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DESIGN OF CATASTROPHE MORTALITY BONDS BASED ON THE COMONOTONICITY THEORY AND JUMP-DIFFUSION PROCESS

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Abstract. *Based on the positive dependency characteristic of the mortality in catastrophe areas, this paper develops a pricing model for catastrophe mortality bonds with comonotonicity and the jump-diffusion process. Due to the fact that classical pricing methods are rarely suited to the hypotheses of complete markets, we use the Wang transform method to price the bond in an incomplete market framework. The paper also carries out an empirical analysis on the price of catastrophe mortality bonds with data of Sri Lanka and Indonesia, and shows how the parameters affect the price of the bond.*
Keywords: Comonotonicity, Jump-diffusion process, Mortality, Wang transform

1. **Introduction.** Mortality is one of the most important concerns of actuarial work related to life insurance. In recent years, catastrophic events occured frequently. Mortality risk imposes a big potential problem for a life insurer's solvency. Catastrophe mortality bonds provide an alternative risk management tool to hedge the risk of catastrophe mortality for insurers. Traditionally, the risk of mortality was shared between insurers and reinsurers via reinsurance. However, in contrast to these classical approaches, mortality bonds transfer catastrophe mortality risk off their balance sheets to capital markets. The first mortality bond was issued by Swiss Reinsurance Company in December 2003. It matured on January 1, 2007. The mortality risk is defined in terms of an index based on the weighted average annual population death rates in the US, UK, France, Italy and Switzerland.

The structure of catastrophe mortality bond is similar to the other derivative securities. The bond links to a combined mortality index, which is calculated based on the mortality data reported by official entities. If the index exceeds a certain level, the bonds will be triggered and the investors' principal will be reduced. In return, investors receive coupon payments on their principal including spread margins for the adopted risk. Here, how to predict the combined mortality index is complicated not only because the individual mortality is stochastic, but because the stochastic dependence structure between mortality of different countries is unknown or too cumbersome to work with.

The earlier works for modeling mortality can be found in [1]; Lee and Carter introduced a simple model for central mortality rates involving both age-dependent and time-dependent terms. Lee and Carter's model had been developed in the later work [2, 3]. A number of recent studies have sought to model mortality rate as a stochastic process