B.A.J. **10**, V, 1133-1144 (2004)

PAPERS FROM ACTUARIAL JOURNALS WORLDWIDE

Single copies of all the papers listed here can be obtained, subject to charge and copyright regulations, from the actuarial profession's libraries. Issues may be borrowed by members. Tel: 0131 240 1311 or 01865 268206/208; libraries@actuaries.org.uk

Australian Actuarial Journal

Volume **10** (1), 2004

Institute of Actuaries of Australia, General Insurance Practice Committee. *HIH Royal Commission Recommendations.* 207-209. Submission made to the Australian Prudential Regulation Authority in February 2004.

Institute of Actuaries of Australia, General Insurance Practice Committee. *Submission in response to APRA's Discussion Paper on Prudential Supervision of General Insurance — Stage 2 Reforms.* 211-256. Submission made to the Australian Prudential Regulation Authority in March 2004.

Institute of Actuaries of Australia, International Accounting Standards Committee, Institute of Actuaries of Australia, Life Insurance Practice, Institute of Actuaries of Australia, General Insurance Practice Committee. *Submissions on Australian Accounting Standard Board Exposure Drafts 122A and 122B.* 129-190. Two submissions made to the Australian Accounting Standards Board in January 2004.

Institute of Actuaries of Australia, Superannuation and Employee Benefits Practice Committee. *Consultation on taxation of overseas superannuation transfers.* 191-194. Submission made to the Federal Treasury in January 2004.

Institute of Actuaries of Australia, Superannuation and Employee Benefits Practice Committee. *Consultation on the Superannuation Safety Amendment Bill 2003.* 195-197. Submission made to the Senate Economics Legislation Committee in January 2004.

Institute of Actuaries of Australia, Superannuation and Employee Benefits Practice Committee. *Proposed drafting instructions for regulations and operating standards under the Superannuation Safety Amendment Bill.* 199-205. Submission made to the Federal Treasury in February 2004.

Pitrebois, S., Denuit, M. & Walhin, J. F. *Bonus-Malus scales in segmented tariffs: Gilde & Sundt's work revisited.* 107-125. In a recent paper ... the authors have shown how to compute analytically the Bayesian relativities for a Bonus-Malus scale superimposed on a segmented tariff. However, the percentages associated with the levels of such a scale may exhibit an abrupt rise or drop from one level to another. For commercial reasons, it is sometimes preferable that each level inflicts the same relative penalty. In this paper, the authors will show how to obtain such linear relativities for a given Bonus-Malus System. The model allows for a priori ratemaking. It is applied to a real-life portfolio. Keywords: Bonus-Malus System, Markov Chain, stationary distribution, a priori ratemaking, linear scale.

Rogers, G. *The Actuarial Profession: making a difference: 2004 Presidential Address.* 1-106.

Reproduced with the permission of The Institute of Actuaries of Australia.
Subscription details available from: IAA, Level 7 Challis House, 4 Martin Place, Sydney, NSW 2000, Australia. E-mail: insact@actuaries.asn.au

https://doi.org/10.1017/S1357321700002981 Published online by Cambridge University Press

GENEVA PAPERS ON RISK AND INSURANCE THEORY

Volume **29** (2), 2004

BARIGOZZI, F. *Reimbursing preventive care.* 165-186. The paper focuses on secondary prevention, such as diagnostic screening, medical examination and check ups, which refers to the early detection of disease. Secondary prevention is analysed as a self-insurance activity reducing the negative shock of illness and can be either a complement to or substitute for illness treatment. This paper analyses the optimal reimbursement scheme for both prevention and treatment when each activity receives either a linear subsidy (ie cost sharing) or tax. Although optimal reimbursement systematically encourages treatment, it positively affects prevention if and only if prevention reduces the cost of treatment, that is in the case the two activities are substitutes.

CAIN, M. & PEEL, D. *Utility and the skewness of return in gambling.* 145-163. This paper demonstrates that the intuitively appealing argument based on the postulated trade-off between expected return, variance and skewness of return of a risk-averse gambler does not provide an explanation of observed betting behaviour. It is shown how the expected utility of a representative gambler faced with a single-prized outcome event can be expressed in terms of the mean and variance of return, the mean and skewness of return or, generally, of the mean and any other single moment of return; and the standard practice of taking a Taylor series expansion/approximation of the expected utility involving moments of return is usually incorrect. Previous analyses have suggested that a punter will accept a lower mean return for higher skewness and this work seems to have involved invalid expansions of the utility function. The upshot is that with certain utility functions which have been used in a number of studies, any analysis based on expansion and estimation of the derivatives of the utility function may be valid only for data based on odds-on favourites and not for longshots.

