Investment Analysis & Portfolio Management

10TH EDITION

Reilly & Brown

Investment Analysis & Portfolio Management

TENTH EDITION

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Investment Analysis & Portfolio Management, Tenth Edition

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PART 1
The Investment Background

The chapters in this section will provide a background for your study of investments by answering the following questions:

- Why do people invest?
- How do you measure the returns and risks for alternative investments?
- What factors should you consider when you make asset allocation decisions?
- What investments are available?
- How do securities markets function?
- How and why are securities markets in the United States and around the world changing?
- What are the major uses of security-market indexes?
- How can you evaluate the market behavior of common stocks and bonds?
- What factors cause differences among stock- and bond-market indexes?

In the first chapter, we consider why an individual would invest, how to measure the rates of return and risk for alternative investments, and what factors determine an investor's required rate of return on an investment. The latter point will be important in subsequent analyses when we work to understand investor behavior, the markets for alternative securities, and the valuation of various investments.

Because the ultimate decision facing an investor is the makeup of his or her portfolio, Chapter 2 deals with the all-important asset allocation decision. This includes specific steps in the portfolio management process and factors that influence the makeup of an investor's portfolio over his or her life cycle.

To minimize risk, investment theory asserts the need to diversify. Chapter 3 begins our exploration of investments available to investors by making an overpowering case for investing globally rather than limiting choices to only U.S. securities. Building on this premise, we discuss several investment instruments found in global markets. We conclude the chapter with a review of the historical rates of return and measures of risk for a number of alternative asset groups.

In Chapter 4, we examine how markets work in general, and then specifically focus on the purpose and function of primary and secondary bond and stock markets. During the last 15 years, significant changes have occurred in the operation of the securities market, including a trend toward a global capital market, electronic trading markets, and substantial worldwide consolidation. After discussing these changes and the rapid development of new capital markets around the world, we speculate about how global markets will continue to consolidate and will increase available investment alternatives.

Investors, market analysts, and financial theorists generally gauge the behavior of securities markets by evaluating the return and risk implied by various market indexes and evaluate portfolio performance by comparing a portfolio's results to an appropriate benchmark. Because these indexes are used to make asset allocation decisions and then to evaluate portfolio performance, it is important to have a deep understanding of how they are constructed and the numerous alternatives available. Therefore, in Chapter 5, we examine and compare a number of stock-market and bond-market indexes available for the domestic and global markets.

This initial section provides the framework for you to understand various securities, how to allocate among alternative asset classes, the markets where these securities are bought and sold, the indexes that reflect their performance, and how you might manage a collection of investments in a portfolio. Specific portfolio management techniques are described in later chapters.

CHAPTER 1
The Investment Setting

After you read this chapter, you should be able to answer the following questions:

- Why do individuals invest?
- What is an investment?
- How do investors measure the rate of return on an investment?
- How do investors measure the risk related to alternative investments?
- What factors contribute to the rates of return that investors require on alternative investments?
- What macroeconomic and microeconomic factors contribute to changes in the required rates of return for investments?

This initial chapter discusses several topics basic to the subsequent chapters. We begin by defining the term *investment* and discussing the returns and risks related to investments. This leads to a presentation of how to measure the expected and historical rates of returns for an individual asset or a portfolio of assets. In addition, we consider how to measure risk not only for an individual investment but also for an investment that is part of a portfolio.

The third section of the chapter discusses the factors that determine the required rate of return for an individual investment. The factors discussed are those that contribute to an asset's *total* risk. Because most investors have a portfolio of investments, it is necessary to consider how to measure the risk of an asset when it is a part of a large portfolio of assets. The risk that prevails when an asset is part of a diversified portfolio is referred to as its *systematic risk.*

The final section deals with what causes *changes* in an asset's required rate of return over time. Notably, changes occur because of both macroeconomic events that affect all investment assets and microeconomic events that affect the specific asset.

1.1 What Is an Investment?

For most of your life, you will be earning and spending money. Rarely, though, will your current money income exactly balance with your consumption desires. Sometimes, you may have more money than you want to spend; at other times, you may want to purchase more than you can afford based on your current income. These imbalances will lead you either to borrow or to save to maximize the long-run benefits from your income.

When current income exceeds current consumption desires, people tend to save the excess. They can do any of several things with these savings. One possibility is to put the money under a mattress or bury it in the backyard until some future time when consumption desires exceed current income. When they retrieve their savings from the mattress or backyard, they have the same amount they saved.

Another possibility is that they can give up the immediate possession of these savings for a future larger amount of money that will be available for future consumption. This trade-off of *present* consumption for a higher level of *future* consumption is the reason for saving. What you do with the savings to make them increase over time is *investment*.[1]

Those who give up immediate possession of savings (that is, defer consumption) expect to receive in the future a greater amount than they gave up. Conversely, those who consume more than their current income (that is, borrow) must be willing to pay back in the future more than they borrowed.

The rate of exchange between *future consumption* (future dollars) and *current consumption* (current dollars) is the *pure rate of interest*. Both people's willingness to pay this difference for borrowed funds and their desire to receive a surplus on their savings (i.e., some rate of return) give rise to an interest rate referred to as the *pure time value of money*. This interest rate is established in the capital market by a comparison of the supply of excess income available (savings) to be invested and the demand for excess consumption (borrowing) at a given time. If you can exchange $100 of certain income today for $104 of certain income one year from today, then the pure rate of exchange on a risk-free investment (that is, the time value of money) is said to be 4 percent (104/100 − 1).

The investor who gives up $100 today expects to consume $104 of goods and services in the future. This assumes that the general price level in the economy stays the same. This price stability has rarely been the case during the past several decades when inflation rates have varied from 1.1 percent in 1986 to as much as 13.3 percent in 1979, with a geometric average of 4.4 percent a year from 1970 to 2010. If investors expect a change in prices, they will require a higher rate of return to compensate for it. For example, if an investor expects a rise in prices (that is, he or she expects inflation) at the annual rate of 2 percent during the period of investment, he or she will increase the required interest rate by 2 percent. In our example, the investor would require $106 in the future to defer the $100 of consumption during an inflationary period (a 6 percent *nominal*, risk-free interest rate will be required instead of 4 percent).

Further, if the future payment from the investment is not certain, the investor will demand an interest rate that exceeds the nominal risk-free interest rate. The uncertainty of the payments from an investment is the *investment risk*. The additional return added to the nominal, risk-free interest rate is called a *risk premium*. In our previous example, the investor would require more than $106 one year from today to compensate for the uncertainty. As an example, if the required amount were $110, $4 (4 percent) would be considered a risk premium.

1.1.1 Investment Defined

From our discussion, we can specify a formal definition of an investment. Specifically, an **investment** is the current commitment of dollars for a period of time in order to derive future payments that will compensate the investor for (1) the time the funds are committed, (2) the expected rate of inflation during this time period, and (3) the uncertainty of the future payments. The "investor" can be an individual, a government, a pension fund, or a corporation. Similarly, this definition includes all types of investments, including investments by corporations in plant and equipment and investments by individuals in stocks, bonds, commodities, or real estate. This text emphasizes investments by individual investors. In all cases, the investor is trading a *known* dollar amount today for some *expected* future stream of payments that will be greater than the current dollar amount today.

At this point, we have answered the questions about why people invest and what they want from their investments. They invest to earn a return from savings due to their deferred consumption. They want a rate of return that compensates them for the time period of the investment, the expected rate of inflation, and the uncertainty of the future cash flows. This return, the investor's **required rate of return**, is discussed throughout this book. A central question of this book is how investors select investments that will give them their required rates of return.

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[1] In contrast, when current income is less than current consumption desires, people borrow to make up the difference. Although we will discuss borrowing on several occasions, the major emphasis of this text is how to invest savings.

The next section of this chapter describes how to measure the expected or historical rate of return on an investment and also how to quantify the uncertainty (risk) of expected returns. You need to understand these techniques for measuring the rate of return and the uncertainty of these returns to evaluate the suitability of a particular investment. Although our emphasis will be on financial assets, such as bonds and stocks, we will refer to other assets, such as art and antiques. Chapter 3 discusses the range of financial assets and also considers some nonfinancial assets.

1.2 Measures of Return and Risk

The purpose of this book is to help you understand how to choose among alternative investment assets. This selection process requires that you estimate and evaluate the expected risk-return trade-offs for the alternative investments available. Therefore, you must understand how to measure the rate of return and the risk involved in an investment accurately. To meet this need, in this section we examine ways to quantify return and risk. The presentation will consider how to measure both *historical* and *expected* rates of return and risk.

We consider historical measures of return and risk because this book and other publications provide numerous examples of historical average rates of return and risk measures for various assets, and understanding these presentations is important. In addition, these historical results are often used by investors when attempting to estimate the *expected* rates of return and risk for an asset class.

The first measure is the historical rate of return on an individual investment over the time period the investment is held (that is, its holding period). Next, we consider how to measure the *average* historical rate of return for an individual investment over a number of time periods. The third subsection considers the average rate of return for a *portfolio* of investments.

Given the measures of historical rates of return, we will present the traditional measures of risk for a historical time series of returns (that is, the variance and standard deviation).

Following the presentation of measures of historical rates of return and risk, we turn to estimating the *expected* rate of return for an investment. Obviously, such an estimate contains a great deal of uncertainty, and we present measures of this uncertainty or risk.

1.2.1 Measures of Historical Rates of Return

When you are evaluating alternative investments for inclusion in your portfolio, you will often be comparing investments with widely different prices or lives. As an example, you might want to compare a $10 stock that pays no dividends to a stock selling for $150 that pays dividends of $5 a year. To properly evaluate these two investments, you must accurately compare their historical rates of returns. A proper measurement of the rates of return is the purpose of this section.

When we invest, we defer current consumption in order to add to our wealth so that we can consume more in the future. Therefore, when we talk about a return on an investment, we are concerned with the *change in wealth* resulting from this investment. This change in wealth can be either due to cash inflows, such as interest or dividends, or caused by a change in the price of the asset (positive or negative).

If you commit $200 to an investment at the beginning of the year and you get back $220 at the end of the year, what is your return for the period? The period during which you own an investment is called its *holding period*, and the return for that period is the **holding period return (*HPR*)**. In this example, the *HPR* is 1.10, calculated as follows:

1.1
$$HPR = \frac{\text{Ending Value of Investment}}{\text{Beginning Value of Investment}} = \frac{\$220}{\$200} = 1.10$$

This *HPR* value will always be zero or greater—that is, it can never be a negative value. A value greater than 1.0 reflects an increase in your wealth, which means that you received a positive rate of return during the period. A value less than 1.0 means that you suffered a decline in wealth, which indicates that you had a negative return during the period. An *HPR* of zero indicates that you lost all your money (wealth) invested in this asset.

