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GENEVA PAPERS ON RISK AND INSURANCE THEORY

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COURBAGE, C. *Self-insurance, self-protection and market insurance within the dual theory of choice,* 43-56. As demonstrated by Ehrlich and Becker [1972], expected utility theory predicts that market insurance and self-insurance are substitutes, whilst surprisingly, market insurance and self-protection could be complements. This article examines the robustness of this conclusion, as well as its extensions under the dual theory of choice [Yaari, 1987]. In particular, the non-reliability of self-insurance activities, background risk and asymmetric information are considered.

DEMANGE, G. & LAROQUE, G. *Social security with heterogeneous populations subject to demographic shocks,* 5-24. In a previous paper, we showed how a pay-as-you-go social security scheme, based on *voluntary contributions*, can be an appropriate institution to reach an optimal sharing of risks among generations in the presence of demographic uncertainties. We study here the functioning of such schemes when there are different population strata, with different demographic shocks and wages. We show that while a collective *voluntary* pay-as-you-go scheme can provide efficient intergenerational risk sharing, it is likely to be destabilized by pensions funds specialized by agents' types. This is true both when there is a complete set of contingent markets, where the risk pooling capabilities of a collective fund are potentially of less interest, and when markets are incomplete. In this last circumstance, a collective fund may help the living agents to share their intragenerational risks. However, we show that the resulting allocation does not Pareto dominate the outcome of individual funds by agent types, and that there are incentives for agents to separate from any collective organization.

HAU, A. *A general theorem on the comparative statics of changes in risk,* 25-41. In this paper, the concept of 'absolutely riskier than' is introduced to generalize Gollier's (*Journal of Economic Theory*, **66**) necessary and sufficient conditions for the comparative statics of a change in risk for risk averters. The restrictive assumption that the payoff function is monotonic in the risk is relaxed. The 'policymaker's choice problem', the 'newsboy problem', and a farmer's example are used to illustrate how easily the monotonicity assumption is violated. Finally, some important properties of the concept of 'absolutely riskier than', such as its relation with the concept of 'second-order stochastic dominance', are illustrated using the farmer's example.

JENSEN, B., JØRGENSEN, P. L. & GROSEN, A. *A finite difference approach to the valuation of path dependent life insurance liabilities,* 57-84. This paper sets up a model for the valuation of traditional participating life insurance policies. These claims are characterized by their explicit interest rate guarantees and by various embedded option elements, such as bonus and surrender options. Owing to the structure of these contracts, the theory of contingent claims pricing is a particularly well-suited framework for the analysis of their valuation.

The eventual benefits (or *pay-offs*) from the contracts considered crucially depend on the history of returns on the insurance company's assets during the contract period. This path-dependence prohibits the derivation of closed-form valuation formulas but we demonstrate

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that the dimensionality of the problem can be reduced to allow for the development and implementation of a finite difference algorithm for fast and accurate numerical evaluation of the contracts. We also demonstrate how the fundamental financial model can be extended to allow for mortality risk and we provide a wide range of numerical pricing results.

CARRIÈRE, J. F. *Transition probability functions for martingale laws of bond prices,* 393-399. In this article, the joint transition probability density function of a finite collection of bonds is derived under a martingale valuation law. An application to European options is also given.

CENTENO, M. DE L., ANDRADE, E. & SILVA, J. M. *Bonus systems in an open portfolio,* 341-350. In this paper, we study bonus systems in an open portfolio, i.e. we consider that a policyholder can transfer his policy to a different insurance company at any time. We make use of inhomogeneous Markov chains to model the system and show, under reasonable assumptions, that the stationary distribution is independent of the market shares, and is easily calculated.

DENUIT, M., DHAENE, J. & RIBAS, C. *Does positive dependence between individual risks increase stop-loss premiums?* 305-308. Actuaries intuitively feel that positive correlations between individual risks reveal a more dangerous situation compared to independence. The purpose of this short note is to formalize this natural idea. Specifically, it is shown that the sum of risks exhibiting a weak form of positive dependence known as positive cumulative dependence is larger in convex order than the corresponding sum under the theoretical independence assumption.

