Washington University — Fall 2009
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Economics 487
Final Exam Practice Questions

Again, you will be allowed to bring one single-sided sheet of notes to the exam. The notes must be handwritten. You can also use a calculator. Please bring a dark pen.

1. Why is a stock with $\beta_{i,M} > 1$ considered "risky"? Hint: think about the relative responsiveness of the asset to news that affects the market portfolio.
2. Without actually deriving formulas, explain the "least squares" principle used to calculate estimates of $\hat{\alpha}_i$ and $\hat{\beta}_{i,M}$ from the market model. That is, use scatterplots to help explain the intuition of the estimation procedure. Then, write out the exact minimization problem used to calculate the estimates. What does it mean to say that the "least squares" estimator is "unbiased"?
3. In terms of motivating the CAPM, it is helpful to think of "beta" as reflecting the contribution of asset *i* to the variability of the market portfolio. Using an example of an asset with $\beta_{i,M} < 1$, explain why we can think of "beta" in this way. Why is this useful in motivating the CAPM notion that only systematic risk is priced?
4. The Security Market Line relates the expected return on an asset or portfolio to its beta. Draw this line, labeling the axes and two points on the line. Draw a point off the line for an asset X that has a beta=1, but a higher expected return than the market portfolio. The Security Market Line represents CAPM equilibrium, whereas the existence of an asset with beta and expected return that are not on the Security Market Line suggests the market is not in equilibrium. What is the arbitrage process that will bring the market into equilibrium? Hint: think about investors who hold the market portfolio. What will they want to do? What will be the impact on the expected return on the market portfolio and/or the expected return on asset X?
5. Consider the CAPM regression model:

   $$R_{it} - r_{ft} = \alpha_i^* + \beta_{i,M}(R_{Mt} - r_{ft}) + \varepsilon_{it}, \quad t = 1,\ldots,T,$$

   $\varepsilon_{it} \sim iidN(0,\sigma_{\varepsilon i}^2)$ and R_{Mt} is independent of ε_{it} for all *t*,

   What restriction does the CAPM place on α_i^*? Why?
6. Suppose we get the following regression output using 60 observations of returns for Nortel:

   $$\hat{r}_{Nortel,t} - r_{ft} = \underset{(0.0034)}{0.0082} + \underset{(0.3847)}{1.3224}(r_{S\&P500,t} - r_{ft}), \quad R^2 = 0.2387$$

i. Use a *t*-test to test whether the CAPM restriction on α_i^* can be rejected at the 5% level (95% critical value is 2.00). Draw a probability distribution function (pdf) for the *t*-distribution with 59 degrees of freedom and note where your test statistic lies.

ii. Suppose you want to determine whether Nortel is "risky". Use the same approach as above to test whether you can reject that $\beta_{i,M} = 1$. Again, draw the pdf and the placement of your test statistic.

iii. Why is it important in calculating these tests that the residuals are homoskedastic? How would you test for heteroskedasticity? (Write out auxiliary regression equation, null hypothesis, and test statistic.)

iv. Describe how you would go about conducting a joint test of the CAPM restriction on α_i^* and $\beta_{i,M} = 1$. That is, what statistic would you construct? What distribution should this statistic have? How would you calculate the components of this statistic?

7. Suppose we get the following CAPM regression output for 60 observations of an equally-weighted portfolio of Nortel and Campbell's Soups:

$$\hat{r}_{EWPortfolio,t} - r_{ft} = -\underset{(0.0029)}{0.0046} + \underset{(0.2567)}{0.8965}(r_{S\&P500,t} - r_{ft}),\ R^2 = 0.6035$$

i. What proportion of risk is systematic for the equally-weighted portfolio? Is the proportion of systematic risk higher for Nortel or for the portfolio? Why would you expect to find a higher level for the portfolio?

ii. What must beta be for Campbell's Soups? Explain and show how you arrived at your answer.

8. What is a dummy variable and how would you use it to test whether beta (not alpha) is stable across time? Write out the regression equation you would estimate, the hypothesis of interest, and the test statistic you would use to test this hypothesis.

9. What is an autocorrelation function (ACF)? (Define the components of the autocorrelations.) What is the shape of an ACF for a series with strong momentum (i.e., $\text{cov}(R_{it}, R_{it-k}) > 0, k > 0$, but the covariance gets smaller as k gets larger)? What about under the random walk hypothesis? How would you calculate an estimate $\hat{\rho}_k$ of an autocorrelation at lag k? Why is testing whether an autocorrelation is non-zero considered a test of market efficiency?

10. List a possible reason (other than the rise of day trading) why firm specific risk has permanently increased over the past half century, while market risk has not.

11. How is it possible for there to be a positive underlying tradeoff between risk and return for the stock market as a whole and yet there is a negative empirical relationship between market volatility and market returns?

12. How is it possible for the sign of stock returns to be predictable even if expected returns are constant?

13. Why might the recent increase in the correlation between returns on different stock markets not indicate "contagion"?

14. Write a paragraph on two of the following topics related to <u>A Random Walk Down Wall Street</u>:

i. Review Malkiel's example in chapter 9 ("A New Walking Shoe: Modern Portfolio Theory") of an island economy with two businesses that he uses to discuss the benefits of diversification. Do asset returns need to have a negative correlation to produce benefits of diversification?

ii. Review the key points of Malkiel's discussion in chapter 10 ("Reaping Reward by Increasing Risk") of the evidence on the CAPM. Does he believe "the CAPM is dead"?

iii. Review the key points of Malkiel's discussion in chapter 11 ("Potshots at the Efficient-Market Theory and Why They Miss") of the evidence on the predictability of stock returns. What is survivorship bias?