March 2013

CAIA® Level I

Workbook

Chartered Alternative Investment Analyst Association®

March 2013
Level I Workbook

Preface

Congratulations on becoming a Chartered Alternative Investment Analyst (CAIA) candidate, and welcome to the Level I examination program. The CAIA® program, organized by the CAIA Association® and co-founded by the Alternative Investment Management Association (AIMA) and the Center for International Securities and Derivatives Markets (CISDM), is the only globally recognized professional designation in the area of alternative investments, the fastest growing segment of the investment industry.

The following is a set of materials designed to help you prepare for the CAIA Level I exam.

Exercises

The exercises are provided to help candidates enhance their understanding of the reading materials. The questions that will appear on the actual Level I exam will not be of the same format as these exercises. In addition, the exercises presented here have various levels of difficulty and therefore, they should not be used to assess a candidate's level of preparedness for the actual examination.

March 2013 Level I Study Guide

It is critical that each candidate should carefully review the study guide. **It contains information about topics to be studied as well as a list of equations that the candidate MAY see on the exam.** The study guide can be found here: http://caia.org/caia-program/curriculum

Errata Sheet

Correction notes appear in the study guide to address known errors existing in the assigned readings. Occasionally, additional errors in the readings and learning objectives are brought to our attention and we will then post the errata on the Curriculum page of the CAIA website: http://caia.org/caia-program/curriculum

It is the responsibility of the candidate to review these errata prior to taking the examination. Please report suspected errata to curriculum @caia.org.

The Level II Examination and Completion of the Program

All CAIA candidates must pass the Level I examination before sitting for the Level II examination. A separate study guide is available for the Level II curriculum. As with the Level I examination, the CAIA Association administers the Level II examination twice annually. Upon successful completion of the Level II examination, and assuming that the candidate has met all the Association's membership requirements, the CAIA Association will confer the CAIA Charter upon the candidate. Candidates should refer to the CAIA website, www.caia.org, for information about examination dates and membership requirements.

Topic 2: Introduction to Alternative Investments

Readings

CAIA Level I: An Introduction to Core Topics in Alternative Investments. Second Edition. 2012. Wiley. ISBN: 978-1-118-25096-9. Part One, Introduction to Alternative Investments, Chapters 1 - 7.

Chapter 1
What is an Alternative Investment?

Exercises

1. Which of the following investments are NOT considered to be alternative investments: Credit derivatives, distressed debt, real estate, Treasury bonds, common stock and timberland?

2. Which of the following investments was a significant asset class long before stocks and bonds became important: Real estate, structured products or hedge funds?

3. Which of the following structures is the primary driver of commodities as an alternative asset: Regulatory structure, securities structure, trading structure or compensation structure?

4. Does the term private equity include both debt and equity positions that, among other things, are not publicly traded?

5. Over long time intervals, do the returns of many alternative investments exhibit normality?

6. Do efficient capital markets tend to have low transactions costs and numerous informed investors?

7. Does most real estate have the institutional structure of being privately held or publicly traded?

Solutions

1. Treasury bonds, common stock

   (Section 1.2)

2. Real estate

   (Section 1.1)

3. Securities structure

   (Section 1.3.2)

4. Yes

   (Section 1.2.4)

5. No

   (Section 1.4)

6. Yes for both.

   (Section 1.4.3)

7. Privately held

   (Section 1.3.2)

Chapter 2
The Environment of Alternative Investments

Exercises

1. What is the term for a private management advisory firm that serves ultra-high net worth investors?

2. List several advantages of Separately Managed Accounts (SMAs) relative to funds.

3. Which of the following participants is LEAST LIKELY to be classified as an outside service provider: Arbitrageurs, Accountants, Auditors or Attorneys?

4. Which types of investment advisors may not need to register with the SEC when it has between $25 and $100 million in assets under management and is subject to registration and examination as an investment adviser at the state level?

5. List four ways that a hedge fund manager can increase its use of leverage beyond those established by the Federal Reserve's Regulation T and NYSE and NASD requirements.

Solutions

1. Family Office or Family Home office (as corrected on the errata page)

   (Section 2.1.1)

2. SMA investors are the owners on record of the invested assets, SMAs may have objectives that are designed to suit the specific needs of an investor, and SMAs offer transparency to their investors.

   (Section 2.1.1)

3. Arbitrageurs

   (Section 2.1.3)

4. A mid-sized investment adviser

   (Section 2.3.1)

5. By registering themselves as broker-dealers, by taking derivative positions to obtain synthetic ownership of securities, by using a joint front office account and by implementing a repurchase (repo) transaction.

   (Section 2.3.1)

Chapter 3
Statistical Foundations

Exercises

1. An asset earns a log return of 14% in period 1, and 7% in period 2. What is the log return for the two periods?

2. Describe positive first order autocorrelation of returns.

3. What does the following formula describe: $E[(R - \mu)^4] / \sigma^4$

4. What term is used to refer to the probability that the return will be less than the investor's target rate of return?

5. Hedge fund XYZ currently has only two positions. The fund's analyst reports a VaR of $150K for position #1 and a VaR of $150K for position #2. What is the VaR (rounded) of the combined positions, if they are assumed to have zero correlation?

6. An investment offers a 12% continuously compounded return for one year. Calculate the equivalent simple interest rate.

7. An investment offers a 9% simple interest rate. Calculate the continuously compounded return for one year.

8. Assume that R_m is the return of an index that has an annual volatility (σ) of 25% and has

no autocorrelation. Calculate the volatilities (standard deviations of returns) of: (a) a portfolio that leverages the index 1.4 to 1, (b) a portfolio with a 60% portfolio weight in the index and the remainder in cash, and (c) the index's three-month return volatility.

9. A forty-month returns series has a sample skewness and sample excess kurtosis of 0.41 and 0.38, respectively. Calculate the Jarque-Bera (JB) statistic and test, at a 5% significance level, the hypothesis that this series of returns is normal. The critical value for the JB statistic at the 5% significance level is 5.99.

10. Suppose that the VaR of a portfolio for a 15-day period using 95% confidence is estimated as being $150,000. Interpret this number.

Solutions

1. 21.00%

   (Section 3.2.2)

2. Positive first order autocorrelation is when an above-average (below-average) return in time period *t-1* tends to be followed by an above-average (below-average) return in time period *t*.

   (Section 3.3.1)

3. Kurtosis

   (Section 3.4.4)

4. Shortfall risk

   (Section 3.8.3)

5. VaR = Critical value × Standard Dev. It is $212,132 in this case.

   (Section 3.9.7)

6. Earning a 12% continuously compounded interest rate for one year is equal to earning 12.75% (rounded) simple interest. The answer is found as $e^{0.12} - 1 = 12.75\%$ (rounded).

   (Section 3.2.2)

7. Earning a 9% simple interest rate for one year is equal to earning an 8.62% (rounded) continuously compounded return. The answer is found as $\ln(1.09) = 8.62\%$ (rounded).

   (Section 3.2.2)

8. (a) This volatility is found using equation 3.30. Thus, the 1.4 leverage generates a volatility of 35% (i.e., 25% x 1.4).

   (Section 3.6.4)

   (b) This volatility is found using equation 3.32: Thus, the volatility of this portfolio is equal to 60% x 25% = 15%

   (Section 3.6.4)

   (c) Using equation 3.33, the three-month return has a volatility of 12.50% (i.e., 25%/√4).

   (Section 3.6.4)

9. The JB test statistic is given by:

   $JB = (n/6) [S^2 + (K^2/4)] = (40/6) [0.41^2 + (0.38^2/4)] = 1.3613$

   Since this JB value of 1.3613 is below the critical value of the test of 5.99 (at the 5% significance level), one cannot reject the null hypothesis of returns being normally distributed.

   (Section 3.7.2)

10. In this case, the VaR is a prediction that over a 15-day period there is a 95% chance that the portfolio will earn more than -$150,000. Conversely, there is a 5% chance that the portfolio will earn less than -$150,000.

    (Section 3.8.6)

Chapter 4
Risk, Return, and Benchmarking

Exercises

1. Describe the selection of a peer group for use in benchmarking.

2. The following table illustrates the performance of XYZ Fund for the period January 1994 to June 2009, compared to the S&P 500 Index.

Jan 1994 – June 2009	Annualized Mean Return	Annualized Standard Deviation of Returns	Return in Excess of S&P 500 Index
XYZ Fund	7.62%	12.57%	-0.75%

   What are important questions to ask regarding the benchmarking of XYZ Fund?

3. What are the factors in the Fama-French model?

4. Asset *i* has a beta of 1.5, and the risk-free rate is 3%. If the actual return of the asset was 25% over a one year period, and the actual return of the market was 15%, how can asset *i*'s return be attributed?

5. Asset ABC has a beta of 0.5, and the risk-free rate is 4%. Suppose that the ex ante form of the CAPM predicted an expected return of 10% for asset ABC but asset ABC's actual return was 13%. If the market had performed 4% higher than expected, how much of asset ABC's return was idiosyncratic?

Solutions

1. Peer groups are customized for the specific needs of an investor examining one or more holdings to identify returns based on similar risks.

   (Section 4.1.1)

2. Were the higher returns experienced by XYZ the result of different risk exposures? Similarly, is the Standard &Poor's 500 Index an appropriate benchmark for XYZ Fund? Were the higher returns experienced by XYZ Fund above the S&P 500 statistically significant? Were the higher returns experienced by XYZ Fund above the S&P 500 economically significant?

   (Section 4.1.2)

3. A factor representing the excess return of the overall market portfolio, a factor representing a growth versus value effect, and a factor representing a small-cap versus large-cap effect.

   (Section 4.7.3)

4. Of Asset *i*'s return, 3% is attributable to the risk free rate, 18% is attributable to the market risk/return [(15%-3%)x1.5] and 4% is idiosyncratic.

   (Sections 4.5.1 and 4.5.2)

5. The expected return of the market is 16% (given that ABC with its beta of 0.5 was expected to earn 6% premium), so the market returned 20%. Given a beta of 0.5, a riskless rate of 4% and an actual market return of 20%, Asset ABC should have earned 12%. The idiosyncratic return is therefore 1%.

   (Section 4.5.2)

Chapter 5
Correlation, Alternative Returns, and Performance Measurement

Exercises

1. Consider a $50 million fund with 20% incentive fees and a hard hurdle rate of 10% that lasts a single year. The fund earns a $12 million profit. What incentive fee would the fund manager collect?

2. Consider a portfolio that earns 8% per year when the risk-free rate is 2%. The portfolio has a beta of 1.2 with respect to the market portfolio, and a return standard deviation of 15%. What are the Sharpe and Treynor ratios, respectively?

3. Consider a portfolio that earns 12% per year when the investor's target rate of return is 9% per year. The risk free rate is 6%, the annual standard deviation of the portfolio returns is 15%, and the annual semi-standard deviation of returns using the target rate of 9% is 12%. What is the value of the Sortino ratio?

4. A portfolio has a beta of 0.5 and an annual expected return of 14%. The riskless rate is 8% and the annual expected return of the market is 16%. What is the alpha of the portfolio?

5. The covariance between the returns of stock A and the market is 0.03969, the standard deviation of the returns of A is 24%, and the standard deviation of the returns of the market is 21%. Calculate the correlation between the returns of stock "A" and the market, and the beta of stock A with respect to the market.

6. An investment that costs $120 million is expected to last five years and to generate cash inflows of $35 million, $45 million, $60 million, $70 million, and $80 million in years 1, 2, 3, 4, and 5, respectively. Calculate the internal rate of return (IRR) of the investment.

7. A new investment is expected to cost $55 and be followed by cash inflows of $30 after one year and then $50 after the second year when the project terminates. Calculate the IRR. What type of IRR is this?

8. A new investment cost $120 to purchase and was followed by actual cash inflows of $30 after one year and $40 after the second year. At the end of the third year the investment is appraised at $100. Calculate the IRR. What type of IRR is this?

9. An investment had been in existence for five years when it was purchased by a fund for $200. In the five years following the purchase the investment distributed cash flows to investors of $30, $45, $55, $40 and $45. Now in the sixth year the investment has been appraised as being worth $120. Calculate the IRR. What type of IRR is this?

10. A fund terminates after one year and ultimately returns $90 million for its limited partners while the total initial size of the fund was $74 million. Assuming a carried

interest rate of 20%, what is the carried interest that the general partner should receive? How much was the total profit of the fund?

11. Consider a fund that makes two investments, A and B. Both cost $50 million each. Investment A is successful and generates a $50 million profit after four years. Investment B is valued at cost until it is completely written off after six years. Assume that the fund manager is allowed to take 20% of profits as carried interest calculated on an aggregated basis. How much carried interest will they receive if there is no clawback provision?

12. In the previous problem, how much carried interest will the manager receive if there is a clawback provision?

Solutions

1. $1,400,000

   (Section 5.5.6)

2. 0.40 and 0.05

   (Section 5.6.1)

3. 0.25

   (Section 5.6.1)

4. 2%

   (Section 5.6.2)

5. Using equation 5.3:

   $\rho_{Am} = Cov(R_m, R_A) / (\sigma_i \sigma_j) = 0.03969 / (0.24) \times (0.21) = 0.79$ (rounded)

   (Section 5.1.2)

   Using equation 5.5:

   $\beta_A = Cov(R_m, R_A) / Var(R_m) = 0.03969 / (0.21)^2 = 0.90$

   (Section 5.1.5)

6. The IRR is found as that interest rate that solves the following equation:

   $$-\$120M + \frac{\$35M}{(1+IRR)} + \frac{\$45M}{(1+IRR)^2} + \frac{\$60M}{(1+IRR)^3} + \frac{\$70M}{(1+IRR)^4} + \frac{\$80M}{(1+IRR)^5}$$

The answer is found using the calculator: 32.55%

(Section 5.2.2)

7. The IRR of the investment is 26.44% (found using a calculator). The IRR is based on anticipated cash flows and, therefore, it is a lifetime IRR.

   (Section 5.2.3)

8. The IRR is based on realized cash flows since inception and an appraised value. Therefore, the IRR in this problem is an interim or since inception IRR and is equal to 15.86% (found using a calculator).

   (Section 5.2.3)

9. The IRR is based on realized cash flows after inception and an appraised value. Therefore, the IRR in this problem is a point-to-point IRR and is 13.97%.

   (Section 5.2.3)

10. Carried interest is $4 million. Note that if $16 million is the profit only to the LP (i.e., $90 - $74 million), the total profit of the fund was higher. The answer is found by solving the following equations: LP profit = .8 × Total Profit; so $16 million = .8 ×Total Profits; therefore total profit = $20 million. The second equation is: GP carried interest = .2 × Total Profits; Carried Interest = $4 million.

    (Section 5.5.3)

11. Without a clawback provision, the fund earned $50 million after four years and distributed $10 million of carried interest to the manager. When the second investment failed, the incentive fee would not be returned.

    (Section 5.5.5)

12. In the case of a clawback provision, the fund distributed a $10 million incentive fee to the manager after four years, but when the second investment failed, the incentive fee would be returned to the limited partners since there was no combined profit from A and B.

    (Section 5.5.5)

Chapter 6
Alpha and Beta

Exercises

1. Fund ABC generally tracks the S&P 500 Index before expenses, but has an annual expense ratio 50 basis points higher than other investment alternatives that track the S&P 500 index at virtually zero expense. What is the ex ante alpha of ABC?

2. Consider Fund XYZ, a fund that like Fund ABC from the previous problem attempts to track the S&P 500. However, unlike Fund ABC, the manager of XYZ is not skilled. Also, unlike Fund ABC, Fund XYZ has virtually no expenses. While Fund XYZ generally attempts to track the S&P 500 index, it does so with substantial error because its manager is incompetent. The fund is, however, able to maintain a steady systematic risk exposure of $\beta_i = 1$. Last year, Fund XYZ outperformed the S&P 500 by 75 basis points net of fees. What is XYZ's ex ante alpha? What is XYZ's ex post alpha?

Problems 3 through 5

Assume that Fund ONE has a beta of 1.1 and has an expected return of 11%. Additionally, it is assumed that the expected return of the market is 12% and that the risk-free rate is 3%.

3. Assuming that the CAPM holds, what was Fund ONE's ex ante alpha?

4. During the next year, the market earns -3% and Fund ONE earns -6%. What was Fund's ONE ex post alpha?

5. Given the annual performance of -6% in the previous problem and the ex ante alpha from earlier, what was the portion of the ex post alpha for Fund ONE that was luck and what portion that was skill?

6. What is considered to be the most important task in distinguishing alpha from beta in the performance of an investment manager?

Solutions

1. The ex ante alpha of ABC would be approximately -50 basis points or -0.5% per year. Assuming that $\beta_i = 1$ (given that Fund ABC mimics the S&P 500) we can see from equation 6.1 that:

$$E(R_{i,t} - R_f) = \alpha_i + \beta_i [\, E(R_{m,t}) - R_f) \,]$$
$$E(R_{i,t} - R_f) = \alpha_i + E(R_{m,t}) - R_f$$

Isolating α_i (ex ante alpha) and simplifying one obtains:

$\alpha_i = E(R_{i,t}) - E(R_{m,t})$, which should be equal to -0.5% due to the expense ratio of Fund ABC.

