Mijn model implementeerde alle wensen als zachte restricties, dit om een toegelaten oplossing te kunnen garanderen. De gewichten waarmee schendingen in de doelfunctie werden beboet waren gekozen overeenkomstig de prioriteit van de wensen. De allerbelangrijkste wens was dat alle kinderen van hetzelfde gezin op dezelfde dagen naar school zouden gaan.

Als belangrijkste beslissingsvariabelen heb ik x_{ij} voor elke leerling i en elk deel $j \in \{A,B\}$ binair genomen: voor elke kind i moet idealiter een van x_{iA} of x_{iB} gelijk aan 1 zijn, en de andere is 0. Om een zachte restrictie te implementeren werd $x_{iA} + x_{iB} \leq 1$ genomen, terwijl de som over alle kinderen werd gemaximaliseerd. Voor elke gezin G worden voor alle kinderen $i \in G$ alle x_{iA} gelijk aan elkaar gesteld en ook x_{iB}. Om de delen zo gelijk aan elkaar mogelijk te krijgen werden twee variabelen per groep gedefinieerd voor de aantal kinderen in de kleinste en de grootste deel respectievelijk en het totale verschil werd geminimaliseerd. Alle andere randvoorwaarden werden op een gelijke manier gemodelleerd.

Dit is de gesimplificeerde code (zie ook de hierbij afgebeelde code) waarbij elk gezin in een deel als harde restrictie wordt gemoduleerd en enkel naar delen van zo gelijk mogelijke grootte wordt geoptimaliseerd. Het hierboven geschetste probleem is binnen 1,5 seconden op te lossen met de gratis CBC-solver (https://github.com/coin-or/Cbc).

De volledige puzzel – tegemoetkomend aan **alle wensen** wordt met dezelfde gratis *solver* in minder dan een minuut opgelost. Om de veranderingen niet te groot te laten zijn werd, bij elke toevoeging van een nieuwe wens, getracht om de nieuwe oplossing zo gelijk mogelijk aan de vorige versie te krijgen, dat wederom met zachte restricties. Als extra service heb ik, omdat ik toch in de Pythoncode zat, automatisch door middel van PyLaTex de indelingsbrieven in pdf laten genereren. Geen handwerk, geen knip- en plakwerk, geen fout.

Toen Thomas Davenport in 2012 data scientist het meest sexy beroep op aarde noemde, presenteerden zich in korte tijd op LinkedIn enorme aantallen data scientists. Helaas beschikt slechts een minderheid daarvan over serieuze kennis van wiskunde, statistiek of (nog minder!) mathematische besliskunde. Dat is jammer, want alleen dan kan men dit soort problemen uit het dagelijks leven op een snelle en gemakkelijke manier oplossen.

In deze tijden van lockdown raad ik van harte het geweldige boek *Operationele analyse* (2002) van onze trouwe columnist Henk Tijms aan. Samen met *Pyomo; optimization modeling in Python* van William Hart en Carl D. Laird (2017) komt u een heel eind!

* De medezeggenschapsraad – waarvan ik deel uitmaak – gaf toestemming om de gegevens over gezinssamenstelling onder strikte voorwaarden en enkel voor dit doel te gebruiken. De gegevens zijn anoniem en onherkenbaar verwerkt.

