Week 4 R Practice

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Introduction

Quick recap of the four steps of Hypothesis testing:

- 1. Formulate hypotheses
- 2. Identify a test statistic
- 3. Compute the P-value. The smaller the P-value, the stronger the evidence against the null hypothesis.
- 4. Compare the p-value with alpha If p<=alpha, the null hypothesis is ruled out.

```
knitr::opts_chunk$set(echo = TRUE)
library(MASS) #Loading the package MASS
library(datasets)
library(dplyr)
```

Load the MASS, datasets and other required packages in R using the library function

```
## Warning: package 'dplyr' was built under R version 3.6.3
##
## Attaching package: 'dplyr'

## The following object is masked from 'package:MASS':
##
## select

## The following objects are masked from 'package:stats':
##
## filter, lag

## The following objects are masked from 'package:base':
##
## intersect, setdiff, setequal, union
```

```
## Warning: package 'ggpubr' was built under R version 3.6.3
## Loading required package: ggplot2
## Warning: package 'ggplot2' was built under R version 3.6.3
## Loading required package: magrittr

Two-sample t-test to test difference in means
Use the "cats" dataset to answer the question, "do male and female cat samples have the same body weight?"

?cats

code:
## starting httpd help server ... done

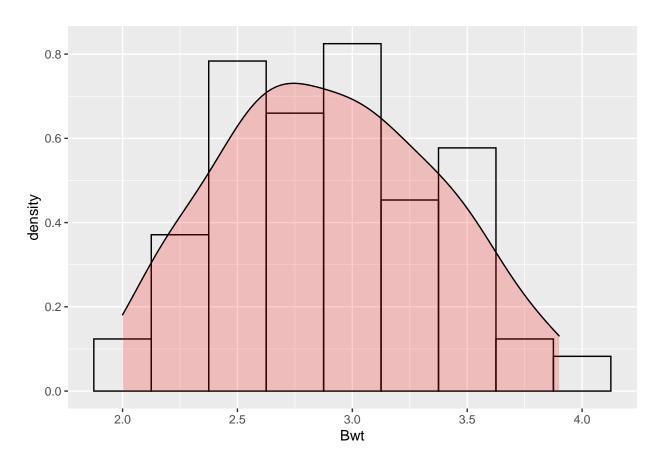
View(cats)
male <- subset(cats, subset=(cats$Sex=="M")) # used subset function to get separate vectors for male an female <- subset(cats, subset=(cats$Sex=="F"))</pre>
```

geom_histogram(aes(y=..density..),binwidth=0.25,colour="black", fill="light grey") +

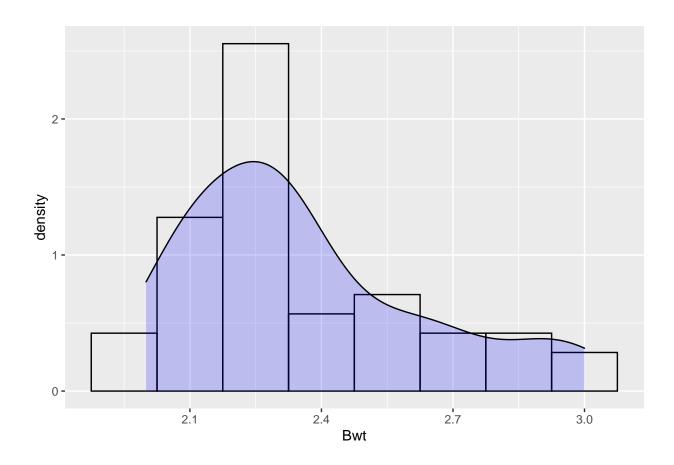
library(ggpubr)

ggplot(male,aes(x=Bwt)) +

geom_density(alpha=.2, fill="red")



```
ggplot(female,aes(x=Bwt)) +
   geom_histogram(aes(y=..density..),binwidth=0.15,colour="black", fill="light grey") +
      geom_density(alpha=.2, fill="blue")
```



```
male_sample <- sample(male, size = 29, replace = TRUE) #Taking sample of 29 values so that n<30 to sati female_sample <- sample(female, size = 29, replace = TRUE)
```

As we need to find out if the bwt of male cats and female cats are same or not, we'll use a two tailed t test Null hypothesis (H0) is as follows: Male and female cat samples have the same body weight, i.e difference of mean (mud) = 0

