

1. Tensile strength tests were carried out on two different grades of wire and the resulting summary statistics are:

Grade 1:  $m = 129$ ;  $\bar{x} = 107.6$ ;  $s_1 = 1.3$

Grade 2:  $n = 129$ ;  $\bar{y} = 123.6$ ;  $s_2 = 2.0$

- (a) Does the data provide compelling evidence that the mean strength of Grade 2 wires exceed the mean strength of Grade 1 wires by 10 units? Test the appropriate hypothesis at a significance level  $\alpha = 0.01$
  - (b) Estimate the difference between true average strengths for the two grades in a way that provides information about precision and reliability, i.e.; provide a confidence interval for the true mean difference (you can choose  $\alpha$  to be equal to 0.05 for this part)
  - (c) If it is known that the population variances are  $\sigma_1^2 = 1.5$  and  $\sigma_2^2 = 4$ , assuming normality and equal sample size  $m = n$ , find the sample size required to have an 80% power for an alternative value of true mean difference equal to 12 units for the test in part (a).
  - (d) If instead of sample sizes given in part (a), the sample sizes are  $m = 14$  and  $n = 22$  respectively, with the same values of sample mean and sample standard deviations in part(a), what will be the appropriate test in part (a) if you know that the population is normal and both Grade1 and Grade2 have the same population variance for tensile strength.
  - (e) Assuming the set up for part (d), provide a 90% CI for the true mean difference of the strength of the two grades.
  - (f) Assuming the set up for part (d) conduct a test for the hypothesis that the two population variances are equal against the alternative that grade 2 population has higher variability when the significance level is 0.1.
  - (g) Suppose in part (a) the proportions of strength values exceeding 100 units are 0.67 and 0.82, respectively for the two samples, test the hypothesis that the percentage of strength exceeding 100 units are same for the two populations against the alternative that the percentage is higher for Grade2.
  - (h) In the previous part, provide a 99% CI lower CI for the difference in the percentage of strength values exceeding 100 units for Grade2 and Grade1.
2. The level of a particular air toxin was measured both outdoor and indoor for a sample of different localities. Suppose the mean difference in the measurements over 14 localities is 0.14 units with a standard deviation of the difference between outdoor/indoor measurements for the 14 readings equal to 0.046 units. Test the hypothesis that the toxin level is same outdoor and indoor versus the alternative that it is higher outdoors. Assume normality and level of significance equal to 0.01.