Joaquim Gromicho is sinds januari 2021 hoogleraar Business Analytics aan de Universiteit van Amsterdam. Ook is hij Science & Education Officer bij ORTEC en hoofdredacteur van *STAtOR*.
E-mail: Joaquim.Gromicho@ortec.com

```
# example data
groups   = { 1 : ['a','c'], 2 : ['b','d'] }
families = [ ['a','b'], ['c'], ['d'] ]

import pyomo.environ as pyo

m       = pyo.ConcreteModel( 'split' )
m.part  = [ 'A', 'B' ]
m.child = {c for f in families for c in f}
m.group = groups.keys()

def familyPairs(m):
    return [ (i,j) for f in families for i,j in zip(f[:-1],f[1:]) if len(f) > 1 ]
m.together = pyo.Set( dimen = 2, initialize = familyPairs )

m.x        = pyo.Var( m.child, m.part, within=pyo.Binary )
m.minPart  = pyo.Var( m.group, within=pyo.NonNegativeReals )
m.maxPart  = pyo.Var( m.group, within=pyo.NonNegativeReals )

m.objective = pyo.Objective( expr = sum( m.maxPart[g]-m.minPart[g] for g in m.group ),
                             sense= pyo.minimize )

m.choose = pyo.Constraint( m.child,
                           rule = lambda m,c : sum( m.x[c,p] for p in m.part ) == 1 )
m.join   = pyo.Constraint( m.together, m.part,
                           rule = lambda m,i,j,p : m.x[i,p] == m.x[j,p] )
m.below  = pyo.Constraint( m.group, m.part,
                           rule = lambda m,g,p : sum( m.x[c,p] for c in groups[g] ) >= m.minPart[g] )
m.above  = pyo.Constraint( m.group, m.part,
                           rule = lambda m,g,p : sum( m.x[c,p] for c in groups[g] ) <= m.maxPart[g] )
```

Code (gesimplificeerd) voor het indelen van schoolklassen met een aantal restricties

VVSOR

VVSOR shows a growing collaboration between disciplines focused on the visibility of statistics and operations research. Despite the troubling times we all faced during 2020, there was a huge increase in the presence of data analysis in society. Never before were phrases like “curve flattening”, “false positive diagnostic tests” and “vaccine efficacy” so widespread.

Several of our members became the face of the scientific response to the pandemic, of the cross-discipline collaboration, data literacy and healthy skepticism. One noteworthy example is prof. dr. Casper Albers. With his columns for the newspaper *de Volkskrant*, Casper Albers encourages his readers to arm themselves with statistics to fight the threat of fake news. In the University of Groningen university newspaper, he empowers both students and employees to be the future of the university. And many news outlets seek his advice, like Nu.nl and *Het Dagblad van het Noorden*, or television shows like Human’s *Medialogica*. Casper is an important voice in the scientific landscape that has argued for critical changes to decrease sloppy research and for a bottom-up approach to scientific progress.

It is with great pride that we announce the candidacy of Casper Albers to be the next president of the VVSOR. At the Annual Meeting of March 18th, if the meeting votes in favour, Casper will succeed Fred van Eeuwijk who served as the VVSOR’s president for four years. Next, Casper gives us a quick introduction.

The VVSOR Daily Board

Foto: Bob Bronshoff

Letter from the president elect

During the Annual Meeting, the Society can elect me as successor of Fred van Eeuwijk. As the next President, I hope to contribute to the visibility of our society, towards our own members as well as towards society at large. The current daily board made great improvements to the administrative structure of our society. The new board can therefore focus on the future: how do we achieve a steady stream of new, young members and how do we stay relevant for the next ten years or so? I hope to contribute to those challenges.

Casper Albers

Casper Albers received his PhD in Groningen in 2003, under the supervision of Willem Schaafsma. After two postdocs he returned to Groningen in 2009, to join the Faculty of Social and Behavioural Sciences. Here, he holds the chair on Applied Statistics and Data Visualisation. His research focuses on longitudinal models for psychological data and statistics communication. Within VVSOR, Casper has served as the president of the social science section for several years. Outside the VVSOR he fulfilled roles as Research Director of the Heymans Institute for Psychological Research, board member of the International Association for Statistical Computing and as a board member of the Groningen University Fund.

Going Viral

Modeling spread

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

ONLINE

Thursday March 18, 2021

12:00 – 17:15

Four international speakers will reflect on modeling Going Viral and modeling spread, or how to reduce the spread of COVID-19, from their respective fields by using concepts from both statistics and OR. Invited speakers:

- Prof. dr. N.V. (Nelly) Litvak
- Prof. dr. G. (Gavin) Shaddick
- Prof. dr. D.J. (Dimitris) Bertsimas
- Prof. dr. J. (Jacco) Wallinga

For the first time, this year the Annual Meeting will be an online streaming event on Zoom and Youtube. We will have a general assembly for members, followed by the actual event with four talks and two award presentations. The AM 2021 will held in English.