Alternative hypothesis (H1) is as follows: Male and female cat samples have unequal body weight, i.e difference of mean (mud) !=0

Test for equal or unequal variance using F-test Test for the variance of the body weight in male and female cats.

```
ftest_unpaired = var.test(male$Bwt, female$Bwt, paired=FALSE)
ftest_unpaired

code:

##
## F test to compare two variances
##
```

```
## data: male$Bwt and female$Bwt
## F = 2.9112, num df = 96, denom df = 46, p-value = 0.0001157
## alternative hypothesis: true ratio of variances is not equal to 1
## 95 percent confidence interval:
## 1.723106 4.703057
## sample estimates:
## ratio of variances
## 2.911196
```

Interpretation of the result

Since the true ratio of variances is not equal to 1, this implies that the Body weight of male cats and body weight of female cats have unequal variances.

Two sample unpaired t test with unequal variances

```
##
## Welch Two Sample t-test
##
## data: male$Bwt and female$Bwt
## t = 8.7095, df = 136.84, p-value = 8.831e-15
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
## 0.4177242 0.6631268
## sample estimates:
## mean of x mean of y
## 2.900000 2.359574
```

Interretation of the results

Since p-value < alpha (0.05), we can reject the NULL hypothesis and adopt our alternative hypothesis that mud!=0, i.e., male and female cats do not have same body weights.

Perform Test of equal or given proportions

Using the "bacteria" data set, answer the question, "did the drug treatment have a significant effect of the presence of the bacteria compared with the placebo?"

```
MASS::bacteria
```

