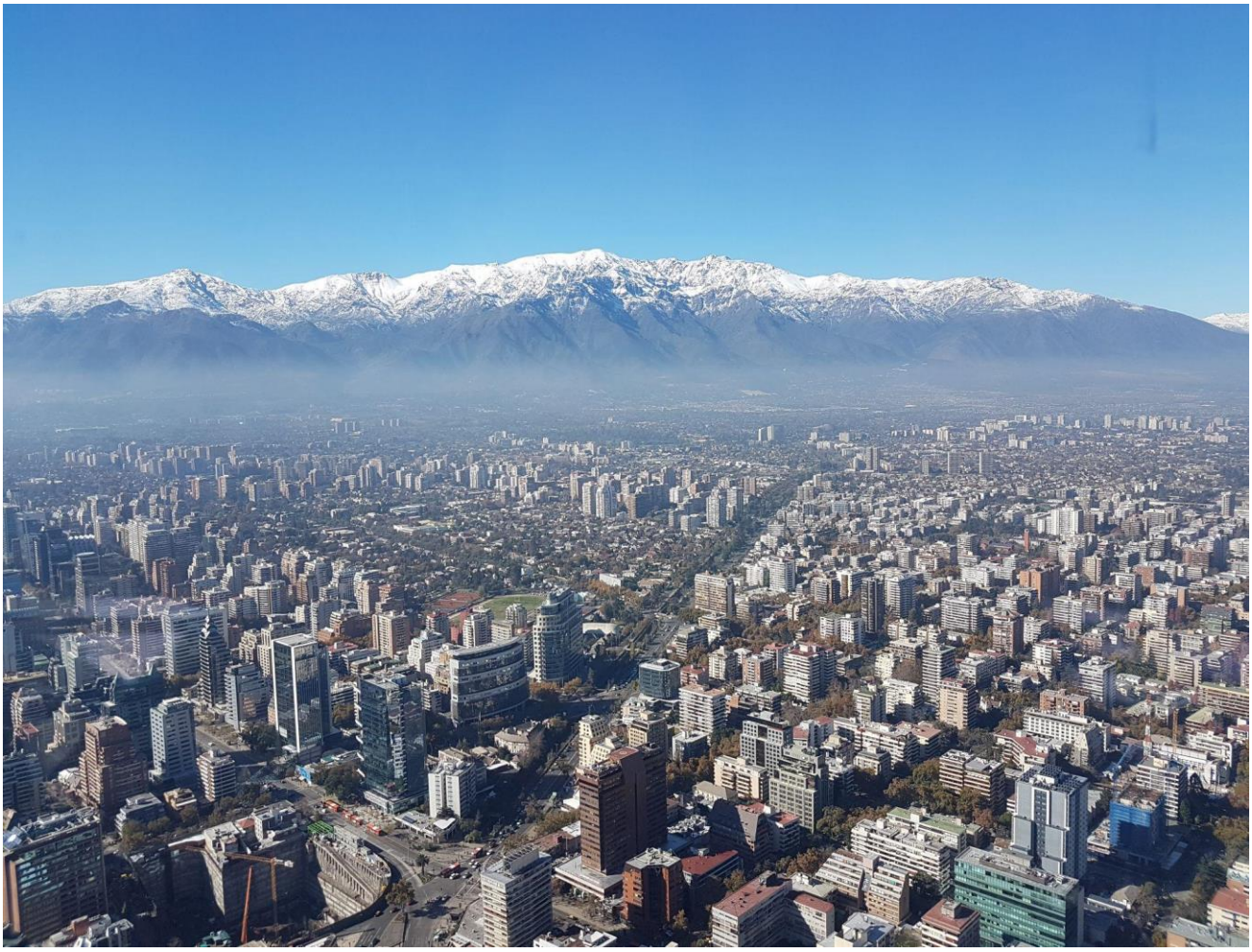
IFORS2023

The 23rd Conference of the International Federation of Operational Research Societies