FRANC, C. & ABADIE, L. *Opting out of public insurance: is it socially acceptable?* 115-136. The privatisation of social services is being increasingly discussed. The market of social services is often characterised by market failures, like informational asymmetries, externalities, distributional problems, which all justify public intervention. But the quality of services provided by public authorities or by private insurers in the context of health insurance is different and could be observable. The public reimbursement of health care is often conditional on rules, like the choice of the physician or the hospital, that induce a disutility of using social insurance instead of private insurance. An alternative solution to a complete privatisation is to allow some individuals to opt out. We can imagine that the government allows and even in some cases favours part of the population leaving the public health insurance system. We analyse the situations where the opting out is welfare improving. We then study the optimal policy depending on the characteristics of the economy considering a Rawlsian criterion.

LINDSET, S. *Relative guarantees.* 187-209. Many real-world financial contracts have some sort of minimum rate of return guarantee included. One class of these guarantees is so-called relative guarantees, i.e. guarantees where the minimum guaranteed rate of return is given as a function of the stochastic return on a reference portfolio. These guarantees are the topic of this paper. We analyse a wide range of different functional specifications for the minimum guaranteed rate of return, hereunder both so-called maturity and multi-period guarantees. Several closed form solutions are presented.

MATHEWS, T. *Portfolio selection with quadratic utility revisited.* 137-144. Considering a simple portfolio selection problem by agents with quadratic utility, an apparently counterintuitive outcome results. When such a choice is over two assets that can be ordered in terms of riskiness, an agent that is more risk averse may optimally invest a larger portion of wealth in

https://doi.org/10.1017/S1357321700002981 Published online by Cambridge University Press

the riskier asset. It is shown that such an outcome is not counterintuitive, since for the portfolios from which agents optimally choose, a larger proportion of investment in the riskier asset leads to a less risky portfolio.

Reproduced with the permission of Kluwer Academic Publishers.
Subscription details available from: Kluwer Academic Publishers, PO Box 322, 3300 AH Dordrecht, The Netherlands.

INSURANCE: MATHEMATICS & ECONOMICS

Volume **35** (2), 2004

ALBRECHER, H. & BOXMA, O. J. *A ruin model with dependence between claim sizes and claim intervals.* 245-254. We consider a generalisation of the classical ruin model to a dependent setting, where the distribution of the time between two claim occurrences depends on the previous claim size. Exact analytical expressions for the Laplace transform of the ruin function are derived. The results are illustrated by several examples.

BATTAUZ, A. & PRATELLI, M. *Optimal stopping and American options with discrete dividends and exogenous risk.* 255-265. In this paper we analyse some problems arising in the evaluation of American options when the underlying security pays discrete dividends. To this aim, we study the problem of maximising the expected gain process over stopping times taking values in the union of disjoint, real compact sets. The results we obtain can be applied to evaluate options with restrictions on exercise periods, but are also useful for the evaluation of American options on assets that pay discrete dividends. In particular, we generalise the evaluation formula for American call options due to Whaley [J. Fin. Econ. 9 (1981) 207], allowing for a stochastic jump of the underlying security at the ex-dividend date and discuss the existence of the optimal stopping time. In the same framework, we analyse American put options, justifying the procedure used in Meyer [J. of Computational Finance 5 (2002)] to account for the presence of discrete dividends in the free boundary formulation from the perspective of optimal stopping theory.

COSSETTE, H., LANDRIAULT, D. & MARCEAU, É. *Compound binomial risk model in a Markovian environment.* 425-443. In this paper, we propose a compound binomial model defined in a markovian environment which is an extension to the compound binomial model presented by Gerber [ASTIN Bull. 18 (1988) 109-123; IME 7, 15-23]. An algorithm is presented for the computation of the aggregate claim amount distribution for a fixed time period. We focus on infinite-time ruin probabilities and propose a numerical algorithm to compute their numerical values. Along the same lines as Gerber's compound binomial model which can be used as an approximation to the classical risk model, we will see that the compound binomial model defined in a markovian environment can approximate the risk model based on a particular Cox model, the marked Markov modulated Poisson process. Finally, we compare via stochastic ordering theory our proposed model to two other risk models: Gerber's compound binomial model and a mixed compound binomial model. Numerical examples are provided.

GERRARD, R., HABERMAN, S. & VIGNA, E. *Optimal investment choices post-retirement in a defined contribution pension scheme.* 321-342. In defined contribution pension schemes, the financial risk is borne by the member. Financial risk occurs both during the accumulation phase (investment risk) and at retirement, when the annuity is bought (annuity risk). The annuity risk faced by the member can be reduced through the 'income drawdown option': the retiree is allowed to choose when to convert the final capital into pension within a certain period of time after retirement. In some countries, there is a limiting age when annuitisation become compulsory (in U.K. this age is 75). In the interim, the member can withdraw periodic

https://doi.org/10.1017/S1357321700002981 Published online by Cambridge University Press

amounts of money to provide for daily life, within certain limits imposed by the scheme's rules (or by law). In this paper, we investigate the income drawdown option and define a stochastic optimal control problem, looking for optimal investment strategies to be adopted after retirement, when allowing for periodic fixed withdrawals from the fund. The risk attitude of the member is also considered, by changing a parameter in the disutility function chosen. We find that there is a natural target level of the fund, interpretable as a safety level, which can never be exceeded when optimal control is used. Numerical examples are presented in order to analyse various indices — relevant to the pensioner — when the optimal investment allocation is adopted. These indices include, for example, the risk of outliving the assets before annuitisation occurs (risk of ruin), the average time of ruin, the probability of reaching a certain pension target (that is greater than or equal to the pension that the member could buy immediately on retirement), the final outcome that can be reached (distribution of annuity that can be bought at limit age), and how the risk attitude of the member affects the key performance measures mentioned above.

