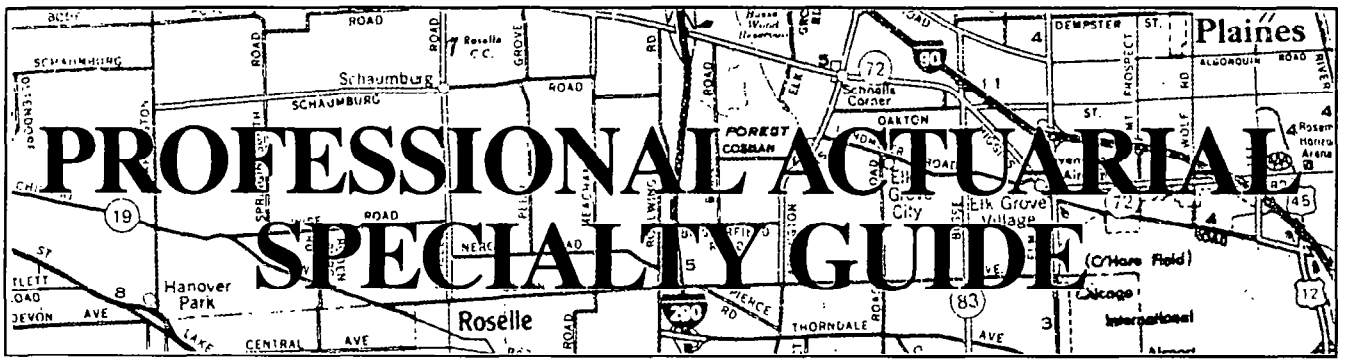
SOCIETY OF ACTUARIES



PROFESSIONAL ACTUARIAL SPECIALTY GUIDE

COMMITTEE ON CONTINUING EDUCATION

LIFE INSURANCE COMPANY INVESTMENTS

Overview

This Guide lists sources that the actuary may use to gain knowledge on investments and asset/liability management. Clearly this represents only a small fraction of the materials available on these topics. Its purpose is to make available a preliminary road map for the actuary seeking direction to enhance his or her knowledge in these areas. The emphasis of this Guide is on fixed-income securities. We do not assume the reader to have studied the Society of Actuaries' syllabus on investments (currently Courses 220 and V-380).

Many insurance companies do not subscribe to research journals. In compiling this Guide, we give preference to books that are readily available. Several articles are selected from actuarial or insurance journals.

The basic reading list is compiled from *The Valuation Actuary Handbook*, published by the Society of Actuaries, and from two books: W.F. Sharpe and G.J. Alexander, *Investments*, 4th ed., Prentice-Hall, Englewood Cliffs, NJ, 1990, and F.J. Fabozzi, T.D. Fabozzi and I.M. Pollack (ed.), *The Handbook of Fixed Income Securities*, 3rd ed., Dow Jones–Irwin, Homewood, IL 1991. Although the two books are not unique in their coverage, we have selected them because they enable the actuary to rapidly gain a good knowledge of investments and fixed-income securities without the need to seek out additional sources. Sharpe & Alexander is a standard textbook on investments at the MBA level; an Instructor's Manual, which provides answers to the questions at the end of each chapter, is available. (Professor Sharpe was one of three financial economists awarded the 1990 Nobel Memorial Prize in Economics.) Fabozzi, Fabozzi & Pollack is a textbook for Fellowship Examinations 220 and V-380 and for the Chartered Financial Analysts examinations; a paperback edition is available.

The main source for the reading list at the intermediate level is again the book Fabozzi, Fabozzi & Pollack. We also list several books with chapters that complement and supplement both Sharpe & Alexander and Fabozzi, Fabozzi & Pollack. For the more adventurous and mathematically inclined actuaries, we have some suggestions at the advanced level.

This Guide is not organized along subtopic lines within the general topic of "Life Insurance Company Investments." An actuary who wishes to investigate a particular subtopic can do so by noting chapter headings which are, for the most part, quite definitive; both Sharpe & Alexander and Fabozzi, Fabozzi & Pollack have extensive indexes. (At the end of Sharpe & Alexander there are eleven pages of a glossary of investment terminology.) However, there are two subtopics of special interest for which we have provided cross-indexed references at the end of this Guide. These two subtopics are Asset/Liability Management, and Options and Derivative Securities. The references are identified by letters in brackets at the beginning of each entry.

