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MANDELBROT SPECIAL

FASCINATING FRACTALS IN NATURE

ALSO FEATURING

- TRIANGLE: STATISTICAL ANALYSIS OF NETWORKS
- SPECIAL: TRAVELING SALESMAN PROBLEM
- PRACTICAL REPORT: RETAIL MARKET

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Preface

A Spring of Specials

As spring has gradually introduced itself by means of a welcome change in weather, it is our duty to simply enjoy this time of the year. Luckily, there are always plenty opportunities to do so. Nekst has done its part and has once again provided some – hopefully enjoyable – articles. First of all, we have interviewed another three professors concerning their research activities, a series of articles we can now rightfully call a recurring special.

Other specials discuss the Mandelbrot set and the Traveling Salesman Problem. Moreover, PhD candidate Mario Rothfelder has written a Triangle and Martijn Heinen introduces us to the econometrics of the retail market in his Practical Report. On a less technical note, we interviewed our fellow student Joost Westland in interest of his activities as chair of the youth organization for the political party PvdA; perhaps we can later say we interviewed a to-be prime minister? Other articles tell you everything about all activities that Astrics has enjoyed during the past months, for example the Trip to the city of Belgian fries and waffles – also known as Ghent.

Let me also not forget to direct your eye to the Easter Egg Hunt, where we do not test your search skills in some backyard, but instead allow you to relive this tradition without having to leave your seat. Lastly, as of this issue, reinforcements have arrived for the Nekst committee; two new editors are (re)introduced in the Committee Introduction. Are you curious as to who they are? I once again suggest you to pick your favorite articles, go for the best seat you can find, and enjoy Nekst!

Stefan ten Eikelder
Editor-in-Chief

COLOPHON

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At the end of February, 35 econometricians enjoyed a wonderful weekend in Ghent! Amongst others, they had a boat tour, visited pubs and dared to play paintball.

NETSPAR

Dear Members,

Spring is the season to get rid of your old life and start a new one. Finally, the temperature rises to an acceptable amount of degrees, the number of hours of sun is getting higher and the birds are singing like flutes. What I like most about spring is the tension in the end of all sports competitions. As a sports fanatic, spring and the beginning of the summer are my highlights of the year. New stars arise and old fade away.

As new sports stars rise, new activities rise at Asset | Econometrics in high speed. Do you want to attend these activities or do you want to know the exact dates of all of them? Visit our website, where you can find more information about all events, which you can easily copy to your Google Agenda.

Are you interested in the field of Operations Research or do you want to know how to outsmart the market based on Data Science? Be sure to visit the Operations Research Conference! The first edition of the ORC will be held on April 26 with the theme "Outsmarting Competitors". During this day, several interesting speakers and companies will shine their light on outsmarting the market. It even includes a lecture of someone of noble birth: jhr. dr. Walther Ploos van Amstel.

Events like stealing Manneke Pis, the opening of the first Russian University and the replacement of David Letterman on Late Night will no longer be named first when the date of April 26 is mentioned; from then on, this right will belong to the ORC. Furthermore, we are convinced that this day will look way better than the fictional humanoid creature that is part of a fantasy race akin to goblins, as an ORC is usually referred to.

Besides this career event, we also have a lot of informal activities to offer. Some of you have just experienced a legendary Active Members Weekend, for others the notorious events start now. On April 19, the second Astrics Cantus will take place. Last year was a tremendous success, but the Drinks & Activities committee is doing everything within their possibilities to exceed the number of participants of last year. Help them by registering for this amazing event and enjoying a wonderful evening with as many econometricians as possible. If you already want to train for this cantus or for the Beer Race Drink, which will take place on May 11, you can pick up your free shot glass at the Astrics rooms.

I understand you are tired of all the stories I am telling you this year in these articles. As I already mentioned, spring means that new life will arise and old life fades away. The same happens with the board of Asset | Econometrics, even if it is not happening during the spring. New board members will take the association to an even higher level. Are you curious whether the new secretary loves cuddly toys as much as the current one? Then visit the Announcement Drink on June 7. Another great part of that day is the possibility to show your football skills versus other students and even versus professors of the EOR department.

I wish you the best of luck in the upcoming months and I hope to see you at one of our activities or at the Astrics rooms!

On behalf of the board,

Thijs Kramer
Chairman Asset | Econometrics 2015-2016

Who's Who?

Text by: Claire Vink

Mike Weltevrede

This 21-year-old is a second-year bachelor student and is also the vice chairman of Cicero, the vivid debating society of Tilburg. Not surprisingly, he gains ultimate joy from winning a debate during a debating tournament. If he is not debating, he will most probably play a video game, edit a YouTube video or you will find him playing darts. Those who know Mike will describe him as a persevering, down-to-earth, enthusiastic, procrastinating and determined person. Amongst others, he is determined to obtain a master's in Mathematical Medicine and Biology at the University of Nottingham. Like one of his favorite quotes states, "Rise and rise again, until lambs become lions", he will not give up and keep on developing himself to pursue his dreams.

Steffi van den Hanenberg

Steffi is a twenty-year-old third-year bachelor student, who is planning to start with her master's in September. She is an enthusiastic and creative person, who considers herself a perfectionist and a stickler. Moreover, Steffi has a strong passion for dancing. As such, she ended in fifth place at the European championship UDO hip-hop, and she ended in eight place at the World Championship UDO hip-hop in the category hip-hop DUO over eighteen. Nowadays, she does not participate in dancing competitions anymore, but she is coach of her own hip-hop crew: SCREAM. Her other passions include blogging and face-painting; once she had to face paint 35 zombies! All those outstanding achievements are most probably due to her 'let's go to work' attitude.

Go West, Young Man

One of my most stupid decisions in life was not to accept the invitation to work in Silicon Valley. It was 1993, I was finishing my PhD thesis, and my algorithms turned out to be very useful in chip-layout design. A start-up company offered me a challenging job and an equivalent salary to implement my algorithms in practice. But I wanted to stay close to my family and friends, and envisaged all kinds of bureaucratic difficulties in arranging to move to the west coast of the USA.

A few months later, I made one of the best decisions in my life, namely to start working for a software and consulting firm (ORTEC), which also focused on implementing optimization algorithms in practice. As during my PhD, I got the opportunity to visit various European countries; but in addition also was able to go to the USA, Canada, Australia and South Africa – all to discuss the riches we have in the Netherlands in terms of our knowledge of algorithms and related fields. People I met in other countries voiced a similar opinion: namely that the Dutch excel when it comes to mathematics, algorithms and logistics.

Research by Deloitte supports this: a firm foundation in mathematics turns out to be an important pillar of Dutch economic success – and that pillar can only continue to gain significance in the future given the explosive increase in the amount of data, ever faster computers and better calculation methods. The research indicates that there is a clear link between mathematical knowledge and a nation's international competitive strength – and the Dutch happen to be good in math. The FD, a Dutch financial newspaper, recently reported on a large-scale study on the skills of citizens in 23 different countries. It revealed that the Dutch are very good with numbers. The study also assessed linguistic abilities. It concluded that the Dutch are good at math and languages, and are natural traders.

You can see this Dutch 'optimization capacity' reflected in the recent winners of the Franz Edelman Award. This prestigious prize is awarded for a major contribution to operations research and analytics in practice. There was Dutch involvement in the 2008, 2011, 2012 and 2013 winning entries (the latter two including Tilburg University), and that is quite unique. Similarly, there are a number of Dutch software heroes, such as Quintiq, ORTEC and Slimstock, enjoying rapid growth across the world.

With our mathematical knowledge, linguistic skills and trading mentality, backed by exceptional software firms, we have huge opportunities across the globe to become world champions in Operations Research. One of the most commonly quoted sayings in 19th century USA was "Go west young man and grow up with the country". It was coined by the writer Horace Greeley, who saw the fertile farmland of the West as an ideal environment for people willing to work hard for the chance to succeed. The phrase came to symbolize the idea that agriculture could solve many of the nation's problems arising from the poverty and unemployment, then characteristic of the big cities of the East.

Similarly, I believe Operations Research can solve many problems, including poverty and unemployment, and would therefore encourage everybody to seize opportunities abroad — whether they be in the West (Silicon Valley), East (China) or somewhere else — to help improve the world. I was scared to take this step over twenty years ago; hopefully you will not be. Fortunately, I have been lucky enough since to have had the opportunity to visit much of the world on various occasions, to meet my wife, and to help the next generation at Tilburg University to 'Go West'.

Goos Kant

Goos Kant is a part time full professor at the Department of Econometrics and OR, as well as partner and member of the supervisory board at ORTEC. His research interests include logistics and supply chain optimization.

Estimation of Time Varying Partial Correlation Networks

Mario Rothfelder
PhD Candidate

Lately, many applications in social, natural and information sciences led to an increased interest in the statistical analysis of networks or, in other words, graph models. Examples within the fields of economics and finance are given amongst others, in a series of articles authored by Francis X. Diebold and Kamil Yilmaz with various collaborators; cf. www.financialconnectedness.org for further details. Kolar et al. [1], inter alia, provide examples from the biology (genome networks) and sociology (U.S. Senate voting behavior) literature. A common feature of these examples is the underlying time dependence of such systems.

Basic Terminology for Networks

Before digging into the estimation of networks, a short overview of what networks actually are and some basic terminology are in order. A network, or graph model, is defined as the tuple $\mathcal{N} = (\mathcal{V}, \mathcal{E})$ where $\mathcal{V} = \{1, ..., N\}$ is called the set of vertices or nodes (think of individuals, firms, countries, genomes, etc.) and $\mathcal{E} \subseteq \mathcal{V} \times \mathcal{V}$ the set of edges (connections between the vertices). Depending on the direction of these connections, we can distinguish two basic kinds of networks: directed and undirected networks. The latter are graphs in which all edges are bidirectional (unordered pairs of elements of $\mathcal{N}$) whereas in the former all edges point into a direction (ordered pairs of elements of $\mathcal{N}$). Another major distinction between graphs is that of a weighted vs. an unweighted graph. In unweighted graphs we only display whether two vertices share a connection or not, whereas in weighted graphs we associate weights with each edge displaying the strength of the connection between vertices.

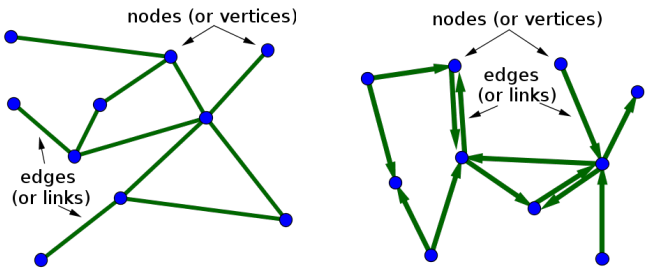

Figure 1: Left panel illustrates an undirected and right panel a directed unweighted network. A weighted network could be illustrated by using different edge thickness or coloring. Taken from [14, 15].

Having presented the basic terminology for networks we can turn our focus to the statistical part of networks. That is, we will now discuss different approaches on how to estimate the set of edges, depending on the underlying data structure, for (weighted) undirected networks. But first, we need to define when an edge between two vertices exists in a statistical meaning. Following the literature, cf. [2], this can be done by means of partial correlation networks. In this context, an edge between two vertices exists if and only if the partial correlation, ρ_{ij}, between the two vertices i and j is non-zero. That is

$$\mathcal{E} = \{(i,j) \in \mathcal{V} \times \mathcal{V} : \ \rho_{ij} \neq 0\}$$

Note that, for weighted networks, ρ_{ij} also defines the weight of the edge between vertices i and j.

To formalize this idea a bit more, suppose that we have a N-dimensional random vector $\mathbf{x}$ with generic i-th element x_i, with mean zero and covariance matrix $\mathbf{\Sigma}$. Moreover, define the precision or concentration matrix $\mathbf{\Omega} \equiv \mathbf{\Sigma}^{-1}$. A classical result states that the (i,j)-th element of $\mathbf{\Omega}$, ω_{ij}, is proportional to the partial correlation coefficient between x_i and x_j, cf. [3]. In other words, an edge between vertices i and j exists only if $\omega_{ij} \neq 0$. Hence, estimating $\mathcal{E}$ turns out to be the same problem as estimating $\mathbf{\Omega}$. Thus, a partial correlation network can also be seen as a graphical representation of the covariance structure of the high-dimensional random vector $\mathbf{x}$.

Due to the seminal work of [4], arguing that most networks are sparse (i.e. the majority of entries in $\mathbf{\Omega}$ are equal to zero) and supported by subsequent empirical analyses, estimating $\mathcal{E}$, respectively $\mathbf{\Omega}$, constitutes a covariance selection problem as introduced in the seminal work of [5]. Since $\mathcal{O}(N^2)$ parameters determine the network structure, the case of small

N and relatively large T, i.e. number of observations, can be tackled with classical estimation methods as, for example, described in [6]. However, in the examples mentioned in the introduction the opposite is usually the case. That is, N is big relative to T and thus, classical methods of estimating $\mathbf{\Omega}$ stop working and we are in need for so called big data methods which are capable of handling cases with a huge amount of unknown parameters relative to the number of samples T. A first proposal to tackle this problem in context of network estimation can be dated to [2] who apply a neighborhood selection (i.e. selecting the edges in a neighborhhood of vertix i) approach based on the Least Absolute Shrinkage and Selection Operator (LASSO). However, this approach only works well for unweighted graphs due to its sequential structure of first estimating the set of edges and then determining the weights based on the previously found restrictions on the concentration matrix. In case of weighted networks the LASSO approach of [7] seems more promising in also correctly determining the weights associated with each edge. However, a major drawback of these methods is that they are only suitable for $i.i.d.$ data and thus, neglect major aspects, such as the long-run or dynamic behavior, of time series.

Figure 2: Illustration of sparsity for a fission yeast protein interaction network. One can clearly see that, by far, not all vertices are connected. Taken from [13].

Moving to Time Dependent Systems

One of the first attempts to relax the $i.i.d.$ assumption on the data was brought forward by [8] who consider smooth variations in the network structure. That is, these authors allowed for smooth changes in the concentration matrix, still maintaining the independence assumption of the data. Mladen Kolar and Eric P. Xing, together with various collaborators, build on the proposal of [8] to further refine methods which relax the assumption of identically distributed data. However, these authors do not yet allow for time dependencies of the data. A first proposal to overcome this hurdle was brought forward by [9] who consider general processes $\mathbf{x}_t$ which possess a $\mathrm{VAR}(\infty)$-representation (and to be approximated by a $\mathrm{VAR}(p)$-process for estimation) and thus, allow them to redefine partial correlation networks for time-dependent processes. We will now quickly review their approach to gain some intuition before moving to time varying networks based on dependent data. Therefore, let $\mathbf{x}_t$ follow a stationary $\mathrm{VAR}(p)$-process

$$\mathbf{x}_t = \sum_{k=1}^{p} \mathbf{A}_k \mathbf{x}_{t-k} + \boldsymbol{\epsilon}_t, \quad \boldsymbol{\epsilon}_t \sim w.n.(0, \mathbf{\Sigma}_\epsilon) \tag{1}$$

where $\mathbf{A}_k$ are $N \times N$-matrices of parameters. Now, recall that the precision matrix of $\mathbf{x}_t$ is defined to be the inverse of the covariance matrix of $\mathbf{x}_t$.It is easy to show, under suitable conditions, that the long-run covariance, $\mathbf{\Sigma}_\mathbf{x}$, of $\mathbf{x}_t$ is given by

$$\mathbf{\Sigma}_\mathbf{x} = \left(\mathbf{I}_N - \sum_{k=1}^{p} \mathbf{A}_k\right)^{-1} \mathbf{\Sigma}_\epsilon \left(\mathbf{I}_N - \sum_{k=1}^{p} \mathbf{A}_k^\top\right)^{-1}$$

and thus, the long-run precision matrix by

$$\begin{aligned}\mathbf{\Omega}_\mathbf{x} \equiv \mathbf{\Sigma}_\mathbf{x}^{-1} &= \left(\mathbf{I}_N - \sum_{k=1}^{p} \mathbf{A}_k^\top\right) \mathbf{\Sigma}_\epsilon^{-1} \left(\mathbf{I}_N - \sum_{k=1}^{p} \mathbf{A}_k\right)^{-1} \\ &\equiv (\mathbf{I}_N - \mathbf{G})^\top \mathbf{C} (\mathbf{I}_N - \mathbf{G}).\end{aligned} \tag{2}$$

Thus, the long-run network of the process $\mathbf{x}_t$ can be characterized via the set of edges

$$\mathcal{E}_\mathbf{x} = \left\{(i,j) \in \mathcal{V} \times \mathcal{V} : \ -\omega_\mathbf{x}^{ij} / \sqrt{\omega_\mathbf{x}^{ii} \omega_\mathbf{x}^{jj}} \neq 0\right\} \tag{3}$$

where $\omega_\mathbf{x}^{ij}$ denotes the (i,j)-th entry of $\mathbf{\Omega}_\mathbf{x}$.
From Equation (3) it is straightforward to see that estimating the long-run network of $\mathbf{x}_t$ entails estimating the parameters of the $\mathrm{VAR}(p)$-process and the inverse of the covariance matrix of the white noise innovations $\boldsymbol{\epsilon}_t$. Recalling that the network structure usually is sparse this can be done, for example, by applying LASSO techniques to both problems separately. In particular, [9] propose to estimate $\mathbf{G}$ by estimating each of the N $\mathrm{VAR}(p)$-equations by the adaptive LASSO separately (due to dimensionality issues) and to estimate $\mathbf{C}$ using the iterative LASSO approach of [7].
A final remark is now in order. Equation (2) allows us to disentangle two different effects influencing the long-run network structure. That is, we can model effects to the long-run network due to $a)$ Granger causality within $\mathbf{x}_t$ via the $\mathbf{G}$-component (also referred to as the Granger network, a weighted directed graph) and $b)$ correlations within the innovations through $\mathbf{C}$ (also referred to as the contemporaneous network, a weighted undirected graph). This has the nice feature that we can gain some more insights into the structures of the long-run network underlying $\mathbf{x}_t$ and their origins. However, this approach still does not allow us to model time-evolving networks.

