6. RESEARCH IN PROGRESS / RECHERCHE EN COURS

UNITED STATES - SOCIETY OF ACTUARIES

Finance

Expense Analysis and Strategic Management of Life Insurers: This monograph will present a framework of expense analysis in the context of resource management and the pricing process within a life and health insurance company. Completion is expected by the end of 2002.

Monograph on Stochastic Calculus and Stochastic Differential Equations: This monograph explains the fundamental conceptual and computational aspects of stochastic calculus.

Interest Rate Models in Actuarial Practice: This project will produce a practical guide on the selection and use of interest rate models.

Intra-Company Capital Allocation: This is a call for papers on the relationship between optimal intra-company allocations of capital by lines of business and risk-based capital requirements.

Interest Rates and Economic Scenarios: This investigation will attempt to model the relationship between interest rate movements and movements in other financial and economic indices, such as stock market indices.

Retirement Planning Methodology and Software: This project is a study reviewing methods used by financial planning software packages to address post-retirement risks.

Regime Switching Model Application: The purpose of this project is to develop an Excel-based workbook that would provide a two-regime-switching model for equity performance and other functions. The workbook will appear on the SOA website.

Actuarial Role In The Viatical Settlements Market: The purpose of this project is to survey the viatical settlements market and investigate the role that actuaries may play in this market. Educational opportunities for actuaries related to viatical settlements will also be identified.

Health Benefit Systems

HEDIS 3.0 Study: This study evaluates the reliability and validity of HEDIS (Health Plan Employer Data and Information Set) measures and assesses their effectiveness in measuring health plan performance.

Medical Large Claims Experience Study: This study, which is a follow-up to an earlier large claims study, examines the incidence and characteristics of large health claims.

Medicare Drug Claim Costs: The purpose of this project is to collect and analyze cost and utilization data on prescription drug coverage for the Medicare population.
Alternative Medicine Experience Study: The purpose of this study is to collect and analyze insurance company data on coverage of integrative and alternative care treatments.

The Troubled Healthcare System: The goal of this project is to evaluate the current state of research on health care benefit system issues and optimize future involvement of actuaries to address these issues.

Health Claim Costs by Age for Older Americans: The purpose of this project is to examine the assumptions health actuaries are using to differentiate costs by age for Americans in their retirement years and study the data behind the key assumptions.

Retirement Systems

Mortality Projections: The objective of this effort is to investigate the materiality of the mortality improvement assumption in the valuation of private pension plans.

Turnover and Retirement Rates – Phase 3: This project improves and builds upon the previous Pension Plan Turnover Rate Tables.

Deferred Retirement Options Programs (DROPs): This study is intended to provide actuaries with an understanding of the design and planning issues associated with DROP plans.

Survey on Retirement Plan Preferences: The goal of the survey is to use the information gained to understand what is important to the public, identify the implications for the use of different types of plans, and to inform public policy, plan sponsors and practicing actuaries.

Preretirement Influences on Retirement Decisions Literature Search: This is a literature review of research on pre-retirement influences on retirement decisions.

SOA Experience Studies

Finance

1986-2001 Credit Risk Loss Experience Study: This is the current phase of the ongoing study of characteristics of loss experience under private placement bond investments.

Health Benefit Systems

Long Term Care Valuation Task Force: This Task Force is considering an update to the 1995 Long-Term Care Insurance Valuation Methods report, including the development of standard tables for the valuation of the many facets of this product.

Group Life Insurance: This Committee is proceeding with a follow up to the 1985-89 Group Life Insurance Experience Study, including the establishment of a regular pattern for this study.

Group Long Term Disability Study: The objective of this effort is to continue the work of the 1996 Group LTD Termination Experience Study.
Individual Disability Study: This Committee is proceeding with an Individual Disability Income Study to reflect current products and practices and for both claims incidence and termination under such policies.

1994-98 Long-Term Care Study: The objective of this study is to compile long-term care data from carriers into an inter-company study.

Life Insurance

Mortality Guarantee in Variable Products Experience Study: This project examines mortality experience during the deferred period under variable annuities and other contracts with similar benefits.