Actuary's Role

Actuaries measure, model and manage risk. Risk associated with the investment function is one of the most important risks faced by many insurance companies. Actuaries involved with insurance companies should have knowledge of the asset side of the balance sheet and how it relates to the liability side. Specifically, such knowledge should include the operation of financial markets, the instruments available (particularly those involving fixed income), the options imbedded in such instruments, and the synthetic instruments available to the insurance companies. In addition, the financial reporting actuary and the product development actuary must both understand the relationship of the company's assets to liabilities, so as to reflect the risks inherent in the insurer's business and thereby enhance its profitability or possibly even its solvency. Investment products are continually being redesigned, updated, expanded and replaced. The practising actuary must be aware of these changes (in order to have a basic knowledge of how they affect the company) and able to communicate regarding them with the company's portfolio managers (or be part of such portfolio management). The coordination of product development, investment operations and financial reporting is essential for a successful insurance company. Actuaries are singular in having the technical education to perform this coordination function.

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Basic Reading List

[SA] Sharpe, W.F., and Alexander, G.J. *Investments*, 4th ed. Englewood Cliffs, NJ: Prentice-Hall, 1990.

Chapter 2	Securities and Markets, 17-66.
Chapter 3	Investment Value and Market Price, 67-81.
Chapter 4	The Valuation of Riskless Securities, 82-111.
Chapter 5	The Valuation of Risky Securities, 112-133.
Chapter 6	The Portfolio Selection Problem, 134-153.
Chapter 7	Portfolio Analysis, 154-193.
Chapter 8	The Capital Asset Pricing Model, 194-240.
Chapter 12	Fixed-Income Securities, 316-354.
Chapter 13	Bond Analysis, 355-377.
Chapter 14	Bond Portfolio Management, 378-402.
Chapter 15	Common Stocks, 403-460.
Chapter 18	Options, 533-593.
Chapter 19	Futures, 594-632.

[FFP] Fabozzi, F.J., Fabozzi, T.D., and Pollack, I.M. (ed.) *The Handbook of Fixed Income Securities*, 3rd ed., Homewood, IL: Dow Jones–Irwin, 1991.

Chapter 2	Features of Fixed Income Securities (by F.J. Fabozzi and M.G. Ferri), 10-29.
Chapter 3	Risks Associated with Investing in Fixed Income Securities (by R.E. Dattatreya, F.J. Fabozzi and T.D. Fabozzi), 30-49.
Chapter 7	Price Volatility Characteristics of Fixed Income Securities (by F.J. Fabozzi, M. Pitts and R.E. Dattatreya), 116-140.
Chapter 9	Treasury and Stripped Treasury Securities (by F.J. Fabozzi and T.D. Fabozzi), 173-207.
Chapter 13	Corporate Bonds (by F.J. Fabozzi, R.S. Wilson, H.C. Sauvain and J.C. Ritchie, Jr.), 253-287.
Chapter 18	High-Yield Bonds (by R.D. Long), 372-382.
Chapter 26	Mortgages (by D. Senft and F.J. Fabozzi), 535-561.
Chapter 27	Mortgage Pass-Through Securities (by L. Lowell), 562-588.
Chapter 32	Fixed Income Options and Futures Markets (by M. Pitts and F.J. Fabozzi), 669-707.
Chapter 34	An Overview of Fixed Income Option Models (by L.J. Dyer and D.P. Jacob), 742-773.
Chapter 56	The Term Structure of Interest Rates (by R.W. McEnally and J.V. Jordan), 1245-1295.

[SoA] Society of Actuaries Committee on Life Insurance Company Valuation Principles. *The Valuation Actuary Handbook*. Itasca, IL: Society of Actuaries, 1987.

Chapter 2	Methods of Analyzing Cash Flows to Test for Reserve Adequacy, 47 pages.
Appendix 1	Theory behind Macaulay Duration and Illustrative Examples, 21 pages.

