2024 CAIA®
Exam Prep

SchweserNotes™

Emerging Topics, Universal Investment Considerations, and Models

LEVEL II **BOOK 1**

KAPLAN SCHWESER

Kaplan Schweser's Path to Success

CAIA® Level II Exam

Welcome

As the head of Advanced Designations at Kaplan Schweser, I am pleased to have the opportunity to help you prepare for the CAIA exam. Kaplan Schweser has decades of experience in delivering the most effective CAIA exam prep products in the market and I know you will find them to be invaluable in your studies.

Our products are designed to be an integrated study solution across print and digital media to provide you the best learning experience, whether you are studying with a physical book, online, or on your mobile device.

Our core product, the SchweserNotes™, addresses all Topic Areas, Readings, and Learning Objectives in the CAIA curriculum. The SchweserNotes are written to clearly and succinctly address the content of each Learning Objective, which form the basis for all exam questions. Our Mock Exams and QuickSheet will help you in the later stages of your study preparation by helping you recall and retain information of important concepts.

All purchasers of the SchweserNotes receive online access to the Kaplan Schweser online platform (our learning management system or LMS) at www.Schweser.com. In the LMS, you will see a dashboard that tracks your overall progress and performance and also includes an Activity Feed, which provides structure and organization to the tasks required to prepare for the CAIA exam. You also have access to the online and eBook versions of the SchweserNotes so that you always have easy access to the readings. There are Reading Quiz questions at the end of each reading. I strongly encourage you to enter your Reading Quiz answers online and use the dashboard to track your progress and stay motivated.

Again, thank you for trusting Kaplan Schweser with your CAIA exam preparation. We're here to help you throughout your journey to become a CAIA charterholder.

Regards,

Derek Burkett

Derek Burkett, CFA, FRM, CAIA
Vice President (Advanced Designations)

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Book 1: Emerging Topics, Universal Investment Considerations, and Models

SchweserNotes™ 2024

CAIA Level II

SCHWESERNOTES™ 2024 CAIA® LEVEL II BOOK 1: EMERGING TOPICS, UNIVERSAL INVESTMENT CONSIDERATIONS, AND MODELS

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WELCOME TO THE 2024 SCHWESERNOTES™

Thank you for trusting Kaplan Schweser to help you reach your career and educational goals. We are very pleased to be able to help you prepare for the CAIA Level II exam. In this introduction, I want to explain the resources included with the SchweserNotes, suggest how you can best use Kaplan Schweser materials to prepare for the exam, and direct you toward other educational resources you will find helpful as you study for the exam.

SchweserNotes

The SchweserNotes consists of three volumes that include complete coverage of all CAIA assigned readings and learning objectives (LOs) as well as reading quizzes (multiple-choice and/or constructed response [essay-type] questions for every reading) to help you master the material and check your retention of key concepts.

Practice Questions

To retain the material, it is important to quiz yourself often. We offer an online version of the SchweserPro™ QBank, which contains hundreds of Level II practice questions and explanations. We also offer Topic Quizzes online to further help you retain and apply what you have learned.

OnDemand Class

Our OnDemand Class provides comprehensive online instruction of every reading in the CAIA curriculum. This video lecture series brings the personal attention of a classroom into your home or office with more than 20 hours of instruction. The class offers in-depth coverage of difficult concepts as well as a discussion of example questions. All videos are available for viewing at any time throughout the exam season. Candidates enrolled in the OnDemand Class also have the ability to email questions to the instructor at any time.

Mock Exams

Schweser offers four full 4-hour practice exams. These online exams are important tools for gaining the speed and skills you will need to pass the exam. The Mock Exams contain answers with full explanations for self-grading and evaluation.

Late-Season Review

Late-season review and exam practice can make all the difference. Our OnDemand Review Package helps you evaluate your exam readiness with products specifically designed for late-season studying. This study package includes the OnDemand Review Workshop (seven-hour archived online workshop covering essential

curriculum topics) and Schweser's Secret Sauce® (concise summary of the CAIA curriculum).

Level II Exam Weightings

When preparing for the exam, be familiar with the weights assigned to each topic area within the curriculum. The Level II exam weights by question format are as follows:

Book	Topic Area	Multiple Choice Exam Weight	Essay Question Exam Weight
1	Emerging Topics	0%	10%
1	Universal Investment Considerations	0%	10%
1	Models	8%–12%	0%–10%
2	Institutional Asset Owners and Investment Policies	8%–12%	0%–10%
2	Risk and Risk Management	8%–12%	0%–10%
2	Methods for Alternative Investments	8%–12%	0%–10%
3	Accessing Alternative Investments	8%–12%	0%–10%
3	Due Diligence and Selecting Managers	8%–12%	0%–10%
3	Volatility and Complex Strategies	8%–12%	0%–10%
	Total	70%	30%

How to Succeed

The CAIA Level II exam is a formidable challenge, and you must devote considerable time and effort to be properly prepared. There are no shortcuts! You must learn the material, know the terminology and techniques, understand the concepts, and be able to answer 100 multiple-choice and 3 multi-part constructed-response questions quickly and (at least 70%) correctly. A good estimate of the study time required is 200 hours on average, but some candidates will need more or less time, depending on their individual backgrounds and experience.

Expect CAIA Association to test your knowledge in a way that will reveal how well you know the Level II curriculum. You should begin studying early and stick to your study plan. You should first read the SchweserNotes and complete the practice questions for each reading. After completing each book, you should answer the provided topic quiz questions to understand how concepts may be tested on the exam.

It is recommended that you finish your initial study of the entire curriculum at least two weeks (earlier if possible) prior to your exam window to allow sufficient time for practice and targeted review. During this period, you should utilize all of your Schweser Mock Exams. This final review period is when you will get a clear indication of how effective your study efforts have been, and which readings require significant additional review. Answering exam-like questions across all readings and improving your exam time management skills will be important determinants of your success on exam day.

Best regards,

Eric Smith

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CONTENTS

READING 1.5

READING 1.6

READING 1.7

READING 1.8

TOPIC 2: UNIVERSAL INVESTMENT CONSIDERATIONS

READING 2.1

READING 2.2

Global Regulation

READING 2.3

Geopolitics

READING 2.4

ESG and Alternative Investments

READING 2.5

ESG Analysis and Application

TOPIC 3: MODELS

READING 3.4

READING 3.5

READINGS AND LEARNING OBJECTIVES

TOPIC 1

"Channels for Exposure to Bitcoin," Jack Neureuter and Yassine Elemandjra, Fidelity Digital Assets, July 2021.

Reading 1.1: Channels for Exposure to Bitcoin

1.1.1: Demonstrate knowledge of institutional-level trading and custody of digital assets.
Including:

- Outline the evolution of and current process for third-party custody of digital assets.
- Describe the benefits of direct custody.
- Discuss the challenges associated with custody of digital assets.

1.1.2: Demonstrate knowledge of the use of passive funds to gain exposure to digital assets.
Including:

- Explain how institutional investors gain exposure to digital assets via private placement.
- Describe the benefits of private placement in passive funds.
- Discuss the challenges with private placement in passive funds.
- Compare and contrast the two types of regulated futures markets for digital assets.
- Describe the benefits of futures exposure.
- Discuss the challenges with using futures to gain exposure to digital assets.
- Analyze the regulatory environment for digital asset Exchange Traded Funds (ETFs).
- Describe the benefits of digital asset ETFs.
- Discuss the challenges associated with digital asset ETFs.

1.1.3: Demonstrate knowledge of actively managed investment vehicles offering exposure to digital assets.
Including:

- Describe the structure and purpose of actively managed digital asset funds.
- Compare actively traded funds with Exchange Traded Funds holding digital assets.

1.1.4: Demonstrate knowledge of the costs associated with adding exposure to digital assets.
Including:

- Compare the costs of establishing bitcoin exposure across the different channels available to institutional investors.

Schär, Fabian, "Decentralized Finance: On Blockchain- and Smart Contract-Based Financial Markets," *Federal Reserve Bank of St. Louis Review*, no. 103(2) (January 2021).

Reading 1.2: Decentralized Finance: On Blockchain- and Smart Contract-Based Financial Markets

1.2.1: Demonstrate knowledge of decentralized finance (DeFi).
Including:

- Define the building blocks of DeFi, including settlement, asset, protocol, application, and aggregation layers.