Although *HPR* helps us express the change in value of an investment, investors generally evaluate returns in *percentage terms on an annual basis*. This conversion to annual percentage rates makes it easier to directly compare alternative investments that have markedly different characteristics. The first step in converting an *HPR* to an annual percentage rate is to derive a percentage return, referred to as the **holding period yield (*HPY*)**. The *HPY* is equal to the *HPR* minus 1.

1.2
$$HPY = HPR - 1$$

In our example:

$$\begin{aligned} HPY = 1.10 - 1 &= 0.10 \\ &= 10\% \end{aligned}$$

To derive an *annual HPY*, you compute an *annual HPR* and subtract 1. Annual *HPR* is found by:

1.3
$$\text{Annual } HPR = HPR^{1/n}$$

where:

n = number of years the investment is held

Consider an investment that cost \$250 and is worth \$350 after being held for two years:

$$\begin{aligned} HPR &= \frac{\text{Ending Value of Investment}}{\text{Beginning Value of Investment}} = \frac{\$350}{\$250} \\ &= 1.40 \\ \text{Annual } HPR &= 1.40^{1/n} \\ &= 1.40^{1/2} \\ &= 1.1832 \\ \text{Annual } HPY &= 1.1832 - 1 = 0.1832 \\ &= 18.32\% \end{aligned}$$

If you experience a decline in your wealth value, the computation is as follows:

$$\begin{aligned} HPR &= \frac{\text{Ending Value}}{\text{Beginning Value}} = \frac{\$400}{\$500} = 0.80 \\ HPY &= 0.80 - 1.00 = -0.20 = -20\% \end{aligned}$$

A multiple-year loss over two years would be computed as follows:

$$\begin{aligned} HPR &= \frac{\text{Ending Value}}{\text{Beginning Value}} = \frac{\$750}{\$1{,}000} = 0.75 \\ \text{Annual } HPR &= (0.75)^{1/n} = 0.75^{1/2} \\ &= 0.866 \\ \text{Annual } HPY &= 0.866 - 1.00 = -0.134 = -13.4\% \end{aligned}$$

In contrast, consider an investment of $100 held for only six months that earned a return of $12:

$$HPR = \frac{\$112}{100} = 1.12 \quad (n = 0.5)$$

$$\begin{aligned} \text{Annual } HPR &= 1.12^{1/.5} \\ &= 1.12^2 \\ &= 1.2544 \\ \text{Annual } HPY &= 1.2544 - 1 = 0.2544 \\ &= 25.44\% \end{aligned}$$

Note that we made some implicit assumptions when converting the six-month *HPY* to an annual basis. This annualized holding period yield computation assumes a constant annual yield for each year. In the two-year investment, we assumed an 18.32 percent rate of return each year, compounded. In the partial year *HPR* that was annualized, we assumed that the return is compounded for the whole year. That is, we assumed that the rate of return earned during the first half of the year is likewise earned on the value at the end of the first six months. The 12 percent rate of return for the initial six months compounds to 25.44 percent for the full year.[2] Because of the uncertainty of being able to earn the same return in the future six months, institutions will typically *not* compound partial year results.

Remember one final point: The ending value of the investment can be the result of a positive or negative change in price for the investment alone (for example, a stock going from $20 a share to $22 a share), income from the investment alone, or a combination of price change and income. Ending value includes the value of everything related to the investment.

1.2.2 Computing Mean Historical Returns

Now that we have calculated the *HPY* for a single investment for a single year, we want to consider **mean rates of return** for a single investment and for a portfolio of investments. Over a number of years, a single investment will likely give high rates of return during some years and low rates of return, or possibly negative rates of return, during others. Your analysis should consider each of these returns, but you also want a summary figure that indicates this investment's typical experience, or the rate of return you might expect to receive if you owned this investment over an extended period of time. You can derive such a summary figure by computing the mean annual rate of return (its *HPY*) for this investment over some period of time.

Alternatively, you might want to evaluate a portfolio of investments that might include similar investments (for example, all stocks or all bonds) or a combination of investments (for example, stocks, bonds, and real estate). In this instance, you would calculate the mean rate of return for this portfolio of investments for an individual year or for a number of years.

Single Investment Given a set of annual rates of return (*HPY*s) for an individual investment, there are two summary measures of return performance. The first is the arithmetic mean return, the second is the geometric mean return. To find the **arithmetic mean (*AM*)**, the sum (Σ) of annual *HPY*s is divided by the number of years (n) as follows:

1.4 $$AM = \Sigma HPY/n$$

where:

ΣHPY = the sum of annual holding period yields

An alternative computation, the **geometric mean (*GM*)**, is the nth root of the product of the *HPR*s for n years minus one.

[2]To check that you understand the calculations, determine the annual *HPY* for a three-year *HPR* of 1.50. (Answer: 14.47 percent.) Compute the annual *HPY* for a three-month *HPR* of 1.06. (Answer: 26.25 percent.)

1.5 $$GM = [\pi HPR]^{1/n} - 1$$

where:

π = the product of the annual holding period returns as follows:

$$(HPR_1) \times (HPR_2) \ldots (HPR_n)$$

To illustrate these alternatives, consider an investment with the following data:

Year	Beginning Value	Ending Value	*HPR*	*HPY*
1	100.0	115.0	1.15	0.15
2	115.0	138.0	1.20	0.20
3	138.0	110.4	0.80	–0.20

$$\begin{aligned} AM &= [(0.15) + (0.20) + (-0.20)]/3 \\ &= 0.15/3 \\ &= 0.05 = 5\% \end{aligned}$$

$$\begin{aligned} GM &= [(1.15) \times (1.20) \times (0.80)]^{1/3} - 1 \\ &= (1.104)^{1/3} - 1 \\ &= 1.03353 - 1 \\ &= 0.03353 = 3.353\% \end{aligned}$$

Investors are typically concerned with long-term performance when comparing alternative investments. *GM* is considered a superior measure of the long-term mean rate of return because it indicates *the compound annual rate of return* based on the ending value of the investment versus its beginning value.[3] Specifically, using the prior example, if we compounded 3.353 percent for three years, $(1.03353)^3$, we would get an ending wealth value of 1.104.

Although the arithmetic average provides a good indication of the expected rate of return for an investment during a future individual year, it is biased upward if you are attempting to measure an asset's long-term performance. This is obvious for a volatile security. Consider, for example, a security that increases in price from $50 to $100 during year 1 and drops back to $50 during year 2. The annual *HPY*s would be:

Year	Beginning Value	Ending Value	*HPR*	*HPY*
1	50	100	2.00	1.00
2	100	50	0.50	–0.50

This would give an *AM* rate of return of:

$$\begin{aligned} [(1.00) + (-0.50)]/2 &= .50/2 \\ &= 0.25 = 25\% \end{aligned}$$

This investment brought no change in wealth and therefore no return, yet the *AM* rate of return is computed to be 25 percent.

The *GM* rate of return would be:

$$\begin{aligned} (2.00 \times 0.50)^{1/2} - 1 &= (1.00)^{1/2} - 1 \\ &= 1.00 - 1 = 0\% \end{aligned}$$

This answer of a 0 percent rate of return accurately measures the fact that there was no change in wealth from this investment over the two-year period.

[3]Note that the *GM* is the same whether you compute the geometric mean of the individual annual holding period yields or the annual *HPY* for a three-year period, comparing the ending value to the beginning value, as discussed earlier under annual *HPY* for a multiperiod case.

When rates of return are the same for all years, the *GM* will be equal to the *AM*. If the rates of return vary over the years, the *GM* will always be lower than the *AM*. The difference between the two mean values will depend on the year-to-year changes in the rates of return. Larger annual changes in the rates of return—that is, more volatility—will result in a greater difference between the alternative mean values. We will point out examples of this in subsequent chapters.

An awareness of both methods of computing mean rates of return is important because most published accounts of long-run investment performance or descriptions of financial research will use both the *AM* and the *GM* as measures of average historical returns. We will also use both throughout this book with the understanding that the *AM* is best used as an expected value for an individual year, while the *GM* is the best measure of long-term performance since it measures the compound annual rate of return for the asset being measured.

A Portfolio of Investments The mean historical rate of return (*HPY*) for a portfolio of investments is measured as the weighted average of the *HPY*s for the individual investments in the portfolio, or the overall percent change in value of the original portfolio. The weights used in computing the averages are the relative *beginning* market values for each investment; this is referred to as *dollar-weighted* or *value-weighted* mean rate of return. This technique is demonstrated by the examples in Exhibit 1.1. As shown, the *HPY* is the same (9.5 percent) whether you compute the weighted average return using the beginning market value weights or if you compute the overall percent change in the total value of the portfolio.

Although the analysis of historical performance is useful, selecting investments for your portfolio requires you to predict the rates of return you *expect* to prevail. The next section discusses how you would derive such estimates of expected rates of return. We recognize the great uncertainty regarding these future expectations, and we will discuss how one measures this uncertainty, which is referred to as the risk of an investment.

1.2.3 Calculating Expected Rates of Return

Risk is the uncertainty that an investment will earn its expected rate of return. In the examples in the prior section, we examined *realized* historical rates of return. In contrast, an investor who is evaluating a future investment alternative expects or anticipates a certain rate of return. The investor might say that he or she *expects* the investment will provide a rate of return of 10 percent, but this is actually the investor's most likely estimate, also referred to as a *point estimate*. Pressed further, the investor would probably acknowledge the uncertainty of this point estimate return and admit the possibility that, under certain conditions, the annual rate of return on this investment might go as low as −10 percent or as high as 25 percent. The point is, the specification of a larger range of *possible* returns from an investment reflects the investor's

Exhibit 1.1 Computation of Holding Period Yield for a Portfolio

Investment	Number of Shares	Beginning Price	Beginning Market Value	Ending Price	Ending Market Value	*HPR*	*HPY*	Market Weight[a]	Weighted *HPY*
A	100,000	$10	$1,000,000	$12	$1,200,000	1.20	20%	0.05	0.01
B	200,000	20	4,000,000	21	4,200,000	1.05	5	0.20	0.01
C	500,000	30	15,000,000	33	16,500,000	1.10	10	0.75	0.075
Total			$20,000,000		$21,900,000				0.095

$$HPR = \frac{21{,}900{,}000}{20{,}000{,}000} = 1.095$$

$$HPY = 1.095 - 1 = 0.095$$

$$= 9.5\%$$

[a]**Weights** are based on beginning values.

uncertainty regarding what the *actual* return will be. Therefore, a larger range of possible returns implies that the investment is riskier.

