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Last Best

I cannot repeat it enough, but time goes by so fast. One year ago I didn't even know I would take on the role of Editor-in-Chief this year and now I'm already writing the last preface. Although at the beginning I was very hesitant to take on this task because I was afraid I would not be able to manage all the tasks, I am now overjoyed to have done so and I would not want to have missed this experience.

I didn't think I would write this preface from home at the beginning of this year. Written from my beautifully created workplace at the kitchen table, which I have been working on for a couple of months now. Even though I would like to pretend that this edition of Nekst is the same as all the others, this is not the case. Of course, there have been few events where an article can be written about, because of the Corona crisis. The interviews with the company Groenewout, teacher David Schindler and familiar face TOP also went differently than usual. Not a pleasant visit with a cup of coffee, but everything in a digital way.

Despite all the changes in these strange times, I'm very proud of my committee that we still managed to bring out what I think is an interesting, content-rich magazine. Everyone did their bit where they could and I am very grateful for that. Since this, for the committee in this form, is the last edition of Nekst, a personal thank you on the last page has been written on our behalf. And I hope that you as readers, as much as I did, enjoyed this year's editions of Nekst!

Emma Segers

Editor-In-Chief

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Dear Members,

I would like to start my last piece by saying thank you. Thank you all for being a part of this association. Thank you for putting all your efforts into the continuous improvement of Asset | Econometrics and thank you for being so understanding and helpful in these weird and strange times.

Personally, I would best describe this situation by referring to the popular song of Di-rect: 'Times are changing, forever'. The measurements that had to be taken in these times, will have a long lasting effect on our daily lives. Not only will we notice this during the (online) events we have all been looking forward to, but also in every other aspect of our lives. Luckily, the effects of this pandemic also had some positive sides. For example, every day I am noticing that people are looking out for one another and are doing the best they can in this situation. As the board of Asset | Econometrics, we have been trying very hard to do the same. In order to keep in contact with our beloved members, we have been (and still are) organizing online events. Some were better than others of course, but we have been experimenting a lot with the online possibilities. Glancing back at the Crazy 79 at home edition, the Baking Class and the online training about Data Mining, makes me feel proud of all the events that we have been setting up over the past few weeks.

Besides organizing various events online, all our other activities have been taking place online as well. Think about our com-

mittee meetings and board meetings, but also the board interviews. Over the past several weeks, we have been conducting these board interviews online. By the time this issue arrives on your doorstep, chances are high that you already know who will be in the 42nd board of Asset | Econometrics. We are very confident that they will do their utmost best to keep improving the association we all love and hope they will create wonderful experiences together with all of you while doing it. Hopefully, you will get every chance to meet them during one of our events or at the rooms when we are allowed to visit them again.

Lastly, I would like to end this piece in a similar way as I started it. Thank you Marieke, Bastiaan, Ricardo and Britte. Thank you for being my fellow board members who have been giving everything this year for our association. Thank you for keeping the positive spirit alive and trying to make the most out of every situation. Without you and all the other wonderful people of Asset | Econometrics, this year would not have been this special to me and we would not have been able to achieve everything we have up until now. You have been giving joy to my life as the chairman of this association and I will cherish this experience forever.

On behalf of Marieke, Bastiaan, Ricardo and Britte,

Denise Jacobs
Chairman Asset | Econometrics 2019-2020

The Art of Optimizing Warehouse Design

written by **Jeffrey Buijk**

On Monday 6 April, Dirk Baltussen and I talked to Rob Besten to find out what it is like to work at Groenewout. After successfully defending his master's thesis in Business Analytics and Operations Research at Tilburg University, Rob joined Groenewout as a consultant. He was particularly attracted to the firm due to the opportunity to analyze logistics processes, plus the idea of working on diverse projects appealed to him.

Founded in 1966, Groenewout is a consultancy firm specialized in engineering and optimizing logistics networks, including the necessary technical and data-driven analysis. Right from the start, Groenewout has always been focused on offering its clients a comprehensive range of solutions in support of their new-build and logistics redesign projects.

In this process, the company always acts as transparently as possible towards its clients in order to meet – and preferably exceed – their expectations. Groenewout currently employs around 25 people. Their roles and backgrounds vary,

ranging from business administration or econometrics to pure mathematics or engineering. Groenewout works with many different clients, but the majority of them are medium-sized companies or multinationals based in the Benelux. The scope of these projects can be European or global, however the client has its supply chain basis in the Benelux, UK, Switzerland or Germany.

Supply Chain Projects
Groenewout works on many different supply chain projects like networking and feasibility studies.
1) As a first step, through computer simulation it is determined how the European supply chain footprint should look like, i.e. multiple warehouses versus one single warehouse and the corresponding route-to-market strategy. As a second step networking studies are consequently aimed at identifying the optimal strategic location for a newly planned warehouse. There are three different approaches in a networking study.
a. The first approach is based on the client's shortlist of possible locations for the new warehouse. In this case, Groenewout evaluates the shortlist to decide on the best location for the new warehouse.

b. In the second approach, Groenewout uses its knowledge of the logistics hotspots to draw up its own shortlist of possible locations for the new warehouse.
c. In the third approach to a networking study, the location for the new warehouse is not based on any geographical preferences. Instead, the main focus is on minimizing the costs in relation to the various inbound and outbound logistics flows. This entails analysis of the road and water infrastructure surrounding the potential warehouse location in order to ensure optimal accessibility, for example.

2) In feasibility studies, Groenewout analyzes the logistics inside a warehouse, such as when a company has outgrown its existing warehouse or when the internal processes are organized inefficiently. Groenewout's starting point is the core of the operation: the warehouse processes. Then, moving beyond the logistics systems, the firm also assesses the IT systems, the building and its technical equipment.

In general, the kick-off starts with a tour of the warehouse so that Groe-

newout can gain an understanding of all the relevant processes. After the data-gathering phase, the data is validated and analyzed. In the next step, several alternatives are designed, modeled and evaluated. In the final step, Groenewout works together with the customer to select one or two alternatives and subsequently provide a detailed calculation of them. If the customer is staying in their current warehouse, any restrictions are taken into account.

If, on the other hand, the customer is building a new warehouse, there is more freedom to design the building first and foremost to support process efficiency. In that case, Groenewout is able to propose some minor changes to the building design if they will optimize the operational performance.

Project Team
Groenewout always starts every project by simulating the client's current situation. This reveals the process bottlenecks as the basis for technical analysis and the proposed solutions. There are always at least two – and usually three – Groenewout employees involved in every project, including one lead consultant. Groenewout's engineering specialists provide input into the technical analysis whenever necessary. Additionally, if Groenewout is also to be involved in the realization of the warehouse, that aspect is always handled by a consultant with an engineering background.

Different and Interesting Projects
According to Rob, one of the best things about working for Groenewout is the opportunity to see a process evolve from start to finish. He also enjoys the sense of satisfaction when a warehouse project is completed and the results are clearly visible. Since Groenewout has many different types of clients, each with their own unique processes and approaches, no two projects are the same. Change is a common thread running through most of the projects.

"When working at Groenewout, you will deal with many different projects. Each project will take approximately three to four months to complete," explains Rob. "A Groenewout consultant typically works on three or four different projects for different clients at the same time. Each project is usually unique, which means that at the start of every project you have to sit down with the client to discuss what they want to achieve from the project. After that, because Groenewout does not work with a standard package, tailored analysis and models are set up. Groenewout's employees are given a lot of autonomy while also being part of a team at all times. As an econometrician at Groenewout, you will have the possibility to use the data analysis skills that you've learned during your studies. Working on so many different and diverse projects is the ideal opportunity to enrich yourself." ●

Rob Besten

Graduated from Tilburg University in 2018

Econometricians' Powers Put to Practice

The Quantitative Investment Group (QIG) is a committee that finds its origin in 2016. On 15 February of that year, the first meeting ever was held and this started what was to be an interesting journey of collective research on quantitative investing.

For those not acquainted with the QIG; the QIG is a group of about 15 members who use their econometric powers (read: mathematical and statistical knowledge) to construct quantitative investing strategies. Each member contributes a certain amount of money and thus has a share in our portfolio. Our portfolio is built systematically by periodically running the strategies that we have developed and accepted. The group mostly consists of researchers, who investigate new investment strategies and test their performance. Besides the researchers, there are members that report on the performance of our portfolio and there are members that work on automating our processes.

Since its origin in 2016, the QIG has conducted quite a few separate researches. Every research group continuously works on developing new investment strategies. This starts by analysing relevant literature and gaining insights. Once a potential strategy is found, the aim is to create a code which executes the strategy automatically based on data that is mostly retrieved from the Data Lab of the library of the university. Once that is settled, the group will test the performance of the strategy on the basis of historic data and possibly tries to optimise the strategy. When the group is satisfied with their product,

they will present it to the rest of the members and give a recommendation whether or not to implement the new strategy. Throughout this process, the research group will keep the whole QIG up-to-date by presenting updates in the monthly meetings. Every piece of research is recorded in our so-called Handover Document. This document currently consists of 39 pages of dense research results and is supposed to maintain the acquired knowledge within the group. At the moment, there are four active strategies that are updated every fourth week and decide which stocks are present in our portfolio.

In the past few years, the group has changed quite a lot. At the start, there of course were no strategies at all and a lot had to be decided on how to organise the group. It had to be found out how large research groups have to be, how the meetings should be organised and even how an investing strategy had to be created. Since then, the group has transformed to a structured club. It seemed to be optimal to work in research groups of three persons and meetings turned out to be most efficient when they are held every two weeks, where every other meeting there is a 'working meeting' in which we simply come together to work on our projects. Everyone's task is clear and this allows the whole group to work in its most efficient way (given the time that every member can invest in the group). This year saw the introduction of the automation group, which should professionalise the group even further. With the introduction of a fourth research group this year the QIG hopes to increase the pace at which it can produce strategies and with that improve the general quality of the active strategies.

Jelle Thijssen

Master QFAS

Age: 22

Besides all these seemingly serious activities, the QIG also holds its own events. The QIG aims to hold at least three events a year with a significant relevance to quantitative investing and enough diversity between them. The QIG tries to hold at least one masterclass at Tilburg University every year. This year Aegon came over to speak about an algorithm that can be used to optimise multiple objectives. They presented a case study in which they showed how the algorithm can be used to pick stocks. Besides the masterclasses, the QIG aims to visit at least one company for an inhouse day every year. The goal is not to go to a regular inhouse day, where a group is led around an office and a recruitment talk is given, but to really let the company present some content related to both their company and to quantitative investing. This year we visited Flow Traders where a quantitative researcher, with a PhD in Astrophysics, gave a presentation of the development on their algorithms. Furthermore, the QIG tries to connect to other investing groups such as A&F Investments and Tilburg Trading Club. Events are often free to join for non-members, so feel free to come along some time!

I hope this article provides a clear profile of the QIG. If you are inspired and want to join the QIG or simply want to have a coffee to talk about the QIG sometime feel free to reach out to me! ●

Teaching and Research in Lockdown

This is my fourth column. When I got the honorable invitation to write columns in the four Nekst issues this academic year, my plan for the last column was to write a diary about my work-related activities during one week. However, now that the time has come that I have to write this column, I am in lockdown! It seems to be an intelligent lockdown, but still I am sitting on my couch with my laptop 24/7. However, autistic as I am, I still decide to pursue the diary plan. The result you see below.

Monday, May 4, 2020
The day starts with an early Zoom session with co authors from Vienna. We have a project about determining the optimal timing of lockdown. We have an objective that maximizes the difference between GDP and costs resulting from having more patients needing intensive care than IC capacity allows. It is going well, results are interesting and we plan to submit a short paper for publication soon so that we can contribute to the current debate.

One day a week I am affiliated with University of Antwerp. In the afternoon there is a Skype session with my Antwerp PhD student Maximilian Brill. He is working on a problem about investments in public transport. The first results are there, now it is a matter of interpreting and developing "punchlines".

Tuesday, May 5, 2020
The day starts with a phone call from Vienna. With close friend Gustav Feichtinger, who took the initiative for the lockdown project, I discussed various aspects of this research. Gustav celebrates his 80th birthday this year and is still very active.

A few years ago my other close friend from Vienna, Richard Hartl, was angry. This usually never happens so I still remember. The reason was that his washing machine broke down. Richard was convinced that these days firms deliberately let their products break down after some time, so that we, consumers, have to buy a new one. Richard's angriness inspired us to start a project on "planned obsolescence". This afternoon I worked on the text to finalize the paper.

Further today I had Skype talks with Micah Abigaba, a PhD student of Oslo University, and Sharif Jaber, who is working on his master thesis.

Wednesday, May 6, 2020
Today I have to travel to Tilburg (I live in Arnhem) to record two lectures in an empty classroom. I plan to prepare in the train, but the first miscalculation is made: due to planned works, there are busses between Nijmegen and 's-Hertogenbosch, and in a bus I cannot read. Stupid, I should have checked beforehand. After the lectures I went to my office to organize my stuff, but got also distracted by my emails and kept on working for a while. I was detected by security who told me it is forbidden to work on the 4th floor. After my promise that I would leave within half an hour, they let me stay in. I like it a lot that they are so friendly and flexible.

Thursday, May 7, 2020
Again to Tilburg to record a lecture. In the train I prepare for the lecture and another Zoom session with Vienna about the lockdown paper. We essentially find two solutions that can be optimal. One eradication solution, where the lockdown essentially kills the virus, and one we called a "curve flattening" strategy, where there is only a short lockdown aiming to reduce the peak of the infection so that intensive care capacity constraint is not violated too much. The advantage of the latter strategy is that the economy stays alive to some extent. After the Zoom session (email) discussions continue until after midnight.