1.2.2: Demonstrate knowledge of asset tokenization.
Including:

- Define and discuss the risks of asset tokenization, including the use of off-chain collateral, on-chain collateral, and no collateral.
- Explain the use of stablecoins in the DeFi system.

1.2.3: Demonstrate knowledge of decentralized exchange protocols.
Including:

- Contrast decentralized and centralized exchanges including advantages and disadvantages.
- Explain decentralized exchange protocols and liquidity systems, such as decentralized order book exchanges, constant function market maker, smart contract-based reserve aggregation, and peer-to-peer protocols.

1.2.4: Demonstrate knowledge of decentralized lending platforms.

Including:
- Discuss collateralized debt positions and collateralized debt markets.

1.2.5: Demonstrate knowledge of decentralized derivatives.
Including:
- Explain asset-based and event-based derivative tokens.

1.2.6: Demonstrate knowledge of the opportunities and risks of the DeFi ecosystem.
Including:
- List and discuss the four opportunities and the six risks.

"Web 3.0 Tokenization and Decentralized Finance (DeFi)," Philip Treleaven, et al., February 2022.

Reading 1.3: Web 3.0 Tokenization and Decentralized Finance (DeFi)

1.3.1: Demonstrate knowledge of tokenization and disintermediation of finance.
Including:
- Describe Web 3.0.
- Understand Decentralized Finance (DeFi).
- Explain Tokenization.
- Distinguish between the digital economy and traditional economy.
- Contrast fiat currencies, cryptocurrencies, and blockchain tokens.
- Distinguish between type of blockchain tokens.
- Understand the various Web 3.0 technologies.
- Understand the DeFi technology stack.
- Contrast electronic trading with tokenized trading.
- Evaluate Venture Capital tokenization.
- List the risks of DeFi.
- Discuss the challenges regulators face with new FinTech innovations.

"Assessing Long-Term Investor Performance: Principles, Policies and Metrics," Gordon L Clark and Ashby Monk, January 2019.

Reading 1.4: Assessing Long-Term Investor Performance: Principles, Policies and Metrics

1.4.1: Demonstrate knowledge of long-term investors' operating models.
Including:
- Explain the three main advantages long-term investors have relative to other investors.
- Discuss the three environmental enablers (intangible advantages) of long-term investors.

1.4.2: Demonstrate knowledge of the measurements and metrics used to assess the effectiveness of the long-term investors' process.
Including:
- Describe the three "intermediate" outputs LTIs can use to measure organizational performance.
- Explain how LTIs measure environmental enablers.
- Explain how LTIs measure production inputs.
- Explain how LTIs measure intermediate outputs.
- Explain how LTIs measure investment results.
- Summarize the simple model of production used to quantitatively measure investment activities of long-term investors.
- Identify the challenges of using traditional measurements of long-term success (i.e., quarterly returns).

Ilmanen, Antti, Swati Chandra, and Nicholas McQuinn. "Demystifying Illiquid Assets: Expected Returns for Private Equity." *The Journal of Alternative Investments* (Winter 2020).

Reading 1.5: Demystifying Illiquid Assets: Expected Returns For Private Equity

1.5.1: Demonstrate knowledge of the factor tilts in private equity portfolios.
Including:
- Explain equity risk, illiquidity premium, size, and value and the role of each as a driver of private equity returns.

1.5.2: Demonstrate knowledge of private equity performance relative to public equity benchmarks.

Including:

- Identify the challenges of comparing private equity returns directly to public equity returns and list more appropriate benchmarks.
- Explain the historical performance of private equity relative to public equity after accounting for leverage and factor tilts.
- Contrast internal rate of return (IRR) and public market equivalent (PME) as appropriate measures of private equity performance.
- Explain how changes in leverage, fundraising activity, and private company purchase multiples have influenced the excess returns of private equity since 2006.

1.5.3: Demonstrate knowledge of the building blocks of US private equity returns.

Including:

- Apply and discuss the yield-based approach to derive the expected return of private equity.

1.5.4: Demonstrate knowledge of the decomposition of excess returns of private equity over public equity.

Including:

- Apply and discuss net-of-fee excess returns for private equity and public equity.

"Value Creation in Private Equity," European Bank for Reconstruction and Development, April 2020.

Reading 1.6: Value Creation in Private Equity

1.6.1: Demonstrate knowledge of the relationship between Private Equity driven operational changes and investors returns.

Including:

- Explain private equity value creation plans (VCPs).
- Distinguish between operational improvements, top-line growth, governance engineering, financial engineering, and cash management.
- Discuss the variability of VCPs across deal type, fund ownership, growth strategy, and geographic focus.
- Discuss the relationship between action items and type of deal.
- Understand the factors influencing the likelihood that a PE firm successfully implements an action item.
- Determine which VCP combinations best predict higher returns and lower returns than average.
- Contrast predicted returns based on planned strategies versus achieved strategies.
- Evaluate the impact single strategies have on return outcomes.
- Assess the four company-level changes that correlate significantly with higher investor returns.

Schneider, Jerome, Sean Klein, Wade Sias, and Simon Fan. "Cash for Calls: A Quantitative Approach to Managing Liquidity for Capital Calls." *The Journal of Alternative Investments* (September 2022).

Reading 1.7: Cash for Calls: A Quantitative Approach to Managing Liquidity for Capital Calls

1.7.1: Demonstrate knowledge of liquidity management challenges facing Limited Partners.

Including:

- Assess the balance between risk and return of uncalled capital and the uncertain timing of future calls.
- Evaluate the decision by an LP to hold unfunded capital commitments in cash equivalents or money market investments.
- Discuss the impact of over-committing to private assets.
- Analyze capital call risk.
- Assess the strategy of investing uncalled capital in public market equivalent assets.
- Understand the impact drawdowns have on shortfall risk.
- Apply the liquidity tiering framework for an investor in private assets.
- Evaluate the four liquidity management strategies.

"An Introduction to Portfolio Rebalancing Strategies," Hossein Kazemi, CAIA Association, July 2022.

Reading 1.8: An Introduction to Portfolio Rebalancing Strategies

1.8.1: Demonstrate knowledge of dynamic trading strategies.
Including:

- Determine the portfolio's asset values after a given change in value of a liquid risk asset, using dynamic trading strategies (i.e., buy-and-hold, constant mix, constant-proportion portfolio insurance, and option-based portfolio insurance).
- Compare the payoff, exposure diagrams, and risk tolerance of the buy-and-hold, constant mix, constant-proportion portfolio insurance, and option-based portfolio insurance strategies.

1.8.2: Demonstrate knowledge of the payoff curves related to dynamic trading strategies.
Including:

- Describe the expected performance and cost of implementing strategies with concave payoff curves relative to those with convex payoff curves under various market situations (i.e., trending markets and flat markets).

1.8.3: Demonstrate knowledge of dynamic strategies with illiquid assets.
Including:

- Explain how dynamic trading strategies are adapted for illiquid portfolios.
- Determine the portfolio's asset values after a given change in value of an illiquid risk asset, using dynamic trading strategies and futures.

TOPIC 2

CAIA Association. *CAIA Curriculum Level II Volume I*. Self-published, CAIA Association, 2023.

Reading 2.1: Professionalism and Fiduciary Responsibilities

2.1.1: Demonstrate knowledge of the purpose, role, and participants of the investment industry.
Including:

- Distinguish between the participants within the investment industry.
- Justify the four facets of purpose of the investment industry.
- Analyze the current investment industry relative to alternative systems.
- Understand the four facets of purpose of the investment industry.

2.1.2: Demonstrate knowledge of the purpose of the investment industry and value creation within the industry.
Including:

- Assess how value is created in the investment industry.
- Understand the role of sustainable finance.

2.1.3: Demonstrate knowledge of professionalism and fiduciary responsibility.
Including:

- Evaluate the purpose of fiduciary duty and the four areas of fiduciary obligations.
- Understand the five values that support a true fiduciary and professional mindset.
- Recommend how investors can navigate instances when the "right" choice is not obvious.
- Assess the role of culture on industry professionalism.
- Understand the challenges that associate with the four areas of fiduciary obligations.

2.1.4: Demonstrate knowledge of a client-first approach.
Including:

- Discuss the role of trust in client relationships.
- Contrast the professional mindset with the characteristics and trademarks of our current system.
- Justify the role a professional mindset has in creating value for a client.
- Describe the virtuous circle of positive forces with respect to the fiduciary and professional mindset.