code:

```
y ap hilo week ID
##
                                 trt
## 1
                      0 X01 placebo
               hi
  2
##
       у
          p
               hi
                      2 X01 placebo
## 3
                      4 X01 placebo
       у
          р
               hi
## 4
       у
          p
               hi
                     11 X01 placebo
## 5
                      0 X02
                               drug+
               hi
       У
           a
## 6
                      2 X02
                               drug+
       У
           a
               hi
                      6 X02
                               drug+
## 7
       n
           a
               hi
## 8
       у
               hi
                     11 X02
                               drug+
           a
## 9
                      0 X03
       у
               10
                                drug
## 10
               10
                      2 X03
                                drug
       у
           a
##
   11
                      4 X03
                                drug
       у
           a
               10
##
   12
               10
                      6 X03
                                drug
       у
           a
##
  13
                     11 X03
       у
           a
               10
                                drug
## 14
                      0 X04 placebo
       у
           p
               10
##
   15
               10
                      2 X04 placebo
       у
          p
##
   16
                      4 X04 placebo
               10
       у
##
   17
               10
                      6 X04 placebo
       у
          p
   18
##
                     11 X04 placebo
       у
          р
               lo
##
   19
       у
          p
               10
                      0 X05 placebo
##
   20
       у
               10
                      2 X05 placebo
           p
## 21
               10
                      4 X05 placebo
       у
          р
## 22
                      6 X05 placebo
               10
       У
          р
## 23
                     11 X05 placebo
       у
               10
          р
##
  24
                      0 X06
       У
               10
                                drug
##
   25
       у
           a
               10
                      2 X06
                                drug
##
   26
                      4 X06
                                drug
       у
           a
               10
##
   27
                     11 X06
               10
                                drug
       у
           a
##
   28
                      0 X07
                               drug+
       У
           a
##
  29
               hi
                      2 X07
                               drug+
       n
           a
##
  30
       n
           a
               hi
                      4 X07
                               drug+
##
   31
       n
               hi
                      6 X07
                               drug+
           a
##
   32
       у
               hi
                     11 X07
                               drug+
           a
##
   33
                      0 X08 placebo
       n
               hi
           p
##
   34
               hi
                      2 X08 placebo
       у
           p
                      4 X08 placebo
##
   35
       у
               hi
           p
          p
##
  36
       у
               hi
                      6 X08 placebo
## 37
               hi
                     11 X08 placebo
       у
          р
## 38
                      0 X09 placebo
       у
          р
               10
##
   39
                      2 X09 placebo
               10
       У
          р
##
   40
                      4 X09 placebo
       у
          р
               10
##
  41
                      6 X09 placebo
       У
          р
               10
##
  42
                     11 X09 placebo
       у
           p
               10
##
  43
               hi
                      0 X10
                               drug+
       у
## 44
                      6 X10
       у
               hi
                               drug+
           a
## 45
                      0 X11 placebo
       У
          p
               hi
## 46
                      2 X11 placebo
       у
               hi
           p
## 47
                      4 X11 placebo
       у
          p
               hi
##
  48
               hi
                      6 X11 placebo
       у
          p
##
   49
               hi
                     11 X11 placebo
       у
          p
## 50
                      0 X12
               10
                                drug
       у
           a
## 51
                      2 X12
       n
           a
               10
                                drug
## 52
               10
                      4 X12
                                drug
       n
           a
                      6 X12
## 53
       V
               10
                                drug
```

```
## 54
               10
                     11 X12
                                drug
       у
           a
## 55
                      0 X13 placebo
               hi
       у
           p
## 56
       У
               hi
                      2 X13 placebo
           p
## 57
                      4 X13 placebo
       у
           р
               hi
## 58
       у
           р
               hi
                      6 X13 placebo
                     11 X13 placebo
##
   59
               hi
       У
           р
                      0 X14 placebo
## 60
       у
               10
           р
                      2 X14 placebo
## 61
       у
           p
               10
## 62
       n
               10
                      4 X14 placebo
           p
## 63
                      0 X15
       у
               10
                                drug
##
   64
       У
               10
                      2 X15
                                drug
           а
                      4 X15
##
   65
                                drug
       у
           a
               10
##
   66
                      6 X15
                                drug
       у
           a
               10
                     11 X15
##
   67
       у
           a
               10
                                drug
## 68
                      0 X16
                               drug+
       у
               hi
           a
## 69
               hi
                      2 X16
                               drug+
       у
           a
## 70
                      4 X16
                               drug+
               hi
       n
           a
##
   71
               hi
                      6 X16
                               drug+
       у
           a
##
                     11 X16
   72
                               drug+
       у
           а
               hi
##
   73
       у
           p
               hi
                      0 X17 placebo
##
   74
       у
               hi
                      2 X17 placebo
           p
## 75
               hi
                      4 X17 placebo
       у
           р
                      6 X17 placebo
