Final Exam

- Bring two 8.5 by 11 formula sheets
- Next Tuesday, May 4, 2-5
- Room 152
- Office Hours: Next Monday, 10:30-1

Today

- APT
  - what
  - intuition
- Quick review of main ideas
- Practice exam
The APT

- CAPM
  - people only care about mean and variance
  - Intuition: only systematic risk should be priced
- APT
  - not based on investor preferences but on ‘factor model’ for returns

APT Model

- Common factors that determine co-movements of returns
- systematic and diversifiable risk
- Intuition of model
  - only systematic risk is rewarded...
Factor Model

\[ \tilde{r}_i = E[\tilde{r}_i] + \beta_{i1}^1 F^1 + \beta_{i2}^2 F^2 + \cdots + \beta_{ik}^k F^K + \varepsilon_i \]

- F: factor
- \( \beta \): factor loading
- \( \varepsilon \): diversifiable risk

Pricing

- Expected returns proportional to factor betas
- Intuition: only systematic risk should command higher expected returns

\[ E[\tilde{r}_i] = r_{free} + \lambda_1 \beta_{i1}^1 + \lambda_2 \beta_{i2}^2 + \cdots + \lambda_K \beta_{iK}^K \]
Example

• 3 factors
• Stock i has
  – $\beta_i^1 = 1.1$, $\beta_i^2 = 0.5$, $\beta_i^3 = 2$
  – $\lambda_1 = 10\%$, $\lambda_2 = 10\%$, $\lambda_3 = 1\%$, Riskfree rate = 5\%
• Expected return on stock?

Main Ideas

• Replication and pricing
• Sensitivity measures
• Diversification
• Risk vs. return
Replication

- Two strategies with same payoff every state must have the same price
  - coupon bonds and pure discount bonds
    - spot interest rates
    - forward interest rates
  - Options
    - put/call parity
    - binomial model

Sensitivity Measures

- Bonds
  - duration and convexity, and ‘factor adjusted’
- Other securities
  - beta with respect to market (CAPM)
  - ‘factor models’
- Application to hedging
Diversification

• Combine securities to reduce risk
  – portfolio optimization
• Co-movements is the key
  – covariance, or in ‘factor’ settings, sensitivities to factors

Risk vs. Return

• Rewarded for systematic risk
  – CAPM-market
  – factor models - factor loading
  – term structure-duration and convexity?
Solutions to practice exam