

# IFORS



# NEWS

International Federation of Operational Research Societies

From the President

## OR in Lockdown

Grazia Speranza <grazia.speranza@unibs.it>

On February 21st, 2020 the COVID-19 was officially identified for the first time in an Italian patient. Hectic and confused weeks followed. A red area was defined. Citizens were not allowed to leave or enter that area. Every day news confirmed cases of infected Italians. Increasing numbers. In the red area first but then outside the red area. Surprise, worries, shock, disbelief. I live in Bergamo and work in Brescia. The virus got every day closer and closer to me. It was in China first (very far), then in the red area (60 km from my home), until I started hearing the ambulance sirens. We were in lockdown and the sirens were the only noise breaking the silence of day and night.



The main hospitals in Bergamo and Brescia started having cases, few at the beginning and then more and more and more. Hundreds of people waiting in the emergency room of the hospitals who could hardly breathe. Bilateral interstitial pneumonia, for all. Doctors and nurses were not enough, beds were not enough, ventilators were not enough. My university graduated 70 nurses two months in advance with respect to what was planned and they all started working immediately. Intensive care units were too small, by far. The destination of hospital wards was changed, now for COVID-19 patients. Most patients with other health problems were not accepted. Most surgeries postponed. All the resources absorbed by the COVID-19.

And then I started receiving news of friends and people I knew severely ill, at home, in hospital, dead. Italy, and Bergamo and Brescia in particular, have been for some time in the news all around the world. Then, the virus started hitting other countries, unfortunately. And others went through the hard days we had experienced. Hopefully, the Italian experience has helped shaping strategies.

The COVID-19 emergency has raised huge challenges for the world, for all of us. When will a vaccine become available? How can people be treated in the meantime? How can we protect the health of people without destroying the economy? Where are the face masks, the gloves, the personal protective equipment? Why the supply chains have not provided us with the needed products? What should we do to avoid falling back into the dramatic situation we have experienced?

Scientists are called to contribute to the problems raised by the COVID-19 emergency, worldwide. Operational researchers cannot search for a vaccine but there are many very important problems we can contribute to solve. Huge amounts of data will become available about patients hit by the virus. What relevant information can be extracted? Who are the fragile people who should be more carefully protected? And how can scarce resources, doctors, nurses, medicines, be distributed in an optimal way? Which patients should stay at home and which go to hospital? What is the optimal way to keep the patients at home under control through site visits?

I really hope to see in our journals in the next months and years several papers on COVID-19 related topics that will show that operational researchers can and want to contribute to the solution of crucial problems for the well-being of the world. 🌍

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### Editorial Box

# From the Editor

**Sunity Shrestha Hada** <sunity.shresthahada7@gmail.com>

The pandemic COVID-19 has created a scene in the world where our own hand is our enemy, as the doctors say that the corona is infected through your eyes, mouth and noses which is under direct contact of our hands. Also, the social distancing has been a great punishment to the human being who is supposed to be the social animal. The impact of COVID-19 on the economy, the labor force, the education, health, industry and almost all domain of human life is a challenge to the world. Only positive impact experienced during the lockdown period is the 'pollution free nature and the environment'. The effect of corona to the IFORS 2020 conference at Seoul is its postponement at present, but hope to happen the event in near future. Whatsoever, the show must go on, and the June issue of IFORS Newsletter is now released.

The June issue includes the reports from AC members including the messages from President Grazia Speranza, immediate past President Michael Tick, Vice President of IFORS Chang Won Lee and the treasurer Richard Hart. It covers the reports of the regional societies from vice-presidents of ALIO by Rosiane Freitas, APORS by Sunity Shrestha Hada, EURO by Stefan Nickel and NORAM by Karla

Hoffman. The only publication of IFORS, i.e. ITOR so far is also presented in this issue by Stefan Nickel and Celso Ribeiro. The report about the IFORS award for 'OR in Development' and the six finalists is presented by Mario Guajardo. This issue includes all the features like articles on OR Development, OR Impact, the Tutorial and the report on conferences by Gerhard-Wilhelm Weber. The report from the program chair of IFORS 2020 conference Natasha Boland describes the status of the conference after the outbreak of COVID-19.

The current situation might be a challenge to OR personnel to explore the modeling and scientific solutions of the problems arisen due to COVID-19 on the socio-economic imbalances.

Please take care of you and your family and stay safe. Let's hope to see in the IFORS conference very soon. 🌐



## IFORS Award for OR in Development

**Mario Guajardo** <mario.guajardo@nhh.no>

In the past issue of the newsletter, we announced the six finalists of the IFORS Prize for OR in Development 2020. Initially, the plan was to hold the presentations of the finalists during the IFORS Triennial conference in Seoul, and to announce the winner during the conference banquet. However, since the conference has been postponed, the finals of the IFORS Prize for OR in Development will also be postponed until the conference is rescheduled.

In these special times where the COVID-19 pandemic is impacting the global population in drastic ways, I would like to remark the importance of our OR field in practice. The IFORS Prize for OR in Development inspires us with wonderful examples in this regard. The prize aims to showcase and acknowledge high quality use of OR in practice in developing countries. Past winners and finalists include works that have improved health, wellness, education, public investments and other issues in Africa, Asia and Latin America. The 2020 finalists include works on very important problems, such as wildfire detection in South Africa, vaccine distribution in Mozambique, minimization of flood impact in Vietnam, design and implementation of the school choice system in Chile, waste collection in Tunisia, and rural water network design in India.

Together with acknowledging the authors for the high quality of their submissions, I would also like to acknowledge their understanding and patience while waiting for the rescheduling of the final presentations. Likewise, I am grateful to the eight members of the panel of judges, who have done a great job by rigorously assessing all the submissions and selecting the finalists.

In the forthcoming issues of the newsletter, we will be featuring more details of the finalist works. Stay tuned! 🌐



# IFORS 2020 Meets Covid-19

Natasha Boland, Program Chair



Plans for the IFORS 2020 Conference in Seoul, South Korea were proceeding very well just a couple months ago, with over 2,000 abstracts submitted, about 3/4 of those invited and 1/4 contributed, plus a terrific line-up of exciting plenary, keynote and industry speakers. My warmest thanks to the phenomenal efforts of the Program Committee members, Area Co-Chairs and all of the Stream Chairs and their Session Chairs, who generated so many wonderful submissions and kept the world informed of the event. My utmost thanks too, to the Organizing Committee, who undoubtedly spent many, many hours on promoting the event and ensuring that the website was informative and attractive, as well as numerous tasks behind the scenes. They have worked incredibly hard.

But as we all know, those couple of months have been very long ones, and the best-laid plans often go astray.

Before talking about the implications of events of these months for IFORS 2020, I first give my heartfelt sympathy and deepest condolences to all those who have been ill, lost family or friends, or in any way been hurt or faced hardship as a result of the spread of covid-19 throughout the world. This is a tragic year for so many people, and it is far from over. In the face of such a huge challenge as covid-19 poses, there has also been the inspiration of so many people coming together to fight the disease, and to support and help each other manage through its consequences. This has been a time when everyone in the world can clearly see and feel our shared humanity and our deep connectedness.

Among these are many from our Operations Research community, who have been and surely will be working on many aspects of the problem, from disease spread simulation models to understand the impacts of public health strategies on fighting the disease to decision support for logistics needed to respond to changes in demand as a result of the pandemic. I look forward to being awed and inspired by your creativity, energy and passion when you share those experiences with us at IFORS 2020, when it is finally able to convene.

On that note, we come to plans for IFORS 2020 in a covid-19 world. Given the current uncertainties, no definite plan is finalized, but certain likelihoods are developing.

1. Recognizing the enormous value that IFORS Triennial conference participants get from meeting each other face-to-face, and joining together in person to learn about and celebrate each other's progress in the field, we plan to retain the usual, in-person format of the conference for IFORS 2020. There is consideration of some online elements, in case these are needed, but the conference will only go ahead at a time that is viable and safe to do so, in person.

2. We hope that at some time in the later half of 2021 it

may again be safe to hold such a meeting. We are currently investigating possible dates that avoid clashes with other large international meetings, that remain feasible for venues, and that offer a good chance that people from around the world can safely attend.

3. Until dates are decided, it is hard to know for sure, but we are optimistic that most highlight speakers (plenary, keynote and industry) will be able to remain in the program, which will be truly wonderful for the event.

4. To maximize re-scheduling flexibility, alternative venues, such as moving to a campus setting, for example, that of Hanyang University, are under consideration. If we change to a campus setting, we may miss the excitement and dynamism of the COEX environment, but we will gain the scholarly and youth-filled energy of a campus.

5. All abstracts currently in the system are being kept, to facilitate communication with you all. Closer to the dates that are ultimately decided for IFORS 2020, authors will have the chance to decide what they want to do about their abstracts.

Although we can provide no definite decisions at this time, we very much appreciate your patience and solidarity throughout this process. Our Korean colleagues handling the conference registration refunds and hotel booking cancellation processes had to do so at a time when Korea was becoming very pressed by the covid-19 crisis, and I know that we are all extremely grateful for their efforts under such difficult circumstances.

On a personal note, I will mention that I have been extremely impressed by the response of South Korea to the covid-19 crisis. They initially faced an extraordinarily large outbreak, but quite quickly thereafter were able to reduce the rate of the disease spread. The strength of their public health measures have enabled them to return with relative safety to relatively normal operations, thanks in part to inventive and swiftly deployed new mobile cell phone apps developed in collaboration with leading Korean technology companies and to AI-based tools from leading Korean experts. Interested readers may appreciate the article from ITU News, a service of the United Nations, published on 2nd April 2020: <https://news.itu.int/covid-19-how-korea-is-using-innovative-technology-and-ai-to-flatten-the-curve/> As a result of this, I have enormous confidence in South Korea as the destination for my first, post-covid-19, conference!

To conclude: I hope that, irrespective of the year in which it actually happens, IFORS 2020 will stand for a clear, "20-20", vision for all of us, for our connectedness to each other, and for our relationships within the world ecosystem. I wish you all the best of health and safety for your families and loved ones in the coming months. 🌐

# Report of the IFORS President

Grazia Speranza <grazia.speranza@unibs.it>

## My first year as IFORS President

I started my term as IFORS President on January 2019. In 2018 Mike Trick, IFORS President at the time, had kindly invited me to join the calls of the IFORS Administrative Committee, which was very useful to start understanding how IFORS functions and also to start thinking about how I might contribute during my term.

I am very grateful to Mike for his commitment to IFORS and well organized management style, and for his availability whenever I needed his help. He has been a great IFORS President.

I started my adventure with IFORS realizing that there are not many options for choosing the time of the day to hold a video call of the Administrative Committee (AC). It should always be around 3pm (Italian time). The reason is that 3pm for me is 9am for Mike and Karla Hoffman and Mary Magrogan, all from the United States, and 10pm for "David" Chang Won Lee, IFORS Vice-President, from Korea.

During the first weeks of 2019, I had one-to-one calls with the AC members to get to know each other and build the trust to work well together. And also to understand what they could be interested to be involved in. I was happy to find in each of them enthusiasm and availability. And I am grateful for that to each to them personally. We agreed that Karla Hoffman, representing NORAM for the second time, would remain responsible for conferences; Stefan Nickel, representing EURO, would be responsible for publications; Rosiane de Freitas, representing ALIO, would chair the Developing Countries Committee; Sunity Shrestha Hada, representing APORS, would become the Editor of the Newsletter; and, last but not least, "David" Chang Won Lee, the Vice-President, would lead the project aimed at redesigning the IFORS web site. The IFORS finances remained in the capable hands of the IFORS treasurer, Richard Hartl.

In 2019 I had monthly video calls with the IFORS AC, the IFORS secretary, Mary Magrogan, and her assistant, Christy Blevins. We all met in person in Dublin in June, in occasion of the 30-th EURO conference. I had also the pleasure to introduce Bill Cook, IFORS Distinguished Lecturer, who gave an incredibly successful lecture on "The Traveling Salesman Problem: postcards from the edge of impossibility".

Let me briefly summarize the IFORS activities we carried out in 2019.

**Conferences.** In 2019 we all focused on our triennial

conference IFORS2020, to be held in June 2020 in Seoul. The Organizing Committee chair Suk-Gwon Chang and the Program Committee chair Natasha Boland did a fantastic job in organizing and promoting the conference. We were all excited, confident we

were going to have a great conference. Shortly after the deadline for the submission of the abstracts, the COVID-19 started hitting Italy. It took us few weeks to understand that there was no hope to hold IFORS2020. It is hard to express in few words how painful this decision has been for us all, and for me personally.

**Publications.** International Transactions of Operational Research, the IFORS journal, continues to improve in terms of its impact and the quality of the papers published. More information is available in an article dedicated to ITOR.

**Website.** The IFORS website is the window through which we present the IFORS activities to our community and to all those who are interested to know more about us. After a certain period of time any website needs to be redesigned. We agreed this was the right time to start rethinking the content and the design.

**Newsletter.** The IFORS Newsletter remains an excellent source of news about the activities of the IFORS Administrative Committee and of insights into the operational research world.

**Developing Countries Committee.** The Committee has been renewed in terms of composition but maintains the same goal of the past, that is that of promoting operational research in the areas where our discipline is least known, and support the creation of new operational research societies, with particular attention to Africa.

**Finances.** The finances of IFORS are solid, due to the wise management of the IFORS savings by the previous Presidents and Treasurers. However, we realized that, after the loss of the income coming from the International Abstracts of Operational Research, we should work on new initiatives that have the potential of bringing new income streams.

We are continuing in 2020 all the above activities. We are also raising new ideas and exploring whether an event can be organized in the future to replace our IFORS2020. We will keep our community informed of any progress. 🌐



# Report of the Immediate Past President

**Michael Trick** < trick@cmu.edu >

The role of Past President of IFORS has no clearly defined boundaries: the Past President provides an historical perspective of IFORS activities and aids the President in implementing her vision and activities. For 2019, the primary responsibility was on issues related to registration of IFORS as a charitable organization so that, for instance, IFORS could receive donations rather than rely solely on conferences and publications to support its activities. This process is longer and more involved than anticipated, but that is the nature of a highly distributed international organization.

It is wonderful to see IFORS continue to grow with interests from a number of countries in forming OR societies and joining IFORS as members. This is particularly strong in Africa where the economic development is spurring interest in the use of data in making decisions, a hallmark of operational research. And, while we sadly lost International Abstracts in Operational Research in 2018, there is still clearly a need for more publication outlets for all the research being done in our field, particularly work

from developing countries on problems faced by those countries.

My report is to concentrate on 2019, but the situation in May, 2020 cannot be ignored. All the hard work of the organizing and program committees for our Triennial in Seoul has been disrupted as that conference has had to be delayed, ideally to be held in 2022. But the world of operational research is instrumental in facing the coronavirus issues that the entire world is confronting. It is only through the use of data and the decisions that come from OR that we will all get past this issue. It is heartening to see OR researchers around the world rallying to this challenge. 🌐



## Report of the IFORS Vice President

**“David” Chang Won Lee** < leecw@hanyang.ac.kr >

2019 was the first year for a three-year IFORS Vice President term. The vice president's responsibility was to help the president analyze and address activities that IFORS plans, prepares and implement. It also included coordinating important discussions, interacted and discussed the details and criteria for resolving current and emerging issues.

The first task in 2019 was to discuss the assignment with Garcia, the president. We discussed who will be assigned what for next year and also challenges faced by future IFORS. Luciana sincerely shared her past three years of experience as vice president. Through the precious experiences and time of many predecessors and co-workers, the activities of the first year went smoothly.