## 76
               hi
       n
           р
## 77
                     11 X17 placebo
       у
               hi
           р
## 78
                      0 X18
       У
               10
                                drug
##
   79
       у
           a
               10
                      2 X18
                                drug
##
   80
                      4 X18
                                drug
       n
           a
               10
                      6 X18
##
   81
               10
                                drug
       n
           a
##
   82
                     11 X18
                                drug
       n
           a
               10
## 83
               10
                      0 X19 placebo
       у
           p
## 84
       у
           p
               10
                      2 X19 placebo
##
   85
               10
                      4 X19 placebo
       n
           p
##
   86
       у
               10
                      6 X19 placebo
           p
                     11 X19 placebo
##
   87
       n
               10
           p
##
   88
               hi
                      0 X20
                               drug+
       у
           a
##
                      2 X20
                               drug+
   89
       у
           а
               hi
## 90
       у
           a
               hi
                      4 X20
                               drug+
## 91
                     11 X20
                               drug+
       у
               hi
           а
## 92
                      0 X21 placebo
       у
           р
               hi
## 93
                      2 X21 placebo
               hi
       У
           р
## 94
                      4 X21 placebo
       у
               hi
           p
## 95
                      6 X21 placebo
       У
           р
               hi
##
   96
                     11 X21 placebo
       у
           p
               hi
##
   97
               hi
                      0 Y01 placebo
       у
           p
## 98
                      2 Y01 placebo
       у
               hi
           p
## 99
                      4 Y01 placebo
       У
           р
               hi
## 100 y
               hi
                      6 Y01 placebo
           p
## 101 y
               hi
                     11 Y01 placebo
## 102 n
               10
                      0 Y02 placebo
           p
## 103 y
               10
                      2 YO2 placebo
           p
## 104 n
                      4 Y02 placebo
               10
           p
## 105 y
           р
               10
                      6 Y02 placebo
## 106 n
               10
                     11 Y02 placebo
           р
                      0 Y03
## 107 y a
               hi
                               drug+
```

```
## 108 y
          a
               hi
                     2 Y03
                              drug+
## 109 y
                     4 Y03
                              drug+
               hi
          а
## 110 n
          a
               hi
                     6 Y03
                              drug+
## 111 n
                    11 Y03
                              drug+
          a
               hi
## 112 n
          a
               10
                     0 Y04
                               drug
## 113 y
                     2 Y04
               10
                               drug
          a
## 114 n
                     4 Y04
                               drug
          a
               10
## 115 n
                    11 Y04
          a
               10
                               drug
                     0 Y05 placebo
## 116 y
          p
               hi
## 117 n
               hi
                     2 Y05 placebo
## 118 n
               hi
                    11 Y05 placebo
          р
## 119 y
                     0 Y06 placebo
               10
## 120 y
               10
                     2 Y06 placebo
          p
## 121 y
          p
               10
                     6 Y06 placebo
## 122 y
                    11 Y06 placebo
          p
               10
## 123 y
               10
                     0 Y07
                               drug
          a
## 124 y
                     2 Y07
                               drug
               10
## 125 y
               10
                     4 Y07
                               drug
          a
## 126 n
                     6 Y07
                               drug
               10
          a
## 127 n
          a
               10
                    11 Y07
                               drug
## 128 y
          a
               hi
                     0 Y08
                              drug+
## 129 y
               hi
                     4 Y08
                              drug+
          a
                     6 Y08
## 130 y
                              drug+
               hi
          a
## 131 n
                    11 Y08
                              drug+
          a
               hi
## 132 y
          р
               10
                     0 Y09 placebo
## 133 y
               10
                     4 Y09 placebo
          p
## 134 y
                     6 Y09 placebo
          p
               10
## 135 y
                    11 Y09 placebo
               10
          p
## 136 y
               10
                     0 Y10
                               drug
## 137 y
               10
                     2 Y10
                               drug
          a
## 138 n
               10
                     4 Y10
                               drug
## 139 y
          a
               10
                     6 Y10
                               drug
## 140 y
               10
                    11 Y10
                               drug
          a
                     0 Y11 placebo
## 141 y
          p
               hi
## 142 y
               hi
                     2 Y11 placebo
          p
## 143 y
                     4 Y11 placebo
          р
               hi
## 144 y
          р
               hi
                     6 Y11 placebo
## 145 y
                    11 Y11 placebo
               hi
          p
## 146 y
                     0 Y12
                              drug+
          a
               hi
## 147 y
                     4 Y12
                              drug+
               hi
          a
## 148 y
                     0 Y13
          a
               10
                               drug
## 149 n
                     2 Y13
                               drug
          a
               10
## 150 n
                     4 Y13
          a
               10
                               drug
                     6 Y13
## 151 n
                               drug
               10
## 152 y
                     0 Y14 placebo
               hi
          p
                     2 Y14 placebo
## 153 y
          р
               hi
## 154 y
          p
               hi
                    11 Y14 placebo
## 155 y
                     0 Z01
               10
                               drug
## 156 y
               10
                     2 Z01
                               drug
          a
                    11 Z01
