INSTRUCTIONS TO CANDIDATES

1. This 95 point examination consists of 49 essay questions. The number of points for each full question or part of a question is indicated at the beginning of the question or part. Answer these questions on the lined sheets provided in your Examination Envelope. Use **dark** pencil or ink. Do not use other colors.

Write your Candidate ID number and the examination number, 8, at the top of each answer sheet. Your name, or any other identifying mark, must not appear.

Do not answer more than one question on a single sheet of paper. **Write on only the lined side of the paper**, and be careful to give the number of the question you are answering on each sheet.

The answer should be concise and confined to the question as posed. **When a list of a specific size is requested, do not offer more items in your list than the number requested.** For example, if you are requested to list three items, only the first three responses will be graded.

**In order to receive full credit or to maximize partial credit on mathematical and computational questions, you must clearly outline your approach in either verbal or mathematical form, showing calculations where necessary.** Also, you must clearly **specify any additional assumptions you have made to answer the question.**

2. Attached to the examination, after question 49, is a table of the Normal Distribution.

3. Do all problems until you reach the last page of the examination where "END OF EXAMINATION" is marked.

4. Your Examination Envelope is pre-labeled with your Candidate ID number, name, exam number, and test center. **Do not remove this label.** Keep a record of your Candidate ID number for future inquiries regarding this exam.

5. At the beginning of the examination, check through the exam booklet for any missing or defective pages. The supervisor has additional exams for those candidates who have defective exam booklets.

**CONTINUE TO NEXT PAGE OF INSTRUCTIONS**

©2003 Casualty Actuarial Society
6. Candidates must remain in the examination center until two hours after the start of the examination. You may leave the examination room to use the restroom with permission from the supervisor. To avoid excessive noise during the end of the examination, candidates may not leave the exam room during the last fifteen minutes of the examination.

7. At the end of the examination, place all answer sheets in the Examination Envelope. Please insert your answer pages in your envelope in question number order. Insert a numbered page for each question, even if you have not attempted to answer that question. BEFORE YOU TURN THE EXAMINATION ENVELOPE IN TO THE SUPERVISOR, BE SURE TO SIGN IT IN THE SPACE PROVIDED ABOVE THE CUT-OUT WINDOW.

Anything written in the examination booklet will not be graded. Only the answer sheets will be graded.

8. If you have brought a self-addressed, stamped envelope, you may put the examination booklet and scrap paper inside and submit it separately to the supervisor. It will be mailed to you. (Do not put the self-addressed stamped envelope inside the Examination Envelope.)

If you do not have a self-addressed, stamped envelope, please place the examination booklet in the Examination Envelope and seal the envelope. You may not take it with you. Do not put scrap paper in the Examination Envelope. The supervisor will collect your scrap paper.

Candidates may obtain a copy of the examination by contacting the CAS Office.

All extra answer sheets, scrap paper, etc., must be returned to the supervisor for disposal.

9. Candidates must not give or receive assistance of any kind during the examination. Any cheating, any attempt to cheat, assisting others to cheat, or participating therein, or other improper conduct will result in the Casualty Actuarial Society disqualifying the candidate's paper, and such other disciplinary action as may be deemed appropriate within the guidelines of the CAS Policy on Examination Discipline.

10. An examination survey and postage-paid reply envelope are included with the examination. No postage is necessary for surveys mailed within the United States. Candidates mailing the survey outside the United States should use the courtesy reply envelope distributed by your exam supervisor. Please complete the survey and leave it with the examination supervisor, or take the survey and envelope with you when leaving the examination center. Please submit the survey to the CAS Office by May 27, 2003. Please do not enclose the survey in the Examination Envelope.

END OF INSTRUCTIONS
EXAM 8, SPRING 2003

1. (1 point)

Two of the important characteristics of common stock as an investment are residual claim and limited liability.

Describe these two characteristics.

2. (1 point)

Given a $5,000 par value T-bill with a market price of $4,900 and a maturity of one-half year, calculate:

a. (0.5 points)

Bank discount yield

b. (0.5 points)

Bond equivalent yield

Show all work.
EXAM 8, SPRING 2003

3. (1.5 points)

The table below summarizes the probability distribution of potential returns for an investment of $50,000.

<table>
<thead>
<tr>
<th>Investment</th>
<th>Probability</th>
<th>Expected Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equities</td>
<td>0.1</td>
<td>+ $20,000</td>
</tr>
<tr>
<td></td>
<td>0.7</td>
<td>+ $10,000</td>
</tr>
<tr>
<td></td>
<td>0.2</td>
<td>- $10,000</td>
</tr>
<tr>
<td>T-bills</td>
<td>1.0</td>
<td>+ $2,500</td>
</tr>
</tbody>
</table>

Based on the table, calculate the following:

a. (0.5 points)

The expected rate of return of investing the full $50,000 in equities.

b. (0.5 points)

The measure of risk (as measured by the standard deviation of the rate of return) of investing fully in equities.

c. (0.5 points)

The risk premium, in dollars, of fully investing in equities versus fully investing in T-bills.

Show all work.
4. (1.0 point)

Answer the questions below based on the following information about a risky portfolio that you manage, and a risk-free asset:

- \( E(r_p) = 11\% \)
- \( \sigma_p = 15\% \)
- \( r_f = 5\% \)

a. (0.5 points)

Client A wants to invest a proportion of her total investment budget in your risky fund to provide an expected rate of return on her overall or complete portfolio equal to 8%.

What will be the standard deviation of the rate of return on her portfolio?

b. (0.5 points)

Client B wants the highest return possible subject to the constraint that you limit his standard deviation to be no more than 12%.

Which client is more risk averse? Explain why.

Show all work.
EXAM 8, SPRING 2003

5. (4 points)

The universe of available securities includes two risky stock funds, X and Y, and T-Bills. The expected returns and standard deviations for the universe are as follows:

<table>
<thead>
<tr>
<th>Asset</th>
<th>Expected Return</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<td>Y</td>
<td>20%</td>
<td>40%</td>
</tr>
<tr>
<td>T-Bills</td>
<td>5%</td>
<td>0%</td>
</tr>
</tbody>
</table>

The correlation coefficient between funds X and Y is −0.3.

a. (2.5 points)

Calculate the expected return and standard deviation for the optimal risky portfolio, P.

b. (0.50 points)

Find the slope of the capital allocation line, CAL, supported by T-Bills and optimal portfolio P, from above.

c. (1 point)

If an investor has a coefficient of risk aversion, A, equal to 4, what proportion will he or she invest in fund X, fund Y, and in T-Bills?

Show all work.
EXAM 8, SPRING 2003

6. (3 points)

A newly issued bond has maturity of 3 years and pays a 7% coupon rate (with annual coupon payments). For the questions below, assume that the bond was purchased at a par value of $100.

a. (1.5 point)

Calculate the modified duration and convexity of the bond.

b. (0.5 points)

Given that the bond’s yield-to-maturity immediately increases from 7% to 8% with the maturity still 3 years, what is the percentage change in the price of the bond?

c. (1 point)

Using the duration rule, including convexity, what is the percentage change in the bond price?

Show all work.

7. (1.5 points)

Identify which one of the following portfolios cannot lie on the efficient frontier and demonstrate why.

<table>
<thead>
<tr>
<th>Portfolio</th>
<th>Expected Return %</th>
<th>Standard Deviation %</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>15</td>
<td>36</td>
</tr>
<tr>
<td>X</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Y</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Z</td>
<td>9</td>
<td>21</td>
</tr>
</tbody>
</table>

CONTINUED ON NEXT PAGE
8. (3 points)
   a. (1 point)
      Describe net worth immunization as a tool for shielding an investor's overall financial status from exposure to fluctuations in interest rate risk.
   
   b. (1 point)
      Describe two reasons why an asset manager will need to rebalance immunized portfolios.
   
   c. (1 point)
      Describe two problems with conventional immunization techniques.

9. (2.5 points)
   a. (0.5 points)
      Define an interest rate swap.
   
   b. (1 point)
      Assume that an intermediary is involved in an interest rate swap. Briefly describe the obligations of each of the three parties involved.
   
   c. (1 point)
      Cite and explain one example of how an interest rate swap could be used by a fixed-income portfolio manager to control risk or improve returns.
10. (1 point)

Given the following information, calculate the expected return of portfolio P, \( E(r_P) \):

- The value of portfolio P is made up of 60% of stock A and 40% of stock B
- Market Price of Risk = Market Risk Premium / Market Variance = 50%
- Expected Market Return, \( E(r_M) \), is 15%.
- The variance of the market portfolio, \( \sigma_m^2 \), is 20%.
- The covariance of stock A with the market, \( \text{cov}(r_A, r_M) \), is 25%.
- The covariance of stock B with the market, \( \text{cov}(r_B, r_M) \), is 10%.

