

2015
CFA® EXAM REVIEW



11TH HOUR GUIDE
LEVEL I CFA®

WILEY

**Wiley 11th Hour Guide for
2015 Level I CFA Exam**

Thousands of candidates from more than 100 countries have relied on these Study Guides to pass the CFA® Exam. Covering every Learning Outcome Statement (LOS) on the exam, these review materials are an invaluable tool for anyone who wants a deep-dive review of all the concepts, formulas and topics required to pass.

Originally published by Elan Guides, this study material was produced by CFA® Charterholders, CFA® Institute members, and investment professionals. In 2014 John Wiley & Sons, Inc. purchased the rights to Elan Guides content, and now this material is part of the Wiley Efficient Learning suite of exam review products. For more information, contact us at info@efficientlearning.com.

Wiley 11th Hour Guide for 2015 Level I CFA Exam

WILEY

Copyright © 2015 by John Wiley & Sons, Inc. All rights reserved.

Published by John Wiley & Sons, Inc., Hoboken, New Jersey.

The material was previously published by Elan Guides.

Published simultaneously in Canada.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning, or otherwise, except as permitted under Section 107 or 108 of the 1976 United States Copyright Act, without either the prior written permission of the Publisher, or authorization through payment of the appropriate per-copy fee to the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, (978) 750-8400, fax (978) 646-8600, or on the Web at www.copyright.com. Requests to the Publisher for permission should be addressed to the Permissions Department, John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, (201) 748-6011, fax (201) 748-6008, or online at <http://www.wiley.com/go/permissions>.

Limit of Liability/Disclaimer of Warranty: While the publisher and author have used their best efforts in preparing this book, they make no representations or warranties with respect to the accuracy or completeness of the contents of this book and specifically disclaim any implied warranties of merchantability or fitness for a particular purpose. No warranty may be created or extended by sales representatives or written sales materials. The advice and strategies contained herein may not be suitable for your situation. You should consult with a professional where appropriate. Neither the publisher nor author shall be liable for any loss of profit or any other commercial damages, including but not limited to special, incidental, consequential, or other damages.

For general information on our other products and services or for technical support, please contact our Customer Care Department within the United States at (800) 762-2974, outside the United States at (317) 572-3993 or fax (317) 572-4002.

Wiley publishes in a variety of print and electronic formats and by print-on-demand. Some material included with standard print versions of this book may not be included in e-books or in print-on-demand. If this book refers to media such as a CD or DVD that is not included in the version you purchased, you may download this material at <http://booksupport.wiley.com>. For more information about Wiley products, visit www.wiley.com.

Required CFA Institute ® disclaimer:

“CFA® and Chartered Financial Analyst® are trademarks owned by CFA Institute. CFA Institute (formerly the Association for Investment Management and Research) does not endorse, promote, review or warrant the accuracy of the products or services offered by John Wiley & Sons, Inc.

Certain materials contained within this text are the copyrighted property of CFA Institute. The following is the copyright disclosure for these materials:

“Copyright 2014, CFA Institute. Reproduced and republished with permission from CFA Institute. All rights reserved.”

These materials may not be copied without written permission from the author. The unauthorized duplication of these notes is a violation of global copyright laws and the CFA Institute Code of Ethics. Your assistance in pursuing potential violators of this law is greatly appreciated. “Copyright (year), CFA Institute. Reproduced and republished with permission from CFA Institute. All rights reserved.”

Disclaimer: John Wiley & Sons, Inc.’s study materials should be used in conjunction with the original readings as set forth by CFA Institute in the 2014 CFA Level 1 Curriculum. The information contained in this book covers topics contained in the readings referenced by CFA Institute and is believed to be accurate. However, their accuracy cannot be guaranteed.

