In the name of God

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OPTIMIZATION METHODS IN PHYSICS

Exercise Set 4

(Due Date: 1400/08/07)

1. Joint PDF:

A : For the input data set, compute $\Delta(\tau) \equiv \int dxdy|p(x,t;y,t+\tau) - p(x,t)p(y,t+\tau)|$ as a function of τ. Explain your results.
B : For the input data set, compute $\Delta(\tau) \equiv \int dx_1dx_3|p(x_3,t+2\tau;x_1,t) - \int dx_2 p(x_3,t+2\tau|x_2,t+\tau)p(x_2,t+\tau|x_1,t)p(x_1,t)|$ as a function of τ. Explain your results.

C : According to Box-Muller algorithm, generate Gaussian random field with $\sigma_0^2 = 2$ and $\langle x\rangle = 3$. Check your results by fitting a Gaussian function on the computed PDF of your generated data.

2. According to Von-Neumann method, generate a set of random data set in the range $x \in [1-5]$ with PDF as: $p(x) = \sin(x^2/100) + \frac{1}{\cos(x^3/100)} + x^{-3}$.

3. PDF transformation: Suppose that in a black box a harmonic oscillator is oscillating and you made a series of snapshots randomly through time. Determine the PDF of the location of the oscillator in the stationary case.

4. Suppose that x has the Pareto distribution, $p(x) = \frac{a}{x^{a+1}}$ for $1 \leq x < \infty$. Find the probability density function of each of the following random variables:

A : $y = x^2$.
B : $z = \frac{1}{x}$.
C : $T = \ln(x)$.

Good luck, Movahed