final_R_reference

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R Reference Guide

Loading Data and Packages

- Use these to show how to load the here and palmerpenguins packages - libary() and require()
- Ginkgo data: use the 2021 ginkgo data to create a data.frame called ginkgo using:

Require() function

This function used for loading the packages, which is already ready to use in R.

```
require(here)
```

```
## Loading required package: here
```

```
## here() starts at /Users/Ragib_katzlab/environmental_data
```

Library() function

This function is about the all stored and downloaded packages in R

```
library(palmerpenguins)
```

Read.csv() function

this function allows csv files to open and rean in R.

```
ginkgo = data.frame(read.csv(here("data", "ginkgo_data_2021.csv")))
```

Data Structures

c() function

The function c() combines or concatenates its arguments into a vector (a 1-dimensional data structure consisting of 1 or more elements).

- All of the elements must be of the same type.
  - I can't combine character and numeric types in the same call to c()

Here's two examples using numeric and character data types:

```
## Create a vector of numbers:
num_vec  = c(1, 4, 8, 9, 13)

## Create a vector of characters:
char_vec = c("a", "fish", "data is cool")
```

I can show the contents of a vector by typing the name of the vector, or using the print() function.

```
## Typing the name of the vector into the console prints the contents
num_vec
```

```
## [1]  1  4  8  9 13
```

```
## The print() function accomplishes the same task:
print(char_vec)
```

```
## [1] "a"            "fish"         "data is cool"
```

print() function

This function print the contents of the vectors

```
print(char_vec)
```

```
## [1] "a"            "fish"         "data is cool"
```

length() function

This functions deals with the length of the vectors

```
length(num_vec)
```

```
## [1] 5
```

```
length(char_vec)
```

```
## [1] 3
```

matrix() function

This function create a matrix from a given set of values to a no of rows and column.

```
matrix(num_vec, nrow = 3, ncol = 5, byrow = TRUE)
```

```
##      [,1] [,2] [,3] [,4] [,5]
## [1,]    1    4    8    9   13
## [2,]    1    4    8    9   13
## [3,]    1    4    8    9   13
```

