Lab 14 Answers

1

$n = 793$

a)

	Reinforced Burrow	Non-Reinforced Burrow	Total
Injured	17	218	235
Not Injured	130	428	558
Total	147	646	793

b) $OR = \frac{17(428)}{218(130)} \approx 0.257$

The odds of a groundhog experiencing an injury given they had a reinforced burrow is 0.257 times the odds of a groundhog experiencing an injury given they did not have a reinforced burrow. This OR makes it seem as if there is a benefit to using a reinforced burrow since it is less than 1. BUT! a CI should be constructed to understand the possible range of the benefit.

c) Formula: $\log(OR) \pm 1.96\sqrt{\frac{1}{a}+\frac{1}{b}+\frac{1}{c}+\frac{1}{d}}$ $\quad\sqrt{\frac{1}{a}+\frac{1}{b}+\frac{1}{c}+\frac{1}{d}} = \sqrt{\frac{1}{17}+\frac{1}{218}+\frac{1}{130}+\frac{1}{428}} = 0.270997$

CI for $\log(OR) = \log(0.257) \pm 1.96(0.270997)$

$= (^{-}1.8898, {}^{-}0.8275)$

CI for $OR = (\exp\{^{-}1.8898\}, \exp\{^{-}0.8275\})$

$= (0.151, 0.437)$

Since this CI is entirely below 1, there is evidence that reinforced burrows help prevent injuries.

d) $E_1 = \frac{235(147)}{793}$ $\quad E_2 = \frac{235(646)}{793}$ $\quad E_3 = \frac{558(147)}{793}$ $\quad E_4 = \frac{558(646)}{793}$

$= 43.5624$ $\quad = 191.4376$ $\quad = 103.4376$ $\quad = 454.5624$

e) Ho: There is an association between burrow type and injury vs

Ha: There is no association between burrow type and injury

$$\chi^2_1 = \sum_{i=1}^{4} \frac{(O_i - E_i)^2}{E_i} = \frac{(17-43.5624)^2}{43.5624} + \frac{(218-191.4376)^2}{191.4376} + \frac{(130-103.4376)^2}{103.4376} + \frac{(428-454.5624)^2}{454.5624}$$

≈ 27.6 with $df = 1$

Approximate p-value : 27.6 $\Rightarrow$ area to the left $\gg$ 0.959

We want area to the right so our p-value $\ll 1-0.959 \Rightarrow$ our p-value $\ll 0.041$

Conclusion: The χ^2_1 test provides evidence of an association between burrow type and injuries for groundhogs.

2

a) If the data are normally distributed a t-test would be the most appropriate. The standard deviations and sample sizes should be considered when determining the type of t-test to perform.

b) Let μ_W = average fire efficiency for Western dragons and

μ_E = average fire efficiency for Eastern dragons

Hypotheses: $H_0: \mu_W = \mu_E$ vs $H_a: \mu_W \neq \mu_E$

Test Statistic: $t = \frac{\bar{X}_W - \bar{X}_E}{SE}$ where $SE = 6.343\sqrt{\frac{1}{249}+\frac{1}{79}} = 0.8191$

$= \frac{20.145 - 30.481}{0.8191}$

$= {}^{-}12.6187$ with $df = 249+79-2 = 326$

Approximate p-value: Regardless of if we choose to use df=200 or df=400, a test statistic of $|{}^{-}12.621| \Rightarrow$ a p-value < 0.0001.

Conclusion: There is evidence of a difference in average fire efficiency between Western and Eastern dragons. Since $\bar{X}_W < \bar{X}_E$, there is evidence that Eastern dragons have higher average fire efficiency.

c) Outliers affect means and standard deviations which makes t-tests sensitive to outliers. If the data is not normally distributed (has outliers) a Wilcoxon rank-sum test should be considered. A log transformation could also be considered.