Reading 2.2: Global Regulation

2.2.1: Demonstrate knowledge of financial market regulation.
Including:

- Identify theories of regulation.
- Discuss principles of securities economic regulation.
- Recognize the importance of regulation in some trading strategies.

2.2.2: Demonstrate knowledge of alternative investment regulation in the United States.
Including:

- Identify the main regulatory bodies and their jurisdictions.
- Recognize regulatory frameworks and statutes within the United States.
- Understand regulation of private funds and why one must register as an investment advisor.
- Identify investment advisor obligations within private fund regulations.
- Understand the process of hedge fund registration in the United States.
- Understand the process of registering both private and public securities and how the Securities Act affects this process.
- Understand the exemptions from registration under the Investment Company Act.
- Identify the role of the chief compliance officer and compliance culture.
- Understand the importance of marketing material review.
- Identify the various SEC Exams.
- Identify reporting requirements.

2.2.3: Demonstrate knowledge of alternative investment regulation in Europe.
Including:

- Identify the European regulatory bodies and their jurisdictions.
- Recognize regulatory frameworks within Europe.
- Identify requirements regarding registration and exemptions from those requirements within Europe.
- Understand disclosure requirements around the marketing of investment products.
- Identify formal requirements in risk management.
- Identify requirements around the reporting of regulations in Europe.
- Analyze the legal structures within European regulatory frameworks.
- Understand how European regulations are enforced.
- Understand how non-EU managers may operate in Europe.

2.2.4: Demonstrate knowledge of alternative investment regulation in Asia.
Including:

- Identify regulatory requirements and frameworks within Hong Kong.
- Identify regulatory requirements and frameworks within Singapore.
- Identify regulatory requirements and frameworks within South Korea.
- Identify regulatory requirements and frameworks within Japan.

Reading 2.3: Geopolitics

2.3.1: Demonstrate knowledge of the various geopolitical paradigms embedded in an investment framework.
Including:

- Evaluate the role of geopolitical beta in long-term investments.
- Contrast the three potential starting systems of geopolitics.
- Contrast the three potential starting systems for politics.

2.3.2: Demonstrate knowledge of the role of geopolitics in investing while applying a constraint-based framework.
Including:

- Contrast the impact of geopolitical risk on public markets and private markets.
- Explain the constraint-based framework for geopolitical analysis.
- Identify the three pillars of the constraint-based framework.
- Distinguish between preferences and constraints.
- Identify material constraints.
- Understand the geopolitical risk premium and the impact on valuation and returns.

2.3.3: Demonstrate knowledge of the impact of geopolitics on private market valuations and return expectations.
Including:

- Discuss the challenges in generating geopolitical beta.
- State the three mistakes investors make when analyzing geopolitical events.
- Distinguish between geopolitical beta and geopolitical alpha.

2.3.4: Demonstrate knowledge of applying the 3×3 framework within an investment context.

Including:

- Construct a 3×3 diagram of the geopolitical and political future.

Reading 2.4: ESG and Alternative Investments

2.4.1: Demonstrate knowledge of ESG in alternative investments.
Including:

- Understand the growth of ESG principles in alternative assets.
- Understand how ESG principles are incorporated by institutional investors.
- Identify and explain challenges in incorporating ESG principles into the investment decision.

2.4.2: Demonstrate knowledge of how ESG impacts natural resources as a real asset.
Including:

- Recognize how environmental issues can impact investments in natural resources.
- Understand how social issues can impact investments in natural resources.
- Recognize how governance issues can impact investments in natural resources.

2.4.3: Demonstrate knowledge of how ESG impacts commodities as a real asset.
Including:

- Explain the role of speculators and speculation in pricing commodity derivatives.
- Understand the implication of changes in volatility on commodity speculation.
- Understand how ESG factors can apply to direct investment in physical commodities.

2.4.4: Demonstrate knowledge of how ESG impacts real estate as a real asset.
Including:

- Identify the impacts ESG considerations can have on real estate development.
- Describe how ESG considerations can impact the use of real estate.
- Explain how issues in ESG can apply to the treatment of tenants, workers, and communities.
- Describe the influence of ESG principles in recovery and disposal of real estate.
- Identify ESG issues in refurbishment and retrofitting.
- Understand the processes of waste management, resource conservation, and recycling in relation to the demolition of real estate assets.
- Understand the process of land recovery and rehabilitation in real estate.

2.4.5: Demonstrate knowledge of how ESG impacts hedge funds.
Including:

- Describe how ESG principles guide hedge fund investment strategies.
- Describe how ESG principles can guide hedge fund governance.
- Explain the relationship between ESG principles and hedge fund transparency.
- Demonstrate knowledge of how ESG interacts with hedge fund investment techniques and instruments.
- Understand the relationship between hedge fund strategies and underlying investments.
- Describe how hedge fund strategies are impacted by activism.
- Describe how hedge fund strategies are impacted by avoidance.

2.4.6: Demonstrate knowledge of how ESG impacts private equity.
Including:

- Explain how partnership organizations can support ESG, including within the GP-LP relationship.
- Describe how the private equity investment process can include ESG principles.
- Understand the monitoring process and how it applies to ESG.

Reading 2.5: ESG Analysis and Application

2.5.1: Demonstrate knowledge of the background of ESG.
Including:

- Describe the history of ESG.
- Identify and describe the Global Reporting Initiative (GRI) Standards.
- Recognize the relationship between social responsibility and evidence of stakeholder wealth within ESG.

2.5.2: Demonstrate knowledge of how ESG is rated and scored within an entity's operating procedures.
Including:

- Discuss ESG ratings and scores as part of operating procedures.

2.5.3: Demonstrate knowledge of ESG materiality and disclosure.

Including:
- Understand how the Global Reporting Initiative (GRI) governs ESG materiality and ESG disclosure.
- Explain KPMG's framework for materiality assessments.
- Interpret the ESG materiality map.
- Discuss the measurement of ESG materiality.

2.5.4: Demonstrate knowledge of the role the United Nations (UN) has in ESG issues.
Including:
- Identify the Six Principles for Responsible Investment (PRI).
- Explain Sustainable Development Goals (SDGs).

2.5.5: Demonstrate knowledge of fiduciary responsibilities and regulation within ESG.
Including:
- Discuss fiduciary responsibilities within the U.S. as they relate to ESG.
- Discuss fiduciary responsibilities within Europe as they relate to ESG.
- Discuss fiduciary responsibilities within Asia as they relate to ESG.
- Discuss how asset managers approach ESG compliance and risk management.

2.5.6: Demonstrate knowledge of methods of ESG investing.
Including:
- Distinguish between negative and positive screening.
- Discuss engagement and proxy voting strategies.
- Describe impact investing in the context of their categories, the steps of implementation, and illiquid investments.

2.5.7: Demonstrate knowledge of market-based methods to address ESG issues.
Including:
- Understand the background of externalities and markets.
- Discuss the Coase Theorem.

2.5.8: Demonstrate knowledge of special investment considerations as they apply to ESG.
Including:
- Understand special consideration, cash flows, returns, and risk.
- Describe the case for special consideration of ESG issues.
- Describe the case against special consideration of ESG issues.

TOPIC 3

CAIA Association. *CAIA Curriculum Level II Volume I*. Self-published, CAIA Association, 2023.

Reading 3.1: Modeling Overview and Interest Rate Models

3.1.1: Demonstrate knowledge of underlying models of investment strategy.
Including:
- Compare normative strategies with positive strategies.
- Distinguish between theoretical and empirical models.
- Distinguish between applied versus abstract models.
- Compare cross-sectional versus time-series models.
- Discuss the importance of methodology in model building.

3.1.2: Demonstrate knowledge of equilibrium models of the term structure.
Including:
- Describe, discuss, and apply Vasicek's model.
- Describe, discuss, and apply the Cox, Ingersoll, and Ross (CIR) model.

3.1.3: Demonstrate knowledge of arbitrage-free models of the term structure.
Including:
- Describe arbitrage-free models of the term structure.
- Describe, discuss, and apply the Ho and Lee model.

3.1.4: Demonstrate knowledge of the Black-Derman-Toy (BDT) model.
Including:

- Interpret a binomial BDT tree.
- Understand how to calibrate the level of rates based on average returns.
- Understand how to calibrate the spread of rates based on volatilities.
- Discuss BDT calibrations in general.

