Question 1 (30 points)

Your employer offers two funds for your pension plan, a money market fund and an S&P 500 index fund. The money market fund holds 3-month Treasury bills, which currently offer a 3% safe return per year. The S&P 500 index fund offers an expected return of 10% per year with a standard deviation of 20%.

(a) (5 points) Consider portfolio A, which according to your level of risk aversion, requires an expected return of 8% per year. What should be the composition of your portfolio? What is the standard deviation of its returns? What is your level of risk aversion?

(b) (5 points) What is the Sharpe ratio of Portfolio A? What does the Sharpe ratio represent? How is it related to the capital allocation line?

(c) (5 points) Illustrate Portfolio A on a graph where you also plot the risk-free asset, the S&P 500 index fund, the capital allocation line and your indifference curve. Are you a relatively risk averse investor? Explain.

(d) (5 points) Now your employer adds an emerging-market fund to the two existing funds. The emerging-market fund offers an expected return of 10% per year, the same as the S&P 500 index fund, but with a standard deviation of 30%, higher than the S&P 500 index fund. Would you consider including the emerging-market fund as part of your portfolio? Explain.

(e) (5 points) The correlation between the S&P 500 index fund and the emerging market fund is 0. Consider portfolio B, which consists of 80% in the S&P index fund and 20% in the emerging-market fund. Calculate portfolio B's expected return and standard deviation. If you mix portfolio B with the money-market fund to achieve an expected return of 8%, is it better than the Portfolio A?

(f) (5 points) Is portfolio B the minimum global minimum variance portfolio? If not, solve for the minimum global variance portfolio. Show your working.

Question 2 (15 points)

In 1997, the rate of return on short-term government securities (perceived to be risk-free) was about 5%. Suppose the expected rate of return required by the market for a portfolio with a beta measure of 1 is 12%. According to the capital asset pricing model (CAPM):

(a) (5 points) What is the expected rate of return on the tangency portfolio? What about the expected rate of return on a stock with $\beta = 0$? If a stock has $\beta = 0$ does this mean that it has no risk?

(b) (5 points) Suppose you consider buying a share of stock at \$40. The stock is expected to pay \$3 dividends next year and you expect it to sell then for \$41. The stock risk has been evaluated by $\beta = -.5$. Is the stock overpriced or underpriced?

(c) (5 points) Your friend tells you that the stock is mispriced because of the “size effect” that we discussed in class. Does this imply that this stock is a large stock or a small stock? According to this anomaly, what explains the mispricing, and what extensions can you make to CAPM to correct for this?

Question 3 (25 points)

The current yield curve for default-free zero coupon bonds are as follows:

Maturity (years)	YTM	Price	Forward Rate
1	10%		
2	11%		
3	12%		

(a) (6 points) Complete the third and fourth column of the above table. Show your working.

(b) (7 points) Plot the term structure of interest rates. If the expectation hypothesis holds, what does the information in the term structure say about the course of future interest rates? What will the price and yields to maturity on the two and three-year zero coupon bonds be next year?

(c) (7 points) What should be the current price of a three-year maturity bond with a 12% coupon rate paid annually? If you purchased it at that price, what would your total expected rate of return be over the next year (coupon plus price change)?

(d) (5 points) What is the liquidity preference theory and how is it different from the expectations hypothesis? Briefly explain.

<u>Question 4 (25 points)</u>

401.com's stock is trading at $100 per share. The stock price will either go up or go down by 25% in each of the next two years. The annual interest rate is 5%.

a) (5 points) Graph the tree diagram showing the current and future possible values of the stock price.

b) (10 points) Determine the price of a two-year European call option on the 401.com stock with a strike price of $X = \$110$.

c) (5 points) If the annual interest rate increases to 7%, explain, without redoing your calculations, whether the price of the two-year European call option will increase or decrease.

d) (5 points) What is the price of a two–year European put option on the 401.com stock with a strike price of X = $110?

<u>Question 5 (20 points)</u>

Joseph Jones, a manager at Computer Science, Inc. (CSI), received 1,000 shares of company stock as part of his compensation package. The stock currently sells at $40 at share. Joseph would like to defer selling the stock until the next tax year. In January, however, he will need to sell all his holdings to provide for a down payment on his new house. Joseph is worried about the price risk involved in keeping his shares. At current prices, he would receive $40,000 for the stock. If the value of his stock holdings falls below $35,000, his ability to come up with the necessary down payment would be jeopardized. On the other hand, if the stock value rises to $45,000, he would be able to maintain a small cash reserve even after making the down payment. Joseph considers three investment strategies:

(a) Strategy A is to write January call options on the CSI shares with strike price $45. These calls are currently selling for $3 each.

(b) Strategy B is to buy January put options on CSI with strike price $35. These options also sell for $3 each.

(c) Strategy C is to establish a zero-cost collar by writing the January calls and buying the January puts.

Evaluate each of these strategies with respect to Joseph's investment goals. Calculate and draw the profit function for each strategy. What are the advantages and disadvantages of each? Which would you recommend? Explain your reasoning in detail.

Question 6 (20 points)

Two futures contracts are traded on a financial asset: a three-month contract with price of \$120 and a six-month contract with price of \$122. There are no dividends on the financial asset and assume that the risk free rate is fixed for over six month period.

(a) (7 points) What is the current spot price of the underlying asset?

(b) (7 points) Suppose that the three-month futures contract is now trading at a price of \$119.5. Does this imply an arbitrage opportunity? How would you take advantage of this opportunity? Outline your strategy.

(c) (6 points) Suppose that the financial asset now pays a dividend of 2%. Without redoing the calculations, do you think that the six-month contract will still have a higher price than the three-month contract? Explain your reasoning.

Question 7 (15 points)

Describe in detail the differences as well as list the advantages and disadvantages of using the binomial tree versus the Black Scholes approach to price options. What are some of the assumptions underlying these two pricing methods that we discussed in class that are not so realistic?