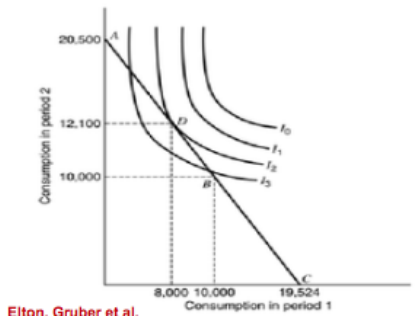
Lecture 1: Introduction to the finance terminology and basic concepts

- Financial Market, Market Participants, and Financial Securities. Be familiar with the notions of preference relation, utility function, certain equivalent and risk premium.
- Physical occupy a physical location, usually a trading floor, where buyers and sellers meet in person vs OTC Market are geographically dispersed markets, where buyers and sellers 'meet' over the telephone or by computer.
- Type of market are broker market or dealer market.
- Type of securities are fixed income, derivatives, equities.
- Utility Function (Choice Under Certainty):



Elton, Gruber et al.

Lecture 2: Portfolio Theory

The **marginal distribution** is simply the function that gives the probability associated with different return outcomes, irrespective of the returns of other securities.

- Expected Return

$$\bar{r} = \frac{1}{T}\sum_{t=1}^{T} r_t$$

$\bar{r}$	expected return (or mean return); E(R)
T	number of observations
R_t	return of the stock at time t
$\sum$	we sum the returns of the sample data and then we

- Continuously Compounded Return with Logarithm

$$\begin{aligned} r_{t+1} &= \ln(1 + R_{t+1}) \\ &= \ln\left(\frac{p_{t+1}}{p_t}\right) \\ &= \ln p_{t+1} - \ln p_t \end{aligned}$$

- Expected Return with Prob

ıssible return

$$E(R) = \sum_{s=1}^{S} p(s)\,R(s)$$

where:

$E(R)$	expected return
s	possible scenarios, s =1,…S
p_s	probability of s scenario)
R_s	return in each scenario
$\sum$	we sum the product

- Correlation must lie between minus one and plus one.

- Correlation coefficient

$$\rho_{AB} = \frac{\sigma_{AB}}{\sigma_A \sigma_B}$$

where:

ρ_{AB}	correlation between stocks A and B
σ_{AB}	covariance between stocks A and B
σ_A	standard deviation of stock A
σ_B	standard deviation of stock B

- Covariance based on probabilities

$$\sigma_{AB} = \sum_{s=1}^{S} p_s (r_{A,s} - \bar{r}_A)(r_{B,s} - \bar{r}_B)$$

- Markowit'z Diversification combine assets that are less than perfectly positively correlated in order to reduce portfolio risk without sacrificing portfolio returns. Diversification can be across industry. Diversification substantially reduce variability of returns without an equivalent reduction in expected returns.
- Asset Expected Return, Variance, Covariance:

✓ Expected return $\bar{r} = \frac{1}{T}\sum_{t=1}^{T} r_t$

✓ Variance $\hat{\sigma}^2 = \frac{1}{T}\sum_{t=1}^{T} (r_t - \bar{r})^2$

✓ Covariance $\hat{\sigma}_{A,B} = \frac{1}{T}\sum_{t=1}^{T} (r_{A,t} - \bar{r}_A)(r_{B,t} - \bar{r}_B)$

- Return as Random Variable
- Variance

$$\sigma_p^2 = w_A^2 \sigma_A^2 + (1 - w_A)^2 \sigma_B^2 + 2 w_A (1 - w_A) \sigma_{AB}$$

- Covariance
- Expected Return of Portfolio

$$E(r_p) = wE(r_A) + (1 - w)E(r_B)$$

where:

$E(r_p)$	expected return of a portfolio
w	weight
$E(r_A)$	expected return of stock A
$E(r_B)$	expected return of stock B
(1-w)	1 minus weight (i.e if the weight for stock A is 30% the weight for stock B is 70% (1-0.7)

- Standard Deviation of the portfolio:

$$\sigma_p = \sqrt{w^2 \sigma^2{}_A + (1 - w)^2 \sigma_B{}^2 + 2w(1 - w)\sigma_{AB}}$$
$$= \sqrt{w^2 \sigma^2{}_A + (1 - w)^2 \sigma_B{}^2 + 2w(1 - w)\rho_{AB} \sigma_A \sigma_B}$$

σ_p	standard deviation of a portfolio
w^2	weight that corresponds to stock A
$\sigma^2 A$	variance of stock A
$(1-w)^2$	weight that corresponds to stock B
$\sigma^2 B$	variance of stock B
w	weight that corresponds to stock A
(1-w)	weight that corresponds to stock B
σ_{AB}	covariance between the two stocks A and B

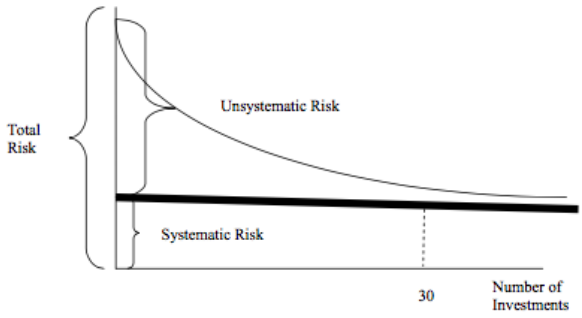
Potential Question

Question 1C 2015
Define and explain the terms of "systematic risk" and "non-systematic risk".
Which type of risk is relevant for pricing assets and why?

The total risk of a security, which is measured by its standard deviation, can be decomposed into systematic risk and non systematic risk.

Non systematic risk is part of the variance of a stock that is eliminated when it is combined in a well diversified portfolio, and is due to the firm specific component of the return. The non systematic risk is the one that affects a single asset or a small group of assets. For example: e.g the risk of bad or fraudulent management, the risk of a plant fire, a labor strike.

The systematic risk of a stock is the part of the stock's variance that contributes to the total variance of a well diversified portfolio. It is the risk that influences a large number of assets, each to a lesser or greater extent. For example, uncertainties for example about general economic conditions such as GDP, interest rates, or inflation are examples of systematic risks.

