UHURU data set visualization

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A tip for working with Rmarkdown

The Working directory inside this Rmarkdown r chunk is the following:

```
getwd()
```

```
## [1] "/Users/davindersingh/Downloads/datasceince2023/documents"
```

Note: remember that workingdirectories in a project and an R chunk are not always the same!

1. Describing the working data set

UHURU data set

2. Reading the data set

We are reading a data set in TSV format. This is a "tab separated values" file. To read it into R we use the function `read.csv()` with the `sep =` argument set to `"\t"` which represents a tab in computer language.

```
read.csv(file = "../data-raw/ACACIA_DREPANOLOBIUM_SURVEY.txt", sep = "\t")
```

```
##      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 20.0
## 2         1 2012 SOUTH     1     TOTAL S1TOTAL  582   2.65  4.10  3.90 28.0
## 3         1 2012 SOUTH     1     TOTAL S1TOTAL 3111    1.5  1.70  0.85 17.0
## 4         1 2012 SOUTH     1     TOTAL S1TOTAL 3112   2.01  1.80  1.60 12.0
## 5         1 2012 SOUTH     1     TOTAL S1TOTAL 3113   1.75  1.84  1.42 13.0
## 6         1 2012 SOUTH     1     TOTAL S1TOTAL 3114   1.65  1.62  0.85 15.0
## 7         1 2012 SOUTH     1     TOTAL S1TOTAL 3115    1.2  1.95  0.90  9.0
## 8         1 2012 SOUTH     1     TOTAL S1TOTAL 3199   1.45  2.00  1.75 12.2
## 9         1 2012 SOUTH     1      MESO  S1MESO  941   1.87  2.15  1.82 13.0
## 10        1 2012 SOUTH     1      MESO  S1MESO  942   2.38  5.55  4.82 35.0
## 11        1 2012 SOUTH     1      MESO  S1MESO  943   2.58  4.90  4.24 24.0
## 12        1 2012 SOUTH     1      MESO  S1MESO  944   2.65  3.75  3.10 27.0
## 13        1 2012 SOUTH     1      MESO  S1MESO  946   2.35  2.34  2.05 20.0
## 14        1 2012 SOUTH     1      MESO  S1MESO  947   1.88  2.10  1.85 28.0
## 15        1 2012 SOUTH     1      MESO  S1MESO 3116   2.32  3.05  2.63 30.0
## 16        1 2012 SOUTH     1      MESO  S1MESO 3117   2.39  2.21  2.10 13.0
```

```
## 17      1 2012 SOUTH       1      MESO  S1MESO 3118    2.2  1.80  1.50 10.0
## 18      1 2012 SOUTH       1      MESO  S1MESO 3119   1.05  0.90  0.55  8.0
## 19      1 2012 SOUTH       1      MESO  S1MESO 3120      2  1.25  1.20 10.0
## 20      1 2012 SOUTH       1      MESO  S1MESO 3131   1.28  1.14  1.00 10.0
## 21      1 2012 SOUTH       2      OPEN  S2OPEN   341   dead    NA    NA    NA
## 22      1 2012 SOUTH       2     TOTAL S2TOTAL 3178    1.4  2.50  2.15 18.0
## 23      1 2012 SOUTH       2     TOTAL S2TOTAL  101    1.9  3.31  2.65 15.0
## 24      1 2012 SOUTH       2     TOTAL S2TOTAL  102   1.75  2.70  2.55 16.0
## 25      1 2012 SOUTH       2     TOTAL S2TOTAL  103    1.8  2.75  2.30 16.0
## 26      1 2012 SOUTH       2     TOTAL S2TOTAL  104    2.7  4.05  4.00 35.2
## 27      1 2012 SOUTH       2     TOTAL S2TOTAL  105   2.02  2.85  1.49 17.0
## 28      1 2012 SOUTH       2     TOTAL S2TOTAL  108    1.9  3.10  2.85 19.0
## 29      1 2012 SOUTH       2     TOTAL S2TOTAL  109   1.85  2.45  1.90 19.0
## 30      1 2012 SOUTH       2     TOTAL S2TOTAL  110   1.65  1.90  1.54 17.0
## 31      1 2012 SOUTH       2     TOTAL S2TOTAL  111    1.4  2.35  1.45 14.0
## 32      1 2012 SOUTH       2     TOTAL S2TOTAL  113    2.5  3.25  2.30 22.0
## 33      1 2012 SOUTH       2     TOTAL S2TOTAL  115   2.05  5.40  4.50 33.0
## 34      1 2012 SOUTH       2     TOTAL S2TOTAL  116   2.26  3.50  3.10 33.0
## 35      1 2012 SOUTH       2     TOTAL S2TOTAL  117   2.13  2.40  2.30 20.0
## 36      1 2012 SOUTH       2     TOTAL S2TOTAL  118    1.8  3.15  2.55 22.0
## 37      1 2012 SOUTH       2     TOTAL S2TOTAL 1211   1.85  2.00  2.27 20.0
## 38      1 2012 SOUTH       2     TOTAL S2TOTAL 1212    1.5  2.15  1.80 15.0
## 39      1 2012 SOUTH       2     TOTAL S2TOTAL 1213   1.87  2.34  2.05 13.0
## 40      1 2012 SOUTH       2     TOTAL S2TOTAL 1214   1.58  1.28  0.75 11.0
## 41      1 2012 SOUTH       2     TOTAL S2TOTAL 1215   2.05  2.10  1.75 17.0
## 42      1 2012 SOUTH       2     TOTAL S2TOTAL 1216   1.75  2.45  3.28 16.0
## 43      1 2012 SOUTH       2     TOTAL S2TOTAL 1217   1.49  1.50  1.45 13.0
## 44      1 2012 SOUTH       2     TOTAL S2TOTAL 1218   1.28  2.00  0.90 10.0
## 45      1 2012 SOUTH       2     TOTAL S2TOTAL 1219   1.49  2.35  1.65 13.0
## 46      1 2012 SOUTH       2     TOTAL S2TOTAL 1220   1.07  1.20  0.95 11.0
## 47      1 2012 SOUTH       2     TOTAL S2TOTAL 1231   1.48  1.25  1.20  9.0
## 48      1 2012 SOUTH       2     TOTAL S2TOTAL 1232   1.25  1.25  0.90 10.0
## 49      1 2012 SOUTH       2     TOTAL S2TOTAL 1233   1.41  1.41  1.40 14.0
## 50      1 2012 SOUTH       2     TOTAL S2TOTAL 1234    1.6  1.60  1.30 13.0
## 51      1 2012 SOUTH       2     TOTAL S2TOTAL 1235    1.2  1.20  1.30 14.0
## 52      1 2012 SOUTH       2     TOTAL S2TOTAL 1236   1.49  1.49  1.20  8.0
## 53      1 2012 SOUTH       2     TOTAL S2TOTAL 1237    1.5  1.50  1.50 14.0
## 54      1 2012 SOUTH       2     TOTAL S2TOTAL 1238   1.65  1.65  2.00 20.0
## 55      1 2012 SOUTH       2     TOTAL S2TOTAL 1239   1.13  1.13  1.20 10.0
## 56      1 2012 SOUTH       2     TOTAL S2TOTAL 1240   1.25  1.25  0.90 10.0
## 57      1 2012 SOUTH       2     TOTAL S2TOTAL 1251    1.1  1.20  1.10 10.0
## 58      1 2012 SOUTH       2     TOTAL S2TOTAL 1252    2.2  2.70  2.40 25.0
## 59      1 2012 SOUTH       2     TOTAL S2TOTAL 1253   1.45  1.65  1.25 10.0
## 60      1 2012 SOUTH       2     TOTAL S2TOTAL 1254    1.6  2.45  2.10 13.0
## 61      1 2012 SOUTH       2     TOTAL S2TOTAL 1255   1.55  2.40  1.80 13.0
## 62      1 2012 SOUTH       2     TOTAL S2TOTAL 1256    1.5  2.40  2.15 13.0
## 63      1 2012 SOUTH       2     TOTAL S2TOTAL 1257   1.03  1.20  1.00 10.0
## 64      1 2012 SOUTH       2     TOTAL S2TOTAL 1258   2.14  1.90  1.70 13.0
## 65      1 2012 SOUTH       2     TOTAL S2TOTAL 1259    1.2  1.90  1.65 12.0
## 66      1 2012 SOUTH       2     TOTAL S2TOTAL 1260   1.05  1.10  1.00  9.0
## 67      1 2012 SOUTH       2     TOTAL S2TOTAL 2131    1.8  2.60  2.40 15.0
## 68      1 2012 SOUTH       2     TOTAL S2TOTAL 2132    1.2  1.00  0.95  7.0
## 69      1 2012 SOUTH       2     TOTAL S2TOTAL 2133   1.75  1.40  1.10 10.0
## 70      1 2012 SOUTH       2     TOTAL S2TOTAL 2134   1.45  3.10  1.80 10.0
```

```
## 71     1 2012 SOUTH       2     TOTAL S2TOTAL 2135  1.17  1.20  1.10  5.0
## 72     1 2012 SOUTH       2     TOTAL S2TOTAL 2136  2.15  3.10  2.58 22.0
## 73     1 2012 SOUTH       2     TOTAL S2TOTAL 2137   1.7  1.70  1.40 12.0
## 74     1 2012 SOUTH       2     TOTAL S2TOTAL 3132  1.98  2.85  2.70 12.0
## 75     1 2012 SOUTH       2     TOTAL S2TOTAL 3133  1.26  1.95  1.75 17.0
## 76     1 2012 SOUTH       2     TOTAL S2TOTAL 3134  1.11  1.95  1.50 10.0
## 77     1 2012 SOUTH       2     TOTAL S2TOTAL 3135  1.14  1.32  1.05 10.0
## 78     1 2012 SOUTH       2     TOTAL S2TOTAL 3136  1.26  1.60  1.40 10.0
## 79     1 2012 SOUTH       2     TOTAL S2TOTAL 3137   1.3  1.40  0.80 10.0
## 80     1 2012 SOUTH       2     TOTAL S2TOTAL 3138  1.29  1.44  1.35 13.0
## 81     1 2012 SOUTH       2     TOTAL S2TOTAL 3139  1.31  1.35  1.15  7.0
## 82     1 2012 SOUTH       2     TOTAL S2TOTAL 3140  1.15  1.70  1.28 10.0
## 83     1 2012 SOUTH       2     TOTAL S2TOTAL 3151  1.87  3.40  1.85 15.0
## 84     1 2012 SOUTH       2     TOTAL S2TOTAL 3152  1.47  2.10  1.61  8.0
## 85     1 2012 SOUTH       2     TOTAL S2TOTAL 3153  1.05  1.79  1.50 10.0
## 86     1 2012 SOUTH       2     TOTAL S2TOTAL 3154   2.1  4.90  3.75 25.0
## 87     1 2012 SOUTH       2     TOTAL S2TOTAL 3155  1.99  1.80  1.35 13.0
## 88     1 2012 SOUTH       2     TOTAL S2TOTAL 3156  1.42  1.90  1.80 14.0
## 89     1 2012 SOUTH       2     TOTAL S2TOTAL 3157   1.5  2.11  1.75 12.0
## 90     1 2012 SOUTH       2     TOTAL S2TOTAL 3158  1.06  1.05  0.85  4.0
## 91     1 2012 SOUTH       2     TOTAL S2TOTAL 3159  1.49  1.50  1.15 13.0
## 92     1 2012 SOUTH       2     TOTAL S2TOTAL 3160   1.8  1.60  1.50 14.0
## 93     1 2012 SOUTH       2     TOTAL S2TOTAL 3171  1.93  1.74  1.20 14.0
## 94     1 2012 SOUTH       2     TOTAL S2TOTAL 3172   1.2  1.60  1.30 10.0
## 95     1 2012 SOUTH       2     TOTAL S2TOTAL 3173  1.65  1.25  1.10 11.0
## 96     1 2012 SOUTH       2     TOTAL S2TOTAL 3174  1.52  1.49  1.10 12.0
## 97     1 2012 SOUTH       2     TOTAL S2TOTAL 3175  1.43  2.05  1.54 13.0
## 98     1 2012 SOUTH       2     TOTAL S2TOTAL 3176  1.25  1.40  1.25 13.0
## 99     1 2012 SOUTH       2     TOTAL S2TOTAL 3177  1.88  2.65  2.64 20.0
## 100    1 2012 SOUTH       2     TOTAL S2TOTAL 3179  1.03  1.40  0.60 13.0
## 101    1 2012 SOUTH       2     TOTAL S2TOTAL 3180   1.1  1.30  1.20 10.0
## 102    1 2012 SOUTH       2     TOTAL S2TOTAL 3191   1.4  1.05  1.00 10.0
## 103    1 2012 SOUTH       2     TOTAL S2TOTAL 3192  1.05  1.55  0.90 10.0
## 104    1 2012 SOUTH       2     TOTAL S2TOTAL 3193  1.18  1.20  1.00  7.0
## 105    1 2012 SOUTH       2     TOTAL S2TOTAL 3194   1.4  1.30  1.85 13.0
## 106    1 2012 SOUTH       2     TOTAL S2TOTAL 3195  1.37  2.67  2.19 19.0
## 107    1 