Midterm 2 Guide

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1 Lecture 7

1.1 Efficient Markets:

Aspects of Market Efficiency
The term *efficient market* is related to the idea of informational efficiency and is a market where **asset prices reflect all available information**
[Past Information->[Public Information->[Private Information]]]
Factors*Factors that Affect Efficient Markets*

- *Time Frame of Price Adjustments* - If the time frame of price adjustments allows many traders to earn profits with little risk, then the market is considered relatively inefficient.
  - In certain markets, such as foreign exchange and developed equity markets, market efficiency relative to certain types of information has been studied using time frames as short as one minute or less. Chordia, Roll, and Subrahmanyam (2005) suggest that the adjustment to information on the New York Stock Exchange (NYSE) is between 5 and 60 minutes.
- *Transaction Costs and information: acquisition costs* - This is something investors should consider when evaluating the efficiency of a market.
  - A price discrepancy must be sufficiently large enough to leave the investor with a profit (adjusted for risk) after taking account of the transaction costs and the information-acquisition costs to reach the conclusion that the discrepancy may represent a market inefficiency
  - Market discrepancy would refer to the fact that sell price is not equal to buy price. Thus, with that kind of difference, the investor could have a profit if sell price > buy price. So if we're attempting to reach the conclusion that the market is inefficient, then since: Profit(π)= sell price - (buy price + transaction costs + information acquisition costs), if this $\pi > 0$ in a "significant" way, then the market is inefficient
- *Other Factors*
  1. The number of market participants and their trading activities
  2. financial disclosure
  3. limits to trading
     - restrictions on short-selling
- *Market Value versus Intrinsic value*
  - Market Value - the price at which a asset can currently be bought and sold
  - Intrinsic Value - AKA fundamental value is the value that would be placed on an asset if investors had a complete understanding of the asset's investment characteristics
    * If the investors believe a market is highly efficient, they will usually accept market prices as reflecting the intrinsic values accurately

1.2 Active vs Passive

Active vs Passive Investment Strategies
So, we must note that Market Efficiency and Active Investment strategies work in opposite ways:

- This is mostly because the active investment strategy works by trying to beat the market. Market Efficiency would mean that essentially, the market cannot be beat.

The extent to which a market is efficient affects the number of profitable trading strategies:

- Passive Strategies - buying and holding a broad market portfolio
  - will outperform active strategies due to cost advantages if markets are highly efficient
- Active investment - may outperform a passive strategy on a risk-adjusted basis if markets are inefficient

Think of a market as being on a spectrum
|Completely Inefficient|————————-(Large Cap Stocks)————————-|Completely Efficient|
Notes:

- Asset prices in a highly efficient market, by definition, reflect information more quickly and more accurately than in a less-efficient market.
- These degrees of efficiency also vary through time, across geographical markets and by type of markets:
- Markets that are considered highly efficient:
  - Large Cap US Stocks
  - US gov't securities
- Markets that are considered less efficient
  - Small Cap US Stocks
  - International Stocks
  - Real Estate and Venture Capital

Fama's forms of Market Efficiency - Eugene Fama developed a framework to decide the degree to which markets are efficient. Each form is defined with respect to the available information that is reflected in the prices.
A finding that investors can consistently earn abnormal returns by trading on the basis of information is evidence is contrary to market efficiency.
In general, abnormal returns are returns in excess of those expected given a security's risk and the market's return.
Abnormal return equals actual return - expected return.
Market Prices Reflect the following, according to Fama:

Forms of Market Efficiency	Past Market Data	Public Information	Private Information
Weak form of Market Efficiency	✓	✗	✗
Semi-strong form of market efficiency	✓	✓	✗
Strong form of market efficiency	✓	✓	✓

Active Management Performance
Jensen's Alpha - tool to identify skilled mutual fund managers in an absolute manner rather than a relative manner
He wanted to answer the question: *Was the manager able to consistently earn returns higher than expected given the level of market-related risk taken?*
Jensen's Alpha is a risk-adjusted measure of an investment's performance.
It takes the volatility of an individual investment and compares its risk-adjusted performance to a benchmark index

