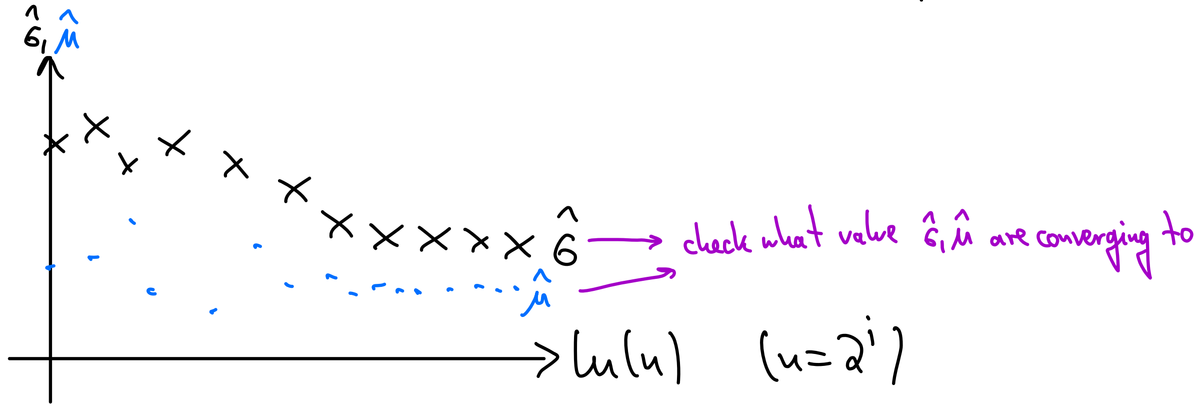
Stochastic Methods Lab, Jacobs University Bremen, Fall 2022 — Session 25

Prof. Dr. Soeren Petrat — Dec. 1, 2022

Homework:

a) one realization of GBM, size 2^k

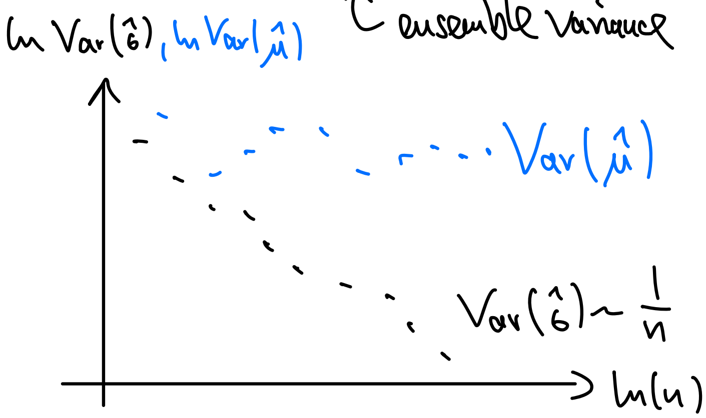
then estimate $\hat{\mu}, \hat{\sigma}$ for every 2^i-th sample point, $i = 0, \dots, k-1$



python: "semilogx(…,…)" for plot with logarithmic x-axis

b) ensemble of GBMs with some parameters

↳ $Var(\hat{\sigma})$, $Var(\hat{\mu})$ ← ensemble variance



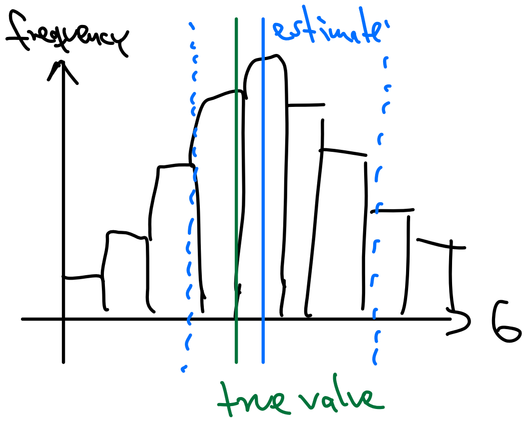
c) "Backtracking"

• given a single time series from part a) $\longrightarrow$ compute $\hat{\mu}, \hat{\sigma}$

- generate ensemble of GBMs with these parameters
- compute $Var(\hat{\mu})$, $Var(\hat{\sigma})$

$\Rightarrow$ test how reliable estimate was

python: hist(sigma_distribution, number of bins, histtype='stepfilled')



very thin for σ
but wide for μ

d), e), f) consider some noise sources:

- periodic noise : $S_{per} = S + c_1 \sqrt{\Delta t} \sin(2\pi f \, \mathrm{arange}(N+1))$ (GBM; frequency)
- Gaussian noise : $S_{Gauss} = S + c_1 \sqrt{\Delta t} \, \mathrm{normal}(0, 1, N+1)$

- how does the noise change estimates for $\hat{\mu}, \hat{\sigma}$?
- normality?
- independence?