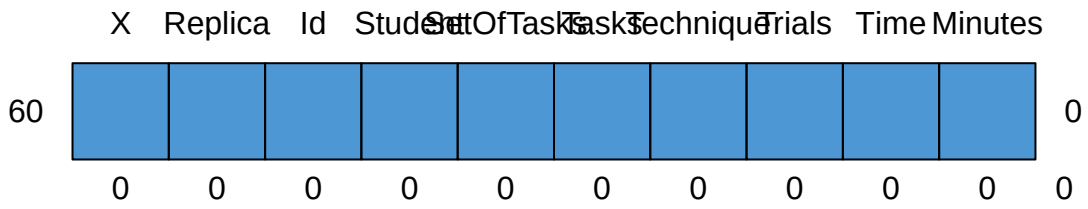
```r
ccwo <- read.csv("datasetatoms.csv")
ccwo$Minutes[ccwo$Minutes < 0] <- NA
```

```r
md.pattern(ccwo)
```

```
##  /\     /\
## {  `---'  }
## {  O   O  }
## ==>  V <==  No need for mice. This data set is completely observed.
##  \  \|/  /
##   `-----'
```




```
##    X Replica Id Student SetOfTasks Tasks Technique Trials Time Minutes
## 60 1       1  1       1          1     1         1      1    1       1 0
##    0       0  0       0          0     0         0      0    0       0 0
```

```
##
##  iter imp variable
##    1   1
##    1   2
##    1   3
##    1   4
##    1   5
##    2   1
```

```
##    2    2
##    2    3
##    2    4
##    2    5
##    3    1
##    3    2
##    3    3
##    3    4
##    3    5
##    4    1
##    4    2
##    4    3
##    4    4
##    4    5
##    5    1
##    5    2
##    5    3
##    5    4
##    5    5
##    6    1
##    6    2
##    6    3
##    6    4
##    6    5
##    7    1
##    7    2
##    7    3
##    7    4
##    7    5
##    8    1
##    8    2
##    8    3
##    8    4
##    8    5
##    9    1
##    9    2
##    9    3
##    9    4
##    9    5
##   10    1
##   10    2
##   10    3
##   10    4
##   10    5
##   11    1
##   11    2
##   11    3
##   11    4
##   11    5
##   12    1
##   12    2
##   12    3
##   12    4
##   12    5
```

```
##    13   1
##    13   2
##    13   3
##    13   4
##    13   5
##    14   1
##    14   2
##    14   3
##    14   4
##    14   5
##    15   1
##    15   2
##    15   3
##    15   4
##    15   5
##    16   1
##    16   2
##    16   3
##    16   4
##    16   5
##    17   1
##    17   2
##    17   3
##    17   4
##    17   5
##    18   1
##    18   2
##    18   3
##    18   4
##    18   5
##    19   1
##    19   2
##    19   3
##    19   4
##    19   5
##    20   1
##    20   2
##    20   3
##    20   4
##    20   5
##    21   1
##    21   2
##    21   3
##    21   4
##    21   5
##    22   1
##    22   2
##    22   3
##    22   4
##    22   5
##    23   1
##    23   2
##    23   3
##    23   4
```

```
##    23   5
##    24   1
##    24   2
##    24   3
##    24   4
##    24   5
##    25   1
##    25   2
##    25   3
##    25   4
##    25   5
##    26   1
##    26   2
##    26   3
##    26   4
##    26   5
##    27   1
##    27   2
##    27   3
##    27   4
##    27   5
##    28   1
##    28   2
##    28   3
##    28   4
##    28   5
##    29   1
##    29   2
##    29   3
##    29   4
##    29   5
##    30   1
##    30   2
##    30   3
##    30   4
##    30   5
##    31   1
##    31   2
##    31   3
##    31   4
##    31   5
##    32   1
##    32   2
##    32   3
##    32   4
##    32   5
##    33   1
##    33   2
##    33   3
##    33   4
##    33   5
##    34   1
##    34   2
##    34   3
```

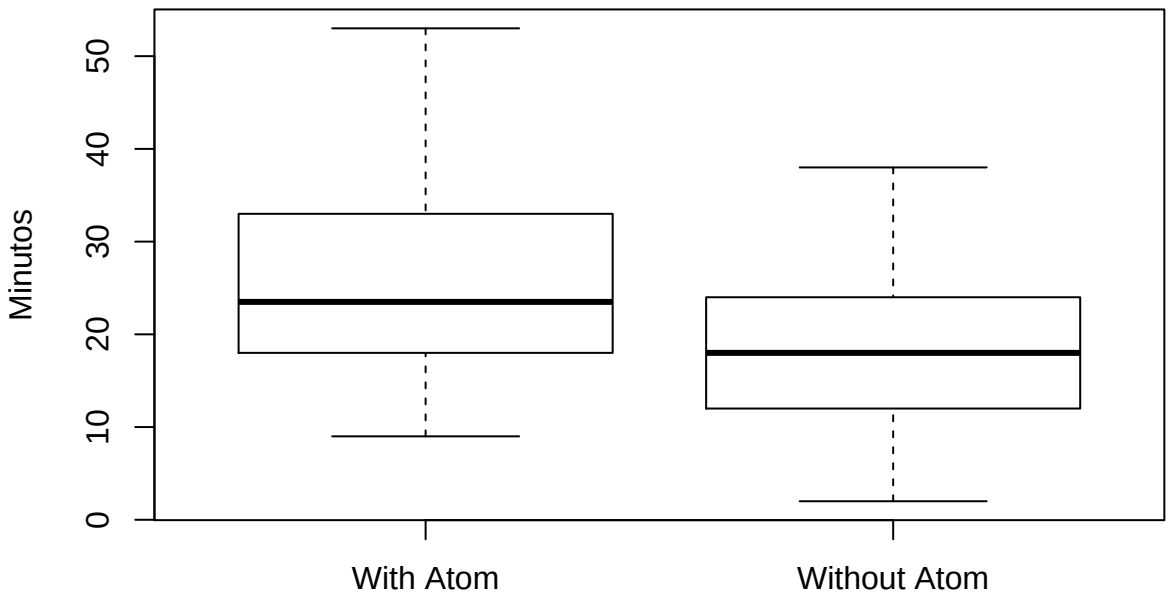
```
##    34   4
##    34   5
##    35   1
##    35   2
##    35   3
##    35   4
##    35   5
##    36   1
##    36   2
##    36   3
##    36   4
##    36   5
##    37   1
##    37   2
##    37   3
##    37   4
##    37   5
##    38   1
##    38   2
##    38   3
##    38   4
##    38   5
##    39   1
##    39   2
##    39   3
##    39   4
##    39   5
##    40   1
##    40   2
##    40   3
##    40   4
##    40   5
##    41   1
##    41   2
##    41   3
##    41   4
##    41   5
##    42   1
##    42   2
##    42   3
##    42   4
##    42   5
##    43   1
##    43   2
##    43   3
##    43   4
##    43   5
##    44   1
##    44   2
##    44   3
##    44   4
##    44   5
##    45   1
##    45   2
```

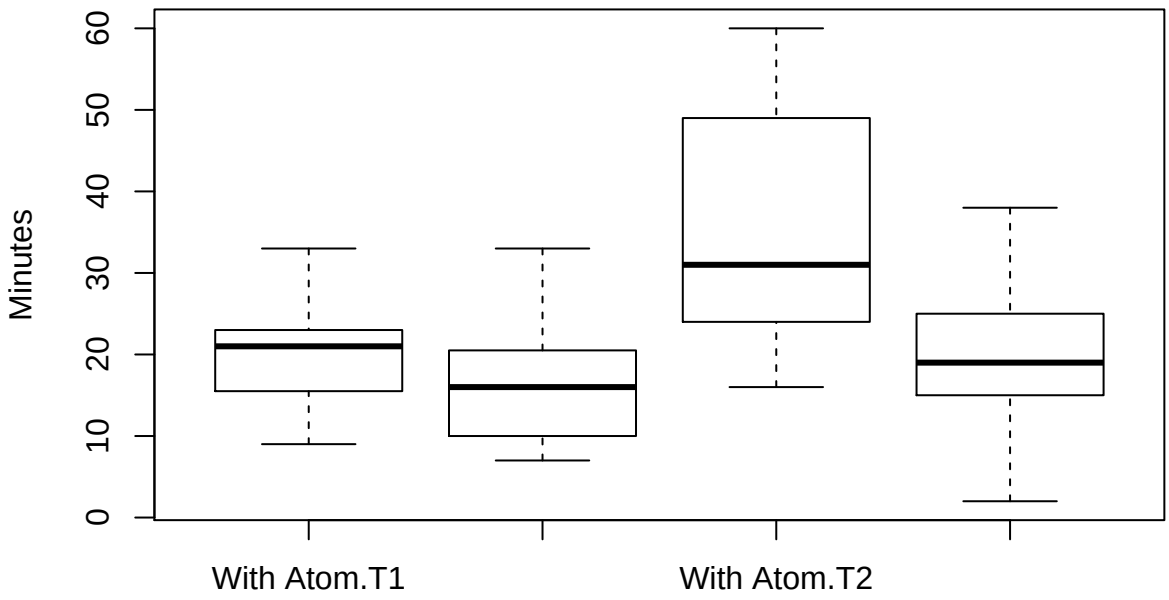
```
##   45   3
##   45   4
##   45   5
##   46   1
##   46   2
##   46   3
##   46   4
##   46   5
##   47   1
##   47   2
##   47   3
##   47   4
##   47   5
##   48   1
##   48   2
##   48   3
##   48   4
##   48   5
##   49   1
##   49   2
##   49   3
##   49   4
##   49   5
##   50   1
##   50   2
##   50   3
##   50   4
##   50   5
```

```
## Warning: Number of logged events: 1
```

```
##    Replica Id SetOfTasks    Technique Trials Time
## 1       41  1        ST1 Without Atom      7   13
## 2       41  1        ST2    With Atom      3   16
## 3       41  2        ST1    With Atom      5   21
## 4       41  2        ST2 Without Atom      3   15
## 5       42  1        ST1 Without Atom      5   14
## 6       42  1        ST2    With Atom     12   39
## 7       42  2        ST1    With Atom      7   16
## 8       42  2        ST2 Without Atom     12   22
## 9       43  1        ST1 Without Atom      5   18
## 10      43  1        ST2    With Atom      9   53
## 11      43  2        ST1    With Atom      9   21
## 12      43  2        ST2 Without Atom      5   15
## 13      44  1        ST1 Without Atom      4    9
## 14      44  1        ST2    With Atom      4   24
## 15      44  2        ST1    With Atom      6   17
## 16      44  2        ST2 Without Atom      6   23
## 17      45  1        ST1    With Atom      9   25
## 18      45  1        ST2 Without Atom      7   28
## 19      45  2        ST1 Without Atom      5    7
## 20      45  2        ST2    With Atom      8   18
## 21      46  1        ST1    With Atom      7   32
## 22      46  1        ST2 Without Atom      9   32
```

