



LUIAS Distinguished Lecture

Nonlinear Expectation: A Robust Framework for Uncertainty in Finance and AI

Speaker

Professor Shige PENG

Chair Professor
School of Mathematics
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Date: 22 January 2026 Time: 12:15PM - 1:15PM

Venue: MBG06, Patrick Lee Wan Keung
Academic Building

Mode: Face-to-face

Abstract

1. The Fundamental Challenge - In both mathematical finance and data-driven AI, a paramount challenge is to measure and control risk under deep uncertainty—environments where the classical statistical approach of determining a single, precise probability distribution from data is fundamentally untenable.
2. A Paradigm Shift: Nonlinear Expectation Theory - We present a novel framework of nonlinear expectations. This theory has led to the discovery of foundational laws, such as the Nonlinear Law of Large Numbers and the Nonlinear Central Limit Theorem, which describe the limit behaviours of systems under model ambiguity.
3. From Theory to Efficient Computation - Based on this framework, we have developed the robust and efficient ϕ -max-mean algorithm. This algorithm provides a practical tool for calculating non-linear distributions and performing robust statistics, specifically in cases where the true probability distribution of a data sequence cannot be identified.
4. Ubiquity and Application - In this talk, we will demonstrate that the phenomena and mechanisms described by nonlinear expectations are pervasive. The theory offers profound insights and practical methodologies for quantitative risk management in finance and for building robust, reliable systems in artificial intelligence. Our aim is to bridge deep mathematical theory with wide-ranging practical applications.

Biography

Shige Peng is an academician of the Chinese Academy of Sciences and Chair Professor at Shandong University, where he directs the Research Center for Mathematics and Interdisciplinary Sciences. Internationally recognised for his pioneering work in stochastic analysis, financial mathematics, and stochastic control, Professor Peng co-founded the theory of Backward Stochastic Differential Equations (BSDE) with Professor Pardoux in 1990, established the nonlinear Feynman-Kac formula, and derived the general maximum principle for optimal stochastic control—regarded as "one of the two main advances in the last twenty years" in the field. He also developed the theory of nonlinear expectation, introducing influential concepts such as G-Brownian motion and G-stochastic differential equations.

Professor Peng's achievements have earned him numerous prestigious awards, including the National Natural Science Award (Second Class, 1995), the Shandong Provincial Science and Technology Award (Highest Class, 2003), the First Su Buchin Applied Mathematics Prize (2006), the Tan Kah Kee Science Award in Mathematics (2008), the Hua Loo-Keng Prize of Mathematics and appointment as a Princeton Global Scholar at Princeton University (both in 2011), the Qiu Shi Science Award (2016), the Future Science Prize (2020), and election as a Fellow of the European Academy of Sciences (2023). He has also been invited to deliver plenary lectures at the International Congress of Mathematicians (2010) and the 8th International Congress on Industrial and Applied Mathematics (2015). His research results have been widely cited both domestically and internationally and have received numerous public accolades, driving the development of related disciplines such as stochastic control theory, financial mathematics, and stochastic analysis theory.

ALL ARE WELCOME

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