Show all work.

11. (2 points)

You are given the following information:

- Risk-free rate of return, \( r_f \), is 5%
- Expected Market Return, \( E(r_M) \), is 10%
- Stock A has a \( \beta \) of 1.2
- Investor expects a return on A, \( E(r_A) \), of 12%

a. (0.5 points)

Calculate alpha, \( \alpha \).

b. (1.5 points)

Graph the security market line (SML) and label the following items:

- x-axis
- y-axis
- coordinate of the risk-free asset
- coordinate of Stock A
- coordinate of the market portfolio, M
- \( \alpha \)

Show all work.
12. (1.5 points)

Assume that the index model for stocks A and B is estimated with the following results:

- $R_A = 1.0\% + 0.95R_M + \epsilon_A$
- $R_B = -2.0\% + 1.2R_M + \epsilon_B$
- $\sigma_M = 25\%$
- $\sigma(\epsilon_A) = 32\%$
- $\sigma(\epsilon_B) = 8\%$

a. (1 point)

Find the standard deviation of each stock.

b. (0.5 points)

Find the covariance between stocks A and B.

Show all work.
EXAM 8, SPRING 2003

13. (1.5 point)

You are given the following information about a two-factor APT model:

<table>
<thead>
<tr>
<th>Factor Portfolio</th>
<th>Expected Return</th>
<th>$\beta_{11}$</th>
<th>$\beta_{12}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10%</td>
<td>1.0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>15%</td>
<td>0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

The risk-free rate, $r_f$, is 5%

a. (0.5 points)

Calculate the expected return for a portfolio A, $E(r_A)$, assuming $\beta_{A1} = 0.5$ and $\beta_{A2} = 0.8$

b. (1 point)

Describe the action of an investor who believed $E(r_A)$ was really 14%. Include the weights of the assets the investor would use to construct a portfolio that would take advantage of a potentially risk-less arbitrage opportunity.

Show all work.

14. (1.5 points)

Briefly describe what is meant by a passive investment strategy and why proponents of the Efficient Market Hypothesis believe that passive investment strategies are superior to active investment strategies.

15. (1.5 points)

Fundamental analysis has revealed a number of so-called anomalies, that is, evidence that seems inconsistent with the Efficient Market Hypothesis. Two such anomalies are the Small-Firm-in-January Effect and the Book-to-Market ratios.

Explain one of these two anomalies identified above and how it is inconsistent with the Efficient Market Hypothesis.

CONTINUED ON NEXT PAGE
16. (1.5 points)

In Investments, by Bodie, Kane, and Marcus, the authors discuss an article written by Mehra and Prescott regarding the Equity Premium Puzzle.

a. (0.5 points)

Describe the Equity Premium Puzzle.

b. (1 point)

Provide one explanation for the Equity Premium Puzzle.

17. (3 points)

An investor believes that the current price of a stock is not going to move significantly in the near future.

Describe two different trading strategies involving options that this investor might consider.

For each of the trading strategies be sure to include the following in your answer:

- The classes of options involved.
- The investor's position in each option.
- A fully labeled payout diagram.
18. (3 points)

A four-month European call option with a strike price of $60 is selling for $5. The underlying price of stock ABC is currently $61, and the risk-free rate is 12% per annum, compounded continuously.

a. (1 point)

Calculate the value of a four-month European put option with a strike price of $60.

b. (0.5 points)

If the put is currently selling for $2, describe the transactions that could be used to capitalize on the arbitrage opportunities that exist.

c. (0.75 point)

Calculate the present value of the profit that would be earned on a per share basis, if the strategy described in part b. was followed.

d. (0.75 points)

There are three scenarios as regards the relationship of the price of Stock ABC in four months and strike price, X:

- ABC > X,
- ABC = X, and
- ABC < X.

For each scenario, describe the final transactions that bring the deal to closure.

Show all work.

CONTINUED ON NEXT PAGE
19. (1 point)

"How To Use The Holes In Black-Scholes" discusses some potential strategies that can be employed if one or more of the assumptions in the Black-Scholes formula were relaxed.

Consider the situation where the short-term interest rate is not constant. Assume that your expectation regarding interest rates is that they will rise to a level higher than the market expectation.

Describe how Black would suggest that you take advantage of this belief.

20. (3 points)

You are given the following information:

- A bond has a three-year maturity with a par value of $100 and 6% annual coupons.
- The bond is callable at the end of the first and second years. The call price is $101.
- Current interest rate volatility is 15%.
- Using the notation in the Fabozzi text, r_0=3%, r_1=4%, and r_2=4.75%.
- The theoretical price of the bond is $103.02.

a. (2.5 points)

If the option-adjusted spread is 25 basis points, calculate the bond’s market value.

b. (0.5 points)

Assume the interest rate volatility increases to 30%.

Describe the direction of the change in the value of the bond and of the option-adjusted spread.

Show all work.
EXAM 8, SPRING 2003

21. (1 point)

Briefly describe the unique features of each of the following bonds.

a. (0.5 points)
   Reverse Floaters

b. (0.5 points)
   Treasury Inflation Protection Securities (TIPS)

22. (2 points)

A 10-year maturity, 9.0% coupon bond paying coupons semiannually is selling at a yield-to-maturity of 8.0%.

a. (0.5 points)
   Calculate the current yield.

b. (0.75 points)
   Assume that you sell the bond in one year at a yield-to-maturity of 7.0%.
   Calculate the holding period return.

c. (0.75 points)
   Your tax rate on interest income is 35% and your tax rate on capital gains is 20%.
   Calculate the after-tax holding period return.

Show all work.

CONTINUED ON NEXT PAGE
23. (1 point)

A bond with a coupon rate of 7% makes semiannual coupon payments on January 15 and July 15 of each year. The Wall Street Journal reports the ask price for the bond on January 30 at 100:02.

Calculate the invoice price of the bond on January 30 (assume a coupon period has 182 days).

Show all work.

24. (2 points)

Briefly discuss two different bond indenture provisions and how they protect the rights of the bondholders.
EXAM 8, SPRING 2003

25. (1.5 points)

The following is a list of prices for zero-coupon bonds with par value of $1,000 and varying maturities.

<table>
<thead>
<tr>
<th>Maturity (Years)</th>
<th>Price of Bond ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>943.40</td>
</tr>
<tr>
<td>2</td>
<td>898.47</td>
</tr>
<tr>
<td>3</td>
<td>847.62</td>
</tr>
<tr>
<td>4</td>
<td>792.16</td>
</tr>
</tbody>
</table>

a. (0.75 points)

Calculate the third year forward rate.

b. (0.75 points)

Calculate the yield-to-maturity for the three-year bond.

Show all work.

26. (2 points)

A one-year maturity Treasury bond with a semiannual coupon rate of 10% sells for $102.875.

A Treasury bill with one-year maturity sells for $93.35.

Derive the current six-month short rate and the forward rate for the following six-month period.

Show all work.

CONTINUED ON NEXT PAGE
27. (4.5 points)

The yield-to-maturity on one-year zero-coupon bonds is currently 7%.

The yield-to-maturity on two-year zero-coupon bonds is currently 8%.

The Treasury plans to issue a two-year maturity coupon bond, paying coupons once per year with a coupon rate of 9%. The face value of the bond is $100.

a. (1 point)

Determine the price for the two-year coupon bond.

b. (1.5 points)

Calculate the two-year coupon bond’s yield-to-maturity.

c. (1 point)

If the expectations theory of the yield curve is correct, what is the market expectation of the price that the bond will sell for in one year?

d. (1 point)

Recalculate the answer to part c. if you believe in the liquidity preference theory and you believe that the liquidity premium is 1%.

Show all work.
28. (1.5 points)

Describe how the following mortgage instruments differ from a fixed-rate level payment mortgage.

Include whether the initial monthly payment for each is below, equal to, or above the initial monthly payment of a fixed-rate level payment mortgage with an identical contract rate.

a. (0.5 points)

   Growing Equity Mortgage

b. (0.5 points)

   Graduated Payment Mortgage

c. (0.5 points)

   Tiered-Payment Mortgage

29. (1 point)

In “Measuring Corporate Bond Mortality and Performance,” Altman states that “despite somewhat higher than expected cumulative mortality rates over long holding periods, return spreads on all corporate bonds are positive, with impressive results for the high yield, low grade categories.”

Give two possible explanations for the above statement.
30. (1.5 points)

A stock index with a continuous dividend yield of 3% per year is currently valued at $800.

The futures price for a contract on the index deliverable in six months is $825.

The risk-free interest rate is 8% per year with continuous compounding.

a. (1 point)

Describe the index arbitrage strategy that could be used to make a riskless profit.

b. (0.5 points)

Calculate the profit per share that would be earned after six months by employing this strategy.

