Essay Questions from Previous CAIA Level II Study Guides

Candidate Guidelines

Responses should be clear and concise, and need not be typed in full sentences. Candidates are not penalized for proper grammar and spelling, although a clear stream of thought is the best way to obtain full points in a given section. Be guided by the notion that complete responses that call for discussion, explanation, or description can be written in one or two paragraphs.

When an essay question asks for a list (say of three things), you will be graded only upon the first three items on the list and not on items beyond three.

Essay questions ask for specific types of responses, such as describe, calculate, or argue. Your answers should be tailored to meet the requirements of the question.

Guideline answers are provided after each question. The guideline answer represents a complete and comprehensive response to each question. Candidates will not be expected to provide responses of this length on the exam.

Question 1 (March 2009 Exam)

Jennifer Siegel has been appointed the portfolio manager of General Steel's Pension Fund. Jennifer studied how the pension allocation was determined by the previous team, but could not find any documentation regarding the inputs used to generate the allocation.

A. Jennifer wants to use a reverse optimization procedure to determine expected returns that, when used in a mean-variance optimization model, would lead to an asset allocation that corresponds to the weights in the global market portfolio. Given only the information provided in the table below, use the Capital Asset Pricing Model (CAPM) to generate expected returns for the above asset classes that would lead to market capitalization weights as optimal weights (i.e., equilibrium weights).

(3 points)

Asset Class	Weight in Global Market Portfolio	Weight in General Steel's Pension	Historical Arithmetic Annual Mean	Beta With Respect to Global Market Portfolio
Cash	0%	10%	4%	0.00
Bonds	35%	25%	6%	0.70
Equity	50%	60%	10%	1.33
Alternative	15%	5%	9%	0.60
Global Market Portfolio			8.45%	1.00

B. Jennifer is confident that the alternative asset class will earn an annual return greater than its historical mean. Explain how the Black-Litterman approach would combine Jennifer's view, her confidence in that view, historical returns on the alternative asset class, and its equilibrium expected return (no calculation is required).

(3 points)

C. Jennifer prepares a complete asset allocation study. List any four (4) of the eight (8) steps that, according to Sharpe in "Expected Utility Asset Allocation," are typically followed in preparing such a study.

(4 points)

Question 2 (March 2009 Exam)

Melinda Kim is an investment analyst for a large pension fund. The fund's investment committee has decided that adding hedge funds to the current portfolio of traditional investments (stocks and bonds) would improve the overall risk-return profile of the fund. The committee asked Ms. Kim to determine which hedge fund strategies offer the most attractive opportunities and to recommend feasible alternatives for obtaining exposure to these strategies. Ms. Kim designed a factor model that relates returns from several hedge fund strategies to three (3) systematic risk factors. She created each dependent variable of her model by calculating the average performance of a set of managers that report to public databases.

A. For the equity long/short strategy, Ms. Kim's model displays an adjusted R-square of 56% and an intercept of about 0.4% per month. Name two database biases that may impact the dependent variable. State whether each of these biases is most likely to increase, decrease, or leave unchanged the estimates of the R-square and the intercept.

(3 points)

B. Ms. Kim recommends that the committee consider investible hedge fund indices as an avenue for obtaining exposure to hedge funds. Mark Warner, a member of the investment committee, asks about the potential impact of access bias on investable hedge fund indices. Describe this bias and explain its impact.

(2 points)

C. The method used by Ms. Kim is known as the Factor Replication Approach. As explained by Amenc et al in "The Myths and Limits of Passive Hedge Fund Replication," the procedure's first step is the calibration of a factor model. The second step is the identification of the replicating portfolio. Describe the major challenge of the first step. Describe why the out-of-sample quality of the replication portfolio may be low.

(2 points)

D. Mr. Warner of the investment committee suggests that Ms. Kim look into other approaches to hedge fund replication. Identify the major alternative to the Factor Replication Approach. Describe the major goal of this alternative approach and contrast its ability to capture the time series of hedge fund returns with that of the Factor Replication Approach.

(3 points)

Question 3 (March 2009 Exam)

Kara Fisher is proposing changes to the current asset allocation of the New Frontier University Endowment. The Endowment's current portfolio consists of two broad asset classes – fixed income and global equity – but Ms. Fisher is looking to expand into different asset classes. She has obtained historical returns, standard deviations, and correlations of the asset classes held currently as well as other asset classes being considered.

A. Ms. Fisher's first approach is to use the mean-variance framework to obtain several optimal portfolios corresponding to different levels of risk tolerance.

- Describe the major problem with the optimal weights that are typically obtained from the unconstrained mean-variance optimization approach.
- Describe the concept of an equilibrium (that is, a "neutral") asset allocation.
- Explain how Ms. Fisher can adjust her estimates so that an equilibrium (that is, a "neutral") asset allocation is obtained.

(3 points)

B. Ms. Fisher is seeking alternatives to mean-variance optimization. Compare the expected utility optimization approach of asset allocation to the mean-variance approach. Describe two conditions related to utility functions or return distributions under which the two approaches would lead to the same asset allocation.

(2 points)

C. Ms. Fisher is considering some allocation to hedge funds. The investment committee has asked her to identify potential generic costs (concerns) associated with such investments. According to Zaker in "Alternative Metrics," there are seven (7) such generic costs (concerns). Identify four (4) of these. Identify the generic cost (concern) that, according to Khandani and Lo in "What Happened to the Quants in August 2007?" became increasingly important since 2000 and may have contributed to the events of August 2007.

(3 points)

D. Ms. Fisher is considering some allocation to real estate as well. Idzorek et al in "Global Commercial Real Estate" discuss two approaches or methods to equity investment in real estate. Identify these two methods of obtaining equity exposure to real estate and describe one advantage of each approach.

(2 points)

Question 4 (March 2009 Exam)

Ahmed Mansour is the portfolio manager of the Crescent Foundation Endowment. He has been instructed by the investment committee to consider expanding the Endowment's investment universe. Mr. Mansour is considering diversifying into alternative investments.