## 157 y
          a
               10
                               drug
## 158 y
                     0 Z02 placebo
               hi
          p
                     2 Z02 placebo
## 159 y
          р
               hi
## 160 y
               hi
                     4 ZO2 placebo
          р
                     6 Z02 placebo
## 161 y p
               hi
```

```
## 162 y p
               hi
                    11 Z02 placebo
## 163 y
                     0 Z03
               hi
                              drug+
          а
## 164 y
                              drug+
          a
               hi
                     2 Z03
## 165 y
                     4 Z03
                              drug+
          a
               hi
## 166 y
          a
               hi
                     6 Z03
                              drug+
## 167 y
                    11 Z03
                              drug+
               hi
          a
## 168 y
                     0 Z05 placebo
               hi
          p
                     2 Z05 placebo
## 169 y
          р
               hi
## 170 n
               hi
                     4 ZO5 placebo
          р
## 171 y
               hi
                     6 Z05 placebo
## 172 n
               hi
                    11 Z05 placebo
          р
## 173 n
                     0 Z06
          a
               hi
                              drug+
                     4 Z06
## 174 y
               hi
                              drug+
          a
## 175 n
                     0 Z07
                              drug
               10
## 176 y
                     2 Z07
                              drug
          a
               10
## 177 y
          a
               10
                     4 Z07
                              drug
## 178 n
                     6 Z07
               10
                              drug
          a
## 179 y
               10
                    11 Z07
                              drug
          a
## 180 y
                     0 Z09
                              drug+
               hi
          a
## 181 y a
               hi
                     2 Z09
                              drug+
## 182 y
          a
               hi
                     6 Z09
                              drug+
## 183 y
               hi
                    11 Z09
                              drug+
          a
## 184 y
                     0 Z10 placebo
               hi
          р
## 185 y
                     2 Z10 placebo
          р
               hi
## 186 y
                     4 Z10 placebo
               hi
## 187 y p
                     6 Z10 placebo
               hi
## 188 y
                    11 Z10 placebo
          p
               hi
## 189 y
                     0 Z11
          a
               10
                              drug
                     2 Z11
## 190 y
               10
                               drug
## 191 y
                     4 Z11
               10
                              drug
          a
## 192 y
          a
               10
                     6 Z11
                              drug
## 193 y
               10
                    11 Z11
                              drug
          a
## 194 y
               hi
                     0 Z14
                              drug+
          a
## 195 y
                     2 Z14
                              drug+
          a
               hi
                     4 Z14
## 196 y
               hi
                              drug+
          a
## 197 y
                     6 Z14
                              drug+
          a
               hi
## 198 n
          a
               hi
                    11 Z14
                              drug+
## 199 y
                     0 Z15
                              drug
          a
               10
                     4 Z15
## 200 y
               10
                              drug
          a
## 201 y
                     6 Z15
               10
                              drug
          a
## 202 y a
                     0 Z19
                              drug+
               hi
## 203 y a
                     2 Z19
                              drug+
               hi
## 204 y
                     4 Z19
          a
               hi
                              drug+
                     6 Z19
## 205 y
                              drug+
          a
               hi
## 206 y
                    11 Z19
               hi
                              drug+
          a
## 207 y
                     0 Z20
                              drug
          a
               10
                     2 Z20
## 208 y
          a
               10
                              drug
## 209 n
                     6 Z20
               10
                               drug
## 210 n
               10
                    11 Z20
                              drug
          a
                     0 Z24
## 211 y
               hi
                              drug+
          a
## 212 y
                     2 Z24
                              drug+
               hi
          a
                     4 Z24
## 213 y
          a
               hi
                              drug+
## 214 n
               hi
                     6 Z24
                              drug+
          а
                    11 Z24
## 215 n a
               hi
                              drug+
```

```
## 216 y a
              hi
                    0 Z26
                             drug+
## 217 y
                    2 Z26
                             drug+
          a
              hi
## 218 y
          a
              hi
                     4 Z26
                             drug+
## 219 n a
                     6 Z26
              hi
                             drug+
## 220 y
              hi
                    11 Z26
                             drug+
?bacteria
View(bacteria)
active <- subset(bacteria, subset=(bacteria$ap=="a")) # taking subset with the presence of the drug eit
placebo <- subset(bacteria, subset=(bacteria$ap=="p"))</pre>
active
       y ap hilo week
                       ID
## 5
                     0 X02 drug+
          a
              hi
       У
## 6
                     2 X02 drug+
              hi
       У
                     6 X02 drug+
## 7
       n
          a
              hi
## 8
                    11 X02 drug+
       У
          a
              hi
## 9
                    0 X03
       У
          a
              10
                            drug
## 10
                    2 X03
       У
          a
              10
                            drug
## 11
                    4 X03
              10
                            drug
       У
          a
## 12
                    6 X03
       У
          a
              10
                            drug
## 13
       У
          a
              10
                   11 X03
                            drug
## 24
                    0 X06
       У
          a
              10
                            drug
## 25
              10
                    2 X06
                            drug
       У
          а
## 26
              10
                    4 X06
                            drug
```

