Trader Contagion

Feng et al (2012)

The paper combines Agent-Based and Stochastic Models to reproduce two important empirical features of financial asset returns exhibit fat-tailed distributions and long-term memory. The agent-based model was developed based on empirical and theoretical research on trader behaviors. The paper demonstrated that the prevalence of "fat" tails in return distributions is a consequence of traders employing similar technical trading strategies. By evolving this model into a stochastic framework, they establish quantitative scaling relations linked to the long-term memory observed in market behavior. This analysis reveals that the long-term memory in absolute and squared price returns is intricately connected to how investors apply technical strategies over various investment horizons, corroborating empirical findings.

Project Objectives

- Assess sensitivity of model output to various input parameters

- Reproduce the paper's feature: "Fat Tailed Return Distribution and Autocorrelation of Returns."

- Compare model outputs with empirical stock return and volume data.

Agent Based Model

The model simulates individual agent behaviors with some randomness to mimic real-world unpredictability.

Key Features of the model:

- Agents (n): represent market participants
- Market Velocities (V): Fundamental and Technical. Vf = 83% based on 1996-2006 data
- Trading Decisions: based on market velocities
- Opinion Groups: randomly distributed based on the evidence III and IV on the paper

Stochastic Model

Two version were implemented:

1. With time horizon: Agents factor weighted sum of the absolute differences between the last return and the returns at various past timesteps. The weights decay exponentially with the age of the return.
2. Without time horizon: Agents only consider returns from immediate previous timestep

Implementation

Conducted 10 runs for each of the 11 ω values from the paper.

Used the following parameters for each run:

- Number of Agents (n): 1024
- Probability of Trading (p): 0.2178
- Steps: 1000

Collected key statistics for each ω value: daily returns, daily trading volume…

Implemented Hill Estimator and Linear Regression Model to explore the relationship between extreme return movements and number of opinion groups.

Parallelization

Parallelized the simulations on different omega values.

The parallel simulation method reduced the execution time by 90% (from 60s to 6s) compared to the sequential method.

There are more opportunities for parallelization including: model steps, daily returns and volumes functions

Insights

The model demonstrates that a diverse range of opinions (ω) in the market can significantly impact the extremities of market movements, with higher diversity leading to reduced herd behavior and more stable market conditions.

Challenges

Plotting log-log graph in Haskell

Parsing complex data: attempted to incorporate empirical data to validate the model

Calculating p-values from linear regression