Registration is open, please register on the vvsor-website https://www.vvsor.nl/articles/vvsor-annual-meeting-2021. This year's annual meeting is free of charge, and members can receive a small snack box if they register early.
E-mail: annualmeeting@vvsor.nl

DATE
Thursday, March 18, 2021

VENUE

Online via Zoom and Youtube

REGISTRATION
Registration for the conference is mandatory at www.vvsor.nl/articles/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 18, 12:00 – 13:00. The relevant documents will be provided on the website two weeks before the meeting.

LUNCH, COFFEE, TEA AND DRINKS
The first 100 members who register before March 1st 2021 can ask for a snack box to be sent to their home address before the meeting.

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

REGISTRATION ENDS AT MARCH 16!

12:00 – 13:00	**Annual General Meeting (ALV)**
13:00 – 13:30	Lunch break
13:30 – 13:45	**Welcome** and **Opening Talk** by Casper Albers, President of the VVSOR
13:45 – 14:15	**Containment strategies for COVID-19 using mobility data** Nelly Litvak, *University of Twente | Eindhoven University of Technology*
14:15 – 14:45	**Incorporating time-use and health data into a Dynamic Microsimulation Epidemiological model for COVID-19** Gavin Shaddick, *University of Exeter*
14:45 – 15:15	Break
15:15 – 15:45	**From predictions to prescriptions: A data-driven response to COVID-19** Dimitris Bertsimas, *Sloan School of Management at MIT*
15:45 – 16:15	**Ceremony of the Willem R. van Zwet Award & the Jan Hemelrijk Award** Prize winners will be presented by the juries, followed by a short presentation by the laureates
16:15 – 16:30	Break
16:30 – 17:00	**Curbing the spread: observations, interventions, models, and predictions** Jacco Wallinga, *Leiden University | RIVM*
17:00 – 17:15	**Final discussion with speakers** & Closure

13:45 – 14:15

CONTAINMENT STRATEGIES FOR COVID-19 USING MOBILITY DATA

Prof. dr. N.V. (Nelly) Litvak

University of Twente | Eindhoven University of Technology

In their response to the COVID-19 outbreak, governments face the dilemma to balance public health and economy. Mobility plays a central role in this dilemma because the movement of people enables both economic activity and virus spread. We use mobility data in the form of counts of travelers between regions, to extend the often-used SEIR models to include mobility between regions. We quantify the trade-off between mobility and infection spread in terms of a single parameter, to be chosen by policy makers, and propose strategies for restricting mobility so that the restrictions are minimal while the infection spread is effectively limited. We consider restrictions where the country is divided into regions, and study scenarios where mobility is allowed within these regions, and disallowed between them. We propose heuristic methods to approximate optimal choices for these regions. We evaluate the obtained restrictions based on our trade-off. The results show that our methods are especially effective when the infections are highly concentrated, e.g., around a few municipalities, as resulting from superspreading events that play an important role in the spread of COVID-19. We demonstrate our method in the example of the Netherlands. The results apply more broadly when mobility data is available.
Joint work with: Martijn Gösgens, Teun Hendriks, Marko Boon, Stijn Keuning, Wim Steenbakkers, Hans Heesterbeek and Remco van der Hofstad.

Nelly Litvak is Professor of Algorithms for Complex Networks at the University of Twente and Eindhoven University of Technology in the Netherlands. She obtained her PhD in Stochastic Operations research from Eindhoven University of Technology in 2002. Her research interests include random graphs, randomized algorithms, and applications in large networks such as on-line social networks and the World Wide Web.

14:15 – 14:45

INCORPORATING TIME-USE AND HEALTH DATA INTO A DYNAMIC MICROSIMULATION EPIDEMIOLOGICAL MODEL FOR COVID-19

Prof. dr. G. (Gavin) Shaddick

University of Exeter

The need to inform policies and mitigation measures aimed at reducing the spread of the coronavirus highlights the need to understand the complex links between our daily activities and opportunities for the virus to spread. The national lockdowns, and more localised measures, have aimed to reduce the number of contacts between susceptible members of the population and those with the disease. Here, we develop a micro-simulation modelling framework and methods for its computational implementation that brings together epidemiological modelling, urban analytics, spatial analysis and data integration to provide the ability to assess the effects of past interventions and forecast the effects of future policy decisions. This information will be crucial in gaining a greater understanding of the effects of future policy decisions in different areas and within different populations. We demonstrate the use of the model in a case study based on the county of Devon where we compare the effects of different lockdown strategies and present a computationally efficient approach to running complex simulation models of this type.

