can be used for optimizing, for instance, routing decisions.

## Introduction

An accurate representation of a road network is essential when performing network analyses. We can often rely on maps such as OpenStreetMap (OSM) and Google Maps for these representations. However, this is not always the case. For instance, in remote areas, roads may not exist in OSM or are not accurately connected with each other. This might lead to significant flaws in optimal routing decisions that are based on these road networks.

To be able to complement such road networks, we can use GPS trajectories. Equipping vehicles with GPS trackers results in lots of data about the location of a vehicle along with its course and current speed. This information tells us, for instance, that a vehicle has been driving on road  $X$  with velocity  $Y$  at time  $Z$ . If a vehicle drives a particular route, the tracker returns an ordered sequence (with respect to time) of such GPS points, which is called a GPS trajectory. We will discuss one way to create and complement road networks using such GPS trajectories. The final graph (result) should be suitable for optimization and navigation purposes.

## Problem definition

We want to be able to optimize routing decisions in an area for which the road network is not completely known. We do, however, have GPS trajectories becoming available each day of vehicles that drive around in this area. Table 1 shows a sample of such data.

Time	Latitude	Longitude	Speed	Course
11:46:44	-0.74603	100.53225	23.90	132
11:46:51	-0.75559	100.54749	24.97	133
11:47:51	-0.75339	100.55469	37.38	126

Table 1: Sample of GPS trajectory data on a particular day.

Now, the goal is to get an accurate representation of the road network. Let us first describe what this means mathemati-

cally. We want to end up with a graph object, say  $G = (V, E)$ , where  $V$  represents the set of nodes of  $G$ , and  $E$  the set of edges of  $G$ . Additionally, we need to be able to extract information about the geometry of the road. This can be used to find actual distances (and later on, travel times), but it is also necessary for navigation purposes. When a driver navigates to his destination, we do not want to only point him in the direction of his next node (see Figure 1).



Figure 1: Information about how a road runs exactly (blue edge) should be in the graph. The yellow dashed line is not appropriate for navigation purposes.

One way to do this is to add a node for each point the road changes its course (the open red circles in Figure 1). However, this increases the number of nodes/edges of the graph significantly, which is not preferable due to computational reasons. Instead, we use the geometry of a road as an attribute of an edge. In particular, we use so-called *linestrings* to represent the geometries. A linestring is a path between two locations. It takes the form of an ordered series of at least two points. For instance, `LineString((lat1, lon1), (lat2, lon2), (lat3, lon3))` represents an edge that starts at the coordinate  $(lat1, lon1)$ , then goes to  $(lat2, lon2)$  and ends at  $(lat3, lon3)$ . In this way, we only need one edge to represent the blue road in Figure 1. This means that for the



ID	highway	oneway	length	geometry	maxspeed	...	u	v	key
1	primary	False	601	LINESTRING (100.51221 -0.73829, 100.51421 -0.7...	40 mph	...	1	3	0
2	residential	False	700	LINESTRING (100.51221 -0.73829, 100.51433 -0.7...	20 mph	...	1	3	1
3	trunk	False	139	LINESTRING (100.54851 -0.76691, 100.54927 -0.7...	15 mph	...	2	3	0
6	track	True	651	LINESTRING (100.55572 -0.77221, 100.55548 -0.7...	15 mph	...	6	5	0

Table 2: Sample of the edges of a graph that represents a road network. Highway indicates the importance of the highway within the road network, and u (v) represents the ID of the start (end) node of this edge. Note that there may be multiple different roads (and therefore edges) between the same start and end point. These are distinguished using a key in the last column.

nodes of  $G$ ,  $V$ , we only include the intersection points of the roads. Points at which a driver can choose between at least two options. Additionally, we include end points of dead ends as nodes, as this might turn out to be a start or end location of a future origin-destination pair. For the edges of  $G$ ,  $E$ , we include all possible roads between the nodes.

Initializing a first graph can be done using the information from OpenStreetMap. Using the work of Boeing [1], we are able to initialize a road network (graph) that has the features discussed above. He develops a method to easily extract the information from OSM into graph structures. In Table 2, we show a sample of how the edges of the graph are represented. In the rest of this article, we focus on how to extend this initial graph using the GPS trajectory information.

### Approach

There are already several methods developed for generating road maps based on (solely) GPS trajectory data. For an overview and introduction of such map construction algorithms in general, we refer to the work of Ahmed et al. [2]. Instead of creating a new network, we discuss how to extend an existing network (based on OSM). Moreover, we need to take several specific restrictions into account. First, many roads that are in the trajectory dataset may not exist in the OSM database. Secondly, we need to take into account that the density of the GPS trajectories may be unevenly distributed. Some of the roads are more often used than other roads. Also, in general, there may not be much redundancy present on each road. We still want all roads that are driven only a few times to occur in our graph structure. Thirdly, we need to incorporate the sampling frequency (e.g., how much time passes between two consecutive GPS point locations). Finally, we prefer to use a method that easily adjusts the found network when additional GPS trajectories are obtained.

Incorporating these restrictions, one approach can be characterized as follows. We start with the initial graph and we subsequently consider GPS trajectories. For each trajectory,

we extend the current graph. Let  $\mathcal{P}$  be the ordered (with respect to time) set of GPS points, then the basic procedure is shown in Algorithm 1.

#### Algorithm 1 Extending graph $G$ using GPS trajectory $\mathcal{P}$

```

1: procedure EXTENDGRAPH( $G$ ,  $\mathcal{P}$ )
2:   for  $p \in \mathcal{P}$  do ▷ For each GPS point in  $\mathcal{P}$ 
3:      $p' = \text{projectPoint}(G, p)$ 
4:      $d = \text{distance}(p', G)$ 
5:     if  $d < \bar{d}$  then
6:       if last_point_of_edge then
7:         Connect (new) edge with  $G$ 
8:         Absorb point into  $G$ 
9:       else
10:        if first_point_of_edge then
11:          Start a new edge of  $G$ 
12:        Extend a previously started edge
13:   return  $G$  ▷ Graph  $G$  is now extended

```

In the rest of this article, a GPS point will be denoted with  $p_{(n)}$ , which represents the  $n^{\text{th}}$  GPS point of  $\mathcal{P}$ . Moreover, any projected point will be denoted with an apostrophe (e.g.,  $p'_{(n)}$  is the projected point corresponding to  $p_{(n)}$ ). In the algorithm, we start with projecting the GPS point  $p$  onto the current network (line 3), while incorporating the geometry of edges and the course of  $p$ . Projecting means that we look for the point on the network that is closest to  $p$  and is headed into a similar direction. Next, we compute the distance between  $p$  and its projected point (line 4).

