MIT MANAGEMENT SLOAN SCHOOL

15.034 Hedge Fund Project: BPP & Stock Trading

Due Dates: Initial submission: Friday, April 16th by 5 pm.
Final Submission: Monday, April 21th by 9 am.

This is a team project. The objective of this project is to use information in the Billion Prices Project data to construct a profitable bond-trading strategy. By the way, PIMCO lost almost 10 billion dollars in 2013 because they were unwilling to use this information properly, and Bill Gross is no longer at the firm! HA…. That will teach them to disregard Roberto!!! We are sure you can do slightly better than that.

Data:

- File **BPPTrain.csv** contains the daily (BPP) and official (CPI) consumer price indexes. As well as the NASDAQ index
  - It has the date as well. The CPI is computed once a month and the value of the CPI is set at the end of the month (so June's change in the index is reflected on June 30th).

- Your first job is to read the data set, check for missing values, and clean the data.

- You can use any other additional source of information if you want, but you are responsible for finding it, providing it to us a data file, and documenting it, so we can reproduce everything.

Learning Objectives:

- Learn how to run AR (autoregression) models and produce forecasts
- Learn how to construct out-of-sample tests
- Learn how to choose a model based on out-of-sample performance
- Learn how quant-strategies are evaluated and constructed

Task:

Assume you are investing $1 million at the beginning of the data set.

- We want to evaluate the average daily return of an investment strategy based on your investment decision rule. Assume that you can only invest in the NASDAQ we gave you and if you do not invest you are holding cash.
- This means that if you take a long position (buy), you have a positive return when NASDAQ goes up. If the price goes down you experience a negative return. The opposite if you are shorting NASDAQ.
- You cannot leverage your wealth but you will be able to use all your money to go either long or short.
- When you decide not to invest your return that day is zero.

Performance measure:

The **objective** of the assignment is to maximize the returns (you can also measure the information ratio):

- The information ratio is the average daily return of the strategy divided by the standard deviation of the same daily returns. This is also called the Sharpe Ratio.

Deliverables:

Part 1:

- Prepare a presentation of **up to** 7 slides showing the performance of the investment strategy.
  - Description of the regression estimated (with output) and how that model was chosen
  - Description of the investment strategy and how it was chosen

- Please hand in a brief write-up that summarizes your findings and explains your investment strategy. This should include any graphs and tables. Also, provide the database used and your R files.

- This will be due on **April 16th by 5 pm.**

- Please fill out this survey with your results for Part 1for our class discussion:

https://survey.qualtrics.com/jfe/form/SV_8j3muFw5qarEpTw

Part 2:

- After that day, your strategy is fixed and you cannot change it. We will give you additional data – a true out-of-sample – and you need to run your strategy in that sample and evaluate the performance.
  So, the out-of-sample will RESTART with 1million dollars and we want to evaluate returns and information ratios

  Prepare up to 2 additional slides showing the performance in the out-of-sample and submit the entire presentation (up to 9 slides) on **April 21th by 9 am.**
  - Description of the out-of-sample performance
  - Average Daily return of your strategy in the out-of-sample data.
  - Standard deviation of your daily returns.

- Please fill out this survey with your results for Part 2 for our class discussion:

https://survey.qualtrics.com/jfe/form/SV_e9k9FPqxB3CDam2

EXAMPLE: Below is an example of a **simple** strategy; remember that you can be as creative as you like:

- Choosing a strategy:
  - Assume we estimate a simple regression where we run the daily NASDAQ on lags of NASDAQ returns, and lags of the daily BPP inflation (inflation is the change in the BPP index). (Your model can be more/less complicated than that, but you must use lags in the model rather than contemporaneous measures—that way you are using yesterday's data to predict the future).
  - The predicted value of this regression is an estimate of the change in the NASDSAQ from today to tomorrow (because the right hand side variables are all in lags).
  - Our trading rule: If the predicted value is >0 we buy, if it is <0 we sell, if it is zero we are out of the market.
- How can you evaluate if your strategy is doing great?
  - One is to evaluate the IN-Sample performance.
    - How good is it at predicting the returns in the data we used to estimate the regression?
  - The other one is that you create an out-of-sample in your data – like rolling windows
    - So, you can drop the last six months.

- Estimate a regression with the earlier data.
- Use those estimates and your investment rule in the 6 months you had dropped. In other words, given the decision rule, compute the daily return in the data not included in the regression. Compute the average daily return and their standard deviation, given your investment strategy.

- In fact, this is what we are going to do. You estimate the decision rule given some data, and then you feed the decision rule with more recent data.

- Complexity in the investment rules
  - Rules can be very complicated:
    - For example, only buy if the forecast is high enough and sell if the forecast is low enough. So, it can have many thresholds as part of the decision rule. You can also vary how much you invest based on the signal.
    - You can incorporate the standard error of the forecast. One way is to calculate the ratio of the forecast to the standard error and invest if that ratio is particularly large or small. (This is akin to using the p-value).
    - In the example above we assumed the holding period was 1 day. But it can be longer than that. You can assume that once you invest you keep the resources for X days.
    - And so on….

  - Rules could change in time (learning):
    - The example above assumes the rule does not change in time, but in real life this is a possibility.
    - These rules are hard to program, and they do not necessarily work better that invariant rules.
    - We are not expecting you to do this!

Please find the accompanying files with an example on how to do an R File:

- In **R-bpp-HF.v5.R** you have an R code so you do not spend too much time on figuring out the programming, freeing you up to be more creative with the model and the trading strategy. That program. It runs a simple strategy…. Within and out-of-sample return performance
- Very importantly, we are here to help.