An investor determines how certain the expected rate of return on an investment is by analyzing estimates of possible returns. To do this, the investor assigns probability values to all *possible* returns. These probability values range from zero, which means no chance of the return, to one, which indicates complete certainty that the investment will provide the specified rate of return. These probabilities are typically subjective estimates based on the historical performance of the investment or similar investments modified by the investor's expectations for the future. As an example, an investor may know that about 30 percent of the time the rate of return on this particular investment was 10 percent. Using this information along with future expectations regarding the economy, one can derive an estimate of what might happen in the future.

The *expected* return from an investment is defined as:

1.6
$$\text{Expected Return} = \sum_{i=1}^{n} (\text{Probability of Return}) \times (\text{Possible Return})$$

$$E(R_i) = [(P_1)(R_1) + (P_2)(R_2) + (P_3)(R_3) + \cdots + (P_n R_n)]$$

$$E(R_i) = \sum_{i=1}^{n} (P_i)(R_i)$$

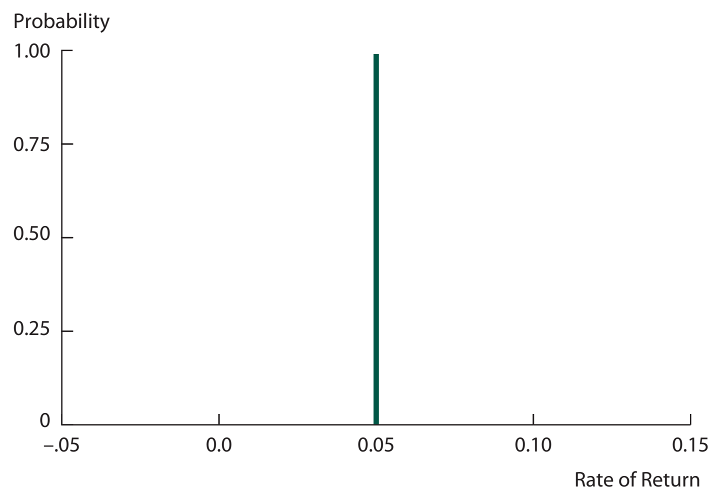
Let us begin our analysis of the effect of risk with an example of perfect certainty wherein the investor is absolutely certain of a return of 5 percent. Exhibit 1.2 illustrates this situation.

Perfect certainty allows only one possible return, and the probability of receiving that return is 1.0. Few investments provide certain returns and would be considered risk-free investments. In the case of perfect certainty, there is only one value for $P_i R_i$:

$$E(R_i) = (1.0)(0.05) = 0.05 = 5\%$$

In an alternative scenario, suppose an investor believed an investment could provide several different rates of return depending on different possible economic conditions. As an example, in a strong economic environment with high corporate profits and little or no inflation, the investor might expect the rate of return on common stocks during the next year to reach as high

Exhibit 1.2 Probability Distribution for Risk-Free Investment



as 20 percent. In contrast, if there is an economic decline with a higher-than-average rate of inflation, the investor might expect the rate of return on common stocks during the next year to be –20 percent. Finally, with no major change in the economic environment, the rate of return during the next year would probably approach the long-run average of 10 percent.

The investor might estimate probabilities for each of these economic scenarios based on past experience and the current outlook as follows:

Economic Conditions	Probability	Rate of Return
Strong economy, no inflation	0.15	0.20
Weak economy, above-average inflation	0.15	–0.20
No major change in economy	0.70	0.10

This set of potential outcomes can be visualized as shown in Exhibit 1.3.

The computation of the expected rate of return [$E(R_i)$] is as follows:

$$\begin{aligned} E(R_i) &= [(0.15)(0.20)] + [(0.15)(-0.20)] + [(0.70)(0.10)] \\ &= 0.07 \end{aligned}$$

Obviously, the investor is less certain about the expected return from this investment than about the return from the prior investment with its single possible return.

A third example is an investment with 10 possible outcomes ranging from –40 percent to 50 percent with the same probability for each rate of return. A graph of this set of expectations would appear as shown in Exhibit 1.4.

In this case, there are numerous outcomes from a wide range of possibilities. The expected rate of return [$E(R_i)$] for this investment would be:

$$\begin{aligned} E(R_i) &= (0.10)(-0.40) + (0.10)(-0.30) + (0.10)(-0.20) + (0.10)(-0.10) + (0.10)(0.0) \\ &\quad + (0.10)(0.10) + (0.10)(0.20) + (0.10)(0.30) + (0.10)(0.40) + (0.10)(0.50) \\ &= (-0.04) + (-0.03) + (-0.02) + (-0.01) + (0.00) + (0.01) + (0.02) + (0.03) \\ &\quad + (0.04) + (0.05) \\ &= 0.05 \end{aligned}$$

The *expected* rate of return for this investment is the same as the certain return discussed in the first example; but, in this case, the investor is highly uncertain about the *actual* rate of

Exhibit 1.3 Probability Distribution for Risky Investment with Three Possible Rates of Return

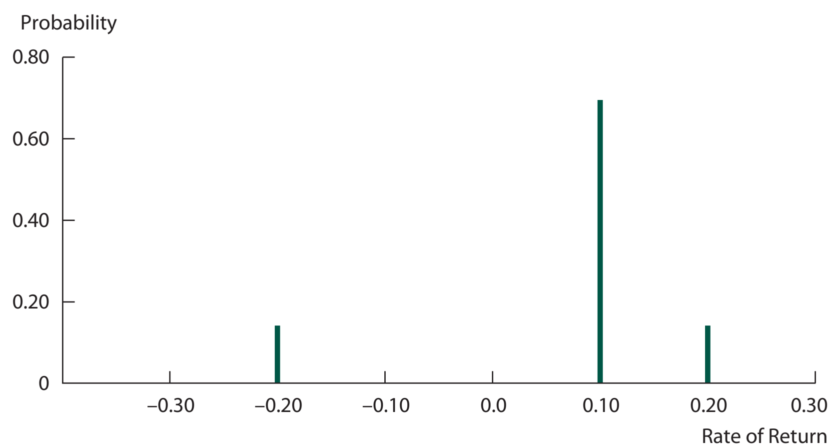
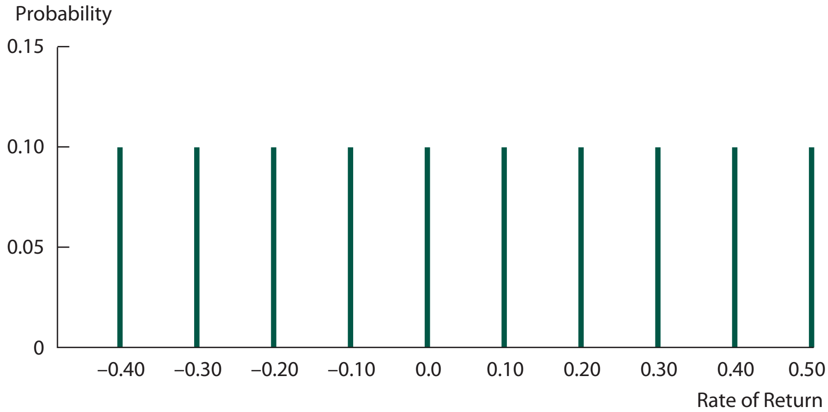


Exhibit 1.4 Probability Distribution for Risky Investment with 10 Possible Rates of Return



return. This would be considered a risky investment because of that uncertainty. We would anticipate that an investor faced with the choice between this risky investment and the certain (risk-free) case would select the certain alternative. This expectation is based on the belief that most investors are **risk averse**, which means that if everything else is the same, they will select the investment that offers greater certainty (i.e., less risk).

1.2.4 Measuring the Risk of Expected Rates of Return

We have shown that we can calculate the expected rate of return and evaluate the uncertainty, or risk, of an investment by identifying the range of possible returns from that investment and assigning each possible return a weight based on the probability that it will occur. Although the graphs help us visualize the dispersion of possible returns, most investors want to quantify this dispersion using statistical techniques. These statistical measures allow you to compare the return and risk measures for alternative investments directly. Two possible measures of risk (uncertainty) have received support in theoretical work on portfolio theory: the *variance* and the *standard deviation* of the estimated distribution of expected returns.

In this section, we demonstrate how variance and standard deviation measure the dispersion of possible rates of return around the expected rate of return. We will work with the examples discussed earlier. The formula for variance is as follows:

1.7

$$\text{Variance } (\sigma^2) = \sum_{i=1}^{n} (\text{Probability}) \times \begin{pmatrix} \text{Possible} & - & \text{Expected} \\ \text{Return} & & \text{Return} \end{pmatrix}^2$$

$$= \sum_{i=1}^{n} (P_i)[R_i - E(R_i)]^2$$

Variance The larger the **variance** for an expected rate of return, the greater the dispersion of expected returns and the greater the uncertainty, or risk, of the investment. The variance for the perfect-certainty (risk-free) example would be:

$$(\sigma^2) = \sum_{i=1}^{n} P_i[R_i - E(R_i)]^2$$

$$= 1.0(0.05 - 0.05)^2 = 1.0(0.0) = 0$$

Note that, in perfect certainty, there is *no variance of return* because there is no deviation from expectations and, therefore, *no risk* or *uncertainty*. The variance for the second example would be:

$$\begin{aligned}(\sigma^2) &= \sum_{i=1}^{n} P_i[R_i - E(R_i)]^2 \\ &= [(0.15)(0.20 - 0.07)^2 + (0.15)(-0.20 - 0.07)^2 + (0.70)(0.10 - 0.07)^2] \\ &= [0.010935 + 0.002535 + 0.00063] \\ &= 0.0141\end{aligned}$$

Standard Deviation The **standard deviation** is the square root of the variance:

1.8 $$\text{Standard Deviation} = \sqrt{\sum_{i=1}^{n} P_i[R_i - E(R_i)]^2}$$

For the second example, the standard deviation would be:

$$\begin{aligned}\sigma &= \sqrt{0.0141} \\ &= 0.11874 = 11.874\%\end{aligned}$$

Therefore, when describing this investment example, you would contend that you expect a return of 7 percent, but the standard deviation of your expectations is 11.87 percent.