LAEVEN, R. J. A. & GOOVAERTS, M. J. *An optimisation approach to the dynamic allocation of economic capital.* 299-319. We propose an optimisation approach to allocating economic capital, distinguishing between an allocation or raising principle and a measure of the risk residual. The approach is applied both at the aggregate (conglomerate) level and at the individual (subsidiary) level and yields an integrated solution to the capital allocation problem. In particular, we formalise a procedure to determine (i) the optimal amount of economic capital to be held by a financial conglomerate, (ii) the optimal allocation of this amount among the subsidiaries are considered. The results provide a theoretical justification for the use of Value-at-Risk, not as a measure of risk, but as an optimal allocation or raising principle. Static solutions are generalised to a dynamic setting. The approach is illustrated using an example of a financial conglomerate represented by a multivariate Wiener process.

MAZZA, C. & RULLIÈRE, D. *A link between wave governed random motions and ruin processes.* 205-222. This article establishes a link between hitting times associated with the risk process (time of ruin) and wave governed random motions, which are widely used in physics. Concerning risk theory, another link holds between processes corresponding to models called positive and negative risk sums. Some classical results appear to be strongly interconnected. An original algorithm is proposed for computing finite-time ruin probabilities in renewal non-Poissonian risk model with exponential claims. Concerning wave-governed random motions, we analyse the distribution of the maxima of the processes. New bonds are directly derived from risk theory and appear to be more accurate than the ones proposed recently in the probabilistic literature. Finally, we propose applications of these notions in finance.

PAVLOVA, K. P. & WILLMOT, G. E. *The discrete stationary renewal risk model and the GerberShiu discounted penalty function.* 267-277. This paper considers the stationary and the ordinary discrete renewal risk models. The main result is an expression of the GerberShiu function in the ordinary model. Subsequently, this relationship is considered in more detail in both the discount free case and under the compound binomial model. The latter case may be viewed as a discrete analog of the classical Poisson model. Simplifications of the general relationship are obtained, and a connection between the defective joint cumulative distribution functions of the surplus prior to ruin and the deficit at ruin in the stationary and the ordinary renewal risk models is established. Moreover, the defective probability function of the claim causing ruin is derived in the compound binomial case.

PITACCO, E. *Survival models in a dynamic context: a survey.* 279-298. Several contributions, which can be considered as landmarks in the evolution of dynamic modelling in actuarial mathematics, are focused. Modern contributions to this topic and research in progress are then dealt with. The paper places a special emphasis on some issues concerning longevity risk,

https://doi.org/10.1017/S1357321700002981 Published online by Cambridge University Press

aiming in particular to stress peculiarity within the context of the mortality risks borne by an insurer (or a pension plan).

RULLIERE, D. & LOISEL, S. *Another look at the Picard-Lefèvre formula for finite-time ruin probabilities.* 187-203. In the compound Poisson risk model, with discrete claim size distribution, Picard and Lefèvre [Scand Actuarial J. 1997, 58-69] derived a formula to compute the finite-horizon ruin probability. Here, some alternatives to this formula are proposed: exact recursive formulas which provide the distribution of time to ruin at once and a Seal-type formula which only involve probabilistic quantities. Depending on the comparison between the initial reserve and the total premium up to the finite horizon their different interests are discussed by comparing their performances. The numerical stability of the formulas is then investigated, and disagreements in the existing literature about the detection of critical values are explained. Formal convolutions for pseudo-compound distributions are introduced, and a theorem is stated in order to switch between formulas based on Appell polynomials and Seal-type formulas. This also provides a derivation of the Picard-Lefèvre formula from sample path properties.

SCHRAGER, D. F. & PELSSER, A. A. J. *Pricing rate of return guarantees in regular premium unit linked insurance.* 369-398. We derive general pricing formulas for Rate of Return Guarantees in Regular Premium Unit Linked Insurance under stochastic interest rates. Our main contribution focuses on the effect of stochastic interest rates. First, we show the effect of stochastic interest rates can be interpreted as, what is known in the financial community as, a convexity correction. Second we link the LIBOR Market Model to our model of the economy. This allows us to find guarantee prices consistent with observed cap and swaption prices. Numerical results show the effect of this more sophisticated interest rate modelling is considerable. We also consider ways of approximating Asian option values through tight bounds. We show that we can obtain accurate bounds in spite of the high volatility induced by the long maturities of the guarantees.

