Chapter 6 - Risk & Return

- Returns
- Historical Returns
- Historical Risk
- Expected Returns
- Expected Risk
- Portfolios: Risk & Return
- Beta
- CAPM

Dollar Returns

- Total Dollar Return:
  - Income comes from:
- Dividend Income
- Capital Gain Income

Total dollar return = Amt Received – Amt Invested

Total dollar return = Dividend Income + Capital Gain (or loss)

Percentage Returns

In investments it is more correct to state returns in percentage terms

Total return = Amt Received – Amt Invested / Amount Invested

Total return = Dividend Yield + Capital gains Yield

Dividend yield = D_{t+1} / P_t

Capital gains yield = $(P_{t+1} - P_t) / P_t$

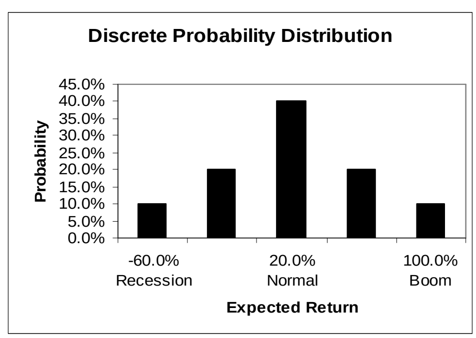
Risk

- What is risk?
- The chance that some unknown event will occur.
- Investment risk is the probability of earning different than the expected return
- Probability distributions graphically show the risk, list possible outcomes with probabilities
- Discrete - lists all possible outcomes
- Continuous - unlimited number of possible outcomes

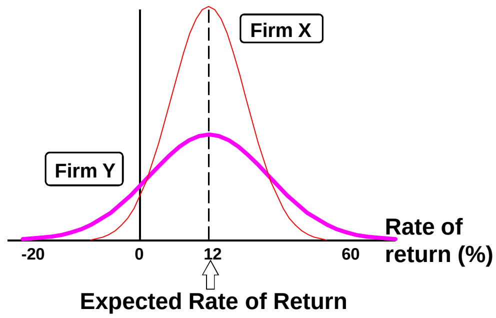
Discrete Probability Distribution

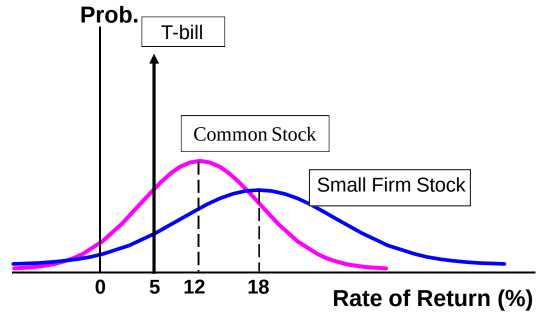
State of the Economy	Probability of the State Occurring	Expected Return under this State
Recession	10.0%	-60.0%
Downturn	20.0%	-20.0%
Normal	40.0%	20.0%
Upturn	20.0%	60.0%
Boom	10.0%	100.0%

Discrete Probability Distribution



Continuous Probability distribution





Types of data

- Ex-ante data:
- Ex-post data:
- What type of data was on the previous slide
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- How do we measure risk?
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Return & Standard Deviation

Ex-ante:

Expected return:

$E(R) = \sum P_i R_i$ from i=1 to n

Standard Deviation:

$\sigma = \sqrt{\sum (R_i - E(R))^2 P_i}$ from i=1 to n

Calculation of Expected Return

$E(R) = \sum P_i R_i$ from i=1 to n

State of the Economy	Probability of the State Occurring	Expected Return under this State	Expected Return (col 2 x col 3)
Recession	10.0%	-60.0%	
Downturn	20.0%	-20.0%	
Normal	40.0%	20.0%	
Upturn	20.0%	60.0%	
Boom	10.0%	100.0%	

Calculation of Standard Deviation

$\sigma = \sqrt{\sum (R_i - E(R))^2 P_i}$ from i=1 to n

Probability of the State Occurring	Expected Return under this State	R_i - E(R)	$(R_i - E(R))^2$	$(R_i - E(R))^2 P_i$
10.0%	-60.0%	-80.0%	6400	
20.0%	-20.0%	-40.0%	1600	
40.0%	20.0%	0.0%	0	
20.0%	60.0%	40.0%	1600	
10.0%	100.0%	80.0%	6400	
			variance =	

Coefficient of Variation

CV shows the risk per unit of return

CV = σ / E(R)

E(R) = 20%
σ = 43.8%
CV = σ / E(R)
CV =

Return & Standard Deviation

Ex-post:

Return:

$$\overline{R} = \frac{\sum R_t}{n} \quad \text{from t=1 to n}$$

Standard Deviation:

$$\sigma = \sqrt{\frac{\sum (R_t - \overline{R})^2}{n - 1}} \quad \text{from t=1 to n}$$