Friday, May 8, 2020
I use the morning to answer emails and prepare a Zoom session of the afternoon, this time with Anne Balter and Kuno Huisman. We are working on a paper considering investment decisions of firms taking into account that products have life cycles. Preliminary results are nice, but there is a problem that for some part of the parameter space Mathematica refuses to come up with a solution. We decide to help the computer to do a considerable part of the calculations ourselves. Apparently it still holds that "computers cannot think". During the session I got an email that Nekst is waiting for my column. Time to stop… ●

Peter Kort
is professor of dynamic optimization in economics and operations research. His main research topics are dynamics of the firm, investment under uncertainty and industrial organization. In particular, he is interested in how competition, dynamics and uncertainty affect the firm's investment and innovative behavior.

The 2020 Dream: Holiday Abroad

It is almost the end of the semester, the beautiful weather is coming and the final exams are in reach. This means, of course, that also the summer holidays are almost here. The perfect moment to take a break for a couple of weeks with your parents, friends, partner or just nice and quiet alone. Unfortunately, it will be slightly different this year. Many holidays have been cancelled by COVID-19. Still, we wondered what the holiday habits of the world population look like. What are the latest trends and in what way do they differ from the past?

written by **Emma Segers**

Before we look at the behavior of the travelers, it's interesting to take a moment to think about the different prices that are attached to cities in the world. To be able to compare the different cities properly, we make the following assumptions (on the right):

- One week for 2 adults staying at an Airbnb location
- Food consumption: casual sit-down (no drinks)
- Nightlife: Mid-range bar with 2 drinks
- Transport: Walking and public transport
- Activities: Museums, shows, tours and day trips
- Transport to the destination is not taken into account

Comparing these prices shows that average costs per week vary between $250 and $3750. So for one of the cheaper holidays you could go to Cairo, Jaipur or Nairobi for example. European cities can be found from a minimum of $750 per week. Cheap cities in this price range include Skopje and Tirana. The most expensive European city is Reykjavik, which you can visit for about $3500 a week. But Amsterdam isn't too cheap either, with an average cost of $2750 a week. When you compare continents, Africa is the cheapest, followed by Asia, South America, Europe, North America and finally Australia is the most expensive place to visit for a week.
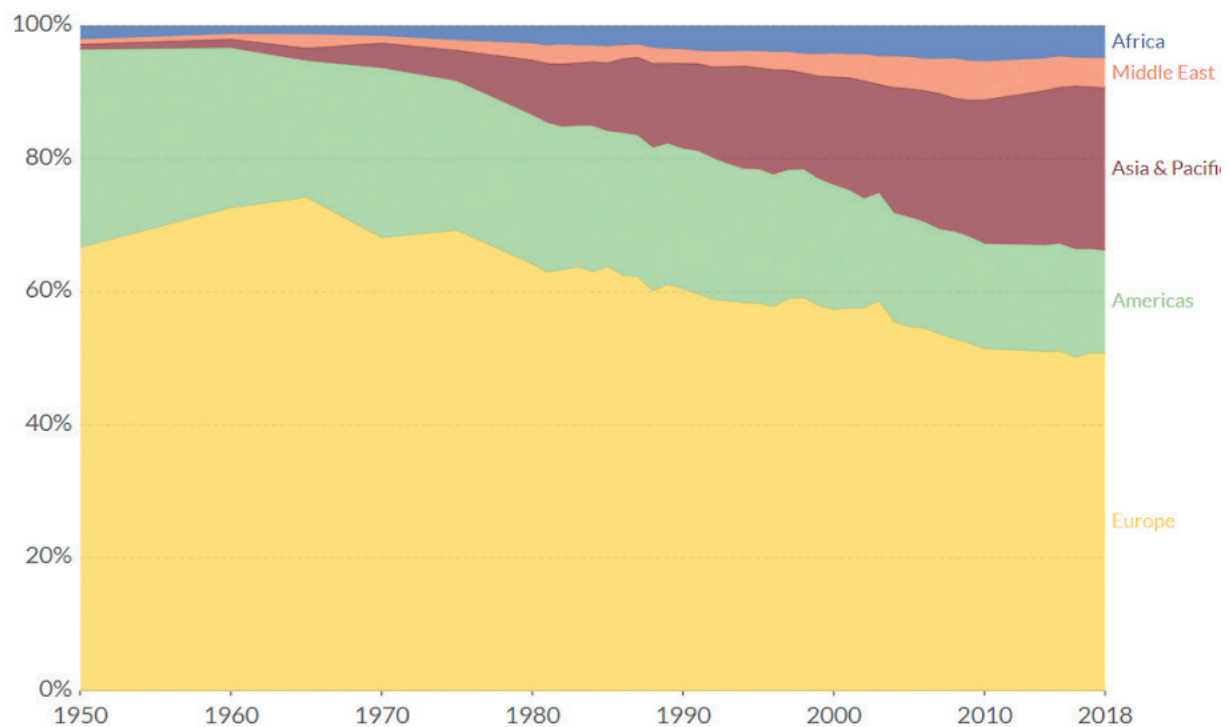

Reykjavik

Figure 1: International Tourist Arrivals by World Region

As you can see, going a week on holiday is sometimes quite expensive. A lot of people choose not to go on holiday because they just can't afford it. When looking at EU residents aged 16 years and older, in 2019 there is a staggering 28.3% who cannot afford a holiday. This percentage is already a lot lower when looking at 2013. At that time, 39.5% of this population could not go on holiday for financial reasons. When looking at countries specifically, this percentage is highest in Romania, Croatia and Greece, respectively 58.9%, 51.3% and 51%. In Denmark, Luxembourg and Sweden this percentage is the lowest, namely 12.2%, 10.9% and 9.7%. The Netherlands is in between and well below the EU average with 14.2%.

When we look at the number of tourist arrivals per world region it becomes really interesting. There's quite a lot of data about this, which makes the difference in tourism over the different years, but also between the different world regions, very visible. When looking at international tourist arrivals by world region in 2019,

most tourists arrived in Europe, namely 713 million, followed by Asia & Pacific, with 343 million tourist arrivals. Africa attracts the least tourists with 'only' 67 million. Furthermore, the Middle East had 64 million tourists and North and South America together had 217 million tourists. These differences are immense, however it really becomes apparent that travel patterns change when you look at the numbers from the year 1950, when it was: 500,000, 200,000, 7.5 million and 16.8 million for Africa, the Middle East, Asia & Pacific, North and South America and Europe respectively. Therefore, relatively speaking, tourism in Africa, the Middle East and Asia & Pacific has increased enormously, while it has decreased in North and South America and Europe. This can be seen clearly in Figure 1.

For many people, going on holiday outside Europe is not really an option. There may be several reasons for this. For example: not wanting to go away for too long, don't want to get on a plane for too long or not wanting to

fly at all, or don't have the money for expensive airline tickets. Going on holiday within Europe is an excellent alternative. If we look at the Dutch population of 15 years and older who go on holiday, we see that about 53% of this target group likes to go on holiday in their own country and 47% likes to go abroad. This last group is divided in the 12% who make a trip of 1 to 3 nights, the rest make a trip longer than 4 nights. For the tourists in their own country it is exactly the other way around, 16% of them make a trip longer than 4 nights and the rest make a short trip of 1 to 3 nights. Within Europe, the difference in tourism is enormous. When we look at the number of nights spent by tourists in a country, Spain tops the list with more than 300 million nights. This is followed by Italy with more than 215 million nights and France with almost 150 million nights. At the bottom of this list we
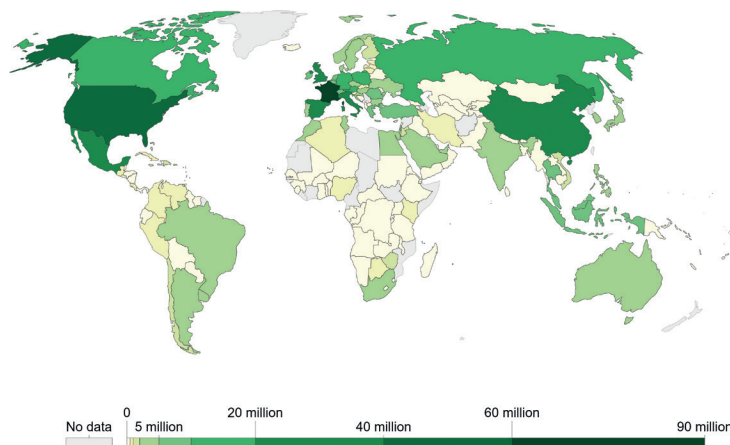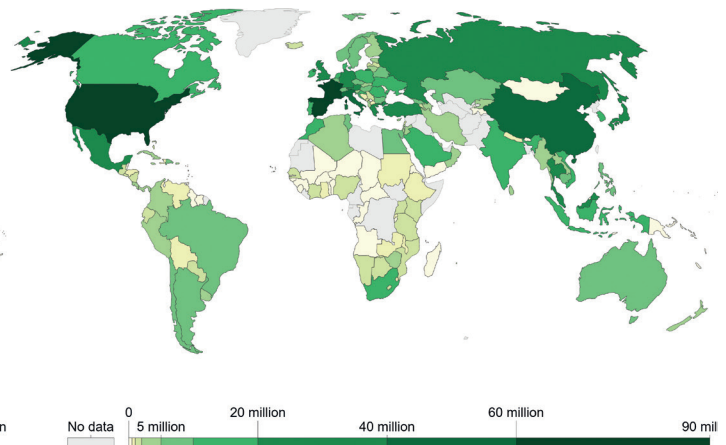
Figure 2: Number of Arrivals, 1996

Figure 3: Number of Arrivals, 2016

find Luxembourg with about 2.5 million nights and Lithuania and Latvia with both around 2.7 million nights. The Netherlands dangles (again) somewhere in between with about 47 million.

This international tourism can also be shown per country. It is very interesting to see how certain parts of the world weren't visited that much 25 years ago and are now suddenly a hotspot on the traveller's lists. This can be clearly seen in Figure 2 and Figure 3.

All these above figures can of course be explained by underlying trends. Well, I won't bother you with all the underlying reasons behind the above mentioned figures, but I thought it would be nice to highlight some interesting trends. As discussed earlier, inbound tourism has grown a lot. One sector that benefits from that is the hotel sector. In total there were over 14.7 million foreign hotel guests in the Netherlands last year. Unfortunately, this will be different

this summer, but this growth is expected to continue when the corona crisis is over. A form of holiday that is becoming more and more popular is taking a cruise. Last year as many as 28.2 million holidaymakers went on a cruise ship. This is an increase of as much as 9.6 million compared to 10 years ago.

In addition, the purpose and requirements of a holiday are also changing somewhat. This has everything to do with Generation Y, the millennials. And even in the holiday industry we can no longer avoid the dreaded word 'experience'. For example, the millennials are looking for good WiFi instead of a TV in the hotel room and little of this generation still has cash in their pockets. You don't eat at the first best beach club anymore, but a night out first requires a careful research on TripAdvisor, for example. No longer with a map, information booklet and guide through the city. No, the millennials can handle the world with just their smartphone in their pocket. In addition, the information market is becoming more

and more transparent and negative aspects of tourism are becoming visible. Because no matter how great it is to discover the slums of South-Africa with a tour, it remains to be seen whether the poor people who live there also experience it that way. When we look at our own country, Amsterdam is of course a good example. Many streets are completely dedicated to tourism. Think of all kinds of AirBnB locations, 'stroopwafel'-tents, cheese shops and tulip sellers. The quality of life of the locals sometimes seems to have been forgotten.

All in all, there are quite a few interesting developments in the field of tourism. At the moment, this industry is at a standstill and it is very interesting to think about how this corona crisis will affect tourism and when it will be back in full swing. This may take a while and it is not yet clear when this will all be back to normal. So this summer it will be mainly in the backyard with a mojito, hopefully some sunshine and hopefully we will be able to go to our favorite holiday destination again very soon! ●

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My First (Pre-) Carnaval

One of the reasons I decided to study in Tilburg was carnaval. In Woerden we never celebrated it and I have been to one 'above the river' carnaval, but this never met the expectations I had heard about the biggest party in the Netherlands. Therefore, it was decided that I had to move to Tilburg to experience this myself.

Being young and foolish led me to believe it was fun to start on Wednesday with celebrating this Western Christian festive. It started as a typical game night and ended as a typical night out. Tilburg centrum was happily filled with people who wanted an early taste of carnaval. The Polly was already preparing for the next day to come and so were we.

Thursday evening Asset General organised the Pre-Carnaval party at Polly Maggoo. Costumes were not optional. Without knowing better, two friends and I went as Pineapple, Strawberry and Banana - a delicious fruit bowl. Upon arrival in the city center I noticed people with self-made costumes, my admiration inclined. Inside Polly carnavals music brought the special ambiance to a level that can only be found in Brabant.

The carnavals music surprised me that week. Some songs I had heard before, but most songs were completely new to me. The songs weren't also particularly good, but it did create this pleasant mood everyone was in. At the end of carnaval my favourite song was 'My little lady', perhaps the reason therefore was my time spent with Willem II fans.

After spending Friday night again in the Polly, I needed a day rest. Saturday night I had a good night sleep, recharging for the days to come.

Sunday and Monday I spent my day on the Heuvel square. (I would've gone to Karneval Festival, but this was cancelled because of bad weather conditions. I hope that one day festivals are again cancelled on account of the weather...). On this square I stood between people of all ages. This was the first time I was at a party where there were this many age groups singing the same songs and having fun with one another.

This is what makes carnaval special for me. Carnaval is not for a certain type of people I noticed. It is for everyone. On stage there was this band playing carnaval songs with classical instruments. Looking at this group I saw the same as I had seen all day. Young children, students, parents and old people, were sitting side by side, having fun, making music.

