uhuru-dataset-visualization.Rmd

Marcos Padilla-Ruiz

2022-10-04

1. Describing the data we are using

This data was gathered through the UHURU experiment which consisted of enclosures of various sizes to gauge the ecological impacts that may occur to Acacia trees in Kenya. Firstly there is the mega-herbivore fence which is designed to keep larger herbivores outside the enclosure such as giraffes and elephants. Then there is https://esapubs.org/archive/ecol/E095/064/metadata.php

add a picture of an acacia ### 2. reading the data table into R

```
acacia <- read.csv(file = "/Users/marcos/Desktop/BIO 197/Data_Science_Project/raw_data/ACACIA_DREPANOLO
```

3. explore our data

```
head(acacia)
```

```
##   SURVEY YEAR  SITE BLOCK TREATMENT    PLOT   ID HEIGHT AXIS1 AXIS2 CIRC
## 1      1 2012 SOUTH     1     TOTAL S1TOTAL  581   2.25  2.75  2.15   20
## 2      1 2012 SOUTH     1     TOTAL S1TOTAL  582   2.65  4.10  3.90   28
## 3      1 2012 SOUTH     1     TOTAL S1TOTAL 3111    1.5  1.70  0.85   17
## 4      1 2012 SOUTH     1     TOTAL S1TOTAL 3112   2.01  1.80  1.60   12
## 5      1 2012 SOUTH     1     TOTAL S1TOTAL 3113   1.75  1.84  1.42   13
## 6      1 2012 SOUTH     1     TOTAL S1TOTAL 3114   1.65  1.62  0.85   15
##   FLOWERS BUDS FRUITS ANT
## 1       0    0     10  CS
## 2       0    0    150  TP
## 3       2    1     50  TP
## 4       0    0     75  CS
## 5       0    0     20  CS
## 6       0    0      0   E
```

```
tail(acacia)
```

```
##     SURVEY YEAR  SITE BLOCK TREATMENT    PLOT   ID HEIGHT AXIS1 AXIS2 CIRC
## 152      1 2012 SOUTH     3     TOTAL S3TOTAL 2175   1.42  1.45  1.30   13
## 153      1 2012 SOUTH     3     TOTAL S3TOTAL 2176   1.02  1.20  1.00    8
## 154      1 2012 SOUTH     3     TOTAL S3TOTAL 2177    1.4  1.20  1.00    9
## 155      1 2012 SOUTH     3     TOTAL S3TOTAL 2178   1.45  2.10  2.05   15
## 156      1 2012 SOUTH     3      MESO  S3MESO 1421   1.95  2.20  1.60   13
## 157      1 2012 SOUTH     3      MESO  S3MESO 1422   dead    NA    NA   NA
```

```
##     FLOWERS BUDS FRUITS ANT
## 152       0    0      0  TP
## 153       0    0      0  TP
## 154       0    0      0  TP
## 155       0    0     20  TP
## 156       0    0      2  CS
## 157      NA   NA     NA
```

```
summary(acacia)
```

```
##      SURVEY       YEAR          SITE               BLOCK
##  Min.   :1   Min.   :2012   Length:157         Min.   :1.000
##  1st Qu.:1   1st Qu.:2012   Class :character   1st Qu.:2.000
##  Median :1   Median :2012   Mode  :character   Median :2.000
##  Mean   :1   Mean   :2012                      Mean   :2.089
##  3rd Qu.:1   3rd Qu.:2012                      3rd Qu.:2.000
##  Max.   :1   Max.   :2012                      Max.   :3.000
##
##   TREATMENT             PLOT                 ID          HEIGHT
##  Length:157         Length:157         Min.   : 101   Length:157
##  Class :character   Class :character   1st Qu.:1062   Class :character
##  Mode  :character   Mode  :character   Median :1301   Mode  :character
##                                        Mean   :1743
##                                        3rd Qu.:3118
##                                        Max.   :3199
##
##      AXIS1           AXIS2            CIRC          FLOWERS
##  Min.   :0.700   Min.   :0.550   Min.   : 4.00   Min.   : 0.0000
##  1st Qu.:1.400   1st Qu.:1.100   1st Qu.:10.00   1st Qu.: 0.0000
##  Median :1.800   Median :1.490   Median :13.00   Median : 0.0000
##  Mean   :1.972   Mean   :1.636   Mean   :13.76   Mean   : 0.4444
##  3rd Qu.:2.350   3rd Qu.:2.000   3rd Qu.:16.00   3rd Qu.: 0.0000
##  Max.   :5.550   Max.   :4.820   Max.   :35.20   Max.   :40.0000
##  NA's   :4       NA's   :4       NA's   :4       NA's   :4
##       BUDS             FRUITS           ANT
##  Min.   : 0.0000   Min.   :  0.00   Length:157
##  1st Qu.: 0.0000   1st Qu.:  0.00   Class :character
##  Median : 0.0000   Median :  0.00   Mode  :character
##  Mean   : 0.3595   Mean   : 20.03
##  3rd Qu.: 0.0000   3rd Qu.: 25.00
##  Max.   :50.0000   Max.   :300.00
##  NA's   :4         NA's   :4
```

```
colnames(acacia)
```

```
##  [1] "SURVEY"    "YEAR"      "SITE"      "BLOCK"     "TREATMENT" "PLOT"
##  [7] "ID"        "HEIGHT"    "AXIS1"     "AXIS2"     "CIRC"      "FLOWERS"
## [13] "BUDS"      "FRUITS"    "ANT"
```

```
nrow(acacia)
```

```
## [1] 157
```

make sure that everything that is a number is actually numeric use function summary to do this and check that the type of data corresponds to this in another way is to use the type function

```
typeof(acacia[, "HEIGHT"])
```

```
## [1] "character"
```

```
acacia$HEIGHT
```

```
##   [1] "2.25" "2.65" "1.5"  "2.01" "1.75" "1.65" "1.2"  "1.45" "1.87" "2.38"
##  [11] "2.58" "2.65" "2.35" "1.88" "2.32" "2.39" "2.2"  "1.05" "2"    "1.28"
##  [21] "dead" "1.4"  "1.9"  "1.75" "1.8"  "2.7"  "2.02" "1.9"  "1.85" "1.65"
##  [31] "1.4"  "2.5"  "2.05" "2.26" "2.13" "1.8"  "1.85" "1.5"  "1.87" "1.58"
##  [41] "2.05" "1.75" "1.49" "1.28" "1.49" "1.07" "1.48" "1.25" "1.41" "1.6"
##  [51] "1.2"  "1.49" "1.5"  "1.65" "1.13" "1.25" "1.1"  "2.2"  "1.45" "1.6"
##  [61] "1.55" "1.5"  "1.03" "2.14" "1.2"  "1.05" "1.8"  "1.2"  "1.75" "1.45"
##  [71] "1.17" "2.15" "1.7"  "1.98" "1.26" "1.11" "1.14" "1.26" "1.3"  "1.29"
##  [81] "1.31" "1.15" "1.87" "1.47" "1.05" "2.1"  "1.99" "1.42" "1.5"  "1.06"
##  [91] "1.49" "1.8"  "1.93" "1.2"  "1.65" "1.52" "1.43" "1.25" "1.88" "1.03"
## [101] "1.1"  "1.4"  "1.05" "1.18" "1.4"  "1.37" "1.32" "1.55" "1.3"  "1.24"
## [111] "1.5"  "1.65" "2.17" "1.28" "1.07" "0.67" "0.68" "1.87" "1.35" "1.75"
## [121] "1.75" "1.64" "1.42" "dead" "0.9"  "dead" "1.8"  "2.47" "2.15" "1.7"
## [131] "1.9"  "1.95" "1.8"  "1.4"  "1"    "1.75" "1.28" "1"    "1.45" "1"
## [141] "1.03" "1.51" "1.17" "1.33" "1.3"  "1.13" "1.58" "1.06" "1.05" "1.45"
## [151] "1.15" "1.42" "1.02" "1.4"  "1.45" "1.95" "dead"
```