Show all work.
EXAM 8, SPRING 2003

31. (2 points)

A stock is expected to pay a dividend of $2 per share in one month and again in four months.

The stock price is $120 and the annual risk-free rate of interest is 5% with continuous compounding for all maturities.

An investor has just taken a short position in a six-month forward contract on the stock.

a. (0.75 points)

Calculate the forward price.

b. (0.25 points)

What is the initial value of the forward contract?

c. (1 point)

Three months later, the price of the stock is $115 and the risk-free rate of interest is still 5% per annum.

Calculate the value of the short position.

Show all work.
32. (1.5 points)

A company has a $5 million portfolio with a beta of 1.3.

It would like to use futures contracts on the S&P 500 to hedge its risk.

The index is currently at 815 and each contract is for delivery of $500 times the index.

a. (0.5 points)

Determine the number of futures contracts required to minimize the company’s risk.

b. (0.5 points)

How many contracts should the company short in order to lower the beta of its portfolio to 0.9?

c. (0.5 points)

What are two reasons why a company would want to use futures contracts to hedge its risk instead of selling the portfolio and investing the proceeds in Treasury bills?

Show all work.
33. (3 points)

You are given the following information on a $100 face value Treasury bond futures contract:

- The cheapest-to-deliver bond will be a 13% coupon bond with a conversion factor of 1.450.
- Delivery will take place in 250 days.
- Coupons are payable semianually on the bond.
- The last coupon date was 40 days ago.
- The next two coupon dates are in 142 days and 325 days.
- The term structure is flat and the rate of interest with continuous compounding is 11%.
- The current quoted bond price is $115.

Calculate the quoted futures price of the contract.

Show all work.

34. (3 points)

Companies X and Y have been offered the following rates per annum on a $10 million five-year loan:

<table>
<thead>
<tr>
<th></th>
<th>Fixed rate</th>
<th>Floating rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company X</td>
<td>10.0%</td>
<td>LIBOR + 0.2%</td>
</tr>
<tr>
<td>Company Y</td>
<td>11.0%</td>
<td>LIBOR + 0.6%</td>
</tr>
</tbody>
</table>

Company X requires a floating-rate loan; company Y requires a fixed-rate loan.

Acting as the intermediary, design a swap that will net the bank 0.04% per annum and that will appear equally attractive to both companies.

Diagram and explain your answer.
An $80 million interest rate swap has a remaining life of 15 months.

Under the terms of the swap, six-month LIBOR is exchanged for 10% per annum (compounded semiannually).

LIBOR rates with continuous compounding have been the same for the past 3 months and are shown by maturity below.

<table>
<thead>
<tr>
<th>Maturity</th>
<th>Annual LIBOR Rate (Continuous Compounding)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 months</td>
<td>8.00%</td>
</tr>
<tr>
<td>6 months</td>
<td>8.25%</td>
</tr>
<tr>
<td>9 months</td>
<td>8.50%</td>
</tr>
<tr>
<td>12 months</td>
<td>8.75%</td>
</tr>
<tr>
<td>15 months</td>
<td>9.00%</td>
</tr>
</tbody>
</table>

Calculate the current value of the swap to the party paying floating rates.

Show all work.
36. (2.5 points)

A stock price is currently $40.

It is known that at the end of one month the stock's price will be either $42 or $38.

The risk-free interest rate is 8% per annum with continuous compounding.

a. (1 point)

Determine the value of a one-month European call option with a strike price of $39.

b. (1.5 points)

Assume that the expected return on the stock is 10% as opposed to the risk-free rate.

What is the correct discount rate to be applied to the payoff in the real world?

Show all work.
37. (2 points)

Suppose that a Portfolio, P is worth $80 million and the S&P 500 Index is at 1000.

a. (1 point)

The value of the portfolio mirrors the value of the Index, and each option contract is for $100 times the Index. What type of options and how many of these options should be purchased to provide protection against the value of the portfolio falling below $72 million in one year?

b. (1 point)

Using the Portfolio P and assuming the following:

- The portfolio now has a beta of 2.0,
- The risk-free interest rate is 5% per annum, and
- The dividend yield on both the portfolio and the Index is 3% per annum.

What type of options and how many of these options should be purchased to provide protection against the value of the portfolio falling below $72 million in one year?

Show all work.

38. (2 points)

Calculate the value of an eight-month European put option on a currency with a strike price of 0.50.

- The current exchange rate is 0.52,
- The volatility of the exchange rate is 12%,
- The domestic risk-free interest rate is 4% per annum, and
- \( (r - r_d) = 4\% \) per annum.

Show all work.
EXAM 8, SPRING 2003

39. (3 points)

The current price of a stock is $50.

The stock value either increases by 6% or decreases by 5% every six months.

The risk-free rate is 3% per annum with continuous compounding.

Determine the value of a one-year European call option with a strike price of $52.

Show all work.

40. (1.5 points)

Recently, a new way for U.S. investors to invest abroad has appeared and is called World Equity Benchmark Shares, or WEBS.

Describe this instrument including where WEBS are traded, how they are managed, and why investing in WEBS can enhance a U.S. portfolio.

41. (1 point)

According to Hull, Options, Futures, and Other Derivatives most traders use sophisticated hedging schemes that involve calculating delta, theta, gamma, and vega.

Briefly describe each of these four terms.
42. (1 point)

Two years ago a colleague set up a static-hedging scheme by creating a delta-neutral portfolio consisting of options on a stock and a position in the stock.

Describe the flaw in this investing approach that could cause a large loss.

43. (1 point)

You are about to sell a six-month European call option contract on 100 shares of a non-dividend-paying stock at strike price of $101 per share. The current price of the stock is $100 per share.

a. (0.5 points)

If the initial value of delta is 0.50, what action should be taken at the outset of this contract to make your position delta neutral?

b. (0.5 points)

After one week, the price falls to $99 per share, and the value of delta declines to 0.44. What action should be taken at this time to rebalance your delta-hedged position?

Show all work.
44. (3 points)

a. (2 points)

Draw graphs showing two portfolios which have the same Value at Risk (VaR) but which have very different levels of actual risk. Identify which portfolio is riskier and explain why.

b. (1 point)

Identify and briefly describe the alternative measure suggested in Options, Futures, and Other Derivatives, by Hull which deals with the problem of two portfolios having identical Values at Risk but very different levels of actual risk.

45. (2 points)

Culp, Miller, and Neves, in "Value at Risk: Uses and Abuses," discuss four great derivatives disasters in the first half of the 1990’s.

Identify and briefly discuss the investment(s) and situation that led to one of these four disasters. In your discussion, include how Value at Risk measures may or may not have helped avoid the disaster.
46. (1 point)

It has been four years since Gorvett’s “Insurance Securitization: The Development of a New Asset Class” appeared in the CAS Discussion Paper Program on Securitization of Risk. While some insurance securitization has occurred, the interest has not developed into widespread utilization.

Based on the paper briefly explain two reasons why utilization may not have been more widespread.

47. (1.5 points)

Stulz, in “Rethinking Risk Management,” identifies three major costs associated with higher variability of cash flow and the firm’s operating value.

Identify one of these costs and discuss how risk management can reduce the cost.
48. (4 points)

The following information pertains to a corporation:

- Expected dividends per share (as forecasted by Value Line Inc):

<table>
<thead>
<tr>
<th>Year Dividend is Paid</th>
<th>Dividend per share</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>$0.170</td>
</tr>
<tr>
<td>2004</td>
<td>$0.183</td>
</tr>
<tr>
<td>2005</td>
<td>$0.197</td>
</tr>
<tr>
<td>2006</td>
<td>$0.210</td>
</tr>
</tbody>
</table>

- Dividend payout ratio as forecasted by Value Line Inc from 2006 onward = 0.12

- Return on Equity as forecasted by Value Line Inc = 15.0%

- Beta as forecasted by Value Line Inc = 1.25

- Dividends are paid annually on June 30.

It is June 30, 2002 and you are charged with estimating this corporation's stock price in 2006 and its intrinsic value today. You assume that earnings and dividend growth rates for this corporation will level off after June 30, 2006.

The risk free rate on June 30, 2002 is 6.0%.

The Market risk premium is being forecasted at 6.5%.

  a. (3 points).

  Calculate the price of this corporation's stock on June 30, 2006.

  b. (1 point)

  Calculate the intrinsic value of this corporation's stock today.

  Show all work.

49. (1 point)

Based on the Casualty Actuarial Society "Statement of Principals Regarding Property and Casualty Valuations," list and describe the four valuation variables that are involved in the determination of the values of all assets, obligations, and considerations.