(Section 6.1.1)

2. Fund XYZ's ex ante alpha was zero. To calculate the fund's ex post alpha, we use Equation 6.2:

   $R_{i,t} - R_f = \beta_i (R_{m,t} - R_f) + \varepsilon_{i,t}$

   Assuming that $\beta_i = 1$ and that $(R_{i,t} - R_{m,t}) = 75$ basis points or 0.75%, it can be calculated that $\varepsilon_{i,t} = +0.75\%$. Thus, Fund XYZ realized a return performance for the year that was 0.75% higher than the S&P 500 or its required rate of return. Therefore, Fund XYZ generated an ex post alpha of 75 basis points even though the fund's ex ante alpha was zero.

   $R_{i,t} - R_f = \beta_i (R_{m,t} - R_f) + \varepsilon_{i,t}$ (6.2)

   Obviously, Fund XYZ must have been lucky during the year because the fund outperformed its benchmark by 0.75% and the managers were assumed to be unskilled. Thus, the ex post alpha cannot be attributable to ex ante alpha.

   (Section 6.2.2)

3. The ex ante alpha is found as the intercept of the ex ante version of the CAPM. Inserting the beta, the risk-free rate and the two expected returns into Equation 6.1 generates the expected required return from Fund ONE:

   $E(R_A) - 3\% = 1.1\ (12\%-3\%) \Rightarrow E(R_A) = 12.90\%$

   The return of 12.90% is the expected return that investors would demand on an asset with a beta of 1.1. The ex ante alpha of Fund ONE is any difference between the expected return of the fund and its required return:

   Ex ante alpha = Expected return - Required return
   => 11% - 12.9% => -1.9%

   Thus, Fund ONE offers 1.9% less return than would be required based on its systematic risk.

   (Sections 6.2.1 and 6.4.1)

4. Ex post alpha is found by inserting the two realized returns, the beta (assuming that the ex post estimated beta of the fund is the same as the ex ante beta) and the risk-free rate into Equation 6.2, and generates:

-6% - 3% = [1.1 (-3%-3%)] + ε => ex post alpha (ε) = -2.4%

Fund ONE underperformed the market portfolio prior to risk adjustment, and performed 2.4% worse than assets of similar risk. Thus, the ex post alpha for Fund ONE was -2.4%.

(Sections 6.2.2 and 6.4.1)

5. Since Fund ONE was assumed to offer an expected inferior return, or ex ante alpha, of −1.9%, Fund ONE's ex post alpha of -2.4% could be said to have been around 80% attributable to the managers of the fund been unskilled (i.e., -1.9% of the -2.4%) and around 20% (i.e., the remaining -0.5% of the -2.4%) attributable to bad luck. Unfortunately, investors in this fund had to deal with incompetent managers that also had bad luck.

   (Section 6.4.1)

6. Identifying true systematic risk exposures

   (Section 6.1.1)

Chapter 7
Hypothesis Testing in Alternative Investments

Exercises

1. True or False: In a test of a hypothesis, the confidence level denotes the probability that the null hypothesis will not be rejected when the null hypothesis is indeed true.

2. True or False: A p-value of 5% indicates that there is only a 5% chance that the estimated value of a parameter (e.g., mean) is equal to true of value of that parameter.

3. What conditions imply that the mean of a sample should be approximately normally distributed?

4. Describe a type II error.

5. Which terms are used to refer to the overuse and misuse of statistical tests by an analyst who is attempting to identify historical patterns?

Solutions

1. True. This is the definition of confidence level.

   (Section 7.1.2)

2. False: A p-value of 5% indicates that there is only a 5% chance that the estimated value (or higher) would occur IF the null hypothesis is true

   (Section 7.1.4)

3. Any of these four conditions: (a) population distribution is normal; (b) the sampling distribution is symmetrical, is unimodal, and contains no outliers, and the sample size is 15 or a little less; (c) the sampling distribution is moderately skewed, is unimodal, and contains no outliers, and the sample size is between 16 and 40; or (d) the sample size is 40 or greater and contains no outliers.

4. Failing to reject the null hypothesis when it is false

   (Section 7.3.2)

5. Data dredging or data snooping

   (Section 7.4.2)

Topic 3: Real Assets

Readings

CAIA Level I: An Introduction to Core Topics in Alternative Investments. Second Edition. 2012. Wiley. ISBN: 978-1-118-25096-9. Part Two, Real Assets, Chapters 8 - 10.

Chapter 8
Land, Infrastructure, and Intangible Real Assets

Exercises

1. What value or cost best represents the strike price of a call option when underdeveloped land is described as containing a call option?

2. When should the implicit perpetual option of undeveloped land be exercised?

3. Consider a parcel of land that can be improved at a construction cost that depends on the state of the economy. If the economy grows, the land can be improved at a construction cost of $150,000 and will create an improved property worth $200,000. If the economy declines, the construction cost drops to $70,000 but the improved property would only be worth $60,000. Comparable improved properties now sell for $116,000. Assuming that the riskless rate is zero, calculate the risk-neutral probabilities of a growing and declining economy respectively.

4. Continuing with the previous problem regarding a parcel of land, compute the value of the land as a call option by assuming that the land would be abandoned after one year if it could not be developed at a profit.

5. Land that remains undeveloped is expected to generate a return of 7% while land that is developed is expected to provide a single-period return of 20%. If the probability that a parcel of land will be developed is 20% over the next period, what is its expected return?

6. Calculate the return on equity (ROE) and the return on assets (ROA or capitalization rate) for the following example of a farmland project.

Purchase Price	$200,000
Financing	$120,000
Equity Investment	$80,000
Annual Revenues	$22,000
Property Taxes	$4,000
Insurance	$2,000
Interest	$7,000

7. Suppose that in the previous problem, annual revenue is expected to rise to $25,000 and that the market capitalization rate is 9%. Calculate the new price of the farmland assuming that all other values remain constant.

Solutions

1. The cost of developing or improving the land

   (Section 8.1.2)

2. When the net benefits of receiving income from the developed assets exceed the net value of retaining the option.

   (Section 8.1.2)

3. The first step is to use the current price of comparable improved properties ($116,000) and the two possible values of improved properties at the end of the period ($200,000 and $60,000) to determine the risk-neutral probability that the economy will grow. When the riskless rate is zero, the current value of a comparable property must equal its end-of period expected value based on risk-neutral probabilities, as shown in Equation 8.1.

   Current Value = Expected Value = (UpValue x UpProb.) + [DownValue x (1- UpProb.)]

   where: UpValue = value in the up state,
   DownValue = value in the down state,
   UpProb = the risk-neutral probability of the up state, and
   (1-Up Prob) = the risk-neutral probability of the down state.

   Inserting the comparable property's current value and possible property values into Equation 8.1 generates a solution for the probabilities:

   $116,000 = ($200,000 x Up Prob) + [$60,000 x (1 – Up Prob)]

   Solving for the above equation generates Up Prob = 0.40 which means that the risk-neutral probability that the economy will decline is 0.60.

   (Section 8.1.3)

4. To compute the value of the call option on the parcel of land we need to insert the probabilities calculated in the previous problem into Equation 8.1. In the Up state, the developer earns $50,000 ($200,000 - $150,000). In the down state development of the land would lose $10,000 ($70,000-$60,000) but by assumption the developer would abandon the land rather than improve upon it. The current value of the call option (on the land) is the weighted average of the outcomes since the riskless rate is zero.

   Call Option Price = ($50,000 x 0.40) + ($0 x 0.60) = $20,000

(Section 8.1.3)

5. Inserting the values into Equation 8.2

   $E(R_l) = [P_d \times E(R_d)] + [(1-P_d) \times E(R_{nd})] =>$

   $E(R_l) = [(0.20 \times 0.20) + (0.80 \times 0.07)] = 9.6\%$.

   (Section 8.1.4)

6. First, we need to calculate the project's net income.

Annual Revenues	$22,000
Less Property Taxes	-$4,000
Less Insurance	-$2,000
= Operating Income	$16,000
Less Interest	-$7,000
= Net Income	**$9,000**

   ROE (net income/equity) is equal to $9,000/$80,000 or 11.25%. The return on assets (operating income/assets) or capitalization rate is $16,000/$200,000 or 8%.

   (Section 8.3.1)

7. Using Equation 8.3: Value of Real Estate = Annual Operating Income / Cap Rate

   The new price of the farmland would rise to $211,111 (rounded to whole dollar). [($25,000-$4,000-$2,000)/.09]

   (Section 8.3.1)

Chapter 9
Real Estate Fixed-Income Investments

Exercises

1. At the end of month 27, a hypothetical mortgage-backed security's conditional prepayment rate stands at 5.50%. The beginning mortgage balance for month 28 is $475,000,000 while the scheduled principal payment is $400,000. What is the projected prepayment for month 28?

2. True or False: When interest rates decline, the life of junior tranches will be extended, thereby extending the expected life of the tranche further than originally expected.

Problems 3 through 5

Marie Lange is considering the purchase of a small beach apartment near Fort Lauderdale, Florida, USA, for which she would need to take a 25-year, $250,000, fixed-rate, constant monthly payment mortgage. The mortgage rate is 7.8% per year, which is expressed yearly and compounded monthly.

3. What would be the mortgage balance exactly one month after the mortgage is taken, assuming that the first payment has been made?

4. What is the interest portion of the payment for the third month after the mortgage is taken?

5. Suppose that Ms. Lange prepays $25,000 of the mortgage balance at the end of the second month. In this case, what is the mortgage balance by the end of the third month after the mortgage is taken?

Problems 6 through 7

Paul Jenkins purchased a house four years ago, taking a 30-year, $100,000, adjustable-rate mortgage with monthly payments. The initial interest rate, which applied only for the first year, was 7.5% per year. The adjustable rate is based on an index plus a margin rate of 1.75%. Starting on the 13^{th} month the following index applied during the second, third, and fourth years after the mortgage was taken: 7.5%, 9.2%, and 8.7%, respectively. All rates are expressed yearly and are compounded monthly.

6. What is the initial monthly mortgage payment?

7. What is the mortgage balance at the end of the first year?

8. Which of the following alternatives is LEAST LIKELY to be a factor that influences prepayment rates: the current level of mortgage rates relative to the rates being charged on the loans in the pool, the path that mortgage rates have followed to arrive to the current interest rate level, the type of mortgages (e.g., fixed-rate, adjustable-rate, capped, etc.) in the pool, or the weather of the geographical area from which the pool of mortgages originates.

Problems 9 through 10

Consider the two-sequential pay tranche Collateralized Mortgage Obligation (CMO) structure that is presented in the following table, where principal payments are made first to Tranche A and then to Tranche B.

Tranche	Outstanding Par Value	Coupon rate
A	$200,000,000	8.50%
B	$75,000,000	8.50%

This CMO received a total cash flow of $2,334,006 in month 1 and a total cash flow of $3,265,791 in month 2 from the underlying collateral.

9. What is the value of the principal payments that Tranche B should receive in the first month?

10. What is the interest payment that Tranche A should receive at the end of the second month?

Solutions

1. $2.2 million

   (Section 9.1.1)

2. False

   (Section 9.4.1)

3. The monthly payment is $1,896.54, which can be used to calculate the balance after one payment: $249,729

   (Section 9.1.1)

4. $1,621

   (Section 9.1.1)

5. $224,018

   (Section 9.1.1)

6. $699.21 (rounded)

   (Section 9.1.3)

7. $99,078

   (Section 9.1.3)

8. The weather of the geographical area from which the pool of mortgages originates.

   (Section 9.3.2)

9. $0

   (Section 9.4.1)

10. $1,413,931.87

    (Section 9.4.1)

Chapter 10
Real Estate Equity Investments

Exercises

1. What is the frequency with which the National Council of Real Estate Investment Fiduciaries (NCREIF) Property Index (NPI) is calculated and how often are the underlying appraisals fully performed?

2. True or False: The relatively high liquidity of closed-end real estate funds shares contrasts to the illiquidity of the underlying real estate assets held in the fund's portfolio?

3. Investment A offers $80 per year in taxable income and an additional final cash flow of $1,000in five years. The current price of this investment is $900. Any capital gain on this investment is taxable. What are the pre-tax and after-tax yields to maturity of this investment for an investor in a 40% tax bracket?

4. Private real estate fund #1 has $50 million of assets and $30 million of debt. Private real estate fund #2 has $45 million of equity and $15 million of debt. Calculate the loan-to-value ratios (LTV) of each fund.

5. Consider a real estate property that cost $10 million and will be sold after three years. For simplicity, ignore inflation and assume that the true value of the property will decline by 8% each year due to wear and aging. Assume that the operating cash flows generated by the property each year are equal to 15% of the property's value at the end of the previous year, and that depreciation is equal to 10% of the property's value at the end of the previous year. The property is expected to be sold at the end of the third year at its year-3 book value. Calculate the internal rate of return (IRR) of the project.

6. Continuing with the previous problem, let us assume now that the tax rate is 30% and that the depreciation can be considered a tax deductible expense for tax accounting purposes. Calculate the internal rate of return (IRR) of the project.

Solutions

1. The index is computed quarterly but the underlying appraisals are performed on a variable basis but typically less often than quarterly.

(Section 10.5.1)

2. True

   (Sections 10.3.2, 10.3.4, and 10.3.6)

3. To obtain the pre-tax yield to maturity, we use a financial calculator with these inputs: PV = 900, PMT = $80, FV = $1,000, N = 5, calculating I, we obtain 10.68%. After tax, the $80 annual income is worth $48 = [$80 × (100% – 40%)]. The final cash flow on an after-tax basis would be 1000- (1000-900) × 40% = 960. To obtain the after-tax yield to maturity, we use a financial calculator with these inputs: PV = 900, PMT = $48, FV = $960, N = 5, calculating I, we obtain 6.50%. Notice that 6.50% is approximately equal to 60% of 10.68%.

   (Section 10.2.1)

4. Fund #1 is 60% debt and therefore has a LTV or debt-to-assets-ratio of 60% (i.e., $30 MM/$50 MM). Fund #2 is 25% debt (assets = debt + equity = $15 MM + $45MM = $60 MM) and therefore has a LTV of 25% (i.e., $15 MM/$60 MM).

   (Section 10.3.5)

5. The calculations of the total cash flows per year are as follows.

	End of Year 0	**End of Year 1**	**End of Year 2**	**End of Year 3**
True Property Value	$10.00	$9.20	$8.464	$7.787
Op. Cash Flow	$0	$1.50	$1.380	$1.2690
-Depreciation	$0	-$1.00	-$0.920	-$0.8464
-Taxes	$0	$0.00	$0.000	$0.000
Net Income	$0	$0.50	$0.460	$0.4232
Sales Proceeds				$7.787
Total Cash (incl. dep.)	-$10.00	$1.50	$1.38	$9.056

   IRR = 7.00%
   (Section 10.4.1)

6. The calculations of the total cash flows per year are as follows.

	End of Year 0	End of Year 1	End of Year 2	End of Year 3
True Property Value	$10.00	$9.20	$8.464	$7.7870
Op. Cash Flow	$0	$1.50	$1.380	$1.2690
-Depreciation	$0	-$1.00	-$0.920	-$0.8464
Pre-Tax Profit	$0	$0.50	$0.46	$0.4232
-Taxes	$0	-$0.15	-$0.138	-$0.12696
Net Income	$0	$0.35	$0.322	$0.29624
Sales Proceeds				$7.7870
Total Cash (incl. dep.)	-$10.00	$1.35	$1.242	$8.92964

IRR = 5.50%

Note that since the property is sold at its depreciated value, there is no income tax due on its sale. Also, note that the after-tax IRR is 70% of the pre-tax IRR when the tax rate is 30% and depreciation for tax purposes equals economic depreciation.

(Section 10.4.1)

Topic 4: Hedge Funds

Readings

CAIA Level I: An Introduction to Core Topics in Alternative Investments. Second Edition. 2012. Wiley. ISBN: 978-1-118-25096-9. Part Three, Hedge Funds, Chapters 11 - 17.

Chapter 11
Introduction to Hedge Funds

Exercises

1. Comment on the following statement: "*We don't know the exact size of the hedge fund universe because the hedge fund industry has always been unregulated.*"

Problems 2 to 5

Hedge fund ABC has a 2 and 20 fee arrangement with no hurdle rate and a net asset value (NAV) of $300 million at the start of the year. At the end of the year, before fees, the NAV is $335 million.

2. Assuming that management fees are computed on start-of-year NAVs and are distributed annually, find the annual management fee.

3. Find the incentive fee for the managers of hedge fund ABC.

4. Find ABC's ending NAV after fees.

5. Suppose that at the end of the year, before fees, NAV was $277 million instead of the original $335 million. Calculate the new annual management fee, incentive fee, and ending NAV after fees for hedge fund ABC.

6. Use options theory to support the following hypothetical statement: "*Most global macro hedge funds had their worst ever returns last year. In fact, the average global macro hedge fund lost around 30%. Therefore, I predict that in coming months many global macro fund managers will start new hedge funds*."

