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THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

SEMINAR ON STATISTICS

The Statistical Limits of Information Sharing: Time-Series Forecasting and Optimization in Decentralized Systems

By

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Abstract

Effective supply chains rely heavily on how demand signals are transmitted, interpreted, and forecasted between firms. This presentation explores the intersection of statistical forecasting and optimal policy design by evaluating the true value of information sharing within a decentralized two-tier supply chain.

By modeling inventory replenishment as a stationary time-series process, we apply tools from harmonic analysis and spectral factorization—specifically the Smirnov-Beurling inner-outer factorization and Wold representation—to understand how information propagates. We demonstrate that the optimal ordering policy is mathematically invertible with respect to the underlying demand shocks. Consequently, the upstream firm can organically recover the exact demand information through the construction of optimal forecasts, rendering explicit data sharing statistically redundant.

We formulate the policy design as an infinite-dimensional optimization problem over the space of moving average coefficients. Solving this reveals a complex mathematical trade-off: a strategic agent optimizes its local objective by intentionally inflating the Mean Square Forecast Error (MSFE) of its output process. To properly evaluate this dynamic, we introduce an *information-adjusted* volatility measure defined strictly as the ratio of the MSFEs. We argue that this forecast-adjusted metric is a far more robust tool for capturing the unforecastable propagation of volatility, highlighting how localized optimization can strategically distort time-series signals in decentralized systems. This presentation draws from https://doi.org/10.1287/moor.2023.0008, https://dx.doi.org/10.2139/ssrn.5077356, https://dx.doi.org/10.2139/ssrn.6016535 and related working papers.

Date : 17 June 2026 (Wednesday)
Time : 11:00a.m.-12:00noon
Venue : Room 4502 (near Lift 25/26)

All are welcome!