A Relative Measure of Risk In some cases, an unadjusted variance or standard deviation can be misleading. If conditions for two or more investment alternatives are not similar—that is, if there are major differences in the expected rates of return—it is necessary to use a measure of *relative variability* to indicate risk per unit of expected return. A widely used relative measure of risk is the **coefficient of variation (*CV*)**, calculated as follows:

1.9 $$\begin{aligned}\text{Coefficient of Variation } (CV) &= \frac{\text{Standard Deviation of Returns}}{\text{Expected Rate of Return}} \\ &= \frac{\sigma_i}{E(R)}\end{aligned}$$

The *CV* for the preceding example would be:

$$\begin{aligned}CV &= \frac{0.11874}{0.07000} \\ &= 1.696\end{aligned}$$

This measure of relative variability and risk is used by financial analysts to compare alternative investments with widely different rates of return and standard deviations of returns. As an illustration, consider the following two investments:

	Investment A	Investment B
Expected return	0.07	0.12
Standard deviation	0.05	0.07

Comparing absolute measures of risk, investment B appears to be riskier because it has a standard deviation of 7 percent versus 5 percent for investment A. In contrast, the *CV* figures show that investment B has less *relative* variability or lower risk per unit of expected return because it has a substantially higher expected rate of return:

$$CV_{\text{A}} = \frac{0.05}{0.07} = 0.714$$

$$CV_{\text{B}} = \frac{0.07}{0.12} = 0.583$$

1.2.5 Risk Measures for Historical Returns

To measure the risk for a series of historical rates of returns, we use the same measures as for expected returns (variance and standard deviation) except that we consider the historical holding period yields (*HPY*s) as follows:

1.10
$$\sigma^2 = \left[\sum_{i=1}^{n} [HPY_i - E(HPY)]^2\right] \Big/ n$$

where:

σ^2 = the variance of the series

HPY_i = the holding period yield during period i

$E(HPY)$ = the expected value of the holding period yield that is equal to the arithmetic mean (AM) of the series

n = the number of observations

The standard deviation is the square root of the variance. Both measures indicate how much the individual *HPY*s over time deviated from the expected value of the series. An example computation is contained in the appendix to this chapter. As is shown in subsequent chapters where we present historical rates of return for alternative asset classes, presenting the standard deviation as a measure of risk (uncertainty) for the series or asset class is fairly common.

1.3 Determinants of Required Rates of Return

In this section, we continue our discussion of factors that you must consider when selecting securities for an investment portfolio. You will recall that this selection process involves finding securities that provide a rate of return that compensates you for: (1) the time value of money during the period of investment, (2) the expected rate of inflation during the period, and (3) the risk involved.

The summation of these three components is called the *required rate of return*. This is the minimum rate of return that you should accept from an investment to compensate you for deferring consumption. Because of the importance of the required rate of return to the total investment selection process, this section contains a discussion of the three components and what influences each of them.

The analysis and estimation of the required rate of return are complicated by the behavior of market rates over time. First, a wide range of rates is available for alternative investments at any time. Second, the rates of return on specific assets change dramatically over time. Third, the difference between the rates available (that is, the spread) on different assets changes over time.

The yield data in Exhibit 1.5 for alternative bonds demonstrate these three characteristics. First, even though all these securities have promised returns based upon bond contracts, the promised annual yields during any year differ substantially. As an example, during 2009 the average yields on alternative assets ranged from 0.15 percent on T-bills to 7.29 percent for Baa corporate bonds. Second, the changes in yields for a specific asset are shown by the three-month Treasury bill rate that went from 4.48 percent in 2007 to 0.15 percent in 2009. Third, an example of a change in the difference between yields over time (referred to as a spread) is shown by the Baa–Aaa spread.[4] The yield spread in 2007 was 91 basis points (6.47–5.56), but the spread in 2009 increased to 198 basis points (7.29–5.31). (A basis point is 0.01 percent.)

[4]Bonds are rated by rating agencies based upon the credit risk of the securities, that is, the probability of default. Aaa is the top rating Moody's (a prominent rating service) gives to bonds with almost no probability of default. (Only U.S. Treasury bonds are considered to be of higher quality.) Baa is a lower rating Moody's gives to bonds of generally high quality that have some possibility of default under adverse economic conditions.

Exhibit 1.5 Promised Yields on Alternative Bonds

Type of Bond	2004	2005	2006	2007	2008	2009	2010
U.S. government 3-month Treasury bills	1.37%	3.16%	4.73%	4.48%	1.37%	0.15%	0.14%
U.S. government 10-year bonds	2.79	3.93	4.77	4.94	3.66	3.26	3.22
Aaa corporate bonds	5.63	5.24	5.59	5.56	5.63	5.31	4.94
Baa corporate bonds	6.39	6.06	6.48	6.47	7.44	7.29	6.04

Source: *Federal Reserve Bulletin,* various issues.

Because differences in yields result from the riskiness of each investment, you must understand the risk factors that affect the required rates of return and include them in your assessment of investment opportunities. Because the required returns on all investments change over time, and because large differences separate individual investments, you need to be aware of the several components that determine the required rate of return, starting with the risk-free rate. In this chapter we consider the three components of the required rate of return and briefly discuss what affects these components. The presentation in Chapter 11 on valuation theory will discuss the factors that affect these components in greater detail.

1.3.1 The Real Risk-Free Rate

The **real risk-free rate (*RRFR*)** is the basic interest rate, assuming no inflation and no uncertainty about future flows. An investor in an inflation-free economy who knew with certainty what cash flows he or she would receive at what time would demand the *RRFR* on an investment. Earlier, we called this the *pure time value of money*, because the only sacrifice the investor made was deferring the use of the money for a period of time. This *RRFR* of interest is the price charged for the risk-free exchange between current goods and future goods.

Two factors, one subjective and one objective, influence this exchange price. The subjective factor is the time preference of individuals for the consumption of income. When individuals give up $100 of consumption this year, how much consumption do they want a year from now to compensate for that sacrifice? The strength of the human desire for current consumption influences the rate of compensation required. Time preferences vary among individuals, and the market creates a composite rate that includes the preferences of all investors. This composite rate changes gradually over time because it is influenced by all the investors in the economy, whose changes in preferences may offset one another.

The objective factor that influences the *RRFR* is the set of investment opportunities available in the economy. The investment opportunities available are determined in turn by the *long-run real growth rate of the economy*. A rapidly growing economy produces more and better opportunities to invest funds and experience positive rates of return. A change in the economy's long-run real growth rate causes a change in all investment opportunities and a change in the required rates of return on all investments. Just as investors supplying capital should demand a higher rate of return when growth is higher, those looking to borrow funds to invest should be willing and able to pay a higher rate of return to use the funds for investment because of the higher growth rate and better opportunities. Thus, a *positive* relationship exists between the real growth rate in the economy and the *RRFR*.

1.3.2 Factors Influencing the Nominal Risk-Free Rate (*NRFR*)

Earlier, we observed that an investor would be willing to forgo current consumption in order to increase future consumption at a rate of exchange called the *risk-free rate of interest*. This rate of exchange was measured in real terms because we assume that investors want to increase the consumption of actual goods and services rather than consuming the same amount that had come to cost more money. Therefore, when we discuss rates of interest, we need to differentiate between *real* rates of interest that adjust for changes in the general price level, as opposed to *nominal* rates of interest that are stated in money terms. That is, nominal rates of interest that prevail in the market are determined by real rates of interest, *plus* factors that will affect the nominal rate of interest, such as the expected rate of inflation and the monetary environment. It is important to understand these factors.

Notably, the variables that determine the *RRFR* change only gradually because we are concerned with *long-run* real growth. Therefore, you might expect the required rate on a risk-free investment to be quite stable over time. As discussed in connection with Exhibit 1.5, rates on three-month T-bills were *not* stable over the period from 2004 to 2010. This is demonstrated with additional observations in Exhibit 1.6, which contains yields on T-bills for the period 1987–2010.

Investors view T-bills as a prime example of a default-free investment because the government has unlimited ability to derive income from taxes or to create money from which to pay interest. Therefore, one could expect that rates on T-bills should change only gradually. In fact, the data in Exhibit 1.6 show a highly erratic pattern. Specifically, there was an increase in yields from 4.64 percent in 1999 to 5.82 percent in 2000 before declining by over 80 percent in three years to 1.01 percent in 2003, followed by an increase to 4.73 percent in 2006, and concluding at 0.14 percent in 2010. Clearly, the *nominal* rate of interest on a default-free investment is *not* stable in the long run or the short run, even though the underlying determinants of the *RRFR* are quite stable. As noted, two other factors influence the *nominal risk-free rate (NRFR)*: (1) the relative ease or tightness in the capital markets, and (2) the expected rate of inflation.

Conditions in the Capital Market You will recall from prior courses in economics and finance that the purpose of capital markets is to bring together investors who want to invest savings with companies or governments who need capital to expand or to finance budget deficits. The cost of funds at any time (the interest rate) is the price that equates the current supply and demand for capital. Beyond this long-run equilibrium, change in the relative ease or tightness in the capital market is a short-run phenomenon caused by a temporary disequilibrium in the supply and demand of capital.

As an example, disequilibrium could be caused by an unexpected change in monetary policy (for example, a change in the target federal funds rate) or fiscal policy (for example, a change in the federal deficit). Such a change in monetary policy or fiscal policy will produce a change in the *NRFR* of interest, but the change should be short-lived because, in the longer

Exhibit 1.6 Three-Month Treasury Bill Yields and Rates of Inflation

Year	3-Month T-bills	Rate of Inflation	Year	3-Month T-bills	Rate of Inflation
1987	5.78%	4.40%	1999	4.64%	2.70%
1988	6.67	4.40	2000	5.82	3.40
1989	8.11	4.65	2001	3.40	1.55
1990	7.50	6.11	2002	1.61	2.49
1991	5.38	3.06	2003	1.01	1.87
1992	3.43	2.90	2004	1.37	3.26
1993	3.33	2.75	2005	3.16	3.42
1994	4.25	2.67	2006	4.73	2.54
1995	5.49	2.54	2007	4.48	4.08
1996	5.01	3.32	2008	1.37	0.91
1997	5.06	1.70	2009	0.15	2.72
1998	4.78	1.61	2010	0.14	1.49

Source: *Federal Reserve Bulletin*, various issues; *Economic Report of the President*, various issues.

run, the higher or lower interest rates will affect capital supply and demand. As an example, an increase in the federal deficit caused by an increase in government spending (easy fiscal policy) will increase the demand for capital and increase interest rates. In turn, this increase in interest rates should cause an increase in savings and a decrease in the demand for capital by corporations or individuals. These changes in market conditions should bring rates back to the long-run equilibrium, which is based on the long-run growth rate of the economy.