2012 SOUTH       2     TOTAL S2TOTAL 3196  1.32  2.15  1.55 11.0
## 108    1 2012 SOUTH       2     MEGA   S2MEGA  182  1.55  2.20  1.20 20.0
## 109    1 2012 SOUTH       2     MEGA   S2MEGA  183   1.3  1.80  0.90  8.0
## 110    1 2012 SOUTH       2     MEGA   S2MEGA  184  1.24  1.20  1.20 25.0
## 111    1 2012 SOUTH       2     MEGA   S2MEGA  185   1.5  2.10  1.75 16.0
## 112    1 2012 SOUTH       2     MEGA   S2MEGA  186  1.65  2.50  2.20 15.0
## 113    1 2012 SOUTH       2     MEGA   S2MEGA  187  2.17  2.00  1.20 15.0
## 114    1 2012 SOUTH       2     MEGA   S2MEGA  188  1.28  1.60  1.50 10.0
## 115    1 2012 SOUTH       2     MEGA   S2MEGA  189  1.07  1.50  1.50 10.0
## 116    1 2012 SOUTH       2     MEGA   S2MEGA  190  0.67  1.00  0.80  8.0
## 117    1 2012 SOUTH       2     MEGA   S2MEGA  191  0.68  0.70  0.60  4.0
## 118    1 2012 SOUTH       2     MEGA   S2MEGA  192  1.87  1.60  1.40  9.0
## 119    1 2012 SOUTH       2     MEGA   S2MEGA  193  1.35  1.90  1.50 14.0
## 120    1 2012 SOUTH       2     MEGA   S2MEGA  194  1.75  2.10  2.10 15.0
## 121    1 2012 SOUTH       2     MESO   S2MESO  462  1.75  3.30  2.50 23.0
## 122    1 2012 SOUTH       2     MESO   S2MESO  463  1.64  2.30  2.00 14.0
## 123    1 2012 SOUTH       2     MESO   S2MESO 2138  1.42  0.90  0.80 10.0
## 124    1 2012 SOUTH       3     OPEN   S3OPEN 1301  dead    NA    NA    NA
```

```
## 125       1 2012 SOUTH        3    OPEN   S3OPEN 1302   0.9  1.30  1.10 11.0
## 126       1 2012 SOUTH        3   TOTAL  S3TOTAL 1061  dead    NA    NA    NA
## 127       1 2012 SOUTH        3   TOTAL  S3TOTAL 1062   1.8  2.60  2.60 15.0
## 128       1 2012 SOUTH        3   TOTAL  S3TOTAL 1063  2.47  3.10  2.20 18.0
## 129       1 2012 SOUTH        3   TOTAL  S3TOTAL 1064  2.15  1.60  1.10 17.0
## 130       1 2012 SOUTH        3   TOTAL  S3TOTAL 1066   1.7  2.50  2.15 15.0
## 131       1 2012 SOUTH        3   TOTAL  S3TOTAL 1066   1.9  1.80  1.50 20.0
## 132       1 2012 SOUTH        3   TOTAL  S3TOTAL 1067  1.95  2.10  1.90 13.0
## 133       1 2012 SOUTH        3   TOTAL  S3TOTAL 1068   1.8  1.70  1.40 13.0
## 134       1 2012 SOUTH        3   TOTAL  S3TOTAL 1069   1.4  2.00  1.60 14.0
## 135       1 2012 SOUTH        3   TOTAL  S3TOTAL 1070     1  1.30  1.20  7.0
## 136       1 2012 SOUTH        3   TOTAL  S3TOTAL 2139  1.75  1.20  1.10 13.0
## 137       1 2012 SOUTH        3   TOTAL  S3TOTAL 2140  1.28  1.50  0.95  4.0
## 138       1 2012 SOUTH        3   TOTAL  S3TOTAL 2151     1  1.40  1.20  4.0
## 139       1 2012 SOUTH        3   TOTAL  S3TOTAL 2152  1.45  1.50  1.30 10.0
## 140       1 2012 SOUTH        3   TOTAL  S3TOTAL 2153     1  1.00  0.75  8.0
## 141       1 2012 SOUTH        3   TOTAL  S3TOTAL 2154  1.03  1.00  0.90  6.0
## 142       1 2012 SOUTH        3   TOTAL  S3TOTAL 2155  1.51  2.00  1.80 12.0
## 143       1 2012 SOUTH        3   TOTAL  S3TOTAL 2156  1.17  1.10  0.90 10.0
## 144       1 2012 SOUTH        3   TOTAL  S3TOTAL 2157  1.33  1.90  1.85 14.0
## 145       1 2012 SOUTH        3   TOTAL  S3TOTAL 2158   1.3  1.10  0.85  8.0
## 146       1 2012 SOUTH        3   TOTAL  S3TOTAL 2159  1.13  1.10  0.90 10.0
## 147       1 2012 SOUTH        3   TOTAL  S3TOTAL 2160  1.58  1.40  1.40 13.0
## 148       1 2012 SOUTH        3   TOTAL  S3TOTAL 2171  1.06  1.40  1.00  5.0
## 149       1 2012 SOUTH        3   TOTAL  S3TOTAL 2172  1.05  1.40  0.95  7.0
## 150       1 2012 SOUTH        3   TOTAL  S3TOTAL 2173  1.45  1.60  1.10  6.0
## 151       1 2012 SOUTH        3   TOTAL  S3TOTAL 2174  1.15  1.10  0.90  5.0
## 152       1 2012 SOUTH        3   TOTAL  S3TOTAL 2175  1.42  1.45  1.30 13.0
## 153       1 2012 SOUTH        3   TOTAL  S3TOTAL 2176  1.02  1.20  1.00  8.0
## 154       1 2012 SOUTH        3   TOTAL  S3TOTAL 2177   1.4  1.20  1.00  9.0
## 155       1 2012 SOUTH        3   TOTAL  S3TOTAL 2178  1.45  2.10  2.05 15.0
## 156       1 2012 SOUTH        3    MESO   S3MESO 1421  1.95  2.20  1.60 13.0
## 157       1 2012 SOUTH        3    MESO   S3MESO 1422  dead    NA    NA    NA
##     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
## 7         0    0      0    CS
## 8         0    0     25    CS
## 9         0    0      0    TP
## 10        0    0     50    TP
## 11        0    0      5    CS
## 12        0    0     60    TP
## 13        0    0     60    TP
## 14        2    0     60    CS
## 15        2    0      0    CS
## 16        0    0      0    TP
## 17        0    0      0    TP
## 18        0    0      0    CS
## 19        0    0      0    CM
## 20        0    0      0    TP
```

```
## 21         NA   NA      NA
## 22          0    0       5   CS
## 23          0    0      45   CS
## 24         40   50      35   CS
## 25          8    2      65   CS
## 26          0    0      20   TP
## 27          0    0      70   CS
## 28          0    0     125   CM
## 29          0    0     200   CM
## 30          0    0      10   CS
## 31          0    0       0   CS
## 32          0    0      35   TP
## 33          0    0     300   CM
## 34          2    2     100   CS
## 35          0    0      30   CM
## 36          0    0      50   TP
## 37          0    0      10   CM
## 38          0    0      25   CS
## 39          0    0      15   TP
## 40          0    0       0   TP
## 41          0    0      15   TP
## 42          0    0       0   TP
## 43          0    0      40   TP
## 44          0    0       0   TP
## 45          0    0      15   CM
## 46          0    0       0   CM
## 47          0    0       0   TP
## 48          0    0       0   TP
## 49          0    0       1   TP
## 50          0    0      20   TP
## 51          0    0       0   TP
## 52          0    0       0   TP
## 53          0    0      20   TP
## 54          0    0       0   TP
## 55          0    0       0   CN
## 56          0    0       0   CN
## 57          0    0       0   TP
## 58          0    0       5   TP
## 59          0    0       0   TP
## 60          0    0      25   TP
## 61          0    0      25   TP
## 62          0    0      20   TP
## 63          0    0       0   TP
## 64          0    0      10   CS
## 65          1    0      25   CS
## 66          0    0       0   TP
## 67          0    0      10   TP
## 68          0    0       0   TP
## 69          0    0       0   TP
## 70          0    0       0   TP
## 71          0    0       0   TP
## 72          0    0       0   CS
## 73          0    0       0   CS
## 74          0    0      25 AB_TP
```

```
## 75          0   0      0   TP
## 76          0   0      0   TP
## 77          0   0      0   TP
## 78          0   0      0   CS
## 79          0   0      0   CS
## 80          0   0      0   CS
## 81          0   0      0   CS
## 82          0   0      5   CS
## 83          6   0      0   CS
## 84          0   0      0   CS
## 85          0   0      1   CS
## 86          0   0     25   CS
## 87          0   0      0   CS
## 88          0   0      0   CS
## 89          0   0     10   CS
## 90          0   0      0   CS
## 91          0   0     35   CS
## 92          0   0      0   CS
## 93          0   0      0   CS
## 94          0   0      0   CS
## 95          0   0      0   CS
## 96          0   0     20   CS
## 97          0   0      0   CS
## 98          0   0      0   CM
## 99          0   0    100   CM
## 100         0   0      0   CS
## 101         0   0      0   CS
## 102         0   0      0   CS
## 103         0   0      0   CM
## 104         0   0      0   TP
## 105         0   0     30   CS
## 106         0   0     50   TP
## 107         0   0     10   CS
## 108         0   0      0   CS
## 109         0   0     15   CS
## 110         0   0     10   CS
## 111         5   0    200   CS
## 112         0   0     80   CS
## 113         0   0    150   TP
## 114         0   0     40   TP
## 115         0   0     60   TP
## 116         0   0      0   CS
## 117         0   0      0   TP
## 118         0   0     40   CS
## 119         0   0     20   CS
## 120         0   0     75   TP
## 121         0   0     20   CM
## 122         0   0      0   TP
## 123         0   0      0    E
## 124        NA  NA     NA
## 125         0   0      0   TP
## 126        NA  NA     NA
## 127         0   0     50   TP
## 128         0   0      0   TP
```

```
## 129       0    0       0    TP
## 130       0    0       2    TP
## 131       0    0      25    TP
## 132       0    0       0    TP
## 133       0    0       0    TP
## 134       0    0       0    TP
## 135       0    0       0    TP
## 136       0    0       0    TP
## 137       0    0       0    TP
## 138       0    0       0    TP
## 139       0    0       0    TP
## 140       0    0       0    TP
## 141       0    0       0    TP
## 142       0    0       0    TP
## 143       0    0       0    TP
## 144       0    0       0    TP
## 145       0    0       0    TP
## 146       0    0       0    TP
## 147       0    0       0    TP
## 148       0    0       8    TP
## 149       0    0       0    TP
## 150       0    0       0    TP
## 151       0    0       0    TP
## 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
```