A. To determine the potential benefits of adding real estate to the current portfolio, Mr. Mansour wants to use historical returns of the National Council of Real Estate Investment Fiduciaries (NCREIF) Index to estimate risk-return characteristics of US real estate. Because NCREIF is a valuation-based index, Mr. Mansour has decided to unsmooth its return series using an unsmoothing parameter of 0.15. The reported returns for January, February, and March are 0.02, -0.01, and 0.03, respectively. Calculate the unsmoothed returns for February and March using a First Order Autoregressive Reverse Filter (FOARF). If Mr. Mansour uses FOARF to unsmooth the returns series of the past five years, how would the mean and the standard deviation of the unsmoothed returns compare to those of the original (smoothed) returns?

(3 Points)

B. Mr. Mansour is considering Australian infrastructure investments such as mature toll roads and power generation stations. To prepare his report for the investment committee of the endowment, he needs to highlight the conceptual characteristics of infrastructure investments. Name and describe four (4) of these characteristics.

(4 points)

C. Mr. Mansour realizes that the investment committee will be concerned about increased allocation to illiquid investments such as private equity. He needs to explain to the committee the factors that might prevent the fund from establishing and maintaining a target allocation to illiquid assets. Describe three (3) of the factors that complicate the establishment and maintenance of target allocations to such illiquid assets.

(3 points)

Question 5 (September 2008 Exam)

Florina Rast heads due diligence for Grandos, a medium-size European private equity investment company. Ms. Rast is examining the investment objectives and processes for several funds in the firm's portfolio and has raised a number of questions regarding diversification strategies and performance measurement.

A. What is naïve diversification and why might this be a suitable investment approach for Grandos?

(2 Points)

B. With regard to private equity portfolio design, which private equity allocation strategy -- market timing or cost averaging -- do Meyer & Mathonet (*Beyond the J Curve*) recommend? List two (2) reasons in support of their recommendation.

(3 Points)

C. Ms. Rast turns to the performance of their newest fund called Stellar. Use the data in the table below to calculate the following three (3) common private equity performance measures: (1) TVPI, (2) DPI, and (3) RVPI. You must show all work to receive credit.

	Amount
Cumulative Paid-In	10
Cumulative Distributions	12
Net Asset Value	5

(3 Points)

D. Ms. Rast is interested in reporting the performance of Grandos' portfolio of funds and has computed the following four (4) aggregate return measures: average, median, committed weighted, and pooled. Which of these four measures represents the "true" return on the aggregate portfolio according to Meyer and Mathonet (*Beyond the J Curve*)? Provide a brief definition for your measure of choice.

(2 Points)

Question 6 (September 2008 Exam)

Jesse Smalls manages an equity fund for Jupiter Investments and is actively looking for equity market segments that can offer consistent positive abnormal returns. Jesse has turned his attention to Real Estate Investment Trusts (REITs).

A. Define the efficient market hypothesis. Provide two (2) arguments why the REIT market may be less efficient than the equity market as a whole.

(3 Points)

B. According to Chan, Erickson, and Wang (*Real Estate Investment Trusts*), what does the available evidence say about the ability of an investor to develop a profitable trading strategy based on the return predictability of REIT stocks?

(3 Points)

C. Jesse is considering employing trading strategies based upon momentum and/or reversals in the REIT market. What is the lowest form of market efficiency that would render these strategies unprofitable? Explain.

(2 Points)

D. Describe the evidence provided by Chan, Erickson, and Wang (*Real Estate Investment Trusts*) regarding the performance of stock-price reversal and momentum strategies in the REIT market.

(2 Points)

Question 7 (September 2008 Exam)

Johan is looking to invest in a two-year, $1,000 par (face) value convertible bond with an annual coupon rate of 7%. This convertible has a conversion ratio of 20 and a delta of 0.6. The current price of the stock underlying this convertible is $40. For the purpose of answering the following questions, assume that the convertible has no credit risk.

A. Suppose that the stock price is expected to remain constant, that the annual dividend yield is 4%, and that the annual discount rate is 8%.

(1) Calculate the yield advantage on a semi-annual basis. Show all work. (2 points)
(2) Calculate the present value of the yield advantage over the two-year holding period. Show all work. (1 point)

(3 Points)

B. Assuming that $2,000,000 is invested in the convertible bond, how many shares would Johan need to short in order to achieve a delta neutral position? Show all work. Assume constant interest rates.

(2 Points)

C. In general, the convertible bond's profile graph plots the price of the convertible bond on the vertical axis against the stock price on the horizontal axis. Contrast the expected level of the delta of any convertible in the "busted" zone with the expected level of the delta of any convertible in the "equity" zone. Explain why the respective deltas are at these levels.

(2 Points)

D. The following question relates to the risk measure known as gamma.

(1) Provide a one sentence definition for the gamma of convertible bonds. (1 point)
(2) Explain the distinction between "upside gamma" and "downside gamma." (1 point)
(3) Describe the point on the gamma curve where gamma is at its highest level. (1 point)

(3 Points)

Guideline Answer For Question 1

1. He, G., and R. Litterman. "The Intuition Behind Black-Litterman Model Portfolios." Investment Management Research, Goldman Sachs Quantitative Resources Group. 1999, p. 1-19.
2. Sharpe, W.F. "Expected Utility Asset Allocation." Financial Analysts Journal. Vol. 63, no. 5, 2007, p. 18-30.
3. Zaker, S. "Alternative Metrics." The Journal of Alternative Investments. Spring 2007, p. 79-92.
4. Idzorek, T.M., M. Barad, and S.L. Meier. "Global Commercial Real Estate." The Journal of Portfolio Management. Special Issue, 2007, p. 37-52.