ISBN 978-1-119-03246-5

Contents

Foreword	VII
Ethics	
Study Session 1: Ethical and Professional Standards	1
Quantitative Methods	
Study Session 2: Quantitative Methods—Basic Concepts	11
Study Session 3: Quantitative Methods—Application	33
Economics	
Study Session 4: Economics—Microeconomic Analysis	65
Study Session 5: Economics—Macroeconomic Analysis	95
Study Session 6: Economics in a Global Context	131
Financial Reporting and Analysis	
Study Session 7: Financial Reporting and Analysis: An Introduction	155
Study Session 8: Income Statements, Balance Sheets, and Cash Flow Statements	169
Study Session 9: Inventories, Long-Lived Assets, Income Taxes, and Non-Current Liabilities	195
Study Session 10: Financial Reporting Quality and Financial Statement Analysis	231
Corporate Finance	
Study Session 11: Corporate Finance	245
Portfolio Management	
Study Session 12: Portfolio Management	275
Equity	
Study Session 13: Market Organization, Market Indices, and Market Efficiency	303
Study Session 14: Equity Analysis and Evaluation	331
Fixed Income	
Study Session 15: Fixed Income—Basic Concepts	355
Study Session 16: Fixed Income—Analysis of Risk	391
Derivatives	
Study Session 17: Derivatives	411
Alternative Investments	
Study Session 18: Alternative Investments	431

Foreword

Wiley 11th Hour Guide for 2015 Level I CFA Exam is a concise and easy to understand review book that is meant to supplement your review for the CFA Level I exam. It becomes extremely difficult to go through the entire curriculum in the last few weeks leading up to the exam so we have condensed the material for you. You must remember though, that this book is not meant to be a primary study too for the exam. It is designed to help you revise the material in an efficient and effective manner so that you can be confident on exam day.

About the Author

Basit Shajani, CFA, founded online education start-up Élan Guides in 2009 to help address CFA candidates' need for better study materials. As lead writer, lecturer, and curriculum developer, Basit's unique ability to break down complex topics helped the company grow organically to be a leading global provider of CFA Exam prep materials. In January 2014, Élan Guides was acquired by John Wiley & Sons, Inc., where Basit continues to serve as director of CFA content. Basit graduated magna cum laude from the Wharton School of Business at the University of Pennsylvania with majors in finance and legal studies. He went on to obtain his CFA charter in 2006, passing all three levels on the first attempt. Prior to Élan Guides, Basit ran his own private wealth management business. He is a past president of the Pakistani CFA Society.

STUDY SESSION 1: ETHICAL AND PROFESSIONAL STANDARDS

CODE OF ETHICS AND STANDARDS OF PROFESSIONAL CONDUCT

Cross-Reference to CFA Institute Assigned Readings #1 & 2

All CFA Institute members and candidates enrolled in the CFA Program are required to comply with the Code of Ethics and the Standards of Professional Conduct (Code and Standards). The CFA Institute Bylaws and Rules of Procedure for Proceedings Related to Professional Conduct (Rules of Procedure) form the basic structure for enforcing the Code and Standards.

The Rules of Procedure are based on the following two principles:

1. Fair process.
2. Maintaining confidentiality of process.

The CFA Institute Board of Governors is responsible for implementing the Professional Conduct Program (PCP) through the Disciplinary Review Committee (DRC).

The CFA Institute Designated Officer, through the Professional Conduct staff, carries out professional conduct inquiries. Circumstances which can initiate an inquiry include:

- Information disclosed on the annual Professional Conduct Statement.
- Written complaints received by Professional Conduct staff.
- Questionable conduct as publicized by the media or any other source.
- A violation report submitted by a CFA examination proctor.

Once an inquiry is initiated, the Professional Conduct staff undertakes an investigation which can include:

- Requesting a written explanation.
- Interviewing related person(s).
- Collecting any supporting documents.

The information collected is reviewed by the Designated Officer, who may conclude that:

1. No disciplinary action is needed
2. A cautionary letter needs to be issued
3. Proceedings need to be continued.

If it is concluded that there has been a violation of the Code and Standards, the Designated Officer can propose a disciplinary sanction. The member or candidate has the right to accept or reject the decision. A rejection would require the matter to be referred to a hearing by a panel of CFA Institute members. Sanctions by CFA Institute may include condemnation by peers, consequences for current or future employment or suspension from the CFA program.

The adherence of investment professionals to ethical practices benefits all market participants.

- Clients are reassured that investment professionals they hire prioritize their interests.
- Investment professionals benefit from the more efficient and transparent operation of the market that promotes integrity.

Sound ethics is fundamental to capital markets and the investment profession as it increases investors' confidence in global financial markets. Ethics is also of paramount importance because of the interconnectedness of global financial markets, which gives rise to the issue of market sustainability. It is imperative that top management foster a strong culture of ethics not just among CFA charter holders and candidates but among all staff members who are involved directly or indirectly with client relations, the investment process, record keeping, and beyond.