SHAPIRO, A. F. *Fuzzy logic in insurance.* 399-424. The insurance industry has numerous areas with potential applications for fuzzy logic (FL). These include classification, underwriting, projected liabilities, fuzzy future and present values, pricing, asset allocations and cash flows, and investment. Given this potential and the impetus of FL during the last decade, it is not surprising that a number of FL studies have focused on insurance applications. This article presents an overview of these studies. The specific purposes of the article are two-fold; first, to review FL applications in insurance so as to document the unique characteristics of insurance as an application area; and second, to document the extent to which FL technologies have been employed.

TSANAKAS, A. *Dynamic capital allocation with distortian risk measures.* 223-243. Tsanakas and Barnett [IME 33 (2003) 239] employed concepts from cooperative game theory [Aumann and Shapley, Values of non-atomic games. Princeton University Press] for the allocation of risk capital to portfolios of pooled liabilities, when distortion risk measures [IME 21 (1997) 173] are used. In this paper we generalise previously obtained results in three directions. Firstly, we allow for the presence of non-linear portfolios. Secondly, based on the concept of correlation order [ASTIN Bulletin 26 (1996) 201] we proceed with discussing the links between dependence structures, capital allocation and pricing, as well as dropping a restrictive assumption on the continuity of probability distributions. Finally, we generalise the capital allocation methodology to a dynamic setting and conclude with a numerical example.

VANMAELE, M., DEELSTRA, G. & LIINEV, J. *Approximation of stop-loss premiums involving sums of lognormals by conditioning on two variables.* 343-367. In literature, lower and upper bounds were obtained for arithmetic Asian and basket options based on comonotonicity results and

https://doi.org/10.1017/S1357321700002981 Published online by Cambridge University Press

by conditioning upon one variable. In this paper, we derive analytical expressions for the comonotonic bounds of stop-loss premiums of sums of dependent random variables by conditioning upon two variables. We also use the idea of several conditioning variables to develop an approximation for cases for which it is cumbersome to obtain a comonotonic lower bound. The numerical analysis shows the conditioning on two variables leads to very sharp results.

INSURANCE: MATHEMATICS & ECONOMICS

Volume **35** (3), 2004

CAI, J. & DICKSON, D. C. M. *Ruin probabilities with a Markov chain interest model.* 513-525. Finite and infinite time ruin probabilities in a discrete time risk process with a Markov chain interest model are studied. Recursive and integral equations for the ruin probabilities are given. When interest rates are non-negative, generalized Lundberg inequalities for the infinite time ruin probability are derived by inductive and martingale approaches. When interest rates can be negative and loss distributions have regularly varying tails, asymptotic formulas for the finite time ruin probability are given by an inductive approach on the recursive equations.

CHEUNG, K. C. & YANG, H. *Ordering optimals proportions in the asset allocation problem with dependent default risks.* 595-609. Financial instruments traded in the market, very often, are subject to default risk. It is well known that the default risks of different instruments are dependent on each other. In this paper, we consider a portfolio selection problem where assets are exposed to dependent default risk. Two different models are proposed to model the default mechanism: the Threshold Model and the Independence Model. By applying some techniques of stochastic orders, we are able to obtain sufficient conditions to order the optimal amount invested in each asset.

DENUIT, M. & LANG, S. *Non-life rate-making with Bayesian GAMs.* 627-647. This paper aims to propose modern rate-making techniques based on Generalized Additive Models (GAMs) and extensions. The method accounts for discrete, continuous, categorical and spatial risk factors in a Bayesian framework. It uses computer-intensive simulation methods for statistical inference. Numerical illustrations based on a Belgian MTPL portfolio enhance the interest of the approach.

GOOVAERTS, M. J., KAAS, R., LAEVEN, R. J. A. & TANG, Q. *A comonotonic image of independence for additive risk measures.* 581-594. This paper presents a new axiomatic characterization of risk measures that are additive for independent random variables. In contrast to previous work, we include an axiom that guarantees monotonicity of the risk measure. Furthermore, the axiom of additivity for independent random variables is related to an axiom of additivity for comonotonic random variables. The risk measure characterized can be regarded as a mixed exponential premium.

IWAKI, H. & YUMAE, S. *An efficient frontier for participating policies in a continuous-time economy.* 611-625. This paper analyzes trading and payment strategies for participating policies in a continuous-time economy by utilizing the martingale method for problems of optimal portfolio selection. We assume that an insurance company invests the premiums collected from policyholders by choosing a portfolio with minimum equity risk among all portfolios characterized by the same expected return of the equity, and a portfolio with maximum expected return among those with the same risk. Based on these assumptions, we derive an efficient frontier of the equity return of the company as well as trading strategies to realize efficient portfolios.

https://doi.org/10.1017/S1357321700002981 Published online by Cambridge University Press

KALUSZKA, M. *An extension of Arrow's result on optimality of a stop loss contract.* 527-536. The optimal, from the cedent's point of view, reinsurance treaties for a fixed reinsurer's premium are derived. We assume that the cedent wants to minimize a convex risk measure, e.g. the variance, semi-variance, upper partial moment or mean absolute deviation. The reinsurer's premium is calculated on the basis of the expectation and variance of his/her part of the total risk. The obtained results provide an extension of Arrow's result on the optimality of a stop loss treaty.