Including Time Variations Into the Network Structure

Based on Equations (1)–(3) it seems natural to model time variation via varying VAR-parameters and time varying covariance matrices for the innovations. For simplicity, we will only focus on VAR-processes with structural breaks:

$$\mathbf{x}_t = \sum_{k=1}^{p_l} \mathbf{A}_{k,l} \mathbf{x}_{t-k} + \boldsymbol{\epsilon}_{t,l}, \quad \boldsymbol{\epsilon}_{t,l} \sim w.n.(0, \mathbf{\Sigma}_{\epsilon,l}), \ t \in [t_{l-1}; t_l) \tag{4}$$

and we assume that there is a structural break at $t = t_l$ when either the lag order, an element of the parameter matrices or of the covariance matrix changes at t_l. If this process is stationary on each segment l, $t \in [t_{l-1}; t_l)$, we shall call $\longrightarrow$

it a piece-wise stationary process. On each such segment where the parameters do not change, the long-run network can then be retrieved from

$$\Omega_{\mathbf{x},l} = [\mathbf{I}_N - \mathbf{G}_l]^\top \mathbf{C}_l [\mathbf{I}_N - \mathbf{G}_l]. \tag{5}$$

The estimation of $\mathbf{G}_l$ is more involved, compared to time stable networks, since we also have to estimate the number and location of break points and we shall now briefly outline a possible approach to tackle this problem elegantly. In what follows, we will estimate each VAR-equation separately. Thus, take x_t to be a generic element of $\mathbf{x}_t$ (we suppress the subscript i to ease notational burden) and consider its representation derived from (4)

$$x_t = \sum_{k=1}^{p_l} \mathbf{a}_{k,l}\mathbf{x}_{t-k} + \epsilon_{t,l} \equiv \mathbf{g}_l \tilde{\mathbf{x}}_{t-1} + \epsilon_{t,l}, \quad t \in [t_{l-1}; t_l) \tag{6}$$

where $\mathbf{a}_{k,l}$ denotes the i-th row of $\mathbf{A}_{k,l}$, $\mathbf{g}_l$ the i-th row of $\mathbf{G}_l$ and $\tilde{\mathbf{x}}_{t-1} = \mathrm{vec}(\mathbf{x}_{t-1}, ..., \mathbf{x}_{t-p})$. Moreover, let $\mathbf{x}^0 = (x_1, .., x_T)^\top$, $\boldsymbol{\epsilon} = (\epsilon_1, ..., \epsilon_T)^\top$ and

$$\mathbf{X} = \begin{pmatrix} \tilde{\mathbf{x}}_0^\top & 0 & \dots & 0 \\ \tilde{\mathbf{x}}_1^\top & \tilde{\mathbf{x}}_1^\top & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{\mathbf{x}}_{T-1}^\top & \tilde{\mathbf{x}}_{T-1}^\top & \dots & \tilde{\mathbf{x}}_{T-1}^\top \end{pmatrix}.$$

Finally, define $\boldsymbol{\beta}_1 = \mathbf{g}_1^\top$ and

$$\boldsymbol{\beta}_t = \begin{cases} \mathbf{g}_l^\top - \mathbf{g}_{l-1}^\top & \text{whenever } t = t_l \\ \mathbf{0} & \text{otherwise} \end{cases}$$

and let $\boldsymbol{\beta} = \mathrm{vec}(\boldsymbol{\beta}_1, ..., \boldsymbol{\beta}_T)$. Thus, (6) can be rewritten in matrix form as

$$\mathbf{x}^0 = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\epsilon} \tag{7}$$

By construction of $\boldsymbol{\beta}$, estimation of (7) constitutes a sparse estimation problem and thus LASSO techniques render themselves a suitable choice. For example, we can utilize, due to the model specific sparsity structure, the (sparse) group LASSO approach:

$$\hat{\boldsymbol{\beta}} = \arg\min_{\boldsymbol{\beta}} \|\mathbf{x}^0 - \mathbf{X}\boldsymbol{\beta}\|_2^2 + (1-\alpha)\lambda_x \sum_{k=1}^{T} \|\boldsymbol{\beta}_k\|_2 + \alpha\lambda_x \|\boldsymbol{\beta}\|_1, \tag{8}$$

where λ_x is a regularization parameter and $\alpha \in [0; 1]$ controls between (number of structural breaks) and within (number of zero parameters on each segment) sparsity of the constructed groups. To restore the missing oracle property of the LASSO and its extensions, we can modify Equation (8) to an adaptive approach using some pre-estimators. Of course, there are also other methods available, such as the parsimoniously time varying VAR-approach of [12].

To estimate the time varying contemporaneous network $\mathbf{C}_l$ we follow Kolar and Xing (2012) and employ their temporal-difference LASSO (TD-LASSO) which utilizes a neighborhood selection set up similar to [2]. As mentioned earlier, due to the sequential procedure of the neighborhood selection procedure, other methods might be preferred but, to the best of my knowledge, another proposal to solve this problem does not yet exist (except for solutions with stronger assumptions, e.g., imposing certain probability structures on the edge formation). Due to heavy notational burden of the TD-LASSO in addition to space constraints, we refer the interested reader to [10] for a presentation of this approach. Furthermore, we note that the TD-LASSO is only capable of determining whether there exists an edge between vertices i and j or not. That is, we cannot determine the weight associated with this edge via the TD-LASSO. However, we can combine it with the iterative procedure of [7] to estimate the weights of the edges on each segment.

Concluding, we reviewed the most important terminology for networks in a statistical setting. Afterwards, we outlined estimation of partial correlation networks based on $i.i.d.$ data, time-varying independent data and extensions to networks based on dependent data and time varying structures.

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[14] http://mathinsight.org/definition/directed_graph

[15] http://mathinsight.org/definition/undirected_graph

The Art of Smart Marketing

Laura Verloop
AGE: 21
Began studies in 2012

Thanks to my friend and housemate Moniek, who was the chair of the Marketing Intelligence Symposium committee. I already knew for quite some time that this year's symposium would take place in March. The day started off nicely, since we were allowed to leave a bit early during a lecture of the course Management Science.

The symposium started with registration and a delicious lunch. Next, we got to meet the chairman of the day, George Knox, who spoke with great enthusiasm. He quickly introduced the Marketing Analytics master's program at our university, but unfortunately he did not have too much time, because after him Bas Donkers, professor of Marketing Research at the Erasmus University Rotterdam, was invited to give the first plenary lecture. Before his lecture, I had some general knowledge about marketing intelligence, but I did not know the difference between marketing intelligence and the techniques which we are taught in our courses; something he explained very clearly. The last speaker was Bart van Krimpen, who works as a Marketing Intelligence Analyst at Randstad Groep Nederland. I found there to be one problem during this last lecture: I unfortunately had no concentration left. However, he did have some nice examples about applying marketing intelligence methods to CV's, which I found quite interesting.

After the plenary lecture, we had a coffee and tea break, during which I regained my concentration. Subsequently, the case round took place, in which MIcompany and Pointlogic presented a case. I followed the case from MiCompany, which focused on whether or not a company should invest in glass fiber. During this case we worked in Excel and it sometimes still amazes me in what ways you can use this program. Sadly, we did not win the prize for the best group: a puzzle book made by the MIcompany employees themselves.

After this case, everybody was a bit tired and we still had one presentation to go: the presentation of NEWCRAFT. I still do not know exactly what they do, but I do know that they have one employee with even more enthusiasm than George Knox. This was something I deemed impossible at the beginning of the day, but he definitely got our attention. After the presentation we had the opportunity to get something to drink and snack, and here we were joined by the companies from the cases and presentations.

A couple of hours after the symposium took place, our monthly drink was about to begin in Café de Nachtwacht. Tonight, a pub quiz would be given by the Actuarieel Genootschap (AG). When we arrived at the café it was rather empty; soon enough I discovered the reason for this, PSV played an important match at that moment. However, this did not spoil the fun, because a couple of minutes after our arrival more people showed up. One hour later even more people had arrived, and this was the time that the AG started their presentation and told us all about being an actuary. This was done by two people: an econometrician and a historian. One would say that historians cannot tell you anything about what it is like being an actuary, but everybody who was present that evening can tell you they do actually know a lot. The talk was followed by the pub quiz, which did not go according to plan: the presentation could not be shown either on the TV or using the beamer. This problem was solved by simply reading the questions out loud. After the pub quiz was over the drink started. All in all, it was an exhausting day, but at the same time it was also fun and informative.

Surviving the Retail Market

Even within the largest retail corporations, members of the board have a different point of focus. A lack of focus within the board leads to an unclear market proposition and a loss in revenues. To overcome this problem a data driven approach to the marketing strategy can enable decision making. The data-driven approach will contribute to a single language among the entire organization upon which decisions can be based.

In the Netherlands numerous retailers are located in shopping and city centers. However, more and more retailers fail to stay in business. Recently V&D has been declared bankrupt[1]. Also Miss Etam failed to be relevant to their customers and had to close their stores[2]. Just a few weeks ago another retailer has entered troubled water, Unlimited Sports Group can no longer pay their bills[3]. The underlying reason for each of these bankruptcies is the lack of differentiation from the competition. These retailers fail to bring value to the customers in a way Starbucks and IKEA do.

A segment in which the margins are especially small is the grocery market. Here, the retailers earn their money due to a large customer base, not a high profit margin. This is due to the ever ongoing price war. The first price war lasted from 2003 until 2006. Later in 2008 and again in 2011 there were price wars amongst supermarkets. Though it is less visible today, supermarkets are still competing on price[4], reducing the margins to a minimum.

The choice to battle on the field of price is remarkable because supermarkets have so much more to differentiate on. One could think of their products, service and accessibility. In order to attract customers to your supermarket you must improve every year. According to Levy et al. (2014) [1], 33% of the customers changed their supermarket in 2013. Of these customers 43% changed due to price, while 25% changed due to long lines, poor selection and low quality. Rude employees were responsible for 17% of the changing customers and crowded stores for the remaining 14%.

Theory

When starting any company, especially a retail store, the manager needs to go through some steps to increase the chance of success. First, the retailer decides on the target market. Second is choosing the correct retail mix, according to Ghosh (1990) [2]. The Costumer Relevancy Theory states that customers search for the retail mix that suits them best. The re-

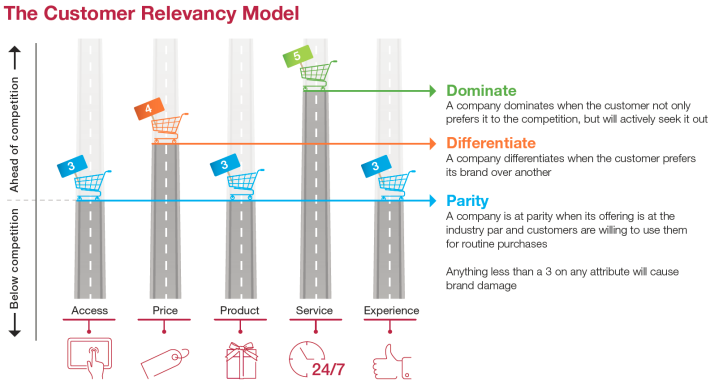

Figure 1: Capgemini's Customer Relevancy Model: dominate, differentiate and compete at parity

[1] http://www.nu.nl/vd/4190872/warenhuisketen-vd-failliet-verklaard.html, accessed on February 21, 2016

[2] http://www.nu.nl/ondernemen/4034896/miss-etam-failliet-verklaard.html, accessed on February 21, 2016

[3] http://www.nu.nl/economie/4218917/moederbedrijf-perry-sport-en-aktiesport-krijgt-uitstel-van-betaling.html, accessed on February 22, 2016

[4] http://www.distrifood.nl/formules/nieuws/2014/12/albert-heijn-voert-in-stilte-prijzenoorlog-10122364, accessed on July 9, 2015

tail mix is a combination of marketing activities by which the retailer creates value for the customer. According to Ghosh the basic elements are:

- location;
- merchandise;
- store atmosphere;
- customer service;
- price;
- advertising;
- personal selling;
- sales incentive programs.

To find the right element to excel in, in order to outmarch the competition, Capgemini Consulting has developed the Customer Relevancy Model. Earlier research conducted among 16,000 consumers across nine countries by Capgemini has proven that the customer values only five attributes in every business interaction, resulting in the Customer Relevancy Model. This tool enables one to think and to make decisions on management level for a distinctive market positioning. Furthermore, it is widely used to talk in the same wordings across all layers of the organization on the level of brand, portfolios, customer segments, and products or services. Also proven by earlier research is that all successful companies have a clear customer experience strategy: dominating on one attribute, differentiating on another and parity on the rest. Or, on a five point Likert scale: score a five on one attribute, a four on another and a three on the rest. The model is visuallv expressed in Figure 1 for a company dominating on service and differentiating on price.

The observant reader might have noticed that the translation from words to numbers makes the model invalid. When each company in a market would obey the Customer Relevancy Model, parity would increase as no company can afford to be below parity. Therefore, it is important to note that the numeric expression for the levels of the model attributes are used to spread understanding.

The model is already, knowingly or unknowingly, widely used by companies around the world. However, until now it is unclear to companies whether they excel or differentiate and which attributes are truly valued by the customers.

Data

To find the preferred attributes and their corresponding levels, a survey among 387 Dutch customers has been conducted. The respondents stated their personal characteristics such as gender, age, income, education, household size, occupation, and role in the household. Furthermore, their shopping behavior was investigated. The questionnaire asked about the used supermarkets and the percentage of the household budget spent in that supermarket. Hereafter, the supermarkets are rated, based on the five Customer Relevancy Attributes: access, price, product, service and experience.

The last part of the survey contains a so called Conjoint Analysis. A Conjoint Analysis asks multiple similar questions. Based on the complexity of the issue the number of both the respondents and questions has to be increased. In this research ten questions are used. In a Conjoint question the respondent has the option to choose between three similar products, or to choose none of the products[5]. The products are three different supermarkets defined by the five attributes. When the

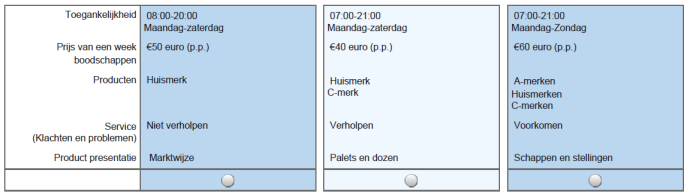

Figure 2: Example of a Conjoint Analysis question

customers answer multiple questions it enables the researcher to find the relative importance of each of the attributes by measuring the trade off between different supermarket characteristics made by the respondent. The questions were asked as in Figure 2.

Practice

The aim is to be able to predict which customer will use which supermarket. A logit model is the obvious choice to predict the choice of supermarket. A downside of the logit model is that it is based on a discrete choice between two options: the response is either zero or one. When modeling the supermarket choice, first the problem of multiple choices has to be overcome. This can be done by extending the model to a multinominal logit model. In a multinominal logit model the choice between two options is extended to m options as developed by McFadden (1974) [3]. Still, the multinominial logit model does not take into account that a customer can use more than one supermarket. To cover for this, each observation gets the weight according to the percentage spend in the supermarket. For example, if one spends 75% at Albert Heijn and 25% at Jumbo, the observations for Albert Heijn and Jumbo have frequency weights 75 and 25. This results in the following model:

$$y_{i,j} = \frac{e^{\sum_{k=1}^{5}[\beta_{j,k} d_{i,j,k} \tilde{u}_{i,k}] + \delta_j X_i}}{\sum_{j=1}^{J} e^{\sum_{k=1}^{5}[\beta_{j,k} d_{i,j,k} \tilde{u}_{i,k}] + \delta_j X_i}}, \tag{1}$$

with

Dependent variable:

- $y_{i,j}$ is the probability that respondent i chooses supermarket j, and can be interpreted as market share.

Independent variables:

- $d_{i,j,k}$ is the subjective score given by each respondent i to each supermarket j on the kth Customer Relevancy Attribute;
- $\tilde{u}_{i,k}$ is a measure for the importance of the kth Customer Relevancy Attribute for respondent i;
- X_i is the vector of personal characteristics, age, gender, education, size household and occupation of respondent i.

Coefficients:

- $\beta_{j,k}$ is a measure for the effect of an increase in subjective score of Customer Relevancy Attribute k of supermarket j on the probability of using supermarket j; →

[5] The none option is excluded in this research as the assumption is made that every household needs to buy groceries in a supermarket

- δ_j is a measure for the effect of a change in personal characteristics of the respondent on the probability of using supermarket j.

From the questionnaire all variables are known except for the importance of each of the attributes, $\tilde{u}_{i,k}$. However, this can be estimated from the Conjoint Analysis. By use of Bayesian Estimation the importance for all levels of all attributes can be estimated. This can be done on an individual level or with a predetermined amount of clusters. Calculating individual levels first and clustering them afterwards gives approximately the same results as direct clustering, where direct clustering leads to smaller standard errors. With the importance determined the multinominal logit model can be estimated. A note, however, is that an estimated value, attribute importance, is used as input for an estimation. Therefore, the input lacks precision and has a confidence interval for itself. Using uncertain values for the estimation makes the standard deviations of the final estimation unreliable.

Results

The Conjoint Analysis showed that five customer segments can clearly be defined. Each segment contains between 14% and 29% of the market and has a focus on either one or two elements from the Customer Relevancy Model. As can be seen in Table 1, the price segment is the largest segment of all. This explains why supermarkets keep trying to compete on price, however it is clear that over 70% of the customers find other aspects of the store more important than the price of the products. Furthermore, it is remarkable that access does not play a role in the choice of supermarket while every student knows that the closest supermarket is most likely to be chosen. Two reasons can be given for this. Firstly, access is defined as opening times and not how close the store is located to the customer's home. Secondly, it turns out that when price is removed from the analysis, access appears to play an important role. From this we conclude that price overrules access in the decision process. Access makes even a stronger entrance when Jumbo is compared to Albert Heijn. When the scores of the two supermarkets are compared, Albert Heijn shows a lower rating on price while having only a minor advantages in the other four areas. Yet the market share of Albert Heijn

	Service & Product Coef.	Service & Price Coef.	Experience Coef.	Product Coef.	Price Coef.
Access	5.805	10.734	3.729	2.652	9.022
Price	16.556	26.118	13.347	9.182	56.206
Product	23.693	20.400	6.992	52.742	13.685
Service	34.544	33.091	19.244	14.381	12.956
Experience	19.401	9.652	56.689	21.042	8.131
Segment Size	19.8 %	16.3 %	14.0 %	20.9 %	28.9 %

* two most important attributes have been underlined

Table 1: Average Importance of the Customer Relevancy Attributes for each segment using Latent Class

(32%) is larger than Jumbo (19%). The underlying difference is the number of stores. Albert Heijn has over 850 stores and Jumbo around 500. The ratio of stores $\frac{5}{8}$ is almost equal to the market share. So, access is unknowingly an important driver for supermarket choice for many customers.