Expected Rate of Inflation Previously, it was noted that if investors expected the price level to increase (an increase in the inflation rate) during the investment period, they would require the rate of return to include compensation for the expected rate of inflation. Assume that you require a 4 percent real rate of return on a risk-free investment but you expect prices to increase by 3 percent during the investment period. In this case, you should increase your required rate of return by this expected rate of inflation to about 7 percent [(1.04 × 1.03) − 1]. If you do not increase your required return, the $104 you receive at the end of the year will represent a real return of about 1 percent, not 4 percent. Because prices have increased by 3 percent during the year, what previously cost $100 now costs $103, so you can consume only about 1 percent more at the end of the year [($104/103) − 1]. If you had required a 7.12 percent nominal return, your real consumption could have increased by 4 percent [($107.12/103) − 1]. Therefore, an investor's nominal required rate of return on a risk-free investment should be:

1.11
$$NRFR = [(1 + RRFR) \times (1 + \text{Expected Rate of Inflation})] - 1$$

Rearranging the formula, you can calculate the *RRFR* of return on an investment as follows:

1.12
$$RRFR = \left[\frac{(1 + NRFR \text{ of Return})}{(1 + \text{Rate of Inflation})}\right] - 1$$

To see how this works, assume that the nominal return on U.S. government T-bills was 9 percent during a given year, when the rate of inflation was 5 percent. In this instance, the *RRFR* of return on these T-bills was 3.8 percent, as follows:

$$\begin{aligned} RRFR &= [(1 + 0.09)/(1 + 0.05)] - 1 \\ &= 1.038 - 1 \\ &= 0.038 = 3.8\% \end{aligned}$$

This discussion makes it clear that the nominal rate of interest on a risk-free investment is not a good estimate of the *RRFR*, because the nominal rate can change dramatically in the short run in reaction to temporary ease or tightness in the capital market or because of changes in the expected rate of inflation. As indicated by the data in Exhibit 1.6, the significant changes in the average yield on T-bills typically were related to large changes in the rates of inflation. Notably, 2009–2010 were different due to the quantitative easing by the Federal Reserve.

The Common Effect All the factors discussed thus far regarding the required rate of return affect all investments equally. Whether the investment is in stocks, bonds, real estate, or machine tools, if the expected rate of inflation increases from 2 percent to 6 percent, the investor's required rate of return for *all* investments should increase by 4 percent. Similarly, if a decline in the expected real growth rate of the economy causes a decline in the *RRFR* of 1 percent, the required return on all investments should decline by 1 percent.

1.3.3 Risk Premium

A risk-free investment was defined as one for which the investor is certain of the amount and timing of the expected returns. The returns from most investments do not fit this pattern. An investor typically is not completely certain of the income to be received or when it will be received. Investments can range in uncertainty from basically risk-free securities, such as T-bills, to highly speculative investments, such as the common stock of small companies engaged in high-risk enterprises.

Most investors require higher rates of return on investments if they perceive that there is any uncertainty about the expected rate of return. This increase in the required rate of return over the *NRFR* is the **risk premium (RP)**. Although the required risk premium represents a composite of all uncertainty, it is possible to consider several fundamental sources of uncertainty. In this section, we identify and discuss briefly the major sources of uncertainty, including: (1) business risk, (2) financial risk (leverage), (3) liquidity risk, (4) exchange rate risk, and (5) country (political) risk.

Business risk is the uncertainty of income flows caused by the nature of a firm's business. The less certain the income flows of the firm, the less certain the income flows to the investor. Therefore, the investor will demand a risk premium that is based on the uncertainty caused by the basic business of the firm. As an example, a retail food company would typically experience stable sales and earnings growth over time and would have low business risk compared to a firm in the auto or airline industry, where sales and earnings fluctuate substantially over the business cycle, implying high business risk.

Financial risk is the uncertainty introduced by the method by which the firm finances its investments. If a firm uses only common stock to finance investments, it incurs only business risk. If a firm borrows money to finance investments, it must pay fixed financing charges (in the form of interest to creditors) prior to providing income to the common stockholders, so the uncertainty of returns to the equity investor increases. This increase in uncertainty because of fixed-cost financing is called *financial risk* or *financial leverage*, and it causes an increase in the stock's risk premium. For an extended discussion on this, see Brigham (2010).

Liquidity risk is the uncertainty introduced by the secondary market for an investment. When an investor acquires an asset, he or she expects that the investment will mature (as with a bond) or that it will be salable to someone else. In either case, the investor expects to be able to convert the security into cash and use the proceeds for current consumption or other investments. The more difficult it is to make this conversion to cash, the greater the liquidity risk. An investor must consider two questions when assessing the liquidity risk of an investment: How long will it take to convert the investment into cash? How certain is the price to be received? Similar uncertainty faces an investor who wants to acquire an asset: How long will it take to acquire the asset? How uncertain is the price to be paid?[5]

Uncertainty regarding how fast an investment can be bought or sold, or the existence of uncertainty about its price, increases liquidity risk. A U.S. government Treasury bill has almost no liquidity risk because it can be bought or sold in seconds at a price almost identical to the quoted price. In contrast, examples of illiquid investments include a work of art, an antique, or a parcel of real estate in a remote area. For such investments, it may require a long time to find a buyer and the selling prices could vary substantially from expectations. Investors will increase their required rates of return to compensate for this uncertainty regarding timing and price. Liquidity risk can be a significant consideration when investing in foreign securities depending on the country and the liquidity of its stock and bond markets.

Exchange rate risk is the uncertainty of returns to an investor who acquires securities denominated in a currency different from his or her own. The likelihood of incurring this risk is becoming greater as investors buy and sell assets around the world, as opposed to only assets within their own countries. A U.S. investor who buys Japanese stock denominated in yen must

[5]You will recall from prior courses that the overall capital market is composed of the primary market and the secondary market. Securities are initially sold in the primary market, and all subsequent transactions take place in the secondary market. These concepts are discussed in Chapter 4.

consider not only the uncertainty of the return in yen but also any change in the exchange value of the yen relative to the U.S. dollar. That is, in addition to the foreign firm's business and financial risk and the security's liquidity risk, the investor must consider the additional uncertainty of the return on this Japanese stock when it is converted from yen to U.S. dollars.

As an example of exchange rate risk, assume that you buy 100 shares of Mitsubishi Electric at 1,050 yen when the exchange rate is 105 yen to the dollar. The dollar cost of this investment would be about $10.00 per share (1,050/105). A year later you sell the 100 shares at 1,200 yen when the exchange rate is 115 yen to the dollar. When you calculate the *HPY* in yen, you find the stock has increased in value by about 14 percent (1,200/1,050) − 1, but this is the *HPY* for a Japanese investor. A U.S. investor receives a much lower rate of return, because during this period the yen has weakened relative to the dollar by about 9.5 percent (that is, it requires more yen to buy a dollar—115 versus 105). At the new exchange rate, the stock is worth $10.43 per share (1,200/115). Therefore, the return to you as a U.S. investor would be only about 4 percent ($10.43/$10.00) versus 14 percent for the Japanese investor. The difference in return for the Japanese investor and U.S. investor is caused by exchange rate risk—that is, the decline in the value of the yen relative to the dollar. Clearly, the exchange rate could have gone in the other direction, the dollar weakening against the yen. In this case, as a U.S. investor, you would have experienced the 14 percent return measured in yen, as well as a currency gain from the exchange rate change.

The more volatile the exchange rate between two countries, the less certain you would be regarding the exchange rate, the greater the exchange rate risk, and the larger the exchange rate risk premium you would require. For an analysis of pricing this risk, see Jorion (1991).

There can also be exchange rate risk for a U.S. firm that is extensively multinational in terms of sales and expenses. In this case, the firm's foreign earnings can be affected by changes in the exchange rate. As will be discussed, this risk can generally be hedged at a cost.

Country risk, also called *political risk*, is the uncertainty of returns caused by the possibility of a major change in the political or economic environment of a country. The United States is acknowledged to have the smallest country risk in the world because its political and economic systems are the most stable. During the spring of 2011, prevailing examples include the deadly rebellion in Libya against Moammar Gadhafi; a major uprising in Syria against President Bashar al-Assad; and significant protests in Yemen against President Ali Abdullah Saleh. In addition, there has been a recent deadly earthquake and tsunami in Japan that is disturbing numerous global corporations and the currency markets. Individuals who invest in countries that have unstable political or economic systems must add a country risk premium when determining their required rates of return.

When investing globally (which is emphasized throughout the book, based on a discussion in Chapter 3), investors must consider these additional uncertainties. How liquid are the secondary markets for stocks and bonds in the country? Are any of the country's securities traded on major stock exchanges in the United States, London, Tokyo, or Germany? What will happen to exchange rates during the investment period? What is the probability of a political or economic change that will adversely affect your rate of return? Exchange rate risk and country risk differ among countries. A good measure of exchange rate risk would be the absolute variability of the exchange rate relative to a composite exchange rate. The analysis of country risk is much more subjective and must be based on the history and current political environment of the country.