However, new challenges continually arise for members and candidates in applying the Code and Standards. This is because ethical dilemmas are not unambiguously right or wrong and require a bit of judgment.

The CFA Institute Code of Ethics plays an integral role in maintaining the integrity of CFA Institute members and upholding professional excellence. All CFA Institute members and CFA candidates must abide by this code and are encouraged to notify their employers of any violations. Violations may result in disciplinary sanctions by CFA Institute, which may include revocation of membership, candidacy in the CFA program and the right to use the CFA designation.

The Code of Ethics requires all members and candidates to:

- Act with integrity, competence, diligence, respect, and in an ethical manner with the public, clients, prospective clients, employers, employees, colleagues in the investment profession, and other participants in the global capital markets.
- Place the integrity of the investment profession and the interests of clients above their own personal interests.
- Use reasonable care and exercise independent professional judgment when conducting investment analysis, making investment recommendations, taking investment actions, and engaging in other professional activities.
- Practice and encourage others to practice in a professional and ethical manner that will reflect credit on themselves and the profession.
- Promote the integrity of, and uphold the rules governing, capital markets.
- Maintain and improve their professional competence and strive to maintain and improve the competence of other investment professionals.

Standards of Professional Conduct:

I. Professionalism

- A. Knowledge of the Law
- B. Independence and Objectivity
- C. Misrepresentation
- D. Misconduct

II. Integrity of Capital Markets

- A. Material Nonpublic Information
- B. Market Manipulation

III. Duties to Clients

- A. Loyalty, Prudence and Care
- B. Fair Dealing
- C. Suitability
- D. Performance Presentation
- E. Preservation of Confidentiality

IV. Duties to Employers

- A. Loyalty
- B. Additional Compensation Arrangements
- C. Responsibilities of Supervisors

V. Investment Analysis, Recommendations and Actions

- A. Diligence and Reasonable Basis
- B. Communication with Clients and Prospective Clients
- C. Record Retention

VI. Conflicts of Interest

- A. Disclosure of Conflicts
- B. Priority of Transactions
- C. Referral Fees

VII. Responsibilities as a CFA Institute Member or CFA Candidate

- A. Conduct as Participants in CFA Institute Programs
- B. Reference to CFA Institute, the CFA Designation, and the CFA Program

The best way to prepare for Ethics is to thoroughly read the Standards themselves, along with related guidance and examples.

INTRODUCTION TO THE GLOBAL INVESTMENT PERFORMANCE STANDARDS (GIPS®)

Cross-Reference to CFA Institute Assigned Reading #3

Individual and institutional investors typically use past investment performance to gauge a fund manager's ability and to make investment decisions. Questions relating to the accuracy and credibility of the data used to present investment performance make comparisons difficult.

The GIPS standards aim to provide clients and prospective clients with comparable and representative investment performance data. They establish an industry-wide, standard approach for calculation and presentation of investment performance. This forces complying firms to avoid misrepresentation and to communicate all relevant information that prospective clients should know to make informed investment decisions. Compliance with GIPS standards for any firm is *voluntary* and not required by any legal or regulatory authorities. However, only investment management firms that actually manage assets can claim compliance. Plan sponsors and consultants cannot claim to comply with GIPS if they do not manage any assets. They can only endorse the standards or require their investment managers to comply with them. Further, compliance is a firm-wide process that cannot be achieved on a single product or composite. In order to claim compliance, the firm needs to comply with all requirements of GIPS standards; there is no such thing as partial compliance to GIPS.

The GIPS standards benefit two main groups - investment management firms and prospective clients.

The GIPS standards require the use of composites. A composite is formed by combining discretionary portfolios into one group that represents a particular investment objective or strategy. A composite representing a particular strategy, must include **all** discretionary portfolios managed according to that strategy.

To ensure that the firm does not include only its best performing funds when presenting its investment performance, the GIPS standards require that the criteria for classifying portfolios into composites be decided before performance is known (i.e. on an ex-ante basis), not after the fact.

Firms that claim compliance with GIPS standards are responsible for ensuring that they really are compliant and that they maintain their compliant status going forward. After claiming compliance, firms may hire an independent third party to verify that they are compliant to add credibility to their claim.

Verification assures that the investment manager is compliant with GIPS standards on a firm-wide basis. Verification needs to be performed on the entire firm rather than specific composites. Verification tests:

- Whether the investment firm has complied with all the composite construction requirements on a firm-wide basis; and
- Whether the firm's processes and procedures calculate and present performance information according to GIPS standards.