Next to the importance of the attributes the match between supermarket and customer is made. Each customer has, based on their answers in the Conjoint Analysis part of the survey, a probability of being in each of the customer segments. This way a customer profile can be made for each of the segments. The profile consists of the personal characteristics of the customers within the customer segment. For example, the average customer with a preference for experience has a higher income. As the customers are placed in one of the five segments and the shopping behavior of the customers is known, a match between the customer segments and the supermarket can also be made. This enables us to answer the question: does each supermarket serve a customer segment? The results of the match are compared with the brand promise of each of the supermarkets. From this follows that Aldi and Lidl are competing with each other, as are Jumbo and Albert Heijn. This is not surprising at all, but the results also show that there is almost no competition between high-end stores, Albert Heijn and Jumbo, and low-end stores, Aldi and Lidl.

Conclusion

From the analysis follows that supermarkets have two options: being high-end and perform on access, product, experience and service or become a low-end store and perform on price. Furthermore, the research has shown the potential of data-driven decisions in the retail market. When the research is extended to include more customers and more supermarket attributes, it can be used to simulate the market conditions and predict customers' choice of supermarket.

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Martijn Heinen
Age: 24
Began studies in 2010

The Life of a PhD Student

What is the story behind the two of us becoming PhD students? What will we do afterwards? Probably you have seen our faces during the tutorials of some first-year courses. You might even have bumped into one of us in the city center and wondered: do these people have a life apart from university? All that made us decide to tell you a bit about our life as a PhD student.

This adventure took off in the summer of 2008, at the TOP week (back then known as TIK week). After three years of bachelor EOR, we continued with our master programs (Marieke ORMS and Nick QFAS). During these years, the option to go for a PhD was introduced to us. But, in order to apply for this job, a research master is required. Since we were not yet bored from studying we decided to go for a fifth year at Tilburg University. Finally, in 2013, we started with our PhD.

A PhD program consists of three years of research and teaching. During these years you focus on at least three different subjects, while writing papers about the research you perform, together with your supervisors. In the final stage you write a book, containing the past three years' research, which you defend before a committee of professors from Tilburg and many other (international) places.

This might seem attractive, but what does it really look like? Although it may all sound very boring - three years of doing research all day - in practice this is not the case. Research knows many stages: writing a paper is very different from programming, which is again very different from modeling a problem. Working on different projects with different people at the same time makes doing a research a dynamic and diversified process. This research is not only done in TiSEM's dollhouse, the K-building offices, we also go (abroad) for seminars, present on conferences and go for research visits. Besides that, there is teaching, grading of exams and assignments, and we take part in the supervision of students.

'Three years seems a long period, but time flies'

Despite that this may all sound very nice, not all that glitters is gold. Three years seems a long period, but time flies, and before you know you can smell the committee's breath. Unfortunately, since there is only one year left for us, we cannot reveal to you whether this smell is pleasant or not. Besides that, the post-PhD job market is very competitive. Even though many PhD students already decided not to pursue a career in academia, there are still very few places available compared to the number of PhD students.

Nevertheless, we enjoy the flexibility of our jobs. For most days we are free to choose when and where to work and we have quite some freedom in choosing our holidays. Moreover, the working environment in our department is informal and friendly. There is a nice group of fellow PhD students with whom, from time to time, we go for some social activities. ●

Nick Huberts & Marieke Musegaas

Marieke Musegaas and Nick Huberts are PhD students at the Department of Econometrics and OR. Marieke's field of research is cooperative game theory and especially OR-games. She likes doing sports, playing board games and going on holidays. Nick's field of research applies game theory to a Real Options setting which analyzes strategic investment decisions under uncertainty. He likes to play (board) games, discover the secrets of Europe's beautiful nature, attend festivals and study Hermetic and Thelemic traditions.

Traveling Sales Rock Star

Being a salesman in the 1800s, traveling from city to city to try to sell goods for a living, does not seem like a very rewarding job. It might indeed not have been, but the job itself has lent its name to the Traveling Salesman Problem (TSP). The recipe for an infamous problem baffling scientists for decades is actually quite simple: despite being very easy to formulate, TSP is extremely hard to solve. On the upside, we can use it to plan holidays and understand animal behavior.

Text by: Stefan ten Eikelder

People have been solving TSPs since long before the problem has been formally formulated. Any animal or human being has the tendency to minimize the distance that has to be covered when, for example, collecting food from multiple locations. Back then, covering more distance cost more energy and led to an increased risk of encountering a predator or being later than competitors, but nowadays, TSP's applications are mostly used to increase profits. Mathematicians W.R. Hamilton and Thomas Kirkman were the first ones to mathematically formulate the problem in the 1800s. More than a century would pass until the first attempts to solve it were made. During the 1950s, the RAND Corporation started to award prizes for notable contributions towards solving the problem. For those not familiar with the problem, it can be described in one sentence: 'Given a collection of cities and the cost of travel between each pair of them, the Traveling Salesman Problem asks to find the cheapest way of visiting all of the cities and returning to your starting point.'

Pushing the boundaries

The Traveling Salesman Problem is a so-called NP-hard problem. Without going into the underlying complexity theory, it is important to mention that we do not have a polynomial-time algorithm for solving the general case of the TSP, meaning we cannot easily solve large instances to optimality. And, possibly also interesting, in case you would find such an algorithm, you have actually solved the infamous P versus NP problem: a Millennium Prize Problem rewarding you $1,000,000. Although that has not happened yet, and perhaps never will, scientists have pushed the boundaries further and further, solving an even larger instance to optimality every once in a while. Techniques that are employed for this include the cutting-plane method, the branch-and-bound algorithm and dynamic programming. Figure 1 shows these milestones; the largest solved instance has 85,900 nodes (or cities if you like) and was solved in 2006. Of course, there are many other problems that are equally hard to solve, but the TSP has long ago claimed the position of most well-known problem: it even has a movie named after it.

> The 2012 movie Travelling Salesman considers four mathematicians hired by the US government to solve the P versus NP problem. Perhaps you could refer to this movie to explain what life as an econometrician is like?

A mathematical holiday

Most problems in mathematics do not acquire the fame of the TSP, let alone having a movie named after them. One of the reasons for this is that its

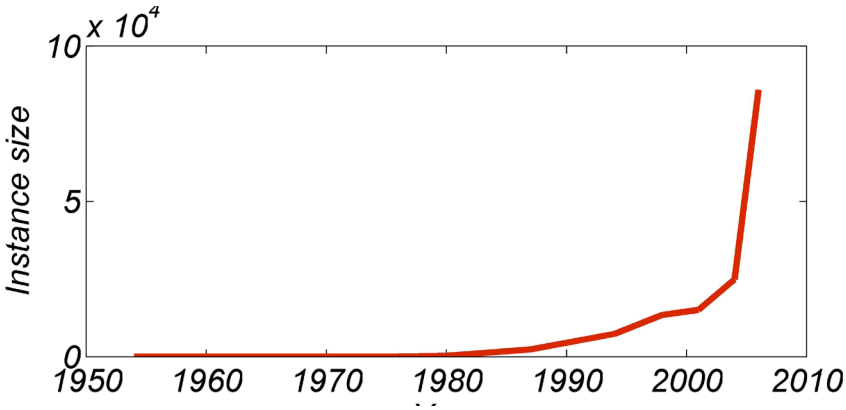

Figure 1: TSP milestones throughout the years

applications are numerous and easy to understand. An important example in industry is drilling holes in computer chips. If the routes for the drilling machines are shorter, time is saved and therefore money is saved. However, when discussing your studies or work on a party, this is not particularly the example you would want to use to impress others. Perhaps people would be more interested if you discuss your road trip through the 45 must-see-places in Europe? Now, that is of course a typical example of a TSP, and the American Dr. Randal Olson thought it would be nice to actually compute what such a route would look like. The first problem he encountered was that in order to minimize the length of the tour, one would need to know the distance of direct travel from every landmark to each other landmark. Smart econometricians like you know that one could simply put that information in a distance matrix, which can be obtained using Google Maps API without too much effort. Given all those distances, the total number of possible (valid) routes adds up to a grand total of approximately 1.3 x 10^{54} possibilities (general formula (n-1)!/2). I guess that your first reaction would be: "I do not want to be the one to check all those routes."

Even though we do not have an exact polynomial-time algorithm for TSP, and trying out all possibilities is indeed not an option, we do have many heuristics that can be applied to obtain (very) good approximations of the optimal solution. Popular methods include tabu search, simulated annealing, genetic algorithms and ant colony optimization. For illustration, using heuristics the current best tour across all 1,904,711 known cities and towns in the world is at most 0.0474% longer than the optimal tour (a lower bound is known). Returning to our road trip, Figure 2 shows the obtained route using a genetic algorithm. The route has a total length of 26,211 kilometers. The code for the algorithm (in Python) is available on Olson's website, as well as an instruction manual for the Google API part, so you can see if you can improve his route or simply plan your own trip.

Figure 2: Road trip through Europe by genetic algorithm

The elastic band approach

Most progress discussed so far involved smart people thinking really hard, using sophisticated algorithms and a lot of computer power. What if we take a step back and let nature give it a try? It is generally accepted that evolution has done some pretty amazing things and it is not without a reason that methods based on behavior observed in nature, such as genetic algorithms and ant colony optimization, are used to provide near optimal solutions to many complex problems. Let us first consider human performance on TSP. If you are given a piece of paper with a small number of dots on it, say four, you will likely figure out quickly how to connect the dots into a closed tour such that the total distance is minimal. For larger problems, such as fifteen nodes, you might not be able to find the optimal solution, but will certainly find something that is acceptable. Studies on Euclidean ('normal' distances satisfying the triangle inequality) TSPs have shown that even for a 120-city problem, humans construct tours that are on average only 11% longer than the optimal tour.

This begs the question: What techniques do humans employ when faced with a TSP instance? First of all, humans tend to look at the convex hull of the set of points under consideration. The convex hull can easily be visualized by taking an elastic band, and stretching it around the outermost nodes such that all nodes are included. Nodes that touch the elastic band are on the boundary of the convex hull, and apparently putting more nodes on this boundary does not lead to a higher complexity for human participants in experiments. It turns out that humans often connect the nodes on the boundary, and then make →

a sequence of the remaining nodes in the interior, subsequently inserting this somewhere in the original tour.

An alternative hypothesis is that humans instinctively try to avoid crossing arcs, reportedly occurring in only approximately 6% of solutions. For a Euclidian TSP, an optimal solution can indeed not contain crossing arcs, so this is not just an aesthetically pleasant strategy. A solution approach that suits this hypothesis is the hierarchical nearest neighbor process. Participants often make small clusters of nodes, and solve these clusters independently, using a nearest neighbor strategy while avoiding crossing arcs. These clusters are then connected to one another using again a nearest neighbor approach on a global level. This again produces a tour that, at first glance, seems reasonable.

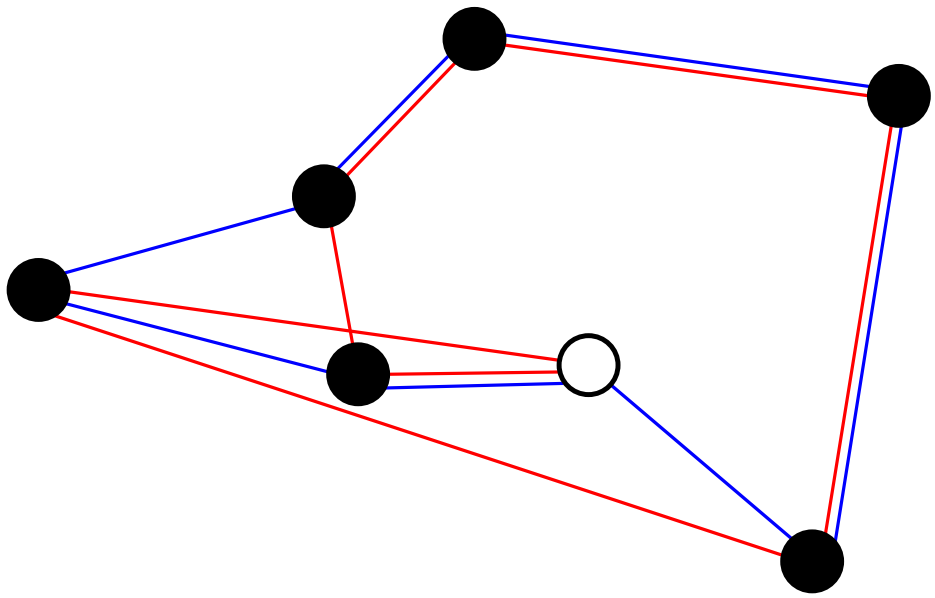

Figure 3: NN route (red) compared to optimal route (blue)

Bumblebee grand prix

Let us omit the neuropsychological details to these approaches and briefly discuss how animals solve TSPs. Yes, animals solve TSPs too: elephants walking from water pond to water pond will not take the recreational route and bees foraging different flowers optimize their routes too. In October 2010, UK newspaper The Guardian wrote an article titled 'Bees' tiny brains beat computers, study finds'. Referring to the TSP, they state that 'bees can solve complex mathematical problems which keep computers busy for days, research has shown'. Although that is a bit misleading, for all we know bees have not actually written a polynomial-time algorithm for solving the general case of TSP, the research did reveal that despite a brain the size of a grass seed, bees perform surprisingly well on small scale TSP instances. When eight bees were confronted with six different artificial flowers, they used an average of 10.75 different routes (out of 720 possibilities). Six bees used the optimal one as their primary (most used) route after approximately 26 foraging bouts, while the other two selected it as their secondary route.

These results already seem rather impressive - remember we are talking about bees, not monkeys - but gets even better. The experiment was designed in such a way that using a nearest neighbor (NN) heuristic would result in long tours. An example of such an instance is shown in Figure 3. Starting from the white node, an NN heuristic would give the red route, but the blue one is clearly better. It can be concluded that bees do not apply an NN heuristic, but some other method. It is clear that bees employ their spatial memory, and keeping track of multiple locations at the same time. At the time of writing, it is unclear exactly which other methods are used. One possible hypothesis states that the bees try to keep a consistent directionality of movements; making a very sharp turn at a node is usually not the best idea. This approach again leads to a circular route and the remaining nodes can be incorporated using trial and error. After all, that is nature's approach to anything. This method is actually very similar to the convex hull approach discussed before, which is remarkable because the human participants in the experiment had a nice overview of the nodes on paper, while the bees certainly did not.

Many more experiments considering the fascinating traveling salesman problem have been executed, involving chimpanzees, amongst others. The experimenter carried the animals past eighteen food locations, in a random order. Upon release, the chimpanzees followed a near optimum path through the eighteen locations.

Whether you would like to plan a road trip or test the problem solving skills of your guinea pig (or indeed your pet bee), the traveling salesman problem offers many nice applications. The rock star of combinatorial optimization can even reward you a nice prize, but we like the challenge, not the money, right?

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Promoting the Promotion Committee!

Denise Ligthart

AGE: 21

Began studies in 2012

Each year, a new committee is formed to give Asset | Econometrics its annual promotional boost. This year, my fellow committee members and I have the honor to take on this noble job. So do not even consider to stop reading – find out all about our multidimensional agenda!

A brand new concept that has already been put into action several times as I am writing this, is the Monthly Afternoon. Each month, we organize a simple yet successful gathering of econometricians, where both active and passive members of our association can come to relax and enjoy themselves after a long day of classes and library visits. Good old-fashioned board games are present and a GameCube is connected to the big screen so that certain fanatics can play Mario Kart. We also try to give each edition a special touch – during the last Monthly Afternoon of 2015, our members had the opportunity to connect with their inner child by decorating a slice of cake. For the January edition, we arranged the game of 30 Seconds which was actually close to causing permanent inter-econometricianal hostility. And yes (I can hear you wondering), there is ice cold beer and a hot meal for those interested. If the enthusiasm remains as great as it is now, the Monthly Afternoon can certainly become a standard event after this year's pilot, so please do not miss out on 2016's upcoming editions!

And of course, what would the promotion committee be without cheap – if not free – and lovely promotional items? I deeply pity the few of you who failed to get their hands on one of our adorable Christmas bears. Your winter months must have been lonely without a cuddly cutie like Dave, Jacques-Johannes or Benedictus (Charlotte and Lotte got increasingly creative naming them). Moreover, when reading this you have definitely already had the chance to come to the rooms and pick up one or two unique and high quality Asset | Econometrics shot glasses. During our meetings, we love to brainstorm about what could increase the living standard of our beloved members. We sometimes unanimously agree on the brilliance of a concept, while at other times we question whether we have sufficiently included the educational aspect into our item ordering policy. All in all, coming up with new promotion items is really fun to do.

Apart from these two main agenda points, there are a lot of small tasks and jobs that we as a committee take care of. Every few months, we make memos and posters to inform you about all upcoming Asset | Econometrics activities and we make sure that the presentation screen in E1.09 is up-to-date. Moreover (I am writing this on Valentine's day), our very own Astrics Cupido is currently checking his inbox on Facebook to see which econometricians want to secretly declare their love for a fellow student. Altogether, being a member of the promotion committee is very enjoyable and for me a nice addition to my regular studying program and other activities. I hope that all Asset | Econometrics members enjoy our promotional items and the activities we organize, and of course I hope for the rest of my year as an active member to remain as fun as it is now!

