Key-points for HW2

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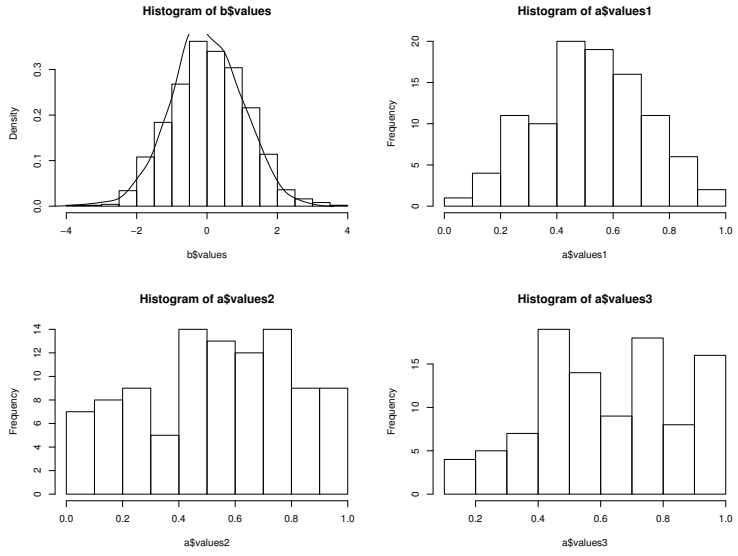
1 Permutation distribution

As shown in Figure 1, permutation ditribution using Satterthwaite;s approximation follows approximately a t ditribution.The proportion of test statistics greater than original test has a fairly uniform distribution using the t-test with the Satterthwaite's approximation. The Wilcoxon test give a left skewed distribution, which indicates that the Rank Test tends not to reject the null hypothesis.The standard t-test shows a far less uniform one. As expected from our experiment design, any test statistic after the permutation should be equally likely. So the t-test with the approximation tends to show it, and the t-test assuming equal variance does worst.

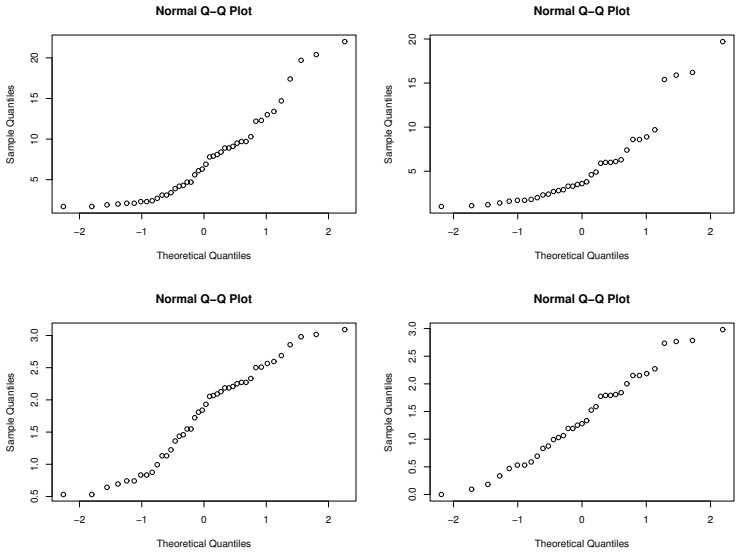


2 Teaching Stereograms

1. As is shown in Figure 2, log transformations seems an appropriate one to make the data normally distributed. The results (as following)from Welch t-test and the Wilcoxon test agree with each other and suggest that the response times from the group that have both

audio and visual input are lower than those just have verbal input.

