Abstract

The problem of excessive losses is significant in economic theory and investment practice, as well as for random processes analysis. One of the recently discovered characteristics of losses and profits on financial markets, which was discovered by Bogachev, Bunde, Ludescher, and Tsallis and is not entirely explained yet, is the universality of the distribution of times between losses (or profits) exceeding a given threshold value. In other words, this distribution does not depend on the underlying asset type or the time resolution of data, but rather only depends on the particular threshold height. Interestingly, similar results were obtained, e.g., in geophysical time series (describing the earthquakes exceeding a particular magnitude). In this thesis I present a thorough description of this universality, employing two complementary approaches: (i) an analytical approach, based on the extreme value theory (EVT) and the continuous-time random walk (CTRW) model, and (ii) a numerical approach, based on the Potts model from statistical mechanics. The thesis makes original contributions to the field of knowledge with the following: (i) an analytical model of the aforementioned universality, with a thorough empirical verification for losses and some proposed applications to value-at-risk simulation, profits description, and geophysical data description, and (ii) an agent-based spin model of financial markets with the novel interpretation of the spin variable (as regards financial-market models), reproducing the main empirical stylized facts, such as the shape of a usual and an absolute-value autocorrelation function of the returns as well as the distribution of times between superthreshold losses. These results extend the knowledge and understanding of stochastic processes, agent-based modeling, financial markets and geophysical systems.