data.frame() function

DataFrame is a data structure, organizes data into a table with rows and column. * We can say ginkgo is a data frame and we can vizualize the ginkgo data as a table in R

```
ginkgo
```

```
##     site_id seeds_present max_width max_depth notch_depth petiole_length
## 1      7719         FALSE      71.0        40         0.0          30.00
## 2      7719         FALSE      64.0        38         0.0          23.00
## 3      7719         FALSE      55.0        32         0.0          20.00
## 4      7719         FALSE      62.0        40         0.0          28.00
## 5      7719         FALSE      65.0        40         0.0          25.00
## 6      7719         FALSE      70.0        50         0.0          55.00
## 7      7719         FALSE      63.0        42         0.0          27.00
## 8      7719         FALSE      56.0        35         0.0          20.00
## 9      7719         FALSE      51.0        45         0.0          50.00
## 10     7719         FALSE      57.0        37         0.0          23.00
## 11     7719         FALSE      59.0        41         0.0          28.00
## 12     7719         FALSE      63.0        42         0.0          26.00
## 13     7719         FALSE      70.0        50         0.0          43.00
## 14     7719         FALSE      50.0        46         0.0          45.00
## 15     7719         FALSE      56.0        46         0.0          42.00
## 16     7719         FALSE      46.0        46         0.0          40.00
## 17     7719         FALSE      54.0        42         0.0          42.00
## 18     7719         FALSE      62.0        43         0.0          40.00
## 19     7719         FALSE      56.0        44         0.0          48.00
## 20     7719         FALSE      55.0        37         0.0          37.00
## 21     7719         FALSE      59.0        46         0.0          50.00
## 22     7719         FALSE      60.0        45         0.0          35.00
## 23     7719         FALSE      63.0        51         0.0          47.00
## 24     7719         FALSE      61.0        40         0.0          23.00
## 25     7719         FALSE      58.0        36         0.0          21.00
## 26     7719         FALSE      55.0        37         0.0          25.00
## 27     7719         FALSE      53.0        40         0.0          41.00
## 28     4847         FALSE      81.0        57         0.0          78.00
## 29     4847         FALSE      94.0        58         0.0          88.00
## 30     4847         FALSE      75.0        46         0.0          38.00
## 31     4847         FALSE      82.0        53         0.0          59.00
## 32     4847         FALSE      86.0        64         0.0          85.00
## 33     4847         FALSE      79.0        45         0.0          42.00
## 34     4847         FALSE      93.0        64         0.0          73.00
## 35     4847         FALSE      88.0        56         0.0          56.00
## 36     4847         FALSE      76.0        55         0.0          76.00
## 37     4847         FALSE      71.0        55         0.0          94.00
```

```
## 38     4847         FALSE      91.0         60          0.0          57.00
## 39     4847         FALSE      71.0         40          0.0          30.00
## 40     4847         FALSE      82.0         43          0.0          28.00
## 41     4847         FALSE      65.0         59          0.0          80.00
## 42     4847         FALSE      83.0         55          0.0          58.00
## 43     4847         FALSE      73.0         49          0.0          70.00
## 44     4847         FALSE     102.0         60          0.0          64.00
## 45     4847         FALSE      78.0         45          0.0          43.00
## 46     4847         FALSE      88.0         58          0.0          58.00
## 47     4847         FALSE      81.0         53          0.0          49.00
## 48     4847         FALSE      70.0         38          0.0          35.00
## 49     4847         FALSE      80.0         56          0.0          72.00
## 50     4847         FALSE      96.0         68          0.0          88.00
## 51     4847         FALSE      80.0         53          0.0          63.00
## 52     4847         FALSE      82.0         55          0.0          55.00
## 53     4847         FALSE      86.0         59          0.0          56.00
## 54     4874         FALSE      87.0         54          0.0          54.00
## 55     4874         FALSE      89.0         52          0.0          49.00
## 56     4874         FALSE      69.0         39          0.0          28.00
## 57     4874         FALSE      93.0         59          0.0          57.00
## 58     4874         FALSE      98.0         60          0.0          53.00
## 59     4874         FALSE      81.0         51          0.0          51.00
## 60     4874         FALSE      79.0         62          0.0          80.00
## 61     4874         FALSE      82.0         41          0.0          42.00
## 62     4874         FALSE      85.0         53          0.0          49.00
## 63     4874         FALSE      81.0         50          0.0          49.00
## 64     4874         FALSE      59.0         33          0.0          36.00
## 65     4874         FALSE      53.0         31          0.0          33.00
## 66     4874         FALSE      83.0         51          0.0          46.00
## 67     4874         FALSE      80.0         58          0.0          59.00
## 68     4874         FALSE      77.0         51          0.0          41.00
## 69     4874         FALSE      81.0         57          0.0          58.00
## 70     4874         FALSE      76.0         57          0.0          96.00
## 71     4873         FALSE      82.0         49          0.0          58.00
## 72     4873         FALSE      81.0         45          0.0          45.00
## 73     4873         FALSE      77.0         49          0.0          34.00
## 74     4873         FALSE      68.0         39          0.0          35.00
## 75     4873         FALSE      41.0         40          0.0          59.00
## 76     4873         FALSE      70.0         49          0.0          78.00
## 77     4873         FALSE      68.0         47          0.0          78.00
## 78     4873         FALSE      80.0         49          0.0          41.00
## 79     4873         FALSE      89.0         55          0.0          75.00
## 80     4873         FALSE      90.0         46          0.0          41.00
## 81     7719         FALSE      71.0         40          0.0          30.00
## 82     7719         FALSE      64.0         38          0.0          23.00
## 83     7719         FALSE      55.0         32          0.0          20.00
## 84     7719         FALSE      62.0         40          0.0          28.00
## 85     7719         FALSE      65.0         40          0.0          25.00
## 86     7719         FALSE      70.0         50          0.0          55.00
## 87     7719         FALSE      63.0         42          0.0          27.00
## 88     7719         FALSE      56.0         35          0.0          20.00
## 89     7719         FALSE      51.0         45          0.0          50.00
## 90     7719         FALSE      57.0         37          0.0          23.00
## 91     7719         FALSE      59.0         41          0.0          28.00
```

```
## 92    7719        FALSE      63.0        42         0.0          26.00
## 93    7719        FALSE      70.0        50         0.0          43.00
## 94    7719        FALSE      50.0        46         0.0          45.00
## 95    7719        FALSE      56.0        46         0.0          42.00
## 96    7719        FALSE      46.0        46         0.0          40.00
## 97    7719        FALSE      54.0        42         0.0          42.00
## 98    7719        FALSE      62.0        43         0.0          40.00
## 99    7719        FALSE      56.0        44         0.0          48.00
## 100   7719        FALSE      55.0        37         0.0          37.00
## 101   7719        FALSE      59.0        46         0.0          50.00
## 102   7719        FALSE      60.0        45         0.0          35.00
## 103   7719        FALSE      63.0        51         0.0          47.00
## 104   7719        FALSE      61.0        40         0.0          23.00
## 105   7719        FALSE      58.0        36         0.0          21.00
## 106   7719        FALSE      55.0        37         0.0          25.00
## 107   7719        FALSE      53.0        40         0.0          41.00
## 108   9603        FALSE      77.0        55         0.0          57.00
## 109   9603        FALSE      72.0        46         0.0          40.00
## 110   9603        FALSE      57.0        37         0.0          25.00
## 111   9603        FALSE      75.0        43         0.0          38.00
## 112   9603        FALSE      75.0        50         0.0          48.00
## 113   9603        FALSE      75.0        56         0.0          48.00
## 114   9603        FALSE      67.0        58         0.0          53.00
## 115   9603        FALSE      74.0        48         0.0          52.00
## 116   9603        FALSE      71.0        55         0.0          52.00
## 117   9603        FALSE      72.0        46         0.0          51.00
## 118   9603        FALSE      55.0        45         0.0          65.00
## 119   9603        FALSE      77.0        54         0.0          48.00
## 120   9603        FALSE      97.0        67         0.0          88.00
## 121   9603        FALSE      73.0        41         0.0          25.00
## 122   9603        FALSE      64.0        45         0.0          33.00
## 123   9603        FALSE      69.0        55         0.0          68.00
## 124   3470        FALSE      92.0        54         0.0          45.00
## 125   3470        FALSE      64.0        40         0.0          55.00
## 126   3470        FALSE      68.0        45         0.0          51.00
## 127   3470        FALSE      53.0        36         0.0          61.00
## 128   3470        FALSE      97.0        48         0.0          30.00
## 129   3470        FALSE     100.0        55         0.0          37.00
## 130   3470        FALSE      90.0        55         0.0          50.00
## 131   3470        FALSE      89.0        54         0.0          72.00
## 132   3470        FALSE      59.0        34         0.0          31.00
## 133   3470        FALSE      97.0        50         0.0          54.00
## 134   3470        FALSE      76.0        42         0.0          27.00
## 135   3470        FALSE      85.0        49         0.0          32.00
## 136   3470        FALSE      90.0        55         0.0          59.00
## 137   6719        FALSE      87.0       105         0.0          48.00
## 138   6720        FALSE      85.0       109         0.0          54.00
## 139   6722        FALSE      80.0       145         0.0          93.00
## 140   6723        FALSE      86.0       111         0.0          54.00
## 141   6725        FALSE      89.0        95         0.0          43.00
## 142   6726        FALSE      84.0        91         0.0          42.00
## 143   6727        FALSE      88.0        94         0.0          14.00
## 144   6728        FALSE      80.0        85         0.0          27.00
## 145   6729        FALSE     102.0       138         0.0          70.00
```

```
## 146   6730        FALSE      94.0       121         0.0          58.00
## 147   6731        FALSE      95.0       110         0.0          48.00
## 148   6732        FALSE     109.0       127         0.0          60.00
## 149  12669        FALSE      84.0       108         0.0          52.00
## 150  12669        FALSE      68.0       100         0.0          55.00
## 151  12669        FALSE      59.0        96         0.0          62.00
## 152  12669        FALSE      74.0        97         0.0          45.00
## 153  12669        FALSE      70.0        97         0.0          45.00
## 154  12669        FALSE      71.0       104         0.0          55.00
## 155  12669        FALSE      69.0        93         0.0          48.00
## 156  12669        FALSE      74.0        87         0.0          41.00
## 157  12669        FALSE      70.0        69         0.0          26.00
## 158  12669        FALSE      78.0       102         0.0          50.00
## 159  12669        FALSE      87.0        70         0.0          70.00
## 160  12669        FALSE      69.0        97         0.0          53.00
## 161  12669        FALSE      60.0        98         0.0          55.00
## 162  12669        FALSE      72.0       103         0.0          53.00
## 163  12669        FALSE      59.0        95         0.0          52.00
## 164  12669        FALSE      75.0        94         0.0          47.00
## 165  12669        FALSE      81.0        96         0.0          43.00
## 166  12669        FALSE      82.0       104         0.0          53.00
## 167  12669        FALSE      74.0       107         0.0          59.00
## 168  12669        FALSE      72.0        75         0.0          34.00
## 169  12669        FALSE      79.0       105         0.0          55.00
## 170  12669        FALSE      84.0        82         0.0          33.00
## 171  12669        FALSE      75.0        89         0.0          40.00
## 172  12669        FALSE      72.0       106         0.0          59.00
## 173  12669        FALSE      88.0       115         0.0          64.00
## 174  12669        FALSE      80.0        87         0.0          38.00
## 175   6721        FALSE      90.0        55         0.0          88.00
## 176   6721        FALSE      58.0        41         0.0          49.00
## 177   6721        FALSE      61.0        49         0.0          50.00
## 178   6721        FALSE      95.0        57         0.0          50.00
## 179   6721        FALSE      72.0        41         0.0          49.00
## 180   6721        FALSE      90.0        45         0.0          37.00
## 181   6721        FALSE      99.0        56         0.0          61.00
## 182   6721        FALSE     102.0        60         0.0          53.00
## 183   6721        FALSE      56.0        53         0.0          78.00
## 184   6721        FALSE      81.0        41         0.0          29.00
## 185   6721        FALSE      69.0        40         0.0          38.00
## 186   6721        FALSE      65.0        42         0.0          34.00
## 187   6721        FALSE      87.0        47         0.0          39.00
## 188   6721        FALSE      86.0        51         0.0          73.00
## 189   6721        FALSE      96.0        51         0.0          41.00
## 190   6721        FALSE      73.0        43         0.0          36.00
## 191   6721        FALSE      98.0        49         0.0          57.00
## 192   6721        FALSE      99.0        58         0.0          53.00
## 193   6718        FALSE      58.0        56         0.0          84.00
## 194  12982        FALSE      65.0        41         0.0          26.00
## 195  12982        FALSE     106.0        68         0.0          76.00
## 196  12982        FALSE      77.0        50         0.0          29.00
## 197  12982        FALSE      80.0        55         0.0          36.00
## 198  12982        FALSE      68.0        44         0.0          25.00
## 199  12982        FALSE      62.0        38         0.0          23.00
```

