Assignment 4

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1 Problem: Risk-Decomposition (20 points)

Using the Bloomberg screenshot for Bank of America, compute

1. The annualized idiosyncratic risk on Bank of America
2. The annualized systematic risk of Bank of America
3. The annualized total risk of Bank of America
4. The volatility of the Market portfolio


1-BLOOMBERG
Analyze Fund Menu
BANK OF AMERICA Equity
BETA
<HELP> for explanation.
BAC US Equity
Relative Index
SPX Index
Historical Beta
Y = 1.577 X -0.294
Y = BANK OF AMERICA CORP
X = S&P 500 INDEX
Linear Beta Range 1
Raw BETA 1.577
Adjusted BETA 1.385
ALPHA (Intercept) -0.294
R^2 (Correlation^2) 0.472
R (Correlation) 0.687
Std Dev of Error 3.451
Std Error of ALPHA 0.216
Std Error of BETA 0.104
t-Test 15.193
Significance 0.000
Last T-Value 1.553
Last P-Value 0.939
Number of Points 260
Last Spread 2055.04
Last Ratio 0.008
BAC US Equity-Percent
SPX Index-Percent
Relative Value Analysis... Timing is everything
Create baskets of related products and mine for pairs.
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2 Problem: Estimating betas (55 points)

1. Download daily returns on the Amazon stock from CRSP (Amazon's permno is 84788 use the CRSP daily stock file, i.e. crsp.dsf in your query) and the CRSP value-weighted market return for the 10 years from 2010 to 2020 and short-term t-bill. The CRSP value-weighted market return can be obtained by using

   ```
   select date,vwretd from crsp.dsi
   ```

   in your query. The daily short-term t-bill rate can be obtained by using

   ```
   select caldt, tdyld from crsp.tfz_dly_rf2
   ```

   in your query.

2. Plot the rolling-window estimate of the beta of the stock using six month data-window assuming a risk-free rate is a t-bill rate.

3. To illustrate how sampling variation can generate this pattern, simulate 10 years of data (excess returns) for a stock that satisfies the CAPM equation and has a constant beta equal to the average you estimated over the 10 years for your stock (and using the same market risk-premium).

4. Plot the rolling-window estimate for the beta using the same code as in (2) above but using the simulated data. On the same graph, plot the adjusted beta series (using the Bloomberg formula) and the actual constant beta.

3 Problem: Portfolio choice with liabilities (25 points)

There are N risky assets available for investment. R is the vector of asset returns, μ is the vector of asset expected returns, Σ is the variance-covariance matrix of returns, and w is the vector of portfolio weights (fractions of wealth invested in the N risky assets). There is a riskless asset with a rate of return of R_0 and no borrowing or short-sale constraints ($w_0 = 1 - w'\mathbf{1}$ is the fraction of wealth invested in the riskless asset).

1. Let R_p denote the return on the portfolio w and consider the following investment problem

$$\max_w \left(E[R_p] - \frac{a}{2} Var(R_p) \right) \tag{1}$$

Solve for the optimal portfolio w. Show that there is "two-fund separation" in the sense that all investors will choose to divide their wealth between the risk-free asset and the tangency portfolio, a portfolio with weights w_{tan} you should identify, that is fully invested in risky assets and independent of risk-aversion. What happens to the fraction invested in the risk-free asset when risk-aversion becomes infinitely large?

2. Suppose the investor also has a liability L with $E[L] = \mu_L$, $Var(L) = \sigma_L$, and $Cov(R, L) = \Sigma_L$ (a vector of covariances between the N returns and L). Consider the following investment problem in the presence of the liability:

$$\max_w \left(E[R_p - L] - \frac{a}{2} Var(R_p - L) \right) \tag{2}$$

Solve for the optimal portfolio w.

3. Show that there is now "three-fund separation" in the sense that all investors will choose to divide their wealth between the risk-free assets, the tangency portfolio w_{tan} and a portfolio w_L you should identify and that is identical for all investors and related to the liability risk. What happens to the optimal position in the risk-free asset when risk-aversion becomes infinitely large? Give some intuition.