

Financial Risk Management

Prepared by Dr. Walaa Mohamed

PMG 633

Calculation of Return & Risk

Lecture Eight



LEARNING OBJECTIVES

ملحوظة هامة: كل المسائل والمعدلات اي كان مشروحة على السبورة أو داخل السلايدات فهي عليك ويمكن ان يأتي على أي منهم سؤال في الاختبار.

After studying this lecture, you should be able to do the following:

LO.1 calculate and interpret major return measures

LO.2 calculate and interpret the mean, variance, and covariance (or correlation) of asset returns
based on historical data

LO.3 Types of investors

LO.4 Calculate Expected Return of a portfolio

LEARNING OBJECTIVES

LO.5 calculate and interpret portfolio standard deviation

LO.6 calculate and interpret beta

LO.7 explain return generating models and their uses

LO.8 Market efficiency

calculate and interpret major return measures

Return

Financial assets normally generate two types of return for investors. First, they may provide periodic income through cash dividends or interest payments. Second, the price of a financial asset can increase or decrease, leading to a capital gain or loss.

Holding Period Return

A **holding period return** is the return earned from holding an asset for a single specified period of time.

The period may be 1 day, 1 week, 1 month, 5 years, or any specified period.

$$R = \frac{(P_1 - P_0) + I_1}{P_0} = \frac{P_1 + I_1}{P_0} - 1$$

1. For ease of illustration, we assumed that the dividend is paid at time $t = 1$. If the dividend was received any time before $t = 1$, our holding period return would have been higher because we would have earned a return by reinvesting the dividend for the remainder of the period.
2. The holding period return can be computed for a period longer than one year.

The holding period return can be computed for a period longer than one year. For example, you may need to compute a three-year holding period return from three annual returns. In that case, the holding period return is computed by compounding the three annual returns: $R = [(1 + R_1) \times (1 + R_2) \times (1 + R_3)] - 1$, where R_1 , R_2 , and R_3 are the three annual returns.

Arithmetic or Mean Return

The arithmetic average return is easy to compute and has known statistical properties, such as standard deviation. We can calculate its standard deviation to determine how dispersed the observations are around the mean or if the mean return is statistically different from zero.

$$\bar{R}_i = \frac{R_{i1} + R_{i2} + \dots + R_{i,T-1} + R_{iT}}{T} = \frac{1}{T} \sum_{t=1}^T R_{it}$$

Geometric Mean Return

The arithmetic mean return assumes that the amount invested at the beginning of each period is the same. In an investment portfolio, however, even if there are no cash flows into or out of the portfolio, the base amount changes each year.

$$\bar{R}_{Gi} = \sqrt[T]{(1 + R_{i1}) \times (1 + R_{i2}) \times \dots \times (1 + R_{i,T-1}) \times (1 + R_{iT})} - 1$$

Annualized Return

- To annualize any return for a period shorter than one year, the return for the period must be compounded by the number of periods in a year. A monthly return is compounded 12 times, a weekly return is compounded 52 times, and a quarterly return is compounded 4 times. Daily returns are normally compounded 365 times. For an uncommon number of days, we compound by the ratio of 365 to the number of days.

$$r_{annual} = \left(1 + r_{period}\right)^c - 1$$

EXAMPLE: Return measures

An investor purchased \$1,000 of a mutual fund's shares. The fund had the following total returns over a 3-year period: +5%, -8%, +12%. Calculate the value at the end of the 3-year period, the holding period return, the mean annual return, and the geometric mean annual return.

Answer:

$$\text{ending value} = (1,000)(1.05)(0.92)(1.12) = \$1,081.92$$

$$\text{holding period return} = (1.05)(0.92)(1.12) - 1 = 0.08192 = 8.192\%, \text{ which can also be calculated as } 1,081.92 / 1,000 - 1 = 8.192\%$$

$$\text{arithmetic mean return} = (5\% - 8\% + 12\%) / 3 = 3\%$$

$$\text{geometric mean return} = \sqrt[3]{(1.05)(0.92)(1.12)} - 1 = 0.02659 = 2.66\%, \text{ which can also be calculated as}$$

$$\text{geometric mean return} = \sqrt[3]{1 + \text{HPR}} - 1 = \sqrt[3]{1.08192} - 1 = 2.66\%.$$

EXAMPLE 4

Annualized Returns

An analyst is trying to evaluate three securities that have been in her portfolio for different periods of time.