END OF EXAMINATION
The Normal Distribution

\[ \Pr(X \leq x) = \Phi(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} e^{-\frac{t^2}{2}} \, dt \]

<table>
<thead>
<tr>
<th>x</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>.5000</td>
<td>.5040</td>
<td>.5080</td>
<td>.5120</td>
<td>.5160</td>
<td>.5199</td>
<td>.5239</td>
<td>.5279</td>
<td>.5319</td>
<td>.5359</td>
</tr>
<tr>
<td>0.1</td>
<td>.5398</td>
<td>.5438</td>
<td>.5478</td>
<td>.5517</td>
<td>.5557</td>
<td>.5596</td>
<td>.5636</td>
<td>.5675</td>
<td>.5714</td>
<td>.5753</td>
</tr>
<tr>
<td>0.2</td>
<td>.5793</td>
<td>.5832</td>
<td>.5871</td>
<td>.5910</td>
<td>.5948</td>
<td>.5987</td>
<td>.6026</td>
<td>.6064</td>
<td>.6103</td>
<td>.6141</td>
</tr>
<tr>
<td>0.3</td>
<td>.6179</td>
<td>.6217</td>
<td>.6255</td>
<td>.6293</td>
<td>.6331</td>
<td>.6368</td>
<td>.6406</td>
<td>.6443</td>
<td>.6480</td>
<td>.6517</td>
</tr>
<tr>
<td>0.4</td>
<td>.6554</td>
<td>.6591</td>
<td>.6628</td>
<td>.6664</td>
<td>.6700</td>
<td>.6736</td>
<td>.6772</td>
<td>.6808</td>
<td>.6844</td>
<td>.6879</td>
</tr>
<tr>
<td>0.5</td>
<td>.6915</td>
<td>.6950</td>
<td>.6985</td>
<td>.7019</td>
<td>.7054</td>
<td>.7088</td>
<td>.7123</td>
<td>.7157</td>
<td>.7190</td>
<td>.7224</td>
</tr>
<tr>
<td>0.6</td>
<td>.7257</td>
<td>.7291</td>
<td>.7324</td>
<td>.7357</td>
<td>.7389</td>
<td>.7422</td>
<td>.7454</td>
<td>.7486</td>
<td>.7517</td>
<td>.7549</td>
</tr>
<tr>
<td>0.7</td>
<td>.7580</td>
<td>.7611</td>
<td>.7642</td>
<td>.7673</td>
<td>.7704</td>
<td>.7734</td>
<td>.7764</td>
<td>.7794</td>
<td>.7823</td>
<td>.7852</td>
</tr>
<tr>
<td>0.8</td>
<td>.7881</td>
<td>.7910</td>
<td>.7939</td>
<td>.7967</td>
<td>.7995</td>
<td>.8023</td>
<td>.8051</td>
<td>.8079</td>
<td>.8106</td>
<td>.8133</td>
</tr>
<tr>
<td>0.9</td>
<td>.8159</td>
<td>.8186</td>
<td>.8212</td>
<td>.8238</td>
<td>.8264</td>
<td>.8289</td>
<td>.8315</td>
<td>.8340</td>
<td>.8365</td>
<td>.8389</td>
</tr>
<tr>
<td>1.0</td>
<td>.8413</td>
<td>.8438</td>
<td>.8461</td>
<td>.8485</td>
<td>.8508</td>
<td>.8531</td>
<td>.8554</td>
<td>.8577</td>
<td>.8599</td>
<td>.8621</td>
</tr>
<tr>
<td>1.1</td>
<td>.8643</td>
<td>.8665</td>
<td>.8686</td>
<td>.8708</td>
<td>.8729</td>
<td>.8749</td>
<td>.8770</td>
<td>.8790</td>
<td>.8810</td>
<td>.8830</td>
</tr>
<tr>
<td>1.2</td>
<td>.8849</td>
<td>.8869</td>
<td>.8888</td>
<td>.8907</td>
<td>.8925</td>
<td>.8944</td>
<td>.8962</td>
<td>.8980</td>
<td>.8997</td>
<td>.9015</td>
</tr>
<tr>
<td>1.3</td>
<td>.9032</td>
<td>.9049</td>
<td>.9066</td>
<td>.9082</td>
<td>.9099</td>
<td>.9115</td>
<td>.9131</td>
<td>.9147</td>
<td>.9162</td>
<td>.9177</td>
</tr>
<tr>
<td>1.4</td>
<td>.9192</td>
<td>.9207</td>
<td>.9222</td>
<td>.9236</td>
<td>.9251</td>
<td>.9265</td>
<td>.9279</td>
<td>.9292</td>
<td>.9306</td>
<td>.9319</td>
</tr>
<tr>
<td>1.5</td>
<td>.9332</td>
<td>.9345</td>
<td>.9357</td>
<td>.9370</td>
<td>.9382</td>
<td>.9394</td>
<td>.9406</td>
<td>.9418</td>
<td>.9429</td>
<td>.9441</td>
</tr>
<tr>
<td>1.6</td>
<td>.9452</td>
<td>.9463</td>
<td>.9474</td>
<td>.9484</td>
<td>.9495</td>
<td>.9505</td>
<td>.9515</td>
<td>.9525</td>
<td>.9535</td>
<td>.9545</td>
</tr>
<tr>
<td>1.7</td>
<td>.9554</td>
<td>.9564</td>
<td>.9573</td>
<td>.9582</td>
<td>.9591</td>
<td>.9599</td>
<td>.9608</td>
<td>.9616</td>
<td>.9625</td>
<td>.9633</td>
</tr>
<tr>
<td>1.8</td>
<td>.9641</td>
<td>.9649</td>
<td>.9656</td>
<td>.9664</td>
<td>.9671</td>
<td>.9678</td>
<td>.9686</td>
<td>.9693</td>
<td>.9699</td>
<td>.9706</td>
</tr>
<tr>
<td>1.9</td>
<td>.9713</td>
<td>.9719</td>
<td>.9726</td>
<td>.9732</td>
<td>.9738</td>
<td>.9744</td>
<td>.9750</td>
<td>.9756</td>
<td>.9761</td>
<td>.9767</td>
</tr>
<tr>
<td>2.0</td>
<td>.9773</td>
<td>.9778</td>
<td>.9783</td>
<td>.9788</td>
<td>.9793</td>
<td>.9798</td>
<td>.9803</td>
<td>.9808</td>
<td>.9812</td>
<td>.9817</td>
</tr>
<tr>
<td>2.1</td>
<td>.9821</td>
<td>.9826</td>
<td>.9830</td>
<td>.9834</td>
<td>.9838</td>
<td>.9842</td>
<td>.9846</td>
<td>.9850</td>
<td>.9854</td>
<td>.9857</td>
</tr>
<tr>
<td>2.2</td>
<td>.9861</td>
<td>.9864</td>
<td>.9868</td>
<td>.9871</td>
<td>.9875</td>
<td>.9878</td>
<td>.9881</td>
<td>.9884</td>
<td>.9887</td>
<td>.9890</td>
</tr>
<tr>
<td>2.3</td>
<td>.9893</td>
<td>.9896</td>
<td>.9898</td>
<td>.9901</td>
<td>.9904</td>
<td>.9906</td>
<td>.9909</td>
<td>.9911</td>
<td>.9913</td>
<td>.9916</td>
</tr>
<tr>
<td>2.4</td>
<td>.9918</td>
<td>.9920</td>
<td>.9922</td>
<td>.9925</td>
<td>.9927</td>
<td>.9929</td>
<td>.9931</td>
<td>.9932</td>
<td>.9934</td>
<td>.9936</td>
</tr>
<tr>
<td>2.5</td>
<td>.9938</td>
<td>.9940</td>
<td>.9941</td>
<td>.9943</td>
<td>.9945</td>
<td>.9946</td>
<td>.9948</td>
<td>.9949</td>
<td>.9951</td>
<td>.9952</td>
</tr>
<tr>
<td>2.6</td>
<td>.9953</td>
<td>.9955</td>
<td>.9956</td>
<td>.9957</td>
<td>.9959</td>
<td>.9960</td>
<td>.9961</td>
<td>.9962</td>
<td>.9963</td>
<td>.9964</td>
</tr>
<tr>
<td>2.7</td>
<td>.9965</td>
<td>.9966</td>
<td>.9967</td>
<td>.9968</td>
<td>.9969</td>
<td>.9970</td>
<td>.9971</td>
<td>.9972</td>
<td>.9973</td>
<td>.9974</td>
</tr>
<tr>
<td>2.8</td>
<td>.9974</td>
<td>.9975</td>
<td>.9976</td>
<td>.9977</td>
<td>.9977</td>
<td>.9978</td>
<td>.9979</td>
<td>.9979</td>
<td>.9980</td>
<td>.9981</td>
</tr>
<tr>
<td>2.9</td>
<td>.9981</td>
<td>.9982</td>
<td>.9982</td>
<td>.9983</td>
<td>.9984</td>
<td>.9984</td>
<td>.9985</td>
<td>.9985</td>
<td>.9986</td>
<td>.9986</td>
</tr>
<tr>
<td>3.0</td>
<td>.9987</td>
<td>.9987</td>
<td>.9987</td>
<td>.9988</td>
<td>.9988</td>
<td>.9988</td>
<td>.9989</td>
<td>.9989</td>
<td>.9989</td>
<td>.9990</td>
</tr>
</tbody>
</table>
Sample Answers

Exam 8
Question 1

Residual Claim means that the holder of a common stock doesn’t receive anything from the company, until the company has paid all of its obligations to bondholders, preferred stockholders, and creditors. Common stockholders have no claim on company assets until these other obligations have been paid.

