FINC460 - Winter 2010 Final Exam

NAME: _____ SECTION: _____

1. Please do not open this exam until directed to do so.
2. This exam is 3 hours long.
3. Please write your name and section number on the front of this exam, and on any examination books you use.
4. Please show all work required to obtain each answer. Answers without justification will receive no credit.
5. State clearly any assumptions you are making.
6. This is a closed book exam. No books or notes are permitted. Calculators are permitted. Laptops are permitted but you are only allowed to use Excel and only a blank worksheet. You are not allowed to use other spreadsheets with pre-entered formulas.
7. Brevity is strongly encouraged on all questions.
8. The exam is worth 200 points.
9. Relax, and good luck!

Hints:

1. *Think through problems before you start working. Draw pictures.*
2. *If you get stuck on part of a problem, go on to the next part. You may need to use answers from earlier parts of the question to calculate answers to the later parts. If you weren't able to solve the earlier part, assume something.*
3. *Remember, setting up the problem correctly will get you most of the points.*

Short questions (50 points)

Assess the validity of the following statements (True, False or Uncertain) and explain your answers.

1. Since investors like excess return and dislike risk, more volatile (i.e. higher standard deviation) assets should earn higher returns to compensate investors for the additional risk.

   False. Since investors can diversify idiosyncratic risk, only systematic risk (beta with respect to something) matters for expected returns.

2. An empirical fact is that small firms have higher average returns than large firms. Small firms also have higher market betas. Thus, the size premium is consistent with the CAPM.

   False/Uncertain. Small firms have higher market betas than large firms, but that does not mean that the CAPM explains the size premium. In fact, if you look at firms with the same size, but different market beta, you see no difference in average returns. This is evidence against the CAPM.

3. Given that the APT can have multiple factors, whereas the CAPM has only one, the market portfolio, the two models cannot both hold at the same time.

   False. The APT and the CAPM can be consistent with each other, as long as the market portfolio is the tangency portfolio. The APT does not say what the tangency portfolio is. It is the combination of the factors (or factor-mimicking portfolios) that has the highest Sharpe Ratio.

4. A portfolio that buys firms with positive earnings surprises and sells firms with negative earnings surprises earns abnormally high returns.

   True. This is the so-called earnings anomaly. This is probably due to investor's under-reaction: Investors tend to react the news slowly. Thus, stock prices of firms with positive (negative) earnings surprises increases (decreases) gradually. This phenomenon yields abnormally high returns.

5. Suppose firm ABC announces that it plans to merge with firm XYZ. It makes an offer to firm XYZ's shareholders to buy their shares at a price of 100. If markets are efficient, XYZ's stock price should immediately jump to 100. Otherwise, this will be an arbitrage opportunity.

   False/Uncertain. If there is a risk of deal failure, investors take into account the risk and the stock price can be lower than 100.

Question 1 (150 points)

The data below applies to all questions:

Assume that a two-factor APT describes the returns of all well-diversified portfolios, and that the two factors are unexpected changes in production (factor 1), and a "credit spread" factor (factor 2). The credit spread factor is constructed as the difference in yields between BAA and AAA bonds.

You have identified two well diversified portfolios:

1. Portfolio V is a value-weighted portfolio of all value stocks, which is well diversified in the APT sense. The loadings of V on the two factors are: $b_{V,1} = +1 \quad b_{V,2} = -3$ The expected return of portfolio V is 11%/year.

2. Portfolio G is a value-weighted portfolio of all growth stocks, which is well diversified in the APT sense. The loadings of G on the two factors are: $b_{G,1} = +1 \quad b_{G,2} = -1$ The expected return of portfolio G is 7%/year.

Both Portfolios V and G contain only risky assets.

Also, you should assume that all investors in this economy (including you) can borrow and lend at a risk-free rate of 2%/year.

Additionally, the market believes that the standard deviations of $\tilde{f}_1$ and $\tilde{f}_2$ over the next year are $\sigma(f_1) = 0.1$ and $\sigma(f_2) = 0.2$, respectively, and that $cov(\tilde{f}_1, \tilde{f}_2) = 0$. Also, the market believes that production growth over the next year will be 2%.

Based on this scenario, answer the following questions:

1. (15 points) Interpret the factor loadings of the V and G portfolios on factor 2 ($b_{V,2}, b_{G,2}$). Do their signs make sense? What about their relative magnitudes?