- In the last 100 days, Security A has earned a return of 6.2 percent.
- Security B has earned 2 percent over the last 4 weeks.
- Security C has earned a return of 5 percent over the last 3 months

The analyst is trying to assess the relative performance of the 3 securities.

Solution:

Annualized return for Security A: $R_{SA} = (1 + 0.062)^{365/100} - 1 = 0.2455 = 24.55\%$

Annualized return for Security B: $R_{SB} = (1 + 0.02)^{52/4} - 1 = 0.2936 = 29.36\%$

Annualized return for Security C: $R_{SC} = (1 + 0.05)^4 - 1 = 0.2155 = 21.55\%$

- **Other Major Return Measures and their Applications**

- ***Gross and Net Return***

gross return is the return earned by an asset manager prior to deductions for management expenses, custodial fees, taxes, or any other expenses that are not directly related to the generation of returns but rather related to the management and administration of an investment.

- ***Pre-tax and After-tax Nominal Return***

All return measures discussed previously are pre-tax nominal returns—that is, no adjustment has been made for taxes or inflation. In general, all returns are pre-tax nominal returns unless they are otherwise designated.

- ***Real Returns***

A nominal return (r) consists of three components: a real risk-free return as compensation for postponing consumption (RF), inflation as compensation for loss of purchasing power (π), and a **risk premium** for assuming risk (RP).

calculate and interpret the mean, variance, and covariance (or correlation) of asset returns based on historical data;

Variance (Standard Deviation) of Returns for an Individual Security

We can calculate the population variance, σ^2 , when we know the return R for each period, the total number periods (T), and the mean or expected value of the population's distribution (μ), as follows:

$$\sigma^2 = \frac{\sum_{t=1}^T (R_t - \mu)^2}{T}$$

In the world of finance, we are typically analyzing only a sample of returns data, rather than the entire population. To calculate sample variance, s^2 , using a sample of T historical returns and the mean, $\bar{R}$, of the observations, we use the following formula:

$$s^2 = \frac{\sum_{t=1}^T (R_t - \bar{R})^2}{T-1}$$

Covariance and Correlation of Returns for Two Securities

Covariance measures the extent to which two variables move together over time. A positive covariance means that the variables (e.g., rates of return on two stocks) tend to move together. Negative covariance means that the two variables tend to move in opposite directions. A covariance of zero means there is no linear relationship between the two variables.

$$\text{Cov}_{1,2} = \frac{\sum_{t=1}^n \{ [R_{t,1} - \bar{R}_1] [R_{t,2} - \bar{R}_2] \}}{n-1}$$

The covariance of the returns of two securities can be standardized by dividing by the product of the standard deviations of the two securities. This standardized measure of co-movement is called correlation and is computed as:

$$\rho_{1,2} = \frac{\text{Cov}_{1,2}}{\sigma_1 \sigma_2}$$

$$\text{Cov}_{1,2} = \rho_{1,2} \sigma_1 \sigma_2$$

- A correlation coefficient of +1 means that deviations from the mean or expected return are always proportional in the same direction. That is, they are perfectly positively correlated.
- A correlation coefficient of −1 means that deviations from the mean or expected return are always proportional in opposite directions. That is, they are perfectly negatively correlated.
- A correlation coefficient of zero means that there is no linear relationship between the two stocks' returns. They are uncorrelated. One way to interpret a correlation (or covariance) of zero is that, in any period, knowing the actual value of one variable tells you nothing about the value of the other.

Positive correlation is measured from 0.1 to 1. Weak positive correlation being 0.1 to 0.3, moderate 0.3 to 0.5, and **strong positive correlation from 0.5 to 1.**

Negative correlation is measured from -0.1 to -1. Weak negative correlation being -0.1 to -0.3, moderate -0.3 to -0.5, and **strong negative correlation from -0.5 to -1.**

EXAMPLE: Calculating mean return, returns variance, returns covariance, and correlation

Given three years of percentage returns for assets A and B in the following table, calculate the mean return and sample standard deviation for each asset, the sample covariance, and the correlation of returns.

