Week 1: Introduction

- Real vs Financial assets
  - Real assets earn income → tangible and intangible (e.g. Intellectual Property)
  - Financial assets are claims to income earnt by real assets
- Financial markets
  - **Money markets** = short-term, marketable, liquid, low-risk debt securities
    - T-bills
    - Certificate of Deposits → term deposits
    - Commercial paper
    - Bankers' acceptance
    - Eurodollars
    - Repurchase agreements
    - Federal funds
    - Brokers' calls
  - **Capital markets** = longer term and riskier securities
    1) Longer term bond markets
       - Treasury notes (10 years) and bonds (10-30 years) → TIPS = inflation protected
       - Corporate bonds → secured, unsecured (debentures), subordinated debentures (lower repayment priority = riskier)
       - Municipal bonds → tax-free bonds issued by State or Local Government
       - Mortgage securities
       - Federal agency debt – e.g. by Fannie Mae and Freddie Mac
    2) Equity markets
       - Common stock
       - Preferred stock
    3) Derivative markets for options (RIGHT) and futures (OBLIGATION)
       - OPTION: Call option (buy) + Put option (sell) → purchase price
       - FUTURE: Long position (buy) + Short position (sell) → no cost to enter
- Passive vs Active management
  - Efficient Market Hypothesis (EMH)
  - Passive = market efficient
  - Active = market not efficient
- **GFC (2008)**
  - TED spread → 3month LIBOR – 3month T-bill → indicates credit default risk in banking sector
  - Case-Shiller Index of US Housing Prices → in 2008, house prices rose as more finance available from securitised mortgages, that were traded to investors

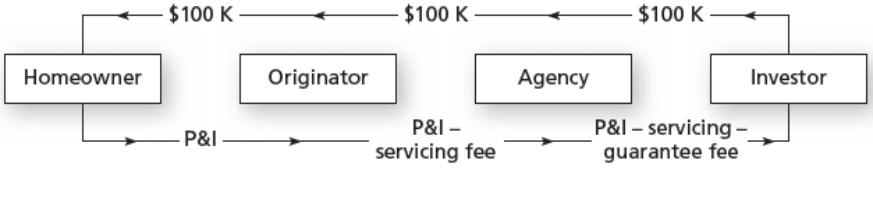

Figure 1.4 Cash flows in a mortgage pass-through security

  - Homeowner = borrows money from Loan Originator (Bank) → homeowner repays interest + principle to Loan Originator
  - Loan Originator = passes on P + I to agency (Freddie or Fannie), but retain a service fee
  - Agency = pools the loans into mortgage-backed securities → sells the securities to investors (pension funds/mutual funds) → agency guarantees the default risk of loans in each pool → and retains a guarantee fee before passing remaining cash flow to investor.
    - In GFC, Fannie and Freddie had to be bailed out

1) Determine the optimal risky portfolio → this is purely technical → i.e. finding the min-variance frontier of portfolios (that can be achieved with all available securities)
2) Allocation to risk-free asset versus risky portfolio depends on personal preference → depending risk aversion level of clients

- **The power of diversification**
  - Recall → **VARIANCE** (for two risky assets):

$$\sigma_P^2 = w_D^2\sigma_D^2 + w_E^2\sigma_E^2 + 2w_D w_E Cov(r_D, r_E)$$

Or (for more than two risky assets):

$$\sigma_P^2 = \sum_{i=1}^{n}\sum_{j=1}^{n} w_i w_j Cov(r_i, r_j)$$

  - **Average variance** of the securities:

$$\overline{\sigma}^2 = \frac{1}{n}\sum_{i=1}^{n}\sigma_i^2$$

  - **Average covariance** of the securities:

$$\overline{Cov} = \frac{1}{n(n-1)}\sum_{\substack{i=1\\ j\neq i}}^{n}\sum_{j=1}^{n} w_i w_j Cov(r_i, r_j)$$