LANDSMAN, Z. M. *On the generalization of Esscher and variance premiums modified for the elliptical family of distributions.* 563-579. Esscher premiums, Esscher transforms and "exponential tilting" are regarded as convenient tools in risk measurement and portfolio allocation. The main component of these measures is the variancecovariance structure of the multivariate distribution, which makes them especially attractive for multivariate normal portfolios, since the latter are uniquely determined by their variancecovariance structure. However, if the distribution deviates from the normal by having, for example, heavy tailed marginals, the allocation methods based on Esscher transforms fail to reflect this deviation even if the distribution still preserves the same variancecovariance structure as normal.

LI, S. & GARRIDO, J. *On a class of renewal risk models with a constant dividend barrier.* 691-701. We consider a compound renewal (Sparre Andersen) risk process in the presence of a constant dividend barrier in which the claim waiting times are generalized Erlang(n) distributed (i.e., convolution of n exponential distributions with possibly different parameters). An integro-differential equation with certain boundary conditions for the Gerber-Shiu function is derived and solved. Its solution can be expressed as the Gerber-Shiu function in the corresponding Sparre Andersen risk model without a barrier plus a linear combination of n linearly independent solutions to the associated homogeneous integro-differential equation. Finally, explicit results are given when the claim sizes are exponentially distributed.

PRIVAULT, N. & WEI, X. *A Malliavin calculus approach to sensitivity analysis in insurance.* 679-690. Using the Malliavin calculus on Poisson space and a method initiated by Fournié et al for continuous financial markets, we compute the probability density of risk reserve processes and the sensitivities of probabilities of ruin at a given date for insurance portfolios under interest force. The simulation graphs provided show that this method is computationally more efficient than the standard approximation of derivatives by finite differences.

WANG, N., GERRARD, R. & HABERMAN, S. *The premium and the risk of a life policy in the presence of interest rate fluctuations.* 537-551. In this work, we consider the premium setting and the associated risk with regard to a life insurance policy when the interest rate process is a diffusion. Explicit formulas and numerical examples are given for the premiums determined by the equivalence principle under some well-known interest rate models such as the Vasicek model and the CIR model. Two types of premium design, single deposit premium and continuous premium, are considered. A martingale related to the discounted reserve process is introduced. With this martingale, an analysis of the risk of ruin is also carried out on a collective basis when the premium is the natural premium plus an initial positive loading. A bound of exponential type is derived for the ruin probability.

WANG, R., YANG, H. & WANG, H. *On the distribution of surplus immediately after ruin under interest force and subexponential claims.* 703-714. The compound Poisson risk process with a constant interest force is an interesting stochastic model in risk theory. It provides a basic understanding about how investments will affect the ruin probability and related ruin functions. This paper considers the compound Poisson risk model with a constant interest force for an insurance portfolio and studies the distribution of the surplus immediately after ruin under the model. By using the techniques of Kalashnikov and Konstantinides and a

https://doi.org/10.1017/S1357321700002981 Published online by Cambridge University Press

formula obtained by Yang and Zhang, we give asymptotic formulas of the low and upper bounds for the distribution of the surplus immediately after ruin under subexponential claims. To some extent, we can view our work here as the continuation of the recent important work of Kalashnikov and Konstantinides, Yang and Zhang, and Konstantinides *et al.*

YANG, Z. & TSUI, A. K. C. *Analytically calibrated Box–Cox percentile limits for duration and event-time models.* 649-677. This paper proposes a unified approach to constructing confidence limits for a future percentile duration or event-time. The construction is based on an analytical calibration of the Box–Cox-type 'plug-in' percentile limits (PL). The performance of the calibrated Box–Cox PL is investigated using Monte Carlo experiments. Comparisons are made with PLs that are specifically designed for a particular distribution such as Weibull and lognormal. Excellent performances of the calibrated Box–Cox PL are observed. Simulation based on other popular duration models such as gamma and inverse Gaussian reveal that the proposed PL is robust against distributional assumptions and that it performs much better than the distribution-free PL. An empirical illustration is also provided.

ZHOU, X. *When does surplus reach a certain level before ruin?* 553-561. Laplace transform of the first passage time across a given level before ruin is investigated for the surplus process in a perturbed risk model. Such a result is used to obtain the joint distribution of the maximal surplus before ruin, the surplus immediately before ruin and the deficit at ruin, associated with the ruin time. It also allows us to study the similar joint distribution for a risk model with a two-step premium rate.