Jensen's Alpha

$$\alpha_p = \mathbb{E}(R_p) - [R_F + \beta_P(\mathbb{E}(R_M) - R_F)]$$
$$= \mathbb{E}(R_P) - R_F - \beta_P(\mathbb{E}(R_M) - R_F)$$

Note: second main operand of the first equation is the CAPM equation

Jensen's measure measures a fund manager's performance against the returns that could have been expected from a market-related investment while adjusting for the fund's correlation to that market

- $\mathbb{E}(R_P)$ should be the risk adjusted portfolio return
- Jensen's alpha is commonly used for evaluating:
  - institutional managers
  - pension funds
  - mutual funds
- Values of alpha can be used to rank:
  - different managers
  - performance of their portfolios
  - magnitude of underperformance/overperformance
    - *For instance*: If a portfolio's (A_P) alpha is 2% and another portfolio's (B_P) alpha is 5%. Then, we note that A_P has outperformed B_P by 3% *and* that B_P has beaten the market by 5%
- Jensen's alpha is the *max amount* that you should be willing to pay the manager to manage your money

1.3 Beta β_P

Beta β_P

- If we hold a well diversified portfolio, we can essentially eliminate the unsystematic risk (the specific risk)
- We also realize that each security has its own unique level of market risk
- We find a measure of the non diversifiable or market risk that indicates how the price of a security reponds to market forces as **beta**
- Thus, essentially, beta is the measure of the systematic risk.
- Portfolio M Risk = security1 market risk + security2 market risk +...+securityN market risk
- Standard Deviation (σ) is total risk, $\rightarrow$ we are currently working with beta
- Beta is found relating the historical returns with the market return.
- $\beta_i = \frac{\sigma_i}{\sigma_M} CORR_i(i, M) \rightarrow \beta_i \frac{CORR(i,M)}{\sigma_M^2}$
Market $\beta = 1$	
Security $\beta < 1$	risk < market portfolio risk
Security $\beta > 1$	risk > market portfolio risk

- Security beta > 1 means security contributes more than average risk to a well diversified portfolio
- Numerical value of beta is important to return
  - For instance, if stock COST has beta of 0.83, then this means that the market portfolio return changes 1% COST return will change by 0.83%
- Beta is a relative measure, so relative to what market index makes a difference
- High beta security returns move more aggressively than the market portfolio and low beta security returns move conservatively

Portfolio Betas

$$\beta_P = \sum_{i=1}^{N} w_i \beta_i = (0.4 \cdot 1.5) + (0.6 \cdot 1.2) = 1.32$$

The portfolio's expected return given by the CAPM is:

$$\mathbb{E}(R_P) = R_F + \beta_P[\mathbb{E}(R_m) - R_f]$$
$$\mathbb{E}(R_P) = 3\% + 1.32[9\% - 3\%] = 10.92\%$$

Beta Notes

This means that if we have 40% invested in 1 security with β 1.5 and 60% invested with security 2 with β 1.2 and a 9% $\mathbb{E}(R_M)$.

Portfolio beta is the weighted sum of component securities betas.

Article: VaR vs Expected Shortfall (ES)

Value-at-risk - the loss level that will not be exceeded with a certain confidence level during a certain period of time.
For instance, if a bank's 10-day 99% VaR is 3 million, you could lose 3 million on average 5% of the time.
Is VaR the best choice?
Expected Shortfall - a measure that produces better incentives for traders than VaR is expected shortfall. (Sometimes referred to as conditional VaR or tail loss).
Another way of thinking about it is:
VaR asks the question: How bad can things get?
ES asks: If things do get bad, what is our expected loss?
More on ES

- it's like VaR, function of 2 parameters: N (time horizon in days) and X% (confidence interval)
- It's the $\mathbb{E}(Loss)$ during an N-day period, conditional that the loss is > than the Xth percentile of the loss distribution.
  - For instance: X=00, N=10, the ES is the avg amount that is lost over a 10 day period.
  - Thus, we can assume that the loss is greater than the 99th percentile of the loss distribution

Conclusion: Regulators make extensive use of VAR and its importance as a risk measure is therefore unlikely to diminish. However, expected shortfall has a number of advantages over VAR. This has led many financial institutions to use it as a risk measure internally.