Belgian Food and Brilliant Insights

On one early dawn, one bright group of econometricians came together to engage in the adventure of going to Ghent. Although some of them were a bit more on time than others, we were eventually ready to go. Armed with Ice Age 1, our bus departed to the city of Ganda!

Maarten van Hooft

AGE: 24

Began studies in 2014

A small two hours and some bumpy roads later, we arrived at the city center. First, we checked in to our hostel to come to the conclusion that we were fortunate enough to have a ballroom as dorm. After we acclimatized to our well-earned luxury, we went out for lunch. I was amongst the lucky ones who were on a mission to eat pancakes! Although pancakes are not the first thing that come to mind when you think about Ghent, our first success was officially achieved! In the afternoon a guided walking tour was scheduled. Here we learned quite a lot of historical facts about Ghent. Did you, for instance, know that the city's symbol is an igneous dragon? And that the narrowest house in Ghent is only 1.40 meters wide? Being boring at parties suddenly belongs to the past! It was also this afternoon that my phobia of heights was agitated again. We – well, some of us – climbed the 95-meter high Belfort Tower. At the top, there was the possibility to walk on the outside of the tower. A couple of dazzling moments later, we were back downstairs again. Fear of heights: 0. Maarten: 1. Take that!

A good start

First night, pizza night! After a small walk we arrived at the pizza & pasta house. Although the service was a bit peculiar, the pizza was great! Together we headed home to prepare ourselves for the long awaited pub crawl. And what a pub crawl it was! I would really like to go into detail, but I guess that if I do so, half of my newly acquired Facebook friends will abruptly unfriend me. Therefore, I would like to recap to the Trollenkelder. This beer house – although it is presumably a normal pub for Belgian standards - had trolls, beers, and poor jokes all over the place. What could a person want more, right? If I recall correctly, we concluded the evening with a dance that reminded me of a German underground Disko.

At morning glory, a soft and amiable sunshine entered the foyer of our ballroom. Assisted by the fresh insights obtained yesterday, all of us hopped to the common room; it was like a fragment of 'The sound of music'. Fair enough, that might be mildly exaggerated. But if I am speaking for myself, I was quite fresh! Subsequent to a definitely not disappointing breakfast, we made our way up to Castle Gravensteen. We were allowed to walk freely over there, and it was quite impressive. The typical Flemish blue hardstone out of which the castle is build, is aesthetically pleasing and undoubtedly pure enjoyment for every self-respected econometrician. Surprisingly, the torture section of the castle was subject to above-average popularity. Gladly, we all still managed to come out unharmed and alive.

Time for action

Some hours and a brilliant insight later, a select group arrived at the Krokettenbar (Croquette bar) for lunch. It probably sounds less amazing than it actually was, as we were treated to, amongst others, truffle, salmon, and goat cheese croquettes! After this experience, we felt the moral duty to give ourselves a well-deserved rest in the bright sun. It was around this time that the group congregated for our next activity: the boat tour! As the weather was still great, and some information that we were provided with was the same as during the walking tour, some of us decided it was the perfect time for a nap. But then, the moment suprême of the whole trip arrived: the pub quiz! Again, I was fortunate enough to be amongst the cleverest participants of the tour. Due to some brilliant views, astonishing remarks, and a thorough knowledge on long-jumping, we obviously managed to walk away with the virtual trophy, Belgian chocolate, ánd Gentse Neuzen.

The second night topped the first night's food, as we had quite a fancy meal in a hotel. The food was great, the beers were obviously just as good, but in particular the service was fantastic. The main waitress made the dinner totally complete, and it was touching to see how joyous she seemed by us having a good night. We then returned to the hostel once again, where everyone could make oneself look tip-top for

the upcoming night out. That could mean only one thing… Perudo! Boy o boy did we have fun playing this game! Consecutively, we once again visited the Trollenkelder to make sure that our beer consumption levels did not drop below average Belgian levels.

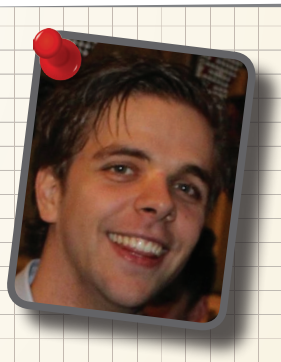
Belgian traditions

Morning has broken, like the first morning. Alright, alright. Once again the morning was a bit less magical. The final day had begun! We enjoyed our last hours of free time by going to an idyllic book market. Over there I continued my lucky streak, and obtained a book with wonderful facts about the world of mathematics! Yay! Afterwards, we finally succeeded in obtaining a waffle, something which obviously should not be forgotten when visiting a Belgian city. It was definitely not disappointing. Noon had arisen, and it was time for our last group activity: paintball. This was the activity where I expected that well established friendships would be permanently destroyed to make place for a furious anger. The battle of red versus green had started! And was over very soon; my streak of luck had finally come to an end and our team was demolished. Totally annihilated. But well, at least we came in second, right?

The final night another prescribed Belgium tradition was followed: Belgian fries were consumed. Oddly enough, it took quite some time to find a place where these could be ordered. But it was worth waiting for. Although one of us got sick of it, I did not enjoy my meal any less! We returned to the hostel and enjoyed ourselves with one final game of Perudo. We all got our luggage, and once again headed our way to the bus. Of course it was a pity that we were headed back home, but Ice Age 2 turned out to be a valid instrument in healing the pain.

When I heard about the trip to Ghent, I was not really sure whether to participate. There were some people that I knew vaguely, but definitely not good at all. A final, "What is the worst that could happen?" made the decision for me. And I am so glad that I joined the trip. Due to everyone's openness I truly had an unforgettable weekend. Thanks buddies!

CAREER PORTAL



Ivo Lagarde
AGE: 24
Began studies in 2012

Take Control of Your Future

February 2, it was that day of the year again: the National Econometricians Day (LED)! After meeting up with fellow econometricians at Tilburg Central Station, we took the train to Rotterdam where we were expected to be at the World Trade Center at around 9.30 hours.

When we arrived, we first picked up our badges. The badges told us which companies we had been assigned to for the three rounds spread over the day. Since we did not know this beforehand, it was an exciting moment. After finishing my first coffee of the day, we were invited to the main hall for the opening lecture. The chairman of the LED welcomed us and Peter van Manen held a lecture about Smart Cities. In short, it was about how to gather and use data in urban environments in order to make things run better, with fewer surprises. I had never thought about this subject in an econometric way before, so this lecture was surprisingly interesting.

After the lecture, it was time to go to the first case round. I was assigned Veneficus, which was in my top three preferences, so I was happy. In the case they had prepared, we had to determine the best location for a new bar. We were split into groups of four and were given a laptop and a large dataset with all kinds of information about existing bars, demographics and potential locations. It turned out to be that our group was the only one of which none of the members knew how to program in R. As a result, this case was a bit more challenging than anticipated. In the end, we managed not to be last, so we counted that as a win.

At around 13.45 hours, the first case ended and it was finally time for lunch. During the lunch, all companies were spread around the dining hall and you could have an informal talk with them. After finishing my sandwiches it was time for the second case round, for which I was assigned to OM Partners: again one of my preferences. After a short introduction about the company, the case started. We had to extend a supply chain of yoghurt in such a way that we included uncertainty about demand. Considering that we were not given any data and just a pen and paper, it was a little confusing what the exact objective of this case was and based on the end presentations, we were not the only confused group.

Next, it was time for the closing lecture by Sophie Conijn, who coaches students and young professionals in positive psychology. She gave us tips on how to be confident and boost your self-esteem. I did not expect much from it, but Sophie managed to make it interactive and overall it was a pretty fun lecture. After this lecture, there was a networking drink where you could talk with employees and recruiters from different companies again about everything you like. However, since it has been a long and tiring day, my mind was already set on the recruitment dinner. For this dinner, I was assigned to PwC, which was not in my top three company choices. However, as econometricians, we know that in an assignment problem based on ordinal preferences, it might be the case that not everybody can be assigned their preferences. Therefore, I knew you win some and you lose some. After the dinner, it was time for the LED party with free drinks! As you can imagine, this party was a perfect ending to a very informative day.

The Mysterious Mandelbrot Set

Text by: Steffi van den Hanenberg

It is rarely the case that something is easier than it looks. However, in my opinion, the Mandelbrot set is the perfect example. For those who have never heard of it: the Mandelbrot set is a fairly simple recursive formula resulting in a complex symmetrically evolving structure that will even intrigue people that are not particularly interested in math.

The basics

Before we get into the specifics, let us start off with a crash course on complex number theory. Complex numbers extend the concept of the one-dimensional real number line R to the two-dimensional complex plane C, using the horizontal axis and the vertical axis for the real part and the imaginary part, respectively. All complex numbers are coordinates on the complex plane and can be written as a+bi, where i is called the imaginary unit and $i^2=-1$.

It was Leonhard Euler (1707-1783) who introduced the imaginary unit i, widely known as the cornerstone of complex number theory and complex analysis, and Carl Friedrich Gauss (1777-1855) was the one to introduce the term 'complex number'.

Complex numbers can be used to solve cubic equations or quadratic equations with negative roots, which are undefined for the set of real numbers. If it had not been for complex number theory, the Mandelbrot set would never have been discovered in the first place, as the complex plane is actually the 'canvas' of the Mandelbrot set.

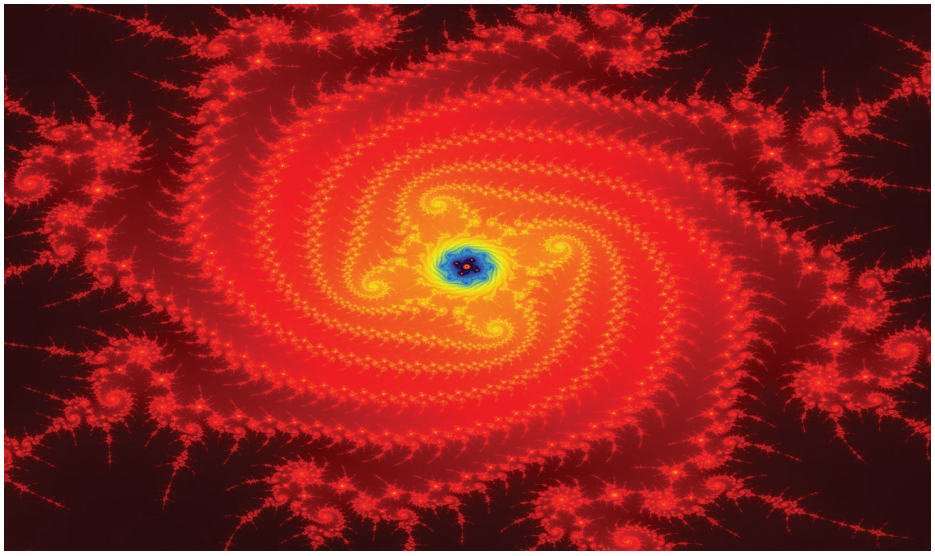


Figure 2: The M-set in its true glory

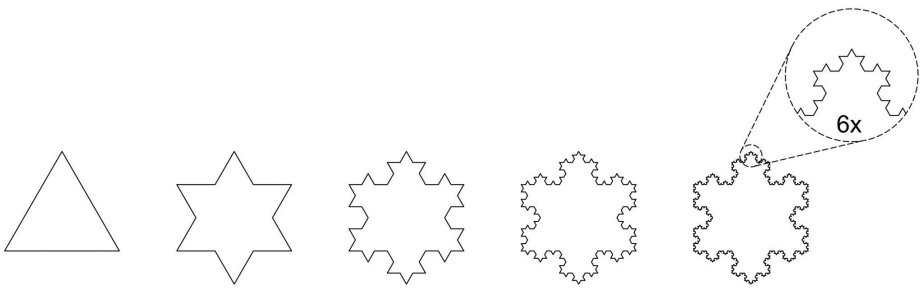


Figure 1: Koch Snowflake fractal

Now the foundation is clear, we can move to the fun part: the actual Mandelbrot-set (M-set) itself. The M-set is a fractal: a geometric structure defined by its expanding symmetry. Fractals make use of recursion, which results in a detailed pattern that repeats itself. It was Benoît Mandelbrot (1924-2010), who extended the notion of theoretical fractional dimensions to geometric patterns in nature. Yes, mathematics in nature, you read that correctly. We will discuss that some more, later in this article.

Fractals

A basic and famous fractal is for example the Koch Snowflake, which is shown in Figure 1. As any fractal, it starts with a basis which will, after

recursively applying a transformation, reveal a self-similar pattern at any scale. However, the Mandelbrot set, although created by relatively easy mathematics, results in a much more complex symmetrically evolving structure.

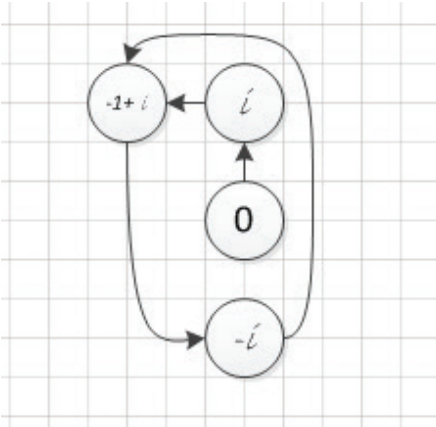


Figure 3: An example of a bounded sequence: an element of the M-set

What about this relatively easy mathematics? It all comes down to the recursive formula z_n (c), defined as $z_n=z_{(n-1)}^2+c$, where n is a natural number, c is a constant complex number and $z_0=0$. As you can see, the equation is using its output as the input of the next iteration. From this, a sequence of complex numbers arises which starts at the origin, by definition. From our analysis course we all know a thing or two about sequences and the M-set is defined as the set of complex numbers of which the sequences obtained by the formula is bounded. In other words, complex numbers c of which the sequence $z_n(c)$ turns out to diverge to infinity as $n \to \infty$ are not included in the Mandelbrot set.

However, constants c of which the corresponding sequence $z_n(c)$ converges to a finite (complex) number, or constants c such that z_n (c) will keep repeating (part of) itself are contained in the M-set. For example, the so called Misiurewicz-points, named after the Polish-American mathematician Michal Misiurewicz, are dense in the boundary of the M-set, which means that for any boundary point of the M-set the epsilon neighborhood of that point contains at least one Misiurewicz-point.

Without getting into the specifics, we will provide two Misiurewicz-points; their periodic behavior is shown in Figure 3 and Figure 4 The two points are are c_1=0+1i and c_2=-2+0i. The first results in the pre-periodic sequence z_n (c_1)= (0,i,(-1+i),-i,(-1+i),…) and the sequence of the latter is z_n (c_1)= (0,-2,2,2,…).

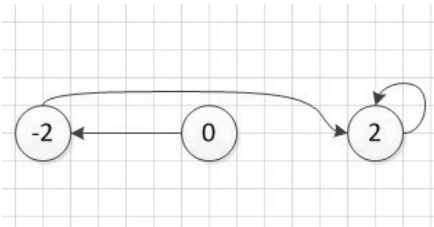


Figure 4: The recursive Mandelbrot formula results in a real valued sequence for c being a real starting point

It turns out that the collection of complex constant numbers c that meet the requirements for the Mandelbrot set remain within the circle with radius 2 and its center on the origin of the complex plane, as shown in Figure 5. Therefore, the complete Mandelbrot set is included in this circle.

'Beautiful, damn hard, increasingly useful. That is fractals' - Benoît Mandelbrot

Hence, being a fractal, the M-set is infinitely self-similar and it contains detailed mathematical constructs. Zooming in on the Mandelbrot set will reveal new generations: cute, little babies, no matter at what scale it is looked at. This explains why the M-set was not discovered until the 19th century, even though the necessary complex number theory had already been discovered two centuries before that: modern computers were needed to perform the iterated cal-culations on the complex plane.

The M-set mostly owes its fascinating appearance to the varying use of color ranges. The coordinates in the complex plane that belong to the Mandelbrot

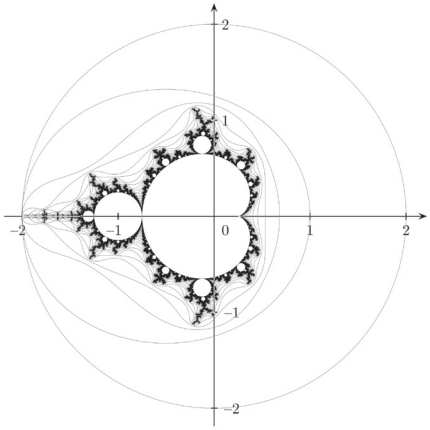


Figure 5: The M-set is bounded by a circle with radius 2 around the origin

set are often colored black. I am sorry to say that it is actually the coloring of the coordinates that do not belong to the M-set that results in the most marvelous pictures. This is because these are often assigned color ranges that depend on the number of iterations after which the sequence is known to be unbounded. For some sequences this only becomes clear after more than 1500 iterations. Because of the differences in the number of iterations needed before this becomes clear, beautiful, lively colored swirls and frills are revealed: the Mandelbrot set in its true glory.

