# NMFM401 – Mathematics of Non-Life Insurance 1

9. Ruining

## A Exercises

**1.** Let the Poisson process $\{N_t,\, t \geq 0\}$ represents the number of claims on a portfolio of business. For fixed $t_0 > 0$, prove that the time until the next claim occurs is exponential with mean $\lambda^{-1}$. [Hint: Condition on the joint distribution of the time since the last claim occured and the number of claims in $(0, t_0]$.]

**2.** Calculate the adjustment coefficient if the individual loss size density is

$$f(x;\beta) = \frac{\sqrt{\beta/x}\exp\{-\beta x\}}{\Gamma(1/2)}, \quad x > 0,\, \beta > 0.$$

**3.** If $c = 2.99$, $\lambda = 1$, and the individual loss size distribution is given by $\mathbb{P}[X = 1] = 0.2$, $\mathbb{P}[X = 2] = 0.3$, and $\mathbb{P}[X = 3] = 0.5$, use the Newton-Raphson procedure to numerically obtain the adjustment coefficient.

## B Homework

**1.** If $N_t$ is the number of claims in $(0, t]$, show that

$$\mathbb{P}[N_{t+s} - N_s = n] = \frac{(\lambda t)^n \exp\{-\lambda t\}}{n!}, \quad n = 0, 1, \ldots$$

implies

$$\mathbb{P}[N_{t+s} - N_s = 1] = \lambda t + o(t), \quad \text{and} \quad \mathbb{P}[N_{t+s} - N_s > 1] = o(t),\, t \to 0_+.$$

**2.** Calculate the adjustment coefficient if $\theta = 0.32$ and the claim size distribution has density

$$f(x;\beta) = \beta^{-2} x \exp\{-x/\beta\}, \quad x > 0,\, \beta > 0.$$

**3.** Calculate the adjustment coefficient if $c = 3$, $\lambda = 4$, and the individual loss size density is

$$f(x) = \exp\{-2x\} + \frac{3}{2}\exp\{-3x\}, \quad x > 0.$$

Do not use an iterative numerical procedure.

**4.** Repeat previous Exercise using the Newton-Raphson procedure begining with an initial estimate based on $\kappa < 2\theta\mu/\mathbb{E}X^2$.

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**Source**


[1] Klugman, Stuart A., Panjer, Harry H., and Willmont, Gordon E. *Loss Models: From Data to Decisions*. John Wiley & Sons, Inc., New York, NY, 4th Edition, 2012.