  - **Portfolio variance**:

$$\sigma_P^2 = \frac{1}{n}\overline{\sigma}^2 + \frac{n-1}{n}\overline{Cov}$$

  - Portfolio variance can be driven down to zero if average covariance is zero
  - Risk of a well-diversified portfolio depends on the covariance of returns of component securities
    - For well-diversified portfolios → there are more stocks in our portfolio → n would increase → so average variance tend towards 0 [as larger n makes $\frac{1}{n}\overline{\sigma}^2$ smaller]
    - Thus, highly diversified portfolio risk depends on covariance
    - So, if covariance is 0, then portfolio variance can reduce to 0
  - **Weight in the Optimal Risky Portfolio (Two risky assets – stocks and bonds):**

$$w_S = \frac{[E(r_S)-r_f]\times\sigma_B^2 - [E(r_B)-r_f]\times Cov(r_S, r_B)}{[E(r_S)-r_f]\times\sigma_B^2 + [E(r_B)-r_f]\times\sigma_S^2 - [E(r_S)-r_f + E(r_B)-r_f]\times Cov(r_S, r_B)}$$

  - **Optimal Weight in the Optimal Risky Portfolio (y) and the Risk-free Asset (1 – y):**

$$E(r_C) = (1-y)\times r_f + y\times E(r_P) = r_f + y\times[E(r_P)-r_f]$$

→ from Week 4

  - **Overall Weight held in each individual risky asset in the optimal risky portfolio**:
    → Overall weight in risky asset 1 = y * weight of risky asset 1 in the optimal risky portfolio
    → Overall weight in risky asset 2 = y * weight of risky asset 2 in the optimal risky portfolio
  - **Risk Reduction of Equally Weighted Portfolios**

		ρ = 0		ρ = .40	
Universe Size *n*	Portfolio Weights *w* = 1/*n* (%)	Standard Deviation (%)	Reduction in σ	Standard Deviation (%)	Reduction in σ
1	100	50.00	14.64	50.00	8.17
2	50	35.36		41.83	
5	20	22.36	1.95	36.06	0.70
6	16.67	20.41		35.36	
10	10	15.81	0.73	33.91	0.20
11	9.09	15.08		33.71	
20	5	11.18	0.27	32.79	0.06
21	4.76	10.91		32.73	
100	1	5.00	0.02	31.86	0.00
101	0.99	4.98		31.86	

Bubbles and Behavioural Economics

- Bubbles are easier to spot after they end
  - Dot-com bubble
    - 6-year period beginning in 1995
    - Overconfidence in tech firms and representativeness biases → stock analysts saw prices rising despite consistent cash flow (thus, same intrinsic value) → they expected prices to continue rising, but then it collapsed
  - Housing bubble
    - Set off worst financial crisis in 75 years
- Rational explanation for stock market bubble using the dividend discount model:

$$PV_o = \frac{D_i}{k - g}$$

- S&P 500 is worth $12,883 million if dividend growth rate is 8% (close to actual value in 2000) → before dot com bubble
- S&P 500 is worth $8,589 million if dividend growth rate is 7.4% (close to actual value in 2002) → after dot com bubble
  → This was close to the values in the respective periods → suggests that higher dividends may account for the stock price bubble

The Index Model and the Single-Factor SML

- Expected Return-Beta Relationship

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

$$\beta_i = \frac{Cov(r_i, r_M)}{\sigma_M^2}$$

- Estimating the security characteristic line (SCL)

$$r_{i,t} - r_{f,t} = a_i + b_i(r_{M,t} - r_{f,t}) + e_{i,t}$$

Testing the CAPM: Estimating the SCL

- Tests of the expected return-beta relationship (predicted by CAPM)
  - **First-pass regression** – time series regression to estimate the betas of securities or portfolios
  - **Second-pass regression** – cross-sectional regression of portfolio excess returns on betas, where estimated slope is the measurement of the reward for bearing systematic risk during the period

