



Davide Duma
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Dip. Matematica
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Davide Duma

Working experiences

Research

Mar 2021 - Present, *Post-doctoral researcher (RTDa)*

Group of Computational Optimization at Department of Mathematics "Felice Casorati", University of Pavia; currently involved in research projects: "Development of a multimodal schedule-based route planner" with European Commission - Joint Research Center in Seville, "Artificial Intelligence Models and Algorithms to support the maintenance of bio-pharmaceutical industrial machines" with Fedegari Autoclavi SpA, "Scheduling of processes in a medical 3D printing laboratory" with 3D4Med, and "Optimization of the emergency patient flow" with Istituto di Radiologia, Policlinico San Matteo di Pavia.

May 2014 - Dec 2020, *Research fellow*

Group of Operational Research and Combinatorial Optimization at Department of Computer Science, University of Turin: research fellow ("borsista di ricerca") for the project "Clinical Pathways: New Patient Centered Organizational and Management Models" (May 2014 – Oct 2014); Ph.D candidate (Nov 2014 – Oct 2018); research fellow ("borsista di ricerca") for the project "Online optimization methods applied to urgent and emergency health systems" (Nov 2017 – Jun 2018); post-doctoral researcher ("assegnista di ricerca") for the project "Big data supporting Emergency Care imprOveMEnt (BECOME)" (Jul 2019 – Dec 2020).

Teaching and mentoring

Academic years 2020-21, 2021-22, and 2022-23, *Course holder*

"Decision Support Under Uncertainty" for Ph.D. Program in Computational Mathematics and Decision Sciences (a.y. 2022–23, 24h, planned start in November); "Numerical Optimization and Data Science" for M.Sc. in Mathematics and M.Sc. in Finance (a.y. 2022–23, 24h, planned start in March); "Foundations of Data Analysis" (module of "Optimization", 24h) for M.Sc. in Mathematics (a.y. 2020–21 and 2021–22, 28h); "Mathematical Methods" for B.Sc. in Bioengineering (a.y. 2021–22 and 2022-23). University of Pavia.

Jan 2022 - Feb 2022, *Mentor*

Mentoring for Winter School of Operational Research in Public Health EmergencieS (ORPHES) organized by The South-East Asia Regional Office of the World Health Organization (WHO-SEARO), the Global Outbreak Alert and Response Network (GOARN), and operations research societies (EURO, ORAHS, and APORS).

Academic year 2020–21, *Adjunct professor*

"Matrix Algebra and Operations Research" for B.Sc. in Computer Science, University of Turin.

Academic year 2019-20, *Adjunct professor*

Two courses of "Operations Research" for (i) B.Sc. in Strategic Science and (ii) M.Sc. in Strategic and Military Science at the Interdepartmental University School of Strategic Sciences (SUISS), University of Turin.

Academic year 2016-17, *Teaching tutor*

"Operations Research" for B.Sc. in Strategic Science at SUISS, University of Turin.



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Academic year 2013–14, *Teaching tutor*

Pre-course for B.Sc. in Mathematics, University of Turin.

Academic year 2018–19 - present, *Supervision of students*

Co-supervisor of a M.Sc. thesis in Computer Science; supervisor of a B.Sc. thesis in Mathematics; co-tutor of a Ph.D. student in Mathematics; advisor of a team of 3 Ph.D. students in Computational Mathematics and Decision Sciences in an international optimization modeling competition.

Education

2014 - 2018, *Ph.D. in Computer Science*

University of Turin. Thesis: "Online optimization methods applied to the management of health services", supervisor Roberto Aringhieri.

2011 - 2014, *M.Sc. in Mathematics*

University of Turin. Thesis: "A simulation and optimisation model for operating room planning", supervisor Roberto Aringhieri. Final grade 108/110.

2006 - 2011, *B.Sc. in Mathematics and Computer Science*

University of Salento. Thesis: "Approximation algorithms for the multiway cut problem", supervisor Paolo Nobili. Final grade 105/110.