Purpose: *To understand the difficulties of applying traditional mean-variance optimization techniques; to consider alternative (to mean-variance) optimization techniques; to apply expected utility optimization to an alternative investment portfolio.*

Keywords: *Black-Litterman asset allocation, Black-Litterman model, constrained optimization, efficient market forecasts, expected utility optimization, Markowitz framework, mean-variance optimization, reverse optimization.*

Learning Objectives

1. *Outline the shortcomings of the traditional Markowitz framework for portfolio allocation decisions.*
2. *Explain how the Black-Litterman asset allocation model addresses the practical problems associated with the traditional Markowitz framework.*
3. *Describe how the Black-Litterman asset allocation model establishes neutral reference points for expected returns and portfolio weights.*
4. *Discuss how an investor's views and level of confidence are incorporated into the Black-Litterman model and reflected in optimal portfolio weights.*
5. *Outline the intuitively appealing properties of the optimal portfolio weights generated by the Black-Litterman model.*
6. *Explain how the Black-Litterman portfolio optimization process is modified given three common portfolio constraints.*
7. *Outline the typical steps when performing a complete asset allocation study.*
8. *Evaluate the validity of the mean-variance approach to optimization.*
9. *Explain the costs and benefits of using a generalized approach to optimization that requires discrete return distributions.*
10. *Describe expected utility optimization.*
11. *Illustrate a benefit of using an expected utility maximization approach.*
12. *Explain the purposes and justifications of reverse optimization.*
13. *Contrast the benefits and limitations of allocating to hedge funds.*
14. *Compare the assumptions and results of the CAPM approach to the Black-Litterman approach when determining forward-looking asset allocations.*

Jennifer Siegel has been appointed the portfolio manager of General Steel's Pension Fund. Jennifer studied how the pension allocation was determined by the previous team, but could not find any documentation regarding the inputs used to generate the allocation.

A. Jennifer wants to use a reverse optimization procedure to determine expected returns that, when used in a mean-variance optimization model, would lead to an asset allocation that corresponds to the weights in the global market portfolio. Given only the information provided in the table below, use the capital asset pricing model (CAPM) to generate expected returns for the above asset classes that would lead to market capitalization weights as optimal weights (i.e., equilibrium weights).

(3 points)

Asset Class	Weight in Global Market Portfolio	Weight in General Steel's Pension	Historical Arithmetic Annual Mean	Beta With Respect to Global Market Portfolio
Cash	0%	10%	4%	0
Bonds	35%	25%	6%	0.7
Equity	50%	60%	10%	1.33
Alternative	15%	5%	9%	0.6
Global Market Portfolio			8.45%	1

The capital asset pricing model (CAPM) is closely related to mean-variance optimization. If one uses the expected returns implied by the CAPM, the optimal weights resulting from the application of a mean-variance model would be equal to the market capitalization weights of the assets that are included in the market portfolio. Therefore, to justify the market capitalization weights as optimal weights, the expected return should be given by:

$$E\left[R_i\right] = R_f + \beta_i \times \left(E\left[R_M\right] - R_f\right)$$

The equilibrium expected returns of the asset classes are:

Cash = 4% + 0(8.45% - 4%) = 4%*
Bonds = 4% + 0.7(8.45% - 4%) = 7.12%*
Equity = 4% + 1.4(8.45% - 4%) = 9.92%*
Alternatives = 4% + 0.6(8.45% - 4%) = 6.67%*

B. Jennifer is confident that the alternative asset class will earn an annual return greater than its historical mean. Explain how the Black-Litterman approach would combine Jennifer's view, her confidence in that view, historical returns on the alternative asset class, and its equilibrium expected return (no calculation is required).

(3 points)

In the Black-Litterman approach, the portfolio manager will adjust the equilibrium returns to reflect her views. Depending on the confidence of the portfolio manager, the final estimate of the expected return will fall between the equilibrium return and the manager's view. If the manager is very confident in her views, the estimate would be close to her view. A neutral view is the one in which the portfolio manager has no confidence in her view and therefore the estimate of the expected return is equal to the equilibrium return.

C. Jennifer prepares a complete asset allocation study. List any four (4) of the eight (8) steps that, according to Sharpe in "Expected Utility Asset Allocation," are typically followed in preparing such a study.

(4 points)

According to Sharpe, a fund's staff (often with the help of consultants):

1. *Selects desired asset classes and representative benchmark indices.*
2. *Chooses a representative historic period and obtains returns for the asset classes.*
3. *Computes historic asset average returns, standard deviations, and correlations.*
4. *Estimates future expected returns, standard deviations, and correlations taking into account historic data, current market conditions and typical relationships in capital markets.*
5. *Finds several mean/variance efficient asset mixes for alternative levels of risk tolerance.*
6. *Projects future outcomes for the selected asset mixes, often over many years.*
7. *Presents to the Board relevant summary measures of future outcomes for each of the selected asset mixes.*
8. *Requests that the Board chooses one of the candidate asset mixes to be the asset allocation policy, based upon the Board's views concerning the relevant measures of future outcomes.*

Guideline Answer for Question 2

1. Jaeger, L., and C. Wagner. "Factor Modeling and Benchmarking of Hedge Funds: Can Passive Investments in Hedge Fund Strategies Deliver?" *The Journal of Alternative Investments.* Winter 2005, p. 6-33.

2. Amenc, N., W. Géhin, L. Martellini, and J.-C. Meyfredi. "The Myths and Limits of Passive Hedge Fund Replication." Edhec Risk and Asset Management Research Centre. June 2007, p. 4-38.

Purpose*: To provide candidates with an overview of modeling hedge fund returns using liquid instruments; to examine the sources of risk and return to various hedge fund strategies to replicate returns on hedge fund indices.*

Keywords: *Access bias, alternative betas, backfill bias, survivorship bias.*

Learning objectives*: The candidate should be able to:*

1. *Compare and contrast investable and noninvestable hedge fund indices with respect to survivorship bias, backfill bias, selection bias, autocorrelation, access bias, and representativeness.*
2. *Describe the impact of hedge fund biases on the results of regression analyses that employ the indices as dependent variables.*
3. *Discuss the implications of a significant autoregressive term in regression analyses that employ the indices as dependent variables.*
4. *Explain the difference between the index returns and the Replicating Factor Strategy (RFS) returns.*
5. *Explain the significance of explanatory factors used to calculate the RFS returns for various hedge fund investment strategies.*
6. *State reasons for the potential decline of "alpha" in the hedge fund industry.*
7. *Compare the factor-based approach to hedge fund replication with the payoff distribution approach to hedge fund replication in terms of their:*
   a. *Goals*
   b. *Methodology*
   c. *Ability to replicate hedge fund returns*
   d. *Benefits*
   e. *Drawbacks*

Melinda Kim is an investment analyst for a large pension fund. The fund's investment committee has decided that adding hedge funds to the current portfolio of traditional investments (stocks and bonds) would improve the overall risk-return profile of the fund. The committee asked Ms. Kim to determine which hedge fund strategies offer the most attractive opportunities and to recommend feasible alternatives for obtaining exposure to these strategies. Ms. Kim designed a factor model that relates returns from several hedge fund strategies to three (3) systematic risk factors. She created each dependent variable of her model by calculating the average performance of a set of managers that report to public databases.