Assign the data to a varibale so we can work with it

```
acacia <- read.csv(file = "../data-raw/ACACIA_DREPANOLOBIUM_SURVEY.txt", sep = "\t")
```

3. Acessing elements of a `data.frame`

```
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
```

```
str(acacia)
```

```
## 'data.frame':     157 obs. of  15 variables:
##  $ SURVEY   : int   1 1 1 1 1 1 1 1 1 1 ...
##  $ YEAR     : int   2012 2012 2012 2012 2012 2012 2012 2012 2012 2012 ...
##  $ SITE     : chr   "SOUTH" "SOUTH" "SOUTH" "SOUTH" ...
##  $ BLOCK    : int   1 1 1 1 1 1 1 1 1 1 ...
##  $ TREATMENT: chr   "TOTAL" "TOTAL" "TOTAL" "TOTAL" ...
##  $ PLOT     : chr   "S1TOTAL" "S1TOTAL" "S1TOTAL" "S1TOTAL" ...
##  $ ID       : int   581 582 3111 3112 3113 3114 3115 3199 941 942 ...
##  $ HEIGHT   : chr   "2.25" "2.65" "1.5" "2.01" ...
##  $ AXIS1    : num   2.75 4.1 1.7 1.8 1.84 1.62 1.95 2 2.15 5.55 ...
##  $ AXIS2    : num   2.15 3.9 0.85 1.6 1.42 0.85 0.9 1.75 1.82 4.82 ...
##  $ CIRC     : num   20 28 17 12 13 15 9 12.2 13 35 ...
##  $ FLOWERS  : int   0 0 2 0 0 0 0 0 0 0 ...
##  $ BUDS     : int   0 0 1 0 0 0 0 0 0 0 ...
##  $ FRUITS   : int   10 150 50 75 20 0 0 25 0 50 ...
##  $ ANT      : chr   "CS" "TP" "TP" "CS" ...
```

It is similar to what we do for vectors, but we have two dimensions

```
acacia[,6]
```

```
##   [1] "S1TOTAL" "S1TOTAL" "S1TOTAL" "S1TOTAL" "S1TOTAL" "S1TOTAL" "S1TOTAL"
##   [8] "S1TOTAL" "S1MESO"  "S1MESO"  "S1MESO"  "S1MESO"  "S1MESO"  "S1MESO"
##  [15] "S1MESO"  "S1MESO"  "S1MESO"  "S1MESO"  "S1MESO"  "S1MESO"  "S2OPEN"
##  [22] "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL"
##  [29] "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL"
##  [36] "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL"
##  [43] "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL"
##  [50] "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL"
##  [57] "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL"
##  [64] "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL"
##  [71] "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL"
##  [78] "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL"
##  [85] "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL"
##  [92] "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL"
##  [99] "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL" "S2TOTAL"
## [106] "S2TOTAL" "S2TOTAL" "S2MEGA"  "S2MEGA"  "S2MEGA"  "S2MEGA"  "S2MEGA"
## [113] "S2MEGA"  "S2MEGA"  "S2MEGA"  "S2MEGA"  "S2MEGA"  "S2MEGA"  "S2MEGA"
## [120] "S2MEGA"  "S2MESO"  "S2MESO"  "S2MESO"  "S3OPEN"  "S3OPEN"  "S3TOTAL"
## [127] "S3TOTAL" "S3TOTAL" "S3TOTAL" "S3TOTAL" "S3TOTAL" "S3TOTAL" "S3TOTAL"
## [134] "S3TOTAL" "S3TOTAL" "S3TOTAL" "S3TOTAL" "S3TOTAL" "S3TOTAL" "S3TOTAL"
## [141] "S3TOTAL" "S3TOTAL" "S3TOTAL" "S3TOTAL" "S3TOTAL" "S3TOTAL" "S3TOTAL"
## [148] "S3TOTAL" "S3TOTAL" "S3TOTAL" "S3TOTAL" "S3TOTAL" "S3TOTAL" "S3TOTAL"
## [155] "S3TOTAL" "S3MESO"  "S3MESO"
```

```
str(acacia)
```

```
## 'data.frame':     157 obs. of  15 variables:
##  $ SURVEY   : int   1 1 1 1 1 1 1 1 1 1 ...
##  $ YEAR     : int   2012 2012 2012 2012 2012 2012 2012 2012 2012 2012 ...
```

```
## $ SITE     : chr  "SOUTH" "SOUTH" "SOUTH" "SOUTH" ...
## $ BLOCK    : int  1 1 1 1 1 1 1 1 1 1 ...
## $ TREATMENT: chr  "TOTAL" "TOTAL" "TOTAL" "TOTAL" ...
## $ PLOT     : chr  "S1TOTAL" "S1TOTAL" "S1TOTAL" "S1TOTAL" ...
## $ ID       : int  581 582 3111 3112 3113 3114 3115 3199 941 942 ...
## $ HEIGHT   : chr  "2.25" "2.65" "1.5" "2.01" ...
## $ AXIS1    : num  2.75 4.1 1.7 1.8 1.84 1.62 1.95 2 2.15 5.55 ...
## $ AXIS2    : num  2.15 3.9 0.85 1.6 1.42 0.85 0.9 1.75 1.82 4.82 ...
## $ CIRC     : num  20 28 17 12 13 15 9 12.2 13 35 ...
## $ FLOWERS  : int  0 0 2 0 0 0 0 0 0 0 ...
## $ BUDS     : int  0 0 1 0 0 0 0 0 0 0 ...
## $ FRUITS   : int  10 150 50 75 20 0 0 25 0 50 ...
## $ ANT      : chr  "CS" "TP" "TP" "CS" ...
```

All are the following ways to accesing a column or variable in data

```
acacia$SURVEY
```

```
##   [1] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [38] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [75] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [112] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [149] 1 1 1 1 1 1 1 1 1 1
```

```
acacia[, 1]
```

```
##   [1] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [38] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [75] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [112] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [149] 1 1 1 1 1 1 1 1 1 1
```

```
acacia[, "SURVEY"]
```

```
##   [1] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [38] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [75] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [112] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
## [149] 1 1 1 1 1 1 1 1 1 1
```