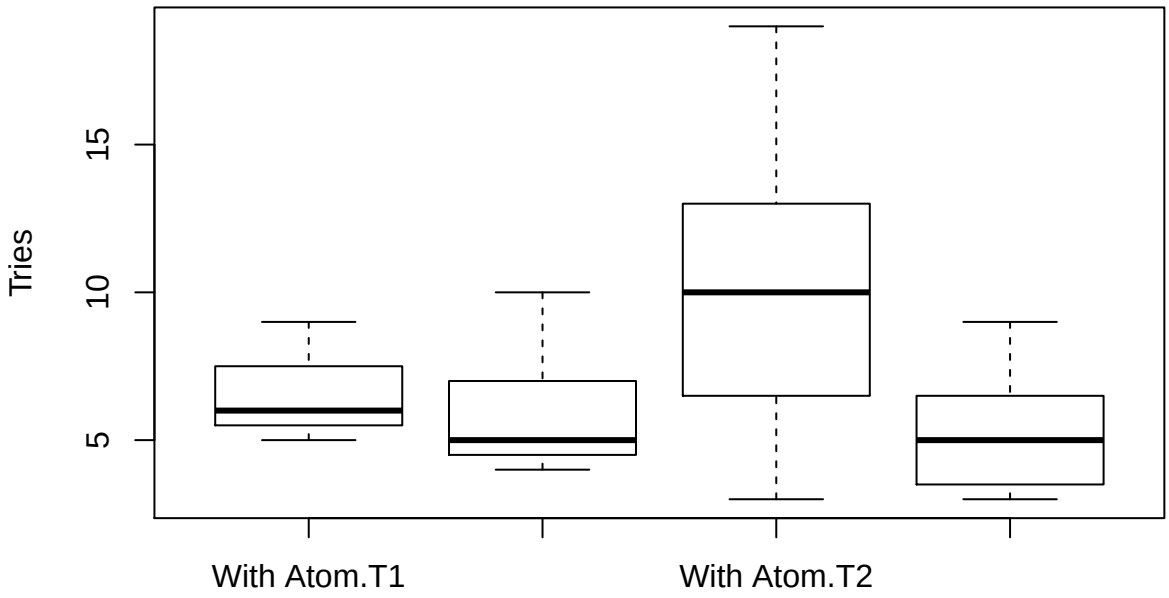
```
## 23      46  2        ST1 Without Atom      4   10
## 24      46  2        ST2    With Atom     12   31
## 25      47  1        ST1 Without Atom      4   18
## 26      47  1        ST2    With Atom      5   53
## 27      47  2        ST1    With Atom      5   21
## 28      47  2        ST2 Without Atom      4   24
## 29      48  1        ST1    With Atom      7   15
## 30      48  1        ST2 Without Atom      3   12
## 31      48  2        ST1 Without Atom     10   25
## 32      48  2        ST2    With Atom     29   60
## 33      49  1        ST1 Without Atom      8   33
## 34      49  1        ST2    With Atom     10   23
## 35      49  2        ST1    With Atom      6    9
## 36      49  2        ST2 Without Atom      3    2
## 37      50  1        ST1    With Atom      8   21
## 38      50  1        ST2 Without Atom      5   19
## 39      50  2        ST1 Without Atom      7   19
## 40      50  2        ST2    With Atom     10   29
## 41      51  1        ST1 Without Atom      5   22
## 42      51  1        ST2    With Atom      6   24
## 43      51  2        ST1    With Atom      6    9
## 44      51  2        ST2 Without Atom      5   15
## 45      52  1        ST1    With Atom      9   23
## 46      52  1        ST2 Without Atom     24   38
## 47      52  2        ST1 Without Atom      7   16
## 48      52  2        ST2    With Atom     14   52
## 49      53  1        ST1    With Atom      5   11
## 50      53  1        ST2 Without Atom      4    8
## 51      53  2        ST1 Without Atom      5    9
## 52      53  2        ST2    With Atom     15   31
## 53      54  1        ST1 Without Atom      4   27
## 54      54  1        ST2    With Atom      7   34
## 55      54  2        ST1    With Atom      6   33
## 56      54  2        ST2 Without Atom      3   26
## 57      55  1        ST1    With Atom      5   23
## 58      55  1        ST2 Without Atom      4   19
## 59      55  2        ST1 Without Atom      5   10
## 60      55  2        ST2    With Atom     19   46
```


Minutos
0
10
20
30
40
50
With Atom
Without Atom




```
##    Replica Tasks    Technique Trials Time
## 1       41    T1    With Atom      5   21
## 2       41    T1 Without Atom      7   13
## 3       41    T2    With Atom      3   16
## 4       41    T2 Without Atom      3   15
## 5       42    T1    With Atom      7   16
## 6       42    T1 Without Atom      5   14
## 7       42    T2    With Atom     12   39
## 8       42    T2 Without Atom     12   22
## 9       43    T1    With Atom      9   21
## 10      43    T1 Without Atom      5   18
## 11      43    T2    With Atom      9   53
## 12      43    T2 Without Atom      5   15
## 13      44    T1    With Atom      6   17
## 14      44    T1 Without Atom      4    9
## 15      44    T2    With Atom      4   24
## 16      44    T2 Without Atom      6   23
## 17      45    T1    With Atom      9   25
## 18      45    T1 Without Atom      5    7
## 19      45    T2    With Atom      8   18
## 20      45    T2 Without Atom      7   28
## 21      46    T1    With Atom      7   32
## 22      46    T1 Without Atom      4   10
## 23      46    T2    With Atom     12   31
## 24      46    T2 Without Atom      9   32
## 25      47    T1    With Atom      5   21
```

```
## 26      47    T1 Without Atom      4   18
## 27      47    T2    With Atom      5   53
## 28      47    T2 Without Atom      4   24
## 29      48    T1    With Atom      7   15
## 30      48    T1 Without Atom     10   25
## 31      48    T2    With Atom     29   60
## 32      48    T2 Without Atom      3   12
## 33      49    T1    With Atom      6    9
## 34      49    T1 Without Atom      8   33
## 35      49    T2    With Atom     10   23
## 36      49    T2 Without Atom      3    2
## 37      50    T1    With Atom      8   21
## 38      50    T1 Without Atom      7   19
## 39      50    T2    With Atom     10   29
## 40      50    T2 Without Atom      5   19
## 41      51    T1    With Atom      6    9
## 42      51    T1 Without Atom      5   22
## 43      51    T2    With Atom      6   24
## 44      51    T2 Without Atom      5   15
## 45      52    T1    With Atom      9   23
## 46      52    T1 Without Atom      7   16
## 47      52    T2    With Atom     14   52
## 48      52    T2 Without Atom     24   38
## 49      53    T1    With Atom      5   11
## 50      53    T1 Without Atom      5    9
## 51      53    T2    With Atom     15   31
## 52      53    T2 Without Atom      4    8
## 53      54    T1    With Atom      6   33
## 54      54    T1 Without Atom      4   27
## 55      54    T2    With Atom      7   34
## 56      54    T2 Without Atom      3   26
## 57      55    T1    With Atom      5   23
## 58      55    T1 Without Atom      5   10
## 59      55    T2    With Atom     19   46
## 60      55    T2 Without Atom      4   19
```



