Risk and Return

The Risk-Return Trade-off

- All else equal, people like returns.
- All else equal, people dislike risk.

Calculating Percent and Dollar Returns

- On October 16, 2018, Home Depot stock closed at $193.58 It paid dividends of $1.03 per share on November 28, 2018, and $1.36 per share on March 13, _____, and _____, 2019. It is currently trading at $. What is your dollar return over this period? What is your percent return?

Calculating Percent and Dollar Returns

Home Depot

- The stock of Home Depot has had the following annual returns:

2018: -7.30%
2017: 44.61%
2016: 3.54%
2015: 28.52%

Mean

- Arithmetic Mean:

$$\overline{R} = \frac{(R_1 + \ldots + R_T)}{T}$$

Sample Variance (σ^2)

- The variance (σ^2) of returns tells us how much the actual returns each year vary from the average return. In other words, it is a measure of the volatility of returns.

$$\sigma^2 = \left[\frac{1}{T-1}\right] \times \left[\left(R_1 - \overline{R}\right)^2 + \left(R_2 - \overline{R}\right)^2 + \ldots + \left(R_T - \overline{R}\right)^2\right]$$

$$\sigma^2 = \frac{1}{T-1}\sum_{t=1}^{T}\left(R_t - \overline{R}\right)^2$$

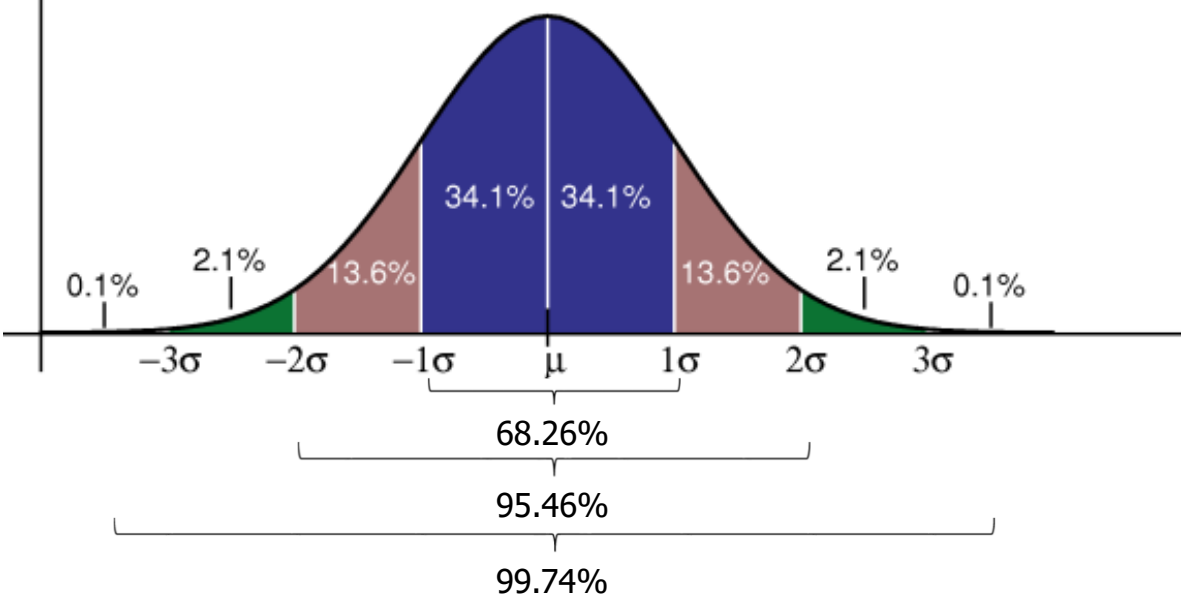
Sample Variance (σ^2)

Sample Standard Deviation (σ)

- The standard deviation (σ) is just the square root of the variance and explains the deviation from expected returns as a percentage.

$$\sigma = \sqrt{\sigma^2}$$

The Normal Distribution



Expected Returns

There are four possible states of the world: severe recession with a probability of 10%, slow growth with a probability of 30%, recovery with a probability of 40%, and boom with a probability of 20%. Big Maui, Inc. stock will have a return of -3% in the severe recession state, 3% in the slow growth state, 7% in the recovery state, and 10% in the boom state. What is the expected return on this stock?

