

## EP 4130/PH 6130 Assignment 3

Deadline **5 February 2024** before **23:59 hrs**

First two problems have equal weightage of 25 points each. Last problem has a weightage of 10 points. Please show the source code used for each of the problems.

1. In class, we showed histograms of standard deviation and  $\sigma_G$  of bootstrap samples drawn from a Gaussian distribution with mean equal to 0 and standard deviation equal to 1. Draw a similar histogram of median of 10,000 bootstrap samples drawn from the same Gaussian distribution. According to <http://tinyurl.com/h6p43o8>, the standard deviation of the sample median of a Gaussian distribution is equal to  $\sqrt{\frac{\pi}{2n}}$ . Overlay a Gaussian distribution on top of the histogram with mean equal to the mean of the generated data sample and standard deviation equal to the standard deviation of the median (Hint: Look up `astroML.stats.median_sigmaG`. Also note that you don't have to draw 10,000 histograms, but only one histogram consisting of 10,000 bootstrap resamples.)
2. arXiv:1008.4686, Exercise 1 on Page 5, except the last sentence of the question related to  $\sigma_m^2$ . (Hint : Use  $\chi^2$  minimization to obtain best-fit values of  $b$  and  $m$ , instead of linear algebra. You can look up `curve_fit` function in `scipy`.)
3. Calculate the  $p$ -value for the four chi-square values for the plot shown in class from `astroML` book which can be found at [https://www.astroml.org/book\\_figures\\_1ed/chapter4/fig\\_chi2\\_eval.html](https://www.astroml.org/book_figures_1ed/chapter4/fig_chi2_eval.html). (Hint : You can read off the  $\chi^2$  values from the graph by multiplying by D.O.F.)