```
## 200   12982         FALSE      65.0        39         0.0          25.00
## 201   12982         FALSE      52.0        32         0.0          16.00
## 202    3704         FALSE      84.0       104         0.0          50.00
## 203    3704         FALSE      59.0        71         0.0          34.00
## 204    3704         FALSE      60.0       120         0.0          70.00
## 205    3704         FALSE      85.0       109         0.0          55.00
## 206    3704         FALSE      59.0        90         0.0          50.00
## 207    3704         FALSE      51.0        93         0.0          57.00
## 208    3704         FALSE      56.0        66         0.0          25.00
## 209    3704         FALSE      66.0        72         0.0          28.00
## 210    3704         FALSE      67.0        84         0.0          39.00
## 211    3704         FALSE      69.0        80         0.0          36.00
## 212    3704         FALSE      54.0       103         0.0          60.00
## 213    3704         FALSE      59.0        80         0.0          42.00
## 214    3704         FALSE      60.0        65         0.0          25.00
## 215    3704         FALSE      73.0        85         0.0          37.00
## 216    3704         FALSE      69.0        90         0.0          39.00
## 217    3704         FALSE      58.0        62         0.0          24.00
## 218    3704         FALSE      65.0        92         0.0          47.00
## 219    3704         FALSE      64.0        71         0.0          28.00
## 220    3704         FALSE      69.0        89         0.0          44.00
## 221    3704         FALSE      69.0        95         0.0          45.00
## 222    3704         FALSE      62.0        80         0.0          39.00
## 223    3704         FALSE      42.0        55         0.0          21.00
## 224    3704         FALSE      52.0        55         0.0          19.00
## 225    2183         FALSE      44.0        38         0.0          52.00
## 226    2183         FALSE      27.0        23         0.0          22.00
## 227    2183         FALSE      42.0        41         0.0          71.00
## 228    2183         FALSE      49.0        40         0.0          49.00
## 229    2183         FALSE      75.0        47         0.0          40.00
## 230    2183         FALSE      66.0        58         0.0          39.00
## 231    6071         FALSE      80.0        87         0.0          40.00
## 232    6071         FALSE      78.0       100         0.0          43.00
## 233    6071         FALSE      75.0        91         0.0          42.00
## 234    6071         FALSE      72.0       111         0.0          55.00
## 235    6071         FALSE      87.0       106         0.0          50.00
## 236    6071         FALSE      85.0       106         0.0          50.00
## 237    6071         FALSE      70.0       100         0.0          49.00
## 238    6071         FALSE      70.0       113         0.0          58.00
## 239    6071         FALSE      70.0        98         0.0          48.00
## 240    6071         FALSE      74.0       103         0.0          49.00
## 241    6071         FALSE      71.0        93         0.0          42.00
## 242    6071         FALSE      84.0        79         0.0          29.00
## 243    6071         FALSE      65.0        85         0.0          39.00
## 244    6071         FALSE      86.0        95         0.0          40.00
## 245    6071         FALSE      71.0        62         0.0          24.00
## 246    6071         FALSE      84.0       103         0.0          52.00
## 247    6071         FALSE      65.0        80         0.0          35.00
## 248    6071         FALSE      69.0        78         0.0          34.00
## 249    6071         FALSE      90.0        89         0.0          35.00
## 250    6071         FALSE      77.0        84         0.0          36.00
## 251    6071         FALSE      75.0       108         0.0          51.00
## 252    6071         FALSE      70.0        79         0.0          36.00
## 253    6071         FALSE      90.0       111         0.0          51.00
```

```
## 254    6071        FALSE      77.0       106         0.0          50.00
## 255    6071        FALSE      56.0       100         0.0          51.00
## 256    6071        FALSE      47.0        67         0.0          33.00
## 257    6071        FALSE      72.0       105         0.0          52.00
## 258    6071        FALSE      52.0       108         0.0          58.00
## 259    6071        FALSE      72.0        81         0.0          34.00
## 260    3705        FALSE      85.0       127         0.0          66.00
## 261    3705        FALSE      78.0       110         0.0          55.00
## 262    3705        FALSE      81.0        88         0.0          36.00
## 263    3705        FALSE      92.0        97         0.0          37.00
## 264    3705        FALSE      80.0        85         0.0          34.00
## 265    3705        FALSE      78.0        85         0.0          31.00
## 266    3705        FALSE      75.0       106         0.0          52.00
## 267    3705        FALSE      90.0        92         0.0          35.00
## 268    3705        FALSE      82.0       113         0.0          54.00
## 269    3705        FALSE     109.0       125         0.0          60.00
## 270    3705        FALSE      72.0        70         0.0          21.00
## 271    3705        FALSE      85.0       109         0.0          55.00
## 272    3705        FALSE      52.0        62         0.0          27.00
## 273    3705        FALSE      90.0        92         0.0          38.00
## 274    3705        FALSE     102.0       118         0.0          53.00
## 275    3705        FALSE      82.0        80         0.0          30.00
## 276    3705        FALSE      59.0        54         0.0          20.00
## 277    3705        FALSE      67.0       111         0.0          57.00
## 278    3705        FALSE      95.0       132         0.0          70.00
## 279    3705        FALSE      67.0       120         0.0          68.00
## 280    3705        FALSE      96.0       105         0.0          45.00
## 281    3705        FALSE      94.0        96         0.0          38.00
## 282    3705        FALSE     101.0       100         0.0          42.00
## 283    3705        FALSE      79.0       110         0.0          59.00
## 284    3705        FALSE      82.0        80         0.0          31.00
## 285    3705        FALSE      98.0       110         0.0          52.00
## 286    3705        FALSE      89.0       112         0.0          50.00
## 287    3705        FALSE      87.0       113         0.0          55.00
## 288    6066        FALSE      59.0        39         0.0          44.00
## 289    6066        FALSE      54.0        38         0.0          26.00
## 290    6066        FALSE      84.0        68         0.0          70.00
## 291    6066        FALSE      56.0        55         0.0          75.00
## 292    6066        FALSE      56.0        39         0.0          32.00
## 293    6066        FALSE      70.0        52         0.0          42.00
## 294    3469         TRUE      53.0        30         0.0          26.00
## 295    3469         TRUE      65.0        32         0.0          20.00
## 296    3469         TRUE      95.0        53         0.0          57.00
## 297    3469         TRUE      95.0        54         0.0          60.00
## 298    3469         TRUE      47.0        29         0.0          22.00
## 299    3469         TRUE      46.0        28         0.0          20.00
## 300    3469         TRUE      82.0        52         0.0          86.00
## 301    3469         TRUE      81.0        44         0.0          49.00
## 302    3469         TRUE      82.0        49         0.0          46.00
## 303    3469         TRUE      68.0        37         0.0          29.00
## 304    3469         TRUE      46.0        33         0.0          26.00
## 305    3469         TRUE      84.0        56         0.0          81.00
## 306    3469         TRUE      52.0        41         0.0          83.00
## 307    3469         TRUE      73.0        50         0.0          76.00
```

```
## 308    3469          TRUE      85.0        49         0.0          66.00
## 309    3469          TRUE      88.0        50         0.0          57.00
## 310    2187          TRUE      75.0        49         0.0          67.00
## 311    2187          TRUE      72.0        41         0.0          35.00
## 312    2187          TRUE      81.0        49         0.0          80.00
## 313    2187          TRUE      79.0        46         0.0          54.00
## 314    2187          TRUE      68.0        48         0.0          75.00
## 315    2187          TRUE      82.0        50         0.0          49.00
## 316    2187          TRUE      76.0        48         0.0          66.00
## 317    2187          TRUE      69.0        43         0.0          30.00
## 318    2187          TRUE      64.0        37         0.0          34.00
## 319    2187          TRUE      65.0        49         0.0          75.00
## 320    2187          TRUE      82.0        46         0.0          46.00
## 321    2187          TRUE      75.0        47         0.0          34.00
## 322    2187          TRUE      60.0        44         0.0          36.00
## 323    2187          TRUE      87.0        54         0.0          54.00
## 324    2187          TRUE      57.0        28         0.0          21.00
## 325    2187          TRUE      76.0        45         0.0          55.00
## 326    2187          TRUE      63.0        33         0.0          25.00
## 327    2187          TRUE      88.0        52         0.0             NA
## 328    2187          TRUE      70.0        44         0.0          63.00
## 329    2187          TRUE      40.0        38         0.0             NA
## 330    2187          TRUE      70.0        39         0.0             NA
## 331    2187          TRUE      72.0        39         0.0             NA
## 332    3703          TRUE      66.0        81         0.0          34.00
## 333    3703          TRUE      54.0        47         0.0          12.00
## 334    3703          TRUE      74.0        83         0.0          38.00
## 335    3703          TRUE      78.0       138         0.0          77.00
## 336    3703          TRUE      86.0        89         0.0          38.00
## 337    3703          TRUE      70.0        67         0.0          25.00
## 338    3703          TRUE     104.0       101         0.0          41.00
## 339    3703          TRUE      81.0       123         0.0          65.00
## 340    3703          TRUE      86.0       127         0.0          68.00
## 341    3703          TRUE      75.0        92         0.0          42.00
## 342    3703          TRUE      90.0       114         0.0          56.00
## 343    3703          TRUE      88.0       134         0.0          75.00
## 344    3703          TRUE      97.0       120         0.0          58.00
## 345    3703          TRUE      78.0       134         0.0          77.00
## 346    3703          TRUE      85.0        82         0.0          32.00
## 347    3703          TRUE      83.0        83         0.0          28.00
## 348    3703          TRUE      58.0        73         0.0          35.00
## 349    3703          TRUE      68.0        64         0.0          23.00
## 350    3703          TRUE      81.0        79         0.0          35.00
## 351    3703          TRUE      80.0        75         0.0          28.00
## 352    3703          TRUE      72.0       116         0.0          64.00
## 353    3703          TRUE      76.0        85         0.0          38.00
## 354    3703          TRUE      71.0       129         0.0          77.00
## 355    3703          TRUE      75.0        70         0.0          24.00
## 356    3703          TRUE      75.0       124         0.0          70.00
## 357    3703          TRUE      82.0       101         0.0          49.00
## 358    2188          TRUE      61.0        36         0.0          32.00
## 359    2188          TRUE      55.0        25         0.0          20.00
## 360    2188          TRUE      72.0        45         0.0          65.00
## 361    2188          TRUE      69.0        36         0.0          40.00
```

```