Ex-post Return & Standard Deviation Calculation

$$\overline{R} = \frac{\sum R_t}{n} \quad \text{from t=1 to n} \qquad \sigma = \sqrt{\frac{\sum (R_t - \overline{R})^2}{n - 1}}$$

Date	Return	R_t - R	$(R_t - R)^2$
1992	12%	4.0%	
1993	14%	6.0%	
1994	-4%	-12.0%	
1995	8%	0.0%	
1996	10%	2.0%	
return =	8%		
	variance = 200 / (5 - 1) =		
	standard deviation =		

- Most investors are **risk averse.**

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Portfolio Return

- The portfolio return, ex-ante or ex-post is based upon all of the stocks in the portfolio:

$$R_P = \sum w_j R_j \quad \text{from j=1 to n}$$

where:
w_j = weight of each stock in the portfolio
R_j = return of each stock in the portfolio

Portfolio Standard Deviation

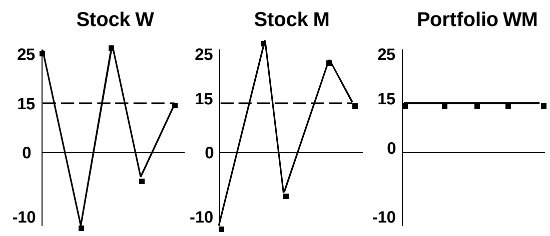
- The portfolio standard deviation is not the weighted average of the individual stock's standard deviations.
- It also depends on the relationship between the individual securities, the correlation coefficient.

- Correlation Coefficient:
- Measures the tendency of two stock's returns to move together.

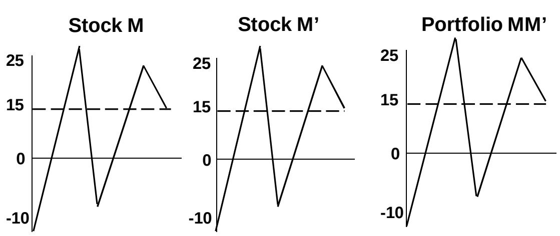
$$-1.0 \le \rho \le +1.0$$

- Perfect positive correlation: +1.0
- Perfect negative correlation: -1.0
- Perfect negative correlation gives maximum risk reduction
- Perfect positive correlation gives no risk reduction
- Correlation between -1.0 and +1.0 gives some, but not all, risk reduction

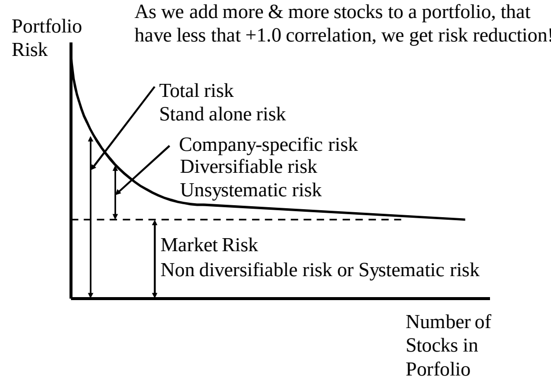
Returns Distribution for Two Perfectly Negatively Correlated Stocks (r = -1.0) and for Portfolio WM



Returns Distributions for Two Perfectly Positively Correlated Stocks (r = +1.0) and for Portfolio MM'



As we add more & more stocks to a portfolio, that have less that +1.0 correlation, we get risk reduction!



Types of Risk

- Company-specific risk, diversifiable risk, unsystematic risk: caused by events specific to one firm, part of the risk that can be eliminated by diversification.
- Market risk, nondiversifiable risk, systematic risk: caused by events that affect all firms (such as inflation, recessions, interest rates, war), part of the risk that can not be diversified away.
- Total risk (stand alone risk): sum of company-specific and market risk
- Market risk is the relevant risk, it reflects a securities contribution to the portfolio risk.

Beta Risk

- Beta (ß) measures the tendency of a stock to move with the market.
- Beta is a measure of the stock's volatility (riskiness) relative to the market.
- What is the market?
- The market has a beta of 1.0.
- A stock that is riskier than the market has a beta > 1.0.
- A stock that is less risky than the market has a beta < 1.0.
- Beta measures the contribution of a stock's risk to the portfolio risk.
- Beta takes into account the correlation of returns & risk between securities in a portfolio.

$$\beta_i = \left(\frac{\sigma_i}{\sigma_M}\right)\rho_{i\,M}$$ (use this formula for problem 6-13)

Portfolio Beta

- Calculate beta for a portfolio as:

  $ß_P = \sum w_j ß_j$ from j=1 to n

where:

w_j = weight of each stock in the portfolio

$ß_j$ = beta risk of each stock in the portfolio

Portfolio Return

- To calculate the return on a portfolio:
- Start with the market risk premium:

  $k_M - k_{RF}$

  the return over the risk-free rate
- Then add the stock's risk premium, beta:

  $ß_j (k_M - k_{RF})$

  to get the return of the individual stock over the risk-free rate
- Add back the risk-free rate to get the stock's return:

  $k_j = k_{RF} + ß_j (k_M - k_{RF})$

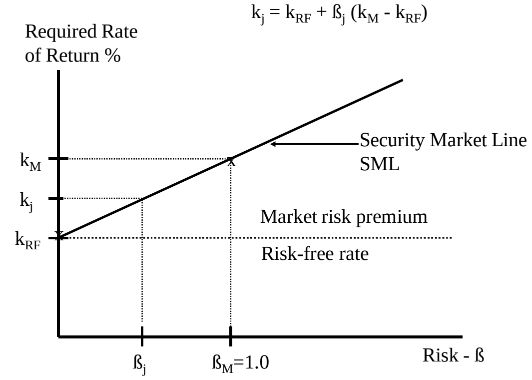
CAPM

- This is the CAPM

  Capital Asset Pricing Model

  $k_j = k_{RF} + ß_j (k_M - k_{RF})$
- The CAPM shows the relationship between risk (beta) and required return for individual securities.
- The CAPM can be used to find the required return for any security, given we know beta.

CAPM



CAPM Example

Assume the return on the market is 12%, the risk-free rate is 4%, and the beta for ABC Corporation is 1.2. What is the required return for this stock?

$k_j = k_{RF} + ß_j (k_M - k_{RF})$

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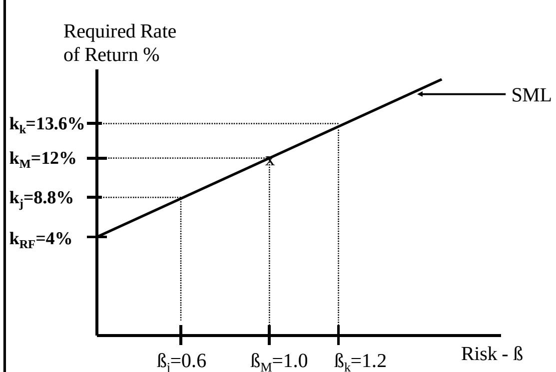
What is the required return if the stock's beta is 0.6?

$k_j = k_{RF} + ß_j (k_M - k_{RF})$ =

CAPM Example



Beta Example

Assume Stetson fund has $450 million in 5 stocks, as shown below:

Stock	Inv (M$)	Beta
1	$130	0.4
2	110	1.5
3	70	3.0
4	90	2.0
5	50	1.0

Calculate the portfolio beta and required return, using 12% as the risk-free rate and 18% as the market return.

Beta Example continued

Portfolio Beta:

The five stocks add up to $450 million in assets, so

$ß_P$ =

Required Return:

$k_j = k_{RF} + ß_j (k_M - k_{RF}) =$

Changes in the SML

- What would we expect to happen to the SML with a change in inflation expectations?
- What would we expect to happen to the SML with a change in risk aversion?
- What would we expect to happen if the risk of one company's stock changed?

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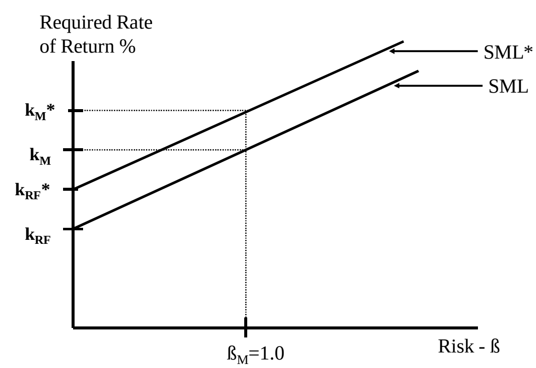
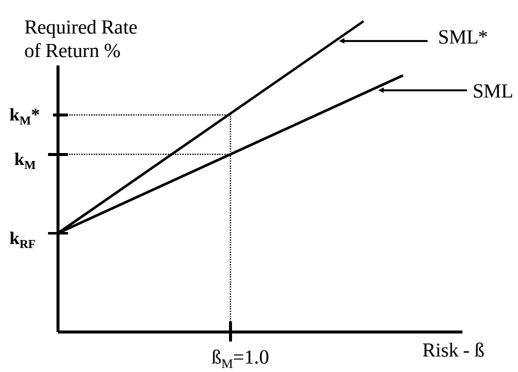
Changes in Inflation Expectation Example



Changes in Risk Aversion Example



Changes in Company Specific Risk Example