Expected Returns

- Little Gulf, Inc. stock will have a return of 2% in the severe recession state, 4% in the slow growth state, 10% in the recovery state, and 20% in the boom state. What is the expected return on this stock?

Variance (σ^2) of Expected Returns

$$\sigma^2 = \left[P_1 \times \left(R_1 - \overline{R}\right)^2\right] + \left[P_2 \times \left(R_2 - \overline{R}\right)^2\right] + \ldots + \left[P_T \times \left(R_T - \overline{R}\right)^2\right]$$

$$\sigma^2 = \sum_{t=1}^{T} P_t \times \left(R_t - \overline{R}\right)^2$$

Standard Deviation (σ) of Expected Returns

$$\sigma = \sqrt{\sigma^2}$$

An Example

- Calculate the variance and standard deviation of the expected returns for Big Maui, Inc. and Little Gulf, Inc.

Variance (σ^2) and Standard Deviation (σ) of Expected Returns

Portfolio Returns

- The return on a portfolio is simply a weighted sum of the returns of the securities in the portfolio.

Portfolio Returns

- In 2018, Papa John's Pizza had a return of -33.7% and the Boston Beer Company had a return of 31.2%. If we had a $100 portfolio with $50 invested in Papa John's Pizza and $50 invested in the Boston Beer Company, what is the return on our beer and pizza portfolio?

Portfolio Expected Returns

- The expected return on a portfolio is simply a weighted sum of the expected returns of the securities in the portfolio.
- What is the expected return on an equally-weighted portfolio of Big Maui, Inc. and Little Gulf, Inc.?

Covariance

- The covariance of returns tells us how returns of different securities move together.

$$Cov\ (X,Y) = P_1\left[\left(X_1 - \overline{X}\right)\left(Y_1 - \overline{Y}\right)\right] + P_2\left[\left(X_2 - \overline{X}\right)\left(Y_2 - \overline{Y}\right)\right] + \ldots$$

$$Cov\ (X,Y) = \sum_{t=1}^{T} P_t\left(X_t - \overline{X}\right)\left(Y_t - \overline{Y}\right)$$

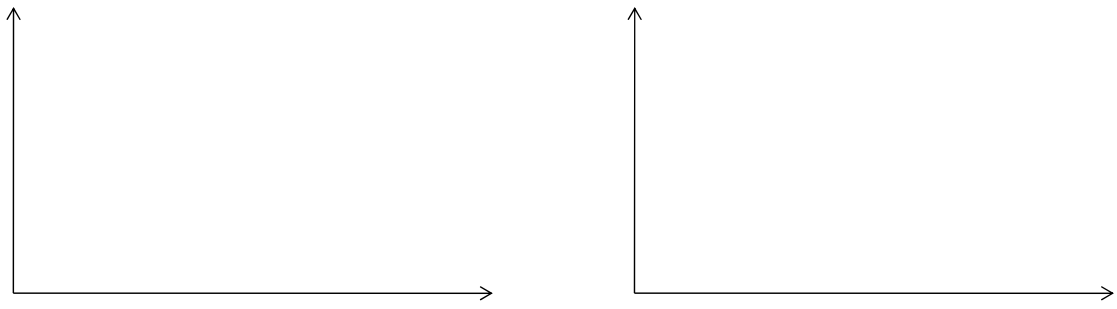
Correlation Coefficient (ρ)

- Like variance, covariance is unbounded. The correlation coefficient is a standardized measure of how returns move together. The correlation coefficient is always between –1 and +1.

$$Corr\ (X,Y) = \rho_{X,Y} = \frac{COV\ (X,Y)}{\sigma_X \times \sigma_Y}$$

$$Cov\ (X,Y) = \rho_{X,Y} \times \sigma_X \times \sigma_Y$$

Correlation Coefficient (ρ)



An Example

- Calculate the covariance and correlation coefficient of the expected returns for Big Maui, Inc. and Little Gulf, Inc.