Year	Asset A	Asset B
1	5%	7%
2	-2%	-4%
3	12%	18%

Answer:

$$\text{mean return for asset A} = (5\% - 2\% + 12\%) / 3 = 5\%$$

$$\text{mean return for asset B} = (7\% - 4\% + 18\%) / 3 = 7\%$$

$$\begin{aligned}\text{sample variance of returns for asset A} &= \frac{(5-5)^2 + (-2-5)^2 + (12-5)^2}{3-1} = \\ &= 49\end{aligned}$$

$$\text{sample standard deviation for asset A} = \sqrt{49} = 7\%$$

$$\text{sample variance of returns for asset B} = \frac{(7-7)^2 + (-4-7)^2 + (18-7)^2}{3-1} = 121$$

$$\text{sample standard deviation for asset B} = \sqrt{121} = 11\%$$

$$\text{sample covariance of returns for assets A and B} = \frac{(5-5)(7-7) + (-2-5)(-4-7) + (12-5)(18-7)}{3-1} = 77$$

$$\text{correlation of returns for assets A and B} = \frac{77}{7 \times 11} = 1$$

In this example, the returns on assets A and B are perfectly positively correlated.

How to Calculate Expected Return of a portfolio

To calculate the expected return of a portfolio, the investor needs to know the expected return of each of the securities in their portfolio as well as the overall weight of each security in the portfolio.

$$\text{Expected return} = (w_1 * r_1) + (w_2 * r_2) + \dots + (w_n * r_n)$$

- w_i = weight of each investment in the portfolio
- r_i = rate of return of each investment in the portfolio

Types of investors

- A **risk-averse investor** is simply one that dislikes risk (i.e., prefers less risk to more risk). Given two investments that have equal expected returns, a risk-averse investor will choose the one with less risk (standard deviation, σ).
- If expected returns are identical, a risk-averse investor will always choose the investment with the least risk. However, an investor may select a very risky portfolio despite being risk averse; a risk-averse investor will hold very risky assets if he feels that the extra return he expects to earn is adequate compensation for the additional risk.
- A **risk-seeking** (risk-loving) investor actually prefers more risk to less and, given equal expected returns, will choose the more risky investment.
- A **risk-neutral** investor has no preference regarding risk and would be indifferent between two such investments.

calculate and interpret portfolio standard deviation;

- The variance of returns for a portfolio of two risky assets is calculated as follows:

$$\text{Var}_{\text{portfolio}} = w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2w_1 w_2 \text{Cov}_{12}$$

- where w_1 is the proportion of the portfolio invested in Asset 1, and w_2 is the proportion of the portfolio invested in Asset 2. w_2 must equal $(1 - w_1)$.
- Substituting this term for Cov_{12} in the formula for the variance of returns for a portfolio of two risky assets, we have the following:

$$\text{Var}_{\text{portfolio}} = w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2w_1 w_2 \rho_{12} \sigma_1 \sigma_2$$

$$\sigma_{\text{portfolio}} = \sqrt{w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2w_1 w_2 \rho_{12} \sigma_1 \sigma_2}$$

EXAMPLE: Calculating portfolio standard deviation

A portfolio is 30% invested in stocks that have a standard deviation of returns of 20% and is 70% invested in bonds that have a standard deviation of returns of 12%. The correlation of bond returns with stock returns is 0.60. What is the standard deviation of portfolio returns? What would it be if stock and bond returns were perfectly positively correlated?

Answer:

portfolio standard deviation

$$\begin{aligned} &= \sqrt{(0.3^2)(0.2^2) + (0.7^2)(0.12^2) + 2(0.3)(0.7)(0.6)(0.2)(0.12)} \\ &= 12.9\% \end{aligned}$$

If stock and bond returns were perfectly positively correlated, portfolio standard deviation would simply be the weighted average of the assets' standard deviations: $0.3(20\%) + 0.7(12\%) = 14.4\%$.

Describe the effect on a portfolio's risk of investing in assets that are less than perfectly correlated.

- If two risky asset returns are perfectly positively correlated, $\rho = +1$, then the square root of portfolio variance (the portfolio standard deviation of returns) is equal to:

$$\sigma_{\text{portfolio}} = \sqrt{\text{Var}_{\text{portfolio}}} = \sqrt{w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\sigma_1\sigma_2(1)} = w_1\sigma_1 + w_2\sigma_2$$

Focusing on returns correlation, we can see that the greatest portfolio risk results when the correlation between asset returns is +1. For any value of correlation less than +1, portfolio variance is reduced.

