# EP 4130/PH 6130 Assignment 4

Deadline **19** February 2024 before **23:59 hrs**
Please show source code for all the problems (except the third)

1. Download the data corresponding to $x$, $y$, and $\sigma_y$ from `http://www.iith.ac.in/~shantanud/testdata.dat`. Find the best-fit values after fitting the data to linear, quadratic, and cubic polynomials. Find out which model fits the data best from frequentist model comparison as well as using AIC and BIC. For frequentist model comparison, using the linear model as the null hypothesis, find out the $p$ value corresponding to the preferred model. (or if the linear model is the prefered model, then compare it to the quadratic model). Also show a plot overlaying the data with best fit solutions from linear, quadratic and cubic functions with different line styles for each of the fits. [30 pts]

2. For the model comparison problem shown in class on JVDP's blog, calculate AIC and BIC for the linear and quadratic models. Do these results agree with the frequentist model comparison results shown on the blog? Also mention the qualitative significance using strengt of evidence rules. [10 pts]

3. Find out one paper in research literature which uses the Kolmogorov-Smirnov test and explain briefly how it was used in that paper. Is K-S test used incorrectly (in this paper) as per the warnings on the Penn State website discussed in class? [10 pts]
(Hint : Use google scholar or enter "Kolmogorov-Smirnov" or "K-S" test in the abstract tab in the astro-ph or hep-ex section of arXiv. Also indicate the paper reference.)

4. - Calculate the significance in terms of no of sigmas of the Higgs boson discovery claim from the $p$ value given in the abstract of the ATLAS discovery paper, arXiv:1207.7214.
   - Do the same for the LIGO discovery of GW150914, for which the $p$ value $= 2 \times 10^{-7}$. (Hint : look up `norm.isf`)
   - From the Super-K discovery paper for neutrino oscillations (hep-ex/9807003), calculate the $\chi^2$ GOF using the best-fit $\nu_\mu \leftrightarrow \nu_\tau$ oscillation solution. (Hint : check page 4 of the paper, second column, last paragraph) [10 pts]