In the name of God

# Department of Physics
# Shahid Beheshti University

## STOCHASTIC PROCESSES

### Exercise Set 1

### (Date Due: 1396/12/06)

**1.** Error analysis and propagation: Using the input file, write a proper program file to do following tasks:

**A** : Read input data file which contains more than $10^6$ one-column data. and spilt it to 100 input files.
**B** : Making directories and send each data sets to corresponding directory.
**C** : Compute mean, variance and mean standard deviation of each data sets. And write them in a file which contains the label of data, mean, standard deviation and mean standard deviation. Finally plot them.
**D** : Compute $p_i(x)$ as a function of $x$ for each sets. To this end, use $W(x, q)$ for $q = 0$ and $q = 1$.
**D** : Smooth the computed $p_i(x)$ in the previous question with a Gaussian kernel with a typical variance and finally plot them.
**E** : Compute $\sigma_m(p(x))$. Plot $p(x)$ versus $x$ and show its error-bar for 5 sets of data.

**2.** Convolution theorem: For a kernel estimation it is useful to use $F(x) = \mathcal{K} \bigotimes f = \int \mathcal{K}(x - x')f(x')dx'$. Write convolution in the Fourier space and explain the motivation behind such transformation.

**3.** Different Probability density functions:

**A** : For A binomial distribution, compute $\langle k \rangle$, $\langle (k - \langle k \rangle)^2 \rangle$, $\langle (k - \langle k \rangle)^3 \rangle$ and show $P(k)$ for binomial is normalized.
**B** : For A Poisson distribution, compute $\langle k \rangle$, $\langle (k - \langle k \rangle)^2 \rangle$, $\langle (k - \langle k \rangle)^3 \rangle$ and show $P(k)$ for binomial is normalized. Also show:

$$P_{poisson}(k) = \lim_{N \to \infty} P_{binomial}(k)$$

**C** : Show $P_{Gaussian}(k) = \lim_{\lambda \to \infty} P_{poisson}(k)$

Good luck, Movahed