3.1.5: Demonstrate knowledge of P-Measures and Q-Measures.
Including:

- Interpret and discuss p-measures and q-measures.

Reading 3.2: Credit Risk Models

3.2.1: Demonstrate knowledge of the economics of credit risk.
Including:

- List and describe types of credit events that may lead to an increase in credit risk, and define exposure at default (EAD) and loss given default (LGD).
- Define adverse selection and moral hazard and describe how they relate to credit risk.
- Discuss how probability of default (PD) and recovery rate (RR) affect credit risk and calculate loss given default and expected loss from credit risk.

3.2.2: Demonstrate knowledge of credit risk modeling.
Including:

- Describe the basic concepts of credit risk modeling, including the difference between sovereign and higher-levered entities, the related effects of credit risk, and credit risk modeling approaches.

3.2.3: Demonstrate knowledge of the Merton model.
Including:

- Apply the Merton model to determine equity values and payoffs to bondholders for a given investment.
- Use the Black-Scholes option pricing model in the Merton model to price a given firm's equity as a call option on the stock of the underlying company.
- Use the Black-Scholes option pricing model in the Merton model to price a given firm's debt as a put option on the stock of the underlying company.
- Analyze the role of credit spreads in structural models and how the credit spread can be used to calculate the price of risky debt.
- Evaluate advantages and disadvantages of the Merton model.
- Discuss four important properties of the Merton model.

3.2.4: Demonstrate knowledge of the Kealhofer, McQuown, and Vasicek (KMV) credit risk model.
Including:

- Describe the characteristics and application of the KMV model.
- Use the KMV model to estimate the credit score (the distance to default) for a given firm.
- Use the KMV model to estimate the expected default frequency for a given investment.

3.2.5: Demonstrate knowledge of reduced-form models.
Including:

- Describe the characteristics of reduced-form models.
- Discuss the role of default intensity in reduced-form models and calculate default intensity for a given firm.
- Demonstrate how default intensity can be incorporated into the valuation of risky debt.
- Recognize the relationship among credit spreads, default intensities, and recovery rates, and use two of these factors as variables to solve for the third for a given investment.
- Describe the two predominant reduced-form credit models.

3.2.6: Demonstrate knowledge of empirical credit models.
Including:

- Describe empirical credit models and recognize how they differ from structural and reduced-form models.
- Describe the purpose and characteristics of the Altman Z-score model.
- List and describe the five financial ratios that are used as inputs to determine Altman Z-scores.
- Calculate and interpret Z-scores in Altman's credit scoring model.

Reading 3.3: Multifactor Equity Pricing Models

3.3.1: Demonstrate knowledge of multifactor asset pricing models.
Including:

- Explain multifactor asset pricing.
- Recognize the role of marginal investor utility in the CAPM and how it relates to asset factors.
- Explain how multiple factors relate to "bad times."
- Discuss factors based on expected utility or anomalies.
- Identify the three major categories of factors.
- Compare theoretically versus empirically derived multifactor return models.
- Identify the fundamentals of empirical models.
- Discuss the tradability of factors and the intercepts.

3.3.2: Demonstrate knowledge of the original Fama-French Model.
Including:
- Describe the original Fama-French Model.
- Describe the Fama-French-Carhart Model.
- Calculate models with numerous factors.

3.3.3: Demonstrate knowledge of the three challenges of empirical multifactor models.
Including:
- Understand how factors can be falsely identified.
- Differentiate factor correlation from factor causation.
- Explain why the CAPM may not be sufficient.

3.3.4: Demonstrate knowledge of factor investing.
Including:
- Discuss the emergence of return factor analysis.
- Identify how return factors are described.
- Explain how risk premiums vary across return factors.
- Explain how factor returns vary across market conditions.
- Explain the relationship between return factors and investability.
- Interpret risk allocation based on return factors.
- Understand performance with allocations based on return factors.

3.3.5: Demonstrate knowledge of the adaptive markets hypothesis (AMH).
Including:
- Describe the AMH.

3.3.6: Demonstrate knowledge of time-varying volatility.
Including:
- Explain how equity market volatility is predictable.
- Explain how volatility is negatively correlated with average returns.
- Discuss time-varying volatility and multiple factors.
- Discuss time-varying volatility and higher moments.

3.3.7: Demonstrate knowledge of stochastic discount factors.
Including:
- Calculate traditional discount factors.
- Interpret stochastic discount factors.
- Understand the stochastic discount factors present value formula.
- Discuss the importance of stochastic discount factors.

Reading 3.4: Asset Allocation Processes and the Mean-Variance Model

3.4.1: Demonstrate knowledge of asset allocation processes and the mean-variance model.
Including:
- Understand the origin of mean-variance optimization.
- Discuss the tradeoff between expected returns and volatility.
- Evaluate risk and return with utility.
- Interpret and calculate risk aversion and interpret the shape of the utility function.
- Interpret and calculate utility functions in terms of expected returns and variance.
- Interpret and calculate utility functions with higher moments.
- Interpret and calculate utility functions with value at risk.
- Identify investor risk aversion based on the asset allocation decision.
- Understand how to manage assets with risk aversion and growing liabilities.

3.4.2: Demonstrate knowledge of how the mean-variance optimization is implemented.
Including:

- Interpret and calculate mean-variance optimization.
- Interpret and calculate mean-variance optimization with a risky and riskless asset.
- Interpret and calculate mean-variance optimization with growing liabilities.
- Interpret and calculate mean-variance optimization with various degrees of risk aversion.

3.4.3: Demonstrate knowledge of mean-variance optimization with multiple risky assets.
Including:
- Describe a riskless asset and the linearity of efficient frontier.
- Describe a riskless asset with multiple risky assets.
- Describe unconstrained optimization and unrealistic weights.

3.4.4: Demonstrate knowledge of mean-variance optimization with hurdle rates.
Including:
- Interpret and calculate hurdle rates.

3.4.5: Demonstrate knowledge of issues using optimization for portfolio selection.
Including:
- Interpret optimizers as error maximizers.
- Discuss portfolio optimization and smoothing of illiquid returns.
- Understand data issues for large-scale optimization.
- Understand how mean-variance ignores higher moments.
- Discuss three ways to address skewness and kurtosis.

3.4.6: Demonstrate knowledge of adjustments of the mean-variance approach for illiquidity.
Including:
- Interpret and calculate the liquidity penalty function.
- Interpret and calculate adjustments for illiquidity.
- Understand takeaway points on illiquidity adjustments.

3.4.7: Demonstrate knowledge of adjustments of the mean-variance approach for factor exposure.
Including:
- Interpret and calculate factor exposure for mean-variance approach.

3.4.8: Demonstrate knowledge of how to mitigate estimation error risk in mean-variance optimization.
Including:
- Discuss estimation error risk reduction through objective measures of estimation error risk.
- Describe sampling to reduce the effect of estimation error.
- Discuss shrinkage to reduce the effect of estimation error.
- Understand the Black-Litterman approach to mean-variance optimization.
- Discuss the use of constraints in mean-variance optimization.

Reading 3.5: Other Asset Allocation Approaches

3.5.1: Demonstrate knowledge of the core-satellite approach.
Including:
- Interpret the core-satellite approach.

3.5.2: Demonstrate knowledge of top-down and bottom-up asset allocation approaches.
Including:
- Understand the bottom-up approach.
- Understand the top-down approach.
- Understand the mixed approach.

3.5.3: Demonstrate knowledge of risk budgeting.
Including:
- Identify specifications in risk budgeting.
- Define risk in risk budgeting as well as risk buckets.
- Understand the concept of defining an objective function to obtain a unique solution.
- Understand how to include correlations and view of marginal risks.
- Understand how to include expected returns with risk budgeting.

3.5.4: Demonstrate knowledge of factor-based implementations of a risk budgeting approach.
Including:

- Describe attributing the risk of a portfolio to three attributes of each asset.
- Understand how to use factor-based returns and risk buckets.
- Calculate the risk contribution to each risk factor.

3.5.5: Demonstrate knowledge of risk parity.
Including:

- Interpret risk parity with two risky assets.
- Understand Sharpe Ratios and leverage within risk parity.
- Identify the three steps in implementing the risk parity approach.
- Discuss how to create a portfolio using the risk parity approach.
- Understand the primary economic rationale for the risk parity approach.
- Interpret the volatility anomaly and risk parity.
- Discuss the criticisms of three popular rationales for risk parity.

