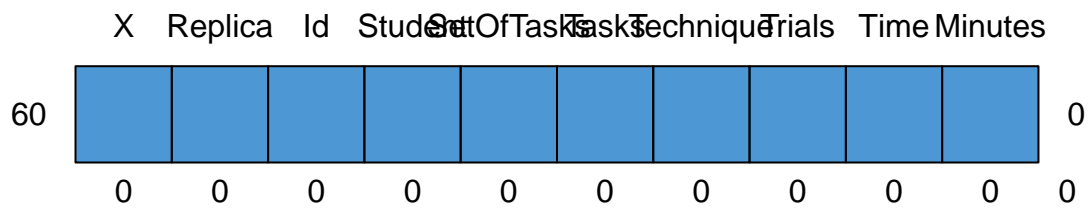```
ccwo <- read.csv("C:/Users/nando/workspaces/ufal/masters_experiment_analysis/datasetatoms.csv")
ccwo$Minutes[ccwo$Minutes < 0] <- NA
```

```
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
```

totalTime3$Technique : totalTime3$Tasks
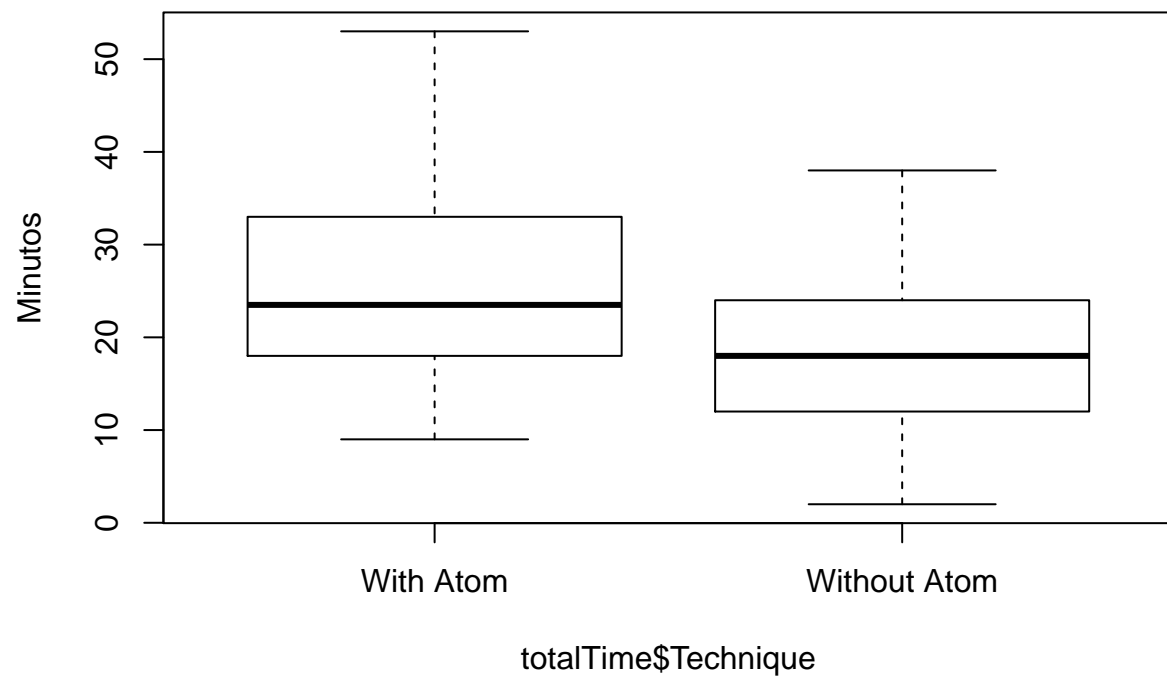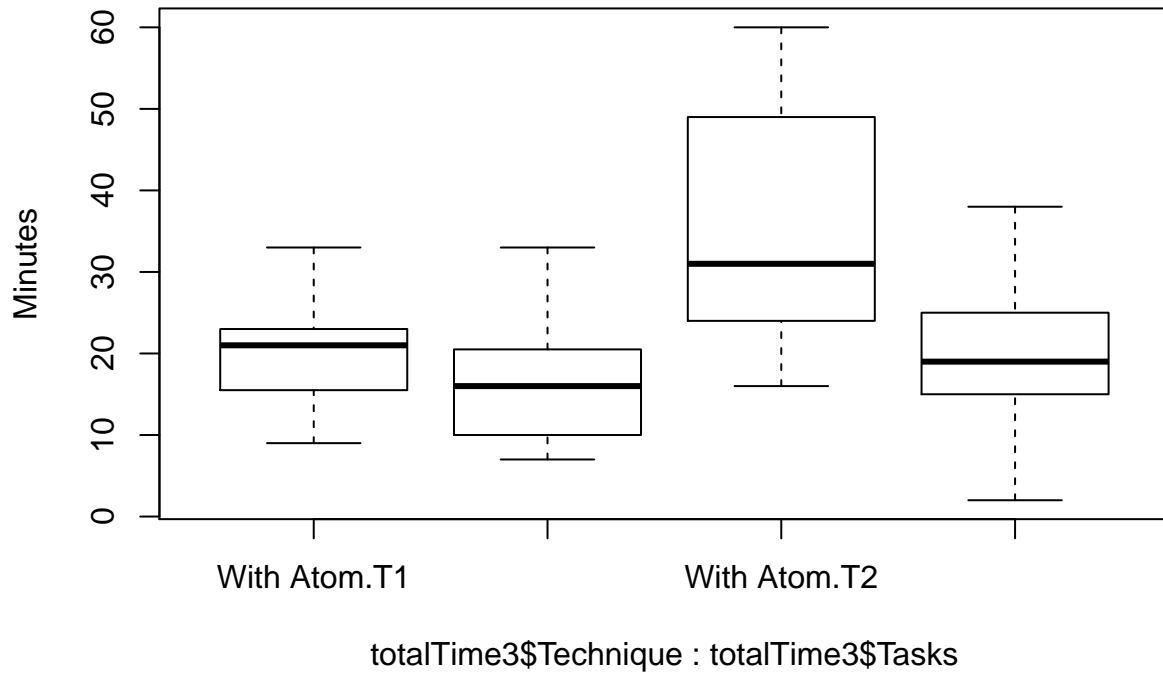
```
##    Replica Tasks    Technique Trials Time
## 1       41    T1    With Atom      5   21
## 2       41    T1 Without Atom      7   13
## 3       41    T2    With Atom      3   16
## 4       41    T2 Without Atom      3   15
## 5       42    T1    With