A. For the equity long/short strategy, Ms. Kim's model displays an adjusted R-square of 56% and an intercept of about 0.4% per month. Name two database biases that may impact the dependent variable. State whether each of these biases is most likely to increase, decrease, or leave unchanged the estimates of the R-square and the intercept.

(3 points)

The concept of beta and alpha and how they are related is a running theme in this article. From a risk management perspective, the analyst must recognize that estimates from models can include mis-estimation and biases into the reported results.

The three potential biases present in public databases are backfilling bias, survivorship bias, and selection bias. All of these biases are most likely to affect the estimated value of the intercept. The impact on R-square of all of these biases is zero.

B. Ms. Kim recommends that the committee consider investible hedge fund indices as an avenue for obtaining exposure to hedge funds. Mark Warner, a member of the investment committee, asks about the potential impact of access bias on investable hedge fund indices. Describe this bias and explain its impact.

(2 points)

The investment capacity of some hedge fund managers can be a scarce resource such that investable index providers must compete with other investors (e.g., funds of funds). In hedge fund markets, access is not determined by the market price but by the investor's ability to get and keep direct access to the individual fund managers. Often this is determined by personal relationships and other "soft factors." These access factors carry a cost not dissimilar from the one incurred by regular fund-of-funds. As a rule, investible hedge fund indices underperform the non-investible strategy benchmarks as reported by public databases. ''Access bias'' indicates that only certain types of managers may be willing to be part of an investible index. These are typically hedge funds that have more liquid positions and are able to report accurate daily return figures.

C. The method used by Ms. Kim is known as the Factor Replication Approach. As explained by Amenc et al in "The Myths and Limits of Passive Hedge Fund Replication," the procedure's first step is the calibration of a factor model. The second step is the identification of the replicating portfolio. Describe the major challenge of the first step. Describe why the out-of-sample quality of the replication portfolio may be low.

(2 points)

The Factor Replication Approach requires a well-specified model that includes all relevant factors in the regression. If the model is not well specified, then out-of-sample performance of the regression suffers and the replicating portfolio does not perform as expected.

Factor replication models tend to have poor out-of-sample performance because of a rebalancing problem induced either by the presence of noise or because of a non-stationary series. There is strong evidence that managers dynamically change their factor exposures. This means that the estimated beta exposures are time varying, leading to the low quality of the replication portfolio's performance.

D. Mr. Warner of the investment committee suggests that Ms. Kim look into other approaches to hedge fund replication. Identify the major alternative to the Factor Replication Approach. Describe the major goal of this alternative approach and contrast its ability to capture the time series of hedge fund returns with that of the Factor Replication Approach.

(3 points)

The other major approach to replication is called the "Payoff Distribution Approach." This alternative approach uses options to replicate the payoff distribution of a target (a hedge fund index or a hedge fund manager). Unlike the factor replication approach, the goal is not to maximize the correlation between the replicating portfolio and the target but instead to create a portfolio that matches the volatility, skewness, and kurtosis of the target portfolio. The replicating portfolios obtained through the payoff distribution approach tend to perform very poorly in capturing the time series behavior of the target.

Guideline Answer for Question 3

1. He, G., and R. Litterman. "The Intuition Behind Black-Litterman Model Portfolios." Investment Management Research, Goldman Sachs Quantitative Resources Group. 1999, p. 1-19. (118-136)
2. Sharpe, W.F. "Expected Utility Asset Allocation." *Financial Analysts Journal*. Vol. 63, no. 5, 2007, p. 18-30. (137-149)
3. Zaker, S. "Alternative Metrics." *The Journal of Alternative Investments*. Spring 2007, p. 79-92. (150-163)
4. Idzorek, T.M., M. Barad, and S.L. Meier. "Global Commercial Real Estate." *Journal of Portfolio Management*. Special Issue, 2007, p. 37-52. (164-179)

Purpose: *To understand the difficulties of applying traditional mean-variance optimization techniques; to consider alternative (to mean-variance) optimization techniques; to apply expected utility optimization to an alternative investment portfolio.*

Keywords: *Constrained optimization, efficient market forecasts, expected utility optimization, reverse optimization, private (direct) commercial real-estate debt, public (indirect) commercial real-estate debt, private (direct) commercial real-estate: equity, public (indirect) commercial real-estate: equity, quadratic utility function, mean-variance optimization.*

Learning Objectives: *The candidate should be able to:*

1. *Outline the shortcomings of the traditional Markowitz framework for portfolio allocation decisions.*
2. *Explain how the Black-Litterman asset allocation model addresses the practical problems associated with the traditional Markowitz framework.*
3. *Describe how the Black-Litterman asset allocation model establishes neutral reference points for expected returns and portfolio weights.*
4. *Discuss how an investor's views and level of confidence are incorporated into the Black-Litterman model and reflected in optimal portfolio weights.*
5. *Outline the intuitively appealing properties of the optimal portfolio weights generated by the Black-Litterman model.*
6. *Evaluate the validity of the mean-variance approach to optimization.*
7. *Describe expected utility optimization.*
8. *Illustrate a benefit of using an expected utility maximization approach.*
9. *Explain the purposes and justifications of reverse optimization.*
10. *For hedge fund investing and the alpha uncertainty relationship:*
    a. *List the generic costs associated with hedge funds.*
    b. *Discuss the difficulty with applying an alpha/beta centric methodology.*
    c. *Discuss why alpha is not an appropriate metric for hedge fund allocations.*
    d. *Discuss the four degrees of freedom that hedge funds are allowed to use.*
11. *Discuss the role of global commercial real estate in a strategic asset allocation setting.*
12. *Identify the components of the commercial real estate asset class and the relative advantages of direct real estate investment and real estate investment trusts (REITs).*

Kara Fisher is proposing changes to the current asset allocation of the New Frontier University Endowment. The Endowment's current portfolio consists of two broad asset classes – fixed income and global equity – but Ms. Fisher is looking to expand into different asset classes. She has obtained historical returns, standard deviations, and correlations of the asset classes held currently as well as other asset classes being considered.