Reproduced with the permission of Elsevier Science.
Subscription details available from: Elsevier Science, PO Box 311, 1000 AE Amsterdam, The Netherlands. E-mail: nlinfo-f@elsevier.nl

JOURNAL OF RISK AND INSURANCE

Volume **71** (4), 2004

AASE, K. K. *A pricing model for quantity contracts.* 617-642. An economic model is proposed for a combined price futures and yield futures market. The innovation of the article is a technique of transforming from quantity and price to a model of two genuine pricing processes. This is required in order to apply modern financial theory. It is demonstrated that the resulting model can be estimated solely from data for a yield futures market and a price futures market. We develop a set of pricing formulas, some of which are partially tested, using price data for area yield options from the Chicago Board of Trade. Compared to a simple application of the standard Black and Scholes model, our approach seems promising.

BHATTACHARYA, J., GOLDMAN, D. & SOOD, N. *Price regulation in secondary insurance markets.* 643-675. Secondary life insurance markets are growing rapidly. From nearly no transactions in 1980, a wide variety of similar products in this market has developed, including viatical settlements, accelerated death benefits, and life settlements and as the population ages, these markets will become increasingly popular. Eight state governments, in a bid to guarantee sellers a "fair" price, have passed regulations setting a price floor on secondary life insurance market transactions, and more are considering doing the same. Using data from a unique random sample of HIV+ patients, we estimate welfare losses from transactions prevented by binding price floors in the viatical settlements market (an important segment of the secondary life insurance market). We find that price floors bind on HIV patients with greater than 4 years of life expectancy. Furthermore, HIV patients from states with price floors are significantly less likely to viaticate than similarly healthy HIV patients from other states. If price floors were adopted nationwide, they would rule out transactions worth $119 million per

https://doi.org/10.1017/S1357321700002981 Published online by Cambridge University Press

year. We find that the magnitude of welfare loss from these blocked transactions would be highest for consumers who are relatively poor, have weak bequest motives, and have a high rate of time preference.

BOYER, M. M. *Overcompensation as a partial solution to commitment and renegotiation problems: the case of ex post moral hazard.* 559-582. In a Costly State Verification world, an agent who has private information regarding the state of the world must report what state occurred to a principal, who can verify the state at a cost. An agent then has what is called ex post moral hazard: he has an incentive to misreport the true state to extract rents from the principal. Assuming the principal cannot commit to an auditing strategy, the optimal contract is such that: (1) the agent's expected marginal utility when there is an accident (high- and low-loss states) is equal to his marginal utility when there is no accident; (2) the lower loss is undercompensated, while the higher loss is overcompensated; and (3) the welfare of the agent is greater under commitment than under no-commitment. Result 2 is contrary to the results obtained if the principal can commit to an auditing strategy (higher losses underpaid and lower losses overpaid). The reason is that by increasing the difference between the high and the low indemnity payments, the probability of fraud is reduced.

BRAUN, M. & MUERMANN, A. *The impact of regret on the demand for insurance.* 737-767. We examine optimal insurance purchase decisions of individuals that exhibit behavior consistent with Regret Theory. Our model incorporates a utility function that assigns a disutility to outcomes that are ex post suboptimal, and predicts that individuals with regret-theoretical preferences adjust away from the extremes of full insurance and no insurance coverage. This prediction holds for both coinsurance and deductible contracts, and can explain the frequently observed preferences for low deductibles in markets for personal insurance.

COX, L. A. & GE, Y. *Temporal profitability and pricing of long-term care insurance.* 677-705. Equilibrium models of dynamic insurance markets can be bifurcated according to underlying assumptions about whether or not insurers commit to long-term contracts. The difference is substantial in that commitment models imply price highballing over time while no-commitment models indicate price lowballing. Extant empirical studies provide mixed evidence, however. We use long-term care (LTC) insurance data, which allow us both to better control for heterogeneous, observable risk, to examine dynamic profitability and pricing in a relatively young, innovative insurance market. Our tests generally indicate temporal price lowballing, thereby providing support for the no-commitment models.

D'ARCY, S. P. & GORVETT, R. W. *The use of dynamic financial analysis to determine whether an optimal growth rate exists for a property-liability insurer.* 583-615. Prior research on the aging phenomenon has demonstrated that new business for property-liability (P-L) insurers generates high loss ratios that gradually decline as a book of business goes through successive renewal cycles. Although the experience on new business is initially unprofitable, the renewal book of business eventually becomes profitable over time. Within this context, insurers need to manage their exposure growth in order to maximize long run profitability. Dynamic financial analysis (DFA), a relatively new tool for P-L insurers, utilizes Monte Carlo simulation to generate the overall financial results for an insurer under a large number of scenarios. This article uses a publicly available DFA model along with the estimated market value of an insurer, based on 1990-2001 data for stock P-L insurers and underlying financial variables to determine optimal growth rates of a P-L insurer based on mean-variance analysis, stochastic dominance, and constraints on leverage.