When you open up your imagination, the M-set is not only a mathematical structure, it becomes art. Its shape will remind you of numerous things. Seahorses (Figure 6), a Buddha (Figure 8), lightning bolts, leaves, trees and many more. →

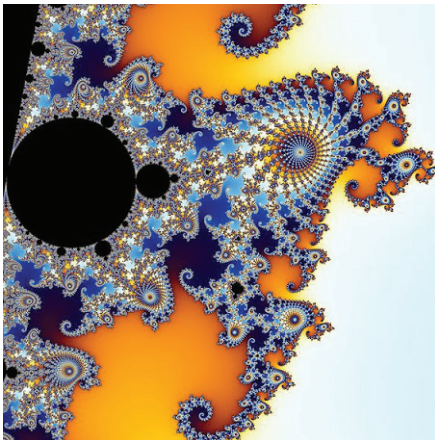


Figure 6: Seahorse

Figure 7: Fractals are unescapable in real life

Fractals in nature

As I mentioned before, it was professor Mandelbrot that linked theoretical fractional dimensions to geometric patterns in nature. From now on I promise you, you will not be able to not see the fractal symmetry in nature. Just to get the creativity flowing, I will provide you with some examples. For the vegetable lovers: buy a Romanesco broccoli, but do not get so fascinated that you forget to eat the thing. After my example

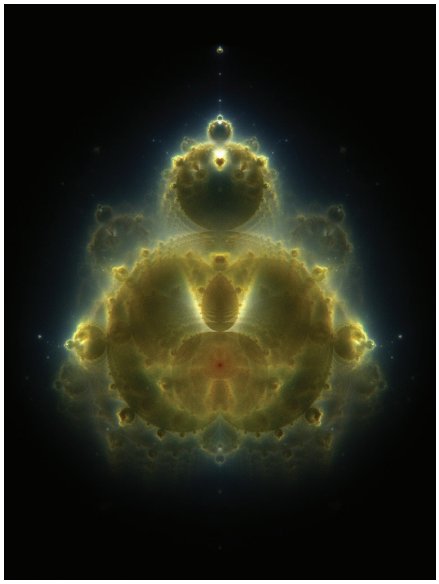


Figure 8: Buddha

of the Koch Snowflake, ice crystals and snowflakes will probably already have crossed your mind. But also air bubbles, water drops and fossils are examples of fractal symmetry in nature (Figure 7). The beauty of mathematics in nature, you just cannot escape it!

Admittedly, as an Econometrics student, you might already have known this. What you probably do not know is that fractals are used to predict patterns in nature, which helps us to sharpen low resolution images, as can be seen in Figure 9 The thing is, fractal algorithms can sharpen your pictures without making them look over processed, because it actually is adding sharpness and not just pumping up the contrast or anything like that. In addition, it is insensitive to digital artifacts in your photos, because it really looks for patterns.

I think I covered the most interesting aspects of the Mandelbrot set. For the interested reader, I highly encourage you to visit www.Nekst-Onlne.nl for some 'Mandelbrot Set Zoom' videos.

But watch out, an epilepsy/seizure warning might be in order.

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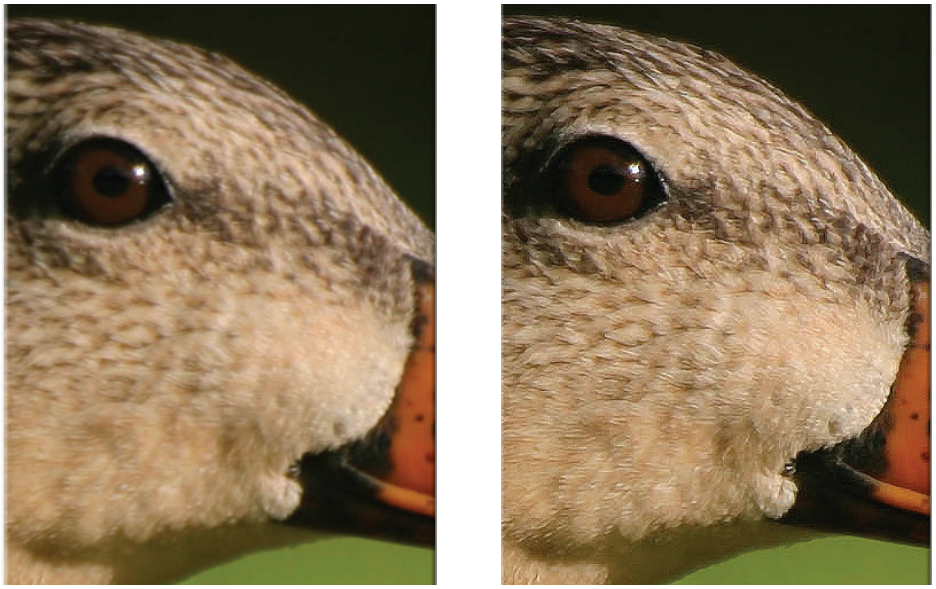


Figure 9: Note the fine detail a fractal sharpening technique can accomplish

Tim van der Heijden
AGE: 21
Began studies in 2012

Let Your Voice Be Heard!

I was invited by the board of Asset | Econometrics to attend the Department Members Meeting (DMM) and the New Year's drink on Tuesday January 19. They lured me into coming to the DMM by offering cherry flaps and convinced me to go to the New Year's drink by including free champagne and magnificent performances of our talented Asset | Econometrics members in the art of karaoke. Offers I just could not refuse.

Around 19.15 hours my fellow student Thomas and I arrived at 'De Heuvel Gallery' to attend the DMM, just in time for the start of the second meeting, which took place because there were not enough members present for the first meeting of the evening. We were not the first, and luckily not the last ones to arrive. About nine members were present who take interest in the boards' thoughts about the past half year and their proposals for the second semester. During the first part of the meeting all committees and their main pursuits of the past four months were discussed. Also, we were given a general update on the goals set at the beginning of the academic year 2015-2016 and the Advisory Council's report. After the break the meeting continued with a financial update and the report of the Finance Monitoring Committee.

Honestly, I think all this talking was the boring part of the DMM. Did I already mention the real reason why I was present? It might had something to do with the famously delicious cherry flaps. During the break everyone was treated with a flap, including whipped cream if you liked, together with a cup of tea or coffee. After the DMM ended, we enjoyed some well-deserved beverages with the board, waiting for the New Year's party to start.

At Café Qwibus we waited for more people to join in, who were (unfortunately) not able to attend the DMM. To celebrate the start of the New Year of Astrics free champagne was served. Slowly but steady the room got more crowded and the beer was flowing freely. Later that night the Drinks & Activities committee kicked off the karaoke with a marvellous and entertaining performance. Apparently the biggest part of the crowd was not yet drunk enough because at first no one volunteered, looking all shy, seeing in which way the wind blew. Luckily there are always some members who do not back off for singing in public and took the microphone like it was their second nature.

As the evening progressed more and more people lost their shame to show their talent and stole the show. After a while even the self-proclaimed 'worst singer of the evening' was present on stage: me. I joined forces with Bart and Coenraad so my bad singing was camouflaged by their bad singing skills. For the sake of the public I genuinely hope that double negative meant positive in this case as well. Everybody was still present after our showcase, which I take as a compliment, and other courageous people took over the stage. At 24.00 hours sharp, we interrupted the karaoke by celebrating the birthday of the most beautiful board member ever known: Ennia. Everyone sung a happy birthday to her and with all of the small presents in the form of karaoke songs she

must have had the best birthday ever. As the hours passed the free beer had done its work as also the public joined in the singing and people were fighting over the microphones. Another karaoke song made an end to the evening although most students carried on their singing in the city centre of Tilburg.

I had a great evening and was not disappointed about the promises the board made me. The cherry flaps were delicious, the free champagne was present and I want to thank everyone who gave one of the thrilling performances this evening, I enjoyed them very much.

ASSET


Trip

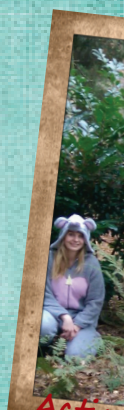

International Business Tour


Nekst


Finance Expedition


Operations Research Conferenc


Drinks and Activities


Activ

Promotion


Symposium

Econometrics

Committees 2015-2016


Orientation and Connection Day

Introduction Activity


Quantitative Investment Group


Book of Faces

(Active) Members Day


Members Weekend


Freshmen

Education

Cutting-edge Research

As you will likely know, the work of a professor goes far beyond the walls of the lecture hall. While relatively unknown to most of her students, Tilburg University is home to a very passionate department of researchers, each active on the forefronts of their particular field. In this article, we will highlight three of them. First, Tobias Klein will tell us about trying to answer economic questions with data by bringing methods together with questions. Next, Jaap Abbring will tell us about the dynamics of oligopolistic markets and last but definitely not least, Hein Fleuren will inform us about the way he applies operations research and the complications of actually implementing methods and ideas.

Text by: Pepijn Wissing

Tobias Klein
Associate Professor

After studying in Mannheim, Berkeley and London, Tobias Klein was very happy to land a professorship in Tilburg. "Tilburg University is a very special place," he says, "Our university is doing extremely well and many people in the region do not realize this; it is a very attractive place to work for. What makes it so special is that it is a research university; most people here do both research and teaching, not just one of them. The idea is that the teaching becomes better if it is done by the people who actually also do research themselves. And at the same time, the research becomes better as a result of your teaching. We are all scholars, you know."

When asked about what he is currently working on, Tobias notes that all of his current projects involve data in some way. Like progress in society, Tobias believes that progress in research comes from many small steps and many small questions, rather than one big step. Tobias does like theory, but feels that theory without any link to actual data is empty. In his view, theory should be tailored to the question you want to answer. The way it usually works for him is that he or one of the various people he collaborates with comes across some interesting question with an interesting dataset and, perhaps most importantly, something new to measure. For example, he is currently collaborating with Blue Mango - a firm in Eindhoven that Tobias acutely nicknames 'Google of the Netherlands' – on a project for the Staatsloterij.

> **'You cannot understand a teacher without also understanding his research'**

The fact that they have access to a dataset that contains information on Staatsloterij's radio and television advertisements, as well as online sales data, is what makes this project so special. Now, as you might imagine, these data can be used to measure the short term effects of the advertisements. But the power of data does not stop at that point: they are also used to build a model to think about the long term effects of the advertisements. In particular, the effect of the timing of advertisements is interesting to consider: should Staatsloterij advertise close to the deadline, which is when people tend to buy their lottery tickets, or should they spread advertisements instead, in order to reach more people?

It turns out that the former option is in fact more advantageous than the latter.

The paper that Tobias is most proud of has recently been accepted for publication by one of the top five journals in the field. It also involves a great dataset and an interesting question. In this paper, reputation systems are investigated, which have become more and more common on the internet—think of Ions, Tripadvisor, Airbnb and Uber, where people rate one another. The question Tobias has tried to answer in the paper is what these ratings actually do. It turns out that more transparency leads to better behavior of the sellers, which is what a reputation system is all about. Normally, the effects of such a reputation system would be very hard to measure, but due to a clever – Tobias calls it lucky – trick, they were able to measure this nonetheless, by applying various econometric techniques. "I am very proud of this paper because it has a positive message and because we captured something that is normally hard to measure. And on the way, we did econometrics", he says.

At some point in his career, Tobias would like to do some work into actually measuring health. In particular, the effects of investment in one's health and the long run effects of behavior that one has early in his/her life. Due to the heavily endogenous nature of treatments, he is not certain whether this question can be answered, but at the same time, he is intrigued by it.

By now, you might be wondering whether this data-enthusiast is involved in the brand-new data science programs. Indeed, he tells us, he will be teaching a course in the bachelor: Data Science Research Methods. This course is intended to teach students to answer questions by applying the wide range of methods to find patterns in data that they will have learned by then. Given Tobias' own research interests, it seems that this course would fit him perfectly.

We would like to thank Tobias for his time and wish him the best of luck in using data to his advantage to answer interesting questions.

Jaap Abbring
Full Professor

"So then he said 'sure, you should come visit' ", Jaap laughs, talking about none other than Nobel Prize winner James Heckman, who had invited him to Chicago as a visiting assistant professor. After he had returned from Chicago – a great school for economists, he notes – he spent most of his time in Amsterdam and Rotterdam, among others serving as director of education of the Tinbergen Institute for several years. When this came to an end, Jaap realized that his research field had shifted from labor economics – something in which they specialize in Amsterdam - toward industrial organization and insurance markets. This caused him to move his work to Tilburg, which has proven to be an excellent choice.

'Sometimes simpler models are just more useful'

Currently, Jaap is working on a diverse selection of projects, most of which involve dynamic choice models and dynamic games in some way. For example, in one of his current working papers, he considers a dynamic model of an oligopoly in which firms may enter or exit. These kinds of models may be used in practice to evaluate the existing competition policy, or to determine how competitive the market currently is. However, making predictions based on these models has proven to be rather difficult, since they commonly do not have a unique equilibrium and the existing equilibria are hard to find.

In Jaap's line of research, he is trying to reduce this difficulty by relieving the models that exist in the literature – which generally incorporate many complexities a market might have – of some of their unnecessary complications. This could allow for the resulting models to be calculated much more quickly, while not significantly compromising the integrity of the solution. Then, because such a model can be solved quickly, it could easily be evaluated many times, to be able to find parameter values for which the model's predictions match available data. As a direct consequence, these slightly simpler models might be much more useful in practice than the existing, very complex ones. According to Jaap's research, this approach has appeared to be working well.

An example of such oligopolies would be local cinema markets in the United States. "This sounds very specific, but has been widely studied," Jaap says, "even in the 1950's, when television started coming around and people expected cinemas to disappear as a consequence of the competition the new medium would offer." Because there are relatively few players on each local cinema market – pretty much everyone sticks to the town he lives in to visit a cinema – it can be modeled as an oligopoly. Through deriving the theoretical properties of this model, coming up with the algorithms to numerically find the equilibria and applying econometric methods to find estimators for crucial parameters, Jaap and his collaborators are able to estimate the effect of a new player – say, Netflix – entering in this market. "So, analogously to that," he tells us, "one could model any market in which one has some form of local competition of retail businesses that serve local customers and analyze them with these methods. There is some methodology there, but also some applications. It is just fun to do some applied work."

This is also the reason that he is most proud of this particular work. They have done some very serious →

theoretical work while keeping it simple enough to be actually put to practice. But that is not all: they have also formulated their own practical methods. This breadth is what he likes. "It is just the most satisfying to me when you can see how theory becomes useful," he concludes.

We would like to thank Jaap for his time and wish him the best of luck in his continued research.

Hein Fleuren
Full Professor

As opposed to Tobias and Jaap, who are working in the field of econometrics, Hein specializes in operations research (OR). His research is commonly practically oriented: more often than not, his research is directly tied to some problem an organization may have. It is on the edge of research and practice where Hein enjoys himself best. "Usually, when research is being done into a certain problem, especially when it is fundamental research, some aspects of the problem that are particularly complex are left out, which is fine: in fundamental research one really tries to get to the essence of the problem. However, when I look at some situation in practice, I often find that these fundamental results cannot be used. So then, what my research is all about is trying to find ways to be able to apply those fundamental results anyway."

Typically, Hein works with large organizations such as TNT Express or the United Nations World Food Programme. These organizations offer problems that are so complex that through Hein's research, enormous differences can be made. One of the things that Hein has learned from his projects at large corporations is that unlike some students like to believe, some of the major factors that have to be taken into account are people's unwillingness to change and simply their lack of understanding of the benefits of optimization. Hein tells us that at the "wonderful playground of optimization problems" that is TNT, they tried to solve those issues by setting up the GO (Global Optimization) Academy: a two-year series of courses for the TNT employees, designed to teach them the basics of optimization in a non-mathematical way. "What we did not expect, and was really great to see, was that through only a little explanation, people started recognizing optimization problems by themselves. All of a sudden, we were no longer the ones trying to convince them but instead, the employees themselves came to us to ask for help."

Next to such projects, Hein also supervises master's theses and PhD candidates. He often does this in cooperation with a large organization, where they will set up a series of multiple theses for several students. Currently, this organization is the World Food Programme. One of the theses that has been written there, the thesis by Koen Peters, is one that Hein is especially proud of. The WFP provides food to people in areas struck by disaster. The required food comes from all over the world and has to be transported to areas that are hard to reach. And, to complicate matters even further, just serving the people in need with only Brussels sprouts for several months is not going to take care of their nutritious needs too well.

The way this used to be approached by the WFP is to have two separate divisions: one that optimizes the baskets of food to be as nutritious as possible, and one division that optimized the transportation of those baskets. Now, in Koen's thesis, both divisions are actually joined and the transportation of certain nutrients is optimized, rather than complete baskets. This change by itself has allowed for a million more people in Syria to be fed on the same budget as before, which is of course a great achievement.

When asked about a field of research Hein would like to get into at some point in the future, he tells us about two fields. Firstly, the issue of acceptation of operations research solutions and the psychology involved in this is very interesting to him. For example, we might calculate the optimal solution to some depot-allocation problem and think we are done. In practice, however, this is where the big job actually starts. Depots might have to be built or improved, people might lose their jobs due to 'our' cost reduction; these are issues that have to be dealt with. In short, it boils down to the question "why are the beautiful things that we compute implemented so little?"

'Only after we have calculated the optimal solution, the big job actually starts'

Secondly, Hein is very interested in the humanitarian applications of OR and the complications those bring to the table, which we do not commonly see in 'western optimization'. For example, the simple lack of a distance matrix we all know and love is only the tip of the iceberg.

We would like to thank Hein for his time and hope he is able to find out how we can get people to implement the beautiful things we have computed.

Bas Verkaik
AGE: 20
Began studies in 2015

Knowledge Against Intuition

On Thursday February 18, this year's Freshman Information Day took place. This day full of activities was organized with the intention to acquire knowledge about all opportunities besides the regular study program. This was done by means of a combination of pure information and a game of Settlers of Tilburg.

The day started off with a general information hour about all opportunities in the second and third year of the study, such as taking part in one of the many honors programs that are available. This was new information for most people and you could see many were interested. After this information hour the group split up, because at the same time there were the lunch of the Freshman Information Day and an instruction hour of Analysis 2. After this lunch, the case Settlers of Tilburg started. In this case, teams of three had to battle each other; starting with an equivalent value of supplies and money the goal was to create the highest total value at the end of the session. This value could be increased by either directly selling supplies for money or by handing in certain combinations of supplies. The game consisted of a few trading rounds, an auction part and a few information moments. When the game started one could directly see a difference between the strategies of the groups. Out of seven groups in total, three groups started slowly, trying to calculate supply values or determine a certain strategy, while the other four started very intuitive and instantly started to trade with one another.

When we had traded for about fifteen minutes of trading, the first bit of information was acquired. We were told that the best strategies were to somehow use optimization to determine the values of supplies. When this information was provided, all teams suddenly started playing very defensively: they made calculations and waited for a bit. After this trading round, the auction took place. There were five resource bundles to be auctioned with different sale mechanisms. After the first two were sold, something unexpected happened.

> **'One could directly see a difference between the strategies of the groups'**

During the third sale, team 3 made the mistake of bidding more money than they had and were excluded from taking part in all remaining parts of the game. Many students found this penalty a bit rough, but it was applied anyway.