Risk Management

- Deviation and risk are different management concepts
- Deviation is volatility price fluctuation
- Risk is chance of loss how much can we lose in a given time frame?

1.4 Value at Risk

- A statistical technique used to measure and quantify the level of financial risk within a firm or investment portfolio over a specific time frame
- VaR is measured in three variables: the amount of potential loss, the probability of that amount of loss, and the time frame
- For instance:
  - A financial firm may determine that is has a 5% one month value at risk of $100 million.
  - This means that there is a 5% chance that the firm could lose more than $100 million in any given month.
  - Thus, a $100 million loss should be expected to occur once every twenty months.

3 broad approaches to VaR

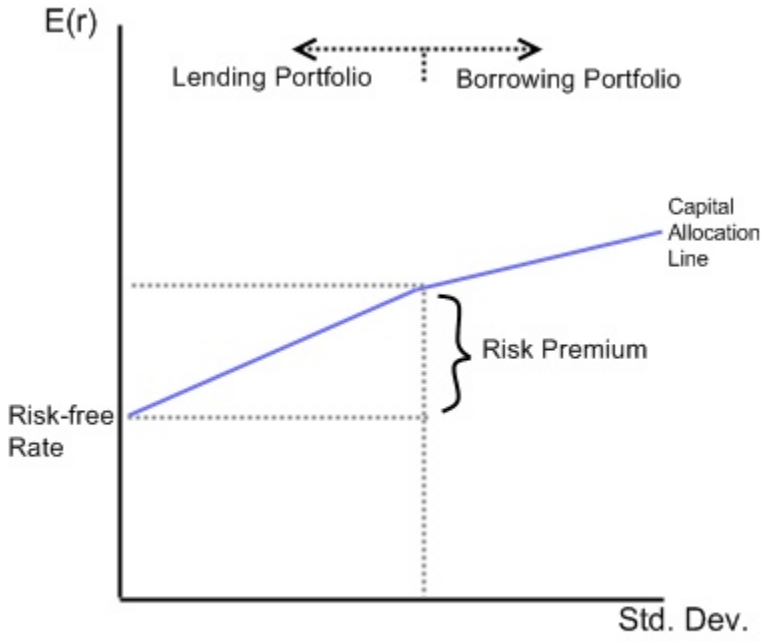
- **Historical** - This method consists of going back in time, e.g. over the last 5 years, and applying current weights to a time-series of historical asset returns. This return does not represent an actual portfolio but rather reconstructs the history of a hypothetical portfolio using the current position. Of course, if asset returns are all normally distributed, the VAR obtained under the historical-simulation method should be the same as that under the delta-normal method.
- **Monte Carlo** - First, the risk manager specifies a stochastic process for financial variables as well as process parameters; the choice of distributions and parameters such as risk and correlations can be derived from historical data.
  Second, fictitious price paths are simulated for all variables of interest. At each horizon considered, which can go from one day to many months ahead, the portfolio is marked-to-market using full valuation. Each of these "pseudo" realizations is then used to compile a distribution of returns, from which a VAR figure can be measured.
- **Delta Normal** - The delta-normal method assumes that all asset returns are normally distributed. As the portfolio return is a linear combination of normal variables, it is also normally distributed. This method consists of going back in time, e.g. over the last 5 years, and computing variances and correlations for all risk factors. Portfolio risk is then generated by a combination of linear exposures to many factors that are assumed to be normally distributed, and by the forecast of the covariance matrix.
- **Comparisons**
  - *Delta-Normal Method:* This is the simplest method to implement. Drawbacks, however, are the assumptions of normal distributions for all risk factors, and that all securities are linear in the risk factors (e.g. no options).
  - *Historical-Simulation Method:* This is also relatively simple to implement. We just keep a historical record of previous price changes; distributions can be non-normal, and securities can be non-linear. One drawback is that only one sample path is used, which may not adequately represent future distributions.
  - *Monte Carlo Method:* This is the most sophisticated method. It allows for any distribution and non-linear securities. The method, unfortunately, requires computer time and a good understanding of the stochastic process used.