3.5.6: Demonstrate knowledge of other quantitative portfolio allocation strategies.
Including:

- Understand the market-weighted strategy.
- Interpret an equally-weighted or 1/N diversification strategy.
- Describe inverse volatility-weighted portfolio strategies.
- Discuss minimum volatility portfolio allocation strategies.
- Understand equivalence between allocation strategies.
- Describe risk allocation based on return factors.
- Understand four practical issues with allocation based on return factors.

3.5.7: Demonstrate knowledge of the new investment model.
Including:

- Discuss the new investment model.

The following is a review of the Emerging Topics principles designed to address the learning objectives set forth by CAIA Association®. Cross-reference to CAIA Association Assigned Reading—Neureuter and Elemandjra.

READING 1.1

CHANNELS FOR EXPOSURE TO BITCOIN

Topic 1

EXAM FOCUS

This reading provides an overview of investor opportunities for participating in digital assets, such as Bitcoin. For the exam, understand the overall concepts, benefits, and challenges associated with third-party custody, passive Bitcoin fund investments, open-ended private trusts, futures (cash-settled and physical-settled), and exchange-traded funds (ETF). Hedge funds are a mechanism for Bitcoin exposure that uses active management, which comes with significant costs and restrictions. Be familiar with the cost study performed using multiple Bitcoin investment mechanisms and understand which forms are least and most expensive depending on the size of the position.

INSTITUTIONAL-LEVEL TRADING AND DIGITAL ASSET CUSTODY

LO 1.1.1: Demonstrate knowledge of institutional-level trading and custody of digital assets.

Including:
- **Outline the evolution of and current process for third-party custody of digital assets.**
- **Describe the benefits of direct custody.**
- **Discuss the challenges associated with custody of digital assets.**

Custody of Digital Assets

A significant selling point for the merits of digital assets, such as a Bitcoin, is that holders may establish ownership via the **self-custody** of assets. However, the challenges of self-custody include not only the inherent security and risk management processes required to safeguard these assets, but also the operational and regulatory limitations which prevent some institutions from being able to take direct custody of digital assets.

Custody solutions were initially few and far between, as the digital asset infrastructure was geared mostly toward meeting retail trading demands. However,

recent efforts have been made to provide institutional-focused custody solutions to protect client assets. While there are now several avenues for gaining exposure, spot trading and third-party custody is the most common path chosen by investors.

Benefits of Third-Party Custody

Third-party custodians provide several benefits to digital asset investors, including institutional grade trading and custody, relatively low costs, and capital efficiency opportunities.

Institutional Grade Trading and Custody

Integrated trade execution and custody solutions for the acquisition, storage, and safeguarding of Bitcoin have specifically been designed to support institutional and other large, regulated investors. **Digital asset custodians** are heavily regulated, often undergo system and organizational control (SOC) audits, and may even hold national banking charters or state trust licenses. Some Bitcoin custodians having met these standards may be deemed as qualified custodians, which meets the needs of registered funds and other investors who must hold their securities (and other investments like Bitcoin) with qualified custodians.

Low Costs

The relatively low aggregate fees (custody and trade execution costs) make spot Bitcoin exposure a very cost-efficient way to access the asset. Custody costs are for the most part under 50 basis points of total assets under custody. Trade execution costs, which incorporate both trading (taker) fees and slippage, are expressed as a percentage of order size. As the order gets larger, slippage costs will increase and trading costs will decrease.

Capital Efficiency Opportunities

Exposure to physical Bitcoin creates capital efficiencies, as Bitcoin and other digital assets may serve as collateral to access liquidity. Bitcoin's advantages of liquidity, fast settlement, real-time price discovery, and borderless structure may also be very appealing to lenders.

Challenges of Third-Party Custody

While there are several benefits of third-party custody, there are also challenges that investors must take into consideration, including due diligence, liquidity, and portfolio integration.

Technical Due Diligence

Gaps in technical knowledge and experience may lead investors and institutions to outsource due diligence efforts of service providers. Differences such as segregated versus omnibus custody, or hardware security models (HSMs) versus multi-party computations (MPCs) models are examples of where investors may not have the knowledge needed to perform adequate due diligence.

Fragmented Liquidity

Bitcoin and other digital assets trade on a myriad of exchanges that are not required to guarantee "best execution" on trades like traditional capital markets. While the latter are required to guarantee investors the national best bid and offer (NBBO) or best available purchase and sale prices, the exchanges that digital assets trade on will vary in terms of security, transparency, and regulation. Increasing numbers of service providers are providing execution services and routing solutions to help mitigate this concern.

Traditional Asset Integration

In the current environment, it is difficult for investors to access Bitcoin through the same channels that they access traditional asset classes. As time passes, the hope is that Bitcoin holdings can be integrated into traditional portfolios and can be viewed together with traditional assets.

EXPOSURE TO DIGITAL ASSETS USING PASSIVE FUNDS

LO 1.1.2: Demonstrate knowledge of the use of passive funds to gain exposure to digital assets.

Including:

- **Explain how institutional investors gain exposure to digital assets via private placement.**
- **Describe the benefits of private placement in passive funds.**
- **Discuss the challenges with private placement in passive funds.**
- **Compare and contrast the two types of regulated futures markets for digital assets.**
- **Describe the benefits of futures exposure.**
- **Discuss the challenges with using futures to gain exposure to digital assets.**
- **Analyze the regulatory environment for digital asset Exchange Traded Funds (ETFs).**
- **Describe the benefits of digital asset ETFs.**
- **Discuss the challenges associated with digital asset ETFs.**

Passive Bitcoin Funds

Investors who want long-only exposure to Bitcoin may go the route of private placement in **passive Bitcoin funds**. These funds are popular because they provide investors access through familiar investment structures, while removing the complexities associated with the trading and custody of digital assets. However, these investors will incur management, trading, and custody fees.

Benefits and Challenges of Passive Bitcoin Funds

The benefits of private placement in passive Bitcoin funds include familiarity and convenience as well as the ability to account for the investment at fair value on the balance sheet. The challenges associated with private placement funds include the relatively high costs and varying redemption mechanisms and frequencies.

Familiarity and Convenience

Accredited and institutional investors may participate in these funds via the allocation of "in-kind" assets or currency. Investors must exhibit a significant

amount of trust in fund managers, as the fund managers are responsible for managing service providers, selecting trading and custody partners, and making decisions on security and risk. The tax and reporting benefits provided by passive funds are also beneficial to investors.

Accounting

On a public company balance sheet, an investment in Bitcoin is classified as an indefinite-lived intangible asset recorded at the lowest traded price each period. Bitcoin investments established through a passive fund may be categorized as an equity investment and are therefore recorded at fair value on the balance sheet each period.

Costs

Although many new players have recently entered the passive fund community and put competitive pressure on fees, investors will still incur annual management fees between 50 and 200 basis points along with custody, trade execution, and other fund administration costs.

Redemptions

Individual passive Bitcoin funds may have different redemption mechanisms and frequencies. The different mechanisms include in-kind physical Bitcoin, cash, or secondary market share redemptions. Frequencies for allowable redemptions may be daily, weekly, or various other options.

Publicly Traded Bitcoin Shares

Open-ended private trusts like the Grayscale Bitcoin Investment Trust (GBIT) provide investors with exposure to Bitcoin through publicly traded shares which represent ownership in the trust. The trust is set up to hold Bitcoin and track its price movements. Both retail and institutional investors may participate in the trust, although accredited investors may participate at net asset value (NAV) via daily private placements and after a six-month lockup period sell shares in the secondary market.

Benefits include access to these investments via traditional brokerage firm channels and avoiding the complex logistics of physical Bitcoin ownership. Challenges include high management fees and trading premiums/discounts associated with secondary shares due to (1) no redemption mechanisms and (2) non-aligned liquidity and trading hours between traditional Bitcoin exchanges and secondary markets.

Bitcoin Futures Markets

The two types of regulated futures markets for Bitcoin are cash-settled and physical-settled futures. Bitcoin futures may be used by investors to add long exposure, establish risk-neutral exposure, and hedge spot exposure. Futures may be highly regulated on common platforms or loosely regulated on offshore platforms.