The consequence was that after the five normal sales, the cards of team 3 were sold in several bundles. Finally, when this auction was over, the teams started to trade amongst each other, to work towards the supply combinations that would reward money, and after some trading the teams started to collect their prizes. In total there were three kilograms of sweets to be distributed, which would only happen if the teams managed to create the optimal total value. However, the teams did not reach this so a lot of sweets were not claimed. After the payment we were given the final part of information. We were told that the ideal situation was reached if the teams would share all supplies and money with one another, did not pay anything at the auction and shared all the sweets afterwards.

When the Settlers of Tilburg case was finished, the day was not yet over, as two more speakers concluded the day. The first speakers talked about his role as an advisor between the students and the program management, and the second speaker told about her experience with an honors program. The day ended with a drink, where there was the opportunity to talk to the speakers about how and when to start with the extracurricular activities. A couple of students seemed really interested in this. Overall, the day informed and motivated people for the forthcoming opportunities, so I think that it was a great success.

THE TEACHER

Finding the Art in Mathematics

Text by: Aurel Macias Minambres

On a day with a small shining sun, so clearly a day with South-American weather, Mike and I went to interview Colombian professor Juan Vera. I thought this was a nice opportunity to talk about his view on mathematics and the difference between Colombia and the Netherlands. By the end of the interview, he had convinced me that mathematics is an art.

Traveling the world

Juan was born in Colombia, in the city of Cali: a city that, in population, is exceeding even Amsterdam. In Colombia, it is customary that one attends primary school from the age of seven, and ends secondary school at around eighteen. Already at these ages Juan knew that he wanted to do 'something with mathematics', although he did not knew right away that it allowed for nice career opportunities. His interest in mathematics never fell into a slumber and when he became older, Juan knew that he wanted to study mathematics. Even though moving to a different city was very unusual at that time, Juan went to study in the Colombian capital of Bogota; the university in Bogota was considered better than the university in Cali. Juan had some problems adapting to his new life in Bogota, especially because it was so far away from his friends and family. Still, he made good friends quickly and had a great time in Bogota. During a couple of years of his bachelor, he also had a part-time job teaching mathematics at a secondary school.

After his stint in Bogota, Juan married his then-girlfriend and they went to the United States. One might not know, but in Colombia there were almost no PhD programs when Juan did his studies, so everyone who wanted to do a PhD had to go abroad. Europe was something Juan never considered: it was that far away. Spain had the same language, but it was really no option for him. The United States was a very good place for your PhD studies at that time, and it was pretty popular for Colombians anyway. Juan studied pure mathematics at Carnegie Mellon University and was active in the international student association there. Although Juan was studying pure mathematics, it was in this period that he became interested in more applied mathematics. Juan saw many different math applications in the States and even saw a presentation by Larry Page, the CEO of Google, at the time when search engines were still developing. He was inspired when he saw the mathematics behind the program that turned out to became a huge success.

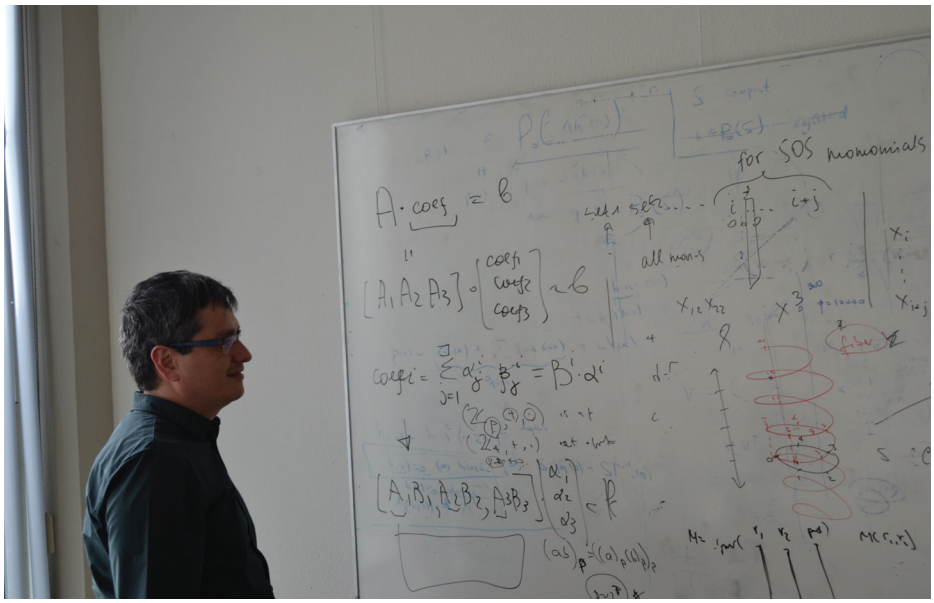
> **'The nice thing of pure math is that it cannot be applied'**

Juan considers himself very lucky, he knew he wanted to be a mathematician already from his childhood and he enjoys being one nowadays. His view about mathematics has changed, but that is normal in Juan's point of view; as a kid he thought to be successful in math you need to be the very best, now he thinks mathematics is an art, and you do not need to be the greatest to practice it; you still need to be practicing it on a solid level though, which Juan likes.

After his PhD, Juan did a post doc in Georgia Tech and Waterloo. Juan and his wife decided that they did not like the USA too much. He had good friends here and there, even back from Colombia, but in the end they did not like the culture. In the USA people mostly think about bigger and better, and spend their money on everything that is large, such as a car or house. It is a culture of spending and, in Juan's view, wasting money on unnecessary things. When one thinks of the Colombian situation on the other hand, hardly anything goes to waste and people think before they act concerning money. Also, Juan felt some hostility in the politics in America. Initially, they went to Canada; Juan applied for a job here, there and everywhere and eventually found himself in the Netherlands.

Adapting to Tilburg

Juan did not know much about the Netherlands when he arrived. He knew that the weather and food were a big minus, but that was mostly it, concerning his prior knowledge. When he came here, one of the first things Juan noticed was the rationality and honesty of the Dutch people. He also noticed many major differences to Colombia, with the



distinctiveness of different places in the country being an interesting one for him. Every neighborhood really has its own identity, whereas in Colombia large amounts of land have the same identity; the same holds for the United States. On more minor notes, cycling is something really popular in the Netherlands and seeing the bike parkings at the train station was really something remarkable for Juan. Furthermore, dancing is something very important in Colombian culture, but in the Netherlands, it is just not quite as important. Everyone dances in Colombia and Juan likes it very much.

In Tilburg, Juan is lecturing three different courses (according to him: "one, a half and another half, so that is a little over two") and helping a couple of PhD students. Other than that, he is working on his own research, spending every working day from nine to five at the university. At least, he is trying to, since he and his wife have a two-year-old baby. What he likes most about his job is the contact with people: interacting with students and colleagues and the people he works with on his research. He also likes that he gets the chance to put his heart into something; if he does not like what he is doing that much, Juan can easily give his tasks away, so he thinks that working at a university gives you more freedom in research. He also likes that working at a university gives one the possibility to enhance knowledge of future generations.

Hobbies and dreams

Even though Juan was dedicated to mathematics from square one, he still would have liked to be a dancer or a football player. Juan thinks there are some serious competition issues in these professions though: the rivalry is immense in these kinds of professions. Still, football and dancing are preferred hobbies of Juan, although he does not have much time to practice either nowadays. Since he is in Tilburg, Juan has also adopted interest in economics, and not necessarily the mathematical parts of it. Policymaking is something Juan finds kind of interesting, although he hates politics. He just thinks politics is full of big talking along with very dirty games. And considering the history of Colombia, Juan knows these dirty games can and will become seriously dirty.

In his spare time, Juan does not like watching TV; to the extent that he and his wife have abandoned TV a decade ago, just because they think it is useless. They still watch some series and movies, but either watch them online or watch them on the large projection screen at home. Also, they still sometimes go to the cinema. Something he likes more is reading, mostly all different kinds of fiction. There is no type of fiction he really does not like. Because of the reading habits Juan has at his work, that is, he needs to read books about mathematics often, he does not like to read too serious books at home. Still, he reads some non-fiction, like Gladwell, from time to time.

He also tries to read Nekst when it comes out, pointing at some magazines lying on one of his shelves when saying this. Ironically, 'The Teacher' is his favorite part of the magazine, because he can learn something about his colleagues from these interviews. This time around, that will probably not happen, but there are still the quotes from professors which he likes very much.

Juan also likes cooking, especially quick dishes. Sometimes, though, when he can afford it, he wants to take his time cooking and try complex recipes. One of his favorite dishes is pasta with Rockefeller cheese, and he also really likes the Mexican chocolate-based Mole sauce.

To all of us, Juan has some last piece of advice: do not think that focusing on applications only is good enough. There can really be something like 'too applied' in his view. A strong theoretic background is extremely important and makes you more creative in adapting to different situations. And with that last statement, the interview with Juan was concluded and we all went our merry way, thinking about all the art.

Bert & Ernie Questions

Bert or Ernie?
Ernie

Listening or Speaking?
Listening

Theory or Practice?
Theory

Cinema or Theatre?
Theatre

Word Finder or Sudoku?
Soduku

Beer or wine?
Beer

Stress or boredom?
Boredom (but preferably not)

Charlotte van Beijsterveld
AGE: 20
Began studies in 2013

Bentley: the Best Choice Ever

Almost one year ago I received great news: United States' Bentley University accepted me to come and study there for a semester. After seeing many American movies about college life, it was time to get my own experience on an American campus. My exchange in short (with an American touch): amazing, awesome and I really LOVED it!

In the fourth year of secondary school I got the opportunity to go on an exchange trip to Italy for one week. It was very interesting to experience daily life in an Italian high school. Furthermore, I enjoyed the beautiful landscape, the cities and the people. Back home I decided this exchange experience was only the beginning and that I wanted to go on an exchange again, and, if possible, for a much longer period.

Two years later I graduated and started my studies in EOR at Tilburg University. During my studies I had many more reasons for going on exchange: I wanted to go for the experience, for improving my English, because of my ambition to work in an international environment, for the ongoing globalization of economic business and also for having a 'break' after my first two bachelor years in Tilburg. After completing the fall semester of my second year I got permission to go to Bentley University: a dream come true.

First, some facts about the university I stayed at. Bentley University is a business school and located in Waltham, a thirty minutes' drive from Boston. The university provides a free shuttle bus from Bentley to Boston almost every hour, so it is easy to visit the city. Bentley University has approximately 5,700 students, half the number of students that Tilburg University has. The student to faculty ratio is 14:1 and 78% of the students live on campus and so did I.

Before departure

From the moment that I was selected until I departed I was busy uploading documents and sending emails to Bentley University. According to American preferences I tried to get a stamp on almost every document. I also needed a visum, which took a lot of time. Firstly, I had to fill out several online documents and afterwards I had an appointment at the US Embassy in Amsterdam. I was advised to prepare myself well, because it is custom to get asked many questions about what you are going to do in the USA and why. I took many documents with me, so that I could prove that I would not be staying in the USA for a period longer than four months. The appointment got me a little bit confused. The man at the embassy asked me what my major was and then he saw that my hand was bandaged and was very curious about what had happened to me. I told him that I had burned my hand by making caramel. We talked a lot about this topic and after the conversation he told me that my visum was approved. Before I knew what exactly had happened I was already standing outside the building with the announcement that I was ready to go!

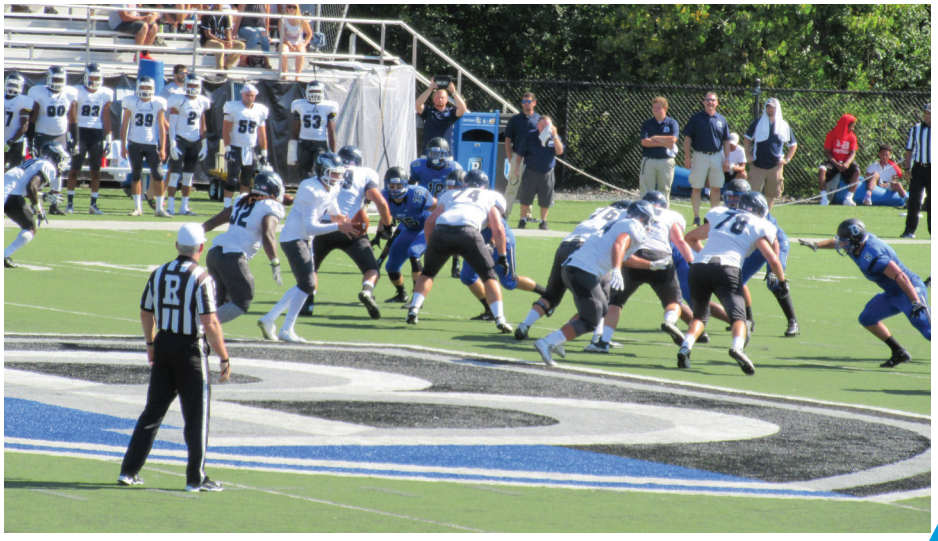
Arrival

After I arrived at the Logan Airport in Boston my patience was tested to the limit by all kinds of security checks. Finally, I could take a taxi to the hotel and I could change my clothes because it was really hot. I left home with 10 Celsius degrees and I arrived in Boston with 86 Fahrenheit. A rule of thumb I used during my time in Boston: degrees Fahrenheit minus thirty divided by two. The next day I took a taxi to the nearest train station so I could visit Bentley University for the first time. I was relieved when I arrived at the station because my taxi driver was very annoyed by the other drivers, so I did not quite feel safe in his cab. Luckily I arrived at the university without any further troubles.

The campus at Bentley University is very beautiful. It is clean, extensive and it has large buildings with red bricks. It really looks like an American campus as you see in the movies. I shared a two-person apartment with an American girl from Maine. I really had to adapt, because besides sharing the kitchen, living room and bathroom I also had to share my bedroom. On the left-hand side of the bedroom there was my bed and desk, and then there was an invisible line and on the right-hand side my roommate had her bed and much other stuff. I really had to get used to her in the beginning because we had very different habits. This one time, in the middle of the night, I heard a very strange noise. I thought that the rain lashed against the window, but when I looked through the window it was full moon and a clear sky. Then I noticed that the sound came from the other side of the room. So, I asked my roommate what she was doing and I was very surprised when she answered: "Oh nothing special, I am just eating popcorn." Hmm yes, totally normal, eating popcorn in the middle of the night if you are going to sleep. I was surprised about so many things I saw and experienced. For example, eating macaroni cheese in the morning, in the afternoon and in the evening! Apparently it is not boring because there are different kinds of flavors (blue, Parma etc.). Also, I got the question why I would make so much effort to cook spaghetti with sauce and fresh vegetables if everything (including the spaghetti and meat balls) can be bought in a tin. In the beginning I found many things strange and crazy, but I changed my view of these things to just different.

Sport

I really love the American people. They are very kind and polite and I already felt at home from the →



beginning. Many room parties were held on campus and everyone was invited. It does not matter where you come from or whether or not you know someone who lives there, just come, join the party and dance. Typically American, you take your own snacks and drinks with you, so it does not matter how many people are coming. Furthermore, the fraternity at the university is very strong. Students are called the falcons and there is a school mascot Flex the Flacon. For each school sport game, for example American football, ice hockey or basketball, there are many students supporting their colleagues. I had never seen so many sports games in a semester, but I really started to like it. I even went to a Red Sox baseball game in Boston. I recall it being a really relaxed Sunday afternoon, sitting in the sun, eating, drinking and watching the game. The fans of both teams were sitting next to each other without any trouble and everyone was enjoying the game. Additionally, a large dance battle took place and was broadcast on a huge screen. The prize was a free pair of shoes, but unfortunately there was too much talent in the audience.

During my exchange I joined several clubs. I went ballroom dancing and learned the basic steps of the samba, tango and cha cha cha. Although I had to leave my saxophone in the Netherlands I was very surprised that I could still participate in the Bentley jazz band because borrowing one was no problem. Many performances were planned and it was a great opportunity to really become part of the student life at the campus. Furthermore, I also participated in the Bentley outdoor club. We hiked Mount Monadnock in New Hampshire, which treated us with a great view over the whole area. It was very beautiful because the Indian summer had already started and the leaves of the trees had a very deep and beautiful color. I had never seen anything like that before; it looked like a fairy tale.

Courses

Of course I also needed to take five courses so my exchange would not delay my studies at home. I was very happy that I could find courses that fitted in my program. I had class with nine to twenty students: very small groups compared to Tilburg University. I was sitting at a small table during the lessons, just as in the movies. I quickly noticed that the Bentley students really want to interact during the lectures. It does not matter what they really say but they just want to say something. The workload was very high because I got assigned one or two obligated quizzes or exercises per week for each course. The courses also included many midterms and other group works, which meant that the final exam counted for only 25 percent. Unfortunately, there was no resit. If there would have been one, I might have decided to not pass an exam on purpose so that I could come back during summer.

I enjoyed my stay at this university very much and I also really loved the environment. Boston is a great place to live; there are many nice places to eat, to visit and many things to do. I spent my last night on the couch of a new friend who lives in Boston with her boyfriend. They brought me to the airport the day after. After that night I was convinced for more than hundred percent that this exchange was the best opportunity I have ever had. I am sure that I will return to Boston because it was a place with very nice people, and it has become to feel like home!

Dominique Bavelaar

AGE: 18

Began studies in 2015

Beer, Songs, Beer, Fun, and Beer!

After the exams of the first semester and second unit were over, the Asset | Econometrics Freshmen committee decided that it was a good idea to drink all pain, stress, and new brain cells away during a beer cantus that will be remembered as one of the most legendary ever.

For those of you wondering what a Beer Cantus exactly is; the concept is not that difficult to understand. You just need some econometricians and a lot of beer. When mixing these two together, you get bunch of drunk econometricians who just cannot stop singing songs, for which the Latin word is 'cantus', so that is why this phenomenon is called 'Beer Cantus'.

