TUT 1: Dynamics and Fluctuations in Economic and Financial Markets (joint session SOE/DY/TUT/AKjDPG)

Financial and economic markets display nontrivial fluctuation statistics that called attention among physicists. Methods from statistical physics have demonstrated to be able to derive stylized facts from microscopic models, to extract networks from data, and to relate multivariate economic time series to the underlying mechanisms.

Time: Sunday 16:00–18:30 Location: H 0104

Tutorial TUT 1.1 Sun 16:00 H 0104
Market microstructure: dynamics of the stock markets — •Thomas Guhr — Fakultät für Physik, Universität Duisburg-Essen

At first sight, stock prices look like random walks. Indeed, Brownian motion models and related stochastic processes do a good job in describing some of the features which are empirically found in financial data. This is consistent with Fama's celebrated Efficient Market Hypothesis (EMH) which states that price changes are unpredictable. However, the closer one looks, the less reliable are those schematic models. This is so, because the way how the trading proceeds in time, i.e. the rules imposed and the ensuing dynamics, is largely ignored. Traders submit their buy and sell orders to the order book, whose content is made available to all market participants. The order flow eventually leads in a highly complex fashion to the realized prices.

Market microstructure is a quickly growing field in which economists, physicists, data scientists and mathematicians try to clarify these dynamical processes. An appealing feature, particularly for physicists, is the wealth of data available for analysis and subsequent model building. I am going to present large-scale data analysis to identify non-Markovian features. Fundamental economic reasoning as in the EMH favors Markovian models in which prices develop (apart from a deterministic drift) without memory. Sizeable memory effects could be exploited to make profit. I will present large-scale data analyses which show that there are various non-Markovian effects due to the highly complex market dynamics. Thus, there are limits to market efficiency which, furthermore, can be quantitatively identified.

Tutorial TUT 1.2 Sun 16:50 H 0104
Maximum-entropy models in economics and finance — •Tiziano Squartini — IMT School for Advanced Studies Lucca, P.zza San Francesco 19, 55100 Lucca (IT)

Entropy-maximization represents the unifying concept underlying the definition of a number of methods which are now part of the discipline known as "network theory". Despite the perfect generality of this approach, a particularly fruitful application of it has been observed in disciplines like economics and finance. This tutorial will be devoted to illustrate the methodological aspects of the aforementioned approach, with particular emphasis on the definition of null models. The latter can be employed in a number of applications, ranging from pattern detection to network reconstruction: examples will be provided of both, by taking as case studies real-world systems, as the World Trade Web and the Dutch Interbank Network. The aforementioned framework also allows one to properly model fluctuations: the latter can be interpreted as errors affecting the estimation of the quantities of interest and strongly depend on the kind of constraints defining the maximization procedure. In order to illustrate how different reconstruction algorithms perform, a comparison of proposed approaches on the aforementioned real-world systems will be also carried out.

Tutorial TUT 1.3 Sun 17:40 H 0104
350 years of puzzles in economics – and a solution. — •Ole Peters — London Mathematical Laboratory — Santa Fe Institute

In 1654 Fermat and Pascal puzzled over a gambling problem and invented probability theory. Three years later, Huygens declared that random quantities and their expectation values are "the same thing." Economics was the first adopter of the budding theory and to this day maintains much of the spirit of Huygens's early proclamation. Problems arising from this view of randomness have led to numerous puzzles in economic theory and beyond. An early example is the St. Petersburg paradox of 1713, a recent example is the insurance puzzle in general competitive equilibrium theory.

Economics has responded to these puzzles largely with labels. Humans are labelled irrational or risk averse.

An alternative treatment emerged from physics, where randomness entered in the 1850s with the development of statistical mechanics. Here, the question of ergodicity arose: are expectation values indicative of temporal behavior? The insight that in many cases an expectation value does not reflect the dynamics can be used to resolve the class of economics puzzles I will discuss. It leads to an alternative economic formalism that makes testable predictions. It can answer economic questions by assessing systemic stability where previously only moral assessments were available.

More at https://ergodicityeconomics.com/lecture-notes/