## 362    2188         TRUE      75.0        45         0.0         51.00
## 363    2188         TRUE      72.0        45         0.0         32.00
## 364    6067        FALSE      74.0        51         1.0         39.00
## 365    4873        FALSE      78.0        45         1.0         64.00
## 366    4873        FALSE      85.0        49         1.0         44.00
## 367    4873        FALSE      78.0        45         1.0         63.00
## 368    4873        FALSE      68.0        44         1.0         55.00
## 369    7206        FALSE      56.0        39         1.0         30.00
## 370    7206        FALSE      41.0        38         1.0         32.00
## 371    7206        FALSE      55.0        34         1.0         24.00
## 372    9603        FALSE      72.0        49         1.0         62.00
## 373    9603        FALSE      60.0        46         1.0         32.00
## 374    3470        FALSE      67.0        36         1.0         26.00
## 375    6066        FALSE      69.0        48         1.0         37.00
## 376    6066        FALSE      44.0        51         1.0         22.00
## 377    3469         TRUE      98.0        48         1.0         57.00
## 378    2188         TRUE      61.0        31         1.0         25.00
## 379    2188         TRUE      82.0        47         1.0         69.00
## 380    2188         TRUE      66.0        40         1.0         30.00
## 381    2188         TRUE      84.0        50         1.0         70.00
## 382    2188         TRUE      63.0        35         1.0         36.00
## 383    7719        FALSE      44.0        37         2.0         13.00
## 384    7719        FALSE      57.0        38         2.0         18.00
## 385    6067        FALSE      64.0        47         2.0         56.50
## 386    6067        FALSE      73.0        45         2.0         38.50
## 387    6067        FALSE      87.0        45         2.0         25.00
## 388    6067        FALSE      63.0        40         2.0         28.00
## 389    6067        FALSE      59.0        45         2.0         70.00
## 390    4874        FALSE      73.0        54         2.0         51.00
## 391    4874        FALSE      75.0        42         2.0         42.00
## 392    4874        FALSE      48.0        46         2.0         80.00
## 393    4874        FALSE      72.0        43         2.0         38.00
## 394    4874        FALSE      49.0        49         2.0         84.00
## 395    4874        FALSE      64.0        40         2.0         39.00
## 396    4874        FALSE      54.0        33         2.0         34.00
## 397    4873        FALSE      67.0        50         2.0         80.00
## 398    4873        FALSE      60.0        48         2.0         77.00
## 399    4873        FALSE      77.0        55         2.0         80.00
## 400    4873        FALSE      76.0        50         2.0         47.00
## 401    4873        FALSE      63.0        41         2.0         69.00
## 402    4873        FALSE      42.0        28         2.0         22.00
## 403    4873        FALSE      83.0        51         2.0         62.00
## 404    4873        FALSE      70.0        44         2.0         57.00
## 405    4873        FALSE      74.0        37         2.0         32.00
## 406    4873        FALSE      63.0        45         2.0         69.00
## 407    4873        FALSE      71.0        41         2.0         33.00
## 408    7719        FALSE      44.0        37         2.0         13.00
## 409    7719        FALSE      57.0        38         2.0         18.00
## 410    7206        FALSE      70.0        41         2.0         48.00
## 411    7206        FALSE      51.0        30         2.0         16.00
## 412    9603        FALSE      74.0        55         2.0         70.00
## 413    9603        FALSE      67.0        40         2.0         45.00
## 414    9603        FALSE      72.0        54         2.0         85.00
## 415    9603        FALSE      76.0        62         2.0         85.00
```

```
## 416   3470        FALSE      89.0        61         2.0         71.00
## 417   3470        FALSE      71.0        51         2.0         64.00
## 418   1896        FALSE      64.0        42         2.0         37.00
## 419  12978        FALSE     100.0        65         2.0         85.00
## 420  12978        FALSE      98.0        67         2.0         91.00
## 421  12978        FALSE      89.0        59         2.0         84.00
## 422  12978        FALSE      90.0        63         2.0         90.00
## 423  12978        FALSE     105.0        68         2.0         84.00
## 424   6066        FALSE      62.0        55         2.0         67.00
## 425   6066        FALSE      53.0        42         2.0         30.00
## 426   6066        FALSE      70.0        57         2.0         53.00
## 427   6066        FALSE      82.0        62         2.0         43.00
## 428   6066        FALSE      54.0        55         2.0         48.00
## 429   3469         TRUE      86.0        50         2.0         42.00
## 430   3469         TRUE      67.0        39         2.0         25.00
## 431   2187         TRUE      75.0        45         2.0         48.00
## 432   2188         TRUE      78.0        46         2.0         47.00
## 433   2188         TRUE      89.0        52         2.0         51.00
## 434   2188         TRUE      68.0        40         2.0         61.00
## 435   2188         TRUE      73.0        42         2.0         45.00
## 436   2188         TRUE      70.0        39         2.0         35.00
## 437   7719        FALSE      56.0        32         3.0         20.00
## 438   6067        FALSE      68.0        42         3.0         61.00
## 439   6067        FALSE      68.0        50         3.0         57.00
## 440   6067        FALSE      60.0        35         3.0         31.00
## 441   6067        FALSE      80.0        47         3.0         43.00
## 442   6067        FALSE      77.0        53         3.0         46.83
## 443   6067        FALSE      73.5        45         3.0         34.00
## 444   6067        FALSE      93.0        60         3.0         52.50
## 445   4847        FALSE      89.0        49         3.0         49.00
## 446   4874        FALSE      68.0        43         3.0         37.00
## 447   4874        FALSE      84.0        60         3.0         55.00
## 448   4873        FALSE      96.0        55         3.0         52.00
## 449   4873        FALSE      75.0        49         3.0         72.00
## 450   7719        FALSE      56.0        32         3.0         20.00
## 451   7206        FALSE      60.0        34         3.0         20.00
## 452   9603        FALSE      67.0        62         3.0         61.00
## 453   3470        FALSE      64.0        53         3.0         70.00
## 454   6724        FALSE      90.0       100         3.0         44.00
## 455   1896        FALSE      72.0        54         3.0         77.00
## 456  12669        FALSE      74.0        89         3.0         47.00
## 457   7202        FALSE      69.0        46         3.0         35.00
## 458   7202        FALSE      79.0        58         3.0         85.00
## 459   7202        FALSE      78.0        58         3.0         38.00
## 460   6721        FALSE      98.0        52         3.0         74.00
## 461   6721        FALSE      99.0        62         3.0         62.00
## 462   6721        FALSE      71.0        58         3.0         94.00
## 463  12978        FALSE      97.0        61         3.0         61.00
## 464  12978        FALSE     106.0        67         3.0         57.00
## 465  12978        FALSE      99.0        68         3.0         72.00
## 466  12978        FALSE      96.0        65         3.0         95.00
## 467   6718        FALSE      94.0        57         3.0         54.00
## 468   6718        FALSE      92.0        54         3.0         56.00
## 469   6718        FALSE      85.0        49         3.0         31.00
```

```
## 470   6718        FALSE      73.0        44        3.0         29.00
## 471   6718        FALSE      95.0        60        3.0         67.00
## 472  12982        FALSE      78.0        55        3.0         34.00
## 473   3704        FALSE      60.0        75        3.0         35.00
## 474   6066        FALSE      83.0        64        3.0         62.00
## 475   2187         TRUE      82.0        48        3.0         53.00
## 476   2187         TRUE      85.0        50        3.0         72.00
## 477   2187         TRUE      66.0        37        3.0         39.00
## 478   2188         TRUE      71.0        45        3.0         72.00
## 479   2188         TRUE      59.0        40        3.0         45.00
## 480   2188         TRUE      70.0        40        3.0         46.00
## 481   2188         TRUE      78.0        45        3.0         43.00
## 482   2188         TRUE      62.0        40        3.0         72.00
## 483   6067        FALSE      71.0        53        3.5         45.00
## 484   6067        FALSE      90.0        52        4.0         33.00
## 485   6067        FALSE      70.0        50        4.0         58.00
## 486   6067        FALSE      63.0        44        4.0         50.90
## 487   6067        FALSE      82.7        49        4.0         31.50
## 488   4847        FALSE      59.0        46        4.0         83.00
## 489   4847        FALSE      82.0        54        4.0         59.00
## 490   4873        FALSE      51.0        40        4.0         73.00
## 491   4873        FALSE      62.0        43        4.0         73.00
## 492   9603        FALSE      66.0        57        4.0         72.00
## 493   3470        FALSE      91.0        56        4.0         44.00
## 494   7202        FALSE      89.0        55        4.0         69.00
## 495   6721        FALSE      93.0        51        4.0         68.00
## 496   6721        FALSE      67.0        34        4.0         22.00
## 497  12978        FALSE      98.0        59        4.0         57.00
## 498  12978        FALSE      81.0        47        4.0         25.00
## 499  12978        FALSE      88.0        57        4.0         35.00
## 500  12978        FALSE     100.0        58        4.0         36.00
## 501  12978        FALSE      90.0        61        4.0        109.00
## 502  12978        FALSE      94.0        53        4.0         33.00
## 503  12978        FALSE     117.0        65        4.0         79.00
## 504   6718        FALSE     101.0        59        4.0         57.00
## 505   6718        FALSE      92.0        60        4.0         60.00
## 506   6718        FALSE      88.0        57        4.0         44.00
## 507   3704        FALSE      65.0        90        4.0         45.00
## 508   3705        FALSE     102.0       103        4.0         44.00
## 509   6066        FALSE      65.0        54        4.0         46.00
## 510   3469         TRUE      91.0        51        4.0         64.00
## 511   3469         TRUE      92.0        48        4.0         54.00
## 512   3469         TRUE      97.0        52        4.0         66.00
## 513   3703         TRUE      97.0       124        4.0         62.00
## 514   2188         TRUE      78.0        47        4.0         76.00
## 515   2188         TRUE      73.0        41        4.0         31.00
## 516   2188         TRUE      79.0        46        4.0         51.00
## 517   2188         TRUE      72.0        39        4.0         35.00
## 518   2188         TRUE      74.0        42        4.0         32.00
## 519   2188         TRUE      73.0        44        4.0         51.00
## 520   6067        FALSE      72.0        48        5.0         50.00
## 521   6067        FALSE      76.0        49        5.0         34.00
## 522   6067        FALSE      69.0        31        5.0         19.50
## 523   4847        FALSE      92.0        53        5.0         60.00
```

```
## 524    7206         FALSE      70.0        42         5.0          46.00
## 525    9603         FALSE      72.0        57         5.0          44.00
## 526    3470         FALSE     106.0        54         5.0          48.00
## 527    3470         FALSE      89.0        46         5.0          36.00
## 528    1896         FALSE      77.0        54         5.0          90.00
## 529    1896         FALSE      63.0        49         5.0          74.00
## 530    1896         FALSE      52.0        51         5.0          85.00
## 531    1896         FALSE      57.0        46         5.0          71.00
## 532    1896         FALSE      54.0        39         5.0          50.00
## 533   12669         FALSE      85.0        94         5.0          47.00
## 534   12669         FALSE      72.0        78         5.0          32.00
## 535    6721         FALSE      87.0        47         5.0          30.00
## 536    6721         FALSE      72.0        42         5.0          26.00
## 537   12978         FALSE     120.0        73         5.0          58.00
## 538   12978         FALSE      93.0        55         5.0          40.00
## 539    6718         FALSE      86.0        51         5.0          36.00
## 540    6718         FALSE      88.0        49         5.0          30.00
## 541    6718         FALSE      84.0        59         5.0          71.00
## 542    6066         FALSE      90.0        66         5.0          53.00
## 543    6066         FALSE      69.0        38         5.0          26.00
## 544    2188          TRUE      70.0        35         5.0          36.00
## 545    2188          TRUE      72.0        48         5.0          65.00
## 546    2188          TRUE      70.0        41         5.0          27.00
## 547    6067         FALSE      72.0        41         6.0          42.50
## 548    4874         FALSE      88.0        62         6.0          61.00
## 549    4873         FALSE      89.0        51         6.0          50.00
## 550    7206         FALSE      50.0        39         6.0          72.00
## 551    9603         FALSE      68.0        45         6.0          38.00
## 552    9603         FALSE      93.0        54         6.0          41.00
## 553    3470         FALSE      80.0        44         6.0          35.00
## 554    1896         FALSE      63.0        40         6.0          48.00
## 555    1896         FALSE      85.0        45         6.0          41.00
## 556    1896         FALSE      89.0        60         6.0          95.00
## 557    7202         FALSE      50.0        34         6.0          23.00
## 558    6721         FALSE     108.0        61         6.0          47.00
## 559    6721         FALSE      83.0        56         6.0          70.00
## 560    6721         FALSE     113.0        64         6.0          58.00
## 561   12978         FALSE      80.0        65         6.0          71.00
## 562   12978         FALSE      86.0        54         6.0          34.00
## 563   12978         FALSE     110.0        68         6.0          72.00
## 564    6718         FALSE      92.0        49         6.0          37.00
## 565    6718         FALSE      73.0        61         6.0          73.00
## 566    6718         FALSE      95.0        64         6.0          65.00
## 567   12982         FALSE      85.0        65         6.0          78.00
## 568    3704         FALSE      65.0        62         6.0          25.00
## 569    6066         FALSE      64.0        52         6.0          74.00
## 570    3469          TRUE     100.0        52         6.0          44.00
## 571    2187          TRUE      75.0        40         6.0          39.00
## 572    3703          TRUE      83.0        78         6.0          28.00
## 573    6067         FALSE      69.0        55         7.0          74.50
## 574    4874         FALSE      75.0        59         7.0          64.00
## 575    7206         FALSE      69.0        44         7.0          46.00
## 576    3470         FALSE      88.0        48         7.0          52.00
## 577    3470         FALSE     108.0        63         7.0          63.00
```

