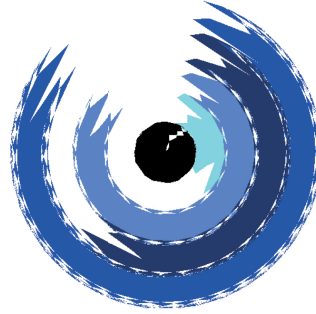# Statistics & Operations Research for
# seeing the invisible

**VVSOR** Annual meeting
March 21, 2024

## Annual Meeting of the Netherlands Society for Statistics and Operations Research (VVSOR)

*Thursday March 21, 2024*

10:30 – 17:30

In de Driehoek

Willemsplantsoen 1 C, 3511 LA Utrecht

How can statistics and operations research help in seeing the invisible? Eight speakers will discuss how their research contributes to seeing the invisible, all of them with a different perspective on the topic and coming from an other field of study.

- Kitty Berkhout-van Kessel, MSc (FrieslandCampina)
- Prof. dr. Ton de Kok (TUe/ CWI)

Just like last year, this year's Annual Meeting will be at In de Driehoek in Utrecht. We will have a general assembly for members, followed by the actual event with two keynote speakers, three parallel sessions and two award presentations. The AM 2024 will be in English.

Attending the meeting at In de Driehoek (including drinks and lunch) costs 65 euro. Reduced price for students: 20 euro. Additional registration is required for dinner and pubquiz at De Winkel van Sinkel.

Please register on the vvsor-website
https://www.vvsor.nl/vvsor-annual-meeting

## DATE

Thursday, March 21, 2024

## VENUE

In de Driehoek, Willemsplantsoen 1C, 3511 LA Utrecht

## REGISTRATION

Registration for the conference is mandatory at https://www.vvsor.nl/vvsor-annual-meeting. Detailed information can be found on our website.

## LANGUAGE

The talks at the annual meeting will be in English.

## ALGEMENE LEDENVERGADERING (ALV)

The Annual General Meeting of members (ALV) takes place on March 21, 10:30 – 11:15. The relevant documents will be e-mailed two weeks before the meeting.

## SNACKS AND DRINKS

Lunch and drinks during the breaks will be provided.

## DINNER WITH PUBQUIZ

Dinner at De Winkel van Sinkel, Oudegracht 158, 3511 AZ Utrecht. The pubquiz will be organized by the Young Statisticians.

## ORGANIZING COMMITTEE

The annual meeting is organized by a special committee in cooperation with the board of the VVSOR. For questions, contact the organizers by email at annualmeeting@vvsor.nl.

**PLEASE REGISTER BEFORE MARCH 19**

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|---|---|
| 10:00 - 10:30 | **Registration + coffee & tea** |
| 10:30 - 11:15 | **ALV, General Assembly (members only)** |
| 11:15 - 11:30 | **Break with coffee & tea** |
| 11:30 - 11:40 | **Prof. dr. Casper Albers | Welcome & Opening of the AM 2024** |
| 11:40 - 12:30 | **Demand planning taken over by AI system, how to handle this new colleague** Kitty Berkhout-van Kessel, MSc FrieslandCampina |
| 12:30 - 13:15 | **Lunch at In de Driehoek** |
| 13:15 - 13:45 | **Ceremony of the Willem R. van Zwet Award and the Jan Hemelrijk Award** Prize winners will be presented by the juries, followed by a short presentation by the laureates |
| 13:45 - 14:10 | **Parallel session 1** Gertrudiskapel Stéphanie M. van den Berg - The Abuse of Statistical Inference in Machine Learning: What is the Inference about? Zocherzaal Ronald van der Velden - Optimizing emergency supply pre-positioning and nutrition allocation |
| 14:10 - 14:15 | **Short break** |
| 14:15 - 14:40 | **Parallel session 2** Gertrudiskapel Daan Zult - The impact of finite-sample bias in multiple-recapture estimation and a new correction method Zocherzaal Inez Maria Zwetsloot - AI and the Future of Work in Analytics |
| 14:40 - 14:45 | **Short break** |
| 14:45 - 15:10 | **Parallel session 3** Gertrudiskapel Hanne Oberman - Data visualization for incomplete datasets in R Zocherzaal Alex Kuiper - Appointment Scheduling with Updates |
| 15:10 - 15:25 | **Break with coffee & tea** |
| 15:25 - 16:15 | **Supply Chains: networks with hidden hierarchies** Prof. dr. Ton de Kok Eindhoven University of Technology/ Research institute for mathematics and computer science in the Netherlands (CWI) |
| 16:15 - 16:30 | **Wrap up & Finish** |
| 16:30 - 17:30 | **Drinks at In de Driehoek** |
| 17:45 - 21:00 | **Dinner + Pubquiz at De Winkel van Sinkel (extra registration required, walk-in from 17.30)** |

