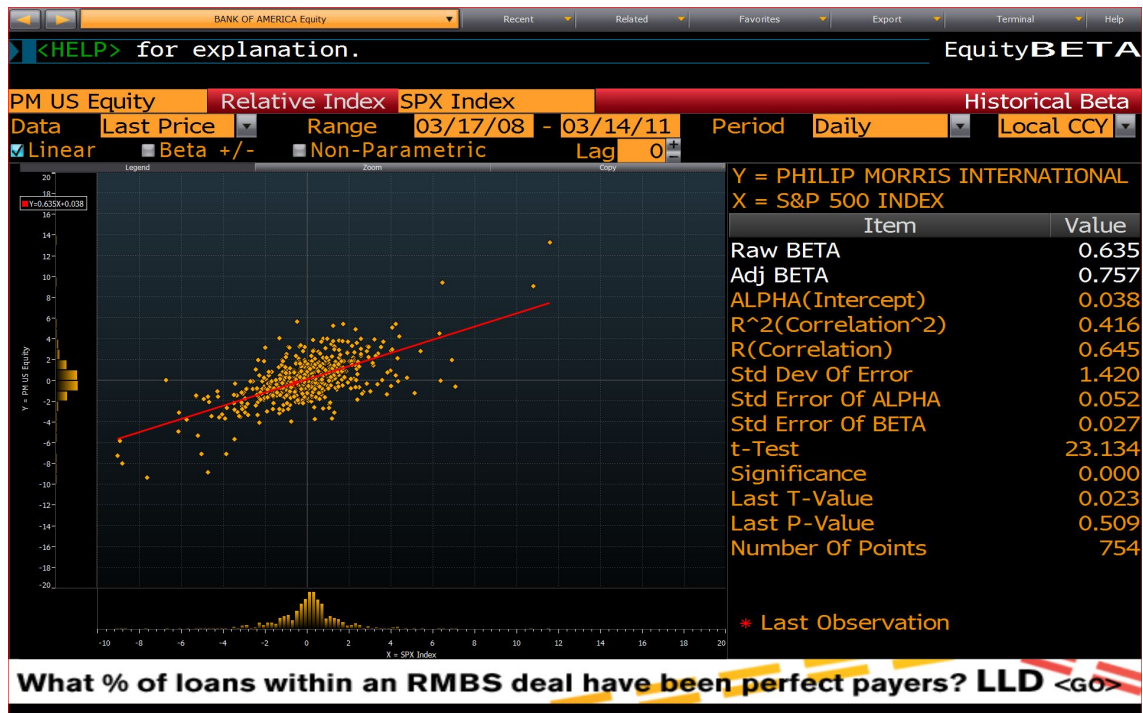


# Assignment 4: Solutions

## Problem 1: Risk-Decomposition (10 points).

Using the Bloomberg screenshot for Philip Morris (PM), compute

- (a) The annualized idiosyncratic risk of PM
- (b) The annualized systematic risk of PM
- (c) The annualized total risk of PM
- (d) The volatility of the Market portfolio



### Solution

(a) We have

$$\begin{aligned}\beta &= 0.635 \\ R^2 &= 0.416 = \frac{\beta_i^2 \sigma_M^2}{\beta_i^2 \sigma_M^2 + v_i^2} \\ \text{Var}[\epsilon_i] &= (0.0142)^2 \cdot 250 = v_i^2\end{aligned}$$

From the second equation, we can derive the implied volatility of the Market portfolio

$$\begin{aligned}\beta_i^2 \sigma_M^2 &= R^2 \beta_i^2 \sigma_M^2 + R^2 v_i^2 \\ \sigma_M^2 \beta_i^2 (1 - R^2) &= R^2 v_i^2 \\ \sigma_M &= \sqrt{\frac{R^2}{1 - R^2}} \frac{v_i}{\beta_i} = 29.84\%.\end{aligned}$$

The annualized total risk on Bank of America is then

$$\text{Var}[R_i] = \beta_i^2 \text{Var}[R_M] + \text{Var}[\epsilon_i] = 0.086318493,$$

which is equal to 29.38% in standard deviation terms. The annualized systematic risk is 0.03590, which is equal to 18.95% in standard deviation terms.

### Problem 3: CAPM: True or False? (10).

Please provide a short explanations along with your answers.

- (a) The CAPM implies that stocks with the same expected return cannot have the same beta.
- (b) The CAPM implies that two securities with different level of idiosyncratic risk must have different expected returns, otherwise no agent would choose to hold the security with higher idiosyncratic risk.
- (c) According to the CAPM standard deviation is the right measure of risk for all assets? for

some assets?

- (d) According to the CAPM beta is the right measure of risk for all assets? for some assets?
- (e) Suppose an asset has a positive alpha (i.e., it is above the security market line). Is this asset under or over-valued? Should you invest all your wealth in this asset if you are a mean-variance investor?
- (f) Suppose the CAPM holds in an economy with 2 risky assets that have equal market capitalization. Can their idiosyncratic risk be uncorrelated?

### **Solution**

- (a) False. The CAPM implies precisely that
- (b) False. Idiosyncratic risk is not priced.
- (c) False. The beta is the right measure of risk. For efficient portfolios, the beta is proportional to the risk and thus also a good measure of risk.
- (d) With a positive alpha, the asset is undervalued (the return is higher than it should be, i.e. the current price is lower than it should be). In general you should not invest all your wealth in that asset, since the return is risky.
- (e) Only if their returns are perfectly correlated (then their returns are also perfectly correlated with the market and the stocks have no idiosyncratic risk).