ACSC/STAT 4703, Actuarial Models II

FALL 2024

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Homework Sheet 2

Due: Thursday 26th September: 11:30 AM

Note: This homework assignment is only valid for FALL 2024. If you find this homework in a different term, please contact me to find the correct homework sheet.

Basic Questions

1. An insurer models losses as following a distribution with distribution function $F(x) = \frac{x^3+x^2+x}{x^3+x^2+5x+1}$. They find that $c_n = n^{\frac{1}{2}}$ and $d_n = n^{\frac{1}{2}}$ make the distribution of block maxima converge. What is the limiting distribution?
2. An insurer models losses as following a distribution with survival function $S(x) = 1 - e^{-\frac{1}{x}-\frac{1}{x^2}}$. What values of c_n and d_n make the distribution of block maxima converge, and what is the limiting distribution?
3. A loss follows a distribution from the MDA of a Gumbel distribution. A reinsurer estimates that the probability of the loss exceeding \$1,000,000 is 0.005. The expected payment on an excess-of-loss reinsurance contract of \$1,000,000 over \$1,000,000 for this loss is \$911.40. What is the expected payment on an excess-of-loss reinsurance contract of \$2,000,000 over \$1,000,000.

Standard Questions

4. The file `HW2_data.txt` contains 1,000,000 values of a random variable.
   (a) By dividing into blocks of different sizes, and using the `fit.GEV` function in the `QRM` package in `R`, estimate the tail index ξ.
   (b) Use the Hill estimator to estimate ξ at a range of different thresholds, from the data in the file `HW2_data.txt`.
5. A insurer wants to calculate the ILF for a heavy-tailed loss. Based on previous data, they estimate that the distribution of the loss is in the MDA of a Weibull EV distribution with $\xi = -1$. The ILF from \$1,000,000 to \$2,000,000 is 1.18 and the ILF from \$2,000,000 to \$5,000,000 is 1.39. Assuming the GPD approximation applies to losses above \$1,000,000, what is the ILF from \$5,000,000 to \$10,000,000?