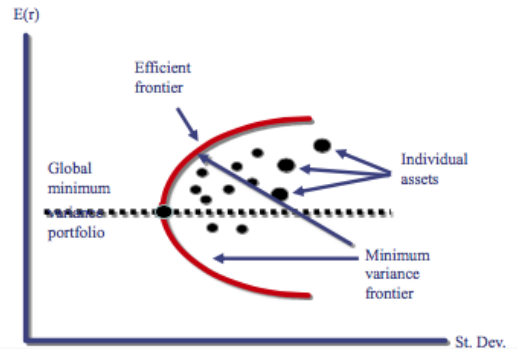


Lecture 3: Efficient Portfolios

Portfolios that have lowest standard deviation given their expected return and the highest expected return given their standard deviation

- Feasible set is the set that contains all possible portfolios made up of different combinations of the N assets.
- Minimum variance set, or the envelope, comprises the portfolios that have the lowest standard deviation (variance) for any given expected return
- Solving minimisation problem:

$$\min \sigma_p = \sum_{i=1}^{N} w_i^2 \sigma_i^2 + \sum_{i=1}^{N} \sum_{\substack{j=1 \\ j \neq i}}^{N} w_i w_j \sigma_{ij}$$

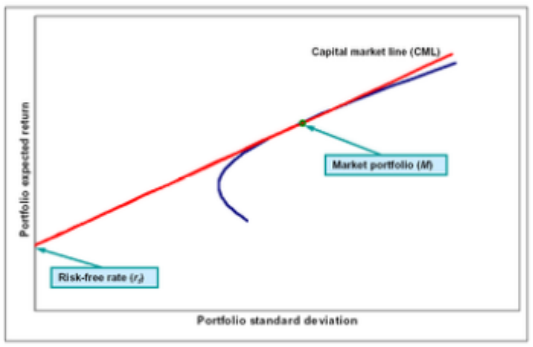


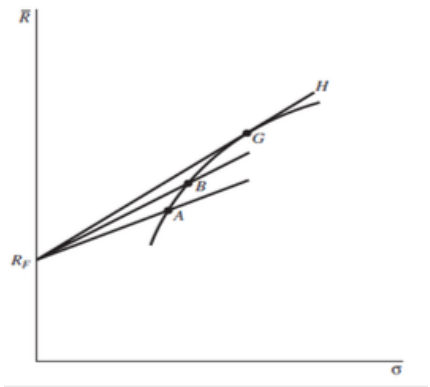
- Capital Market Line shows the trade-off between risk and return for a portfolio that consist of the risk free rate asset and the market portfolio.

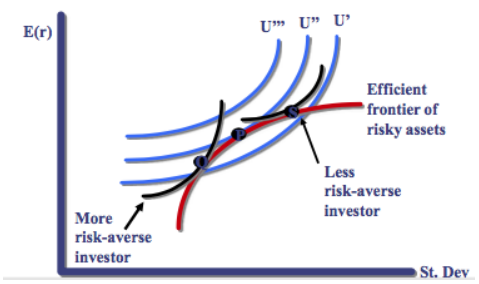
$$E(R_\rho) = R_f + \sigma_\rho \left(\frac{E(R_M) - R_f}{\sigma_M}\right)$$

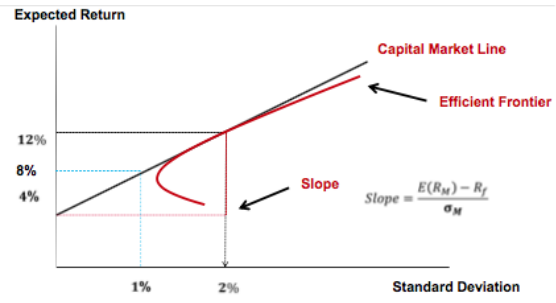
where:

$E(R_P)$	expected return of the portfolio
R_f	risk free rate
σ_p	standard deviation of the portfolio
$E(R_M)$	expected return of the market
σ_M	standard deviation of the market





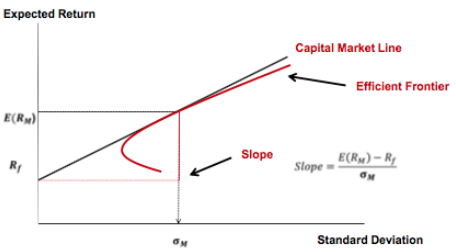




Suppose the Expected Return on the market is 12%, the risk free rate is 4% and the standard deviation of the market is 2%. Find the expected return for a portfolio that has a standard deviation of 1%.

$$E(R_\rho) = R_f + \sigma_\rho \left(\frac{E(R_M) - R_f}{\sigma_M}\right)$$

$$4\% + 1\% \left[\frac{12\% - 4\%}{2\%}\right] = 8\%$$



Potential Question:

- What are the expected returns of stock A and B based on the Security Market Line (SML) and Capital Market Line (CML).

Stock	α	β	σ_e
A	2%	1.3	30%
B	10%	1.2	40%

You also estimate that the expected return on the market portfolio is 16%, the standard deviation of the market portfolio is 20%, and the riskless rate is 8%.

CML Expected Return (Use SD from Single Factor Model:
A: 8% + 39.6% ((16% - 8%) / 20%) = 23.88
B: 8% + 46.6% ((16% - 8%) / 20%) = 26.64

SML Expected Return
A: 8% + 1.3 (16% -8%) = 18.4%
B: 8% + 1.2 (16% -8%) = 17.6%

Standard Deviation (Using Single Factor Model Formula Lecture 4)
A: 1.3^2 x 20%^2 + 30%^2 = 1.69 x 0.04 + 0.09 = 0.1576 = 0.396
B: 1.2^2 x 20%^2 + 40%^2 = 1.44 x 0.04 + 0.16 = 0.2176 = 0.466

Lecture 4: Factor Models

- Single Factor Model (Relates to CAPM), individual return are driven by a single common factor. Single factor model will not adequately capture the covariance structure of return.
  - If we assume that the common covariance with the market is the ony source of correlation between individual stock returns, then the expected error for i and j is 0 for all I not equal j

$$r_{it} = \alpha_i + \beta_i r_{Mt} + \varepsilon_{it}$$

  - The parameter beta measures **the sensitivity of the stock's return to changes in the market return,** and under the assumptions of the single factor model is

$$\beta_i = \frac{\sigma_{iM}}{\sigma_M^2}$$

  - The parameter alpha measures the return that is expected on asset I when the return on the market is zero

$$\alpha_i = \overline{r}_i - \beta_i \overline{r}_M$$

- Multifactor Model (Relates to APT), individual return are driven by more than on common factor such as output, inflation, interest rates, exchange rates (successful tests include the change in industrial production, change in expected inflation, unexpected inflation, excess returns of corporate bonds of government bonds and long term bonds over short term bond).

