

assignment_2

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Question: In an experiment, the following survival times (in minutes) of the peroneal nerves of four cats and ten rabbits were recorded under a certain condition.

$$c = (25, 33, 43, 45)$$

$$r = (15, 16, 16, 17, 20, 23, 28, 28, 35, 35)$$

We want to do a permutation test based on sample means at $\alpha = 0.05$, to investigate whether these samples are from the same distribution, and use $\sum_{i=1}^4 c_i$ as the test statistic.

- (a) Define your null and alternative hypotheses.

We have C, R random variable, with samples c, r defined above.

Suppose that $C \sim F(\lambda_1)$ and $R \sim F(\lambda_2)$, where λ_1, λ_2 are parameters and F distribution.

$$H_0 : \lambda_1 = \lambda_2$$

$$H_1 : \lambda_1 \neq \lambda_2$$

We will perform a permutation test to assess this hypothesis. We can do that since:

- (b) Why can we use $\sum_{i=1}^4 c_i$ as the test statistic instead of $d = \bar{c} - \bar{r}$?

We can use the $\sum_{i=1}^4 c_i$ as the test statistic instead of $d = \bar{c} - \bar{r}$, because in our case these two are exactly equivalent. Since we are performing a *permutation test*, whether we measure how many times in each permutation the $\sum_{i=1}^4 c_i$ is bigger than our given $\sum_{i=1}^4 c_i$, or how many times d is bigger than our observed d is the same thing.

- (c) Find the p-value and state clearly what you can conclude from the result of your test.

These are the permutations for which, the $\sum_{i=1}^4 c_i$ is bigger or equal than the given sample.

Obs	x_1	x_2	x_3	x_4	TOTAL
Obs	25	33	43	45	146
1	25	43	45	35	148
2	25	43	45	35	148
3	33	43	45	28	149
4	33	43	45	28	149
5	33	43	45	35	156
6	33	43	45	35	156
7	33	43	35	35	146
8	33	45	35	35	148
9	43	45	23	35	146
10	43	45	23	35	146
11	43	45	28	35	151
12	43	45	28	35	151
13	43	45	28	35	151
14	43	45	28	35	151
15	43	45	35	35	158

test thodoris! voisheia!!

- (d) Define the test hypotheses.

- (e) Find the observed value of the test statistic U (without using R).

- (f) Use R to find the (approximate) p-value and compare the result with that of part (c) for $\alpha = 0.05$.

```

# helper
m1 = 'The 2-sided p-value is:'
reject_message = '\nTherefore we reject the Null Hypothesis'
accept_message = '\nTherefore we do not have evidence to reject the Null Hypothesis'

# data
c = c(25,33,43,45)
r = c(15,16,16,17,20,23,28,28,35,35)
c_len = length(c)

alpha = 0.05
d = mean(c) - mean(r)
z = c(c,r)
z_len = length(z)
ds = NULL
P = combn(z_len, c_len)

# calculate combinations
for (b in 1:ncol(P)){
  s = P[,b]
  c_s = s
  r_s = (1:z_len)[-s]
  ds = c(ds, mean(z[r_s]) - mean(z[c_s]))
}
# calculate and print the p-value
# pvalue_1_side = mean(ds >= d)
pvalue_2_side = 2*min(mean(ds >= d), mean(ds <= d))
if(pvalue_2_side<alpha) cat(m1, pvalue_2_side, reject_message) else cat(m1, pvalue_2_side, accept_message)

## The 2-sided p-value is: 0.01198801
## Therefore we reject the Null Hypothesis
wilcox.test(c,r, alternative = "two.sided")

## Warning in wilcox.test.default(c, r, alternative = "two.sided"): cannot compute
## exact p-value with ties

##
## Wilcoxon rank sum test with continuity correction
##
## data: c and r
## W = 34, p-value = 0.05543
## alternative hypothesis: true location shift is not equal to 0

# data
c = c(25,33,43,45)
r = c(15,16,16,17,20,23,28,28,35,35)
c_len = length(c)

alpha = 0.05
d = mean(c) - mean(r)
z = c(c,r)
z_len = length(z)
ds = NULL

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P = combn(z_len, c_len)

list_2 = matrix(ncol=4)
# calculate combinations
for (b in 1:ncol(P)){
  s = P[,b]
  c_s = s
  summation = sum(z[c_s])
  summation
  list_2 = rbind(list_2, z[c_s])
  ds = c(ds, summation)
}
list_2 <- na.omit(list_2)
list_2 = cbind(list_2, ds)
colnames(list_2) <- c('x1','x2','x3','x4','sum')
list_2

##          x1 x2 x3 x4 sum
## [1,] 25 33 43 45 146
## [2,] 25 33 43 15 116
## [3,] 25 33 43 16 117
## [4,] 25 33 43 16 117
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##      x1 x2 x3 x4 sum
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