```
## 578   6721        FALSE      91.0       105         7.0          35.00
## 579   6733        FALSE      90.0       127         7.0          65.00
## 580   1896        FALSE      74.0        49         7.0          72.00
## 581   1896        FALSE     102.0        73         7.0         101.00
## 582  12669        FALSE      69.0       125         7.0          69.00
## 583   7202        FALSE      72.0        48         7.0          35.00
## 584   6721        FALSE      99.0        52         7.0          39.00
## 585   6718        FALSE      92.0        60         7.0          64.00
## 586   6718        FALSE      85.0        44         7.0          31.00
## 587  12982        FALSE      91.0        54         7.0          37.00
## 588   3705        FALSE     100.0       130         7.0          63.00
## 589   6066        FALSE      71.0        50         7.0          43.00
## 590   3469         TRUE      99.0        46         7.0          49.00
## 591   3469         TRUE      55.0        35         7.0          39.00
## 592   3469         TRUE      90.0        50         7.0          68.00
## 593   3470        FALSE      86.0        49         8.0          35.00
## 594   3470        FALSE      72.0        52         8.0          93.00
## 595   7202        FALSE      83.0        48         8.0          27.00
## 596   6718        FALSE      84.0        58         8.0          56.00
## 597  12982        FALSE     105.0        70         8.0          80.00
## 598  12982        FALSE      74.0        64         8.0          62.00
## 599  12982        FALSE      83.0        63         8.0          41.00
## 600  12982        FALSE      76.0        50         8.0          32.00
## 601  12982        FALSE      48.0        45         8.0          22.00
## 602   3704        FALSE      66.0        99         8.0          49.00
## 603   3469         TRUE      52.0        47         8.0          80.00
## 604   6067        FALSE      74.0        40         9.0          33.00
## 605   6067        FALSE      81.5        55         9.0          58.00
## 606   3470        FALSE     114.0        64         9.0          74.00
## 607   3470        FALSE     104.0        62         9.0          50.00
## 608   3470        FALSE      78.0        42         9.0          59.00
## 609   6721        FALSE      97.0        56         9.0          32.00
## 610  12982        FALSE      92.0        55         9.0          30.00
## 611   6067        FALSE      54.0        50        10.0          80.00
## 612   6067        FALSE      83.0        53        10.0          36.00
## 613   6067        FALSE      86.0        40        10.0          26.00
## 614   6067        FALSE      80.0        49        10.0          46.90
## 615   7206        FALSE      28.0        29        10.0          26.00
## 616   9603        FALSE      52.0        31        10.0          54.00
## 617   6718        FALSE     101.0        63        10.0          66.00
## 618  12982        FALSE      96.0        58        10.0          35.00
## 619   2187         TRUE      76.0        43        10.0          33.00
## 620   6067        FALSE      73.0        37        11.0          38.00
## 621   4874        FALSE      84.0        47        11.0          45.00
## 622   7206        FALSE      68.0        41        11.0          37.00
## 623  12669        FALSE      89.0        97        11.0          55.00
## 624   7202        FALSE      87.0        54        11.0          33.00
## 625   7202        FALSE      78.0        68        11.0         113.00
## 626  12978        FALSE      91.0        67        11.0          73.00
## 627  12978        FALSE      97.0        55        11.0          64.00
## 628   6718        FALSE      80.0        53        11.0          59.00
## 629  12982        FALSE      92.0        52        11.0          35.00
## 630   7206        FALSE      81.0        54        12.0          64.00
## 631  12982        FALSE      96.0        58        12.0          54.00
```

```
## 632   12982         FALSE      42.0        47        12.0          23.00
## 633    6066         FALSE      71.0        47        12.0          47.00
## 634    3469          TRUE     111.0        61        12.0          71.00
## 635    2187          TRUE      60.0        41        12.0          27.00
## 636    3703          TRUE      77.0        73        12.0          28.00
## 637    3703          TRUE      35.0        30        12.0           8.00
## 638    3470         FALSE      84.0        58        14.0          75.00
## 639   12978         FALSE     119.0        75        14.0          70.00
## 640   12982         FALSE      98.0        70        14.0         100.00
## 641   12982         FALSE     103.0        75        14.0          83.00
## 642   12982         FALSE      55.0        55        14.0          33.00
## 643    7206         FALSE      81.0        51        15.0          64.00
## 644   12982         FALSE     100.0        72        15.0          77.00
## 645    4874         FALSE      75.0        53        16.0          87.00
## 646   12978         FALSE     123.0        74        16.0          62.00
## 647   12982         FALSE     107.0        65        16.0          52.00
## 648    3469          TRUE      73.0        46        16.0          79.00
## 649    7206         FALSE      76.0        50        17.0          45.00
## 650    3470         FALSE     109.0        62        17.0          80.00
## 651    2187         FALSE      85.0        54        18.0          57.00
## 652   12978         FALSE     121.0        76        18.0          67.00
## 653    6718         FALSE      96.0        62        18.0          42.00
## 654    7202         FALSE     100.0        59        19.0          45.00
## 655   12978         FALSE      86.0        55        20.0          29.00
## 656    6066         FALSE      55.0        46        20.0          34.00
## 657    2187         FALSE      82.0        55        21.0          59.00
## 658   12978         FALSE     115.0        74        21.0          66.00
## 659    6718         FALSE     116.0        76        21.0          55.00
## 660    6718         FALSE      66.0        70        21.0          39.00
## 661    2187          TRUE      78.0        44        21.0          30.00
## 662   12978         FALSE     121.0        73        22.0          61.00
## 663   12982         FALSE      60.0        65        22.0          36.00
## 664   12982         FALSE     101.0        60        23.0          49.00
## 665    3469          TRUE      90.0        66        24.0          81.00
## 666    6718         FALSE      65.0        68        26.0          25.00
## 667   12978         FALSE     130.0        80        27.0          76.00
## 668    6718         FALSE      86.0        80        28.0          51.00
## 669   12982         FALSE      72.0        73        29.0          38.00
## 670   12982         FALSE      59.0        63        29.0          22.00
## 671    9603         FALSE      90.0        78        30.0          18.00
## 672    9603         FALSE      72.0        59        30.0          25.00
## 673    6718         FALSE     103.0        74        32.0          69.00
## 674    6718         FALSE      84.0        68        32.0          52.00
## 675   12982         FALSE      78.0        85        32.0          20.00
## 676   12982         FALSE      87.0        70        32.0          45.00
## 677    6718         FALSE      95.0        77        40.0          80.00
## 678   12982         FALSE      68.0        77        47.0          24.00
## 679    6718         FALSE      83.0        76        49.0          23.00
## 680    7206         FALSE      70.0        39         0.0          53.00
## 681    7206         FALSE      71.0        41         0.0          68.00
## 682    7206         FALSE      63.0        40         0.0          36.00
## 683    7206         FALSE      62.0        39         0.0          36.00
## 684    7206         FALSE      51.0        38         0.0          22.00
## 685    7206         FALSE      51.0        32         0.0          30.00
```

```
## 686    7206         FALSE      66.0         39          0.0          16.00
## 687    7206         FALSE      73.0         47          0.0          42.00
## 688    7206         FALSE      65.0         43          0.0          52.00
## 689    7206         FALSE      66.0         32          0.0          38.00
## 690    7206         FALSE      81.0         55          0.0          42.00
## 691    7206         FALSE      49.0         26          0.0          16.00
## 692    7206         FALSE      61.0         31          0.0          26.00
## 693    7206         FALSE      48.0         25          0.0          20.00
## 694    7206         FALSE      43.0         25          0.0          18.00
## 695    7206         FALSE      61.0         36          0.0          40.00
## 696    2187         FALSE      53.0         31          0.0          36.00
## 697    2187         FALSE      55.0         33          0.0          31.00
## 698    2187         FALSE      38.0         37          0.0          50.00
## 699    2187         FALSE      78.0         48          0.0          51.00
## 700    2187         FALSE      58.0         40          0.0          25.00
## 701    2187         FALSE      58.0         39          0.0          42.00
## 702    2187         FALSE      53.0         35          0.0          39.00
## 703    2187         FALSE      53.0         32          0.0          35.00
## 704    2187         FALSE      55.0         37          0.0          41.00
## 705    2187         FALSE      40.0         30          0.0          58.00
## 706    2187         FALSE      35.0         25          0.0          42.00
## 707    2187         FALSE      54.0         37          0.0          32.00
## 708    2187         FALSE      54.0         33          0.0          27.00
## 709    2187         FALSE      38.0         31          0.0          52.00
## 710    2187         FALSE      44.0         25          0.0          20.00
## 711    2187         FALSE      53.0         31          0.0          32.00
## 712    2187         FALSE      42.0         27          0.0          35.00
## 713    2187         FALSE      49.0         25          0.0          23.00
## 714    2187         FALSE      45.0         32          0.0          45.00
## 715    2187         FALSE      42.0         27          0.0          26.00
## 716    2187         FALSE      34.0         20          0.0          17.00
## 717    2187         FALSE      36.0         26          0.0          12.00
## 718    2187         FALSE      39.0         26          0.0          26.00
## 719    2187         FALSE      16.0         19          0.0          49.00
## 720    1896         FALSE      75.0         50          0.0          60.00
## 721    1896         FALSE      62.0         46          0.0          78.00
## 722    1896         FALSE     103.0         72          0.0          70.00
## 723    1896         FALSE      92.0         63          0.0          86.00
## 724    1896         FALSE      74.0         54          0.0          59.00
## 725    1896         FALSE      68.0         41          0.0          39.00
## 726    1896         FALSE      84.0         51          0.0          60.00
## 727    1896         FALSE      88.0         65          0.0          81.00
## 728    1896         FALSE      70.0         49          0.0          79.00
## 729    1896         FALSE      41.0         32          0.0          56.00
## 730    1896         FALSE      70.0         51          0.0          70.00
## 731    1896         FALSE      38.0         27          0.0          22.00
## 732    1896         FALSE      75.0         53          0.0          65.00
## 733    1896         FALSE      67.0         42          0.0          46.00
## 734    1896         FALSE      72.0         50          0.0          56.00
## 735    1896         FALSE      61.0         42          0.0          43.00
## 736    1896         FALSE      68.0         46          0.0          49.00
## 737    1896         FALSE      54.0         43          0.0          70.00
## 738    7202         FALSE      93.0         57          0.0          65.00
## 739    7202         FALSE      75.0         45          0.0          85.00
```

```
## 740    7202         FALSE      74.0        50         0.0          54.00
## 741    7202         FALSE      61.0        44         0.0          59.00
## 742    7202         FALSE      72.0        46         0.0          52.00
## 743    7202         FALSE      68.0        45         0.0          62.00
## 744    7202         FALSE      62.0        38         0.0          35.00
## 745    7202         FALSE      72.0        45         0.0          45.00
## 746    7202         FALSE      66.0        42         0.0          34.00
## 747    7202         FALSE      68.0        58         0.0          37.00
## 748    7202         FALSE      74.0        46         0.0          35.00
## 749    7202         FALSE      65.0        49         0.0          81.00
## 750    7202         FALSE      68.0        47         0.0          58.00
## 751    7202         FALSE      78.0        52         0.0          39.00
## 752    7202         FALSE      75.0        48         0.0          38.00
## 753    7202         FALSE      78.0        52         0.0          49.00
## 754    7202         FALSE      65.0        49         0.0          48.00
## 755    7202         FALSE      74.0        67         0.0          46.00
## 756    7202         FALSE     105.0        64         0.0          53.00
```

