

## EP 4130/PH 6130 Assignment 1

Deadline **16 January 2023 before 23:59 hrs**

All problems (Except the last) have equal weightage of 10 points each. The last problem has 20 points. Please show the source code used for each of the problems.

1. Create 1000 draws from a normal distribution of mean of 1.5 and standard deviation of 0.5. Plot the pdf. Calculate the sample mean, variance, skewness, kurtosis as well as standard deviation using MAD and  $\sigma_G$  of these samples.
2. Plot a Cauchy distribution with  $\mu=0$  and  $\gamma=1.5$  superposed on the top of a Gaussian distribution with  $\mu=0$  and  $\sigma=1.5$ . Use two different line styles to distinguish between the Gaussian and Cauchy distribution on the plot and also indicate these in the legends.
3. Plot Poisson distribution with mean of 5, superposed on top of a Gaussian distribution with mean of 5 and standard deviation of square root of 5. Use two different line styles for the two distributions and make sure the plot contains legends for both of them.
4. The following were the measurements of mean lifetime of K meson (as of 1990) (in units of  $10^{-10}$  s) :  
 $0.8920 \pm 0.00044$ ;  $0.881 \pm 0.009$ ;  $0.8913 \pm 0.00032$ ;  $0.9837 \pm 0.00048$ ;  $0.8958 \pm 0.00045$ . Calculate the weighted mean lifetime and uncertainty of the mean.
5. Download the eccentricity distribution of exoplanets from the exoplanet catalog <http://exoplanet.eu/catalog/>. Look for the column titled  $e$ , which denotes the eccentricity. Draw the histogram of this distribution. Then redraw the same histogram after Gaussianizing the distribution using Box-transformation either using `scipy.stats.boxcox` or from first principles using the equations shown in class or in arXiv:1508.00931. Note that exoplanets without eccentricity data can be ignored.