There were so many issues and agenda discussed through the IFORS AC (Administrative Committee) monthly meetings. Some important issues were selecting a new editor for IFORS newsletter, registering IFORS in Switzerland, scheduling IFORS Seoul meeting, developing new journal, attending EURO Dublin conference, deciding 2023 IFORS Conference and announcing 2026 Call for Host Societies, estimating 2020 budget, discussing with Latvia Society, Paraguay Society and South African initiatives, discussed joint events with other international organizations and other various activities. Analyzed and discussed global and new IFORS initiatives and many conflicting activities. To that end, AC discussed issues and agendas in its monthly conference calls.

In 2019, my primary activities among others were reviving education committee and redesigning IFORS website. Although educational activity is important, there has been little activity in the last few years. I wanted to emphasize the importance of education activity in IFORS. So, while developing and presenting proposals for IFORS educational programs, it has been discussed as an important agenda in AC meetings. Currently, it is underway to find a better educational activity.



The next major activity was to redesign IFORS homepage. The IFORS homepage has been around since it was designed in 2012 and has not changed much. To this end, we discussed a redesigning sitemap and a platform with Grazia, Mary, Christy and Ruel through conference calls. Now it keeps updating to be effective to member societies and visitors and linked to the 2020 Seoul meeting website. Currently, the homepage is being developed to be a more user-oriented homepage. In 2019, I wanted to create more value through study tours in China, Eswatini, New Zealand, Ireland, Vietnam and USA, and wanted to convey this value to IFORS growth. In order to make a better IFORS, I want to hear the advice and thoughts of experienced and volunteers who love IFORS. 🌐

# Report of the Treasurer

**Richard Hartl** <richard.hartl@univie.ac.at>

The 2019 budget (approved by the IFORS AC) showed an operating deficit of \$ 91,040. In years without an IFORS triannual conference, we usually observe a deficit and the above number was a conservative forecast. It turned out that IFORS did financially much better than that. Before accruing (done by the auditor) the unaudited budget shows a deficit of \$ 64,587.

What follows is a summary of the unaudited results for 2019 (all numbers in \$US). The publication revenues of \$ 57,051 from ITOR were below the budget of \$60,000, mainly due to exchange rate differences. Publication revenues from IAOR have stopped in 2018 since this journal is not published anymore. Members' dues collections at \$ 21,121 were slightly below budget. Interest

revenue continued to be positive but small due to the globally low interest rates. The net effect of these revenue movements was an income of \$ 81,769, a bit lower than the budget of \$ 84,000.

2019 spending at \$ 146,355 was about the same as 2018, and significantly below budget (\$ 175,040). Only a few items were slightly above budget, the expenses for the ITOR editors, webhosting for the past IAOR volumes, and preparations for the triennial conference IFORS



2019 IFORS Financials			
		Approved Budget 2019	Unaudited Actual 2019
<b>INCOME</b>			
Member Society Dues		22 500	21 121
Royalties ITOR		60 000	57 051
Interest		1 500	3 597
<b>TOTAL INCOME</b>		<b>84 000</b>	<b>81 769</b>
<b>EXPENSES</b>			
Activities			
	Administrative Committee	15 000	16 444
	Publications Committee		
	IAOR Webhosting	1 200	1 951
	ITOR Editor	26 000	30 173
	Other		726
	Scientific Activities & External Affairs		
	IDL, ITL, Fellowships, & Grants	13 000	5 615
	IFORS Website	7 000	4 448
	Summer/ Winter Schools	10 000	6 500
	Meetings Committee		
	Seoul 2020	7 000	10 563
	IFORS Newsletter	11 000	4 371
	Developing Countries Committee	8 000	600
General Business Operations			
	Office & Secretary	60 840	60 255
	Auditor	2 000	1 905
	Bank Charges	1 500	1 462
	Contingency	2 500	
	Preparation new legal structure	10 000	685
	Other		659
<b>TOTAL EXPENSES</b>		<b>175 040</b>	<b>146 355</b>
<b>OPERATING RESULT</b>		<b>(91 040)</b>	<b>(64 587)</b>

2020 in Seoul. All other items remained below budget, most remarkably the expenses for IFORS distinguished lectures (IDL) and IFORS tutorial lectures (ITL), for summer schools, for website, newsletter, and for the Developing Countries Committee. The latter does not mean that less activities for Developing Countries were made, but that the organizers of the corresponding events found other sources of funding.

As mentioned, a deficit of \$ 91,040 was budgeted, while end of December the actual unaudited deficit was \$ 64,587. The audited statements will be slightly different as a result of the way that the auditors handle accruals.

Total assets of IFORS consist of checking accounts with the Bank of Ireland and the Bank of America and Investments with the Bank of Ireland, totaling \$ 1,426,466 by the end of 2019. Typically, the audited numbers will be slightly higher mainly because part of the ITOR profit share (for 2019) is paid in the year after (2020) while the auditor does some accruing and adds these to credits in 2019.

Summing up, 2019 did not materially change IFORS financial strength. In view of the Federation's financial position, no change in member society dues is recommended at this time. However, since the annual deficits remains high, IFORS will have to find additional sources of income.

Typically, in a year with a triannual conference such as 2020, IFORS makes a profit or a smaller deficit. The conservative 2020 budget (approved by the IFORS AC in 2019) shows an operating deficit of about \$ 5,000. However, the IFORS triannual conference 2020 in Seoul had to be cancelled or deferred to 2021. Consequently, all the income and some expenses in connection with this conference will disappear. Due to the global lockdown because of Covid-19, less activities and travels will be made in 2020, which is why a deficit somewhat smaller than that in 2019 is expected. 🌐

# Report of the Vice President representing ALIO

Rosiane de Freitas <rosiane@icomp.ufam.edu.br>

In this time of COVID-19 pandemic, in which only at the end of April, there were more than 200,000 people infected with more than 10,000 deaths in Latin America, I would like to thank the entire scientific community, including the OR multi/interdisciplinary field, who is running against time trying to mitigate losses and damages, and find feasible solutions.

The Association of Latin-Iberoamerican Operational Research Societies (ALIO) was created in Rio de Janeiro in November 1982, with the purpose to promote the exchange of experience and information among researchers, academics and professionals related to Operational Research in the region, as well as the circulation of techniques and methodologies related to these disciplines. ALIO is also the Latin American Regional Chapter of IFORS. National societies taking part in ALIO are those from Argentina, Brazil, Chile, Colombia, Cuba, Ecuador, México, Perú, Uruguay, Spain, and Portugal. These societies are also part of IFORS with the exceptions of Ecuador and Cuba.

The main activity of ALIO is its biennial meeting the Latin-Iberian-American Conference on Operational Research, CLAIO. The last CLAIO was held in Lima, Peru, in 2018 (see <http://www.sopios.org.pe/claio2018>). The next one, due to the COVID-19, was postponed until next year, from August 30th to September 1st, and will be held in Madrid, Spain. For more information, please visit <https://claio2020.com/en/>

Another important activity of ALIO is the organization of an annual Latin-Iberian-American OR school (ELAVIO). The first ELAVIO was held in Chile in 1994. Since then, the School has run the event every summer to promote education in operational research among young researchers and graduate students (Ph.D. and Master's degree levels), mainly from Latin America. The purpose of ELAVIO is to stimulate new collaborations and encourage the involvement of young people in OR by bringing them up to date on research topics through short courses and plenary conferences. Participants also have the opportunity to present and discuss their works. At every School, a strong sense of camaraderie has developed, solidifying contacts between the members of research groups from different countries.

The last edition, XXIII ELAVIO was held in Lleida, Spain, from July 1-5, 2019, as reported in September 2019 issue of IFORS News. See in <http://www.elavio2019.udl.cat/>. The next edition, XXIV ELAVIO, which would be held in 2020, was postponed to 2021, on a date to be defined, while maintaining the place, in the city of Arequipa, Peru. For more information, please visit <https://sites.google.com/site/elavio2020/>.

During 2019 and early 2020, important and relevant Operational Research events were organized and

carried out by ALIO and the OR societies that are part of ALIO in the different countries. As of April this year, most of the major events in Latin American countries have also been postponed (or even canceled) and many have moved to virtual mode. An example is the OR Brazilian Symposium (SOBRAPO), which was postponed to November 3-5, in virtual mode (see <https://sbpo2020.galoa.com.br/>). For more information on other OR LATAM events, please visit ALIO's website: <http://www.alio-online.org/>.



## Developing Countries Committee (DCC)

As chair of the Developing Countries Committee (DCC) since 2019, I have been involved in deliberating several pertinent issues concerning the developing countries committee activities. Some of these activities were related to the interaction with the OR research groups and societies in Africa. One important action was to support the sequence of the Operations Research Techniques and Applications School for Africa (ORTASA). The first edition took place in 2018, in Dangbo, Benin, November 20-29, as reported in the March 2019 issue of IFORS News. The second edition, which would take place in 2020, was postponed due to the COVID-19 pandemic to a date to be defined (further information in <https://www.ceasma-benin.org/>). We also maintain long-term support for the successful ELAVIO, the annual OR school of ALIO (Latin America).

The African Federation of Operations Research Societies (AFROS) has a new President, Hatem Masri, a Tunisian OR researcher who works in Bahrain. Thus, to our great pleasure, the OR African community has been growing, where new national OR societies are emerging and being added to AFROS. Besides the Operations Research Society of South Africa (ORSSA), the Tunisian Operational Research Societies (TORS), the Institute for Operations Research of Nigeria, and the Operational Practice in Africa (ORPA), was created the Operational Research Society of Kenya (ORSK), as informed by Charles Malack Oloo (from Kenya) the AFROS Past President. Further information from <http://www.afrosocieties.org/societies.php>.

The IFORS DCC ended 2019 with the following committee: Rosiane de Freitas (Brazil), Sue Merchant (UK), Sunity Shrestha Hada (Nepal), Adam Ouorou (France/Benin), Yu-Hong Dai (China), Theo Stewart (South Africa), and with the administrative support of Mary Magrogan, IFORS secretary. 🌐

# Report of the Vice President representing APORS

**Sunity Shrestha Hada** <sunity.shresthahada7@gmail.com >

The first APORS conference was hosted by the Korea OR Society in August 1988 in Seoul. It has currently 12 member societies. It conducts triennial conferences and the 12th triennial conference is scheduled to be hosted by OR Society of Philippines in 2021. Hopefully, if COVID-19 situation is normal it will be held in Manila in November 8-11, 2021. The activities of the APORS member societies from 2019 until March 2020 are as below.

**The Operations Research Society of China (ORSC)** was founded in 1980, and it has been a national member of IFORS since 1982. It now has more than 2000 registered members and 16 special interest sub-societies/groups including three newly established ones on healthcare management, smart industry and data analytics, and behavioral OR in recent three years, respectively. ORSC have three journals: OR Transaction (4 issues/year) and OR&MS (monthly), both publish papers written in Chinese, an English journal of ORSC published quarterly with Springer.

The following are highlights of some activities organized by ORSC and its sub-societies during 2019:

The 12th National Conference on Mathematical Optimization at Nanjing in April 19-22 with nearly 900 participants, National Conference on Scheduling at Fuzhou on May 11-12 with more than 200 participants, International Symposium on Frontiers of Operations Research at Beijing on June 22-23 with about 150 participants, National Conference on Stochastic Service and Operation Management at Hefei on July 6-8 with more than 200 participants, The 8th International Symposium on Graph Theory and Combinatorial Algorithms at Xuzhou on July 5-7 with more than 300 participants, National Conference on Financial Engineering and Risk Management at Shanghai on August 29-30 with about 160 participants, The 3rd OR Youth Forum at Nanjing on Oct. 25-27 with about 50 participants, The 11th International Symposium on Behavioral OR and Operation Management at Beijing on Dec. 14-16 with more than 400 participants, National Conference on Reliability Theory and Method at Beijing on Dec. 14-15 with about 200 participants.

**Iranian Operations Research Society (IORS)** has been a dynamic society emphasizing quality and extending reliability of scientific activities relating Operations Research in Iran as well as internationally. The activities include research, education and administrative affairs for development of programs concerning Operations Research.

In addition to regular monthly meetings of the executive council of IORS in 2019 (website: [www.iors.ir](http://www.iors.ir)), several local seminars were held in various parts of the country. The 12th annual International Iranian Operations Research Conference (IIRC) was held in Babolsar (website: <http://icors2019.ir/en>):

IIRC 2019 received over 500 papers from which 300 were accepted (160 as oral and 140 as poster presentations) including talks from Iran, France, Germany, Czech Republic, Italy, USA and South Africa. A book of abstracts and a CD containing the talks were published. There were also workshops and sightseeing of the city of Babolsar and the state of Mazandaran. The general assembly of IIRC was held on May 1, 2019 and a new executive council was elected as Dr. Jafar Fathali, Shahrood University of Technology, Dr. Farhad Hosseinzadeh Lotfi, Iran's Islamic Azad University, Dr. Majid Iranmanesh, Director general of information technology & administrative affairs, Dr. Esmail Khorram, Amirkabir University of Technology, Dr. Iraj Mahdavi (President), Mazandaran University of Science and Technology, Dr. Seyed Hadi Nasserri (vice President), University of Mazandaran, Dr. Reza Tavakoli Moghadam (Treasurer), University of Tehran



In the closing ceremonies, announcement was also made for the next conference to be held in the city of Shahrood as follows (international participation is strongly recommended): <http://icors2020.shahroodut.ac.ir/en> The time of the event is going to be announced later due to uncertainties of the Corona virus days.

**The Operations Research Society of Japan (ORSJ)** operates about 20 research committees to promote the propagation and application of operations research. In 2019, we launched new research committees for the application of health care and quantum computing. On September 12th and 13th, 2019, we hosted our autumn research conference in Higashi-Hiroshima. This location is also known as a great producing area for traditionally brewed Japanese saké. At the conference, we raised the special topic of "Regional Revitalization and Operations Research," primarily discussing how operations research could support regions that struggle with the problem of shrinking populations. We also held 49 other sessions with discussions. There were 372 participants overall, with a total of 135 oral presentations conducted. Other ORSJ activities include our support for young researchers. In 2019, we financially supported two young researchers in their stays abroad (at the University of British Columbia and the Hong Kong Polytechnic University). On a less auspicious note, we had to cancel our spring research conference to prevent the spread of COVID-19. While this pandemic has become a globally unprecedented crisis, I believe that now is precisely the time to utilize our operations research expertise and overcome this hardship.



**Korean Operations Research and Management Science Society (KORMS)** held its annual national OR conference on October 25th 2019, at the Korea Aerospace University. With more than 200 participants and a total of 81 paper presentations, the conference featured a plenary speech from the Vice President of LG Telecommunications and two tutorials on machine learning and DEA models. In addition, KORMS held 4 data analytics workshops.

KORMS Organizing committee for IFORS2020 has also been working diligently with the conference program committee for the IFORS2020 conference and had more than 2000 abstracts submitted. The unfortunate situation regarding COVID-19 has forced the conference to be postponed however, members are working hard to reschedule the conference in the near future and hopeful that with continued hard work the IFORS2020 conference will still be one of the most successful meetings in IFORS history.