Replacing elements in a data frame

4. quality control

```
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
```

```
str(acacia)
```

```
## 'data.frame':    157 obs. of  15 variables:
##  $ SURVEY   : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ YEAR     : int  2012 2012 2012 2012 2012 2012 2012 2012 2012 2012 ...
##  $ SITE     : chr  "SOUTH" "SOUTH" "SOUTH" "SOUTH" ...
##  $ BLOCK    : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ TREATMENT: chr  "TOTAL" "TOTAL" "TOTAL" "TOTAL" ...
##  $ PLOT     : chr  "S1TOTAL" "S1TOTAL" "S1TOTAL" "S1TOTAL" ...
##  $ ID       : int  581 582 3111 3112 3113 3114 3115 3199 941 942 ...
##  $ HEIGHT   : chr  "2.25" "2.65" "1.5" "2.01" ...
##  $ AXIS1    : num  2.75 4.1 1.7 1.8 1.84 1.62 1.95 2 2.15 5.55 ...
##  $ AXIS2    : num  2.15 3.9 0.85 1.6 1.42 0.85 0.9 1.75 1.82 4.82 ...
##  $ CIRC     : num  20 28 17 12 13 15 9 12.2 13 35 ...
##  $ FLOWERS  : int  0 0 2 0 0 0 0 0 0 0 ...
##  $ BUDS     : int  0 0 1 0 0 0 0 0 0 0 ...
##  $ FRUITS   : int  10 150 50 75 20 0 0 25 0 50 ...
##  $ ANT      : chr  "CS" "TP" "TP" "CS" ...
```

```
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 20.0
## 2       1 2012 SOUTH     1     TOTAL S1TOTAL  582   2.65  4.10  3.90 28.0
## 3       1 2012 SOUTH     1     TOTAL S1TOTAL 3111    1.5  1.70  0.85 17.0
## 4       1 2012 SOUTH     1     TOTAL S1TOTAL 3112   2.01  1.80  1.60 12.0
## 5       1 2012 SOUTH     1     TOTAL S1TOTAL 3113   1.75  1.84  1.42 13.0
## 6       1 2012 SOUTH     1     TOTAL S1TOTAL 3114   1.65  1.62  0.85 15.0
## 7       1 2012 SOUTH     1     TOTAL S1TOTAL 3115    1.2  1.95  0.90  9.0
## 8       1 2012 SOUTH     1     TOTAL S1TOTAL 3199   1.45  2.00  1.75 12.2
## 9       1 2012 SOUTH     1      MESO  S1MESO  941   1.87  2.15  1.82 13.0
## 10      1 2012 SOUTH     1      MESO  S1MESO  942   2.38  5.55  4.82 35.0
## 11      1 2012 SOUTH     1      MESO  S1MESO  943   2.58  4.90  4.24 24.0
## 12      1 2012 SOUTH     1      MESO  S1MESO  944   2.65  3.75  3.10 27.0
## 13      1 2012 SOUTH     1      MESO  S1MESO  946   2.35  2.34  2.05 20.0
## 14      1 2012 SOUTH     1      MESO  S1MESO  947   1.88  2.10  1.85 28.0
## 15      1 2012 SOUTH     1      MESO  S1MESO 3116   2.32  3.05  2.63 30.0
## 16      1 2012 SOUTH     1      MESO  S1MESO 3117   2.39  2.21  2.10 13.0
## 17      1 2012 SOUTH     1      MESO  S1MESO 3118    2.2  1.80  1.50 10.0
## 18      1 2012 SOUTH     1      MESO  S1MESO 3119   1.05  0.90  0.55  8.0
## 19      1 2012 SOUTH     1      MESO  S1MESO 3120      2  1.25  1.20 10.0
```

```
## 20     1 2012 SOUTH    1    MESO   S1MESO 3131   1.28  1.14  1.00 10.0
## 21     1 2012 SOUTH    2    OPEN   S2OPEN  341   dead    NA    NA   NA
## 22     1 2012 SOUTH    2   TOTAL  S2TOTAL 3178    1.4  2.50  2.15 18.0
## 23     1 2012 SOUTH    2   TOTAL  S2TOTAL  101    1.9  3.31  2.65 15.0
## 24     1 2012 SOUTH    2   TOTAL  S2TOTAL  102   1.75  2.70  2.55 16.0
## 25     1 2012 SOUTH    2   TOTAL  S2TOTAL  103    1.8  2.75  2.30 16.0
## 26     1 2012 SOUTH    2   TOTAL  S2TOTAL  104    2.7  4.05  4.00 35.2
## 27     1 2012 SOUTH    2   TOTAL  S2TOTAL  105   2.02  2.85  1.49 17.0
## 28     1 2012 SOUTH    2   TOTAL  S2TOTAL  108    1.9  3.10  2.85 19.0
## 29     1 2012 SOUTH    2   TOTAL  S2TOTAL  109   1.85  2.45  1.90 19.0
## 30     1 2012 SOUTH    2   TOTAL  S2TOTAL  110   1.65  1.90  1.54 17.0
## 31     1 2012 SOUTH    2   TOTAL  S2TOTAL  111    1.4  2.35  1.45 14.0
## 32     1 2012 SOUTH    2   TOTAL  S2TOTAL  113    2.5  3.25  2.30 22.0
## 33     1 2012 SOUTH    2   TOTAL  S2TOTAL  115   2.05  5.40  4.50 33.0
## 34     1 2012 SOUTH    2   TOTAL  S2TOTAL  116   2.26  3.50  3.10 33.0
## 35     1 2012 SOUTH    2   TOTAL  S2TOTAL  117   2.13  2.40  2.30 20.0
## 36     1 2012 SOUTH    2   TOTAL  S2TOTAL  118    1.8  3.15  2.55 22.0
## 37     1 2012 SOUTH    2   TOTAL  S2TOTAL 1211   1.85  2.00  2.27 20.0
## 38     1 2012 SOUTH    2   TOTAL  S2TOTAL 1212    1.5  2.15  1.80 15.0
## 39     1 2012 SOUTH    2   TOTAL  S2TOTAL 1213   1.87  2.34  2.05 13.0
## 40     1 2012 SOUTH    2   TOTAL  S2TOTAL 1214   1.58  1.28  0.75 11.0
## 41     1 2012 SOUTH    2   TOTAL  S2TOTAL 1215   2.05  2.10  1.75 17.0
## 42     1 2012 SOUTH    2   TOTAL  S2TOTAL 1216   1.75  2.45  3.28 16.0
## 43     1 2012 SOUTH    2   TOTAL  S2TOTAL 1217   1.49  1.50  1.45 13.0
## 44     1 2012 SOUTH    2   TOTAL  S2TOTAL 1218   1.28  2.00  0.90 10.0
## 45     1 2012 SOUTH    2   TOTAL  S2TOTAL 1219   1.49  2.35  1.65 13.0
## 46     1 2012 SOUTH    2   TOTAL  S2TOTAL 1220   1.07  1.20  0.95 11.0
## 47     1 2012 SOUTH    2   TOTAL  S2TOTAL 1231   1.48  1.25  1.20  9.0
## 48     1 2012 SOUTH    2   TOTAL  S2TOTAL 1232   1.25  1.25  0.90 10.0
## 49     1 2012 SOUTH    2   TOTAL  S2TOTAL 1233   1.41  1.41  1.40 14.0
## 50     1 2012 SOUTH    2   TOTAL  S2TOTAL 1234    1.6  1.60  1.30 13.0
## 51     1 2012 SOUTH    2   TOTAL  S2TOTAL 1235    1.2  1.20  1.30 14.0
## 52     1 2012 SOUTH    2   TOTAL  S2TOTAL 1236   1.49  1.49  1.20  8.0
## 53     1 2012 SOUTH    2   TOTAL  S2TOTAL 1237    1.5  1.50  1.50 14.0
## 54     1 2012 SOUTH    2   TOTAL  S2TOTAL 1238   1.65  1.65  2.00 20.0
## 55     1 2012 SOUTH    2   TOTAL  S2TOTAL 1239   1.13  1.13  1.20 10.0
## 56     1 2012 SOUTH    2   TOTAL  S2TOTAL 1240   1.25  1.25  0.90 10.0
## 57     1 2012 SOUTH    2   TOTAL  S2TOTAL 1251    1.1  1.20  1.10 10.0
## 58     1 2012 SOUTH    2   TOTAL  S2TOTAL 1252    2.2  2.70  2.40 25.0
## 59     1 2012 SOUTH    2   TOTAL  S2TOTAL 1253   1.45  1.65  1.25 10.0
## 60     1 2012 SOUTH    2   TOTAL  S2TOTAL 1254    1.6  2.45  2.10 13.0
## 61     1 2012 SOUTH    2   TOTAL  S2TOTAL 1255   1.55  2.40  1.80 13.0
## 62     1 2012 SOUTH    2   TOTAL  S2TOTAL 1256    1.5  2.40  2.15 13.0
## 63     1 2012 SOUTH    2   TOTAL  S2TOTAL 1257   1.03  1.20  1.00 10.0
## 64     1 2012 SOUTH    2   TOTAL  S2TOTAL 1258   2.14  1.90  1.70 13.0
## 65     1 2012 SOUTH    2   TOTAL  S2TOTAL 1259    1.2  1.90  1.65 12.0
## 66     1 2012 SOUTH    2   TOTAL  S2TOTAL 1260   1.05  1.10  1.00  9.0
## 67     1 2012 SOUTH    2   TOTAL  S2TOTAL 2131    1.8  2.60  2.40 15.0
## 68     1 2012 SOUTH    2   TOTAL  S2TOTAL 2132    1.2  1.00  0.95  7.0
## 69     1 2012 SOUTH    2   TOTAL  S2TOTAL 2133   1.75  1.40  1.10 10.0
## 70     1 2012 SOUTH    2   TOTAL  S2TOTAL 2134   1.45  3.10  1.80 10.0
## 71     1 2012 SOUTH    2   TOTAL  S2TOTAL 2135   1.17  1.20  1.10  5.0
## 72     1 2012 SOUTH    2   TOTAL  S2TOTAL 2136   2.15  3.10  2.58 22.0
## 73     1 2012 SOUTH    2   TOTAL  S2TOTAL 2137    1.7  1.70  1.40 12.0
```

```
## 74     1 2012 SOUTH     2    TOTAL S2TOTAL 3132   1.98  2.85  2.70 12.0
## 75     1 2012 SOUTH     2    TOTAL S2TOTAL 3133   1.26  1.95  1.75 17.0
## 76     1 2012 SOUTH     2    TOTAL S2TOTAL 3134   1.11  1.95  1.50 10.0
## 77     1 2012 SOUTH     2    TOTAL S2TOTAL 3135   1.14  1.32  1.05 10.0
## 78     1 2012 SOUTH     2    TOTAL S2TOTAL 3136   1.26  1.60  1.40 10.0
## 79     1 2012 SOUTH     2    TOTAL S2TOTAL 3137    1.3  1.40  0.80 10.0
## 80     1 2012 SOUTH     2    TOTAL S2TOTAL 3138   1.29  1.44  1.35 13.0
## 81     1 2012 SOUTH     2    TOTAL S2TOTAL 3139   1.31  1.35  1.15  7.0
## 82     1 2012 SOUTH     2    TOTAL S2TOTAL 3140   1.15  1.70  1.28 10.0
## 83     1 2012 SOUTH     2    TOTAL S2TOTAL 3151   1.87  3.40  1.85 15.0
## 84     1 2012 SOUTH     2    TOTAL S2TOTAL 3152   1.47  2.10  1.61  8.0
## 85     1 2012 SOUTH     2    TOTAL S2TOTAL 3153   1.05  1.79  1.50 10.0
## 86     1 2012 SOUTH     2    TOTAL S2TOTAL 3154    2.1  4.90  3.75 25.0
## 87     1 2012 SOUTH     2    TOTAL S2TOTAL 3155   1.99  1.80  1.35 13.0
## 88     1 2012 SOUTH     2    TOTAL S2TOTAL 3156   1.42  1.90  1.80 14.0
## 89     1 2012 SOUTH     2    TOTAL S2TOTAL 3157    1.5  2.11  1.75 12.0
## 90     1 2012 SOUTH     2    TOTAL S2TOTAL 3158   1.06  1.05  0.85  4.0
## 91     1 2012 SOUTH     2    TOTAL S2TOTAL 3159   1.49  1.50  1.15 13.0
## 92     1 2012 SOUTH     2    TOTAL S2TOTAL 3160    1.8  1.60  1.50 14.0
## 93     1 2012 SOUTH     2    TOTAL S2TOTAL 3171   1.93  1.74  1.20 14.0
## 94     1 2012 SOUTH     2    TOTAL S2TOTAL 3172    1.2  1.60  1.30 10.0
## 95     1 2012 SOUTH     2    TOTAL S2TOTAL 3173   1.65  1.25  1.10 11.0
## 96     1 2012 SOUTH     2    TOTAL S2TOTAL 3174   1.52  1.49  1.10 12.0
## 97     1 2012 SOUTH     2    TOTAL S2TOTAL 3175   1.43  2.05  1.54 13.0
## 98     1 2012 SOUTH     2    TOTAL S2TOTAL 3176   1.25  1.40  1.25 13.0
## 99     1 2012 SOUTH     2    TOTAL S2TOTAL 3177   1.88  2.65  2.64 20.0
## 100    1 2012 SOUTH     2    TOTAL S2TOTAL 3179   1.03  1.40  0.60 13.0
## 101    1 2012 SOUTH     2    TOTAL S2TOTAL 3180    1.1  1.30  1.20 10.0
## 102    1 2012 SOUTH     2    TOTAL S2TOTAL 3191    1.4  1.05  1.00 10.0
## 103    1 2012 SOUTH     2    TOTAL S2TOTAL 3192   1.05  1.55  0.90 10.0
## 104    1 2012 SOUTH     2    TOTAL S2TOTAL 3193   1.18  1.20  1.00  7.0
## 105    1 2012 SOUTH     2    TOTAL S2TOTAL 3194    1.4  1.30  1.85 13.0
## 106    1 2012 SOUTH     2    TOTAL S2TOTAL 3195   1.37  2.67  2.19 19.0
## 107    1 2012 SOUTH     2    TOTAL S2TOTAL 3196   1.32  2.15  1.55 11.0
## 108    1 2012 SOUTH     2     MEGA   S2MEGA  182   1.55  2.20  1.20 20.0
## 109    1 2012 SOUTH     2     MEGA   S2MEGA  183    1.3  1.80  0.90  8.0
## 110    1 2012 SOUTH     2     MEGA   S2MEGA  184   1.24  1.20  1.20 25.0
## 111    1 2012 SOUTH     2     MEGA   S2MEGA  185    1.5  2.10  1.75 16.0
## 112    1 2012 SOUTH     2     MEGA   S2MEGA  186   1.65  2.50  2.20 15.0
## 113    1 2012 SOUTH     2     MEGA   S2MEGA  187   2.17  2.00  1.20 15.0
## 114    1 2012 SOUTH     2     MEGA   S2MEGA  188   1.28  1.60  1.50 10.0
## 115    1 2012 SOUTH     2     MEGA   S2MEGA  189   1.07  1.50  1.50 10.0
## 116    1 2012 SOUTH     2     MEGA   S2MEGA  190   0.67  1.00  0.80  8.0
## 117    1 2012 SOUTH     2     MEGA   S2MEGA  191   0.68  0.70  0.60  4.0
## 118    1 2012 SOUTH     2     MEGA   S2MEGA  192   1.87  1.60  1.40  9.0
## 119    1 2012 SOUTH     2     MEGA   S2MEGA  193   1.35  1.90  1.50 14.0
## 120    1 2012 SOUTH     2     MEGA   S2MEGA  194   1.75  2.10  2.10 15.0
## 121    1 2012 SOUTH     2     MESO   S2MESO  462   1.75  3.30  2.50 23.0
## 122    1 2012 SOUTH     2     MESO   S2MESO  463   1.64  2.30  2.00 14.0
## 123    1 2012 SOUTH     2     MESO   S2MESO 2138   1.42  0.90  0.80 10.0
## 124    1 2012 SOUTH     3     OPEN   S3OPEN 1301   dead    NA    NA   NA
## 125    1 2012 SOUTH     3     OPEN   S3OPEN 1302    0.9  1.30  1.10 11.0
## 126    1 2012 SOUTH     3    TOTAL S3TOTAL 1061   dead    NA    NA   NA
## 127    1 2012 SOUTH     3    TOTAL S3TOTAL 1062    1.8  2.60  2.60 15.0
```

```
## 128      1 2012 SOUTH         3    TOTAL S3TOTAL 1063  2.47 3.10  2.20 18.0
## 129      1 2012 SOUTH         3    TOTAL S3TOTAL 1064  2.15 1.60  1.10 17.0
## 130      1 2012 SOUTH         3    TOTAL S3TOTAL 1066   1.7 2.50  2.15 15.0
## 131      1 2012 SOUTH         3    TOTAL S3TOTAL 1066   1.9 1.80  1.50 20.0
## 132      1 2012 SOUTH         3    TOTAL S3TOTAL 1067  1.95 2.10  1.90 13.0
## 133      1 2012 SOUTH         3    TOTAL S3TOTAL 1068   1.8 1.70  1.40 13.0
## 134      1 2012 SOUTH         3    TOTAL S3TOTAL 1069   1.4 2.00  1.60 14.0
## 135      1 2012 SOUTH         3    TOTAL S3TOTAL 1070     1 1.30  1.20  7.0
## 136      1 2012 SOUTH         3    TOTAL S3TOTAL 2139  1.75 1.20  1.10 13.0
## 137      1 2012 SOUTH         3    TOTAL S3TOTAL 2140  1.28 1.50  0.95  4.0
## 138      1 2012 SOUTH         3    TOTAL S3TOTAL 2151     1 1.40  1.20  4.0
## 139      1 2012 SOUTH         3    TOTAL S3TOTAL 2152  1.45 1.50  1.30 10.0
## 140      1 2012 SOUTH         3    TOTAL S3TOTAL 2153     1 1.00  0.75  8.0
## 141      1 2012 SOUTH         3    TOTAL S3TOTAL 2154  1.03 1.00  0.90  6.0
## 142      1 2012 SOUTH         3    TOTAL S3TOTAL 2155  1.51 2.00  1.80 12.0
## 143      1 2012 SOUTH         3    TOTAL S3TOTAL 2156  1.17 1.10  0.90 10.0
## 144      1 2012 SOUTH         3    TOTAL S3TOTAL 2157  1.33 1.90  1.85 14.0
## 145      1 2012 SOUTH         3    TOTAL S3TOTAL 2158   1.3 1.10  0.85  8.0
## 146      1 2012 SOUTH         3    TOTAL S3TOTAL 2159  1.13 1.10  0.90 10.0
## 147      1 2012 SOUTH         3    TOTAL S3TOTAL 2160  1.58 1.40  1.40 13.0
## 148      1 2012 SOUTH         3    TOTAL S3TOTAL 2171  1.06 1.40  1.00  5.0
## 149      1 2012 SOUTH         3    TOTAL S3TOTAL 2172  1.05 1.40  0.95  7.0
## 150      1 2012 SOUTH         3    TOTAL S3TOTAL 2173  1.45 1.60  1.10  6.0
## 151      1 2012 SOUTH         3    TOTAL S3TOTAL 2174  1.15 1.10  0.90  5.0
## 152      1 2012 SOUTH         3    TOTAL S3TOTAL 2175  1.42 1.45  1.30 13.0
## 153      1 2012 SOUTH         3    TOTAL S3TOTAL 2176  1.02 1.20  1.00  8.0
## 154      1 2012 SOUTH         3    TOTAL S3TOTAL 2177   1.4 1.20  1.00  9.0
## 155      1 2012 SOUTH         3    TOTAL S3TOTAL 2178  1.45 2.10  2.05 15.0
## 156      1 2012 SOUTH         3    MESO   S3MESO 1421  1.95 2.20  1.60 13.0
## 157      1 2012 SOUTH         3    MESO   S3MESO 1422  dead   NA    NA   NA
##     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
## 7         0    0      0   CS
## 8         0    0     25   CS
## 9         0    0      0   TP
## 10        0    0     50   TP
## 11        0    0      5   CS
## 12        0    0     60   TP
## 13        0    0     60   TP
## 14        2    0     60   CS
## 15        2    0      0   CS
## 16        0    0      0   TP
## 17        0    0      0   TP
## 18        0    0      0   CS
## 19        0    0      0   CM
## 20        0    0      0   TP
## 21       NA   NA     NA
## 22        0    0      5   CS
## 23        0    0     45   CS
```

```
## 24        40    50    35    CS
## 25         8     2    65    CS
## 26         0     0    20    TP
## 27         0     0    70    CS
## 28         0     0   125    CM
## 29         0     0   200    CM
## 30         0     0    10    CS
## 31         0     0     0    CS
## 32         0     0    35    TP
## 33         0     0   300    CM
## 34         2     2   100    CS
## 35         0     0    30    CM
## 36         0     0    50    TP
## 37         0     0    10    CM
## 38         0     0    25    CS
## 39         0     0    15    TP
## 40         0     0     0    TP
## 41         0     0    15    TP
## 42         0     0     0    TP
## 43         0     0    40    TP
## 44         0     0     0    TP
## 45         0     0    15    CM
## 46         0     0     0    CM
## 47         0     0     0    TP
## 48         0     0     0    TP
## 49         0     0     1    TP
## 50         0     0    20    TP
## 51         0     0     0    TP
## 52         0     0     0    TP
## 53         0     0    20    TP
## 54         0     0     0    TP
## 55         0     0     0    CN
## 56         0     0     0    CN
## 57         0     0     0    TP
## 58         0     0     5    TP
## 59         0     0     0    TP
## 60         0     0    25    TP
## 61         0     0    25    TP
## 62         0     0    20    TP
## 63         0     0     0    TP
## 64         0     0    10    CS
## 65         1     0    25    CS
## 66         0     0     0    TP
## 67         0     0    10    TP
## 68         0     0     0    TP
## 69         0     0     0    TP
## 70         0     0     0    TP
## 71         0     0     0    TP
## 72         0     0     0    CS
## 73         0     0     0    CS
## 74         0     0    25    AB_TP
## 75         0     0     0    TP
## 76         0     0     0    TP
## 77         0     0     0    TP
```