A. Ms. Fisher's first approach is to use the mean-variance framework to obtain several optimal portfolios corresponding to different levels of risk tolerance.

   - Describe the major problem with the optimal weights that are typically obtained from the unconstrained mean-variance optimization approach.
   - Describe the concept of an equilibrium (that is, a "neutral") asset allocation.
   - Explain how Ms. Fisher can adjust her estimates so that an equilibrium (that is, a "neutral") asset allocation is obtained.

(3 points)

Mean-variance optimization relies on historical estimates of expected means, standard deviations, and correlations. When unconstrained mean-variance optimization is performed, the weights are typically too extreme, requiring the portfolio manager to take very large long and short positions in some asset classes. The reason is that estimated inputs are subject to estimation errors and mean-variance optimization has the tendency to maximize the errors.

One possible solution to this problem is to adjust the estimated expected returns such that the resulting weights would correspond to an equilibrium (or neutral) allocation. When applied to traditional asset classes, the neutral allocation typically means allocations that are proportional to market capitalization of those asset classes. These expected returns are referred to as equilibrium returns when they correspond to returns obtained using an equilibrium model such as CAPM.

B. Ms. Fisher is seeking alternatives to mean-variance optimization. Compare the expected utility optimization approach of asset allocation to the mean-variance approach. Describe two conditions related to utility functions or return distributions under which the two approaches would lead to the same asset allocation.

(2 points)

The expected utility optimization approach is a more general form of mean-variance optimization. In general, an investor would seek a portfolio that maximizes an objective function. For example, the weights, w(i), are selected such that

$$Max\ E[U(R(p))]$$

$$Where\ R(p) = \sum_{i=1}^{N} w(i)R(i).$$

In mean variance optimization the objective is written as E[R(p)] – (1/t) Var[R(p)], where t is the measure of risk tolerance. So the expected utility optimization approach is more general than the mean-variance approach.

The expected utility approach is reduced to the mean-variance approach if (a) the utility function is of quadratic form or (b) asset returns are normally distributed.

C. Ms. Fisher is considering some allocation to hedge funds. The investment committee has asked her to identify potential generic costs (concerns) associated with such investments. According to Zaker in "Alternative Metrics," there are seven (7) such generic costs (concerns). Identify four (4) of these. Identify the generic cost (concern) that, according to Khandani and Lo in "What Happened to the Quants in August 2007?" became increasingly important since 2000 and may have contributed to the events of August 2007.

(3 points)

According to Zaker there are seven (7) costs to hedge fund investing:

1. *Illiquidity and lack of risk transparency*
2. *Monitoring cost*
3. *Regulatory cost*
4. *Client specific costs (e.g., fiduciary issues for some institutional clients)*
5. *Factor impact on client's policy portfolio*
6. *Limited capacity, higher fees, longer lock-up*
7. *High base of investment and incentive fees*

According the K&L, the illiquidity of most hedge funds and equity long/short has steadily increased since 2000. This lack of liquidity was a major contributing factor to the events that took place in August 2007.

D. Ms. Fisher is considering some allocation to real estate as well. Idzorek et al in "Global Commercial Real Estate" discuss two approaches or methods to equity investment in real estate. Identify these two methods of obtaining equity exposure to real estate and describe one advantage of each approach.

(2 points)

The two approaches are direct or indirect. The direct approach refers to an investment in the property and can be called "private" while the indirect approach refers to investment in securities such as real estate investment trusts (REITs). REITs are backed by such properties and can be called "public".

Advantages of direct investment are: direct control, the ability to select individual properties, greater capacity, potential tax benefits.

Advantages of indirect investment are: lower cost, liquidity, independent analysis, corporate governance, real-time pricing.

Guideline Answer for Question 4

1. Marcato, G., and T. Key. "Smoothing and Implications for Asset Allocation Choices." The Journal of Portfolio Management. Special Issue 2007, p. 85-98.

2. Mansour, A., and H. Nadji. "Performance Characteristics of Infrastructure Investments." RREEF Research – A Member of the Deutsche Bank Group. August 2007, p. 1-18.

3. Meredith, R., N. De Brito, and R. De Figueiredo. "Portfolio Management with Illiquid Investments." Citi Alternative Investments. June 2006, p. 26-31.. (217-223)

Purpose: *To understand the constraints imposed by an illiquid market; to dissect the asset allocation decision under conditions of smoothed and unsmoothed returns; to design target asset allocations when asset classes are illiquid.*

Keywords: *First Order Autoregressive Reverse Filter (FOARF), Full Information Value Index (FIVI), listed infrastructure funds, unlisted infrastructure funds.*

Learning Objectives*: The candidate should be able to:*

The candidate should be able to:

1. *In the Marcato and Key (2007) study, compare and contrast the results of using UK data with those employing US and Australia real estate return data.*
2. *Argue the best method of adjusting a real estate return series when conducting an asset allocation study.*
3. *Describe factors complicating the establishment and maintenance of target allocations to illiquid asset classes.*
4. *Describe the conceptual characteristics of infrastructure sectors.*
5. *Compare infrastructure with other traditional and alternative assets.*
6. *Critique the evidence on the performance history for infrastructure investments.*
7. *Explain how the composition and construction of the following indices impact their relative performance:*
   a. *RREEF Hypothetical Infrastructure Index*
   b. *UBS Global Infrastructure & Utilities Index*
   c. *Moody's Economy.com Infrastructure Index*
8. *Identify risks involved with infrastructure investments.*

Ahmed Mansour is the portfolio manager of the Crescent Foundation Endowment. He has been instructed by the investment committee to consider expanding the Endowment's investment universe. Mr. Mansour is considering diversifying into alternative investments.

A. To determine the potential benefits of adding real estate to the current portfolio, Mr. Mansour wants to use historical returns of the National Council of Real Estate Investment Fiduciaries (NCREIF) Index to estimate risk-return characteristics of US

real estate. Because NCREIF is a valuation-based index, Mr. Mansour has decided to unsmooth its return series using an unsmoothing parameter of 0.15. The reported returns for January, February, and March are 0.02, -0.01, and 0.03, respectively. Calculate the unsmoothed returns for February and March using a First Order Autoregressive Reverse Filter (FOARF). If Mr. Mansour uses FOARF to unsmooth the returns series of the past five years, how would the mean and the standard deviation of the unsmoothed returns compare to those of the original (smoothed) returns?