**Management Science / Operations Research Society of Malaysia (MSORSM)** Another exciting year lies behind us. 2019 to MSORSM can be described as another successful year where we were able to conduct activities that involved not just members of the society, but also the MS/ OR community in Malaysia, in general. Among the main activities in 2019, MSORSM re-introduced the MSORSM Research Awards. However, this year's award did not include participation from industries, thus just awards for research thesis and dissertations where nominations of the recipients were submitted by higher learning institutions across the country. The results were released in March 2019, but the MSORSM Awards were presented during the Annual General Meeting (AGM) of the society.

The MSORSM 28th AGM was held on 1 July 2019 at the Faculty of Information and Communication Technology, Universiti Teknikal Malaysia (UTEM), Melaka. In conjunction with the MSORSM 28th AGM, the MSOR Seminar was conducted in the morning where invited speakers include a UTEM OR professor, a Director of SAS Malaysia and a Senior Consultant from Kimberly Clark Regional Services Sdn Bhd. Earlier, the MSORSM Round Table Discussion was held on 30 June 2019 involving the MSORSM Council members and invited key individuals, from among MSORSM members academicians and practitioners from industries, to revisit the strategic planning of the society and decide on key activities that can increase the MSORSM's visibility.

The MSORSM has also received a visit by delegates from the Operational Research Society of Nepal (ORSN) on 30 August 2019. The delegates from ORSN were invited to a collaboration meeting at the Malaysia Institute of transport (MITRANS), Universiti Teknologi MARA (UiTM) in Shah Alam, Selangor in which the MSORSM President and Honorary Secretary were among members of the meeting. In the afternoon, the Head of the ORSN delegates, Prof. Dr. Tanka Nath Dhamala, delivered

a talk at the Weekly Seminar of the Institute for Mathematical Research (INSPEM), Universiti Putra Malaysia (UPM) in Serdang Selangor.

**Operational Research Society of Nepal (ORSN)** has conducted 11th International Conference on "Operations Research: Sustainable Development" from February 1-2, 2020 at Janapriya Multiple Campus, Pokhara. The conference was attended by 121 participants from Nepal, China, India and Japan. Prior to conference from January 30 to 31, 2020, ORSN had successfully conducted pre-conference workshop on Data Analysis with R. The workshop had benefitted 100 participants including both academia and practitioners representing various academic and government institutions. The Society has joined hand with China Management Modernization Research Council Decision Specialized Committee under Chinese Academy of Management to bring the opportunity for 30 students of School of Management Tribuvan University with assistance from School of Statistics, South Western University of Finance and Economics, to participate in business simulation competition under MBA students category by forming 10 virtual firms through internet with Chinese MBA Students. ORSN has also started ORSN webinar series through ZOOM on various contemporary issues at present COVID-19 crisis around the world. The aim of the webinar is to bring people from various walks of life to come together and discuss about the relevant topic in order to aware the society about contemporary issues particularly operations.

**Operational Research Society of New Zealand (ORSNZ)** In 2019/2020 the ORSNZ was very pleased to welcome several notable visitors. Prof Margaret Brandeau was a plenary speaker at the 2019 Annual Conference (themed "Influencing policy-making with evidence-based modelling") alongside Prof Vicky Mabin and a keynote by Dr James Tipping (both ORSNZ members). Margaret and Vicky spoke on their work to inform healthcare decision making as part of the ORSNZ SIG for Healthcare Analytics (OSHA) day on Health during the conference. Vicky's plenary was due to her being awarded the Hans Daellenbach Prize, the ORSNZ's top honour, in 2017. James highlighted a session from the Energy and Natural Resources (ENR) SIG and he discussed how analytics can inform decision making in the electricity sector.

In early 2020 Margaret and Prof Shane Henderson participated in an OSHA workshop that coincided with ORSNZ sponsored presentations by Prof Margot Gerritsen and Prof Dimitris Bertsimas as part of a NZ Data Science and Analytics Forum. Margot spoke about her founding of Women in Data Science (WiDS) as a conference in November 2015. WiDS is now a global conference with 150+ regional events worldwide featuring 100,000+ participants. Dimitris spoke on his new work on Interpretable AI, and the successes he is achieving with this.

## Operational Research Society of Philippines (ORSP)

Starting the year was the Student Congress which focused on integrating OR in business and innovation. Over 27 school organizations listened to what experts had to say on this. Of course, the much-awaited annual Case Study and Quiz Bee competitions formed part of the congress.

The 2019 Technical Forum was a huge success, with the Ateneo De Manila University Leong Hall filled to capacity with participants wanting to know more about OR: A Powerful Tool for Real-Life Problems. Speakers from industry, though only scratching the surface of possible applications, did well to show the potentials of OR in addressing problems of business, government and society.

The 13th National Conference last November brought together key players in the OR world who shared their experiences and insights on how OR has contributed

in serving the services sector. Topics ranged from: importance of innovation to businesses, how OR can improve productivity and efficiency for global e-commerce, how OR can optimize store network capacity planning, labor productivity through process, workstation and tool improvement. There were also lightning talks on OR applications in Project Design, Scheduling and Project Management, Mining industry, Government, Education sector, and Supply Chain. It was further enriched with the impact and opportunities of the 4th industrial revolution.

The ORSP Committee on Public Service had also been called on several assignments to help with optimization of public services. It could thus be said that the year was marked by efforts at bringing OR closer to people who need them most, by focusing on experiences at providing OR solutions to problems all around us. 🌐

# Report of the Vice President representing EURO

**Stefan Nickel** <stefan.nickel@kit.edu >

**The European regional grouping within IFORS, EURO (The Association of European Operational Research Societies)**, currently consisting of 32 member societies, has had a very productive year 2019. The main highlight was the 30th European Conference on Operational Research, EURO 2019, which took place at University College Dublin (UCD), Ireland, from the 23rd until the 26th of June of last year. About 70 different countries were represented at the conference by approximately 2,400 participants.

Among the program points, the opening ceremony with welcoming speeches of the Irish Government Minister for Higher Education, Mary Mitchell O'Connor, and the UCD Dean of Business, Tony Brabazon, can be highlighted. Performances by Irish musicians and dancers set a lively atmosphere for the following three days of the conference.

The main program of EURO 2019 covered a wide variety of current topics with numerous talks, presentations, and sessions, including three plenary and 12 keynote talks. The IFORS Distinguished Lecture by William Cook on the Travelling Salesman Problem and the speech by Graham Rand on the development of the statistical t-test by an employee of Guinness in Dublin can be named as examples here.

During the conference, the usual EURO awards were presented. Among the winners were Paolo Toth, receiving the 2019 EURO Distinguished Service Award, and Martine Labbé, winning the 2019 EURO Gold Medal.

Finally, the sponsors of EURO 2019, especially Fáilte Ireland and Platinum Sponsor Gurobi, should be mentioned at this point. With their help, the sponsorship target set for the conference has been exceeded by more than twofold.

In 2019 the 33 working groups associated with EURO

were actively promoting their fields of research. Members of a working group regularly exchange ideas and results, support each other's research work, publish their findings, and organize seminars or conferences. As an example, the working groups can act as (co-)organizers of EURO Mini Conferences, of which there were two held in 2019. One organized by the EURO Working Group on Decision Support Systems in Madeira, Portugal (detailed report), and one (co-)organized by the EURO Working Group on Ethics and OR in Vilnius, Lithuania (detailed report). Another example would be the yearly ORAHS-conference organized by the same-named working group and devoted entirely to OR-topics in healthcare. In 2019 the conference took place in Karlsruhe, Germany (webpage).

The scientific results of the year 2019 generated by the researchers associated with EURO and its working groups are captured in the four EURO journals among others: European Journal of Operational Research (EJOR), EURO Journal on Computational Optimization (EJCO), EURO Journal on Decision Processes (EJDP), and EURO Journal on Transportation and Logistics (EJTL). The latter has now become Open Access starting with 2020. More information on the EURO journals can be found online on the EURO webpage.

The EURO association continued supporting especially young researchers with various education and sponsoring programs in 2019. The EURO Ph.D. School, for example, is an initiative established for post-graduate education for Ph.D. students under a school format.



The 2019 EURO Ph.D. school in Lisbon, Portugal, from the 1st until the 8th of September, was dedicated to value-based healthcare. EURO supports the attendance of young European scholars in ELAVIO (Escuela Latinoamericana de Verano en Investigación Operativa) conferences (the 2019 ELAVIO was held in Spain). EURO further supports Ph.D. students interested in participating in the National Taught Course Centre in Operational Research (NATCOR), which delivers taught courses in the UK.

The EURO Summer and Winter Institutes (ESWI), another EURO education initiative, are meant to give early-stage researchers an opportunity for scientific exchange with other researchers of their field. For more information on ESWI and all previously mentioned EURO education initiatives, see the EURO webpage.

In conclusion, 2019 was a very successful and productive year for the entire EURO association and all its members. Now, we give a summary of the events of the beginning of 2020 and provide an outlook on activities planned for the rest of the year.

First, there are two changes to the Executive Committee of EURO compared to 2019: The new President-Elect is now Marc Sevaux, who has replaced Richard Eglese who served as Past President after his successful term as President in 2017 and 2018. The new Vice President 1 is Joanna Józefowska who has replaced Albert Wagelmans in this position. The Association is further administered by VP 2 Prof. Julia Bennell, VP 3

Prof. Claudia Archetti, Secretary Prof. Jesper Larsen, Treasurer Prof. Marino Widmer, and IFORS Vice-President Prof. Stefan Nickel (for details see <https://www.euro-online.org/web/pages/1456/executive-committee>).

EURO is supported by additional Officers who have specific responsibilities and administrative roles: Manager Dr. Sarah Fores, Executive Assistant and Website Editor Diane Wilson, Information Technologies Manager Prof. Bernard Fortz, and Advisor to EURO-k Conferences Prof. Gerhard-Wilhelm Weber (cf. <https://www.euro-online.org/web/pages/1598/euro-officers>).

Second, the most recent events related to the CoViD-19 pandemic have, of course, also impacted EURO. Conferences, working group meetings, and education programs such as the EURO Ph.D. Schools have been either canceled or postponed to a later date. For more information, see the monthly EURO e-Newsletter or the webpages of the events in question.

However, despite the rather difficult current situation, EURO activities have not come to a complete halt. A new initiative, the EURO WISDOM Forum (Women In Society: Doing Operational Research and Management Science), has been recently created and has already held its first webinar (see EURO e-Newsletter, April 2020). Another example is the EURO 2021 conference in Athens, Greece, for which the planning and preparations are already running in full swing! 🌐

## Report of the Vice President representing NORAM

**Karla Hoffman** <[khoffman@gmu.edu](mailto:khoffman@gmu.edu)>

The North American Research Societies (NORAM) is made up of two societies: The Canadian Operations Research Society (CORS) and the Institute for Operations Research and the Management Sciences (INFORMS). Activities of the two societies for 2019 as well as planned events for 2020 are reported below.

### CORS ACTIVITIES.

The Canadian Operational Research Society (CORS), a.k.a. Société Canadienne de Recherche Opérationnelle (SCRO) ([www.cors.ca](http://www.cors.ca)) is the leading Canadian professional society for operational researchers. Established in 1958, CORS brings together OR professionals with annual conferences held across Canada, special interest groups, traveling speakers' programs, and student support. CORS sponsors the INFOR journal and also publishes the Bulletin, a newsletter of the Society and related activities. It is administered by a Council of eleven members.

### Meetings.

The COVID-19 pandemic has impacted all operations research societies and CORS is no exception. The CORS 65th National Meeting was to be held in Toronto from June 8 through June 10, 2020. It has now been rescheduled to take place in Toronto in Spring 2021.

The exact dates have not yet been determined. The meeting had received over 500 abstracts and it is hoped that all will come when it is held sometime in the Spring, 2021. Abstract submission will reopen in October 2020 and everyone will have the opportunity to revise an existing abstract or submit a new one. The plenary speakers for the conference include: **Susan Athey**, Economics of Technology Professor at Stanford Graduate School of Business; **Anna Nagurney**, John F. Smith Memorial Professor in the Department of Operations and Information Management I the Isenberg School of Management at the University of Massachusetts, Amherst; and **Georgia Perakis**, William F. Pounds Professor of Management and Codirector of the Operations Research Center at the MIT Sloan School of Business. It will feature a collection of exciting tutorials as well as a workshop on neural networks and two all-day events: *Analytics Day* and the Canadian Healthcare Optimization Workshop (CHOW).



The CORS 2019 meeting was held in Saskatoon, Saskatchewan May 27-29, 2019. The Plenary speakers included **Terry Rockafellar** (University of Washington) who gave the Harold Lardner Memorial Lecture on: *Risk and Reliability in Optimization Under Uncertainty*, **Michael Trick** (Carnegie Mellon Qatar) on *Impacting Business by Combining Predictive and Prescriptive Analytics* and **Ed Kaplan** whose talk was on *Adventures in Policy* For more about this meeting, please visit: <https://www.cors2019.ca/>.

#### Awards.

**The 2019 Harold Lardner Prize** was awarded to **R.Terry Rockafellar** (University of Washington) The 2019 recipient of the **Omond Solandt Award** was **Federated Co-operatives Limited** (providing energy solutions for Western Canada). The **Award of Merit** recipient was **Mikael Rönnqvist** (Natural Sciences and Engineering, Université Laval); and the **Eldon Gunn Service Award** went to **Dionne Aleman** (Dept. of Mechanical and Industrial Engineering, University of Toronto); Finally, the **2018 CORS Practice Prize** was awarded to **Francis Marleau-Donais, Irène Abi-Zeid, Edward Owen Douglas Waygood, Roxane Lavoie** (Université Laval & Polytechnique Montréal) for "*Prioritizing the redesign of streets according to Complete Street principles: A multi-criteria approach.*"

**Publications.** CORS publishes the journal **INFOR**, a quarterly journal on Information Systems and Operational Research (**Samir Elhedli and Elkafi Hassini**, Editors in Chief) as well as the **CORS Bulletin** (**Andrea Friars**, Editor)

#### INFORMS ACTIVITIES.

INFORMS ([www.INFORMS.org](http://www.INFORMS.org)) promotes best practices and advances in operations research, management science, and analytics through an array of highly-cited publications, conferences, competitions, networking communities, and professional development services.

#### Meetings:

As with most societies, the COVID-19 pandemic has impacted INFORMS' activities this year. INFORMS normally holds two major conferences each year: The Annual Meeting in the fall (scheduled to be held this year in the Washington DC area), which is mainly oriented towards academics, and the Analytics Conference in the spring for practitioners. The Annual Fall INFORMS meeting is scheduled to take place at the National Harbor in MD on November 8-11, 2020. However, the Analytics Meeting which had been scheduled for April 26-28, 2020 in Denver has been re-scheduled as a virtual meeting to take place on May 18-22, 2020. The conference is free and will have four talks each of four days. Many of the special interest meetings have also been postponed, gone virtual or been cancelled: The 2020 INFORMS Regional Analytics Conferences in Richmond/Tidewater on April 29th was cancelled, while the Regional Meeting in Seattle that was to be held in May is now rescheduled for September 2020. The Optimization Society, The Revenue Management and Pricing Section Meeting, the Manufacturing and Service Operations Meeting have all cancelled their meetings scheduled for 2020, while the Organization Science Meeting, the Freight and Rail Meeting, the Transportation Science and Logistics Society Meeting, the Marketing Science Conference and

the Service Science Conference have each postponed meetings this year. To obtain updates on the cancelled or postponed meetings, please see: [info.informs.org/canceled-informs-meetings](http://info.informs.org/canceled-informs-meetings).

