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Evaluation of Fractal Dimension for Some Financial Time Series

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Fractal dimension can be used as a measure of smoothness of a function, to evaluate the Hurst exponent and thus explore market memory using financial time series. It can also be used to evaluate the number of independent variables to model a dynamic system which generates financial time series. In this work, we used box-counting, Hall-Wood, rodogram, madogram, variogram, and, more recent, FD4 fractal dimension estimators. A Monte Carlo simulation experiment was carried out to compare fractal dimension estimators, with the madogram estimator performing the best in case of this experiment plan. We analyzed currency exchange rate and gold price time series data sets with 2^{20} observations. The Hurst exponent was evaluated for these time series using different fractal dimension estimators. Further, correlation dimension of time-delay embedding reconstruction of an attractor was evaluated. We show that more observations are needed to evaluate the correlation dimension in higher embedding dimensions to obtain saturated values.