July 10-14 · SANTIAGO, CHILE



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Proceedings of the 23rd International Conference of the International Federation of Operational Research Societies

Alice E. Smith, Jorge R. Vera, and Bernard Fortz (editors)

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Preface

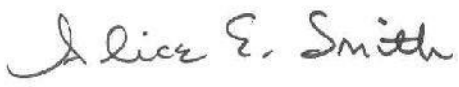
IFORS 2023 was a resounding success! The technical program had 946 submissions with 726 presentations actually given at the conference. Authors of submissions came from 55 countries. There were 36 clusters/streams headed by 55 cluster chairs. The program spanned four days with many parallel tracks spread over two nearby venues. The conference took place in Santiago, Chile in July of 2023.

The compilation herein contains the titles, authors, and abstracts of the presentations at the conference. These include four plenary addresses, six keynote speeches, six tutorials, and several special sessions such as panels and mini-workshops. The bulk of the abstracts come from the technical program, both invited and contributed (we make no distinction between these herein). The abstracts are grouped by session and thence into clusters/streams. Each session has between two and four abstracts, and these constitute a coherent set on the topic named in the session title. Each session is part of a cluster/stream, which is similarly titled with its focus.

If you reference or cite an abstract from IFORS 2023, please cite this online volume by its ISBN and DOI. We invite you to share these proceedings with your colleagues and students. It may be distributed freely to promote scientific and technical inquiry and to facilitate exchange and networking of the rich set of research presented at this conference.

To all the participants in the technical program of IFORS 2023, thank you! These include the authors, presenters, session chairs, cluster chairs, plenary and keynote speakers, and tutorial leaders. And, of course, to Bernard Fortz of University of Liège, who orchestrated the submission and program building software.

We can all be proud of the breadth and rigor of the work presented and the many conversations stimulated at the conference and going forward, which will no doubt enrich our operations research community and its work. Enjoy this volume which is the permanent technical record of the conference.



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The proposed work develops a multioperation sequencing model finding an optimal solution for the scheduling problem in an affordable time.

3 - Critical path analysis for permutation flow shop scheduling problem
Daniel Rossit, *Jatinder N. D. Gupta*, *Martin Safe*, *Óscar C. Vásquez*, *Fernando Tohmé*, *Mariano Frutos*

Scheduling problems in flow shop processes have a great impact on a large number of applications, both at a production and industrial level, as well as process systems in general (information technologies and business). In all these applications, the most studied objective function is the makespan, seeking to minimize the total processing time for a given set of jobs - in its simplest structure (one machine per stage of the process, without release date, and no particular conditions for job processing), an NP-Hard problem for 3 machines or more. Within the way of approaching the problem according to the solution category, permutation solutions are the most widely used; in them, the same order of jobs is respected in all process stages. In the literature, there are a large number of approaches and methods proposed to address the optimization of the makespan for this problem. This paper proposes to study the structure of the solutions from the perspective of the structure of its critical path, considering as a critical path the set of operations supporting the makespan. In this approach, some results from the literature will be used to extend the solutions to other cases. In turn, the potential impacts of considering the solution structure for the design of solving methods will be presented and discussed.

Novel OR Applications in Healthcare and Beyond

Cluster: Scheduling in Logistics
Invited session
Chair: *Celia Glass*

1 - AI Rostering for NHS Doctors in Training: Enhancing Well-being with Mathematical Programming
Celia Glass