  If the factors fully capture the common covariance between individual stock returns, then the error is 0.

  - ✓ Expected return
    $$E(r_i) = \alpha_i + \beta_{1i}E(I_1) + \ldots + \beta_{Ki}E(I_K)$$
  - ✓ Variance of returns
    $$\sigma_i^2 = \beta_{1i}^2\sigma_1^2 + \ldots + \beta_{Ki}^2\sigma_K^2 + \sigma_{ei}^2$$
  - ✓ Covariance between the returns on security i and security j
    $$\sigma_{ij} = \beta_{1i}\beta_{1j}\sigma_1^2 + \ldots + \beta_{Ki}\beta_{Kj}\sigma_K^2$$

  The diversifiable risk is the covariance of error and the non-diversifiable risk is beta power two times covariance power 2.

The founder of this model is Fama and French (1992, 1993) show that the CAPM cannot explain the cross section of asset return. They propose three factor model that includes a factor related to size and factor related book to market.

$$R(t) - RF(t) = a + b\,[RM(t) - RF(t)] + sSMB(t) + hHML(t) + e(t)$$

R(t): **Return on a stock at time t**

RF(t): **Return on the risk-free asset at time t**

SMB(t): **Return on the size factor at time t**

HML(t): **Return on the book-to-market factor at time t**

e(t): **error term of the regression**

In order to operationalise a multi-factor model, we must (arbitrarily) specify the factors

- If the single factor model holds, then the expected return of a stock can be written as

$$E(r_i) = \alpha_i + \beta_i E(r_M)$$

- The variance of the stock's return is given (single index model) by

$$\sigma_i^2 = \beta_i^2 \sigma_M^2 + \sigma_{\varepsilon i}^2$$

$$\text{where } \sigma_M^2 = \text{var}(r_M) \text{ and } \sigma_{\varepsilon i}^2 = \text{var}(\varepsilon_i)$$

- The covariance between the returns on stocks i and j is given by:

$$\sigma_{ij} = \beta_i \beta_j \sigma_M^2$$

- Under the single factor model, the expected return of a portfolio of stocks is given by

$$\begin{aligned} \mathrm{E}(r_P) &= \sum_{i=1}^{N} w_i \mathrm{E}(r_i) = \\ &= \sum_{i=1}^{N} w_i [\alpha_i + \beta_i \mathrm{E}(r_M)] = \\ &= \sum_{i=1}^{N} w_i \alpha_i + \sum_{i=1}^{N} w_i \beta_i \mathrm{E}(r_M) \end{aligned}$$

- The total risk of an individual stock is equal to

$$\sigma_i^2 = \beta_i^2 \sigma_M^2 + \sigma_{\varepsilon i}^2$$

$$\text{where } \sigma_i^2 = \text{var}(r_{it}), \sigma_M^2 = \text{var}(r_{Mt}), \text{ and } \sigma_{\varepsilon i}^2 = \text{var}(\varepsilon_{it})$$

Potential Question:

1. Based on the single-factor model, what are the expected returns and standard deviations of stock A and stock B?

2. Question 4C 2015 40 Marks
   An analyst wants to account for financial distress and market capitalisation as well as a market risk in his/her cost of equity capital for a particular traded company. The following options are available:
   a. The Fama and French Three Factor Model
   b. Macroeconomic Factor model
   Describe and discuss the above models. Which model is most appropriate for achieving

his/her objective? Explain giving reasons for your answer.

Answer

1. In Progress Single Factor Model
2. Financial distress and market capitalisation
    a. The Fama and French Three Factor Model
    How SMB (Small Minus Big) and HML (High Minus Low) factors are constructed (This model is more appropriate)
    b. Macroeconomic Factor Model using variables used in Burmeister, Roll and Ross (2004) macroeconomic factors used.

Lecture 5: Capital Asset Pricing Model (CAPM)

Assumptions for CAPM

- Investors make decisions based solely on the expected return and the variance of returns
- Investors have homogenous information regarding the input factors for the decision making. Therefore it form similar efficient frontier.
- There are no transaction costs
- There is no personal taxation
- Unlimited short sales are allowed
- All assets are infinitely divisible
- Individual investors cannot influence the price of an asset
- There are unlimited opportunities for lending and borrowing at the risk-free rate
- All assets are marketable

The CAPM beta of the asset is defined as:
See the formula derivation below that it can be converted into available information.

$$\beta_i = \frac{\text{cov}(r_i, r_M)}{\text{var}(r_M)}$$

$$\beta_A = \frac{\text{cov}(R_A, R_M)}{\text{var}(R_M)}$$

$$= \frac{\text{cov}(R_A, W_A R_A + W_B R_B)}{\text{var}(R_M)}$$

$$= \frac{W_A \,\text{var}(R_A) + W_B \,\text{cov}(R_A, R_B)}{\text{var}(R_M)}$$

$$= \frac{W_A \sigma_A^{\,2} + W_B \rho_{AB} \sigma_A \sigma_B}{\sigma^2_M}$$

$$= \frac{0.30 \times 0.20^2 + 0.70 \times 0.2 \times 0.20 \times 0.30}{0.2293^2}$$

Beta is an index of a security's systematic risk relative to that of the market portfolio. It indicates the responsiveness of expected return on stocks relative to the expected return on the market. Beta can be calculated using historical return or using regression analysis.