Limited Liability means that the common stockholders can only lose the amount invested in the stock. They have no other liability.

Exam 8
Question 2

a) Bank Discount Yield

\[ \text{BDY} = \frac{5000 - P}{5000} \times \frac{360}{n} = \frac{5000 - 4900}{5000} \times \frac{360}{182} = 3.96\% \]

b) Bond Equivalent Yield

\[ \text{BEY} = \frac{5000 - P}{P} \times \frac{365}{n} = \frac{5000 - 4900}{4900} \times \frac{365}{182} = 4.09\% \]
Exam 8
Question 3

a) \[ E(r) = \sum Pr(s) r(s) = \frac{.1(20,000) + .7(10,000) - .2(10,000)}{50,000} = .14 \text{ or } 14\% \]

b) \[ \text{Var}(r) = \sum Pr(s) \ (r(s) - E(r(s)))^2 = .1(.4 - .14)^2 + .7(.2 - .14)^2 - .2(-.2 - .14)^2 = .0324 \]

Standard Deviation = \sqrt{\text{Var}} = \sqrt{.0324} = .18

c) Risk Prem = Expected return from equities minus the expected return from T-Bills: \[ \frac{(.14 \times 50,000) - 2500}{50,000} = 4,500 \]

Exam 8
Question 4

a) \[ E(r) = 0.08 = W_E (0.11) + (1-W_E) (0.05) \]
\[ = 0.11 W_E + 0.05 - 0.05 W_E \]
\[ W_E = 0.5 \]
\[ O_p = 0.15 \times 0.5 = 0.075 \]

Client A is more risk averse because her standard deviation is 7.5% which is a lower volatility than client B is willing to accept (12%).
Exam 8
Question 5

a) \( E(r_P) = W_1 E(r_1) + W_2 E(r_2) \)
\[
\sigma_P^2 = W_1^2 \sigma_1^2 + W_2^2 \sigma_2^2 + 2W_1 W_2 \sigma_1 \sigma_2 \rho_{1,2}
\]

* First, need weights for the optimal risks portfolio

\[
W_D = \frac{(E(r_o) - r_f)\sigma_x^2 - (E(r_e) - r_f)(\text{cov}(r_o, r_e))}{(E(r_o) - r_f)\sigma_x^2 + (E(r_e) - r_f)\sigma_o^2 - (E(r_o) - r_f + E(r_e) - r_f)(\text{cov}(r_o, r_e))}
\]

\[
W_X = \frac{(.10 - .05)(.4)^2 - (.20 - .05)(.2)(.4)(-.3)}{(.10 - .05)(.4)^2 + (.20 - .05)(.2)^2 - (.1 - .05 + .20 - .05)(.4)(.2)(-.3)}
\]
\[W_X = \frac{(0.0116)}{(0.0188)} = 0.6170, \text{ so } W_Y = 1 - W_X = 1 - 0.6170 = 0.3830\]

\[
E(r_P) = .617 (.10) + .383(.2) = .1383
\]
\[
\sigma_P^2 = .617^2 (.2^2) + .383^2 (.4^2) + 2(.617)(.383)(.2)(.4)(-.3)
\]
\[= .02735\]
\[
\sigma_P = .1654
\]

b) \[
\frac{E(r_e) - r_f}{\sigma_e} = \frac{0.1383 - .05}{.1654} = 0.5339
\]
\[
y = \frac{E(r_e) - r_f}{(0.01)(4)(\sigma_e)} = \frac{13.83 - .05}{(0.01)(4)(16.54)^2} = .8069 \text{ Portion invested in risky portfolio}
\]

c) portfolio

\[
.8069 (.617) = .4979 \text{ invest in } X
\]
\[
.8069 (.383) = .3090 \text{ invest in } Y
\]
\[
1 - .8069 = .1931 \text{ invest in Tbills}
\]
\[\Sigma = 1.000\]
Exam 8
Question 6

a) 3 yr maturity at 7% cap (annual)
Par Value = 100 = Price
Modified Duration = \[ \frac{1}{100(1.07)} \times \left( \frac{7}{1.07^2} + \frac{2(7)}{1.07^2} + \frac{3(107)}{1.07^3} \right) \]
Coupons = .07(100) = 7
= 2.624
Convexity = \[ \frac{1}{100(1.07)^2} \times \left( \frac{1}{1.07} + \frac{2(3)(7)}{1.07^2} + \frac{3(4)(107)}{1.07^3} \right) \]
= 9.589

b) Use BA-35 calculation
N = 3
FU = 100
CPT & PV = 97.42
% = 8%
PMT = 7
% Change = 97.42/100 – 1 = -2.580%

c) \[ \frac{P}{P} = -2.624 (+.01) + (.5)(9.58944)(+.01^2) \]
\[ = -2.576% \]

Exam 8
Question 7

Portfolio Z cannot lie on the efficient frontier.
The efficient frontier is the set of potential portfolios that have the minimum standard deviation for any given return, and the maximum return for a given standard deviation. If there exists a portfolio that has a greater return for the same or lower standard deviation than a second portfolio, then the second portfolio cannot be on the efficient frontier. X has both a greater return and a lower standard deviation than Z. Therefore Z cannot be on the efficient frontier.
Exam 8
Question 8

a) In net worth immunization the duration of assets is set equal to the duration of liabilities. If rates increase, the decline in asset values is balanced by a decline in liabilities.

b) When interest rates change, the durations change. Asset and liability durations also can change with the passage of time.

c) I. If you have a liability that is to be paid over a long period of time it may be difficult to find an asset with a duration that high.
II. Duration works for small changes in interest rates. After a rate change, the portfolio will have to be rebalanced.

Exam 8
Question 9

a) An **Interest Rate Swap** is a deal whereby one exchanges a series of fixed interest rate payments for a series of floating interest rate payments or vise versa.

b) One party borrows money at a fixed rate, and pays the intermediary at a floating rate. The other party borrows money at a floating rate and pays the intermediary at a fixed rate. The intermediary receives the payments then pays fixed/floating rates to the appropriate party, and keeps a commission. The only risk to the intermediary is the default risk of one party.

c) A fixed income portfolio manager receives fixed scheduled interest payments. This leaves the value of the portfolio vulnerable to rises in interest rates. A fixed for floating swap will lower the risk of the portfolio.
a) **Interest Rate Swap** = an agreement to exchange interest on a predefined principle (not actually exchanged) at some time in the future, e.g., fixed-for floating.

b) **Intermediary** would receive payments from each party and pass some form of them along to the other. Of course in reality, the intermediary may not have an offsetting position. The intermediary is subject to default risk if either party defaults since he is still obligated to pay the other party. The two companies involved are obligated to the lender they borrowed from and to the intermediary. They pay interest to the intermediary and the lender and receive interest from the intermediary.

c) The fixed income portfolio manager may feel rates are going to be a risk. To “hedge” his portfolio and/or to take advantage of increased rates, he could enter into a fixed-for-floating interest rate swap. In this case, he will receive floating and pay fixed.
Exam 8
Question 10

\[ E(r_p = r_f + B [E(r_m) - r_f] \]

\[ Ba = \text{Cov}(r_a, r_m) = \frac{.25}{T^2_m} = 1.25 \]

\[ Bb = \text{Cov}(r_b, r_m) = \frac{.10}{T^2_m} = 0.5 \]

\[ Bp = .6(1.25) + .4(.5) = 0.95 \]

\[ E(r_m) - r_f = .50 \]

\[ .15 - r_f = .50 \]

\[ .2 \]

\[ r_f = .05 \]

\[ E(r_p) = .05 + .95 [.15 - .05] = 14.5\% \]
a) \( \alpha = \text{Actual Return} - \text{Expected Return} \)

\[
\text{Expected Return} = E(\ r \ ) = rf + \beta [ E(\text{rm}) - rf] \\
= .05 + 1.2 \times (.1 - .05) \\
= .11
\]

\( \alpha = .12 - .11 = .01 \)

b) \( E(\ r \ ) \) SML

\[
A(1.2, .12) \quad \alpha = .01
\]

\[
M(1, .1)
\]