2 Lecture 8

2.1 Capital Allocation Line (CAL)

The capital allocation line (CAL) is a line created on a graph of all possible combinations of risk-free and risky assets. The graph displays to investors the return they might possibly earn by assuming a certain level of risk with their investment. The slope of the CAL is known as the reward-to-variability ratio (Investopedia).
CAL - describes the optimal expected return and standard deviation combinations available from combining risky assets with a risk-free asset.

- This is a line originating at the expected return - that is, the standard deviation coordinates of the risk-free asset and the lying tangent to the efficient frontier.
  - The slope of this line is known as the **Sharpe** ratio, and it represents the best possible risk - return trade off by construction



$$\mathbb{E}(R_P) = R_F + \frac{\mathbb{E}(R_T) - R_F}{\sigma_{R_T}} \cdot \sigma_P$$

The intercept is the risk-return coordinate for the risk-free asset $(R_F, 0)$.
The slope is the excess return $\mathbb{E}(R_T) - R_F$ per unit of risk $\sigma_R T$

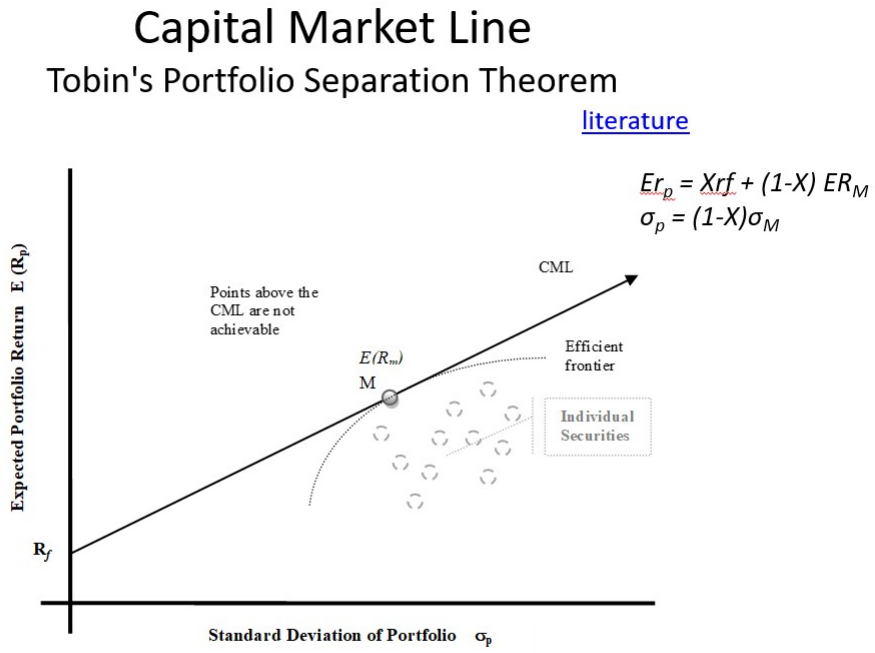
2.2 Capital Market Line (CML)

The Capital market line, shown below has the same axes as the CAL. However, the CML is tangent to the Efficient Frontier.
Note that all the points on the interior of the Markowitz Efficient Frontier are inefficient portfolios in that:

- they provide the same level of return with a higher level of risk or

- they provide lower level of return and the same amount of risk

Note that the point at which the CML is tangent to the Markowitz efficient frontier is the *optimal combination of risky and risk-free assets based on market prices and market capitalizations.* The optimal risky portfolio is the market portfolio.
Note that the *capital market line* is a special case of the capital allocation line in which the risky portfolio is the market portfolio.