- The Formula for SML

$$E_s = r_f + B_s(E_{mkt} - r_f)$$

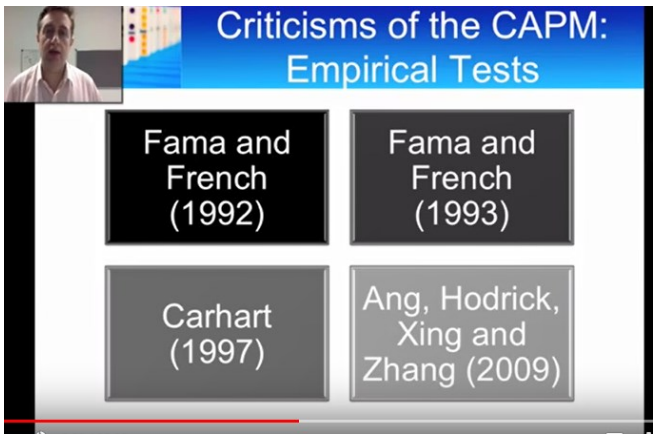
Where: r_f = the risk-free rate

B_s = the beta of the investment

E_{mkg} = the expected return of the market

E_s = the expected return of the investment

Slides 42-46 on Zero Beta CAPM are excluded from the exams



Possible Question:

- What are the expected returns of stocks A and B based on the Security Market Line (SML) and Capital Market Line (CML)?
- "Under the assumption of the standard CAPM, an investor who is very risk averse will only invest in the riskless asset and risky assets with very low variances."
- The standard CAPM implies that:
    - Investors are compensated for all risk they take
    - Investors are compensated for all market risk they take
    - Portfolio diversification does not matter
    - High-return investments have higher variances than low return investments.

Answer:

- True, low beta stocks are a result of low standard deviation, which means a low risk of non-performance of an asset. Low risk of an asset gives lower returns on the asset due to the linear correlation between a security or portfolio's returns and Beta. Hence, an investor who wishes to minimize default risk and is ready to get lower returns on his portfolio, should predominantly buy low variance stocks.

Lecture 6: Arbitrage Pricing Theory (APT)

$$r_i = \alpha_i + \beta_{1i}F_1 + \ldots + \beta_{Ki}F_K + \varepsilon_i$$

where

r_i is the actual return on security I

F_k is the k-th zero-mean factor that influences r_i

β_{ki} is the sensitivity of security i to the k-th factor

ε_i is a zero-mean term that is uncorrelated across securities

α_i is the expected return on the stock when all factors take the value zero

- Macroeconomic Factor Model

$$R_{i,t} = \alpha_i + \beta_{i,1}F_{1,t} + \beta_{i,2}F_{2,t} + \ldots \beta_{i,k}F_{k,t} + \varepsilon_{i,t},$$

where:

R_i = return on stock i
α_i = constant term
β_i = sensitivity of a stock i to a set of k macroeconomic factors
F_n = realizations of macroeconomic factors, $n=1,2\ldots,k$
ε_i = disturbance term with an expected value of zero and constant variance

$$R_{i,t} = \alpha_i + \beta_I I_t + \beta_{AIP}AIP_t + \beta_{IR}IR_t + \beta_{MI}MI_t + \beta_O O_t + \varepsilon_{i,t},$$

where:

R_i = return for stock i
α_i = constant term
β_I = sensitivity of stock i to annual change in CPI
I = annual change in CPI
β_{AIP} = sensitivity of stock i to annual change in industrial production volume
AIP = annual change in industrial production volume
β_{IR} = sensitivity of stock i to 3-month ZIBOR
IR = 3-month ZIBOR
β_{MI} = sensitivity of stock i to monthly change in CROBEX index
MI = monthly change in CROBEX index
β_O = sensitivity of stock i to annual change in oil prices
O = annual change in oil prices
ε_i = disturbance term

PLUS ALSO:
Fama, E., and K. French, 1992. *The Cross-Section of Expected Stock Returns.* Journal of Finance, 47(2), pp. 427-466
Chen, N.-F., Roll, R., and R. Ross, 1986, *Economic Forces and the Stock Market*. Journal of Business 59(3), pp. 386-403

Lecture 7: Market Efficiency

A Market is efficient with respect to a particular set of information if any investment strategy based on that information is expected to earn a zero abnormal return (any abnormal return earned differs from zero only by chance). Fama's notation for efficient markets:

$$ar_{j,t+1} = r_{j,t+1} - E(r_{j,t+1} \mid \Phi_t) \quad \left[\equiv E_t(r_{j,t+1})\right]$$

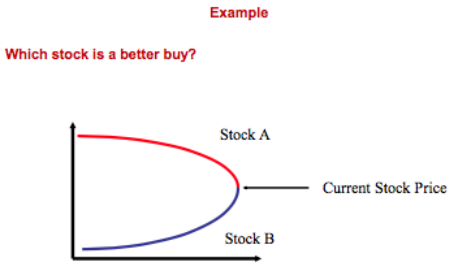
$$\text{EMH} \Rightarrow E(ar_{j,t+1} \mid \Phi_t) = 0 \quad \left[E_t(ar_{j,t+1}) = 0\right]$$

- Operational and informational efficiency. Operational efficiency measures how well things function in terms of speed of execution and accuracy. It tells about the function of the number of orders that are lost or filled incorrectly.

Informational efficiency is a measure of how quickly and accurately the markey reacts to new information. It tells about how security prices adjust rapidly and fairly accurately to new information.

- There are 3 level of efficient market hypothesis:

1. Weak form: prices reflect all past market level (price and volume) information. Charting techniques are of no use in predicting stock price data.



Test: Run test is a nonparametric statistical technique to test the likelihood that a series of price movements occurred by chance. A runs test calculates the number of ways an observed number of runs could occur given the relative number of different observations and the probability of this number.

2. Semi-strong form: prices reflect past market information (past stock price) + all publicly available fundamental company and economic information (economic reports, brokerage firm recommendations, investment advisory letters. Academic research support Semi-strong form of the EMH by investigating various corporate announcements, such as stock splits, cash dividends, stock dividends.

