Key-points for HW3

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1 Prison Data

1.1 Were the treatments effective?

$$H_0 : \mu_i \leq 0 \quad \text{vs.} \quad H_a : \mu_i > 0, i = 1, 2, 3$$

1. Assume normality,perform a t-test:

$treatment$	gp	$p-value$	$mean$	$95\%CI$	
1		0.04059	6.214286	0.3932839	Inf
2		0.1006	2.857143	-0.901212	Inf
3		0.908	-3.214286	-7.269576	Inf

   The Bonferroni Adjustment: 0.05/3=0.01666667. Since all the p-values are greater than 0.02, we can not say the treatments are effective overall. However, we are intereted in the individual treatments. For treatment 1, we can barely believe it is effective in the 95% confidence leve.

2. Nonparametric,do a Wilcoxon signed rank test. We get p-values of 0.04102,0.05334,0.8368 for each treatment group. Again, there is no evidence for effectiveness. we get same conclusion as the parametric way.

1.2 Do the treatments differ in effectiveness?

$$H_0 : \mu_1 = \mu_2 = \mu_3 \quad \text{vs.} \quad H_a : otherwise$$

1. Assume normality,perform a one-way ANOVA test. p-value is 0.04607. So there is light evidence for the differnces in the treatments. But we need to be careful since we did not check the assumptions ahead.

2. Nonparametric,do a Kruskal-Wallis Rank Sum Test: p-value = 0.09429, which support the null hypothesis.

1.3 Is treatment 1 the best?

$$H_0 : \mu_1 \leq \mu_2, \mu_1 \leq \mu_3 \quad vs. \quad H_a : otherwise$$

1. Assume normality,perform a t- test:

$Test \quad gp$	$p-value$	mean of μ_1	mean of $\mu_2(\mu_3)$	$95\%CI$	
$\mu_1 \leq \mu_2$	0.2	6.214286	2.857143	-3.358175	Inf
$\mu_1 \leq \mu_2$	0.01371	6.214286	-3.214286	2.565478	Inf

   Bonferroni adjustment is 0.025. So we can say treatment 1 is better than treatment 3, but cannot decide which is more effective between 1 and 2.

2. Nonparametric,do a Wilcoxon sum of rank test. We get p-values of 0.3996 and 0.06064. According to this, we cannot reject the null hypothesis. That is, treatment 1 is neither better than 2 nor than 3.

1.4 Assumptions and Conclusions:

The parametric and nonparametric methods do give different results. As is shown in our previous EDA in HW1, the normal and equal variances assumptions does not hold well. So we shall not rely on the methods,like t-test and one-way anova that need those assumptions.

2 Competition among Species for nesting sites

2.1 EDA

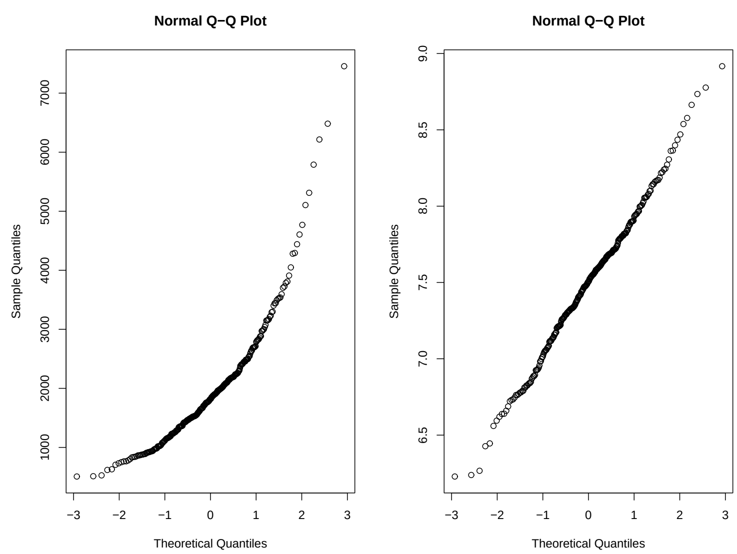

Figure 1: QQ plot of the Sizes

As shown in fig 1, we find the log transformation appropriate. As the normality assumption holds, we would like to choose the parametric methods to do our hypothesis test since the nonparametric is less likely to pick up the difference when it exits.

As shown in fig 2, we can see there is difference among the species, also , there is similarity among certain species.