\( rf \) (0, .05)
Exam 8
Question 12

a) $\sigma_i^2 = \beta_i^2 \sigma_m^2 + \sigma^2(e_i)$ for single index model

$\sigma_a^2 = (0.95)^2 (0.25)^2 + (0.32)^2$ by substitution

$\sigma_a^2 = 0.1588$

$\sigma_a = 0.3985$

$\sigma_b^2 = (1.2)^2 (0.25)^2 + (0.08)^2$

$\sigma_b^2 = 0.0964$

$\sigma_b = 0.3105$

b) $\text{Cov}[R_A, R_B] = \beta_{A} \beta_{B} \sigma_m^2$ for single index model

$\text{Cov}[R_A, R_B] = (0.95) (1.2) (0.25)^2$

$\text{Cov}[R_A, R_B] = 0.07125$

Exam 8
Question 13

a) $E(R_A) = R_F + B_{A1}(E(r_1) - r_F) + B_{A2}(E(r_2) - r_F)$

$= 5\% + 0.5(10\% - 5\%) + 0.8(15\% - 5\%)$

$= 15.5\%$

b) He would sell Portfolio A and buy the Portfolio B made up of the Factor Portfolios as follows:

Portfolio B = 0.5 of Factor Portfolio 1
= 0.8 of Factor portfolio 2
= - 0.3 of the risk free asset, i.e. borrow at the risk free rate

He would get an expected return of 15 – 5% on Portfolio B, with the same risk as Portfolio A, and thus making a 1.5% risk free return up front.
a) A passive investment strategy simply seeks to replicate a market index by holding a well-diversified portfolio of stocks. There is no attempt to actively look for mispricing.

b) Proponents of the EMH believe that stock prices reflect all available information. They point out that active strategies do no better with respect to performance than a passive strategy. Passive strategies are able to save the costs of actively managing a portfolio as well as gain the benefit from the work of active managers.

Exam 8
Question 14

a) Passive Management is the investment in a portfolio that mirrors a market index without searching mispriced securities. This strategy does not try to have more return than commensurate with risk.

b) Under Efficient Market Hypothesis, all information is included in a stock price. So all stocks are priced correctly and there are no mispriced securities. So passive investment is superior because there is no need to find mispriced securities because they don’t exist. So it is less costly to “follow” a market portfolio than to try to find mispriced securities at a high cost of research. There is no additional gain to do active management.
The Small-Firm-In-January anomaly, portfolios of small cap stocks that tend to out perform portfolios of large cap stocks, even after the differences in investment performance are adjusted for differences in risk. This effect is most pronounced in January. One explanation is investors sell small cap stocks in December to realize the tax benefits (e.g. capital losses) and then repurchase the stocks in January, temporarily increasing demand and return.

This is inconsistent with the EMH because if investors are aware of this effect, then they would attempt to exploit it by buying stocks in December, pushing up the price and eliminating the January profit opportunity.

The Book-to-Market ratio anomaly shows that firms with high ratios of book value to market value have higher rates of return than would be expected given their level of risk.

This is inconsistent with EMH because both book and market value of a firm are publicly available information. EMH believes that all such information is already contained in firms’ stock prices.

a) Results over the past 50 years suggest that securities are averaging returns that are much higher than expected given the level of risk.

b) Survivorship Bias: the returns used to show this result were based on US markets. If you include markets from around the world which have may not been around as long or may no longer be in existence, the risk premium exhibited is not as large.

Realized vs. expected returns
Expected returns = Dividend yield + Dividend growth
Realized returns = Dividend yield + Capital gains

- It seems that in the past year, the capital gains have far exceeded the dividend growth, and that is why stock returns have been larger than expected.
- We don’t expect to see this in future years.
Exam 8
Question 17

1. A Butterfly Spread

Payment Diagram:

- Purchase 2 calls, one at strike price $K_1 < K_2$ and another at $K_3 > K_2$
- Sell 2 calls, both at strike price $K_2 = \text{Current Stock Price}$

A Straddle

- Sell a Put with strike price $K_2 = \text{Current Stock Price}$
- Sell a Call with Stock Price $K_2$
Exam 8
Question 18

a) $\text{Stock} + \text{Put} = \text{PV(Strike)} + \text{Call}$

$61 + \text{Put} = 60e^{-0.12(4/12)} + 5$

$\text{Put} = 1.65$

b) $\text{Put} = \text{PV(Strike)} + \text{Call} - \text{Stock}$

Sell an actual Put for $2$, then invest the PV(Strike) in risk free investments, buy a call, and short a share of stock.

c) $2 - 1.65 = 0.35$

d) If $\text{ABC} > \text{X}$, the call is in the money and the put is out. Exercise your call and buy a share with the invested cash and give that share to the person you owe it to.

If $\text{ABC} = \text{X}$, both options are unexercised. Buy a share with the invested cash and hand it over.

If $\text{ABC} < \text{X}$, the put is in the money. Buy the share from the put holder and give it to the person short.

Exam 8
Question 19

Black suggests that if the expectations regarding changes in the interest rates are going to change, you are better off taking a position in fixed income securities than options because option values don’t change much with interest changes.

However, if you still want to use options, buy calls or sell puts to take advantage.
3 yr $100 bond, 6% coupon, callable 1\textsuperscript{st} and 2\textsuperscript{nd} yrs at $101
\[ r = .15 \]
\[ r_0 = 3\% \quad r_1 = 4\% \quad r_2 = 4.75\% \]

a) OAS = 25 basis pts
\[ r_H = .04e^{2(.15)} = .054 \quad r_{LH} = .0475e^{2(.15)} = .0641 \quad r_{HH} = .0475e^{4(.15)} = .08655 \]

Bond market values

At Time 2, \( \frac{106}{1.08905} = 97.3325 \quad \frac{106}{1.0666} = 99.3812 \quad \frac{106}{1.05} = 100.95 \)
All < 101 so will not be called

At Time 1, \( \frac{(97.3325 + 99.3812)/2 + 6}{1.0565} = 98.776 \)
\( \frac{(99.3812 + 100)/2 + 6}{1.0425} = 101.837 \) Will be called for 101

At Time 0, \( \frac{(98.776 + 101)/2 + 6}{1.0325} = 102.55, \)

b) The bond’s value will decrease, the option adjusted spread will decrease.
Exam 8
Question 21

a) Reverse floaters pay interest that varies inversely with an interest rate index. Rate used might = Constant – index rate

b) TIPS are inflation indexed and are tied to the Consumer Price Index. Their coupon rate is constant, but the par value of the bond increases by the same % as the CPI.

Exam 8
Question 21

a) Reverse Floaters
   a. Coupon payments that are inversely related to some reference rate.
   b. Therefore, when \( t \) increases, not only will the present value of payments be less, but the coupon payments themselves will be

b) The par value is adjusted each period for inflation, so that the par value keeps up with inflation, and so do the coupons, which are fixed percentages of the par value.
Exam 8
Question 22

a) Bond price = 20 \( \frac{4.5}{1.04^1} + \frac{104.5}{1.04^{20}} = 106.80 \)

\[ \sum_{i=1}^{18} \]

Current Yield = 9/106.80 = 8.43%

c) At the end of one year, the bond will sell for:

\[ \sum_{i=1}^{18} \frac{4.5}{1.035^i} + \frac{104.5}{1.035^{18}} = 113.19 \]

\[ \text{HPR} = \frac{113.19 + 4.5 \times 1.04 + 4.5}{106.80} - 1 = 14.58\% \]

d) \[ \frac{(113.19 - 106.80) \times 80\% + (4.5 \times 1.04 + 45) \times 65\%}{106.80} = 10.37\% \]
Question 22

a) Price = 4.5a_20 \times 4\% + 100(1.04)_20 \quad \text{Assume Par} = 100

= 106.795

Current Yield = 4.5(2) = 8.43\%

b) After 1 year, \textit{yield to maturity} = 7\%

Price @ i = 1 = 4.5a_18 \times 3.5\% + 100(1.035)_18

= 113.19

106.795(1 + Y)1 = 113.19 + 4.5(1.04) + 4.5 = 122.37

= 14.58\%

Assume coupon earns 4\% for every 6 month period

c) Capital Gain = 113.19 – 106.795 = 6.395

After tax on Capital Gains = 5.116

Interest Income = 9.18

After Tax = 5.967

Total after Tax Gains = 11.083

After Tax Holding Period = 4* = 11.083 = 10.38\%

= 106.795
Exam 8
Question 23

Invoice Price = (Quoted Price) + (Accrued Interest)
C= .07, Ask Price = 100 2/32 = 100.0625

<table>
<thead>
<tr>
<th>Dates</th>
<th>Coupon Payment</th>
<th>Days from 1/15</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/15</td>
<td>3.50</td>
<td>0</td>
</tr>
<tr>
<td>1/30</td>
<td></td>
<td>15</td>
</tr>
<tr>
<td>7/15</td>
<td>3.50</td>
<td>157</td>
</tr>
</tbody>
</table>

Accrued Interest = 15/182 (3.50) = .288
Invoice Price = 100.0625 + .288 = 100.35

Exam 8
Question 23

Invoice (cash) price = quoted price + accrued interest
Invoice price = 100 2/32 +.29

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1/15 1/30 7/15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coupon</td>
<td>Coupon</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Since Accrued Interest = (.035) (100) (15/182) = .29

Invoice Price = $100.35
Exam 8
Question 24

One is subordination. The issuer can put into the bond contract a promise that any additional debt issued will be “subordinated” to the current issue. This means, in the event of default, the holders of the subordinated issue don’t get paid until the senior debt holders are paid. This makes default less likely on the senior debt holders because they become “first in line” for payment if additional debt is issued.

