FINC460: Homework 6

1 Empirical Factors

Open the dataset HW6Factors.xls. It contains historical data on four empirical factors:

1. "MKT-RF" : value-weighted return on all NYSE, AMEX, and NASDAQ stocks in excess of the risk-free rate.

2. "SMB" : small minus big return on the small portfolio minus that on the big portfolio.

3. "HML" : high minus low return on the high value portfolio minus that on the low value (high growth) portfolio.

4. Momentum (MOM): past winner minus past loser return on the past winner portfolio minus that on the past loser portfolio.

The dataset also contains monthly returns of the four empirical factors (Market, SMB, HML and MOM) and the 1-month Treasury bill rates from January 1927 to December 2011.

1. The Market Portfolio. From January 1926 to December 2011, what is the average monthly rate of return of the market portfolio in excess of 1-month T-bills? Use the notation $\hat{m}^M$ for this estimate. Report the standard error of $\hat{m}^M$.

2. The "SMB" strategy of buying small firms and selling big firms.

   a) Report an estimate for the market risk exposure $\hat{\beta}^{SMB}$ of the SMB portfolio. Hint: There are two ways to do this calculation:

      i) By definition,
      $$\beta^{SMB} = \frac{cov(R_{SMB}, R_M)}{var(R_M)}$$
      Replace the variance and covariance by their sample estimates to obtain your estimate $\hat{\beta}^{SMB}$.

ii) Perform the regression:

$$R_{SMB,t} = a + bR_{M,t} + \epsilon_t$$

The slope coefficient b is the market risk exposure $\hat{\beta}^{SMB}$.

b) The expected return of the SMB portfolio according to the CAPM[1]:

$$E(R_{SMB}) = \beta^{SMB}(ER_M - r_f)$$

Given your estimates $\hat{\beta}^{SMB}$ and $\hat{m}^M$, what is the expected return of the SMB portfolio according to the CAPM?

c) Use the actual realized returns $R_{SMB,t}$ of the SMB portfolio from 1963 to 2007 to obtain an estimate $\hat{m}^{SMB}$ of its expected return. Compare your estimate $\hat{m}^{SMB}$ with that predicted by the CAPM.

d) For each of the past five decades: 60s, 70s, 80s, 90s, and 00's, report the average monthly returns from following the SMB strategy. Are they statistically significant? Some people commented that the size effect is going away. Do you agree or disagree?

3. The "HML" strategy of buying value firms and selling growth firms.

a) Report an estimate for the market risk exposure $\hat{\beta}^{HML}$ of the HML portfolio.

b) Given your estimates $\hat{\beta}^{HML}$ and $\hat{m}^M$, calculate the expected return of the HML portfolio according to the CAPM.

c) Use the actual realized returns $R_{HML,t}$ of the HML portfolio from 1963 to 2007 to obtain an estimate $\hat{m}^{HML}$ of its expected return. Compare your estimate $\hat{m}^{HML}$ with that predicted by the CAPM.

d) For each of the past five decades: 60s, 70s, 80s, 90s, and 00's, report the average monthly returns from following the HML strategy. Are they statistically significant?

4. The "Momentum" strategy of buying past winners and selling past losers.

a) Report an estimate for the market risk exposure $\hat{\beta}^{MOM}$ of the Momentum portfolio.

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[1]You may notice that the expected return on the left hand side is NOT in excess of the riskfree rate. This is because that the SMB portfolio is a combination of long and short positions. Same thing for the HML and Momentum portfolios.

b) Given your estimates $\hat{\beta}^{MOM}$ and $\hat{m}^M$, calculate the expected return of the Momentum portfolio predicted by the CAPM.

c) Use the actual realized returns $R_{MOM,t}$ of the Momentum portfolio from 1963 to 2004 to obtain an estimate $\hat{m}^{MOM}$ of its expected return. Compare your estimate $\hat{m}^{MOM}$ with that predicted by the CAPM.

d) For each of the past five decades: 60s, 70s, 80s, 90s, and 00's, report the average monthly returns from following the Momentum strategy. Are they statistically significant?

5. Diversifying across strategies. We will use the Markowitz spreadsheet to compute the optimal allocation between the MKT-RF, HML, SMB and MOM. To simplify matters, assume that the risk-free rate equals zero.

a) Compute the historical correlation matrix and the standard deviations of the four assets.

b) Given your estimates from above, use the Markowitz spreadsheet to compute the optimal weights to each of the four trading strategies. Here note that since these trading strategies are zero-investment portfolios, the weights do not technically need to sum to 1. However, we will still impose this as an arbitrary scaling.

c) Report the Sharpe Ratio of the optimal portfolio. How does it compare to the Sharpe Ratio of the individual assets?

Aside: This is essentially how hedge funds manage these strategies. The first step is to find strategies that generate "alpha", and then construct a diversified portfolio of these strategies. You can do this with more assets than stocks, such as bonds, currency and commodities and then diversify across markets. For the interested, read 'Value and Momentum across asset classes' by Cliff Asness, Toby Moskowitz and Lasse Pedersen. The former is the founder of AQR, a large hedge fund, and the paper essentially describes the fund's trading strategies (or at least what they used to be).