First, if this distance is small enough (impose a threshold, line 5), we *absorb* the point into the network (line 8). This means that we do not add any edges or nodes to the current network. However, there is one exception. For now, suppose that  $p_{(n)}$  will connect a newly created edge to the network (*last\_point\_of\_edge*, line 6). Note that this requires the previous point to not be absorbed into the network. In this case, we need to reconnect this new edge with the network (line 7). We illustrate this procedure in Figure 2.

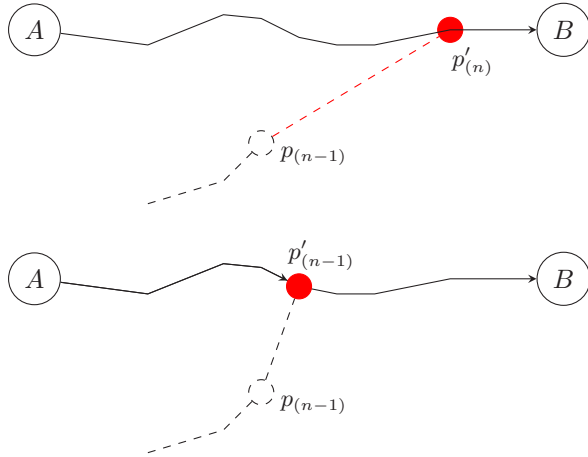


Figure 2: Connecting an edge with the network. Due to the fact that  $p_{(n)}$  is absorbed in the network, we re-project  $p_{(n-1)}$  onto the network to obtain the connection of the new edge with the current network.

The solid black line represents an edge from the current network. The dashed black line represents the edge that has been created up to this point. We are currently examining GPS point  $p_{(n)}$ . Since this point is close to the network, we need to connect the new edge with the network. Instead of adding the red dashed line (illustrated in the top plot), we re-project the previous GPS point (which is part of the new edge to be created) onto the network, **without** incorporating the direction of this point. Then, we add this projected point,  $p'_{(n-1)}$ , as node and we split the edge onto which this node exists ( $A, B$ ) into two edges:  $(A, p'_{(n-1)})$  and  $(p'_{(n-1)}, B)$ . Finally, we add the new edge (dashed black lines) to the network (illustrated in the bottom plot).

Secondly, suppose the distance between the current GPS point and the projected point is not small enough (line 9). In this case, we must include this GPS point into a new edge. If this edge already exists, we extend it with this new point (line 12). If this is the first point in a sequence that cannot be absorbed (*first\_point\_of\_edge*), we need to start a new edge (line 11). This can be done in a similar way as connecting a new edge with the network. We re-project the current point onto the network, without incorporating the direction, and we consider this point as the starting point of the new edge.

Based on this algorithm, we can extend a graph with multiple GPS trajectories sequentially. There are, however, still some things that can go wrong. Next, we discuss some potential drawbacks of this algorithm along with possible solutions for these drawbacks.

### Missing roads

The first thing that can go wrong is that two consecutive points may be absorbed in the network, while there is no (direct) possibility to go from the first point to the second point in the current network. Such a situation is sketched in Figure 3.

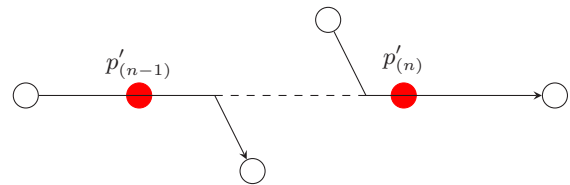


Figure 3: Example situation in which both  $p_{(n-1)}$  and  $p_{(n)}$  are absorbed into the network, but there is no direct connection from  $p'_{(n-1)}$  to  $p'_{(n)}$ .

A similar situation may occur when there is no (direct) connection from  $p'_{(n-1)}$  to  $p'_{(n)}$  in the example sketched in Figure 2. Therefore, we introduce another parameter that can be included into the `projectPoint` algorithm: `close_to_edge`. This parameter represents an edge that has to be close to the edge onto which we project a point. So when we project a point onto the network, we can use the fact that it must be projected onto an edge that is close to the `close_to_edge`. Note that `close` is defined per situation:

- i) When  $p_{(n-1)}$  was absorbed into edge  $(A, B)$ , we prefer to project  $p_{(n)}$  onto the same edge. If this is not possible, we would prefer projecting  $p_{(n)}$  onto edges that leave node  $B$ . If this is also not possible, we prefer to project onto edges leaving one of the endpoints of the edges leaving node  $B$ , etc.
- ii) Secondly, when  $p_{(n)}$  starts a new edge, we define `close` as follows. Suppose  $p_{(n-1)}$  was absorbed into edge  $(A, B)$  of the current network. In this case, we prefer to project  $p_{(n)}$  onto the same edge. If this is not possible, we would prefer projecting  $p_{(n)}$  onto edges that leave node  $B$ . If this is also not possible, we would prefer to project onto edges leaving one of the endpoints of the edges leaving node  $B$ , etc.
- iii) Finally, we define `close` when  $p_{(n-1)}$  must connect a new edge with the current graph. Suppose  $p_{(n)}$  (which is the last point of the edge) was absorbed into the network (into edge  $(A, B)$ ). In this case, we want to project  $p_{(n-1)}$  onto an edge that easily gets to  $(A, B)$ , preferably  $(A, B)$  itself. If this is not possible, we would prefer projecting  $p_{(n-1)}$  onto edges that end in node  $A$ . If this is also not possible, we would prefer to project onto edges ending in one of the start points of the edges ending in node  $A$ , etc.



### Connecting GPS trajectories

Besides the missing roads, we also need to be careful when having multiple GPS trajectories. If end or start points of trajectories are *close* to each other, we may need to combine these points into one node in order to ensure that a vehicle may pass this node. This situation is sketched in Figure 4.

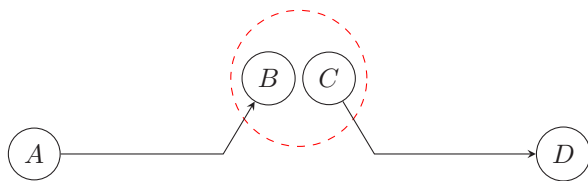


Figure 4: Example situation in which we merge node  $B$  and  $C$  into one node, in order to ensure that there is no disconnection between the two trajectories.

One trajectory has as final edge  $(A, B)$  and one trajectory has as first edge  $(C, D)$ . However, in this case, we are not able to move from  $A$  to  $D$ . To incorporate this information that multiple GPS traces could form a longer road, we build in a function that checks whether a point can be merged into another point. In the example in Figure 4, we combine  $B$  and  $C$  into one node, which ensures that we are able to move from  $A$  to  $D$ .