Several useful functions to vizualize the specific data information from the DataFrame:

nrow() function

```
## Helps to vidualize the rows prsent in a data frame
nrow(ginkgo)
```

```
## [1] 756
```

ncol() function

```
## Helps to vidualize the columns prsent in a data frame
ncol(ginkgo)
```

```
## [1] 6
```

dim() function

```
## Helps to vidualize the rows and columns prsent in a data frame
dim(ginkgo)
```

```
## [1] 756   6
```

Subsetting

Useful function in R, which allow to filter only the specific part from the data set or data

$

Selecting or mentioning (subsetting) a data set by the name

```
head(ginkgo$petiole_length)
```

```
## [1] 30 23 20 28 25 55
```

[]

Selects data sets py position

```
## Select the first row.
head(ginkgo[1,])
```

```
##   site_id seeds_present max_width max_depth notch_depth petiole_length
## 1    7719         FALSE        71        40           0             30
```

```
## Select the third column.
head(ginkgo[,3])
```

```
## [1] 71 64 55 62 65 70
```

subset() function

subset use to select a certain subset from vectors, matrices or data frames

```
## Recover all Adelie penguins data from the "palmerpenguins" dataset.
head(subset(penguins, species == "Adelie"))
```

```
## # A tibble: 6 x 8
##   species island bill_length_mm bill_depth_mm flipper_length_~ body_mass_g sex
##   <fct>   <fct>           <dbl>         <dbl>            <int>       <int> <fct>
## 1 Adelie  Torge~           39.1          18.7              181        3750 male
## 2 Adelie  Torge~           39.5          17.4              186        3800 fema~
## 3 Adelie  Torge~           40.3          18                195        3250 fema~
## 4 Adelie  Torge~           NA            NA                 NA          NA <NA>
## 5 Adelie  Torge~           36.7          19.3              193        3450 fema~
## 6 Adelie  Torge~           39.3          20.6              190        3650 male
## # ... with 1 more variable: year <int>
```

Numerical Data Exploration

summary() function

This function provides the model summary

```r
summary(penguins)
```

```
##       species          island    bill_length_mm  bill_depth_mm
##  Adelie   :152   Biscoe   :168   Min.   :32.10   Min.   :13.10
##  Chinstrap: 68   Dream    :124   1st Qu.:39.23   1st Qu.:15.60
##  Gentoo   :124   Torgersen: 52   Median :44.45   Median :17.30
##                                  Mean   :43.92   Mean   :17.15
##                                  3rd Qu.:48.50   3rd Qu.:18.70
##                                  Max.   :59.60   Max.   :21.50
##                                  NA's   :2       NA's   :2
##  flipper_length_mm  body_mass_g       sex           year
##  Min.   :172.0     Min.   :2700   female:165   Min.   :2007
##  1st Qu.:190.0     1st Qu.:3550   male  :168   1st Qu.:2007
##  Median :197.0     Median :4050   NA's  : 11   Median :2008
##  Mean   :200.9     Mean   :4202                Mean   :2008
##  3rd Qu.:213.0     3rd Qu.:4750                3rd Qu.:2009
##  Max.   :231.0     Max.   :6300                Max.   :2009
##  NA's   :2         NA's   :2
```

mean () function

This function provides the average (mean) of a data set

```r
# For observing the mean bill length
mean(penguins$bill_length_mm, na.rm = TRUE)
```

```
## [1] 43.92193
```

sd() function

This function produces the standard daviation from a dataset. For example we can calculate the standard deviation of bill length

```r
sd(penguins$bill_length_mm, na.rm = TRUE)
```

```
## [1] 5.459584
```