Mortality & Morbidity Liaison Committee: This joint committee of actuaries, medical directors and underwriters investigates experience of various facets of the insurance and disability underwriting process, especially those reflecting extra mortality.

The major areas of activity:

Medical Impairment Study from Databases: This study examines the experience of various impairments that may exhibit extra mortality in the period following the 1979 and 1983 studies.

Blood Pressure Study: The Elevated Blood Pressure Study examines the mortality experience of recently issued life insurance policies that had an identified elevated blood pressure.

Mortality & Underwriting Survey Committee: This committee is to oversee and conduct surveys on topics related to underwriting practices and mortality experience on life insurance and annuities.

The major areas of continuing activity:

Mortality Improvement: This survey examines the use of mortality improvement in the life insurance product development process.

Preferred Underwriting: This survey examines, for a third time, underwriting practices with respect to preferred products.

Technology: This survey examines the use of computer technology for mortality studies and underwriting.

Simplified Issue: This survey is expected to examine various aspects relating to insurance policies issued with less than full underwriting.

Individual Life 1995-96/1996-97/1997-98/1990-95 Cause of Death: This study is the ongoing reporting of mortality experience under standard, fully underwritten life insurance policies.

Task Force on Preferred Underwriting & Large Amounts: The broad objective of this study is to capture electronically all aspects of the underwriting that is done today for individual life insurance. The immediate objective is to capture lab test data and basic
policy data and to build from there as possible.

**Structured Settlements 1998-99:** The objective of this study is to examine the mortality experience under structured settlement annuity contracts.

Retirement Systems

**Group Annuity 1999-2000:** This study is the next in the series examining the mortality experience under group annuity contracts, primarily those in payment status.

Recently Completed Finance Experience Study

**1986-98 Credit Risk Loss Experience Study:** The Society of Actuaries' Private Placement Experience Committee has completed this report, which measures incidence rates, loss severities and economic loss rates associated with credit risk events for privately placed debt during the years 1986-98. One of the values of this report is the comparison between private placement bond default experience and that of publicly traded bonds. In this edition of this ongoing study, migration rates for internal and NAIC credit ratings of assets are tabulated for the first time and the relative predictive power of different kinds of ratings is examined. This report can be found on the SOA Web site ([www.soa.org](http://www.soa.org)) under Research.

Recently Completed Health Project and Health Experience Studies

**Analysis of Claim Based Risk Adjusters:** The result of this project is a report, “A Comparative Analysis of Claims-based Methods of Health Risk Assessment for Commercial Populations” that compares the predictive accuracy of various risk adjusters to the methods analyzed in the 1995 study. The final report is on the SOA website [www.soa.org/sections/riskadfinalreport1.pdf](http://www.soa.org/sections/riskadfinalreport1.pdf).

**Credit Insurance Experience Committee:** In May of 2001, the Society of Actuaries' Credit Insurance Experience Committee was asked to respond to the National Association of Insurance Commissioner's request to develop a recommendation for a uniform national valuation standard for credit life insurance policy reserves. A draft of this report was presented to the NAIC's Life and Health Actuarial Task Force at their June, 2002 meeting. It is being presented as a potential update to the valuation table for credit life insurance. This draft report can be found on the SOA Web site ([www.soa.org](http://www.soa.org)) under Research.

**Continuing Care Retirement Communities:** This project brought to a conclusion the CCRC Experience Data Collection and Analysis Project of Hal Barney. A final publication venue for this report is still being determined.

Recently Completed Life Projects and Life Experience Studies

**Shape of the Mortality Curve at Higher Ages:** An international symposium featuring current research on high age mortality was the result of this call-for-papers. The “Living to 100 and Beyond: Survival at Advanced Ages” symposium took place in Orlando, FL on January 16-18, 2002 and was a resounding success. Approximately 110 attendees gathered for presentations and discussions of twenty papers.
1997 & 1998 Reinsurance Mortality Studies: Manulife Reinsurance and the Reinsurance Section Council of the Society of Actuaries perform an annual study of mortality experience on large amounts and older age policies. The experience data has been submitted to the SOA. Six companies contributed to the current study. The aggregated data are examined in terms of mortality ratios by number and amount, and the results are further subdivided by duration, sex, age, smoking and underwriting status, level of retention and reinsurance method. This report is available on the SOA Web site (www.soa.org) under Sections/Special Interest, Reinsurance.

