

STATS 205: Homework Assignment 5

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Solution to Problem 1

We say that two observations X_1 and X_2 are *independent* of one another with respect to a collection of events \mathcal{A} if

$$Pr \{X_1 \in A \text{ and } X_2 \in B\} = Pr \{X_1 \in A\} Pr \{X_2 \in B\}$$

where A and B are any two not necessarily distinct sets of outcomes belonging to \mathcal{A}^3 .

- 2.2.1 Independent Observations; Permutation, Parametric, and Bootstrap Tests of Hypotheses; Good, Phillip I

In deciding whether your own observations are exchangeable and a permutation test applicable, the key question is the one we posed in the very first chapter: Under the null hypothesis of no differences among the various experimental or survey groups, can we exchange the labels on the observations without significantly affecting the results?

- 2.2.2 Exchangeable Observations; Permutation, Parametric, and Bootstrap Tests of Hypotheses; Good, Phillip I

Solution to Problem 2

```
cysticerici <- c(28.9, 32.8, 12.0, 9.9, 15.0, 38.0, 12.5, 36.5, 8.6, 26.8);cysticerici
## [1] 28.9 32.8 12.0 9.9 15.0 38.0 12.5 36.5 8.6 26.8
worms_reco <- c(1.0, 7.7, 7.3, 7.9, 1.1, 3.5, 18.9, 33.9, 28.6, 25.0); worms_reco
## [1] 1.0 7.7 7.3 7.9 1.1 3.5 18.9 33.9 28.6 25.0
length(cysticerici)
## [1] 10
length(worms_reco)
## [1] 10
```

The null hypothesis is that the mean weight of introduced cysticerici *has no correlation with* the mean weight of worms recovered. That is,

$$H_0 : \tau = 0$$

The alternative hypothesis is that the mean weight of introduced cysticerici is *positively correlated with* the mean weight of worms recovered. That is,

$$H_A : \tau > 0$$

To test the null hypothesis against the alternative hypothesis, we will use the Kendall test, a distribution-free test for independence based on signs.

```
cor.test(x = cysticerci, y = worms_reco, method = "kendall", alt = "greater")
```

```
##
## Kendall's rank correlation tau
##
## data:  cysticerci and worms_reco
## T = 19, p-value = 0.7578
## alternative hypothesis: true tau is greater than 0
## sample estimates:
##      tau
## -0.1555556
```

The p -value is 0.000386, which is significant at the $\alpha = 0.05$ level. There is strong evidence that allergic smokers have higher sputum histamine levels than nonallergic smokers.