Wim van Duuren

Bachelor EOR

Age: 18
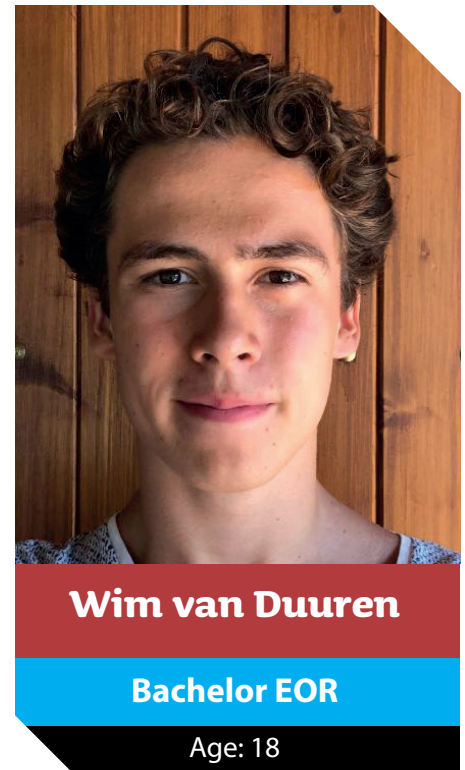
After these two fun days with the people of Tilburg, I was done with the music and the party. Next year I will take it a bit slower. What I do have missed is the parade. Luckily I now have something to look forward to. And aside from me getting sick the week after carnaval, my epic expectations were met and I wouldn't've missed it for the world! ●

Unilateral support equilibria

The concept of Nash equilibria is the most well-known concept within non-cooperative game theory and is widely used in many other fields. In a Nash equilibrium, every player maximizes his or her own pay-off with respect to the Nash equilibrium strategy combination of the other players. On the other hand, in a Berge equilibrium, every player's pay-off is maximized by the group of all other players and this player is thus supported by them. We introduce a new equilibrium concept based on individual support rather than the group support underlying a Berge equilibirum. In a unilateral support equilibrium, every player is supported by every other player individually.

Introduction

Non-cooperative game theory deals with situations of interaction and conflict between individuals (or players). Within the field of non-cooperative game theory, special attention goes to providing equilibrium concepts to somehow solve these conflicts. Such a concept should answer the question how to determine a good strategy if you do not know the strategies of the other players beforehand.

The standard Nash equilibrium concept is defined by Nash (1951, [5]) and is based on the fact that no player should have an incentive to unilaterally deviate from an equilibrium strategy.

The idea of Berge (1957, [1]) yields an equilibrium concept in which players are not maximizing their own pay-offs, but maximize the other players' pay-off instead. This follows the motto of The Three Musketeers: 'one for all, and all for one': every player supports (as part of a larger group) every other player and all other players support every single player.

However, the support relation in a Berge equilibrium is restricted to group support as the group of all players except for one single player supports the single player in the best way possible. To do so, they have to coordinate their actions, which can cause coordination issues for the players. To avoid these rather complex coordination issues, we consider individual support rather than group support.

Our main idea[1] is to introduce a new equilibrium concept,

which is based on support relations between the individual players. We model these support relations by bijections and in particular, by using derangements, in which there are no fixed points. The interpretation of such a derangement is that every player supports exactly one other player and every player is supported by exactly one other player. Then, a unilateral support equilibrium is a strategy combination that is unilaterally supportive with respect to every possible derangement.

Preliminaries

First, we provide the preliminaries on non-cooperative game theory and the two equilibrium concepts. A *non-cooperative (strategic) game* is a triple

$$G = (N, (X_i)_{i \in N}, (\pi_i)_{i \in N}),$$

where N is a non-empty, finite set of players, with $|N| \geq 2$, X_i the set of strategies for player $i \in N$ and $\pi_i : X \to \mathbb{R}$ the pay-off function of player $i \in N$. Here, $X = \prod_{i \in N} X_i$ is called the *set of strategy combinations*.

A strategy combination $x^* \in X$ is called a *Nash equilibrium* if for every $i \in N$ it holds that

$$\pi_i(x_{-i}^*, x_i) \leq \pi_i(x_{-i}^*, x_i^*),$$

for every $x_i \in X_i$ (Nash, 1950, [4]).[2] The set of Nash equilibria for G is denoted by $NE(G)$. For $i \in N$ and $x_{-i} \in X_{-i}$, define the *set of best reply strategies against* x_{-i}, $BR_i(x_{-i})$,

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[1]This Triangle is a short version of our paper 'Unilateral support equilibria', Schouten, Borm, Hendrickx (2019), [6].

[2]Note that $x_{-i} = (x_j)_{j \in N \setminus \{i\}} \in X_{-i} = \prod_{j \in N \setminus \{i\}} X_j$ in general.

as follows:

$$BR_i(x_{-i}) = \{x_i \in X_i \mid \pi_i(x_{-i}, x_i') \leq \pi_i(x_{-i}, x_i)$$
$$\text{for every } x_i' \in X_i\}.$$

Clearly, $x^* \in NE(G)$ if and only if $x_i^* \in BR_i(x_{-i}^*)$ for every $i \in N$.

A strategy combination $x^* \in X$ is called a *Berge equilibrium* if for every $i \in N$ it holds that

$$\pi_i(x_i^*, x_{-i}) \leq \pi_i(x_i^*, x_{-i}^*),$$

for every $x_{-i} \in X_{-i}$ (Berge, 1957, [1]). The set of Berge equilibria for G is denoted by $BE(G)$. For $i \in N$ and $x_i \in X_i$, define the *set of best support strategy combinations against* x_i, $BS_i(x_i)$, as follows (cf. Musy et al., 2012, [3]):

$$BS_i(x_i) = \{x_{-i} \in X_{-i} \mid \pi_i(x_i, x_{-i}') \leq \pi_i(x_i, x_{-i})$$
$$\text{for every } x_{-i}' \in X_{-i}\}.$$

Clearly, $x^* \in BE(G)$ if and only if $x_{-i}^* \in BS_i(x_i^*)$ for every $i \in N$.

Set $N = \{1, 2, \ldots, n\}$. A *bijection* $\sigma : N \to N$ is a map that is both surjective (onto) and injective (one-to-one) and is denoted by $\sigma = (\sigma(1), \sigma(2), \ldots, \sigma(n))$. The set of all such bijections is denoted by $\Pi(N)$. The identity bijection is denoted by Id, i.e. $Id = (1, 2, \ldots, n)$. In the context of supportive behavior, a bijection $\sigma \in \Pi(N)$ should be interpreted as follows: player $i \in N$ supports player $\sigma(i) \in N$. Finally, we introduce the set of all *derangements*, given by

$$D(N) = \{\delta \in \Pi(N) \mid \delta(i) \neq i \quad \text{for every } i \in N\}.$$

Unilateral support equilibria

We start by introducing unilaterally supportive strategy combinations with respect to a bijection. Afterwards, this is generalized to the definition of a unilateral support equilibrium, where the dependence on a certain bijection is removed.

Definition 1 Let G be a non-cooperative game and let $\sigma \in \Pi(N)$ be a bijection. A strategy combination $x^* \in X$ is called *unilaterally supportive with respect to* σ if, for every $i \in N$,

$$\pi_{\sigma(i)}(x_{-i}^*, x_i) \leq \pi_{\sigma(i)}(x_{-i}^*, x_i^*),$$

for every $x_i \in X_i$. The set of such strategy combinations is denoted by $USE_\sigma(G)$. ◁

In a unilaterally supportive strategy combination with respect to a bijection σ, player $i \in N$ supports player $\sigma(i) \in N$ in the best way possible. This means that player i is going to maximize the pay-off of player $\sigma(i)$, given the unilaterally supportive strategy combination of the other players. This implies that every set of unilaterally supportive strategy combinations with respect to a bijection σ of a game G coincides with the set of Nash equilibria of the game G_σ with twisted pay-off functions, in which player i's pay-off function is replaced by the pay-off function of player $\sigma(i)$, i.e.,

$$G_\sigma = \left(N, (X_i)_{i \in N}, (\pi_{\sigma(i)})_{i \in N}\right).$$

Proposition 1 Let G be a non-cooperative game and let $\sigma \in \Pi(N)$ be a bijection. Then it holds that

$$USE_\sigma(G) = NE(G_\sigma).$$

Remark Note that if one applies Proposition 1 to the identity bijection, it follows that $USE_{Id}(G) = NE(G)$.

For every bijection, the corresponding set of unilaterally supportive strategy combination with respect to that bijection can be defined. However, only derangements really reflect the idea of supportive behavior. If a player is mapped to himself, then this player does not support another player. The set of unilaterally supportive strategy combinations with respect to a derangement has the disadvantage that it is not anonymous in the sense that it relies on the predetermined support relations given by the derangement. For this reason, in order to define the set of unilateral support equilibria, we will consider the set of unilaterally supportive strategy combinations with respect to all derangements.

Definition 2 Let G be a non-cooperative game. Then the set of *unilateral support equilibria* is defined as

$$USE(G) = \bigcap_{\delta \in D(N)} USE_\delta(G). \qquad ◁$$

The following theorem provides an alternative formulation of the set of unilateral support equilibria in terms of the pay-off functions. This contrasts the definition, which is formulated as the intersection of sets of unilaterally supportive strategy

combinations. The theorem clearly highlights the underlying feature of unilaterally supportive behavior.

Theorem 1 *Let G be a non-cooperative game and let $x^* \in X$ be a strategy combination. Then $x^* \in USE(G)$ if and only if for every $i \in N$ and every $j \in N \setminus \{i\}$ it holds that*

$$\pi_i(x^*_{-j}, x_j) \leq \pi_i(x^*_{-j}, x^*_j) \quad \text{for every } x_j \in X_j.$$

Unilateral support, Berge and Nash equilibria

Theorem 1 shows that in a unilateral support equilibrium, every player is supported by every other player individually. In a Berge equilibrium, every player is supported by the group of all other players together. Subsequently, every Berge equilibrium is in fact a unilateral support equilibrium. This result is based on the fact that a Berge equilibrium is unilaterally supportive with respect to any derangement.

Theorem 2 *Let G be a non-cooperative game. Then it holds that $BE(G) \subseteq USE(G)$.*

For a two-person game, however, the group of all other players together consists of only one other player. This implies that the set of Berge equilibria consists of those strategy combinations in which every player is supported by the other player in the best way possible. Hence, the set of Berge equilibria coincides with the set of unilateral support equilibria.

Proposition 2 *Let G be a non-cooperative game with $|N| = 2$. Then it holds that*

$$BE(G) = USE(G) = NE(G_{(2,1)}).$$

To conclude, we give an example of a game in which there is a unilateral support equilibrium, while there is no Berge equilibrium. This shows that the inclusion of Theorem 2 is a strict inclusion.

Example 1 Consider the following game, proposed by Corley (2015, [2]):

$$G = \begin{array}{c} \\ e_1 \\ e_2 \end{array} \begin{array}{cc} f_1 & f_2 \\ \left[\begin{array}{cc} (1,1,0) & (0,0,0) \\ (0,0,0) & (0,0,1) \end{array} \right. \end{array} \begin{array}{cc} f_1 & f_2 \\ \left. \begin{array}{cc} (0,0,1) & (0,0,0) \\ (0,0,0) & (1,1,0) \end{array} \right] \end{array}.$$
$$\qquad\qquad g_1 \qquad\qquad\qquad g_2$$

Here, G is represented as a trimatrix game.[3]

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[3]That is, in short, player 1 randomizes over e_1 and e_2, player 2 over

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(a) $BS_1(\cdot)$ **(b)** $BS_2(\cdot)$ **(c)** $BS_3(\cdot)$
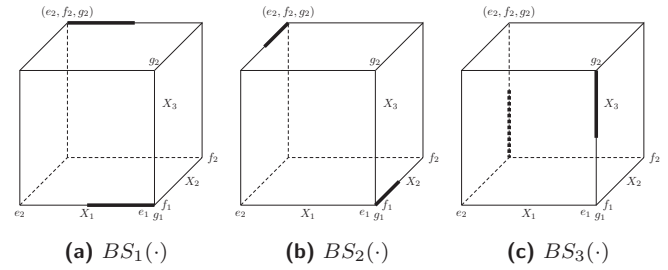
Figure 1 – *The three sets of best support strategy combinations corresponding to $BE(G)$*

First, we show that there are no Berge equilibria by using the sets of best support strategy combinations, which are presented in Figure 1. For example, Figure 1a shows that, if player 1 chooses a strategy $\lambda e_1 + (1 - \lambda)e_2 \in X_1$ with $\lambda \in [\frac{1}{2}, 1]$ (bottom part), then the best thing players 2 and 3 together can do to support player 1 is the strategy combination $(f_1, g_1) \in X_{-1}$.

Using Figure 1, it can be readily seen that the intersection between the three sets of best support strategy combinations is empty. Hence, $BE(G) = \emptyset$.

Secondly, we show that $(e_1, f_1, g_1) \in USE(G)$. Using the characterization provided in Theorem 1, this can be seen from the following six inequalities:

$$\pi_1(e_1, x_2, g_1) \leq 1 = \pi_1(e_1, f_1, g_1) \quad \text{for every } x_2 \in X_2;$$
$$\pi_1(e_1, f_1, x_3) \leq 1 = \pi_1(e_1, f_1, g_1) \quad \text{for every } x_3 \in X_3;$$
$$\pi_2(x_1, f_1, g_1) \leq 1 = \pi_2(e_1, f_1, g_1) \quad \text{for every } x_1 \in X_1;$$
$$\pi_2(e_1, f_1, x_3) \leq 1 = \pi_2(e_1, f_1, g_1) \quad \text{for every } x_3 \in X_3;$$
$$\pi_3(x_1, f_1, g_1) = 0 = \pi_3(e_1, f_1, g_1) \quad \text{for every } x_1 \in X_1;$$
$$\pi_3(e_1, x_2, g_1) = 0 = \pi_3(e_1, f_1, g_1) \quad \text{for every } x_2 \in X_2.$$

Consequently, $USE(G) \neq \emptyset$.

