

## Problem-2

```
#install.packages("R.utils")  
library(R.utils)
```

```
## Warning: package 'R.utils' was built under R version 4.2.2
```

```
## Loading required package: R.oo
```

```
## Loading required package: R.methodsS3
```

```
## R.methodsS3 v1.8.2 (2022-06-13 22:00:14 UTC) successfully loaded. See ?R.methodsS3 for help.
```

```
## R.oo v1.25.0 (2022-06-12 02:20:02 UTC) successfully loaded. See ?R.oo for help.
```

```
##
```

```
## Attaching package: 'R.oo'
```

```
## The following object is masked from 'package:R.methodsS3':
```

```
##
```

```
##      throw
```

```
## The following objects are masked from 'package:methods':
```

```
##
```

```
##      getClasses, getMethods
```

```
## The following objects are masked from 'package:base':
```

```
##
```

```
##      attach, detach, load, save
```

```
## R.utils v2.12.2 (2022-11-11 22:00:03 UTC) successfully loaded. See ?R.utils for help.
```

```
##
```

```
## Attaching package: 'R.utils'
```

```
## The following object is masked from 'package:utils':
```

```
##
```

```
##      timestamp
```

```
## The following objects are masked from 'package:base':
```

```
##
```

```
##      cat, commandArgs, getOption, isOpen, nullfile, parse, warnings
```

```

Standard= c(2.5, 3.4, 2.9, 4.1, 5.3, 3.4, 1.9, 3.3, 1.8 )
Additive=c(3.5, 6.3, 4.2, 4.3, 3.8, 5.7, 4.4, 0, 0)
diff=Additive - Standard
sttrue= mean(diff)
n=length(diff)
nf=2^n-1
st=numeric(nf)
stat = numeric(n)

for (i in 0:nf)
  { rearr=intToBin(i)
  nn=nchar(rearr)
  u=strrep("0", n-nn)
  rearr=paste(u,rearr,sep="")
  for (j in 1:n){stat[j]=ifelse(substr(rearr,j,j)==0, diff[j], -diff[j])}
  st[i]=mean(stat)
}
pvalue <-length(st[st<=sttrue])/(2^n) # p-value
pvalue

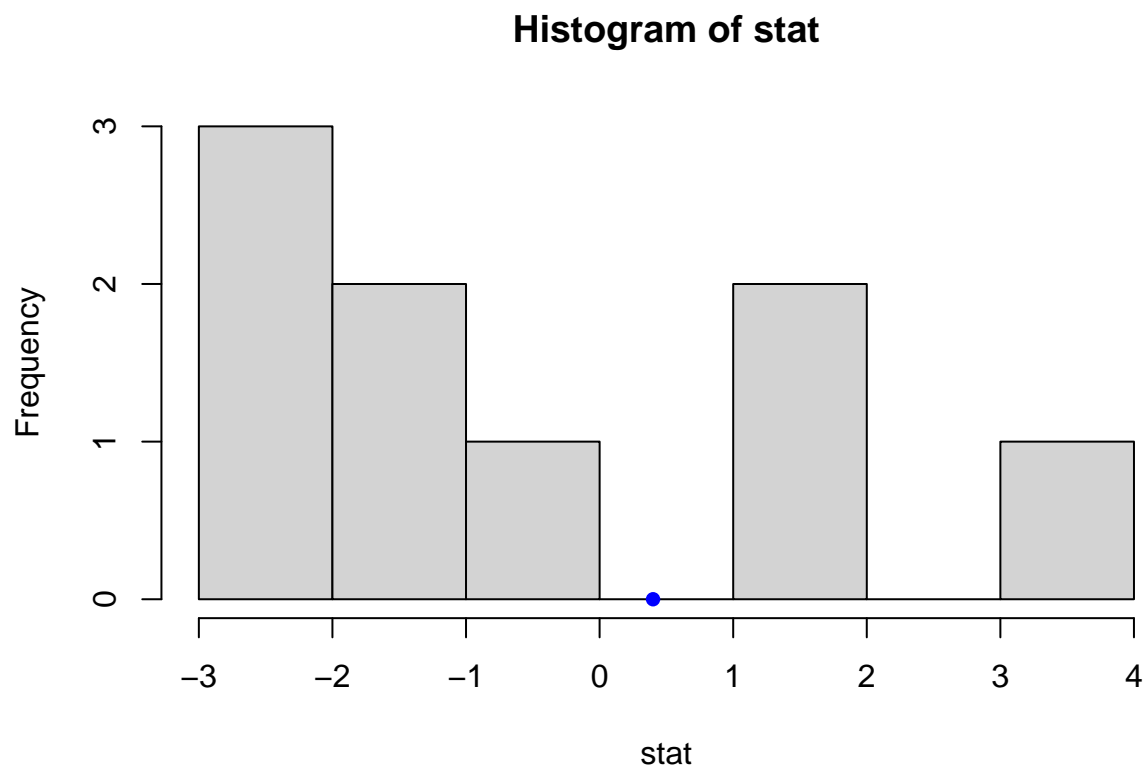
```

```
## [1] 0.7167969
```

```

hist(stat)
points(sttrue,0,pch = 16,
       col = "blue")