idenitifed a columnn thta has problmeatic data so wee need to fix it so were gonna read the data table and assign “NA” to “dead” value in the height column

```
acacia <- read.csv(file = "/Users/marcos/Desktop/BIO 197/Data_Science_Project/raw_data/ACACIA_DREPANOLO
                   sep = "\t", na.strings = "dead")
getwd()
```

```
## [1] "/Users/marcos/Desktop/BIO 197/Data_Science_Project/scripts"
```

```
acacia$HEIGHT
```

```
##   [1] 2.25 2.65 1.50 2.01 1.75 1.65 1.20 1.45 1.87 2.38 2.58 2.65 2.35 1.88 2.32
##  [16] 2.39 2.20 1.05 2.00 1.28   NA 1.40 1.90 1.75 1.80 2.70 2.02 1.90 1.85 1.65
##  [31] 1.40 2.50 2.05 2.26 2.13 1.80 1.85 1.50 1.87 1.58 2.05 1.75 1.49 1.28 1.49
##  [46] 1.07 1.48 1.25 1.41 1.60 1.20 1.49 1.50 1.65 1.13 1.25 1.10 2.20 1.45 1.60
##  [61] 1.55 1.50 1.03 2.14 1.20 1.05 1.80 1.20 1.75 1.45 1.17 2.15 1.70 1.98 1.26
##  [76] 1.11 1.14 1.26 1.30 1.29 1.31 1.15 1.87 1.47 1.05 2.10 1.99 1.42 1.50 1.06
##  [91] 1.49 1.80 1.93 1.20 1.65 1.52 1.43 1.25 1.88 1.03 1.10 1.40 1.05 1.18 1.40
## [106] 1.37 1.32 1.55 1.30 1.24 1.50 1.65 2.17 1.28 1.07 0.67 0.68 1.87 1.35 1.75
## [121] 1.75 1.64 1.42   NA 0.90   NA 1.80 2.47 2.15 1.70 1.90 1.95 1.80 1.40 1.00
## [136] 1.75 1.28 1.00 1.45 1.00 1.03 1.51 1.17 1.33 1.30 1.13 1.58 1.06 1.05 1.45
## [151] 1.15 1.42 1.02 1.40 1.45 1.95   NA
```

4. visualize our data

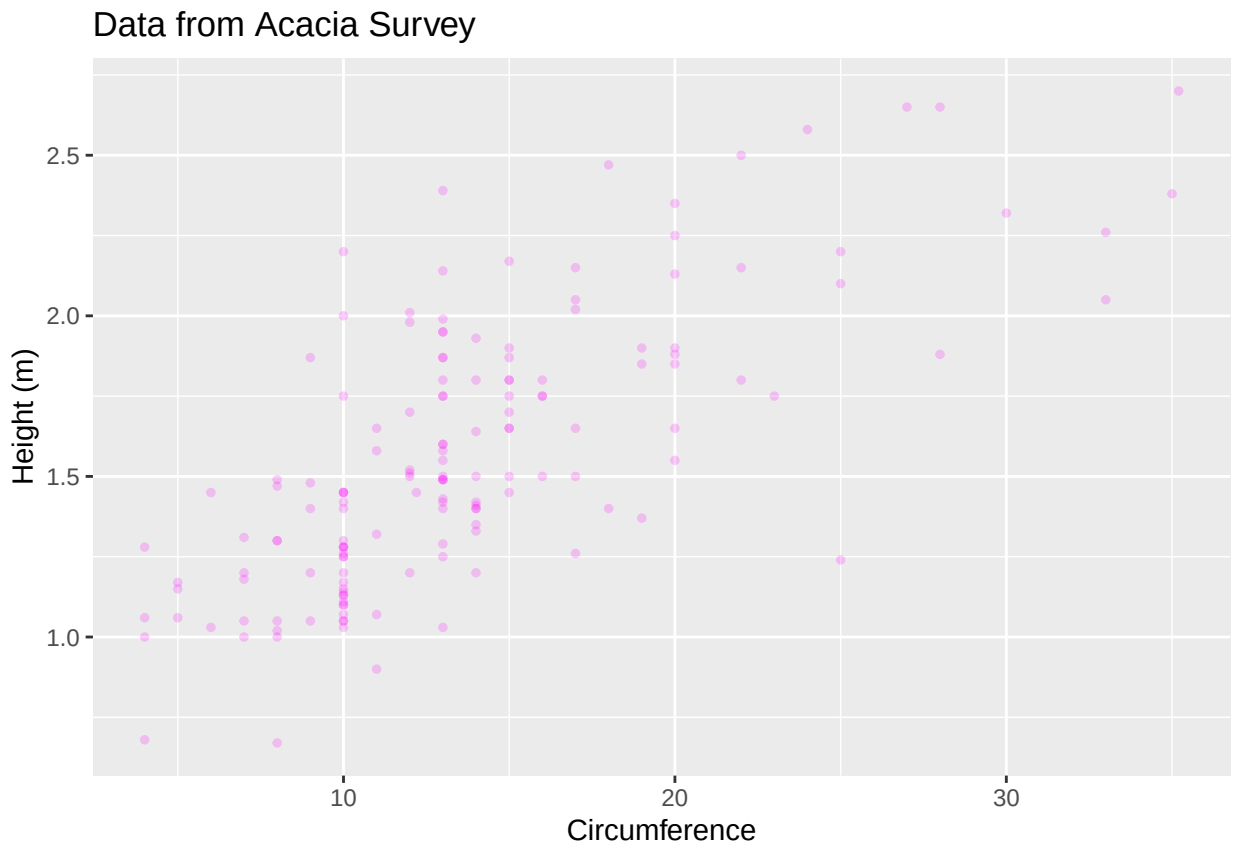
for this we use ggplot package let install it first

```
#install.packages("ggplot2")
library(ggplot2)
```

now we are gonna creat oiuur first plotting layer with ggplot function

```
ggplot(data = acacia, mapping = aes(x = CIRC, y = HEIGHT)) +
  geom_point(size = 1, col= "magenta", alpha = 0.2) +
  labs(x = "Circumference", y = "Height (m)", title = "Data from Acacia Survey")
```

