2. ϵ-outage probability

The simulation consists of two parts:

(1) **Generate theoretical curve**

Generate the theoretical curve under different L and SNR by

$$C_{\epsilon,\text{theoretical}} = \log\left(1 + F^{-1}(1-\epsilon)\,\text{SNR}\right)$$

where $F(x) = P\left(\|h\|^2 > x\right)$ and $\|h\|^2$ is chi-square distribution with $2L$ degrees of freedom.

(2) **Generate Simulated curve**

To generate the simulated curve, recall the definition of ϵ-outage probability:

$$\epsilon\left(C\right) = P\left(\log(1 + \|h\|^2\,\text{SNR}) < C\right)$$

Given ϵ, L, and SNR, we first generate a large number ($N = 2L \cdot 10^6$) of channel realizations from $\mathcal{CN}(0,1)$. For every $2L$ channel realization, we obtain $\|h\|^2$ by

$$\|h\|^2 = \sum_{l=1}^{2L} x_l^2$$

Calculate $\log(1+\|h\|^2\,\text{SNR})$ for each $\|h\|^2$ and sort them into nondecreasing order. Let $k = 10^6 \cdot \epsilon$. From the definition above we conclude that the kth smallest value from the sorted data is the simulated result.

The comparison between theoretical computation and simulation is shown below. Solid lines represent the theoretical result and marked points show the simulated result.