The event took place at Café Boulevard, where some wooden tables were set up in a cozy hall. While the participants slowly shuffled in, some of them were assigned by the Cantus' lead singers (cantors) to be the so called 'bierhalers'. These are the only ones that are allowed to leave the table during the Cantus and they only have got one purpose: keeping everyone happy by refilling the beer cans (people do not need much in life in order to stay happy). Yes, you read that correctly, they are the only ones to leave the table, because all participants had to dedicate themselves completely to the art of singing and drinking. That means no drinking while singing (as if that is even possible), not checking phones while either drinking or chanting, and, since everyone needs to stay at their table during the Cantus, even the loo is a no-go zone. Drinking beer is only allowed when the cantors give their permission explicitly, which usually happens after the participants showed what skilled singers they are (so after every song). Then, "Trink, trink, Brüderlein, trink" is chanted by all people present, after which everyone consumes some brew. Soon, a new song is announced, and the whole story starts again, until the Cantus' code of conduct is broken. That is, as soon as one of the participants shows even the tiniest amount of disrespect towards one of the rules, firm action has to be taken by the lead singers...

They were nice enough to have prepared a "Wheel of Ad's", which had some really interesting ways to drink beer on it. When a Cantus rule was broken, the wheel was turned, after which it suggested a suitable way to punish the offender for their bad behavior. Some of us had to drink beer out of their own sock, others were forced to change their beer glass for a vuvuzela, and also shoes were frequently used as 'ad-instrument'. Personally, I had to drink my beer pretending I was a bat, because one of the cantors caught me checking the score of the Feyenoord game of that night (they were losing, as per usual). However, a nice thing about those punishments is that all other participants are allowed to visit the lavatory or just have fun while watching others struggle, so it was not all as harsh as it might sound.

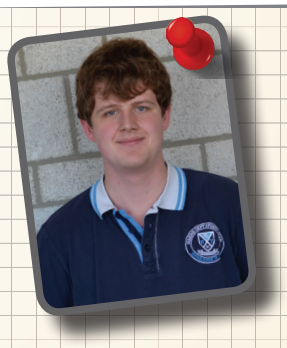
After two hours, a lot of songs, and even more glasses of beer the Cantus came to an end. Those who were still able to walk to the city center proceeded the drinking out there, in order to make the evening even more/less memorable. All in all, I can safely say that everyone had a great evening in which every little bit of exam stress has been banished out of their bodies.

THE PASSION OF...
JOOST WESTLAND

What Is Your Ideal World?

Text by: Mike Weltevrede

Second-year bachelor student Joost Westland has a passion that is somewhat different from the ones that we have seen so far. That is, Joost is actually very interested in politics. Personally, I am not that much into politics, but I had a lot of fun interviewing Joost and learning about his views and thoughts. So please keep on reading to find out everything you can about this eighteen-year-old, who is the youngest person from Brabant ever to have been on the electoral list for the provincial council elections.



Joost Westland
AGE: 18
Began studies in 2014

Joost's main political thoughts are based on the idea that everyone deserves the same opportunities. Moreover, he believes that there is too much long-term poverty right now; a problem that is difficult to solve. In fact, the latter notion was the fundamental idea for Joost to become active in politics during the first Rutte cabinet, back in 2010. Back then, almost all social services were neglected, which made Joost feel agitated. However, there is not much one can do as an individual, so collaboration is necessary. As such, Joost searched for options to share his thoughts and, in doing so, ended up at political organizations. Ideologically, Joost finds himself in between the PvdA (the Labor Party) and the SP (the Socialist Party). However, since it appeared to him that the SP shames others without naming alternatives, he chose to join the political youth organization (PJO) for the PvdA, namely the JS (Jonge Socialisten). This is an organization that is politically independent from, but allied to the PvdA.

What do you currently do within the JS?

I am in the current board as chair. Myself including, there are eight of us running the organization. Our goal is to make the voice of young people be heard, especially in the municipality ('gemeente' in Dutch). We are able to propose most of our ideas to the city and provincial council members of the PvdA; they often consider and implement them. The implementations commonly differ slightly from our original ideas, since there are some practical points that need to be considered, about which they are more knowledgeable. Moreover, we introduced a somewhat playful prize for the most asocial policy in Brabant,

the "Brabantse Schaamroos". Last year, Hans Kokke won the controversial award for not allowing holders of the Tjippas - typically low-income households - to go to the swimming pool for free anymore.

What are some of the other tasks that you have?

I am also the campaign coordinator for PvdA Tilburg. This entails mostly campaigns for elections, for which I visit citizens regularly to investigate the problems and ideas present among them. These visits are not only paid to PvdA voters of course, but also people that are not (yet) convinced of our ideology. However, Tilburg is way more popular between PvdA voters than its surrounding areas - such as Goirle and Oisterwijk - so it is kind of a strategic choice nonetheless. I was asked to become the campaign coordinator when I observed that the PvdA was not involved with the food banks. They considered it and indeed came to the conclusion that it would be a good idea to join in.

Joost's passion seems really time-consuming - we also talked about many other activities that he is involved in as a member of the JS - but he still manages to squeeze in that bit of extra time to study. This is partly because it is relatively easy to ask other people to cover for him when he has little time left to focus on studying. On a regular basis, Joost spends around twelve hours on the JS and PvdA per week, excluding extra meetings and activities. Adding these and his time spent on studying together amounts to a grand total of 55 to 65 hours per week spent. In an election month, however, it will cost Joost approximately five more hours more per week.

As stated earlier, Joost is the youngest person from Brabant ever to have been on the electoral list for the provincial council elections. Joost tells us that it was a great honor to have experienced that, and especially the positive reactions that he received were fantastic. Joost received approximately 153 personal votes, of which he is really proud. He is particularly happy of the sudden attention and good comments given by former high school and primary school classmates. That gave him a boost of energy and the feeling that people actually trust you. All of his work does indeed impact others.

Sometimes, however, ugly situations present themselves, Joost tells us. For example, he has heard people calling him a National Socialist (NSB'er) or traitor. It seems as if people do not blame the party but the person going door-to-door. Even though it seems depressing, Joost explains that it is pretty easy to distance yourself from that negativity, especially since the good conversations outweigh the negative ones by 200%.

One last thing that Joost would want to achieve still is raising the participation in the 'meedoenregeling', which provides low income families with €100 to be spent on courses in sport and dance for the children, for example. However, it is easy to imagine that this amount is difficult to manage if a family has multiple children. Joost would like to see some concrete changes in this policy, but has no preference for a certain format. He does, however, stress that sport is especially important, since it provides a healthy lifestyle and focus at school and at work.

'I have learned a few things that are somewhat unorthodox'

What skills have you learned that you can apply in daily life?

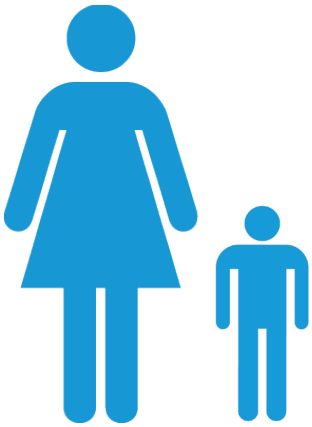
I have learned a few things that are somewhat unorthodox. For example, once you have reached a set goal, you should not focus on it anymore. Rather, you would want to just keep an eye on it while paying attention to other aspects. Moreover, journalism needs a more critical eye. Quite often, random articles are bluntly copied by major organizations, without checking their validity. Lastly, my social skills have developed and I am easier to talk to. In this aspect, I learned to find people's motives for their actions quickly, and to find and solve conflicts in cooperation. I also apply econometric thinking a little bit, as we need to analyze the distribution of voters. Moreover, even though I am not a specialist, I can check the budget of the municipality on basic aspects, such as the choices of risks.

Why should others take up politics as well?

I do not think they should per se. Affinity is very important in politics and you should be comfortable in that world. If one thinks he wants to take up politics, then I would suggest him to firstly contemplate on what their ideal world would look like and what party aligns best with it. Secondly, I would advise him to think about what policies of which parties appeal to him, for example on poverty or racism. Lastly, just visit a PJO. The JS, for example, is very open to everyone, as long as you are just respectful and amicable.

We would like to thank Joost for letting us interview him on his, in my opinion, very interesting passion.

THE MOTHER OF...
PEPIJN VAN DEN BRINK



A Big Welcoming Family

After a solid one-hour drive, Stefan and I arrived at a nicely located house in the small city of Huissen, close to Arnhem. Because we were completely unable to find a nice music radio channel while driving, Stefan already informed me that Pepijn has a very large family, who are all fanatic Vitesse supporters, and that Pepijn plays draughts at a very high level. His mother Annemieke has always greatly supported him and has a central role in the family.

Text by: Jesson Einmahl

Upon arrival, most of the statements above were immediately confirmed. The door was opened by Pepijn and we were introduced to Annemieke and his father Gert-Jan as well as his little brother and another little brother and another one. Annemieke was curious about our opinion on whether her children look more like her or more like Gert-Jan, and was pleased to hear we thought they look like her. It was also immediately stated we should watch the Vitesse match while we were at their home, and it was noted that Huissen is a city and not a village, as we accidently called it. When we arrived, Pepijn was cooking. It turns out he always does this in the weekends. What an ideal son! After his sister had arrived as well, we began with a wonderful pasta dinner. They always try to eat together and it is very important for them to share many family moments together. After his little brothers had fought a little over the dessert, we could begin with the interview with Annemieke and Pepijn himself.

A quick introduction

Annemieke van den Brink was born 48 years ago in Arnhem, in the east of Netherlands, and is, according to herself, a real Arnhem girl. She is mother of four sons and one daughter, Pepijn being the oldest child. Being a mother to her children is her main focus and she regularly helps in her husband's company; he is owner of an audit firm, for which he travels all over the country.

Out of a movie

As a child, Annemieke was like her youngest son: a glad, always running around kid. She has one little brother and during her youth her family moved to Sprang Capelle, a village a bit to the north of Tilburg. After primary school and high school, she left home at an early age; she was a very curious person. She went to study psychiatric nursing education in Deventer, where she stayed after her studies to work as psychological test assistant. During her student life, which she very much enjoyed, she also practiced ballet. The most wonderful love story begins during this period, a story I found utmost amazing. Annemieke explained that she was a bit of an alternative 'hippie' type, and at some point she went to visit a very nice student room. It turned out that Gert-Jan had also visited this room before her. In the end, Annemieke got the nice room Gert-Jan got the basement room instead, so he came to live below her. Her first impression of him was that he was definitely a "kakker" (cocky, formal and overdressed). As she was regularly broke she always borrowed money from him, which he has never actually received back, she jokes. On the other hand, he always joined her for dinner as he never cooked for himself. At first they were just friends, but after a year some other girl mentioned that Gert-Jan was really nice, and it was at that moment when she realized it was actually 'her' Gert-Jan. As of now, that is 24 years ago and they have been together ever since. As if taken right out of a movie!

A most beautiful baby

When Pepijn was born they were awfully glad; Annemieke was convinced it was the most beautiful baby ever. Pepijn was a very sweet, kind and clever child. "He taught himself to read and write at a very early age and was already very interested" she explains. At school, Pepijn was a special boy as well: he was a bit of a different child than average and had different interests than the other children. He skipped the 3rd grade in primary school and was often far ahead of others. Later, he was tested and indeed turned out to be highly intelligent. At high school, he was more comfortable, being around more likeminded children. "It was a very nice time at a very nice school" Pepijn adds. At that time, his draughts career had already begun. During primary school, he had chess and draughts lessons and won all matches. As he continued to win most draughts matches afterwards, he chose for draughts over chess and participated in the national tournaments

within a year. He even went to Poland for the European championship! Annemieke always joined him during the tournaments, and she has always incredibly enjoyed the game. Pepijn has even reached the fourth place at the world championship for the youth twice, a very painful result, he states. Pepijn recalls that at that time he was very impatient and wanted to play too fast. As a remedy, his trainer told him to sit on his hands while playing. Adding to this, Annemieke mentions that he was a very bad loser. Unfortunately, Pepijn thinks he will not be successful at the senior championships anymore: the level is simply too high. Nevertheless, what is most important is that Annemieke has always been incredibly proud of Pepijn; they have always had a great connection. "He is a very loving and warm son."

Pepijn van den Brink
AGE: 20
Began studies in 2013

Annemieke van den Brink
AGE: 48
Residence: Huissen

Entertainer

Pepijn's direction into econometrics is an interesting story as well. "I have no feeling for technical studies whatsoever, but I do have talent for learning languages", he explains. At the end of high school he decided to start with the course mathematics B, and while it did not go very well in the beginning, he eventually scored a nice grade at his finals. He had already considered philosophy before and was enrolled for business economics at the time, which is more in the direction of Gert-Jan. He remembered having heard a very successful person mention that you should study econometrics, if possible. Hence, on the last day that switching studies was possible, he very impulsively switched to econometrics in Tilburg, without having visited the university even once. In hindsight, he is very glad with his choice. He currently lives in the student house with fellow econometricians Tom, Björn and Emile and is a very active member of Asset | Econometrics, having been in many committees. He still plays draughts and works during his study. Annemieke especially hears about the stories of Pepijn where he is a "successful" cantus singer with a lot of experience. He absolutely is an entertainer, something he enjoys very much! This is certainly something no one had ever imagined when he was young.

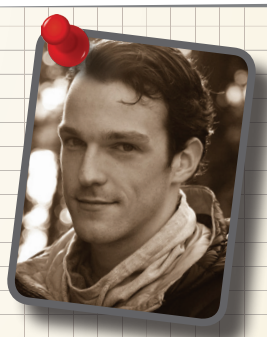
Family time

After Annemieke and Pepijn wished the smallest son a good night, we continued the interview. We wondered whether Pepijn thinks he looks more like Annemieke or Gert-Jan, to which he answered: "Both." Annemieke explains that "Pepijn is a 'people-person' and he is interested in philosophy and psychology", which makes him closer to Annemieke again. That the family is very close, is clear from the fact that from Wednesday on, the smallest son already starts asking when "Peppi" the big brother comes home. "On Fridays, it always is nice to be all together again", Annemieke admits. His brothers are very glad when he is home and he also a bit of an example to the others. He has an almost perfect connection with sister as well. Last summer, they went to Bali with the whole family; Annemieke is half Indonesian and she had always wanted to go there. Lastly, they almost always go to the Vitesse matches.

Future

Annemieke finds it very important that everyone stays healthy, that they stay together as a family and that all her children follow their own heart to do what makes them happy. She also hopes to become a grandmother one day, she jokes. She explains that she will not be too surprised when Pepijn chooses another unexpected direction at some point or when he starts to cooperate with his father. Both Annemieke and Pepijn agree he will most likely not work for a very big company, because he does not like to be a number, and Pepijn thinks he might start his own company sometime. Annemieke's final advice for Pepijn is to continue with his activities, especially with the singing, and follow his heart, laugh and be happy.

After making some photos of the entire family in the living room, we had to watch the Vitesse match before we were allowed to leave. After complimenting them on being a most welcoming family, it was time to head back to Tilburg again and Pepijn joined us for the late drive back on a wonderful evening.



Willem Jongen
AGE: 24
Began studies in 2010

Pre-Carnaval to the Next Level

On this planet there are various types of people. There are those fanatics who like to do sports and to work out (or show off), those people who like to drink beer (or are sensitive to group pressure to consume alcoholic beverages), those people who like to party, and those people who like to dress funny and might even paint their face. Luckily, these different categories of people are not mutually exclusive and so the people belonging to the intersection of these categories created another optimal night.

As we all might know by now, Asset | Econometrics can be considered as one of the most (successful) sportive study associations in Tilburg. However, a former sports hero once said "getting to the top is the easier part, staying there is the real test". Therefore, it was of utmost importance that our association would not only participate at the 'Carnaval Volleybal Toernooi' but also would participate in a way that we would leave an indelible impression on our competitors. And guess what? We did! We played great. We played big. We played simply outstanding! Without doubt the best performance ever of Astrics Elite.

The night of our great success started at approximately 19.32 hours. The weather was cold, dark and rainy, but we felt that this would be the moment we would shine; this was the moment Astrics Elite would rise and crush the first competitor. After a blistering start, we took a lead of 6 points. However, as some of us already felt sorry for the competitor, we made a mistake on purpose to give the other team a chance. Before we had realized what we had done, the scores were already even and people started to get nervous. The tension was palpable. However, just a minute later we again acquired a nice lead; this time of only three points. But, everything was unfortunately for nothing as the other team came back again to 9-9. This was the signal: it was time to make some tactical changes. Astrics Elite gave everything it had, which led to a close battle no one had ever seen before. It was even closer than the distance between 0 and $\lim_{\varepsilon \downarrow 0} \varepsilon$:11-10, 11-11, 11-12, 12-12, 13-12 and so on till 19-17 for our opponent. But then Astrics showed its strength, and thanks to shocking services and massive blocks at the net Astrics won the first game by 21-19!

The second game was, unfortunately, not such a great success. Some might say that the others were better, but, as this is of course impossible, the real reason for the loss might have been an overkill of the magic booze. On the other hand, our third and final game of the group stages was of great class. After our recent loss we put our heads together and recharged our power levels with golden liquids that can unleash powers of which one could only dream about. And it worked! Astrics Elite was impeccable; this game illustrated the true meaning of dominance. This game showed what crushing was: 27-10.

After this last great match we had earned a place in the next round. However, we donated our spot in the tournament to one of the other teams as we decided to maximize our pre-carnaval possibilities. We left the set of people present at the sports center and joined the set of people present at Café de Boekanier for the Asset Pre-Carnaval Party, where we were distributed in such a way that we made the no-memory property a big success.

The Expired Costume Party

Rick van de Meulenhof
AGE: 23
Began studies in 2010

A costume party one week after the biggest costume party mankind has ever seen seems like a nice excuse for us, econometricians, to act like Carnival has not turned its back on us yet. Dressed up as Heidi and Anton, our members filled their mugs with beer, and drank as if they ended up in a ski hut after a long day of fun in the snow.