Test: Event Study. 1) Collect a sample of firms that have a surprise announcement, 2) Determine the precise day of the announcement and designate this day as zero, 3) Define the period to be studied, 4) For each of the firms in the sample, compute the return on each of the days being studied, 5) Compute the abnormal return for each of the days being studied in the sample, 6) Compute for each day in the event period the average abnormal return for all the firms in the sample, 7) Often the individual day's abnormal return is added together to compute the cumulative abnormal return form the beginning of the period.

Fama (JF, 1991) "The cleanest evidence on market-efficiency comes from event studies, especially event studies on daily returns. The results indicate that on average stock prices adjust quickly to information about investment decisions, dividend changes, changes in capital structure, and corporate-control transactions [mergers, takeovers, etc.]"

3. **Strong form**: prices reflect all past market information + all publicly + privately held information that would affect the value of the company and its securities. Inside information is information not available to the general public.
Test: Examining the performance of professionally managed investment funds
   - some funds appear to outperform simple stock indexes on a consistent basis
   - early interpretations of this evidence suggested persistent skill in active management
   - more recent studies suggest that controlling properly for risk (and not just stock-index-related risk) shows that these funds earn returns consistent with the risk associated with following mechanical styles and do not have

persistent stock selection skills (e.g. Carhart JF97)
    - some recent evidence of stock selection ability (Wermers, JF2000, pp.1655−1703)

- "Information is that which causes changes" – Claude Shannon
- A market is efficient with respect to a particular set of information if any investment strategy based on that information is expected to earn a zero abnormal return (any abnormal return earned differs from zero only by chance). Students are expected to discuss in each individual category of market efficiency the regularities below with as many details as possible.
- "If markets are semi-strong-form efficient, one should not observe excess returns after the announcement of a dividend increase". True
- "If semi-strong efficiency holds, then weak-form efficiency must hold." True
- No investor will do better than the S&P 500 consistently after adjusting for risk and transactions costs.

- **Testing for market efficiency**
    1. **Weak form**
        - Patterns/regularities in security price changes (returns): weak-form efficiency
        - seasonalities: January effect, day-of-the-week/weekend effects
        - momentum: 3–12 month investment horizons
        - reversals: contrarian investment over 3–5 years
    2. **Public information: semi-strong form**
        - event studies: an event study is a formal way of testing the security market reaction to a particular event/piece of information
        - traditionally, the event was the public announcement of some information item (e.g. announcements of takeover bids or annual earnings)—i.e. related to semi-strong form efficiency
        - but the research method is also used in testing for patterns, e.g. momentum (weak-form efficiency)
            - Some anomalies from event studies
            - post-earnings announcement drift long-horizon, selective event studies; e.g. takeovers, IPOs, SEOs.
    3. **Strong form efficiency**

    Examining the performance of professionally managed investment funds
        - some funds appear to outperform simple stock indexes on a consistent basis
        - early interpretations of this evidence suggested persistent skill in active management
        - more recent studies suggest that controlling properly for risk (and not just stock-index-related risk) shows that these funds earn returns consistent with the risk associated with following mechanical styles and do not have persistent stock selection skills (e.g. Carhart JF97)
        - some recent evidence of stock selection ability (Wermers, JF2000, pp.1655−1703)

- ***Slides 37-42 on accruals anomaly are excluded from the exams***
  PLUS ALSO:
  Fama, E. F., 1991. Efficient capital markets II. Journal of Finance 46, 1575–1617.
  Fama, E., 1998. Market efficiency, long-term returns, and behavioural finance, Journal of Financial Economics 49, 286–306.

<u>Potential Questions</u>

Question 5A 2015

a. A market is efficient with respect to a particular set of information if any investment strategy based on that information is expected to earn a zero-abnormal return (any abnormal return earned differs from zero only by chance)" Discuss the various issues arising from this definition.
b. Discuss the implications of market efficiency for portfolio managers.
c. Discuss whether the following statement is true or false:
"A certain retailing firm has a strong seasonal pattern to its sales. Therefore, we would expect to find a seasonal pattern to its stock price as well.
d. Tests of market efficiency tend to
    - Look for statistical dependencies that exist in price changes over time.
    - Measure the nature of the impact of new information on security prices as that new information becomes available.
    - Search for trading systems that might be able to generate supernormal profits.
    - All of the above.

Answer

a. Issues on the definition: Students are expected to explain them. The below is only a guidance in the form of bullet points.
    - Abnormal return and the model of normal / expected return
    - Zero expected returns P on average, actual returns are zero
    - But actual returns for a particular investment strategy in a specific period will be non zero due to random/chance effects
    - The joint hypothesis problem the researcher simultaneously test market efficiency and a maintained model of asset pricing/returns
    - Non-zero abnormal returns due to chance – testing for statistical significance.
b. In an efficient market, portfolio managers are responsible for tailoring the portfolio to meet the investor's need rather than requirements and risk tolerance. Rational portfolio management also require examining the investor's constraints such as liquidity, time horizon, laws etc. Developing a well-diversified portfolio with the selected level. Although an efficient market prices securities fairly, each security still has firm-specific risk that portfolio managers can eliminate through diversification. Therefore, national security selection requires selecting a well-diversified portfolio that provides the level of systematic risk that matches the investor's tolerance. Other issues include: reducing transactions costs with a buy and hold strategy, developing capital market expectations, implement the chosen investment strategy and review it regularly for any needed adjustments.
c. In an efficient market, we should not observe a seasonal pattern in stock prices. If investors observe high returns in a particular month they will start purchasing the stock just before the month when sales are expected to rise to take advantage of the extra return. This adjustment of the pattern of investor purchases should cause the pattern to disappear. Hence, the stock prices of the firm will not follow the same pattern as sales in an efficient market.

