Project C: Portfolio and Risk Management

Due October 18, 2018, 11:00 P.M.

1. Beta: Use the data from "crispy04" to examine the CAPM beta between "the market" and your favorite Dow stock for the period 1/1/2008 to 12/31/2009. Pick a stock that was in the DJIA for the entire period and then create and compare the following:

a. A time series plot of the 3-month rolling beta of the stock vs. the S&P 500. (Use the stored, pre-computed values.) The primary tables to use are {dailyvalue, benchvalue}. Tables with supplementary attributes that may be useful include {dim_equity, bench, indexmember, and dim_numtype}.
b. A scatter plot of 1-day stock returns vs. the SPTR (S&P 500 total return index) 1-day returns along with a line of best fit (OLS regression) and its slope equation. How does this result relate to, and compare with, the time series plot above?
c. A scatter plot of 1-day stock returns vs. the VIX (CBOE implied volatility index) 1-day returns along with regression line and its slope equation. Should the VIX be considered as a "factor" in addition the "the market" as part of a linear regression model for stock returns?

2. Performance modeling: You are an evaluating a potential investment in a hedge fund. It is the end of 2004, and you have in-depth access to the fund's daily position data for the period 2001-2004. Your goal is to characterize the past return profile in order to estimate its future success. Use the data for the equity long/short strategy called "Contra01" in the OLAP database **StatArb03** using the cube **Positions03**. For performance results, use the weighted returns net of transaction costs, given by the fields "Weighted Return Tc." Ignore hedge fund management fees.

a. Give the annualized return, volatility, and Sharpe ratio (using $r_f=0$) for the strategy.
b. Use linear regression to report on the CAPM alpha, beta, and R-squared for the strategy, including standard errors of your estimates and t-statistics. Is the alpha statistically different from a CAPM prediction? How would you characterize the market-neutrality of the fund in light of its beta?
c. Extend this regression model to include Fama-French factors, and repeat the analysis in the previous question. (Data is available in crispy04.dbo.famafrench.)
d. Plot the strategy one-day returns in order, from lowest to highest. What fraction of days were winners and what fraction were losers? What was the median return of winners and what was the median return of the losers?
e. Based on your analysis in 2004, how do you expect the fund to perform for the five-year period ahead?

3. Performance attribution: Analyze the performance of the contrarian equity long/short strategy "Contra01" over the period 2005-2009 using the data in the OLAP database **StatArb03**

using the cube **Positions03**. For performance results, use the weighted returns net of transaction costs, given by the fields "Weighted Return Tc"

a. Give the annualized return, volatility, and Sharpe ratio (using $r_f=0$) for the strategy overall and for the long and short halves of the strategy. (That is, do the same calculations just using the long positions and then just the short positions.)
b. Use linear regression to report on the CAPM alpha, beta, and *R*-squared for the strategy, including standard errors of your estimates and *t*-statistics. Is the alpha statistically different from a CAPM prediction? How would you characterize the market-neutrality of the fund in light of its beta?
c. Plot the strategy one-day returns in order, from lowest to highest. What fraction of days were winners and what fraction were losers? What was the median return of winners and what was the median return of the losers?
d. How do these results compare with your predictions from the period 2001-2004 from Question #2 above? Do you believe the portfolio manager's style changed or remained constant over time? Why or why not?
e. Which SIC sector contributed the largest total return, in absolute value, for calendar year 2006? What was the return, and what fraction of strategy total return did it contribute? (A plot or table of total weighted return, aggregated by sector and filtered on 2006 tradedates would be helpful.)
f. Same as previous question using GICS sectors.

4. Risk measurement: Analyze the exposures of the contrarian equity long/short strategy "Contra01" using the fund data for 2005-2009 in the OLAP database **StatArb03** using the cube **Positions03**. This strategy focused on security selection and mean-reversion dynamics at the individual stock level. While the overall longs and shorts were constrained to be balanced, the individual sectors and other factors were not. Use the data on the history of portfolio exposures, measured primarily by aggregating security weights, to answer the following.

a. For each GICS sector, give its highest and lowest net exposure over the period 2005-2009. Which sectors stayed within +/- 10% of portfolio weight throughout?
b. On 9/15/2008, which GICS sector was the most unbalanced? Give the total portfolio weight long, total weight short, and net portfolio weight for that sector. What was the day's portfolio return?
c. Same as previous question for 2/27/2007.
d. Suppose a sub-strategy were defined by restricting the "Contra01" portfolio weights and returns to the GICS Financials sector only. Is this sub-strategy "market-neutral" on its own? How do the sub-strategy exposures evolve over time in the absence of constraints? Plot and the net long/short exposure as well as the gross long vs. gross short exposures.

5. Correlation dynamics: Analyze the behavior of the *average correlation* among stocks in the Dow Jones Industrial Average for the period 2008-2009 using the data in **crispy04.** Create two plots: one for a 1-month correlation window and the second using a 3-month window. On each graph, plot lines for the following daily time series:

a. Average ("implied") correlation, as discussed in class,

$$\overline{\rho} \equiv \frac{\sigma_p^2 - \sum_{i=1}^{N} w_i^2 \sigma_i^2}{2 \sum_{i<j} w_i w_j \sigma_i \sigma_j} = \frac{\sigma_p^2 - \sigma_{(0)}^2}{\sigma_{(1)}^2 - \sigma_{(0)}^2}$$

b. Index realized variance
c. Index variance$_{0,}$ the variance the index would have if all member correlations were zero
d. Index variance$_{1,}$ the variance the index would have if all member correlations were 100%
e. For each window size, what is the maximum value of the average correlation and when does it occur?
f. What constraints should be satisfied by the four values? Do they hold for the period in question?
g. What could cause the constraints to be violated?

About this project: Each problem in this assignment can be done in multiple ways. It is up to you to select appropriate and efficient tools for each task. That means that part of the assignment is to decide the appropriate tool or combination of tools for each task. Some of the options include

- For #2, #3, and #4, the "Contra01" data can be accessed via the OWC web pages linked on the Obelix web server, via Excel, or via the Management Studio, while the analytics (vol, Sharpe ratio, etc.) can be done in Excel, in R, ... even in Python.