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Fall 2015

## MATH 5803

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*University of New Orleans*

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## MATH 5803 -001 Financial Math I

**Class Time:** M W 3:30-4:45  
**Classroom:** Math 118  
**Instructor:** Jairo Santanilla  
**Office:** MATH 243  
**Office Hours:** Mon. & Wed. 1:30 – 3:30; Fr. 11-1  
**Phone:** 280-6120  
**E-mail Address:** jsantani@uno.edu

### Textbook:

- Ruckman, C., and Francis, J., Financial Mathematics: A Practical Guide for Actuaries and other Business Professionals (Second Edition), 2005, BPP Professional Education. (Required).
- McDonald, R.L., Derivatives Markets. There is a 3rd edition, but it is not that different from the 2nd edition. (Recommended).

### Tentative Dates:

#### **Week of**

17-Aug	Chapter 1
24-Aug	Chapter 1
31-Aug	Chapter 2
31-Aug	Chapter 2
7-Sep	Labor Day, Tuesday Sept. 8 last day to drop with "W"
14-Sep	Chapter 3
14-Sep	Chapter 4
21-Sep	Chapter 4
21-Sep	Test 1
28-Sep	Chapter 5 (excluding the investment year method portion of 5.4)
5-Oct	Chapter 5 (excluding the investment year method portion of 5.4)
12-Oct	Chapter 6 (excluding 6.1.6, 6.1.7, 6.4, and 6.5), Oct. 14 last day to drop.
19-Oct	Chapter 7 (excluding 7.4)
26-Oct	Chapter 7 (excluding 7.4)
2-Nov	Chapter 8 (excluding 8.4, 8.5, and 8.6)
9-Nov	Chapters 1–3 (McDonald)
16-Nov	Chapters 1–3 (McDonald)
23-Nov	Test 2
23-Nov	Chapter 4 (4.1–4.4) (McDonald)
30-Nov	Chapter 5 (5.1–5.4 and Appendix 5.B) (McDonald)
30-Nov	Chapter 8 (8.1–8.3) (McDonald)
7-Dec	Final exam (please check <a href="http://www.uno.edu/registrar/bulletin/finals.aspx#fall">http://www.uno.edu/registrar/bulletin/finals.aspx#fall</a> )

NOTE: Assignments are posted on Moodle after the completion of each chapter.

### Important Dates\*

Last day to adjust schedule w/out fee .....	08/18/2015
Semester Classes Begin .....	08/19/2015
Last day to adjust schedule w/fee, or withdraw with 100% refund.....	08/25/2015
Last day to apply for December commencement ...	09/25/2015
Final day to drop a course or resign .....	10/14/2015
Mid-semester examinations.....	10/05-10/09/2015
Final examinations.....	12/07-12/11/2015
Commencement .....	12/18/2015

\*Note: check Registrar's website for Saturday and A/B sessions, and for items not listed here:  
<http://www.registrar.uno.edu>

### **Course Description and Prerequisites:**

Prerequisites: MATH 2314 (or MATH 2785), and MATH 2114 or MATH 2107. The Measurement of Interest, problems in interest, elementary annuities, yield rates, amortization schedules and sinking funds, bond and other securities, practical applications, more advanced financial analysis, a stochastic approach to interest. This is the material covered on Exam FM (Financial Mathematics) and Exam 2 administered by the Society of Actuaries and the Casualty Actuarial Society, respectively. This course requires the use of a financial calculator.

### **Student Learning Outcomes:**

#### **I. Interest Theory (65-80%)**

##### **A. Time Value of Money (5-15%)**

1. The candidate will be able to define and recognize the definitions of the following terms: interest rate (rate of interest), simple interest, compound interest, accumulation function, future value, current value, present value, net present value, discount factor, discount rate (rate of discount), convertible m-thly, nominal rate, effective rate, inflation and real rate of interest, force of interest, equation of value
2. The candidate will be able to:
  - a. Given any three of interest rate, period of time, present value, and future value, calculate the remaining item using simple or compound interest. Solve time value of money equations involving variable force of interest.
  - b. Given any one of the effective interest rate, the nominal interest rate convertible m-thly, the effective discount rate, the nominal discount rate convertible m-thly, or the force of interest, calculate any of the other items.
  - c. Write the equation of value given a set of cash flows and an interest rate.