## Keynote speaker 1

11:40 - 12:30

## Demand planning taken over by AI system, how to handle this new colleague

### Kitty Berkhout-van Kessel, MSc
*FrieslandCampina*

At FrieslandCampina Professional Kitty is involved in the implementation of a new planning tool OMP. Value drivers behind this initiative are improvement on KPIs like forecast accuracy and service level while reducing safety stock and waste. Besides a planner productivity improvement in both demand and supply planning is expected.

The demand planning team is responsible for forecasting and thorough analysis of deviations to provide input for customer conversations to sales. Today these analysis are based on actual sales volumes, quotes, contracts and qualitative information from account managers. With the implementation of OMP an AI solution will be introduced and a central demand planning team is installed to advise on the use of mathematics models like demand sensing and statistical forecasting. This new planning tool requires a mindset change for demand planning and her stakeholders: to trust on the maths and convince business partners in sales and supply planning on their forecast accuracy while also taking actual market dynamics and sales experience into account.

**Kitty Berkhout-van Kessel, MSc** is Demand Manager at FrieslandCampina Professional. Before joining Professional Kitty worked for several other business groups within FrieslandCampina and in various Customer Supply Chain management positions. She started her career in business consultancy at Atos and Coppa and afterwards worked for Nutreco in logistics and product management roles. Kitty studied Business Economics at Tilburg University.
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## Keynote speaker 2

15:25 - 16:15

## Supply Chains: networks with hidden hierarchies

### Prof. dr. Ton de Kok
*TU Eindhoven, School of Industrial Engineering / Research institute for mathematics and computer science in the Netherlands (CWI)*

The COVID-19 pandemic brought many supply chains to a standstill. From one day to the other companies did not know if they could ship their products to their markets and if their suppliers could ship components needed for processing. Supply Chain disruptions draw the attention of many researchers. In 2005 we reported on the success of operational Collaborative Planning (CP) at Philips Semiconductors with their customers and customers' customers. CP functionality enabled to deal with supply chain disruptions due toinnovations in this high-tech high-volume supply chain.

The so-called Synchronized Base Stock (SBS) policy underlying the tool enabling immediate analysis of disruption consequences is based on hidden hierarchical structures in the seemingly unstructured networks that constitute real-life supply chains. These hierarchical structures are divergent so-called decision node structures that are derived from the incidence relationships between items and the lead times of items.

The decision node structures enable the derivation of close-to-optimal SBS policies that so far outperform alternative policies proposed in literature. Case studies over a twenty-year period show the empirical validity of performance analysis under SBS policies. Thus, SBS policies hold a promise for dealing with future supply chain disruptions.

**Prof. dr. Ton de Kok** has been a full professor at the School of Industrial Engineering of TU Eindhoven from 1992. His main interest is stochastic processes as these emerge in real-life production and service systems, and supply chains. From 2020 he is director of CWI.
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## Parallel session 1

## The Abuse of Statistical Inference in Machine Learning: What is the Inference about?

Dr. Stéphanie M. van den Berg
*University of Twente*

In the machine learning literature, new methods are devised and tested all the time. To prove their worth, newly proposed methods are compared with the current state of the art using a statistical test, usually along the following lines: a given data set is trained using the new method using various subsets of the data, after which predictions on hold-out data are used to measure performance. For example, with k-fold cross-validation, one obtains k Root Mean Square Errors (RMSEs) for the new method, and k RMSEs for the state-of-the-art method. A statistical test is then used to determine whether the performance based on the new method is significantly better than the performance based on the state-of-the-art, that is, whether the average RMSE is lower for the new method. Instead of k-fold cross-validation, other kinds of taking subsamples are also often applied, such as taking random subsamples, with or without replacement, but the overall logic is the same, usually applying some sort of t-test. There are a couple of well-known problems with this t-test approach in cross-validation. However, we argue that the exercise of using a statistical test in and of itself is not valid, at least not as it is usually done, because it is not at all clear what population the test refers to.

