Nonparametric statistics: Course work

1. For a group of 12 female students, the changes in heart rate (beats per minute) when standing up from lying down are: 2, 4, 8, 25, 5, 16, 3, 1, 12, 17, 20, 9. Test whether the median change in heart rate is 15 or not. Perform sign as well as Wilcoxon signed-rank test. State all the assumptions.

2. The distances from one end at which each of 20 threads 6 cm long break when subjected to strain are given below. Evaluate and plot the emipirical distribution function. For convenience the distances are given in ascending order. 0.6, 0.8, 1.1, 1.2, 1.4, 1.7, 1.8, 1.9, 2.2, 2.4, 2.5, 2.9, 3.1, 3.4, 3.4, 3.9, 4.4, 4.9, 5.2, 5.9.

   Compare the distirbution of breaking points with
   (i) uniformly distribution over $(0, 6)$
   (ii) the distribution with cumulative distribution function over $(0, 6)$ given by

   $$F(x) = x/5, 0 < x = 3; F(x) = 0.2 + 4x/30, 3 < x = 6.$$

3. A random sample of American colleges and universities resulted in the following numbers of students and faculty in spring 1973.

Students	Faculty	Students	Faculty
2546	129	1189	90
1355	75	2755	240
1019	87	5602	300
1858	99	2697	170
4500	300	988	73
1141	109	3164	190
784	77	753	61
1063	64	267	40

   a) Draw a scatter plot using faculty as the x-axis.
   b) Estimate the regression line using least squares methods assuming intercept to be zero.
   c) Plot the fitted line of regression on the plot in a).
   d) Test the hypothesis that the true slope is 15.
   e) Find a confidence interval for the slope. Is it connected to Kendall's τ? If yes, then explain.