

Tutorial 3

1. The following differences between pulse rates before and one minute after exercise are recorded for 8 subjects:

Difference: 1 0 -1 4 1 2 -1 5

- (a) Find a 95% two-sided confidence interval for the increase. (Note that you have to state the assumptions made.)
- (b) Based on the interval, should we reject the claim that there is no evidence to indicate an increase in pulse rates at the level $\alpha = 0.05$?
2. Determine the sample size necessary to test the hypothesis that the probability of contracting a particular disease is 0.1 against the alternative that it is greater than 0.1 if the test has significance level $\alpha = 0.05$ and the test must reject the null hypothesis with probability at least 0.95 when the true proportion is actually 0.13.
3. Use the Neyman-Pearson lemma to derive the most powerful test for testing that the probability of success, p in an independent sequence of Bernoulli trials is p_0 against the alternative that it is $p_1 (> p_0)$ based on a sample of size n . Is the test uniformly most powerful for testing $H_0 : p = p_0$ vs. $H_1 : p > p_0$?
4. The research department of a company that produces industrial string proposes a new technique for strengthening the string and making it able to withstand stronger forces. To find out whether the new technique really does strengthen the string, five lengths of string are produced by the standard techniques and five by the new technique and samples are compared for their respective breaking points, in pounds of force. The breaking points are as follows:

Standard technique	144	131	155	126	134
New technique	139	154	132	143	147

- (a) Test the hypothesis that the two populations have the same variance.
- (b) Do the data support the contention of the research department that the new technique produces stronger string? Use the two-sample t -test.

(State formally the hypothesis to be tested and the assumptions required.)

Computer Exercise

1. The datasets `ratcon` and `ratoz` are weight gains for two groups of rats kept in an ozone free environment and in an environment containing ozone.
 - (a) Obtain side-by-side boxplots of the two samples, and a normal qq-plot of the combined residuals from the sample means.
 - (b) Comment on your plots in (a) (symmetry, equality of variance, approximate normality, etc) and explain if a t -test is appropriate to test for ozone effect.
 - (c) Use `t.test` to obtain a t -test and a 95% confidence interval assuming equal variances and without assuming equal variances. Comment on their similarity.
 - (d) Perform the steps of the Wilcoxon rank-sum test “manually” to test for ozone effect.
 - (e) Use `wilcox.test` to confirm your findings in (d).
 - (f) Comment on the p -values obtained by using `t.test` and `wilcox.test`.