Solutions

1. It is true that we don't know the exact size of the hedge fund universe. It is also true that the hedge fund industry has been unregulated throughout most of its history, and that this is a fact that helps explain the uncertainty regarding the true size of the hedge fund industry.

(Section 11.1.2)

2. The annual management fee is simply 2% of $300 million or $6 million.

   (Section 11.3.1)

3. After the management fee of $6 million, the fund earned a profit of $29 million ($335 – $6 – $300). The incentive fee on the profit is $5.8 million ($29 x 20% => $5.8).

   (Section 11.3.1)

4. The ending NAV after distribution of fees to fund manager is $323.2 million ($335 – $6 – $5.8).

   (Section 11.3.1)

5. The annual management fee would be the same as before, 2% of $300 million or $6 million. In this case, the fund had a loss and therefore no incentive fee would be collected by the manager. The ending NAV after distribution of management fees (the only fees that were collected in this case) to the fund manager is $271 million ($277 – $6).

   (Section 11.3.1)

6. When the incentive fee option becomes deeply out-of-the-money, as must be the case for many of the global macro hedge funds mentioned in this question, the manager has two choices to increase the value of the option. The first is to increase the volatility of the underlying asset. However, according to the hypothetical statement in the question, the average global macro hedge fund lost an astonishing 30% last year. This would imply that a global macro hedge fund manager would need to take extremely risky bets and increase the fund's volatility to dangerous levels so that the fund's net asset value could end up back to being at-the-money. This is unreasonable, if the bets go sour, the fund and the manager's reputation will go under. Besides, many investors would redeem their shares as soon as they realize that the fund volatility is increasing.

   The second choice when the incentive fee option is deep out-of-the-money consists of restriking the option (i.e., setting a new strike price – the net asset value at which incentive fees begin to be paid). However, current investors in the global macro hedge fund will most likely not allow the manager to restrike the option.

   Therefore, the only way to restrike the incentive fee call option back to being at-the-money is to start a new hedge fund, as suggested in the hypothetical statement. Unfortunately, the existing investors from the old global macro hedge funds are negatively affected when the manager starts a new hedge fund and diverts his time and attention to the new fund where the incentive fee call option is more valuable than in the old hedge fund.

   (Section 11.3.5)

Chapter 12
Hedge Fund Returns and Asset Allocation

Exercises

1. Exhibit 1 below presents performance statistics for U.S. stocks, U.S. bonds, and hedge funds. XYZ is a pension fund that currently has allocations only to traditional investments. Peter Lanz, a portfolio manager at XYZ Pension fund, has been recently pondering whether to recommend including hedge funds in XYZ's portfolio. However, Mr. Lanz has become pessimistic about adding hedge funds to XYZ's portfolio after finding out that the correlation coefficient between hedge funds (CISDM Hedge Fund Equally Weighted Index) and U.S. stocks (S&P 500) was 0.79 during that same period (2001-2008). Does the evidence in Exhibit 1 imply that there are no benefits of adding hedge funds to a portfolio of traditional investments?

   Exhibit 1: Hedge Fund and Comparison Index Performance (2001-2008)

Performance	U.S. Stocks (S&P 500)	U.S. Bonds (BarCar U.S. Agg.)	Hedge Funds (CISDM Equal W. HFs)
Annualized Total Return	-2.9%	5.7%	5.6%
Annualized Standard Deviation	15.0%	4.0%	6.6%
Correlation with hedge Funds	0.79	0.00	1.00

   Source: Edited from Schneeweis, Crowder and Kazemi, *The New Science of Asset Allocation* (Wiley: New Jersey, 2010)

2. Looking at Exhibit 2 below, what would explain the relatively high correlation between hedge funds (CISDM Hedge Funds Equally Weighted Index) and U.S. stocks (S&P 500 Index) that was documented in Problem 1?

   Exhibit 2: Performance of CISDM Hedge Fund Strategy Indices (2001-2008)

	Annualized Return	Standard Deviation	Correlation with S&P 500	Correlation with BarCap U.S. Gov	Correlation with BarCap Corp. High Yd.
CISDM EqualMarket Neutral	5.6%	2.0%	0.44	-0.16	0.40
CISDM Fixed Income Arbitrage	3.6%	4.8%	0.56	-0.18	0.75
CISDM Convertible Arbitrage	3.3%	6.2%	0.46	0.05	0.69
CISDM Distressed Securities	7.6%	6.0%	0.65	-0.16	0.77
CISDM Event-Driven Multi-Strategy	5.6%	6.3%	0.76	-0.27	0.78
CISDM Merger Arbitrage	4.8%	3.4%	0.66	-0.17	0.65
CISDM Emerging Markets	7.9%	10.5%	0.69	-0.17	0.71
CISDM Equity Long/Short	4.4%	6.0%	0.77	-0.32	0.62
CISDM Global Macro	6.4%	3.3%	0.30	0.05	0.28
S&P 500	-2.9%	15.0%	1.00	-0.39	0.68
BarCap U.S. Gov.	6.4%	4.7%	-0.39	1.00	-0.09
BarCap U.S. Corporate High Yield	3.2%	11.0%	0.68	-0.09	1.00

   Source: Edited from Schneeweis, Crowder and Kazemi, The New Science of Asset Allocation (Wiley: New Jersey, 2010)

3. Julia Smith is the hedge fund manager of ABC Tech, a fund specializing in the technology industry. She has followed the tech industry for years and has developed a superior information set. On the long side, the manager purchases those stocks that she believes will be the winners. On the short side, she takes short positions in those stocks that she believes will decline in value. The fund offers investors the ability to extract value on both the long side and the short side of the tech market. Can the investment strategy of ABC Tech be characterized as opportunistic investing? Explain.

4. Consider an absolute return program, where a portfolio has a specific target rate of return, volatility, and largest acceptable drawdown, while the individual hedge funds (underlying the program) have a target range of rates of return, a target range of volatilities, and a target largest acceptable drawdown. Liquidity for both the absolute return portfolio and the individual hedge funds is semiannual. Why does the liquidity of the absolute return portfolio have to be the same as that of the individual hedge funds?

5. Comment on the following statement: "*Published hedge fund indices have significant survivorship bias*."

6. Comment on the following statement: "*Published hedge fund indices have significant instant history bias*."

7. XYZ started as a convertible bond trading hedge fund in 2003. In 2007, based on the perceived availability of attractive opportunities in the market, the fund morphed its trading activities into being dominated by merger arbitrage trading. What is the term used in the hedge fund literature to refer to this problem?

8. Continuing with the previous problem, assume that XYZ Fund reports its returns to *Hedge Fund Index Inc.* but is not reclassified as a merger arbitrage fund. In 2007 XYZ had a return of -6.2% while the Convertible Bond Trading Hedge Fund Index and the Merger Arbitrage Hedge Fund Index published by *Hedge Fund Index Inc.*, exhibited returns of 4.1% and 3.8%, respectively. What consequence would the wrong classification of XYZ as a convertible bond trading hedge fund have on the returns reported by the Convertible Bond Trading Hedge Fund Index and the Merger Arbitrage Hedge Fund Index?

9. Critique the following statement: "*I disregard the information offered by those hedge fund index providers that include in their indices hedge funds which are closed to new investors*."

10. Provide two arguments in favor of the use of asset-weighted hedge fund indices.

11. Calculate an equally-weighted return and an asset-weighted return for an index that includes the following five hedge funds for the month of October. Comment on the differences in the results obtained.

Hedge Fund Name	October Returns (%)	Asset Size (U.S. $m)
Hedge Fund I	-4.00	300
Hedge Fund II	3.00	50
Hedge Fund III	1.00	100
Hedge Fund IV	5.00	40
Hedge Fund V	6.00	60

Solutions

1. According to portfolio theory, any new investment to be included in a portfolio would need to add value in terms of correlation (the only variable that Peter Lanz is considering to reach his conclusion), and also in terms of expected return and risk. In the case of hedge funds, even though their correlation to U.S. stocks was relatively high between 2001 and 2008 (and, incidentally, that correlation was higher than that of previous periods, such as 1990-2000), hedge funds managed to provide a higher return when compared to stocks (5.6% versus -2.9%), and with lower volatility (6.6% versus 15.0%). Hedge funds provided basically the same return as U.S. bonds (5.6% versus 5.7%), but with slightly higher volatility (6.6% versus 4.0%), and exhibited no correlation with bonds. Therefore, even during the difficult period of 2001-2008 (which included the bear markets of 2000-2002, and the Global Financial Crisis of 2008), hedge funds managed to provide positive returns (stocks provided negative returns) with low volatility (stocks had almost triple the volatility of hedge funds) and diversification benefits relative to bonds.

   (Section 12.1)

2. According to the Exhibit, the correlation of hedge fund strategies with U.S. stocks differs greatly among strategies. For example, whereas the correlation between global macro hedge funds and the S&P 500 index is only 0.3, the correlation between equity biased hedge funds (equity long/short and emerging markets hedge funds) and the S&P 500 index is close to or above 0.70. However, the observed correlation in Exhibit 1 between the returns of a combination of hedge fund strategies and U.S. stocks (0.79) is higher (0.79). This high correlation is likely due to two factors. First, it implies that equity biased hedge fund indices dominate hedge fund index returns. Second, correlation between indices is usually much higher than the average correlation of individual funds because diversification within indices eliminates a substantial portion of fund-specific risks.

   (Sections 12.1 and 12.2)

3. Yes, hedge fund ABC can be characterized as using an opportunistic investment strategy. Opportunistic investing does not need to have a hedged portfolio. Instead, opportunistic investing in sectors can lead to an expanded investment space, a more efficient investing, and allows managers to invest on a broader information set. In the specific case of hedge fund ABC, this fund can assemble a long/short market neutral portfolio based on tech stocks if that is where the fund considers that it possesses the capability to add value to investors.

   (Section 12.4.1)

4. Liquidity has to be the same for both the absolute return portfolio and the individual hedge funds because the investor in the portfolio must be able to cash out of each individual hedge fund within the portfolio using the same time frame as was established for the overall portfolio.

   (Section 12.3.5)

5. This is a common misconception. Most published hedge fund indexes use all available managers who report to the database to create the index. Performance of those hedge funds that stop reporting to the database will obviously not be reflected in the future values of the index. However, the historical performance of these hedge funds will continue to be reflected in the historic record of the values of the index. Thus the historic values of the index reflect the returns of fund that failed to survive.

   (Section 12.6.5)

6. The instant history or backfill bias does not affect the historical performance of most published indices because index providers do not revise the history of an index once a new hedge fund is incorporated in the index. Only the current and future performance of a hedge fund affects the index. Databases may contain instant histories and their accompanying potential biases, but indexes are typically not constructed using backfilled data.

   (Section 12.6.5)

7. This is referred to as strategy or style drift.

   (Section 12.6.6)

8. The wrong *inclusion* of XYZ as a convertible bond trading hedge fund in 2007 in the Convertible Bond Trading Hedge Fund Index computed by *Hedge Fund Index Inc.* has caused that index to underestimate the true return of convertible bond trading hedge funds. This is because the correct exclusion of XYZ, which had a return of -6.2% in 2007, from the Convertible Bond Trading Hedge Fund Index, which had a return of 4.1% in 2007, would have raised the return of the latter.

On the contrary, the wrong *exclusion* of XYZ in 2007 from the Merger Arbitrage Hedge Fund Index computed by *Hedge Fund Index Inc.* has caused that index to overestimate the true return of merger arbitrage hedge funds. This is because the correct inclusion of XYZ, which had a return of -6.2% in 2007, into the Merger Arbitrage Hedge Fund Index, which had a return of 3.8% in 2007, would have diminished the return of the latter.

In general, the impact that the problem of style drift by one particular hedge fund may have on an index is minimal, considering that many strategies usually consist of more than one hundred hedge funds. However, the problem becomes more serious when the number of hedge funds experiencing style drifts increases.

(Section 12.6.6)

9. An argument has been made that hedge fund indexes should be investable so that they can truly reflect the performance of investments that are open to new investors and, therefore, attainable. The problem with this approach is that an investable index will exclude a large section of the hedge fund universe (and in so doing misrepresent the actual experiences of investors who already have positions in funds that are closed) because closed funds represent a substantial portion of invested capital. Therefore, to be a truly representative index (of performance being experienced by existing investors) both open and closed funds should be included when calculating the performance of hedge fund indices. In sum, a major trade-off exists between having as wide a representation as possible of manager performance versus having a smaller group of hedge funds that embody the performance that may be accessible to new investors.
(Section 12.6.7)

10. First, smaller hedge funds can transact with a smaller market impact. An asset-weighted hedge fund index will include their performance based on how much capital is actually deployed in the small funds rather than the number of small funds. Second, many other asset classes (stocks, bonds, etc.) are also benchmarked against capital-weighted indexes, thus making comparisons between them more meaningful.

(Section 12.6.3)

11. The equally-weighted index return for October was:

(-4% + 3% +1% + 5% + 6%) = 2.2%

The asset-weighted index return for October was:

[(-4% x 300m) + (3% x 50m) + (1% x 100m) + (5% x 40m) + (6% x 60 m)] / 550 m
= -0.71%

The equally-weighted return was positive because only one of the five hedge funds (hedge fund I) had a negative return, and that negative return was not large enough (in

absolute value) to compensate the four positive returns of the remaining hedge funds when equally averaged.

The asset-weighted return was negative even though only one of the five hedge funds had a negative return (hedge fund I). This is because hedge fund I is larger in size than the other four hedge funds combined and also because its negative return was large enough (in absolute value).

(Section 12.6.3)

Chapter 13
Macro and Managed Futures Funds

Exercises

1. A stock price experiences the following five consecutive daily prices:

Day	-5	-4	-3	-2	-1
Price	205	204	201	201	195

What are the 3-day simple moving average prices on days -1 and 0?

2. A stock price experiences the following five consecutive daily prices:

Day	-5	-4	-3	-2	-1
Price	205	204	201	201	195

What are the 3-day weighted moving average prices on days -1 and 0?

3. A stock price experiences the following five consecutive daily prices:

Day	-5	-4	-3	-2	-1
Price	202	204	210	213	216

What are the exponential moving average prices on days -1 and 0 using λ=0.3? Assume that the exponential moving average up to and including the price on day -3 (i.e., the day -2 average) was 203.

4. XYZ, a stock listed on the Tokyo Stock Exchange, has experienced the following ten consecutive daily high prices.

Day	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1
Price	¥519	¥522	¥523	¥533	¥530	¥517	¥523	¥525	¥529	¥533

What is the day 0 price level that would signal a breakout and possibly a buy/sell position, using these ten days of data as being representative of a trading range?

5. If the price series of the previous problem contained the low prices for each day, what is the day-0 price level that would signal a breakout and possibly a buy/sell signal, using these ten days of data as being representative of a trading range?

Solutions

1. The simple moving average on day -1 is:
   (201 + 201 + 204)/3 = 202

   The simple moving average on day 0 is:
   (195 + 201 + 201)/3 = 199

   (Section 13.6.1)

2. The sum of the digits 1 through 3 is 6. The 3-day weighted moving average on day 0 is:

   [(195 x 3) + (201 x 2)+(201 x 1)]/6 = 198.

   The 3-day moving average on day -1 is:

   [(201 x 3) + (201 x 2)+(204 x 1)]/6 = 201.50.

   (Section 13.6.2)

3. The exponential moving average on day -1 is found as 0.30 x 213 (the day -2 price) plus 0.70 x 203 (the previous exponential moving average) which equals 206.

   The exponential moving average on day 0 is found as 0.30 x 216 (the day -1 price) plus 0.70 x 206 (the previous exponential moving average) which equals 209.

   (Section 13.6.2)

4. A price of ¥534 would exceed the range of the past data and would signal that a long position should be established according to the strategy.

   (Section 13.6.4)

5. If the price series of the previous problem contained the low prices for each day, a current price of ¥516 would be lower than the range. This price would signal a breakout on the downside and would typically be interpreted as a sell signal.

   (Section 13.6.4)

Chapter 14
Event-Driven Hedge Funds

Exercises

1. *Air ZZZ Corp.* is a publicly listed airline and has offered to purchase another publicly listed company, *MNO Airlines*, for $19 per share. Immediately after the announcement *MNO Airlines* trades at $17 per share. Immediately before the merger proposal announcement *MNO Airlines* was trading at $12 per share. *XYZ* is an event-driven hedge fund that has estimated the share price of *MNO Airlines* would fall to $10 if the deal failed. Assuming that the riskless interest rate is 0%, describe a long position in *MNO Airlines* taken by *XYZ hedge fund* as a combination of positions in a risk free bond and a binary call option.

2. Continuing with the previous question, describe a long position in *MNO Airlines* taken by *XYZ hedge fund* as a combination of positions including a binary put option.

3. *A Corp.* has just announced that it plans to merge with *B Corp* offering one of *A Corp's* shares for 3 shares of *B Corp.* Prior to the merger announcement *A Corp.* was trading at $56 per share, while *B Corp.* was trading at $15 per share. After the merger announcement, *A Corp.* still trades at $56 while *B Corp.* jumps to $17. Ignoring transactions costs, dividends and interests, how much money would the arbitrageur earn per share of *A Corp.* if the merger is consummated and how much money would be lost if the deal failed and the prices reverted to their pre-announcement levels?

