University of St.Gallen

Decisions Under Uncertainty: From Theory to Practice

A mini-conference organized by the

Institute of Economics
University of St. Gallen

fgn.unisg.ch/en/fgn-conference-2022

18-19 May 2022

Program & Abstracts

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Conference overview

Decision Theory is, in its essence, an interdisciplinary field that draws on economics, mathematics, statistics, machine learning, operations research, forecasting, behavioral sciences and cognitive psychology. Broadly speaking, decision research in economics addresses three fundamental and inter-related questions. First, how should people make decisions? This question is at the heart of economics, and often serves as a baseline for evaluating human decision-making. Second, how do people really make decisions? Recent research has explored the ways in which people are "boundedly rational" and utilize rules-of-thumb and shortcuts to formulate judgments and to choose among alternatives. Typically, these shortcuts do well, but equally often they lead to systematic biases and serious errors. Finally, given what we know about rational decision-making and actual behavior, how can we help people, from individual decision makers to managers and governments, improve their decision-making?

Research in decision theory employs a variety of techniques to understand and improve decision-making under uncertainty, ranging on one hand from theoretical models and quantitative decision theory, to experimental and empirical analysis of decision-making in the real world. The recent socioeconomic crisis induced by the pandemic has brought decision-making — at both the individual and governmental level — into focus.

With the interdisciplinary nature and increasing salience of decision theory and the nature of uncertainty in mind, the goal of this conference is twofold. First, to bridge the gap between the theory and practice of decision research. Second, to discuss the latest developments and practical applications in a variety of different fields. All invited talks are interdisciplinary in nature and in methodology and will be given by leading experts in their respective fields. Theoretical talks will provide new theoretical models with a focus on a real world application and/or on how to make these models relevant in the real world. Fields of practical applications and real world examples of decision-making include data science, finance, psychology, artificial intelligence, and economics among others.

Organization

The conference is organized by the Institute of Economics of the University of St. Gallen and will take place at the Einstein Conference Center of the University of St. Gallen:

Hotel Einstein, Berneggstrasse 2, 9000 St. Gallen

For more information, feel free to reach out to the organizing committee:

Ola Mahmoud: `ola.mahmoud@unisg.ch`

Schedule

Day 1: Wednesday 18 May

08:30 – 09:00	Welcome and Coffee
09:00 – 09:45	**Loïc Berger**, CNRS and IESEG School of Management *Rational Policymaking Under Deep Uncertainty*
09:45 – 10:30	**Rui Mata**, University of Basel *Using the Cognitive and Decision Sciences to Advance the SDGs*
10:30 – 11:00	Coffee break
11:00 – 11:45	**Ganna Pogrebna**, University of Sydney and Alan Turing Institute UK *Anthropomorphic Learning: Bridging Behavioral Science and Data Science to Predict Human Behavior*
11:45 – 12:30	**Spyros Zoumpoulis**, INSEAD *Quantifying the Benefits of Targeting for Pandemic Response*
12:30 – 14:00	Lunch break
14:00 – 15:00	**Keynote Lecture: Olivier Sibony**, HEC Paris *Judgment, Error and Noise in Organizations*
15:00 – 15:30	Coffee break
15:30 – 16:15	**Marie Louise Vjerø**, Aarhus University *Unawareness Premia*
16:15 – 17:00	**Stefania Minardi**, HEC Paris *Meaning and Discontinuity in Consumer Choice*
18:30 – onwards	Dinner at Einstein Hotel

Day 2: Thursday 19 May

08:30 – 09:00	Welcome and Coffee
09:00 – 09:45	**Peter Bossaerts**, University of Melbourne and University of Cambridge *Towards Behavioural and Biological Foundations of Decisions under Uncertainty: A Mission Incomplete*
09:45 – 10:30	**Paolo Piacquadio**, University of St. Gallen *From Altruism to Social Justice*
10:30 – 11:00	Coffee break
11:00 – 12:30	**Keynote Lecture: Itzhak Gilboa**, HEC Paris *What Were You Thinking? Decision Theory as Coherence Test*
12:30 – 14:00	Lunch at Einstein Hotel
14:00 – 17:00	St. Gallen Excursion

Keynote speakers

Itzhak Gilboa

Itzhak Gilboa is Professor of Economic and Decision Sciences at the HEC Paris., where he is also the holder of the AXA Chair in Decision Sciences. He studied Mathematics and Computer Science (BSc, 1982) and Economics (BA, 1982, MA, 1984, Ph.D., 1987) at Tel Aviv University, with the graduate studies under the supervision of David Schmeidler.