In conclusion, to be able to have a working algorithm, we need to know what could go wrong. Needless to say, this knowledge is often obtained when testing your algorithm for the first (or second, or ...) time.

### Case study

Finally, to check whether the proposed algorithm performs as expected, we try using it with some actual data. We create a small piece of a road network for a region in Indonesia for which we have GPS trajectories available of trucks transporting goods. We start with the OSM base map and run the algorithm for 11 GPS trajectories. The result is shown in Figure 5. We observe that some additional edges are added to the base map that will significantly affect the shortest paths between locations. Note that in the bottom right we see (if looking carefully) two parallel edges. Since all edges from the GPS trajectories are one-way only, these edges represent the two one-way edges running in opposite direction.

Next steps include predicting or learning the (actual) travel time of (new) edges based on the distance of an edge and the used speed of vehicles traversing this edge. ●

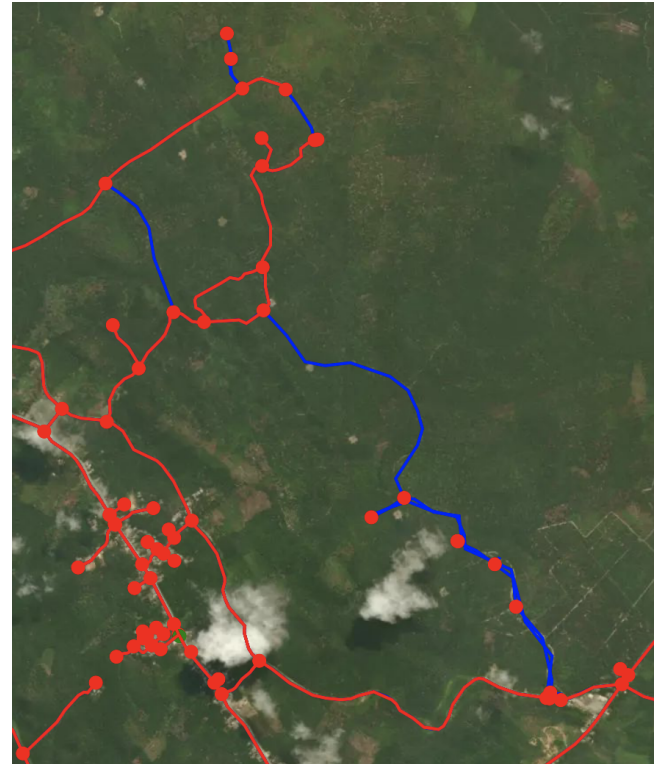


Figure 5: Result of extending the OSM base map (red edges) using the 11 GPS trajectories. Blue edges represent those edges added after running the algorithm.

### References

- [1] Boeing, G. (2017). OSMnx: New methods for acquiring, constructing, analyzing, and visualizing complex street networks. *Computers, Environment and Urban Systems*, 65, 126-139.
- [2] Ahmed, M., Karagiorgou, S., Pfoser, D., and Wenk, C. (2015). *Map Construction Algorithms*. Springer.



**Valentijn Stienen**  
Ph.D. Candidate

# Econometrics in an Online Practice Day

**I**n the beginning, when the well-known coronavirus hit our country, we as the Econometrics in Practice Day committee still thought we could organize our event in real-life. Therefore, I mainly focused on finding a location at the beginning of the process. As you can imagine, we were really happy when we found a good location eventually. However, when time passed, we realized that COVID-19 was something we had to deal with and it would not leave the country any time soon.

Determined that we would make this day successful, we looked at all possibilities. Could we still organize this event in real-life? We definitely had to make a 'Plan B' in which the event would be held online. After considering all the arguments for having this day online or offline, we decided on the online alternative. But what is the Econometrics in Practice Day (EPD) without companies? Nadia Cissen and Polle Dankers, our external affairs commissioners, called a lot of companies. We saw that many companies hesitated to participate in our event because of all uncertainties regarding the virus. However, we managed to get three exciting and interesting companies to participate in our event. Districon, Eyeon, and TBA, all Business Analytics and Operations Research related companies, agreed to provide us with the cases.



Nonetheless, we quickly agreed that we wanted something extra. Therefore, we decided to look for a guest lecture given by someone who has a lot of experience in our discipline and could talk about this with enthusiasm. Bas ter Weel would be this person as he works in a team that tries to answer particular questions from the government and other businesses. With econometric models, he tries to answer these questions in the best way possible. In this process, he has to take a lot of considerations into account. During his guest lecture, he also talked about all the problems he faced in developing the solution. He told us that econometrics is a necessary tool for the government to make good decisions. Additionally, he showed the process of answering the following political question: What is the impact of increasing the youth minimum wage?

After the guest lecture of Bas ter Weel, all participating students would have one case from either Districon or Eyeon. In the afternoon, they would have a case from TBA or a training from De Kleine Consultant on how to take a structured approach to manage a project. In all the programs, the company representatives would first talk about their company and their case. However, most of the time, the students would work on a case in a small group. It is of course 'the Econometrics in Practice Day' and not the 'Econometrics and Listen Day'. The companies also made sure that the winning group of the cases received fantastic prizes.

The Eyeon case was about making forecasts based on historical data. I was lucky, but it was with the strength of my group that I won this case. The Districon case was about clustering stores of a supermarket chain to obtain an efficient balance of



**Christel Janssen**

**Bachelor EOR**

Age: 20

the transport workload. In the afternoon, I coordinated the TBA case. This case required the students to design a quay by evaluating the expected vessel arrival schedules. The students had to determine the length of the quay and the number of quay cranes needed to get the work done. The group with the lowest costs in total would win.

For me, coordinating meant that while all the groups were working on their case, I talked a bit with the two employees from TBA. I made sure that everything was going in the way it was planned. At first, I thought being with these two men would be a bit awkward, because I was in a Zoom call with them for maybe 1.5 hours. However, I had a really interesting conversation with them. In the end, I thanked the TBA employees in my faulty English. I realized too late that the whole case was in Dutch because all participating students were Dutch. I was a bit ashamed, but those mistakes are just who I am, and now I can laugh about them. Overall, it was a very successful day and I thank everyone that participated! ●



# The Resemblance Between Pensions and Melting Icebergs

**D**uring the last decade, many records were broken: warmer and longer heatwaves were measured than ever before and after almost ten years of negotiations, the new Dutch pension deal was approved. When you decided to study at a Dutch university, you might have expected to ice-skate on the canals in winter. However, nowadays, even a white Christmas seems to be a rare phenomenon, reflecting a noticeable effect of global warming in the Netherlands. The effect of melting icebergs causing sea levels to rise is a serious threat against which the Netherlands, which literally means Lowlands, attempts to defend itself.