Schools and other courses

Jul 2017: Optimization, Big Data and Applications (OBA) Summer School. Veroli, Italy.

Jul 2015: ESI XXXII - EURO Summer Institute on Online Optimization. Szeged, Hungary.

Apr 2015: Short Course "Data Mining with Applications to Healthcare". Cardiff, UK.

Feb 2015: BISS 2015 - Bertinoro International Spring School. Bertinoro, Italy.

Jun 2014: ESI XXXI - EURO Summer Institute on Operational Research applied to Health in a Modern World. Bard, Italy.

International conferences and workshops

As an invited speaker

Sep 2022: 3rd Spanish Young Statisticians and Operational Researchers Meeting (SYSORM 2022). Elche, Spain. Talk: "Computing lower and upper bounds for the maximum chi-square index through a combinatorial relaxation". Invited speaker as "talented young researcher", selected by AIRO board.

Apr 2019: Data Science Workshop for Public Health Residents. Turin, Italy. Talk: "Mining and Optimising a patient flow through an Emergency Department".

As a speaker

Jul 2022: 48th Annual Meeting of EURO Working Group on Operational Research Applied to the Health Services (ORAHS) "In the red zone". Bergamo, Italy. Talk: "Stochastic optimization of inpatient and outpatient surgery scheduling".

Jul 2022: 32nd European Conference on Operational Research (EURO). Espoo, Finland. Talk: "On the computation of the maximum chi-square index by Integer Programming".

May 2022: 7th International Symposium on Combinatorial Optimization (ISCO). Online. Talk: "A particular quadratic transportation problem".



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Jul 2021: 47th e-ORAHs Conference - Applications of OR to Healthcare Adversity. Online. Talk: "Modelling the Regional Hospital Network using Big Data and Discrete Event Simulation".

Jul 2020: 46th e-ORAHs Conference. Online. Talk: "Optimising the daily swab test collection to identify new cases of Covid-19".

Jul 2019: 45th ORAHs Conference. Karlsruhe, Germany. Talk: "Analysing the impact of prediction in real-time management of ambulances".

Dec 2018: Winter Simulation Conference (WSC) – Simulation for a Noble Cause. Göteborg, Sweden. Talk: "A Simulation and Online Optimization Approach for the Real-time Management of Ambulances".

Sep 2018: 2nd International Conference on Optimization and Decision Science (ODS). Taormina, Italy. Talk: "Reducing Overcrowding at the Emergency Department Through a Different Physician and Nurse Shift Organisation: A Case Study".

Aug 2018: 44th ORAHs Conference – Connected Care. Oslo, Norway. Talk: "Resource allocation in an Emergency Department: an online optimisation approach".

Sep 2017: 3rd International Conference on Machine Learning, Optimization and Big Data (MOD). Volterra, Italy. Talk: "Evaluating the dispatching policies for a regional network of emergency departments exploiting health care big data".

Sep 2017: 1st ODS Conference. Sorrento, Italy. Talk: "Patient-centred objectives as an alternative to maximum utilisation: comparing surgical case solutions".

May 2017: 3rd International Conference on Health Care Systems Engineering (HCSE). Florence, Italy. Talk: "Mining the patient flow through an Emergency Department to deal with overcrowding".

Jul 2016: 42nd ORAHs Conference – Finding better health-care decisions in new oceans of health data. Pamplona, Spain. Talk: "Reducing the overcrowding at the emergency department". Session chair.

Jul 2016: 28th EURO Conference. Poznań, Poland. Talk: "Sharing operating rooms between elective and non-elective surgeries: an online optimization approach".

Jul 2015: 41st ORAHs Conference – Networking Health: Facing the Challenges in Health Services Management. Montréal, Canada. Talk: "A mixed offline and online approach to manage elective and non-elective patients".

Aug 2014: 4th International Conference on Simulation and Modeling Methodologies, Technologies and Applications (SIMULTECH). Vienna, Austria. Talk: "A hybrid model for the analysis of a surgical pathway".