Alcohol Abuse & Liver Enzyme Study: The Alcohol Abuse and Liver Enzyme Study similarly examine cases with admitted alcohol abuse or with an abnormal liver enzyme test. It was published in the 2001 Journal of Insurance Medicine, No. 3.

Recently Completed Retirement Projects

Retirement Implications of Demographic & Family Change: This Call for Papers examined the broader implications on the workplace of the changing workforce and the retirement needs of the public in light of the increase in divorce and two earner households, phased retirement, and the aging of baby boomers. The Symposium that resulted from this call for papers was held on June 25-26, 2002 in San Francisco, CA. Papers that were presented at the Symposium have been placed on the SOA Web site and can be found at: www.soa.org/sections/ridfc/ridfc.html

Factors Affecting Retirement Mortality: This multi-phased project probes the impact on mortality of various risk characteristics, such as education and income. The first phase was a literature search of papers describing the applicable factors. Summaries of the papers reviewed as part of the search will be available on the SOA Web site (www.soa.org).

SOA Committee on Knowledge Extension Research

The Cost of Mismatch in Stochastic Interest Rate Models: Professor Michel Jacques of Université Laval, Quebec, is evaluating the cost of mismatch by a percentile of the cash flows distribution when interest rates follow a stochastic model, in contrast to the usual scenario testing approach.

Generalized Cox, Ingersoll and Ross Model: Statistics and Valuation of Interest Rate Derivatives: Professor Wojciech Szatzschneider of Universidad Anahuac, Mexico, is studying semi-closed formulas and computer programs to valuate interest rate derivatives including statistics of interest rate models in real and risk neutral worlds. A second paper resulting from the research has been accepted for publication in the Mexican Journal in Economics and Finance, Volume 1, No. 3, August 2002.

Mathematical Models and Software for Financial Organizations at Risky Markets: Professors Alexander Vasin and Vladimir Morozov of Moscow State University are developing mathematical methods and software for accumulation of the capital and investment portfolio management problems under specific conditions of the Russian financial markets.
Application of Nonparametric (Model Free) Technique for Forecasting Big Jumps and Falls in Interest Rate Values: Researchers Faye Albert, FSA, Vladimir Cherepanov and Vladimir Ladyzhets examined investment risk pertaining to interest rate volatility to contribute to a better understanding of the statistical mechanism of interest rate fluctuations.

Modern Modeling Technologies for Pension Actuaries: Professor Arnold Shapiro of Pennsylvania State University investigated the role of modern modeling technologies for the pension actuary. Two articles resulting from the project have been published in the Journal of Insurance: Mathematics and Economics.

Application of Quasi-Monte Carlo Methods to Actuarial Science: Professors Phelim Boyle and Ken Seng Tan of the University of Waterloo are examining Quasi-Monte Carlo methods and their applications to actuarial science.

Practical Implementation of the Mixture of Exponentials Model: Professors Stuart Klugman of Drake University and Jacques Rioux of Université Laval, Quebec, proposed to extend the results of Clive Keatinge’s paper, “Modeling Losses with the Mixed Exponential Distribution” and develop a Windows-based program to implement the algorithm and the goodness-of-fits test.

The research was presented at the 2002 Actuarial Research Conference in Waterloo, Canada and will be published in the proceedings from that conference.

Valuation of Equity-Indexed Annuities under Stochastic Interest Rate: Professors Sheldon Lin of the University of Toronto and Ken Seng Tan of the University of Waterloo are developing pricing and hedging techniques for equity-indexed annuities.

Actuarial Aspects of Dependencies in Insurance Portfolios: Professors Jan Dhaene, Michel Denuit and Marc Goovaerts of K.U. Leuven, Belgium, are studying the consequences of the introduction of dependency relations in actuarial models.