#### Publications:

INFORMS publishes 16 journals, and three newsletters (OR/MS Today, Analytics and a student newsletter). INFORMS also a number of research series publications including, *Editor's Cut*, *TutORials in Operations Research*, and *Topics in Operations Research*.

#### Subdivisions:

In addition, INFORMS has various subdivisions directed at members of the OR/MS community including 12 Societies, 23 sections and 4 for a. There are also 65 regional and student chapters.

#### Awards:

The following prize winners for 2019 include: **The Daniel H. Wagner Prize for Excellence in Operations Research Practice** was jointly awarded to the following employees of Didi Corporation: **Zhiwei (Tony) Qin, Xiaocheng Tang, Yan Jiao, Fan Zhang, Zhe Xu, Hongtu Zh** and **Jieping Ye**; **The Doing Good with Good OR - Student Paper Competition** was awarded to **Somya Singhvi**, Massachusetts Institute of Technology; **The George B. Dantzig Dissertation Prize** was given to **Sebastien Martin**, MIT Operations Research Center; **The George E. Kimball Prize** was awarded to **Peter C. Bell**, University of Western Ontario, Richard Ivey School of Business; **The George Nicholson Student Paper Prize** was awarded to **Yilun Chen**, Cornell University; **The Frederick W. Lanchester Prize** was awarded to **Tim Roughgarden**, Columbia University; as well as the team consisting of: **Omar Besbes**, Columbia University, **Yonatan Gur**, Stanford University, **N. Bora Keskin** Duke University, **Assaf Zeevi**, Columbia University; **The INFORMS President's Award** was given to **Dimitris J. Bertsimas**, Massachusetts Institute of Technology, Sloan School of Management and Operations Research Center; **The INFORMS Prize** was awarded to **Booz Allen Hamilton**; **The John von Neumann Theory Prize** was awarded to **Dimitris J. Bertsimas**, Massachusetts Institute of Technology, and **Jong-Shi Pang**, University of Southern California; **The Judith Liebman Prize** was awarded to **Andrew Chung Chee Law**, Virginia Tech and **Brittany Segundo**, Texas A&M University and **Anna Svirsko**, University of Pittsburgh; **The Saul Gass Expository Writing Prize** was awarded to **Sunil Chopra**, Northwestern University; **The Volunteer Service Prize** was given to **Stefan Karisch**, The Boeing Company; **The Undergraduate Operations Research Prize** was awarded to **Milan Preet Kaur**, Management Engineering, University of Waterloo; **The UPS George D. Smith Prize** was given to the **University of Cincinnati - Operations, Business Analytics and Information Systems Department**; the **Prize for the Teaching of OR Practice** was given to **Patrick Noonan**, Emory University; the **INFORMS Case Competition** was awarded to **Saurabh Bansal, Philip Jones**, and **Timothy Lowe** for the project: Suncrest AgriBusiness: Exploiting the Flexibility of Backup Capacity; >>

>> the **Franz Edelman Award for the Achievement in Operations Research and the Management Sciences** was awarded to **The Louisville Metropolitan Sewer District (MSD)**; and the **Philip McCord Morse Lectureship** was awarded to **Peter Glynn**, Stanford University;

In addition, those inducted as INFORMS Fellows in 2019 included: **Karen Aardal**, Senior Researcher, Delft University of Technology; **Alper Atamturk** Professor, University of California – Berkeley; **Hung-Po Chao**, Senior Director and Chief Economist, PJM Interconnection; **Xiuli**

**Chao**, Professor, University of Michigan; **Antonio Conejo** Professor, The Ohio State University; **Louis Anthony Cox Jr.** University of Colorado and Cox Associates; **Brian T. Denton** Professor and Chair, University of Michigan; **Costis Maglaras** Chair of the Decision, Risk & Operations Division, Columbia Business School; **Jong-Shi Pang** Chair and Professor, University of Southern California; **Roman Slowinski** Professor & Founding Chair, Poznań University of Technology (Poland); **Chung Piaw Teo** Director, Institute of Operations Research and Analytics, National University of Singapore; **Zelda Zabinsky** Professor, University of Washington. 🌐

## IFORS PUBLICATIONS

### International Transactions in Operational Research (ITOR)

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ITOR is the flagship journal of IFORS, published by Wiley-Blackwell. Celso Ribeiro continues to be the General Editor, with an editorial board of 63 Associate Editors from 21 countries.

The new impact factor for 2018, reported in 2018, moved to 2.341. The average acceptance ratio has been at about 19% on average over the last three years.

The number of submissions remained stable with 532 submissions in 2019, increasing from just over 100 annually at the start of the decade. The last months have shown a significant acceleration in the number of submissions and we anticipate an increase of 30 to 40% for the current year.

The average acceptance ratio has been at about 19% on average over the last three years.



The journal has made an exceptional progress in terms of size and content. Papers published by year have increased from 25 (2006) to 85 (2018) and to 112 (2019), and pages printed by year from 584 (2006) to 2060 (2018) and 2580 (2019). These figures are even more exciting for the current year: the last issue of the 2020 volume will appear in June and we may already announce that this volume featured 122 papers



published and about 3200 pages printed.

The 2019 volume included three special issues on “Matheuristics and Metaheuristics”, “Efficiency in Education, Health and Other Public Services”, and “Operations Research Models for Supply Chain Finance”. There are six open Call for Papers with different deadlines along 2020, which can be checked at IFORS’ website.

In 2019, 6,612 institutions offered access to the latest content in ITOR via either a Wiley license or a traditional (title-by-title) subscription.

Downloads via Wiley Online Library increased by 44.8% in 2019 with respect to the previous year. This compares remarkably with an increase of 27.8% across all Wiley journals in the Business & Management subject area. The five top downloading countries were China (21%), USA (18%), Brazil (5%), Germany, UK, and India (4% each). The most downloaded article appeared in the 2018 volume and had 3221 accesses in 2019.

A panel of judges appointed the winners and the runners-up in the two categories (surveys and tutorials; methodology and applications) of the 2019 IFORS-ITOR-Wiley best paper award. The awards will be announced and handed over as soon as the situation allows. 🌐



## World-leading Scholars of OR in Agriculture Celebrating BigDSSAgro in Valparaíso, Chile

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▲ Attendance of BigDSSAgro 2019 at USM Auditorium

The III International Conference on Agro Big-Data and Decision Support Systems in Agriculture (BigDSSAgro 2019) has been the third annual conference in the series devoted to decision support systems in agriculture, combining Operational Research methods and Big Data techniques to support many real-world decision-making problems in small-scale farming, industrial agriculture, smart farms, agri-business supply chains, land use and environmental protection, and many more challenges. The conference 2019 BigDSSAgro focused on decisions, technologies and innovation for the 2030 agriculture, and took place at *Universidad Técnica Federico Santa María* in the World Heritage city of Valparaíso, Chile, from 25th to 27th of September 2019.

**BigDSSAgro 2019** was organized jointly by the Industrial Engineering Department of *Universidad Técnica Federico Santa María (USM)*, hosting the event, and by the Industrial and Systems Engineering Department of *Pontificia Universidad Católica de Chile*. The conference has also received the support of the Spanish CYTED-funded BigDSSAgro network, The *Chilean Institute of Operations Research (ICHIO)*, and the *Association of Latin Ibero-American Operations Research Societies (ALIO)*. We authors served as the *General Chairs of the Conference*.

In this version of **BigDSSAgro 2019** ([www.bigdssagro2019.usm.cl/](http://www.bigdssagro2019.usm.cl/)), more than 60 scientists, practitioners and students from 14 different countries attended; 32 papers and 11 plenary conferences were presented on different topics such as: *Operational Research* models and methods relevant to agriculture, forestry and environment, Big Data techniques and applications in agriculture, Sustainability in agriculture, modelling sensor-based data, Decision support tools based on Big Data and Operational Research techniques, Economic aspects of adoption of Big Data analytics, Precision agriculture, Industrial agriculture, Small

scale farming, Agri-business supply chain, Land use, among many others topics.

At this conference we got the opportunity to have a number of renowned researchers and practitioners as Keynote Speakers. Many thanks to: *Prof. Renzo Akkerman* (Wageningen University, Netherlands), *Prof. Fernando Auat* (USM, Chile), *Prof. José Caixeta Filho* (Universidade de Sao Paulo, Brazil), *Prof. José Cuevas* (Viña Concha y Toro, Chile), *Prof. Simon Dunstall* (CSIRO, Australia), *Prof. Martin H.P. Grunow* (TUM, Germany), *Prof. Yordi Norero* (Dynamic Wings UAS, Chile), *Prof. Rodrigo Ortega* (USM, Chile), *Prof. Hugo Poblete* (La Rosa Sofrucu, Chile), *Prof. René Villalobos* (Arizona State University, USA) and *Prof. Andrés Weintraub* (Universidad de Chile). The Program Committee integrated researchers from all over the world, widening the appeal of the event and receiving a support well exceeding the groups participating in the CYTED BigDSSAgro network.

A Special Issue on “OR and Big Data in Agriculture” was agreed with the prestigious journal *International Transactions of Operational Research*, published by IFORS, opening an outlet for publications of extended versions of papers which were mainly presented at our conference <https://onlinelibrary.wiley.com/doi/10.1111/itor.12696>.

The conference ended with a beautiful *Closing Reception* at Casas del Bosque Vineyard in Casablanca valley, where we had the opportunity to enhance our professional and human connections in a very nice environment with a glass of good wine. We hope that this third edition serves to consolidate this very successful series of events, leading to improved cooperation in the community interested in decision support systems for agriculture, using *Operational Research* methods and Big Data techniques to support many real-world decision-making problems in the emerging areas of agriculture. 🌍



# Current Practices of Operational Research in Emerging Economies – “Summer School on Large Scale Optimization” in Indore, India

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▲ “Summer School on Large Scale Optimization” in Indore; sitting: Prof. Dr. G. Srinivisan; kneeling: the 1st: Prof. Dr. Sachin Jaiswal; standing, in 1st row, from the left, the 1st: Prof. Dr. Sadia Samar Ali; standing, in last row, from the left, the 1st: Prof. Dr. Amit Vatsa, the 2nd: Prof. Dr. Saurabh Chandra; the remaining ones are doctoral students.

Modern workplaces demand attention, agility, openness, innovation so working professionals need platforms to update their skills to honor their professional engagements and sense of responsibility. Continuous shifts in business scenarios require working professionals to stay ahead and prepare well resulting in the dire necessity of career enhancing workshops. Keeping these requirements in mind, *Indian Institute of Management (IIM)*, Indore (<https://www.iimdr.ac.in/>), organized a one-week summer school to prepare participants for the challenges resulting from the pressures of ongoing economic, digital, organizational, environmental and societal transitions. Located in the heart of India, in the state of *Madhya Pradesh*, known for its rich cultural, educational and spiritual, heritage, this institute offered the students a vista of experiences ranging from grassroot level to top notch corporate setups. Driven by the need of competitive education and growing corporate demand, Premium management institutes of India have started a unique program of training the working professionals from research, education and corporate backgrounds for a short duration of time. IIM organizes this event every year for a period of 1-2 weeks. *Society of Operations Management* and *Indian Institute of Management*, Indore, conducted this event in June 2019 with a focus of providing in-depth insights with hands on training in the field of Large-Scale Optimization in MILP and MINLP problems. The candidates were encouraged to participate with full enthusiasm and were requested to install AMPL and the CPLEX community package software, Python and/or Visual studio C++ on their laptops.

The seven-day workshop “Summer School on Large Scale Optimization” during 15th-22nd of June 2019 was designed

to provide to early researchers, analyst and teaching professionals a platform for engagements in investigations, and facilitate raising awareness on increasing avenues in the field of *Operational Research*. The sessions provided valuable insights on scope and challenges of research opportunities and operational complexities in the developing countries. India being a developing country faces its own set of challenges in the field of Operational Research education. Academicians, researchers, and professionals often faced the challenges of irrelevance or inadequacies of data, over-emphasis on quantitative data leading to unmanageable or incomplete models, resulting in unsuitable or undesirable course of action. Developing countries could discard the traditional methods and opt for *Operational Research* models, aimed at specific problems of the respective country for concrete outcomes. This formed the premise for the workshop which witnessed a participation of more than 30 candidates from various backgrounds. This seven-day workshop was a unique initiative undertaken by IIM and provided the participants a considerable time period for optimum exposure and learning.

Indore is the first city to have both *IIT* (Indian Institute of Technology) and *IIM*. Organized by IIMs and IITs from all over India, the workshop included prominent speakers from varying backgrounds of management and technology from premium educational institutes of India. The sessions were presided over by the expert faculty members like Prof. G. Srinivisan (IIT-M), Prof. Yogesh Aggarwal (IIM-L), Prof Saurabh Chandra (IIM-I), Prof. Sachin Jaiswal (IIM-A), Prof. Anshuman Mahajan (IIT-B), Prof. Amit Vatsa (IIM-I), Prof. Hasmukh Gajjar (IIM-I). >>

>> Updated scientific information on *Efficient Mathematical Modelling in Integer Programming, Mixed Integer Programming, Mixed Integer Non Linear Programming, Lagrangian Relaxation, Column Generation, Dantzig-Wolfe Decomposition, Benders Partitioning, Cutting Planes, Valid Inequalities* and *Heuristics* was imparted to the participants.

Multiple sessions were organized for a period of seven days to share knowledge on interventions, strategies or tools that can enhance the quality and coverage of Operational Research in the fields of education and industrial setups. Categorized according to experience and background of the participants, the sessions offered an exemplary atmosphere for discussions, comparisons, decision making backed by reasoning, maximum knowledge absorptions, and conversion of abstracts into frameworks. This was a way to encourage PhD and "Fellow Program in Management" participants, especially, in corporate setups, to understand the value of research education and its role in bringing changes in *policies and practices*. Adequate focus was given to qualitative and quantitative research methods, analysis using IBM CPLEX. Python and optimization software packages for first-time participants or those who were new to the research field.

Experts with international reputation having communicative and conceptual expertise and clarity created an encouraging collaborative and immersive environment for meaningful communications among participants. Towards the end of the seven-day program, two days were given to the participants, encouraging them to deliver their presentations, and deal with complex case scenarios. This offered them an excellent opportunity to learn from their own mistakes and get feedback from the best minds.

Participants presented on various topics about recurring themes of supply chain challenges, forecasting related to uncertain situations of demand and supply, routing issues of shipping cargos, and multiple other topics. Participants bonded well with each other, forming groups for healthier discussions after the sessions resulting in many memorable friendly moments. The participants were contended with judicious use of their time and resources. The workshop concluded with an interesting tour of the historic city of Indore. The event ended with a *Gala Dinner*. It arranged and created wonderful memories for participants encouraging them to engage in similar research opportunities in future, too. 🌐



## Smart and Sustainable Supply Chain Management Successfully Analyzed in Konya, Turkey, City of Antiquity and Modernity

Turan Paksoy <tpaksoy@ktun.edu.tr>



▲ Participants of 2nd International Annual Workshop on Lean and Green SCM'2019.

*Lean & Green Supply Chain Management Lab at Konya Chamber of Commerce (KTO) Karatay University* (<https://lgscmlab.karatay.edu.tr/index.html>) was founded in 2017 under the directorship of *Dr. Turan Paksoy*, professor at Department of Industrial Engineering of Konya Technical University. One of the main objectives of *Lean & Green Supply Chain Management Lab* is to provide a virtual environment for professionals, academics and students dedicated to enhancing their studies on lean and green manufacturing philosophy and techniques. Furthermore, the lab offers technical consultancy services to companies that are practicing lean and green manufacturing in the region. It

organizes an annual international workshop series to bring together professionals who discuss the current trends that will shape the future of supply chain management. Since classical antiquity when it was called Iconium, Konya has been a center of culture and economy.