From an econometric viewpoint, estimating and forecasting trends in climate data is a possible application of the tools you learn(ed). Predicting long-term trends in temperature and interest rate levels rely on similar kinds of theoretical methods. For both applications, observed time series data is used. For example, CO<sub>2</sub> emission at several places in the world or bond prices with several maturities can be fitted to, e.g., mean-reverting processes. Additionally, when calculating the 'fair' price of climate change, the long-term interest rates are directly needed. Hence, the parallels between climatology and financial econometrics can be traced back to the pure panel data regressions and forecasts. Moreover, the decision-making process of emission mitigation plans involves the determination of the social cost of carbon.

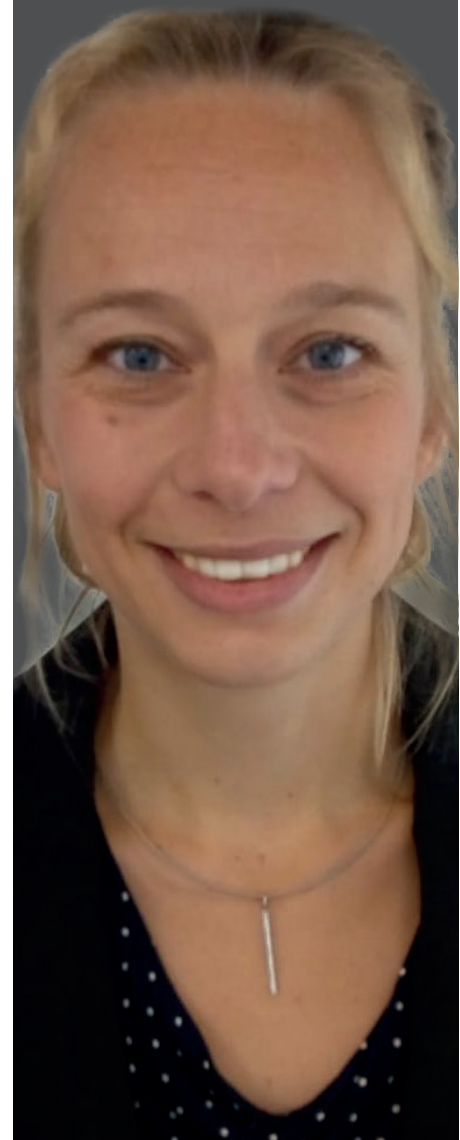
Changes in climate cause externalities, which are largely negative such as heatwaves and rising sea levels. However, some positive externalities may also result, such as local increases in crop.

When the damages outweigh the benefits in terms of costs, the question arises as to how much society should be willing to pay to avoid future climate damages. Likewise, in a Net Present Value (NPV) calculation, all cash flows have to be discounted to time zero in order to make a valid decision with respect to the implementation choice. The social cost of carbon (SCC) represents the sum of all quantifiable costs and benefits in monetary terms of emitting one additional tonne of CO<sub>2</sub>. These costs can be avoided by emission reduction plans, which brings us back to the NPV calculation.

Not only is there a lot of uncertainty involved in the prediction of the future costs of potential damages due to global warming, but the choice of the discount rate is also crucial for the SCC. Once again, we spot a similarity with the pension industry. Since bond prices with maturities beyond 50 years are rare, but the effect of climate change stretches out on a much longer horizon, model-based rates are required. Similarly, as life expectancies are rising, pension funds need these rates too. It is significant to note that the horizon of climate effects spans hundreds of years, which is much longer than the rise in life expectancies. The sensitivity of the funding ratio on the level of interest rates with long maturities is high and therefore this is a topic that is heavily discussed in public debate. It turns out that the long end of the term structure of interest rates is actually hard to project as there is a lot of uncertainty involved. Therefore, the current version of the pension agreement has omitted this dependence of pensions on uncertain interest rates. However, the effect of damage to nature due to climate change in the distant future cannot be avoided by a change of modeling but only by a change of our behavior. ●

## Anne Balter

*is an assistant professor at the Department of Econometrics and OR and a senior research fellow at Netspar. Her research interests include mathematical finance, in particular robust portfolio problems, pension economics, and real options.*



# Emiel Caron: 'Our Singing Teacher'

written by **Tamara Dert** and **Casper Heemskerk**

**F**or this edition of *The Teacher* we had the pleasure of finding out what makes Assistant Professor Emiel Caron 'run'. Not a lot of 'debugging' was necessary as Emiel is a very open man with quite a lot of interests. As you now hopefully guessed, Emiel gives a programming course in our program. This is, however, only a small part of his work at Tilburg University. Besides being our teacher, Emiel also teaches in other study programs and oversees two International Information Management Masters as Academic Director.

## Where it all started

Dr. Emiel Caron is from origin a true Brabander. Therefore, it was not very surprising that he started studying right here at Tilburg University. After having studied something else for a year, he came into contact with BIK (Bestuurlijke Informatiekunde), the predecessor of Information Science, stating: "Studying was no longer something that needed to be done, it became something I liked doing out of intrinsic motivation." That feeling made him realize that he was in the right place. A place he acknowledges is not always easy to find but is definitely worthwhile to go looking for. About the 'non-study related part' of his study period he smilingly said: "During my high school period, I did not focus a lot on school. The partying was a lot of fun. However, when I started studying at the university, I soon became serious about my studies." Nonetheless, he did become an 'active-passive member' of Asset | SBIT and played guitar in a band with friends.

After university, he worked for one of the biggest IT firms in the Netherlands: Pinkroccade. Ten to fifteen years ago, the IT sector was still very small but growing. It is interesting how fast this sector has evolved and grown: from being a small tool in a process to being the entire framework. However, Emiel did not really feel part of the company, stating: "After having worked two years on mostly standard business issues, I was quite done with it." He decided to change it by going for a PhD at the Erasmus University of Rotterdam. This was the start of his academic career. As of then, he has worked all around the Netherlands both in business as in the academic world, but always in his specialty: Business Analytics and Data Science. As for some years now, Emiel Caron is back at Tilburg University. He lives next door in Oosterhout, has two ice-hockeying children who will become teenagers in a few years, and a wife that he probably bedazzled with his guitar skills and his singing voice. Moreover, he really enjoys cycling.