14

```
## 78        0    0      0    CS
## 79        0    0      0    CS
## 80        0    0      0    CS
## 81        0    0      0    CS
## 82        0    0      5    CS
## 83        6    0      0    CS
## 84        0    0      0    CS
## 85        0    0      1    CS
## 86        0    0     25    CS
## 87        0    0      0    CS
## 88        0    0      0    CS
## 89        0    0     10    CS
## 90        0    0      0    CS
## 91        0    0     35    CS
## 92        0    0      0    CS
## 93        0    0      0    CS
## 94        0    0      0    CS
## 95        0    0      0    CS
## 96        0    0     20    CS
## 97        0    0      0    CS
## 98        0    0      0    CM
## 99        0    0    100    CM
## 100       0    0      0    CS
## 101       0    0      0    CS
## 102       0    0      0    CS
## 103       0    0      0    CM
## 104       0    0      0    TP
## 105       0    0     30    CS
## 106       0    0     50    TP
## 107       0    0     10    CS
## 108       0    0      0    CS
## 109       0    0     15    CS
## 110       0    0     10    CS
## 111       5    0    200    CS
## 112       0    0     80    CS
## 113       0    0    150    TP
## 114       0    0     40    TP
## 115       0    0     60    TP
## 116       0    0      0    CS
## 117       0    0      0    TP
## 118       0    0     40    CS
## 119       0    0     20    CS
## 120       0    0     75    TP
## 121       0    0     20    CM
## 122       0    0      0    TP
## 123       0    0      0     E
## 124      NA   NA     NA
## 125       0    0      0    TP
## 126      NA   NA     NA
## 127       0    0     50    TP
## 128       0    0      0    TP
## 129       0    0      0    TP
## 130       0    0      2    TP
## 131       0    0     25    TP
```

```
## 132       0    0       0    TP
## 133       0    0       0    TP
## 134       0    0       0    TP
## 135       0    0       0    TP
## 136       0    0       0    TP
## 137       0    0       0    TP
## 138       0    0       0    TP
## 139       0    0       0    TP
## 140       0    0       0    TP
## 141       0    0       0    TP
## 142       0    0       0    TP
## 143       0    0       0    TP
## 144       0    0       0    TP
## 145       0    0       0    TP
## 146       0    0       0    TP
## 147       0    0       0    TP
## 148       0    0       8    TP
## 149       0    0       0    TP
## 150       0    0       0    TP
## 151       0    0       0    TP
## 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
```

```
class(acacia$HEIGHT)
```