Atom      7   16
## 6       42    T1 Without 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
```

Tries

With Atom.T1   With Atom.T2
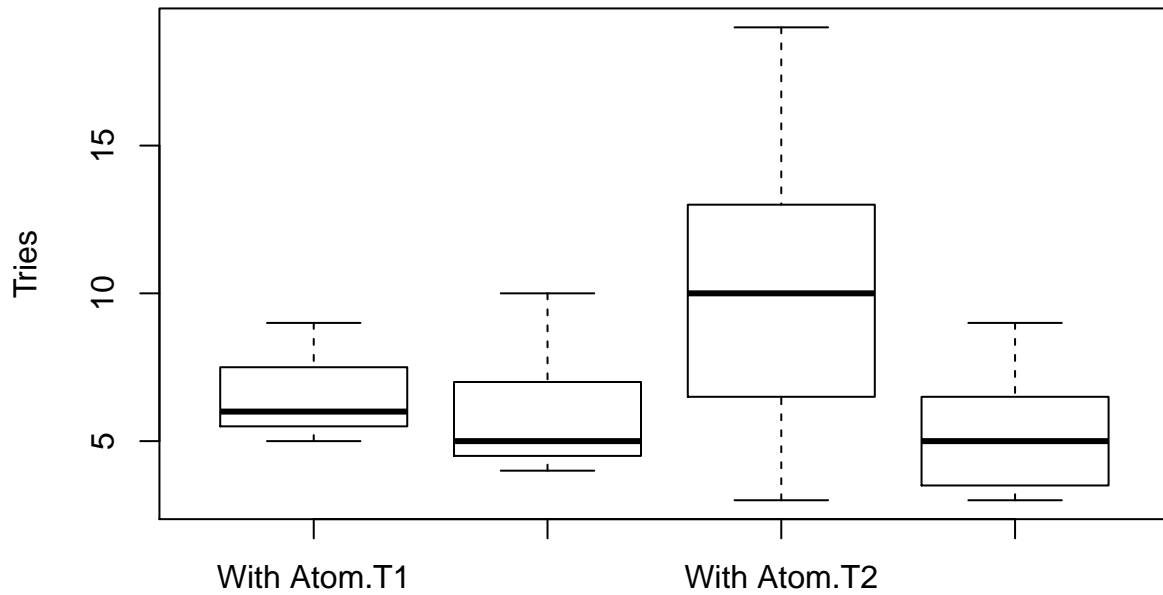
totalTime3$Technique : totalTime3$Tasks

```
##     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                