Test	Statistic	p-value
Welch-t	2.11	0.03842
Wilcoxon	938	0.03826



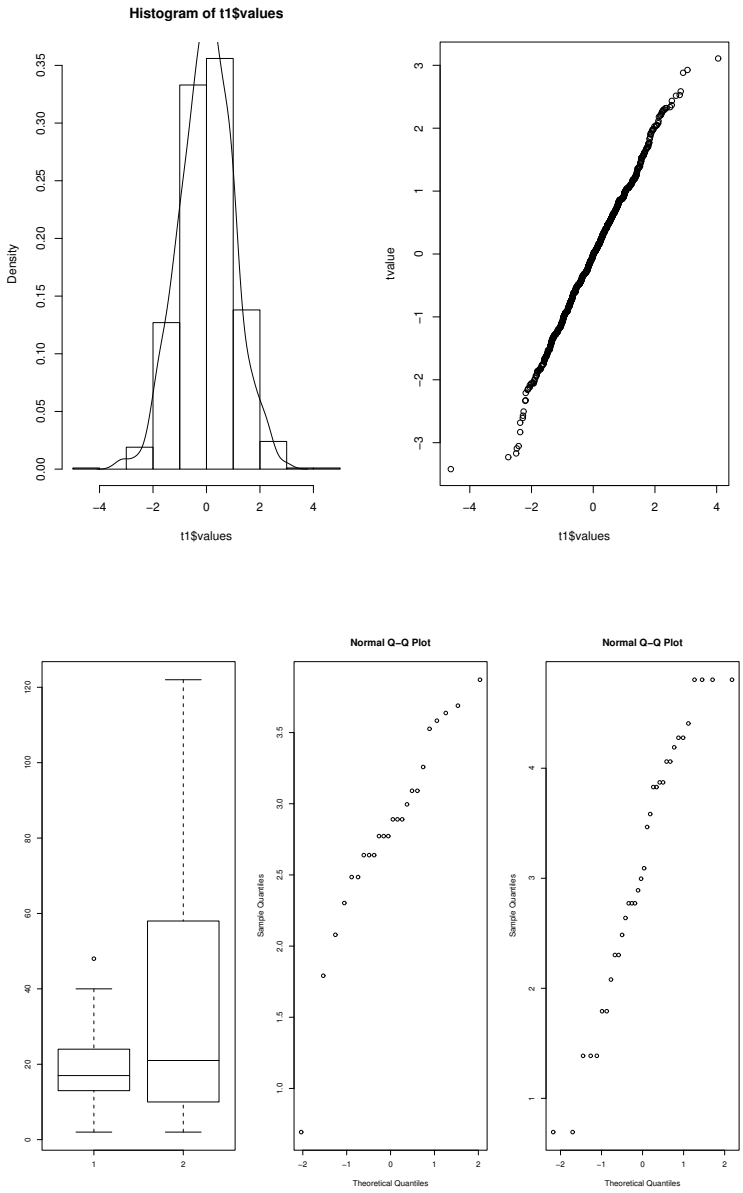
2. We do a permutation test and get a p-vaule of 0.021, which again, reject the null hypothesis in 95 percent confidence level. As we can see in Figure 3, the permutation distribution and the approximate t distribution using the Satterthwaite approximation agree quite well.

3 Survival time for Breast Cancer Patients

1. As shown in Figure 4, the mean of the treatment group is increased by 40.41-19.58=20.83, but the standard deviation is 38.38026, which is also large.
   Since survival time cannot be negative, we will assume it is ditributed as log-normal, which seems appropriate from the QQ plot

2. The test results are shown as following. Neither the t-test using Satterthwaite approximation nor the Rank test (one-tailed) can reject the null hypothesis. Also, do a permutation test, we find 99.1 percent of test statistics after permutation are greater than the original statistic, which again, suggest the null hypothesis is true.

$Test$	$Statistic$	$p-value$
$Welch-t$	-1.1209	0.1337
$Wilcoxon$	337	0.1325



3. However, we will worry about the 3 censored values. What's more, the t-test still depends on the normal assumption, which does not hold strongly in our data. So the Rank test come to be a properer test procedure, since the rank does not change whatever the 3 true survival time is. So that we do not lose any information. For advanced students, a survival analysis can be conducted .