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n a

11 X06

0 X07 drug+

2 X07 drug+

4 X07 drug+

6 X07 drug+

0 X10 drug+

6 X10 drug+

0 X12

2 X12

4 X12

6 X12

0 X15

2 X15

4 X15

6 X15

11 X15

0 X16 drug+

2 X16 drug+

4 X16 drug+

6 X16 drug+

11 X16 drug+

4 X18 drug

0 X18

2 X18

11 X12

11 X07 drug+

drug

10

hi

hi

hi

hi

hi

hi

hi

lo

10

10

10

10

10

10

10

10

hi

hi

hi

hi

hi

10

10

lo

27

28

29

30

31

32

43

44

50

51

52

53

54

63

64

65

66

67

68

69

70

71

72

78

79

80

```
6 X18 drug
## 81 n a
              10
## 82
                   11 X18 drug
      n
              10
          a
## 88
       У
          a
              hi
                    0 X20 drug+
## 89
                    2 X20 drug+
       У
          a
              hi
## 90
       У
          a
              hi
                    4 X20 drug+
## 91
              hi
                   11 X20 drug+
       У
          a
## 107 y
              hi
                    0 Y03 drug+
          a
## 108 y
                    2 Y03 drug+
          a
              hi
## 109 y
          a
              hi
                    4 Y03 drug+
## 110 n
                    6 Y03 drug+
              hi
## 111 n
          a
              hi
                   11 Y03 drug+
## 112 n
                    0 Y04
          a
              10
                           drug
## 113 y
                    2 Y04
              10
                           drug
          a
## 114 n
                    4 Y04
                           drug
              10
## 115 n
              10
                   11 Y04
                           drug
          a
## 123 y
          a
              10
                    0 Y07
                           drug
## 124 y
                    2 Y07
              10
                           drug
          a
## 125 y
              10
                    4 Y07
                           drug
          a
## 126 n a
                    6 Y07
              10
                           drug
## 127 n
         a
              10
                   11 Y07 drug
## 128 y a
              hi
                    0 Y08 drug+
## 129 y a
              hi
                    4 Y08 drug+
                    6 Y08 drug+
## 130 y a
              hi
## 131 n a
              hi
                   11 Y08 drug+
## 136 y
                    0 Y10 drug
          a
              10
## 137 y
          a
              10
                    2 Y10
                           drug
## 138 n a
                    4 Y10
                           drug
              10
## 139 y
                    6 Y10
         a
              10
                          drug
## 140 y
              10
                   11 Y10
                          drug
          a
                    0 Y12 drug+
## 146 y
              hi
          a
                    4 Y12 drug+
## 147 y
          a
              hi
## 148 y
         a
              10
                    0 Y13
                          drug
## 149 n
                    2 Y13
              10
                           drug
## 150 n
                    4 Y13
              10
                           drug
         a
                    6 Y13
## 151 n a
              10
                           drug
## 155 y a
                    0 Z01
              10
                           drug
## 156 y a
              10
                    2 Z01
                           drug
## 157 y a
              10
                   11 Z01 drug
## 163 y
         a
              hi
                    0 Z03 drug+
## 164 y a
                    2 Z03 drug+
              hi
## 165 y a
              hi
                    4 Z03 drug+
## 166 y a
              hi
                    6 Z03 drug+
## 167 y a
                   11 Z03 drug+
              hi
## 173 n a
                    0 Z06 drug+
              hi
## 174 y
                    4 Z06 drug+
          a
              hi
## 175 n
                    0 Z07
                           drug
          a
              10
## 176 y
                    2 Z07
          a
              10
                           drug
## 177 y
                    4 Z07
                           drug
## 178 n a
              10
                    6 Z07
                           drug
## 179 y a
                   11 Z07
              10
                           drug
## 180 y a
                    0 Z09 drug+
              hi
                    2 Z09 drug+
## 181 y a
              hi
## 182 y a
              hi
                    6 Z09 drug+
## 183 y a
                   11 Z09 drug+
              hi
```

```
## 189 y a
             10
                   0 Z11 drug
## 190 y a
                   2 Z11 drug
             lo
## 191 y a
             10
                   4 Z11
                          drug
## 192 y a
                   6 Z11 drug
             10
## 193 y a
             10
                  11 Z11 drug
## 194 y a
                   0 Z14 drug+
             hi
                   2 Z14 drug+
## 195 y a
             hi
                   4 Z14 drug+
## 196 y a
             hi
## 197 y a
             hi
                   6 Z14 drug+
## 198 n a
             hi
                  11 Z14 drug+
## 199 y a
             10
                   0 Z15
                          drug
                   4 Z15
## 200 y a
             10
                          drug
## 201 y a
                   6 Z15
                          drug
             10
                   0 Z19 drug+
## 202 y a
             hi
## 203 y a
                   2 Z19 drug+
             hi
## 204 y a
             hi
                   4 Z19 drug+
## 205 y a
                   6 Z19 drug+
             hi
## 206 y a
             hi
                 11 Z19 drug+
## 207 y a
                   0 Z20 drug
             10
                   2 Z20
## 208 y a
             10
                          drug
## 209 n a
             10
                   6 Z20
                          drug
## 210 n a
             10
                  11 Z20 drug
                   0 Z24 drug+
## 211 y a
             hi
## 212 y a
                   2 Z24 drug+
             hi
## 213 y a
                   4 Z24 drug+
             hi
                   6 Z24 drug+
## 214 n a
             hi
## 215 n a
                 11 Z24 drug+
             hi
## 216 y a
                   0 Z26 drug+
             hi
## 217 y a
                   2 Z26 drug+
             hi
## 218 y a
             hi
                   4 Z26 drug+
## 219 n a
             hi
                   6 Z26 drug+
## 220 y a
                  11 Z26 drug+
count_active <- nrow(active) # count of rows with the drug present</pre>
```