Note that for a correlation of zero, the entire third term in the portfolio variance equation is zero.

- For negative values of correlation ρ , the third term becomes negative and further reduces portfolio variance and standard deviation.
- The lower the correlation of asset returns, the greater the risk reduction (diversification) benefit of combining assets in a portfolio.
- If asset returns were perfectly negatively correlated, portfolio risk could be eliminated altogether for a specific set of asset weights.
- Adding more assets to the portfolio with low correlation, standard deviation of the portfolio is decreased when they are equally weighted as correlation is the only determinant of risk reduction as weights are constant.

EXAMPLE: Portfolio risk as correlation varies

Consider two risky assets that have returns variances of 0.0625 and 0.0324, respectively. The assets' standard deviations of returns are then 25% and 18%, respectively. Calculate the variances and standard deviations of portfolio returns for an equal-weighted portfolio of the two assets when their correlation of returns is 1, 0.5, 0, and -0.5.

The calculations are as follows:

$$\text{variance}_{\text{portfolio}} = w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2w_1 w_2 \rho_{12} \sigma_1 \sigma_2$$

$$\sigma_{\text{portfolio}} = \sqrt{\text{variance}_{\text{portfolio}}}$$

$$\sigma_{\text{portfolio}} = \sqrt{w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2w_1 w_2 \rho_{12} \sigma_1 \sigma_2}$$

$\rho = \text{correlation} = +1$:

$$\sigma = \text{portfolio standard deviation} = 0.5(25\%) + 0.5(18\%) = \mathbf{21.5\%}$$

$$\sigma^2 = \text{portfolio variance} = 0.215^2 = 0.046225$$

$\rho = \text{correlation} = 0.5$:

$$\sigma^2 = (0.5^2)0.0625 + (0.5^2)0.0324 + 2(0.5)(0.5)(\mathbf{0.5})(0.25)(0.18) = 0.034975$$

$$\sigma = \mathbf{18.70\%}$$

$\rho = \text{correlation} = 0$:

$$\sigma^2 = (0.5^2)0.0625 + (0.5^2)0.0324 = 0.023725$$

$$\sigma = \mathbf{15.40\%}$$

$\rho = \text{correlation} = -0.5$:

$$\sigma^2 = (0.5^2)0.0625 + (0.5^2)0.0324 + 2(0.5)(0.5)(\mathbf{-0.5})(0.25)(0.18) = 0.012475$$

$$\sigma = \mathbf{11.17\%}$$

c. explain systematic and nonsystematic risk, including why an investor should not expect to receive additional return for bearing nonsystematic risk;

Systematic Risk and Nonsystematic Risk

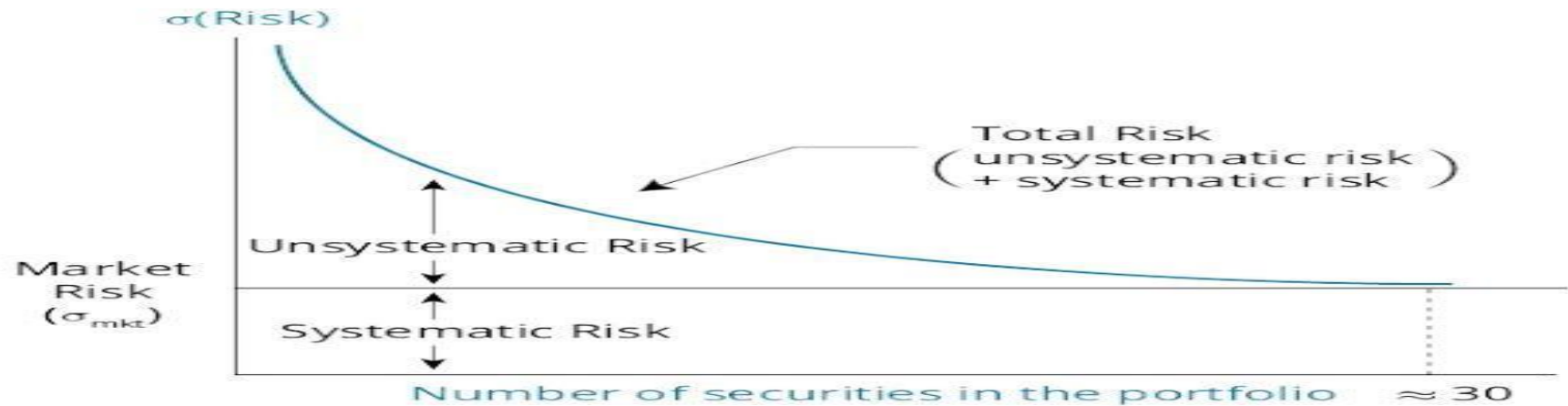
Systematic risk, also known as **non-diversifiable** or **market** risk, is the risk that affects the entire market or economy. In contrast, **nonsystematic** risk is the risk that pertains to a single company or industry and is also known as **company-specific, industry-specific, diversifiable**, or **idiosyncratic** risk.