Verification is optional, and it cannot be performed by the firm itself.

GLOBAL INVESTMENT PERFORMANCE STANDARDS (GIPS®)

Cross-Reference to CFA Institute Assigned Reading #4

Objectives of GIPS

- To establish investment industry's best practices for calculating and presenting investment performance that promote investor interests and instill investor confidence.
- To obtain worldwide acceptance of a single standard for the calculation and presentation of investment performance based on the principles of fair representation and full disclosure.
- To promote the use of accurate and consistent investment performance data.
- To encourage fair, global competition among investment firms without creating barriers to entry.
- To foster the notion of industry "self-regulation" on a global basis.

Overview

GIPS standards have the following key features:

- GIPS standards are ethical standards to ensure full disclosure and fair representation of investment performance. In order to claim compliance, firms must adhere to all the requirements of the GIPS standards.
- Apart from adhering to the minimum requirements of the GIPS standards, firms should try to adhere to the recommendations of the GIPS standards to achieve best practice in the calculation and presentation of performance.
- Firms should include all actual, discretionary, and fee-paying portfolios in at least one composite defined by investment mandate, objective, or strategy in order to prevent firms from cherry-picking their best performance.
- The accuracy of performance presentation is dependent on the accuracy of input data. The underlying valuations of portfolio holdings drive the portfolio's performance. Therefore, it is essential for these and other inputs to be accurate. The GIPS standards require firms to adhere to certain calculation methodologies and to make specific disclosures along with the firm's performance.
- Firms must comply with all requirements of the GIPS standards, including any updates, Guidance Statements, interpretations, Questions & Answers, and clarifications published by CFA Institute and the GIPS Executive Committee, which are available on the GIPS website as well as in the GIPS Handbook.

The GIPS standards do not address every aspect of performance measurement or cover unique characteristics of each asset class. However, they will continue to evolve over time to address additional areas of investment performance.

Fundamentals of Compliance

The fundamentals of compliance include both recommendations and requirements.

Requirements

- Firms must comply with all the requirements of the GIPS standards, including any updates, Guidance Statements, interpretations, Questions & Answers, and clarifications published by CFA Institute and the GIPS Executive Committee, which are available on the GIPS website as well as in the GIPS Handbook.
- Firms must comply with all applicable laws and regulations regarding the calculation and presentation of performance.
- Firms must not present performance or performance-related information that is false or misleading.
- The GIPS standards must be applied on a firm-wide basis.
- Firms must document their policies and procedures used in establishing and maintaining compliance with the GIPS standards, including ensuring the existence and ownership of client assets, and must apply them consistently.
- If the firm does not meet all the requirements of the GIPS standards, it must not represent or state that it is “in compliance with the Global Investment Performance Standards except for...” or make any other statements that may indicate partial compliance with the GIPS standards.
- Statements referring to the calculation methodology as being “in accordance”, “in compliance”, or “consistent with” the GIPS standards, or similar statements, are prohibited.
- Statements referring to the performance of a single, existing client portfolio as being “calculated in accordance with the GIPS standards” are prohibited, except when a GIPS-compliant firm reports the performance of an individual client’s portfolio to that particular client.
- Firms must make every reasonable effort to provide a compliant presentation to all prospective clients. Firms must not choose whom they present a compliant presentation to. As long as a prospective client has received a compliant presentation within the previous 12 months, the firm has met this requirement.
- Firms must provide a complete list of composite descriptions to any prospective client that makes such a request. They must include terminated composites on their list of composite descriptions for at least five years after the composite termination date.
- Firms must provide a compliant presentation for any composite listed on their list of composite descriptions to any prospective client that makes such a request.

- Firms must be defined as an investment firm, subsidiary, or division held out to clients or prospective clients as a distinct business entity.
- For periods beginning on, or after 1 January 2011, total firm assets must be aggregate fair value of all discretionary and non-discretionary assets managed by the firm. This includes both fee-paying and non-fee-paying portfolios.
- Total firm assets must include assets assigned to a sub-advisor provided that the firm has discretion over the selection of the sub-advisor.
- Changes in a firm's organization must not lead to alteration of historical composite performance.
- When the firm jointly markets with other firms, the firm claiming compliance with the GIPS standards must ensure that it is clearly defined and separate from the other firms being marketed, and that it is clear which firm is claiming compliance.