Itzhak Gilboa works in decision theory and other fields in economic theory such as game theory and social choice. His main research areas are decision under uncertainty, focusing on the definition of probability, notions of rationality, non-Bayesian decision models, and related issues. His work include the seminal theory of Maxmin Expected Utility with David Schmeidler. This theory explains individual attitudes towards ambiguity that are consistent with the Ellsberg paradox.

He has taught a variety of courses on microeconomics, decision theory, game theory, psychology and economics, and related fields, at the undergraduate, graduate, and MBA levels.

He is the author of severel books such as *Analogies and Theories: Formal Models of Reasoning*, Oxford University Press, 2015; *Theory of Decision under Uncertainty*, Cambridge University Press, 2009; *Rational Choice*, MIT Press, 2010 and *Making Better Decisions*, Wiley-Blackwell, 2010.

His recent research papers are published in prestigious scientific journals such as American Economic Review, Games and Economic Behavior, Annual Reviews in Economics, BE Journals in Theoretical Economics, Econometrica, Economics and Philosophy, Journal of Economic Theory, Journal of Economic Perspectives, Mathematical Social Sciences, Review of Economics and Statistics, The Journal of Econometrics.

Olivier Sibony

Olivier Sibony is Professor of Strategy at HEC Paris, author and advisor specializing in the quality of strategic thinking and the design of decision processes. He is a graduate of HEC Paris and holds a Ph. D. from Université Paris-Dauphine. He is a knight in the French Order of the Légion d'Honneur.

He is also an Associate Fellow of Saïd Business School in Oxford University, and has taught at London Business School, Ecole Polytechnique, ENA, IE Madrid, and other institutions. Previously, he spent 25 years with McKinsey & Company in France and in the U.S., where he was a Senior Partner. There, he was a leader of the Global Strategy Practice and of the Consumer Goods & Retail Sector.

Olivier's latest book, *Noise: A Flaw in Human Judgment*, co-authored with Daniel Kahneman and Cass R. Sunstein, has appeared on multiple bestseller lists worldwide, including the New York Times list. His previous book, *You're About to Make a Terrible Mistake!*, was awarded the 2019 Manpower Foundation Grand Prize for best management book of the year, and is translated into multiple languages. He is also the co-author of *Cracked It! How To Solve Big Problems and Sell Solutions Like Top Strategy Consultants* (with B. Garrette et C. Phelps), and a contributor to the 2019 edition of *Strategor*, the best-selling French-language strategy textbook. In addition, he is the author or co-author of numerous scientific articles in peer-reviewed journals (Strategy Science, Long Range Planning, Research in Economics) and in practitioner-oriented publications (Harvard Business Review, McKinsey Quarterly, MIT Sloan Management Review, California Management Review).

Olivier builds on this research and experience to advise senior leaders on strategic and operational decision-making. He is a frequent keynote speaker and facilitator of top management and board meetings. He also serves as a member of corporate, advisory and investment boards.

Abstracts of talks

Loïc Berger

CNRS and IESEG School of Management

Rational Policymaking Under Deep Uncertainty

The COVID-19 pandemic or the global climate change issue expose decision problems faced by governments and international organizations. Policymakers are charged with taking actions to protect their population while lacking reliable information. The rational policy decision would combine the best available scientific evidence—typically provided by expert opinions and modeling studies. However, in a deeply uncertain environment, the pertinent evidence is highly fluid, making it challenging to produce scientifically grounded predictions of the outcomes of alternative courses of action. Insights from decision theory provide a valuable way to frame policy challenges and ambitions. Even if the decision-theory constructs are ultimately used only informally in practice, they offer a useful guide for transparent decision-making that copes with the severe uncertainty in sensible ways.

Rui Mata

University of Basel

Using the Cognitive and Decision Sciences to Advance the SDGs

The United Nations' Sustainable Development Goals (SDGs) have become an important guideline for both governmental and non-governmental organizations to monitor and plan their contributions to social, economic, and environmental transformations. Crucially, many challenges surrounding the SDGs concern effective decision-making and, thus, can benefit from evidence-based solutions that consider the power and limits of human psychology. This talk aims to show how the cognitive and decision sciences can make important contributions to advancing the SDGs in three main ways, namely, monitoring, planning of interventions, and communication. More specifically, I present key examples of how the cognitive and decision sciences can, first, help monitor work on sustainable development goals using innovative data analytic techniques, including text-as-data approaches. Second, by guiding interventions based on a modern toolkit of behavioral change principles that go well beyond nudging and boosting and have been distilled through research synthesis from the collective expertise of the behavioral sciences. Third, and finally, by helping develop communication strategies to build networks and partnerships for the goals that can amplify behavioral change.

