Daniel and Vaaler Mathematical Interest Theory coverage for the SOA/CAS Financial Mathematics (FM/2) Exam

Option C (official for May 2008):

- *Mathematical Interest Theory, 2007,* by Daniel, J.W. and Vaaler, L.J.F., Chapter 1 (1.3–1.12, 1.14), Chapter 2 (2.2–2.5, 2.7), Chapter 3 (3.2–3.9, 3.11, 3.13), Chapter 4 (4.2–4.6), Chapter 5 (5.2–5.4), Chapter 6 (6.2–6.6, 6.9), Chapter 7 (7.1), Chapter 8 (8.3), Chapter 9 (9.1 – 9.5)
- *Derivatives Markets* (second edition), 2006 by McDonald, R., Chapter 1 (1.1–1.4), 2 (2.1–2.6 and Appendix 2.A), 3 (3.1–3.5), 4 (4.1–4.4), 5 (5.1–5.4 and Appendix 5.B), 8 (8.1–8.2).

What follows is an overview of the chapters of *Mathematical Interest Theory.*

Basic Interest Theory

Chapters 1 – 5 of *Mathematical Interest Theory* gives a traditional treatment of basic interest theory. However, yield rates are treated earlier than usual, then revisited whenever warranted by newly introduced financial arrangements. In addition, great care is taken to show the student how best to use the calculator for solving problems.

- Chapter 1 introduces accumulation functions and a variety of interest and discount rates. There are sections on simple interest and simple discount, as well as an extensive treatment of compound interest. Constant force of interest is introduced and general force of interest functions are studied. The time value of money is stressed, and net present value is introduced. The final section looks at inflation and real interest rates.

- Chapter 2 introduces equations of value. Yield rates (internal rates of return) are introduced with examples, some of which involve multiple parties or reinvestment.

- Chapter 3's topic is annuities-certain. Annuities with payments in geometric or arithmetic progression are discussed in detail, along with those with level payments. Included are annuities-immediate and annuities-due; each may have payments forever, in which case we use the term perpetuity, or each may be deferred. The methods of this chapter require us to find the effective interest rate for the payment period.

- Chapter 4 continues the study of annuities-certain, but here we work without explicitly computing the effective interest rate for the payment period. Among the annuities we consider are those with multiple equally spaced payments per interest period, which in the limit produce continuously paying annuities. When you do not have compound interest, these continuously paying annuities are especially important as they give approximations to those with discrete payments; here, students have another opportunity to work with non-constant force of interest functions.

- Chapter 5 includes a study of amortization. In particular, the division of a payment into principal and interest is addressed. The retrospective and prospective methods for determining outstanding loan balances, which were first seen in chapter 3, enter the discussion. Following the section on amortized loans, sinking funds are discussed; these may be used for accumulating a required balloon payment or for recapitalization.

Stocks and Bonds

- Chapter 6 gives an introduction to bonds. Topics include bond pricing at issue and at later dates, possibly after interest rates have changed, and both callable and putable bonds. Guaranteed investment contracts (GIC's) are introduced.

- Chapter 7's topic is stocks. We consider how to take a short or long position and include discussion of margin accounts. Mutual funds are mentioned.

Financial Derivatives

Our book was written so as to cover all the material that was on the FM exam syllabus prior to the changes announced in spring 2006 (to take effect with the May 2007) exam. Moreover, we were aware that material on financial derivatives was apt to be added, and we took this into account when determining the contents of our book. For instance, the no-arbitrage binomial pricing model for options is discussed at length. *Mathematical Interest Theory* meets the new learning objectives announced by the SOA and CAS; it includes "an introduction to financial derivatives, (forwards, options, futures, swaps) and their use in risk management" as well as "an introduction to the concept of no-arbitrage as a fundamental concept in financial mathematics."

- Chapter 8 of *Mathematical Interest Theory* contains an introduction to derivatives, forwards, futures, short and long positions, call and put options, hedging, arbitrage, and swaps. Spreads and collars are the only topics that are included in the May 2007 SOA/CAS FM/2 exam syllabus that are not included in our text.

Each of the two options currently recommended by the SOA/CAS for use in preparing for the FM/2 exam ask you to study the material on financial derivatives

using portions of chapters 1—5 of *Derivative Markets (second edition*) by R. McDonald. While we feel that our book covers all of that material except for spreads and collars, you may of course use McDonald's book for financial derivatives or for just spreads and collars in conjunction with *Mathematical Interest Theory*.

Risk Management

- Chapter 9 looks at how you might protect yourself from shift in interest rates. Firstly, asset-liability management is addressed. We then introduce Macaulay and modified durations and convexities, which are subsequently used in our discussions of Redington and full immunization. Effective duration is also included.