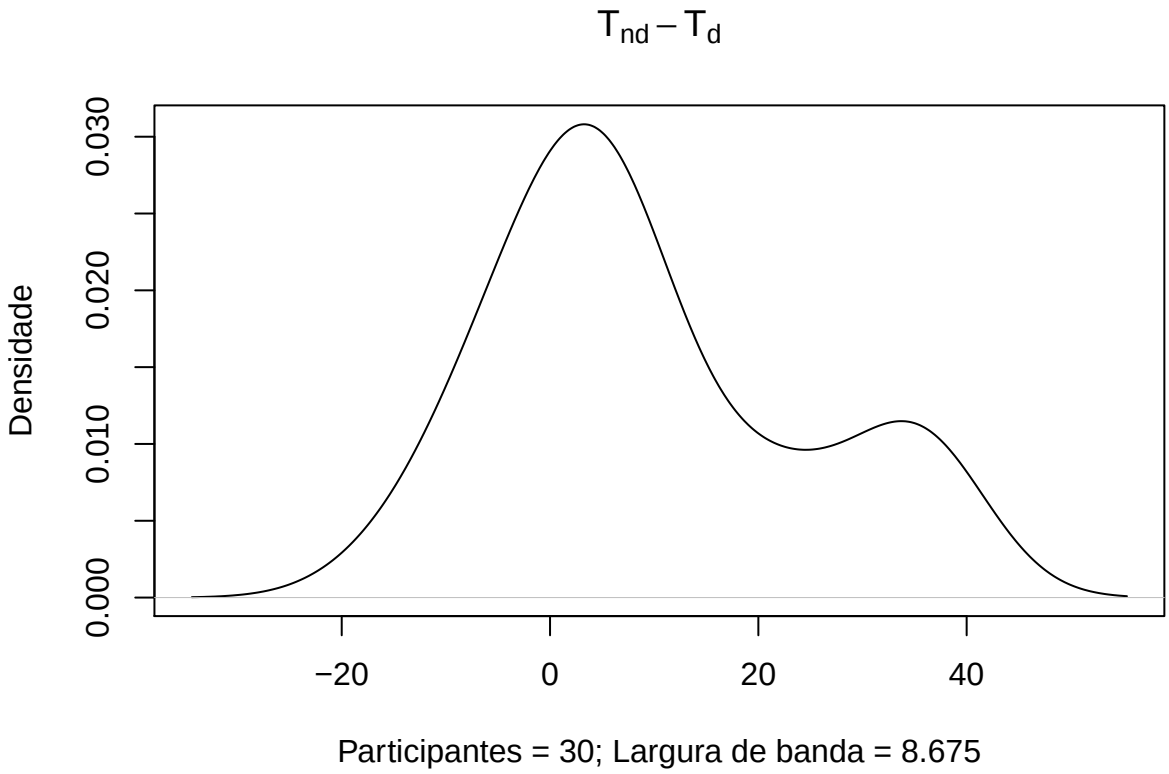

```
##     X Replica Id                  Student SetOfTasks             Tasks
## 1   1      41  1                    paulo        ST1 AV1.2:CO1.2:DE1.2
## 2   1      41  1                    paulo        ST2 AV2.1:CO2.1:DE2.1
## 3   1      41  2                  Romário        ST1 AV1.1:CO1.1:DE1.1
## 4   1      41  2                  Romário        ST2 AV2.2:CO2.2:DE2.2
## 5   2      42  1                     Igor        ST1 AV1.2:CO1.2:DE1.2
## 6   2      42  1                     Igor        ST2 AV2.1:CO2.1:DE2.1
## 7   2      42  2                    Hyago        ST1 AV1.1:CO1.1:DE1.1
## 8   2      42  2                    Hyago        ST2 AV2.2:CO2.2:DE2.2
## 9   3      43  1                                 ST1 AV1.2:CO1.2:DE1.2
## 10  3      43  1                                 ST2 AV2.1:CO2.1:DE2.1
## 11  3      43  2                                 ST1 AV1.1:CO1.1:DE1.1
## 12  3      43  2                                 ST2 AV2.2:CO2.2:DE2.2
## 13  4      44  1                                 ST1 AV1.2:CO1.2:DE1.2
## 14  4      44  1                                 ST2 AV2.1:CO2.1:DE2.1
## 15  4      44  2                                 ST1 AV1.1:CO1.1:DE1.1
## 16  4      44  2                                 ST2 AV2.2:CO2.2:DE2.2
## 17  5      45  1              Matheus Costa        ST1 AV1.1:CO1.1:DE1.1
## 18  5      45  1              Matheus Costa        ST2 AV2.2:CO2.2:DE2.2
## 19  5      45  2                  Davi Jose        ST1 AV1.2:CO1.2:DE1.2
## 20  5      45  2                  Davi Jose        ST2 AV2.1:CO2.1:DE2.1
## 21  6      46  1               Marlon Lúcio        ST1 AV1.1:CO1.1:DE1.1
## 22  6      46  1               Marlon Lúcio        ST2 AV2.2:CO2.2:DE2.2
## 23  6      46  2 Jackson Barbosa da Silva        ST1 AV1.2:CO1.2:DE1.2
## 24  6      46  2 Jackson Barbosa da Silva        ST2 AV2.1:CO2.1:DE2.1
## 25  7      47  1                      Allan        ST1 AV1.2:CO1.2:DE1.2
```

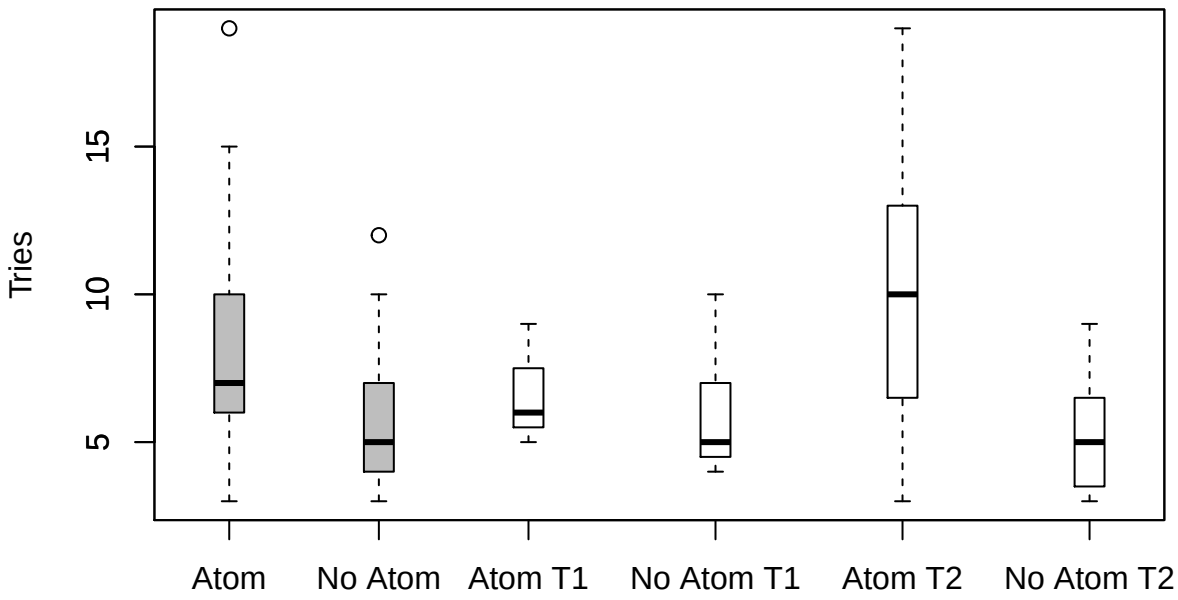
```
## 26  7      47  1                     Allan        ST2 AV2.1:CO2.1:DE2.1
## 27  7      47  2 Dielson Sales de Carvalho        ST1 AV1.1:CO1.1:DE1.1
## 28  7      47  2 Dielson Sales de Carvalho        ST2 AV2.2:CO2.2:DE2.2
## 29  8      48  1                    Thiago        ST1 AV1.1:CO1.1:DE1.1
## 30  8      48  1                    Thiago        ST2 AV2.2:CO2.2:DE2.2
## 31  8      48  2                                  ST1 AV1.2:CO1.2:DE1.2
## 32  8      48  2                                  ST2 AV2.1:CO2.1:DE2.1
## 33  9      49  1              Rodrigo Lima        ST1 AV1.2:CO1.2:DE1.2
## 34  9      49  1              Rodrigo Lima        ST2 AV2.1:CO2.1:DE2.1
## 35  9      49  2              Jardel Costa        ST1 AV1.1:CO1.1:DE1.1
## 36  9      49  2              Jardel Costa        ST2 AV2.2:CO2.2:DE2.2
## 37 10      50  1             Felipe Pontes        ST1 AV1.1:CO1.1:DE1.1
## 38 10      50  1             Felipe Pontes        ST2 AV2.2:CO2.2:DE2.2
## 39 10      50  2               Jairo Souza        ST1 AV1.2:CO1.2:DE1.2
## 40 10      50  2               Jairo Souza        ST2 AV2.1:CO2.1:DE2.1
## 41 11      51  1                    julios        ST1 AV1.2:CO1.2:DE1.2
## 42 11      51  1                    julios        ST2 AV2.1:CO2.1:DE2.1
## 43 11      51  2          Romero Malaquias        ST1 AV1.1:CO1.1:DE1.1
## 44 11      51  2          Romero Malaquias        ST2 AV2.2:CO2.2:DE2.2
## 45 12      53  1 Bruno Georgevich Ferreira        ST1 AV1.1:CO1.1:DE1.1
## 46 12      53  1 Bruno Georgevich Ferreira        ST2 AV2.2:CO2.2:DE2.2
## 47 12      53  2                    jadson        ST1 AV1.2:CO1.2:DE1.2
## 48 12      53  2                    jadson        ST2 AV2.1:CO2.1:DE2.1
## 49 13      55  1                                  ST1 AV1.1:CO1.1:DE1.1
## 50 13      55  1                                  ST2 AV2.2:CO2.2:DE2.2
## 51 13      55  2                    Arthur        ST1 AV1.2:CO1.2:DE1.2
## 52 13      55  2                    Arthur        ST2 AV2.1:CO2.1:DE2.1
## 53 14      52  1                                  ST1 AV1.1:CO1.1:DE1.1
## 54 14      52  1                                  ST2 AV2.2:CO2.2:DE2.2
## 55 14      52  2            vinicius lopes        ST1 AV1.2:CO1.2:DE1.2
## 56 14      52  2            vinicius lopes        ST2 AV2.1:CO2.1:DE2.1
## 57 15      54  1            Thiago Tenorio        ST1 AV1.2:CO1.2:DE1.2
## 58 15      54  1            Thiago Tenorio        ST2 AV2.1:CO2.1:DE2.1
## 59 15      54  2 Joao Victor Ribeiro Ferro        ST1 AV1.1:CO1.1:DE1.1
## 60 15      54  2 Joao Victor Ribeiro Ferro        ST2 AV2.2:CO2.2:DE2.2
##       Technique Trials Time Minutes
## 1  Without Atom      7   13      13
## 2     With Atom      3   16      16
## 3     With Atom      5   21      21
## 4  Without Atom      3   15      15
## 5  Without Atom      5   14      14
## 6     With Atom     12   39      39
## 7     With Atom      7   16      16
## 8  Without Atom     12   22      22
## 9  Without Atom      5   18      18
## 10    With Atom      9   53      53
## 11    With Atom      9   21      21
## 12 Without Atom      5   15      15
## 13 Without Atom      4    9       9
## 14    With Atom      4   24      24
## 15    With Atom      6   17      17
## 16 Without Atom      6   23      23
## 17    With Atom      9   25      25
## 18 Without Atom      7   28      28
```