Ganna Pogrebna

University of Sydney and Alan Turing Institute UK

Anthropomorphic Learning: Bridging Behavioral Science and Data Science to Predict Human Behavior

Modeling human behavior is one of the major tasks facing the industry and academia of the future. This task is especially important when we consider interactions between humans and technology. Decision support systems, suggestion systems, automation, etc. – all these technologically intense aspects of human life require accurate predictions of what people like, what people prefer, and where people need the help of algorithms and automated agents. Under these circumstances, recent advances in computer science, statistics, and mathematics offer several methods which try to model human behavior. Specifically, the methodology of machine learning and, more recently, deep learning, allows us to generate predictions useful for many different facets of human life. Yet, there are many aspects of human life and decision-making where machine learning and deep learning fail to provide reliable and accurate results. One of the most notorious examples is suggestion systems: many of us regularly shop online using different platforms (such as Amazon) and receive suggestions for future purchases. Yet, very few of us find these suggestions helpful. One of the reasons why AI fails in many cases to correctly anticipate human behavior is that AI algorithms tend to ignore existing insights from decision theory and behavioral science. By combining behavioral science models with AI algorithms, we are able to significantly improve and simplify predictions of human behavior in a wide variety of contexts. The resulting methodology which we label anthropomorphic learning allows us to develop more functional systems which better understand humans. This methodology is explainable, traceable, requires smaller training sets, and, generally, outperforms existing algorithms by generating more accurate predictions. Anthropomorphic learning is one of the methods of behavioral data science, a new interdisciplinary field, which emerges as a direct response to the need for studying behavior "in the wild", outside the "sterile" laboratory setting and controlled environments. The field's ambition is to identify ways to embed human values into the heart and operation of AI systems, establishing methods to verify their integrity, accountability, and resilience thereby ensuring that they, and the data which feeds them, ultimately operate in the service of successful, democratic, digitally empowered yet human-centred communities. Concentrating on decision-theoretic models of stochastic choice, this talk will show how machine and deep learning algorithms could be pre-treated by decision-theoretic models in order to achieve better predictions of human behavior. Use cases from consumer choice, finance, and entertainment will be used to illustrate the power of this proposed methodology.

Spyros Zoumpoulis
INSEAD

Quantifying the Benefits of Targeting for Pandemic Response

Problem definition: To respond to pandemics such as COVID-19, policy makers have relied on interventions that target specific population groups or activities. Since targeting is potentially contentious, rigorously quantifying its benefits is critical for designing effective and equitable pandemic control policies. Methodology/results: We propose a flexible modeling framework and a set of associated algorithms that compute optimally targeted, time-dependent interventions that coordinate across two dimensions of heterogeneity: age of different groups and the specific activities that individuals engage in during the normal course of a day. We showcase a complete implementation focused on the Île-de-France region of France, based on commonly available public data. We find that targeted policies generate substantial complementarities that lead to Pareto improvements, reducing the number of deaths and the economic losses, as well as the time in confinement for each age group. Optimized dual-targeted policies are interpretable: by fitting decision trees to our raw policy's decisions across many problem instances, we find that a feature corresponding to the ratio of marginal economic value prorated by social contacts is highly salient in explaining the confinements that any group - activity pair experiences. We also quantify the impact of fairness requirements that explicitly limit the differential treatment of distinct groups, and find that satisfactory trade-offs are achievable through limited targeting. Implications: Given that some amount of targeting of activities and age groups is already in place in real-world pandemic responses, our framework highlights the significant benefits in explicitly and transparently modelling targeting and identifying the interventions that rigorously optimize overall societal welfare.