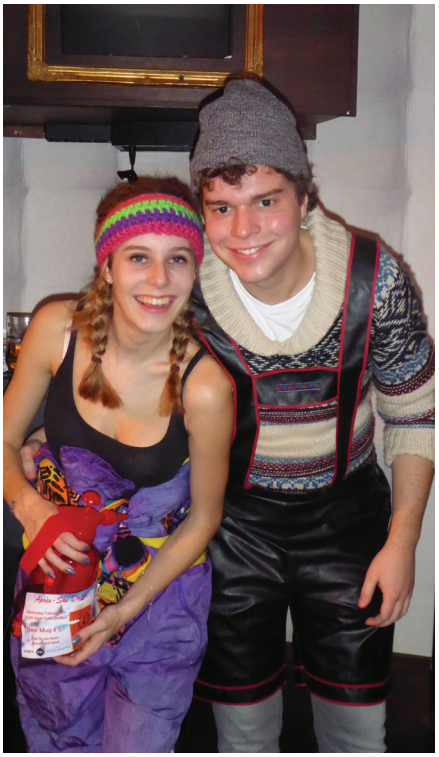
On February 11, one of the most famous drinks of Asset | Econometrics took place in Cafe Qwibus: the Après-Ski Drink. This annual drink is something to look forward to year after year. Just to get a feeling: when I receive the Asset | Econometrics year calendar at the beginning of the academic year, it gets a nice place in my dorm after which I mark the date of this drink with a big circle.

Receiving the mug upon arrival gave a good feeling right away. It was already the sixth printed Drink & Activities mug that I could add to my collection. Together with Tim, I started having some beers at the bar, noticing some drunken econometricians. But it was only 23.00 hours?! After some time it came to our attention that the drunken people were all members of the D&A committee. Maybe this was due to the vodka party they organized for themselves, before the start of the drink. We will never know.

Next to our members, members of other boards of Asset can also attend the Après Ski drink. This is the opportunity for them to get familiar with the way of partying at an econometricians' party. They certainly did not reject this invitation; there were almost as many board members of the other faculty associations as there were members of our own association. We have to compliment them, since none of them neglected the dress code and they all showed up in style. Apart from their looks they also showed not to be afraid to display their dance skills while listening to classics as DJ Ötzi's 'Anton aus Tirol' and 'Wir wollen die Eisbären sehen'.

After we emptied our first couple of mugs, it was time to have a thought about who had to be chosen as best dressed Heidi and Anton. Over the past years there were some rumors that this election was all about nepotism. Therefore, I was pleased to notice the invocation of an independent committee to elect the winners. After some deliberation they came to a unanimous decision: Loes and Bart were awarded best dressed Heidi and Anton. Congratulations, I am pretty sure you are very happy to now belong to the special list of econometricians who have shown to be able to be a look-a-like of Heidi and Anton.

For me, the night ended with a scoop. Never before had I cleaned the pub that I polluted before. But as they say, once has to be the first time. Who would have thought I ended the costume party as a real cleaner? Together with the well-known Patricia and the less famous bartender we kept going until the whole place was clean. You cannot imagine the mess you made! Especially the blood in the woman's bathroom was a delight to clean. Where that came from? Maybe it had something to do with the vodka party mentioned earlier. Tired, but satisfied, the three of us ended up at the bar. After some fisherman's tales, together with some last drinks, we decided to call it a night.



LIVING IN LODGES

Independent in Tilburg

Steffi and I got the opportunity to talk to a well-known face at Asset | Econometrics: Ridho Hidayat. As he welcomed us into his home, the first thing we saw was his comfortable living room. After a brief tour around the house and shooting some pictures, we began the interview.

Text by: Max van der Lee

Ridho Hidayat
AGE: 21
Address: Lijsterstraat 21
Rent: € 293

A quick introduction

The house of Ridho and his roommates is located in Groenewoud, also known as the 'Vogeltjesbuurt', which is in southern Tilburg near the hospital. Thanks to our navigation, Steffi and I found Ridho's home fairly easy. It is no more than a pleasing ten minutes from the city center, but less ideal is the fact that it takes Ridho almost twenty minutes to get to the university. Two Jumbo's and one Albert Heijn are located at just a stone's throw away, and there is a bus stop at the end of the street. The neighborhood is not full of fellow students, instead, you can find many working people living here in their single-family houses. And do not forget the flamboyant celebrity Roy Donders, who was born and raised in this area of Tilburg.

Ridho Hidayat, a third year's EOR student, has been active at Astrics for quite a while. For those who did not already know, Ridho is in this year's Drinks & Activities committee, after being a member of other Astrics committees in the past. Apart from living nearer to the university, moving to Tilburg has made a large addition to Ridho's study and student life. Now that he lives by himself, he can do whatever he wishes to. For example, it makes it possible for Ridho to attend more of the popular Astrics activities and also the possibility to interact more with his fellow students outside of the lectures is a big plus. All in all, Ridho enjoys being more independent and choosing his own daily schedule.

From Den Bosch to Tilburg

It has only been a couple of months since Ridho started living in Tilburg. He decided to wait a while before moving to Tilburg, since it was only a half hour from Den Bosch, where he lived with his family. Still, he has many friends who live in Den Bosch, which is one of the reasons why he still visits his home town every weekend. With a few of them he plays football in a Sunday league team. Besides his football team, Ridho also enjoys his loyal status at the Albert Heijn in Den Bosch, having worked there for over six years now. He is a multifunctional employee who usually works as a shelf stacker, but also helps out at other departments like the vegetable section every now and then.

Ridho moved to Tilburg last summer when he and two of his friends found this single-family house. His roommate Thijs

took the initiative and it did not take him long to find this cozy house. After he visited the house together with Ridho and Quintin, a friend whom they made during the TOP week, they decided quickly and said 'yes' the very same day. Since the house has five bedrooms they started looking for another two roommates, who they found fairly easy. Thijs is the main tenant and therefore carries the most responsibility of the five of them. It is his task to contact their landlord in time of trouble, who unfortunately reacts very slowly to their requests.

Studying, gaming and cooking

The first impression you get as you enter Ridho's room is that it is a spacious, but typical student room. Ridho tells us his room is only fifteen square meters, nevertheless it looks a lot bigger as a result of his built-in closet, which he mainly uses to store his clothing. Ridho describes his room as "quiet, simplistic and somewhat tidy, at least for most of the time". Ridho thinks he got the best room of the house and therefore he spends a fair amount of his time in it. He prefers studying in his room compared to the university's library; when he wants to study his roommates are nice enough not to disturb him, and let him concentrate on his work.

The enormous BioShock Infinite poster on the wall of the room stands out, which led us to Ridho's spare time activities. Ridho mentions that in his spare time he enjoys gaming on his Playstation 3, which he brought with him to Tilburg. Back at home in Den Bosch he uses his Playstation 4 to play various games such as Bloodborne, The Last of Us and Call of Duty. Taking his hobby a step further, Ridho also writes about the ins and outs of games, and does so for a popular gaming website. He writes short news articles on the website of Gamekings, a Dutch TV show that rates the latest games and discusses any upcoming game. Apart from gaming and playing football, Ridho watches a lot of series and movies. His favorites are Game of Thrones, Suits and sci-fi action movies such as Star Wars.

Apart from his Playstation 4, Ridho sometimes misses a home cooked dinner made by his parents, and how easy it was that his dinner was prepared for him every day. He now cooks himself most of time, as he is one of the few in his house that enjoy cooking. After cooking he has a luxury that all students will appreciate, namely getting help from a dishwasher. Nevertheless not everything is perfect; he dislikes the house missing an oven in the kitchen, which limits him in choosing what meal to prepare. Despite his Indonesian roots, Ridho is most keen on cooking meals with potatoes and less on Indonesian meals, because according to him he gets those already plenty back home.

Another luxury Ridho benefits from is not having to clean too much. One of Ridho's roommates used to be a professional cleaner and has accepted to do most of the necessary cleaning in the house. Hence, Ridho only has to clean his own mess. When asked about any disadvantages of the house, the only one Ridho could come up with, apart from missing an oven, was having problems with some mice in the kitchen. One of the best memories he has from living at Tilburg is the celebration of last Christmas together with his roommates, together with the game nights they have every once in a while. After asking Ridho's roommate Linda what she thinks the biggest disadvantage is of living with him, she answered that Ridho is missed a lot of the time, because he visits his parents and friends in Den Bosch often. Especially around the exam period Ridho stays at home to avoid wasting his essential study time on chores in and around his room.

What the future will bring

Ridho tells us that it depends on which master program he will choose whether he will keep living in Tilburg or not. This because he is very much interested in the Data Science master which will be offered back home in Den Bosch.

After the interview we had some small talk about the American elections. Ridho expressed himself by telling us that he supports Bernie Sanders and his 2016 campaign. After that it was time to say goodbye and Steffi and I headed out for the rest of the day. We are looking forward to seeing Ridho again at any of the upcoming Astrics activities, and we wish him all the best. Of course, we would like to thank him for taking the time for the interview.

Bert & Ernie Questions

Bert or Ernie?
Bert

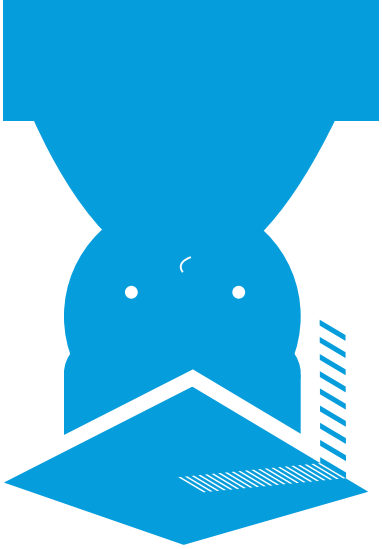
Beer or Wine?
Beer

Pizza or Kebab?
Pizza

Studying: At home or Library?
At home

Albert Heijn or Jumbo?
Albert Heijn

Morning or night person?
Morning person



Asset | Econometrics congratulates...

Name: Stefka Arsenova
Title: Estimation of storm loss return levels: a study of the Greenhouse Portfolio of Achmea Reinsurance
Supervisors: Prof.dr. J.H.J. Einmahl, Prof.dr. A.M.B. De Waegenaere

Name: Ward Broeders
Title: On the production efficiency of Dutch insurance intermediaries
Supervisors: Dr. M.H. ten Raa, Prof.dr. A.H.O. van Soest

Name: Alexandros Kyriakos
Title: Market Risk Estimation: An application to Greek Financial Institutions
Supervisors: Dr. P. Cizek, Prof.dr. B.J.M. Werker

Name: Cas Luijten
Title: Combining supplier scheduling and storage allocation in a retail supply chain
Supervisors: Prof.dr. G. Kant, Dr. J. Vera

Name: Rens Ramaekers
Title: Predicting Default Rates at Marketplace platforms
Supervisors: Dr. G. Nieuwenhuis, Dr. R. vd Akker

Name: Ronald Smits
Title: Fundamental Indexation for Corporate Bond Markets A practical view and a quantitative analysis
Supervisors: Dr. P. Cizek, Dr. S.J. Sender

Name: Anna Szczygielska
Title: Longevity risk and hedging using mortality-linked securities
Supervisors: Prof.dr. B. Melenberg, Dr. F.C. Drost

Name: Diederik van de Wiel
Title: Valuation of insurance products using a Normal Inverse Gaussian distribution
Supervisors: Prof.dr. J.M. Schumacher, Prof.dr. J.H.J. Einmahl

Name: Xuan Yang
Title: Modelling Risk Margin in Group Life Contracts
Supervisors: Prof.dr. J.H.J. Einmahl, Dr. O. Boldea

Name: Ioannis Zempekakis
Title: Does Big Data add value to Network Optimization: An Empirical Examination
Supervisors: Dr. J.C. Vera, Prof.dr.ir. D. den Hertog

Name: Theodoros Zigkiris
Title: An empirical comparison: autoregressive conditional heteroskedasticity and multifactor models in asset return predictability
Supervisors: Prof.dr. B. Melenberg, Dr. P. Cizek

...on obtaining their Master's degree.

Hunting for Glory

Whether you want to search in your epsilon-neighborhood, perform a local search or use another method to differentiate yourself from your peer students, let us face it: we all like to search easter eggs. This has inspired Nekst to come up with a new contest, the Easter Egg Hunt! Scattered around this magazine, you find easter eggs hidden everywhere.

Your task is simple: find the easter eggs, and let us know how many we have hidden in total. Please send your solution to Nekst@Asset-Econometrics.nl before June 3. The winner, chosen amongst those with the correct answer, will be awarded a nice prize!

Quatsch!

Maud Lich: "Ik heb geen ochtend humeur, maar je moet gewoon niet tegen mij praten 's ochtends."

Thijs Kramer: "Als ik een vrouw was, was ik sowieso lesbisch."

Tim van der Heijden: "Een enchilada, dat is een Pokémon toch?"

Renata Sotirov: "Let's quit the babysitting."

Jochem Bruijninckx: "Ik word veel liever gefolterd dan gemarteld."

Cleo Mauritsz: "Ik denk soms wel: als ik tijd had, zou ik jou van de weg afrijden." Thijs Kramer: "Ik maak daar tijd voor."

Mike Weltevrede: "Het Koningshuis, daar wonen de koning en koningin toch?"

Erwin van Oosten: "Onze tafels vallen tegelijkertijd stil; onze periodes zijn hetzelfde. Jullie moeten even een half pi wachten met praten."

Jelle de Rooij: "Het is geen sport als de tegenstander niet huilend naar huis gaat."

Thijs Kramer: "Ik hoef niet te functioneren in de maatschappij, ik heb een mes."

Anouk Claassen: "Ik ben zo creatief als een euh... Ehh..."

Peter Borm: "If you solve stupid games, you get stupid answers."

Ennia Suijkerbuijk: "Al is de naaktslak nog zo snel, naakt is hij toch wel."

Wise words of ...

Hans Schumacher: "Breaking a leg is not nice, so I suggest you don't do it."

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. Therefore, 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!

PUZZLE

Even though Easter has already passed, most people will agree that chocolate Easter eggs are among the most pleasant parts of this tradition. Therefore, this puzzle does not consider just a single chocolate Easter egg, but ten bowls full of the tasty chocolate treats!

You have been given ten bowls of chocolate eggs, each containing twenty eggs. Also, you have been informed that nine of the bowls contain eggs with a weight of ten grams. The remaining bowl contains eggs with a weight of just nine grams. However, which bowl is which is left in the dark; you cannot tell with the naked eye which bowl contains the lighter eggs. You have been given an electronic scale to help you determine which of the ten bowls contains the eggs of nine grams. Unfortunately, the scale is almost out of battery and can only be used exactly once before you run out of battery completely. How can you determine which bowl is the one with the lighter chocolate eggs, using only one measurement on the scale?

Please send your solution to Nekst@Asset-Econometrics.nl before June 3. A crate of beer or a delicious pie, whichever the winner prefers, will be waiting for whoever has the best (partial) solution. Please note that, as before, every recipient of this magazine is eligible to send in their solution, so members of the department are invited to participate as well. Good luck!

For elaboration visit
NEKST-ONLINE

Martijn Tervelde is the winner of the previous puzzle. As a reward, he can come and pick up a crate of beer or a pie at room E1.10. The answer to the previous puzzle was no. If you want to know more, visit www.Nekst-Online.nl.

Agenda
Spring 2016

Asset Conference

Monday April 11

The Economic Business weeks Tilburg will be opened on April 11 by the Asset Conference. This year's theme is "Technological economy: Disruption and Abundance", which will be discussed in a plenary session, various deepening sessions and two keynote lectures.

FAM Dinner

Saturday April 16

Asset | Econometrics wants to thank their (Aspirant) Former Active Members for their contributions to the association by taking them out for dinner on April 16 at Stadskasteel Oudaen in Utrecht.

Batavierenrace

Saturday April 23 – Sunday April 24

The Batavierenrace is a relay race from Nijmegen to Enschede, where we will form a team together with Asset | Accounting & Finance. Are you the enthusiastic runner who wants to fill one of the last spots in our team?

Operations Research Conference

Tuesday April 26

On April 26, the very first Operations Research Conference will take place in collaboration with Eindhoven. The OR Conference is themed "Outsmarting Competition" and will include incredible keynote speakers and companies.

Monthly Afternoon

Tuesday April 12

The next Monthly Afternoon will take place on April 12. You can catch up with your fellow students while having a drink or playing a game. There is no need to register, you can just swing by from 16.00 hours onwards.

Astrics Cantus

Tuesday April 19

Last year's Astrics Cantus was a great success, and this year's D&A committee is doing everything within their possibilities to exceed the number of participants of last year. If you want to have a great night with your fellow econometricians and unlimited beer, then make sure to register!

Freshmen Activity & Beer Race Drink

Tuesday May 10

The final Freshmen Activity of this year will take place on May 10. All first-year students are invited to have dinner and participate in a pub quiz. Afterwards, it is time to meet up with all other econometricians and show your ad fundum talent during the Beer Race Drink.

Asset Pubquiz

Wednesday May 11

This year's one-and-only Asset Pubquiz will take place on May 11. It is the perfect opportunity to show that you, as an econometrician, can do more than compute difficult formulas!

Monthly Afternoon

Tuesday May 12

The month May brings great weather, but also exams for most of you. If you want to blow off some steam from studying, the Monthly Afternoon is the perfect opportunity to do so! You are more than welcome to join us for a drink, chat and game from 16.00 hours onwards.

Informal Activity

Thursday June 9

Most of you are probably familiar with EY, the former Ernst & Young, but what is the atmosphere at this immense company? With our activity on June 9, you get the opportunity to get to know EY employees in an informal setting and ask all your questions.

Parents Evening

Friday May 13

Do your parents know what Asset | Econometrics is, or what you as an active member do for your committee? A special evening will be organized especially for the parents of active members, such that they can better understand the value of student life. We hope to see your parents there!

Football Tournament & Announcement Drink

Tuesday June 7

The time has come to show off your football or cheerleading skills, for our Football Tournament will take place on June 7. In the evening, the board of Asset | Econometrics for 2016-2017 will be announced during a spectacular drink, so make sure you are there!

Asset Champions League

Thursday June 16

Did you not get the chance to practice your football skills during the Astrics Football Tournament, or are you eager to practice them once more? The Asset Champions League will take place on June 16, for which all members (post active and passive) can register.

WILLIS
TOWERS
WATSON