RomÃ¡rio        ST1 AV1.1:CO1.1:DE1.1
## 4   1      41  2                RomÃ¡rio        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 LÃºcio        ST1 AV1.1:CO1.1:DE1.1
## 22  6      46  1            Marlon LÃºcio        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
```
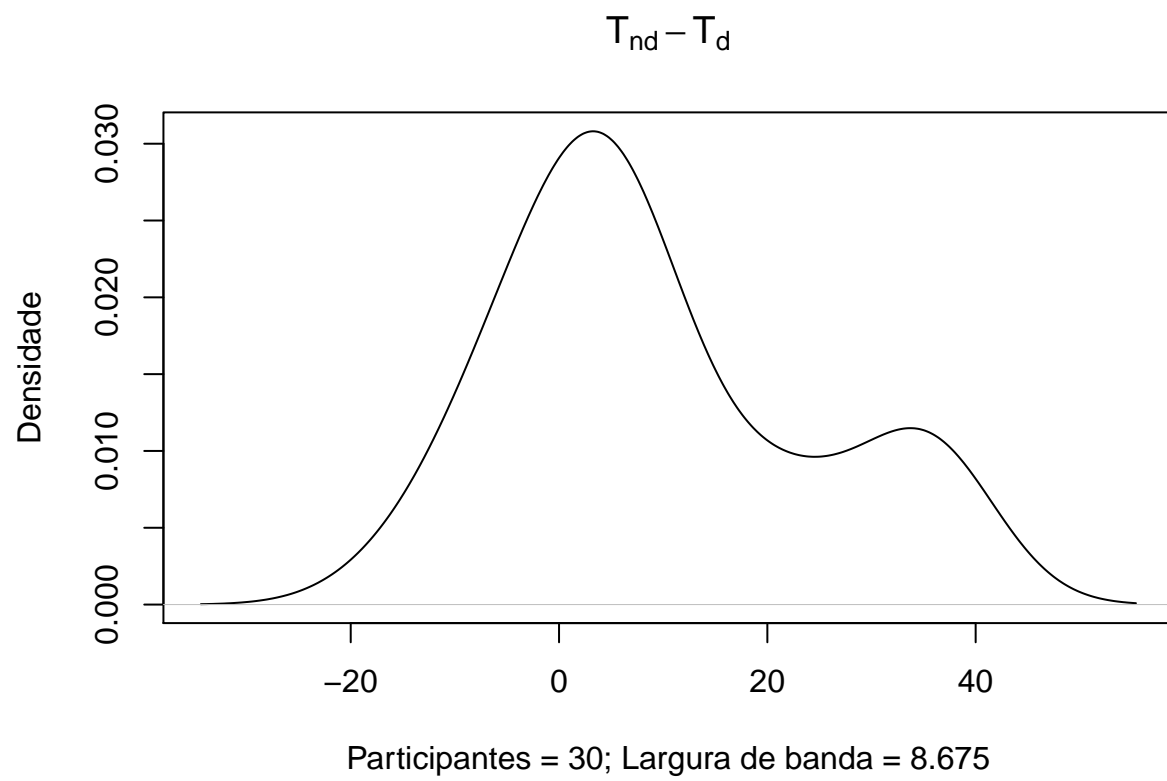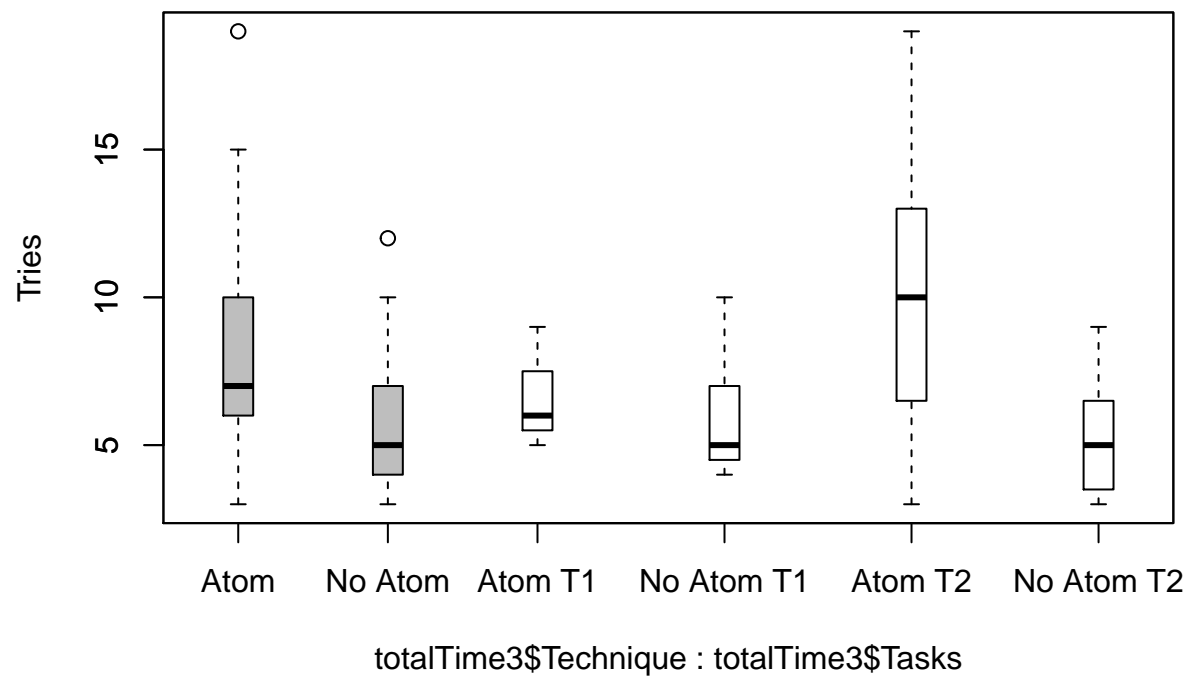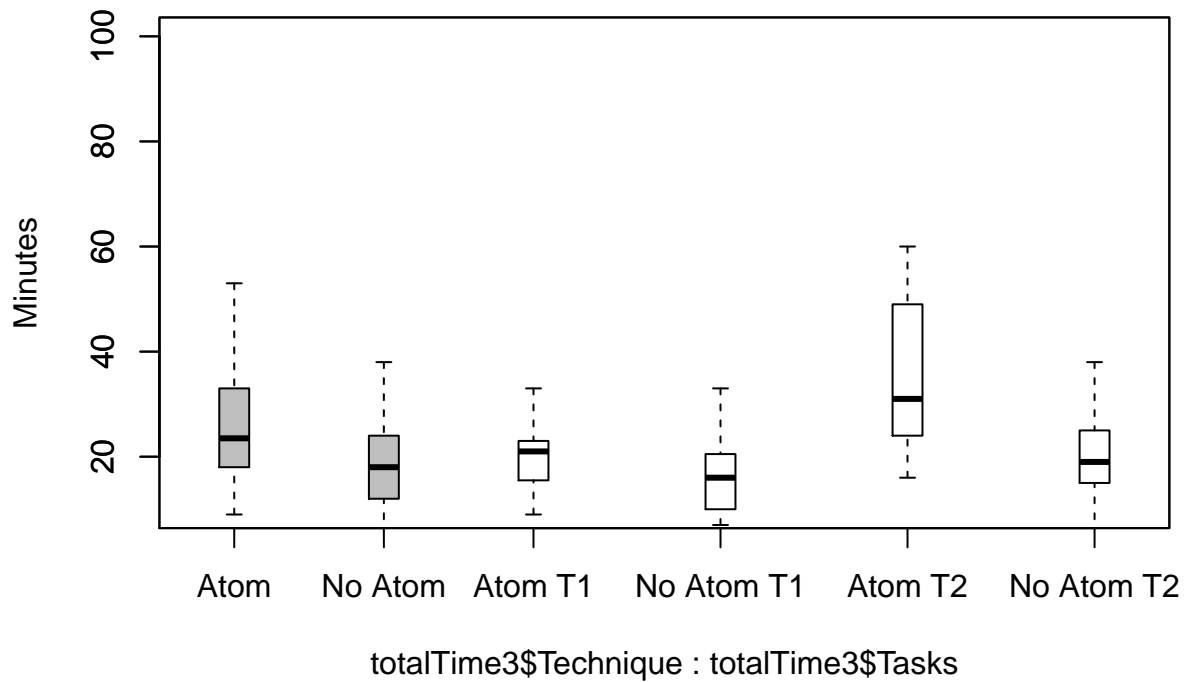
$$T_{nd} - T_d$$

Participantes = 30; Largura de banda = 8.675

totalTime3$Technique : totalTime3$Tasks

totalTime3$Technique : totalTime3$Tasks

```
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)
```