Graphical Data Exploration

Scatterplot()

- Scatterplot can be generated usung the plott() function. Plot requires arguments as following:

col: Deals with the colors. Useful functions for using the colors are- rgb() and colors() functions (color names and IDs)

pch: Assigns the types of points (circle, triangle, star etc.) within the plot

cex: Specifies the size of the points in the scatterplot

main: Title of the plot

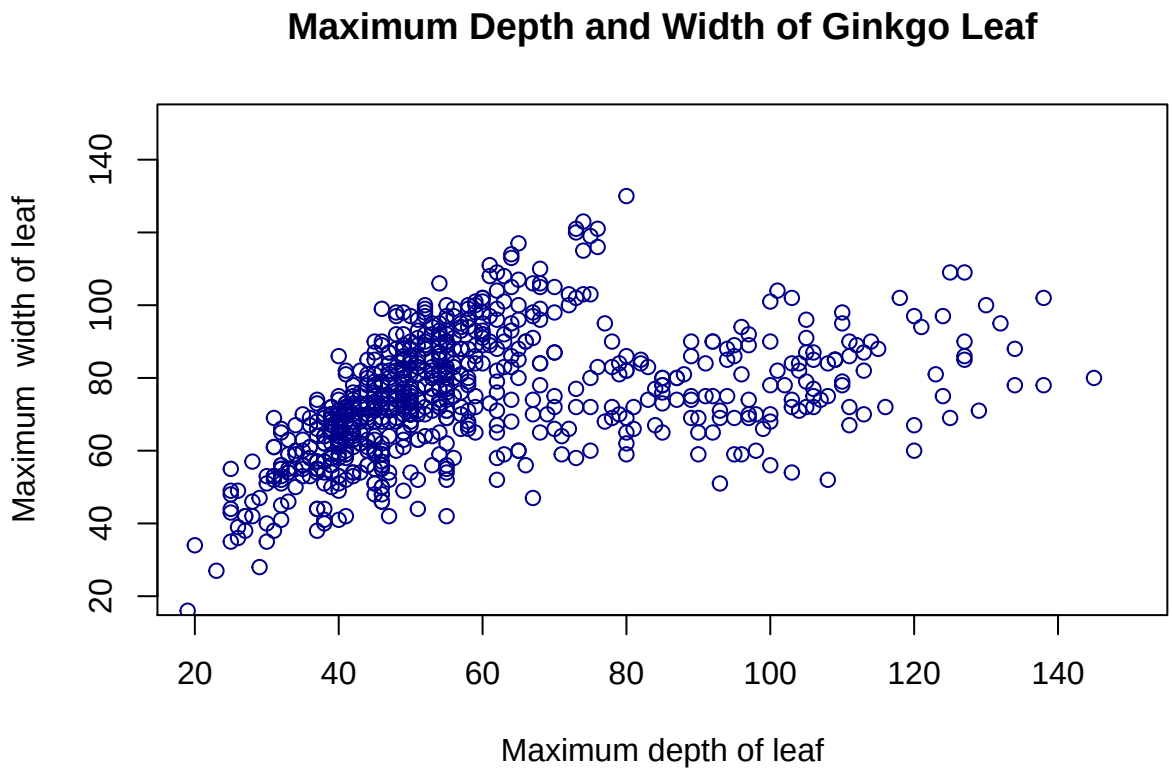
xlab: Title of x-axis

ylab: Title of y-axis

xlim: Controls the minimum and maximum values in the x-axis

ylim: Controls the minimum and maximum values in the y-axis

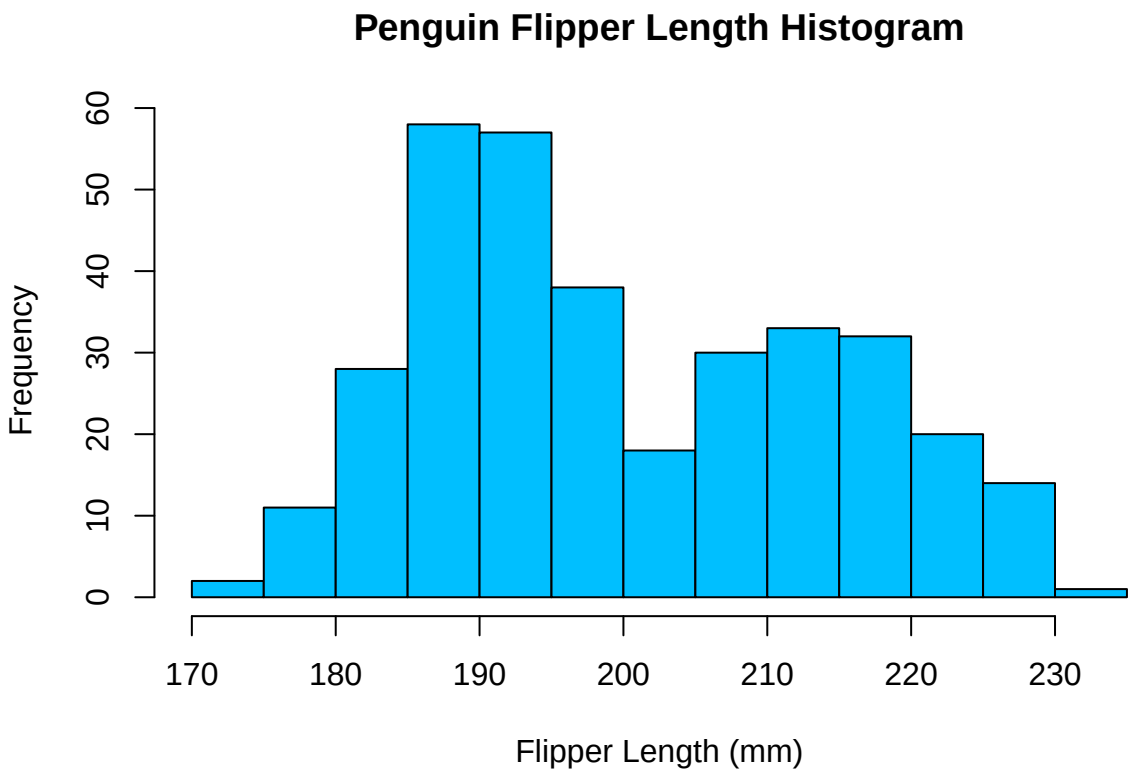
```
plot(max_width ~ max_depth, data = ginkgo, main = "Maximum Depth and Width of Ginkgo Leaf",
     xlab = "Maximum depth of leaf", ylab = "Maximum  width of leaf",
     pch = 1, cex = 1,
     col = "blue4",
     xlim = c(20,150),
     ylim = c(20,150)
)
```



hist() function

Creates histogram.

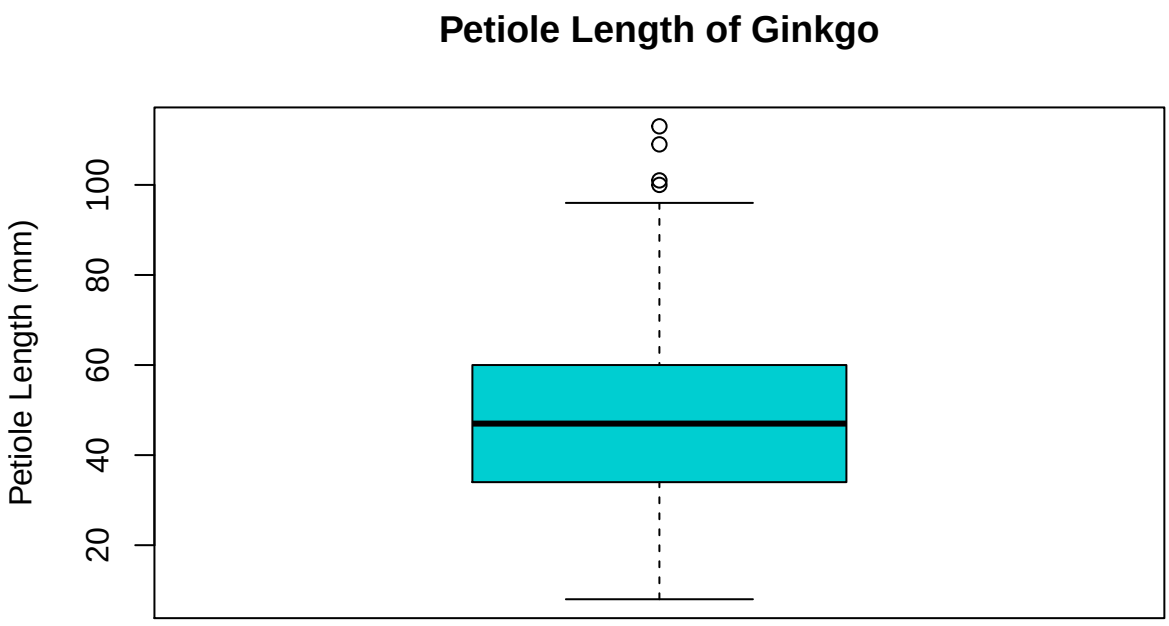
```
hist(penguins$flipper_length_mm,
     breaks = 9,
     main = "Penguin Flipper Length Histogram",
     xlab = "Flipper Length (mm)",
     col = "deepskyblue1")
```