Financial Analysis of the Canadian Annuity Market: Professor Moshe Arye Milevsky of York University, Toronto, is studying the economic pricing, efficiency and long-term evolution of the Canadian life annuity market, employing the modeling paradigm of continuous-time finance theory.

Predictive Distributions of Multivariate Total Claims Models: Professor Rohana Ambagaspitiya, University of Calgary, is studying techniques to compute multivariate claims distributions.

Contaminated Exponential Dispersion Loss Models: Professors Udi Makov and Zinoviy Landsman, University of Haifa, Israel, are studying families of contaminated exponential dispersion loss models, their theoretical properties and applicability to real heavy tailed loss data.

Survey of Bayesian Mortality Data Models with related Robust and Nonparametric Extensions: Professors Manuel Mendoza and N.D. Shyamal Kumar of the Instituto Tecnológico Autónomo de México (ITAM), Mexico City, are surveying Bayesian models...
for mortality data and related frequentist models and will publish their findings in a monograph.

**Application of Financial Services Risk Management Techniques to Problems of Environmentally Sustainable Economics:** Michelle Smith, FIAA, ASA of Tillinghurst-Towers Perrin, Atlanta, is adapting risk management techniques widely used in the financial services sector to develop theoretical tools to assist in environmental management.

**Valuation of Variable Annuities:** Lijia Guo, Ph.D., A.S.A., University of Central Florida, Orlando proposed to identify various types of inverse problems in actuarial science and introduce regularization methods to solve these inverse problems and compare them to the existing actuarial treatments.

**Inverse Problems and Their Solutions in Actuarial Science:** X. Sheldon Lin of University of Toronto, Toronto and Ken Seng Tan, University of Waterloo, Waterloo proposed to consider stochastic volatility model and carry out extensive numerical studies to assess the impact of the volatility of interest rates on the variable annuities.

**Pricing of Guaranteed Annuity Conversion Options:** Steven Haberman, City University, London proposed to present a theoretical model (consistent with financial economics theory) for the pricing of guaranteed annuity conversion options associated with certain deferred annuity pension-type contracts in the UK. Preliminary results of the research was presented at the 2002 Actuarial Research Conference and fuller results will be presented at appropriate academic and professional conferences in the US and UK.

**Edward A. Lew Award 2000 – Development of Educational Material Related to Actuarial Modeling:** As recipient of the award, Bruce Jones, University of Western Ontario, is creating Course 7 education material in electronic format so that actuarial students can interact with the program as they learn about developing basic actuarial models.

**Recently Completed CKER Projects**

**Interaction between Asset Liability Management and Risk Theory:** Dr. Jacques Janssen, professor at CESIAF, Belgium, devised a model to be used as an operational tool for asset liability management for insurance companies. The project resulted in a paper published in *Applied Stochastic Models and Data Analysis* and a summary paper published in *Actuarial Research Clearing House*.

**Statistical Methods for Monitoring Health Care Process Measurements:** Professor Marjorie Rosenberg, University of Wisconsin-Madison, created a statistical monitor using measurements generated from a logistic regression model as a supplement to utilization management process to inexpensively track non-acceptable in-patient hospital claims. This research resulted in two papers. “A Decision-Theoretic Method for Assessing a Change in the Rate of Non-Acceptable Inpatient Claims” was published in *Health Services and Outcomes Research Methodology Journal*, Volume 2, No. 1, March 2001. “A Statistical Method for Monitoring a Change in the Rate of Non-Acceptable

**Non-Traditional Case Studies in Actuarial Modeling:** Professor Bruce Jones of the University of Western Ontario developed case studies dealing with non-traditional applications related to actuarial modeling. SOA Education and Examination Committees are exploring using the case studies as material for the modeling-related courses.

**Robust and Efficient Fitting of Loss Models:** Professor Robert Serfling, University of Texas, is investigating loss model estimators that are both efficient and robust. “An Efficient and Robust Fitting of Lognormals Distribution” will be published in the *North American Actuarial Journal*, Volume 6, No. 4, October 2002.