In this talk, I address an important aspect of hospital logistics - the rostering of staff, central to the efficient running of any hospital and to the lives of its staff. I explain how a sophisticated OR rostering tool allows us to address the well-being and progression of doctors in training in UK National Health Service (NHS) hospitals. Central to the approach is the use of HSE fatigue factors and prioritisation of staff training and leave preferences. Rostering is known to be an NP-complete Combinatorial Optimisation problem; all expected is a tolerably good solution. By capturing the mathematical structure of the underlying problem, however, we have solved it using Mathematical Programming Optimisation (MP); the application runs on an MPL-Gurobi commercial package, in the Cloud. In this talk, I report how the efficiency of our MP approach reduced doctors' reported fatigue, locum staff costs and rota manager's time. More consistent staff cover improved doctors' morale and caused less tiredness among doctors, leading to better patient care. The positive impact for the doctors, the hospital, and the patients provide win-win-win benefits. In particular, we demonstrate how training can be incorporated into hospital rosters. By planning training into the rosters, attendance at specialist training courses ceased to conflict with covering patient duties, and progression to consultant was improved. Personalised rosters doubled surgical training, while improving continuity of care for patients. We, thus, address the key issues of • doctors' well-being, • personalised training planned into department rosters, and • flexibility of working hours. I illustrate how training, progression and retention in the NHS can be significantly improved through the use of our MP rostering tool. The underlying model is transferable to other health systems across the world. The results present a positive paradigm shift for health professionals with mathematics, meaning caring for the carers!

2 - An Approximate Dynamic Programming Approach to Network-Based Scheduling of Chemotherapy Treatment Sessions
Pablo A. Rey, *Alejandro Cataldo*, *Antoine Sauré*, *Arturo Wenzel*

A solution approach is proposed for the interday problem of assigning chemotherapy sessions at a network of treatment centres, with a view to increasing the efficiency of system-wide capacity use. This network-based scheduling procedure is subject to the condition both the first and last sessions of a patients treatment protocol are administered at the same centre the patient is referred to by their oncologist; all intermediate sessions may be administered at other centres. The problem is modelled as a Markov decision process, then solved approximately using techniques of approximate dynamic programming. The benefits of the approach are evaluated and compared through simulation with the existing manual scheduling procedures at two treatment centres in Santiago, Chile. The approach would obtain a 20% reduction in operating costs for the whole system and cut existing first-session wait times by half. A network-based scheduling procedure brings no real benefits, however, if it is not implemented in conjunction with a proactive assignment policy like the one proposed.

3 - Study of waiting lists in health services based on medical planning
Kevin Roa, *Sebastián Dávila*, *Franco Quezada*

Medical staff planning can cause significant challenges for patients and healthcare systems and can substantially impact waiting lists; inadequate planning can lead to shortages of resources, delays in referrals, improper prioritization of patients and longer wait times for medical care. These issues can have severe consequences for patients' health and the effectiveness of the healthcare system as a whole. To address these challenges, we study the problem of planning medical staff for a discrete planning horizon, assuming the demand for medical care is unknown and dynamic. We use a two-stage stochastic programming approach, where medical staff is a first decision variable, i.e., they must be decided before the uncertainty realization and patient allocation (second-stage variables). We develop a mixed integer linear programming (MILP) model considering resource constraints and several specialties and allocating medical resources effectively to patients, to minimize waiting lists under various criteria. Three planning approaches are considered in the model: flexible, semi-flexible, and rigid; they address the uncertainties arising from demand for healthcare services and offer varying degrees of flexibility to respond to changes in demand.

Key performance indicators (KPIs) are used to evaluate the performance of medical formulations under each planning approach; they measure waiting times, utilization rates, and the number of patients waiting for treatment. The proposed models achieve superior performance indicators, compared to random and deterministic solutions, and provide medical assignments ensuring compliance with budgetary and material constraints, while improving waiting list management. They also show relevant managerial insight, such as the importance of considering flexibility in medical staff planning to respond to changes in demand and to optimize patient outcomes, offering an innovative optimization tool for healthcare managers.

Gurobi - New Highlights and Innovations

Cluster: Software for Optimization
Invited session
Chair: *Michael Winkler*

1 - Solving Optimization Problems with Gurobi - New Highlights and Innovations
Michael Winkler