[1] 124

count_active

placebo

```
##
       y ap hilo week ID
                              trt
## 1
         р
              hi
                    0 X01 placebo
       У
## 2
                    2 X01 placebo
       У
              hi
## 3
              hi
                    4 X01 placebo
       у р
## 4
                   11 X01 placebo
       У
         p
              hi
## 14
              10
                    0 X04 placebo
       У
         р
## 15
              10
                    2 X04 placebo
      у р
## 16
              10
                    4 X04 placebo
      у р
## 17
                    6 X04 placebo
       у р
              10
## 18
              10
                   11 X04 placebo
       у р
## 19
              10
                    0 X05 placebo
## 20
                    2 X05 placebo
       у р
              10
## 21 y p
                    4 X05 placebo
              10
```

```
## 22
               10
                     6 X05 placebo
       у
          p
## 23
               10
                     11 X05 placebo
       у
          р
## 33
       n
          p
               hi
                     0 X08 placebo
##
  34
                     2 X08 placebo
       у
          р
               hi
##
   35
       у
               hi
                     4 X08 placebo
          р
                      6 X08 placebo
##
   36
               hi
       У
          р
   37
                     11 X08 placebo
##
               hi
       у
          р
## 38
       у
          p
               10
                     0 X09 placebo
##
   39
                     2 X09 placebo
       У
          p
               10
##
   40
       у
               10
                     4 X09 placebo
          p
##
  41
                     6 X09 placebo
       у
               10
          p
##
   42
       У
                     11 X09 placebo
          p
##
   45
                     0 X11 placebo
       у
               hi
          p
##
   46
       у
          p
               hi
                     2 X11 placebo
## 47
                     4 X11 placebo
       у
               hi
          p
## 48
               hi
                     6 X11 placebo
       у
          p
##
  49
                     11 X11 placebo
               hi
       У
##
   55
                     0 X13 placebo
       у
               hi
          p
##
  56
                     2 X13 placebo
       у
          р
               hi
##
   57
       у
          p
               hi
                     4 X13 placebo
##
   58
       у
               hi
                     6 X13 placebo
          p
## 59
                     11 X13 placebo
       у
               hi
          р
                     0 X14 placebo
## 60
       У
          р
               lo
## 61
                     2 X14 placebo
               10
       у
          р
##
  62
       n
          p
               10
                     4 X14 placebo
##
   73
       У
               hi
                     0 X17 placebo
          p
##
   74
                     2 X17 placebo
       у
               hi
          р
##
   75
               hi
                     4 X17 placebo
       у
          p
##
   76
       n
                      6 X17 placebo
          p
##
  77
                     11 X17 placebo
       у
          p
               hi
## 83
       у
          p
               10
                     0 X19 placebo
##
   84
               10
                     2 X19 placebo
       у
          p
##
   85
               10
                     4 X19 placebo
       n
          p
##
  86
                     6 X19 placebo
       у
               10
          p
##
   87
               10
                     11 X19 placebo
       n
          p
## 92
       у
               hi
                     0 X21 placebo
          p
## 93
       у
          p
               hi
                     2 X21 placebo
## 94
                     4 X21 placebo
       у
               hi
          р
## 95
                     6 X21 placebo
       у
               hi
          р
##
  96
               hi
                     11 X21 placebo
       У
          р
## 97
                     0 Y01 placebo
       у
               hi
          p
## 98
                     2 Y01 placebo
       У
          р
               hi
## 99
       У
          p
               hi
                     4 Y01 placebo
## 100
                      6 Y01 placebo
       У
## 101 y
               hi
                     11 Y01 placebo
          p
## 102 n
                     0 Y02 placebo
               10
## 103 y
          p
               10
                     2 YO2 placebo
## 104 n
                     4 Y02 placebo
## 105 y
               10
                     6 Y02 placebo
          p
## 106 n
               10
                     11 Y02 placebo
          p
## 116 y
               hi
                     0 Y05 placebo
          p
## 117 n
               hi
                     2 Y05 placebo
## 118 n
                     11 Y05 placebo
               hi
          р
## 119 y p
               10
                     0 Y06 placebo
```

```
## 120 y p
             lo
                  2 Y06 placebo
## 121 y p
                  6 Y06 placebo
             lo
## 122 y p
             10
                11 Y06 placebo
## 132 y p
                 0 Y09 placebo
             lo
## 133 y p
             lo
                  4 Y09 placebo
                 6 Y09 placebo
## 134 y p
             lo
## 135 y p
                11 Y09 placebo
             lo
## 141 y p
             hi
                  0 Y11 placebo
## 142 y p
             hi
                  2 Y11 placebo
## 143 y p
             hi 4 Y11 placebo
## 144 y p
             hi
                 6 Y11 placebo
## 145 y p
                11 Y11 placebo
             hi
## 152 y p
                0 Y14 placebo
            hi
## 153 y p
             hi
                2 Y14 placebo
## 154 y p
                11 Y14 placebo
             hi
## 158 y p
             hi
                0 ZO2 placebo
## 159 y p
                2 ZO2 placebo
             hi
## 160 y p
                4 ZO2 placebo
             hi
## 161 y p
                 6 ZO2 placebo
             hi
## 162 y p
             hi
                11 ZO2 placebo
## 168 y p
             hi
                0 Z05 placebo
## 169 y p
                2 ZO5 placebo
             hi
## 170 n p
                4 ZO5 placebo
             hi
## 171 y p
                 6 ZO5 placebo
           hi
## 172 n p
           hi 11 Z05 placebo
## 184 y p
           hi
                0 Z10 placebo
## 185 y p
                  2 Z10 placebo
            hi
## 186 y p
            hi
                4 Z10 placebo
                  6 Z10 placebo
## 187 y p
             hi
## 188 y p
             hi
                11 Z10 placebo
count_placebo <- nrow(placebo) # count of rows with the drug absent</pre>
count_placebo
## [1] 96
p_active <- sum(active$y == "n") #TRUE is interpreted as 1 and FALSE as 0, this returns the number of T
p_active
## [1] 31
p_placebo <- sum(placebo$y == "n") #Returns count of rows wherever bacteria is absent in case of placeb
p_placebo
## [1] 12
31/124 # proportion of children without bacteria while being treated with drug
## [1] 0.25
```

```
## [1] 0.125
```