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

```
is.numeric(acacia$HEIGHT)
```

```
## [1] FALSE
```

```
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"
```

```
as.numeric(acacia$HEIGHT)
```

```
## Warning: NAs introduced by coercion
```

```
##   [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
```

We identified that HEIGHT should be numeric and is instead character:

```
acacia$HEIGHT <- as.numeric(acacia$HEIGHT)
```

```
## Warning: NAs introduced by coercion
```

```
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
```

Coercion in R computer language ,eams tjat a va;ie was forced to be a type, in this case, the word "DEAD" cannot be transformed to a number, so it is assigned the NA value

```
read.csv(file = "../data-raw/ACACIA_DREPANOLOBIUM_SURVEY.txt",
         sep = "\t",
         na.strings = "dead")
```

```
##     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 20.0
## 2        1 2012 SOUTH     1     TOTAL S1TOTAL  582   2.65  4.10  3.90 28.0
## 3        1 2012 SOUTH     1     TOTAL S1TOTAL 3111   1.50  1.70  0.85 17.0
## 4        1 2012 SOUTH     1     TOTAL S1TOTAL 3112   2.01  1.80  1.60 12.0
## 5        1 2012 SOUTH     1     TOTAL S1TOTAL 3113   1.75  1.84  1.42 13.0
## 6        1 2012 SOUTH     1     TOTAL S1TOTAL 3114   1.65  1.62  0.85 15.0
```

```
## 7      1 2012 SOUTH      1      TOTAL S1TOTAL 3115   1.20  1.95  0.90  9.0
## 8      1 2012 SOUTH      1      TOTAL S1TOTAL 3199   1.45  2.00  1.75 12.2
## 9      1 2012 SOUTH      1      MESO  S1MESO   941   1.87  2.15  1.82 13.0
## 10     1 2012 SOUTH      1      MESO  S1MESO   942   2.38  5.55  4.82 35.0
## 11     1 2012 SOUTH      1      MESO  S1MESO   943   2.58  4.90  4.24 24.0
## 12     1 2012 SOUTH      1      MESO  S1MESO   944   2.65  3.75  3.10 27.0
## 13     1 2012 SOUTH      1      MESO  S1MESO   946   2.35  2.34  2.05 20.0
## 14     1 2012 SOUTH      1      MESO  S1MESO   947   1.88  2.10  1.85 28.0
## 15     1 2012 SOUTH      1      MESO  S1MESO  3116   2.32  3.05  2.63 30.0
## 16     1 2012 SOUTH      1      MESO  S1MESO  3117   2.39  2.21  2.10 13.0
## 17     1 2012 SOUTH      1      MESO  S1MESO  3118   2.20  1.80  1.50 10.0
## 18     1 2012 SOUTH      1      MESO  S1MESO  3119   1.05  0.90  0.55  8.0
## 19     1 2012 SOUTH      1      MESO  S1MESO  3120   2.00  1.25  1.20 10.0
## 20     1 2012 SOUTH      1      MESO  S1MESO  3131   1.28  1.14  1.00 10.0
## 21     1 2012 SOUTH      2      OPEN  S2OPEN   341     NA    NA    NA   NA
## 22     1 2012 SOUTH      2      TOTAL S2TOTAL 3178   1.40  2.50  2.15 18.0
## 23     1 2012 SOUTH      2      TOTAL S2TOTAL  101   1.90  3.31  2.65 15.0
## 24     1 2012 SOUTH      2      TOTAL S2TOTAL  102   1.75  2.70  2.55 16.0
## 25     1 2012 SOUTH      2      TOTAL S2TOTAL  103   1.80  2.75  2.30 16.0
## 26     1 2012 SOUTH      2      TOTAL S2TOTAL  104   2.70  4.05  4.00 35.2
## 27     1 2012 SOUTH      2      TOTAL S2TOTAL  105   2.02  2.85  1.49 17.0
## 28     1 2012 SOUTH      2      TOTAL S2TOTAL  108   1.90  3.10  2.85 19.0
## 29     1 2012 SOUTH      2      TOTAL S2TOTAL  109   1.85  2.45  1.90 19.0
## 30     1 2012 SOUTH      2      TOTAL S2TOTAL  110   1.65  1.90  1.54 17.0
## 31     1 2012 SOUTH      2      TOTAL S2TOTAL  111   1.40  2.35  1.45 14.0
## 32     1 2012 SOUTH      2      TOTAL S2TOTAL  113   2.50  3.25  2.30 22.0
## 33     1 2012 SOUTH      2      TOTAL S2TOTAL  115   2.05  5.40  4.50 33.0
## 34     1 2012 SOUTH      2      TOTAL S2TOTAL  116   2.26  3.50  3.10 33.0
## 35     1 2012 SOUTH      2      TOTAL S2TOTAL  117   2.13  2.40  2.30 20.0
## 36     1 2012 SOUTH      2      TOTAL S2TOTAL  118   1.80  3.15  2.55 22.0
## 37     1 2012 SOUTH      2      TOTAL S2TOTAL 1211   1.85  2.00  2.27 20.0
## 38     1 2012 SOUTH      2      TOTAL S2TOTAL 1212   1.50  2.15  1.80 15.0
## 39     1 2012 SOUTH      2      TOTAL S2TOTAL 1213   1.87  2.34  2.05 13.0
## 40     1 2012 SOUTH      2      TOTAL S2TOTAL 1214   1.58  1.28  0.75 11.0
## 41     1 2012 SOUTH      2      TOTAL S2TOTAL 1215   2.05  2.10  1.75 17.0
## 42     1 2012 SOUTH      2      TOTAL S2TOTAL 1216   1.75  2.45  3.28 16.0
## 43     1 2012 SOUTH      2      TOTAL S2TOTAL 1217   1.49  1.50  1.45 13.0
## 44     1 2012 SOUTH      2      TOTAL S2TOTAL 1218   1.28  2.00  0.90 10.0
## 45     1 2012 SOUTH      2      TOTAL S2TOTAL 1219   1.49  2.35  1.65 13.0
## 46     1 2012 SOUTH      2      TOTAL S2TOTAL 1220   1.07  1.20  0.95 11.0
## 47     1 2012 SOUTH      2      TOTAL S2TOTAL 1231   1.48  1.25  1.20  9.0
## 48     1 2012 SOUTH      2      TOTAL S2TOTAL 1232   1.25  1.25  0.90 10.0
## 49     1 2012 SOUTH      2      TOTAL S2TOTAL 1233   1.41  1.41  1.40 14.0
## 50     1 2012 SOUTH      2      TOTAL S2TOTAL 1234   1.60  1.60  1.30 13.0
## 51     1 2012 SOUTH      2      TOTAL S2TOTAL 1235   1.20  1.20  1.30 14.0
## 52     1 2012 SOUTH      2      TOTAL S2TOTAL 1236   1.49  1.49  1.20  8.0
## 53     1 2012 SOUTH      2      TOTAL S2TOTAL 1237   1.50  1.50  1.50 14.0
## 54     1 2012 SOUTH      2      TOTAL S2TOTAL 1238   1.65  1.65  2.00 20.0
## 55     1 2012 SOUTH      2      TOTAL S2TOTAL 1239   1.13  1.13  1.20 10.0
## 56     1 2012 SOUTH      2      TOTAL S2TOTAL 1240   1.25  1.25  0.90 10.0
## 57     1 2012 SOUTH      2      TOTAL S2TOTAL 1251   1.10  1.20  1.10 10.0
## 58     1 2012 SOUTH      2      TOTAL S2TOTAL 1252   2.20  2.70  2.40 25.0
## 59     1 2012 SOUTH      2      TOTAL S2TOTAL 1253   1.45  1.65  1.25 10.0
## 60     1 2012 SOUTH      2      TOTAL S2TOTAL 1254   1.60  2.45  2.10 13.0
```

```
## 61     1 2012 SOUTH     2     TOTAL S2TOTAL 1255   1.55  2.40  1.80 13.0
## 62     1 2012 SOUTH     2     TOTAL S2TOTAL 1256   1.50  2.40  2.15 13.0
## 63     1 2012 SOUTH     2     TOTAL S2TOTAL 1257   1.03  1.20  1.00 10.0
## 64     1 2012 SOUTH     2     TOTAL S2TOTAL 1258   2.14  1.90  1.70 13.0
## 65     1 2012 SOUTH     2     TOTAL S2TOTAL 1259   1.20  1.90  1.65 12.0
## 66     1 2012 SOUTH     2     TOTAL S2TOTAL 1260   1.05  1.10  1.00  9.0
## 67     1 2012 SOUTH     2     TOTAL S2TOTAL 2131   1.80  2.60  2.40 15.0
## 68     1 2012 SOUTH     2     TOTAL S2TOTAL 2132   1.20  1.00  0.95  7.0
## 69     1 2012 SOUTH     2     TOTAL S2TOTAL 2133   1.75  1.40  1.10 10.0
## 70     1 2012 SOUTH     2     TOTAL S2TOTAL 2134   1.45  3.10  1.80 10.0
## 71     1 2012 SOUTH     2     TOTAL S2TOTAL 2135   1.17  1.20  1.10  5.0
## 72     1 2012 SOUTH     2     TOTAL S2TOTAL 2136   2.15  3.10  2.58 22.0
## 73     1 2012 SOUTH     2     TOTAL S2TOTAL 2137   1.70  1.70  1.40 12.0
## 74     1 2012 SOUTH     2     TOTAL S2TOTAL 3132   1.98  2.85  2.70 12.0
## 75     1 2012 SOUTH     2     TOTAL S2TOTAL 3133   1.26  1.95  1.75 17.0
## 76     1 2012 SOUTH     2     TOTAL S2TOTAL 3134   1.11  1.95  1.50 10.0
## 77     1 2012 SOUTH     2     TOTAL S2TOTAL 3135   1.14  1.32  1.05 10.0
## 78     1 2012 SOUTH     2     TOTAL S2TOTAL 3136   1.26  1.60  1.40 10.0
## 79     1 2012 SOUTH     2     TOTAL S2TOTAL 3137   1.30  1.40  0.80 10.0
## 80     1 2012 SOUTH     2     TOTAL S2TOTAL 3138   1.29  1.44  1.35 13.0
## 81     1 2012 SOUTH     2     TOTAL S2TOTAL 3139   1.31  1.35  1.15  7.0
## 82     1 2012 SOUTH     2     TOTAL S2TOTAL 3140   1.15  1.70  1.28 10.0
## 83     1 2012 SOUTH     2     TOTAL S2TOTAL 3151   1.87  3.40  1.85 15.0
## 84     1 2012 SOUTH     2     TOTAL S2TOTAL 3152   1.47  2.10  1.61  8.0
## 85     1 2012 SOUTH     2     TOTAL S2TOTAL 3153   1.05  1.79  1.50 10.0
## 86     1 2012 SOUTH     2     TOTAL S2TOTAL 3154   2.10  4.90  3.75 25.0
## 87     1 2012 SOUTH     2     TOTAL S2TOTAL 3155   1.99  1.80  1.35 13.0
## 88     1 2012 SOUTH     2     TOTAL S2TOTAL 3156   1.42  1.90  1.80 14.0
## 89     1 2012 SOUTH     2     TOTAL S2TOTAL 3157   1.50  2.11  1.75 12.0
## 90     1 2012 SOUTH     2     TOTAL S2TOTAL 3158   1.06  1.05  0.85  4.0
## 91     1 2012 SOUTH     2     TOTAL S2TOTAL 3159   1.49  1.50  1.15 13.0
## 92     1 2012 SOUTH     2     TOTAL S2TOTAL 3160   1.80  1.60  1.50 14.0
## 93     1 2012 SOUTH     2     TOTAL S2TOTAL 3171   1.93  1.74  1.20 14.0
## 94     1 2012 SOUTH     2     TOTAL S2TOTAL 3172   1.20  1.60  1.30 10.0
## 95     1 2012 SOUTH     2     TOTAL S2TOTAL 3173   1.65  1.25  1.10 11.0
## 96     1 2012 SOUTH     2     TOTAL S2TOTAL 3174   1.52  1.49  1.10 12.0
## 97     1 2012 SOUTH     2     TOTAL S2TOTAL 3175   1.43  2.05  1.54 13.0
## 98     1 2012 SOUTH     2     TOTAL S2TOTAL 3176   1.25  1.40  1.25 13.0
## 99     1 2012 SOUTH     2     TOTAL S2TOTAL 3177   1.88  2.65  2.64 20.0
## 100    1 2012 SOUTH     2     TOTAL S2TOTAL 3179   1.03  1.40  0.60 13.0
## 101    1 2012 SOUTH     2     TOTAL S2TOTAL 3180   1.10  1.30  1.20 10.0
## 102    1 2012 SOUTH     2     TOTAL S2TOTAL 3191   1.40  1.05  1.00 10.0
## 103    1 2012 SOUTH     2     TOTAL S2TOTAL 3192   1.05  1.55  0.90 10.0
## 104    1 2012 SOUTH     2     TOTAL S2TOTAL 3193   1.18  1.20  1.00  7.0
## 105    1 2012 SOUTH     2     TOTAL S2TOTAL 3194   1.40  1.30  1.85 13.0
## 106    1 2012 SOUTH     2     TOTAL S2TOTAL 3195   1.37  2.67  2.19 19.0
## 107    1 2012 SOUTH     2     TOTAL S2TOTAL 3196   1.32  2.15  1.55 11.0
## 108    1 2012 SOUTH     2     MEGA  S2MEGA   182   1.55  2.20  1.20 20.0
## 109    1 2012 SOUTH     2     MEGA  S2MEGA   183   1.30  1.80  0.90  8.0
## 110    1 2012 SOUTH     2     MEGA  S2MEGA   184   1.24  1.20  1.20 25.0
## 111    1 2012 SOUTH     2     MEGA  S2MEGA   185   1.50  2.10  1.75 16.0
## 112    1 2012 SOUTH     2     MEGA  S2MEGA   186   1.65  2.50  2.20 15.0
## 113    1 2012 SOUTH     2     MEGA  S2MEGA   187   2.17  2.00  1.20 15.0
## 114    1 2012 SOUTH     2     MEGA  S2MEGA   188   1.28  1.60  1.50 10.0
```