*The 2nd International Annual Workshop on Lean and Green SCM* was held on November 21, 2019 (<https://lgscmlab.karatay.edu.tr/workshop.html>). This **focused event** was titled "**Industry 4.0: Digital Transformation**" and aroused considerable interest from the academic and business worlds. >>



>> After the Opening Speeches by *President of Konya Chamber of Commerce Karatay University, Dr. Bayram Sade*, and *Director of Lean & Green Supply Chain Management Lab, Dr. Turan Paksoy*, Invited Speakers addressed the audience: *Dr. Sercan Demir* presented on “*Industry 4.0: Digital Transformation*”, followed by the talk on “*Block Chain Technology in Supply Chain Management*” by *Dr. Abdullah Yildizbasi*, and a lecture on *Model Smart Factory* by *Mr. Mustafa İzzet Ötgün*.

In his opening speech, *Dr. Paksoy* said: “*First of all, [...] Lean-Green Supply Chain Management [...] forms the theme of our laboratory. In order to become more competitive in the global market, respond quickly to customer needs and gain an advantage in an international business environment, many business managers focus on increasing the efficiency of Supply Chain Management.*”

A supply chain is a professional business network consisting of various actors such as suppliers, manufacturing facilities, distribution centers and distribution channels between them, transforms raw materials into final products, and organizes the delivery of these final products to customers. Increasing impacts of climate change, environmental awareness of societies and legal regulations enacted by the governments, decreasing resources and profit margins; increasing need and importance for sustainability have become more evident in the past few decades. In this process, SCM has been transformed into a cyclical and sustainable structure by collecting used products from the end-users. Hereby, the concept of “**Closed-Loop Supply Chain Management**” or “Sustainable SCM” emerged.

Due to increasing environmental awareness and the importance of sustainability, sustainable SCM has started to receive more attention from academicians and practitioners. This structure, in the literature called as **Sustainability Triple Bottomline Approach**, is built upon three main columns: environmental, social and economic factors. Recent researches show that the integrated use of sustainable tools and methods creates a synergy in organizations and simultaneously increases both operational and environmental performance. This is not surprising, because one of the most popular economic paradigms used for continuous improvement is Lean Manufacturing, and one of its main objectives, the reduction of waste (materials, water, energy, etc.), directly overlaps with the green philosophy.

On the other hand, competition in the market and cost pressures are increasing day by day, and businesses are trying to adapt to new technologies and new approaches in order to respond to increasing customer needs, to expectations of speed and flexibility. These technologies, which managers and businesses benefit from, were first addressed in Germany as Industry 4.0 in 2011 to define the name of an era. Since then, these technologies have drawn the attention of executives in the manufacturing and service industries, due to their ability to quickly collect, analyze, and make changes in the decision making process of business and supply chain management.

Thus, SCM has evolved into a new concept “**Smart and Sustainable Supply Chain Management**”, namely, **SCM 4.0**. SCM 4.0 includes connecting several physical items such as sensors, further newest devices and enterprise



▲ Prof. Dr. Turan Paksoy (Director, Lean&Green SCM Lab).

resources with each other and with the Internet; it uses emerging technologies such as the Internet of Things (IoT), Cyber-Physical Systems (CPS), Artificial Intelligence, Robotics, Blockchain Technology (BCT), and Cloud Systems. The concept of SCM 4.0 can be defined as the inclusion of social and environmental thinking in all SCM activities, like product design, workplace organization, supplier selection, on-site logistics, packaging, transportation, and product recycling, by using Industry 4.0 tools.

Smart and Sustainable SCM's philosophy and techniques eliminate environmental waste and make businesses more environmentally friendly by minimizing the use of natural resources through encouraging the reuse and recycling of raw materials, materials and products. Furthermore, this philosophy contributes to social development by automating repetitive and creativity-free jobs by developing business environments and new job descriptions suitable for human nature. That philosophy also improves the economic performance of businesses by reducing production times and costs, improving product quality and on-time delivery performance.

As a result, the concepts of SCM and environmental management have gained attention increasingly, especially in the late 1980s and early 1990s, as they provided competitive advantages in strategic organizational practices. Indeed, today, Smart and Sustainable Supply Chain Management (SCM 4.0) has emerged as an important approach for organizations that want to enhance their competitiveness with the help of the disruptive technologies of the Industry 4.0 era, and strive to make social and environmentally sustainable business in their markets.

In this workshop, we drew a comprehensive conceptual framework for Smart and Sustainable SCM and discussed the latest developments and practices of Digital Transformation and Industry 4.0 in theory and practice.

Now, I express my respect and gratitude to Rector *Prof. Dr. Bayram Sade*, to Chairman of the Board of Trustees, *Mr. Selçuk Öztürk*, and thank all the speakers and participants for their support to our Laboratory and our meeting.

The workshop ended with a Closing Session, including speeches, handing-over of honorary plaques, and a cheerful photo session. The attendees gladly agreed to meet again in Konya in 2021! 🌐



# Seminars Going Online ...The Digitalized World

**Burcu Gürbüz** <burcugrbz@gmail.com >

Many scientific events have been postponed or moved to online platforms in this digitalized world since the coronavirus became a serious problem globally. On the other hand, research communities need novel ways to stay connected. Therefore, many mathematical seminars, conferences, and research lectures have changed to an *online* format. These new communication channels have been uniting the researchers under the label of “One World”. In these days, we better understand the meaning of this *unity* while we have become more aware of this unique planet we are living on.

“One World Seminars” are events which respond to this essential fact and, at present, they are organized in many fields of mathematics and computer science. These novel types of organization have been started with the first event, named as “One World Probability Seminar”, and have been enhanced properly to other disciplines and fields. Prof. Dr. Monica Musso (University of Bath, UK), Prof. Dr. Angela Pistoia (Sapienza University of Rome) and Dr. Miles Wheeler (University of Bath, UK) are the organizers of “One World PDE Seminar” which is inspired by “One World Probability Seminar”. These seminars keep our community connected in times of mass cancellation of in-person conferences and seminars due to the coronavirus pandemic. They are mainly



▲ Dr. Burcu Gürbüz (JGU-Mainz & Üsküdar University), an attendee of online OWPDE Seminar.

currently, I have become more interested in *dynamical systems*, PDEs, their qualitative analysis and modern applications. On April 7, 2020, Prof. Dr. José Antonio Carrillo (University of Oxford, UK) gave a talk with the title “Nonlinear Aggregation-Diffusion Equations: Stationary States, Functional inequalities & Stabilization”. Prof. Carrillo introduced to us modelling based on PDEs, the equilibration between two competing effects, repulsion modelled by nonlinear diffusion, and attraction modelled by nonlocal interaction - which appears under which specific conditions. Besides qualitative properties and numerical schemes for nonlinear aggregation-diffusion, he presented on existence of global minimizers and uniqueness of equilibria for any given mass up to translation, and convergence of solutions of

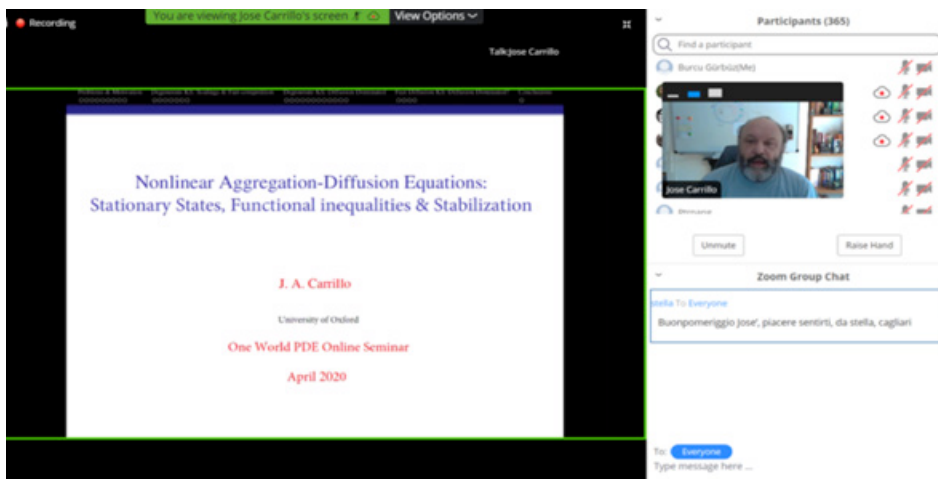
the associated nonlinear aggregation-diffusion equations. Moreover, some applications of these types of studies have been given, such as *statistical mechanics* and *crystallization*, *astrophysics* and *chemotaxis*, economic applications in *mean-field games* and with *Cournot-Nash equilibria*.

Besides, at the same day, Prof. Dr. Maria del Mar Gonzalez (Universidad Autónoma de Madrid, Spain) spoke on “A free boundary problem for the half-Laplacian, the Steklov eigenvalue and higher order generalizations”. She introduced to us the *eigenvalue optimization* for the *composite membrane problem* with fractional Laplacian, which is related to the Steklov eigenvalue.

During these seminars, members of the audience got a chance to introduce themselves to the community, ask their questions on the online platform and discuss on applications of the studies.

Upcoming seminars can be found at the following link: <https://people.bath.ac.uk/mw2319/owpde/>.

These seminars will likely to be extended to “One World Optimization Seminar”



▲ Prof. Dr. José Antonio Carrillo presenting at OWPDE Seminar, April 7, 2020.

about providing a venue for investigators’ work on, e.g., partial differential equations (PDEs) and their world-wide applications, which are made accessible to as many researchers as possible.

I have found a chance to attend one of the “One World PDE” seminars via an online invitation from a colleague, Prof. Dr. Patrick Tolksdorf (Johannes Gutenberg-University of Mainz, Germany). Due to my post-doctoral research project,

(<https://owos.univie.ac.at/>) which is organized by Prof. Dr. Radu Ioan Boț (University of Vienna, Austria), Prof. Dr. Shoham Sabach (Technion-Israel Institute of Technology Haifa, Israel), and Prof. Dr. Mathias Staudigl (Maastricht University, the Netherlands). In the following days, we hope to further expand the events of “One World Operational Research Seminar” which may serve our *Operational Research* communities to stay connected and share their studies during globally unusual times. 🌐



# EURO Launches the WISDOM Forum – First Event Celebrated

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In January 2020, *EURO*, the *Association of European Operational Research Societies* (<https://www.euro-online.org/>) within IFORS, launched an initiative called the *EURO WISDOM Forum*. **WISDOM** stands for **Women In Society: Doing Operational Research and Management Science**.

This initiative restates the need for gender main-streaming and affirms that OR/MS can offer exciting opportunities for all women if they have equal access to resources and adequate training. Gender main-streaming aims to integrate a gender dimension into existing institutions and practices in order to achieve meaningful gender equality.

*WISDOM* is designed as a forum to support, empower, and encourage the participation of all genders in Operational Research and Management Science within *EURO*. In particular, it aims to promote *inclusivity* by the following actions:

1. Advise/make recommendations / highlight best practices to the *EURO* executive on issues facing women in OR. Such guidelines can be disseminated to *EURO* member societies and Working Groups. Positive progress, outcomes and activities of member societies can serve as a template for other member societies;
2. Promote championing, networking and mentoring, particularly of women at the early stages of their career in OR;
3. Promote a conversation around how OR can be utilized to help create a diverse and inclusive future.

At the moment, the *WISDOM Forum organizing committee (OC)* includes 21 members from 10 European OR societies including two *EURO* representatives, the *EURO* Vice Presidents *Julia Bennell* and *Claudia Archetti*. The chair of the *WISDOM OC* is *Paula Carroll* and the Secretary is *Annunziata Esposito Amideo*, both from the University College Dublin, Ireland.

The *WISDOM Forum* will operate through *three subcommittees*: Research, Events and Public Relations. The Forum plans to establish connections with all national OR societies of *EURO* and the *EURO* Working Groups. In its work, *WISDOM* will welcome establishing links and developing mutually fruitful collaboration with other similar groups.

On April 20, 2020, *WISDOM* held its first event, a *Webinar* on **“Bias/Fairness and Artificial Intelligence”**. In light of the current epidemiology situation in the world caused by covid19 a webinar over Zoom was deemed appropriate.

The Webinar facilitator, *Dr. Paula Carroll*, UCD, *EURO WISDOM Forum Chair*, invited four expert panelists from Ireland to explain data bias in their respective disciplines and application areas.

The first speaker, *Prof. Alan Smeaton* (<https://www.computing.dcu.ie/~asmeaton/>), a Professor of Computing at Dublin City University, Ireland and Founding Director of the Insight Centre for Data Analytics at DCU, spoke on *“Data bias in automatic image and video captioning and its impact”*.


*Dr. Claire Gormley* (<https://people.ucd.ie/claire.gormley>), an Associate Professor in the School of Mathematics and Statistics in University College Dublin, Ireland, and a Funded Investigator in the Insight Centre for Data Analytics and the *VistaMilk* research centre presented a talk *“Be fair to the models: the importance of assumptions in data analytics and modelling”*.

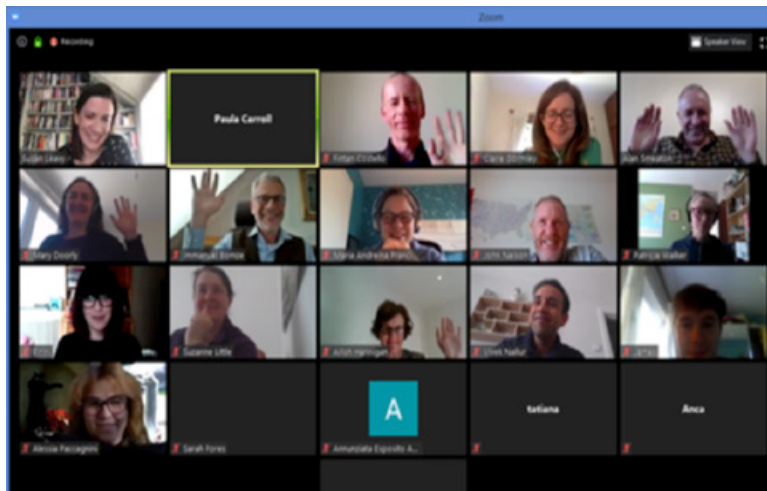
*Dr. Fintan Costello* (<https://people.ucd.ie/fintan.costello>), an Associate Professor in the School of Computer Science, University College Dublin, Ireland, covered a number of different areas in computer science, psychology and mathematics. The topic of his talk was *“Bias and rationality in human reasoning (and why the same biases apply to AI)”*.

*Dr. Susan Leavy* (<https://people.ucd.ie/susan.leavy>) an Assistant Professor in the School of Information and Communication Studies, University College Dublin, Ireland, with research interests in artificial intelligence and digital policy, developing interdisciplinary frameworks for the governance and regulation of machine learning algorithms, spoke on *“Gender bias and Artificial Intelligence”*.

The webinar was well attended with more than 50 participants who showed their interest and participated in a lively roundtable discussion in the form of written questions. Unfortunately the time limits were strict and not all the questions were given and answered. However, all the webinar participants expressed their interest in continuing the discussion in future events.