## Why teaching econometricians is different

Emiel's main occupation is teaching at the university. Because he does not only teach econometricians, he is in the perfect position to compare us a bit with others. He starts off by stroking our egos a little by stating: "In general econometricians are

better. I see that the stepwise way of thinking that computer programming is also based on really suits them." This, he reckons, is a logical effect of all the statistics and math we are confronted with. The other side that probably also follows from this, is that most econometricians like their questions and information to be really specific: "If I give the same vague assignment to economics students and econometrics students, the economics students start by just trying, whereas econometrics students rather want everything cleared up first." Relatable right? Emiel continued again by stroking our egos: "Econometricians are able to be successful in every situation." He is aware that econometricians have little knowledge of economics compared to the other studies at the faculty as not much attention is paid to economics in the course program of econometrics. The remaining question is whether it is necessary for econometricians to be taught extra about economics. Emiel thinks it is not because econometricians are always able to fall back on their 'toolkit'.

Dr. Caron teaches Computational Aspects in Econometrics, which is a third-year Bachelor elective course for us. Emiel convincingly says: "Computer programming has become an indispensable tool in the toolkit of an econometrician." As most of us know by now, data is often shred-

*"Studying was no longer something that needed to be done, it became something I liked doing out of intrinsic motivation."*



ded. Cleaning and using it is therefore harder, and should be done with caution. At Tilburg University, we made the step from Java to Python because this is more compatible with the kind of data science that modern econometricians encounter more and more. Furthermore, the Python optimization functions made AIMMS as good as redundant. Whether the course Computational Aspects in Econometrics should become mandatory is not for him to say, according to Emiel. However, he does strongly recommend it, stating: "Computational Aspects is very practical and has a strong connection to business life. It can definitely help you in your future job, but it will certainly be useful in your studies too."

#### Living the Life at Tilburg University

Working at Tilburg University offers several aspects: Emiel is not only teaching, but also doing research. Because teaching takes a lot of time, it is sometimes hard for him to find time for his research. At the moment, his research field is data cleaning which is also a big part of what he teaches. Emiel is currently developing some automatic methods for data cleaning. Besides data cleaning, artificial intelligence is also a part of his research field. He tries to declare why some things keep going wrong and tries to solve these issues. Sometimes, Emiel also works with some econometrics students. Like Emiel said: "Econometricians are better with models and they like to work outside their comfort zone."

Emiel likes to work at the university and especially on the campus. Emiel appreciates being part of, what he calls, 'an academic house'. He likes to have many conversations with his colleagues during a simple coffee break for example. It is very important to him that the work environment is friendly and comfortable. Maybe that is, at the moment, the hardest part of working at home for him. He misses the contacts at the university a lot as he values the contact with his colleagues. However, his favorite colleagues are Amin Amiri and Ruud Brekelmans, who teach programming courses as well.

The impact of the COVID-19 virus is impossible to neglect for the teachers at the university. Emiel had already begun with some online teaching and therefore, it was not a completely new field for him when suddenly everything had to switch to online. Emiel thinks that the quality of the lectures has remained quite the same. The biggest challenge is the computer labs. In the computer rooms on the campus, it is very easy to help someone and to solve simple problems. While now, it takes much time to solve such simple problems and to help the students personally. According to Emiel, education does not suffer that much at the moment, but the contact with the students and colleagues is a big miss for both the students and the teachers. The whole feeling of being part of a bigger institution is completely gone.

#### What the future will bring

Emiel likes working at the university and he is really looking forward to proceeding this way. Emiel is also an academic director at the university and supports Master students who are doing their Master's abroad. He would like to expand his work as an academic director to involve some international students in this project. However, working the business life is also a chapter that will not yet be completely closed. The speed of working with a company is very interesting and the urgency is very different compared to working at the university. ●



**dr. Emiel Caron**

## Bert & Ernie Questions

**Movie or Book?**

"Book"

**Beer or Wine?**

"Wine"

**Carnival or Christmas?**

"Carnival"

**America or Asia?**

"America"

**Saint Nicholas or Santa Claus?**

"Saint Nicholas"



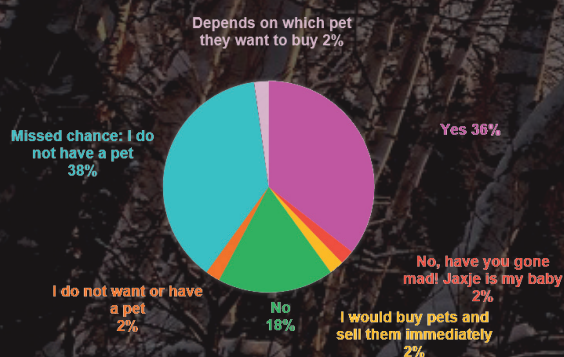
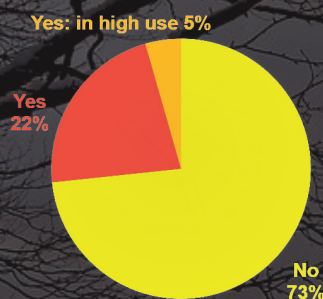
# Let's small Talk!

As the COVID-19 crisis paces on and on, we still see each other during Zoom meetings for our committees, our lectures, and even some quite fun interactive activities! However, let us be honest, it is not the same. Meetings are often described as 'efficient'. Great for in a workplace, but we miss the formerly favorite (and longest) part of the meetings: 'Any Other Business'. Therefore, we decided it was time to go looking for some juice. We took an anonymous questionnaire among our active members asking questions in four categories: love, leisure, politics, and Asset | Econometrics.

written by **Tamara Dert**

## Love

Since we can no longer enjoy the busy nightlife or our own Monthly Drinks, where regularly hearts were won, we wonder: how are we looking for some love now? Hence, our questionnaire asks: "Do you currently have a dating app installed on your phone?" Looking back, we probably should have added the option of being in a relationship. Nevertheless, we found out that more than one out of four members currently has a dating app installed on their phones. Seventeen percent of these members even state that it is 'in high use'. We wish you all a lot of love around you and we look forward to hearing your stories!