(3 Points)

The article by Marcato and Key discusses methods for unsmoothing the returns. FOARF is the most common and the simplest method for unsmoothing returns. According to this approach:

$$R_{tu} = \frac{R_{ts} - \alpha \times R_{t-1s}}{(1-\alpha)}$$

where α is the unsmoothing parameter, R_{ts} is the smoothed return in time t and R_{tu} is the unsmoothed return in time t. It can be seen that the expected value of the unsmoothed returns will be the same as the expected value of the smoothed returns. However, the volatility of the unsmoothed return will be higher than the volatility of the smoothed return.

B. Mr. Mansour is considering Australian infrastructure investments such as mature toll roads and power generation stations. To prepare his report for the investment committee of the endowment, he needs to highlight the conceptual characteristics of infrastructure investments. Name and describe four (4) of these characteristics.

(4 points)

The article by Mansour and Nadji discusses various aspects of infrastructure investments. Though these investments are rather heterogeneous, they share some common characteristics. They are:

1. *Monopoly: Infrastructure assets are typically large-scale investments with very high initial fixed costs. The high initial capital outlays act as a barrier to entry for new entrants. Such barriers block potential entrants from entering the market profitably since incumbents face declining average operational costs. As a result, infrastructure assets have monopolistic or "quasi-monopolistic" characteristics.*
2. *Inelastic Demand: Infrastructure assets provide essential services to the community. Since these services are "necessities," demand does not react to price movements. Demand for these essential services is immune to the broader vagaries of the business*

cycle. In addition, infrastructure assets have few substitutes, which contributes to the inelastic nature of demand.

3. *Stable Cash Returns: Since infrastructure assets are monopolies in the provision of essential services, demand for infrastructure services is relatively inelastic, rendering them immune to the business cycle, which ensures stable cash returns. The stable cash returns are a feature of mature infrastructure assets with a proven demand history. The stable cash flow underlying mature infrastructure assets permits relatively high leverage ratios.*
4. *Long Duration: Similar to real estate, infrastructure assets are long-lived, often lasting over 50 years. Durable assets that provide the potential for long-term investment horizons are much in demand by institutional investors. Public and corporate pension funds in particular are facing long-term liabilities. The long-duration nature of infrastructure assets is appealing to many plan sponsors.*
5. *Inflation Hedge: Infrastructure is a tangible real asset and provides an inflation hedge. In an inflationary environment, the replacement cost of real assets increases, hence protecting the value of existing infrastructure assets. In addition, concessions governing the structure of leases on infrastructure assets permit rent escalations, which are usually Consumer Price Index (CPI)-linked.*
6. *Hybrid Asset: Infrastructure shares many common traits with a variety of assets including real estate, fixed income, and private equity. Investing in a mature, government-regulated utility is analogous to a fixed-income investment with the upside of having a degree of inflation protection. Developing infrastructure assets in India share common return characteristics and risks to opportunistic real estate development. An infrastructure investment in an airport is common to private equity investing where you are also investing in the operating company.*

C. Mr. Mansour realizes that the investment committee will be concerned about increased allocation to illiquid investments such as private equity. He needs to explain to the committee the factors that might prevent the fund from establishing and maintaining a target allocation to illiquid assets. Describe three (3) of the factors that complicate the establishment and maintenance of target allocations to such illiquid assets.

(3 points)

Illiquid investments give rise to certain risks and uncertainties that may prevent a portfolio manager from establishing and maintaining a steady state allocation. For example, the initial investment in private equity cannot be equal to the target allocation because private equity investment is associated with capital calls that take place through time and are subject to uncertain distributions. The following factors make it difficult to achieve target allocation to illiquid investments:

1. *Illiquidity. This means that investors may be locked up for 10 years in investments, preventing them from adjusting their allocation.*

2. *Uncertainty regarding size and timing of capital calls. While investors typically commit to an investment amount, it may take years for the entire capital to be called in. Also, the amount called in is not certain.*
3. *Uncertainty regarding size and timing of distributions. Distributions typically take place after a few years, and distributions reduce invested capital. It is difficult to maintain the targeted allocation to illiquid assets.*
4. *Valuation subjectivity. Illiquid investments are typically valued based on accounting or other subjective methods. Therefore, it is difficult for investors to know the market value of their investment.*

Guideline Answer for Question 5

Thomas Meyer, Pierre Yves Mathonet, "Beyond the J-curve", John Wiley & Sons, 2005, ISBN-13 978-0-470-01198-0.

Keywords: *cost averaging, distribution to paid-in ratio (DPI), naïve diversification, net asset value (NAV), residual value to paid-in (RVPI), total value to paid-in ratio (TVPI), vintage year diversification*

Learning Objectives: *The candidate should be able to:*

1. *explain the rationale for using naïve diversification in private equity markets,*
2. *compare the mixed approach with the core satellite approach when constructing a private equity portfolio,*
3. *compare market timing with cost averaging in the private equity markets,*
4. *calculate the following performance measures and discuss their drawbacks: total value to paid-in ratio (TVPI), distribution to paid-in ratio (DPI), and residual value to paid-in ratio (RVPI),*
5. *discuss performance measures for portfolios of funds relative to performance measures for individual funds.*

Florina Rast heads due diligence for Grandos, a medium-size European private equity investment company. Ms. Rast is examining the investment objectives and processes for several funds in the firm's portfolio and has raised a number of questions regarding diversification strategies and performance measurement.

A. Ms. Rast has suggested that Grandos adopt a naïve diversification strategy. What is naïve diversification and why might this be a suitable approach for Grandos?

(2 Points)

While all candidates are aware of the role that diversification and modern portfolio theory play in the management of a group of assets, the Markowitz "Big-D" is difficult to apply for private equity. An alternative is "Little-D" or equal weighting as the optimal solution when there is little to no information that allows for the differentiation between assets. The "1/N heuristic" works well when data and forecasts are not reliable. Writing on the management of private equity portfolios, an article by Lhabitant and Learned state that modern portfolio theory is seldom applied to the full degree, and that naive diversification usually results in reasonably diversified portfolios that posses risk and return attributes approaching those represented by the efficient frontier.