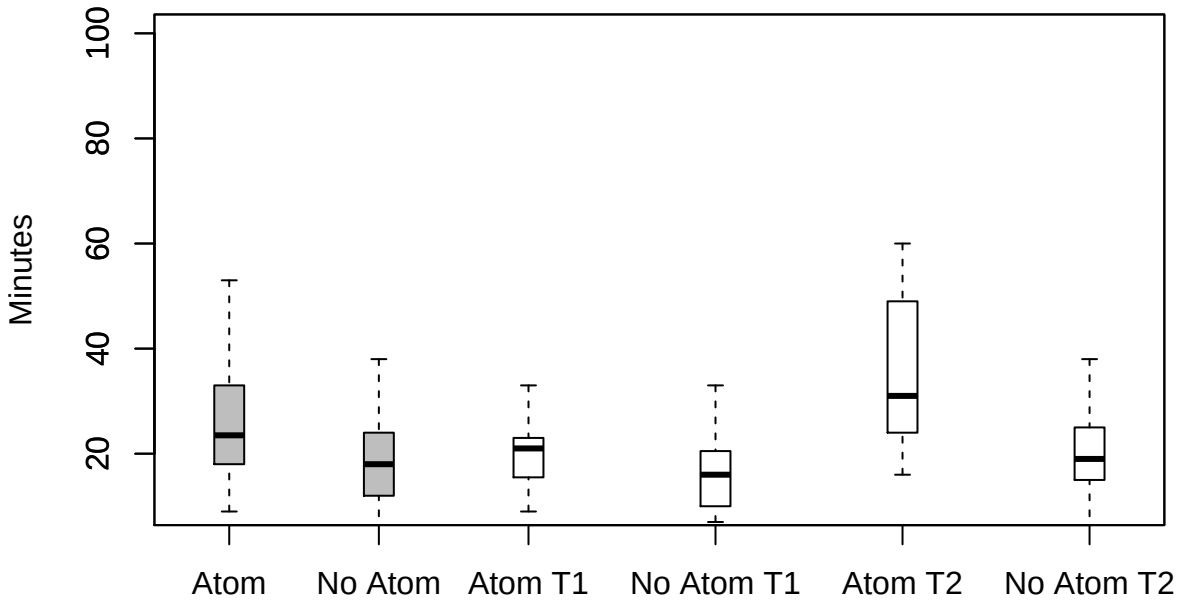
```
## 19 Without Atom      5    7       7
## 20    With Atom      8   18      18
## 21    With Atom      7   32      32
## 22 Without Atom      9   32      32
## 23 Without Atom      4   10      10
## 24    With Atom     12   31      31
## 25 Without Atom      4   18      18
## 26    With Atom      5   53      53
## 27    With Atom      5   21      21
## 28 Without Atom      4   24      24
## 29    With Atom      7   15      15
## 30 Without Atom      3   12      12
## 31 Without Atom     10   25      25
## 32    With Atom     29   60      60
## 33 Without Atom      8   33      33
## 34    With Atom     10   23      23
## 35    With Atom      6    9       9
## 36 Without Atom      3    2       2
## 37    With Atom      8   21      21
## 38 Without Atom      5   19      19
## 39 Without Atom      7   19      19
## 40    With Atom     10   29      29
## 41 Without Atom      5   22      22
## 42    With Atom      6   24      24
## 43    With Atom      6    9       9
## 44 Without Atom      5   15      15
## 45    With Atom      5   11      11
## 46 Without Atom      4    8       8
## 47 Without Atom      5    9       9
## 48    With Atom     15   31      31
## 49    With Atom      5   23      23
## 50 Without Atom      4   19      19
## 51 Without Atom      5   10      10
## 52    With Atom     19   46      46
## 53    With Atom      9   23      23
## 54 Without Atom     24   38      38
## 55 Without Atom      7   16      16
## 56    With Atom     14   52      52
## 57 Without Atom      4   27      27
## 58    With Atom      7   34      34
## 59    With Atom      6   33      33
## 60 Without Atom      3   26      26

##    Replica             Tasks Minutes Time
## 1       41 AV1.2:CO1.2:DE1.2      13   13
## 2       41 AV1.1:CO1.1:DE1.1      21   21
## 3       42 AV1.2:CO1.2:DE1.2      14   14
## 4       42 AV1.1:CO1.1:DE1.1      16   16
## 5       43 AV1.2:CO1.2:DE1.2      18   18
## 6       43 AV1.1:CO1.1:DE1.1      21   21
## 7       44 AV1.2:CO1.2:DE1.2       9    9
## 8       44 AV1.1:CO1.1:DE1.1      17   17
## 9       45 AV1.1:CO1.1:DE1.1      25   25
## 10      45 AV1.2:CO1.2:DE1.2       7    7
```

```
## 11      46 AV1.1:CO1.1:DE1.1      32   32
## 12      46 AV1.2:CO1.2:DE1.2      10   10
## 13      47 AV1.2:CO1.2:DE1.2      18   18
## 14      47 AV1.1:CO1.1:DE1.1      21   21
## 15      48 AV1.1:CO1.1:DE1.1      15   15
## 16      48 AV1.2:CO1.2:DE1.2      25   25
## 17      49 AV1.2:CO1.2:DE1.2      33   33
## 18      49 AV1.1:CO1.1:DE1.1       9    9
## 19      50 AV1.1:CO1.1:DE1.1      21   21
## 20      50 AV1.2:CO1.2:DE1.2      19   19
## 21      51 AV1.2:CO1.2:DE1.2      22   22
## 22      51 AV1.1:CO1.1:DE1.1       9    9
## 23      53 AV1.1:CO1.1:DE1.1      11   11
## 24      53 AV1.2:CO1.2:DE1.2       9    9
## 25      55 AV1.1:CO1.1:DE1.1      23   23
## 26      55 AV1.2:CO1.2:DE1.2      10   10
## 27      52 AV1.1:CO1.1:DE1.1      23   23
## 28      52 AV1.2:CO1.2:DE1.2      16   16
## 29      54 AV1.2:CO1.2:DE1.2      27   27
## 30      54 AV1.1:CO1.1:DE1.1      33   33

##    Replica             Tasks Minutes Time
## 1       41 AV2.1:CO2.1:DE2.1      16   16
## 2       41 AV2.2:CO2.2:DE2.2      15   15
## 3       42 AV2.1:CO2.1:DE2.1      39   39
## 4       42 AV2.2:CO2.2:DE2.2      22   22
## 5       43 AV2.1:CO2.1:DE2.1      53   53
## 6       43 AV2.2:CO2.2:DE2.2      15   15
## 7       44 AV2.1:CO2.1:DE2.1      24   24
## 8       44 AV2.2:CO2.2:DE2.2      23   23
## 9       45 AV2.2:CO2.2:DE2.2      28   28
## 10      45 AV2.1:CO2.1:DE2.1      18   18
## 11      46 AV2.2:CO2.2:DE2.2      32   32
## 12      46 AV2.1:CO2.1:DE2.1      31   31
## 13      47 AV2.1:CO2.1:DE2.1      53   53
## 14      47 AV2.2:CO2.2:DE2.2      24   24
## 15      48 AV2.2:CO2.2:DE2.2      12   12
## 16      48 AV2.1:CO2.1:DE2.1      60   60
## 17      49 AV2.1:CO2.1:DE2.1      23   23
## 18      49 AV2.2:CO2.2:DE2.2       2    2
## 19      50 AV2.2:CO2.2:DE2.2      19   19
## 20      50 AV2.1:CO2.1:DE2.1      29   29
## 21      51 AV2.1:CO2.1:DE2.1      24   24
## 22      51 AV2.2:CO2.2:DE2.2      15   15
## 23      53 AV2.2:CO2.2:DE2.2       8    8
## 24      53 AV2.1:CO2.1:DE2.1      31   31
## 25      55 AV2.2:CO2.2:DE2.2      19   19
## 26      55 AV2.1:CO2.1:DE2.1      46   46
## 27      52 AV2.2:CO2.2:DE2.2      38   38
## 28      52 AV2.1:CO2.1:DE2.1      52   52
## 29      54 AV2.1:CO2.1:DE2.1      34   34
## 30      54 AV2.2:CO2.2:DE2.2      26   26

## [1] 18.23333
```

```
## [1] 27.7
```


