Stable measure of dependence for network analysis

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Network models are popular tools for financial market analysis Tumminello M., Aste T., Matteo T.D., Mantegna R.N. [1], Boginsky V.,Butenko S.,Pardalos P. [2]. The network model is a complete weighted graph in which nodes corresponds to a stocks and weights of edges between nodes are equal to value of measure of similarity (dependence) of stocks behavior. The most popular measure of dependence of the random variables used in network analysis is the classic Pearson correlation. It is well known that for a multivariate normal distribution covariance matrix is a sufficient statistics Anderson T.W. [3]. However the assumption of multivariate normal distribution of real data is not satisfied. In particular multivariate distributions of real data of stock returns have a more heavy tails, than multivariate normal distribution Shiryaev A.N. [4].

In Bautin G.A., Kalyagin V.A., Koldanov A.P., Koldanov P.A., Pardalos P.M. [5] sign correlation is used as an alternative measure of dependence. This measure is based on the probability of coincidence of the random variables signs. It is shown that such a measure is appropriate for the market network analysis, has a simple interpretation, can be generalized to any number of random variables and has a connection to the Pearson correlation in the case of normal distribution. In Bautin G.A., Kalyagin V.A., Koldanov A.P. [6] these measures are compared for different models of financial market.

In the present report connection between Pearson correlation and sign correlation is investigated for elliptically contoured distributions. A mixture of multivariate normal distribution and multivariate Student distribution is considered as a model of simultaneous behavior of stock returns of financial market. Stability of statistical estimations of Pearson and sign correlations is compared for the model. Some structural characteristics of complete weighted graph, namely minimal spanning tree Tumminello M. [1], market graph Boginsky V., Butenko S., Pardalos P. [2], are considered. Construction problem of these characteristics as multiple decision statistical procedure is formulated Koldanov A.P., Koldanov P.A., Kalyagin V.A., Pardalos P.M. [7]. Stability of such procedures is measured by conditional risk Lehmann E.L., Romano J.P. [8]. It is shown that statistical procedures based on sign correlation are

stable with respect to parameters of mixture of multivariate normal distribution and multivariate Student distribution.

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