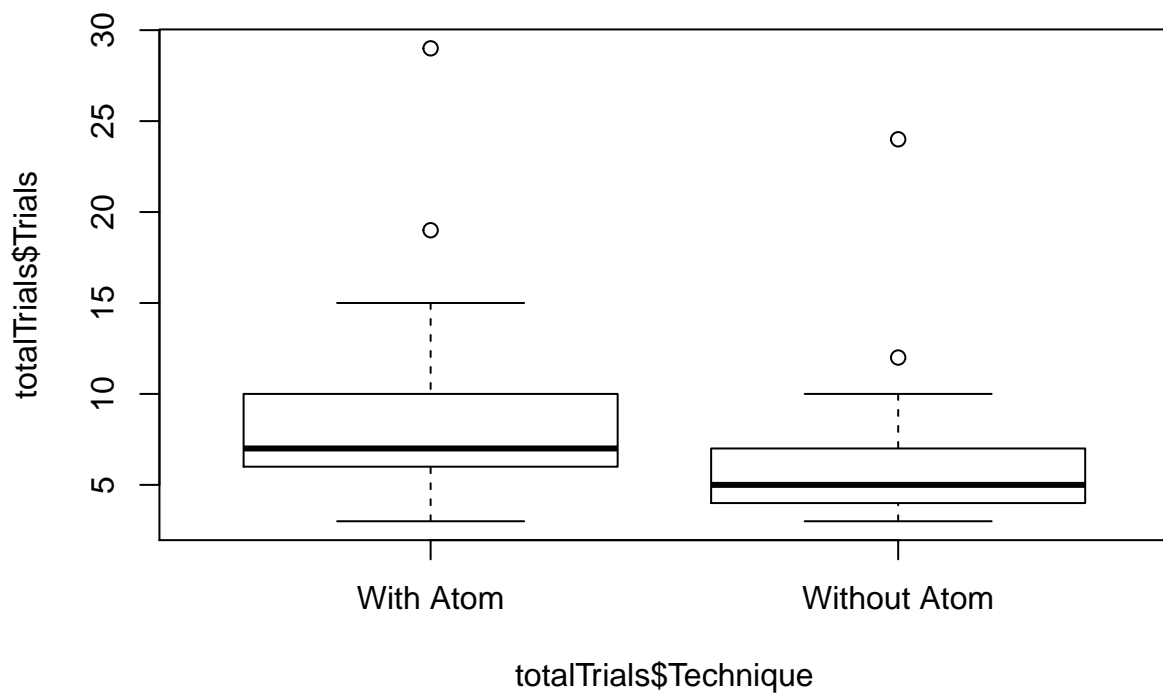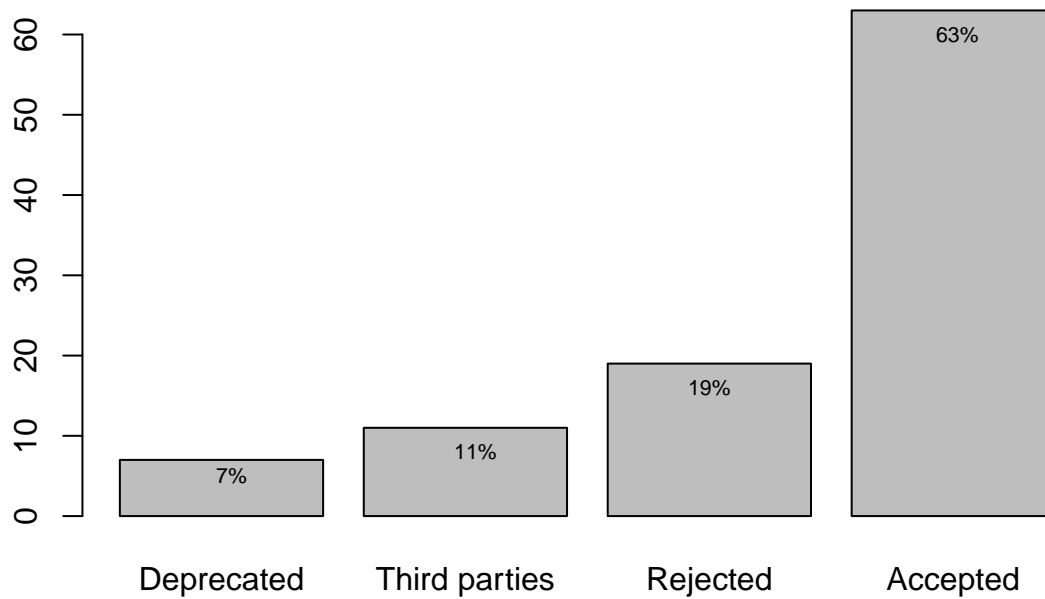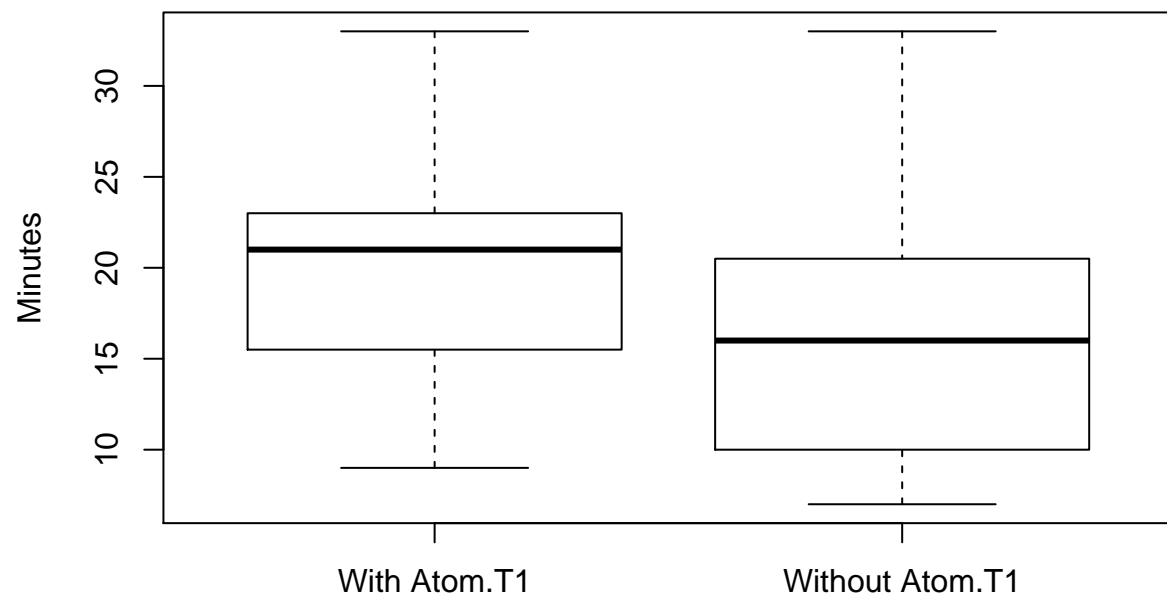
talTime3[totalTime3$Tasks == "T1",]$Technique : totalTime3[totalTime3$Tasks == "T1",

$$T_{nd} - T_d$$
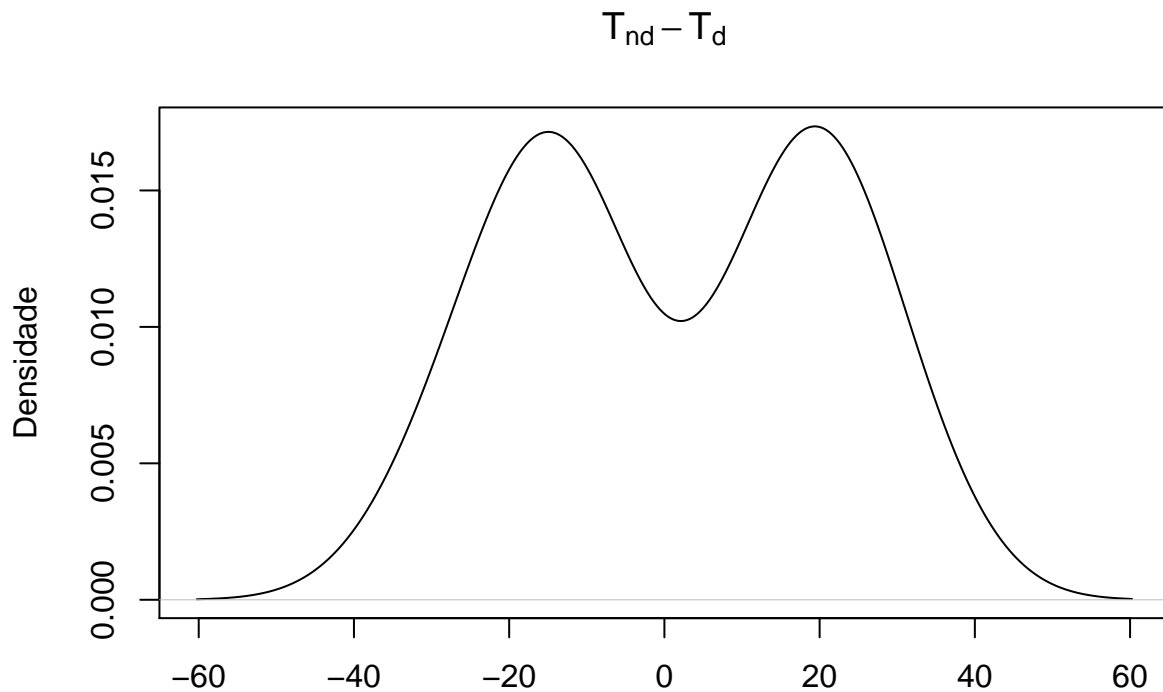
Participantes = 30; Largura de banda = 4.082

```