Tests of the CAPM

- Early tests performed by Lintner → later replicated by Miller and Scholes
  - Results are inconsistent with the CAPM
    - SML is "too flat" and intercept is "too large" → compared to the relationship predicted by CAPM
  - Difficulties with approach employed to test CAPM:
    - Stock returns are extremely volatile, lessening the precision of any tests of average return
    - Fundamental concerns about the validity of the tests
      - Market index used is not the "market portfolio" of CAPM → which is unobservable
      - Betas from first-stage are estimated with sampling error
      - Investors cannot borrow at risk-free rate

The Market Index: Roll's Critique

1. Single testable hypothesis associated with CAPM → this is; market portfolio is mean-variance efficient
2. All other implications of the model are not independently testable → since market portfolio is unobservable, we can't test it
3. If betas are calculated against mean-variance efficient portfolios, they will satisfy the SML relation exactly regardless of whether the true market portfolio is mean-variance efficient in the ex-ante sense → if we use ex-post data on excess returns of stock index, then on average, the scale covariance with respect to that ex-post historical index excess returns has to be a 1 on average → it does not prove anything with the efficiency of the market portfolio

- **<u>The dollar proceeds from your futures position</u>**

$$
\begin{aligned}
&24 \times \$50 \times (F_0 - F_1) && \text{Mark to market on 24 contracts sold}\\
&= \$1{,}200 \times [S_0(1.01) - S_1] && \text{Substitute for futures prices from parity relationship}\\
&= \$1{,}200 \times S_0[1.01 - (1 + r_M)] && \text{Because } S_1 = S_0(1 + r_M) \text{ when no dividends are paid}\\
&= \$1{,}200 \times [S_0(.01 - r_M)] && \text{Simplify}\\
&= \$30{,}000 - \$3{,}000{,}000 \times r_M && \text{Because } S_0 = 2{,}500
\end{aligned}
$$

  - Proceeds from futures = no of contracts * index multiplier * (Futures price today – Futures price in one month time)
  - Futures price today = spot price of index today * 1.01 → (1 + risk-free rate) → allows for parity pricing between futures index contract → idea that the index future contract is not simply buying an index future today and paying for it today → we pay it later on (so multiply it by risk-free rate to see the cost of it later on) → we assume no dividend yield
  - Futures price in one month = spot price in one month time → at the maturity date, the futures price is always equal to the spot price of the underlying index
- **<u>Hedged proceeds</u>** = $2,575,000 + $2,500,000 × e
  - e = firm specific risk
  - Beta of zero → return on market does not appear in the hedged proceeds
  - Monthly return = 3% (alpha + risk-free rate) → as represented by the 2.575M → then adding firm-specific risk (adding 2.5M*e)
- Beta is zero and your monthly return is 3% plus the remaining non-systematic risk