Lecture 8: Fixed Income Securities (Bond) / Options and Futures

Bond

- There are different type of debts securities, some traded on organized exchanges, others traded over the counter. The most common debt instruments are: government bonds, corporate bonds, municipal bonds, mortgage bonds and annuities
- Coupon bond is the interest paid on a regular basis (typically every six months)
- A bond generally make a regular payment, called a coupon, at regular intervals and terminal payment called the face value, nominal value or maturity amount on a known date called the maturity date or the redemption date. Redemption payment of Bond is given by (annual), assume that the rate is similar for all horizon.

$$P = \frac{c}{(1+r)} + \frac{c}{(1+r)^2} + \ldots + \frac{c}{(1+r)^n} + \frac{B}{(1+r)^n} = \frac{B}{(1+r)^n} + \sum_{t=1}^{n} \frac{c}{(1+r)^t}$$

Semi-annual:

$$P = \frac{\frac{c}{2}}{\left(1+\frac{r}{2}\right)} + \frac{\frac{c}{2}}{\left(1+\frac{r}{2}\right)^2} + \ldots + \frac{\frac{c}{2}}{\left(1+\frac{r}{2}\right)^{2n-1}} + \frac{\frac{c}{2}}{\left(1+\frac{r}{2}\right)^{2n}} + \frac{B}{\left(1+\frac{r}{2}\right)^{2n}}$$

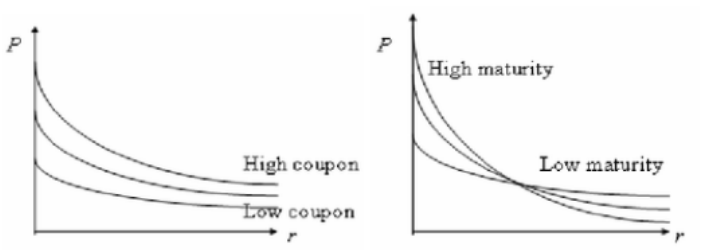
$$P = \frac{B}{\left(1+\frac{r}{2}\right)^{2n}} + \sum_{t=1}^{2n} \frac{\frac{c}{2}}{\left(1+\frac{r}{2}\right)^t}$$

- Bond have many types of yield:
  - **Yield to maturity** (redemption yield) is the single rate of interest which equates the present value of the income stream with current price.
  - **Spot yield** is the yield to maturity of a zero coupon bond and therefore measures the rate of interest that is appropriate for discounting a single payment in the future.

    - For instance, if the one-year spot yield, r_1 is 10% and the two-year spot yield, r_2, is 12%, then the implied one-year spot rate in one year's time is given by

      $$r_f = \frac{(1+r_2)^2}{1+r_1} - 1 = \frac{1.12^2}{1.10} - 1 = 14.04\%$$

  - **Current yield (flat yield, interest yield)** is the coupon expressed as a percentage of the current price.
  - **Holding period yield** is the return from holding a bond for a fixed period.
  - **Forward yield** is the future rate of interest that is implied by spots yields for different maturities.
- Bond have several factor such as maturity, coupon, yield and price
- **Price yield curves** offer a qualitative summary of characteristic of a set of bonds. It is plot of the price of a bond against its yield to maturity. The following **graph** is the bond with different coupons or bonds of different maturities



- There is a **negative relationship** between the price of a bond and its yield because with a fixed coupon, the price of a bond is determined by rate at which the bond's cash flow are discounted.
- **Immunisation**, suppose the company has a liabilities over the next 1 years that have a present value at the current interest rate of 1m, the company wants to ensure that it has sufficient funds to meet these liabilities. Liabilities convexity
- The **Macauley** duration (or just duration) of the bond is defined as

$$D = \frac{1}{P}\sum_{t=1}^{N}\frac{tC_t}{(1+r)^t}$$

- **Duration** of the bond can be shown to measure the sensitivity of the bond price to changes in interest rate.
- **Convexity** means the duration produces a first order approximation to the change in the value of a bond or obligation with respect to change in the interest rate.
- Why do bond prices go down when interest rates go up? Don't lenders like high interest rates?
  A bond's coupon interest payments and principal repayment are not affected by changes in market rates. Consequently, if market rates increase, bond investors in the secondary markets are not willing to pay as much for a claim on a given bond's fixed interest and principal payments as they would if market rates were lower. This relationship is apparent from the inverse relationship between interest rates and present value. An increase in the discount rate (i.e., the market rate) decreases the present value of the future cash flows.

Combining the Present Value of a Bond's Interest and Maturity Amounts

Recall that the present value of a bond =

1. The present value of a bond's interest payments, **PLUS**
2. The present value of a bond's maturity amount.

The present value of the 9% 5-year bond that is sold in a 10% market is $96,149 consisting of:

1. $34,749 of present value for the interest payments, **PLUS**
2. $61,400 of present value for the maturity amount.

The bond's total present value of $96,149 is approximately the bond's market value and issue price.

It is reasonable that a bond promising to pay 9% interest will sell for less than its face value when the market is expecting to earn 10% interest. In other words, the 9% $100,000 bond will be paying $500 less semiannually than the bond market is expecting ($4,500 vs. $5,000). Since investors will be receiving $500 less every six months than the market is requiring, the investors will not pay the full $100,000 of a bond's face value. The $3,851 ($96,149 present value vs. $100,000 face value) is referred to as **Discount on Bonds Payable, Bond Discount, Unamortized Bond Discount, or Discount**.

The journal entry to record the $100,000 bond that is issued on January 1, 2016 for $96,149 and no accrued interest is:

Date	Account Name	Debit	Credit
Jan 1, 2016	Cash	96,149	
	Discount on Bonds Payable	3,851	
	Bonds Payable		100,000

https://www.accountingcoach.com/bonds-payable/explanation/

Potential Question

- Question 3A 2015

  You have identified a one-year bond with an 8% coupon rate and a face value of £1,000 selling at a market price of £955. The bond pays coupons annually. Calculate the yield to maturity and duration of this bond.

  Let y be the yield to maturity

  Market Price = [Coupon (Face Value) + Face Value] / (1+YTM)
  955 = [0.08 (1000) + 1000] / (1+y) = 1080 / (1+y)
  y = 13.089%

The yield to maturity (YTM) is defined as the interest rate that makes the present value of a bond's payment equal to its price. This interest rate is often viewed as a measure of the average rate of return that will be earned a bond if it is bought now and held until the maturity. To calculate the YTM we solve the bond price equation for the interest rate given the bond's price.

- Question 3B 2015

  You have also identified a three-year bond with a 10% coupon rate and a face value of £1,000 that pays coupons annually. Based on your calculation in part (a), what is the price and duration of this three-year bond?