Recommendations

- Firms should comply with the recommendations of the GIPS standards, including recommendations in any updates, Guidance Statements, interpretations, Questions & Answers, and clarifications published by CFA Institute and the GIPS Executive Committee, which will be made available on the GIPS website as well as in the GIPS Handbook.
- Firms should be verified.
- Firms should adopt the broadest, most meaningful definition of the firm, encompassing all geographical offices operating under the same brand name regardless of the actual name of the individual investment management company.
- Firms should provide to each existing client, on an annual basis, a compliant presentation of the composite in which the client's portfolio is included.

Historical Performance Record

Firms are required to present a minimum of five years of GIPS-compliant historical investment performance. If the firm or composite has been in existence for less than five years, the presentation should include performance since inception. After initiating compliance with GIPS standards, the firm must add one year of compliant performance each year, so that the firm eventually presents a (minimum) performance record of 10 years.

Firms may link non-GIPS-compliant performance records to their compliant history as long as the non-compliant record is not for data after January 1, 2000. In such a case the firm must disclose the period of non-compliant data and disclose how the performance presentation differs from GIPS standards.

Firms that manage private equity, real estate, and/or wrap fee/separately managed account (SMA) portfolios must also comply with Sections 6, 7, and 8, respectively, of the Provisions of the GIPS standards that became effective as of 1 January 2006.

The effective date for the 2010 edition of the GIPS standards is 1 January 2011. Compliant presentations that include performance for periods that begin on or after 1 January 2011 must be prepared in accordance with the 2010 edition of the GIPS standards. Prior editions of the GIPS standards may be found on the GIPS website.

Implementation of GIPS Standards

In countries where laws and regulations regarding performance presentation do exist, firms are encouraged to adhere to GIPS in addition to their local laws. In case of a conflict, local laws are applicable and firms are required to disclose the conflict.

Nine Major Sections of the GIPS Standards

The nine major sections of the GIPS standards are:

0. **Fundamentals of compliance** which discusses issues pertaining to definition of a firm, documentation of policies and procedures, maintaining compliance with any updates and ensuring proper reference to claim of compliance with GIPS and references to verification of GIPS.
1. **Input data** which specifies standards for input data to be used to calculate investment performance. For periods beginning on or after 1 January 2011, all portfolios must be valued in accordance with the definition of fair value and the GIPS Valuation Principles.
2. **Calculation methodology** includes definitions of specific methods for return calculations of portfolios and composites.
3. **Composite construction:** Composites should be constructed to achieve consistency and fair presentation. Details were discussed in LOS 3b.
4. **Disclosures** Requirements for disclosure of information pertaining to a firm's policies and performance presentation.
5. **Presentation and reporting:** Performance presentation must be according to GIPS requirements.
6. **Real estate** standards must be applied to present performance relating to real estate investments.
7. **Private equity:** GIPS Private Equity Valuation Principles must be used to value private equity investments, except for open-end and evergreen funds.
8. **Wrap Fee/Separately Managed Account (SMA) Portfolios:** Firms must include the performance record of all wrap fee/SMA portfolios in appropriate composites in accordance with the firm's established portfolio inclusion policies.

STUDY SESSION 2: QUANTITATIVE METHODS—BASIC CONCEPTS

TIME VALUE OF MONEY

Cross-Reference to CFA Institute Assigned Reading #5

Interest rates can be thought of in three ways:

- The minimum rate of return that you require to accept a payment at a later date.
- The discount rate that must be applied to a future cash flow to determine its present value.
- The opportunity cost of receiving money today as opposed to saving it for a certain period and earning a return on it.

Interest rates are composed of the real risk-free rate plus compensation for bearing various risks.

- The **real risk-free rate** is the single-period return on a risk-free security assuming zero inflation. With no inflation, every dollar holds on to its purchasing power, so this rate purely reflects individuals' preferences for current versus future consumption.
- The **inflation premium** is added to the real risk-free rate to reflect the expected loss in purchasing power over the term of a loan. The real risk-free rate plus the inflation premium equals the nominal risk-free rate.
- The **default risk premium** compensates investors for the risk that the borrower might fail to make her payments on time in full.
- The **liquidity premium** compensates investors for any difficulty they might face in converting their holdings readily into cash at close to the most recent market price. Securities that trade infrequently or with low volumes require a higher liquidity premium than those that trade frequently with high volumes.
- The **maturity premium** compensates investors for the higher sensitivity of the market values of longer term debt instruments to changes in interest rates.

