Donation Impact Experiment

```
set.seed(9079)
# the data for the group of students that receive persuaion
dataW <- round(rnorm(316/2-13,30,1),2); print(dataW)
```

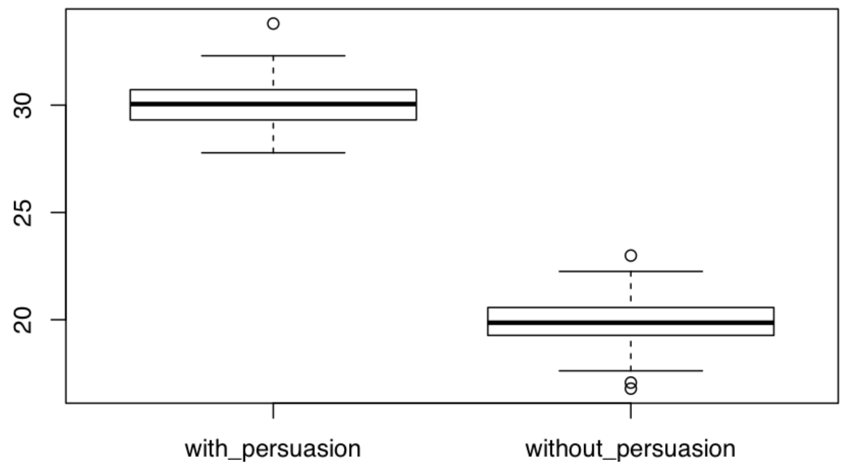
```
##   [1] 28.80 27.78 28.88 29.94 31.45 30.94 33.80 29.27 31.34 28.64 29.50
##  [12] 27.80 28.58 29.59 30.93 29.58 30.56 31.18 30.30 28.97 30.22 31.61
##  [23] 31.66 30.12 27.93 30.54 31.70 31.11 31.56 28.68 29.79 29.43 28.79
##  [34] 30.03 30.44 30.22 30.84 29.06 28.26 28.76 30.28 30.45 30.68 31.15
##  [45] 29.33 29.25 30.33 30.72 30.25 30.09 31.04 31.98 30.56 28.54 31.34
##  [56] 29.72 30.49 30.56 28.93 30.95 30.64 30.63 28.61 29.28 31.54 29.94
##  [67] 30.37 31.03 29.40 29.64 29.08 30.61 30.02 28.48 30.09 29.81 30.16
##  [78] 29.83 28.71 29.95 29.92 30.55 31.22 30.44 28.88 28.99 29.30 30.05
##  [89] 28.04 30.10 30.57 29.23 29.75 32.30 29.30 30.85 29.53 30.29 31.14
## [100] 29.39 31.02 28.41 30.17 31.46 30.31 29.85 29.79 30.71 28.51 29.62
## [111] 31.05 30.21 30.76 31.31 29.67 29.07 29.42 29.95 30.42 28.77 28.91
## [122] 30.56 29.84 31.49 29.48 29.87 29.97 28.94 30.99 30.58 30.89 31.24
## [133] 30.15 30.74 29.17 28.66 29.43 29.88 31.19 29.64 29.31 31.14 29.41
## [144] 29.35 31.32
```

```
# the data for the group of students that do not receive persuaion
dataWO <- round(rnorm(316/2-24,20,1),2); print(dataWO)
```

```
##   [1] 20.90 19.46 19.14 17.62 20.01 19.43 21.39 19.47 19.56 19.54 20.26
##  [12] 20.07 19.20 20.06 20.26 20.65 19.44 19.86 19.70 20.10 20.81 19.48
##  [23] 18.99 19.63 20.71 17.62 19.44 18.96 20.42 20.45 19.99 17.69 17.07
##  [34] 19.78 21.17 21.32 21.15 20.22 19.77 22.99 18.44 19.51 20.09 20.34
##  [45] 20.93 20.28 20.92 19.77 17.84 20.24 19.68 20.19 21.14 20.55 19.31
##  [56] 20.81 18.06 19.90 19.46 19.35 18.95 19.25 19.65 21.46 18.58 21.37
##  [67] 19.92 21.24 19.76 21.03 17.94 20.07 18.48 19.93 19.94 20.27 18.34
##  [78] 20.70 21.39 18.84 18.97 19.21 18.71 20.02 19.62 19.03 20.31 19.23
##  [89] 18.92 20.66 21.36 19.57 20.96 21.46 19.47 19.49 21.25 17.81 19.49
## [100] 16.79 18.40 20.96 20.50 19.61 19.39 20.28 19.13 18.90 19.32 19.86
## [111] 20.51 21.32 20.96 19.90 19.27 21.12 19.89 19.09 19.98 19.41 19.40
## [122] 20.52 20.57 18.68 18.76 19.43 19.43 22.25 19.15 20.98 21.74 21.16
## [133] 20.33 20.92
```

