# KEY PUBLICATIONS


1. Yaochu Jin, Handing Wang, Tinkle Chugh, Dan Guo and Kaisa Miettinen: "Data-Driven Evolutionary Optimization: An Overview and Case Studies". IEEE Transactions on Evolutionary Computation, 23(3), 442-458, 2019

2. Ana B. Ruiz, Vesa Ojalehto, Kaisa Miettinen, Francisco Ruiz, and Mariano Luque: "A Decision Support System for Interactive Multiobjective Optimization Without Trading-off: NAUTILUS Navigator". Journal of Global Optimization 74(2), 213-231, 2019

3. Mirka Saarela and Tommi Kärkkäinen: "Knowledge Discovery from the Programme for International Student Assessment", Learning Analytics: Fundaments, Applications, and Trends: A View of the Current State of the Art to Enhance e-Learning, Springer, 229-267, 2017

4. Santtu Tikka and Juha Karvanen: "Enhancing identification of causal effects by pruning". Journal of Machine Learning Research 18(194), 1-23, 2018


## SOFTWARE

1. DESDEO: desdeo.it.jyu.fi
2. https://cran.r-project.org/package=causalefect

# VISIT JYVÄSKYLÄ


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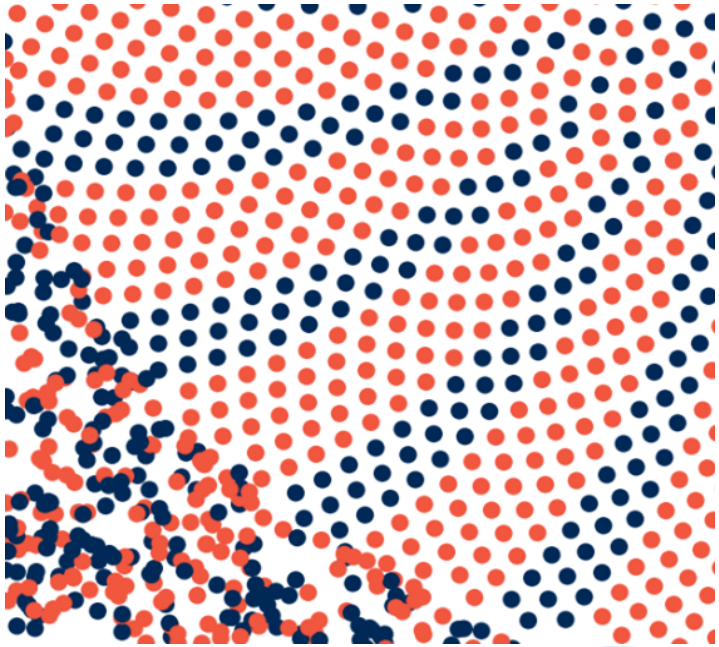
CAUSALITY, STUDY DESIGN AND MISSING DATA


Prof. Tommi Kärkkäinen

Faculty of Information Technology


SCALABLE NEURAL COMPUTING AND DATA MINING



# DEMO

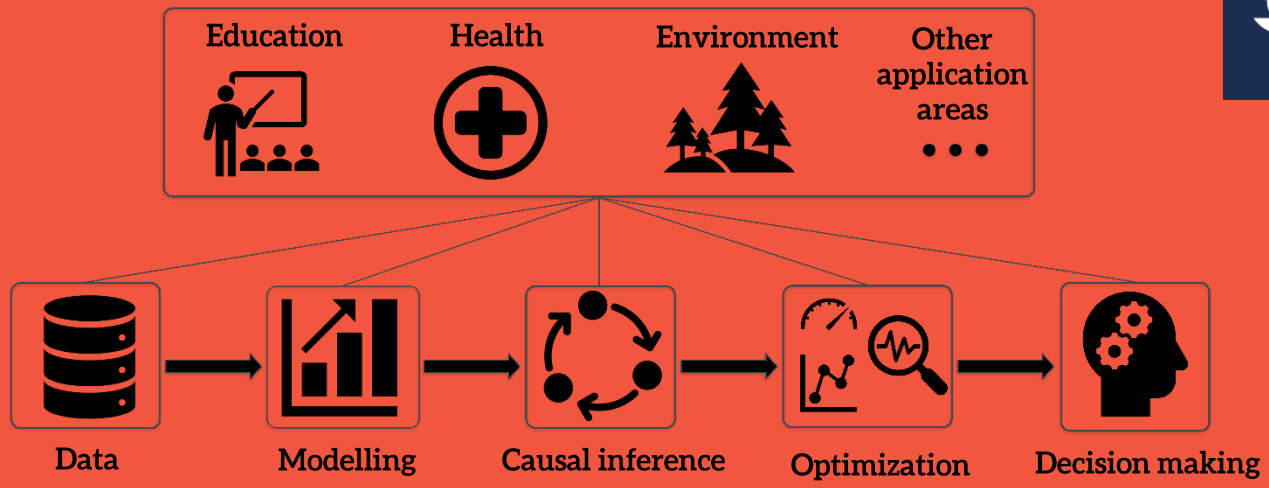
## DECISION ANALYTICS UTILIZING CAUSAL MODELS AND MULTIOBJECTIVE OPTIMIZATION

## jyu.fi/demo


Thematic research area of the University of Jyväskylä (JYU) supported by the profiling funding of the Academy of Finland

The **GOAL** of DEMO is creating means to make the most of the data and support data-driven decision-making.

DEMO focuses on explicit, concrete decision problems that can be presented with mathematical formalism. Predictive analytics, statistical modelling, causal inference, prescriptive analytics and multiobjective optimization are the key elements needed to create a seamless chain from data to decision. We refer to this as decision analytics. Thanks to method and software development, decision analytics will be applied to support e.g. other profiling areas of the University of Jyväskylä, especially related to education and health in dealing with their decision making problems.




The core concept is the **SEAMLESS CHAIN** from data to decision making.

## DATA
We can have data from various sources and of different types (e.g. open data, heterogeneous data, streaming data etc.).

## MODELLING
To model decision problems based on data, we utilize methods from descriptive and predictive analytics as well as other statistical modelling techniques.

## CAUSAL INFERENCE
To augment the modelling, causal mechanisms within the model are studied and included in the problem formulation whenever feasible.

## OPTIMIZATION
Decision problems are formulated as optimization problems that typically contain multiple conflicting objectives (i.e. multiobjective optimization problems) to characterize the desirability of solutions.

## DECISION MAKING
A human decision maker responsible for the final, most preferred solution is supported through an interactive decision making process via decision support tools. This involves prescriptive analytics. When feasible, decision making can be partially automated utilizing appropriate machine learning tools.

# APPLICATION AREAS

**ENVIRONMENT ANALYTICS:** In Finland, a plethora of data exists related to the environment and e.g. forests. Connecting this data with decision support tools enables decision makers to balance between e.g. economic and ecological objectives in forest management.

**MULTIDISCIPLINARY EDUCATIONAL ANALYTICS:** JYU coordinates the national participation and reporting related to multiple international, large-scale educational assessment studies providing large pools of off-line educational databases. This data and its analysis support management and improvement of educational activities, learning environments and the whole educational systems.

**HEALTH ANALYTICS:** The scope varies from general policy decisions to decisions on individual treatments, operations and recommendations. The Faculty of Sport and Health Sciences of JYU and the regional health cluster offer an excellent environment for health related research.

**OTHER APPLICATION AREAS** include lot sizing in inventory management, pricing of services, building energy management and prescriptive crime analytics.

Other applications are also of high interest.