This is a closed book exam. However, you are allowed one page of notes (double-sided). Answer all questions. For the numerical problems, if you make a computational error you may still receive full credit if you provide the correct formula for the problem. There are 25 questions, and each question is worth 4 points. Total points = 100. You have 2 hours and 10 minutes to complete the exam. Good luck.

I. Portfolio Theory (28 points, 4 points each)

Consider portfolios of three assets: Amazon stock (stock A), Boeing stock (stock B) and T-bills (risk-free asset). Assume the following information

\[
E[R_A] = 0.20, \quad E[R_B] = 0.10 \\
SD(R_A) = 0.30, \quad SD(R_B) = 0.20 \\
CORR(R_A, R_B) = 0.2 \\
r_f = 0.03
\]

Transfer the diagram below to your blue book and use it to answer the following questions.
a. Let $x_A$ denote the share of wealth in Amazon stock and $1 - x_A$ denote the share of wealth in T-Bills. Using the information in the diagram, sketch the portfolio expected return and standard deviation values for portfolios of T-bills and Amazon stock for values of $x_A$ between 0 and 1.5.

b. Let $x_B$ denote the share of wealth in Boeing stock and $1 - x_B$ denote the share of wealth in T-Bills. Using the information in the diagram, sketch the portfolio expected return and standard deviation values for portfolios of T-bills and Boeing stock for values of $x_B$ between 0 and 1.5.

c. What are the values of Sharpe’s slope for Amazon and Boeing stock? Using Sharpe’s slope, which stock provides better investment opportunities when combined with T-Bills?

Transfer the diagram below to your blue book and use it to answer the following questions

d. The curved line in the diagram represents expected return and standard deviation values for portfolios of Amazon and Boeing stock. Using this curved line, indicate the location of the efficient portfolios of Amazon and Boeing stock.

e. Graph the expected return and standard deviation values for efficient portfolios consisting of T-Bills, Amazon stock and Boeing stock.
f. Consider the portfolio of T-Bills, Amazon stock and Boeing stock with
\( x_A = 0.25, x_B = 0.50, x_J = 0.25 \). Compute the expected return of this portfolio.

g. Consider the portfolio of T-Bills, Amazon stock and Boeing stock with
\( x_A = 0.25, x_B = 0.50, x_J = 0.25 \). Compute the variance and standard deviation of this
portfolio. (Hint: \( \text{cov}(R_A, r_J) = \text{cov}(R_B, r_J) = 0 \). Write out the 3 \( \times \) 3 covariance matrix.)

II. (16 points, 4 points each)

Insightful Corporation, a local software company, is trying to decide which of two
mutually exclusive projects to do. The nominal cash flows associated with the projects
are described in the table below:

<table>
<thead>
<tr>
<th>Project/year</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>B</td>
<td>-70</td>
<td>60</td>
<td>70</td>
</tr>
</tbody>
</table>

Project A has risk that is comparable to the company’s current assets. Project B has risk
that is twice that of the company's current assets. The current annual risk-free interest rate
is 3 percent, and the expected annual market risk premium is 7 percent. The company has
a debt/equity ratio of 0.2, and the beta for the company's stock is 1.5 while the beta for its
debt is 0.4.

a. What is the beta for the company’s current assets?
b. What are the betas for the two projects?
c. Using the CAPM, what are the appropriate discount rates (risk adjusted expected
returns) for the two projects?
d. Compute the NPV for the two projects. Which project should Insightful choose?

III. Market Efficiency (12 points, 4 points each)

1. State the efficient markets hypothesis, and name the three types of market efficiency.

2. “If the efficient-market hypothesis is true, a pension fund manager might as well
select a portfolio by throwing darts at the financial assets listed in the Wall Street
Journal.” Explain why this is not so.

3. A marketing statement for a mutual fund company is “Our Spartacus equity fund
outperformed the S&P 500 three out of the last four years. Why would you invest in the
S&P 500 when you can do better by buying our fund?” Explain why this statement may
be misleading.
IV. Options (20 points, 4 points each part)

1. The stock of Heavy Metal (HM) changes only once a month: with equal probability either it goes up by 20 percent or it falls by 16.7 percent. Its price now is $40. The interest rate is 12.7 percent per year, or about 1 percent per month. Consider a one-month call option of HM stock with an exercise price of $40.

a. Graph the tree diagram showing the current stock price of HM and the two possible values of the stock price next month.

b. At the expiration date of the option, what is the value of the call if the stock price goes up and what is the value if the stock price goes down?

c. What is the current value of the call option?

d. If you know the current value of the call option, how can you determine the current value of a put with the same exercise price and expiration date as the call? (Hint: I am not asking you to compute the numerical value of the put option)

f. What happens to the current value of the call option if the stock price increase next period stays at 20 percent per year, but that the stock price fall doubles to 25.4 percent per year? (Hint: draw the new stock price tree and compute the new payoffs to the call option)

2. Graph the payoffs at expiration of the following derivative securities based on the price of the S&P 500 index. (8 points, 4 points each)

a. A long position in a futures contract at a price of X.

b. The combination of a long position in a call option and a short position in a put option, where both options have an exercise price of X.

V. Hedging (16 points, 4 points each)

1. You own a $1 million portfolio of aerospace stocks with a beta of 1.2 and an R² of 0.3. You are very enthusiastic about aerospace but uncertain about the prospects for the overall stock market.

a. Explain how you could hedge out your market exposure by selling the market short. How much would you sell?

b. What is the beta of your hedge portfolio that is long in aerospace stocks and short in the market?
c. How confident are you about the quality of the hedge against the market? Justify your answer.

d. How in practice would you go about “selling the market”?

VI. Extra Credit (15 points, 5 points each)

Consider an individual whose utility of wealth function is $U(W) = \ln(W)$, i.e. the person's utility associated with any given level of wealth is equal to the natural log of the wealth level. If the person chooses occupation A, his or her wealth is given by the following wealth distribution:

<table>
<thead>
<tr>
<th>Wealth</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000,000</td>
<td>0.8</td>
</tr>
<tr>
<td>2,000,000</td>
<td>0.2</td>
</tr>
</tbody>
</table>

If the person chooses occupation B, his or her wealth is given by the following wealth distribution:

<table>
<thead>
<tr>
<th>Wealth</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,100,000</td>
<td>0.5</td>
</tr>
<tr>
<td>1,300,000</td>
<td>0.5</td>
</tr>
</tbody>
</table>

a. Which occupation will the person choose and why? Or will the person be indifferent to the alternatives? Explain.

b. Compute the certainty equivalent wealth and risk premium for occupation A.

c. Repeat parts (a) and (b) using the utility function $U(W) = W$. 