Analyse the (fabricated) data.

```
#From the side by side boxplots we know there are suspected outliers for two data gorups.
boxplot(dataW,dataWO,names=c("with_persuasion","without_persuasion"))
```




```r
summary(dataW)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   27.78   29.31   30.05   30.04   30.72   33.80
```

```r
summary(dataWO)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   16.79   19.28   19.86   19.86   20.57   22.99
```

In the boxplot of "with_persuasion", we can see the outlier is greater than Q3+1.5IQR=(30.72+1.5*(30.72-29.31))= 32.835, which is the data point 33.08.

In the boxplot of "without_persuasion", we can see the outliers are beyond the limit of (Q1-1.5IQR,Q3+1.5IQR)=(19.28-1.5*(20.57-19.28),20.57+1.5*(20.57-19.28))=(17.345, 22.505) the outliers are data points 16.79, 17.07, 22.99.

```r
#Hence, after removing these outliers we can get the final tables for these two data groups.
dataW_final <- sort(dataW[dataW<32.835])
dataWO_final <-sort(dataWO[17.345<dataWO]);dataWO_final <-sort(dataWO_final[dataWO_final<22.505])
#Tables for two data groups
with_persuasion <- 1:length(dataW_final)
without_persuasion <- 1:length(dataWO_final)
# Table for the group that receives persuasion
table1 <-data.frame(with_persuasion,dataW_final);print(table1)
```

```
##    with_persuasion dataW_final
## 1                1       27.78
## 2                2       27.80
## 3                3       27.93
## 4                4       28.04
## 5                5       28.26
## 6                6       28.41
## 7                7       28.48
## 8                8       28.51
## 9                9       28.54
## 10              10       28.58
```

```
## 11                    11       28.61
## 12                    12       28.64
## 13                    13       28.66
## 14                    14       28.68
## 15                    15       28.71
## 16                    16       28.76
## 17                    17       28.77
## 18                    18       28.79
## 19                    19       28.80
## 20                    20       28.88
## 21                    21       28.88
## 22                    22       28.91
## 23                    23       28.93
## 24                    24       28.94
## 25                    25       28.97
## 26                    26       28.99
## 27                    27       29.06
## 28                    28       29.07
## 29                    29       29.08
## 30                    30       29.17
## 31                    31       29.23
## 32                    32       29.25
## 33                    33       29.27
## 34                    34       29.28
## 35                    35       29.30
## 36                    36       29.30
## 37                    37       29.31
## 38                    38       29.33
## 39                    39       29.35
## 40                    40       29.39
## 41                    41       29.40
## 42                    42       29.41
## 43                    43       29.42
## 44                    44       29.43
## 45                    45       29.43
## 46                    46       29.48
## 47                    47       29.50
## 48                    48       29.53
## 49                    49       29.58
## 50                    50       29.59
## 51                    51       29.62
## 52                    52       29.64
## 53                    53       29.64
## 54                    54       29.67
## 55                    55       29.72
## 56                    56       29.75
## 57                    57       29.79
## 58                    58       29.79
## 59                    59       29.81
## 60                    60       29.83
## 61                    61       29.84
## 62                    62       29.85
## 63                    63       29.87
## 64                    64       29.88
```

```
## 65              65       29.92
## 66              66       29.94
## 67              67       29.94
## 68              68       29.95
## 69              69       29.95
## 70              70       29.97
## 71              71       30.02
## 72              72       30.03
## 73              73       30.05
## 74              74       30.09
## 75              75       30.09
## 76              76       30.10
## 77              77       30.12
## 78              78       30.15
## 79              79       30.16
## 80              80       30.17
## 81              81       30.21
## 82              82       30.22
## 83              83       30.22
## 84              84       30.25
## 85              85       30.28
## 86              86       30.29
## 87              87       30.30
## 88              88       30.31
## 89              89       30.33
## 90              90       30.37
## 91              91       30.42
## 92              92       30.44
## 93              93       30.44
## 94              94       30.45
## 95              95       30.49
## 96              96       30.54
## 97              97       30.55
## 98              98       30.56
## 99              99       30.56
## 100            100       30.56
## 101            101       30.56
## 102            102       30.57
## 103            103       30.58
## 104            104       30.61
## 105            105       30.63
## 106            106       30.64
## 107            107       30.68
## 108            108       30.71
## 109            109       30.72
## 110            110       30.74
## 111            111       30.76
## 112            112       30.84
## 113            113       30.85
## 114            114       30.89
## 115            115       30.93
## 116            116       30.94
## 117            117       30.95
## 118            118       30.99
```

```