Present Value versus Future Value

- Present value (PV) is the current worth of sum of money or stream of cash flows that will be received in the future, given the interest rate.
 - For a given discount rate, the *longer* the time period till the future amount is received, the *lower* the present value.
 - For a given time period, the *higher* the discount rate, the *lower* the present value of an amount.
- Future value (FV) is the value of a sum of money at a specified date in the future.
 - For a given interest rate, the future value *increases* as the number of periods *increases*.
 - For a given number of periods, the future value *increases* as the interest rate *increases*.

Since PV and FV are separated in time, remember the following that we can add sums of money only if they are being valued at exactly the same point in time.

Annuities

- An **annuity** is a series of recurring periodic level payments.
- An **ordinary annuity** is an annuity where the cash flows occur at the end of each compounding period.
- An **annuity due** is an annuity where cash flows occur at the beginning of every period. Problems relating to annuities due can either be solved in [BGN] mode or by converting the value of an ordinary annuity to that of an annuity due.

$$\begin{aligned} PV_{\text{Annuity Due}} &= PV_{\text{Ordinary Annuity}} \times (1 + r) \\ FV_{\text{Annuity Due}} &= FV_{\text{Ordinary Annuity}} \times (1 + r) \end{aligned}$$

Perpetuities

A **perpetuity** is a never ending series of level payments, where the first cash flow occurs one period from now (at $t = 1$).

$$PV = \frac{PMT}{I/Y}$$

The Effects of Compounding Frequency

- As the number of compounding periods *increases*, the future value of the investment *increases*.
- As the number of compounding periods *increases*, the present value of the investment *decreases*.
- The effective annual rate *rises* as compounding frequency *increases*.

Loan Payments and Amortization Schedules

Loan amortization is the process of retiring a loan obligation through predetermined equal monthly payments. Each of these payments includes an interest component, which is calculated on the principal outstanding at the beginning of the period, and a principal repayment component. The principal component increases with the passage of time, and the interest component declines over time in line with the decreasing amount of principal outstanding.

The principal outstanding at any payment date equals the present value of the remaining payments discounted at the periodic discount rate.

The Cash Flow Additivity Principle

The additivity principle states that the present value of any stream of cash flows equals the sum of the present values of the individual cash flows. If we have two streams of cash flows, the sum of the present values of the two streams at any point in time is the same as the present value of the two series combined by adding cash flows that occur at the same point in time. The cash flow stream can also be divided in any desired manner, and the present value of the pieces will equal the present value of the series.

DISCOUNTED CASH FLOW APPLICATIONS

Cross-Reference to CFA Institute Assigned Reading #6

Net Present Value

The net present value (NPV) of an investment equals the present value of all expected inflows from the project minus the present value of all expected outflows. The rate used to discount all cash flows is the appropriate cost of capital, which reflects the opportunity cost of undertaking the particular investment, and compensates investors for various risks inherent in the project.

- Positive NPV projects increase shareholder wealth and should be accepted.
- Negative NPV projects decrease shareholder wealth and should be rejected.
- For mutually exclusive projects (where only one project can be chosen from several options) the project with the highest, positive NPV should be chosen as it would add the most value to the firm.

Internal Rate of Return (IRR)

The internal rate of return (IRR) of a project is the discount rate that equates the project's NPV to zero. Effectively, it is the discount rate that equates the present value of all inflows from a project to the present value of all project-related outflows. Calculating IRR only requires forecasts of cash flows in the future; there is no need for externally generated market data to determine appropriate discount rates. An important thing to remember regarding IRR is that it assumes that all cash flows from the project will be reinvested at the IRR.

- Projects for which the IRR *exceeds* the required rate of return should be accepted.
- Projects for which the IRR is *lower* than the required rate of return should be rejected.

NPV versus IRR

In deciding whether a single project should be undertaken, IRR and NPV will offer the same recommendation.

- If IRR is *greater* than the required rate of return, NPV is *positive*.
- If IRR is *less* than the required rate of return, NPV is *negative*.

When only one of two or more projects can be accepted, the projects are said to be mutually exclusive. For mutually exclusive projects, NPV and IRR may offer conflicting conclusions. This can happen in two scenarios:

- When the projects' initial cash outlays are different.
- When there is a difference in timing of the cash flows across the projects.