We note that, having read Sharpe & Alexander [SA], one is ready for investment journals such as *Financial Analysts Journal* and *Journal of Portfolio Management*.

Intermediate Reading List

[Ti] Tilley, J.A. "The Application of Modern Techniques to the Investment of Insurance and Pension Funds," *Transactions of the 23rd International Congress of Actuaries, Helsinki*, R (1988): 301-326. This paper is also available as Society of Actuaries Study Note 220-27-90.

> This paper discusses the applications of modern option-pricing theory, such as the valuation of assets and liabilities with stochastic cash flows and generalization of Redington's theory of immunization.

[L-T] Lamm-Tennant, J. "Asset/Liability Management for the Life Insurer: Situation Analysis and Strategy Formulation," *Journal of Risk and Insurance*, 56 (1989): 501-517.

> This paper examines the current operational status and planning procedures of seven asset/liability management processes appropriate for life insurers.

[FFP] Fabozzi, F.J., Fabozzi, T.D., and Pollack, I.M. (ed.) *The Handbook of Fixed Income Securities*, 3rd ed., Homewood, IL: Dow Jones–Irwin, 1991.

Chapter 10	Federally Sponsored Agency Securities (by L.S. Goodman, J. Jonson and A. Silver), 208-222.
Chapter 11	Commercial Paper, Medium-Term Notes, Bankers' Acceptances, and CDs (by F.J. Fabozzi), 223-237.
Chapter 12	Repurchase Agreements (by O.H. Rogg), 238-250.
Chapter 14	Domestic Floating-Rate and Adjustable-Rate Debt Securities (by R.S. Wilson), 288-299.
Chapter 15	Convertible Securities and Warrants (by J.C. Ritchie, Jr.), 300-318.
Chapter 16	Nonconvertible Preferred Stock (by R.S. Wilson), 319-342.
Chapter 24	Eurocapital Markets (by H.Q. Tran, L. Anderson and E.-L. Drayss), 481-506.
Chapter 29	Collateralized Mortgage Obligations (by G.J. Parseghian), 601-632.
Chapter 30	Stripped Mortgage Pass-Through Securities (by S.J. Carlson and T.D. Sears), 633-653.
Chapter 36	Approaches to the Valuation of Callable Corporate Bonds (by R.E. Dattatreya and F.J. Fabozzi), 791-808.
Chapter 37	Option-Adjusted Spread Analysis (by L.S. Hayre and K. Lauterbach), 809-838.
Chapter 38	The Valuation and Exposure Management of Bonds with Embedded Options (by R. Bookstaber), 839-872.
Chapter 49	Hedging with Futures and Options (by M. Pitts and F.J. Fabozzi, 1036-1067.
Chapter 53	Customized Interest-Rate Risk Agreements and Their Applications (by A.K. Bhattacharya and S. Breit), 1157-1188.

In addition to the above, there are many other sources from which an actuary can learn about investments and asset/liability management. Listed below are five papers and some readily available books on these subjects. We also list the titles of some chapters that are of particular interest.

[Fl] Fabozzi, F.J. (ed.) *Fixed-Income Portfolio Strategies.* Chicago: Probus, 1989.

Chapter 7	Finding the Immunizing Investment for Insurance Liabilities: The Case of the SPDA (by P.D. Noris and S. Epstein), 97-141. This paper is also available as Society of Actuaries Study Note 380-22-91.
Chapter 17	Hedging with Futures and Options (by L.S. Goodman), 321-344.
Chapter 21	Capping the Interest Rate Risk in Insurance Products (by D.F. Babbel, P. Bouyoucos and R. Strickler), 445-474.

[F2] Fabozzi, F.J. (ed.) *Portfolio and Investment Management: State-of-the-Art Research, Analysis and Strategies.* Chicago: Probus, 1989.

Chapter 4	Active Equity Management (by T.D. Coggin), 51-72.

This paper outlines the various active equity management styles and models commonly used for equity valuation.

[Fe] Fen, A.M. "Interest Rate Futures: An Alternative to Traditional Immunization in the Financial Management of Guaranteed Investment Contracts," *TSA* 37 (1985): 153-184; Discussion 185-186.