Benefits and Challenges of Bitcoin Futures

Cash-settled Bitcoin futures are offered and regulated by the Commodity Futures Trading Commission (CFTC) and trade on the same platforms as futures contracts on other assets (e.g., Chicago Mercantile Exchange [CME]). Trading on the CME also provides access to more than two dozen futures commission merchants (FCMs) that can be used to access and clear other contracts. Cash settlement also eliminates the need to worry about custody upon physical delivery.

Physical-settled Bitcoin futures deliver actual Bitcoin to buyers upon contract expiration. This is beneficial to those who want to hold the physical asset and eliminates concerns about spot exchange manipulation that can impact cash-settled transactions.

Price manipulation is a concern with cash settlements, as the settlement price will depend on a spot price index. Long exposure may be expensive, as cash-settled Bitcoin futures often trade at a premium to spot and longer-dated futures trade at higher premiums than shorter-dated futures. Trading costs are also a concern when rolling the futures contracts is needed prior to expiration in order to maintain long exposures.

Premiums associated with futures contracts may stem from custody costs or from investor demand due to the attractiveness of avoiding the operational and/or regulatory limitations associated with spot Bitcoin acquisitions.

Physical-settled futures have not produced the same open interest and volume as cash-settled futures, which may be due to a lack of support from FCMs not wanting to clear and settle physical transactions.

Bitcoin Exchange-Traded Fund (ETF) Applications

While there have been several approved Bitcoin ETF applications across the globe, in the United States, the Securities and Exchange Commission (SEC) has not approved any ETF applications. Filings continue to be made with the SEC in the hopes that future applications will be accepted given the increase in interest and maturation of the Bitcoin market.

Three potential benefits of the ETF structure for Bitcoin investments are (1) product acceptance, (2) the redemption mechanism, and (3) accessibility.

Product Acceptance

Registered investment advisors and other fiduciaries may be limited to investing in Bitcoin via publicly traded trusts, which tend to deviate from net asset value (NAV). A Bitcoin ETF (which would require approval by the SEC) trading on a national exchange would offer more disclosures and protections than the digital asset vehicles currently available in the marketplace.

Redemption Mechanism

A benefit of a Bitcoin ETF is the potential for real-time redemptions through authorized participants who arbitrage ETF shares when share values in secondary markets deviate from NAV. Publicly traded trusts, which were discussed earlier,

often trade at discounts or premiums because of the lock-up period associated with private placements.

Accessibility

Access to Bitcoin through an ETF could be very beneficial to institutional and retail investors because it is (1) low cost, (2) likely to trade at values close to NAV, and (3) available through financial institutions and traditional brokerage firms. Greater ease of use and transparency will offer more security to investors who may be limited by the options available to access Bitcoin currently and may be overwhelmed by the due diligence needed to adequately assess security providers.

Regarding ETF challenges, the SEC to date has rejected Bitcoin ETF applications due to concerns regarding custody, market size, and surveillance of and manipulation within Bitcoin markets.

Custody

Bitcoin trading and security custody have both been key concerns of the SEC and regulators in general. Significant improvements have been made in the quality and suitability of asset custody, as there are now many more custodians which will meet the requirements for institutional investment.

Market Size, Surveillance, and Manipulation

Bitcoin trades occur across a myriad of non-interconnected exchanges all day, every day. However, pricing efficiencies have developed due to the maturity of trading venues across both spot and derivatives markets. This will hopefully lead to the SEC approving future Bitcoin 19b-4 ETF filing requests.

EXPOSURE TO DIGITAL ASSETS USING ACTIVELY MANAGED INVESTMENT VEHICLES

LO 1.1.3: Demonstrate knowledge of actively managed investment vehicles offering exposure to digital assets.

Including:

- **Describe the structure and purpose of actively managed digital asset funds.**
- **Compare actively traded funds with Exchange Traded Funds holding digital assets.**

The most common form of actively managed Bitcoin vehicles is a hedge fund. These funds carry management fees of 1–2 percent and carried interest of 10–20 percent. Redemptions are typically offered quarterly and lockup periods are between 1–3 years.

Investors are attracted to Bitcoin as a liquid, transparent, and volatile asset that trades constantly. The Bitcoin network's economics and activity are evident via a global, real-time ledger that provides more data to investors than traditional investment vehicles.

While the hedge fund mechanism is currently available for investing in Bitcoin, as noted previously, the ETF mechanism has not been approved by the SEC in the

United States yet. Presumably, once ETF opportunities are available, they will offer similar advantages to actively traded funds.

COSTS OF DIGITAL ASSET EXPOSURE

LO 1.1.4: Demonstrate knowledge of the costs associated with adding exposure to digital assets.

Including:
- **Compare the costs of establishing bitcoin exposure across the different channels available to institutional investors.**

A hypothetical comparison by Coin Metrics was performed in an effort to compare the costs of establishing Bitcoin positions (e.g., $5 million, $50 million, and $1 billion) across three investment channels: (1) spot trading (and custody), (2) private passive Bitcoin funds, and (3) CME Bitcoin futures.

The assumptions for the spot trading and custody platform were an annual custody fee of 35 basis points, a one-time $10,000 custody initiation fee, and total trading costs of 0.175%, 0.14%, and 0.225% for $5 million, $50 million, and $1 billion positions, respectively. The private passive Bitcoin fund has assumed expense ratios of 50 basis points, 75 basis points, and 200 basis points. For the CME Bitcoin futures, quarterly rolling of the contract was assumed, and custody fees were not required (for cash-settled Bitcoin futures). Also, the natural contango (premium) for Bitcoin futures over spot prices was not considered, nor was the increase in time required to roll larger positions.

The ranking from most to least economical for both the $5 million and $50 million positions were CME Bitcoin futures, followed by spot trading and custody, and then private passive Bitcoin funds. For the $1 billion position, the most economical choice was spot trading and custody, followed by the private passive fund with a 50 basis point expense ratio, and then rolling CME Bitcoin futures. In all three investment channels, the private passive Bitcoin fund with a 200 basis point expense ratio was the most expensive.

KEY CONCEPTS

LO 1.1.1

For Bitcoin exposure, spot trading and custody is the most common path chosen by investors. The benefits to third-party custody include institutional grade trading, relatively low costs, and capital efficiency opportunities. The challenges include gaps in technical knowledge and experience, fragmented liquidity, and integration with traditional assets.

LO 1.1.2

A benefit of private placement in passive Bitcoin funds is that the responsibilities of selecting trading and custody partners, as well as making decisions on security and risk, are left to the fund managers. The tax and reporting benefits provided by passive funds are also beneficial to investors, as is the ability to classify the

investment as equity and record it at fair value on the balance sheet. The challenges associated with private placement funds include the relatively high costs and varying redemption mechanisms and frequencies.

Open-ended private trusts provide investors with exposure to Bitcoin through publicly traded shares which represent ownership in the trust. Benefits include access to investments via traditional brokerage firm channels and avoiding the complex logistics of physical Bitcoin ownership. Challenges include high management fees and trading premiums/discounts associated with secondary shares.

The two types of regulated futures markets for Bitcoin are cash-settled and physical-settled futures. Cash-settled Bitcoin futures offer a regulatory environment, trading advantages, and the elimination of concerns over custody upon physical delivery. Price manipulation is a concern with cash settlements and long exposure may be expensive, as cash-settled Bitcoin futures often trade at a premium to spot and longer-dated futures trade at higher premiums than shorter-dated futures. Trading costs are also a concern when rolling the futures contracts is needed prior to expiration to maintain long exposure.

Physical-settled Bitcoin futures deliver actual Bitcoin to buyers upon contract expiration. This is beneficial to those who want to hold the physical asset and eliminates concerns about spot exchange manipulation that can impact cash-settled transactions. However, these futures have not produced the same open interest and volume as cash-settled futures.

While there have been several approved Bitcoin ETF applications across the globe, in the United States, the Securities and Exchange Commission (SEC) has not approved any ETF applications due to concerns about custody, market size, surveillance, and market manipulation. Three potential benefits of the ETF structure for Bitcoin investments are product acceptance, the redemption mechanism, and accessibility.

