

# Capital Markets and Investments

Fall 2016, Mathematics, GR 5280

Instructor: *Alexei Chekhlov*, [ac3085@columbia.edu](mailto:ac3085@columbia.edu) or  
[achekhlov@systematicalpha.com](mailto:achekhlov@systematicalpha.com)

Teaching Assistant: *Mengying Zhang*, [mz2522@columbia.edu](mailto:mz2522@columbia.edu)

***The dates of seminars (double lecture every Friday)***

1. 9/9/2016;
2. 9/16/2016;
3. 9/23/2016;
4. 9/30/2016;
5. 10/7/2016;
6. 10/14/2016;
7. 10/21/2016;
8. 10/28/2016;
9. 11/4/2016;
10. 11/11/2016;
11. 11/18/2016 (take home Final Exam given out);
12. 11/25/2016;
13. 12/2/2016 (take home Final Exam collected).

**LECTURE TIME: Fridays, 5:00 PM – 7:20 PM**

**LECTURE ROOM: 312, Mathematics Building**

**GRADE = ATTENDANCE (20%) + HWs (40%) + FINAL EXAM (40%)**

## ***The course Objectives***

By following the classical text of Bodie, Kane, Marcus "Investments" [1], introduce the students to the following notions:

- 1) That in the reasonably free and competitive financial markets the securities prices are nearly efficient, and how useful this observation is for the securities valuation and investments strategies selection.
- 2) Risk/return tradeoff, diversification and their role in the modern portfolio theory, their consequences for asset allocation, portfolio optimization. We will cover Capital Asset Pricing Model, Modern Portfolio Theory, Factor Models, and Equities Valuation.
- 3) Definition and treatment of futures, options, fixed income securities.

Even though [1] is a classical MBA/CFA text, we will be trying to place a larger emphasis on the empirical finance (heavy use of Bloomberg Professional data) and applied math/quantitative considerations of the above subjects.

## ***Tentative subjects to be covered***

1. The investment environment. Real assets versus financial assets. Financial assets. Some examples from Bloomberg. Role of financial assets in economy: the informational role of financial markets; consumption timing; allocation of risk; separation of ownership and management. The investment process. Markets competitiveness: risk-return trade-off; efficient markets. The players in financial markets: financial intermediaries; investment bankers. The financial crisis of 2008: conditions before the crisis; various illustrations from Bloomberg; changes in housing finance; mortgage derivatives; credit default swaps; the rise of systemic risk; crisis unfolding; systemic risk and the real economy.

*Reading: chapter 1 of [1].*

2. Asset classes and financial instruments: money markets and capital markets. Money markets components. Treasury Bills, their yield calculation, Bloomberg examples. Certificates of Deposit; Commercial Paper (examples and quotation); Banker's Acceptances; Eurodollars; Repos and Reverses; Federal Funds; Broker Calls; LIBOR (examples of quotations); EURIBOR. Bond market: Treasury, Corporate, Municipal, Mortgage, Federal Agency. Treasury bonds and Notes: valuation and quotation (Bloomberg examples). Yield to maturity. Inflation-Protected Treasury Bonds. Negative real yield. Federal Agencies and their debt. International bonds. Municipal bonds. Equivalent taxable yield and tax-exempt yield. Corporate bonds. Mortgages and MBSs. Equity securities. Common stock, preferred stock. Depositary Receipts. Equity indices: Dow Jones (change in divisors after split); S&P 500 index; other U.S. indices. Various Bloomberg examples. Equally weighted indices. International indices. Derivatives: options, futures.

*Reading: chapter 2 of [1].*

3. How securities are traded: primary market, secondary market. Issuing securities. Public offering; Private placement. Investment banking. Shelf registration, private placements. Initial Public Offering: parts of the process and examples from Bloomberg. Secondary markets: direct search markets, brokered markets, dealer markets, auction markets. Trading orders: market orders, limit orders, stop orders. Detailed examples of trade orders. Dealer markets, electronic markets. ECNs. Specialist markets. NASDAQ exchange and its listing requirements. NYSE exchange and its listing requirements. Trading costs. Buying on margin. Margin arithmetic examples. Short sales. Short arithmetic examples. Margin call on a short. Securities regulations. Sarbanes-Oxley Act. Insider trading.