## 119              119       31.02
## 120              120       31.03
## 121              121       31.04
## 122              122       31.05
## 123              123       31.11
## 124              124       31.14
## 125              125       31.14
## 126              126       31.15
## 127              127       31.18
## 128              128       31.19
## 129              129       31.22
## 130              130       31.24
## 131              131       31.31
## 132              132       31.32
## 133              133       31.34
## 134              134       31.34
## 135              135       31.45
## 136              136       31.46
## 137              137       31.49
## 138              138       31.54
## 139              139       31.56
## 140              140       31.61
## 141              141       31.66
## 142              142       31.70
## 143              143       31.98
## 144              144       32.30
```

```r
# Table for the group that did not receive persuasion
table2 <- data.frame(without_persuasion,dataWO_final);print(table2)
```

```
##     without_persuasion dataWO_final
## 1                    1        17.62
## 2                    2        17.62
## 3                    3        17.69
## 4                    4        17.81
## 5                    5        17.84
## 6                    6        17.94
## 7                    7        18.06
## 8                    8        18.34
## 9                    9        18.40
## 10                  10        18.44
## 11                  11        18.48
## 12                  12        18.58
## 13                  13        18.68
## 14                  14        18.71
## 15                  15        18.76
## 16                  16        18.84
## 17                  17        18.90
## 18                  18        18.92
## 19                  19        18.95
## 20                  20        18.96
## 21                  21        18.97
## 22                  22        18.99
## 23                  23        19.03
## 24                  24        19.09
```

```
## 25                    25         19.13
## 26                    26         19.14
## 27                    27         19.15
## 28                    28         19.20
## 29                    29         19.21
## 30                    30         19.23
## 31                    31         19.25
## 32                    32         19.27
## 33                    33         19.31
## 34                    34         19.32
## 35                    35         19.35
## 36                    36         19.39
## 37                    37         19.40
## 38                    38         19.41
## 39                    39         19.43
## 40                    40         19.43
## 41                    41         19.43
## 42                    42         19.44
## 43                    43         19.44
## 44                    44         19.46
## 45                    45         19.46
## 46                    46         19.47
## 47                    47         19.47
## 48                    48         19.48
## 49                    49         19.49
## 50                    50         19.49
## 51                    51         19.51
## 52                    52         19.54
## 53                    53         19.56
## 54                    54         19.57
## 55                    55         19.61
## 56                    56         19.62
## 57                    57         19.63
## 58                    58         19.65
## 59                    59         19.68
## 60                    60         19.70
## 61                    61         19.76
## 62                    62         19.77
## 63                    63         19.77
## 64                    64         19.78
## 65                    65         19.86
## 66                    66         19.86
## 67                    67         19.89
## 68                    68         19.90
## 69                    69         19.90
## 70                    70         19.92
## 71                    71         19.93
## 72                    72         19.94
## 73                    73         19.98
## 74                    74         19.99
## 75                    75         20.01
## 76                    76         20.02
## 77                    77         20.06
## 78                    78         20.07
```

```
## 79                   79        20.07
## 80                   80        20.09
## 81                   81        20.10
## 82                   82        20.19
## 83                   83        20.22
## 84                   84        20.24
## 85                   85        20.26
## 86                   86        20.26
## 87                   87        20.27
## 88                   88        20.28
## 89                   89        20.28
## 90                   90        20.31
## 91                   91        20.33
## 92                   92        20.34
## 93                   93        20.42
## 94                   94        20.45
## 95                   95        20.50
## 96                   96        20.51
## 97                   97        20.52
## 98                   98        20.55
## 99                   99        20.57
## 100                 100        20.65
## 101                 101        20.66
## 102                 102        20.70
## 103                 103        20.71
## 104                 104        20.81
## 105                 105        20.81
## 106                 106        20.90
## 107                 107        20.92
## 108                 108        20.92
## 109                 109        20.93
## 110                 110        20.96
## 111                 111        20.96
## 112                 112        20.96
## 113                 113        20.98
## 114                 114        21.03
## 115                 115        21.12
## 116                 116        21.14
## 117                 117        21.15
## 118                 118        21.16
## 119                 119        21.17
## 120                 120        21.24
## 121                 121        21.25
## 122                 122        21.32
## 123                 123        21.32
## 124                 124        21.36
## 125                 125        21.37
## 126                 126        21.39
## 127                 127        21.39
## 128                 128        21.46
## 129                 129        21.46
## 130                 130        21.74
## 131                 131        22.25
```