$T_{nd} - T_d$
Densidade
0.000
0.010
0.020
0.030
−20
0
20
40
Participantes = 30; Largura de banda = 8.675


Tries
5
10
15
Atom
No Atom
Atom T1
No Atom T1
Atom T2
No Atom T2

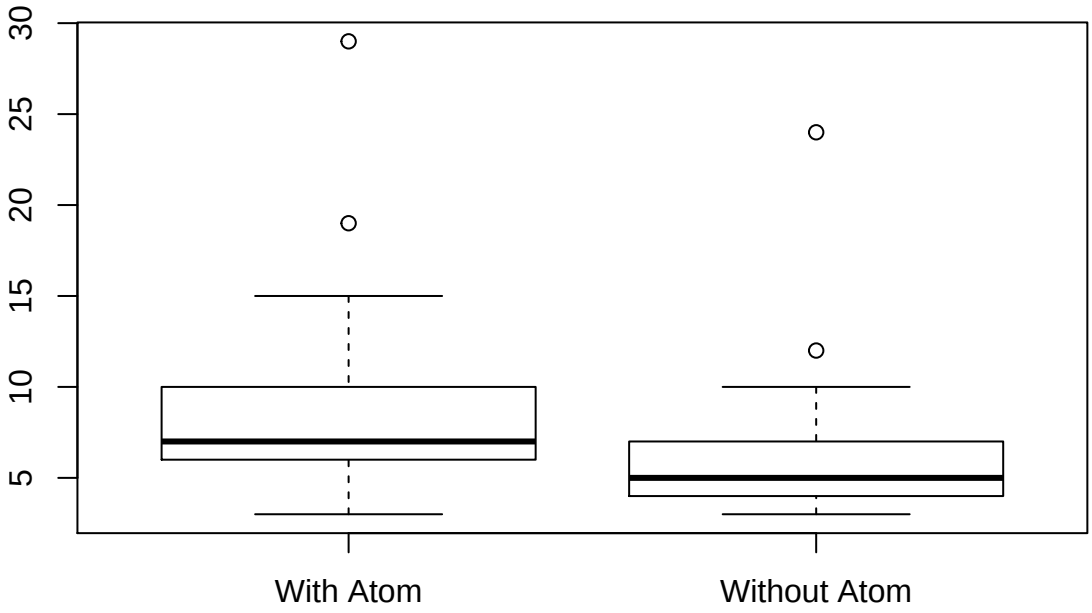


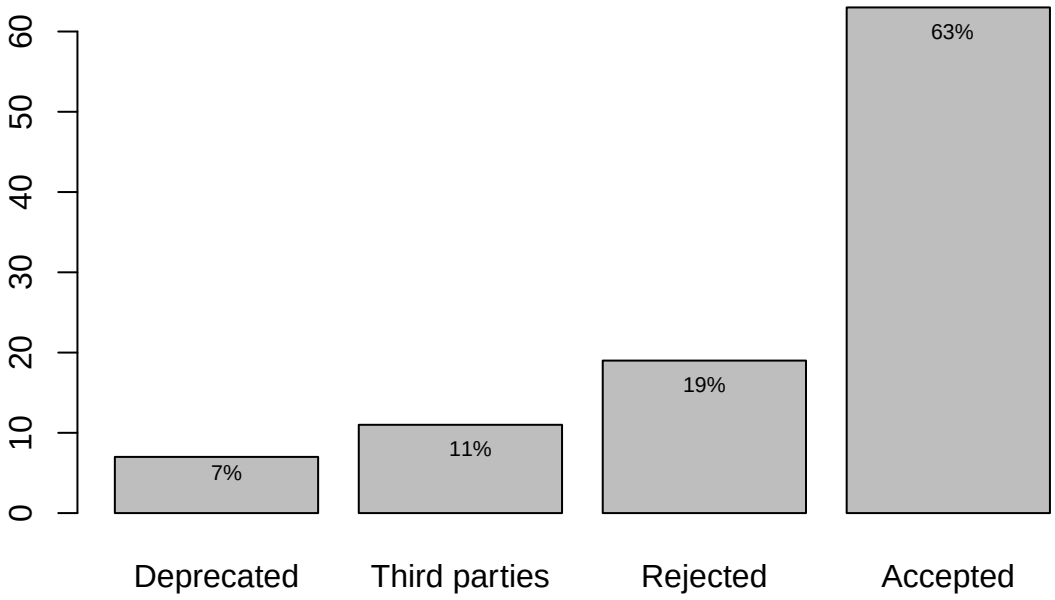

```
totalTrials <- sqldf("select Replica, Id, SetOfTasks,
                     Technique, sum(Trials) as Trials
                     from ccwocd
                     group by Replica, Id,SetOfTasks, Technique")

totalTrials
```

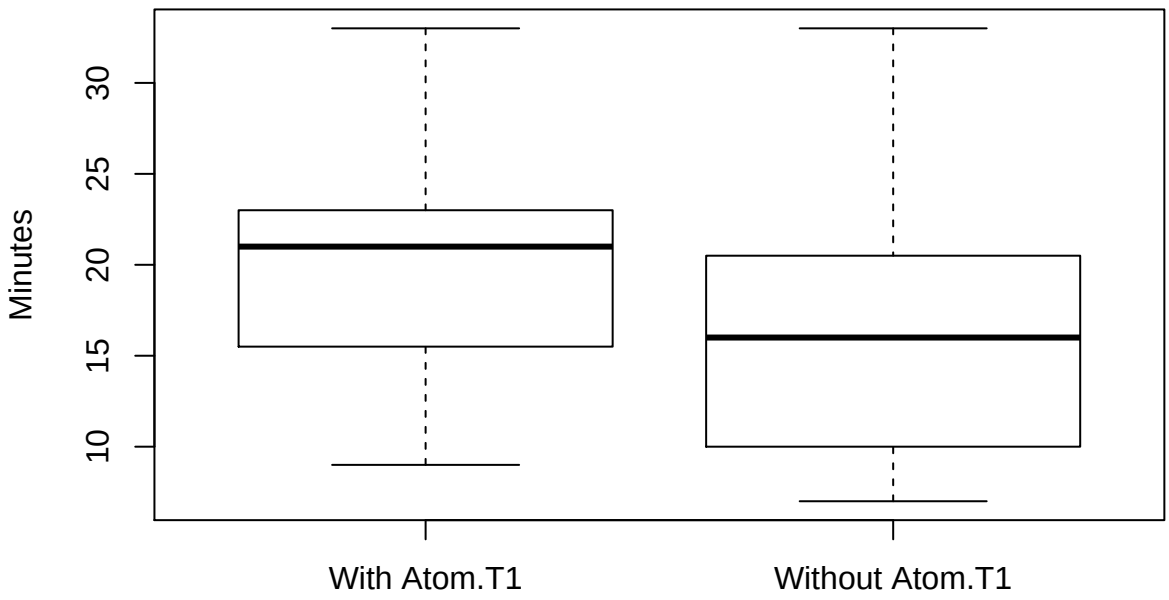
```
##    Replica Id SetOfTasks    Technique Trials
## 1       41  1        ST1 Without Atom      7
## 2       41  1        ST2    With Atom      3
## 3       41  2        ST1    With Atom      5
## 4       41  2        ST2 Without Atom      3
## 5       42  1        ST1 Without Atom      5
## 6       42  1        ST2    With Atom     12
## 7       42  2        ST1    With Atom      7
## 8       42  2        ST2 Without Atom     12
## 9       43  1        ST1 Without Atom      5
## 10      43  1        ST2    With Atom      9
## 11      43  2        ST1    With Atom      9
## 12      43  2        ST2 Without Atom      5
## 13      44  1        ST1 Without Atom      4
## 14      44  1        ST2    With Atom      4
## 15      44  2        ST1    With Atom      6
## 16      44  2        ST2 Without Atom      6
## 17      45  1        ST1    With Atom      9
## 18      45  1        ST2 Without Atom      7
```