Publications

Articles on scientific journals

2022. R Aringhieri, S Bigharaz, D Druetto, D Duma, G Grosso, A Guastalla. The daily swab test collection problem. *Annals of Operations Research* (to appear).

2022. R Aringhieri, S Bigharaz, D Duma, A Guastalla. Fairness in Ambulance Routing for Post Disaster Management. *Central European Journal of Operational Research*.

2022. R Aringhieri, D Duma, P Landa, S Mancini. Combining workload balance and patient priority maximisation in operating room planning through hierarchical multi-objective optimisation. *European Journal of Operational Research*.



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2020. D Duma, R Aringhieri. An ad hoc process mining approach to discover patient paths of an Emergency Department. *Flexible Services and Manufacturing Journal* 32(1), pp. 6-34.

2019. D Duma, R Aringhieri. The management of non-elective patients: shared vs. dedicated policies. *Omega* 83, pp. 199-212.

2018. R Aringhieri, D Duma, A Grosso, P Hosteins. Simple but effective heuristics for the 2-constraint bin packing problem. *Journal of Heuristics* 24(3), pp. 345-357.

2018. R Aringhieri, D Duma, V Fragnelli. Modeling the rational behavior of individuals on an e-commerce system. *Operations Research Perspectives* 5, pp. 22-31.

2015. D Duma, R Aringhieri. An online optimization approach for the real time management of operating rooms. *Operations Research for Health Care* 7, pp. 40-51.

2015. IM Bulai, R Cavoretto, B Chialva, D Duma, E Venturino. Comparing disease-control policies for interacting wild populations. *Nonlinear Dynamics* 79 (3), pp. 1881-1900.

Book chapters

2018. D Duma, R Aringhieri. The real time management of operating rooms. In: *Operations Research Applications in Health Care Management*. International Series in Operations Research and Management Science 262, pp. 55–79.

2015. R Aringhieri, D Duma. The optimization of a surgical clinical pathway. In: *Simulation and Modeling Methodologies, Technologies and Applications*. Advances in Intelligent Systems and Computing 402, pp. 313–331. *Invited chapter*.

Conference proceedings

2022. R Aringhieri, S Bigharaz, D Duma, A Guastalla. Novel applications of the Team Orienteering Problem in health care logistics. In: *Optimization in Artificial Intelligence and Data Sciences*. AIRO Springer Series.

2020. P Ballarini, D Duma, A Horváth, R Aringhieri. Petri Nets Validation of Markovian Models of Emergency Department Arrivals. In: *International Conference on Applications and Theory of Petri Nets and Concurrency*. Lecture Notes in Computer Science 12152, pp. 219–238.

2020. R Aringhieri, D Duma, GF Squillace. Pattern-based online algorithms for a general patient-centred radiotherapy scheduling problem. In: *International Conference on Optimization and Decision Science*. Springer Proceedings in Mathematics and Statistics 316, pp. 251–262.

2019. R Aringhieri, S Bocca, L Casciaro, D Duma. A simulation and online optimization approach for the real-time management of ambulances. In: *Proceedings - Winter Simulation Conference, 2018-December*, pp. 2554–2565.

2018. R Aringhieri, D Duma, E Faccio. Ex post evaluation of an operating theatre. *Electronic Notes in Discrete Mathematics* 69, pp. 157-164.

2018. R Aringhieri, G Bonetta, D Duma. Reducing Overcrowding at the Emergency Department Through a Different Physician and Nurse Shift Organisation: A Case Study. In: *New Trends in Emerging Complex Real Life Problems*. AIRO Springer Series 1, pp. 43–53.



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2018. R Aringhieri, D Duma, F Polacchi. Integrating Mental Health into a Primary Care System: A Hybrid Simulation Model. In: *New Trends in Emerging Complex Real Life Problems*. AIRO Springer Series 1, pp. 55–63.

2018. R Aringhieri, D Dell’Anna, D Duma, M Sonnessa. Evaluating the dispatching policies for a regional network of emergency departments exploiting health care big data. In: *International Workshop on Machine Learning, Optimization, and Big Data*. Lecture Notes in Computer Science 10710, pp. 549–561.