**AERF Research**

**An Investigation of Earnings Management via Pension Actuarial and Pension Accountant Changes:** David Ziebart, University of Illinois, is investigating how the pension actuary communicates actuarial information to others. In particular, the study focuses on the communication links between the actuary, the auditor, and users of the financial statements through which actuarial information is summarized and presented.

**Premium Death Spirals: Theory and Empirical Evidence:** Harry Sutton, Allianz Life and Bryan Dowd, and Roger Feldman, University of Minnesota, are examining if high and low health risk consumers have different preferences for premiums and benefits, and if a competitive health insurance market can sustain health plans that appeal to high risks. The research will be presented at the October 2002 Annual Meeting in Boston.

**Some Nonlinear Time Series Models for Actuarial Use:** Wai Sum Chan, University of Hong Kong, is studying some advanced nonlinear time-series techniques that might be useful in building stochastic models for pricing and reserving. He plans to prepare a step-by-step illustration of these techniques so that actuaries and actuarial students not expert in this area can perform the procedures.

**The Bayesian Implementation and Analysis of Various Chain Ladder Models Using Markov Chain Monte Carlo Simulation Methods via WinBUGS:** David Scollnik, University of Calgary, is examining the Bayesian implementation and analysis of various chain ladder models using Markov Chain Monte Carlo simulation methods via WinBUGS.

**Calculating Insurance Premiums Using Dependent Risk Models and Catastrophe Databases:** Thierry Duchesne, University of Toronto, and Etienne Marceau and Helene Cosette, Universite Laval, are deriving systematic methods for calculating insurance premiums when natural disasters induce dependence in the risks.

**Life Insurance Account:** Robert Reuter was awarded a grant to study the components of individual life insurance and annuity plan premiums in order to provide new insights into their nature and to encourage consumer-driven programs.
Recently Completed AERF Projects

**Measurement of Relative Equity and Yaari’s Dual Theory of Risk:** Researchers David Promislow, York University, and Virginia Young, University of Wisconsin, used Yaari’s dual theory of risk to measure the relative inequity that arises when insurers use imperfect information to estimate the net premium of insureds. “Measurement of Relative Inequity and Yaari’s Dual Theory of Risk” has been accepted for publication by *Insurance: Mathematics and Economics*. Decomposition Properties of Dual Choice Functions has been accepted for publication in *Social Choice and Welfare*.

**Retrospective and Prospective Analysis of the Privatized Mandatory Pension System in Mexico:** Tapen Sinha, ITAM, studied the effectiveness of the privatization of the pension system in Mexico. The research report resulting from this project is being published as part of the SOA Monograph series.

**Actuarial and Financial Applications of Integral Functions of Levy Processes:** Daniel Dufresne, University of Montreal, studied integral exponential functionals in probability theory. The first paper resulting from this research, “The Integral of Geometric Brownian Motion” has been published in *Advances in Applied Probability*, Volume 33, No. 1. The research was presented at the November 2001 Math Week Conference in New York and will be submitted to the *North American Actuarial Journal* for publication consideration.

**Robust and Efficient methods for Estimation of Reinsurance Parameters:** Vytaras Brazauskas, University of Wisconsin, compared empirical nonparametric and robust parametric estimators of different reinsurance premiums on the basis of two generally competing criteria; efficiency and robustness. The asymptotic variance of the estimator was used as an efficiency criterion, and the breakdown point of the estimator was used as a robustness criterion. The final project paper was submitted to *Insurance: Mathematics and Economics* for publication consideration.

**Stock Return Models for Financial Guarantees:** Mary Hardy, University of Waterloo, is collating and extending the current research in equity linked life insurance. The final report is to be practitioner oriented, covering all aspects of actuarial management of financial guarantees. The emphasis of the applications in the report will be on Canadian segregated fund contracts. The techniques will also be applicable to variable annuity contracts in the U.S., to guaranteed annuity rate options in the UK, and to equity-linked insurance in many other countries. Wiley Publications will publish the final report.