SO, J. & WEI, J. Z. *Deposit insurance and forbearance under moral hazard.* 707-735. We study the efficacy of forbearance using a real options approach. Our model endogenizes moral hazard embedded in credit risk undertaken by the bank. The bank's interest rate risk is

https://doi.org/10.1017/S1357321700002981 Published online by Cambridge University Press

modeled as duration mismatch. Other modeling improvements over previous studies include such features as stochastic interest rates and deposits, continuous interest payments on an ongoing deposit portfolio, and a stochastic forbearance period. We find that the bank does have an incentive to engage in undue risk taking. Even in the presence of moral hazard, however, forbearance can still be a desirable course of action in reducing the FDIC's expected liability. In addition, the capital ratio plays an extremely important role in determining the fair insurance premium. Finally, using the mismatch of asset and deposit durations as the correct measurement of interest rate risk, our model reveals that an optimal asset variance may exist for a particular bank, contrary to what the contingent claims framework would predict. Therefore, we resolve the puzzle that banks in practice do not increase asset risk to take full advantage of the limited liability.

Reproduced with the permission of the American Risk and Insurance Association.
Subscription details available from: the American Institute for CPCU, 720 Providence Road, Malvern, PA 19355, U.S.A. E-mail: aria@cpcuiia.org

NORTH AMERICAN ACTUARIAL JOURNAL

Volume **8** (3), 2004

CARRIÈRE, J. F. *Martingale valuation of cash flows for insurance and interest models.* 1-16. Using a pricing axiom from financial economics, a martingale valuation method is presented with the properties of numeraire invariance and no arbitrage. The pricing method is then applied to cash flows in actuarial models like loans, bonds, insurances, annuities, reserves, and surplus processes. Special emphasis is given to portfolios of defaultable bonds, where new modeling results are given. Also, an optimal repayment analysis of a common loan arrangement reveals that the book and market interest rates have to be equal.

DAY, T. *Financial economics and actuarial practice.* 90-102. Starting in the United Kingdom and continuing through the U.S. and Canadian actuarial professions, proponents of financial economics have been forcefully promoting a review of traditional actuarial practices and training. In particular, the financial theories first proposed by Modigliani and Miller and subsequently developed by others have been used to highlight serious weaknesses in typical actuarial thinking. In summary, it is claimed that much actuarial advice wrongly specifies value, that guidelines and standards need radical revision, and that traditional actuarial intuition suffers in comparison to newer modes of thought adopted by other professions.

This paper examines concepts from both financial economics and actuarial science as applied to defined benefit schemes using a simple discounted cash-flow framework as a reference point. The general finding is that many standard modes of actuarial thought are, in fact, indefensible when examined with the tools and techniques of financial economics. The call for revision of actuarial training and practices is credible and necessary.

However, the paper also touches upon areas where a heavy-handed application of finance theory could be misguided due to limitations in the simple financial economic models presented. It concludes that financial economics should be carefully integrated into actuarial thought rather than appended to existing actuarial theory or inserted as a wholesale replacement.

MORALES, M. *On an approximation for the surplus process using extreme value theory: Applications in ruin theory and reinsurance pricing.* 46-67. Extreme value theory is of particular importance to insurance mathematics. It studies extreme events that, although low in frequency, cause high claims to the industry. Here I present an approximation to the surplus process when the claim severities belong to the domain of attraction of an extreme distribution; this allows for all kinds of heavy- and medium-tailed distributions. The

https://doi.org/10.1017/S1357321700002981 Published online by Cambridge University Press

approximation is based on a Levy process with an underlying Levy measure proportional to the generalized Pareto distribution. Under extreme value theory considerations, this paper constructs a generalized Pareto-stable Levy process that approximates the aggregate claims process. This process is a particular type of compound Poisson process. Such a construction leads to an universal simulation scheme to estimate ultimate ruin probabilities for the classical surplus model in the presence of heavy- and medium-tailed severity distributions. I show how for a generalized Pareto-stable process a coherent risk measure can be defined that can be used as loaded stop-loss premium. I use the duality between relative entropy and distortion functions to hint at a way to price reinsurance layers over a retention value using the generalized Pareto-stable approximation. I provide some numerical results to illustrate this approach.

RALFE, J., SPEED, C. A. & PALIN, J. *Pensions and capital structure: Why hold equities in the pension fund?* 103-132. This paper considers the pension plan as part of the capital structure of the sponsoring employer. This enables lessons from financial theory concerning capital structure to be used to answer the question, "What assets should a pension fund hold?". The standard Modigliani-Miller framework is expanded on to consider the implications of corporate tax. This leads to the conclusion that bond investment for pension plans has tangible advantages over holding risky assets (e.g., equities). The paper considers a case study of the pension plan of the Boots Company, a U.K. pharmacy retailer with a pension fund of around £2.3 billion ($3.5 billion), where these ideas were put into practice. Finally, the paper discusses the value released to shareholders and the extra security members of the pension fund have derived from putting theory into practice.