$$\text{Total variance} = \text{Systematic variance} + \text{Nonsystematic variance}$$

Total risk (as measured by standard deviation) **total risk = systematic risk + unsystematic risk**

Systematic or non-diversifiable risk is **priced** and investors are compensated for holding assets or portfolios based only on that investment's systematic risk. Investors do not receive any return for accepting nonsystematic or diversifiable risk. Therefore, it is in the interest of risk-averse investors to hold only well-diversified portfolios.

One important conclusion of capital market theory is that equilibrium security returns depend on a stock's or a portfolio's systematic risk, not its total risk as measured by standard deviation.



explain return generating models and their uses;

Return-Generating Models

A **return-generating model** is a model that can provide an estimate of the expected return of a security given certain parameters. If systematic risk is the only relevant parameter for return, then the return- generating model will estimate the expected return for any asset given the level of systematic risk.

A **multi-factor model** allows more than one variable to be considered in estimating returns and can be built using different kinds of factors, such as macroeconomic, fundamental, and statistical factors.

Macroeconomic factor models use economic factors that are correlated with security returns. These factors may include economic growth, the interest rate, the inflation rate, productivity, employment, and consumer confidence. **Three-Factor and Four-Factor Models Like Fama French.**

The Single-Index Model The simplest form of a return-generating model is a single-factor linear model, in which only one factor is considered. The most common implementation is a single-index model, which uses the market factor in the following form:

$$E(R_i) - R_f = \beta_i [E(R_m) - R_f].$$

Calculate and interpret beta;

Calculation and Interpretation of Beta

Because **systematic risk** depends on the correlation between the asset and the market, we can arrive at a measure of systematic risk from the covariance between R_i and R_m , where R_i is defined using the above equation.

$$\beta_i = \frac{\text{Cov}(R_i, R_m)}{\sigma_m^2} = \frac{\rho_{i,m} \sigma_i \sigma_m}{\sigma_m^2} = \frac{\rho_{i,m} \sigma_i}{\sigma_m}$$

As shown in the above equation, **beta** is a measure of how sensitive an asset's return is to the market as a whole.

A positive beta indicates that the return of an asset follows the general market trend, whereas a negative beta shows that the return of an asset generally follows a trend that is opposite to that of the market. In other words, a positive beta indicates that the return of an asset moves in the same direction of the market, whereas a negative beta indicates that the return of an asset moves in the opposite direction of the market. A risk-free asset's beta is zero because its covariance with other assets is zero. In other words, a beta of zero indicates that the asset's return has no correlation with movements in the market. The market's beta can be calculated by substituting σ_m for σ_i in the numerator. Also, any asset's correlation with itself is 1, so the beta of the market is 1

As we have shown, beta captures an asset's systematic risk, or the portion of an asset's risk that cannot be eliminated by diversification. The variances and correlations required for the calculation of beta are usually based on historical returns.

EXAMPLE 5

Calculation of Beta

Assuming that the risk (standard deviation) of the market is 25 percent, calculate the beta for the following assets:

- 1 A short-term US Treasury bill.
- 2 Gold, which has a standard deviation equal to the standard deviation of the market but a zero correlation with the market.
- 3 A new emerging market that is not currently included in the definition of “market”—the emerging market’s standard deviation is 60 percent, and the correlation with the market is -0.1 .
- 4 An initial public offering or new issue of stock with a standard deviation of 40 percent and a correlation with the market of 0.7 (IPOs are usually very risky but have a relatively low correlation with the market).