4. A senior bond of *Rotten Corp.* is purchased at 40% of face value. Later, the corporation declares bankruptcy and 32% of the bond's face value is ultimately recovered. Express the rate of return as a non-annualized rate, and as an annualized rate based on a three-year holding period ignoring compounding and assuming no coupon income.

5. Among the various hedge fund strategies in the event-driven category, which is involved in: (1) identifying corporations whose management teams are not maximizing shareholder wealth, (2) establishing investment positions that can benefit from particular changes in corporate governance, and (3) executing corporate governance changes that are perceived to benefit the investment positions that have been established?

6. Continuing with the previous question, do the positions taken by hedge funds following this strategy contain systematic risk or idiosyncratic risk embedded in the resulting portfolios?

Solutions

1. *XYZ hedge fund's* position may be viewed as a long position in a riskless bond with a face value of $10 and a long position in a binary call option with a strike price of $10 and therefore potential payout of $9 in case the merger is successful and shares of *MNO Airlines* rise to $19 per share.

(Section 14.1.1)

2. *XYZ hedge fund's* position may also be viewed as a long position in a riskless bond with a face value of $19 and a short position in a binary put option with a strike price of $19 and a potential payout of $9 in case the merger is not successful and shares of *MNO Airlines* decline to $10 per share.

   (Section 14.1.2)

3. After the merger announcement, an arbitrageur would take a short position on the stock of the bidding firm (*A Corp*) and a long position in the stock of the firm to be acquired (*B Corp.*). The short position in one share of *A Corp.* generates cash proceeds of $56, while buying 3 shares of *B Corp.* costs $51. If the deal goes through, the arbitrageur pockets the $5 net proceeds (i.e., $56-$51) as profit and delivers the exchanged shares to cover the short position. If the deal fails, the arbitrageur sells the 3 shares of *B Corp.* at $15 per share for a total of $45, buys back *A Corp.* at $56 and expends $11 (i.e., $56-$45), which is a $6 loss.

   (Section 14.3.1)

4. The non-annualized rate is -20% found as an $8 loss on a $40 investment (per bond). The annualized rate based on a three-year holding period is -6.67% found as -20%/3, ignoring compounding.

   (Section 14.4.3)

5. This corresponds to a description of an activist investment strategy.

   (Section 14.2)

6. There is a substantial amount of both systematic and idiosyncratic risk embedded in the resulting portfolios of activist hedge funds.

   (Sections 14.1.2 and 14.2.4)

Chapter 15
Relative Value Hedge Funds

Exercises

1. A convertible bond is issued by *ABC Corp.* at par with a conversion ratio of 20. The face value of the bond is $1,000. Calculate the conversion price of the bond.

2. A convertible bond issued by *ZYZ Corp.* has a face value of $100, a coupon rate of 8%, and a conversion ratio of 10. Common stocks of ZYZ Corp. are trading at $23 per share. Calculate the conversion value of the bond.

3. Consider a firm with a borrowing cost of 6% on unsecured, subordinated straight debt and a current stock price of $19. The firm is able to issue a five-year convertible bond at par ($100) by offering a coupon rate of 3% and by offering a conversion ratio of 5. Calculate the implicit option strike price implied by the conversion ratio. Assume a face value of the bond of $100.

4. Calculate the value of the portion of the convertible bond's price that is attributable to its implied straight bond value (i.e., ignoring the conversion option) using annual coupons and annual compounding for simplicity.

5. Assume that the fair market price of a five-year European style call option with the strike of $20 on one share of the firm is $2.53. Calculate the value of the convertible bond price.

6. Calculate the conversion premium of this bond.

7. A 30-day variance swap on the returns of the S&P 500 index with a variance notional value of $1,000,000 has a strike price of 5.00. After the 30-day reference period is observed, the realized annualized variance in the index is 5.50. Calculate the final payoff of the variance swap.

8. What is the market value of a short position in a five year zero coupon bond that would form a duration neutral hedge with a $1,000,000 long position in a bond with a duration of 3?

Solutions

1. The conversion price of the bond is $1,000/20 shares = $50

   (Section 15.1.1)

2. The conversion value of the bond is 10 x $23 = $230

   (Section 15.1.1)

3. The implicit option strike price implied by the conversion ratio is equal to:

   $100 / 5 = $20

   (Section 15.1.1)

4. The straight value of the bond is $87.36, found introducing the following inputs in the calculator: n=5, i=6, PMT=3, FV=100 and solving for PV.

   (Section 15.1.1)

5. The value of the convertible bond is equal to the value of straight corporate debt plus the value of the implicit equity call option. In this problem, adding the straight bond value of $87.36 found in the previous problem to the implicit value of 5 options (i.e., $12.65 = $2.53 x 5), yields a convertible bond valuation of $100.01, a value which is very close to the bond's face value of $100.

   (Section 15.1.1)

6. We need to calculate the conversion value of the bond first, found as the current stock price multiplied by the conversion ratio. This gives a conversion value of $95 (i.e., $19 x 5).

   Conversion Premium = (Convertible Bond Price - Conversion Value)/Conversion Value

   Conversion Premium = ($100.01 - $95)/$95 = 5.2737%

   (Section 15.1.1)

7. The final payoff of the variance swap is:

   $1,000,000 × (5.50 – 5.00) = $500,000

   (Section 15.2.1)

8. The duration of the five year zero coupon bond is equal to its maturity of five years. The size of the short position must be $1,000,000 × (3/5) or $600,000.

   (Section 15.3.2)

Chapter 16
Equity Hedge Funds

Exercises

1. An equity long/short hedge fund has the following portfolio composition:

   Long positions: 150% of the portfolio value
   Short positions: 50% of the portfolio value (in absolute value)

   The long exposure comprises a single asset with a beta of 1.25 whereas the short exposure comprises an exchange traded fund that passively replicates the overall stock market. What is the beta of this equity long/short fund?

2. With regard to the Fundamental Law of Active Management (FLOAM), what is the name of the term that represents the correlation between forecasted returns and actual returns across active bets?

3. XYZ is an equity hedge fund. At the beginning of the year, the hedge fund held 130% of the portfolio's value in an exchange-traded fund (ETF) that passively replicates exposure to the technology sector of the S&P 500. Simultaneously, the hedge fund manager established a short position of 100% of the portfolio value in an exchange-traded fund that passively replicates exposure to the financial sector of the S&P 500. 70% of the portfolio was in cash. Assuming that the relevant market index is the S&P 500 and that the estimated beta of the technology ETF is 1.52 and the estimated beta of the financial sector ETF is 0.98, calculate the weighted average beta of this equity long/short portfolio.

4. From January to June, the return on the S&P 500 was 3.50% while the risk-free rate was 2.50%. Ignoring idiosyncratic risk, fees and transactions costs, calculate the expected return on the hedge fund's portfolio according to CAPM.

5. For Year 1, the return on the technology ETF was 8% while the return on the financial sector ETF was -13%. Calculate the return on the combination of ETFs in the portfolio ignoring fees and transactions costs and interest on cash.

6. Suppose that in the previous problem, the return on the technology ETF was -3% while the return on the financial sector ETF was 5%. Calculate the return on the portfolio ignoring fees and transactions costs and interest on cash.

7. An equity market-neutral hedge fund dedicated to the Brazilian stock market has selected a list of underpriced companies that the manager believes will outperform the Brazilian aggregate stock market by 4% over the next year. The manager has also selected another list of overpriced companies that the manager believes will underperform the Brazilian aggregate stock market by 6% over the next year. The hedge fund has a capital of $5 million available to create a market-neutral position. The fund's prime broker requires that a margin deposit equal to 20% of the market value of the stocks shorted be posted as collateral. Ignoring fees, transactions costs, and interest rates, sketch the most levered market neutral strategy that the hedge fund could follow. Also assume that the portfolios of overpriced and underpriced stocks have the same dividend yields and betas; and calculate the expected percentage return on the $5 million capital. What effect will Brazilian aggregate stock market return have on the portfolio return expectation?

Solutions

1. 1.375

   (Section 16.5.3)

2. IC, or information coefficient

   (Section 16.3)

3. The weighted average beta of this equity long/short portfolio is:

$(1.3 \times 1.52) - (1.0 \times 0.98) = 0.996$

This long/short equity portfolio has approximately the same systematic risk as the S&P 500.

(Section 16.5.3)

4. Given the realized return on the market portfolio and beta of the hedge fund, the expected return on this portfolio, and according to the CAPM, should be:

   Return = 2.50% + 0.996 (3.50% − 2.50%) = 3.496%

   (Section 16.5.3)
5. The portfolio would have earned the following return:

   $(1.3 \times 8\%) + (-1.0 \times -13\%) = 23.4\%$

   (Section 16.5.3)

6. The portfolio would have earned the following return:

   $(1.3 \times -3\%) + (-1.0 \times 5\%) = -8.9\%$

   In this case, the two bets behave contrary to what the hedge fund was expecting and thus the fund experienced a loss.

   (Section 16.5.3)

7. Suppose the hedge fund takes a short position equal to X. The full proceeds from the short transaction are not available as the fund has to put up $0.2 \times X$ as margin. Thus the fund will have $(5 - 0.2 \times X + X)$ to invest in long positions. The maximum amount that the fund can invest in short positions is $25 million (i.e., $5 million/0.20) in stocks. The maximum amount that the fund can invest in long positions is $25 million as well. This will happen when the fund shorts $25 million of stock. Of this amount $20 million will be available for long positions, which means the firm can invest a total of $25 million in long positions. Since both portfolio components have symmetrical market exposure (one is long, the other is short), the market return component will cancel out. The portfolio return expectation is independent of the expected market return. Thus, if the rate of return on the market is r, the total return on fund at the end of the year will be: $\$25 \times (r+4\%) - \$25 \times (r-6\%) = \$2.5$. This translates into a 50% rate of return (2.5/5).

   (Section 16.5.5)

Chapter 17
Funds of Hedge Funds

Exercises

1. ABC is a fund of hedge funds (FoHF). Suppose a year ago ABC invested 200 million Euros in only two hedge funds, 100 million Euros in hedge fund 1 and 100 million Euros in hedge fund 2. Hedge funds 1 and 2 each charge an incentive fee of 20% and neither has a hurdle rate or charges management fees. If the gross rate of return earned this year by hedge fund 1 is 30% and the gross rate of return earned by hedge fund 2 this year is -50%, calculate the (return net of fees) obtained by ABC. Interpret the results obtained.

2. Based on the previous problem, suppose now that ABC is a multistrategy fund that has the same two investments earning the same returns but the two investments are internal strategies inside a single (multistrategy) fund rather than being outside investments inside a fund of funds. The multistrategy fund charges a 20% incentive fee on aggregated profit. Calculate the net returns obtained by investors in ABC. Interpret the results obtained.

3. The prospectus of a fund of hedge funds *SINGLE, LLC* states that this FoHF allocates its capital only among hedge funds dedicated to investing in stocks of the technology sector. The prospectus of another fund of hedge funds *MULTI, LLC* states that this FoHF invests in hedge funds dedicated to any strategy that the fund may determine to be suitable for its investors. In theory, which of the two funds of hedge funds would need to invest in a larger number of hedge funds to obtain the same degree of diversification in its portfolio as the other FoHF?

Solutions

1. The following table shows the value of ABC's investments on each hedge fund in year 0 and year 1, as well as the total investment made by this fund of hedge funds. At the end of the year, ABC's gross investment in both hedge funds declined from 200 million Euros to 180 million Euros, for a gross aggregate percentage return of -10%. ABC's investment in hedge fund 1 (HF1) experienced a gross return of 30 million Euros and thus HF1 charged an incentive fee of 6 million Euros (i.e., 30 million Euros x 0.2). ABC's investment in hedge fund 2 experienced a gross return of -50 million Euros and therefore no incentive fee was charged on this investment. As a result of the incentive fee of 6 million Euros charged by hedge fund 1, the value of ABC's investment in both hedge funds at the end of the year, net of fees, amounts to 174 million Euros, for a -13% net aggregate return. Notice that even though ABC's aggregate investments in HF1 and HF2 lost value during the year (due to the dismal performance of HF2), ABC was charged incentive fees on the first hedge fund and, therefore, a -10% gross return (i.e., 200 million Euros declining to 180 million) became a -13% net return (i.e., 200 million Euros declining to 174 million).

	HF 1	HF 2	Fund of HF ABC
Investment (year 0, Million Euros)	€ 100	€ 100	€ 200
Investment (year 1, Million Euros)	€ 130	€ 50	€ 180
Gross Return (Million Euros)	€ 30	-€ 50	-€ 20
Incentive fee (Million Euros)	€ 6	-	€ 6
Investment, net of fees (year 1, Million Euros)	€ 124	€ 50	€ 174
Return, (net of fees, percentage)	24%	-50%	-13%

(Section 17.1)

2. Given that ABC experienced a loss in its aggregate investments during the year, no incentive fee is charged to its investors. Therefore, the net return perceived by investors in the multistrategy fund will be -10%. There is no incentive fee due to the aggregated loss and so the net return of the multistrategy fund is the same as the gross return of the fund of funds.

   (Section 17.1)

3. In theory, *SINGLE, LLC* would need to invest in a larger number of hedge funds than *MULTI, LLC* to reach the same degree of diversification in its portfolio. This is because the degree of correlation in the returns offered by hedge funds dedicated to the same strategy (hedge funds dedicated to investing in stocks of the technology sector) would presumably be higher than the degree of correlation in the returns offered by hedge funds dedicated to multiple (and many of them unrelated) strategies. In fact, it may be impossible for the technology fund of funds to obtain the same degree of diversification as the Multi fund if the Multi fund is well diversified.

   (Section 17.1)

Topic 5: Commodities

Readings

CAIA Level I: An Introduction to Core Topics in Alternative Investments. Second Edition. 2012. Wiley. ISBN: 978-1-118-25096-9. Part Four, Commodities, Chapters 18 - 19.

Chapter 18
Commodity Futures Pricing

Exercises

1. What is the value of a 6-month futures contract on the Standard & Poor's (S&P) 500 index given the following information: an index at 1500, the risk-free rate at 5%, and the dividend yield at 1%?

2. Consider the case of a non-dividend-paying financial asset where $F > Se^{r(T-t)}$. How, in this case, can the hedge fund manager earn a profit?

3. XYZ is a non-dividend paying stock whose current market price is $19. The risk-free rate is 9% per year with continuous compounding. Calculate the price of a 9-month forward contract on XYZ stock.

4. Consider a stock index whose current value is 227. The dividend yield on the stock index is 4.6% and the risk-free interest rate is 8%. Both are annual rates with continuous compounding. What is the 12-month futures price?

5. The dividend yield on a stock index and the risk-free rate are 3% and 6%, respectively (both are annual rates assuming continuous compounding). The current value of the index is 865. What is the 6-month futures price?

6. Calculate the futures price of silver for delivery in 4 months assuming the following information: Current price of silver: $30 per ounce, storage costs: 2% per year with continuous compounding, risk-free rate: 5.5% per year with continuous compounding (the term structure is flat).

7. Explain the difference between storage costs and convenience yield.

Solutions

1. $1,530.30

   (Section 18.3.4)

2. By buying the underlying asset and establishing a short position in the futures contract.

   (Section 18.3.3)

3. Using the equation for the futures price for a financial asset that pays no income, we have:

   $F = Se^{r \times T}$
   $F = \$19e^{(0.09)(9/12)} = \$20.33$

   (Section 18.3.3)

4. Using the equation for the futures price for a financial asset that pays income, we have:

   $F = Se^{(r-d) \times T}$
   $F = 227e^{(0.08-0.046)} = \$234.85$

   (Section 18.3.3)

5. According to the equation for the futures price for a financial asset that pays income, we have:

   $F = Se^{(r-d) \times T}$
   $F = 865e^{(0.06-0.03)(6/12)} = 878.07$

   (Section 18.3.3)

6. According to the equation for the futures price for a financial asset that pays income, we have:

   $F = Se^{(r+c) \times T}$
   $F = \$30e^{(0.055+0.02)(4/12)} = \$30.76$

   (Section 18.3.4)

7. Storage costs are the costs associated to the storage of physical commodities. These costs must be factored into the pricing equation and can be regarded as negative income. Convenience yields arise when users of physical commodities feel that there are benefits from the ownership of the commodity that cannot be obtained by owning a futures contract. Convenience yields can be considered a positive income.