At the moment, the *EURO WISDOM Forum* pages on the *EURO* website are under construction. Further details of the webinar will be made available on the website once it is up and running.

If you are interested, please feel free to contact the *EURO WISDOM Forum* by emailing to [wisdom@euro-online.org](mailto:wisdom@euro-online.org). 



▲ *EURO WISDOM Webinar participants wave goodbye.*



# WoMBaT 2019 - Celebrating Optimization and OR in Melbourne

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▲ Together at New Frontiers of Optimization research and OR application.

The fourth Workshop on Metric Bounds and Transversality (WoMBaT 2019) (cf. <https://wombat.mocao.org/wombat-2019/>) took place in Melbourne at Swinburne and RMIT Universities at December 8-10, 2019.

This is an annual event happening regularly in Australia since 2016, and organised jointly by the Centre for Informatics and Applied Optimisation at Federation University Australia, optimisation groups at Royal Melbourne Institute of Technology, Deakin University, Swinburne University of Technology, University of New South Wales, Sydney, and Mathematics of Computation and Optimisation Special Interest Group of the Australian Mathematical Society (<http://www.mocao.org/>). The whole history of WoMBaTs and the preliminary information about WoMBaT 2020 (December 2-4, 2020) can be found here: <https://wombat.mocao.org/>.

At WoMBaT 2019, there were 26 talks on various topics related to optimisation and variational analysis by Australian (14) and overseas (12) researchers, including 3 presentations by PhD students. Traditionally we do not have parallel sessions, and all speakers: renowned experts, postdocs and PhD students are given the same 30 minutes for their presentations. The highlights of WoMBaT 2019 included talks by Jean-Pierre



▲ Prof. Asen Donchev

Crouzeix (France): "A short, easy and constructive proof of the alternation Tchebicheff theorem", Asen Dontchev (USA): "The Bartle-Graves theorem", Alexander Ioffe (Israel): "Regularity and existence problems", and Marco López (Spain): "Lipschitz modulus of linear and convex systems with the Hausdorff metric"



▲ Prof. Fusheng Bai, Prof. Adil Bagirov, PhD student Vinesha Peiris and Prof Napsu Karmita

There were multiple productive discussions during coffee breaks. As in 2018, an open problem session took place which attracted significant interest of the attendees.

After the workshop, two international participants Prof. Ewa Bednarczuk from Poland and Prof. Marco López from Spain spent some time doing research in the Centre for Informatics and Applied Optimisation (CIAO) at Federation University Australia, where they also gave talks for staff and research students at the CIAO optimisation seminar.

The Centre for Informatics and Applied Optimization was founded in 2001 at the then University of Ballarat by famous mathematician Professor Alexander Rubinov (the inaugural EUROPT Fellow). It remains an internationally recognised research centre, delivering basic and applied research in mathematics and information technology. 🌐



# From subtropical Lithuania: Workshop of Mathematical Solutions in Business and Industry

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▲ Participants of the workshop on the beach of Baltic Sea in Palanga, Lithuania, June 10-14, 2019.

The 3rd Workshop of Mathematical Solutions in Business and Industry (also known as European Study Groups with Industry) has been organized June 10-14, 2019 in Palanga (a seaside resort on Baltic Sea). While weather in the venue had beaten all times heat records, 25 analysts (divided into 4 groups) from around the globe were solving real-world business and industry problems. In 2019 all problems submitted by industry were directly related to the field of operational research and decision making: 1. SBA group, one of the biggest furniture producers in Lithuania and a local partner of IKEA, posed a problem of optimal cutting for reducing the waste of the laminating film. The insights and the optimization software, provided by the workshop participants, is likely to minimize both the economical and the environmental costs of the production. 2. Telecommunication operator BITĖ is facing a problem of predicting whether a customer will leave BITĖ in a near future. Accurate prediction would help to improve its services and customer satisfaction. The problem was solved using different big data analytics methods and machine learning algorithms. 3. While SPA center EGLE in their daily life is dealing with optimal facility, workload and medical procedures scheduling problems. As almost every client is unique in many aspects such problems often requires advanced mathematical solutions. 4. One of the largest Baltic States milling company Baltic-Mill challenges an increasing competition in the market of wheat flour and its products. As part of this concern, the company decided to use the advanced decision support methods to reduce the possible financial losses as a result of uncertain wheat prices in commodity exchange. The difficulty lies in the uncertainty and exposure of prices that are usually driven by nature highly unpredictable weather conditions around Europe and other wheat exporting countries.

The main motivation of a 5-day workshop was to promote

collaboration between business representatives and mathematicians from scientific community of Lithuania and other countries (participants) by solving real-world problems that are faced by contemporary modern companies.

Whatever the business purpose, the companies usually seek a wide range of operational advancements, such as lower cost, higher efficiency, more accurate prediction or lower cost. These aims usually achieved by mathematical methods within operational research area. Given insights of challenges appearing in the industry, the participants are motivated to tackle them by applying mathematical methods, such as optimization, modelling, simulation, decision analysis, multi-criteria analysis, etc. in order to find a practical and pragmatic solution to the problem provided by a company. This one also encourages mathematicians to apply their knowledge and skills in the areas relevant for industry. Such experience acquired can be further spread during lectures by given application examples and case studies, as well as to be grown up to research projects performed together with SMEs or other useful initiatives. Furthermore, the collaboration between industry and researchers is a key to address technological innovation issues by using successful mathematical methods. The week started with brainstorming and analysis of data provided by the company. Then, the time is devoted for implementing and testing these ideas, at the same time coordinating them with business representatives. By the end of the week, the preliminary solutions were provided to the company. On the final day, the scientific leader of the team presented the main results achieved by a group, and the business representative gave their feedback. Companies usually are more than satisfied with these results obtained; therefore they are open for further cooperation and new projects.

Some business representatives emphasise that by participating and working together with scientists, they learn more about the problem itself and later this leads to better business solutions. In addition, they find these week-long brainstorming workshops very attractive, because the solution to a real-world problem using sophisticated mathematical methods is proposed within one week. Moreover, the participation of representative from companies itself gives a possibility to understand how scientific thinking works, to see all the process from brain storming, "bad ideas elimination" to final stage, when best methods are selected and conclusions are made.



▲ Tuesday morning after brainstorming on commodity prices. From right to left: Piotr Kotlarz (ZHAW), Mariya Naumova (Rutgers University), Audrius Kabašinskas (KTU), Mindaugas Bražėnas (KTU) and Arvydas Noreika (Baltic-Mill).

Faculty of Mathematics and Natural Sciences from *Kaunas University of Technology* organizes Workshop of Mathematical Solutions in Business and Industry (also known as European Study Groups with Industry) since 2017. During the workshop, solutions for the companies (startups, SME and large enterprises) working in the fields of energy, production, electronics, environmental protection, finance, medicine, are developed. Such companies as SBA (regular participant of all events in the past and ESGI in 2019), SEB (Skandinaviska Enskilda Banken), AON Baltic, CallCredit, Citybee, DPD, Finpass, JDE, Bite, Baltic-mills, SPA center EGLE and Gintarinė Vaistinė, already participated in these workshops by providing challenges to the scientific teams. Professionals and young researchers from across Europe (UK, Portugal, Germany, Latvia, Estonia, Belarus, Bulgaria, Poland and Switzerland), USA and (Eur-) Asia (Iran, Turkey) applied for participation and joined the event.

Main areas of problems solved during all Lithuanian ESGI

workshops cover machine learning and big data analytics; optimization of production; optimization of assortment in pharmaceuticals store warehouses; decision making on coffee beans or wheat contracts; optimization of delivery route and scheduling; calculation of sustainable income; forecast of car sharing demand in a city; risk assessment and insurance pricing models; and forecast of client solvency.

European Study Groups with Industry are organised since 1968 (by Oxford University) and are widely recognised as one of the best methods for knowledge exchange between applied mathematics professionals and industry. Such kind of events are mainly coordinated by European Consortium for Mathematics in Industry <https://ecmiindmath.org/study-groups/>

*Lithuanian Workshop of Mathematical Solutions in Business and Industry 2019* was partially supported by EURO. 🌐



## Ergonomic Methods in Practice February 17-18, 2020, Zielonka, Poland: Many Faces of Ergonomics

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**Gerhard-Wilhelm Weber** < [gerhard.weber@put.poznan.pl](mailto:gerhard.weber@put.poznan.pl) >

On February 17-18, 2020, a scientific conference entitled *Ergonomic Methods in Practice* was held - <http://pterg.poznan.pl/news/>. The participants of the conference were scientists dealing with issues in the area of human factors and ergonomics. During this year's edition of the event, organized by the Poznan branch of the *Polish Society of Ergonomics* and the **Department of Applied Ergonomics** at *Poznan University of Technology* in Zielonka (near Poznań, Poland), scientists gathered from many research and scientific centers of Poland, Finland, Turkey, the USA and India. Poznan Branch of Ergonomics is mainly supported by members of Faculty of Engineering Management, Poznan University of Technology, <https://fem.put.poznan.pl>, and it is an example of the development of cluster-based science. Initiated by Prof.

*Dr. Leszek Pacholski* and *Prof. Dr. Edwin Tytyk*, actions to reinforce the role of Human Factors in management and technical-engineering dimension resulted in supplying Poznan with the largest number of ergonomists from all centers in Poland. Currently, *Ergonomic Design* grown at Poznan University of Technology gains a new dimension thanks to the methodical approaches of *mathematics* and *operational research*. A significant role in this area played Professor Gerhard-Wilhelm Weber, whose wide range of interests and willingness to take on new challenges allowed to increase the scientific impact of ergonomics center of Poznan. This combination of areas of research seems to be beneficial to all sides of scientific cooperation and at the same time allows you to create new areas of scientific research.



▲ *Cheerfully together after a day of conference presentations*

Presentations during the conference, lectures and workshops conducted ergonomic design for persons with disabilities were an excellent opportunity to highlight the wide range of issues related to ergonomics. Workshops carried out by *Dr. Eng. Katarzyna Jach* were very popular and allowed participants to familiarize themselves with the complexity of the issues of universal design concepts and usability. Designing for people with different levels of disabilities may be performed in many ways, but only the connection of understanding the existence of the problem (the sphere of scientific and practical awareness of it) with an appropriate methodology allows for obtaining practical and scientific results. Ergonomics permits to combine science with industry practice concerning the management of business enterprises, as shown in the introductory presentation on practical and theoretical problems in the selection of ergonomic evaluation methods in production by *Prof. Dr. hab. Eng. Marcin Butlewski* and *MSc. Wiktoria Czernecka*. The authors showed how ergonomics can be used to improve production processes in an enterprise, allowing for practical application of the phrase management by ergonomics. So far, this issue was treated only as a slogan, but a combination of risk management methods enables for a practical and scientific consideration of this problem. A very interesting lecture given by an international team led by *Prof. Dr. hab. rer. nat. Gerhard Wilhelm Weber*, which concerned the ability to recognize early signs of heart disease. Recognition signals from our body will mean much more than the current effectiveness of coping with diseases of civilization. These researches require a combined expertise in the fields of medicine, mathematics and machine learning techniques. This study is not the only example of the construction of early-warning systems, based on the knowledge from human body. This trend will certainly still grow in the near future. We live in a world of information, yet many of its sources remain undiagnosed. During the conference there were also presented the latest techniques in the field of pilot's stress recognition and the possibility of transferring these experiences for machine operators. Despite the significant

development of knowledge of man, there is still much to be done in this regard. Interdisciplinary research characteristics for ergonomics allows taking on new challenges.

At the end of the first day of the conference was organized campfire, during which the participants continued their scientific discussions. One of the most important outcomes of the conference is to develop a new stream of research which is the ergonomic early-warning systems. This theme met with great interest. So far, this subject was undertaken on the basis of qualifications symptoms that were subject to human activities. Application in the area of machine learning techniques and



▲ *Organizers in action: Prof. Dr. hab. Eng. Marcin Butlewski and Dr. Eng. Krzysztof Hankiewicz, with participant Prof. Dr. hab. Gerhard-Wilhelm Weber (from left to right).*

logical-mathematical apparatus will significantly improve the efficiency of decision making systems. It should be expected in the near future reports regarding many further areas in the application of ergonomic early-warning systems. 🌐

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▲ *Friends from Wroclaw and Lodz Politechnics attended the Conference in Zielonka: Dr. Eng. Aleksandra Sopińska and Dr. Eng. Katarzyna Jach (from left to right).*

# OR and Culture: Scheduling Kid's Carnival Competitions in Uruguay

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## Introduction

Carnival celebration in Uruguay is the most popular event of the country, with international nature and considered to be the longest one in the world. Every year, from end January to mid-March, people enjoy street parades and shows on free and commercial stages installed in different neighborhoods of Montevideo (the capital of Uruguay), as well as in other towns. The antecedents of the Uruguayan carnival come from Europe, where the celebration of harvests or religious holidays served as an opportunity for large gatherings, free from the usual constraints due to social class and wealth differences. In Uruguay the Carnival also incorporated a number of elements of African tradition, brought in the colonial times by the slave population of this origin.

On Montevideo summer nights, artistic carnival groups, highlighting the so-called "Murga", tour the different stages

installed in the city. In these settings they present with humor and satire their vision of what has happened throughout the last year, not only in the city and the country, but also in the world. They make use of choral arrangements, striking costumes and creative makeups. To prepare their show, each group dedicates a large part of the year (around 6 months), involving dozens of people, mainly those who are on stage, but also technicians in

charge of the design and of the staging of the show. Beyond Montevideo, many other Uruguayan cities and towns have their own parades, scenarios and competitions, each with its own peculiarities. For instance, in the case of frontier towns, such as Rivera, Artigas and Melo, the parades adopt more elements of the Brazilian carnival.

Carnival has a strong relevance in the Uruguayan culture. The main event is the Official Carnival Competition, whose first antecedents date back to 1874. This annual competition currently brings together around 40 groups divided into 5 different artistic categories. Another important event is the Carnival of Promises, which is devoted to promoting the social inclusion and integration of children and young people, as well as their artistic, personal and cultural development, and was created by the Municipality of Montevideo more than 30 years ago.

## Problem Description

The Carnival of Promises contest takes place every year, between December and January. It is organized by the Department of Culture of the Municipality of Montevideo and the Association of Directors of the Carnival of Promises (ADICAPRO). The competition involves two rounds, each of which has ten stages to be carried out on consecutive days. At each stage, about four groups from different categories compete, with the dream of achieving the first prize in its category. The groups are evaluated by a jury constituted by technicians with background in the carnival culture. Currently between 1,500 and 2,000 children and young people between the ages of 5 and 18 participate in the competition. During the year, many training workshops are carried out that include activities related to music, singing, choreography, dance, acting, makeup, costumes and set design.



▲ *Figure 1: Team photo including Alfonsina Cardozo, Carolina Guido, Juan Carlos Machin, and ADICAPRO and the Montevideo Municipality project partners, during the 2019-2020 schedule presentation (ANTEL Arena, Montevideo, 2019-11-30).*

The competition is ruled by certain regulations stated in a document, which contains the guidelines for each category: number of members, duration of the shows, fundamentals of the category, etc. The five categories are: "murgas", "societies of lubolos", "humorists", "parodists" and "magazines". In an ideal situation, there must be 2 rounds composed by 10 stages. Each stage comprises shows by 4

groups, each one of them belonging to a different category. The groups opening and closing each stage are chosen so that they fulfill certain conditions. The closing show of a stage is generally reserved for those groups with more experience and recognition, so that the public is enticed to stay until the end. On the other hand, the groups that open a stage are usually those that debut in competition or have less convening power. However, it is intended that the same group only opens a stage once during the competition. One of the aspects of the competition that offers a great difficulty is the scheduling of the second round, since certain restrictions must be taken into account with respect to the first one. For example, no pair of groups acting at the same stage in the first round can act at the same stage in the second round. Another consideration is the difference in days between the acting of a group in the first and second round, since it is intended that all groups have about the same preparation time between both rounds.