[Ho] Ho, T.S.Y. *Strategic Fixed-Income Investment.* Homewood, IL: Dow Jones-Irwin, 1990.

Chapter 6	Duration, 61-81.
Chapter 7	Convexity, 82-108.
Chapter 11	Bond Options, 170-209.
Chapter 12	Corporate Bonds (Investment Grade), 210-251.
Chapter 15	Factorization and Its Application in the Fixed-Income Market, 316-347.

[Hu] Hull, J. *Options, Futures, and Other Derivative Securities,* Englewood Cliffs, NJ: Prentice-Hall, 1989.

This book was written for students in business and economics. Nonessential mathematical material has either been eliminated or included in end-of-chapter appendixes. An informative Instructor's Manual is also available.

Chapter 2	Forward and Futures Contracts, 27-61.
Chapter 3	A Model of the Behavior of Stock Prices, 62-79.
Chapter 4	The Black-Scholes Analysis and Risk-Neutral Valuation, 80-103.
Chapter 5	Stock Options, 104-133.
Chapter 10	Interest-Rate Derivative Securities, 251-282.
Chapter 11	Swaps and the Evaluation of Credit Risks, 283-302.

[KR] Kopcke, R.W., and Rosengren, R.S. (ed.) *Are the Distinctions between Debt and Equity Disappearing?* Proceedings of a Conference Held at Melvin Village, New Hampshire, in October 1989.

This book is available free of charge from the Federal Reserve Bank of Boston, which sponsored the conference to examine the changes in business financing, why these changes had occurred, and the implications of these changes for public policy.

The Changing Nature of Debt and Equity: A Financial Perspective (by F. Allen), 12-38.

Still Searching for Optimal Capital Structure (by S.C. Myers), 80-95.

The Lender's View of Debt and Equity: The Case of Pension Funds (by Z. Bodie), 106-124.

[Me] Mereu, J.A. "A Guide to Quantifying C-3 Risk," *TSA* 41 (1989): 147-176; Discussion 177-188.

[PST] Pedersen, H.W., Shiu, E.S.W., and Thorlacius, A.E. "Arbitrage-Free Pricing of Interest-Rate Contingent Claims," *TSA* 41 (1989): 231-265; Discussion 267-279.

[Pl] Platt, R.B. (ed.) *Controlling Interest Rate Risk: New Techniques and Applications for Money Management.* New York: Wiley, 1986.

Chapter 2	The Term Structure of Interest Rates (by G.D. Latainer), 11-27.
Chapter 3	Use of Duration Analysis for the Control of Interest Rate Risk (by A.L. Toevs), 28-61.
Chapter 4	Hedging with Financial Futures (by A.L. Toevs and D.P. Jacob), 62-116.
Chapter 7	Hedging Interest Rate Risk of Fixed-Income Securities with Uncertain Lives (by A.L. Toevs), 176-196.
Chapter 9	Risk Control Techniques for Life Insurance Companies (by J.A. Tilley), 225-255.

[Sh] Shiu, E.S.W. "On Redington's Theory of Immunization," *Insurance: Mathematics and Economics* 9 (1990), 171-175.

This paper extends Redington's theory of immunization to the general case of nonparallel yield curve shifts.

[VATV] Vanderhoof, I.T., Albert, F., Tenenbein, A., and Verni, R. "The Risk of Asset Default – Report of the Society of Actuaries C-1 Risk Task Force of the Committee on Valuation and Related Areas," *TSA* 41 (1989): 547-582; Discussion 583-591.

Advanced Reading List

[Al] Albrecht, P. "A Note on Immunization under a General Stochastic Equilibrium Model of the Term Structure," *Insurance: Mathematics and Economics* 4 (1985): 239-244.

This paper generalizes Redington's theory of immunization to the case of several state variables which are prescribed by stochastic differential equations.

[Mü] Müller, H. "Modern Portfolio Theory: Some Main Results," *ASTIN Bulletin: Journal of the International Actuarial Association* 18 (1988), 127-145.

This paper gives an elegant presentation of the Markowitz portfolio theory and capital asset pricing model.

[SF]Schweizer, M., and Föllmer, H. "Hedging by Sequential Regression: An Introduction to the Mathematics of Option Trading," *ASTIN Bulletin: Journal of the International Actuarial Association* 18 (1988), 147-160.