Another is collateral. In this case, the issuer must pledge assets that can be liquidated to help pay the bondholders in the event of default. This also protects bondholders because they have the value of the collateral to fall back on if the issuer can’t otherwise pay the owed interest/principle.

Exam 8
Question 24

Dividend Restrictions: Limit firms on amount of dividends payment. This protects bondholders, because firm will retain assets rather than pays, then to stockholders.

Collateral: These are specific assets of the bond insurer, which holders receive when there is a default. This protects the holders because their bonds have specific collateral backing them.

Exam 8
Question 24

Sinking Fund – Requirement that the bond issuer periodically repurchase a certain amount of the issue over the life of the bond. This protects against the issuer being unable to make final payment due to the strain of having to repay the principal all at once.

Collateral – Requirement that issuer devote some assets to support the bond. This insures default recovery to the holder in case of bankruptcy.
Exam 8
Question 25

a) \( H_f^3 = \frac{(H_Y^3)^3}{(H_Y^2)^2} = \frac{1000}{847.62} = 6.0\% \)
\[
\frac{1000}{898.47}
\]

b) \( (H_Y^3)^3 = 1000/847.62 = y_3 = 5.67\% \)

Exam 8
Question 26

T-Bill 1 yr spot = \( \frac{100}{93.35} - 1 = .0712 \)

T-Bond \( 102.875 = \frac{5}{1+r} + \frac{105}{1.0712} \)
\( r = .03 \) 6% annualized 6 mo short rate

Forward Rate = \( \frac{(1.0712)}{(1.03)} - 1 = 4\% \) annualized forward rate = 8%

Exam 8
Question 27

\( S_1 = .07 \)  \( S_2 = .08 \)

a) \( P = 9/1.07 + 109/1.08^2 = 101.86 \)

b) \( 101.86 = 9x + 109 x^2 \)
\[
109x^2 + 9x - 101.86 = 0
\]
\( X = -9 \pm \sqrt{9^2 + 4(109)(101.86)/2.109} = .92629 \)
\( X = 1/(1 + \text{YTM}) \)
\( \text{YTM} = 1/X - 1 = 7.958\% \)

c) In 1 yr. Forward rate = \( \frac{1.08^2}{1.07} = 1.0901 \)
\( P_1 = 109/1.0901 = 99.99 \)

d) Forward rate – Liquidity Premium = \( 1.0901 - .01 = 1.0801 \)
\( P_1 = 109/1.0801 = 100.92 \)
Exam 8
Question 27

a) 
\[ \text{Price} = \frac{9}{1.07} + \frac{109}{(1.08)^2} = 101.86 \]
\[ \text{Price} = \frac{9}{1+Y} + \frac{109}{(1+Y)^2} = 101.86 \]

\[ 101.86(1+Y)^2 - 9(1+Y) - 109 = 0 \]
\[ 1+Y = 9 \pm \sqrt{9^2 - 4(101.86)(-109)/2(101.86)} = 1.0796 \]
\[ YTM = 7.96\% \]

b) 
\[ F2 = (1.08)^2/1.07 = 1 = 9.01\% \]
\[ \text{Price} = \frac{109}{1.0901} = 99.99 \]

c) If liquidity = 1\%, \( E(r_2) = 8.01\% = F_2 - 1\% \)
\[ \text{Price} = \frac{109}{1.0801} = 100.92 \]

Exam 8
Question 28

All three of these mortgages have monthly payments that increase over time.

a) GEM – Initial payment at same level of fixed rate mortgage pmt with increasing pmts over time so that principal is repaid faster.

b) GPM – Initial pmt below fixed rate mortgage pmt with negative amortization in the early years with payments increasing over time.

c) TPM – Initial pmt below fixed rate mortgage payment but no negative amortization because of a buy down account established by someone like a parent or a business associate.

Exam 8
Question 29

1) The bond market has been consistently mispricing fixed income securities due to market inefficiencies.

2) The excess return may compensate investors for liquidity, risk, or reinvestment risk, which were not accounted for in Altman’s study.
Exam 8
Question 30

a) Theoretical: \[ F_0 = S_0 e^{(r-q)t} = 800e^{(0.08-0.03)\cdot0.5} = 820.25 \]
\[ 820.25 < 825 \]
Short the Futures Contract at 825.
Buy the index at 800.
Borrow 800 to buy the index.
b) Profit = \[ F_0 - S_0 e^{(r-q)T} = 825 - 820.25 = 4.75 \]

Exam 8
Question 31

d_1 = 2 \quad S_0 = 120 \quad \text{Short}
d_4 = 2 \quad r = 0.05 \quad T = 0.5

a) \[ F = (S_0 - I)ert \]
\[ I = 2e^{-0.05(1/12)} + 2e^{-0.05(4/12)} = 3.96 \]
\[ F = (120 - 3.96)e^{0.05(0.5)} = 118.98 \]
b) Initial value is Zero

c) S = 115
\[ I = 2e^{-0.05(1/12)} = 1.99 \]
\[ F = (115 - 1.99)e^{0.05(0.25)} = 114.43 \]
\[ V_{0.25} = (118.98 - 114.43)e^{-0.05(0.25)} = 4.49 \]

Exam 8
Question 32

a) \[ N^* = B^*P/Q = 1.3\cdot5M/815\cdot500 = 15.95 \quad \text{Short 16 Contracts} \]
b) \[ N^* = (B - B^*)P/Q = (1.3 - .9)5M/815\cdot500 = 4.908 \quad \text{Short 5 Contracts} \]
c) The investor may feel that his stock selections are superior and he just wants to hedge against systemic risk.
d) The investor may wish to hedge only for a short period of time and will incur transaction costs if he sold his portfolio and bought it back later.
Exam 8
Question 32

Portfolio = 5M

B = 1.3 use futures to hedge
Index = 815 and delivery is 500 X

a) \( (1.3) \frac{5m}{(815)(500)} = 15.95 \) Short 16 futures contracts
b) \( (1.3 - .9) \frac{5m}{(815)(500)} = 4.908 \) Short 5 futures contracts
c) A company may feel that its portfolio will outperform the market but is not sure what the market will do so they hang on. Also, if a company wants to hold on to it’s portfolio for a long time, it would rather hedge then sell and have to buy back and incur transaction costs.

Exam 8
Question 33

Current Cash Price = 115 + 6.5 * 40/182 = 116.43
Current Value of Dividends = 6.5e^{0.11*142/365} = 6.23
Futures Cash Price = (116.43 – 6.23)e^{0.11*(250/365)} = 118.82
Subtract part of last dividend = 118.82 – 6.5*108/183 = 114.98
Divide by conversion factor = 114.98/1.45 = $79.30
Exam 8
Question 34

Company X is a better risk, as has lower rates available. Company X is 1% lower on fixed rates and 0.4% lower on floating rates, a difference of 0.6%.

Bank was net 0.04%, leaving 0.6 – 0.04% = 0.56% for companies X and Y to split as their benefit.

Company X has the comparative advantage entering into a fixed rate loan and swapping for a floating rate.