## The Model

The competition schedule has always been determined manually, based on the knowledge and experience of the organizers. The preparation of the schedule involves several days of work of an expert, trying to contemplate as much as possible the above considerations and other constraints. The result usually does not fulfill all the conditions desired, and moreover, if there arises some problem making the proposed schedule infeasible, the time allowed to find an alternative one is not sufficient to obtain a good quality solution. With the aim of facilitating and shortening the process of making the competition schedule, we developed a mixed integer mathematical programming model for obtaining a schedule with a balanced attendance of public at each stage and that considers many of the problem restrictions simultaneously. The work was part of the Production Engineering final project by Alfonsina Cardozo, Carolina Guido and Juan Carlos Machín, oriented by Pedro Piñeyro and Héctor Cancela. For building the MILP model, we considered similar works in the literature about assignment problems and scheduling problems, such as the work of Durán et al. (2007) for scheduling the Chilean Soccer League. However, we want to point out that after an extensive search, we found very few works related to our subject of scheduling artistic events. In particular, we reference the work of Ortega et al. (2015) about the planning of cultural schedules, considering all the parties involved (artistic agents, sites and administration) in a unified setting.

A major challenge we faced for making the model was how to measure the public attendance in order to define the objective function. At first, we considered to estimate it from the number of tickets sold by each group in previous editions of the competition. However, it would not be a proper choice, since some of the groups with highest attendance do not sell tickets in advance. On the other hand, in the 2019/2020 edition new groups were participating of the competition (so that there could not be information about tickets sold last year for them). The way

chosen to measure the appeal of the groups was through the use of surveys. Thus, one delegate from each group had to indicate whether the expected attendance for the rest of the groups was high, medium or low. In conjunction with the organizers, it was decided that each group would rate other categories, but it would not rate groups in its same category to achieve greater objectivity.

The MILP model developed in the project has two families of binary decision variables. The first family is used to indicate if a certain group  $i$  is assigned to stage  $d$  and time slot  $t$  in round  $c$ . The second family indicates if a category  $k$  group is assigned to stage  $d$  and time slot  $t$  in round  $c$ . Considering around 40 groups, 5 categories, 2 rounds with 10 stages, each one of them with 4 slots of time, the model has in the order of 3600 binaries variables. In addition, continuous variables are used to measure the deviation from the average for a proxy metric (based on the surveys mentioned before) which indicates public attendance at each stage. The formulation has almost 40 families of constraints, of which approximately 30 consider central aspects of the problem, such as the following ones:

- every group must be assigned to only one slot of time per stage and round;
- the groups that can open and close a stage must comply certain conditions (i.e., they belong to some predefined sets);
- a given group cannot be assigned to the beginning of a stage more than once;
- two groups of the same category cannot be assigned in consecutive slots of time in the same stage;
- the maximum number of occurrence of groups pertaining to the same category per stage is bounded;
- no pair of groups that are assigned to the same stage in the first round can be assigned to the same stage in the second round;
- for each group the distance (in days) between the assignment of the first round and that of the second round must be larger or equal to a predefined value.



▲ Figure 2: Group Revista Fenix presenting their show in the opening stage of the Carnival of Promises 2019/2020 (Teatro de verano, Montevideo, 2019-12-19)



▲ Figure 3: Group Sociedad de negros y lubolos Ohana presenting their show in the opening stage of the Carnival of Promises 2019/2020 (Teatro de verano, Montevideo, 2019-12-19)

Additional constraints take into account particular situations of this edition of the competition and also the variable domain definitions.

#### Case study: Carnival of Promises 2019/2020

The project counted with the cooperation from very early stages of ADICAPRO and the Municipality of Montevideo. They helped to understand the problem and the different constraints, and to determine a suitable objective function, as described above. At the same time, their participation in the project helped them to learn what kind of results could be offered by the MILP model, and to gain confidence that the solutions could fulfill their expectations. As a result of this process, they agreed to employ the model to determine the scheduling of the Carnival of Promises 2019/2020 edition. The process involved first determining all the data corresponding to the competence (which in this edition included 6 "murgas", 3 "societies of lubolos", 11 "humorists", 12 "parodists" and 8 "magazines"). A number of preliminary runs allowed to check the different solutions (using AMPL+ CPLEX 12.9.0.0 and a desktop computer with Intel Core i7 - 6700 - 3.40GHz and 24GB RAM). Finally, the assignment results were presented in public on November 30th 2019, during an event where all the participants in the different groups were invited and local authorities also attended. Only first round assignments were published at that time, with a very high satisfaction level from all parts involved. The first round of the competition started on December 19th, and it was programmed to finish on December 28th 2019. Due to rains, some stages were suspended and changed dates, so that the first round actually finished later. On January 3rd 2020 the model was run again, taking as additional constraints the data from the real life first round, and optimizing the second round, resulting in a new assignment for these stages, which then took place in the first two weeks of January 2020.


#### Conclusions

We consider that the project was successful, because it resulted in a MILP formulation for an important artistic event

in Uruguay, which was used in practice and delivered excellent results, according to the evaluation that the event organizers transmitted. We think that this is a nice addition to the state of the art in OR for event scheduling, because we only found a few previous papers in the area. More importantly, the organizers of the Carnival of Promises found that the optimization model allowed them to solve satisfactorily and in short times a problem which usually consumed a large effort and did not achieve all the stated goals and constraints. They participated actively in defining these constraints, and the process of formalizing the model helped them to better formulate and explain these desired conditions, as well as to check that the solution provided complied them. The solution achieved was the result of an objective process, so that all groups felt the schedule results were fair and that no group was unduly advantaged or penalized. The organizers also were able to quickly reprogram the second round of the contest, after some changes happened in the first round due to weather conditions, maintaining the same level of solution quality as in the initial scheduling. This project was also an opportunity to show to a large public of young people the interest of Operations Research techniques and the impact they can have in cultural activities, which is not very usual, at least in Uruguay. We hope that this experience also can motivate some of the children participating in the Carnival groups to consider continuing studies in STEM areas, and particularly in Operations Research.

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## Towards Optimal Alignment Design for Road Construction

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**History.** This work won the EURO Excellence in Practice Award 2019

Transportation is a critical part of modern economies. In the 2015/2016 fiscal year, Canada territorial, provincial and federal agencies spent 15.9 billion dollars to build and extend roads. More than 50% of revenue gained by the territorial, provincial and federal government came from road transportation. Reducing the cost of road construction, without compromising safety, holds the potential for savings in the millions of dollars.

Computers are being increasingly used to help engineers select a “best” design among huge numbers of possibilities. In 2009, Softree Technical Systems (Softree is a software development company that commercializes road-design engineering tools) began a long-term collaboration with the University of British Columbia (UBC) to research automated road design and optimization. Softree’s vision is to leverage optimization techniques to support civil engineers design choices. This article explains how optimization was used to produce less expensive road designs in minutes instead of days.

### The road design problem.

Road design consists in selecting an alignment that connects two given points. The objective is to minimize costs while satisfying safety, building code, and environmental constraints. The road design problem is typically split into four sub-problems. The **corridor selection** problem consists in selecting promising corridors from a ground profile and information on underground materials. Given a corridor, there are two alignments to be chosen: the **horizontal alignment** problem decides where the road is built from a satellite viewpoint; and information forms the input of the **vertical alignment** problem that focuses on which hill to cut or valley to fill to build a road that satisfies all



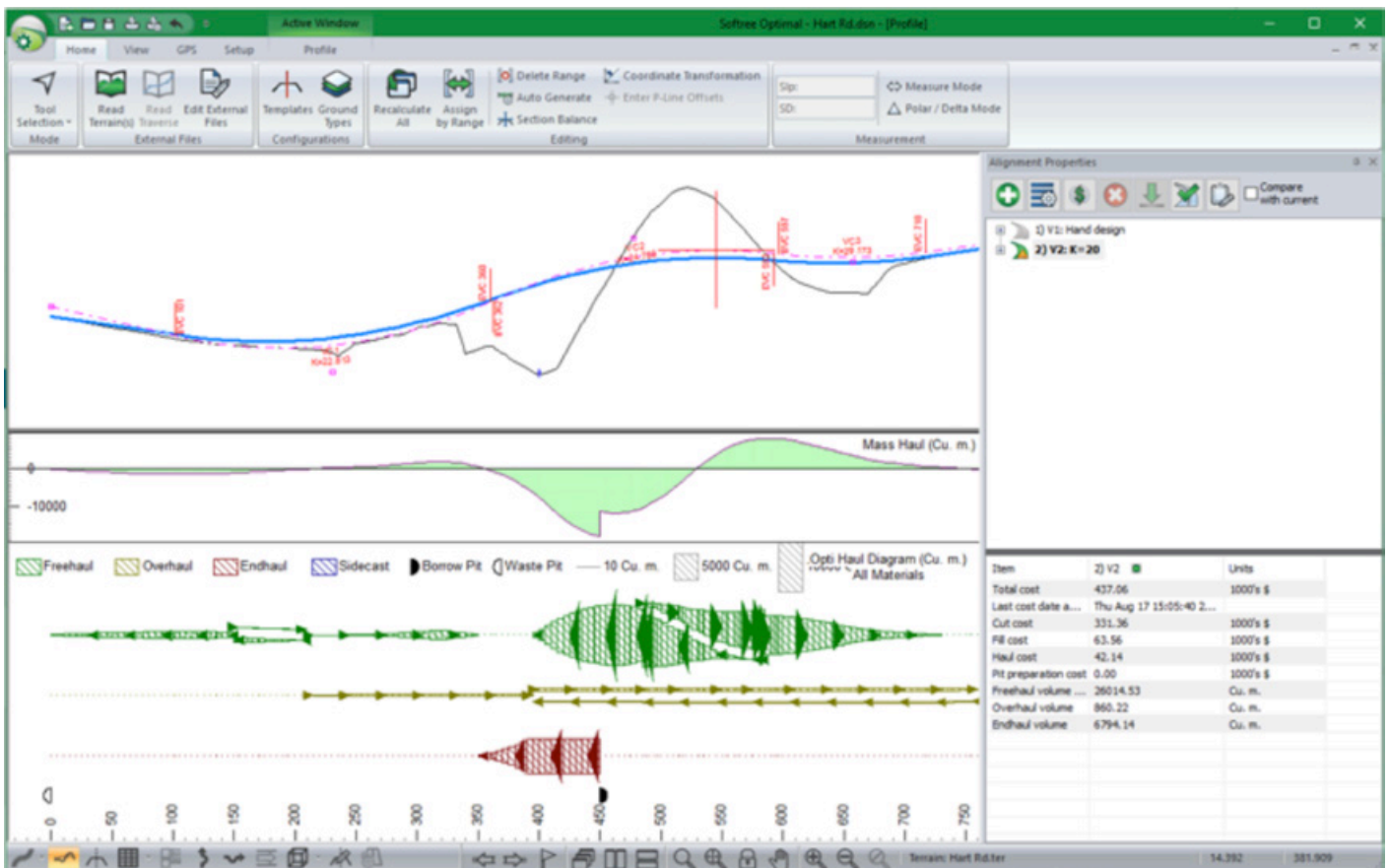
safety standards and building codes. Finally, the vertical alignment makes the input of the **earthwork** problem, which minimizes costs (principally cutting, filling, and moving materials costs) to build the road.

### The need for optimization

Finding the best alignments is challenging. The problems involve too many parameters for an engineer to find a best solution manually. Manual designs are approximate and largely based on trial and error whereby an alignment is iteratively adjusted until the engineer is satisfied. However, small changes in the alignments can create significant cost differences. This is especially true for material movements, which, traditionally is iteratively minimized using a mass haul diagram (a mass haul diagram is a graphical representation of material moved to minimize material movement by displaying balance points; it is illustrated in Figure 2).



▲ Figure 1: Visualization of an alignment



▲ Figure 2: Softree Optimal Screenshot - vertical alignment profile, mass haul diagram, and multi-material hauling diagram.

### Benefits of an optimization approach

The first step to apply optimization techniques to road design is to model the problem carefully to be able to compute an optimal solution in reasonable time. While research on optimizing road designs started in the 1970s, it has yet to become an accepted engineering tool due to the complexity of the problem that necessitated oversimplifications.

Fortunately, several factors make the use of optimization easier today: improvement in modeling, availability of efficient optimization solvers, access to accurate survey information such as LIDAR (Light Detection And Ranging is a laser-based surveying method that produces high resolution maps), and improved computing speed.

### Softree Optimal

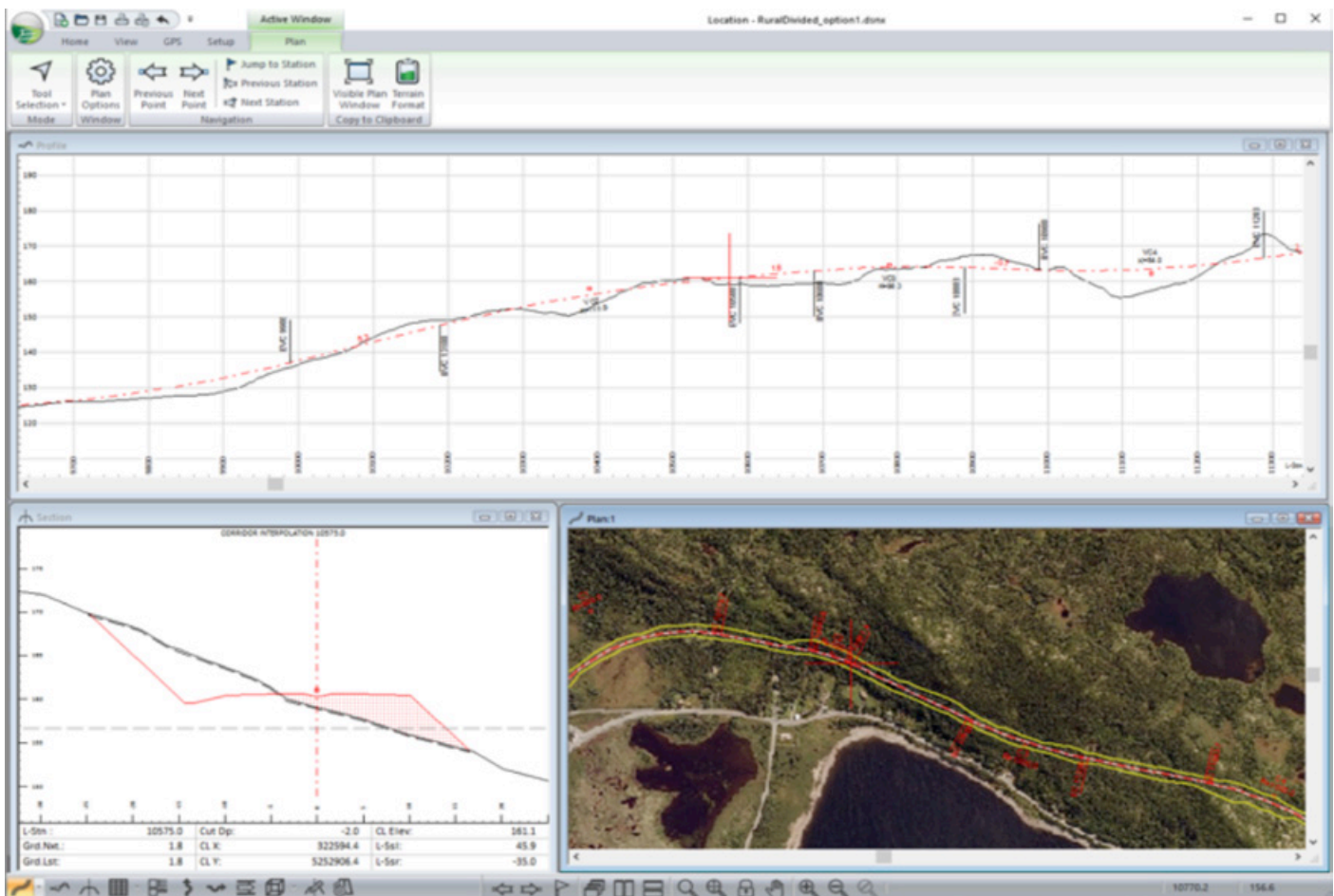
The result of the collaboration between Softree and UBC is the commercial software Softree Optimal. that incorporates several innovations. First, comparing alignments designed manually is difficult due to the large number of parameters that take different values. Softree Optimal solves that problem by providing a consistent environment to compare designs quantitatively. That feature, called design time costing, allows an engineer to compare alignments by explicitly computing their cost. Parameters can be modified and the cost quickly recomputed, which saves the engineer large amounts of time in their search for a best design.