This discussion of risk components can be considered a security's *fundamental risk* because it deals with the intrinsic factors that should affect a security's volatility of returns over time. In subsequent discussion, the standard deviation of returns for a security is referred to as a measure of the security's *total risk*, which considers only the individual stock—that is, the stock is not considered as part of a portfolio.

$$\text{Risk Premium} = f\,(\text{Business Risk, Financial Risk, Liquidity Risk, Exchange Rate Risk, Country Risk})$$

1.3.4 Risk Premium and Portfolio Theory

An alternative view of risk has been derived from extensive work in portfolio theory and capital market theory by Markowitz (1952, 1959) and Sharpe (1964). These theories are dealt with in greater detail in Chapter 7 and Chapter 8 but their impact on a stock's risk premium should be mentioned briefly at this point. These prior works by Markowitz and Sharpe indicated that investors should use an *external market* measure of risk. Under a specified set of assumptions, all rational, profit-maximizing investors want to hold a completely diversified market portfolio of risky assets, and they borrow or lend to arrive at a risk level that is consistent with their risk preferences. Under these conditions, they showed that the relevant risk measure for an individual asset is its *comovement with the market portfolio.* This comovement, which is measured by an asset's covariance with the market portfolio, is referred to as an asset's **systematic risk**, the portion of an individual asset's total variance that is attributable to the variability of the total market portfolio. In addition, individual assets have variance that is unrelated to the market portfolio (the asset's nonmarket variance) that is due to the asset's unique features. This nonmarket variance is called *unsystematic risk*, and it is generally considered unimportant because it is eliminated in a large, diversified portfolio. Therefore, under these assumptions, *the risk premium for an individual earning asset is a function of the asset's systematic risk with the aggregate market portfolio of risky assets*. The measure of an asset's systematic risk is referred to as its *beta*:

$$\text{Risk Premium} = f\,(\text{Systematic Market Risk})$$

1.3.5 Fundamental Risk versus Systematic Risk

Some might expect a conflict between the market measure of risk (systematic risk) and the fundamental determinants of risk (business risk, and so on). A number of studies have examined the relationship between the market measure of risk (systematic risk) and accounting variables used to measure the fundamental risk factors, such as business risk, financial risk, and liquidity risk. The authors of these studies (especially Thompson, 1976) have generally concluded that *a significant relationship exists between the market measure of risk and the fundamental measures of risk*. Therefore, the two measures of risk can be complementary. This consistency seems reasonable because one might expect the market measure of risk to reflect the fundamental risk characteristics of the asset. For example, you might expect a firm that has high business risk and financial risk to have an above-average beta. At the same time, as we discuss in Chapter 8, a firm that has a high level of fundamental risk and a large standard deviation of returns can have a lower level of systematic risk simply because the variability of its earnings and its stock price is not related to the aggregate economy or the aggregate market, i.e., a large component of its total risk is due to unique unsystematic risk. Therefore, one can specify the risk premium for an asset as either:

$$\text{Risk Premium} = f\,(\text{Business Risk, Financial Risk, Liquidity Risk, Exchange Rate Risk, Country Risk})$$

or

$$\text{Risk Premium} = f\,(\text{Systematic Market Risk})$$

1.3.6 Summary of Required Rate of Return

The overall required rate of return on alternative investments is determined by three variables: (1) the economy's *RRFR*, which is influenced by the investment opportunities in the economy (that is, the long-run real growth rate); (2) variables that influence the *NRFR*, which include short-run ease or tightness in the capital market and the expected rate of inflation. Notably, these variables, which determine the *NRFR*, are the same for all investments; and (3) the risk premium on the investment. In turn, this risk premium can be related to fundamental factors, including business risk, financial risk, liquidity risk, exchange rate risk, and country risk, or it can be a function of an asset's systematic market risk (beta).

Measures and Sources of Risk In this chapter, we have examined both measures and sources of risk arising from an investment. The *measures* of market risk for an investment are:

- Variance of rates of return
- Standard deviation of rates of return
- Coefficient of variation of rates of return (standard deviation/means)
- Covariance of returns with the market portfolio (beta)

The *sources* of fundamental risk are:

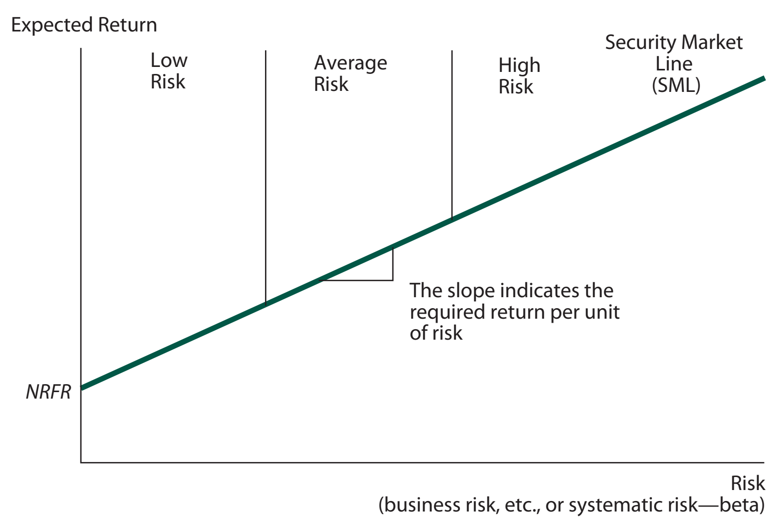
- Business risk
- Financial risk
- Liquidity risk
- Exchange rate risk
- Country risk

1.4 Relationship between Risk and Return

Previously, we showed how to measure the risk and rates of return for alternative investments and we discussed what determines the rates of return that investors require. This section discusses the risk-return combinations that might be available at a point in time and illustrates the factors that cause *changes* in these combinations.

Exhibit 1.7 graphs the expected relationship between risk and return. It shows that investors increase their required rates of return as perceived risk (uncertainty) increases. The line that reflects the combination of risk and return available on alternative investments is referred to as the **security market line (SML)**. The SML reflects the risk-return combinations available for all risky assets in the capital market at a given time. Investors would select investments that are consistent with their risk preferences; some would consider only low-risk investments, whereas others welcome high-risk investments.

Exhibit 1.7 Relationship between Risk and Return



Beginning with an initial SML, three changes in the SML can occur. First, individual investments can change positions on the SML because of changes in the perceived risk of the investments. Second, the slope of the SML can change because of a change in the attitudes of investors toward risk; that is, investors can change the returns they require per unit of risk. Third, the SML can experience a parallel shift due to a change in the *RRFR* or the expected rate of inflation—i.e., anything that can change in the *NRFR*. These three possibilities are discussed in this section.

1.4.1 Movements along the SML

Investors place alternative investments somewhere along the SML based on their perceptions of the risk of the investment. Obviously, if an investment's risk changes due to a change in one of its fundamental risk sources (business risk, and such), it will move along the SML. For example, if a firm increases its financial risk by selling a large bond issue that increases its financial leverage, investors will perceive its common stock as riskier and the stock will move up the SML to a higher risk position implying that investors will require a higher rate of return. As the common stock becomes riskier, it changes its position on the SML. Any change in an asset that affects its fundamental risk factors or its market risk (that is, its beta) will cause the asset to move *along* the SML as shown in Exhibit 1.8. Note that the SML does not change, only the position of specific assets on the SML.

1.4.2 Changes in the Slope of the SML

The slope of the SML indicates the return per unit of risk required by all investors. Assuming a straight line, it is possible to select any point on the SML and compute a risk premium (RP) for an asset through the equation:

1.13 $$RP_i = E(R_i) - NRFR$$

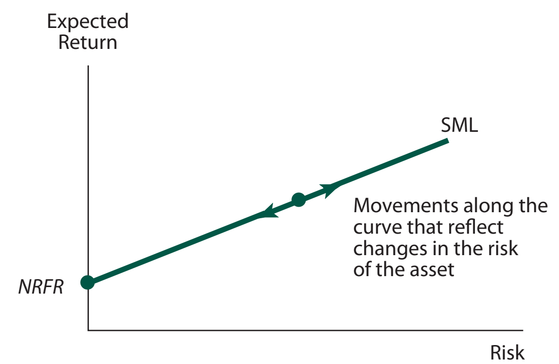
where:

RP_i = risk premium for asset i

$E(R_i)$ = the expected return for asset i

$NRFR$ = the nominal return on a risk-free asset

Exhibit 1.8 Changes in the Required Rate of Return Due to Movements along the SML



If a point on the SML is identified as the portfolio that contains all the risky assets in the market (referred to as the *market portfolio*), it is possible to compute a market RP as follows:

1.14 $$RP_m = E(R_m) - NRFR$$

where:

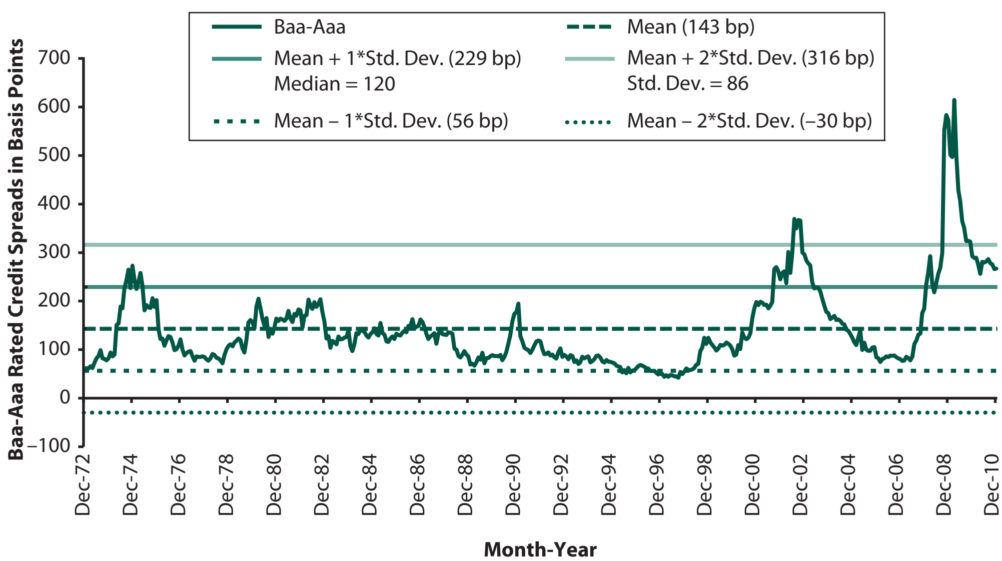
RP_m = the risk premium on the market portfolio
$E(R_m)$ = the expected return on the market portfolio
$NRFR$ = the nominal return on a risk-free asset

This market *RP* is *not constant* because the slope of the SML changes over time. Although we do not understand completely what causes these changes in the slope, we do know that there are changes in the *yield* differences between assets with different levels of risk even though the inherent risk differences are relatively constant.

These differences in yields are referred to as **yield spreads**, and these yield spreads change over time. As an example, if the yield on a portfolio of Aaa-rated bonds is 7.50 percent and the yield on a portfolio of Baa-rated bonds is 9.00 percent, we would say that the yield spread is 1.50 percent. This 1.50 percent is referred to as a credit risk premium because the Baa-rated bond is considered to have higher credit risk—that is, it has a higher probability of default. This Baa–Aaa yield spread is *not* constant over time, as shown by the substantial volatility in the yield spreads shown in Exhibit 1.9.