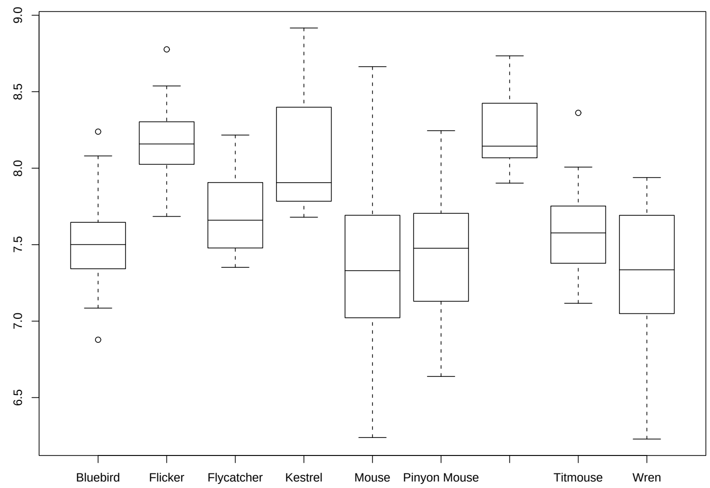

Figure 2: Boxplot by species

2.2 Are the species competing for the same size cavities?

$$H_0 : \text{all the medians of different species are the same} \quad \text{vs.} \quad H_a : otherwise$$

In the normal case, the confidence interval for mean is actually the same as for median. We do a one-way anova on the transformated data, get a p-value of 6.558e-14,which is really small. So we can conclude that there is differences in the cavity sizes selected by animals of different species.

2.3 Are there differences between rodents and birds?

Perform a Welch Two Sample t-test, p-value = 8.248e-07, the CI is (-0.3669187, -0.1609692), so we have 95% confidence that the original median ratio is in (0.6928660, 0.8513183),which does not contain 1. We reject the null hypothesis, that is to say, there are differences between rodents and birds. Similar analysis(in the following) shows that the two rodents might compete with other 2 small birds, but not with the large 3 birds. So it appears that the size of the animal compete for similar cavity size instead of the species.

2.4 Which species have similar nesting requirements

As shown in Figure 3, many confidence intervals overlapes at 0 0. We can roughly say that Flicker,Kestrel,Screech Owl ;Flycatcher,Titmouse; Bluebird, Wren,Mouse,Pinyon Mouse are three groups that compete for similar cavity sizes.

We do one-way anova seperately on those three groups, and get p-values 0.2195,0.3621,0.7384, ,respectively. But if we do one-way anova on the three groups , we can find significant differens($p < 2.2e-16$). As is shown in fig4, none of the CI contains 0.

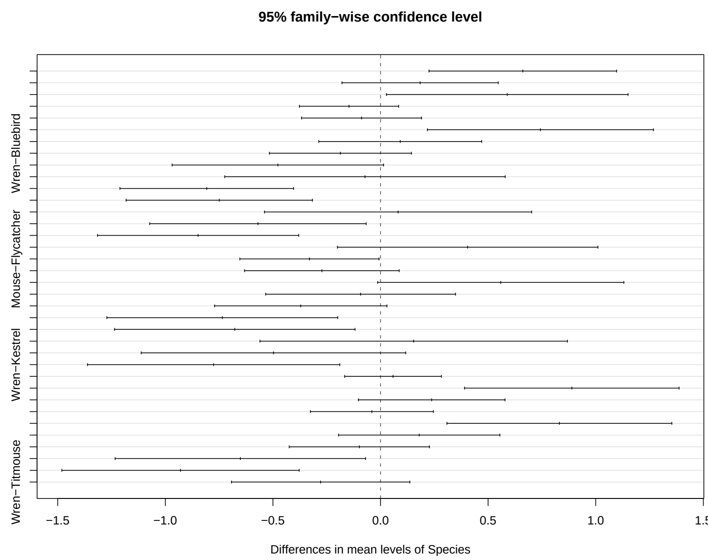

Figure 3: Difference in means(medians) among the species

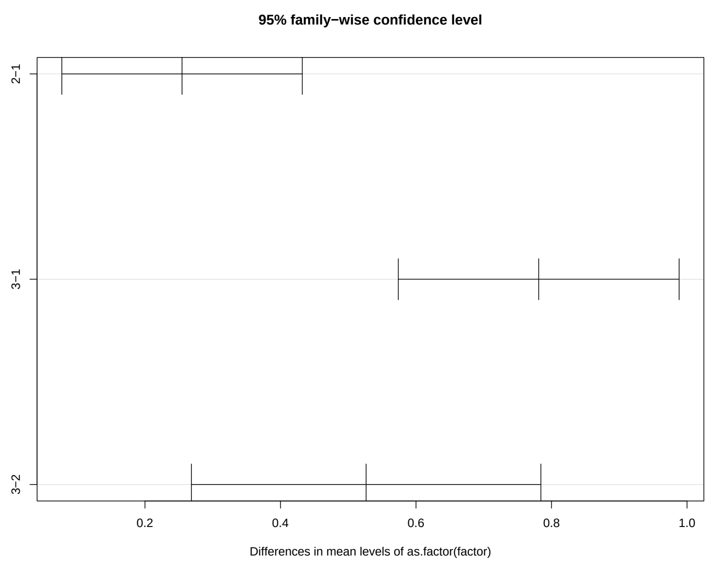

Figure 4: Difference in means(medians) among the 3 groups

3 NOTE

A written summary should only include a brief description of your analysis. Say something about the real problem. For example, what kind of treatment will you recommend based on the prison data. All other necessary materials should be included in the Appendix so that I can know how you do the problem.