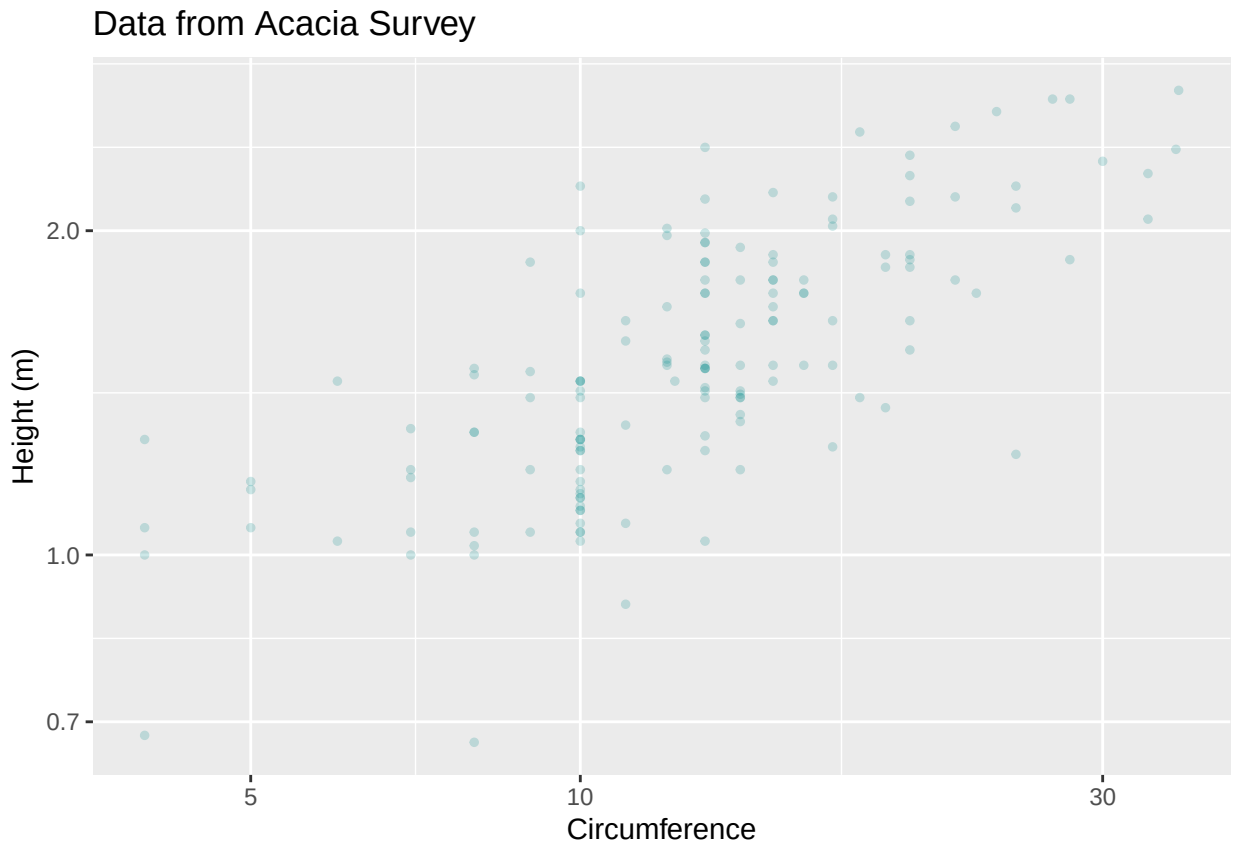
```
## Warning: Removed 4 rows containing missing values (geom_point).
```



to rescale the plotting of the axis to log scale we use the function scale_y_log_10()

```
ggplot(data = acacia, mapping = aes(x = CIRC, y =  HEIGHT)) +
  geom_point(size = 1, col= "cyan4", alpha = 0.2) +
  scale_x_log10() +
  scale_y_log10() +
  labs(x = "Circumference", y = "Height (m)", title = "Data from Acacia Survey")
```

```
## Warning: Removed 4 rows containing missing values (geom_point).
```



we have the informaiton pon experimental treatmenet in treatmnt column

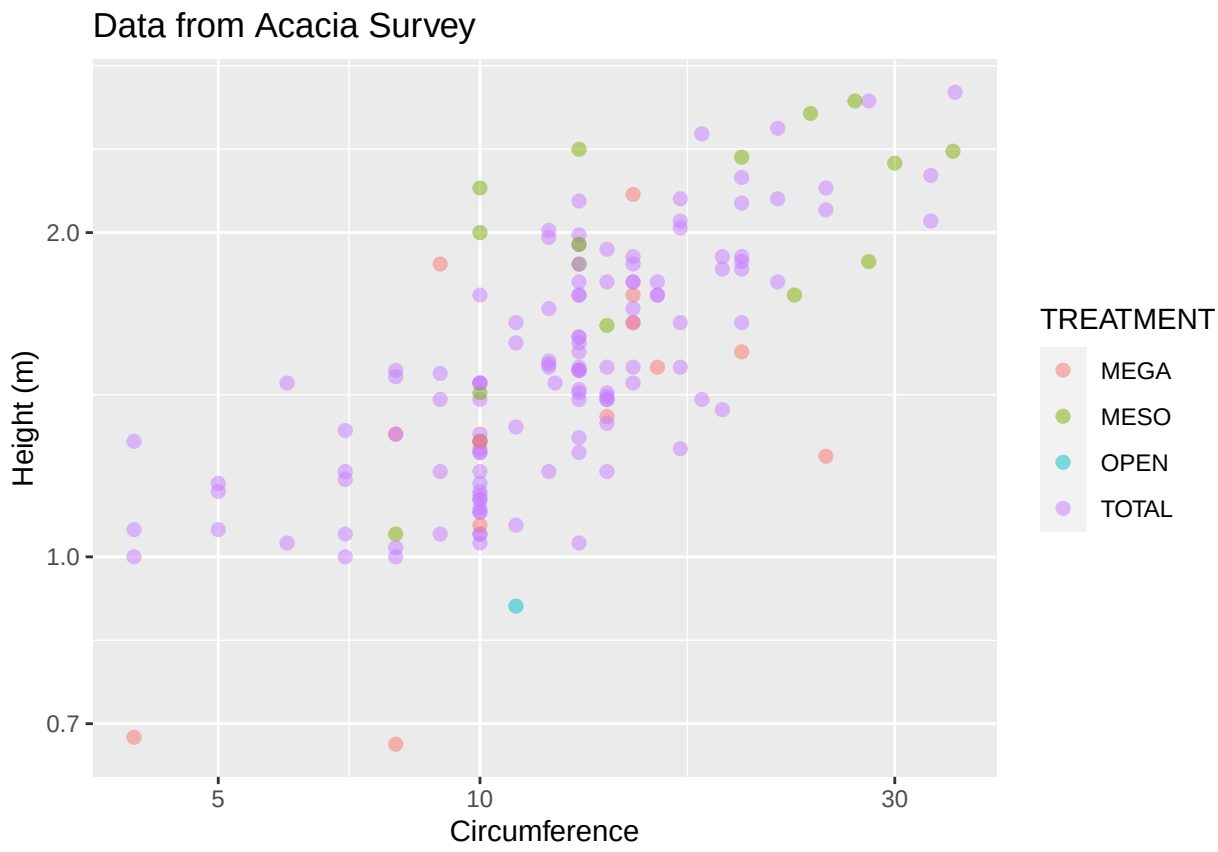
```
acacia$TREATMENT
```

```
##   [1] "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "MESO"
##  [10] "MESO"  "MESO"  "MESO"  "MESO"  "MESO"  "MESO"  "MESO"  "MESO"  "MESO"
##  [19] "MESO"  "MESO"  "OPEN"  "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL"
##  [28] "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL"
##  [37] "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL"
##  [46] "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL"
##  [55] "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL"
##  [64] "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL"
##  [73] "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL"
##  [82] "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL"
##  [91] "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL"
## [100] "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "MEGA"
## [109] "MEGA"  "MEGA"  "MEGA"  "MEGA"  "MEGA"  "MEGA"  "MEGA"  "MEGA"  "MEGA"
## [118] "MEGA"  "MEGA"  "MEGA"  "MESO"  "MESO"  "MESO"  "OPEN"  "OPEN"  "TOTAL"
## [127] "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL"
## [136] "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL"
## [145] "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL" "TOTAL"
## [154] "TOTAL" "TOTAL" "MESO"  "MESO"
```