2017. D Duma, R Aringhieri. Mining the patient flow through an Emergency Department to deal with overcrowding. In: *International Conference on Health Care Systems Engineering*. Springer Proceedings in Mathematics and Statistics 210, pp. 49–59.

2017. R Aringhieri, D Duma. Patient-centred objectives as an alternative to maximum utilisation: comparing surgical case solutions. In: *International Conference on Optimization and Decision Science*. Springer Proceedings in Mathematics and Statistics 217, pp. 105–112.

2014. R Aringhieri, D Duma. A hybrid model for the analysis of a surgical pathway. In: *SIMULTECH 2014 - Proceedings of the 4th International Conference on Simulation and Modeling Methodologies, Technologies and Applications*, pp. 889-900.

2013. IM Bulai, B Chialva, D Duma, E Venturino. Do niches help in controlling disease spread in ecoepidemic models? In: *Proceedings of the 2013 International Conference on Computational and Mathematical Methods in Science and Engineering*, pp. 320-339.

Extended abstracts & posters

2022. D Duma, S Gualandi, F Malucelli. Computing upper bounds for the maximum chi-square index through a combinatorial relaxation. 3rd Spanish Young Statisticians and Operational Researchers Meeting (SYSORM 2022). *Extended abstract*.

2022. D Duma, S Gualandi, F Malucelli. A particular Quadratic Transportation Problem. International Symposium on Combinatorial Optimization (ISCO 2022). *Extended abstract*.

2022. R Aringhieri, S Bigharaz, D Duma, A Guastalla. Evaluating different fairness modelling approaches in Post Disaster Ambulance Routing. International Workshop on Freight Transportation and Logistics (ODYSSEUS 2021). *Extended abstract*.

2020. D Duma. Online optimization methods applied to the management of health services. *4OR - A Quarterly Journal of Operations Research* 18(1), pp. 125-126. *Extended abstract*.

2016. R Aringhieri, D Dell’Anna, D Duma, M Sonnessa. Big Data supporting Public Health policies. In: *Ricerca, innovazione e formazione al tempo dei Big Data*. *Poster*.

Submitted & working papers

2022. D Duma, R Aringhieri. Real-time resource allocation in the Emergency Department: a case study. *Submitted paper*.

2022. D Duma, S Gualandi, F Malucelli. On the computation of the maximum chi-square index by Integer Programming. *Working paper*.

2022. AM Bernardelli, L Bonasera, E Vercesi, D Duma. Stochastic optimization of inpatient and outpatient surgery scheduling *Working paper*.



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2022. R Aringhieri, D Duma, GF Squillace. Online algorithms for a general patient-centred radiotherapy scheduling problem. *Working paper*.

Reviewer for scientific journals

Computers & Operations Research, Omega, Flexible Services and Manufacturing Journal, Computers & Industrial Engineering, Operations Research for Health Care, Health Care Management Science, and others.

Awards and acknowledgments

Jul 2022, 2nd place at the 14th annual AIMMS-MOPTA competition

Contribution: "Scheduling elective surgeries under uncertainty: a multi-objective stochastic approach". Advisor of the team composed by Ambrogio Maria Bernardelli, Lorenzo Bonasera, and Eleonora Vercesi. Competition organized by Lehigh University and sponsored by AIMMS.

Jun 2016, Editors' choice article on Operations Research for Health Care journal

Contribution: "An online optimization approach for the real time management of operating rooms". Co-authored by Roberto Aringhieri.

Aug 2014, SIMULTECH 2014 Best paper award

Contribution: "A hybrid model for the analysis of a surgical pathway". Co-authored by Roberto Aringhieri. Conference organized by INSTICC.

Computer skills

Programming languages: Python, C/C++.

Mathematical programming solvers: Gurobi, CPLEX.

Simulation & Data Analysis: AnyLogic, MATLAB, RapidMiner, ProM.

Drafting: \LaTeX , Microsoft Office, Google Drive.

OS: Windows.

Language skills

Italian: Mother tongue.

English: Intermediate.