Finally, note that also $NE(G) \neq \emptyset$, since $(e_1, f_1, g_2) \in NE(G)$. △

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f_1 and f_2 and player 3 randomizes over g_1 and g_2. The pay-off functions are the expected pay-offs.

Jop Schouten
Promovendus

An (Un)forgettable Evening

After a week of celebrating Carnaval in Tilburg I was completely exhausted, but then I looked at my agenda and I saw that the COdE cantus was coming. The COdE is a semi-annual event that stands for 'Centraal Overleg der Economen' (Central Discussion of Economists). However, little is discussed by the economists. Instead, a lot of songs are sung, and beers are consumed. Active members of Asset get together to have a cantus at student association Vidar. Honestly, I was not that excited about it, because a week with a few hours of sleep had just passed. However, as the days passed and the day of the COdE was approaching, I started looking forward to more and more.

Then the day of the COdE arrived. It was just a normal day. I visited some tutorials and had my usual kebab in the Mensa, which is a great base for an evening of COdE. Thereafter, it was time to go to Vidar. The board of Asset Econometrics came with the idea that we could meet in front of the Boekanier so nobody had to cycle alone to the Beekse Bergen. The bicycle tour was made even more enjoyable by the

rain that was pouring down. Everything does come indeed with a price. After we cycled countless kilometers through Tilburg and places I had seen before, we arrived completely soaked at Vidar. The upside was that the cantus could finally start. The cantus started with the board of each department carrying out their department flag. Then a few funny things were said about each department. Lastly, the rules for the cantus were read out and the party could finally start. Of course, the first thing we had to sing was the Wilhelmus. The Wilhelmus was followed by a lot of beer drinking and some classic songs such as Country Roads and Sweet Caroline. The cantus was a lot of fun and the two hours flew by. After the cantus there was also an afterparty. The afterparty was a nice opportunity to socialize with other people. Getting to know new people from Asset Econometrics and the other departments is a nice thing, especially as a freshman. Unfortunately, everything comes to an end. After a fun night there was still a ride home waiting for me to return back to my room. Unfortunately, I could not find my key. After wandering around at Vidar for half an hour I concluded that it

Pim van Keulen

Bachelor EOR

Age: 18

was still in my pocket. At that moment I definitely knew it was time to go home. Luckily It was not raining anymore. Not knowing how I ended up in my bed, I could look back at a good night. The day after I concluded that my bike was still at Vidar for some reason.

I definitely would not have wanted to miss this night. With the coronavirus being present this will be the last night out for a long time. I am glad that it is one that I will definitely remember. Especially now, I cannot wait till the next COdE takes place. ●
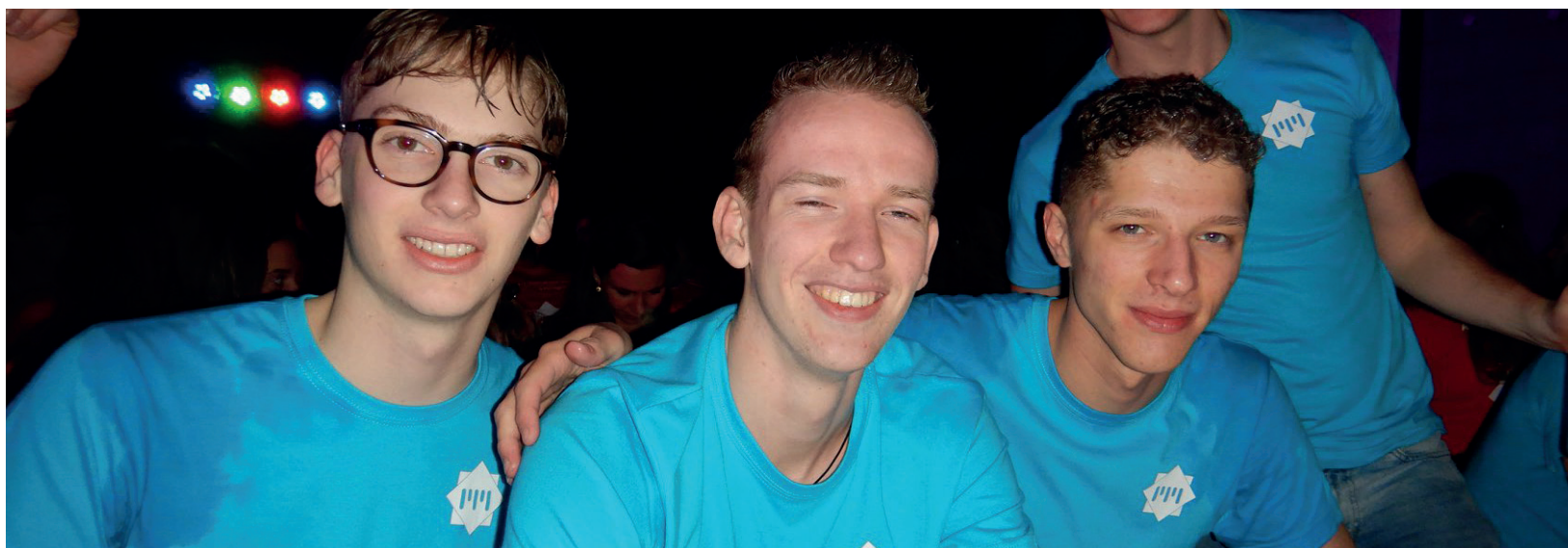
From Germany to The United States to The Netherlands

written by **Dirk Baltussen**

On April 10, Jeffrey Buijk and I had the opportunity to interview David Schindler. He is an Assistant Professor in the Economics department at Tilburg University. Schindler is 36 years old and grew up in a small town in Germany called Moers. Nowadays he lives in Utrecht with his wife and son. He teaches parts of the courses 'Public Sector Economics' and 'Behavioral Economics' and the full course, the one you may know him from, called 'Macro-Economics for EOR'.

When he was in high school, he had the ambition to become a lawyer. But, now he is happy that he made the decision to choose for economics instead. The reason why he chose to study economics, is the fact that he really likes the possibility to use economics for so many different occasions and questions. This is why he thinks it is the broadest social science there is.

David Schindler started his study economics in 2005 at the University of Cologne, where he studied his bachelor economics for five years. He continued this with a master in economics and PhD program at the University of Munich. During his PhD, he spent one year in Pennsylvania. In his first year of college, he thought it was a bit hard to make the adjustment between high school and college, but this just needed time and he really enjoyed all of his time as a student. David Schindler worked part time (20 hours a week) during most of his student life. In the beginning, he worked several years as a Research Assistant for professors at the University of Cologne. During his master, he worked part time in a management consulting firm. While working for this management consulting firm, he decided that he did not want to work in the business sector after graduation. He wanted to see if there were possibilities of a career at a university.

When we asked David Schindler what he would choose if he had the opportunity to choose another profession, he replied that he would rather not choose another profession and stay an economist at the university. So, he clearly made the right choice by choosing for a job at a university.

During his student life, David Schindler did not join a study-, student- or sports association. However, he was a member of the student parliament. You can compare this a little bit with the university council we have in Tilburg. This parliament dealt only with matters for students.

After finishing his PhD program, David Schindler came to the Netherlands to work at Tilburg University. He really likes the work he is doing right now and therefore he hopes that he can stay at Tilburg University until retirement. There are several reasons why he chose for his job at Tilburg University and not for another university elsewhere. First of all, he really likes how the social systems in the Netherlands are regulated like the healthcare system and the education system. In addition, he thinks that Tilburg University is a really good school and that Dutch people speak really good English. He could also choose to work at a university in Germany, but he intentionally chose not to. One reason for this is that Tilburg University offers better possibilities than German universities to work at the same university for a long time. The second reason is

that he thinks Germany is bad in terms of bureaucracy. You will spend a lot of time filling in paperwork and it is hard to achieve stuff.

The thing he finds the most interesting about his job, is that he gets to meet so many exciting people, both researchers and students. Everybody has a very different background and experiences. Therefore, you get to hear so many different perspectives from different people where you can learn from.

A normal working day for him starts off with doing small tasks and answering mails in the train from Utrecht to Tilburg. As soon as David Schindler is on campus, he usually has some meetings with colleagues or graduate students. If this is not the case, he most likely has to do some teaching. The rest of the day at the university is generally also filled with these activities. When he is travelling back home, he again performs some small tasks and answers his mails. In the evening, when his son has gone to bed, he has generally planned time to do his research. He then has some spare time, where he does not want to get disturbed.

During the vacations, David Schindler likes to travel. He travelled a lot while being a student and when he was younger with his parents. These days he travels a lot for his job. There are many conferences across the world where researchers go to. The thing about travelling that he really likes, is the fact that you get many new insights and influences when you are in places where things are very different than at home. In January he went with his family to San Diego, Los Angeles and Philadelphia to attend a big economic conference and enjoy the weather. In Philadelphia (city in Pennsylvania) he visited some friends from the time he lived there. He always

loved flying when going on vacation and because of this, his passion for aviation has developed. He even wants to get his own pilot licence in the near future to be able to fly small aircrafts himself. Next to traveling and flying, David Schindler really likes watching American ice hockey. It already started when he was young with watching ice hockey matches and playing ice hockey games. When he lived in the US, he went to live games whenever he could and he watches the games on tv now he lives in the Netherlands. When he lived in Munich, he also liked to hike a lot in the Alps. When he travelled by train, it was possible to travel really fast to places where you could hike. But, now he lives in the Netherlands it is not possible anymore to find mountains where you can hike.

We asked David Schindler the question if he thinks it is attractive for an econometrics student to work at a university. He thinks that it is very attractive for students who are interested in research, because you will get many different insights in how research is done. Next to this, you will have a great working environment, because most of the professors are among the nicest people to work with according to David Schindler. It can also be very helpful for an econometrician to work at a university, because you will probably learn skills which will help you in your professional life, even if you end up working at another place than a university.

We finally asked him the question: "Is there any advice you would like to give to the econometricians in Tilburg based on your own experiences?". He told us to enjoy your student life as long as it lasts. You can learn and grow so much and you also have enough time to do all kinds of fun things. Make the best out of it, because these good times will never come back. ●

David Schindler

Bert & Ernie Questions

Bert /Ernie
Beer/Wine
Germany**/The Netherlands**
Using a Calculator/Mental Calculation
Pancakes**/Fries**
Ice hockey**/Travelling**

The People That Make Tilburg Feel Like Home

A fresh start at the university is an adventure. For many new students the city is completely unknown, a lot of friends go to a different university and some are going to live on their own. It is very exciting, but it can also be a little frightening. Luckily there is TOP Week. There is no better way to learn your fellow study members than by an informal introduction week with a lot of fun activities. We spoke with two board members of TOP to get an insight in their board life and how they are dealing with the current situation.

written by **Jarno Ringhs** and **Casper Heemskerk**

Many students don't know you very well because you work almost a whole year behind the scenes, would you like to introduce yourself?
Féline: 'I am Féline de Vries. I am Vice-Chairman and PR this year. I have completed the master organizational sciences. I chose to do a board year because it was for me the last fun thing to do to end my student life in a good way.'
Joep: 'I am Joep Hurkmans. I am Internal Affairs this year at TOP. As Internal Affairs I am responsible for the participants, mentors and crews. The position contains in short everything with people. Among other things I supervise a few committees. It is very nice to do. I have completed my bachelor International Business Administration. This year I wanted a gap year to bridge the time between my bachelor and master. I didn't already want to start with my master thesis. Next year I am probably going to start with my master Marketing Management, but I am not sure about that.'

Both of you are already students in Tilburg for quite some time. Can you remember your own TOP Week and what were your experiences from this week?
Féline: 'I have participated in TOP Week as a pre-master student. Therefore, my group was actually reasonably old and this was quite nice because people took a lot more responsibility for things. For me personal-

ly, the most magical moment of the week was the cantus. On Tuesday we had a small cantus at ''De Boekanier''. But when the TOP cantus followed the next day, I didn't know what happened to me. In The Hague I never heard of a cantus before. It is a cliché, but my group members are friends for life. I still have contact with them every day, with one more than the other of course. They are people who helped me through my study. Occasionally I still have a look at the photos of that week.'
Joep: 'For me it is nearly the same. I have participated in TOP Week as a bachelor student. It is also some time ago. A couple of the people who I met there, I still speak to every day. In my case it was a little bit awkward in the beginning because you are at the start of your student life and everything is new. In the unique current situation, we at TOP are all committed to give the people a good start that is not awkward. We try to prepare the participants in a good way, such as every year.'

As board of TOP you focus only on two weeks of the year. How does a normal week actually look like for you?
Féline: 'It is different per position. But our weekly board meeting is the guidance of course. We have a lot of appointments with external parties because we cooperate with a lot of those different parties. However, in my position the camera crew is of great impor-

tance. During TOP Week we have people who make pictures and videos and develop this into an after movie. At the beginning I have had a lot of appointments with different parties for this, because we had to find a new crew. In the end we choose our best option and then we had to make agreements with them for important things such as the script. In addition, I manage the website and the social media which costs some time every day. So, I have a lot of tasks that are every day or every couple of weeks coming back and these tasks are never finished.'
Joep: 'I think this is approximately the case for every position. Of course it differs who we have contact with. I have a lot of contact with mentors and participants. At the moment the situation concerning the mentors is very actual, because we are in the middle of the recruitment period. Eventually, I will get busier with the participants because the registrations will open soon. We don't exactly know when the registrations will open but this will come in the near future. How my working week looks like is very diverse. One week you are very busy with meetings with the board, committees and faculties and the other week you are busy with improving your communication skills. I mostly write a lot of texts. Hence, this

is how my position broadly looks and how I spent my weeks.'