Next, Softree Optimal computes optimal material costs: extraction, transportation, and compaction. The model used is a mixed integer linear program that provides a guaranteed globally optimal solution. In other words, no matter how skilled a civil engineer is, the best they can do is find a design with the same cost. That guarantee is important to convince engineers of the value of Softree Optimal. The model merges both the earthwork and the vertical alignment in a single mixed integer programming model. It incorporates several modeling advances to accurately capture the geometry.

Finally, Softree Optimal also allows computing a horizontal alignment within a given corridor. That optimization problem is much more complicated since it involves discontinuous functions. Softree Optimal uses a bi-level programming model to guarantee local optimality of the solution, i.e. moving parameters by small values results in worse solutions.

### Validation

The optimization techniques incorporated in Softree Optimal have been validated on test sets of problems with results published in peer reviews. On a representative test set of 60 real road-design problems provided by Softree Technical Systems Inc., the model is eight times faster than previously known models, solves 10% more problems, and stays within a 1% relative error. Such improvements were critical in commercializing the Softree Optimal product.



▲ Figure 3: Softree Optimal Screenshot - Vertical alignment profile, cross-section diagram showing the side slopes, and horizontal alignment satellite view.

Several use cases were made public. The Franklin County (Washington, USA) was considering redesigning a road to accommodate higher speeds. The horizontal alignment was to remain straight with a focus on modifying the vertical alignment. All the parameters were entered in Softree Optimal, which computed an optimal alignment in 22 seconds on a laptop computer. After two hours of re-optimizing with changes in parameters, the resulting alignment looked similar to a manually designed alignment, but was 23% cheaper. Moreover, the volume of material excavated and filled was also significantly lower, which reduces the environmental impact of the project.

Another case study involved a city of Lethbridge project to pave an existing gravel road. Tight constraints and even tighter construction schedule expectations were met and exceeded with the use of Softree Optimal. The 80% reduction in preliminary design time was the “difference between meeting the deadline and budget, and building the road; or having the client shelf the project for another year”.

FPInnovations independently evaluated Softree Optimal by comparing alignments manually optimized vs. alignment produced by Softree Optimal. The comparison was performed using two accepted resource road standards. The optimized alignments were found to be 13 to 22% cheaper and computed in a matter of seconds or minutes.

### Future improvements

Further speed improvement were found by detecting

feasibility faster by exploiting the structure of the problem. Since only a few constraints determine feasibility, exploiting the structure of the model allows the determination of feasibility 75 times faster and building a feasible solution 10 times faster than commercial solvers.

### Conclusion

The result of 10 years of work on the road design problem is a patented commercial product available free of charge for educational institutions.

Overall, Softree Optimal has been a great success story. The research and resulting software have made a significant practical impact in how roads are built by providing Softree customers with reduced design times, and improved solutions.

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### Acknowledgements

We would like acknowledge all the students and colleagues who contributed to the road design project since its beginning. Many thanks to Softree personnel for their help. 🌐

# irace: A Tool for the Automatic Configuration of Algorithms

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The design and tuning of optimization algorithms, be they exact or approximate, is a challenging task. Traditionally, this task has been solved through a manual, labor-intensive approach that relies on the expertise and the intuition of the algorithm designer. However, in recent years, these approaches have been sidelined by automated algorithm configuration software with examples being irace [1], ParamILS [2] and SMAC [3]. Configurators have shown to be successful in searching the parameter space to identify high-performing parameter configurations. Here we illustrate irace, which is a high-performing algorithm configurator widely used in practice [1].



Figure 1 gives the general scheme of how irace works. It receives as input: a *parameter space* that defines the parameters of the target algorithm to be configured, a set of *training instances* that are representative of the problem solved by the algorithm, and a *configuration scenario* that defines several options of the configuration process (e.g., the number of evaluations or time available for the configuration process). With these settings, **irace** explores the parameter space searching for the best possible configuration. This is done by iteratively executing the (target) algorithm with different parameter configurations ( $\Theta$ ) on some of the training instances ( $I$ ). The execution of the target algorithm is performed through a *targetRunner* script that runs the target algorithm to solve an instance  $i \in I$  with the given parameter configuration  $\theta \in \Theta$ . The *targetRunner* is, in a sense, an interface between the target algorithm and **irace**, and receives as input an instance and an algorithm configuration and returns to irace the corresponding performance cost  $c(\theta, i)$  being minimized.

The current version of irace can handle complex parameter spaces (both categorical, integer and real-valued), conditional parameters (parameters that only have an effect for particular values of other parameters), constraints of parameter values (i.e., forbidden configurations), and logarithmic scale for numerical parameters.

For numerical and ordinal parameters, the probabilistic model consists of truncated normal distributions  $N(\mu_d^j, \sigma_d^j)$ , where  $\mu_d^j$  is the value that parameter  $d$  assumes for elite configuration  $\theta_j$  and  $\sigma_d^j$  is a standard deviation that becomes smaller as the search advances. If it is a categorical parameter, then a discrete probability distribution is

defined, which is initialized, if nothing else is specified, to a uniform distribution.

Initial configurations are sampled uniformly at random, however, the user may also provide candidate configurations as input, such as default parameter configurations or promising ones. The irace package then iterates the search between the generation of algorithm configurations applying a probabilistic sampling mechanism, the selection of the best configurations through a racing procedure [4], and the update of the probabilistic model around the best configurations obtained in the racing process, called elite configurations.

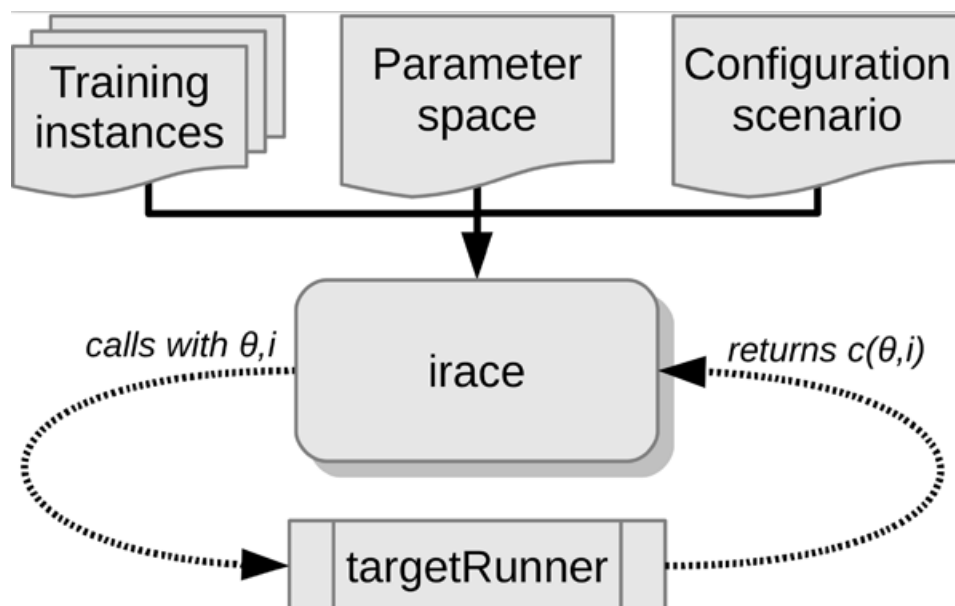
Configurations are evaluated by means of a racing procedure. In a race, every configuration is evaluated first on one instance, then on a second one and so on until some evaluation budget is depleted. After a number of instances have been considered, we apply a statistical test to eliminate underperforming candidate configurations. Two main alternatives can be used for this test. The first is the non-parametric Friedman's two-way analysis of variance by ranks. The second is the pairwise, paired Student t-test with or without multiple test corrections; however, we do not recommend to use multiple test corrections, as otherwise the elimination is very slow. In practice, the statistical test is mainly used as a heuristic rather than as a proof of statistical significance.

Once a race is finished, the sampling model is updated independently for each elite configuration. For numerical and ordinal parameters this is done by centering the expectation at the current elite parameter value and reducing the standard deviation. For categorical parameters the distributions are updated by increasing the probability of the current elite parameter value and decreasing the probability of the others values.

Both, the described probabilistic sampling mechanism and the statistical test are present in the three major versions of *irace* released so far. Version 1 was very similar to the original Iterated F-race. Version 2 introduced an elitist race that preserves the evaluations of elite configurations from previous iterations, requiring that new configurations show better performance on at least the same instances as an elite configuration, in order to eliminate this elite configuration from the race [1]. Version 3 further extended version 2 by adding an adaptive capping mechanism aiming at improving the performance of *irace* when the configuration target is runtime minimization [5]. A few other useful features of *irace* are the possibility of evaluating algorithm configurations in parallel, the online detection of “bad” configurations (e.g., configurations that trigger an error in the target algorithm), and the recovering from an interrupted *irace* run.

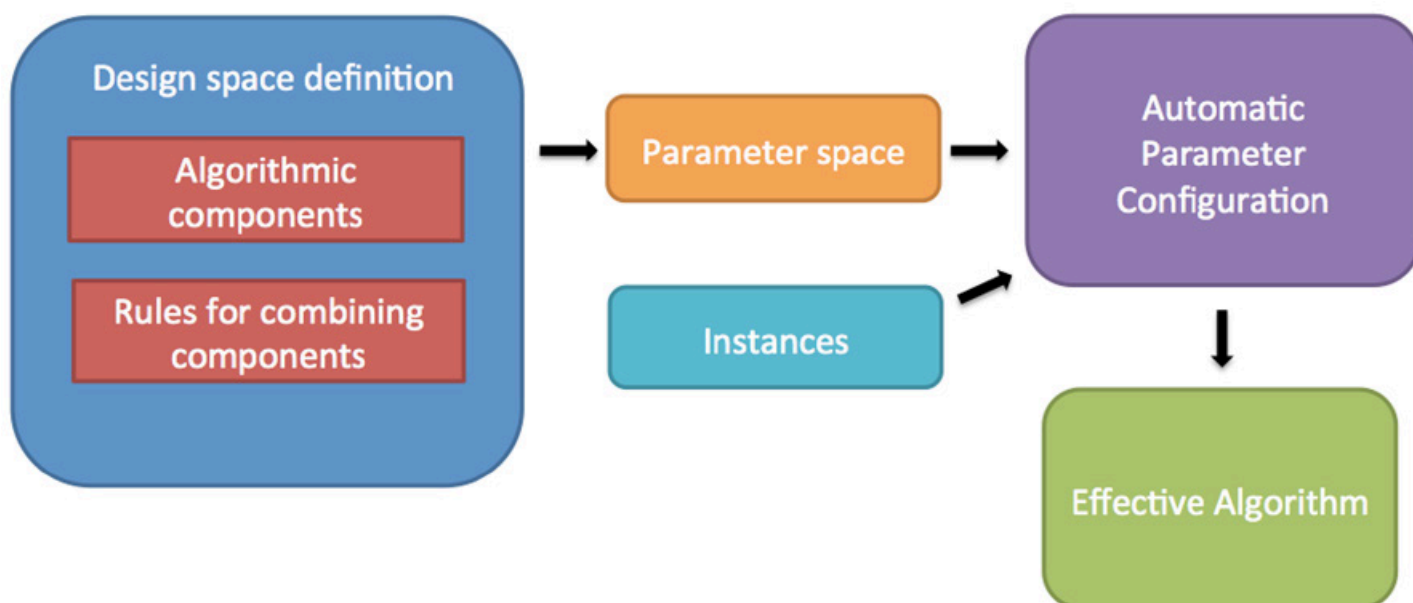
*irace* has been successfully used in a large number of configuration tasks for metaheuristics, mixed-integer programming solvers, machine learning and other algorithms [1]. More recently, *irace* has become a fundamental piece of several automatic algorithm design approaches that aim at generating algorithms from algorithmic components (Fig. 2).

In our research, we have used *irace* to explore top-down and bottom-up approaches to automatic algorithm design. In top-down approaches, a pre-defined algorithmic template is defined, where at specific points mostly



▲ Figure 1: Conceptual view of *irace*. The parameter space, training instances and the configuration scenario are inputs. The target runner script is used by *irace* to interface with the algorithm being configured. It receives the configuration  $\theta$  and the instance  $i$  as input and returns one number as the output of the algorithm.

categorical parameters represent a limited number of design choices. The template together with all available choices are implemented as an algorithmic framework that can be configured by *irace* for various scenarios. We have developed different algorithm frameworks of this kind, which go from continuous optimization frameworks of ant colony optimization (ACO) and artificial bee colony algorithms to multi-objective frameworks of (discrete) ACO and evolutionary algorithms. For example, in the context of multi-objective ACO (MOACO) algorithms, we were able to obtain new MOACO algorithms that outperformed all the MOACO algorithms available for the bi-objective TSP. In bottom-up approaches, the possible compositions of algorithms may be represented through (1) grammars that define possible compositions, (2) finite-state machine representations or (3) a system that holds the grammars at a specific recursion level. >>



▲ Figure 2: General view of approaches to automatic algorithm design that rely on algorithm configuration tools such as *irace*.

>> We have shown how configuration tools such as irace may drive this third alternative and we have proposed a bottom-up system that allows the automatic generation of complex local search algorithms as recursive compositions of variants of iterated local search, simulated annealing, tabu search, GRASP, etc. The system separates generic and problem-specific components, which allows high-performing problem-specific implementations of key components. The first version of this system was very promising. A second version of the system, the EMILI framework, obtained algorithms with further improved performance. For example, on several variants of the flowshop problem (with makespan, total completion time, and total tardiness objectives), EMILI was able to generate three new state-of-the-art algorithms [6].

The **irace** software is implemented as an **R** package but it may be used outside the **R** environment via the command-line. It is publicly available at <http://iridia.ulb.ac.be/irace/>.

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