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.
```

```r
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
```
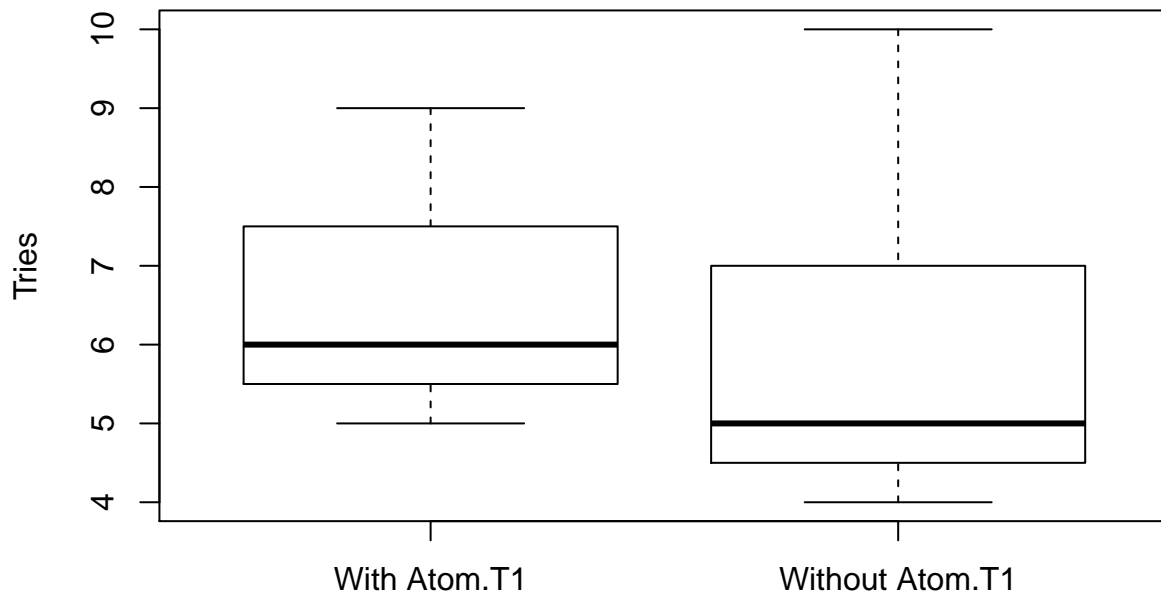
talTime3[totalTime3$Tasks == "T1",]$Technique : totalTime3[totalTime3$Tasks == "T1",

```
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:
```