*Reading: chapter 3 of [1].*

4. Real and nominal interest rates. Equilibrium real rate of interest. Irving Fisher Hypothesis. Effect of taxes. Rates of return for different holding periods. Annualized rates of return. Continuous compounding. Treasury bills and inflation: real T-Bill rate (Bloomberg examples). Expected return and standard deviation. Excess return and risk premium. Time series vs. scenario analysis. Recovering from a drawdown. Variance and standard deviation. Sharpe ratio. Normal (Gaussian)

distribution. Excel examples. Constructing normal curve. Pascal triangle in Excel. Binomial coefficients. Some Gaussian properties. Gaussian distribution. Gaussian moments. Deviations from Normal (Gaussian). Negative skewness. Positive kurtosis. Value at Risk (VaR). Conditional VaR or Expected Shortfall. Lower partial standard deviation and Sortino ratio. Historical returns analysis (Excel examples). Global view.

*Reading: chapter 5 of [1].*

5. Capital allocation to risky assets. Speculation and gambling; fair game. Notion of risk-aversion. Gambling may look as speculation: speculation or gambling? Risk-aversion and utility. A reasonable utility function proposal. Utility score. Trade-off between risk and return. Indifference curve. Risk tolerance. Sample risk quiz questions from risk tolerance tests. Allocation between risky and riskless assets. Example of allocation. Rebalancing the portfolio preserving relative weights in risky assets. One risky asset and risk-free asset. Investment opportunity set: Capital Allocation Line. Effect of leverage. Optimal allocation to a risky asset. Indifference curves. Optimal Complete Portfolio. Passive strategy: Capital Market Line.

*Reading: chapter 6 of [1].*

6. Diversification and portfolio risk. Effects of naïve diversification: equal-weighted INDU portfolio, equal-weighted SPX portfolio. Portfolios of two risky assets. Efficient diversification. Using correlation coefficient. Sample portfolio. Negative weights. Effect of varying the stocks weights on portfolio standard deviation. Allocation between stocks, bonds, and bills. Optimal portfolio with two risky assets and a risk-free asset. Graphical solution. Exact analytical solution. Optimal complete portfolio. Markowitz portfolio selection. Efficient frontier. Required estimates for Markowitz procedure. Additional constraints. Separation property. Power of diversification: a simplified case of equally-weighted portfolio. Further simplification: same standard deviations and correlation coefficients. Risk pooling and risk sharing.

*Reading: chapter 7 of [1].*

7. Some Markowitz procedure drawbacks. An index model. Markowitz inputs list revisited. If inputs are produced by “independent” parties, they (correlation coefficients, for example) can be mutually inconsistent. Single-factor model. Risk and covariance formulation. Set of estimates for single-index model. Discussion of index-model. Index-model on portfolio level. Estimating the single-index model (a completely re-worked historical example!). Linear regressions. Optimization using Excel Solver. Various additional weight constraints (leverage-like). Optimal solutions, efficient frontiers. Comparison with exact Markowitz.

*Reading: chapter 8 of [1].*

8. Capital Asset Pricing Model. Market portfolio, security market line. Simplifying the CAPM: Single-index and multi-factor models.

*Reading: chapter 9 of [1]. Some chapters from [7].*

9. Arbitrage Pricing Theory. Market Efficiency. Versions of Efficient Market Hypothesis. Random walk and efficient market hypothesis. Technical and fundamental analysis. Active vs. passive portfolio management. Portfolio strategies and some market anomalies.

*Reading: chapter 10 of [1]. Some chapters from [7].*

10. Efficient market hypothesis. Random walk and efficient market hypothesis. Implications of EMH. Are markets efficient?

*Reading: chapter 11 of [1].*

11. Behavioral finance and technical analysis.

*Reading: chapter 12 of [1].*

## ***References***

1. Bodie, Kane, Marcus, "Investments", Tenth Edition, 2014.
2. Graham and Dodd's Security Analysis, Fifth Edition, Sidney Cottle, Roger F. Murray, Frank E. Block, 1988.
3. Jack D. Schwager, "A Complete Guide to the Futures Markets. Fundamental Analysis, technical Analysis, Trading, Spreads & Options", John Wiley & Sons, 1984.
4. John C. Cox, Mark Rubinstein, "Options Markets", Prentice Hall, 1985.
5. Neil A. Chriss, "Black-Scholes and Beyond. Option Pricing Models", Irwin, 1997.
6. Christina I. Ray "The Bond Market. Trading and Risk Management", McGraw-Hill, 1993.
7. Richard C. Grinold, Ronald N. Kahn, "Active Portfolio Management: Quantitative Theory and Applications", McGraw-Hill, 1995.