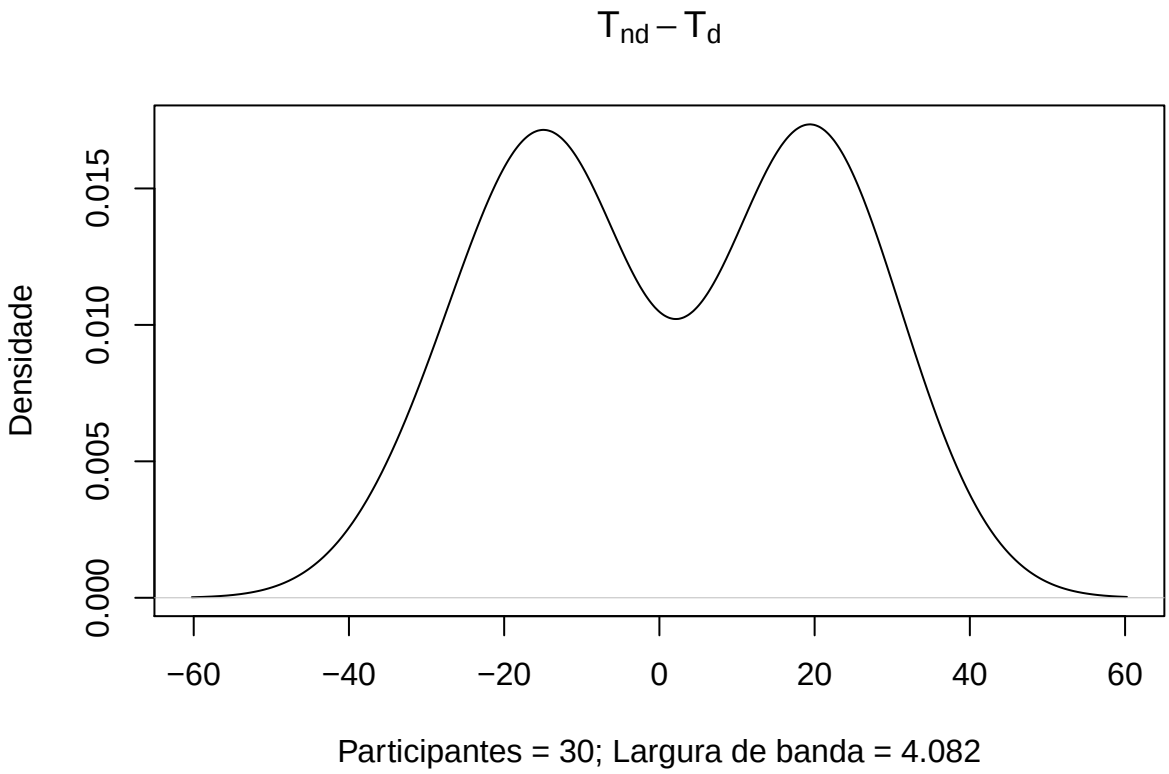
```
## 19      45  2        ST1 Without Atom      5
## 20      45  2        ST2    With Atom      8
## 21      46  1        ST1    With Atom      7
## 22      46  1        ST2 Without Atom      9
## 23      46  2        ST1 Without Atom      4
## 24      46  2        ST2    With Atom     12
## 25      47  1        ST1 Without Atom      4
## 26      47  1        ST2    With Atom      5
## 27      47  2        ST1    With Atom      5
## 28      47  2        ST2 Without Atom      4
## 29      48  1        ST1    With Atom      7
## 30      48  1        ST2 Without Atom      3
## 31      48  2        ST1 Without Atom     10
## 32      48  2        ST2    With Atom     29
## 33      49  1        ST1 Without Atom      8
## 34      49  1        ST2    With Atom     10
## 35      49  2        ST1    With Atom      6
## 36      49  2        ST2 Without Atom      3
## 37      50  1        ST1    With Atom      8
## 38      50  1        ST2 Without Atom      5
## 39      50  2        ST1 Without Atom      7
## 40      50  2        ST2    With Atom     10
## 41      51  1        ST1 Without Atom      5
## 42      51  1        ST2    With Atom      6
## 43      51  2        ST1    With Atom      6
## 44      51  2        ST2 Without Atom      5
## 45      52  1        ST1    With Atom      9
## 46      52  1        ST2 Without Atom     24
## 47      52  2        ST1 Without Atom      7
## 48      52  2        ST2    With Atom     14
## 49      53  1        ST1    With Atom      5
## 50      53  1        ST2 Without Atom      4
## 51      53  2        ST1 Without Atom      5
## 52      53  2        ST2    With Atom     15
## 53      54  1        ST1 Without Atom      4
## 54      54  1        ST2    With Atom      7
## 55      54  2        ST1    With Atom      6
## 56      54  2        ST2 Without Atom      3
## 57      55  1        ST1    With Atom      5
## 58      55  1        ST2 Without Atom      4
## 59      55  2        ST1 Without Atom      5
## 60      55  2        ST2    With Atom     19
```

```
boxplot(totalTrials$Trials~totalTrials$Technique)
```


30
25
20
15
10
5
With Atom
Without Atom


0
10
20
30
40
50
60
7%
11%
19%
63%
Deprecated
Third parties
Rejected
Accepted


Minutes
10
15
20
25
30
With Atom.T1
Without Atom.T1




```
totalTime <- sqldf("select Replica, Id, SetOfTasks,
                    Technique, sum(Trials) as Trials, sum(Minutes) as Time
                    from ccwocd where Tasks = 'AV1.1:CO1.1:DE1.1' or Tasks = 'AV1.2:CO1.2:DE1.2'
                    group by Replica, Id,SetOfTasks, Technique")


totalTime$Time <- with(totalTime, log2(Time))
```

```
totalTime$Replica = as.factor(totalTime$Replica)
totalTime$Id = as.factor(totalTime$Id)
totalTime$SetOfTasks = as.factor(totalTime$SetOfTasks)
totalTime$Technique = as.factor(totalTime$Technique)
```