We use the formula for beta in answering the above questions: $\beta_i = \frac{\rho_{i,m}\sigma_i}{\sigma_m}$

Solution to 1:

By definition, a short-term US Treasury bill has zero risk. Therefore, its beta is zero.

Solution to 2:

Because the correlation of gold with the market is zero, its beta is zero.

Solution to 3:

Beta of the emerging market is $-0.1 \times 0.60 \div 0.25 = -0.24$.

Solution to 4:

Beta of the initial public offering is $0.7 \times 0.40 \div 0.25 = 1.12$.

explain the capital asset pricing model (CAPM), including its assumptions

THE CAPITAL ASSET PRICING MODEL

The capital asset pricing model is one of the most significant innovations in portfolio theory. The model is simple, yet powerful; is intuitive, yet profound. The model provides a linear expected return–beta relationship that precisely determines the expected return given the beta of an asset.

$$E(R_i) = R_f + \beta_i [E(R_m) - R_f]$$

Assumptions of the CAPM

➤ ***Investors are risk-averse, utility-maximizing, rational individuals.***

Risk aversion and utility maximization are generally accepted as reflecting a realistic view of the world. Yet, rationality among investors has been questioned because investors may allow their personal biases and experiences to disrupt their decision making, resulting in suboptimal investments.

➤ ***Markets are frictionless, including no transaction costs and no taxes.***

frictionless markets do not have transaction costs, taxes, or any costs or restrictions on short selling. We also assume that borrowing and lending at the risk-free rate is possible.

➤ ***Investors plan for the same single holding period.***

The CAPM is a single-period model, and all investor decisions are made on the basis of that one period.

➤ ***All investments are infinitely divisible.***

This assumption implies that an individual can invest as little or as much as he or she wishes in an asset.

➤ ***Investors are price takers.***

The CAPM assumes that there are many investors, and that no investor is large enough to influence prices.

➤ ***Investors have homogeneous expectations or beliefs.***

This assumption means that all investors analyze securities in the same way using the same probability distributions and the same inputs for future cash flows. In addition, given that they are rational individuals, the investors will arrive at the same valuations.

Calculate Portfolio Beta

$$\beta_p = \sum_{i=1}^n w_i \beta_i; \sum_{i=1}^n w_i = 1$$

The portfolio's return given by the CAPM is

$$E(R_p) = R_f + \beta_p [E(R_m) - R_f]$$

EXAMPLE 8

Portfolio Beta and Return

You invest 20 percent of your money in the risk-free asset, 30 percent in the market portfolio, and 50 percent in RedHat, a US stock that has a beta of 2.0. Given that the risk-free rate is 4 percent and the market return is 16 percent, what are the portfolio's beta and expected return?

Solution:

The beta of the risk-free asset = 0, the beta of the market = 1, and the beta of RedHat is 2.0. The portfolio beta is

$$\beta_p = w_1\beta_1 + w_2\beta_2 + w_3\beta_3 = (0.20 \times 0.0) + (0.30 \times 1.0) + (0.50 \times 2.0) = 1.30$$

$$E(R_i) = R_f + \beta_i[E(R_m) - R_f] = 0.04 + 1.30 \times (0.16 - 0.04) = 0.196 = 19.6\%$$

The portfolio beta is 1.30, and its expected return is 19.6 percent.

Alternate Method:

Another method for calculating the portfolio's return is to calculate individual security returns and then use the portfolio return formula (i.e., weighted average of security returns) to calculate the overall portfolio return.

Return of the risk-free asset = 4 percent; return of the market = 16 percent

RedHat's return based on its beta = $0.04 + 2.0 \times (0.16 - 0.04) = 0.28$

Portfolio return = $(0.20 \times 0.04) + (0.30 \times 0.16) + (0.50 \times 0.28) = 0.196 = 19.6\%$

Not surprisingly, the portfolio return is 19.6 percent, as calculated in the first method.