   (Section 18.3.4)

Chapter 19
Commodities: Applications and Evidence

Exercises

Problems 1 through 3

Raymond Marceau is in charge of recommending commodity investments to *Athens Fund*, an endowment that, at present, has allocations only to traditional asset classes. The current portfolio of *Athens Fund* consists of diversified investments in fixed-income securities and stocks. Mr. Marceau has collected the following information on commodities, U.S. stocks, U.S. bonds and U.S. inflation for the period 2001-2007:

(2001-2007)	Commodities Composite Commodity Index*	Stocks S&P 500 Total Return Index	Bonds Barclays U.S. Aggregate
Average Return	10.50%	3.30%	5.80%
St. Deviation	15.70%	13.30%	3.60%

CORRELATION MATRIX	
	Commodities
Stocks	0.03
Bonds	-0.05

CORRELATION MATRIX	
	Monthly Inflation (CPI) Changes
Stocks	0.02
Bonds	0.02
Commodities	0.31

* The composite commodity index is calculated as the average of the performances of BCI, GSCI and DJ-UBS indices

Mr. Marceau noticed that commodities provided the highest return of the three asset classes, but he is concerned that the standard deviation of the commodities' return is higher than the standard deviation of the return of either stocks or bonds. This led him to question whether to add commodities to the traditional portfolio of stocks and bonds at all. Mr. Marceau would also like to assess whether commodities provide a better inflation hedge than stocks or bonds and would like to examine the long-term performance of commodity investments.

1. How can Mr. Marceau's fear of the historic risks of commodities be countered in the context of a stand-alone investment?

2. How can Mr. Marceau's fear of the historic risks of commodities be countered in the context of a portfolio?

3. Based on the information collected by Mr. Marceau on the inflation hedging capabilities of commodities, would commodities be helpful in providing protection from inflation?

4. Explain how an investor having restrictions on investing in the commodities markets may obtain commodity exposure through debt instruments.

Solutions

1. The relatively higher standard deviation of commodities' returns was compensated by a sufficiently higher return.

   (Section 19.1.1)

2. The relatively higher standard deviation of commodities' returns was compensated by low correlation with traditional assets such that commodities offered substantial diversification benefits.

   (Section 19.1.1)

3. Commodities offered a better inflation hedge than stocks or bonds.

   (Section 19.1.4)

4. An investor may obtain commodity exposure through debt instruments by investing in commodity-linked notes, which are an intermediate term debt instrument whose value at maturity will be a function of the value of an underlying commodity futures contract or basket of commodity futures contracts.

   (Section 19.3.4)

Topic 6: Private Equity

Readings

CAIA Level I: An Introduction to Core Topics in Alternative Investments. Second Edition. 2012. Wiley. ISBN: 978-1-118-25096-9. Part Five, Private Equity, Chapters 20 - 22.

Chapter 20
Introduction to Private Equity

Exercises

1. What term is most accurately associated with the year in which a particular private equity fund commences operations?

2. Describe the evolution of the private equity (PE) market in recent decades.

3. Describe venture capital (VC).

4. What is the key factor contributing to the growth in leveraged buyouts (LBOs) during the 1980s?

5. What type of private equity represents a hybrid of debt and equity that is typically designed as an intermediate-debt bond plus an equity kicker?

6. What are story credits?

7. Describe the type of firms that distressed debt investing targets.

8. What factors caused the distressed debt market to grow considerably in the first decade of the new millennium?

9. What are common differences between typical hedge fund fees and typical private equity fund fees?

Solutions

1. Vintage year

   (Section 20.1)

2. A few decades ago the supply of private equity capital came typically through a limited number of large private equity firms. Competition has increased with more private equity firms being able to compete. Further, in the past few years hedge fund managers have been bidding for operating assets in open competition with private equity firms.

(Section 20.1)

3. VC represents senior equity stakes in firms that are still privately held and are illiquid. Venture capitalists often take active roles in providing managerial guidance. Investors in VC must be prepared to invest for the long-run.

   (Section 20.2.1)

4. Financing of LBOs using bonds originally issued with low credit ratings

   (Section 20.2.4)

5. Mezzanine financing

   (Section 20.3)

6. Story credits are private debt issues with credit risk based on unusual circumstances that involve special aspects (they have a "story") and are senior secured financings of companies possessing good credit.

   (Section 20.3.1)

7. The companies that distressed debt investing targets may have already defaulted on their debt or may be about to default. These companies may be seeking bankruptcy protection.

   (Section 20.3.2)

8. Many more types of commercial loans were available for resale during the first decade of the new millennium. The issuance of covenant-light loans (cov-lite) increased during the first decade of the new millennium. Many more banks managed their assets from a larger portfolio perspective as opposed to an account level basis during this period, and the volume of very low-quality debt as a percentage of total high-yield bond issuance grew significantly during this period.

   (Section 20.3.3)

9. Private equity fund fees tend to be collected at the termination of deals whereas hedge fund incentive fees are front-loaded. Private equity fund incentive fees tend to be collected at the time of events such as exits whereas hedge fund incentive fees are collected on a regular basis. Private equity funds, but not hedge funds, typically have clawback provisions requiring the return of fees on prior profits when subsequent losses are experienced.

   (Section 20.4.3)

Chapter 21
Equity Types of Private Equity

Exercises

1. Describe differences between venture capital and leveraged buyouts (LBOs).

2. In venture capital, what is a "20-bagger?"

3. What is the range of management fees that is most likely to be charged by typical venture capital funds?

4. A venture capital (VC) firm raises capital from outside investors; the capital is committed first and then invested in businesses. Typically, at which stage is the management fee assessed by the manager?

5. At the very start of new ventures, entrepreneurs need funds to prepare business plans, evaluate the market potential and assemble management teams. Private equity investors commonly provide financing for this stage. What term identifies this type of investing?

6. Leveraged buyout (LBO) funds typically have less risk than venture capital (VC) funds. Provide three explanations for this differential.

7. Describe the J-Curve effect in the typical life cycle of a venture capital fund.

8. A manager of a venture capital fund raised $80 million in committed capital. The management fee is set at 2%. To date, only $30 million of the raised capital has been called and invested in startups. Calculate the annual management fee that the manager is collecting.

9. Assume a private equity firm raises a $6-billion buyout fund and charges a management fee of 1.5%. Calculate the present value of the management fees to the private equity firm assuming an 8-year life for the fund, no change in its value and a 7% discount rate.

Problems 10 to 16

XYZ is a publicly traded firm that is being analyzed as a potential LBO target by ABC fund. The following are some key financial statistics for XYZ:

Equity (market value): $350 million
Debt (face value): $70 million.
Current annual cash flow: $75 million.

ABC fund offers $500 million to purchase the equity of XYZ and to pay off, at face value, its outstanding debt. ABC fund finances this $500 million LBO issuing $450 million in debt and $50 million in equity. After the buyout, XYZ's after-tax cash flow

from operations improves from $75 million to $90 million per year due to operating efficiencies implemented by ABC fund.

10. Calculate the premium that ABC fund is offering to the shareholders of XYZ to entice them to tender their shares.

11. Assuming XYZ does not pay dividends and the cash flow from operations is directed to pay down the debt that was used to finance the acquisition by ABC fund, how many years would ABC fund have to wait so that it can own XYZ free and clear? Assume a zero annual interest rate for the debt.

12. After the fifth year, and assuming a forward looking long-term growth rate of 4% per year and a discount rate of 14%, calculate the value of XYZ in five years using the Constant Dividend Growth Model.

13. Calculate the annual total return on the investment for the LBO transaction.

14. Continuing with the analysis, suppose that all other facts remain the same except that the discount rate used at the end of five years is 20%. Calculate the total annual return on the investment for the LBO transaction.

15. Continuing with the analysis, suppose that all other facts remain the same except that the discount rate is 15% and the growth rate used at the end of five years is 3%. Calculate the total annual return on investment for the LBO transaction.

16. Continuing with the problem, suppose that all other facts remain: the discount rate is 14%, the growth rate used at the end is 4%, but now the investment requires six years to exit. Calculate the total annual return on the investment for the LBO transaction.

Solutions

1. In a leveraged buyout all of the equity of a company is acquired and control is absolute. Many LBOs endeavor to find where they can add operating efficiencies and attempt to discover where they can expand product distribution. Venture capitalists target higher internal rates of return than leveraged buyout firms.

   (Section 21.1)

2. A company that appreciates in value 20-fold compared to the cost of the venture capital investment

   (Section 21.2)

3. 2.0% to 2.5%

   (Section 21.3.2)

4. Management fees are typically charged when committed

   (Section 21.3.2)

5. Angel investing

   (Section 21.3.4)

6. LBOs purchase established public companies that are less risky than VC because they are considerably beyond their IPO stage. LBO firms tend to be less specialized than venture capital firms and therefore LBOs tend to possess greater diversification than their venture capital counterparts. The eventual exit strategy of an LBO is less likely to be a new IPO and is therefore less risky.

   (Section 21.6)

7. Losses in the early years due to write-offs and early expenses, followed by high returns in the later years as successful investments are exited and profits are realized.

   (Section 21.3.3)

8. The annual management fee that the manager collects is $1.6 million (i.e., 2% x $80 million), even though not all of the capital has been invested.

   (Section 21.3.2)

9. The annual fee is $90 million for the life of the fund (i.e., 1.5% x $6 billion). Assuming an 8-year life for the fund and a 7% discount rate for the time value of money, the present value of the management fees to the private equity firm is $537.42 million (in a financial calculator, n=8, i=7, PMT=90 million, FV=0, and solve for PV).

   (Section 21.5.2)

10. [$500 million - $70 million)/$350 million] - 1 = 0.2286 or 22.86%
    In dollars, a premium of $80 million

    (Section 21.5.7)

11. $450 million/$90 million = 5 years

    After five years and ignoring potential growth in cash flows, ABC fund, as the sole equity owner of XYZ, can claim the annual cash flow of $90 million completely for itself.

    (Section 21.5.7)

12. $90 million/(0.14 – 0.04) = $900 million. Notice that this would be by then (in five years) the value of an unlevered firm.

    (Section 21.5.7)

13. ($900 million/$50 million)$^{1/5}$ – 1 = 0.7826 or 78.26%

    (Section 21.5.7)

14. In this case, the new projected value of the company becomes $90 million/(0.20 – 0.04) = $562.5 million, and the five year rate of return becomes ($562.5 million/$50 million)$^{1/5}$ – 1 = 0.6227 or 62.27%.

    (Section 21.5.7)

15. In this case, the new projected value of the company becomes $90 million/(0.15 – 0.03) = $750 million and the five year rate of return becomes ($750 million/$50 million)$^{1/5}$ – 1 = 0.7188 or 71.88%.

    (Section 21.5.7)

16. The projected value of the company is once again $90 million/(0.14 – 0.04) = $900 million and the six year rate of return becomes ($900 million/$50 million)$^{1/6}$ – 1 = 0.6189 or 61.89%.

    (Section 21.5.7)

Chapter 22
Debt Types of Private Equity

Exercises

1. How does the control of the underlying company in the case of an LBO typically compare to the control of the underlying company in the case of mezzanine financing?

2. True or false: An exit strategy for mezzanine debt may occur when the underlying company obtains capital through a large equity issuance.

3. Compared to leveraged loans and high-yield bonds, how liquid is mezzanine debt?

4. Who are typical investors in mezzanine funds?

5. What is the typical size of mezzanine funds compared to leveraged buyout funds?

6. Describe common restrictions placed by a mezzanine lender on a borrower.

7. What characteristic of mezzanine investing allows an investor to purchase the senior debt once it has been repaid to a particular level?

8. Company XYZ has a simple capital structure where assets are financed 70% by bank loans and 30% by equity. The cost of debt is 10% and the cost of equity is 27%. Suppose now that half of the equity capital is replaced with mezzanine debt at a coupon rate of 16% and that, as a result of equity capital being now more risky, the cost of equity capital rises to 31%. Calculate the weighted average cost of capital when there was no mezzanine debt and when mezzanine debt was contracted.

9. ABC´s assets are currently being financed 70% by bank loans at an interest rate of 9%, and 30% by equity. ABC´s beta is 1.5, the risk-free rate is 3% and the expected return on the market portfolio is 12%. Calculate the weighted average cost of capital of ABC.

10. Continuing with the previous question, assume now that 50% of the equity financing is replaced with mezzanine debt with a coupon of 10%. Calculate the weighted average cost of capital of ABC.

11. In bankruptcy proceedings, what is the meaning of the term cramdown?

Solutions

1. In contrast to an LBO, mezzanine financing typically does not necessarily involve control of the underlying company

   (Section 22.1)

2. True

   (Section 22.1)

3. The liquidity of mezzanine debt is minimal

   (Section 22.1.2)

4. Pension funds, endowments and foundations

   (Section 22.1.4)

5. Mezzanine funds are typically considerably smaller than leveraged buyout funds

   (Section 22.1.4)

6. The lender may approve or disapprove the issuance of additional debt by the borrower, may require that new debt be subordinated to the original mezzanine debt, and may enjoy final approval on dividend payments by the borrowing firm.

(Section 22.1.5)

7. The takeout provision

   (Section 22.1.5)

8. Weighted Average Cost of Capital (without mezzanine debt) = (70% x 10%) + (30% x 27%) = 15.1%

   Weighted Average Cost of Capital (with mezzanine debt) = (70% x 10%) + (15% x 16%) + (15% x 31%) = 14.05%

   (Section 22.1.1)

9. First of all, we need to calculate the cost of equity using the CAPM as follows:

   $Rf + B\ [E(R_M) - Rf]$

   3% + 1.5(12%-3%) = 16.5%

   The weighted average cost of capital of ABC is equal to:

   (bank loan weight x cost of bank loans) + (equity weight x cost of equity)

   (70% x 9%) + (30% x 16.5%) = 11.25%

   (Section 22.1.1)

10. The weighted average cost of capital of ABC is now equal to:

    (bank loan weight × cost of debt) + (equity weight × cost of equity) + (mezzanine debt x cost of mezzanine debt)

    (70% × 9%) + (15% × 16.5%) + (15% × 10%) = 10.275%, which is lower than the 11.25% obtained in the previous question when there was no mezzanine financing.

    (Section 22.1.1)

11. Cramdowns can occur when the creditors and the debtor cannot reach an agreement. According to the U.S. bankruptcy code, a reorganization plan under Chapter 11 may be confirmed by the Court over objections so long as the plan (1) does not unfairly discriminate against the members of any impaired class that may have voted against it, and (2) is fair and equitable with respect to the members of that class.

    (Section 22.2)

Topic 7: Structured Products

Readings

CAIA Level I: An Introduction to Core Topics in Alternative Investments. Second Edition. 2012. Wiley. ISBN: 978-1-118-25096-9. Part Six, Structured Products, Chapters 23 - 25.

Chapter 23
Credit Risk and the Structuring of Cash Flows

Exercises

1. What are the three major types of credit risk?

2. Describe structural models of credit risk.

3. The structural model approach to credit risk recognizes the option-like characteristics of structured cash flows. In this context, use call options to describe the position held by equity holders on the assets of a leveraged corporation.

4. Describe the fundamental relationship of options theory known as put-call parity (assuming that both the call option and the put option are on the same underlying asset and have the same strike price and expiration date).

5. In the context of Merton's structural model and making use of basic properties of option prices, what are the five changes in its underlying determinants that will cause call option premiums to increase?

6. In what case will risk-neutral probabilities be interpreted as statistical probabilities?

7. List two advantages and two disadvantages of structural models of credit risk.

8. Describe advantages of reduced-form models of credit risk.

9. Which options strategy best describes the position held by the most senior tranche (the senior debt) in a collateralized debt obligation (CDO)?

10. True or false: Downgrade risk originates from a review by an independent agency while credit spread risk originates from a reaction in the financial markets.

11. Use the following information and the one-step binomial process approach to firm value estimation (discrete time compounding). Suppose the current value of XYZ Corporation's assets is £200, and that the value of the firm's assets is expected to increase or decrease by 25% over the next year. If the one-year riskless rate is 1%, what is the risk-neutral probability (π) of an up-move?

12. Suppose the current value of ABC Corporation's assets is $500. The value of its assets is expected to either increase or decrease by 20% over the next year. The one-year riskless rate is 3%. The firm has one-period, zero-coupon debt outstanding with the notional (or principal) value of $430. Calculate the implied risk-neutral probabilities.

13. Calculate the price of the implicit European put option written on the firm's assets.

14. Calculate the arbitrage-free price of ABC's risky debt.

15. Calculate the credit spread for ABC's bond.

16. Assume now that the value of ABC's assets is expected to either increase or decrease by 15% over the next year but that other assumptions remain the same. Calculate the new value of the put.

17. Following the analysis of #16, calculate the arbitrage-free price of ABC' risky debt.

18. Following the analysis of #16 and #17, calculate the credit spread for the bond of the previous example.

19. A bank has extended a $100 million one-year loan at an interest rate of 15% to a client with a BBB- credit rating. Suppose that the one-year probability of default for firms with a BBB- rating is 7% and that investors are typically able to recover 30% of the notional value of an unsecured loan to such firms. Calculate the expected credit loss of the bank and the loss in case a default occurs.

20. Suppose the risk-free rate is 3% per year and a one-year, zero-coupon corporate bond yields 7% per year. Assuming a recovery rate of 70% on the corporate bond, calculate the bond's risk-neutral probability of default using the exact formula and the approximation formula.

21. Suppose that the junior debt of LBC Corporation currently trades at a credit spread of 2.50% over riskless bonds of comparable maturity. The senior debt of the firm has not been regularly traded because it was primarily held by a few institutions, and a new issue of debt has been issued that is subordinated to all other debt and is rated to be speculative. The expected recovery rates of the most senior debt is 80%, the old junior debt is 50% and the recently issued speculative debt is 20%. Using approximation formulas, what arbitrage-free credit spreads should be expected on the senior and speculative debt issues?

