Two different flavours of complexity in economic and financial data: an Econophysics perspective

Tiziana Di Matteo[1,2,3]

[1]King's College London, London, United Kingdom, [2]Centro Ricerche Enrico Fermi, Rome, Italy, [3]Complexity Science Hub Vienna, Vienna, Austria

In this talk I will briefly give you a broad overview of the state of the art in Econophysics [1]: a discipline that has already a rich history and even controversial trends and I will discuss how tools used within Econophysics might be useful for data scientists at large.

I will discuss the two main elements that define the complexity of economic and financial time series: the first is multifractality [2-4], which is associated to the behaviour of each single variable and the way it scales in time; the second is the structure of dependency between time series, associated with the collective behaviour of the whole set of variables [5]. I will highlight achievements, major challenges and open problems [6].

In particular, I will show results on the application of the Generalized Hurst exponent tool to different financial time-series, and I will show the powerfulness of such tool to detect changes in markets' behaviours, to differentiate markets accordingly to their degree of development, to asses risk and to provide a new tool for forecasting. I will also show results to assess the interplay between price multiscaling and volatility roughness, defined as the (low) Hurst exponent of the volatility process [7,8].

I will also introduce correlation-based information filtering networks tools and I will show that these are powerful tools to study complex datasets, valuable tools for risk management and portfolio optimization too [9-10] and they allow to construct probabilistic sparse modeling for financial systems that can be used for forecasting, stress testing and risk allocation [11]. Next, I will present a newly developed method, the Best-Path Algorithm Sparse Graphical Model (BPASGM) [12]. This machine-learning framework for portfolio construction combines sparse graphical modeling with portfolio theory, offering a statistically grounded and computationally efficient approach for dependence-aware asset selection. Applications to real financial datasets demonstrate the BPASGM's practical utility.

References:

[1] Ryszard Kutner, Marcel Ausloos, Dariusz Grech, T. Di Matteo, Christophe Schinckus, H. Eugene Stanley, Physica A 516 (2019) 240–253.

[2] T. Di Matteo, Quantitative Finance 7(1) (2007) 21.

[3] R. J. Buonocore, T. Aste, T. Di Matteo, Chaos, Solitons and Fractals 88 (2016) 38-47.

[4] G. Brandi, T. Di Matteo, The European Journal of Finance (2021).
DOI: 10.1080/1351847X.2021.1908391.

[5] M. Raddant, T. Di Matteo, Journal of Economic Interaction and Coordination, 2023
https://doi.org/10.1007/s11403-023-00389-6

[6] R. J. Buonocore, N. Musmeci, T. Aste, T. Di Matteo, Eur. Phys. J. Special Topics 225, (2016) 310 5–3113.

[7] Giuseppe Brandi, T. Di Matteo, International Review of Financial Analysis 84 (2022) 102324.

[8] G. Brandi, T. Di Matteo, "Multiscaling in the Rough Bergomi Model: A Tale of Tails", Quantitative finance, submitted 2026, arXiv preprint arXiv:2601.11305.

[9] F. Pozzi, T. Di Matteo and T. Aste, Scientific Reports 3 (2013) 1665.

[10] N. Musmeci, T. Aste and T. Di Matteo, Scientific Reports 6, 36320; doi:1038/srep36320 (2016).

[11] W. Barfuss, G. Previde Massara, T. Di Matteo, T. Aste, Phys.Rev. E 94 (2016) 06230.

[12] T. Di Matteo L. Riso, M. Zoia, "A Novel approach to portfolio construction", arXiv preprint arXiv:2602.03325, submitted 2026.