B. With regard to private equity portfolio design, which private equity allocation strategy -- market timing or cost averaging -- do Meyer & Mathonet (*Beyond the J Curve*) recommend? List two (2) reasons in support of their recommendation.

(3 Points)

The cost averaging principle establishes an annual investment target for each private-equity subclass in order to eliminate market timing issues. Cost averaging provides adequate exposure to all vintage years (the year in which the venture/private equity firm began making investments). To implement cost averaging correctly, one must stick to the long-term plan and avoid any temptation to overweight commitments to the hot strategy of the moment.

A market timing strategy attempts to predict which vintage years will produce the best investments. It is a high-risk strategy that may cause investors to hold a portfolio that differs from long-term objectives.

Meyer and Mathonet recommend using a cost averaging allocation strategy and support their recommendation with the following:

- *Investing on a consistent basis provides vintage year diversification of the portfolio.*
- *Forecasting the most profitable vintage years is difficult at best.*
- *Investors need to remain present in the market to "reserve the right to play." Entering and exiting the market may result in the exclusion of the investor from future opportunities.*
- *Attempts at market timing exposes the portfolio to avoidable risks and may stray from long-term strategic targets.*

C. Ms. Rast turns to the performance of their newest fund called Stellar. Use the data in the table below to calculate the following three (3) common private equity performance measures: (1) TVPI, (2) DPI, and (3) RVPI. You must show all work to receive credit.

	Amount
Cumulative Paid-In	10
Cumulative Distributions	12
Net Asset Value	5

(3 Points)

Calculations:

1. *The multiple (or Total Value to Paid-In) (TVPI) = (12+5)/10 = 1.70*
2. *The Distribution to Paid-In (DPI) = 12/10 = 1.20*
3. *The Residual Value to Paid-In (RVPI) = 5/10 = 0.50*

D. Ms. Rast is interested in reporting the performance of Grandos' portfolio of funds, and has computed the following four (4) aggregate return measures: average, median, committed weighted, and pooled. Which of these four measures represents the "true" return on the aggregate portfolio according to Meyer and Mathonet (*Beyond the J Curve*)? Provide a brief definition for your measure of choice.

(2 Points)

The four (4) aggregation methodologies are:

1. *Average: The arithmetic mean of the funds' performance.*
2. *Median: The value appearing in the middle of a table ranking funds' performance.*
3. *Commitment Weighted: The weighted average performance where the weights are determined by fund size.*
4. *Pooled: Portfolio performance obtained by combining all individual funds cash flows and residual values together as if they were from one single fund.*

As suggested by Meyer and Mathonet, it is the pooled measure that gives the "true" return on the portfolio. However, they state that for practical reasons, it may make sense to use the others as well.

Guideline Answer for Question 6

Chan, Su Han, John Erickson, and Ko Wang. *Real Estate Investment Trusts*. Oxford University Press, Inc., 2003. ISBN: 0195155343.

Purpose: *To examine trading strategies using REIT stocks; to relate trading strategies to market efficiency.*

Keywords: *Abnormal return, efficient market hypothesis, filter rule, large capitalization stocks, momentum trading, semistrong-form efficiency, small capitalization stocks, strong-form efficiency, weak-form efficiency*

Learning Objectives: *The candidate should be able to*

1. *Describe the three levels of market efficiency (prerequisite materials,*
2. *Defend the argument that the REIT market is inefficient using the following terms: small-cap, mid-cap, and large-cap.*
3. *Assess the predictability of REIT stock returns in the context of filter rules and momentum trading.*
4. *Argue for and against an investor's ability to realize abnormal returns by investing in REITs.*

Jesse Smalls manages an equity fund for Jupiter Investments and is actively looking for equity market segments that can offer consistent positive abnormal returns. Jesse has turned his attention to Real Estate Investment Trusts (REITs).

A. Define the efficient market hypothesis. Provide two (2) arguments why the REIT market may be less efficient than the equity market as a whole.

(3 Points)

An efficient market is one where prices reflect all available information. The implication is that prices move in random patterns governed by the arrival of new information. Since there's no pattern to when new information arrives, we observe price changes occurring in a random fashion. Since investors can't forecast accurately the arrival of new information, no trading strategy would yield consistent above-average, risk-adjusted returns.

There are two arguments why the REIT market might be less efficient than the stock market as a whole. First, the market capitalization of REITs places them in the category of small cap stocks (market capitalizations of less than $500 million). Since institutional investors have relatively little interest in small caps, security analysts are less likely to follow them. The argument is that with less information available to digest, the market will find it more difficult to value REITs, providing more potential opportunities for

investors to earn abnormal profits. Second, the information about the value of the properties owned by REITs can be difficult to obtain, especially if the REIT holds a diversified portfolio of properties. Since real estate markets tend to be separated geographically into smaller local markets, one would have to investigate every local market, perhaps even each underlying property, to accurately assess the value of the REIT holdings.

B. According to Chan, Erickson, and Wang (*Real Estate Investment Trusts*), what does the available evidence say about the ability of an investor to develop a profitable trading strategy based on the return predictability of REIT stocks?

(3 Points)

This question examines the ability of investors to develop trading strategies that lead to abnormal returns. The authors make the point that this is a different question from "Are REIT returns predictable?" That is, even in the case when they are, the question here is whether or not an investor can develop a trading strategy based upon return predictability that will earn the investor abnormal returns.

The authors review the existing research and find mixed results.

There is some support that active trading can outperform similar risk buy-and-hold passive investing. For example, one study found that REIT portfolios that actively change their composition can outperform passively managed portfolios of similar risk. Another study found that investors could earn abnormal returns by purchasing REITs when excess returns in the real estate market are expected to rise and selling them when excess returns are expected to fall.

There is little support for the notion that investors can use economic variables to develop a successful trading strategy based upon the return predictability of REIT stocks. The authors cite a study that examined the excess return performance of five (5) active trading strategies and found that these active strategies failed to beat a buy-and-hold passive trading strategy of similar risk stocks.

