STATS 242: Algorithmic Trading and Quantitative Strategy Summer 2015

Assignment 2

Due: July 22, 2015

Instructions:

- This assignment can be done individually or in a team of two.
- Please attach the relevant R code and provide any outputs and/or plots to support your answers, giving clear narratives of how those outputs lead you to your stated conclusions.
- Turn in your submissions to the STATS 242 homework dropbox located on the second floor of Sequoia Hall.

Data file:

- `Bankdata.csv` contains data for tickers SPY, WFC and JPM.

1. *Technical Rules*

Consider the daily prices for three tickers, WFC (Wells - Fargo), JPM (JP Morgan Chase) and SPY (S&P 500 ETF Trust). In order to compare the performance of a strategy, appropriately normalize the entry point: invest equal amounts of capital in each stock. Total portfolio return on each day should be computed as a weighted sum of returns from each active trade (weighted by the current value of each trade). Evaluate the signals discussed in (a) and (b) below using the Sharpe, Treynor, Sortino, Calmar and Information ratios and PNL with and without including transaction costs of 10 basis points. Assume a risk free rate of 3%. (1 basis point = 10^{-4}; so each dollar traded costs 0.0010 in transaction costs)

(a) *Moving average trading rules*: Trading signals are generated from the relative levels of the price series and a moving average of past prices.

- Rule 1: Let $ma_t = \frac{1}{L}\sum_{i=0}^{L-1} p_{t-i}$; use the strategy to sell if $p_t > \omega * ma_t$ and to buy if $p_t < \frac{1}{\omega} * ma_t$. Evaluate this strategy. What are the optimal values for "ω" and "L"?
- Rule 2 (Momentum): Compute a short-term moving average over the last m prices, $ma_t^{(S)}(m)$ and a long-term average over the last n prices, $ma_t^{(L)}(n)$ with $m < n$. If $ma_t^{(S)}(m)$ crosses $ma_t^{(L)}(n)$ from below, sell and if it crosses $ma_t^{(L)}(n)$ from above, buy. Evaluate this strategy. What are the optimal values of m and n ?
- Rule 3 (Bollinger band): Define the following quantities

$$\bar{p}_t^{(L)} = \frac{1}{L}\sum_{i=0}^{L-1} p_{t-i}$$

$$\hat{p}_t^{(L)} = \frac{1}{\sum_{i=1}^{L} i}\sum_{i=0}^{L-1}(L-i)p_{t-i}$$

$$\sigma_t^{(L)} = \left\{\frac{1}{L-1}\sum_{i=0}^{L-1}\left(p_{t-i} - \bar{p}_t^{(L)}\right)^2\right\}^{1/2}$$

and define the bands $p_t^+ = \hat{p}_t^{(L)} + 2\sigma_t^{(L)}$ and $p_t^- = \hat{p}_t^{(L)} - 2\sigma_t^{(L)}$. If $p_t > p_t^+$, sell and if $p_t < p_t^-$, buy. Evaluate this trading rule. What is the optimal "L"?

(b) *Oscillator Rule*: Define

$$RSI_t = 100\left(\frac{U_t}{U_t + D_t}\right)$$

where U_t is the cumulative up movement and D_t is the cumulative down movement over the last L periods, mathematically defined as

$$U_t = \sum_{i=0}^{L-1} I(S_{t-i} - S_{t-i-1} > 0)(S_{t-i} - S_{t-i-1})$$

$$D_t = \sum_{i=0}^{L-1} I(S_{t-i} - S_{t-i-1} < 0)(S_{t-i} - S_{t-i-1})$$

If $RSI_t < 30$, buy and if $RSI_t > 70$, sell. Evaluate this trading strategy. What is the optimal "L"?

2. *Use the method of Anatolyev and Gospodinov (2010), decomposing the return r_t as:*

   $r_t = c + |r_t - c|(2 * I(r_t > c) - 1)$, where $'c'$ is the transaction cost, to jointly model the direction of the change in price and size of the change; develop a rule for trading and evaluate its performance using all the indices stated in Problem 1.

3. *Pairs Trading:*

   (a) *Distance Method*

   We want to develop a pairs trading strategy and check if it does any better than the strategies in Problem 1. At the last trading day of the month, look back 3 months and identify if any pairs are worth trading. Use the distance measure, and appropriate thresholds, evaluate the portfolio returns and summarize the results using the same format as in Problems 1 & 2.

   (b) *Cointegration Method*

   Use the cointegrating relationships between pairs to decide which one to long and how much the other to short and compare the results with 3(a).

4. *Multiple Stocks Trading: Cointegration Method*

   Consider all three tickers together; evaluate if there is co-integration based on a moving window of durations, such as sixty days. Using the co-integrating vectors, decide how much to short for a unit of long and develop a rule for trading. Evaluate the rule.

5. Overall Summary:

   Write a brief report on the use of univariate, bivariate and trivariate strategies; provide intuitive reasoning behind the results and suggest some recommendations for trading.