

Constrained Dynamics of Financial Correlations

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The extraction of relevant information from massive streams of data has become one of the major challenges for the scientists that are working in the field of complex systems. In particular, when financial data are concerned, one of the main goals is to extract information about the underlying system that leads to such complex collective markets dynamics. A natural instrument in the study of the collective behavior of a system comprised by many elements consists in the analysis of the correlations. However, for many practical purposes, correlations still retain an excessive amount of information and several tools have been developed to filter out the redundancies and keep the essential features that characterize the system's properties.

From a geometrical perspective, correlations among n time series over a period T , can be viewed as the scalar products between n unit vectors in a T -dimensional Euclidean space: $c_{i,j} = \vec{v}_i \cdot \vec{v}_j$, with $|\vec{v}_i| = 1$ and $i, j = 1, \dots, n$. The topological structure associated to such system of correlations is a complete graph where each node is connected with any other node. The corresponding geometrical structure is an irregular simplex (triangle in $2D$, tetrahedron in $3D$ etc.) with edge lengths equal to $d_{i,j} = \sqrt{2(1 - c_{i,j})}$. It can be shown that such a simplex can be embedded on the surface of an n -dimensional unit sphere. The system's collective dynamics is in this way reduced to the study of the trajectories of n points on a n -dimensional unit sphere. Our general aim is to extract from such a structure some relevant patterns which are robust and persistent.

In particular, in this work we discuss the geometrical and topological properties associated with the correlation-filtering method introduced in Ref.[1]. Such a filtering reduces the complete graph associated with the correlations to a planar graph that keeps all the relevant information [2,3]. The constrained correlation dynamics associated with such a correlation filtering is discussed and applications of this filtering procedure to different kinds of correlation matrices are shown.

[1] T. Aste, T. Di Matteo and S. T. Hyde, "Complex Networks on Hyperbolic Surfaces", *Physica A* 346 (2005) 20-26. (arXiv:cond-mat/0408443, 2004).

[2] M. Tumminello, T. Aste, T. Di Matteo, R.N. Mantegna, "A tool for filtering information in complex systems", *PNAS* 102 (2005) 10421-10426. (arXiv:cond-mat/0501335, 2005).

[3] T. Di Matteo, T. Aste, S. T. Hyde and S. Ramsden, "Interest rates hierarchical structure", *Physica A*, 335 (2005) 21-33.