##### **B. Annuities/cash flows with payments that are not contingent (5-20%)**

1. The candidate will be able to define and recognize the definitions of the following terms: annuity-immediate, annuity due, perpetuity, payable m-thly or payable continuously, level payment annuity, arithmetic increasing/decreasing annuity, geometric increasing/decreasing annuity, term of annuity

2. For each of the following types of annuity/cash flows, given sufficient information of immediate or due, present value, future value, current value, interest rate/yield rate, payment amount, and term of annuity, the candidate will be able to calculate any remaining item
  - a. Level annuity, finite term
  - b. Level perpetuity
  - c. Non-level annuities/cash flows
    - i) Arithmetic progression, finite term
    - ii) Arithmetic progression, perpetuity
    - iii) Geometric progression, finite term
    - iv) Geometric progression, perpetuity
    - v) Other cash flows
- C. Loans (5-20%)
  1. The candidate will be able to define and recognize the definitions of the following terms: principal, interest, term of loan, outstanding balance, final payment (drop payment, balloon payment), amortization, sinking fund
  2. The candidate will be able to:
    - a. Given any four of term of loan, interest rate, payment amount, payment period, principal, calculate the remaining item.
    - b. Calculate the outstanding balance at any point in time.
    - c. Calculate the amount of interest and principal repayment in a given payment.
    - d. Given the quantities, except one, in a sinking fund arrangement calculate the missing quantity.
- D. Bonds (5-20%)
  1. The candidate will be able to define and recognize the definitions of the following terms: price, book value, amortization of premium, accumulation of discount, redemption value, par value/face value, yield rate, coupon, coupon rate, term of bond, callable/non-callable
  2. Given sufficient partial information about the items listed below, the candidate will be able to calculate the any of the remaining items.
    - a. Price, book value, amortization of premium, accumulation of discount
    - b. Redemption value, face value
    - c. Yield rate
    - d. Coupon, Coupon rate
    - e. Term of bond, point in time that a bond has a given book value, amortization of premium, or accumulation of discount
- E. General Cash Flows and Portfolios (5-20%)
  1. The candidate will be able to define and recognize the definitions of the following terms: yield rate/rate of return, dollar-weighted rate of return, time-weighted rate of return, current value, duration (Macaulay and modified), convexity (Macaulay and modified), portfolio, spot rate, forward rate, yield curve, stock price, stock dividend

2. The candidate will be able to:
    - a. Calculate the dollar-weighted and time-weighted rate of return
    - b. Calculate the duration and convexity of a set of cash flows.
    - c. Calculate either Macaulay or modified duration given the other.
    - d. Use duration and convexity to approximate the change in present value due to a change in interest rate
    - e. Calculate the price of a stock using the dividend discount model
- F. Immunization (5-15%)
1. The candidate will be able to define and recognize the definitions of the following terms: cash flow matching, immunization (including full immunization), Redington immunization
  2. The candidate will be able to:
    - a. Construct an investment portfolio to fully immunize a set of liability cash flows.
    - b. Construct an investment portfolio to match present value and duration of a set of liability cash flows
    - c. Construct an investment portfolio to exactly match a set of liability cash flow

## II. Financial Economics (20-35%)

- A. General Derivatives (0-5%)
1. The candidate will be able to define and recognize the definitions of the following terms: derivative, underlying asset, over the counter market, short selling, short position, long position, ask price, bid price, bid-ask spread, lease rate, stock index, spot price, net profit, payoff, credit risk, dividends, margin, maintenance margin, margin call, mark to market, no-arbitrage, risk-averse
  2. The candidate will be able to evaluate an investor's margin position based on changes in asset values
- B. Options (0-5%)
1. The candidate will be able to define and recognize the definitions of the following terms: call option, put option, expiration, expiration date, strike price/exercise price, European option, American option, Bermudan option, option writer, in-the-money, at-the-money, out-of-the-money, covered call, naked writing, put-call parity
  2. The candidate will be able to evaluate the payoff and profit of basic derivative contracts.
- C. Forwards and Futures (0-10%)
1. The candidate will be able to define and recognize the definitions of the following terms: forward contract, futures contract, outright purchase, fully leveraged purchase, prepaid forward contract, cost of carry.
  2. The candidate will be able to:
    - a. Determine forward price from prepaid forward price.
    - b. Explain the relationship between forward price and futures price.
    - c. Explain the relationship between forward price and future stock price.
    - d. Use the concept of no-arbitrage to determine the theoretical value of futures and forwards
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- e. Given sufficient partial information about call premium, put premium, forward price, strike price and interest rate, calculate any remaining item using the put-call parity formula
- D. Swaps (0-5%)
1. The candidate will be able to define and recognize the definitions of the following terms: swap, swap term, prepaid swap, notional amount, swap spread, deferred swap, simple commodity swap, interest rate swap
  2. The candidate will be able to use the concept of no-arbitrage to determine the theoretical values of swaps.
- E. Hedging and Investment Strategies (5-15%)
1. The candidate will be able to define and recognize the definitions of the following terms: hedging, arbitrage, diversifiable risk, non-diversifiable risk, spreads (option, bull, bear, vertical, box, ratio), collar width, collared stock, zero-cost collar, straddle, strangle, written straddle, butterfly
  2. The candidate will be able to:
    - a. Explain how derivative securities can be used as tools to manage financial risk.
    - b. Explain the reasons to hedge and not to hedge.
    - c. Evaluate the payoff and profit of hedging strategies.