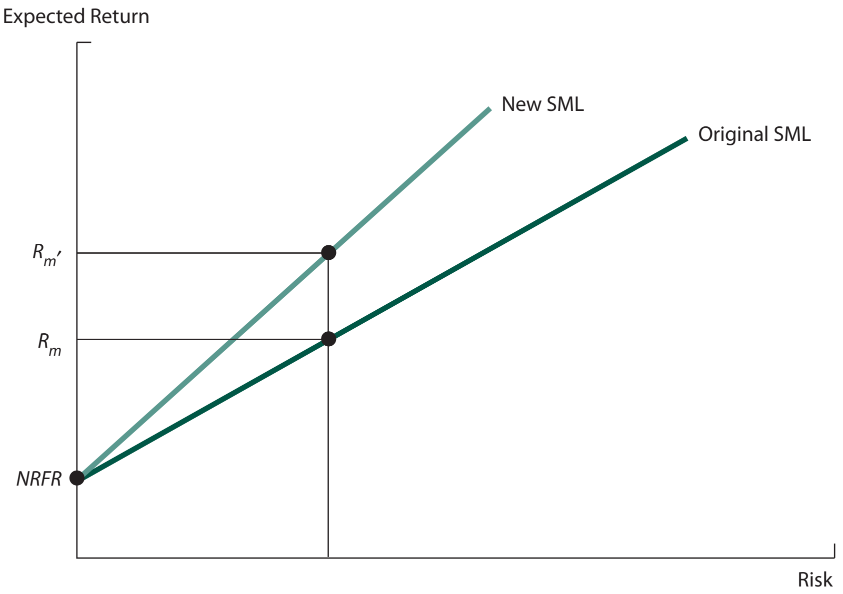
Although the underlying business and financial risk characteristics for the portfolio of bonds in the Aaa-rated bond index and the Baa-rated bond index would probably not change dramatically over time, it is clear from the time-series plot in Exhibit 1.9 that the difference in yields (i.e., the yield spread) has experienced changes of more than 100 basis points (1 percent) in a short period of time (for example, see the yield spread increases in 1974–1975, 1981–1983, 2001–2002, 2008–2009, and the dramatic declines in yield spread during 1975, 1983–1984, 2003–2004, and the second half of 2009). Such a significant change in the yield spread during a period where there is no major change in the fundamental risk characteristics of Baa bonds

Exhibit 1.9 Barclays Capital U.S. Credit Monthly Yield Spreads in Basis Points (U.S. Credit Aaa – U.S. Credit Baa) Jan. 1973–Dec. 2010



Source: Barclays Capital data; computations by authors.

Exhibit 1.10 Change in Market Risk Premium



relative to Aaa bonds would imply a change in the market RP. Specifically, although the intrinsic financial risk characteristics of the bonds remain relatively constant, investors changed the yield spreads (i.e., the credit risk premiums) they demand to accept this difference in financial risk.

This change in the *RP* implies a change in the slope of the SML. Such a change is shown in Exhibit 1.10. The exhibit assumes an increase in the market risk premium, which means an increase in the slope of the market line. Such a change in the slope of the SML (the market risk premium) will affect the required rate of return for all risky assets. Irrespective of where an investment is on the original SML, its required rate of return will increase, although its intrinsic risk characteristics remain unchanged.

1.4.3 Changes in Capital Market Conditions or Expected Inflation

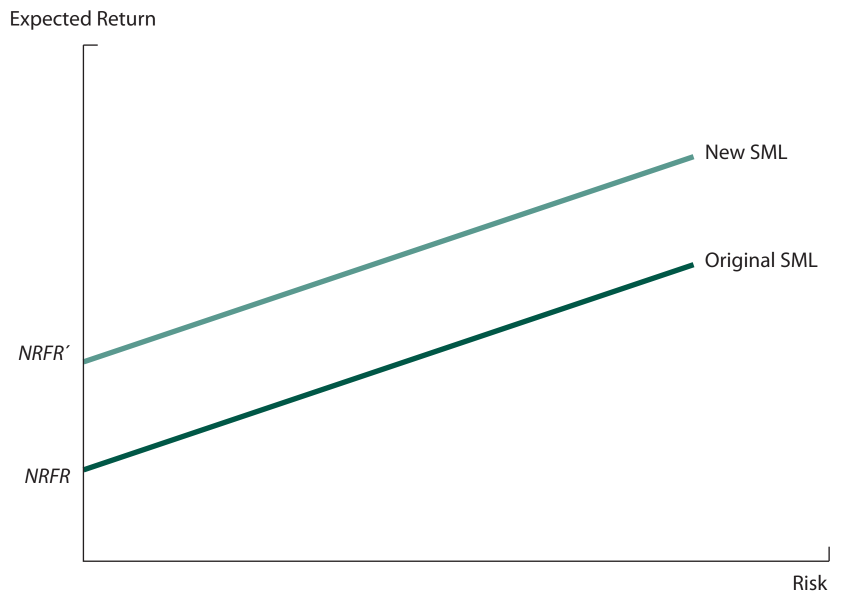
The graph in Exhibit 1.11 shows what happens to the SML when there are changes in one of the following factors: (1) expected real growth in the economy, (2) capital market conditions, or (3) the expected rate of inflation. For example, an increase in expected real growth, temporary tightness in the capital market, or an increase in the expected rate of inflation will cause the SML to experience a parallel shift upward as shown in Exhibit 1.11. The parallel shift occurs because changes in expected real growth or changes in capital market conditions or a change in the expected rate of inflation affect the economy's nominal risk-free rate (*NRFR*) that impacts all investments, irrespective of their risk levels.

1.4.4 Summary of Changes in the Required Rate of Return

The relationship between risk and the required rate of return for an investment can change in three ways:

1. A movement *along* the SML demonstrates a change in the risk characteristics of a specific investment, such as a change in its business risk, its financial risk, or its systematic risk (its beta). This change affects only the individual investment.

Exhibit 1.11 Capital Market Conditions, Expected Inflation, and the Security Market Line



2. A change in the *slope* of the SML occurs in response to a change in the attitudes of investors toward risk. Such a change demonstrates that investors want either higher or lower rates of return for the same intrinsic risk. This is also described as a change in the market risk premium (R_m − *NRFR*). A change in the market risk premium will affect all risky investments.
3. A *shift* in the SML reflects a change in expected real growth, a change in market conditions (such as ease or tightness of money), or a change in the expected rate of inflation. Again, such a change will affect all investments.

SUMMARY

The purpose of this chapter is to provide background that can be used in subsequent chapters. To achieve that goal, we covered several topics:

- We discussed why individuals save part of their income and why they decide to invest their savings. We defined *investment* as the current commitment of these savings for a period of time to derive a rate of return that compensates for the time involved, the expected rate of inflation, and the uncertainty.
- We examined ways to quantify historical return and risk to help analyze alternative investment opportunities. We considered two measures of mean return (arithmetic and geometric) and applied these to a historical series for an individual investment and to a portfolio of investments during a period of time.
- We considered the concept of uncertainty and alternative measures of risk (the variance, standard deviation, and a relative measure of risk—the coefficient of variation).
- Before discussing the determinants of the required rate of return for an investment, we noted that the estimation of the required rate of return is complicated because the rates on individual investments change over time, because there is a wide range of rates of return available on alternative investments, and because the differences between required returns on alternative investments (for example, the yield spreads) likewise change over time.

- We examined the specific factors that determine the required rate of return: (1) the real risk-free rate, which is based on the real rate of growth in the economy, (2) the nominal risk-free rate, which is influenced by capital market conditions and the expected rate of inflation, and (3) a risk premium, which is a function of fundamental factors, such as business risk, or the systematic risk of the asset relative to the market portfolio (that is, its beta).
- We discussed the risk-return combinations available on alternative investments at a point in time (illustrated by the SML) and the three factors that can cause changes in this relationship. First, a change in the inherent risk of an individual investment (that is, its fundamental risk or market risk) will cause a movement along the SML. Second, a change in investors' attitudes toward risk will cause a change in the required return per unit of risk—that is, a change in the market risk premium. Such a change will cause a change in the slope of the SML. Finally, a change in expected real growth, in capital market conditions, or in the expected rate of inflation will cause a parallel shift of the SML.

Based on this understanding of the investment environment, you are prepared to consider the asset allocation decision, which is discussed in Chapter 2.

SUGGESTED READINGS

Fama, Eugene F., and Merton H. Miller. *The Theory of Finance*. New York: Holt, Rinehart and Winston, 1972.

Fisher, Irving. *The Theory of Interest*. New York: Macmillan, 1930, reprinted by Augustus M. Kelley, 1961.

QUESTIONS

1. Discuss the overall purpose people have for investing. Define investment.
2. As a student, are you saving or borrowing? Why?
3. Divide a person's life from ages 20 to 70 into 10-year segments and discuss the likely saving or borrowing patterns during each period.
4. Discuss why you would expect the saving-borrowing pattern to differ by occupation (for example, for a doctor versus a plumber).
5. *The Wall Street Journal* reported that the yield on common stocks is about 2 percent, whereas a study at the University of Chicago contends that the annual rate of return on common stocks since 1926 has averaged about 10 percent. Reconcile these statements.
6. Some financial theorists consider the variance of the distribution of expected rates of return to be a good measure of uncertainty. Discuss the reasoning behind this measure of risk and its purpose.
7. Discuss the three components of an investor's required rate of return on an investment.
8. Discuss the two major factors that determine the market nominal risk-free rate (*NRFR*). Explain which of these factors would be more volatile over the business cycle.
9. Briefly discuss the five fundamental factors that influence the risk premium of an investment.
10. You own stock in the Gentry Company, and you read in the financial press that a recent bond offering has raised the firm's debt/equity ratio from 35 percent to 55 percent. Discuss the effect of this change on the variability of the firm's net income stream, other factors being constant. Discuss how this change would affect your required rate of return on the common stock of the Gentry Company.
11. Draw a properly labeled graph of the security market line (SML) and indicate where you would expect the following investments to fall along that line. Discuss your reasoning.
    a. Common stock of large firms
    b. U.S. government bonds
    c. U.K. government bonds
    d. Low-grade corporate bonds
    e. Common stock of a Japanese firm

12. Explain why you would change your nominal required rate of return if you expected the rate of inflation to go from 0 (no inflation) to 4 percent. Give an example of what would happen if you did not change your required rate of return under these conditions.

13. Assume the expected long-run growth rate of the economy increased by 1 percent and the expected rate of inflation increased by 4 percent. What would happen to the required rates of return on government bonds and common stocks? Show graphically how the effects of these changes would differ between these alternative investments.

14. You see in *The Wall Street Journal* that the yield spread between Baa corporate bonds and Aaa corporate bonds has gone from 350 basis points (3.5 percent) to 200 basis points (2 percent). Show graphically the effect of this change in yield spread on the SML and discuss its effect on the required rate of return for common stocks.

15. Give an example of a liquid investment and an illiquid investment. Discuss why you consider each of them to be liquid or illiquid.