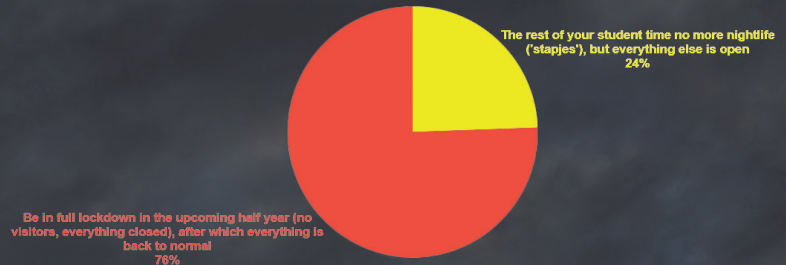
Of course, we acknowledge that there are more kinds of love. Whether it is love for pets or love for money, we do not judge. We, however, did wonder what happens if decisions must be made. We asked: "If someone offered you €100,000, would you sell your pet?" Answers diverged from "No, have you gone mad! Jaxje is my baby" to some quite disturbing reactions like: "Depends on which pet they want to buy" and "I do not have a pet, but I would love to sell my sister's hamster." Furthermore, there were a few that saw a business model, stating things like: "I would buy pets and sell them immediately." Looking at the final score, we see that around 60 percent of the pet owners would sell their pet for this price. Maybe the money wolves stereotype about econometricians has a grain of truth in it after all.

"It turns out that around 60% of the pet owning econometricians would sell their pet for €100,000,-"

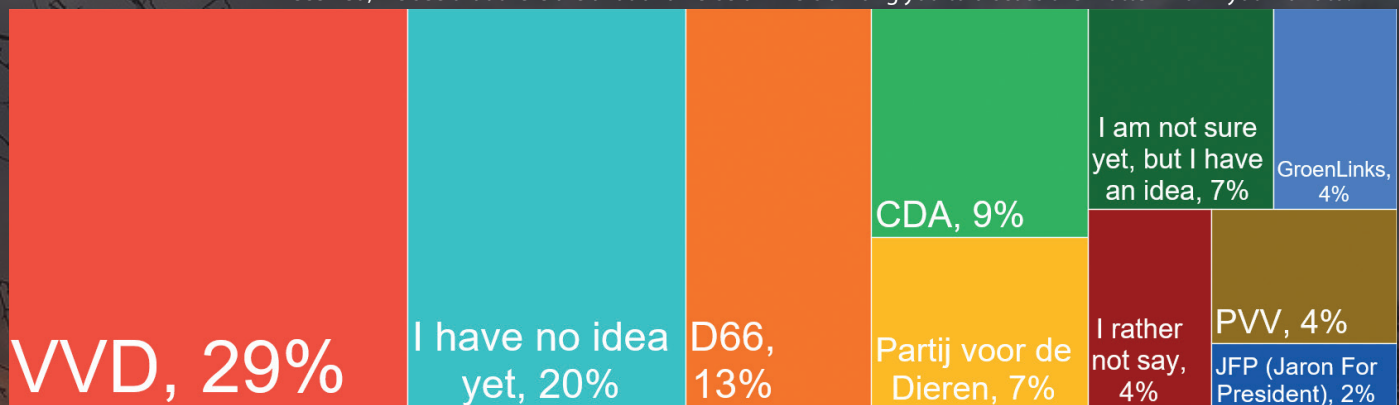


# Politics

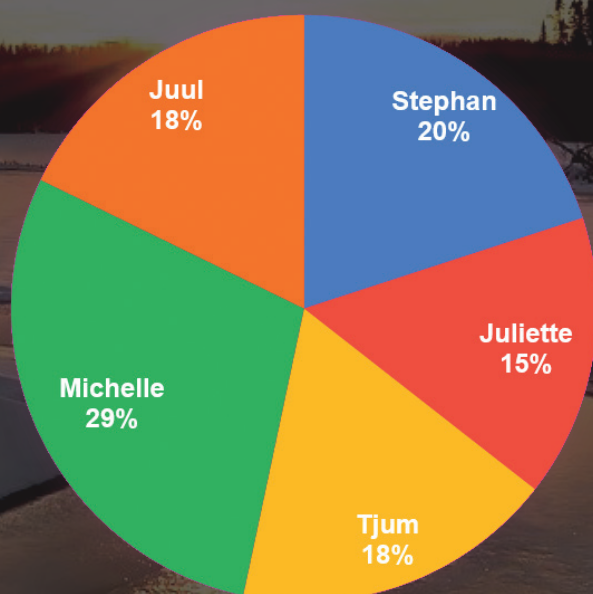
With the elections coming up in March, 'small talk' tends to divert a bit into 'big talk': namely politics. It has been quite a politically turbulent time with last-minute changes in party listings. Also, the natural discussion arose about whether the current government deserves praise for their actions or that they dropped the ball a little. We started by asking our members a small COVID-19 politics 'Would You Rather' dilemma. Here we see that the vast majority chooses short term harsh rules over long term personal loss of nightlife.



Moving on, we asked what they think they will vote in the upcoming elections. A big majority tends to vote for the currently ruling parties: VVD, D66, and CDA. The party for animals is also doing quite well, but we see that the second most voted option is still 'I have no idea yet'. You all still have time and from the reactions we have received, we see that there are a lot of diverse thinkers among you to discuss the matter with if you want to!



# Asset | Econometrics



This questionnaire was filled in just before the board announcement. So, we had the fun of seeing who everyone thought it was going to be. However, firstly, we would like to congratulate our very own board coordinator Michelle for being the favorite boardie of the current board after overtaking our runner-up Stephan. The end score can be seen on the left.

As most of you hopefully know by now, we have two new board members. The new Internal Affairs is Bram Marsman, which was not a very big surprise. From those who dared to guess, 50 percent predicted that Bram would be one of the new board members. On the other hand, the new External Affairs was not even named once. Constantijn Wessel can keep a secret! Somebody else was suspected to be in his place, namely Polle Dankers. He almost had as many votes as Bram had for the position of Internal Affairs. Furthermore, not one, not two, but three members thought that Tjum might have been persuaded to extend his board experience.



>> let's talk

## Leisure

The feeling of losing yourself in a different world through a book or series can be quite nice. We asked our members in which world they would like to live. The most named world is 'the upper east side of Gossip girl'. However, these votes are alternated with beautiful magical worlds, delicious soaps, and others. Here is the full list:

*Friends*

*How I met your mother*

*Avatar*

*The world of Winnie de Poeh*

*Harry Potter*

*Gossip Girl*

*Once Upon A Time*

*Hunger Games*

*Alice in Wonderland*

*Temptation Island*

*House of cards*

*Gilmore girls*

*Billions*

*Ex on the beach*

*Jane the virgin*

*Drive to survive*

*Emily in Paris*

*Brooklyn 99*

*The Brothers Lionheart*

*Suits*

*Hunted*

Have fun binging and reading!

As the hospitality sector is now often closed, people have started experimenting more in the kitchen themselves. We asked the members for some weird combinations that they would recommend:

Banana + honey

Peanut butter + jam

Beef + pineapple

Tomato + sugar

Lasagne + Bratwurst

Peanut butter + Nutella

Crispino + Broccoli

Sirop + pate

Peanut butter + carrots

Sirop + cheese

Of course, this also brought up the old yes or no question about pineapple on pizza. It seems that econometricians love it. No less than 50 percent of the respondents do not only not hate it, they recommend it.