Féline: 'We work with a lot of peaks. We have a lot of peaks that we have to complete. Eventually, we will arrive at our last peak and that is TOP Week.'

Luckily the TOP Winter Week could go on. How do you look back on this week and the organization of it?

Joep: 'Naturally, it was a lot of fun to organize a whole week. From October till the end of January we were busy with the organization of it. The week itself was extremely exciting in my opinion. I think everyone from the board shares my opinion. We organized it just with the seven of us, there were no committees yet. You had to rely just on yourself and your fellow board members. The week itself was very stressful behind the scenes. We were busy all the time and had to communicate well. There were a lot of people dependent of the things we had organized. Generally, it was just a very nice week! It was a lot different than the upcoming week in the summer

will be. Then you work with a lot more participants and committees, which makes a difference of course.'

Féline: 'When you asked us about it we started laughing and maybe even started shining a little bit. It is just something that we build and it was so awesome to experience! Besides the stress you have, you are really on cloud nine. Fortunately we still have the after movie that I watch now and then.'

It is unavoidable that there are some disappointments and problems in the preparation period and in the week self. What did you find the biggest challenges of organizing the TOP Winter Week?

Féline: 'As a board you are just new. So, getting to know each other is quite a challenge at the start. This is separate from the week by the way. Although it is something you take into the preparations for TOP Winter Week. Furthermore, the contact with external parties is a challenge. You have to be more formal with one than the other. You are going to request quotations, chose particular parties and you have to look at your budget all the time.

You are dealing with many aspects, before you are able to make a choice. I thought that was occasionally a challenge.'

Joep: 'I agree. As a board you know each other from a past TOP Week but in October you really start working together. I think that went well with us and it still does. With the seven of us we are at the board room and dependent of each other. I am a person who works individually most of the time and I had to get used to depend on another. You also rely on other functions of course. If I need money, I have to speak to the treasurer for example.'

Are there any things you have learned from the TOP Winter Week, that you would do different if the week in the summer was able to go through in the old way?

Féline: 'The scripts. We organized the scripts in such a way that there was quite a lot of time left. This would have been a bit more tighter in the summer, but it is just a small detail. Generally, everything went well.'

Joep: 'Everything in front of the scenes went flawless. Behind the scenes there are always a few points of improvement. The function of the Winter Week is also to prepare us for the week

in the summer. We work with a lot less people and the small things that went wrong are learning points for the next week.'

Féline: 'We are very happy that there didn't occur serious accidents and everyone was able to return home safely. That is very important to us.'

Joep: "As a board we got prepared very well. We followed first aid courses and an emergency response course. For TOP Week in the summer we even had to follow a forklift course. We had a lot of training for things that could happen behind the scenes. Little can go wrong.'

What was your personal highlight of the week?

Together: 'The cantus. We got called onto the podium twice and then you got for thousand people staring at you. At that moment you realize what you have built.'

It is quite a pity that the upcoming TOP Week cannot go through in the way it was originally planned. We assume that you had already prepared some

things for this week. Were you prepared for the cancellation of big events?

Joep: 'When nothing was clear about the consequences of corona on big events in the summer, we were already discussing with external parties what the options were if TOP Week could not take place in a normal way. What are we able to do and what are we going to do on the night that the announcement is made that big physical events cannot go through? Fortunately, we had prepared this very well. It came not out of the blue for us. We preferred of course that TOP Week could continue in a physical way, maybe this is still possible with a smaller number of people. Every possible situation we take into account. When it got known that the week could not continue physically or with a large number of people we released statements , messages to mentors, and mails to external parties. With the external parties we discussed our options of what we can do to give the students still an appropriate introduction in whatever way that is possible.'

Have you already come up with specific activities as a replacement for the old ones?

Féline: 'At the moment we are still in the phase of brainstorming. We are working together with our committees and a lot of ideas have already arisen. We do not yet know what is possible and what not. So, at the moment we cannot give an answer to that.'

Joep: 'Usually the program is ready at this point in time. It looks every year very much the same. In 2016 during my TOP Week there was "The Single Party" at 013 for example, but that has been removed from the schedule because such an event did not get evaluated properly or it was time to change some things. Every year we build upon the schedule of the past. The construction of such an program is usually done in a month and then we can start with the preparations. Now we are coming up with something completely new and we are at an advanced stage. With the thing we have in mind at the moment all student- and study associations will feature.'

Féline: 'We would like to have it completed at the end of May, but we cannot say that with complete certainty.' ●

(Board) Life Goes On

Corona. Not a day passes without hearing or reading about it. Since the beginning of March, it has been the number one topic for conversation: on the news, among families, among colleagues, and among friends. Even when checking out at the grocery store, odds are that the customer in front of you has just been talking about it with the cashier. To keep this line of thought, I think you can guess what this article is about. Exactly, Corona.

On us, the board of Asset | Econometrics, the infamous virus has had a huge impact, just like on everyone in our society. For us, meeting people has been the main occupation of nearly every day, and we cannot do this any longer. Now, an average day is way different from what it used to be. I still remember a week in February, when I went from our board weekend in Maastricht back to Tilburg, a few days later to the LED in Nieuwegein, and in the weekend to Leiden for work. After this busy week, we had our Europe Trip to Ljubljana. In other words, we have been swarming all over the place. In the past months, this has become impossible. An average week in April for me would be in Middelburg solely, with my family, where the most exciting thing to

do would be watching things like 'Erica op Reis', to learn about places we cannot visit anyway. However, I do want to make the disclaimer that I do not really have the right to complain. Me and the people around me are still in good health, and I have the biggest faith in our government that they can deal with the virus in the best way possible. But still, the difference in lifestyle is dramatic.

Now, a typical working day starts with a virtual meeting with the board. Since we do not see each other any more in real life, we do this so we are updated on what we are working on. Sometimes we have important things to discuss. Especially after a government press conference with new dates and new rules. The day after we would start looking at which events were canceled, and make a plan for the coming weeks. Fortunately, some morning meetings are just chatting. For example, the cat of our chairman, Denise, has just had three kittens, which she absolutely loves to tell about. Since we hear about them almost every day, we know everything there is to know about them. To some of the board, this is a bigger joy than to others. So if you, while reading this, are also interested in Denise's new pets, send her a text message! She would love to tell you more about it!

Ricardo van Belzen

Bachelor EOR

Age: 20

Even though there are no real life events, the association has to keep running. Therefore, we still have work to do. There are still (online) committee meetings to organize events in the new academic year. Additionally, acquisition still has to be done, there are still meetings with the university to improve the quality of education, and obviously, a new board has to be there next year. Lastly, there are still active members who celebrate their birthday. And how can they celebrate such a day without a beautiful Astrics' birthday card?

It goes without saying that this period comes with challenges. However, though it may be difficult, we still try to do our best to look for solutions, instead of focusing on problems. Together with our members, we try to find a way. And if there is no path in front of us, we try to make one. Together. Our mission is to help students throughout their studies: by providing study support, bringing them in contact with each other and by bringing them in contact with companies. No pandemic changes this. No pandemic can change our goal of helping students. No pandemic can change Asset | Econometrics. ●

Going Crazy (79) At Home

Sadly, due to corona all events of Asset | Econometrics have been cancelled. Luckily, some online replacements have been organized. After an online pubquiz and watching a movie together using Netflix Party, it was now time for a more interactive online activity: a crazy 79. Most of you will know it from the first day of AMW (Active Members Weekend), when we would be doing all kinds of challenges in a city together with our team. However, this time that was of course not possible. Instead of walking through a city, we were doing the tasks at home and instead of doing them together we had to meet with our teammates using a video call. The tasks were divided in different self-quarantine themed categories: stay safe, stay home, stay Astrics blue, stay connected, stay fit, stay smart and stay crazy.

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In my team sadly, the start did not go that well. In the first 45 minutes we only got one task done and had some internet struggles. The organization even started to wonder what we were doing all the time. After that however, we started to get a lot of tasks done, such as throwing a bucket of water over our head, singing the Willem II anthem together and solving puzzles. However, there were also some tasks that involved getting a certain number and word from other groups. Most of us had faith in the rest and just gave other groups the right number and word, however of course there were a couple of groups that thought winning was more important than helping each other…

Polle Dankers
Bachelor EOR
Age: 21

As usually with fun things, time flew by way more quickly than we thought. Suddenly only fifteen minutes were left. To get as most points as possible Bram decided to smash an egg on his head and we even got five challenges done in the last five minutes, which is quite a lot compared to the one challenge in the first 45 minutes.

We then calculated how many challenges we successfully completed, and found out we did 56/79 challenges. We thought this was quite a lot and confidently waited for the final results. However it turned out that the other groups were even more enthusiastic than us as we only got the 5th place out of 6. Congratulations to team Madelieve for winning in the end. Then we also got to see the most creative submissions of various groups, which might have been the best part of the whole activity. I think that everyone will agree with me that after seeing these submissions, the true winners were team Ferdy (sorry team Madelieve). They had some of the funniest submissions, and Luuk even did the best bottleflip I have ever seen. It certainly had the potential to become a hit on Dumpert.

Even though it is still not the same as seeing each other for real, this activity was a great way to still stay in touch with each other in these weird times. Thanks to the organization for this fun activity! ●

Pepijn Wissing
is currently a PhD student at the department of Econometrics & Operations Research in Tilburg. From 2012 to 2018, he studied at Tilburg University, finishing the Bachelor Econometrics & Operations Research and the Research Master in Business. His research interests include Combinatorics, Graph Theory and Algebra.

Ideas For Your Spare Time

In my winter column, I talked about the importance of something useless in one's life; something that is done, simply and pretty much only for the fun of it. Reason being, if you recall, that such a something would effectively lubricate one's mental engine. In a time where everyone is stuck at home, and an astounding portion of the population seems to have some kind of mental hic-up, it seemed appropriate to then talk about my favorite ways to waste some time.

During my teenage years, I was into various video games, to the point where I spent a few nights a week killing internet dragons with an organized group of people. Thus, it is both surprising and obvious to me that this interest has warped into a passion for board games. On the one hand, they are still games, and on the other, it sometimes seems like a step back. I should mention straight away, though, that modern board games are nothing like the Monopoly of your childhood. A well-designed board game has the power to scratch that cognitive itch, to make you strategize in increasingly complex systems, while still being in essence a social gathering. Yes, your friend will be a little mad when your master plan comes to fruition and you murder his puny cardboard town with your plastic figurine of doom, and yes, sometimes you might be equally mad. It is delightful.

For those of you that just get kind of turned off by the idea of having your cardboard towns murdered, I have some good news. Recently, cooperative board games, in which the players band together to defeat the game, have become increasingly popular. They come in various forms: puzzly ones that require tight coordination, story-driven ones that basically let you live inside of a story, or a nice mix of the two.

To anyone that regularly finds himself binge-watching some not-all-that-interesting Netflix show, and standing up more exhausted than a few hours before, I would profoundly recommend dipping a toe into the modern board game hobby. There are some truly amazing experiences to be had and (to me, at least) it is far more rewarding than passively consuming some show.

Speaking of rewarding, my next-favorite hobby is probably best described as "making things." A few years ago, I spent the downtime of a summer with a picture from the internet, a jigsaw and a whole lot of sanding paper. The result was this awesome knife holder in the shape of a roman soldier, which is still a part of my furniture today. It is hard to describe, but somehow, even after five years of seeing it every day, I am still quietly proud of my work, whenever I draw a knife from its shield. Yes, you can most likely buy this kind of object in a store, but that feeling makes all the difference.

More recently, with the help of a cheap Chinese 3D-printer, some free 3D-modeling software and a few YouTube tutorials, I have upped my game from manual labor to designing my own stuff on the computer, and then bringing it to life on my printer. The usefulness varies from plastic figures to bling out a board game to custom made objects to fix a problem that has been bugging you since forever. Messing around with this kind of technology is absolutely relaxing, and simultaneously highly rewarding, to me, and I would advise anyone with a vague interest in engineering to take the plunge!

With these final words, I end my career as Nekst-columnist. I dearly hope that you have enjoyed my quarterly rants, and I thank the Nekst editorial staff for their tireless effort. Take care. ●

Tips & Tricks

The coronavirus has changed our lives enormously in a small amount of time. Even when you, your family and friends are in good health, many things have changed: no days at campus, seeing your friends and a great deal of other things. Concerning your study program, you are now solely studying from home. This has without a doubt a significant impact on your study routine. To make the transition from studying at the university library to studying at home a bit more pleasant, we have sorted out some tips that might come in handy.

written by **Janne Vos**

Tip 1: Stick to your usual routine

Due to all the online lectures that you are able to watch anytime you want, the temptation might be that your day and night rhythm will get mixed up. This can negatively disturb the balance between studying and relaxing. To tackle this problem, it helps to plan your day as you would usually go to your lectures and tutorials. This helps you to be more effective and makes sure that you have enough time for relaxing in the evening when you have done your work in the morning and afternoon.

Tip 2: Distinguish between study and home mode

When staying home all day, it might be tempting to stay in your PJ's all day since you are not likely to meet any others or leave the house. However, try to prepare yourself for the day as you would do on a regular weekday. Take a shower, get dressed properly, have a good breakfast and start the day with the aim of getting things done. Moreover, when you are dressed properly and ready for the day, you are less likely to get back to bed or end up binge-watching Netflix on your couch.