**Dr. Stéphanie M. van den Berg**   has a PhD in psychology with extensive experience in data analytics and heads the CODE department at the University of Twente and leads the Behavioural Data Science Incubator at the faculty of BMS. She is also chair of the Statistics Education section of the VVSOR.
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Maryam Amir Haeri has an MSc in Computer Engineering and a PhD in Artificial Intelligence. Is currently an assistant professor at the department of CODE, University of Twente, where she teaches data science to social science students. Her research is on developing machine learning methods for challenging data sets in the health domain.
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## Parallel session 1

## Optimizing emergency supply pre-positioning and nutrition allocation

Ronald van der Velden, MSc
*GUROBI Optimization*

The Invisible – The ones that you don't normally see as well-predicted demand in your daily supply chain puzzle. The ones that don't respond to your well-optimized marketing campaigns. The ones that don't take our well-organized public transport. Still these people – millions of them – can benefit from mathematical optimization.

In this talk we will look at two interesting applications of operations research techniques to emergency relief planning. In this context, planners typically look at allocating emergency relief goods either to warehouses (before disasters have taken place) or regions with actual demand.

In the first case, we look at pre-allocating disaster relief material to warehouses in countries that are likely to need them. Individual organizations used to build up inventory independently. By modelling combined inventory in a two-stage linear program, logistics metrics can be defined that show the value of moving existing inventory between warehouses, as well as adding inventory to the overall system capacity.

The second case focuses on distributing emergency nutrition from producers and warehouses worldwide, to countries with an actual, severe food crises. By periodically solving an extended version of an assignment problem, lead times can be minimized which is a crucial performance indicator when delivering nutrition one week earlier makes the difference between life and death.

**Ronald van der Velden, MSc**   is a technical account manager at Gurobi, helping teams around the world get started with mathematical optimization and the Gurobi solver. He studied Operations Research in Rotterdam and previously implemented advanced planning solutions as a consultant with Quintiq.
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## Parallel session 2

14:15 - 14:40

## The impact of finite-sample bias in multiple-recapture estimation and a new correction method

### Daan Zult, MSc
*Statistics Netherlands*

If part of a population is hidden but two or more samples are available that each cover parts of this population, multiple-recapture estimation can be applied to estimate the total size of this population. At Statistics Netherlands, such a partly observed population may, for example, be the number of people residing in the Netherlands or the number of homeless people in the Netherlands. However, it is known that multiple-recapture estimates suffer from finite-sample bias, which can be substantial in case of a small sample or a small (sub-)population size. This problem was recognised by Chapman (1951), who derived an estimator that is corrected for bias. Unfortunately, his estimator can only be applied in case of two samples, while in practice often more than two samples are needed to obtain accurate estimates. Therefore, we developed a generalized Chapman-estimator, which is new and can be used with any number of samples. We show in a Monte Carlo experiment that this new estimator shows hardly any bias and performs much better than competing bias-reduced estimators. Finally, a real data example on homelessness in the Netherlands shows that it can make a substantial difference in practice.

**Daan Zult, MSc**   has a background in econometrics and psychometrics, and for the past twelve years worked on various topics at Statistics Netherlands. One of these topics concerns the issue of partly unobserved populations, for which he developed a number of methodological improvements. Further details on the method are available in the paper that is available here: https://arxiv.org/abs/2311.01297.
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## Parallel session 2

14:15 - 14:40

## AI and the Future of Work in Analytics

### Dr. Inez Maria Zwetsloot
*Department of Business Analytics, University of Amsterdam*

Generative AI applications such as ChatGPT, GitHub Copilot, Bard, Midjourney, and others have created worldwide buzz and excitement due to their ease of use, broad utility, and perceived capabilities. This talk will introduce two projects both first attempts to understand the impact of ChatGPT on analytics.

