Spring 2002
BAFI 431:
Fixed Income Markets and Their Derivatives

Instructor Peter Ritchken
Office Hours Tuesday: 2.00pm - 5.00pm,
(or by appointment)
Tel. No.  368-3849

My web page is:
http://weatherhead.cwru.edu/ritchken

The Course Material will be posted on the BAFI 431 section of my web. page.

This class is concerned with fixed income securities and interest rate risk management. Fixed income securities account for about two thirds of the market value of all securities that are outstanding in the world, and hence this topic is worthy of at least one full course!.

BAFI 430 is a prerequisite for this class. Knowledge of derivatives, and particularly the Black Scholes model, together with the Greeks will be assumed.

There is no required textbook for this class. Excellent books that you may find useful are

• Fixed Income Markets And Their Derivatives by S. Sundaresan, published by South Western.

• Bond Markets, Analysis And Strategies, by F. Fabozzi, published by Prentice Hall

• Fixed Income Securities, by B. Tuckman, published by Wiley.

The Sundaresan text is a very good reference book that has significant details of the operations of markets. It also contains some of the theory and has good examples. The Tuckman book is probably closest in spirit to the type of class I hope to teach and if you want to buy a book, this is the book I would recommend.

I will provide class notes through my web page.

The grade for the course will be determined as follows:

Mid Term 35%
Final  45%
Homework  10%
Project  10% (plus tie-breaker)

The **Mid Term Exam Date** will be on March 7th
The **Final Exam** is scheduled for Thursday evening of exam week, May 2\textsuperscript{nd}.
**Project**

You can do the project in teams of up to 3 people, or individually. The larger the team the bigger the scope of the project. Every team will be responsible for the following:

- Preparation and distribution to the class of a set of notes on the topic, one week prior to the presentation.
- Preparation of a set of overheads for distribution to the class.
- Preparation of a set of problems that illustrate the main ideas.
- Preparation of a solution set for the problems.

Each team will make a presentation to the class. After the students have heard the presentation, they will grade the presentation (A, B, C or F). After reading all the material provided, and solving the problems provided, students will provide a second grade. I will provide feedback to the project group and provide a final grade.

I may request that some teams make longer class presentations, while others could make brief presentations, with other details presented to me outside of class time. We will discuss this in more detail in class.

The topics for the presentation will apply some of the skills that you will have learnt in the first part of the class. The types of projects that I have in mind include:

- Credit Derivatives- What they are and how they can be used.
- Credit Derivatives- Valuation.
- Mortgage backed securities: An overview of products.
- Prepayment models for Mortgage backed securities.
- Hedging Pipeline Risk in Mortgage Markets.
- Creditmetrics. What is it? Some applications
- The ins and outs of Municipal Bonds.
- Case Studies involving Bloomberg. Looking at some exotic products and commenting on them.
- Value at Risk Systems for Interest Rate Risk.
- Pricing of Corporate Bonds
- Pricing of Corporate Securities.
- Implementing Vasicek (or other) models
- Investigating special interest rate products that trade on option or futures exchanges in Europe and/or US and/or Asia…
- The list is endless and I will mention some in class. Once you have an idea, then you need to confirm it with me.

**The material covered in these presentations will be tested in the final exam.**
Homework

Homework should be turned in on time. If not, do not bother to turn it in. Your lowest grade on a homework will be discarded. All homework assignments carry equal weight. Full solutions will be provided to the homework problems.

The course outline is VERY tentative. We may spend more time on some topics than others. For example, we may spend time on credit derivatives which are currently very timely.

Office Hours

I have office hours on Tuesday afternoon. If you cannot see me during the scheduled window, you need to make an appointment to see me. For part time students, perhaps you can call me in my office during office hours and I can respond to your questions on the phone. In addition, I will be available before and after class.

If you have urgent questions then you can e-mail me. All questions regarding grading of homework should be initially directed to the grader of the class. She will have office hours during which time she can also assist you with any questions related to the class. Please do not submit your homework to me electronically without my permission.

The grader for the class is Wei Wei. She can assist you with your homework, with excel spreadsheet assignments, and she will respond to any questions about the class or about grading. She is a terrific resource for this class.

Grader:    Wei Wei
Tel.       368-5009
Office:    Sears 631
Office Hours: To be provided.
I will provide you with some reading assignments so that, time permitting, you can prepare for the next class. The class notes will be placed on my web page. Most of my handouts will be password protected, and I will provide the password to you.

What follows is a very tentative course outline. I may depart from it quite considerably, based on how we proceed, class interests etc. For example, credit derivatives is very timely and we may want to spend some time on this topic. I also have not given as much attention to Mortgage Backed Securities and their derivatives as I should. Finally, we could spend a significant amount of time on corporate securities, such as Convertibles, Warrants etc.