Putting all the evidence together seems to tip the balance in favor of the view that investors cannot build strategies that predict REIT returns. The authors end with the statement, "We are quite sure that the empirical evidence will not end here," suggesting that the jury is still out.

C. Jesse is considering employing trading strategies based upon momentum and/or reversals in the REIT market. What is the lowest form of market efficiency that would render these strategies unprofitable? Explain.

(2 Points)

The question refers to two (2) types of trading strategies; momentum and reversals. Momentum strategies look for security prices that move in the same direction over some defined period of time. Reversals look for underperforming securities to outperform and vice versa, a pattern consistent with investors overreacting to news.

Both of these strategies are governed by trading based upon pricing patterns and fall within the category of weak-form tests of market efficiency. In a weak-form efficient market, patterns of past prices provide no information about patterns of prices in the future. If patterns such as those described do not persist, then momentum and reversal trading would be of no use.

D. Describe the evidence provided by Chan, Erickson, and Wang (*Real Estate Investment Trusts*) regarding the performance of stock-price reversal and momentum strategies in the REIT market.

(2 Points)

A few studies quoted by Chan et al found that REITs exhibit significant price reversals. Studies have also found trading rules that follow a reversal pattern earn significant abnormal returns before transactions costs are considered, that these returns increase with the length of the investment horizon out to one year, and that the returns decline over each successive decade examined. Chan et al also quote from a more recent study that develops reversal portfolios based upon a filter rule. This study finds that abnormal returns can be earned even after factoring in a moderate level of transactions costs.

Summary of reversal strategies: evidence of success using reversals is mixed.

Summary of momentum strategies: evidence of success using momentum is also mixed but clearer as the authors state "it appears that momentum trading is likely to continue to be a viable strategy."

Guideline Answer for Question 7

Convertible Arbitrage: Insights and Techniques for Successful Hedging, Calamos, Wiley Publishers, 2003.

Purpose: *To examine the convertible arbitrage strategy in-depth; to understand the terminology of convertible arbitrage; to value convertible bonds; to understand the various hedging techniques of convertible bonds.*

Keywords: *Delta, downside gamma, gamma, transition multiplier, transition probability, upside gamma.*

Learning Objectives:

1. *Discuss methods of valuation for convertible securities; calculate the value of a convertible using the stock-plus method; and understand the components of the convertible profile graph.*
2. *Construct a two-period binomial stock price tree given a stock's current price, volatility, and the risk-free interest rate.*
3. *Describe the basic steps for constructing a conversion probability tree using the convertible value formula.*
4. *Understand the significance of the basic Greeks (delta, modified delta, gamma, vega, theta, and rho) for convertible arbitrage strategies.*
5. *Identify delta neutral hedge opportunities; calculate profit and loss; and describe the risks involved in such hedges.*
6. *Understand the benefits as well as risks of dynamic rebalancing.*
7. *Understand and explain gamma hedging. {p. 134-147}*
8. *List criteria used to identify gamma hedge opportunities and illustrate a gamma hedge.*
9. *Discuss the use of leverage in a gamma hedge.*

Johan is looking to invest in a two-year, $1,000 par value convertible bond with an annual coupon rate of 7%. This convertible has a conversion ratio of 20 and a delta of 0.6. The current stock price underlying this convertible is $40. For the purpose of the following questions, assume that the convertible has no credit risk.

A. Suppose that the stock price is expected to remain constant, that the annual dividend yield is 4%, and that the annual discount rate is 8%.

   (1) Calculate the yield advantage on a semi-annual basis. Show all work. (2 points)
   (2) Calculate the present value of the yield advantage over the two-year holding period. Show all work. (1 point)

(3 Points)

The yield advantage is defined as the difference between the coupon payment earned on the bond and the dividend payment from the stock.

Yield advantage	*= yield on bond over dividend on stock* *= 1000 X 3.5% - 20 X 40 X 2%* *= $19*
Present value of yield advantage	*= 19 X Annuity Factor (4 periods at 4%)* *= 19 X ((1/0.04) X (1-(1/1.04^4))* *= 19 X 3.63* *= $68.97*

B. Assuming that $2,000,000 is invested in the convertible bond, how many shares would Johan need to short in order to achieve a delta neutral position? Show all work. Assume constant interest rates.

(2 Points)

Number of shares to short	*= 2,000,000 X 0.6/40* *=30,000 shares*

C. In general, the convertible bond's profile graph plots the price of the convertible bond on the vertical axis against the stock price on the horizontal axis. Contrast the expected level of the delta of any convertible in the "busted" zone with the expected level of the delta of any convertible in the "equity" zone. Explain why the respective deltas are at these levels.

(2 Points)

The delta of a convertible represents the change in the price of a convertible with respect to a change in the underlying stock price. Delta is a number that is always between zero and one. We would expect the delta in the "busted zone" to be low, perhaps even close to zero. The busted zone is where the convertible is out-of-the money such that small changes in the stock price would not be expected to have much, if any, impact on the convertible's price. In contrast, we would expect the delta in the equity zone to be closer or perhaps equal to one such that changes in the stock price cause a similar change in the convertible's price.

D. The following question relates to the risk measure known as gamma.

(2) Provide a one sentence definition for the gamma of convertible bonds. (1 point)

(3) Explain the distinction between “upside gamma” and “downside gamma.” (1 point)
(4) Describe the point on the gamma curve where gamma is at its highest level. (1 point)

(3 Points)

(1) Gamma is the change in delta with respect to changes in the price of common stock. Mathematically, it is the second order derivative of the convertible price with respect to changes in the underlying common stock. A fancier way of defining gamma is that it measures or reflects the convexity of the convertible’s price track.

(2) Convertible hedging to capture gamma is a means of profiting from the disproportionate change in delta caused by rising versus falling stock prices. There are two gamma measures that can be defined; one for upward stock price movements, and one for downward stock price movements. Upside gamma is the change in delta with respect to a specific upward price move, and downward gamma is the change in delta with respect to a downward price move.

(3) The gamma curve for a range of stock prices indicates that gamma reaches its maximum at the conversion price. Thus gamma decays slowly as the stock price goes above and below the conversion price of the bond.