READING SUMMARY

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Since the first paper I read turned out to be rather short, I decided to read a second and provide a summary for it as well.

1. Paper 1

For my summary, I chose to read a paper that might help in finding future directions for my project. I chose to examine *Frequency-based Analysis of Financial Time Series*, written by Mohammad Hamed Izadi. In this paper, the author examines the spectral density of stock prices and log stock prices, and finds that their power spectral density is consistent with that predicted by a random walk model ($S(f) \propto 1/f^2$).

First, the author gives a summary of previous work in the area, referencing many papers that have also found ($S(f) \propto 1/f^2$). Then, he performs his own analysis of some stock data, confirming the results by performing a fit in γ, C_0 on $S(f) = C_0/f^\gamma$ for new datasets.

The author then shows that for a random walk process

$$X_t = \mu + X_{t-1} + \varepsilon_t$$

(where μ is a drift parameter, and the ε_i are all independent random variables), with some constraints, the power spectral density must be of the form $1/f^2$. The author then goes on to examine extracting correlation between low-frequency points in sequences of the form $1/f^2$, as such sequences are not memoryless. Thus, the author concludes, it might be possible to make some predictions about stock prices.

2. Paper 2

For my second paper, I chose to read *Dynamics of the Dow Jones and the NASDAQ stock indexes*, by Fernando B. Duarte, J. A. Tenreiro machado, and Gonçalo Monteiro Duarte. In this paper, the authors analyze the properties of financial data using techniques from dynamical systems. In particular, they use Takens' embedding theorem to determine whether a time series is "a deterministic signal from a low-dimensional dynamical system." They state the theorem as follows:

Theorem 2.1. *If a time series is one component of an attractor that can be represented by a smooth d-dimensional manifold (where $d \in \mathbb{Z}$), then the topological properties of the signal are equivalent to the topological properties of the embedding formed by the m-dimensional phase space vectors*

$$y(t) = [s(t), s(t+\tau), s(t+2\tau), \cdots, s(t+(m-1)\tau)]$$

whenver $m > 2d + 1$. The vector $y(t)$ can be plotted in a d-dimensional space forming a curve in the Pseudo Phase Space.2 △

In the particular case of stock data, the authors use power functions to approximate the modulus of the fourier transform amplitudes, as a method for studying signal spectrums:

$$|\mathcal{F}\{x(t)\}| \cong p\omega^q \qquad p, q \in \mathbb{R}$$

then, the authors use a sliding-window Fourier Transform (to try and keep both time and frequency information), and then applied Pseudo Phase Plane analysis to calculate relationships between different time partitions for a stock.