This paper provides an introduction to some key features of the mathematical theory of option pricing, with special emphasis on the user of linear regression.

[EMN] Eatwell, J., Milgate, M., and Newman, P. *The New Palgrave: Finance.* New York: W.W. Norton, 1989.

This book is a collection of finance articles originally published in the four volume encyclopedia of economics *The New Palgrave: A Dictionary of Economics*, Macmillan, London, 1987. An inexpensive paperback edition is available.

[BC] Bhattacharya, S., and Constantinides, G.M. (ed.) *Frontiers of Modern Financial Theory*, Vol. 1: *Theory of Valuation*, Totowa, NJ: Rowan and Littlefield, 1988.

This book reprints, with commentaries, some of the most important papers on valuation theory.

[Me] Merton, R.C. *Continuous-Time Finance*, Oxford: Blackwell, 1990.

This book contains the classical papers written by Professor R.C. Merton, who is known as the expert among experts. It is highly mathematical.

Below are five textbooks written for doctoral students in finance.

[Do] Dothan, M.U. *Prices in Financial Markets.* New York: Oxford University Press, 1990.

[Du] Duffie, D. *Security Markets: Stochastic Models*, New York: Academic Press, 1988.

[HL] Huang, C.-F., and Litzenberger, R.H. *Foundations for Financial Economics*, New York: North-Holland, 1988.

[In] Ingersoll, J.E., Jr. *Theory of Financial Decision Making*, Totowa, NJ: Rowan and Littlefield, 1987.

[Ja] Jarrow, R.A. *Finance Theory*, Englewood Cliffs, NJ: Prentice-Hall, 1988.

To conclude the advanced reading list, we note that the t journals in finance and investments are: *Journal of Finance, Journal of Financial and Quantitative Analysis Journal of Financial Economics* and *Review of Financial Studies.* The *Journal of Business* also contains many important articles on finance and investments. The following book lists 12,728 entries (author(s), title, source, publication date, issue and exact page) and organizes them around 40 main areas such as hedging instruments, inflation, options, real estate, risk, etc.

[BE] Brealey, R., and Edwards, H. *A Bibliography of Finance*, Cambridge, MA: MIT Press, 1991.

Asset/Liability Management

Survey on Tools	[L-T]
Immunization (Duration and Convexity)	
Fixed and Certain Cash Flows	[SA, Ch 14], [SoA, Ch 2, Appendix I], [FFP, Ch 7], [Ho, Ch 6, 7], [PI, Ch 3], [Sh]
Interest-Sensitive Cash Flows	[SoA, Ch 2], [FFP, Ch 36, 38], [FI, Ch 7], [PI, Ch 7, 9], [TI]
Hedging with Futures	[Fe], [FFP, Ch 49], [FI, Ch 17], [PI, Ch 4]
Multivariate Immunization	[Ho, Ch 15], [Al]
Scenario/Sensitivity Testing	[SoA, Ch 2], [Mé], [PI, Ch 9]
Customized Interest Rate Contracts	[FFP, Ch 53], [FI, Ch 21]

Options and Derivative Securities

Option Pricing Theory	
Stocks (Binomial, Black-Scholes)	[SA, Ch 18], [Hu, Ch 3, 4], [SF]
Fixed Income Securities	[FFP, Ch 34, 38], [Ho, Ch 11], [Hu, Ch 10], [PST]
Fundamental Derivative Instruments	
Options	[SA, Ch 18], [Hu, Ch 5], [FFP, Ch 32, 36]
Futures	[SA, Ch 19], [Hu, Ch 2], [FFP, Ch 32]
Interest Rate Swaps	[Hu, Ch 11], [FFP, Ch 53]
Complex Derivative Instruments	
Caps, Floors and Swaptions	[FFP, Ch 53], [FI, Ch 21], [Hu, Ch 10]
Mortgage-Backed Securities	[FFP, Ch 29, 30, 37]

This Actuarial Specialty Guide on Life Insurance Company Investments was developed under the auspices of the Professional Actuarial Specialty Guides Committee on Continuing Education by

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