   When the credit spread factor increases by 1%, returns of V and G decreases by 3% and 1%, respectively. Since the factor represents the possibility of entering the recession (if the factor increases, then the probability of entering the recession increases) as analyzed in 4, the returns usually decrease when the factor increases. Thus, the negative signs make sense. Also, value firms are more likely to be firms in distress, such firms are more likely to be sensitive to a systematic increase in default rates.

2. (15 points) If production grows by 5% over the next year, and credit spreads do exactly what the market expects, what will be the returns on the V and G portfolios?

   Since $f_1 = 0.05 - 0.02 = 0.03$ and $f_2 = 0$,

$$\begin{aligned} E(R_V|f_1, f_2) &= E(R_V) + b_{V,1}f_1 + b_{V,2}f_2 = 14(\%), \\ E(R_G|f_1, f_2) &= E(R_G) + b_{G,1}f_1 + b_{G,2}f_2 = 10(\%). \end{aligned}$$

3. (15 points) What are the values of λ_0, λ_1 and λ_2 in this economy?

The APT pricing equation says

$$E(R_V) = \lambda_0 + \lambda_1 b_{V,1} + \lambda_2 b_{V,2}, \quad E(R_G) = \lambda_0 + \lambda_1 b_{G,1} + \lambda_2 b_{G,2}.$$

Since there is a risk-free asset whose rate is 2%, $\lambda_0 = 2$. Then, the above equations become

$$11 = 7 + \lambda_1 - 3\lambda_2, \quad 11 = 2 + \lambda_1 - \lambda_2.$$

Solving these equations yields $\lambda_1 = 3$ and $\lambda_2 = -2$.

4. (20 points) Give an economic rationale for why λ_2 should be positive or negative. Specifically, answer the following questions. *All explanations should* very *brief.*

   (a) Which firms are more likely to enter bankruptcy in a recession, low-grade (BAA) or high-grade (AAA) firms? Assume that the ratings agency have done their due diligence and credit ratings reflect true probabilities of default.

   BAA firms are more likely to enter bankruptcy in a recession than AAA firms, as they have a higher chance of default.

   (b) How does the yield differential between low-grade corporate bonds (BAA) and high-grade corporate bonds respond to an increase in the probability of entering a recession? In this case, will $\tilde{f}_2$ be higher or lower?

   When the probability of entering a recession increases, yields of BAA bond increases more than those of AAA bond due to the compensation for the higher bankruptcy risk. Thus, the yield differential increases and $\tilde{f}_2$ will be higher.

   (c) Assume that a portfolio C has a positive loading on this factor (*i.e.*, $b_{C,2} > 0$). Will the return on C be unexpectedly high or low in when the credit spread moves in this way? Explain.

Since $b_{C,2} > 0$, the return on C will be unexpectedly high when $\tilde{f}_2$ increases. Thus this portfolio provides a hedge against an increase in the probability of entering a recession.

(d) Based on this, would you think that C would have a higher or lower expected return than a portfolio D with $b_{D,2} < 0$? Explain.

Similarly to (c), since $b_{D,2} < 0$, the return on D will be unexpectedly low when $\tilde{f}_2$ increases. Portfolio D is risky, as it loses value in recessions. Thus, C would have a lower expected return than a portfolio D.

(e) Based on this, explain why λ_2 should be positive or negative.

From the previous parts, $b_{C,2} > 0$ means that C can perform well in a recession when we are more likely to need money.Since it hedges the risk of a recession and and has a lower expected return as a result, λ_2 should be negative.

5. (20 points) Suppose you want to construct a factor mimicking portfolio for credit spreads (factor 2). You want this portfolio to move 1-1 with factor 2. You would like to invest \$1 million into it. Exactly how much would you invest in the V and G portfolios (and the risk-free asset) to create this portfolio? What is the expected return and return standard deviation of this portfolio over the next year?

   Consider a portfolio which invests \$1 million in the risk free asset, \$0.5 million dollars in G and sells \$0.5 million dollars of V. Then the portfolio return is

$$\begin{aligned} R_p &= r_f + \frac{1}{2}R_G - \frac{1}{2}R_V \\ &= r_f + E(R_G) - E(R_V) + \frac{1}{2}(b_{G,1} - b_{V,1})\tilde{f}_1 + \frac{1}{2}(b_{G,2} - b_{V,2})\tilde{f}_2 \\ &= 2\% - 2\% + \tilde{f}_2. \end{aligned}$$