Olivier Sibony

HEC Paris

Judgment, Error and Noise in Organizations

Behavioral decision making is arguably the field of decision-making research that has had the largest impact on the "real world" in recent years. Most leaders in the corporate world and in the public sector are at least familiar with the word "bias." Invoking overconfidence, loss aversion, anchoring, are now standard ways of explaining mistakes. Many corporations have taken steps to reduce the perceived effects of cognitive and behavioral biases in their decisions, e.g., in HR, finance, and investment management. Others use behavioral interventions ("nudges") to produce the changes they desire in the behaviors of customers, employees, or other constituents. This focus on bias, however, risks blinding decision makers to the other component of error: noise. Organizations should certainly care about the mean of their errors, but they should also worry about their variance. Just like bias, noise – defined as the unwanted variability of judgments – leads to error and unfairness, and yet we all pay a lot less attention to it. Noise can be measured, often quite easily. Importantly, once identified, it can also be reduced if organizations adopt one or several "decision hygiene" techniques. Evaluating the contributions of these techniques and explicating the mechanisms that underlie them may be a promising agenda for decision-making research.

Marie-Louise Vierø
Aarhus University

Unawareness Premia

This paper builds a Capital Asset Pricing Model (CAPM) with awareness of unawareness. It is shown that when there exist states about which investors feel they are unaware, asset prices contain an unawareness premium. Under certain circumstances, the systematic portion of this unawareness premium can be estimated. Using data from 1985 to 2018, we estimate the systematic unawareness premium. The findings indicate that awareness of unawareness is reflected in market variables.

Stefania Minardi
HEC Paris

Meaning and Discontinuity in Consumer Choice

Continuity is a basic assumption in consumer theory, and it seems rather plausible when physiological processes are taken into account. But when consumption is the carrier of meaning, discontinuities may arise. Specifically, consumer preferences may behave discontinuously at zero quantities, as in the case of vegetarians who prefer not to consume any amount of animal meat. We argue that, as opposed to the example of lexicographic preferences, the discontinuity in such cases is not only in stated preferences, but can also be matched by consumption behavior. Relatedly, it can be represented by a numerical utility, and we provide an axiomatization of such a function.

Peter Bossaerts

University of Melbourne and University of Cambridge

Towards Behavioural and Biological Foundations of Decisions under Uncertainty: A Mission Incomplete

We know a lot about how humans deal with one type of uncertainty, where trial-and-error (reinforcement learning) works effectively, such as in foraging, in gambling, or in repairing, tuning, and even in strategic games. Animals such as monkeys, rats or mice approach this type of uncertainty in the same way, and hence, we have a fantastic animal model, with which to study the biological foundations. The findings have generated some of the algorithms that are at the core of Artificial Intelligence (AI). But what if uncertainty is generated by computational complexity? Theoretically, one cannot deal effectively with it by means of trial-and-error. A more methodical approach is called for. And indeed, humans follow fundamentally different strategies when faced with complexity. The talk will summarize ten years of research on human attitudes towards complexity. It will show what makes a decision difficult for humans, how the theory of computation sheds light on it, which brain structures are engaged, and how "smart drugs" may (or may not) help.

Paolo Piacquadio
University of St. Gallen

From Altruism to Social Justice

People care about each other. They care about their families and friends, and also about strangers. In this paper, we ask how these feelings affect social preferences, under the assumption that social preferences are continuous, fair, and satisfy a Pareto condition. We show that, for sufficiently large populations, people's aversion to income inequality among strangers places tight bounds on the plausible amounts of social inequality aversion. In contrast, people's degree of egoism and their altruistic feelings towards their families do not. Our results also suggest a new rationale for paternalism: when people are paternalistic with respect to the choices of others, the social welfare function must be as well.

Itzhak Gilboa
HEC Paris

What Were You Thinking? Decision Theory as Coherence Test

The role of decision theory can be viewed as providing a language for a dialog between a decision maker and a theorist. In one extreme, the dialog takes the form of outsourcing: the decision maker presents a problem, receives a best course of action and implements it. In another extreme, the theory does not provide a single answer, but can be used to test the logic of decision making—one may ask whether a given set of decisions can be justified by a decision-theoretic model. Indeed, in principal-agent settings, such justifications may be required—a manager of an investment fund may be asked what beliefs she used when valuing assets and a government may be asked whether a portfolio of rules and regulations is coherent. In this paper we ask which collections of uncertain-act evaluations can be simultaneously justified under the maxmin expected utility criterion by a single set of probabilities. We draw connections to the the Fundamental Theorem of Finance (for the special case of a Bayesian agent) and revealed-preference results. The general approach to decision theory and its relationship to objective and subjective rationality will be discussed.