Early Warning Methods for Rare Events Detection
Dragos Bozdog, Ionut Florescu, Khaldoun Khashanah, Jim Wang

Abstract
We present a methodology to detect unusual trading activity defined as high price movement with relatively little volume traded. The analysis is applied to high-frequency transactions of thousands of equities and the probability of price recovery in the proximity of these rare events is calculated. Similar results are obtained when analyzing commodities with different expiration dates. The propagation of rare events in the commodity structure and the liquidity problems are addressed.

Specific objectives of the study
- Develop a method to detect large price movements corresponding to small volume of shares traded.
- Analyze the evolution of price after these unusual events and study the probability of price recovery.
- Estimate the expected return if a trade is placed at the detected event.
- Analyze rare events propagation in futures with several expiration dates.
- Liquidity considerations using rare events & aggressor indicator.

Methodology
In this analysis we use tick-by-tick data of 5,369 equities (TAQ), US and EUREX futures.

To further simplify we retain only the maximum price movement with respect to change in volume for each window with \( \Delta V < V_c \). Consequently, all the analysis that follows is based on the following distribution:

\[
V_i \sim \text{Max}(V_i, \Delta V < V_c)
\]

For example for IFF stock, we obtain 1,970 observations for \( V_i = 1,000 \) shares, 1,562 observations for \( V_i = 0,000 \) shares, 1,544 observations for \( V_i = 10,000 \) shares.

The proposed sampling technique generates new distributions that share similar behavior of the tails and provides a computationally feasible approach to this analysis.

Comparison of Rare Events Detection with other computationally expensive algorithms
The detection of Rare Events is compared with p-level efficient points variant generation and \( \alpha \)-zonoid trimmed regions method.

Comparative Study of Equity Groups
We analyze the change in price from the volume perspective. We classify stocks into classes based on the average daily traded volume. We refer to this classification as the multi-scale volume classification of the 5,369 stocks considered in this study.

Application to Futures
The Rare Events Detection is implemented for several expirations dates of the same underlying futures contract. The propagation of the rare events in the future structure is influenced by the trading activity and results in asynchronous behavior.

Publications

Contact
Dragos Bozdog, Program in Financial Engineering
School of Systems and Enterprises, Stevens Institute of Technology, Hoboken, NJ 07030.
Phone: (201) 216-5298, Fax: (201) 216-5541
Email: dbozdog@stevens.edu, Web: http://personal.stevens.edu/~dbozdog/