Describe market efficiency

- An **informationally efficient capital market** is one in which the current price of a security **fully, quickly, and rationally reflects all available information** about that security. This is really a statistical concept
- An academic might say, “Given all available information, current securities prices are unbiased estimates of their values, so that the expected return on any security is just the equilibrium return necessary to compensate investors for the risk (uncertainty) regarding its future cash flows.”
- This concept is often put more intuitively as, “You can’t beat the market.” In a **perfectly efficient market**, investors should use a **passive investment** strategy (i.e., buying a broad market index of stocks and holding it) because **active investment** strategies will **underperform due to transactions costs and management fees**

- However, to the extent that market prices are **inefficient**, **active investment strategies can generate positive risk-adjusted returns**
- One method of measuring a market's efficiency is to determine the **time it takes for trading activity to cause information to be reflected in security prices** (i.e., the lag from the time information is disseminated to the time prices reflect the value implications of that information)

Distinguish between market value and intrinsic value

- The **market value** of an asset is its current price. The **intrinsic value** or **fundamental value** of an asset is the value that a **rational investor with full knowledge about the asset's characteristics would willingly pay for the asset**
- For example, a bond investor would fully know and understand a bond's coupon, maturity, default risk, liquidity, and other characteristics and would use these to estimate its intrinsic value
- In markets that are **highly efficient**, investors can typically **expect market values to reflect intrinsic values**. If markets are **not completely efficient**, active managers will **buy assets for which they think intrinsic values are greater than market values** and sell assets for which they think intrinsic values are less than market values
- Intrinsic values **cannot be known with certainty** and are estimated by investors who will have differing estimates of an asset's intrinsic value. The more **complex an asset**, the **more difficult it is to estimate its intrinsic value**. Furthermore, intrinsic value is constantly changing as new (unexpected) information becomes available

Explain factors that affect a market's efficiency

- Markets are generally neither perfectly efficient nor completely inefficient. The degree of informational efficiency varies across countries, time, and market types. **The following factors affect the degree of market efficiency**
 1. **Number of market participants**. The **larger the number** of investors, analysts, and traders who follow an asset market, **the more efficient the market**
 - The number of participants can vary through time and across countries. For example, some countries **prevent foreigners** from trading in their markets, **reducing market efficiency**

2. Availability of information. The more information is available to investors, the **more efficient the market**. In large, developed markets such as the New York Stock Exchange, information is plentiful and markets are quite efficient

- In **emerging markets**, the availability of information is **lower**, and consequently, **market prices are relatively less efficient**.
- Some assets, such as bonds, currencies, swaps, forwards, mortgages, and money market securities that trade in over-the-counter (OTC) markets, may have less available information
- Access to information should not favor one party over another. Therefore, regulations such as the U.S. Securities and Exchange Commission's Regulation FD (fair disclosure) require that firms disclose the same information to the public that they disclose to stock analysts
- **Traders with material inside information** about a firm are **prohibited from trading** on that information

3. **Impediments to trading.** **Arbitrage** refers to buying an asset in one market and simultaneously selling it at a higher price in another market

- This buying and selling of assets will continue **until the prices in the two markets are equal**. Impediments to arbitrage, such as high transactions costs or lack of information, will limit arbitrage activity and allow some price inefficiencies (i.e., mispricing of assets) to persist

4. **Transaction and information costs.** To the extent that the **costs of information**, analysis, and trading are **greater than the potential profit** from trading misvalued securities, **market prices will be inefficient**. It is generally accepted that markets are efficient if, after deducting costs, there are no risk-adjusted returns to be made from trading based on publicly available information

Contrast weak-form, semi-strong-form, and strong-form market efficiency

Professor Eugene Fama originally developed the concept of market efficiency and **identified three forms of market efficiency**. The difference among them is that each is based on a different set of information

Different assumptions about how much information is reflected in prices give rise to different types of market efficiency.

A market in which prices reflect all knowledge, including past and current publicly known and private information, is a **strong-form efficient market**. In such an efficient market, even corporate officers and other insiders cannot earn above-average, risk-adjusted profits from buying and selling stock. Even their detailed, exclusive information is reflected in current stock prices according to the strong-form hypothesis. Few markets can pass the test of strong-form efficiency, and insiders can profit from information not known by others. As discussed in the previous chapter, that is a reason why U.S. laws prohibit insider trading, or trading based on important, nonpublic information.

In a **semi-strong-form efficient market**, all public information, both past and current, is reflected in asset prices. The U.S. stock market appears to be a fairly good example of a semi- strong-form efficient market. News about the economy or individual companies appears to produce quick stock price changes without subsequent trends or price reversals.

A **weak-form efficient market** is a market in which prices reflect all past market information, such as past prices, price trends, and trading volume.