PROBLEMS

1. On February 1, you bought 100 shares of stock in the Francesca Corporation for $34 a share and a year later you sold it for $39 a share. During the year, you received a cash dividend of $1.50 a share. Compute your *HPR* and *HPY* on this Francesca stock investment.

2. On August 15, you purchased 100 shares of stock in the Cara Cotton Company at $65 a share and a year later you sold it for $61 a share. During the year, you received dividends of $3 a share. Compute your *HPR* and *HPY* on your investment in Cara Cotton.

3. At the beginning of last year, you invested $4,000 in 80 shares of the Chang Corporation. During the year, Chang paid dividends of $5 per share. At the end of the year, you sold the 80 shares for $59 a share. Compute your total *HPY* on these shares and indicate how much was due to the price change and how much was due to the dividend income.

4. The rates of return computed in Problems 1, 2, and 3 are nominal rates of return. Assuming that the rate of inflation during the year was 4 percent, compute the real rates of return on these investments. Compute the real rates of return if the rate of inflation was 8 percent.

5. During the past five years, you owned two stocks that had the following annual rates of return:

Year	Stock T	Stock B
1	0.19	0.08
2	0.08	0.03
3	–0.12	–0.09
4	–0.03	0.02
5	0.15	0.04

a. Compute the arithmetic mean annual rate of return for each stock. Which stock is most desirable by this measure?

b. Compute the standard deviation of the annual rate of return for each stock. (Use Chapter 1 Appendix if necessary.) By this measure, which is the preferable stock?

c. Compute the coefficient of variation for each stock. (Use the Chapter 1 Appendix if necessary.) By this relative measure of risk, which stock is preferable?

d. Compute the geometric mean rate of return for each stock. Discuss the difference between the arithmetic mean return and the geometric mean return for each stock. Discuss the differences in the mean returns relative to the standard deviation of the return for each stock.

6. You are considering acquiring shares of common stock in the Madison Beer Corporation. Your rate of return expectations are as follows:

MADISON BEER CORP.

Possible Rate of Return	Probability
−0.10	0.30
0.00	0.10
0.10	0.30
0.25	0.30

Compute the expected return $[E(R_i)]$ on your investment in Madison Beer.

7. A stockbroker calls you and suggests that you invest in the Lauren Computer Company. After analyzing the firm's annual report and other material, you believe that the distribution of expected rates of return is as follows:

LAUREN COMPUTER CO.

Possible Rate of Return	Probability
−0.60	0.05
−0.30	0.20
−0.10	0.10
0.20	0.30
0.40	0.20
0.80	0.15

Compute the expected return $[E(R_i)]$ on Lauren Computer stock.

8. Without any formal computations, do you consider Madison Beer in Problem 6 or Lauren Computer in Problem 7 to present greater risk? Discuss your reasoning.

9. During the past year, you had a portfolio that contained U.S. government T-bills, long-term government bonds, and common stocks. The rates of return on each of them were as follows:

U.S. government T-bills	5.50%
U.S. government long-term bonds	7.50
U.S. common stocks	11.60

During the year, the consumer price index, which measures the rate of inflation, went from 160 to 172 (1982 – 1984 = 100). Compute the rate of inflation during this year. Compute the real rates of return on each of the investments in your portfolio based on the inflation rate.

10. You read in *BusinessWeek* that a panel of economists has estimated that the long-run real growth rate of the U.S. economy over the next five-year period will average 3 percent. In addition, a bank newsletter estimates that the average annual rate of inflation during this five-year period will be about 4 percent. What nominal rate of return would you expect on U.S. government T-bills during this period?

11. What would your required rate of return be on common stocks if you wanted a 5 percent risk premium to own common stocks given what you know from Problem 10? If common stock investors became more risk averse, what would happen to the required rate of return on common stocks? What would be the impact on stock prices?

12. Assume that the consensus required rate of return on common stocks is 14 percent. In addition, you read in *Fortune* that the expected rate of inflation is 5 percent and the estimated long-term real growth rate of the economy is 3 percent. What interest rate would you expect on U.S. government T-bills? What is the approximate risk premium for common stocks implied by these data?

THOMSON REUTERS

Find general information for Walgreens (stock symbol: WAG) and Walmart (WMT), two firms in the retail industry (or try two firms in an industry of your choice). On what stock markets are the firms traded? How do their growth rates in sales and earnings compare? How have their stocks performed over the past few months? Are stock analysts recommending investors buy or sell each of the two firm's stocks?

Computation of Variance and Standard Deviation

Variance and standard deviation are measures of how actual values differ from the expected values (arithmetic mean) for a given series of values. In this case, we want to measure how rates of return differ from the arithmetic mean value of a series. There are other measures of dispersion, but variance and standard deviation are the best known because they are used in statistics and probability theory. Variance is defined as:

$$\text{Variance } (\sigma^2) = \sum_{i=1}^{n} (\text{Probability})(\text{Possible Return} - \text{Expected Return})^2$$

$$= \sum_{i=1}^{n} (P_i)[R_i - E(R_i)]^2$$

Consider the following example, as discussed in the chapter:

Probability of Possible Return (P_i)	Possible Return (R_i)	P_iR_i
0.15	0.20	0.03
0.15	–0.20	–0.03
0.70	0.10	0.07
		Σ = 0.07

This gives an expected return $[E(R_i)]$ of 7 percent. The dispersion of this distribution as measured by variance is:

Probability (P_i)	Return (R_i)	$R_i - E(R_i)$	$[R_i - E(R_i)]^2$	$P_i[R_i - E(R_i)]^2$
0.15	0.20	0.13	0.0169	0.002535
0.15	–0.20	–0.27	0.0729	0.010935
0.70	0.10	0.03	0.0009	0.000630
				Σ = 0.014100

The variance (σ^2) is equal to 0.0141. The standard deviation is equal to the square root of the variance:

$$\text{Standard Deviation } (\sigma^2) = \sqrt{\sum_{i=1}^{n} P_i[R_i - E(R_i)]^2}$$

Consequently, the standard deviation for the preceding example would be:

$$\sigma_i = \sqrt{0.0141} = 0.11874$$

In this example, the standard deviation is approximately 11.87 percent. Therefore, you could describe this distribution as having an expected value of 7 percent and a standard deviation of 11.87 percent.

In many instances, you might want to compute the variance or standard deviation for a historical series in order to evaluate the past performance of the investment. Assume that you are given the following information on annual rates of return (*HPY*) for common stocks listed on the New York Stock Exchange (NYSE):

Year	Annual Rate of Return
2012	0.07
2013	0.11
2014	–0.04
2015	0.12
2016	–0.06

In this case, we are not examining expected rates of return but actual returns. Therefore, we assume equal probabilities, and the expected value (in this case the mean value, R) of the series is the sum of the individual observations in the series divided by the number of observations, or 0.04 (0.20/5). The variances and standard deviations are:

Year	R_i	$R_i - \bar{R}$	$(R_i - \bar{R})^2$	
2012	0.07	0.03	0.0009	$\sigma^2 = 0.0286/5$
2013	0.11	0.07	0.0049	$= 0.00572$
2014	−0.04	−0.08	0.0064	
2015	0.12	0.08	0.0064	$\sigma = \sqrt{0.00572}$
2016	−0.06	−0.10	0.0110	$= 0.0756$
			$\Sigma = 0.0286$	$= 7.56\%$

We can interpret the performance of NYSE common stocks during this period of time by saying that the average rate of return was 4 percent and the standard deviation of annual rates of return was 7.56 percent.

Coefficient of Variation

In some instances, you might want to compare the dispersion of two different series. The variance and standard deviation are *absolute* measures of dispersion. That is, they can be influenced by the magnitude of the original numbers. To compare series with very different values, you need a *relative* measure of dispersion. A measure of relative dispersion is the coefficient of variation, which is defined as:

$$\text{Coefficient of Variation } (CV) = \frac{\text{Standard Deviation of Returns}}{\text{Expected Rate of Return}}$$

A larger value indicates greater dispersion relative to the arithmetic mean of the series. For the previous example, the CV would be:

$$CV_1 = \frac{0.0756}{0.0400} = 1.89$$

It is possible to compare this value to a similar figure having a markedly different distribution. As an example, assume you wanted to compare this investment to another investment that had an average rate of return of 10 percent and a standard deviation of 9 percent. The standard deviations alone tell you that the second series has greater dispersion (9 percent versus 7.56 percent) and might be considered to have higher risk. In fact, the relative dispersion for this second investment is much less.

$$CV_1 = \frac{0.0756}{0.0400} = 1.89$$

$$CV_2 = \frac{0.0900}{0.1000} = 0.90$$

Considering the relative dispersion and the total distribution, most investors would probably prefer the second investment.

Problems

1. Your rate of return expectations for the common stock of Gray Cloud Company during the next year are:

GRAY CLOUD CO.

Possible Rate of Return	Probability
−0.10	0.25
0.00	0.15
0.10	0.35
0.25	0.25

a. Compute the expected return $[E(R_i)]$ on this investment, the variance of this return (σ^2), and its standard deviation (σ).
b. Under what conditions can the standard deviation be used to measure the relative risk of two investments?
c. Under what conditions must the coefficient of variation be used to measure the relative risk of two investments?

2. Your rate of return expectations for the stock of Kayleigh Cosmetics Company during the next year are:

KAYLEIGH COSMETICS CO.

Possible Rate of Return	Probability
−0.60	0.15
−0.30	0.10
−0.10	0.05
0.20	0.40
0.40	0.20
0.80	0.10

a. Compute the expected return $[E(R_i)]$ on this stock, the variance (σ^2) of this return, and its standard deviation (σ).
b. On the basis of expected return $[E(R_i)]$ alone, discuss whether Gray Cloud or Kayleigh Cosmetics is preferable.
c. On the basis of standard deviation (σ) alone, discuss whether Gray Cloud or Kayleigh Cosmetics is preferable.
d. Compute the coefficients of variation (*CV*s) for Gray Cloud and Kayleigh Cosmetics and discuss which stock return series has the greater relative dispersion.

3. The following are annual rates of return for U.S. government T-bills and U.K. common stocks.

Year	U.S. Government T-Bills	U.K. Common Stock
2012	0.063	0.150
2013	0.081	0.043
2014	0.076	0.374
2015	0.090	0.192
2016	0.085	0.106

a. Compute the arithmetic mean rate of return and standard deviation of rates of return for the two series.
b. Discuss these two alternative investments in terms of their arithmetic average rates of return, their absolute risk, and their relative risk.
c. Compute the geometric mean rate of return for each of these investments. Compare the arithmetic mean return and geometric mean return for each investment and discuss the difference between mean returns as related to the standard deviation of each series.