Group active with drug: n = 124 Group placebo without drug: n = 96

The number of infections persisting in each group is as follow:

Proportion of Group active without bacteria: n = 124, p = 31 patients without bacteria, p/n = 31/124 = 0.25Proportion of Group placebo without bacteria: n = 96, p = 12 patients without bacteria, p/n = 12/96 = 0.125

As we need to find out if the drug treatment had a significant reduction in the presence of bacteria, we'll use a one-tailed, two sample t test for proportions.

Null hypothesis (H0) is as follows: The drug treatment did not cause a significant reduction in the presence of bacteria in the infected patients, i.e. P(Active) = P(Placebo), where P(Active) represents the proportion of patients who lost the bacteria because of the drug and P(Placebo) represents the proportion of patients who lost the bacteria because of the placebo, i.e. without the drug.

Alternative hypothesis (H1) is as follows: The drug treatment caused a significant reduction in the presence of bacteria in the infected patients, i.e. P(Active) > P(Placebo)

```
?prop.test
```

one-tailed, two sample t test for proportions.

```
##
## 2-sample test for equality of proportions with continuity correction
##
## data: c(p_active, p_placebo) out of c(count_active, count_placebo)
## X-squared = 4.6109, df = 1, p-value = 0.01588
## alternative hypothesis: greater
## 95 percent confidence interval:
## 0.03106271 1.00000000
## sample estimates:
## prop 1 prop 2
## 0.250 0.125
```

Interpretation of the result

The p-value of the test is 0.01588, which is less than the significance level alpha = 0.05. We can conclude that the drug treatment had a significant effect of the presence of the bacteria compared with the placebo, i.e. it significantly reduced the presence of bacteria in children.