22. Suppose a CDO that is being used to structure the cash flows from a portfolio of high yield bonds. There are $70 million of high-yield bonds earning an average yield of 6% that serve as the collateral portfolio for the structure. The following tranches provided the financing for the portfolio: A $50 million Super tranche, rated AAA, yielding 4%; a $12 million Mezzanine tranche, rated BBB-, yielding 7%; and an $8 million Equity tranche,

unrated, which yields 12%. Ignoring defaults, fees and expenses, how much annual income should be available to each of the tranches?

Solutions

1. Default risk, downgrade risk and credit spread risk

   (Section 23.1)

2. Structural models explicitly consider the structuring of the cash flows (i.e., debt levels) and the behavior of the underlying assets as underlying factors driving the default process. Structural models consider defaults as events occurring when the value of assets relative to the amount of debt reaches a particular threshold. The probability of default is calculated by modeling the behavior of assets.

   (Section 23.2.1)

3. Equity holders are the owners of a call option on the assets.

   (Section 23.3)

4. Call + Riskless Bond = Assets + Put

   (Section 23.3.1)

5. When the value of the underlying assets of the firm is higher, when the volatility of the underlying assets of the firm is higher, when the time to maturity of the firm's debt is longer, when the amount of the firm's debt is lower and when the risk-free rate in the economy is higher.

   (Section 23.3.2)

6. When investors are risk-neutral

   (Section 23.3.3)

7. Structural models are capable of managing different securities of the same issuer, the default correlation can be modeled quite naturally, but if equity prices experience irrational pricing bubbles they may provide poor signals of how credit markets should be priced and sovereign bonds are difficult to model because it is difficult to assess their assets and liabilities.

   (Section 23.3.5)

8. Reduced-form models of credit risk can be calibrated using liquid segments of the bond market and then used to price less liquid bonds. These models are very tractable and are

well suited for pricing derivatives and portfolio products and can be used in the absence of balance sheet information (e.g., for sovereign issuers).

(Section 23.4.5)

9. A bull option spread on the portfolio assets

(Section 23.5.2)

10. True

(Section 23.1)

11. Solve for "prob" (risk neutral probability of an upward movement):

£200 = [(1.25 × £200 × Prob) + (0.75 × £200 × (1-Prob))]/1.01
Prob = .52

(Section 23.3.3)

12. The implied risk-neutral probabilities can be calculated using the formula:

$$V(0) = \frac{1}{1+r}\left(\pi V_u(1) + (1-\pi)V_d(1)\right)$$

$$\$500 = \frac{1}{1+0.03}(\pi \times \$500 \times (1.20) + (1-\pi) \times \$500 \times (0.80))$$

Isolating π we get a value of 0.575, which is the risk-neutral probability of an up movement, and $(1-\pi) = 0.425$ is the risk-neutral probability of a down movement.

(Section 23.3.3)

13. The price of the European put is given by the following formula:

$$P(0) = \frac{1}{1+r}\left(\pi \times 0 + (1-\pi) \times (K - V_d(1)\right)$$

$$P(0) = \frac{1}{1+0.03}(0.575 \times 0 + 0.425(430 - 400)) = \$12.38$$

(Section 23.3.3)

14. The arbitrage-free price of ABC's risky debt is calculated using the following formula:

$$B(0,1) = \frac{K}{1+r} - P(0)$$

$$B(0,1) = \frac{\$430}{1+0.03} - \$12.38 = \$405.10$$

15. The credit spread for ABC's bond is calculated by finding the value of X in the following equation (that solves for the discounted bond value when added to the one-year riskless rate of 3%):

    $405.10 = $430/(1+0.03+X)

    X is the credit spread, which is equal to 0.0315 or 3.15%.

    (Section 23.3.3)

16. The new value for π is 0.60 and the new price of the European put option is $1.94, found as (.4 × (430-425))/1.03. This put value is lower because the volatility of the underlying asset is lower.

    (Section 23.3.3)

17. The new arbitrage-free price of ABC's risky debt is $415.54, found as ((430/1.03)-1.94), which is lower than the price obtained before because the price of the put option is now lower.

    (Section 23.3.3)

18. The new credit spread for ABC's bond decreases to 0.4809% (found as (430/415.54) – (1+3%), reflecting the fact that the volatility of ABC's assets has decreased, thus making it less risky to invest in ABC's bonds.

    (Section 23.3.3)

19. We know that (Equation 23.14): Expected Credit Loss = *PD* x *EAD* × (1-*R*)

    For this problem, the values of the variables are:

    PD = 7%
    EAD = $100 million x (1+0.15) = $115 million
    R = 0.30 so that LGD = 0.70

    Therefore,

    Expected Credit Loss = 0.07 × $115 million × (1-0.30) = $5.635 million.

    If a default actually occurs then the loss in this example is 70% × $115 million = $80.5 million.

    (Section 23.4.1)

20. The exact risk-neutral probability of default, or λ is equal to
$[1/(1-0.70)][0.04/(1+0.03+0.04)] = 12.46\%$.

The approximate formula generates 13.33% since a 13.33% probability of losing 30% of the bond's value requires a 4% spread.

(Section 23.4.3)

21. The 2.50% credit spread and 50% recovery rate of the junior debt implies a risk-neutral default probability of 5.0% using Equation 23.17. The same risk-neutral default probability is then used with recovery rates of 20% and 80% to find credit spreads on the other debt using Equation 23.18. That process generates a credit spread of 1.0% on the senior debt and 4.0% on the speculative debt.

(Section 23.4.5)

22. The answer is that $2 million would go to the senior tranche, $840,000 would go to the mezzanine tranche, and the remaining $1,360,000 (i.e., $4,200,000 – $2,000,000 – $840,000) would be available for the equity tranche.

(Section 23.5.1)

Chapter 24
Credit Derivatives

Exercises

1. What are the three primary groupings or distinctions among credit derivatives?

2. What are acceptable deliverable assets that a credit protection buyer in a credit default swap may choose to deliver for physical settlement according to a standard ISDA agreement?

3. What are the three primary ways for the unwinding of a position on an OTC credit default swap (CDS)?

4. Name five motivations for entering credit default swaps.

5. What is a credit linked-note?

6. What are two types of risk that are likely to be incurred by a bank using a credit default swap with a three-year maturity to hedge a loan with four years to maturity?

7. Describe the liquidity of typical CDS indices. Do such indices have fixed or variable maturities?

8. Suppose a transaction takes place between a hedge fund (Fund) as a seller of protection and a Bank (a commercial bank) as a buyer of protection in a credit default swap. The reference entity is an auto company. The referenced asset is $30 million of face value debt. The term of the transaction is five years. In exchange for the protection provided over the next five years, the Fund receives 4% of the notional amount per year, payable quarterly. Default occurs after exactly two years. What cash flow exchanges take place?

Solutions

1. Single-name v. multi-name, funded instruments v. unfunded instruments, and sovereign entities v. non-sovereign entities

   (Section 24.1.1)

2. Corporate bonds of the referenced entity participating in the credit default swap, bank loans of the referenced entity participating in the credit default swap, obligations of a subsidiary of the referenced entity if the subsidiary is at least 50% or more owned by the referenced entity, obligations of a third party that the referenced entity may have guaranteed (also known as qualifying guarantees)

   (Section 24.2.2)

3. The party can enter into an offsetting transaction by entering a position in another CDS contract, the party can enter into a novation (also known as an assignment), and the parties to the OTC contract can agree to terminate the contract.

   (Section 24.2.4)

4. Risk decomposition, synthetic shorts, synthetic cash positions, market linking and liquidity during stress

   (Section 24.2.6)

5. A credit linked-note is a bond issued with an embedded credit option.

   (Section 24.1.1 and 24.3.4)

6. Basis risk and counterparty risk

   (Section 24.4.1)

7. CDS indices are highly liquid and have fixed maturities.

   (Section 24.4.2)

8. Each quarter for eight quarters the Bank pays the Fund $300,000 [i.e., $30 million x (4%/4)]. When the default takes place, the Bank delivers $30 million in face value of the

referenced bond to the Fund in exchange for $30 million in cash. The credit default swap terminates immediately after these exchanges.

(Section 24.4.2)

Chapter 25
Collateralized Debt Obligations

Exercises

1. Which tranche of a collateralized debt obligation (CDO) will be the first to receive any cash flows from the CDO collateral and is also the last tranche to be affected by any defaults or losses in the CDO collateral?

2. Which entities are most likely to be the primary originators of balance sheet collateralized debt obligations?

3. What are three major reasons why banks would divest assets through a balance sheet collateralized debt obligation?

4. Are interest payments and/or principal payments from the loan portfolio for most balance sheet collateralized debt obligations (CDOs) passed through or reinvested?

5. How can managers of CDO trusts benefit from arbitrage collateralized debt obligations (CDOs)?

6. What is the major distinguishing feature of synthetic collateralized debt obligations (CDOs)?

7. Consider a collateralized debt obligation (CDO) trust with a market value of collateral assets of $200 million. The CDO trust issues three tranches. Tranche A is the senior tranche and consists of $150 million of securities. Tranche B with the face value of $40 million is a subordinated fixed income tranche and is paid after the senior tranche is paid in full. Finally, there is a $10 million equity tranche. What is the level of overcollateralization for the senior tranche?

8. Continuing with the previous question, what is the level of overcollateralization of Tranche B?

9. How does spread compression risk arise in a collateralized debt obligation (CDO)?

10. What are the three periods in the life cycle of collateralized debt obligations (CDOs)?

11. A collateralized debt obligation (CDO) trust holds $500 million in bonds with a 9% coupon. The CDO has three tranches: A $400 million A tranche with a coupon rate of 8%, a $50 million B tranche with a coupon rate of 12%, and a $50 million equity tranche

with an expected return of 14%. Ignoring bond defaults, changes in market values, and any fees, what is the annual cash flow that the equity tranche holders can expect to receive?

12. Bank XYZ has a $200-million loan portfolio that it wishes to sell. To support these loans XYZ must hold risk-based capital equal to 10% of the loan portfolio. If XYZ sponsors a CDO trust where the trust purchases the $200-million loan portfolio from the bank and finds outside investors to purchase all of the CDO securities, how much regulatory capital would the bank have freed?

13. Suppose that the sponsoring bank from the previous example had to retain a $5-million equity piece in the CDO trust to attract other investors and take a one-for-one regulatory capital charge for this first-loss position. In this case, how much regulatory capital will be freed by the CDO trust?

14. Consider a CDO trust with a market value of collateral assets of $100 million. The CDO trust issues three tranches. Tranche A is the senior tranche and consists of $65 million of securities. Tranche B consists of $25 million of subordinated fixed income securities and is paid after the senior tranche is paid in full. Finally, there is a $10-million equity tranche with the lowest seniority. Calculate the overcollateralization rate for the senior tranche.

Solutions

1. The senior tranche

   (Section 25.2.4)

2. Banks and insurance companies

   (Section 25.2.1)

3. To reduce credit exposure to a particular client or a particular industry; banks might need a capital infusion or banks might wish to decrease their regulatory capital charges.

   (Section 25.2.1)

4. Interest and principal payments from the commercial loans are typically passed through to the CDO investors.

   (Section 25.2.1)

5. The manager of the CDO trust can earn management fees for its money management expertise, and can earn potential arbitrage income from the CDO trust between the CDO collateral income and the payouts on the CDO notes.

   (Section 25.2.2)

6. Physical ownership of the underlying basket of securities is not transferred to the CDO. Synthetic CDOs do not actually own the underlying assets but rather may obtain their credit exposure through total return swaps or credit default swaps.

   (Section 25.3)

7. $200 million / $150 million = 133%

   (Section 25.5.2)

8. $200 million / $190 million = 105%

   (Section 25.5.2)

9. Spread compression risk arises when credit spreads decline over time, reducing interest rate receipts from the CDO's collateral.

   (Section 25.7.4)

10. Ramp-up period, revolving period and amortization period

    (Section 25.1.2)

11. $7,000,000

    (Section 25.2.4)

12. 10% × $200 million = $20 million

    (Section 25.3.1)

13. The bank must take a one-for-one regulatory capital charge (i.e., $5 million) for this first-loss position. This means that only $15 million ($20 million minus $5 million) of regulatory capital will be freed by the CDO trust.

    (Section 25.3.1)

14. $100 million / $65 million = 154%

    (Section 25.5.2)

Topic 8: Risk Management and Portfolio Management

Readings

CAIA Level I: An Introduction to Core Topics in Alternative Investments. Second Edition. 2012. Wiley. ISBN: 978-1-118-25096-9. Part Seven, Risk Management and Portfolio Management, Chapters 26 - 31.

Chapter 26
Lessons from Hedge Fund Failures

Exercises

1. What was Amaranth's main trading strategy? Why did it collapse? What lessons can be learned?

2. What was Peloton's main trading strategy? Why did it collapse? What lessons can be learned?

3. What was Carlyle's main trading strategy? Why did it collapse? What lessons can be learned?

4. What was Marin Capital's main trading strategy? Why did it collapse?

5. What was Bayou's main trading strategy? Why did it collapse? What lessons can be learned?

6. What was Bernie Madoff's scheme? Why did it collapse? What lessons can be learned?

7. A particular strategy generates return on assets of 0.6% per month. The strategy uses a ratio of 3 to 1 leverage and has an interest expense on its leverage of 0.3% per month. What is the strategy's ROE?

8. A strategy generating profits on assets of 0.5% per month has an interest expense on its leverage of 0.3% per month. What is the leverage (L) that the fund must utilize to generate a desired ROE of 1.0% per month?

9. A strategy has leverage of 5 to 1 and an interest expense on its leverage of 0.4% per month. What monthly ROA must the fund generate to attain the desired monthly ROE of 1.2%?

Solutions

1. Amaranth was a self-described multi-strategy hedge fund, purportedly investing across strategies and asset classes. However, Amaranth's debacle in late 2006 came as the result

of extremely concentrated bets in the energy markets and, more specifically, in natural gas, to which this hedge fund had devoted a large fraction of its capital by 2006. Amaranth's manager, who had a big incentive to take huge bets, took large positions in natural gas calendar spreads, and kept directing more money into that bet. When natural gas calendar spread prices moved against Amaranth in August and September 2006, the fund could not recoup its losses.

In multi-strategy funds, positions should not be highly concentrated in a single market. Similarly, funds should manage their risks to ensure that the positions are not so large relative to the underlying market that the trades will be difficult to efficiently exit. The risk management team needs to effectively manage the firm, ensuring that position sizes do not grow too large and that the risks incurred by traders, especially in satellite offices, are appropriately monitored and limited. On top of that, Amaranth's risk management was calibrated using a relatively short history of natural gas markets. The extent of natural gas market moves that happened during Amaranth's collapse was not historically unusual.

(Section 26.1.1)

2. Peloton Partners was an asset-backed securities hedge fund that made a big gamble in 2007 that the mortgage bond market would collapse. The fund, which was highly leveraged, took long positions on AAA-rated mortgage tranches and bet that BBB-rated tranches would fall in value. When they did in the midst of the subprime mortgage meltdown, the fund made an eye-popping 87% annual return.

   However, Peloton collapsed when in early 2008 the long positions (which amounted to $16 billion) declined in value while the short positions (which amounted to $3.2 billion) declined only modestly. The fund's net asset value plunged. To make matters worse, most investment banks serving as Peloton's creditors were in a similar position as Peloton and, as a result, the large banks demanded additional collateral from Peloton when the mortgage market collapsed. Peloton was unable to meet these margin calls and was forced to liquidate the fund.

   The lessons here are the dangers of leverage and the importance of the prime brokerage relationship. When a fund holds $19.2 billion in positions on just $2 billion in assets under management, a small move in the underlying trades can rapidly diminish investor capital. When prime brokers have the ability to increase margin requirements and liquidate positions, fund managers must understand how those changes affect the risk and leverage of the fund and manage risk accordingly.

   (Section 26.1.2)

3. Similar to Peloton, the collapse of Carlyle Capital Corporation (CCC) was the result of a liquidity crisis that led to over $50 billion in losses at major investment banks. CCC's strategy was relatively simple: borrow at low short-term interest rates and invest these borrowed funds in long-term AAA-rated mortgage backed securities issued by Freddie

Mac and Fannie Mae. These AAA bonds were considered to be almost certain to be repaid by their issuers because they were issued by U.S. government-sponsored companies with either an explicit or an implicit guarantee by the U.S. government. However, the value of these bonds plunged dramatically in February and March 2008 as investors worldwide shunned risk and as the U.S. housing market plummeted. Furthermore, CCC was exposed to potentially large losses because its investment strategy was highly leveraged. When margin calls from lenders reached more than $900 million in March 2008, and CCC held only $670 million in client assets, the lenders began to seize the hedge fund's collateral and its main assets, namely, AAA-rated mortgage bonds.