An Example

Portfolio Variance and Portfolio Standard Deviation

- For a portfolio containing two securities, with weights w_1 and w_2, variances σ_1^2 and σ_2^2, and covariance $Cov(R_1,R_2)$:

$$\sigma_p^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2Cov(R_1,R_2)$$

$$\sigma_p^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\rho_{1,2}\sigma_1\sigma_2$$

Portfolio Variance and Portfolio Standard Deviation

- What if there are more than 2 assets?

An Example

- What are the variance and standard deviation of an equally-weighted portfolio of Big Maui, Inc. and Little Gulf, Inc.?

Diversification and Risk

- What is risk?
- Systematic and Unsystematic Risk
- What is diversification?
- What does diversification do?

Beta

- What does it measure?
- What is the market portfolio's beta?
- What is the beta of a risk-free asset?
- How do we calculate a beta coefficient?

The Capital Asset Pricing Model (CAPM)

- The CAPM: An equilibrium asset pricing model showing that the expected return for a particular asset depends on the pure time value of money plus a reward for bearing systematic risk.

$$\text{CAPM} \quad \Rightarrow \quad E(R_i) = R_f + \beta_i (R_M - R_f)$$

An Example

- What is the expected return on a share of stock whose beta is 1.15 if the risk-free rate is 4% and the expected return on the market is 10%?

Portfolio Betas

- An Example: We have $100 invested in stock A, which has an expected return of 7% and a beta of 0.5. We have $150 invested in stock B, which has an expected return of 11.2% and a beta of 1.2. We also have $250 invested in stock C, which has an expected return of 10% and a beta of 1.0. What is the expected return of this portfolio? What is the portfolio beta?

Strengths and Weaknesses of the CAPM

- Strengths:

- Weaknesses:

Chapters 10 and 11 Suggested Problems

- Concept Questions
  - Chapter 10: 3, 4, 6, and 7
  - Chapter 11: 2, 3, 4, 5, and 8
- Questions and Problems
  - Chapter 10: 1, 2, 3, 4 (part a only), 9, 13, and 14
  - Chapter 11: 2, 5, 10, 11, 12, 23, 26, and 27

Additional Practice

- There are three possible states of the world: recession (20% of the time), growth (60% of the time), and boom (20% of the time). Catwoman Cruiselines, Inc. earns -15%, 3%, and 25% in the recession, growth, and boom states, respectively. Batman Repossessions, Inc. earns 15%, -3%, and -6% in the recession, growth, and boom states, respectively.

Additional Practice

- What is the expected return of Catwoman Cruiselines, Inc.?

$$E(R_C) = 3.8\%$$

- What is the variance and standard deviation of the expected returns of Catwoman?

$$\sigma_C^2 = 0.0161$$
$$\sigma_C = 0.1269$$

Additional Practice

- What is the expected return of Batman Repossessions, Inc.?

$$E(R_B) = 0.0\%$$

- What is the variance and standard deviation of the expected returns of Batman?

$$\sigma_B^2 = 0.0058$$
$$\sigma_B = 0.0759$$

Additional Practice

- What are the covariance and correlation coefficient of the expected returns of Catwoman and Batman?

$$Cov(C,B) = -0.0080$$

$$Corr(C,B) = -0.8347$$

Additional Practice

- What is the expected return of an equally-weighted portfolio of Catwoman and Batman?

$$E(R_P) = 1.9\%$$

- What is the standard deviation of the equally-weighted portfolio?

$$\sigma_P = 0.0384$$