Student rooms seem to attract weird objects. Some things end up there as childhood memories, while other stuff is a result of a drunk night or weird gift. Here are some things that our members have lying around in their room:

The standard of my bicycle

A bendable fork

Bain & Engelhardt

A 0 euro bill

Kinetic sand

A wheelbarrow

The House of Anubis book series

A sheep

Bacardi cups as bed legs

A flesh-eating plant

A sex-bible

A rubber duck

A parroting Christmas elf

A penguin

Tamara her Ukelele

A fidget spinner with Bluetooth

Rein's rabbit tail

No further comments from us except: let the scavenger hunt begin!










# Need Study Support?

[www.Asset-Econometrics.nl/Study](http://www.Asset-Econometrics.nl/Study)

You can find old exams and more on our website!

## Guidelines

-  Introduction Analysis and Probability Theory
-  Mathematical Analysis 1
-  Mathematical Analysis 2
-  Probability and Statistics
-  Statistics for Econometrics
-  Games and Economic Behavior
-  Games and Cooperative Behavior

## Give us your feedback!

We try to contribute to the quality of the education within the Econometrics department in several ways. For example, we take part in soundboard meetings with the Academic Director(s) and the Program Coordinator. Do you have feedback on one of the Bachelor or Master courses? Contact one of the board members or fill in the Course Evaluation form on our website!

## Write a Guideline!

We are always looking for students willing to write a new guideline. For every decent self-written guideline that is published you will be financially compensated up to €150,-. Do you want to publish a guideline? Contact us via [Education@Asset-Econometrics.nl](mailto:Education@Asset-Econometrics.nl)!

ASSET



Econometrics



# Quatsch!



## 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 send in your quotes at: [www.Asset-Econometrics.nl/more/nekst/Quatsch](http://www.Asset-Econometrics.nl/more/nekst/Quatsch)

**Lotte**

"Ik krijg altijd meldingen van k3 tiktoks"

**Marieke**

"Wat voor smaakje zeep is dat?"

**Max**

"We hebben aangenomen dat het gaat om een supermarkt ketting" i.p.v. keten

**Bob tegen Dirk**

"Ben jij eigenlijk actief?"

*(Sidenote: Bob en Dirk zitten samen in een commissie)*

**Patrick**

"Ik weet niet of ik orgaandonor wil worden, het lijkt me niet fijn dat ze mijn organen eruit gaan halen als ik nog leef."

Probeert de enkelvoud verleden tijd van meten te zeggen:

**Joyce**

"... is dat dan mat?"

**Pim**

"Hoe duur is die kapsalon?"

**Jarno**

"€7.50"

**Pim**

"Ja dat ga ik dus niet bestellen. Dat is de helft van mijn vermogen"



# PuzzleTime

A robbery just happened and they stole a game and left a mess behind. All four bookshelves fell with the board games on them. The problem, however, is that all the games are mixed together and it is almost impossible to get them apart. Are you able to sort all the board games and find the missing one?

You immediately see what happened to the bookshelves and that the mess is not really a mess, but more of a neat mess. It namely has a few rules applied to it to get every board game restored. Each bookshelf is labeled as Floor one to four. All board games can be found horizontally, vertically, or diagonally, which can be read from left to right as well as from right to left. In addition, you start with the letters on Floor 1 and replace each letter that will form a board game. For example, if you cross out the word 'TRACE' on Floor 1, those letters are being replaced by 'CSSTA', which can be found on Floor 2 in the same spots. Repeating this process results in ending in Floor 4 and thus creating spots without any letters left to use. In the end, you will find a clue for the missing board game. Besides these rules, you also have a list of all the board games that you need to cross out.

written by **Patrick Floor**

## FLOOR 1

G	T	R	A	C	E	G	O
O	U	R	O	H	G	T	L
M	R	E	A	E	N	E	E
I	A	R	S	C	I	T	B
N	B	I	Y	S	I	R	B
I	B	S	S	E	W	U	A
O	L	K	J	R	L	H	M
N	A	S	S	S	O	R	O

## FLOOR 2

D	C	S	S	T	A	P	C
O	C	L	A	K	D	A	R
S	E	Q	U	E	R	C	I
T	W	I	R	N	D	D	U
M	O	N	O	K	C	L	Y
C	H	E	Z	S	O	I	L
M	A	H	N	O	N	S	G
P	E	L	K	W	A	C	D

Agricola	Othello
Azul	Pandemic
Blokus	Password
Catan	Qwirkle
Checkers	Qwixx
Chess	Risk
Cluedo	Scrabble
Cranium	Sequence
Cribbage	Set
Dominion	Sorry
Dominoes	Speak Out
Guess who	Stratego
Jenga	Tetris
Ludo	Trouble
Mahjong	Twister
Monopoly	Uno
Nemesis	Yahtzee

## FLOOR 3

S	S	W	X	X	I	O	T
S	P	E	C	H	O	U	T
M	E	E	R	E	G	U	O
I	Z	U	S	K	E	R	S
N	H	L	N	O	U	E	B
O	C	A	R	U	L	S	N
E	A	G	A	E	J	G	E
S	Y	S	I	R	I	W	E

## FLOOR 4

D	B	H	E	T	I	W	Q
O	E	N	C	B	O	A	R
L	R	D	O	A	A	N	M
L	E	M	U	T	T	I	E
E	N	E	T	P	O	A	I
H	T	S	E	O	L	M	Y
T	A	I	B	O	U	I	T
O	E	B	R	D	S	?	Q

Can you figure out the puzzle?

Please enter your solutions at [www.Nekst-Online.nl](http://www.Nekst-Online.nl). A goodiebag 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. Good luck!

**Eva Schoenmakers** is the winner of the previous puzzle. The solution can be found at [www.Nekst-Online.nl](http://www.Nekst-Online.nl).

# Asset | Econometrics congratulates...

Name **Yilin Cao**

Title Application of Data Science Methods in  
Chinese Futures Limit Order Book Data

MSc EME

Supervisors Dr. D. Kojevnikov, Dr. P. Cizek

Name **Koen van Kemenade**

Title Allocating interest rate risk in a collective  
pension fund

MSc QFAS

Supervisors Dr. A.G. Balter, Dr. F.C. Drost

Name **Hanneke Valkenburg**

Title Capacitated vehicle routing problems: a game  
theoretic approach

MSc EME

Supervisors Prof.dr. P.E.M. Borm, A. van Beek MSc.