There are several lessons from CCC's collapse. First, no security is safe from a liquidity crisis. Second, prime brokers and bankers have no patience when it comes to declining collateral values, and even a reputable group such as CCC could not negotiate a grace period from its bankers. Even apparently safe assets can be risky when highly leveraged. With $21.7 billion in positions with just $670 million in client assets, a small change in the value of underlying assets can quickly eliminate the investors' entire contribution to the fund.

(Section 26.1.3)

4. Marin Capital was a well-known convertible bond arbitrage hedge fund manager. Convertible arbitrage is generally regarded to be a safe, conservative strategy, which typically involves buying convertible corporate bonds and hedging the equity exposure by short selling the stock. This strategy worked well until the summer of 2006 when two bond-rating agencies downgraded the investment-grade status of both Ford and General Motors (two of the largest issuers in the corporate bond market) to junk status. The price effects of this downgrade were very large because the downgrade from investment grade to non-investment grade meant that pension funds and other investors might be restricted from investing in the bonds of these two firms. To complicate matters, at the same time that GM's and Ford's bonds were being downgraded to junk status, the billionaire financier Kirk Kerkorian announced that he would acquire a large stake in GM, causing a price spike in the stock of this company and other related corporations like Ford. The combined effect of these two events affected hedge fund managers like Marin Capital very negatively because they had sold short the common stock of GM (which rose sharply after the unsolicited bid by Mr. Kerkorian) and held long positions in the underlying bonds (which declined sharply after the bonds were downgraded to junk status). Hedge fund managers were forced to cover their short stock sales by purchasing GM and Ford stock that had appreciated substantially in value. Convertible bond hedge fund managers lost on both sides of their trades and suffered losses that were exacerbated by the leverage that had been used.

   (Section 26.1.4)

5. Bayou Management started out as a genuine hedge fund but quickly evolved into utter fraud. The two principals of the fund were founder Samuel Israel III and CFO Daniel Marino. Within a few months after the Bayou Fund opened in 1996, Bayou suffered

trading losses and began lying to investors about the hedge fund's profits and losses. By December of 1998, the Bayou Fund's mounting losses could not hold up an independent audit. So Marino, a certified public accountant, agreed to fabricate the annual audit of the Bayou Fund in order to cover up the trading losses. He created a virtually fictitious accounting firm, Richmond-Fairfield Associates, to pose as the independent auditor of the Bayou Fund. But Marino was the sole principal of Richmond-Fairfield, and the firm had no other clients. Throughout this time, Bayou actively solicited both new and current investors and raised tens of millions of dollars of extra capital. The beginning of the end for Bayou started when authorities stumbled upon strange money transfers involving Bayou. In May 2005, $100 million was seized by legal authorities from the State of Arizona. Samuel Israel III and Daniel Marino were both eventually sentenced to over 10 years in prison.

The main lessons from Bayou are the importance of background checks, independent auditing firms, and the conflicts of a captive brokerage firm. Samuel Israel III had misstated material facts on his resume, which should have been discovered during a background check. When a hedge fund uses a small outside audit firm, in fact, one that was unknown outside of Bayou, a red flag should be raised. Furthermore, the only employee of the Richmond-Fairfield accounting firm was Daniel Marino, one of the two principals of Bayou. Finally, when a brokerage firm is owned by the fund manager, there are temptations to overtrade to earn excessive commissions as well as to misstate the performance of the fund.

(Section 26.2.1)

6. Bernie Madoff managed to defraud high net worth investors, managers of funds of hedge funds, movie stars, movie producers, and university endowments. All told, the scheme was reputed to have grown to $50 billion before being unmasked. Madoff supposedly used a strategy called split-strike conversion, which consisted of a combination of a protective put and a covered call. Split-strike conversion is an options strategy that should provide limited risk and limited rewards. Even so, the consistency of Madoff's reported performance was too good to be true. Harry Markopolos, an investment manager, studied the strategy purportedly used by Mr. Madoff and found that when he tried to replicate a similar strategy, he was not able to obtain the results that Madoff claimed to have earned. Mr. Markopolos went to the SEC's Boston Office with his conclusions in 2000, and then again in 2001. Unfortunately, these initial visits were disregarded by the SEC. In 2005, Mr. Markopolos contacted the SEC's New York office. He handed a 21-page report to the SEC explaining why he had concluded that Madoff's business was "the world's largest Ponzi scheme." He continued to send warnings to the SEC in 2006 and 2007, but no action followed. Mr. Madoff was arrested by federal agents on December 11, 2008, after being turned in to the authorities by his sons and reportedly admitting to his family that his business was "all just one big lie," and basically "a giant Ponzi scheme."

   There are several lessons to be learned from Madoff. First, there needs to be a separation of duties with the returns to the fund being independently verified and audited by a reputable and well-known accounting firm. Funds where returns differ substantially from

those earned by other managers pursuing the same strategy should be viewed with suspicion. Also be aware of the potential role of affinity fraud, as investors should complete due diligence on all managers before investment, even those with whom they might have a close social relationship.

(Section 26.2.2)

7. A leverage of 3 to 1 can be viewed as meaning that there are $3 of assets for each $1 of equity (L=3). Thus,
   ROE = (ROA × L) – [r × (L-1)]
   = (0.6% × 3) - (0.3% × 2) = 1.2% per month.

   (Section 26.1.5)

8. Inserting the known values into Equation 26.1,

   ROE = (ROA × L) – [r × (L-1)]

   1.0% = (0.5%×L) – [0.3% × (L-1)], and solving for L generates L= 3.5.

   This means that the firm must borrow $3.5 for each $1 of equity.

   (Section 26.1.5)

9. Inserting the known values into Equation 26.1:

   1.2% = (ROA×5) – [0.4% × (5-1)], and solving for ROA generates a monthly ROA of 0.56%.

   (Section 26.1.5)

Chapter 27
Risk Analysis

Exercises

1. Why might the risk of an actual investment strategy for a market neutral fund differ from the risk of the stated investment strategy?

2. What is rogue trading?

3. Which is easier to enforce: risk limits or position limits?

4. Write the equation for put-call parity that illustrates a riskless hedge by placing Bond on the left hand side and all other variables on the right hand side.

5. What are the values of the delta, gamma and vega of a portfolio that is long a call and short a put on the same underlying asset and with the same strike price and time to expiration?

Solutions

1. The strategy as implemented by market neutral funds might not be perfectly hedged and could contain at least some systematic risk. The risks may be unintentional due to imperfect hedging models or intentional due to rogue trading or strategy drift. Substantial levels of systematic risk could be exacerbated by leverage, including leverage in excess of the mandate. Special concern should be used when numerous relatively large funds are competing for profits from the same strategy.

   (Section 27.2.3)

2. A rogue trader intentionally establishes substantial positions well outside the investment mandate. Rogue trading is most often caused by strong incentives or pressures to generate performance, combined with losses that jeopardize a trader's career if not recouped.

   (Section 27.3.2)

3. Position limits

   (Section 27.5.2)

4. Bond = +Stock + Put - Call

   (Section 27.7.1)

5. Delta = 1, gamma = 0, and vega = 0

   (Section 27.7.2)

Chapter 28
Due Diligence of Fund Managers

Exercises

1. Consider the following disclosure from a hedge fund document that purports to summarize the fund's investment objective:

   "The fund's objective is to achieve long-term capital appreciation by investing in financial and commodity markets through allocation to one or more professionally selected investment vehicles, managed by highly skilled trading advisers."

What can an analyst conclude about the markets in which the hedge fund manager invests?

2. Based on the investment objective stated in Exercise #1, what can be concluded about the hedge fund manager's general investment strategy?

3. Based on the investment objective stated in Exercise #1, what can be concluded about the hedge fund manager's benchmark?

4. Consider the following disclosure from a hedge fund document that purports to summarize the fund's investment objective:

   "The fund will invest in unlevered long positions in equities of Russian companies. The fund will attempt to select underpriced equities and to time trading decisions to improve profitability. The fund aims to beat the MSCI emerging market country index for Russia by 150bps, with an optimal target of 250bps out-performance after costs."

   What could an analyst conclude about the markets in which the hedge fund manager invests?

5. Based on the investment objective stated in Exercise #4, what can be concluded about the hedge fund manager's general investment strategy?

6. Based on the investment objective stated in Exercise #4, what can be concluded about the hedge fund manager's benchmark?

7. Consider the following disclosure from a hedge fund document:

   "The General Partner has more than 20 years of experience in the health care technology sector, which includes biotechnology, pharmaceutical, medical device and drug delivery companies. The General Partner has managed a substantial portfolio of securities in the health care technology sector and believes that the sector is on the edge of a new era of medical discovery… With appropriate research, the General Partner will search for successful investment opportunities in this technology revolution."

   Does this description of the hedge fund manager imply that the manager has a superior information set or is the manager an information filterer?

8. What is the justification for the existence of a master trust fund account?

9. Consider a hedge fund manager that has two investors: one based in the U.S. and one in Spain. Where should the manager locate her hedge fund? Note: Consider the tax consequences of your recommendation when suggesting an answer.

10. Mr. Christopher Carlton is the CIO, CFO and CEO of XYZ, a long/short hedge fund that invests in large cap U.S. stocks and which was incorporated last year. Mr. Carlton did not finish his undergraduate studies. Previously, Mr. Carlton was the manager of ABC, a long-only hedge fund that closed last year. Mr. Carlton is registered with the Securities and Exchange Commission (SEC) as an investment adviser. Documents reveal the sharing of the ownership of the hedge fund management company with key employees. Are there any due diligence concerns based on this information?

11. Continuing with Exercise #10, the outside auditor of hedge fund XYZ is one of the five largest firms in the sector, while the prime broker is TTT, an investment bank that has recently experienced financial distress arising from investments in mortgage-backed securities made during the past few years. However, TTT has a bullish outlook for the mortgage-backed securities market and has recently predicted that the bank will be well-capitalized by the end of the year if the mortgage-backed securities market recovers. Are there any due diligence concerns based on this information?

12. Continuing with Exercise #10, Mr. Carlton recently expressed that XYX Fund's performance should be evaluated relative to a fixed rate of return of 6.5% per year. Comment on his idea for using a fixed benchmark rate to evaluate the Fund's returns and suggest any benchmark that may be more appropriate.

13. Continuing with Exercise #10, suppose that due diligence on the current portfolio positions of hedge fund XYZ reveals that the fund's portfolio is concentrated in a few sectors of the equity market rather than being well diversified. Should this concentration in the current portfolio positions of hedge fund XYZ raise a due diligence red flag?

14. Continuing with the Exercise #10, is hedge fund XYZ expected to suffer from limited capacity?

15. Continuing with Exercise #10, is hedge fund XYZ expected to suffer adverse effects such as high costs associated with a withdrawal by a limited partner?

16. Continuing with Exercise #10, would one expect hedge fund XYZ to be subject to substantial counterparty risk?

17. Continuing with Exercise #10, a due diligence process conducted on Mr. Carlton revealed that in the past three years his landlord sued him on three different occasions claiming that Mr. Carlton had not paid his rent. Considering that these civil lawsuits were outside the operating business of the hedge fund, would the existence of these lawsuits serve as a due diligence red flag?

18. Explain two benefits provided by lock-up periods.

19. Explain the rationale for the existence of notice periods.

20. Describe two reasons for the existence of high subscription amounts in hedge fund investments. Why do some hedge funds have a maximum subscription amount?

21. State important due diligence questions regarding the following service providers: Outside auditors, prime broker, and legal counsel.

22. What are the typical questions to be asked to existing clients of a hedge fund when performing due diligence checks?

Solutions

1. Since the fund can invest in "financial and commodity markets," this hedge fund's investment universe is widespread and virtually unconstrained. As a result, the analyst has gained little information on the markets in which the fund will actually invest.

   (Section 28.1.1)

2. Very little can be concluded. The fund's investment strategy is to achieve long-term capital appreciation from investments. This answer is uninformative. Capital appreciation is assumed to be a goal for most investments.

   (Section 28.1.1)

3. Very little can be concluded. There is no implicit or explicit benchmark. The scope of this fund's stated investment objective is simply too broad, rendering any benchmark useless.

   (Section 28.1.1)

4. The fund will invest in stocks of Russian companies. The markets in which the fund will invest are clearly defined.

   (Section 28.1.1)

5. The fund focuses on a long-only strategy with market timing and security selection. The fund aims to beat the MSCI emerging market country index for Russia by 150bps, with an optimal target of 250bps out-performance after costs. This investment strategy is relatively clearly defined.

   (Section 28.1.1)

6. Clearly, the benchmark is the MSCI emerging market country index for Russia.

   (Section 28.1.1)

7. This manager is most clearly an information filterer. He is an expert with more than 20 years of experience in the health care technology sector. The role of having superior information cannot be ruled out.

   (Section 28.1.3)

8. The justification for the use of a master trust is to invest the assets of both the onshore (e.g., U.S. based) hedge fund and the offshore hedge fund consistently so that investors from different tax jurisdictions can all gain from the manager's insights and at the same time avoid unnecessary income taxation. This is because master trusts are typically established in tax-neutral sites and, therefore, they usually do not pay any corporate income tax. Therefore, there are no adverse tax consequences to the hedge fund investors at the master trust level.

   (Section 28.2.1)

9. If the manager were to locate the hedge fund in the United States, the U.S. investor would be pleased, but the Spanish investor might have to pay double the income taxes: both in the U.S. and in Spain. On the other hand, if the manager were to locate the hedge fund in Spain, the Spanish investor would be pleased, but the U.S. investor might have to pay double the income taxes: both in Spain and in the U.S. The best way for the manager to resolve this problem is to set up two hedge funds, one onshore and one offshore, and to establish a master trust account (in a tax-neutral site) so that each investor will be liable only for the taxes imposed by the laws of their respective countries. If there are tax treaties between U.S. and Spain, then the U.S. investor would pay the highest of the tax rates in the U.S. and Spain. The same would apply to the Spanish investor.

   (Section 28.1.1)

10. There are at least three due diligence concerns in this case:

    i. It is not a good business practice when the hedge fund's CIO, CFO and CEO are the same person, as it is the case for hedge fund XYZ. This problem has been documented in the corporate governance literature.
    ii. It is advisable that a hedge fund manager demonstrate a background of competence and success. Mr. Carlton did not even finish his undergraduate studies (incidentally, this should have been a yellow flag for investors in Bayou Fund because his manager, Sam Israel, did not finish his undergraduate studies either). Of course, this should not be used as a single reason to disqualify a manager's ability to generate alpha. However, the manager should have other positive attributes to compensate for this.
    iii. Presumably, Mr. Carlton has experience as a long-only investor because he was the manager of ABC, a long-only hedge fund that closed last year (and a due diligence on Mr. Carlton should also investigate meticulously the reasons for the closure of ABC). However, short selling of stocks is very different from taking long positions. For example, the ability to locate and borrow stock, to short stocks

subject to various rules, to avoid or handle short squeezes, and to limit losses in a bull market, are abilities that cannot be developed overnight and would generally not be obtained through experience with a long-only strategy.

Note: In the case of hedge fund ABC, the sharing of the ownership of the hedge fund with key employees is actually considered a positive attribute because it can ensure proper alignment of interests as well as retention of key personnel. Also, the fact that he is registered with the Securities and Exchange Commission as an investment adviser is generally a plus.

(Section 28.2.2)

11. The fact that the outside auditor of hedge fund XYZ is one of the five largest firms in the sector is a plus for investors in hedge fund XYZ. On the other hand, in the case of its prime broker TTT, this is an investment bank currently experiencing financial distress and, therefore, it is more likely to be forced to make margin calls on their hedge fund clients if confronted with a liquidity crisis. When Lehman Brothers, one of the largest investment banks, failed in September 2008, its hedge fund clients suffer some of these potentially disastrous consequences. The piece of information that TTT has a bullish outlook for the mortgage-backed securities market and that they have recently expressed that such a recovery would help them become better capitalized offers little or no confidence. Moreover, it is a concern that the bank believes it will be able to solve the financial distress problems that is currently facing.

    (Section 28.2.4)

12. Hedge fund XYZ is a long/short hedge fund focused on U.S. large cap stocks. Due to a common long-bias among long/short funds, a fixed benchmark may be inappropriate and the use of an index return that includes a passive equity index such as the S&P 500 index may be more appropriate.

    (Section 28.3.2)

13. There is nothing unusual when a hedge fund is heavily concentrated in a particular sector of the market, such as is the case with hedge fund XYZ. Hedge fund managers typically run concentrated exposure and investors are therefore exposed to more stock-specific risk than market risk. This stock- and/or sector-specific risk is the potential source of the hedge fund manager's alpha. Of course, the fund's risk management team must be aware of the risk of poor diversification.

    (Section 28.3.4)

14. Hedge fund XYZ is unlikely to face capacity problems because its investment strategy is long/short in large cap U.S. stocks, a very large (in terms of market capitalization) and liquid market.

(Section 28.3.6)

15. The answer is no. This is because equity long/short equity hedge funds (and, in particular, hedge fund XYZ which invests in U.S. large cap stocks), usually have the lowest cost associated with a redemption since the equity markets in which the Fund participates has high liquidity. Note that the loss of AUM could make it difficult to run the fund effectively (e.g., may lack resources to hire to retain qualified people) if the fund was not very large to begin with.