  Yield curve is flat
  Let P3 be the price of the three-year bond

  P3 = [0.1(1000)] / (1+y)^1 + [0.1(1000)] / (1+y)^2 + [0.1(1000) + 1000] / (1+y)^3
  = 100 / (1.13089)^1 + 100 / (1.13089)^2 + 1100 / (1.13089)^3
  = 88.42593 + 78.19145 + 760.5567
  = 927.1741

  D3 = {1[100 / (1.13089)^1] + 2[100 / (1.13089)^2] + 3[1100 / (1.13089)^3]} / 927.1741
  = (88.42593 + 156.3829 + 2281.67) / 927.1741
  = 2.724924

- Question 3C 2015

  An investor is considering purchasing either a zero-coupon bond with 5 years to maturity or 10% coupon bond with 5 years to maturity, but if both bonds have identical yields to maturity and the investor expects to hold the bond for the full 5 years, then it does not matter which bond is purchased.

  Answer

  Yield to maturity implicitly assumes that any intermediate income received from a bond is reinvested at the same rate. If the interest rates in the market move, the coupons received on a bond will need to be reinvested at the new rates, consequently affecting the realized yields. This is commonly known as **re-investment risk**. However, for a zero-coupon bond, the yield to maturity will always be equal to the realized yield.

Lecture 9: Capital Budgeting (Corporate Finance)

Investment principle, financing principle (capital structure) and dividend principle (dividend policy)

A researcher has estimated that stock X has a standard deviation of 20% and a beta of 1.15. Using a similar process, the researcher has determined that stock Y has a standard deviation of 30% and a beta of 0.50. Which stock carries more total risk? Which has more market risk? If the risk-free rate is 4%, and the market's expected return is 9%, calculate the equity cost of capital for X and Y. Which company has a higher cost of equity capital?

Return X = Risk free rate + Beta (Rm – Rf) → CAPM
X has a higher beta 1.15. The equity cost of capital for X is:
R(X) = 4% + 1.15* (9% - 4%) = 4% + 5.75% = 9.75%
Y has a lower beta of 0.50. The equity cost of capital for Y is:
R(Y) = 4% + 0.50* (9% - 4%) = 4% + 2.5% = 6.5%
Because market risk cannot diversified, it is market risk that determines the cost of capital, thus X

has a higher cost of equity capital than Y, even though it is less volatile.

Lecture 10: Cost of Capital

- **Advantages of ARR**
  - easy to compute because the firm collects the accounting information anyway (for budgeting and planning purposes)
- **Disadvantages of ARR**
  - ignores the time value of money
  - choice of target ARR is arbitrary
  - based on earnings not cash flows
    - uses accounting depreciation
    - tax charge based on accounting earnings
- No standard calculation method
- Not a true return on investment

- Weighted Average Cost of Capital

$$WACC = \frac{D}{D+E} r_D (1-T_C) + \frac{E}{D+E} r_E$$

D is the amount of debt used to finance the investment, E is the amount of equity, r_D is the cost of debt, r_E is the cost of equity and T_C is the firm's marginal corporate tax rate.

- Tax adjusted CAPM

$$E(r_i) = r_f (1-T_C) + \beta_i [E(r_M) - r_f (1-T_C)]$$

- WML is the difference between the value weighted average of firms with the highest 30% eleven months return lagged one month (Winners) and the value weighted average of firms with the lowest 30% eleven month return lagged one month (losers)
- Macroeconomic factor models: the factors are variables that affect future cash flows of companies and or the discount rate that is appropriate to determining the present values. Example done by Burmeister, Roll and Ross: Confidence risk, Time horizon risk, Inflation risk, Business cycles risk, Market timing risk
- Cost of debt is the marginal cost to the company of borrowing an additional dollar.
- A project's cost of capital using unlevered cost of capital:

$$r_U = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D$$

- Unlevered Beta. because the beta of a portfolio is the weighted average of the betas of securities in the portfolio, we have a similar expression for the unlevered beta which we can use to estimate the beta of our project.

$$\beta_U = \frac{E}{E+D} \beta_E + \frac{D}{E+D} \beta_D$$

- Net Debt = Debt – Excess Cash and short term investment. The intuition for using net debt is that if the firms hold 1 pound in cash and 1 pound in risk free debt. Then the interest earned and paid will cancel out.

<u>Potential Question</u>

Lewis Co. has the opportunity to invest in a new machine. The cost of the machine is £50,000 and the company expects that this machine will have a scrap value of £9,000 at the end of its four year life. Expected net revenues, excluding any charge for depreciation, starting in year 1 are £16,000 and will remain at the same level for the next three years.

If Lewis Co. undertakes this project then the working capital of the company is immediately increased by £8,500 and it will remain at the same level for year 1. After year 1, the company will reduce this investment in working capital to £5,500 in year 2 and year 3. Finally at the end of year 4 this working capital reduces to zero. Capital allowances are 25 percent on a reducing balance basis with any profit (or loss) on disposal attracting an immediate balancing charge allowance. The corporation tax rate is 35 percent and the company pays its tax in the same year in which it becomes due (i.e. no lag).

Other information concerning this new machine is as follows. Lewis Co. has already invested £6,000 in market research to explore the market for the new product it plans to manufacture with this new machine. If the company buys this new machine then it could sell off its older machine immediately for £3,500. Lewis Co. believes it can finance half of the project with debt requiring 9 percent return and the remainder with equity, requiring a 16 percent return.

(a) Calculate the expected incremental after-tax cash flows for the project.
Market research 6000 is sunk cost.
(b) Calculate the after-tax weighted average cost of capital for the project.
(c) Calculate the NPV of this project. Should the firm accept this project?
(d) Briefly discuss the advantages and disadvantages of using an accounting rate of return rule to appraise a project.