In the first part, I will introduce ChatSQC, an innovative chatbot system that combines the power of OpenAI's Large Language Models (LLM) with a specific knowledge base in Statistical Quality Control (SQC). Our research focuses on enhancing LLMs using specific SQC references, shedding light on how data preprocessing parameters and LLM selection impact the quality of generated responses.

In the second part, I will share ongoing work focused on defining quality metrics to evaluate Generative AI's analytics capabilities. Currently, Generative AI systems are evaluated mainly in designing and training the LLM models that generate output in various forms depending on the user's request. The models are not, however, universally evaluated based on the quality of the output in terms of the output's fitness for use by the user. We therefore define user oriented quality metrics and evaluate, from a user perspective, the LLMs generated output in a variety of analytics tasks.

**Dr. Inez Maria Zwetsloot**   is an assistant professor in the Department of Business Analytics, University of Amsterdam. Her research interests include statistical process monitoring, network analysis, outlier detection, data science and statistical engineering. She received the Feigenbaum Medal (2022) from ASQ and the young statistician award from ENBIS (2021). She is a member of the board of ISEA, the International Statistical Engineering Association.
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# Data visualization for incomplete datasets in R

Hanne Oberman, MSc

*Utrecht University*

In many data analysis efforts, missing data are conveniently ignored. With default settings such as 'list-wise deletion' in analysis software, analysists need not even bother with the ubiquitous problem of incomplete data. I argue that this is wasteful: not only can missing data bias analysis results if not addressed well, but moreover, missing data can provide valuable insights into the phenomena of interest.

The visualization of incomplete data can uncover associations and intricacies between variables that may otherwise go overlooked. Which, in turn, can be leveraged in amending the missingness by means of imputation. The R package ggmice aids data analysts in exploring the missing parts of their data. In this presentation, I will showcase the use and usefulness of a data visualization workflow for incomplete datasets in R.

**Hanne Oberman, MSc** is a PhD candidate at Utrecht University, working on computational evaluation and data visualization in the Missing Data research group. She has developed the R package ggmice which facilitates data analysts in the exploration, evaluation, and imputation of incomplete data.
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# Appointment Scheduling with Updates

Dr. Alex Kuiper

*Amsterdam Business School, University of Amsterdam*

Traditionally, appointment schedules have been determined by minimizing a specific cost function consisting of clients' waiting times, server idling, and overtime. This intra-day problem is nearly always studied in a static sense because no further updates are given once a schedule is announced. However, technological advancements have opened up the possibility of communicating with upcoming clients during the day. Using such channels allows for updating appointment schedules on the fly. Yet, while the potential savings are clear, overly trying to control the session by sending many updates may be unrealistic in practice and cause client confusion and frustration. Therefore, two main research questions are studied to make interventions effective: how many updates and at what times updates should ideally be sent. For this purpose, the classical static appointment schedule is extended to a dynamic setting.

Under stochastic service times and no-shows, various practical considerations are incorporated in a dynamic scheduling framework with sending updates, including a grace period in which no updates are allowed to account for clients already underway. We find that the new schedules start more condensed to combat idle time and that already, with one or several updates, extreme waiting scenarios are largely averted. By rescheduling, the scheduler takes over control of a running session, and we find that updates should be equally spread to be most effective. The experiments further indicate that the costs are decreasing and convex in the number of rescheduling moments.

**Dr. Alex Kuiper** is an Associate Professor in the Department of Business Analytics at the Amsterdam Business School of the University of Amsterdam and a senior consultant at the Institute for Business and Industrial Statistics of the University of Amsterdam. In 2013, he received a double MSc in Stochastics & Financial Mathematics and Econometrics, and completed his Ph.D. in Operations Research at the University of Amsterdam in 2016. His current research includes various topics, such as operations improvement, logistics, and healthcare optimization. Joint work with Roshan Mahes MSc.
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