PART ONE: The Basic Products

1. Bond Price Arithmetic
   - Future Values and Compounding Intervals
   - Annualizing Holding Period Returns
   - Compounding over fractional periods
   - Discounting
   - Bond Prices and Yield-to-Maturity
   - Annuities and Perpetuities
   - Price Quotations and Accrued Interest
   - Interest Rate Conventions
   - Yields as a Method for Communicating Prices

2. Treasury Bills, Notes, Bonds and Strips
   - The T- Bill Market
   - The T-Note and T- Bond Market
   - Stripped Coupon Bonds
   - Arbitrage Relationships between Strips and Coupon Bonds
   - Other Short Term Money Market Instruments

   - The Role of the Federal Reserve Bank
   - The Primary Dealer Market
   - US Treasury Auctions
   - The Secondary market
   - Market Size, Volume, and other Statistics
   - Repurchase Agreements and the Repo Market

4. Spot Rates, Par Rates and Forward Rates
   - The Discount Function
   - Yield to maturity for discount Bonds
   - Yield to Maturity for Coupon Bonds.
   - Establishing Forward Prices of Discount and Coupon Bonds
   - Forward Rates, and Forward Rate Curves.
5. **ED Deposits, ED Futures, and FRAs**
   - The Eurodollar Market
   - Eurodollar Futures
   - Using ED Futures
   - Forward Rate Agreements
   - Pricing Forward Rate Agreements
   - Eurodollar Futures and FRAs

6. **Interest Rate Swaps**
   - Interest Rate Swaps.
   - Pricing Interest Rate Swaps
   - Pricing Forward Starting Swaps.
   - Pricing Floaters and Forward Starting Floaters.
   - Constructing the LIBOR Curve using EDs, ED Futures, and Swaps.

7. **Constructing Zero Curves.**
   - More on Discount Rates, Spot Rates and Forward Rates.
   - Practical Considerations
   - Spline technology
   - Examples

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**PART TWO  RISK MANAGEMENT 1**

8. **Measures of Price Sensitivity 1**
   - Sensitivity of Coupon Bond Prices
   - Maturity and Duration
   - Linear and Quadratic Approximations to Bond Price Changes.
   - Duration and Convexity of Bonds and Bond Portfolios
   - Bullets, Bellbars and Ladders
   - DVO1
   - Immunization
   - Examples and Case Studies

9. **Measures of Price Sensitivity 2**
   - Key Rate Durations
   - Present Value of a Basis Point
   - Applications of Key Rate Durations.
   - Strip Equivalents.
   - Key Rate Duration Profiles of Options
   - Applications

10. **Simple Hedging Strategies using Futures.**
• Short Term Contracts, T-Bill Futures and ED Futures.
• Duration Based Hedging
• Long Term Interest Rate Futures
• Hedging with T-Bond Futures
• Creating Synthetic Instruments and Asset Allocation
• Applications

11 Over the Counter Interest Rate Claims and the Black Model

• The wide variety of interest rate claims
• Over the counter interest rate claims
• Caps, floor and options on ED futures
• Swaption markets
• The Black Model
• Market convention for quotations.
• What makes pricing interest rate claims difficult

PART 3: PRICING INTEREST RATE CLAIMS

12 Theories of the Term Structure

• Term Structure in a Certain Economy
• Term Structure in an Uncertain Economy
• The Unbiased Expectations Hypothesis
• The Local Expectations Hypothesis
• The Return to Maturity Hypothesis
• Preferred Habitat and Liquidity Premium Theories.
• The use of the Yield Curve for Extracting Forecasts of Future Spot Rates
• Empirical Evidence.

13 Arbitrage Free Pricing

• Pricing Under Uncertainty
• Pricing Under Risk Neutrality and under Risk Aversion
• Risk Neutral Pricing Trick
• Local Expectations Hypothesis and Arbitrage Free Pricing
• Examples
• Externally Consistent Pricing

14 Single Factor Models for Pricing Interest Rate Claims

• Single Factor Models
• Binomial Approximation for the Square Root Model
• The Cox Ingersoll Ross model
• Pricing Options on Bonds.
• Calibrating Single Factor Models.
• Applications
15 The Art of Term Structure Modeling
- Term Structure Constrained Models
- Properties of an Interest Rate Option Model
- Ho Lee Model and Vasicek Models
- Black Derman Toy, and Black Karasinski Models
- Other Simple Models

16 Risk Management of an Interest Rate Book
- Identifying where the risk is.
- Identifying hedging instruments
- Establishing the hedge
- Evaluating the robustness of the hedge
- Marking to Market and Marking to Model.
- Examples and Case Studies.

PART FOUR: CORPORATE SECURITIES AND CREDIT RISK

17 Corporate Bonds and Credit Risk
- Basics of Corporate Bonds
- Option Features in Corporate Bonds
- Callable Bonds
- Convertible Bonds
- Advanced Pricing of Corporate Bonds

18 Credit Derivatives
- Definitions and Examples
- Economic rationale
- Valuation
- Credit Swaps

PART FIVE: MORTGAGES AND THEIR DERIVATIVES

19 Mortgages and Mortgage Backed Securities
- Mortgage Backed Securities
- Mortgage Backed Derivative Markets
- Prepayment Functions

20 Special Topics
- More on Corporate Securities
- Structured Products