**Graduate students will be able to**

- **Generalize statements of results introduced in the course.**
- **Solve problems beyond the level of the text-book.**
- **Proof results of statements beyond the level of the text-book.**

**Attendance:**

Attendance is required. Attendance will be taken each class period. It is your responsibility to find out what is covered in class if you do miss a class. You are also responsible for any announcements made in class.

**Assignments:**

Selected problems will be assigned after the completion of each chapter and students are encouraged to ask questions about any difficulties they are having with the suggested problems.

**Suggestions:**

After reading the grading policy for the course, one quickly realizes that over 90% of the grade in this class comes from the problems. Consequently, some students decide to pay as little attention to the concepts as possible and concentrate exclusively on the problems. This is fine if you feel comfortable with concepts and formulas. Otherwise, I strongly recommend to have a good understanding of the concepts and formulas before attempting to solve problems related to those concepts/formulas. This will help you learn the material for the long run.

Even if you feel comfortable with the concepts and formulas you will find that some problems are challenging. Please do not read the solution of a problem unless you feel comfortable with related concepts/formulas and have attempted to solve that problem. If after your attempt(s), you are not satisfied, you may read a portion of that solution to look for hints. Never start working on a problem by reading its solution.

If you have any difficulties with a problem, please make sure you participate in the surveys. You may also email me or post (see Forums) any questions you may have about the material or problems.

### **Course Grade:**

Quizzes: 5%
Test 1: 25%
Test 2: 25%
<b>Project: 15%</b>
Final Exam: 30%

- **Graduate Project is due on final exam date. Please turn in the following, excluding any questions answered in slides or in the book. Please include a full reference.**
  - 1. Work on at least 10 extra-problems in preparation for Exam FM,**
  - 2. At least 3 problems generalizing material included in the syllabus,**
  - 3. At least 2 proofs of statements/theorem related to the material.**
- Problems will be assigned after each topic/section/chapter.
- Quizzes will be used determine your understanding of the assigned problems.
- There is no predefined grading scale, but the standard scale (100% -90% = A, 89% -80% = B, 79% -70% = C, 69% -60% = D, 59% -0% = F), is the least favorable scale. Final grades are assigned base on "GAPS" between total scores. Examples of "GAPS" will be provided with test scores.

### **Student Conduct:**

The University of New Orleans (UNO) is a multicultural community composed of diverse students, faculty and staff. UNO will not tolerate discrimination or harassment of any person or group of persons based on race, color, religion, sex, disability, national origin, age, sexual orientation, marital or veteran status or any other status protected by law. Each member of the university is held accountable to this standard, which is strongly reflected in this code.

### **Academic Dishonesty:**

Academic integrity is fundamental to the process of learning and evaluating academic performance. Academic dishonesty will not be tolerated. Academic dishonesty includes, but is not limited to, the following: cheating, plagiarism, tampering with academic records and examinations, falsifying identity, and being an accessory to acts of academic dishonesty. Refer to the Student Code of Conduct for further information. The Code is available online at <http://www.studentaffairs.uno.edu>.

### **Accommodations for students with disabilities:**

It is University policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities that may affect their ability to participate in course activities or to meet course requirements. Students with disabilities should contact the Office of Disability Services as well as their instructors to discuss their individual needs for accommodations. For more information, please go to <http://www.ods.uno.edu>.

### **Expectations of students:**

Students are expected to review the notes prior to each class and do practice problems and graded homework on a regular basis. This is necessary in order to perform well on the tests. Students are also expected to arrive on time, remain for full class session, conduct themselves in a respectful manner to other students and the instructor and not use cell phones during class.

**Incomplete or late coursework:**

Late assignments will not be accepted.

**Additional Information:**

Additional information and a “Syllabus Attachment” is posted on Moodle.