In the name of God

Department of Physics
Shahid Beheshti University

COMPUTATIONAL PHYSICS

Exercise Set 4

(Due Date: 1402/01/15)

Stationary checking: The weak definition of stationary for a time series as $\{x(t), t = 1, ..., N\}$ is evaluating

$$\sigma(\tau) \equiv \frac{1}{M} \sum_{i=1}^{M} \sigma(i)$$

as a function of τ. Here $M = \left[\frac{N}{\tau}\right]$ and $\sigma^2(i) = \frac{1}{\tau}\sum_{t=1}^{\tau}(x_i(t) - \langle x_i(t)\rangle)^2$ and i runs from 1 to M and represents the label of various partitions. Any τ dependency indicates the footprint of non-stationary in underlying series.

A : Compute $\sigma(\tau)$ as a function of τ for "FBM.txt" data.

B : Compute $\sigma(\tau)$ as a function of τ for "FGN.txt" data.

C : Use the FBM.txt data and write a program to generate its increment as $y(t) \equiv x(t+1) - x(t)$ and for new constructed signal, compute $\sigma(\tau)$ and compare your result with part A.

D : Use the FGN.txt data and write a program to generate its profile as $y(t) \equiv \sum_{i=1}^{t} x(i)$ and for new constructed signal, compute $\sigma(\tau)$ and compare your result with part B.

E : The stationary intensity: Various series may show the different amount of non-stationary properties. In order to compare the intensity of non-stationary of different series, a way is computing associated $\sigma(\tau)$ and plot them in a same figure (log-log plot is recommended). The value of τ for which the $\sigma(\tau)$ would be almost saturated is so-called $\tau_{stationary}$ and for $\tau \geq \tau_{stationary}$ the signal can be considered as stationary regime. For the different data sets, compute corresponding $\tau_{stationary}$ and plot it versus the name of given series.

Good luck, Movahed