   Thus, this portfolio has a loading of 1 with factor 2. The expected return and return standard deviation of this portfolio are

$$E(R_p) = E(\tilde{f}_2) = 0, \quad \sigma(R_p) = \sigma(\tilde{f}_2) = 0.2.$$

6. (25 points total) You are considering investing in two mutual funds known as the A and B funds. You determine that the return-generating processes for A and B are:

$$\begin{aligned}\tilde{r}_{A,t} &= 0.08 + 2\tilde{f}_{1,t} + 1\tilde{f}_{2,t} + \tilde{\epsilon}_{A,t} \\ \tilde{r}_{B,t} &= 0.05 - 1\tilde{f}_{1,t} - 3\tilde{f}_{2,t} + \tilde{\epsilon}_{B,t}\end{aligned}$$

Also the residual standard deviations ($\sigma(\epsilon)$) for A and B are 10%/year and 20%/year respectively. That is, unlike the passive portfolios V and G, they are not well-diversified.

(a) (9 points) What are the expected returns of the A and B funds? What does the APT pricing equation tell you the expected returns should be? Is there an arbitrage opportunity available here? Explain briefly

Since $E(\tilde{f}_{1,t}) = E(\tilde{f}_{2,t}) = 0$,

$$E(\tilde{r}_{A,t}) = 0.08, \quad E(\tilde{r}_{B,t}) = 0.05.$$

APT pricing equation implies that

$$\begin{aligned}E(\tilde{r}_{A,t}) &= \lambda_0 + \lambda_1 b_{A,1} + \lambda_2 b_{A,2} \\ &= 2\% + 3\% \times 2 + (-2\%) \times 1 = 0.06, \\ E(\tilde{r}_{B,t}) &= \lambda_0 + \lambda_1 b_{B,1} + \lambda_2 b_{B,2} \\ &= 2\% + 3\% \times (-1) + (-2\%) \times (-3) = 0.05,\end{aligned}$$

Although A has a positive alpha with respect to the APT, it is not clear if there is an arbitrage opportunity since A is not well-

diversified.

(b) (8 points) If you could only hold either A or B in your portfolio (in combination with the risk-free asset), and no other risky assets, which one would you choose to hold? Justify your answer (briefly).

First let's compute the standard deviations of A and B:
$\sigma^2(\tilde{r}_{A,t}) = 0.09$ and $\sigma^2(\tilde{r}_{B,t}) = 0.39$. Then, I choose to hold A since A has higher return and lower variance.

(c) (8 points) Does your answer change if you could freely invest in other risky assets?

Yes, I would choose to hold asset A because it has a positive alpha with respect to the APT.

7. (35 points) Suppose now that, through some detailed economic analysis, you have uncovered some information about future growth in production that is not incorporated into market prices. Based your information, you conclude that expected production growth over the next year is 4%. However, you agree with the market's estimate of the change in credit spreads over the next year. You also conclude that, even with your additional information, the market is correct that $\sigma(f_1) = 0.1$, $\sigma(f_2) = 0.2$, and $cov(\tilde{f}_1, \tilde{f}_2) = 0$.

   Suppose that, based on this information, you wish to create a portfolio that you think will have the highest possible Sharpe Ratio.

   (a) (10 points) What loadings on the two factors should your portfolio have?

   Based on your information, you need to adjust the expected return on holding factor 1 by $4 - 2 = 2\%$ upwards. Hence, the expected excess return from holding a factor 1 mimicking portfolio equals $\lambda_1 + 2\% = 5\%$, while we still have $\lambda_2 = -2\%$. Since the two factors are uncorrelated, the optimal weight on factor 1 is given by:

$$w_1 = \frac{(\lambda_1 + 2\%)\sigma_2^2}{(\lambda_1 + 2\%)\sigma_2^2 + \lambda_2\sigma_1^2} = \frac{0.05 \times 0.2^2}{0.05 \times 0.2^2 - 0.02 \times 0.1^2} = 1.11$$

   and $w_2 = 1 - 1.11 = -0.11$.

   (b) (15 points) What do *you* think the expected return of your portfolio is? What does the market think the expected return of your portfolio is?

   You think that this portfolio has an expected return in excess of

the risk-free rate equal to: $w_1(\lambda_1 + 2\%) + (1 - w_1)\lambda_2 = 5.8\%$.

The market believes that your excess return will be $w_1\lambda_1 + +(1 - w_1)\lambda_2 = 3.6\%$

(c) (10 points) What is the maximum fee that you can charge your investors?

Depends what their other options are (see previous question). You have an alpha of 2%, but if investors can only invest in your fund then at most you could charge is the difference between your sharpe ratio and the sharpe ratio of the tangency portfolio (from their perspective).