Tip 3: Create a dedicated study area

Whereas you normally would not make such long hours at your desk in your room at home, you should be able to study there for extended periods now. Therefore make sure that you have a clean and organised workspace. It might not be the best option to study in the living room where people are hanging around. Make sure that on your desk you only have the stuff you need for studying. Switch off your phone, have your water or coffee ready and start focusing!

Tip 4: Stay connected with your fellow students

Due to the measures taken, we are not able to see our friends as we wish to. However, it is important for several reasons to stay connected with them. Obviously for social matters and to exchange experiences, but also related to your studies. It can help enormously to talk to your fellow students about how they are dealing with the situation. What does their study area look like? Which study routine do they follow? Which problems do they face regarding the courses and the online lectures? It is very likely that you are not the only person facing certain problems in the current situation. Discussing matters like these can benefit all parties involved, besides the fact that it is fun to catch up with each other.

Tip 5: Stay fit

The usual bicycle ride that many students have on a daily basis to the university is no longer taking place. Even though this ride can be terrible on cold, rainy winter days, it usually helps to achieve the minimum of 30 minutes of exercise that are recommended daily. In order to maintain a healthy lifestyle, it is important to make sure that you do get your exercise. Go for a morning run, take a walk during your lunch break or take your bike outside after dinner.

First Steps in Consulting

On a cold rainy Monday night, a number of familiar faces started making their way towards the bus station in Maastricht. This was of course the first night of the Econometrics Consultancy Tour, a collaborative effort between SCOPE | Vectum and Asset | Econometrics to introduce students of both associations to potential employers in the field of consultancy. The journey began with a drive to Tilburg, where both association's members finally met for the first time on the bus. While there was an initial silence between both groups, this was quickly broken through friendly conversations and good discussions that echoed in the bus throughout the drive.

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After finally making it to Amsterdam, most of us quickly made our way to our hotel rooms to get some sleep, in preparation for the long days awaiting us. Our day began with breakfast at the hotel, with members of the trip slowly making their way to the dining hall in various levels of preparedness; from full formal attire to casual pajamas. The trip officially began with a visit to

Micompany's headquarters in Amsterdam; a company focusing on a combination of Big data & AI, with a strong affiliation to education. After an informative presentation on the company's main focuses from one of the partners, we began working on a case in small groups. The case proved both challenging and stimulating, eventually cumulating in all of us sharing a well-deserved lunch with the workers of Micompany.

Our afternoon continued with a drive to our next destination; Nielsen, division Pointlogic. Our afternoon began with a description of all the activities Pointlogic engages in, with an emphasis on the data and consultancy aspect of the company. We then participated in a case revolving around targeted advertising in Latin America, where we were tasked with analyzing data and providing advice for a large firm. After a fun and eventful afternoon, we concluded the evening with a hearty dinner with the workers of Pointlogic. While the scheduled events for the day finished, many of us continued the night, either socializing in the hotel or in one of the many local bars. Following such an eventful day, we all found ourselves quickly bonding with one another, sharing stories and experiences from both associations. With our brains still processing all of the information of the day, and our stomachs full from dinner (and drinks), we all slowly made our way back to the hotel.

After a good night's sleep, our day began with a visit to BearingPoint. BearingPoint shared a brief presentation of their core practices, before letting us apply our own skills and knowledge to a practice assignment. Specifically, we were tasked with using our econometrics skills to advise a firm regarding the housing market in the UK. This case allowed us to not only demonstrate and practice our skills, but also got us

Ofek Sverdlov
Bachelor EOR (Maastricht)
Age: 21
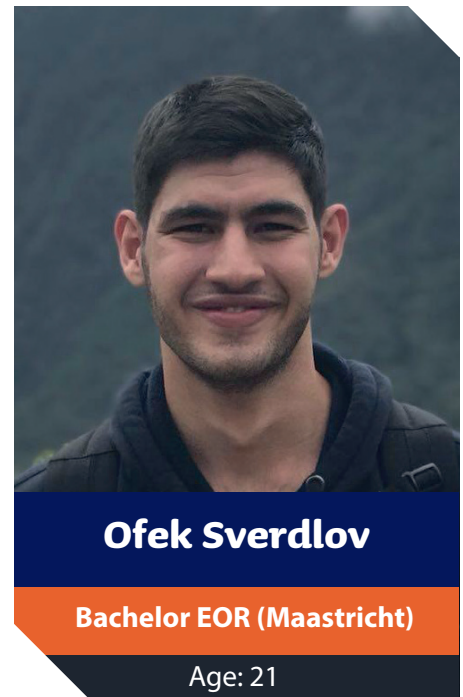
familiar with the type of work done at BearingPoint. After an eventful morning, we packed our bags once more and headed for our last destination of the trip: Capgemini.

Capgemini introduced itself as a large multinational firm with divisions specific to data driven consultancy. We all gained a good insight of their operations through an interactive case regarding data from a fictional hospital. While being tasked to advise the hospital board regarding cost reducing measures, we all better understood the type of consultancy done at Capgemini. With the case, and with it our trip, coming to a conclusion, we all headed to one final dinner with workers from Capgemini. With filled stomachs we started the long drive back to Maastricht, stopping in Tilburg on the way to say goodbye to our new friends.

Overall, the Econometrics Consultancy Tour was not only a great opportunity to get acquainted with future employment possibilities, but also a great way to make connections with companies and fellow students alike. The trip was a great success, thanks to the amazing effort from the organizing committee! On behalf of all members from the SCOPE | Vectum delegation, a huge thank you to the board of Asset | Econometrics for all the cooperation and hard work that led to this amazing event! ●

The Models Behind the Spread of Corona: Transmission Trees and the Reproduction Number

written by **Constantijn Wessel**

Undoubtedly the past week few weeks most students have been spending time thinking about the coronavirus and how to make sure they do not get infected and or spread it. An organization who has been doing the exact same thing only on a bigger scale is the Rijksinstituut voor Volksgezondheid en Milieu (RIVM). The RIVM is a Dutch government ministry who is responsible for the public health and health of the environment. To understand how to not spread and or catch the virus they use complex mathematical models to model possibilities how the virus transmits itself through the population. In this special we will take a closer look at how certain mechanisms of a transmission model work so that you can understand these models better and see similarities with econometrical models.

Before we delve deeper into the specifics of a transmission model it is worthwhile to take a look at the history of these models and the data used for these modes. The period after the second world war saw an increase in hygiene measures, vaccines and antibiotics which resulted in dying out of previous infectious diseases such as the smallpox. This made people believe that infectious diseases were something of the past but nothing turned more out to be wrong when an HIV outbreak

occurred in the 80's. With the rise of the HIV the need for mathematical modelling of how disease spreads increased dramatically since HIV could not be fought by the classic measures mentioned before and thus new models needed to be created.

The models that were already in place for the spread of infectious diseases turned out to be not complex enough to model the spread of HIV. Some very strong assumptions were made in these older models which turned out to be very wrong in reality. One of these assumptions was a homogenous population meaning each individual was as susceptible as another to contract HIV. As we nowadays know this clearly is not true and especially not for HIV where the transmission of the disease strongly depends on gender, age

and sexual orientation. Another important phenomenon that was missing from the models was the so-called "feedback loop". In the case of HIV this feedback loop means that people who have already died of the disease cannot spread it anymore for other infectious diseases the feedback loop might be defined in another. Once these models were updated with among other things the above mentioned they became crucial in the fight against infectious diseases. They were used in the outbreak of SARS in 2003, the bird flu in 2005, influenza in 2009, Ebola in 2013 and now in the fight against the coronavirus outbreak.

The objective of a transmission model for infectious diseases is to describe and predict how quickly the spread of the infectious diseases proceeds through a group of people. For the simplest version of these transmission models not only a vast range of data is needed but also three types of inputs regarding the disease itself are needed. First of all how long does it take for a person to become contagious when he has been infected? A typical flu patient can infect someone else already after one or two days for corona this is estimated between 2 and 12 days. How long is a patient contagious? And finally how many people does a contagious patient on average infect assuming the whole population can still be infected. This last one can be expressed as 'R_0' and is called the reproduction number. With this R_0 the for you by now famous coronacurve can be calculated as seen figure 1.
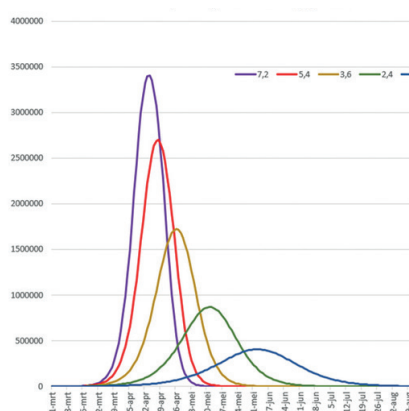

Figure 1: Predicted Corona Infection NL

Besides these inputs a vast amount of data is needed. The models that run on the RIVM servers need three types of data. First of all population data. This data regarding the population is divided by birth cohort. In each of these birth cohorts a certain percentage of the population is more susceptible for the virus then others due to e.g. previous illnesses. This population data is provided by the Centraal Planbureau Statistiek (CBS). From the population data, the RIVM tries to predict how contagious each birth cohort is. In this prediction it became clear that children are less contagious. The largest source of data that is used is a Dutch study from 2017. In this study it has been researched who has had contact with who, for how long this contact lasted, in which context this contact was and how frequent this contact is, based on characteristics such as age and gender. Using this data, a so-called contact matrix can be constructed. This matrix details what the probabilities of infection for each birth cohort (or person or hospital department depending on the formulation of the matrix). From this study the RIVM knows that on average a person comes in contact with 12 other people a day. Therefore with this data the RIVM can calculate the effects of some of the measures against the spread of the virus. They can for example decrease the contact between students by closing the university and see how it affects the R_0 in the model.

Now that we have a general idea about the data and how the model works, we can delve deeper into the mathematics behind the model. Generally, transmission models are complex models consisting of multiple smaller models. In this special we are going to have a look at how the reproduction number is calculated and how 'transmission trees' are constructed as these are most occurring in the media. These transmission trees can predict the spread of infectious diseases as explained by RIVM Epidemiology and Surveillance Unit in 2013. This study is based upon a noro-virus outbreak in a large university hospital in the Netherlands. The goal of this paper was to track who infected whom based on information such as the time the case (patients, birth cohorts, hospital departments etc.) got infected and spatial location of the case. In the early days of the COVID-19 outbreak, most of this information would come from research conducted by the RIVM about who the infected person has been in contact with. To construct a transmission tree and the reproduction number, the researchers started by formulating a so-called transmission matrix. This matrix consists out of probabilities that transmission of a infectious disease between pairs in the population occurs such that each element in the matrix $v_{i,j}$ is the probability that case i acquired its infection from case j. The transmission matrix will initially be close to the contact matrix from the 2017 Dutch study. However, during an outbreak the probabilities of transmission between any two individuals change over time depending on e.g. whether or not the person has been infected. Because of this, the transmission matrix cannot be directly estimated using the contact matrix and a likelihood function that makes estimations for the elements of the matrix is needed. This likelihood function contains a pairwise kernel function, dependent on the available data such as time and location.

$$V = \begin{pmatrix} v_1 \\ v_2 \\ \vdots \\ v_n \end{pmatrix} = \begin{pmatrix} v_{1,1} & v_{1,2} & \cdots & v_{1,n} \\ v_{2,1} & v_{2,2} & \cdots & v_{2,n} \\ \vdots & \vdots & \ddots & \vdots \\ v_{n,1} & v_{n,2} & \cdots & v_{n,n} \end{pmatrix}$$

Figure 2: Transmission matrix

The researchers starts by formulating the conditional probability for $x_{i,j}$ given that i got infected by j as follows:

$$\kappa_{i,j}(x_{i,j}|i \leftarrow j, \theta)$$

Here $x_{i,j}$ is the given data. For example, it could be the distance between the two cases: ij means that case j infected case i and θ stands for parameters needed to construct. Combining this with the probabilities from the transmission matrix gives a likelihood function:

$$\ell_{i,j}(X_{i,j}, v_{i,j}) = \kappa_{i,j}(X_{i,j}|i \leftarrow j)v_{i,j.}$$

If we now combine all the likelihood function over all the observed cases we finally get the kernel likelihood:

$$\ell(X, V) = \prod_{i=1}^{n} \ell_i(X_i, v_i) \propto \prod_{i=1}^{n} \kappa_i(X_i) \cdot v_i.$$

You might have noticed that the kernel likelihood depends on $v_{i,j}$, which is actually what the kernel likelihood tries to estimate. The estimation of these $v_{i,j}$ probabilities are done via a Markov chain Monte Carlo (MCMC) procedure using the Metropolis-Hastings algorithm. Here, the initial value of the Markov chain is estimated using the kernel likelihood function with arbitrary elements in V. Therefore, the initial values of the transmission matrix can still be estimated, since they are first arbitrarily chosen. The MCMC procedure using the Metropolis-Hastings algorithm in short generates a Markov chain using a proposed density for new iterations and a method for rejecting some of the proposed moves in older iterations. Using this method, the transmission matrix starts by being similar to the contact matrix and changes over time accordingly to information it is being fed, such as new infections. To make sure the probabilities of $v_{i,j}$ are between 0 and 1, $v_{i,j}$ is logit transformed. Now given the observed X's the transmission probability matrix V can be estimated using the kernel likelihood.