I then proceed to use the two sample t-test to check whether the mean of these two groups are different from each other. The null hypothesis is that two groups have the same means on the average amount of money donation.

```
t.test(dataW_final,dataWO_final,var.equal = T,alternative="greater")
```

```
##
##  Two Sample t-test
##
## data:  dataW_final and dataWO_final
## t = 87.477, df = 273, p-value < 2.2e-16
## alternative hypothesis: true difference in means is greater than 0
## 95 percent confidence interval:
##  9.940563      Inf
## sample estimates:
## mean of x mean of y
##  30.01187  19.88015
```

```
# Assuming the synthetic data follow unknown distributiom,
# I first intend to check normality using the shapiro.test()
# The null hypothesis is that the data is normal, the alternative hypothesis is the data is not normal.
shapiro.test(dataW_final)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  dataW_final
## W = 0.9898, p-value = 0.3788
```

```
shapiro.test(dataWO_final)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  dataWO_final
## W = 0.9861, p-value = 0.2054
```

```
# Since we can see the p-values for these two data groups are both larger than 0.05,
#the null hypotheses cannot be rejected. Hence, the assumption of normality for two samples is satisfie
```

```
# Then I want to check whether the data have equal variances
var.test(dataW_final,dataWO_final)
```

```
##
##  F test to compare two variances
##
## data:  dataW_final and dataWO_final
## F = 1.0078, num df = 143, denom df = 130, p-value = 0.9661
## alternative hypothesis: true ratio of variances is not equal to 1
## 95 percent confidence interval:
##  0.7182653 1.4101561
## sample estimates:
## ratio of variances
##           1.007794
```

Since we can see the p-value = 0.7153 larger than 0.05, the null hypotheses cannot be rejected. Hence, the assumption of equal variances for two samples is satisfied.

Conclusions

With a p-value which is less than 2.2*10-16, we have strong evidence that the means of these two data groups are not equal. Therefore we reject the null hypothsis and conclude that the group that received persuasion that says their donation's impact will be matched is more likely to give more money compared to the group that received no persuasion.