lets add this information to our plot:

```
ggplot(acacia, mapping = aes (x = CIRC, y = HEIGHT, color = TREATMENT)) +
  geom_point(size = 2, alpha = 0.5) +
  labs(x = "Circumference", y = "Height (m)", title = "Data from Acacia Survey") +
  scale_x_log10() +
  scale_y_log10()
```

```
## Warning: Removed 4 rows containing missing values (geom_point).
```



a scatter plot function can be created using function geom point

```
colors()
```

```
##   [1] "white"                "aliceblue"            "antiquewhite"
##   [4] "antiquewhite1"        "antiquewhite2"        "antiquewhite3"
##   [7] "antiquewhite4"        "aquamarine"           "aquamarine1"
##  [10] "aquamarine2"          "aquamarine3"          "aquamarine4"
##  [13] "azure"                "azure1"               "azure2"
##  [16] "azure3"               "azure4"               "beige"
##  [19] "bisque"               "bisque1"              "bisque2"
##  [22] "bisque3"              "bisque4"              "black"
##  [25] "blanchedalmond"       "blue"                 "blue1"
##  [28] "blue2"                "blue3"                "blue4"
##  [31] "blueviolet"           "brown"                "brown1"
##  [34] "brown2"               "brown3"               "brown4"
```

```
##  [37] "burlywood"           "burlywood1"          "burlywood2"
##  [40] "burlywood3"          "burlywood4"          "cadetblue"
##  [43] "cadetblue1"          "cadetblue2"          "cadetblue3"
##  [46] "cadetblue4"          "chartreuse"          "chartreuse1"
##  [49] "chartreuse2"         "chartreuse3"         "chartreuse4"
##  [52] "chocolate"           "chocolate1"          "chocolate2"
##  [55] "chocolate3"          "chocolate4"          "coral"
##  [58] "coral1"              "coral2"              "coral3"
##  [61] "coral4"              "cornflowerblue"      "cornsilk"
##  [64] "cornsilk1"           "cornsilk2"           "cornsilk3"
##  [67] "cornsilk4"           "cyan"                "cyan1"
##  [70] "cyan2"               "cyan3"               "cyan4"
##  [73] "darkblue"            "darkcyan"            "darkgoldenrod"
##  [76] "darkgoldenrod1"      "darkgoldenrod2"      "darkgoldenrod3"
##  [79] "darkgoldenrod4"      "darkgray"            "darkgreen"
##  [82] "darkgrey"            "darkkhaki"           "darkmagenta"
##  [85] "darkolivegreen"      "darkolivegreen1"     "darkolivegreen2"
##  [88] "darkolivegreen3"     "darkolivegreen4"     "darkorange"
##  [91] "darkorange1"         "darkorange2"         "darkorange3"
##  [94] "darkorange4"         "darkorchid"          "darkorchid1"
##  [97] "darkorchid2"         "darkorchid3"         "darkorchid4"
## [100] "darkred"             "darksalmon"          "darkseagreen"
## [103] "darkseagreen1"       "darkseagreen2"       "darkseagreen3"
## [106] "darkseagreen4"       "darkslateblue"       "darkslategray"
## [109] "darkslategray1"      "darkslategray2"      "darkslategray3"
## [112] "darkslategray4"      "darkslategrey"       "darkturquoise"
## [115] "darkviolet"          "deeppink"            "deeppink1"
## [118] "deeppink2"           "deeppink3"           "deeppink4"
## [121] "deepskyblue"         "deepskyblue1"        "deepskyblue2"
## [124] "deepskyblue3"        "deepskyblue4"        "dimgray"
## [127] "dimgrey"             "dodgerblue"          "dodgerblue1"
## [130] "dodgerblue2"         "dodgerblue3"         "dodgerblue4"
## [133] "firebrick"           "firebrick1"          "firebrick2"
## [136] "firebrick3"          "firebrick4"          "floralwhite"
## [139] "forestgreen"         "gainsboro"           "ghostwhite"
## [142] "gold"                "gold1"               "gold2"
## [145] "gold3"               "gold4"               "goldenrod"
## [148] "goldenrod1"          "goldenrod2"          "goldenrod3"
## [151] "goldenrod4"          "gray"                "gray0"
## [154] "gray1"               "gray2"               "gray3"
## [157] "gray4"               "gray5"               "gray6"
## [160] "gray7"               "gray8"               "gray9"
## [163] "gray10"              "gray11"              "gray12"
## [166] "gray13"              "gray14"              "gray15"
## [169] "gray16"              "gray17"              "gray18"
## [172] "gray19"              "gray20"              "gray21"
## [175] "gray22"              "gray23"              "gray24"
## [178] "gray25"              "gray26"              "gray27"
## [181] "gray28"              "gray29"              "gray30"
## [184] "gray31"              "gray32"              "gray33"
## [187] "gray34"              "gray35"              "gray36"
## [190] "gray37"              "gray38"              "gray39"
## [193] "gray40"              "gray41"              "gray42"
## [196] "gray43"              "gray44"              "gray45"
```