The reproduction number can now be calculated using the transmission matrix. In the transmission matrix row i is a vector of the probabilities that case i is infected by any other case. The sum of all the probabilities in this vector can be interpreted as the expectation of the number of cases produced by infectious case j or the reproduction number of case j.
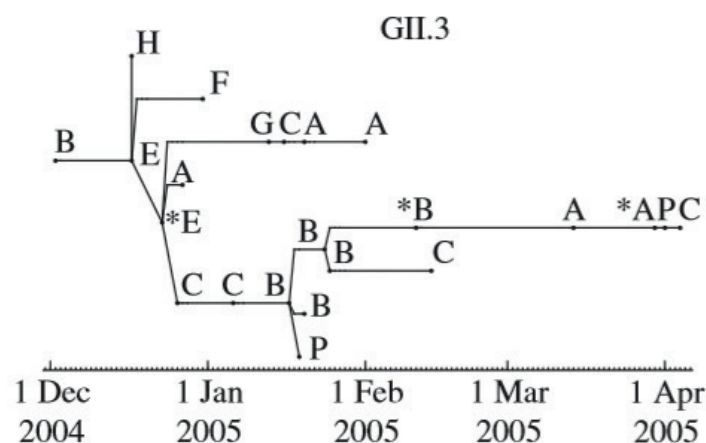
Figure 3

The mentioned method of calculating the reproduction number can be extended to each iteration in the Markov

$$R_j = \sum_{i=1}^{n} v_{i,j}$$

chains to see how the reproduction number changes over e.g. time. Using all the reproduction numbers for $j = 1, \ldots, n$ a total reproduction number for the population can be calculated.

$$R_j = \left\{ \sum_{i=1}^{n} v_{i,j}^{(1)}, \sum_{i=1}^{n} v_{i,j}^{(2)}, \ldots, \sum_{i=1}^{n} v_{i,j}^{(M)} \right\}$$

When deducing a transmission tree from a transmission matrix link, to see who has infected whom, between case i and any other case can be assumed realizations of a random sample from a categorical distribution with probabil-

ity vector $v_{i,j}$. This effectively reduced each row of the transmission matrix to a vector where one element is one and all the other zero. This means that if case j_0 has infected case i the entry $v_{i,j}$ is equal to one and all the other entries where $j_0 \neq j$ are equal to zero. Note that this means that case i can only be infected once, but infected case i can infect multiple other cases. How many other cases i has infected can be tracked when looking at the column vector of i. On average, the amount of infections case i will cause is its reproduction number. Which entry turns out to be one depends on either the given probabilities or on the actual realization. This depends on the purpose of the tree being prediction or mapping on how the infectious disease spreads. When the entries have been reduced to either zero or one, the transmission

matrix turns into an adjacency matrix. This is a matrix where the elements of the matrix indicate whether pairs or vertices are adjacent or not, or in our case have infected each other or not.

Note that we're not done yet, because in a normal adjacency matrix pairs can be adjacency sideways. In our case this would not make sense because this would mean that a case who is already infected could infect another case who also already is infected. After taking this sideways adjacency and other things into account, we finally arrive at our transmission tree. To picture a transmission tree, in Figure 3 the transmission tree of the 2013 RIVM paper is visualized. This tree shows the spread of the noro-virus between hospital departments for the two most common genotypes. ●

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A Graduation With Mixed Feelings

Bart Rutten

Master BAOR

Age: 23

On February 27 I was enjoying a concert of the British band Bear's Den in Amsterdam. I remember that on the way there I had a discussion about the coronavirus and believed that it would not be a big deal in The Netherlands. Only a few hundred meters from the concert hall, my favorite football club Ajax was getting eliminated by the Spanish Getafe for the Europa League. When I checked my phone for the end result, I saw that the first Dutch case of the virus was detected in Tilburg.

At that moment, I could have never imagined that the world would have changed so drastically in only a few weeks. I was busy writing the last part of my Master's thesis and was looking forward to my defense on March 27. I planned everything weeks in advance to make sure that family and friends were present at this milestone. The defense, however, turned out to be far different from how I imagined it.

Instead of standing proudly in front of my family in the University's fanciest room (C186), I was sitting behind the same desk where I attempted to solve the first questions for Linear Algebra 4.5 years ago. Together with my supervisors, I was staring at a screen while being in a Skype meeting. It all felt a little weird and the hours before the defense were insanely nerve-wracking. Once in the Skype call however, everything went surprisingly smooth and I was happy and relieved with the result.

In the days before my Thesis defense, it was uncertain if my defense could even take place on March 27 or should be postponed. Looking back, it is very fortunate that this didn't happen. Only two days after my defense I got sick myself at more or less the same time as my mother. In the next days also my twin brother and later my father got sick and it turned out we were infected with the virus. This of course put all the minor distress of not having a festive defense and not being able to properly celebrate my graduation in a different perspective. Luckily, after some long and emotional weeks, I can happily say that we are all fully recovered.

Right now I have plenty of time to think about the next steps in my life and that's a good thing too, because I feel like I need that. At the moment of writing this article, I'm still not sure yet if I want to get a second Master's degree in the field of Data Science and/or Artificial Intelligence or start with my working career as an econometrician. The schedule was to tie the knot after a proper ending of my student life in Tilburg and a few months of vacation with some nice trips. It's clear that the current circumstances have poisoned this schedule and it feels like someone pressed the 'Pause' button of my life.

Nevertheless, I'm enjoying my spare time. I'm grateful that I have my sense of smell back – which was totally taken away by the virus – and I can smell the Spring, my favorite season, again. A great tit (Dutch: koolmees) is nesting in my parents garden and I can already hear her babies chirp. I like to take a tour on my bike every once in a while and it makes me once more realize that we don't have to obsessively travel enormous distances to visit beautiful spots. Our little country has plenty to offer. Now that we are all at home and have plenty of time, I can recommend to visit the Strabrechtse Heide (see picture) or any other Dutch moorlands, perhaps take a Flesje Rood with you and enjoy the sunset. ●
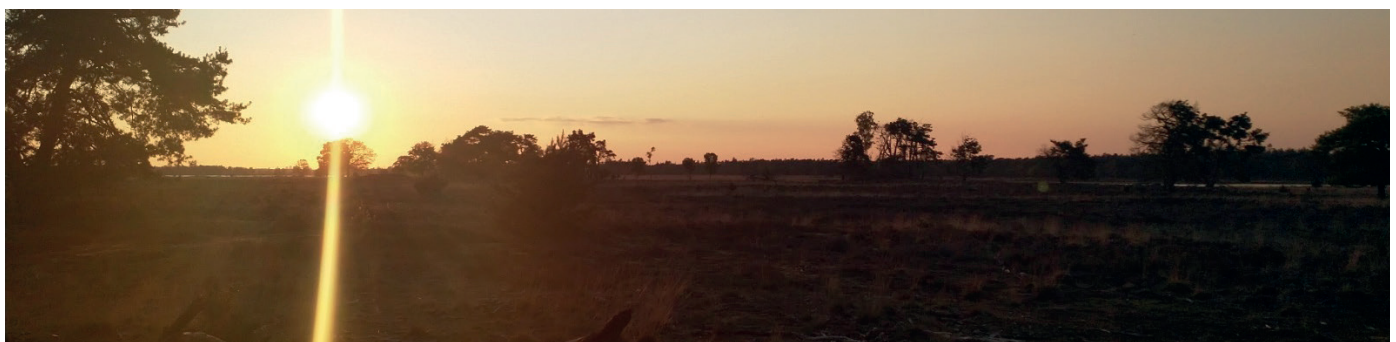
Let's Talk!

Ever since the start of corona, life has not been the same. The outbreak of the pandemic also influenced Asset | Econometrics, with as a result that all activities were cancelled. Astrics members suddenly lost their place to meet and the only way to communicate with each other was online. This has made it difficult to keep track of what everyone is doing, unless you are a social media guru. Nonetheless, the Let's Talk segment has an extra important function this edition.

written by **Juliëtte Tillie**

For the last Nekst of the year I went online to speak to some of you guys. I had thought about a question to ask and there was one thing that I was curious about. Normally, life moves fast and our priorities are set straight. Nowadays, time is there to spare and we have to think of new activities to fill our days with. Some may turn to their study books and become the best in class, others open their laptop each morning to start a new binge-session. Myself, I have started walking… a lot. I discovered places in Tilburg that I would have never found in my 'normal life'. Did you know that there is an old tramway going from Goirle to a small forest on only a 15-minute bike ride from Tilburg? I am curious if there are other people with new hobbies, so: let's talk!

Emile Mol
"I am making an ice hockey stick and have bought inline skates, I used to skate a bit when I was younger and I thought it might be fun to try my hand at some streethockey."

Emma Segers
"My friends and I tried to set up an online 'Fuck the Dealer WITH Minigames' platform, which is a famous drinking game. But unfortunately, that didn't work out that well. And I have watched almost all of the Love Island editions (UK/USA/Australia/Netherlands)."

Juliëtte van der Velden
"I have been busy making a scrapbook of all the best memories from my first year of studying. I can really take the time now to make every page look nice."

Dominique Bavelaar
"My friends and I have set up an online poker competition in order to still create some kind of excitement while all pubs have closed their doors."

Floris Somers
"I kinda feel like a 65+ old man saying this but lately I started walking a lot. It is quite healthy, and I think it is very relaxing. I hope I keep doing this, also after quarantine."
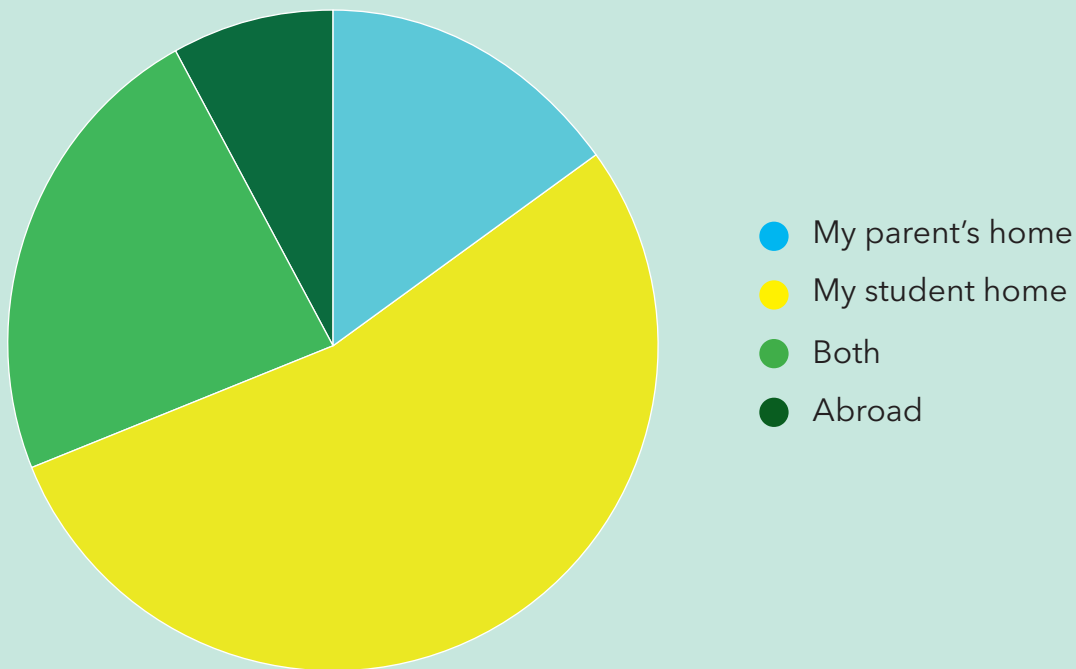
Jochem Bruijninckx
"We made a fort with colorful blankets, called Fort Kahoot, but we messed up the green and yellow colors. Also: board games!"

Jaron Kappers
"I have managed to keep my "normal" life completely intact by still doing nothing."

Doing a Let's Talk while only communicating online can also be fun. For example, it is easy to make a Google Form and send it to a big group to find out even more in a quick and clear way. Here are some graphs regarding your daily activities and more!

Where have you spend your time in quarantaine?

- My parent's home
- My student home
- Both
- Abroad

Who/what do you miss the most?

- My grandparents
- Other family members
- My best friend(s)
- My pet
- My partner
- Nobody
- University Campus
- University Library
- My teachers
- My roommates
- Cinemas
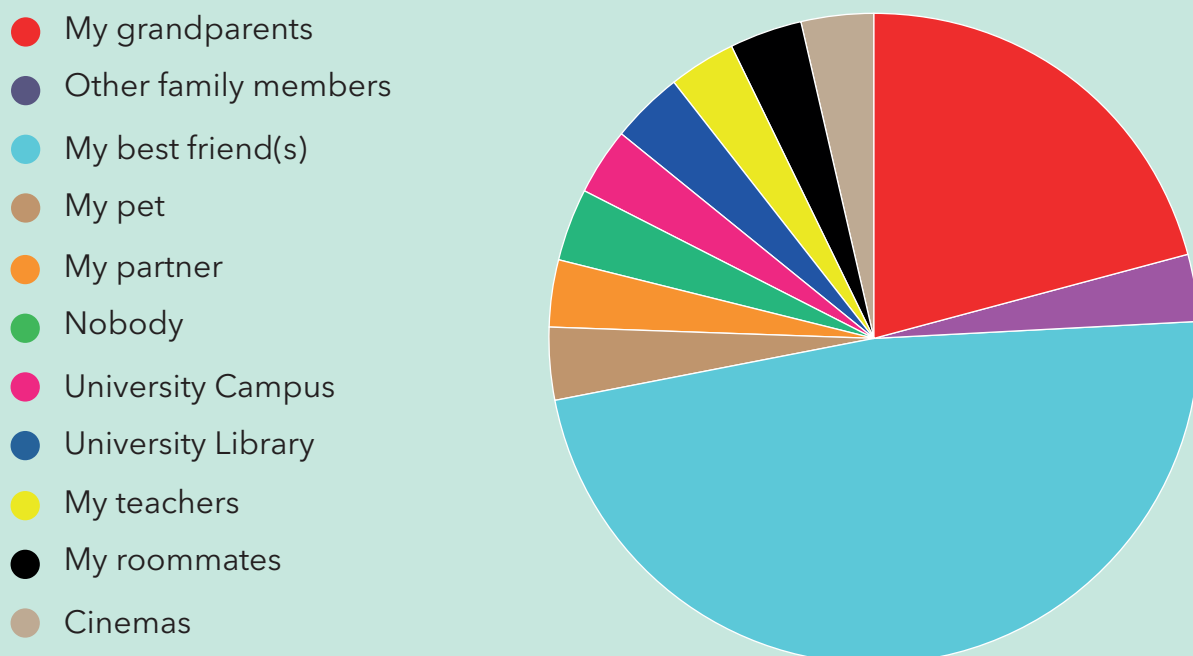
Summer Photo Contest

We challenge you to send in a photo of you doing your favorite summer activity. Let the summer begin!

spgprints®

SPGPrints voorziet bedrijven in de textiel- en grafische industrie van drukmachines en bijbehorende benodigdheden (consumables, met name screens en inkt). De behoefte aan meer inzicht in de supply chain als ook de mogelijkheden voor optimalisatie van de supply chain leidde tot een netwerkstudie. Groenewout vertaalde de bestaande supply chain in een model en rekende verschillende scenario's door.