NPV assumes that interim cash flows from the project will be reinvested at the required rate of return, whereas IRR assumes that they will be reinvested at the IRR. When

choosing between mutually exclusive projects, use the NPV rule if the recommendations of the NPV and IRR rules conflict.

Measures of Portfolio Return

- The **holding period yield (HPY)**, also known as holding period return, is simply the return earned on an investment over the entire investment horizon.
- The **money-weighted rate of return** is simply the internal rate of return of an investment.
- The **time-weighted rate of return** measures the compounded rate of growth of an investment over the stated measurement period.
 - It is not affected by cash withdrawals or contributions to the portfolio.
 - It is basically the geometric mean of subperiod returns.
 - The time-weighted rate of return is preferred because it is not affected by the timing and amount of cash inflows and outflows.
 - Decisions regarding contributions and withdrawals from a portfolio are usually made by clients. Since these decisions are not typically in investment managers' hands, it would be inappropriate to evaluate their performance based on money-weighted returns. If a manager does have discretion over withdrawals and contributions of funds in a portfolio, money-weighted return might be a more appropriate measure of portfolio performance.

Money-Weighted versus Time-Weighted Rates of Return

- If funds are deposited to the investment portfolio prior to a period of superior performance, the money-weighted return will be *higher* than the time-weighted return.
- If funds are deposited into the investment portfolio just before a period of relatively poor performance, the money-weighted return will be *lower* than the time-weighted return.

Market Yields

The **bank discount yield** is a quoting convention used primarily for quoting Treasury bills. It annualizes the discount on the instrument as a percentage of *par or face value* over a *360-day* period.

$$r_{BD} = \frac{D}{F} \times \frac{360}{t}$$

Yields presented on a bank discount basis do not hold much meaning to investors for the following reasons:

- Investors want to evaluate returns on the amount invested to purchase the instrument; BDY calculates returns based on par value.
- Returns are based on a 360-day year; not a 365-day year.
- BDY assumes simple interest. In doing so, it ignores interest earned on interest (compound interest).

The **holding period yield** equals the return realized on an investment over the entire horizon that it is held (which can either be till maturity or sale). It is an *unannualized* return measure.

$$\text{HPY} = \frac{P_1 - P_0 + D_1}{P_0} = \frac{P_1 + D_1 - P_0}{P_0}$$

The **effective annual yield** is an *annualized* return measure that accounts for *compounding* over a 365-day period.

$$\text{EAY} = (1 + \text{HPY})^{365/t} - 1$$

We can also convert an EAY to HPY using the following formula:

$$\text{HPY} = (1 + \text{EAY})^{t/365} - 1$$

The **money-market yield** is the holding period yield annualized on a 360-day year. Further, it does *not* consider the effects of compounding. It is different from the bank discount yield as it is based on the *purchase price*, not par value.

$$R_{\text{MM}} = \frac{360 \times r_{\text{BD}}}{360 - (t \times r_{\text{BD}})}$$

And, more conveniently:

$$R_{\text{MM}} = \text{HPY} \times (360/t)$$

A relatively simple way to get through problems on market yields is to first calculate the HPY and then convert it into the required return measure.

- The HPY is the actual unannualized return an investor realizes over the investment period.
- The EAY is the HPY annualized on a 365-day year *with* compounding.
- The money-market yield is the HPY annualized on a 360-day year *without* compounding.

The **bond equivalent yield (BEY)** is simply the semiannual discount rate multiplied by two. This convention comes from the U.S. where bonds are quoted at twice the semiannual rate because coupon payments are made semiannually.

STATISTICAL CONCEPTS AND MARKET RETURNS

Cross-Reference to CFA Institute Assigned Reading #7

A **population** includes *all* the members of a particular group. It is usually very costly and time consuming to obtain measurements for each member of the population. Therefore, information about a small subset of the population, called a **sample**, is collected and conclusions about the population are drawn from the information obtained from the sample.

Types of Scales

- **Nominal scales** categorize or count data but do not rank them.
- **Ordinal scales** sort data into categories that are ranked according to certain characteristics. However, they tell us nothing about the magnitude of the difference between categories.
- **Interval scales** rank observations such that the difference between scale values is equal so that values can be added and subtracted meaningfully.
- **Ratio scales** have all the characteristics of interval scales and have a true zero point as the origin. Therefore, meaningful ratios can also be computed with ratio scales.