Your firm is considering expanding in household products division. You identify Procter and Gable (PG) as a firm with comparable investments Suppose PF's equity has a market capitalisation of £144billion and a beta of 0.57. PG also has a £37 billion of AA-rated debt outstanding , with an average yield of 3.1%. Estimate the cost of capital of your firm's investment given a risk free rate of 3% and a market risk premium of 5%.

a. First estimate PG's equity cost of capital using CAPM (3% + 0.57 x 5%) = 5.85%
b. Thus PG's unlevered cost of capital is: 144/(144+37) x 5.85% + 37 / (144+37) x 3.1% = 5.29%
c. Alternatively we can estimate PG's unlevered beta. Given its high rating, if we assume PG's debt beta is zero we have:
144 / (144+37) x 0.57 + 37 / (144+37) x 0 = 0.4523
d. Cost of capital = 3% + 0.453 x (5%)

PLUS ALSO:
Burmeister, Roll and Ross: Using Macroeconomic factors to control for Portfolio Risk.
http://www.ftse.com/Analytics/BIRR/Documents/Using_Macroeconomic_Factors.pdf

Gregory, A., and M. Michou, (2009), "*Industry Cost of Equity Capital in the UK*", *Journal of Business Finance and Accounting, Vol. 36,/5-6 , pp 679 – 704*

- Uncertainty about the cost of equity capital comes from three sources such as model of estimation, factor prices associated with various models, estimation of factor loadings or slope coefficient.
- Test of static models:
  - CAPM results: All industries have significant betas, adjusted R-square is around 31%

- Three Factor Model: 23 industries have significant positive loadings on SMB. 9 industries significant positive loadings on HML. Adjusted R-square is around 34%.
- Four Factor Model results: Broadly similar, but 2 industries have significant positive loading on WML, with 5 negative. Adjusted R-squared slightly higher.

Other references:
Eugene F. Fama & Kenneth R. French (1997), "Industry Costs of Equity", *Journal of Financial Economics*, Vol. 43, pp.153-193.

Lecture 11: Capital Structure

- Propositions of Modigliani and Miller is MM without taxation and MM with taxation.
- There exist an optimal capital structure which minimises WACC and maximises firms value. For firms with low gearing ratios (D/E) the cost of debt < cost of equity.

Miller or Modgiliani propositions, MM without and with taxation. A firm can raise funds by issuing both debt and equity securities.

- Without tax: When there are no taxes and capital markets function well, the market value of a compay does not depend on its capital structure.
- MM proved that if two firms are identical except for theor capital structires, an opportunity to earn arbitrage profits exist if the firms do not have same values.
- MM argue that managers either should not worry about the capital structure decision or should borrow as much as possible to minimize taxes. In reality firms with no debt do equally well.
- MM Proposition I

$$V_l = V_u + T_c D$$

- Miller (1977) Debt and Taxes model

$$V_l = V_u + \left[1 - \frac{(1-T_{pe})(1-T_C)}{(1-T_{pd})}\right] D = V_u + T^* D$$

- Financial distress costs and the static trade off
- Asymmetric information and adverse selection and the Pecking Order model (POT)
- Agency costs of debt and equity.
- Value of firm

Value of firm = unlevered firm value
+ PV(*Tax shield*)
- PV(*Financial distress costs*)

$$V_L = V_U + PV(DITS) - PV(FDC)$$

- Tax advantages of debt are the fourth most important factor for capital structure choices in both US and European countries: particularly for large, high-leverage firms; but Germany considers tax effects less important; both US and European countries do no put much weight on the personal tax considerations of their investors;

• ***Slides 53-89 are excluded from the exams***

GENERAL MATERIALS:

• Whole lecture handout
• **PLUS** relevant required reading material from the book
• **PLUS** assigned problems

COMBINATIONS OF QUESTIONS:
Based on your calculations above in part a) state whether each of the following statements is completely true, completely false, or uncertain separately for each of the three models: the Single factor Model, the Security Market Line (SML), and the Capital Market Line (CML). Explain your answers.

Per Single Factor Model

- False, in any given year, stock B is certain to outperform stock A.
  Based on single index model and CML return, the stock return B outperform stock A
- True, An investor would consider stock B to be riskier than stock A.
  Yes because it has almost 16% more standard deviation than stock A.
- False, Stock A is not undervalued because stock A have higher return using SML formula.
- False, If an investor had to select one investment to combine with the riskless asset, the investor would prefer stock A to the market portfolio.

Per Security Market Line
- False, False, Uncertain, Uncertain

Per Capital Market Line
- False, True, False, False

THE FOLLOWING ARE ALSO EXAMINABLE:
Set of exercises:
Exercises of Elton and Gruber that you were assigned for each lecture and their solutions. For each lecture, a very comprehensive set of solutions is available on LEARN.
Tutorial Exercises and solutions
I have been given detailed guidance throughout the tutorials on how to answer numerical questions and essay type questions. The tutorial exercises and their solutions are available on LEARN.
VERY IMPORTANT INFORMATION:
ADVICE FOR YOUR REVISION
• Study very carefully the lecture handouts for the above topics.
• Study all relevant required reading including relevant papers (in relevant lectures) that were discussed in the class.
• Study all tutorial exercises and their solutions.
• Study all set of exercises from Elton, Gruber et al that you were assigned at the end of each lecture.

DURING THE EXAMS
Structure of the paper:
• you will have TWO HOURS to complete the paper;
• you will be required to ANSWER THREE QUESTIONS;
• each question carries equal marks;
• a PAST EXAM PAPER to see the structure is available on LEARN

NOTES ON ANSWERING EXAM QUESTIONS

• Show details of all the steps and calculations you used in arriving at your answer.

• Manage your time! Remember, you only have 2 hours to answer three questions. Make sure you do not spend too long on answering the first question, in order to avoid running out of time on the second and /or third.

• Address the question! Do not simply write down everything you know about the topic or about related but *irrelevant* issues.

• Make sure your handwriting in the exam script is legible.

• Please use calculators as instructed by your programme handbook. **FINANCIAL CALCULATORS ARE NOT PERMITTED**. Please familiarise yourself with your calculator.

SMB and HML factors are computed using six portfolios formed using size and book-to-market.

HML = 1/2 (Small Value + Big Value)
- 1/2 (Small Growth + Big Growth)

	Median ME	
70th Percentile B/M	Small Value	Big Value
	Small Neutral	Big Neutral
30th Percentile B/M	Small Growth	Big Growth