Screens

PIKE ink cans

Netwerkstudie maakt het belang van supply chain binnen SPGPrints zichtbaar

De digitalisering rukt op in de textiel- en grafische industrie. In de textielindustrie kiezen steeds meer bedrijven voor digitale drukmachines. "Derhalve groeit de afzet van inkt met twintig tot dertig procent per jaar, vorig jaar zelfs met vijftig procent," vertelt Geert Wanten van SPGPrints. Als director operations is hij verantwoordelijk voor de operatie in Nederland en member van de board van SPGPrints met productielocatie in Nederland, Oostenrijk, India, China en Brazilië.

De opmars van digitaal drukken leidt tot extra complexiteit in de supply chain van SPGPrints, dat naast drukmachines ook de bijbehorende verbruiksartikelen produceert. Bij conventionele drukmachines gaat het om screens: grote rollen met nikkel als hoofdbestandsdeel. "Dat is een metaal dat relatief eenvoudig in grote volumes kan worden ingekocht. Bij digitale drukmachines daarentegen gaat het om inkten in verschillende, trendgevoelige kleuren. De daarin verwerkte kleurstoffen zijn vaak van natuurlijke oorsprong, wat betekent dat variatie in kleur kan ontstaan. Daarom zijn extra kwaliteitscontroles vereist, die leiden tot langere doorlooptijden. Bovendien zitten de leveranciers van die grondstoffen niet direct om de hoek", verklaart Wouter Visser, supply chain manager van SPGPrints.

Supply chain network study

Om antwoord te vinden op de vraagstukken, heeft SPGPrints een beroep gedaan op Groenewout voor een global supply chain network study. Visser: "We zijn gestart met het verzamelen van een heleboel data, onder meer over de transportstromen. Al die data hebben we in een model gestopt, waarna we verschillende scenario's hebben doorgerekend. Wat is handiger wat screens betreft? Productielocaties in India en Brazilië die alleen voor de lokale markt produceren? Of productielocaties die screens produceren met een lengte die het beste bij de afmetingen van hun productielijn past? In dat laatste geval dalen de productiekosten, maar weegt dat op tegen de stijgende transportkosten en wat is de invloed van de importduties?"

Meer inzicht, lagere kosten

De global supply chain network study was alleen al waardevol vanwege het verkregen inzicht in de huidige supply chain-kosten. "We zijn in staat geweest om onze supply chain-kosten te benchmarken met andere vergelijkbare bedrijven. Bijkomend voordeel is dat alle verkoop- en productielocaties nu beter samenwerken. Dankzij de studie van Groenewout zijn we veel meer met elkaar gaan praten", vertelt Wanten. "Volgens Groenewout kunnen we tot twintig procent besparen op supply chain-kosten."

"Meer inzicht, lagere kosten"

Supply chain wint aan belang

Het misschien wel belangrijkste voordeel van de studie laat zich niet direct in euro's vertalen: de verbeterde samenwerking tussen de verschillende locaties van SPGPrints. De vijf productievestigingen die voorheen onafhankelijk van elkaar opereerden, functioneren meer en meer als één supply chain. "Er is binnen alle geledingen van het bedrijf meer acceptatie ontstaan voor de bemoeienissen van supply chain", vertelt Visser. Wanten vult aan: "Ik ken Groenewout al van mijn vorige werkgever en weet welke kennis en ervaring zij op dit gebied hebben. De samenwerking is uitstekend verlopen, bovendien is het project op tijd en binnen budget opgeleverd."

More information

Voor het volledige interview: www.groenewout.nl/business-cases
Meer informatie nodig? Contacteer Mo Lasgaa,
lasgaa@groenewout.com | +31 76 533 04 40

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Quatsch!
¯_(ツ)_/¯

Quatsch?

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

Emma Segers over een ronde tafel
"Ik zit aan de korte kant van de tafel."

Rick Greeber
"Als Corona een gezicht had, dan was zij het."

Wim van Duuren tijdens carnaval
"I'm going as a banana, and Frank is going as anana... pineapple."

"(..) moest jij niet nog een verplicht online college kijken?"
Jasmijn Aartsen
"Klopt, die staat nu te spelen op mijn kamer!"

Marieke Derks
"Stephan, wil je het nummer van mijn zusje?"

"(...) wat is de lievelingskleur van Emma?"
Emma Segers
"Oeh, die weet ik!"

Puzzle

Denise is throwing an online end-of-the-semester party but she has to stay within the budget Bastiaan gave her. She spent:

- Half of the budget plus €30.00 on a fancy DJ
- Half of what she had left plus €20.00 on beer and wine
- Half of what she had left plus €10.00 on food (very important!)

Now she is out of money. The question is: what budget did Bastiaan give to her?

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

Bas Dietzenbacher is the winner of the previous puzzle. As a reward, he can come and pick up a crate of beer or a pie at room E1.10 (when possible). The solution can be found at www.Nekst-Online.nl.

Asset | Econometrics congratulates…

Name	**Joost Westland**
Title	Dynamic panel data model with unknown clusters: is bias reduction applicable?
MSc	EME
Supervisors	Dr. P. Cizek, Prof.dr. B. Melenberg

Name	**Deyu Huang**
Title	Predicting China and U.S. Composite Stock Indexes in post the 2008 Subprime Mortgage Financial Crisis Period Using ARIMA and Neural Networks
MSc	BAOR
Supervisors	Prof.dr.ir. H.A.M. Daniels, Dr. M.P. Rothfelder

Name	**Hans de Ferrante**
Title	Estimating the causal effects of adjuvant thera- py on overall survival for breast cancer patients from Dutch, population-wide registry data
MSc	EME
Supervisors	Dr. M. Salm, Dr. J.R. de Bresser

Name	**Charlotte Nijman**
Title	Estimating Increasing Conversion Rates on Adaptively Collected Data
MSc	EME
Supervisors	Prof.dr. T.J. Klein, Dr. J.R. de Bresser

Name	**Sjors Cooijmans**
Title	Housing satisfaction in housing associations
MSc	EME
Supervisors	Prof.dr. A.H.O. van Soest, Dr. C.B.T. Walsh

Name	**Jelle van der Ham**
Title	Ranking Football (Soccer) Trainers: An Elo Rat- ing System Based Approach
MSc	BAOR
Supervisors	Dr. C. Dobre, Dr. S. Sadikoglu

Name	**Kinga Droog**
Title	Increasing responsiveness through optimizing inventory levels at Vanderlande
MSc	BAOR
Supervisors	Dr. R.C.M. Brekelmans, Dr. Y. Merzifonluoglu

Name	**Wouter Faro**
Title	Developing a Prototype of an Integrated Pro- duction and Distribution Scheduling Tool
MSc	BAOR
Supervisors	Prof.dr.ir. H.A. Fleuren, Dr.ir.ing. M.J.P. Peeters

Name	**Julia Klimaszewska**
Title	The effect of international differences in corporate income tax rates on cross-country bilateral royalty flows
MSc	EME
Supervisors	Dr. M. Salm, Prof.dr. A.M. Lejour

Name	**Jeffrey Buijk**
Title	Optimization of Personalized Product Recommendation in E-Commerce
MSc	EME
Supervisors	Dr. S. Sadikoglu, Dr. N.F.F. Schweizer

Name	**Erik van der Poel**
Title	On estimating the point in time probability of default exhibiting serial autocorrelation in a VASRF setting
MSc	QFAS
Supervisors	Dr. R. van den Akker, Prof.dr. B. Melenberg

Name	**Frank van der Burgt**
Title	Time Slot Management for a Subscription Based Attended Home Delivery Service: a Case Study
MSc	BAOR
Supervisors	Dr. R.C.M. Brekelmans, Dr.ir.ing. M.J.P. Peeters

Name	**Maureen Los**
Title	Exploring Alternative Estimation Methods for the Dutch Risk Equalization Model for Mental Healthcare Costs
MSc	EME
Supervisors	Dr. M. Salm, Prof.dr. J. Boone (Economics)

Name	**Ege Altinel**
Title	A Framework for Calculating the Safety Stock Levels Across Different Industries and Business Settings
MSc	BAOR
Supervisors	Dr. J.C. Wagenaar, Dr. Y. Merzifonluoglu

Name	**Guus Vlaskamp**
Title	Mutually dependent importance ranking of links and nodes in infrastructural networks from GIS data
MSc	BAOR
Supervisors	Dr. J.C. Wagenaar, Prof.dr.ir. H.A. Fleuren

Name	**Koen Dekker**
Title	Improving Neighborhood Selection in an Iterative Optimizer: A Learning to Rank Solution
MSc	EME
Supervisors	Prof.dr. T.J. KleinDr. J., C. Vera-Lizcano

Name	**Olivier Thijssens**
Title	Decision support for prostate cancer treatment
MSc	BAOR
Supervisors	Dr. M.P. Rothfelder, Dr. M. Salm

Name	**Bart Rutten**
Title	Improving Order Picking Efficiency Using Data Mining and Reinforcement Learning
MSc	BAOR
Supervisors	Prof.dr.ir. H.A.M. Daniëls, Dr. R.C.M. Brekelmans

Name **Jasper van der Wall**
Title Complaint classiffcation Predicting complaints against lawyers
MSc BAOR
Supervisors Prof.dr. J.H. Abbring, Prof.dr. B.J.M. Werker

Name **Dion Pijpelink**
Title The identification of risk drivers for prepayments using machine learning
MSc QFAS
Supervisors Dr. R. van den Akker, Dr.ir. G.W.P. Charlier

Name **Maud Lich**
Title A Game Theoretic Approach to Information Transfer Markets
MSc EME
Supervisors Prof.dr. P.E.M. Borm, Dr. M.Quant

Name **Spiros Fotopoulos**
Title Modelling Prepayments and Re nances with Data Science and Cure Model Techniques
MSc QFAS
Supervisors Prof.dr. F.C. Drost, Dr. P. Cizek

Name **Thijmen Goossens**
Title Price Forecasting of Pork Products using Linear Models and Artificial Neural Networks
MSc EME
Supervisors Dr. D. Kojevnikov, Dr. C.B.T. Walsh

Name **Irmgard Oude Alink**
Title A promotion study at IRI: can random forest improve it?
MSc EME
Supervisors Dr. O. Boldea, Dr. C.B.T. Walsh

Name **Sven Nieuwenhuijze**
Title Modelling the comovement across time series: A case study of short-term demand forecasting
MSc BAOR
Supervisors Dr. O. Boldea, Dr. D. Kojevnikov

…on obtaining their Master's degree

Thank You!

For this committee this was our last Nekst edition. Therefore we would like to personally thank you as readers for reading all the pieces, the sometimes critical (often justified) feedback and the hilarious quatsches. To thank you, our creative editors would like to share some last words with you. Our committee was very diverse and so are these quotes. Have fun reading!

Bob: "It's been a blast designing Nekst this year! Everyone on the team did their best and I think that this is reflected in all editions. I am proud of everyone!"

Jelle: "I really miss University."

Constantijn: "I experienced this unfortunate short year with the Nekst committee as my most fun and entertaining year with Asset so far. Moreover I hope I have broadened the scope of my readers in the sense that econometrics can not only be applied to standard econometrics problems but to a wider range of complex problems."

Stephan: "Never take anything for granted, especially your alvleesklier."

Marieke: "I am very proud to have been the coordinator of this new, fresh, enthousiastic Nekst committee! I will always cherish the copies of the editions of this year, as it is an amazing memory of my board year. Nekst has a special place in my heart. A massive thanks to Emma and Bob, who did an amazing job!"

Juliette: "Listen to the podcast Man Man Man to stop all the Corona boredom."

Jarno: "Having contributed a bit is always better than having contributed nothing."

Jeffrey: "Thank you all for reading our articles, sending in nice quatsches and a special thanks to everyone who has contributed to one of our articles this year!"

Marco: "It's all fun and games 'till the goshdarn plague hits your social life like a fourteen wheeler blasting through a squirrel."

Emma: "Is *Fries Before Guys* an appropriate final Nekst quote?"

Casper: "Even though I didn't join until February, I felt welcome right away and I really enjoyed writing articles for Nekst."

Rick: "Even though the workload was immense, I really enjoyed working on Nekst-Online."

Dirk: "I think it was a great idea to give the Nekst committee an extra boost this year and due to this I hope you enjoyed the articles we've made even more!"

Janne: "I definitely enjoyed working with this committee on our 4 editions of Nekst and would like to thank all the external writers who saved us work by sending in articles."

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

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

Together, we unlock potential.

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