

# Review

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BUSI 448: Investments

# Exam Information

- Closed notes and book
- You may **not** use (and will not need) Excel, Python, or calculator
- Questions will be a mix of true/false, multiple choice, and short answer
- Practice problems available on Canvas.
- Please study beforehand and then use the practice problems to gauge understanding.

# Some Review

# This course as a portfolio

1. Introductory Material (19%)
2. Financial Markets (23%)
3. Optimal Portfolios (23%)
4. Equity Topics (15%)
5. Fixed Income Topics (12%)
6. Performance Evaluation (4%)
7. Taxes (4%)

# Introductory Material (19%)

# Savings problems

- Annuity calculations
- Basic bond prices
- Saving for retirement
- Real and nominal cash flows and rates

# Returns

- How to calculate
- Compounding returns
- Arithmetic vs. geometric averages
- Dispersion: variance and standard deviation
- Comovement: covariance and correlation
- Calculating portfolio return characteristics
  - Expected returns; variance; SD

# Financial Markets (23%)

# Equity Market

- Over long horizons, average returns in the US stock market have exceeded those of bonds.
- Stock returns are risky; that is, volatile.
- Stock return distributions are fat-tailed and negatively skewed.
- Past aggregate returns do **not** predict future aggregate returns.
- Volatility is time-varying and persistent.

# Treasury Markets

- Term structure of interest rates
- Spot rates
  - zero-coupon bonds
  - bootstrapping from coupon bonds

# Arbitrage

- Free risk-free return
- Bootstrapping spot rates based on **no-arbitrage** pricing
- Law of One Price says that price of bond = price of replicating portfolios
  - If not, there exists an arbitrage

# Markets and Trading

- Adverse selection: taking advantage of information asymmetry
- Winner's Curse: you might regret winning an auction!
- Bid-ask spreads in limit order books are partially due to adverse selection concerns

# Leverage and Margin

- **Leverage** is investing with borrowed money
  - amplifies good and bad returns
- **Margin:** borrowing money from your broker to buy assets
- Brokers and regulators require initial and maintenance margins to protect against default risk
- Price movements against your position may generate margin calls.

# Short-selling and Limits to Arbitrage

- Borrow the asset, sell it **short**, then buy back later
- Margin accounts on short positions require extra collateral to protect against price increases (liability increases)
- In practice, arbitrage trades are limited by frictions like equity borrowing fees and margin requirements.
- Prices might move the wrong way before they correct!

# Optimal Portfolios (23%)

# Diversification

- **Diversification:** portfolios of assets may reduce overall risk
- **Efficient Frontier:** the set of portfolios that minimize portfolio risk for a given target expected return
- **Global Minimum Variance:** portfolio of risky assets with the smallest variance

# Theory

- Capital allocation with a risk-free asset
- **Tangency portfolio:** portfolio of risky assets with the highest Sharpe ratio
- **Capital Allocation Line:** set of portfolios combining risk-free asset and tangency portfolio
- Location on CAL depends on investor's **risk aversion**

# Borrowing Frictions

- Borrowing rates usually exceed savings rates
- For a single risky asset, this leads to a kinked CAL
- Efficient frontier consists of
  - a CAL consisting of saving and maximum Sharpe ratio portfolio w.r.t savings rate
  - a portion of the all-risky-asset frontier
  - a CAL consisting of borrowing and maximum Sharpe ratio portfolio w.r.t borrowing rate

# Shorting Constraints

- Some investors may not be able to short assets
- This reduces the investment opportunity set
- Recall how to implement efficient and tangency portfolios with position limits

# Rebalancing

- Assuming our inputs stay constant over time, price movements will cause portfolios to drift from optimal weights over time.
- Rebalancing portfolios back to optimal weights improves expected performance.

# Input Sensitivity

- Mean-variance optimization is sensitive to inputs
- Position limits can mitigate error-maximization problem
- In practice, some try to estimate a subset of the inputs
  - GMV (assume equal means)
  - Risky parity (assume equal means and zero corr)
  - Equal-weighted (equal means & SDs; zero corr)

# Equity Topics (15%)

# Market Model

- $\beta$  measures sensitivity to market returns
- $\alpha$  measures historical average abnormal return
- $\beta$ 's can be used in estimating the covariance matrix with fewer parameters

# CAPM

- Widely used model for expected equity returns
- Requires 3 inputs
  - Risk-free rate
  - Beta
  - Market risk premium
- Performs poorly in explaining differences in stock return empirically
  - Security market line is too flat

# Cross-sectional Predictability

- Sorting stocks on characteristics has been more successful in explaining cross-sectional differences in returns than beta
  - Market cap, book-to-market, momentum, liquidity, idiosyncratic volatility
- Cross-sectional regressions of returns on lagged characteristics are another method of explaining returns

# Multifactor Models

- Beyond the market excess return as a factor
- Size: Small Minus Big
- Value: High B/M Minus Low
- Momentum: Winners Minus Losers
- Op. profitability: Robust Minus Weak
- Investment: Conservative Minus Aggressive

# Fixed Income Topics (12%)

# Duration

- **Duration** is a weighted average time to maturity
- Duration allows us to quickly compare interest rate risk for bonds with different coupons, maturity, yields, etc.
- Duration is also the horizon at which reinvestment risk and interest risk cancel out

# Convexity

- **Convexity** measures the curvature of the pricing function
- Duration + Convexity allow for better approximation of pricing function
- Investors like positive convexity (standard coupon bond)
- Issuers prefer negative convexity (callable bonds / MBS)

# Credit Risk

- **Credit risk:** risk issuer will not pay promised CFs
- Credit ratings are a standard way to measure
- Yields higher for lower rated debt
- Yield  $\neq$  expected return!

# Performance Evaluation (4%)

# Evaluating Asset Managers

- $\alpha$ 's from a factor model are average benchmark-adjusted average returns
- **Attribution analysis:** performance can be decomposed into the benchmark component(s) (factor loadings times factor realizations) and the active component.

# Taxes (4%)

# Tax-efficient Investing

- Calculating Taxes
- Effects of deductibility of tax-advantaged savings
  - Traditional IRA/401(k)
- Effects of deferral of taxation
  - Non-dividend stock; non-deductible IRA

**Thanks and Good Luck!**