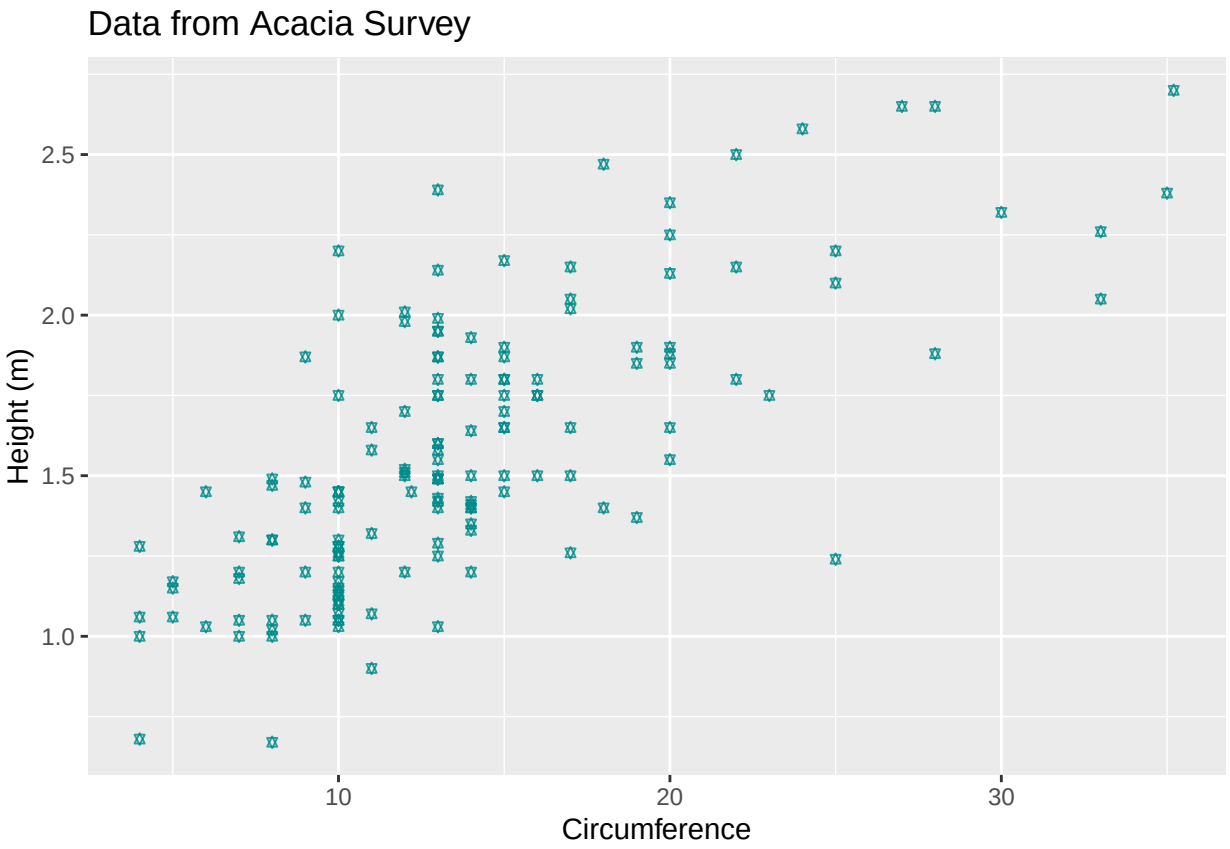
```
## [199] "gray46"             "gray47"             "gray48"
## [202] "gray49"             "gray50"             "gray51"
## [205] "gray52"             "gray53"             "gray54"
## [208] "gray55"             "gray56"             "gray57"
## [211] "gray58"             "gray59"             "gray60"
## [214] "gray61"             "gray62"             "gray63"
## [217] "gray64"             "gray65"             "gray66"
## [220] "gray67"             "gray68"             "gray69"
## [223] "gray70"             "gray71"             "gray72"
## [226] "gray73"             "gray74"             "gray75"
## [229] "gray76"             "gray77"             "gray78"
## [232] "gray79"             "gray80"             "gray81"
## [235] "gray82"             "gray83"             "gray84"
## [238] "gray85"             "gray86"             "gray87"
## [241] "gray88"             "gray89"             "gray90"
## [244] "gray91"             "gray92"             "gray93"
## [247] "gray94"             "gray95"             "gray96"
## [250] "gray97"             "gray98"             "gray99"
## [253] "gray100"            "green"              "green1"
## [256] "green2"             "green3"             "green4"
## [259] "greenyellow"        "grey"               "grey0"
## [262] "grey1"              "grey2"              "grey3"
## [265] "grey4"              "grey5"              "grey6"
## [268] "grey7"              "grey8"              "grey9"
## [271] "grey10"             "grey11"             "grey12"
## [274] "grey13"             "grey14"             "grey15"
## [277] "grey16"             "grey17"             "grey18"
## [280] "grey19"             "grey20"             "grey21"
## [283] "grey22"             "grey23"             "grey24"
## [286] "grey25"             "grey26"             "grey27"
## [289] "grey28"             "grey29"             "grey30"
## [292] "grey31"             "grey32"             "grey33"
## [295] "grey34"             "grey35"             "grey36"
## [298] "grey37"             "grey38"             "grey39"
## [301] "grey40"             "grey41"             "grey42"
## [304] "grey43"             "grey44"             "grey45"
## [307] "grey46"             "grey47"             "grey48"
## [310] "grey49"             "grey50"             "grey51"
## [313] "grey52"             "grey53"             "grey54"
## [316] "grey55"             "grey56"             "grey57"
## [319] "grey58"             "grey59"             "grey60"
## [322] "grey61"             "grey62"             "grey63"
## [325] "grey64"             "grey65"             "grey66"
## [328] "grey67"             "grey68"             "grey69"
## [331] "grey70"             "grey71"             "grey72"
## [334] "grey73"             "grey74"             "grey75"
## [337] "grey76"             "grey77"             "grey78"
## [340] "grey79"             "grey80"             "grey81"
## [343] "grey82"             "grey83"             "grey84"
## [346] "grey85"             "grey86"             "grey87"
## [349] "grey88"             "grey89"             "grey90"
## [352] "grey91"             "grey92"             "grey93"
## [355] "grey94"             "grey95"             "grey96"
## [358] "grey97"             "grey98"             "grey99"
```

```
## [361] "grey100"              "honeydew"             "honeydew1"
## [364] "honeydew2"            "honeydew3"            "honeydew4"
## [367] "hotpink"              "hotpink1"             "hotpink2"
## [370] "hotpink3"             "hotpink4"             "indianred"
## [373] "indianred1"           "indianred2"           "indianred3"
## [376] "indianred4"           "ivory"                "ivory1"
## [379] "ivory2"               "ivory3"               "ivory4"
## [382] "khaki"                "khaki1"               "khaki2"
## [385] "khaki3"               "khaki4"               "lavender"
## [388] "lavenderblush"        "lavenderblush1"       "lavenderblush2"
## [391] "lavenderblush3"       "lavenderblush4"       "lawngreen"
## [394] "lemonchiffon"         "lemonchiffon1"        "lemonchiffon2"
## [397] "lemonchiffon3"        "lemonchiffon4"        "lightblue"
## [400] "lightblue1"           "lightblue2"           "lightblue3"
## [403] "lightblue4"           "lightcoral"           "lightcyan"
## [406] "lightcyan1"           "lightcyan2"           "lightcyan3"
## [409] "lightcyan4"           "lightgoldenrod"       "lightgoldenrod1"
## [412] "lightgoldenrod2"      "lightgoldenrod3"      "lightgoldenrod4"
## [415] "lightgoldenrodyellow" "lightgray"            "lightgreen"
## [418] "lightgrey"            "lightpink"            "lightpink1"
## [421] "lightpink2"           "lightpink3"           "lightpink4"
## [424] "lightsalmon"          "lightsalmon1"         "lightsalmon2"
## [427] "lightsalmon3"         "lightsalmon4"         "lightseagreen"
## [430] "lightskyblue"         "lightskyblue1"        "lightskyblue2"
## [433] "lightskyblue3"        "lightskyblue4"        "lightslateblue"
## [436] "lightslategray"       "lightslategrey"       "lightsteelblue"
## [439] "lightsteelblue1"      "lightsteelblue2"      "lightsteelblue3"
## [442] "lightsteelblue4"      "lightyellow"          "lightyellow1"
## [445] "lightyellow2"         "lightyellow3"         "lightyellow4"
## [448] "limegreen"            "linen"                "magenta"
## [451] "magenta1"             "magenta2"             "magenta3"
## [454] "magenta4"             "maroon"               "maroon1"
## [457] "maroon2"              "maroon3"              "maroon4"
## [460] "mediumaquamarine"     "mediumblue"           "mediumorchid"
## [463] "mediumorchid1"        "mediumorchid2"        "mediumorchid3"
## [466] "mediumorchid4"        "mediumpurple"         "mediumpurple1"
## [469] "mediumpurple2"        "mediumpurple3"        "mediumpurple4"
## [472] "mediumseagreen"       "mediumslateblue"      "mediumspringgreen"
## [475] "mediumturquoise"      "mediumvioletred"      "midnightblue"
## [478] "mintcream"            "mistyrose"            "mistyrose1"
## [481] "mistyrose2"           "mistyrose3"           "mistyrose4"
## [484] "moccasin"             "navajowhite"          "navajowhite1"
## [487] "navajowhite2"         "navajowhite3"         "navajowhite4"
## [490] "navy"                 "navyblue"             "oldlace"
## [493] "olivedrab"            "olivedrab1"           "olivedrab2"
## [496] "olivedrab3"           "olivedrab4"           "orange"
## [499] "orange1"              "orange2"              "orange3"
## [502] "orange4"              "orangered"            "orangered1"
## [505] "orangered2"           "orangered3"           "orangered4"
## [508] "orchid"               "orchid1"              "orchid2"
## [511] "orchid3"              "orchid4"              "palegoldenrod"
## [514] "palegreen"            "palegreen1"           "palegreen2"
## [517] "palegreen3"           "palegreen4"           "paleturquoise"
## [520] "paleturquoise1"       "paleturquoise2"       "paleturquoise3"
```

```
## [523] "paleturquoise4"      "palevioletred"       "palevioletred1"
## [526] "palevioletred2"      "palevioletred3"      "palevioletred4"
## [529] "papayawhip"          "peachpuff"           "peachpuff1"
## [532] "peachpuff2"          "peachpuff3"          "peachpuff4"
## [535] "peru"                "pink"                "pink1"
## [538] "pink2"               "pink3"               "pink4"
## [541] "plum"                "plum1"               "plum2"
## [544] "plum3"               "plum4"               "powderblue"
## [547] "purple"              "purple1"             "purple2"
## [550] "purple3"             "purple4"             "red"
## [553] "red1"                "red2"                "red3"
## [556] "red4"                "rosybrown"           "rosybrown1"
## [559] "rosybrown2"          "rosybrown3"          "rosybrown4"
## [562] "royalblue"           "royalblue1"          "royalblue2"
## [565] "royalblue3"          "royalblue4"          "saddlebrown"
## [568] "salmon"              "salmon1"             "salmon2"
## [571] "salmon3"             "salmon4"             "sandybrown"
## [574] "seagreen"            "seagreen1"           "seagreen2"
## [577] "seagreen3"           "seagreen4"           "seashell"
## [580] "seashell1"           "seashell2"           "seashell3"
## [583] "seashell4"           "sienna"              "sienna1"
## [586] "sienna2"             "sienna3"             "sienna4"
## [589] "skyblue"             "skyblue1"            "skyblue2"
## [592] "skyblue3"            "skyblue4"            "slateblue"
## [595] "slateblue1"          "slateblue2"          "slateblue3"
## [598] "slateblue4"          "slategray"           "slategray1"
## [601] "slategray2"          "slategray3"          "slategray4"
## [604] "slategrey"           "snow"                "snow1"
## [607] "snow2"               "snow3"               "snow4"
## [610] "springgreen"         "springgreen1"        "springgreen2"
## [613] "springgreen3"        "springgreen4"        "steelblue"
## [616] "steelblue1"          "steelblue2"          "steelblue3"
## [619] "steelblue4"          "tan"                 "tan1"
## [622] "tan2"                "tan3"                "tan4"
## [625] "thistle"             "thistle1"            "thistle2"
## [628] "thistle3"            "thistle4"            "tomato"
## [631] "tomato1"             "tomato2"             "tomato3"
## [634] "tomato4"             "turquoise"           "turquoise1"
## [637] "turquoise2"          "turquoise3"          "turquoise4"
## [640] "violet"              "violetred"           "violetred1"
## [643] "violetred2"          "violetred3"          "violetred4"
## [646] "wheat"               "wheat1"              "wheat2"
## [649] "wheat3"              "wheat4"              "whitesmoke"
## [652] "yellow"              "yellow1"             "yellow2"
## [655] "yellow3"             "yellow4"             "yellowgreen"
```

```
ggplot(data = acacia, mapping = aes(x = CIRC, y =  HEIGHT)) +
  geom_point(size = 1, col= "cyan4", alpha = 0.8, shape = 11) +
  labs(x = "Circumference", y = "Height (m)", title = "Data from Acacia Survey")
```

```
## Warning: Removed 4 rows containing missing values (geom_point).
```

