

## Quiz On The Day After Lecture # 9

### Single-Index and Multifactor Models

Consider the following two regression lines for stocks A and B in the following figure.

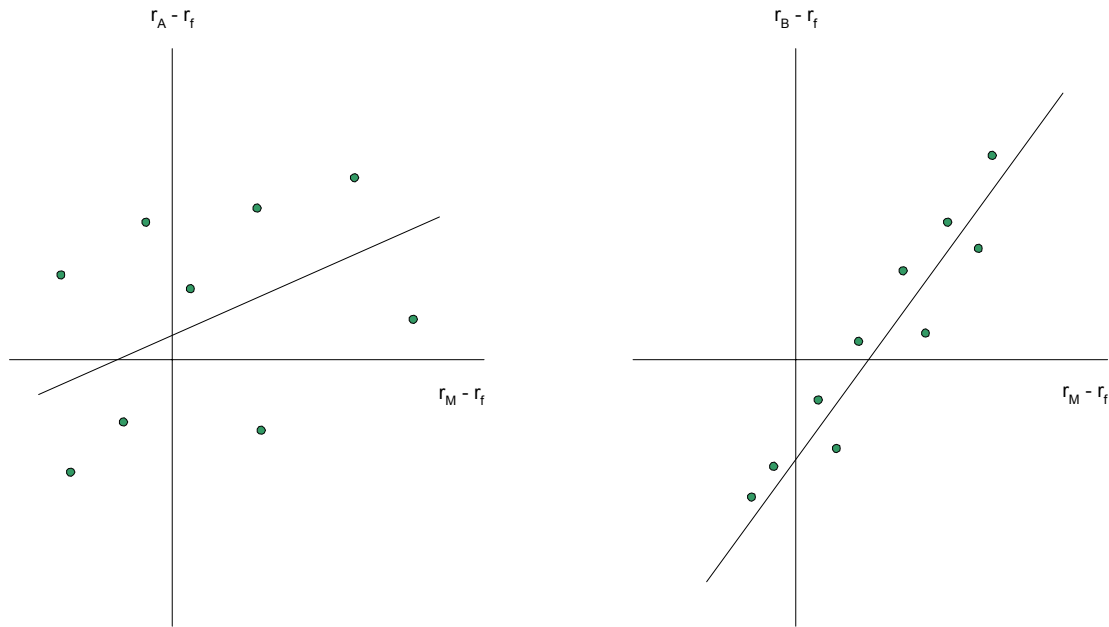


Figure 1: Regressions of Stock A and B vs. Market

which stock has higher firm-specific risk?

Which stock has greater systematic (market) risk

Which stock has higher  $R^2$

which stock has higher alpha?

which stock has higher correlation with the market?

Problem-statement: Discuss the questions, no analytical solution required.

Solution:

BKM ch. 3, p. 314 # 3

The two figures depict the stocks security characteristic lines (SCL) Stock A has a higher firm-specific risk because the deviations from the SCL are larger for A than for B. Deviations are measured by the vertical distance of each observation from the SCL.

Beta is the slope of the SCL, which is the measure of systematic risk. Stock B's SCL is steeper, hence stock B's systematic risk is greater.

The  $R^2$  (or squared correlation coefficient) of the SCL is the ratio of the explained variance of the stock's return to total variance, and the total variance is the sum of the explained variance plus the unexplained variance (the stock's residual variance).

$$R^2 = \frac{\beta_i^2 \sigma_M^2}{\beta_i^2 \sigma_M^2 + \sigma_{\varepsilon_i}^2}$$

Since stock B's explained variance is higher (its explained variance is  $\beta_B^2 \sigma_M^2$ , which is greater since its beta is higher, and its residual variance  $\beta_B^2 \sigma_{\varepsilon_B}^2$  is smaller, its  $R^2$  is higher than stock A's.

Alpha is the intercept of the SCL with the expected return axis. Stock A has a small positive alpha whereas stock B has a negative alpha, hence stock a's Alpha is larger.

The correlation coefficient is simply the square root of  $R^2$ , sto stock's B correlation with the market is higher.

$$\rho_{i,M} = \sqrt{R^2} = \sqrt{\frac{\beta_i^2 \sigma_M^2}{\beta_i^2 \sigma_M^2 + \sigma_{\varepsilon_i}^2}}$$

Try to solve the following questions 4,5 and 6 analytically.