Name **Anne de Vries**

Title Strategic capacity planning for the world leader  
in photo-lithography systems

MSc BAOR

Supervisors Dr.ir. M.P.M. Hendriks, Dr. Y. Merzifonluoglu

Name **Tim Kelch**

Title Decomposition Heuristic for Rich Large Scale  
VRP

MSc BAOR

Supervisors Dr.ir.ing. M.J.P. Peeters, Prof.dr. G. Kant

Name **Rens van Gastel**

Title Dynamic life-cycle strategies in pension funds

MSc QFAS

Supervisors Prof.dr. T.E. Nijman, Prof.dr. F.C. Drost

Name **Ezra Solognier**

Title Risk assessment of longevity risk under Sol-  
vency II: Comparing the one-year VaR frame-  
work with a terminal VaR framework

MSc QFAS

Supervisors Prof.dr. A.M.B De Waegenaere, Dr. R. van den  
Akker

Name **Dominique Bavelaar**

Title Macro Longevity Risk under the New Dutch  
Pension Deal

MSc QFAS

Supervisors Prof.dr. A.M.B De Waegenaere, Prof.dr. B.J.M.  
Werker

Name **Francisco Fernandez Lopez**

Title Assessment of the predictions of an image  
recognition model: reliability of child growth  
monitor measurements

MSc EME

Supervisors Dr. P. Cizek, Dr. C.B.T. Walsh

Name **Mara Leest**

Title Discovering the Optimal Search Algorithm for  
Internal Data Management by modelling user  
behavior

MSc EME

Supervisors Prof.dr. J.H. Abbring, Prof.dr. T.J. Klein

Name **Rens van der Sande**

Title The intergenerational welfare effect of the  
design of solidarity buffers

MSc QFAS

Supervisors Dr. A.G. Balter, Prof.dr. B.J.M. Werker



Name **Merve Topaktaş**

Title Selective Newsvendor Problems: Models, Extensions, and a Distributionally Robust Analysis

MSc BAOR

Supervisors Dr. Y. Merzifonluoglu, Prof.dr. J.S.H. van Leeuwen

Name **Gergana Markova**

Title Private Forecasters' Responses to ECB Forward Guidance

MSc EME

Supervisors Dr. J.R. Campbell, Dr. D. Kojevnikov

Name **Dimitris Panas**

Title Is government spending multiplier higher in recessions? A double and triple post lasso approach

MSc EME

Supervisors Dr. O. Boldea, Dr. J.R. Campbell

Name **Andrea Cascone**

Title The ECB's Forward Guidance and Eurozone Reality

MSc EME

Supervisors Dr. J.R. Campbell, Dr. O. Boldea

Name **Jenni van Gelder**

Title A Simulation-Driven Approach for Improving On-Time Delivery

MSc BAOR

Supervisors Dr. Y. Merzifonluoglu, Dr. R.C.M. Brekelmans

Name **Fleur de Graaf**

Title The sky is the limit? An Analysis of Efficiency in the European Banking Sector

MSc EME

Supervisors Dr. J.R. Campbell, Prof.dr. J.H. Abbring

Name **Carli Keizer**

Title The Capability Approach: An Assessment of Social Welfare in The Netherlands

MSc EME

Supervisors Dr. B.M. Siflinger, Dr. J.R. de Bresser

Name **Thomas Zinkhaan**

Title An Expert System for Color Regulation in Beer Brewing: A Data-Driven Approach

MSc EME

Supervisors Dr. J.R. Campbell, Dr. O. Boldea

...on obtaining their  
Master's degree



Career  
Platform  
Tilburg

Meet your future employer here!

1

Visit [www.CareerPlatformTilburg.nl](http://www.CareerPlatformTilburg.nl)

2

Choose your **interest field**

3

Discover **endless opportunities**

Find your dream job

ASSET



TILBURG



UNIVERSITY



Economic  
Business weeks  
Tilburg



# Agenda

## TUE Male/Female Activity

**23** FEB On Tuesday February 23, the Male/Female Activity will take place. On this evening, there will be a separate activity for males and females. Both activities will be organized by the Drinks and Activities committee.


## THU Active Members Meeting

**25** FEB During the Active Members Meeting, all active members get the chance to express their opinions on certain matters.

## TUE Master Experience Day

**02** MAR On March 2, it is time for the online Master Experience Day! During this day you can find out what every Master is about and which one has your preference.

## MON Econometrics Consultancy Tour

**01** MAR  During the Econometrics Consultancy Tour, you get the opportunity to meet several companies! Every company will talk about their field of work and will provide an interesting case. This event will take three days.


## MON Brothers and Sisters Evening

**08** MAR On March 8, it is time for our biannual Brothers and Sisters Evening! Take your siblings with you and show them what your studies and student life are like.

## TUE Informal Activity Building Blocks

**09** MAR On March 9, there is an informal activity with Building Blocks! This is the perfect opportunity to get to know Building Blocks in an informal setting. Get to know how Building Blocks creates unique and highly personalized consumer experiences.

## TUE Inhouse Day Anago

**16** MAR  On March 16, there is an Inhouse Day with Anago. During this day, Anago will tell us all about their smart solutions for planning problems and will also provide the participants with an interesting case.


## WED Freshmen Information Day

**17** MAR On March 17, there will be a Freshmen Information Day. During this day, the Academic Director will explain the possibilities during the Bachelor. An older student will come and tell all about the experiences of an exchange.

## THU Olden Goldies Activity

**18** MAR On March 18, the Olden Goldies Activity for fourth-year students and older will take place. Be ready to make it an unforgettable night!

## MON QIG Masterclass Optiver

**22** MAR  On March 22, there will be a masterclass especially for students part of the Quantitative Investment Group. Optiver will give a masterclass about trading, so do not miss this out.

Register and find more information about our events at  
[www.Asset-Econometrics.nl/events](http://www.Asset-Econometrics.nl/events)



# NOTHING BEATS TRADING

**GRADUATE TRADER**

**SUMMER TRADING INTERN**

We are looking for talented individuals with excellent mathematical and analytical skills combined with an interest in global financial markets.

Our Traders manage and optimize our daily positions, formulate innovative trading strategies whilst also developing tools. As a Summer Intern you will learn about our trading strategies, trading system and experience life as a Trader at Flow.

**Reach out to us at:**

[careers.europe@flowtraders.com](mailto:careers.europe@flowtraders.com)  
[flowtraders.com/careers](http://flowtraders.com/careers)

Flow Traders is an international leading principal trading firm.

**FLOW ■ TRADERS**

