Answers to Exercises from Chapter 7.

The plots below are simulation experiments illustrating the relationship between Monte Carlo and estimation error in two situations.

The first is a simulation of a Poisson variable N with parameter $J\mu$ with $\mu = 5\%$ and $J = 100$. A total of m simulations were run and the probability distributions estimated by counting the relative number of times j appeared. This distribution was then plotted against j for three different versions: (i) When N is drawn from $J\mu$, (ii) when μ was replaced $\hat{\mu} = N_z/(10J)$ where N_z was simulated as a Poisson$(10J\mu)$ which imitates that the portfolio had been followed for ten years and (iii) that $\hat{\mu} = N_z/(10J)$ itself was simulated $m = 1000$ times and one single N^* was simulated from each $\hat{\mu}$. Try to figure out why (iii) is very close to (i).

The second round of experiments used the model $R = \xi + \sigma\varepsilon$ where ε is $N(0,1)$ and ξ and σ parameters. Their values were $\xi = 5\%$ and $\sigma = 25\%$ that could correspond to one-year returns for equity. Estimates $\hat{\xi}$ and $\hat{\sigma}$ were obtained from 30 years of historical returns and the three density function plotted on the right were obtained as follows. (i) the first is the true, normal density function with ξ and σ as parameters, (ii) is the normal density function with $\hat{\xi}$ and $\hat{\sigma}$ inserted for ξ and σ and (iii) is the kernel density estimate of $m = 1000$ simulations obtained from $\hat{\xi}$ and $\hat{\sigma}$. The similarity of (i) and (iii) is an indication of how little Monte Carlo uncertainty means compared to the errors in the parameters.