SIU, T. K., TONG, H. & YANG, H. *On pricing derivatives under GARCH models: A dynamic Gerber–Shiu approach.* 17-31. This paper proposes a method for pricing derivatives under the generalized autoregressive conditional heteroskedasticity (GARCH) assumption for underlying assets in the context of a "dynamic" version of Gerber and Shiu's (1994) option-pricing model. Instead of adopting the notion of a local risk-neutral valuation relationship (LRNVR), introduced by Duan (1995), the authors here employ the concept of conditional Esscher transforms introduced by Buhlmann *et al.* (1996) to identify a martingale measure under the incomplete market setting. One advantage of this model is that it provides a unified and convenient approach to deal with different parametric models for the innovation of the GARCH stock-price process. Under the conditional normality assumption for stock innovation, our pricing result is consistent with that of Duan (1995). In line with the celebrated Gerber–Shiu option pricing model, the pricing result can be justified within the dynamic framework of utility maximization problems, which makes the economic intuition of the pricing result more appealing. In fact, the use of the Esscher transform for option valuation can also be justified by the minimization of the relative entropy between the statistical probability and the risk-neutralized pricing probability. Numerical results for comparing the model with the Black-Scholes option-pricing model are also presented.

VERRALL, R. J. *A Bayesian generalized linear model for the Bornhuetter–Ferguson method of claims reserving.* 67-89. This paper shows how Bayesian models within the framework of generalized linear models can be applied to claims reserving. The author demonstrates that this approach is closely related to the Bornhuetter–Ferguson technique. Benktander (1976) and Mack (2000) previously studied the Bornhuetter–Ferguson technique and advocated using credibility models. The present paper uses a Bayesian parametric model within the framework of generalized linear models.

WINDCLIFF, H. & BOYLE, P. P. *The 1/n pension investment puzzle.* 32-45. This paper examines the so-called 1/n investment puzzle that has been observed in defined contribution plans whereby some participants divide their contributions equally among the available asset classes. It has been argued that this is a very naive strategy since it contradicts the fundamental

https://doi.org/10.1017/S1357321700002981 Published online by Cambridge University Press

tenets of modern portfolio theory. We use simple arguments to show that this behavior is perhaps less naive than it at first appears. It is well known that the optimal portfolio weights in a mean-variance setting are extremely sensitive to estimation errors, especially those in the expected returns. We show that when we account for estimation error, the 1/n rule has some advantages in terms of robustness; we demonstrate this with numerical experiments. This rule can provide a risk-averse investor with protection against very bad outcomes.

Reproduced with the permission of the Society of Actuaries.
Subscription details available from: Society of Actuaries, 475 N. Martingale Road, Schaumburg, ILL 60173 U.S.A., www.soa.org

SCANDINAVIAN ACTUARIAL JOURNAL

2004-5

BÄUERLE, N. *Traditional versus non-traditional reinsurance in a dynamic setting.* 355-371. We consider a stochastic risk reserve process whose risk exposure can be controlled dynamically by applying proportional reinsurance and by issuing CAT Bonds. The CAT Bond payments are only partly correlated with the insurers losses. The aim is to minimize the probability of ruin. Using a two-dimensional diffusion approximation we obtain a controlled diffusion problem which can be solved explicitly with the help of the HJB equation. We present some numerical results and discuss to which extend the proportional reinsurance can be replaced by issuing CAT Bonds.

HIPP, C. & SCHMIDLI, H. *Asymptotics of ruin probabilities for controlled risk processes in the small claims case.* 321-335. We consider a risk process with the possibility of investment into a risky asset. The aim of the paper is to obtain the asymptotic behaviour of the ruin probability under the optimal investment strategy in the small claims case. In addition we prove convergence of the optimal investment level as the initial capital tends to infinity.

JØRGENSEN, P. L. *On accounting standards and fair valuation of life insurance and pension liabilities.* 372-394. The actuarial profession is increasingly teaming up with financial economists for a fruitful cooperation on the proper valuation of life insurance and pension (L&P) liabilities. This has been a natural consequence of a recent sharply increased focus on market values in financial reports of L&P companies from regulators, standard setters, the financial press, stakeholders, and others with an interest in the L&P business.
This article provides a financial economist's point of view on recent developments in relation to the fair valuation of L&P liabilities. The role of accounting standards and the background for the international harmonization in this field are first discussed. We then review and explain the concept of fair value and provide a general view on appropriate techniques for estimating fair values of L&P liabilities in accordance with the definition of the concept. The paper also contains a section which briefly reviews recent and quite innovative regulatory initiatives in relation to market value.

REINHARD, J.-M. & SNOUSSI, M. D. *A monotonically converging algorithm for the severity of ruin in a discrete semi-Markov risk model.* 336-354. This paper deals with the severity of ruin in a discrete semi-Markov risk model. It is shown that the work of Reinhard and Snoussi (Stochastic Models, 18) can be extended to cover the case where the premium is an integer value and no restriction on the annual result is imposed. In particular, it is shown that the severity of ruin without initial surplus is solution of a system of equations. It can be obtained by a monotonically converging algorithm when the claims are bounded.

Reproduced with the permission of Taylor & Francis, www.tandf.no/saj

https://doi.org/10.1017/S1357321700002981 Published online by Cambridge University Press