LO 1.1.3

Investors are attracted to Bitcoin as a liquid, transparent, and volatile asset that trades constantly and provides a global, real-time ledger with more data available to investors than traditional investment vehicles. The hedge fund is the most common actively managed Bitcoin vehicle and its characteristics are typical of standard hedge funds, with management fees of 1–2 percent, carried interest of 10–20 percent, quarterly redemptions, and lockup periods between 1–3 years.

LO 1.1.4

A hypothetical comparison by Coin Metrics was performed to compare the costs of establishing Bitcoin positions ($5 million, $50 million, and $1 billion) across three investment channels: spot trading (and custody), private passive Bitcoin funds, and CME Bitcoin futures. Given various assumptions across all three channels, the results showed that the most to least economical for both the $5 million and $50 million positions were CME Bitcoin futures, followed by spot trading and custody, and then private passive Bitcoin funds. For the $1 billion position, the most

economical choice was spot trading and custody, followed by the private passive fund with a 50 basis point expense ratio, and then rolling CME Bitcoin futures.

READING QUIZ

Essay Questions

1. **Discuss** why an investor may still want to take third-party custody of Bitcoin in spite of the challenges.
2. **Identify** *two* reasons why an investor may choose physical-settled Bitcoin futures over cash-settled Bitcoin futures.
3. An investor wishes to add actively managed digital assets to her portfolio by incorporating hedge funds holding Bitcoin investments. **Describe** the fees, lockup period, and redemption frequency she can expect as an investor in the fund.
4. Based on the Coin Metrics study used to assess the costs of Bitcoin investments across multiple mechanisms (spot trading and custody, CME Bitcoin futures with rolling contracts quarterly, and private passive funds), **explain** why investors may be least likely to invest in the private passive funds.

READING QUIZ ANSWERS

1. While fragmented liquidity, traditional asset integration challenges, and insufficient technical knowledge and expertise may drive investors away from third-party custody, there are several benefits associated with taking custody of Bitcoin. First, trading and custody solutions have improved dramatically as the digital asset market has evolved over the years. Second, custody and trade execution costs are relatively favorable. Finally, Bitcoin is liquid, borderless, settles quickly, offers real-time price discovery, and may be eligible to serve as collateral. (LO 1.1.1)

2. While cash-settled Bitcoin futures eliminate the burden of physical custody, investors may still choose physical-settled rather than cash-settled futures. One reason is that investors may want to hold the physical asset rather than simply being paid cash or paying cash to close the transaction. Another reason is that one of the major concerns with cash-settled futures is that spot exchange manipulation can negatively impact returns. There is no such opportunity for manipulation of physical-settled transactions. (LO 1.1.2)

3. Investing in hedge funds with Bitcoin holdings is a form of active management. The fees associated with hedge funds include a management fee which typically ranges from 1 to 2 percent and carried interest which is typically between 10 and 20 percent. Lockup periods are often between 1 to 3 years and redemption frequency is often quarterly. (LO 1.1.3)

4. The Coin Metrics study assessed costs across three mechanisms: spot trading and custody, CME Bitcoin futures, and private passive funds. For all three positions reviewed ($5 million, $50 million, and $1 billion), the most economical position varied between spot trading and custody and CME Bitcoin futures. However, the least economical (and therefore most expensive) option, in general, was the private passive fund. The high cost for private

passive funds is a key reason why investors may choose other approaches for gaining Bitcoin exposure. (LO 1.1.4)

The following is a review of the Emerging Topics principles designed to address the learning objectives set forth by CAIA Association®. Cross-reference to CAIA Association Assigned Reading—Schär.

READING 1.2

DECENTRALIZED FINANCE: ON BLOCKCHAIN- AND SMART CONTRACT-BASED FINANCIAL MARKETS

Topic 1

EXAM FOCUS

This reading examines decentralized finance (DeFi), which is a blockchain-based financial infrastructure. For the exam, understand the fundamentals of DeFi and the five layers which constitute its building blocks. Asset tokenization, the value of stablecoins, and the different forms of collateral are critical elements of this structure. As decentralization is one of the primary advantages of this platform, be able to explain the concept of a decentralized exchange and differentiate between the various options for protocols and liquidity systems. Collateralized debt positions and collateralized debt markets (pooled and P2P) are used to secure loans in the DeFi system. The two types of decentralized derivatives that you should be able to distinguish between for the exam include asset-based and event-based derivatives. On-chain funds can provide investors with diversification benefits, so be familiar with the fundamentals of this form of asset management. Finally, as DeFi is still relatively new, it comes with myriad opportunities and risks that must be fully understood.

DECENTRALIZED FINANCE

LO 1.2.1: Demonstrate knowledge of decentralized finance (DeFi).

Including:
- **Define the building blocks of DeFi, including settlement, asset, protocol, application, and aggregation layers.**

Decentralized Finance Defined

Decentralized finance (DeFi) is defined as a blockchain-based financial infrastructure built on public smart contract platforms that are open, permissionless, transparent, and interoperable. Every participant has equal access to

the infrastructure. Rather than relying on centralized institutions and intermediaries like a traditional financial services model, DeFi is based on open protocols and decentralized applications (dApps). Roles traditionally filled by central clearing houses and custodians are assumed by smart contracts. Transactions are secure and verifiable, agreements are enforced by code, and the public blockchain keeps a permanent record of any changes.

Smart contracts, which are small applications stored on a blockchain and executed by a large set of validators, are the backbone of all DeFi applications and protocols. While facilitating the involvement of every participant may be deemed inefficient, the high level of security afforded by smart contracts is considered a significant advantage. The highly transparent nature of smart contracts, which will always be executed as specified and allow anyone to verify changes to the blockchain, will outweigh the disadvantages of any inefficiencies.

While a regular server-based web application does not allow the user to control the execution environment or see how the internal logic works, the contract code for a smart contract is stored on the underlying blockchain and is open to public scrutiny. Transactions are processed by all network participants in parallel, which helps to ensure the execution of a transaction is legitimate. Any execution which results in a state change to the blockchain will be subjected to the network's consensus rules and will appear in the blockchain's state tree. The flexibility of smart contracts is also beneficial, as they can fill a custodial role by storing cryptoassets and determining how and when the assets can be released.

As noted earlier, a decentralized smart contract platform that is blockchain-based helps to ensure secure global states and eliminates any trust issues regarding the transaction execution environment. Contracts have composability in that they interact with and build on top of each other.

Although DeFi is still considered a niche market, its volume and the value of the reserves locked in smart contracts are growing considerably. Ethereum is the largest smart contract platform in terms of development activity, available applications, and market capitalization.

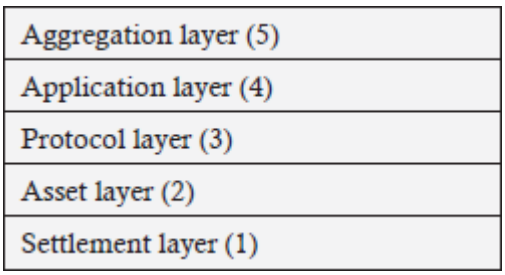
Building Blocks

DeFi has a multi-layered infrastructure with five distinct layers each serving a different purpose. The layers are hierarchical and build on each other, with each layer only as secure as the layers below it. The five layers are: (1) settlement, (2) asset, (3) protocol, (4) application, and (5) aggregation, each described below and shown in Figure 1:

- *Settlement layer (Layer 1).* Includes both the blockchain and the native protocol asset (e.g., ETH represents the Ethereum blockchain). The blockchain serves as the foundation layer and a settlement or dispute resolution layer. It is here that the network securely stores ownership information and ensures any state changes are following a defined ruleset.
- *Asset layer (Layer 2).* All assets issued on top of the settlement layer are here, including the native protocol asset and any additional assets (tokens) issued on the blockchain.

- *Protocol layer (Layer 3).* Standards typically implemented as a set of smart contracts which are for specific use cases like debt markets, derivatives, decentralized exchanges, and on-chain asset management.
- *Application layer (Layer 4).* Includes user-oriented applications used to connect to individual protocols.
- *Aggregation layer (Layer 5).* Serves as an extension of the application layer. Aggregators connect user-centric platforms to several protocols and applications simultaneously and provide the tools that users need to rate and compare services.

Figure 1: DeFi Stack



ASSET TOKENIZATION

LO 1.2.2: Demonstrate knowledge of asset tokenization.