```



```
#since the p-value is larger,we have enough evidence to support the
#null hypothesis therefore,the null hypothesis is not rejected,so we can conclude
# that the additive is not effective.
```

```
#(b) Explore several statistics in order to perform the permutation test.
#What is the final conclusion?
#we are going to use several statistic like pearson correlation coefficient and
#spearman correlation coefficient
```

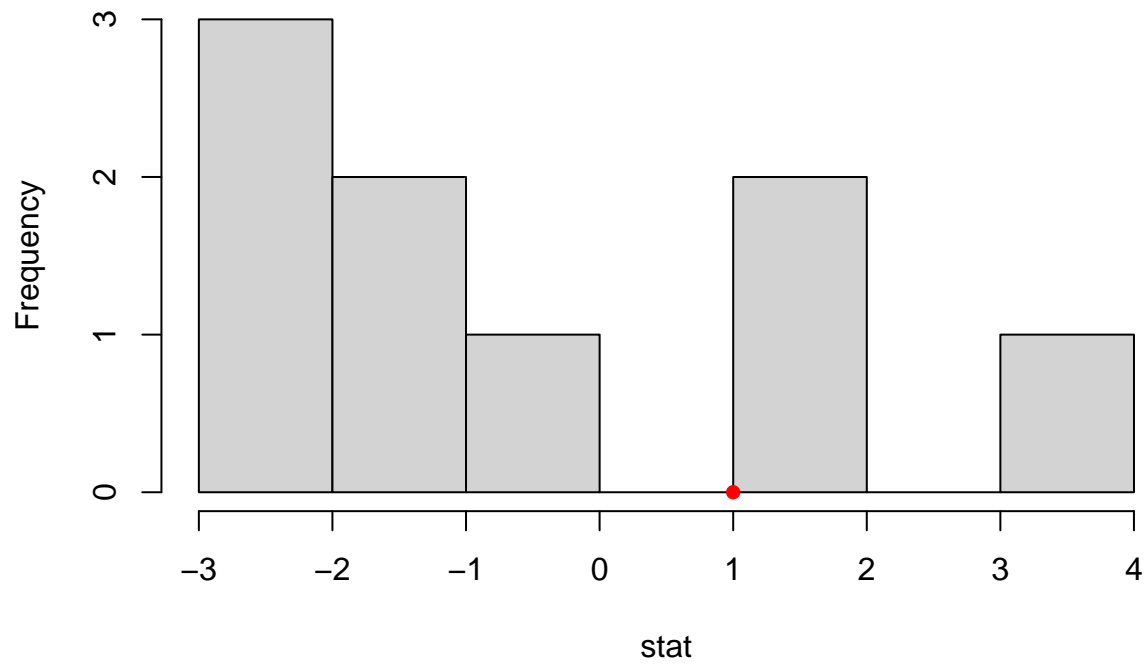
```
Standard= c(2.5, 3.4, 2.9, 4.1, 5.3, 3.4, 1.9, 3.3, 1.8 )
Additive=c(3.5, 6.3, 4.2, 4.3, 3.8, 5.7, 4.4, 0, 0)
diff=Additive - Standard
n=length(diff)
sttrue1= median(diff)
n=length(diff)
nf=2^n-1
st1=numeric(nf)
stat = numeric(n)

for (i in 0:nf)
{ rearr=intToBin(i)
nn=nchar(rearr)
u=strrep("0", n-nn)
rearr=paste(u,rearr,sep="")
for (j in 1:n){stat[j]=ifelse(substr(rearr,j,j)==0, diff[j], -diff[j])}
st1[i]=median(stat)
}
pvalue1 <-length(st1[st1<=sttrue1])/(2^n) # p-value
pvalue1
```

```
## [1] 0.7714844
```

```
hist(stat)
points(sttrue1,0,pch = 16,
      col = "red")
```

**Histogram of stat**



*#in this case,using different statistic the p-value is also larger,we  
#have enough evidence to support the null hypothesis  
#therefore,the null hypothesis is not rejected,so we can conclude that  
#there does not exist a significant difference before and after the additive  
#that is the additive is not effective*