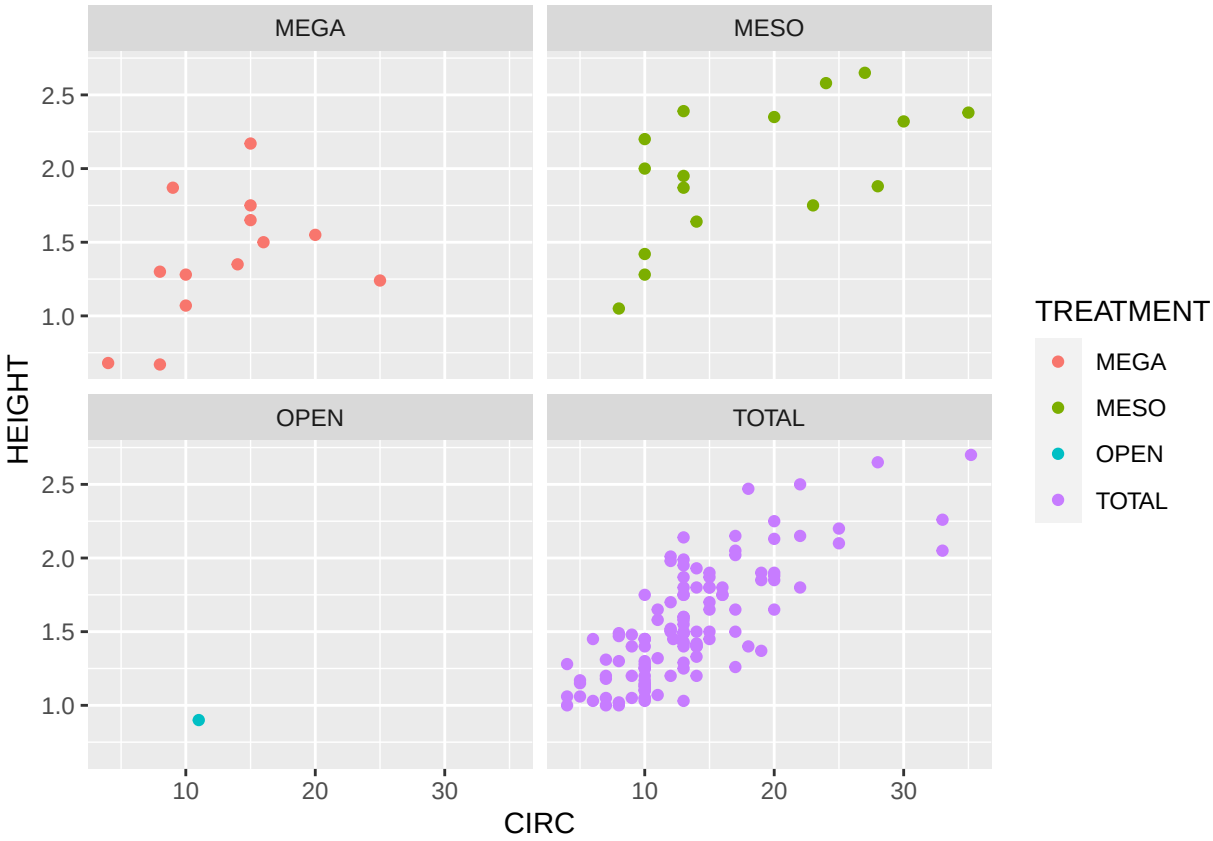


#subplots or facets

function to create subplots is called facet_wrap()

```
ggplot(data = acacia, mapping = aes(x = CIRC, y =  HEIGHT, color = TREATMENT)) +
  geom_point() +
  facet_wrap(~TREATMENT)
```

```
## Warning: Removed 4 rows containing missing values (geom_point).
```



The plot above indicates that acacia trees within the megaherbivore fence enclosure were typically smaller both in height and in circumference in compariosn to the acacua trees within the mesoherbivore fence enclosure.

When comparing the open and total we can see that in an open enclosure there are very few trees whereas in an entirelt closed off encolsure contained much more trees.

how to test these hypotheses

model fitting functions

the geom_smooth() function allows us to fit linear models to a set of points

```
ggplot(data = acacia, mapping = aes(x = CIRC, y =  HEIGHT, color = TREATMENT,
linetype = TREATMENT)) +
  geom_point() +
  geom_smooth(method = "loess") +
  facet_wrap(~TREATMENT)
```

```
## `geom_smooth()` using formula 'y ~ x'
```

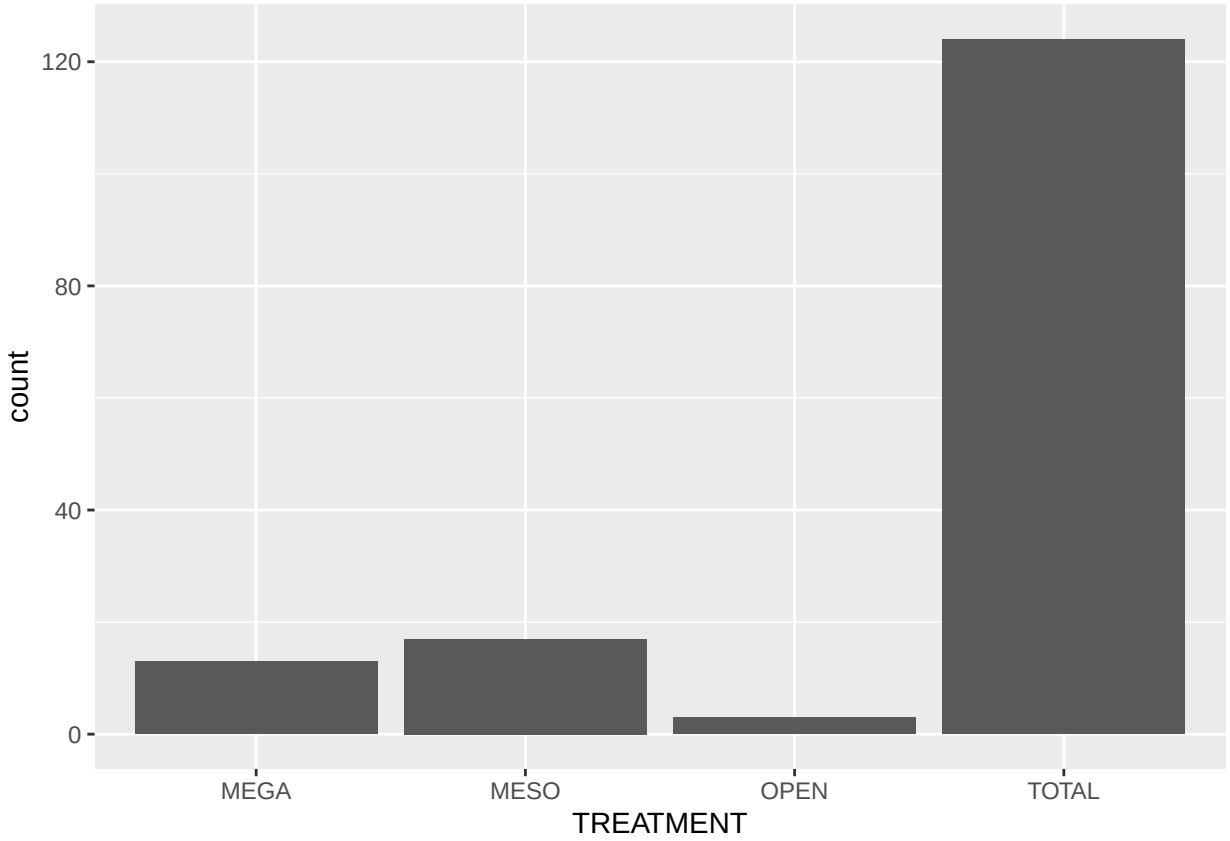
```
## Warning: Removed 4 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 4 rows containing missing values (geom_point).
```

histograms and barplots

for bar plots we use geom_bar() function:

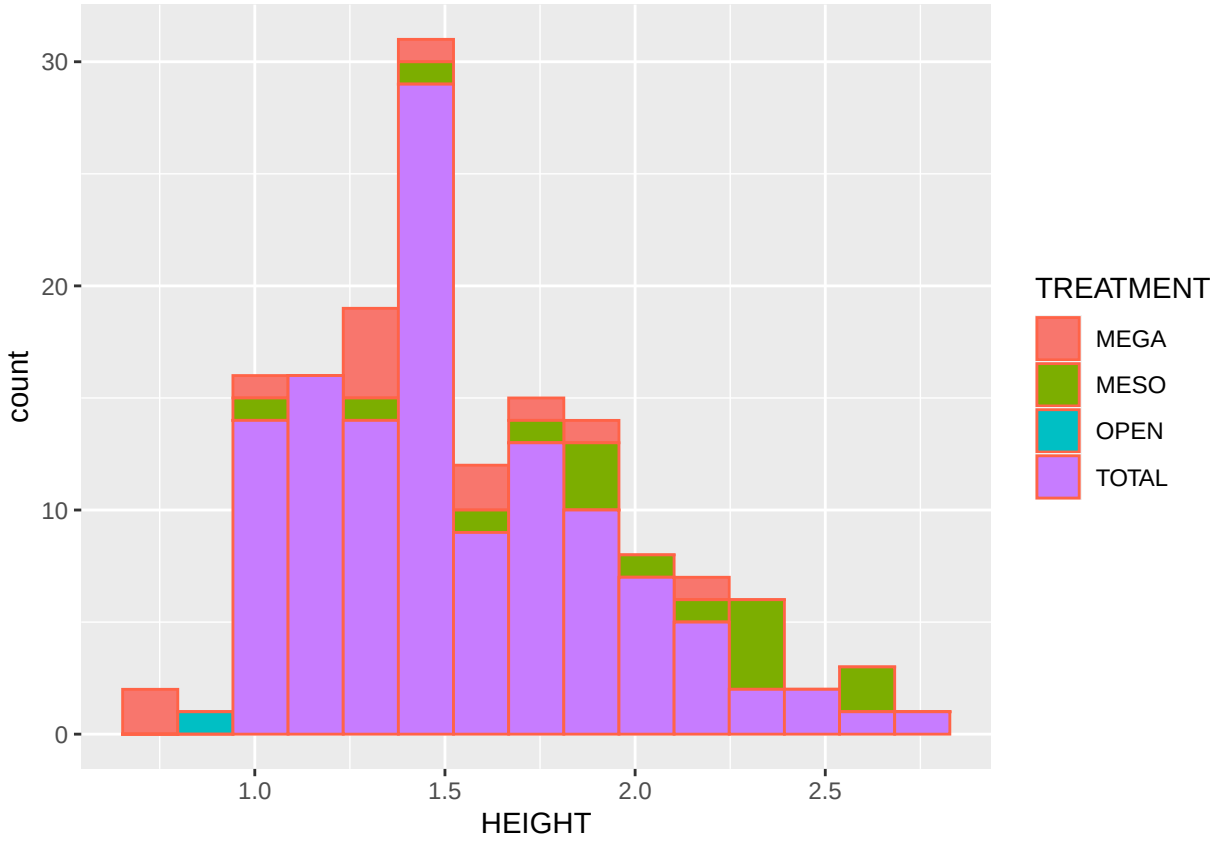
```
ggplot(data = acacia, mapping = aes(x = TREATMENT)) +
  geom_bar()
```



if we want to see the distribution of a continuous variable like height or circ we use geom_histogram() function

```
ggplot(data = acacia, mapping = aes(x = HEIGHT, fill = TREATMENT)) +
  geom_histogram(bins = 15, col = "tomato")
```

```
## Warning: Removed 4 rows containing non-finite values (stat_bin).
```



layer multiple data from the same or different data sets

```
ggplot() +
  geom_point(data = acacia,
             mapping = aes(x = CIRC, y = HEIGHT,
                           color = TREATMENT)) +
  geom_smooth(data = acacia, mapping = aes(x = CIRC, y = HEIGHT)) +
  geom_histogram(data = acacia,
                 mapping = aes(x = CIRC, col = TREATMENT), alpha = 0.1)
```

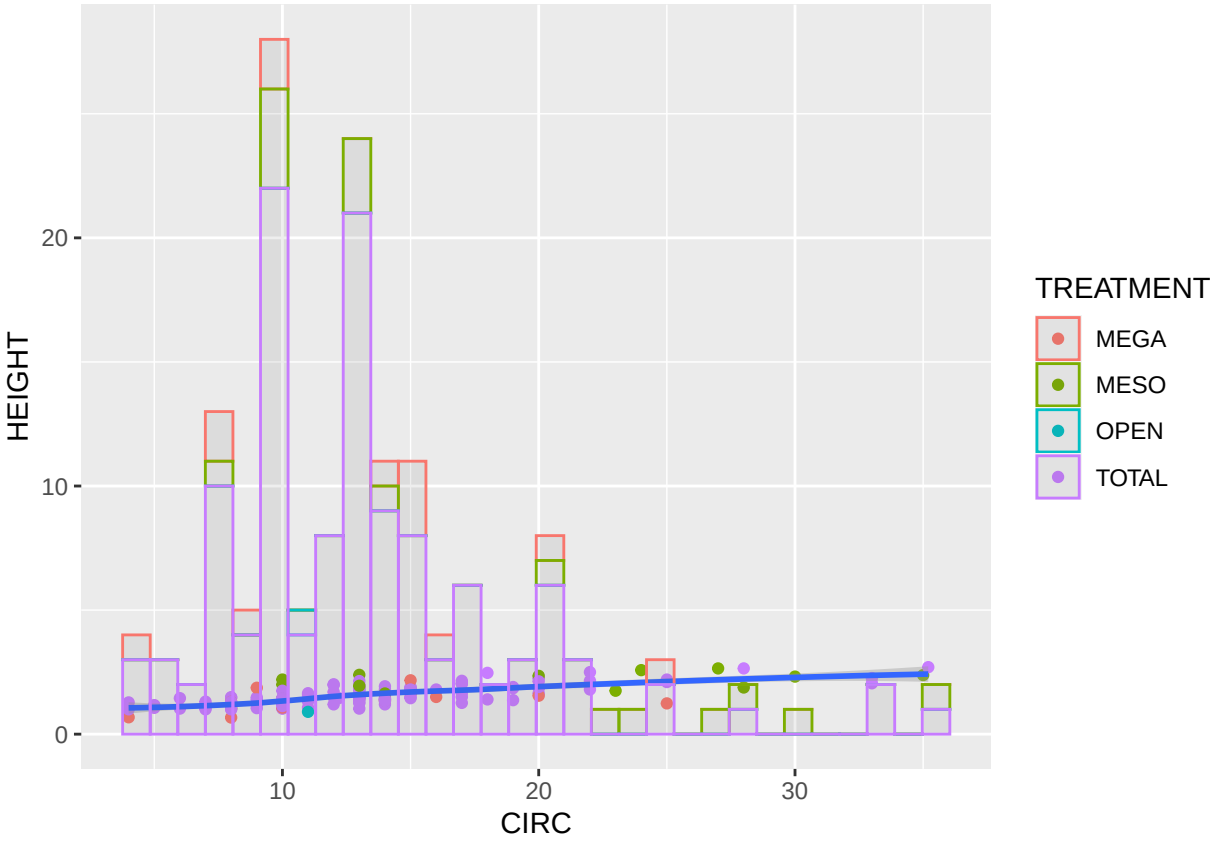
```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'

## Warning: Removed 4 rows containing non-finite values (stat_smooth).

## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.

## Warning: Removed 4 rows containing non-finite values (stat_bin).

## Warning: Removed 4 rows containing missing values (geom_point).
```



4.2 visualize a statistical anlaysis of correlation