    (Section 28.5.4)

16. The answer is no. Hedge fund XYZ is a long/short equity hedge fund investing in U.S. large cap stocks. Therefore, investments made by this fund will be expected to be exchange-traded and, therefore, they will not be subjected to counterparty risk because the clearinghouse for the exchange will make good on any defaulted contract. Counterparty risk arises, for example, in over-the-counter derivatives transactions, because the hedge fund manager must rely on its counterparty's good faith and credit to perform its obligations under the derivative contract.

    (Section 28.6.1)

17. A history of civil actions filed against a hedge fund manager may offer an important insight into that manager's character. A pattern of civil lawsuits filed against a hedge fund manager might indicate other trouble, even if those lawsuits are outside the operating business of the hedge fund. In this case there are multiple lawsuits and they should be considered to be at least a due diligence yellow flag, if not a red flag. Another problem brought about by lawsuits consists in that they are distracting. They can easily take a toll in terms of money, time, and emotions, thus affecting a manager's performance with respect to the hedge fund.

    (Section 28.4.1)

18. Lock-up periods provide the following two benefits:

    i. They allow the hedge fund manager to benefit from the existence of a longer minimum amount of time to execute his investment strategies (without having to worry about how to fund redemption requests).
    ii. Considering that ill-timed withdrawals of capital by one investor in a hedge fund can hurt the returns of the remaining investors, the existence of lock-up periods offers an assurance to investors that their investment in a hedge fund will not suffer because of early redemptions by another partner.

    (Section 28.7.3)

19. Limited partners in a hedge fund normally must give notice to the manager that they plan to redeem their investment. This notice period can often be from 30 to 90 days in advance

of the redemption. The purpose of the notice period is to give the manager the ability to position the hedge fund's portfolio to fund the redemption request without substantial costs or disruptions to the remaining investors.

(Section 28.7.3)

20. The following are two reasons for the existence of high subscription amounts in hedge fund investments:

    i. Managers of hedge funds typically are permitted only a limited number of investors.
    ii. Higher capital commitments guarantee that only sophisticated investors possessing a large net worth will subscribe to the hedge fund.

    Some hedge funds have a maximum subscription amount because of either of the following two reasons:

    i. This way no single investor becomes too large relative to other investors in the hedge fund.
    ii. Because the strategy the fund follows may have capacity issues that require limits on an investor's capital contribution.

    (Section 28.7.4)

21. The following are important due diligence questions that an investor should ask service providers when investing in a hedge fund:

    Outside auditors: When was the last audit conducted? Did the auditors issue an unqualified opinion? Additionally, were there any issues that outside auditors raised with the hedge fund manager over the course of their engagement?

    Prime broker: How frequently have margin calls been made? What was the size of those calls? Were any of the calls not met? A discussion with the prime broker should also provide the investor with information regarding whether the hedge fund manager is properly valuing the hedge fund's portfolio.

    Legal counsel: What is the veracity of any civil, criminal, or other regulatory actions against the hedge fund manager or its principals? What is the status of any regulatory registrations under which the hedge fund manager operates?

    (Section 28.2.4)

22. Typical questions to be asked to existing clients of a hedge fund are: Have the financial reports been timely? Have the financial reports been easy to understand? Has the manager responded promptly and clearly to questions about financial performance? Has the manager maintained his investment strategy? What concerns does the current investor

have regarding the hedge fund's performance? Would the existing client invest more money with the hedge fund manager?

(Section 28.8.2)

Chapter 29
Regression, Multivariate, and Nonlinear Methods

Exercises

1. What is the name of the condition in which error terms in a time series regression are correlated through time?

2. What is the name of the condition in which error terms in a least squares regression have unequal levels of variance?

3. What is the name of the condition in which two or more independent variables in a linear regression area highly correlated?

4. Consider a linear regression with an alpha estimate of 0.9% that has a standard error of 0.3% and a beta estimate of 0.9 that has a standard error of 0.7. At a 5% significance level, the critical value is 1.96. What can be inferred from the regression?

5. Suppose that the r-square of a regression of the returns of a particular strategy on a market index yields a value of 0.70 (i.e., 70%). What is the common interpretation of this r-square in this regression?

6. What does the evidence suggest on whether alternative investment managers exhibit return persistence?

Solutions

1. Autocorrelation

   (Section 29.1.4)

2. Heteroskedasticity

   (Section 29.1.5)

3. Multicollinearity

   (Section 29.2.1)

4. The alpha is significantly different from zero while the beta does not differ significantly from zero.

(Section 29.1.7)

5. The market index explains approximately 70% of the variation in the returns to the strategy.

   (Section 29.1.7)

6. The empirical evidence on return persistence is mixed and therefore it is unclear whether alternative investment managers can generate consistently superior risk-adjusted returns.

   (Section 29.6)

Chapter 30
Portfolio Optimization and Risk Parity

Exercises

1. What term describes the set of portfolios that has the maximum expected return for each level of return standard deviation or, equivalently, the set of portfolios that has the minimum standard deviation for each level of expected return?

2. What does the two-fund separation theorem state?

3. What are two major complications to the use of mean-variance optimization for portfolio construction?

4. Describe the extent to which expected returns explicitly determine the portfolio allocations assigned by risk budgeting approaches?

5. Exhibit 30.1 from the chapter (reproduced below) indicates the mean return and risk for three assets: U.S. Equity, Global Bonds and Funds of Funds. The return correlation between U.S. equity and global bonds was 0.173, between U.S. equity and funds of funds was 0.549, and between global bonds and funds of funds was 0.071.

   Section 30.1.1 of the book then calculates a mean return of 8.42% and a standard deviation of 8.94% to a portfolio based on the following weights: 50% to U.S. equities, 25% to global bonds, and 25% to funds of funds.

   Use the same data and methodology to calculate the mean return and standard deviation of returns for a portfolio constituted as follows: 30% to U.S. equities, 40% to global bonds, and 30% to funds of funds. Compare the results obtained here to those of the example presented in the chapter.

EXHIBIT 30.1 Historical Asset Class Returns
February 1990 to December 2010

	Return	**Std Dev**	**Sharpe Ratio (5%)**	**Skewness**	**Excess Kurtosis**
U.S. Equity	9.2%	15.4%	0.27	–0.73	1.35
Global Bond	7.2%	5.6%	0.39	–0.02	0.43
Funds of Funds	8.1%	5.9%	0.52	–0.73	4.06

6. Using information presented in Exhibit 30.7 (where the monthly standard deviation of returns of MSCI World and Barclays Cap were 4.50% and 1.62%, respectively, and the covariance between these two assets was 0.021% - as corrected), calculate the marginal contributions of Barclays Capital Global Bond Index and MSCI World Equity Index to the total risk of a portfolio that is 40% invested in equity and 60% invested in fixed income, and compare the results obtained to those of the book's example, where the weights were 60% in equity and 40% in fixed income (i.e., reverse the weights).

7. Assume that an asset allocator is using risk budgeting and desires a beta of 0.80 for the entire portfolio that she is managing. The following table illustrates possible investment opportunities and their corresponding betas, desirability to be included in the portfolio and limits on the weight that each of them can have in the portfolio.

Asset Name	Asset Type	Beta	Desirability	Limit
Bonds	Traditional	0	Neutral	50%
Stocks	Traditional	1	Positive	65%
Fund #1	Alternative	0.50	Positive	25%
Fund #2	Alternative	0.50	Very positive	20%

The asset allocator decides to budget 0.60 of the 0.80 total portfolio beta to traditional assets and the remaining 0.20 of the beta to alternative investments. Further, the 0.20 beta to alternative assets may be budgeted further into subcategories such as 0.10 to various types of funds. For simplicity, assume that the allocator opts to allocate 0.10 of the total beta budget to each of the two funds. Calculate the resulting allocations per asset.

Solutions

1. The efficient frontier

   (Section 30.1.2)

2. The two-fund separation theorem states that, under particular assumptions, all investors can maximize their utility by investing only in a combination of two portfolios. In the context of the CAPM, those two portfolios are the market portfolio and the riskless asset.

   (Section 30.1)

3. Mean-variance optimization may ignore higher moments (skewness and kurtosis) and maximizes errors such as by allowing errors in forecasting mean, variance and covariance to cause recommended portfolio allocations to be poorly diversified and highly speculative.

   (Section 30.2)

4. Risk budgeting generally does not explicitly use expected returns in the determination of portfolio allocations. (Section 30.3)

5. Using formula (30.1), we can find the mean historic return as the expected return of the portfolio (rounded):

   $E[R_p] = 0.30 \times 0.092 + 0.40 \times 0.072 + 0.30 \times 0.081 = 8.07\%$

   This expected return is lower than the 8.42% expected return of the portfolio depicted in the chapter, which was invested 50% in U.S. equities, 25% in global bonds, and 25% in funds of funds.

   Using formula (30.3), we can find the variance (risk) of the returns of a three-asset portfolio (rounded):

   $\sigma_p^2 = (0.30^2 \times 0.154^2) + (0.40^2 \times 0.056^2) + (0.30^2 \times 0.059^2)$
   $+ (2 \times 0.30 \times 0.40 \times 0.173 \times 0.154 \times 0.056)$
   $+ (2 \times 0.30 \times 0.30 \times 0.549 \times 0.154 \times 0.059)$
   $+ (2 \times 0.40 \times 0.30 \times 0.071 \times 0.056 \times 0.059) = 0.004262$

   The standard deviation of the returns is equal to the square root of the variance (rounded):

   $\sigma = 0.0653$ or 6.53%.

   The standard deviation of this three asset portfolio is lower than the standard deviation of the portfolio depicted in the chapter, which was invested 50% in U.S. equities, 25% in global bonds, and 25% in funds of funds. However, the new portfolio (30% to U.S. equities, 40% to global bonds, and 30% to funds of funds) does not dominate the portfolio presented in the chapter (50% to U.S. equities, 25% to global bonds, and 25% to funds of funds). This is because the new portfolio has a lower standard deviation but also a lower expected return.

   (Section 30.1.1)

6. The marginal contributions are found by using equations 30.8a and 30.8b (results are rounded):

   $MC_{MSCI} = 40\% \times [(40\% \times 4.50\%^2 + 60\% \times 0.021\%) / 2.28\%] = 1.64\%$

$MC_{BarCap} = 60\% \times [(60\% \times 1.62\%^2 + 40\% \times 0.021\%) / 2.28\%] = 0.64\%$

Where the new portfolio standard deviation was calculated as follows (rounded):

$\sigma_p^2 = (0.40^2 \text{ x } 0.0450^2) + (0.60^2 \text{ x } 0.0162^2) + (2 \text{ x } 0.40 \text{ x } 0.60 \text{ x } 0.021\%) = 0.000519$

Thus, the standard deviation of the returns of the portfolio is (rounded):

$\sigma_p = 0.0228$ or 2.28%

Note that equity contributes 1.64% to the total portfolio risk of 2.28%, while the remainder, 0.64%, is contributed by fixed income. Given the lower weight invested in equities in this example compared to the example presented in the book (40% versus 60%), it is not surprising that the contribution of equity to total risk declines from approximately 89% (when equity had a weight of 60%) to approximately 72% (i.e., 1.64%/2.28%, now that equity weights 40%).

(Section 30.4.3)

7. The resulting allocations would be 60% in stocks, 20% in Fund #1, and 20% in Fund #2. The weight to each asset is found by dividing the allocation by the beta of the asset or asset class, as we illustrate next:

   Stocks: Allocating 0.60 of the beta budget to stocks with a beta of 1 results in an asset allocation of 60% (i.e., 0.60/1.00), a weight that is below the pre-established limit of 65% for this asset.
   Fund #1: Allocating 0.10 of the beta budget to Fund #1 with a beta of 0.50 results in an asset allocation of 20% (i.e., 0.10/0.50), a weight that is below the pre-established limit of 25% for this asset.
   Fund #2: Allocating 0.10 of the beta budget to Fund #2 with a beta of 0.50 results in an asset allocation of 20% (i.e., 0.10/0.50), a weight that coincides with the pre-established limit of 20% for this asset.

   (Section 30.3.3)

Chapter 31
Portfolio Management, Alpha, and Beta

Exercises

1. Consider this simplified example that relates to alpha and beta estimation. Suppose that two people each buy one lottery ticket each day for a month. The lottery tickets offer a fully random one-in-one-million chance to receive $1,000,000 and are fairly priced at $1 each. One person wins once during the month and the other person is winless. Describe the ex ante alpha of the gambles and the true beta (systematic risk) of the gambles based

on your understanding of the facts. Then describe the likely estimations of alpha and beta that would be made based on an historical analysis of the outcomes during the month.

2. Describe portable alpha.

3. Describe the relative importance of strategic and tactical allocation decisions for active and passive investors.

4. Describe appropriate risk and return expectations for enhanced index products.

5. Suppose an index is trading at $950 and the futures contract on that index represents a multiple of 250 times the index. Assuming that the index has a beta of 1.0 relative to the index and setting the basis equal to zero for simplicity, calculate the notional value of one futures contract.

6. Continuing with the previous exercise, consider a $50 million portfolio with a beta of 1.4 relative to the index. Setting the basis to zero for simplicity, calculate the number of contracts necessary to hedge a $50 million long position in the portfolio.

7. The manager of a €200 million portfolio benchmarked to the equity index of Country A has decided to allocate €30 million to a hedge fund with an ex ante alpha of 100 basis points per year and a beta of 0.80 to the stocks of Country B. The remainder of the portfolio remains in a strategy that has no ex ante alpha and virtually no tracking error to the equity index of Country A. Futures contracts trade on the equity indices of Countries A and B. Country A's equity futures contract trades at 200 times the index, with a current index value of €1,200. Country B's equity futures contract trades at 300 times the index, with a current index value of €100. Assume riskless interest rates and dividend rates are zero, and ignore transaction costs. With respect to the €30 million allocation to the hedge fund, what position should be established in the futures contracts of the equity index of Country A, what position should be established in the futures contracts of the equity index of Country B, and how much ex ante alpha should the asset allocator expect to obtain expressed on the basis of the entire €200 million portfolio?

Solutions

1. The true alpha of the gambling strategy is zero since the lottery is fairly priced. The true beta of the gambling strategy is zero since the lottery outcomes have no true correlation with the returns of the market portfolio.

   The estimated alpha of the winning gambler will be positive, while the estimated alpha of the losing gambler will be negative. The estimated beta of the losing gambler will be zero, while the beta of the winning gambler will depend on whether the market portfolio happened to rise or fall on the day the gambler won. The point is that alphas and betas are usually estimated with error. If the true alphas and betas are shifting through time the estimation becomes even more difficult.

(Section 31.1)

2. Portable alpha is the process of separating alpha from the beta of an investment product. Once the alpha of the product has been separated, it can be combined with another asset in order to add the alpha of the first product to the beta return of the second product. When alpha is not portable, an investor would have to bear the systematic risks of a strategy to attempt to enjoy the alpha of that strategy. Derivatives such as options, futures and swaps are the primary tools for controlling beta while porting alpha.

   (Section 31.3.2)

3. For the passive investment manager or indexer, the strategic tactical allocation decision is the only major decision. For active investment managers, both strategic and tactical asset allocation decisions are important.

   (Section 31.4.1)

4. Enhanced index products are designed to assume some tracking error risk relative to the respective index within tightly controlled parameters. Enhanced index products are designed to offer a little extra return than the respective index, usually on a large pool of capital.

   (Section 31.4.3)

5. The notional value of one futures contract is: $950 x 250 = $237,500

   (Section 31.3.1)

6. The total notional value to be hedged can be determined using equation 31.1:

   Notional Value for Hedging = Value of Position to be Hedged × Beta

   Notional Value for Hedging = $50,000,000 × 1.4 = $70,000,000

   The number of contracts in the hedge is found by dividing the notional value of the desired hedging position by the product of the index value and the multiplier related to the futures contract.

   (Equation 31.2):

   Number of Contracts = Future Contract Notional Value / (Index Value × Multiplier)

   As was already calculated in the previous exercise, a $50 million position with a beta of 1.4 would need $70 million of notional value in a futures contract with a beta of one to hedge the risk. A futures contract with a notional value of $237,500 would require

[$70,000,000 / ($237,500)] = 295 contracts (rounded). The futures position would be established as a short position to hedge the long position in the portfolio.

(Section 31.3.1)

7. The position in Country A's equity index futures contracts should be a long position of 125 contracts = [€30 million / (200 x €1,200)] to provide the desired full exposure of the portfolio to Country A's index. Country B's equity index futures contracts should be a short position of 800 contracts [i.e., 0.80 × €30 million / (300 × €100)] to hedge the undesired exposure of the fund to the systematic risk of Country B. The ex ante alpha of the entire portfolio would be 15 basis points per year, found as the weighted average of the ex ante alphas of the positions comprising the portfolio: 85% (i.e., €170 million / €200 million) with an ex ante alpha of 0 and 15% (i.e., €30 million / €200 million) with an ex ante alpha of 100 basis points.

(Section 31.3.3)

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