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```
## 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.
```

```r
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
```

talTime3[totalTime3$Tasks == "T2",]$Technique : totalTime3[totalTime3$Tasks == "T2",

26

$T_{nd} - T_d$

Participantes = 30; Largura de banda = 5.528

```r
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.
```

```r
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
```
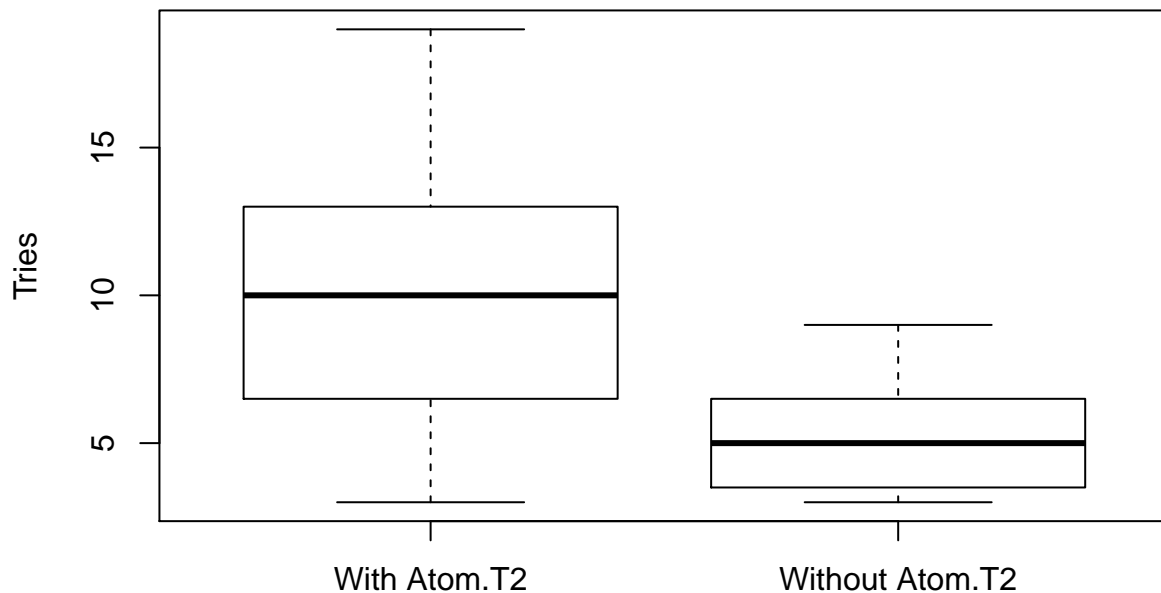
talTime3[totalTime3$Tasks == "T2",]$Technique : totalTime3[totalTime3$Tasks == "T2",

```r
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
```

```r
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.
```

```r
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
```

```r
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"
```

```r
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
```

```r
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))
  )
```

Perfectiva 67%

Não Perfectiva 33%