AC297r Bitcoin Trading Project

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Objectives

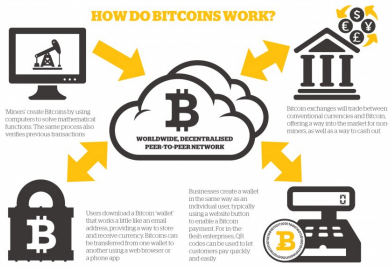
The initial motivation of this project is to implement some bitcoin trading strategies and investigate its arbitrage opportunities.Here are the trading strategies implemented:

- Momentum trading
- Pairs Trading
- Markov Chain Monte Carlo
- Hidden Markov Model
- Pattern Recognition BackTesting

Two ways to explore arbitrage opportunities:

- Two Market Exchange
- Cross Currency Exchange

Bitcoin Introduction



Trading Strategies

Momentum Trading To participate in momentum investing, a trader will take a long position in an asset, which has shown an upward trending price, or short sell a security that has been in a downtrend.

Pairs Trading In this project, we use Huobi and Okcoin. At a time t, given the 2 exchanges, 1 and 2, one can calculate $D_t = F(ask_{1,t}) - bid_{2,t}$ and $E_t = G(bid_{1,t}) - ask_{2,t}$ where $F(p) = a * p + b$ where a and b are determined through regression on training times.

MCMC Asset price $dlnS = udt + \sigma dW$. $Y_n = lnS_n - lnS_{n-1}$. Denote m and v for the mean and variance of the return over the period Δt and get the equation as $Y_n = m + \sqrt{v}w_n$. Start from an initial guess of parameter value m_0 and v_0. Make a random draw from the distribution for the parameters conditional on the observations.

Pairs/Momentum Trading

Figure 1: Pairs Trading Performance

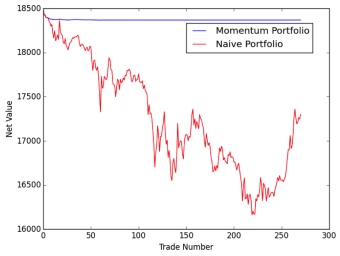
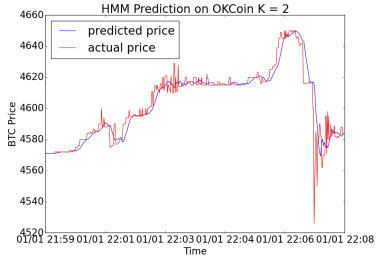


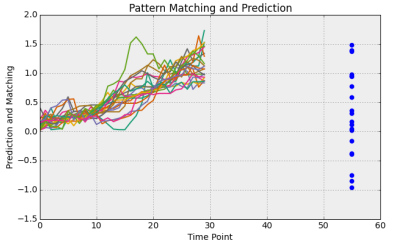
Figure 2: Momentum Trading Performance

Hidden Markov Models and Pattern Matching



Hidden Markov Models is a technique for inferring hidden states through observations when the structure of the model is known but the parameters are not. The parameters are estimated using a version of the Expectation Maximization (EM) algorithm known as the Bausch and Lomb algorithm.Formally, Hidden States: $X = x_1, ...x_n$. Observations: $Y = y_1, y_2...y_n$. $P(X, Y) =$ Probability: $P(X, Y) = \prod P(x_1) \prod P(x_i|x_{i-1})(y_i|x_i)$

Pattern Matching saves the current trend of bitcoin prices and looks for similar patterns in historial trends by computing the similarity of two patterns. A pattern corresponding to a time point is defined as a list of length N that stores the percentage difference between the price of the time point and the price i time unit before that where i ranges from 1 to N. Similarity can be computed using normalized Euclidean distances or Pearson/Spearman Correlation Coefficient. The historical future prices of matched patterns are then collected to make predictions based on their distributions.



Conclusion

Algorithm	Start	End	Percentage Change
Baseline	10000	10295.739	2.95%
MACD	10000	10848.446	8.48%
Momentum Trading(Shortsale)	10000	8188.88	-18.112%
Momentum Trading(No Shortsale)	10000	10080.279	0.80279%
Pairs Trading	10000	11251	12.51%
HMM(K=2)	10000	10534	5.34%
HMM(K=4)	10000	10841	8.41%
HMM(K=8)	10000	10499	4.99%
MCMC	10000	10235	2.35%

Table 1: Algorithm Performance Comparison

References

Patrik Idvall and Conny Jonsson Algorithmic Trading: Hidden Markov Models on Foreign Exchange Data

Mantas Landauskas Modelling of stock prices by the markov chain monte carlo method

Future Research

We are interested in developing an ensemble trading technique in the future. Given k trading strategies, one can dynamically weight the predicted returns of the strategies given a common trailing window. First, we discretize return prediction into 3 bins: buy, short, and hold. Then we combine precision and recall of each strategy over the trailing window into a F-score to find the weights.

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