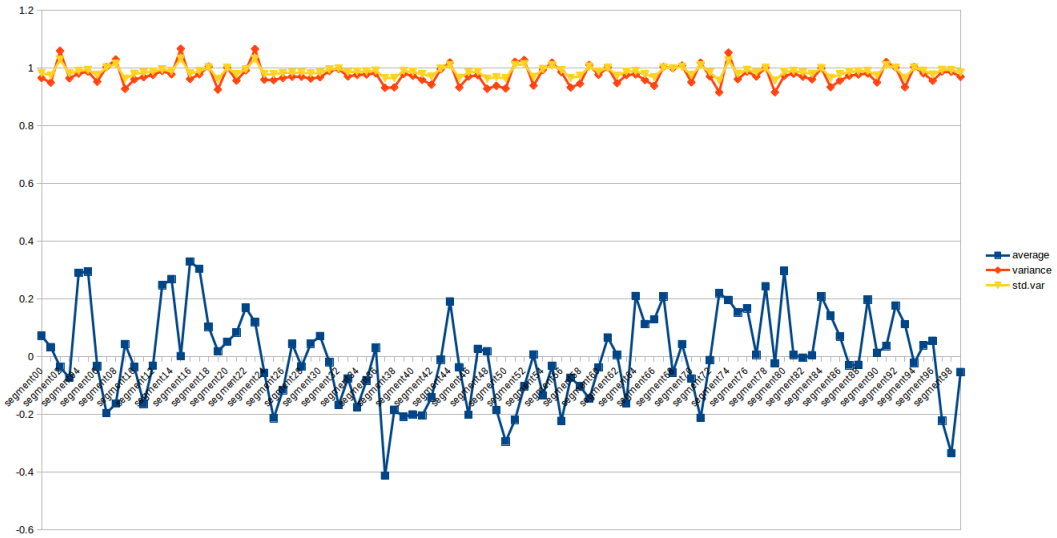
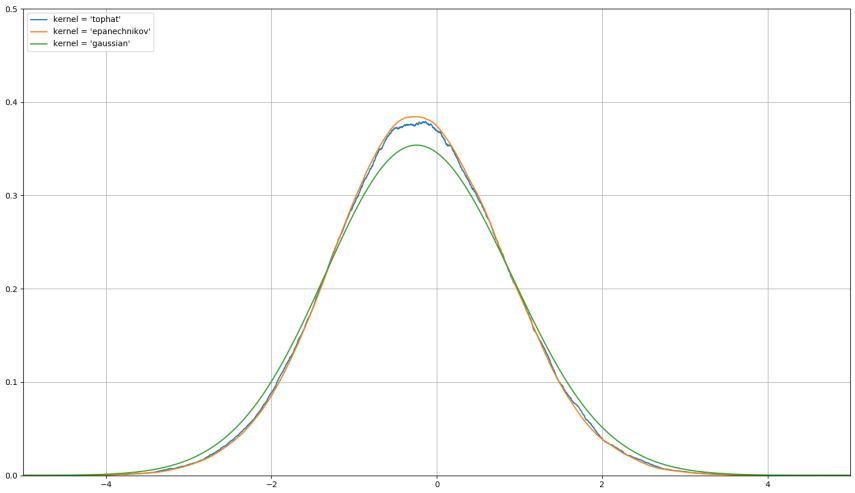
Produced by **A. Kargaran** and **M. Bagheri** under supervision of **Dr. Movahed**

Answer to Exercise set 1

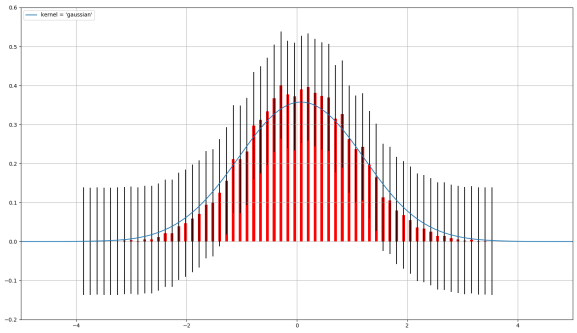
1.**Part A and B**: You can use bash script or any thing else to compute PDF with different kernels.
2. **Part C**: your result should be somethig like figure below:



Part D and D: Smooth out data with different kernels (for one splited data) we have something like this:



Part E: Copute error bar and plot it, we can get:



2. F(k) is Fuorier transform of F(x) so:

$$F(k) = \int_{-\infty}^{\infty} F(x) e^{ikx} dx$$

using kernel we have:

$$F(x) = \int_{-\infty}^{\infty} \mathcal{K}(x - x') f(x') dx'$$

put F(x) in F(k) and change variable of integral:

$$\begin{aligned} F(k) &= \int_{-\infty}^{\infty} f(x') e^{ikx'} dx' \int_{-\infty}^{\infty} \mathcal{K}(u) e^{iku} du \\ &= f(k)\mathcal{K}(k) \end{aligned}$$

Fast Fuorier transform steps of calculation is $N \log N$ and this is not expensive calculation to transform to Fuorier space and numerically solve problem and transform back to real space.

3.**Part A**: For Binomial distribution [1]:

$$\begin{aligned} \langle k \rangle &= Np \\ \langle (k - \langle k \rangle)^2 \rangle &= Npq \\ \langle (k - \langle k \rangle)^3 \rangle &= Npq(1 - 2p) \end{aligned}$$

Part B: For Possion distribution:

$$\begin{aligned} \langle k \rangle &= \lambda \\ \langle (k - \langle k \rangle)^2 \rangle &= \lambda \\ \langle (k - \langle k \rangle)^3 \rangle &= \lambda \end{aligned}$$

For limit proof check this website [2].

Part C: Read this PDF.[3].

[1] `http://mathworld.wolfram.com/BinomialDistribution.html`
[2] `https://en.wikipedia.org/wiki/Poisson_limit_theorem`
[3] `http://webdev.physics.harvard.edu/academics/undergrad/probweek/sol84.pdf`