boxplot() function

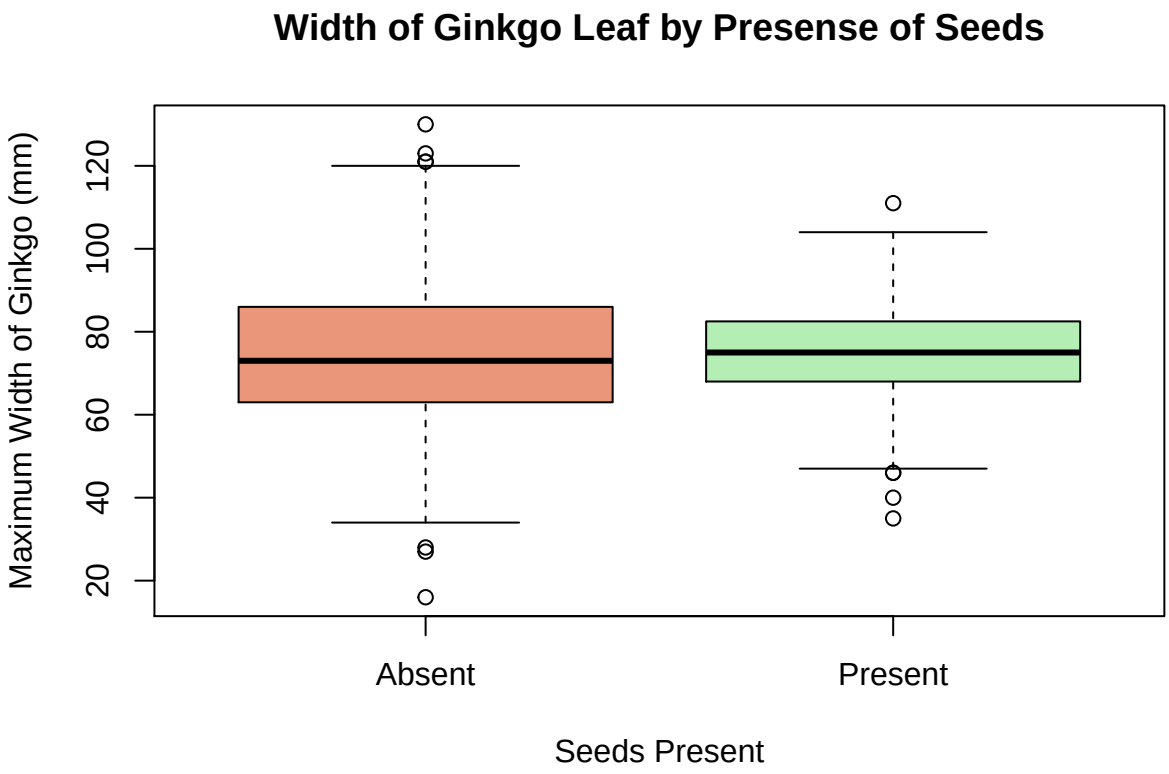
1. a simple boxplot of ginkgo petiole lengths

```
boxplot(
  ginkgo$petiole_length,
  main = "Petiole Length of Ginkgo",
  ylab = "Petiole Length (mm)",
  col = "darkturquoise"
)
```



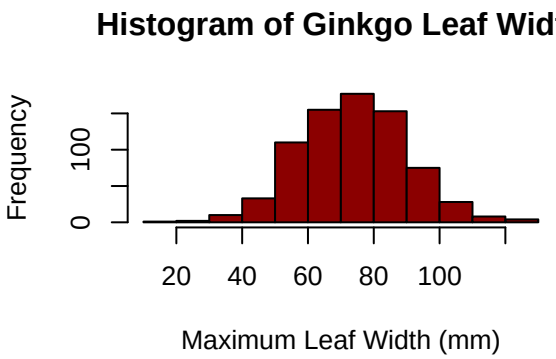
2. conditional boxplot of one of the continuous variables conditioned on the seeds_present column

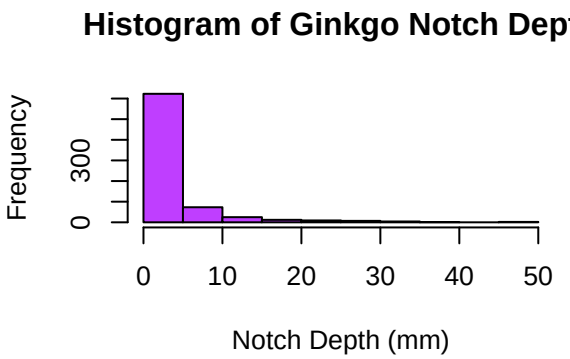
```
boxplot(
  data = ginkgo, max_width ~ seeds_present,
  main = "Width of Ginkgo Leaf by Presense of Seeds",
  xlab = "Seeds Present",
  ylab = "Maximum Width of Ginkgo (mm)",
  names = c("Absent", "Present"),
  col = c("darksalmon", "darkseagreen2")
)
```

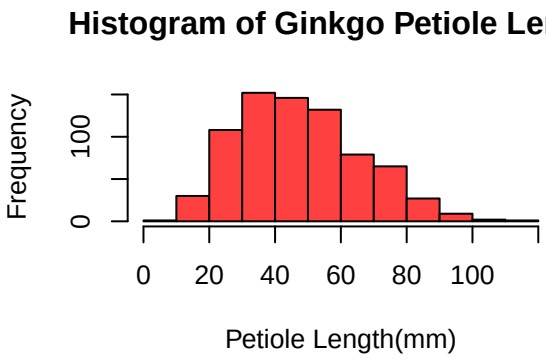


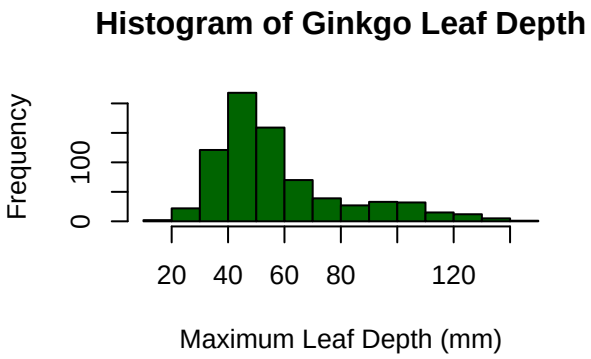
4-panel figure of histograms

```
par(mfrow = c(2,2))

hist(ginkgo$max_width,
     main = "Histogram of Ginkgo Leaf Width",
     xlab = "Maximum Leaf Width (mm)",
     col = "darkred")

hist(ginkgo$notch_depth,
     main = "Histogram of Ginkgo Notch Depth",
     xlab = "Notch Depth (mm)",
     col = "darkorchid1")

hist(ginkgo$petiole_length,
     main = "Histogram of Ginkgo Petiole Length",
     xlab = "Petiole Length(mm)",
     col = "brown1")

hist(ginkgo$max_depth,
     main = "Histogram of Ginkgo Leaf Depth",
     xlab = "Maximum Leaf Depth (mm)",
     col = "darkgreen")
```









Distribution Functions

- Distribution functions are important to get idea about the probability of the specific values or the set of values. Distribution function is two types- ** Normal Distribution ** Binomial Distribution

Normal Distribution

Known as the continuous probability distribution where values are placed in a symmetrical style and situated around the mean.

dnorm() function

It's a probability density function of normal distribution

```
dnorm(5, mean = 2, sd = 1)
```

```
## [1] 0.004431848
```

```
## Probability of observing a value of 5, with a mean value 2 and a SD value 1.
```

pnorm() function

Its a commulative distribution function of the normal distribution

```
pnorm(q = 4, mean = 6, sd = 3)
```

```
## [1] 0.2524925
```

```
## Probability of observing a value of 4 with a mean value 6 and a SD value 3.
```

qnorm() function

Its a quantile function of normal distribution

```
qnorm(p = 0.25, mean = 1, sd = 1)
```

```
## [1] 0.3255102
```

```
## Probability one fourth (25%) with a mean and SD value 1.
```

Binomial Distribution

Known as the discrete probability distribution with two outcomes (number of successes or failure)

dbinom() function

Its the probability density function for the binomial distribution

```
dbinom(x = 5, size = 100, prob = 0.5)
```

```
## [1] 5.939138e-23
```

```
## Probability of observing a value of 5 with a trial size of 100, and prob = 0.5
```

pbinom() function

Cummulative distribution function for the binomial distribution

```
pbinom(q = 4, size = 100, prob = 0.5)
```

```
## [1] 3.224844e-24
```

```
## Probability of observing a value of less than 5 with a trial size of 100 and prob of 0.5
```

qbinom() function

Quantile function for the binomial distribution

```r
qbinom(p = 0.5, size = 100, prob = 0.5)
```

```
## [1] 50
```

```r
## Probability of one fourth (25%) with a trial size of 100, and a prob. = 0.5
```