Including:
- **Define and discuss the risks of asset tokenization, including the use of off-chain collateral, on-chain collateral, and no collateral.**
- **Explain the use of stablecoins in the DeFi system.**

Asset Tokenization and Stablecoins

Public blockchains are like ledgers that allow for participants to record changes in ownership that cannot be altered over time. Although the public blockchain is used to track the native protocol asset, other assets get added to the chain over time. **Tokenization** is the process of adding new assets to the blockchain and the token is defined as the blockchain representation of the asset. The benefit of tokenization is that these assets are highly accessible and easily transferred amongst participants. Tokens are a critical part of the DeFi marketplace, as they can be stored within smart contracts and used in myriad decentralized applications. The overwhelming majority of tokens (close to 90%) are issued through the ERC-20 token standard smart contract template on the Ethereum blockchain and can be used in most DeFi applications.

Additional assets are often added to the chain to add stablecoin, as many financial contracts require an asset with low volatility. **Stablecoins** are digital currency linked to an underlying asset like a national currency (fiat-backed) or precious metals (commodity-backed).

Although native digital tokens do not present issuer risk, this risk is a concern when new tokens (and stablecoins) are introduced and values are contingent on promises (such as dividends, interest payments, etc.) that may never be met by the issuer. For

promise-based tokens, the three backing models are: off-chain collateral, on-chain collateral, and no collateral.

- **Off-chain collateral.** The underlying assets are stored outside of the blockchain, often with escrow services such as commercial banks. Examples of off-chain collateralized stablecoins include two USD-backed coins (USDT and USDC), both available on the Ethereum blockchain as ERC-20 tokens. DGX (an ERC-20 stablecoin backed by gold) and WBTC (tokenized Bitcoin on the Ethereum blockchain) are also examples. Although off-chain collateralized tokens can help mitigate exchange rate risk, they can also create external dependencies and counterparty risk. Any tokens using off-chain collateral require frequent audits and measures to track collateral availability.
- **On-chain collateral.** Assets are typically held in smart contracts and locked on the blockchain. Advantages of on-chain collateral include claims secured by smart contracts and high levels of transparency. However, because the collateral is typically held in a native protocol asset, it will be vulnerable to price fluctuations. An example is the Dai stablecoin, which primarily uses ETH (the native protocol asset on the Ethereum blockchain) as its on-chain collateral. The Dai stablecoin incorporates a stability fee, which is the interest rate paid by an individual or entity creating new Dai.
- **No collateral.** The promise is based on trust alone, which poses the greatest counterparty risk.

Non-fungible tokens (NFTs) are tokens that represent collectibles (unique assets) typically built on the ERC-721 token standard. NFTs are either digitally native units of value with unique characteristics or digital representations of physical objects like art which naturally expose the holder to counterparty risk. Because the tokens are non-fungible, individual asset ownership and precise identification of the asset are easily tracked.

DECENTRALIZED EXCHANGE PROTOCOLS

LO 1.2.3: Demonstrate knowledge of decentralized exchange protocols.

Including:
- **Contrast decentralized and centralized exchanges including advantages and disadvantages.**
- **Explain decentralized exchange protocols and liquidity systems, such as decentralized order book exchanges, constant function market maker, smart contract-based reserve aggregation, and peer-to-peer protocols.**

Decentralized vs. Centralized Exchanges

Most cryptoasset trades occur through centralized exchanges, which are relatively efficient but require that traders first deposit assets with the exchange. Traders lose their access to these assets in this process, and are vulnerable to unprofessional or dishonest exchange operators. In addition, centralized exchanges provide a single point of attack for potential outside parties looking to do harm and create chaos. Because of the rapid growth in cryptoasset transactions, some centralized exchanges

may struggle to offer the infrastructure and regulatory support needed to satisfy traders.

Decentralized exchanges are exchanges that facilitate transactions without the involvement of an intermediary. Users maintain full control of their assets until trades are executed through smart contracts, which reduces counterparty credit risk. The recent evolution of these exchanges incorporated open exchange protocols, which provide asset exchange standards and allow exchanges built on the protocol to use features such as shared liquidity pools. The biggest advantage is that other DeFi protocols can use these marketplaces to liquidate and exchange tokens.

Decentralized Exchange Protocols and Liquidity Systems

Examples of decentralized exchange protocols described below include decentralized order book exchanges, constant function money maker, peer-to-peer protocols, and smart contract-based reserve aggregation.

- **Decentralized Order Book Exchanges.** Although they are likely to differ in how order books are hosted, they all settle transactions using smart contracts. Order books may be on-chain or off-chain. On-chain order books are fully decentralized, with smart contracts storing every order. However, a blockchain transaction is required for every action, which makes it a slow and costly process (especially in volatile markets where order cancellations are a regular occurrence). Some exchange protocols may decide to use blockchain as a settlement layer only, with greater reliance on off-chain order books. Relayers are the centralized third parties that host and update off-chain order books. Relayers do not control funds, match orders, or execute orders; rather, they just provide ordered lists with quotes. 0x is the primary protocol to use this approach and incorporates a three-step trade process: (1) a maker will send an order to the relayer to include in the order book, (2) a potential taker selects one of the orders by talking to the relayer, and (3) the taker submits the order to the smart contract, which executes the exchange of assets.
- **Constant Function Market Maker (CFMM).** This is a smart contract-liquidity pool that holds multiple cryptoassets in reserve and facilitates token deposits in one type along with token withdrawals of a different type. The exchange rate is based on the smart contract's token reserve ratio. The equation $xy = k$ is used to represent the model, with k as a constant and x and y representing each smart contract's token reserve. Any increase (or decrease) in x results in an opposite decrease (or increase) in y. As reserves get lower, tokens will become more expensive such that the liquidity pool cannot be depleted. Arbitrage ultimately forces the liquidity pool price to converge with the current market price. Note that pool share tokens may increase in value as additional funds accumulate in the pool, leading to a higher k. Balancer, Bancor, Curve, and UniSwap are examples of these pool protocols.
- **Peer-to-Peer (P2P) (a.k.a. over-the-counter, OTC) Protocols.** Participants use an automated process to find counterparties in the network interested in trading a cryptoasset pair and negotiate the exchange rate in a bilateral manner, with the trade executed using a smart contract on-chain. Offers may be accepted by those involved in the negotiation, which differs from previously covered protocols. This

eliminates the risk of third parties frontrunning by seeing unconfirmed transactions. Off-chain indexers may also be used for peer discovery. AirSwap is the most prominent example of this protocol.

- **Smart Contract-Based Reserve Aggregation.** With this method, liquidity reserves are consolidated within a smart contract that serves as the hub for users and liquidity providers. Users send their trade requests to the smart contract, which then compares prices set by liquidity providers, accepts the best offer, and executes the trade. To work well, a broad base of liquidity providers must exist. A minimum number of liquidity providers or maximum prices may be put in place as a control mechanism. The Kyber Network is a good example of this system.

DECENTRALIZED LENDING

LO 1.2.4: Demonstrate knowledge of decentralized lending platforms.

Including:
- **Discuss collateralized debt positions and collateralized debt markets.**

Unlike traditional centralized markets, a decentralized lending platform allows for anonymity for both the borrower and the lender. Anyone can access the platform to borrow money or provide liquidity. DeFi loans are therefore not reliant on trusted relationships and are completely permissionless. There are two approaches to protect the lender:

1. A single blockchain transaction can be used to ensure that the borrower receives the funds, uses the funds, and then repays them. These loans are called flash loans and if the borrower does not repay with interest, the transaction and its results are nullified.
2. Loans may be fully secured using collateral that is locked in a smart contract and released only when the debt is repaid. The three variations of this approach are collateralized debt positions, pooled collateralized debt markets, and P2P collateralized debt markets.

Collateralized Debt Positions

Collateralized debt positions (CDP) are loans that use newly created tokens. Some DeFi applications let users issue new tokens backed by collateral, as long as they lock cryptoassets into a smart contract. The number of new tokens created is dependent on the target collateralization ratio, the value of the collateral (the cryptoassets), and the target price of the tokens generated. New tokens serve as loans that are fully collateralized, do not involve a counterparty, and allow user access to a liquid asset with the collateral providing market exposure.

An example of the CDP concept is provided below with the following inputs:

- MakerDAO: a decentralized protocol used to issue Dai stablecoin
- Dai stablecoin: pegged to the U.S. dollar
- ETH: the Ethereum blockchain
- MKR: the governance token for MakerDAO