Company X Pays: Fixed 10.0 + LIBOR
Receives fixed 10.08
Net pays LIBOR -.08% (.28% better than LIBOR + 0.2%)

Company Y Pays: LIBOR + 0.6%
Fixed 10.12%
Receives LIBOR
Net fixed 10.72% (.28% better than Fixed 11.0%)

Intermediary: Pays and Receives LIBOR (wash)
Receives Fixed 10.12%
Pays Fixed 10.08% (net 0.04%)

Exam 8
Question 35

Floating Payment = (e^{0.0825*0.5} – 1) * 80M = 3.369M
Value of floating payments = (3.369 + 80)e^{-0.08*3/12} = 81.72M
Value of fixed payments = (4M e^{-0.08*1/4} + 4M e^{-0.085*9/12} + 84M e^{-0.09*15/12} = 82.736M
Value of Contract = 82.736M – 81.72 M
= 1,017,739 M
Exam 8  
Question 36

a) Value at K = 39

\[ 3 = F_u \]

\[ p = e^{0.08(1/12) - d/u - d} = 0.567 \]

Value = \[ e^{-0.08(1/12)}(1/12) \]

\[ = (e^{-0.081/12})(.567)^3 = 1.69 \]

\[ p = e^{10(1/12) - d/u - d} = 0.584 \]

c) Want 1.69 = \[ e^{u(1/12)}(.584)^3 \]

\[ e^{u(1/12)} = 0.965 \]

\[ -r(1/12) = -0.036 \]

\[ r = 43.2\% \]

Exam 8  
Question 37

a. \( P = 80M \quad S = 1000 \)

Use stock index options. # to hedge = # to hedge = \( B(P/A) \)

\[ = (1) (80,000,000/(100)(1000)) = 800 \) Contracts

Buy Puts with exercise price = 900, 800 contracts

b. Use Stock Options

\[ \text{New/orig} = [B[(\text{index}_{A+1}/\text{index}_A - 1) + q_i - r_i] + r_i - q_p] + 1 \]

\[ \frac{72}{80} = (2[(\text{index}/1000 - 1) + .03 -.05]) + .05 -.03] + 1 \]

\[ -0.10 = 2((\text{index}/1000 - 1) - .02) + .02 \]

Index_{2m} = 960

Buy Put options on the index with an exercise price of.

Index = 960. Buy B P/A = 2(80M/(100))(1000) = 1600 Contracts
Exam 8
Question 38

\[ p = K e^{-rt} N(-d_2) - S e^{-r+t} N(-d_1) \]

\[ d_1 = \ln \left( \frac{s}{k} \right) + \frac{(r - rf + 52/2)\sigma \sqrt{t}}{\sigma \sqrt{t}} \]

\[ = \ln \left( \frac{0.52}{0.5} \right) + \left( \frac{4\% + 12\%}{2} \right) \times \frac{8}{12} \]

\[ = 0.722 \]

\[ d_2 = d_1 - \sigma \sqrt{t} = 0.722 - 0.098 = 0.624 \]

\[ p = 0.5 e^{-4\% \times \frac{8}{12}} N(-0.624) - 0.52 e^{-0\% \times \frac{8}{12}} N(-0.722) \]

\[ = 0.0077 \]
Exam 8
Question 39

Call Strike = 52

<table>
<thead>
<tr>
<th>6 Month</th>
<th>1 Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>56.18</td>
</tr>
<tr>
<td></td>
<td>V = 4.18</td>
</tr>
<tr>
<td>53</td>
<td>V_H = 2.437</td>
</tr>
<tr>
<td>50 V_o</td>
<td>50.35 V=0</td>
</tr>
<tr>
<td>47.5</td>
<td>V_L = 0</td>
</tr>
<tr>
<td></td>
<td>45.125 1/V=0</td>
</tr>
</tbody>
</table>

Value at = \( e^{-rt} (p(u) + 1-p(d)) \)

\[
P = \frac{e^{rt} - d}{u-d} = \frac{e^{0.03(0.5)} - .95}{1.06 - .95} = .5919;
\]

\( \Rightarrow 1 - p = .4081 \)

\[
V_H = e^{-0.03(0.5)} (.5919(4.18) + .4081(0)) = 2.437
\]

\[
V_o = e^{-0.03(0.5)} (.5919(2.437) + .4081(0)) = 1.4209
\]

Value at one year European call = $1.42
WEBS are an index of stocks of publicly traded companies in a single country. They are traded on a US exchange in US dollars so they are easy to invest in. They are passively managed so they have low transaction fees. They add diversification to a US portfolio as they include international stocks, which will perform differently from US stocks.

- WEBS are traded in the US stock exchange
- Traded in US currency
- Similar to close end first – sell rather than redeem
- To mirror the performance of MSCL indices for overseas markets
- Broad exposure rather than individual stocks
- Passively managed; hence; lower cost.
- Enhance US portfolio due to the low correlation which offers significant diversification potential to lower overall portfolio

\[
\text{Delta} = \frac{\partial P}{\partial S}
\] is the rate of change of a portfolio value in response to change in the underlying asset price all other things held constant.

\[
\text{Theta} = \frac{\partial P}{\partial \theta}
\] is the rate of change of a portfolio value as time passes, all other things held constant.

\[
\text{Gamma} = \frac{\partial^2 P}{\partial S^2}
\] is the rate of change of Delta as the underlying asset price changes, all other things held constant.

\[
\text{Vega} = \frac{\partial^2 P}{\partial \sigma^2}
\] is the rate of change of a portfolio value that is in response to change in the volatility of the underlying asset, all other things held constant.
Exam 8
Question 41

Delta is the rate of change of the portfolio value with respect to the change in the underlying asset price.

Theta is the rate of change of the portfolio value with respect to the passing of time. Also known as time decay.

Gamma is the rate of change of the portfolio’s delta with respect to the change in the underlying asset price.

Vega is the rate of change of the portfolio value with respect to the change in the volatility of the underlying assets.

Exam 8
Question 42

Flaw:

- Portfolio delta neutral for short period of time only
- When price changes (more than small), the delta changes
- Portfolio needs to be rebalanced to achieve on-going delta neutral
- Also, making gamma neutral may reduce the need for frequent rebalancing. Still, rebalancing is necessary.
- Gamma – change in delta for change in stock price

Exam 8
Question 42

Delta hedging only works for short time periods and for small changes in the stock price. It needs to be rebalanced often. It involves large transaction costs. Gamma and Vega also need to be monitored.
Exam 8
Question 43

a) Call sold on 100 shares. Delta = 0.50 meaning if price of share changes by a small amount, the price of the call will change by half that asset. Since you sold the call, you are negative (50) (100) = -50 delta. To be delta neutral, buy 50 shares of stock, each share has delta = 1.00.

b) As price falls to 99, delta = .44 on the call you sold a 100 shares. Total delta = -100(.44) = -44. To be delta neutral, you need to own 44 shares of stock, but you previously bought 50. To rebalance, sell 6 of your 50 shares.

Exam 8
Question 43

a) Buy .50(100) = 50 shares of stock
b) Now I only need .44(100) = 44 shares of stock, so I can sell 6 shares of stock.
Exam 8  
Question 44

a) Portfolio B is riskier because if things go badly for the Portfolio, they can get very bad.

b) Hull suggests use of a C-VAR measure, a conditional value at risk. This would let management know the answer to the question, if things go badly for us, how bad can they get?

Exam 8  
Question 45

Metallgesellschaft: Its subsidiary MGRM had entered into fixed price contracts with its customers for 10 years. They hedged their risk to the general price of oil by buying short-term futures prices. When oil prices dropped they gained on the fixed priced contracts, but lost on the futures, which must be marked to the market. This created a cash flow drain on its parent, who forced MGRM to close out its position and realize the loss.

VAR would not have helped because they knew the basic risk (intertemporal risks of heating oil, etc.) they were taking. After all, that is the business they are in.

VAR is a total risk measure, not a cash flow measure.
Exam 8
Question 46

Many people do not understand the securitization product outside the insurance industry. Financial institutions do not have easy access to insurance information and may not realize the diversification benefits there are available.

Pricing is difficult; there is not a lot of historical information (catastrophes) to base pricing of these assets. Determining the proper rates of returns on such assets is still difficult.

Exam 8
Question 47

Bankruptcy Costs. By eliminating the probability of going into bankruptcy, you eliminate: legal fees, bankruptcy court oversight of firm, higher borrowing costs, larger payments to employees, managers, suppliers, etc. Risk management makes firm most stable by eliminating bad outcomes. This also allows managers and employees to better focus on other results.

Exam 8
Question 47

Taxes – limits on carry forwards and increasing marginal tax rates penalize highly variable earnings. Reducing variability by hedging firm’s overall risk will reduce taxes in long run.
Exam 8
Question 48

ROE = 15%
B = 1.25
R_f = .06
E(r_m) – r_f = .065
R = r_f + B (E(r_m) – r_f) = .06 + 1.25 (.065) = .14125

a. P4 = D5/K-g = D4 (1 + g)/K-g

g = ROE x Plowback
   = ROE * (1 – payout) = .15 * (1 - .12) = .132

   P4 = .21(1.132)/(.14125 - .132) = 25.70

b. Vo = D1/(1+K) + D2/(1 + K)^2 + D3/(1 + K)^3 + (D4 + P4)/(1 + K)^4

   = .17/1.14125 + .183/(1.14125)^2 + .197/(1.14125)^3 + (.21 + 25.70)/(1.14125)^4

   = 15.70

Exam 8
Question 49

It refers to any asset, obligation or consideration
Amount – How much will it be?
Timing – When will it occur?
Occurrence – Will it exist?
Interest Rates – At what rate should it be discounted?