Donation Impact Experiment

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

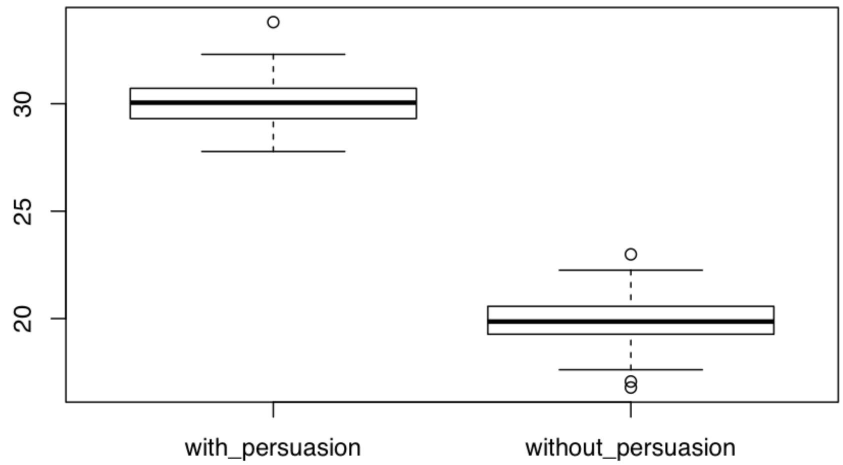
```
##   [1] 28.80 27.78 28.88 29.94 31.45 30.94 33.80 29.27 31.34 28.64 29.50
##  [12] 27.80 28.58 29.59 30.93 29.58 30.56 31.18 30.30 28.97 30.22 31.61
##  [23] 31.66 30.12 27.93 30.54 31.70 31.11 31.56 28.68 29.79 29.43 28.79
##  [34] 30.03 30.44 30.22 30.84 29.06 28.26 28.76 30.28 30.45 30.68 31.15
##  [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
```

```r
# 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.

```r
#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.

For randomization, I used the dice as the objective physical device as mentioned in step 4.

For replication, two runs of different treatments were done through the same event held on different days, so the experiment is run twice under the same experimental conditions.

For blocking, the sample are collected from students who have enrolled in the same course and are in the same age group (18-24). The experiemental group and the control group are similar in terms of the composition of subjects. Hence, blocking was considered in this experiment.