Homework 3

1) Given a dataframe, df, with columns df['x'] and df['y'], how could you isolate the data points with only positive values of x and values of y less than 100?

2) Perform a χ^2 linear fit (y = ax + b) on the data provided in HW3lineardata.xlsx (Note the experimental error of each measurement of y, σ_{y_i} , is given in the column 'sig').

   a) Determine the best fit values of a and b along with the uncertainties in the fitted values, σ_a and σ_b.

   b) Plot your fit along with the original data points (with error bars indicating σ_{y_i} for each point).

3) The data in the attached file, "lin2.xlsx", exhibits linear behavior for small values of x, nonlinear behavior for x ~ 100, and further linear behavior for larger values of x. Fit the two linear regions of the data separately and plot the data points along with the two fit lines.

4) In the Debye model, the specific heat (in $\frac{J}{K*mol}$) of a material at low temperature is given by

$$C_V = 322.77\left(\frac{T}{T_D}\right)^3,$$

where T_D is the Debye temperature of the material. Measurements from a specific heat experiment of silicon are given in the included data file, "DebyeDat.txt". Fit the given data to this model to determine T_D and graph the best fit line with the data included.

5) Write a python code to generate a set of uniformly distributed random points $\{x_i, y_i\}$ where x and y are both in the range from $[-1,1]$. Using approximately 10^6 points, approximate π by determining the ratio of points which fall within the circle to the total number of points.