PANTHÉON-ASSAS UNIVERSITÉ PARIS

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LEMMA
Laboratoire d'économie mathématique et de microéconomie appliquée

SÉMINAIRE

A THEORY OF FRAGMENTED RISK: DEALING WITH ST. PETERSBURG AND RABIN PARADOXES - JOSÉ FARO

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Lemma - 4 rue Blaise Desgoffe, 75006 Paris. Salle Maurice Desplas

*The LEMMA seminar will host **José Faro**.*

José is a professor at INSPER São Paulo. His research interests are in decision theory and its role in the foundations of economic theory and its applications. He has worked in areas such as ambiguity aversion, incomplete preferences, stochastic choice, and pricing rules in financial markets.

Abstract: *The emergence of fragmented risk and granular bubbles in modern digital markets reveals a recursive logic that echoes the St. Petersburg paradox, yet operates at scales that traditional models cannot capture. To address these phenomena, this paper introduces fractal lotteries: a class of stochastic prospects that extends the classical paradox by embedding risk within self-similar state spaces. We formalize this process using self-similar tilings, where a branching factor n dictates the speed of fragmentation. We demonstrate that when rewards scale with the cumulative complexity of this space, the resulting super-exponential growth leads to a Fractal St. Petersburg Paradox.*

A central contribution of this work is the critique of traditional resolutions based on bounded utility functions (e.g., Aumann). We prove that while these functions avoid infinite valuations, they suffer from a computational collapse of preference through dimensional saturation. In fractal environments, these models are acutely susceptible to the Rabin Paradox: the local grain of caution required to reject modest losses is geometrically compounded by the Expected Utility Theory (EUT) machinery, triggering a state of global anesthesia where the agent becomes unresponsive to even infinite gains at higher recursive depths.

To resolve this divergence, we characterize Fractal Utility Rules as cognitive filters calibrated to the scale of risk. Our main result, the Fractal Calibration Theorem, proves that a representative agent deciphers recursive complexity as a standardized unit of subjective certainty. Building on this calibration, we propose the Cross-Valuation Criterion as an objective metric for ranking disparate recursive structures. Ultimately, we argue that risk preferences emerge as scale-dependent calibrations to recursive depth, providing a formal foundation for understanding the granular dislocations of modern financial landscapes.