HÜRLIMANN, W. *Distribution-free comparison of pricing principles,* 351-360. Given the mean, coefficient of variation and finite range of a risk, we determine the stop-loss ordered extremal prices for four plausible pricing principles, namely the exponential principle, a new truncated linear zero-utility principle, the PH-transform principle and the Dutch principle. If in the extreme situation of a maximum coefficient of variation, the price of a risk should be maximum and uniquely defined, then the obtained distribution-free prices can be made parameter-free and compared. It is shown that the maximum distribution-free truncated linear zero-utility prices coincide with the minimum distribution-free PH-transform and Dutch prices.

IWAKI, H., KIJIMA, M. & MORIMOTO, Y. *An economic premium principle in a multiperiod economy,* 325-339. This paper considers a multiperiod economic equilibrium model for deriving the economic premium principle of Bühlmann [*Astin Bull*. **11** (1980); *Astin Bull*. **14** (1983)]. To do this, we construct a consumption/portfolio model in which each agent is characterized by his/her utility function and income and seeks to invest his/her wealth in both insurance as well as a financial market so as to maximize the expected, discounted total utility from consumption. The state price density in equilibrium is obtained in terms of the Arrow-Pratt index of absolute risk aversion for the representative agent. As special cases, power and exponential utility functions are examined, and some comparative statics results are derived.

LI, Y. & PAKES, A. G. *On the number of near-maximum insurance claims,* 309-323. A near-maximum claim size is one falling within a fixed distance a of the current record claim size. In this paper we study the statistic $\mathcal{K}_t(a)$ counting the number of near-maximum insurance claims in the time period $[0, t]$. Some distributional results of $\mathcal{K}_t(a)$ are considered, as well as asymptotic behaviours as $t \to \infty$. Subject to a limitation on the tail thickness of the claim-size law, these results provide an estimate of the long-term total value of near-maximum insurance claims.

MØLLER, T. *On transformations of actuarial valuation principles,* 281-303. In this paper, we determine optimal trading strategies associated with the financial variance and standard deviation principles proposed by Schweizer [*I.M.E.* **28**, 31-47]. These principles take into consideration the possibilities of hedging on the financial market and are derived by an indifference argument, which embeds the traditional (actuarial) variance and standard deviation principles in a financial framework. We also investigate an alternative way of transforming actuarial principles and show that for the standard deviation principle this leads to the financial standard deviation principle. The principles are applied for the valuation and hedging of unit-linked life insurance contracts.

MÜLLER, A. & PFLUG, G. *Asymptotic ruin probabilities for risk processes with dependent increments,* 381-392. In this paper, we derive a Lundberg type result for asymptotic ruin probabilities in the case of a risk process with dependent increments. We only assume that the probability generating functions exist, and that their logarithmic average converges. Under these assumptions we present an elementary proof of the Lundberg limiting result, which only uses simple exponential inequalities, and does not rely on results from large deviation theory. Moreover, we use dependence orderings to investigate how dependencies between the claims affect the Lundberg coefficient. The results are illustrated by several examples, including Gaussian and AR(1)-processes, and a risk process with adapted premium rules.

TSAI, C. C.-L. *On the discounted distribution functions of the surplus process perturbed by diffusion,* 401-419. In this paper, we derive explicit expressions for the discounted joint and marginal distribution functions of the surplus immediately prior to the time of ruin and the deficit at the time of ruin, and for the discounted distribution function of the amount of the claim causing ruin, based on the surplus process of ruin theory with an independent diffusion process. Furthermore, we show that these distribution functions satisfy defective renewal equations.

WILLMOT, G. E. & CAI, J. *Aging and other distributional properties of discrete compound geometric distributions and related random sums,* 361-379. Distributional properties of some discrete reliability classes, including the class of discrete compound geometric (D-CG) distributions, are discussed. The D-CG distribution is shown to be a subclass of the discrete strongly new worse than used class, and relations with discrete decreasing failure rate classes are considered. Upper bounds for the tail probabilities of D-CG distributions are derived. These upper bounds are of discrete Lundberg-type, and are optimal for some choices of the compounded variable. Lower bounds are also obtained. Numerical examples are given to illustrate the calculations of the bounds. The results are then applied to obtain bounds and monotonicity properties of the ruin probability in a discrete ruin model. Finally, by exploiting connections with both compound geometric and mixed Poisson distributions, reliability classifications and bounds are obtained for the equilibrium M/G/1 queue length distribution.