We can exist above the efficient frontier
if we create a portfolio of the *rf* and the tangent market portfolio

Formulas:

$$\mathbb{E}(R_p) = w_i R_f + (1 - w_i)\mathbb{E}(R_m)$$

$$\sigma_p = (1 - w_1)\sigma_m$$

By substitution, $\mathbb{E}(R_p) = R_f + \frac{\mathbb{E}(R_m) - R_f}{\sigma_m} \cdot \sigma_p$
Note that the y-intercept is the risk-free rate and the slope of the line referredto as the market price of risk is $\frac{\mathbb{E}(R_m) - R_f}{\sigma_m}$

2.3 Capital Asset Pricing Model CAPM

- Since risk averse investors will invest in portfolios with optimal risk-return we look to develop risk-return relationship for securities
  - Only by quantifying a stock's risk can we determine a reasonable expected return for a stock
  - We can compare this predicted return with a required return to decide if this is a good investment

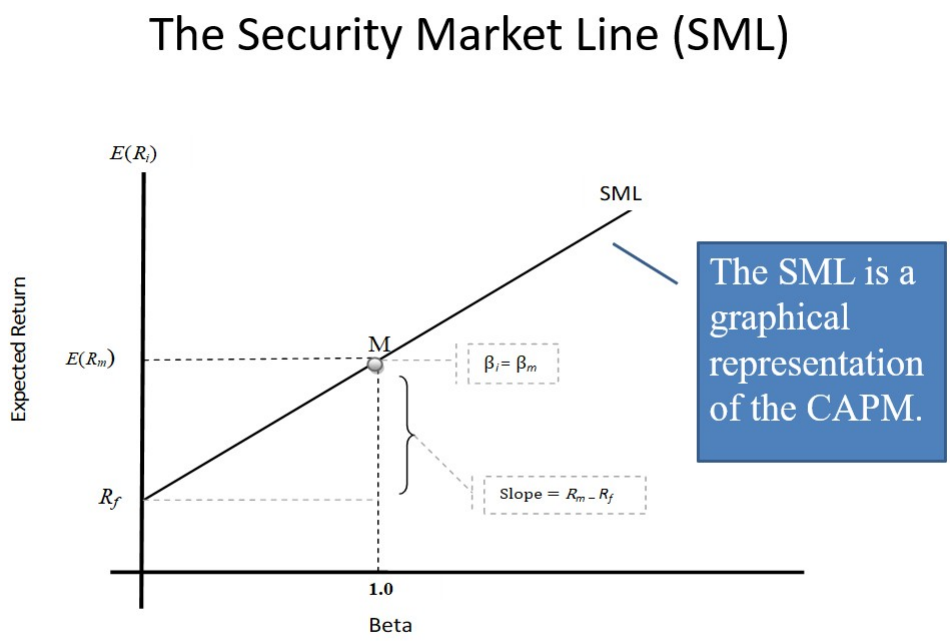
CAPM:

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

, where β is the relative risk of the asset to the market

$$\mathbb{E}(R_p) = R_F + \lambda_1 \beta_{p,1}$$

, where the λ_1 is the risk premium for factor 1 and $\beta_{p,1}$ is the sensitivity of of the portfolio to factor 1



2.4 Multifactor Models

Models of asset returns that use more than one underlying source of risk, known as a multi-factor models

- Features of multifactor models
  - The underlying sources of risk are known as systematic factors and referred to as priced risks
  - Multifactor models explain asset returns better than the market model
  - Multifactor models provide a more detailed analysis of risk than single factor models
- Categories of multifactor models
  - *Macroeconomic* - the factors are suprises in macro vars
  - the factors are attributes of stocks or companies
  - The factors are determined statistically and are often the return on differing portfolios is the component of the factor's return that is unexpected - the difference between the realized value and the predicted value - the error