Methods of Presenting Data

- A **frequency distribution** is a tabular illustration of data categorized into a relatively small number of intervals or classes.
- The **relative frequency** for an interval is the proportion or fraction of total observations that are represented by a particular interval.
- The **cumulative absolute frequency** or **cumulative frequency** for an interval is the number of observations that are less than the upper bound of the interval. Alternatively, it is the sum of the frequencies of all intervals less than and including the said interval.
- The **cumulative relative frequency** for an interval is the proportion of total observations that are less than the upper bound of the interval.
- A **histogram** is used graphically to represent the data contained in a frequency distribution.
- A **frequency polygon** also graphically illustrates the information in a frequency distribution. The coordinates or points of a frequency polygon are the frequency of each interval plotted against the midpoint of the interval.

Measures of Central Tendency

The **arithmetic mean** is the sum of all the observations in a data set divided by the total number of observations. The arithmetic mean of a sample is the best estimate of the value of the next observation.

- All observations are used in the computation of the arithmetic mean.
- All interval and ratio data sets have an arithmetic mean.
- The sum of the deviations from the arithmetic mean always equals zero.
- An arithmetic mean is unique- a data set only has one arithmetic mean.

The **median** is the value of the middle item of a data set once it has been sorted into an ascending or descending order. The advantage of using the median is that, unlike the mean, it is not sensitive to extreme values. However, the median does not use all the information about the size and magnitude of the observations and only focuses on their relative positions.

The **mode** of a data set is simply its most frequently-occurring value. A data set that has one mode is said to be unimodal, while one that has two modes is said to be bimodal. It is also possible for a data set to have no mode, where all values are different and no value occurs more frequently than others. For grouped data, the **modal interval** is the interval with the highest frequency. The mode is the only measure of central tendency that can be used with nominal data.

The **weighted mean** is calculated by assigning different weights to observations in the data set to account for the disproportionate effect of certain observations on the arithmetic mean. The arithmetic mean assigns equal weights to every observation in the data set, which makes it very sensitive to extreme values.

The **geometric mean** is used to average rates of change over time or to calculate the growth rate of a variable over a period. In order to calculate the geometric mean for returns data, we must add 1 to each return observation (expressed as a decimal) and then subtract 1 from the result.

$$R_G = \left[\sqrt[n]{(1 + R_1) \times (1 + R_2) \times \dots \times (1 + R_n)} \right] - 1$$

Important Relationships Between the Arithmetic Mean and Geometric Mean

- The geometric mean is always less than, or equal to the arithmetic mean.
- The geometric mean equals the arithmetic mean only when all the observations are identical.
- The difference between the geometric and arithmetic mean increases as the dispersion in observed values increases.

The **harmonic mean** is used in the investment management arena to determine the average cost of shares purchased over time. It may be viewed as a special type of weighted mean where the weight of an observation is inversely proportional to its magnitude.

$$\text{Harmonic mean: } \bar{X}_H = \frac{N}{\sum_{i=1}^N \frac{1}{X_i}}$$

Mathematically, unless all the observations in the data set are identical (equal in value), the harmonic mean will always be less than the geometric mean, which itself will be less than the arithmetic mean.

Quantiles

A quantile is a value at, or below which a stated proportion of the observations in a data set lie. Examples of quantiles include:

- quartiles, which divide the distribution in quarters or four equal parts.
- quintiles, which divide the distribution into fifths.
- deciles, which divide the data into tenths.
- percentiles, which divide the distribution into hundredths.

Measures of Dispersion

Dispersion is the variability or spread of a random variable around its central tendency.

The **range** is one of the most basic measures of variability of data. It is simply the difference between the highest and lowest values in a data set.

$$\text{Range} = \text{Maximum value} - \text{Minimum value}$$

The **mean absolute deviation (MAD)** is the average of the *absolute* values of deviations of observations in a data set from their mean.

$$\text{MAD} = \frac{\sum_{i=1}^n |X_i - \bar{X}|}{n}$$

The **variance** is the average of the squared deviations around the mean. The **standard deviation** is the positive square root of the variance. While the variance has no units, the standard deviation has the same units as the random variable.

Population Variance and Standard Deviation

$$\sigma^2 = \frac{\sum_{i=1}^n (X_i - \mu)^2}{n}$$

$$\sigma = \sqrt{\frac{\sum_{i=1}^n (X_i - \mu)^2}{n}}$$