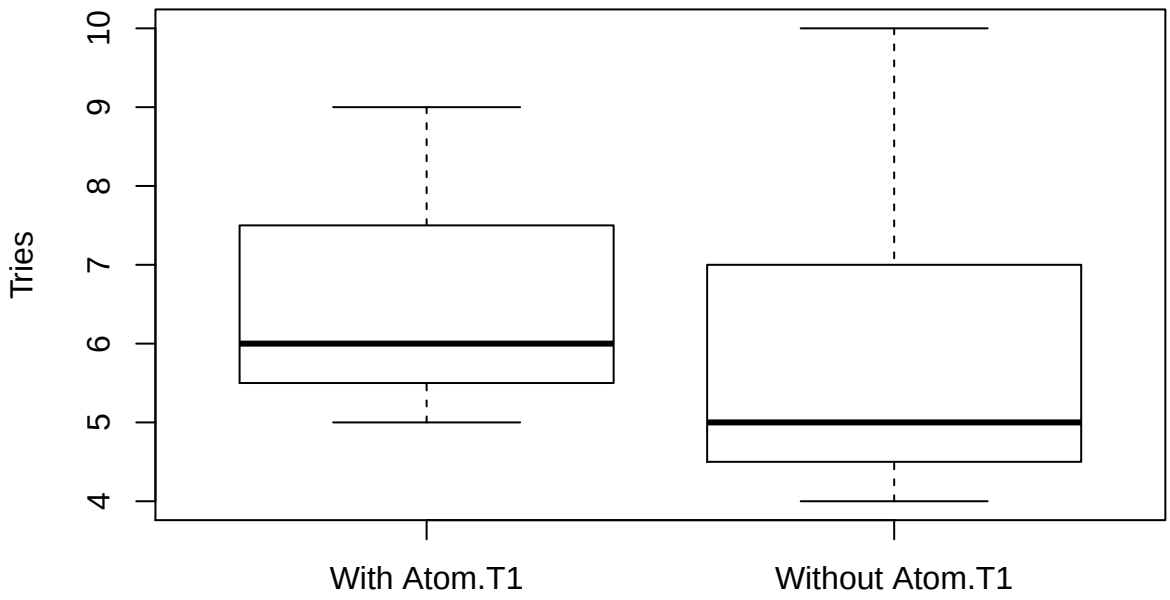
```
totalTime.gvlma = gvlma(lm(Time ~ Technique, data=totalTime))
summary(totalTime.gvlma)
```

```
##
## Call:
## lm(formula = Time ~ Technique, data = totalTime)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -1.1119 -0.5229  0.1858  0.3257  1.1251
##
## Coefficients:
```

```
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)             4.2066     0.1609  26.147   <2e-16 ***
## TechniqueWithout Atom  -0.2873     0.2275  -1.263    0.217
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.6231 on 28 degrees of freedom
## Multiple R-squared:  0.05387,    Adjusted R-squared:  0.02008
## F-statistic: 1.594 on 1 and 28 DF,  p-value: 0.2171
##
##
## ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
## USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
## Level of Significance =  0.05
##
## Call:
##  gvlma(x = lm(Time ~ Technique, data = totalTime))
##
##                       Value p-value                Decision
## Global Stat        2.611e+00  0.6249 Assumptions acceptable.
## Skewness           2.499e-01  0.6171 Assumptions acceptable.
## Kurtosis           9.031e-01  0.3419 Assumptions acceptable.
## Link Function      1.105e-15  1.0000 Assumptions acceptable.
## Heteroscedasticity 1.458e+00  0.2272 Assumptions acceptable.
```

```
summary(aov(lm(Time ~ Technique, data=totalTime)))
```

```
##             Df Sum Sq Mean Sq F value Pr(>F)
## Technique    1  0.619  0.6189   1.594  0.217
## Residuals   28 10.870  0.3882
```




```
totalTrials <- sqldf("select Replica, Id, SetOfTasks,
                     Technique, sum(Trials) as Trials
                     from ccwocd where Tasks = 'AV1.1:CO1.1:DE1.1' or Tasks = 'AV1.2:CO1.2:DE1.2'
                     group by Replica, Id,SetOfTasks, Technique")
totalTrials$Trials <- with(totalTrials, Trials + 1)
totalTrials$Trials <- with(totalTrials, log2(Trials))
```

```
totalTrials$Replica = as.factor(totalTrials$Replica)
totalTrials$Id = as.factor(totalTrials$Id)
totalTrials$SetOfTasks = as.factor(totalTrials$SetOfTasks:totalTrials$Technique)
totalTrials$Technique = as.factor(totalTrials$Technique)
```

```
summary(aov(Trials ~ Replica + Replica:Id + SetOfTasks + Technique, data=totalTrials))
```

```
##             Df Sum Sq Mean Sq
## Replica     14 1.6643  0.1189
## SetOfTasks   1 0.3582  0.3582
## Replica:Id  14 1.1195  0.0800
```

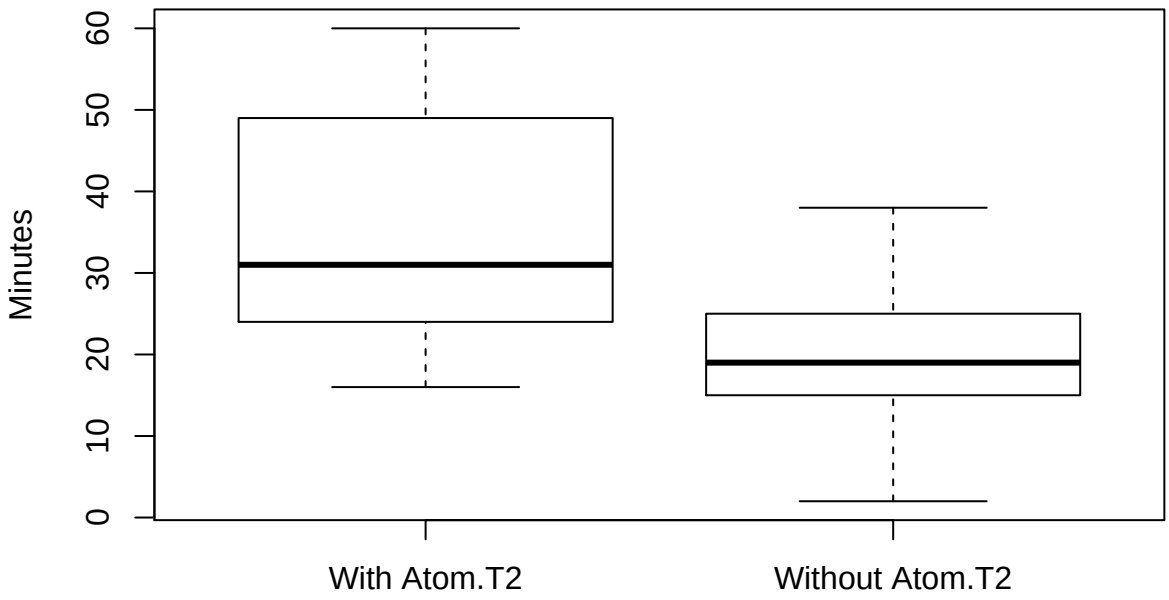
```
totalTrials.gvlma = gvlma(lm(Trials ~ Technique, data=totalTrials))
summary(totalTrials.gvlma)
```

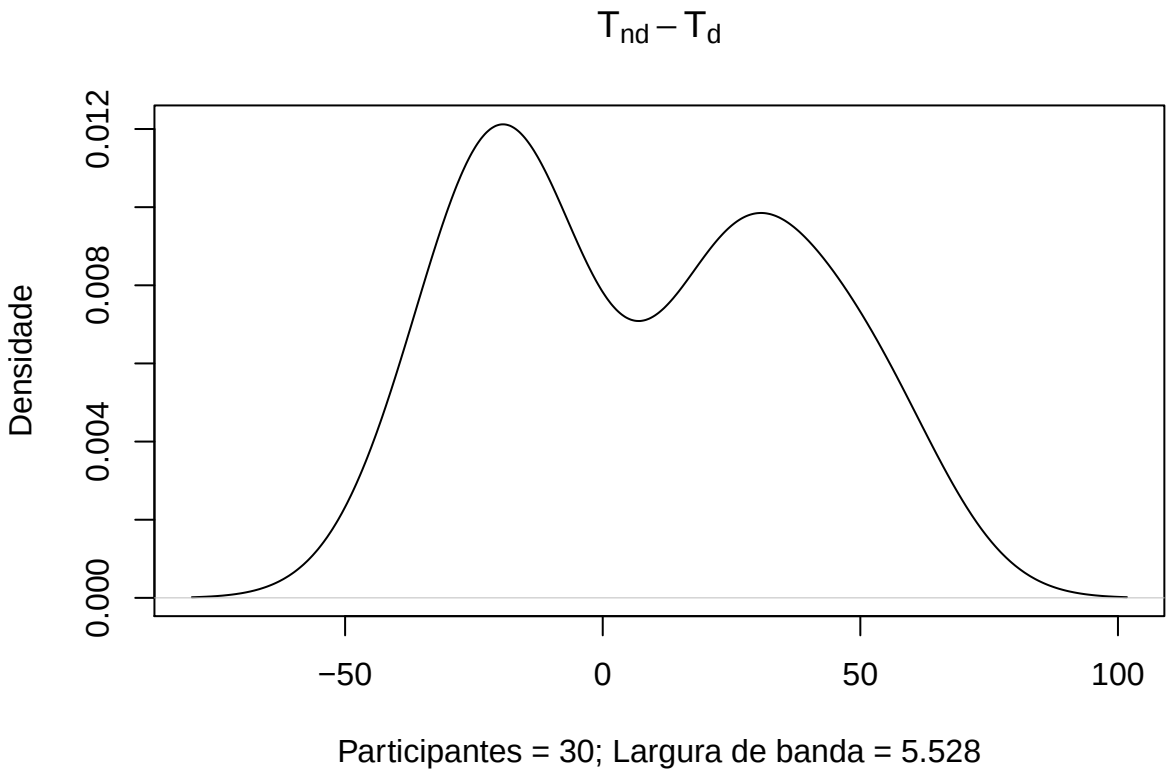
```
##
## Call:
```

```
## lm(formula = Trials ~ Technique, data = totalTrials)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -0.3732 -0.2741 -0.1063  0.2927  0.7643
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)            2.91367    0.08141  35.789   <2e-16 ***
## TechniqueWithout Atom -0.21854    0.11514  -1.898    0.068 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3153 on 28 degrees of freedom
## Multiple R-squared:  0.114,  Adjusted R-squared:  0.08236
## F-statistic: 3.603 on 1 and 28 DF,  p-value: 0.06803
##
##
## ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
## USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
## Level of Significance =  0.05
##
## Call:
##  gvlma(x = lm(Trials ~ Technique, data = totalTrials))
##
##                        Value p-value                Decision
## Global Stat        -3.799e+01  1.0000 Assumptions acceptable.
## Skewness            1.729e+00  0.1886 Assumptions acceptable.
## Kurtosis            3.856e-01  0.5346 Assumptions acceptable.
## Link Function      -4.011e+01  1.0000 Assumptions acceptable.
## Heteroscedasticity  9.333e-04  0.9756 Assumptions acceptable.
```

```
summary(aov(Trials ~ Technique, data=totalTrials))
```

```
##             Df Sum Sq Mean Sq F value Pr(>F)
## Technique    1 0.3582  0.3582   3.603  0.068 .
## Residuals   28 2.7838  0.0994
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```


Minutes
0
10
20
30
40
50
60
With Atom.T2
Without Atom.T2