```
## 115      1 2012 SOUTH      2    MEGA  S2MEGA  189  1.07  1.50  1.50 10.0
## 116      1 2012 SOUTH      2    MEGA  S2MEGA  190  0.67  1.00  0.80  8.0
## 117      1 2012 SOUTH      2    MEGA  S2MEGA  191  0.68  0.70  0.60  4.0
## 118      1 2012 SOUTH      2    MEGA  S2MEGA  192  1.87  1.60  1.40  9.0
## 119      1 2012 SOUTH      2    MEGA  S2MEGA  193  1.35  1.90  1.50 14.0
## 120      1 2012 SOUTH      2    MEGA  S2MEGA  194  1.75  2.10  2.10 15.0
## 121      1 2012 SOUTH      2    MESO  S2MESO  462  1.75  3.30  2.50 23.0
## 122      1 2012 SOUTH      2    MESO  S2MESO  463  1.64  2.30  2.00 14.0
## 123      1 2012 SOUTH      2    MESO  S2MESO 2138  1.42  0.90  0.80 10.0
## 124      1 2012 SOUTH      3    OPEN  S3OPEN 1301    NA    NA    NA    NA
## 125      1 2012 SOUTH      3    OPEN  S3OPEN 1302  0.90  1.30  1.10 11.0
## 126      1 2012 SOUTH      3   TOTAL S3TOTAL 1061    NA    NA    NA    NA
## 127      1 2012 SOUTH      3   TOTAL S3TOTAL 1062  1.80  2.60  2.60 15.0
## 128      1 2012 SOUTH      3   TOTAL S3TOTAL 1063  2.47  3.10  2.20 18.0
## 129      1 2012 SOUTH      3   TOTAL S3TOTAL 1064  2.15  1.60  1.10 17.0
## 130      1 2012 SOUTH      3   TOTAL S3TOTAL 1066  1.70  2.50  2.15 15.0
## 131      1 2012 SOUTH      3   TOTAL S3TOTAL 1066  1.90  1.80  1.50 20.0
## 132      1 2012 SOUTH      3   TOTAL S3TOTAL 1067  1.95  2.10  1.90 13.0
## 133      1 2012 SOUTH      3   TOTAL S3TOTAL 1068  1.80  1.70  1.40 13.0
## 134      1 2012 SOUTH      3   TOTAL S3TOTAL 1069  1.40  2.00  1.60 14.0
## 135      1 2012 SOUTH      3   TOTAL S3TOTAL 1070  1.00  1.30  1.20  7.0
## 136      1 2012 SOUTH      3   TOTAL S3TOTAL 2139  1.75  1.20  1.10 13.0
## 137      1 2012 SOUTH      3   TOTAL S3TOTAL 2140  1.28  1.50  0.95  4.0
## 138      1 2012 SOUTH      3   TOTAL S3TOTAL 2151  1.00  1.40  1.20  4.0
## 139      1 2012 SOUTH      3   TOTAL S3TOTAL 2152  1.45  1.50  1.30 10.0
## 140      1 2012 SOUTH      3   TOTAL S3TOTAL 2153  1.00  1.00  0.75  8.0
## 141      1 2012 SOUTH      3   TOTAL S3TOTAL 2154  1.03  1.00  0.90  6.0
## 142      1 2012 SOUTH      3   TOTAL S3TOTAL 2155  1.51  2.00  1.80 12.0
## 143      1 2012 SOUTH      3   TOTAL S3TOTAL 2156  1.17  1.10  0.90 10.0
## 144      1 2012 SOUTH      3   TOTAL S3TOTAL 2157  1.33  1.90  1.85 14.0
## 145      1 2012 SOUTH      3   TOTAL S3TOTAL 2158  1.30  1.10  0.85  8.0
## 146      1 2012 SOUTH      3   TOTAL S3TOTAL 2159  1.13  1.10  0.90 10.0
## 147      1 2012 SOUTH      3   TOTAL S3TOTAL 2160  1.58  1.40  1.40 13.0
## 148      1 2012 SOUTH      3   TOTAL S3TOTAL 2171  1.06  1.40  1.00  5.0
## 149      1 2012 SOUTH      3   TOTAL S3TOTAL 2172  1.05  1.40  0.95  7.0
## 150      1 2012 SOUTH      3   TOTAL S3TOTAL 2173  1.45  1.60  1.10  6.0
## 151      1 2012 SOUTH      3   TOTAL S3TOTAL 2174  1.15  1.10  0.90  5.0
## 152      1 2012 SOUTH      3   TOTAL S3TOTAL 2175  1.42  1.45  1.30 13.0
## 153      1 2012 SOUTH      3   TOTAL S3TOTAL 2176  1.02  1.20  1.00  8.0
## 154      1 2012 SOUTH      3   TOTAL S3TOTAL 2177  1.40  1.20  1.00  9.0
## 155      1 2012 SOUTH      3   TOTAL S3TOTAL 2178  1.45  2.10  2.05 15.0
## 156      1 2012 SOUTH      3    MESO  S3MESO 1421  1.95  2.20  1.60 13.0
## 157      1 2012 SOUTH      3    MESO  S3MESO 1422    NA    NA    NA    NA
##      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
## 7          0    0      0    CS
## 8          0    0     25    CS
## 9          0    0      0    TP
## 10         0    0     50    TP
```

```
## 11     0     0     5   CS
## 12     0     0    60   TP
## 13     0     0    60   TP
## 14     2     0    60   CS
## 15     2     0     0   CS
## 16     0     0     0   TP
## 17     0     0     0   TP
## 18     0     0     0   CS
## 19     0     0     0   CM
## 20     0     0     0   TP
## 21    NA    NA    NA
## 22     0     0     5   CS
## 23     0     0    45   CS
## 24    40    50    35   CS
## 25     8     2    65   CS
## 26     0     0    20   TP
## 27     0     0    70   CS
## 28     0     0   125   CM
## 29     0     0   200   CM
## 30     0     0    10   CS
## 31     0     0     0   CS
## 32     0     0    35   TP
## 33     0     0   300   CM
## 34     2     2   100   CS
## 35     0     0    30   CM
## 36     0     0    50   TP
## 37     0     0    10   CM
## 38     0     0    25   CS
## 39     0     0    15   TP
## 40     0     0     0   TP
## 41     0     0    15   TP
## 42     0     0     0   TP
## 43     0     0    40   TP
## 44     0     0     0   TP
## 45     0     0    15   CM
## 46     0     0     0   CM
## 47     0     0     0   TP
## 48     0     0     0   TP
## 49     0     0     1   TP
## 50     0     0    20   TP
## 51     0     0     0   TP
## 52     0     0     0   TP
## 53     0     0    20   TP
## 54     0     0     0   TP
## 55     0     0     0   CN
## 56     0     0     0   CN
## 57     0     0     0   TP
## 58     0     0     5   TP
## 59     0     0     0   TP
## 60     0     0    25   TP
## 61     0     0    25   TP
## 62     0     0    20   TP
## 63     0     0     0   TP
## 64     0     0    10   CS
```

```
## 65          1     0      25     CS
## 66          0     0       0     TP
## 67          0     0      10     TP
## 68          0     0       0     TP
## 69          0     0       0     TP
## 70          0     0       0     TP
## 71          0     0       0     TP
## 72          0     0       0     CS
## 73          0     0       0     CS
## 74          0     0      25  AB_TP
## 75          0     0       0     TP
## 76          0     0       0     TP
## 77          0     0       0     TP
## 78          0     0       0     CS
## 79          0     0       0     CS
## 80          0     0       0     CS
## 81          0     0       0     CS
## 82          0     0       5     CS
## 83          6     0       0     CS
## 84          0     0       0     CS
## 85          0     0       1     CS
## 86          0     0      25     CS
## 87          0     0       0     CS
## 88          0     0       0     CS
## 89          0     0      10     CS
## 90          0     0       0     CS
## 91          0     0      35     CS
## 92          0     0       0     CS
## 93          0     0       0     CS
## 94          0     0       0     CS
## 95          0     0       0     CS
## 96          0     0      20     CS
## 97          0     0       0     CS
## 98          0     0       0     CM
## 99          0     0     100     CM
## 100         0     0       0     CS
## 101         0     0       0     CS
## 102         0     0       0     CS
## 103         0     0       0     CM
## 104         0     0       0     TP
## 105         0     0      30     CS
## 106         0     0      50     TP
## 107         0     0      10     CS
## 108         0     0       0     CS
## 109         0     0      15     CS
## 110         0     0      10     CS
## 111         5     0     200     CS
## 112         0     0      80     CS
## 113         0     0     150     TP
## 114         0     0      40     TP
## 115         0     0      60     TP
## 116         0     0       0     CS
## 117         0     0       0     TP
## 118         0     0      40     CS
```

```
## 119      0    0     20      CS
## 120      0    0     75      TP
## 121      0    0     20      CM
## 122      0    0      0      TP
## 123      0    0      0       E
## 124     NA   NA     NA
## 125      0    0      0      TP
## 126     NA   NA     NA
## 127      0    0     50      TP
## 128      0    0      0      TP
## 129      0    0      0      TP
## 130      0    0      2      TP
## 131      0    0     25      TP
## 132      0    0      0      TP
## 133      0    0      0      TP
## 134      0    0      0      TP
## 135      0    0      0      TP
## 136      0    0      0      TP
## 137      0    0      0      TP
## 138      0    0      0      TP
## 139      0    0      0      TP
## 140      0    0      0      TP
## 141      0    0      0      TP
## 142      0    0      0      TP
## 143      0    0      0      TP
## 144      0    0      0      TP
## 145      0    0      0      TP
## 146      0    0      0      TP
## 147      0    0      0      TP
## 148      0    0      8      TP
## 149      0    0      0      TP
## 150      0    0      0      TP
## 151      0    0      0      TP
## 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
```
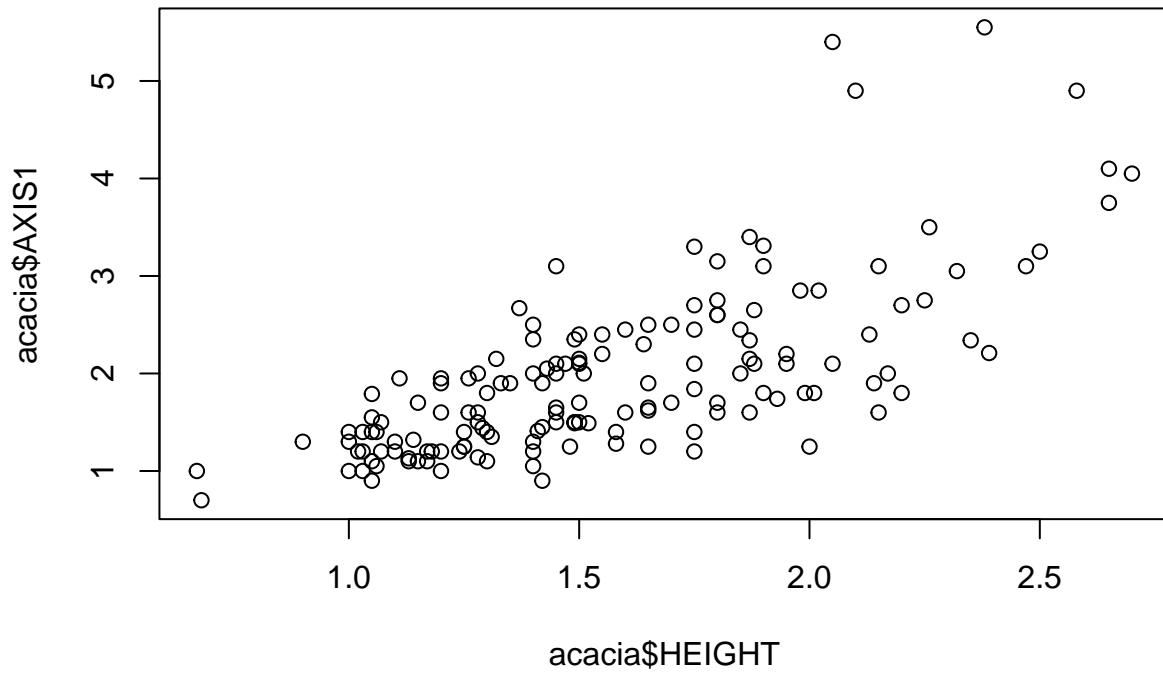
```
is.numeric(acacia$HEIGHT)
```

```
## [1] TRUE
```

