

In the name of God

Department of Physics
Shahid Beheshti University

ADVANCED TOPICS IN STATISTICAL PHYSICS II

Exercise Set 2

(Date Due: 1394/01/20)

1. Compute the auto-correlation function and cross-correlation of data that you have from data set II as a function of τ . determine the statistical error of correlation function.
2. Calculate the relation between Cumulant and Moment using characteristic function.
3. Using the perturbative theory, calculate the average of arbitrary quantity up to σ_0^3 .
4. Calculate JPDF, $p(x(t); x(t + \tau))$, for $\tau = 0, \tau = 1$ and $\tau = 10$. Plot $\Delta(\tau_n) = \sum_{x_1, x_2} |p(x_1(t); x_2(t + \tau_n)) - p(x(t))p(x(t + \tau_n))|$ as a function of τ_n . Do for three kinds of data given in date set II.
5. Compute Markov time scale for data given in date set II.
6. Base on Two-Point correlation function (based on three methods taught in the class), calculate two-point correlation of a 1D data set available in date set II for 0, $+2\sigma$ and -2σ features.
7. Prove that for stationary series, the real part of power spectrum contains all information for data and It is not necessary to take into account the imaginary part of power spectrum.
8. Generate Gaussian data set with given correlation function (e.g. the shape of correlation function follows a scale invariant behavior ($C \sim \tau^{-\gamma}$)) and show that your generated data is Gaussian and has got mentioned correlation function.
9. Generate Non-Gaussian data set with desired correlation function. As an example suppose that the shape of correlation function follows a scale invariant behavior ($C \sim \tau^{-\gamma}$) and show that your generated data is Non-Gaussian and has got mentioned correlation function.
10. Calculate $\langle \delta_D(\alpha - \nu) \rangle_{NG}$ for 1D stochastic field up to $\mathcal{O}(\sigma_0^3)$.

Good luck, Movahed