Gavin Shaddick is Professor of Data Science and Statistics and Head of the Department of Mathematics at the University of Exeter. His focus in research is on the theory and application of Bayesian hierarchical models and spatio-temporal modelling in several fields including epidemiology, environmental modelling, and disease progression in rheumatology. Important applications are estimating the hazards of global air quality and research in the power industry. For this, computational techniques that allow the implementation of complex statistical and spatial models are used, with particular attention to the propagation of uncertainty throughout the modelling process.

15:15 – 15:45

FROM PREDICTIONS TO PRESCRIPTIONS: A DATA-DRIVEN RESPONSE TO COVID-19

Prof. dr. D.J. (Dimitris) Bertsimas

Sloan School of Management, MIT

The COVID-19 pandemic has created unprecedented challenges worldwide. Strained healthcare providers make difficult decisions on patient triage, treatment and care management on a daily basis. Policy makers have imposed social distancing measures to slow the disease, at a steep economic price. We design analytical tools to support these decisions and combat the pandemic. Specifically, we propose a comprehensive data-driven approach to understand the clinical characteristics of COVID-19, predict its mortality, forecast its evolution, and ultimately alleviate its impact. By leveraging cohort-level clinical data, patient-level hospital data, and census-level epidemiological data, we develop an integrated four-step approach, combining descriptive, predictive and prescriptive analytics. First, we aggregate hundreds of clinical studies into the most comprehensive database on COVID-19 to paint a new macroscopic picture of the disease. Second, we build personalized calculators to predict the risk of infection and mortality as a function of demographics, symptoms, comorbidities, and lab values. Third, we develop a novel epidemiological model to project the pandemic's spread and inform social distancing policies. Fourth, we propose an optimization model to re-allocate ventilators and alleviate shortages. Our results have been used at the clinical level by several hospitals to triage patients, guide care management, plan ICU capacity, and re-distribute ventilators. At the policy level, they are currently supporting safe back-to-work policies at a major institution and equitable vaccine distribution planning at a major pharmaceutical company, and have been integrated into the US Center for Disease Control's pandemic forecast.

Dimitris Bertsimas is currently the Boeing Professor of Operations Research, the Associate Dean of Business Analytics at the Sloan School of Management, MIT. He received his MSc and PhD in Applied Mathematics and Operations Research in 1987 and 1988 respectively. His research interests include optimization, machine learning and applied probability and their applications in health care, finance, operations management and transportation. He is the editor in chief of I*NFORMS Journal of Optimization* and former editor of *Optimization for Management Science* and *Financial Engineering in Operations Research*.

16:30 – 17:00

CURBING THE SPREAD: OBSERVATIONS, INTERVENTIONS, MODELS, AND PREDICTIONS

Prof. dr. J. (Jacco) Wallinga

Leiden University | RIVM

The advent of the SARS-CoV-2 virus that causes COVID-19 has elicited an unprecedented research effort to understand the spread, to develop effective interventions, and to predict the possible impact of control measures on the course of the epidemic. Key observations include the number of reported cases over time, and essential interventions include physical distancing and vaccination. The models that are used to describe such observations and analyse the impact of such interventions typically invoke a basic representation of the infection cycle: persons can only be infected after exposure to others who have been infected earlier. Combining such a basic causal model structure with the available observations already allows for predicting the expected impact of control measures. The question is then how this ability to describe, analyse and predict observations can be used to curb the spread.

Jacco Wallinga holds the chair in Mathematical Modelling of Infectious Diseases at the department of Biomedical Data Sciences of the Leiden University Medical Center (LUMC). As an extraordinary Professor, he works on the estimation and prediction of control measures on the dynamics of infectious diseases. He became head of the RIVM department of Modelling of Infectious Diseases in 2005. He published over 150 articles in international peer-reviewed scientific journals and is a member of the editorial board of Epidemiology. He advises the Dutch government and international organizations on vaccination policies