```
totalTime <- sqldf("select Replica, Id, SetOfTasks,
                    Technique, sum(Trials) as Trials, sum(Minutes) as Time
                    from ccwocd where Tasks = 'AV2.1:CO2.1:DE2.1' or Tasks = 'AV2.2:CO2.2:DE2.2'
                    group by Replica, Id,SetOfTasks, Technique")

totalTime$Time <- with(totalTime, log2(Time))
```

```
totalTime$Replica = as.factor(totalTime$Replica)
totalTime$Id = as.factor(totalTime$Id)
totalTime$SetOfTasks = as.factor(totalTime$SetOfTasks)
totalTime$Technique = as.factor(totalTime$Technique)
```

```
totalTime.gvlma = gvlma(lm(Time ~ Technique, data=totalTime))
summary(totalTime.gvlma)
```

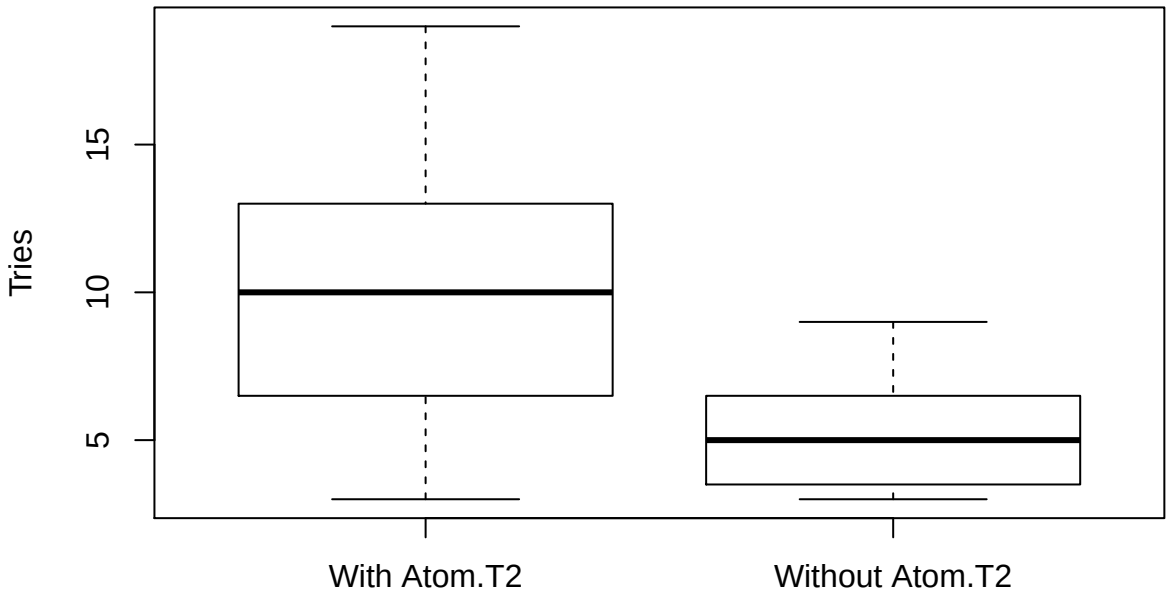
```
##
## Call:
## lm(formula = Time ~ Technique, data = totalTime)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.0750 -0.3861  0.1105  0.5966  1.1729
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept)             5.0393     0.2169  23.232  < 2e-16 ***
## TechniqueWithout Atom  -0.9643     0.3068  -3.143  0.00393 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8401 on 28 degrees of freedom
## Multiple R-squared:  0.2608, Adjusted R-squared:  0.2344
## F-statistic: 9.881 on 1 and 28 DF,  p-value: 0.003928
##
##
## ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
## USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
## Level of Significance =  0.05
##
## Call:
##  gvlma(x = lm(Time ~ Technique, data = totalTime))
##
##                         Value   p-value                   Decision
## Global Stat         3.981e+01 4.734e-08 Assumptions NOT satisfied!
## Skewness            1.471e+01 1.257e-04 Assumptions NOT satisfied!
## Kurtosis            2.491e+01 6.006e-07 Assumptions NOT satisfied!
## Link Function      -1.813e-14 1.000e+00    Assumptions acceptable.
## Heteroscedasticity  1.963e-01 6.577e-01    Assumptions acceptable.
```

```
summary(aov(lm(Time ~ Technique, data=totalTime)))
```

```
##             Df Sum Sq Mean Sq F value  Pr(>F)
## Technique    1  6.974   6.974   9.881 0.00393 **
## Residuals   28 19.762   0.706
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
##
##  Kruskal-Wallis rank sum test
##
## data:  Time by Technique
## Kruskal-Wallis chi-squared = 9.1927, df = 1, p-value = 0.00243
```




```
totalTrials <- sqldf("select Replica, Id, SetOfTasks,
                     Technique, sum(Trials) as Trials
                     from ccwocd where Tasks = 'AV2.1:CO2.1:DE2.1' or Tasks = 'AV2.2:CO2.2:DE2.2'
                     group by Replica, Id,SetOfTasks, Technique")

totalTrials$Trials <-ifelse(totalTrials$Trials == 0, 1, totalTrials$Trials)
totalTrials$Trials <- with(totalTrials, log2(Trials))
```

```
totalTrials$Replica = as.factor(totalTrials$Replica)
totalTrials$Id = as.factor(totalTrials$Id)
totalTrials$SetOfTasks = as.factor(totalTrials$SetOfTasks:totalTime$Id)
totalTrials$Technique = as.factor(totalTrials$Technique)
```

```
summary(aov(Trials ~ Technique, data=totalTrials))
```

```
##             Df Sum Sq Mean Sq F value Pr(>F)
## Technique    1  4.852   4.852   6.608 0.0158 *
## Residuals   28 20.560   0.734
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
totalTrials.gvlma = gvlma(lm(Trials ~ Technique, data=totalTrials))
summary(totalTrials.gvlma)
```

```
##
## Call:
## lm(formula = Trials ~ Technique, data = totalTrials)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.62191 -0.56706 -0.08059  0.39815  2.18244
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)             3.2069     0.2213  14.494 1.53e-14 ***
## TechniqueWithout Atom  -0.8044     0.3129  -2.571   0.0158 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.8569 on 28 degrees of freedom
## Multiple R-squared:  0.1909, Adjusted R-squared:  0.162
## F-statistic: 6.608 on 1 and 28 DF,  p-value: 0.01576
##
##
## ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
## USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
## Level of Significance =  0.05
##
## Call:
##  gvlma(x = lm(Trials ~ Technique, data = totalTrials))
##
##                       Value p-value                Decision
## Global Stat        1.636e+00  0.8023 Assumptions acceptable.
## Skewness           1.544e+00  0.2140 Assumptions acceptable.
## Kurtosis           7.535e-02  0.7837 Assumptions acceptable.
## Link Function      7.228e-15  1.0000 Assumptions acceptable.
## Heteroscedasticity 1.623e-02  0.8986 Assumptions acceptable.
```

```
summary(aov(Trials ~ Technique, data=totalTrials))
```

```
##             Df Sum Sq Mean Sq F value Pr(>F)
## Technique    1  4.852   4.852   6.608 0.0158 *
## Residuals   28 20.560   0.734
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
ss = summary(aov(Trials ~ Technique, data=totalTrials))[[1]]$"Sum Sq"
eta.sq = ss[1]/(ss[1] + ss[2])
print(paste0("The eta-squared is ",toString(round(eta.sq,3))))
```

```
## [1] "The eta-squared is 0.191"
```

```
q <- TukeyHSD(aov(Trials~Technique, data=totalTrials))
q
```

```
##   Tukey multiple comparisons of means
```

```
##     95% family-wise confidence level
##
## Fit: aov(formula = Trials ~ Technique, data = totalTrials)
##
## $Technique
##                               diff       lwr        upr     p adj
## Without Atom-With Atom -0.8043511 -1.445296 -0.1634066 0.0157578
```

```
slices <- c(67, 33)
lbls <- c("Perfectiva", "Não Perfectiva")
pct <- round(slices/sum(slices)*100)
lbls <- paste(lbls, pct) # add percents to labels
lbls <- paste(lbls,"%",sep="") # ad % to labels
pie(slices,labels = lbls, col=rainbow(length(lbls))
  )
```