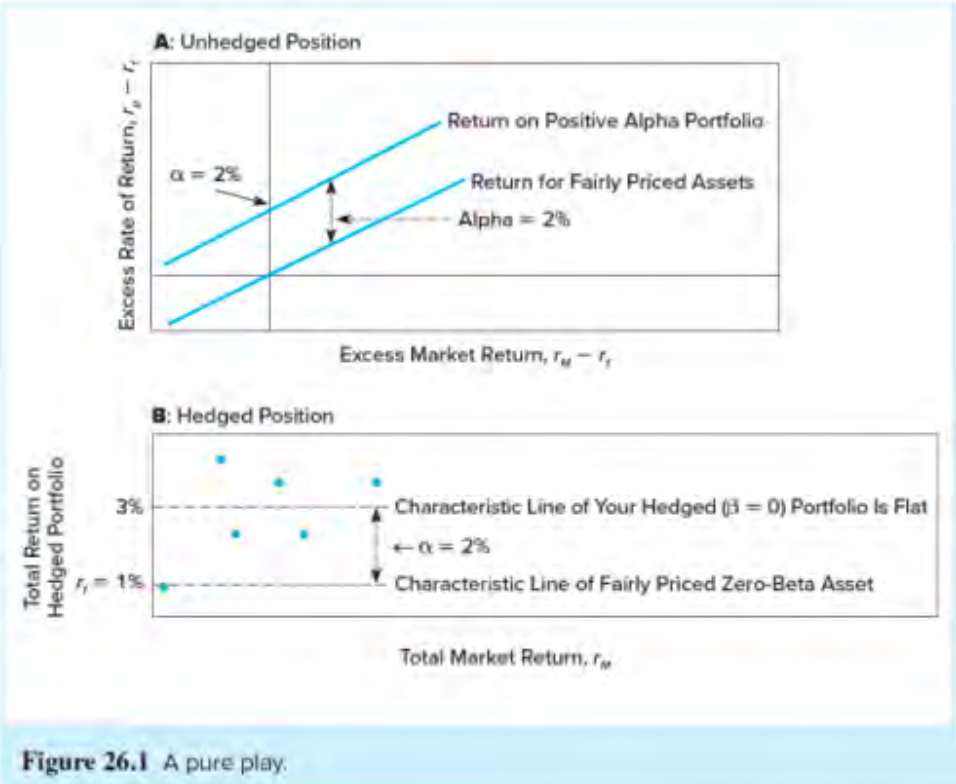

Figure 26.1 A pure play.

- The hedge fund essentially eliminates the beta risk → so that it eliminates the slope change → such that returns is always 3% regardless of the returns on the market in the next month
- Returns of portfolio = alpha + risk-free rate = 2% + 1% = 3%
- The fluctuations around that 3% represent the error term (fluctuation due to firm-specific variability)
- **FOR CALCULATION OF PROBABILITY THAT THE HEDGE FUND MAKES A LOSS → USE Z-SCORE → SEE TUTORIAL 10**

Style Analysis for Hedge Funds

- Since hedge funds lack transparency → analysts may undertake style analysis to see which asset classes are invested in

- **Matrix of Constraints**

Type of Investor	Liquidity	Horizon	Regulatory	Taxes
Individuals	Variable	Life cycle	None	Variable
Personal trusts	Variable	Life cycle	Prudent investor laws	Variable
Mutual funds	Usually low	Short	Little	None*
Pension funds	Young, low; mature, high	Long	ERISA	None
Endowment funds	Low	Long	Little	None
Life insurance companies	Low	Long	Complex	Yes
Non–life insurance companies	High	Short	Little	Yes
Banks	Low	Short	Risk-based capital requirements	Yes

Table 28.5

Matrix of constraints

* The mutual fund itself does not pay taxes, as all investment income is "passed through" to investors. However, it may pay attention to taxes on behalf of its investors.

  - Banks → sources of funds are highly liquid, but assets are much less liquid because they invest in long-term mortgages, and loans to customers, and those loans can't be disposed of in short notice
  - Banks →
- **Sample Policy Statements**
  - An **Investment Policy Statement (IPS)** serves as a strategic guide to the planning and implementation of an investment program
    - Scope and purpose
    - Governance
    - Investment, return, and risk objectives
    - Risk management

- **Asset Allocation**
  - The most important part of policy determination is asset allocation, that is, deciding how much of the portfolio to invest in each major asset category
  - **Asset allocation process:**
    1. Specify asset classes to be included in the portfolio
       - E.g. money market instruments (*cash*), fixed income (*bonds*), stocks, real estate, precious metals, other
    2. Specify capital market expectations
       - Conduct historical data and economic analysis to determine your expectations of future rates of return over the relevant holding period on the asset classes to be included
       - E.g. risk factors: [market, inflation, interest-rate, liquidity, political, event, currency, credit, energy price] risk
    3. Derive the efficient portfolio frontier
       - Markowitz process etc.
    4. Find the optimal asset mix