

## DATA PROJECT

For this data project, please do not consult privately with anyone except the instructor or TA. You are encouraged, however, to post any questions you may have to the forum, and we will do our best to answer them promptly. Please include your code, an explanation of your methods, and a description of your results in your final submission. Have fun!

In the accompanying data file, you will find the closing prices and daily volumes for the 100 largest US stocks from 01/01/2008 to 12/31/2012.

- (1) First investigate a "residual reversion" signal as follows: for the  $i$ -th stock, calculate its CAPM  $\beta^i$  beta to the SPY exchange traded fund (whose price series is included in the data). Then on each day  $t$ , calculate the "residual return"  $v_t^i$  as

$$r_{t-1,t}^i - \beta^i r_{t-1,t}^M$$

where  $r_{t-1,t}^i$  is the stock's return from day  $t-1$  to day  $t$  and  $r_{t-1,t}^M$  is the corresponding quantity for SPY. Does  $v_t^i$  predict  $r_{t,t+1}^i$ ,  $r_{t+1,t+2}^i$ , etc.? Don't worry if you don't find any strong effect—the point of this exercise is for you to show your research methodology, not necessarily discover a tradable signal.

- (2) Using the signal constructed in the first part (whether it works or not), create the corresponding Markowitz portfolio and track its performance. For the purposes of this exercise, assume that the covariance matrix has the form

$$\Omega = \beta\beta^\top(\sigma^M)^2 + D$$

$\beta$  is the vector of betas computed in the first part,  $(\sigma^M)^2$  is the variance of SPY, and  $D$  is a diagonal matrix whose diagonal entries are the variances of the residuals  $v_{t-1,t}^i$ . Track the performance of this portfolio, and compute its average return and variance.

- (3) Now assume that the market impact of an order executed in a short time is proportional to the order's fraction of the total volume traded on that stock in the corresponding period. Write an optimizer that takes impact costs into account.