5. Plotting data with `ggplot2`

Regular way to plot in R

```
plot(x = acacia$HEIGHT, y = acacia$AXIS1, main = "Acacia height vs axis1")
```
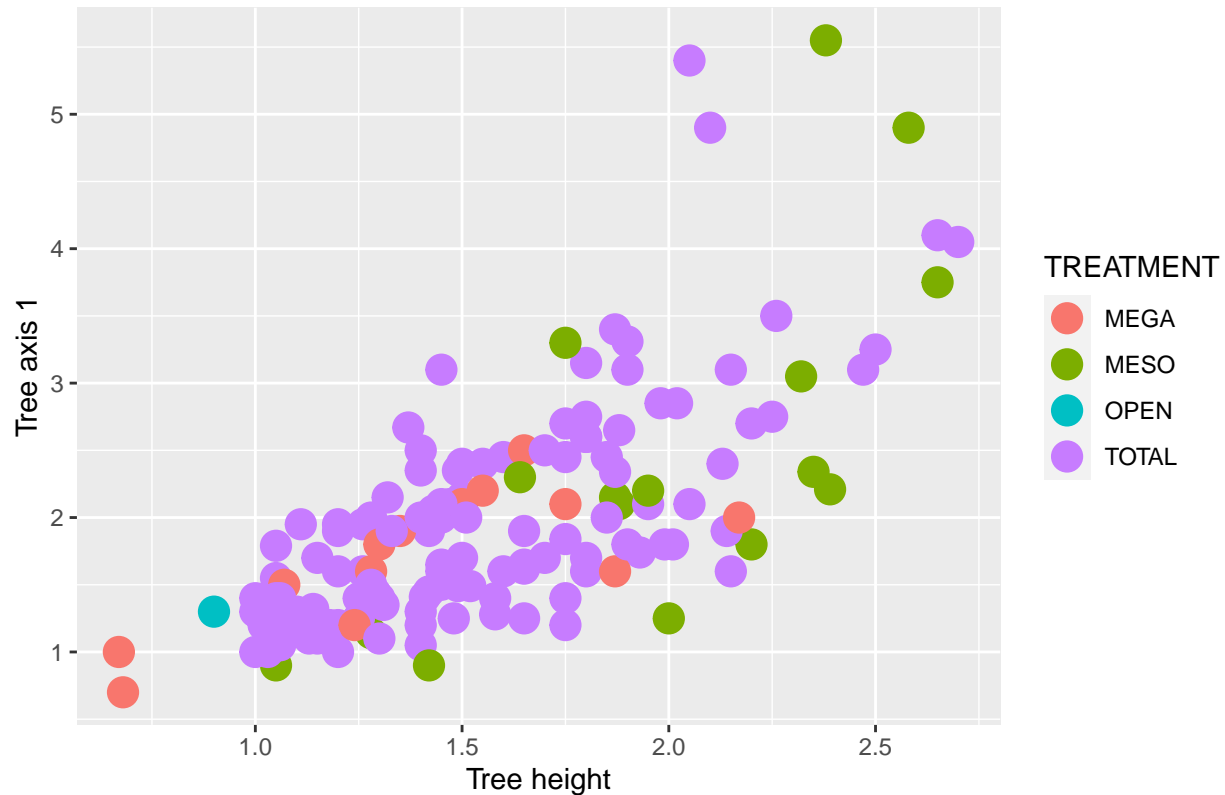
Acacia height vs axis1

With ggplot, we create layers

```
library(ggplot2)

ggplot(data = acacia, mapping = aes(x = HEIGHT, y = AXIS1, color = TREATMENT)) +
  geom_point(size = 5) +
  labs(x = "Tree height", y = "Tree axis 1", title = "Acacia trees size relationships")
```

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

Acacia trees size relationships


```
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"
```