

prpblem-3

#Problem-3: Assume that during a three-hour period spent outside, a person recorded the temperature, the amount of time they mowed the grass, and their water consumption. The experiment was conducted on 7 randomly selected days during the summer.

#(a) Fit the Water Consumption as a linear function of the Temperature (T) and the Time mowing the grass (TMG) by means of a multiple regression model. Hint: Use function lm in R.

```
library(combinat)
```

```
##
```

```
## Attaching package: 'combinat'
```

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

```
##
```

```
##      combn
```

```
df=data.frame(T=c(75,83,85,85,92,97,99),W=c(16,20,25,27,32,48,48),
              TMG=c(1.85,1.25,1.5,1.75,1.15,1.75,1.6))
```

```
df
```

```
##      T  W  TMG
## 1 75 16 1.85
## 2 83 20 1.25
## 3 85 25 1.50
## 4 85 27 1.75
## 5 92 32 1.15
## 6 97 48 1.75
## 7 99 48 1.60
```

```
model<-lm(W~ T+TMG,data=df)
```

```
an<-anova(model)
```

```
an
```

```
## Analysis of Variance Table
```

```
##
```

```
## Response: W
```

```
##           Df Sum Sq Mean Sq F value    Pr(>F)
## T           1  905.53   905.53  584.316 1.737e-05 ***
## TMG          1   65.13    65.13   42.029 0.002918 **
## Residuals    4    6.20     1.55
```

```
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```

FTtrue<-an$"F value"[1]      #True F value of T before permutation test
FTMGtrue<-an$"F value"[2]    #gives the significance between TMG and W
FTtrue

```

```
## [1] 584.3158
```

```
FTMGtrue
```

```
## [1] 42.02869
```

```

#F-value of the variable TR without permutation test is 584.3158
#F-value for the variable TMG without permutation test is 42.02869

```

```

#(b) Test the significance of the variables T and TMG using an
#exact permutation test. Compare the results with those obtained
#with the multiple regression model.

```

```

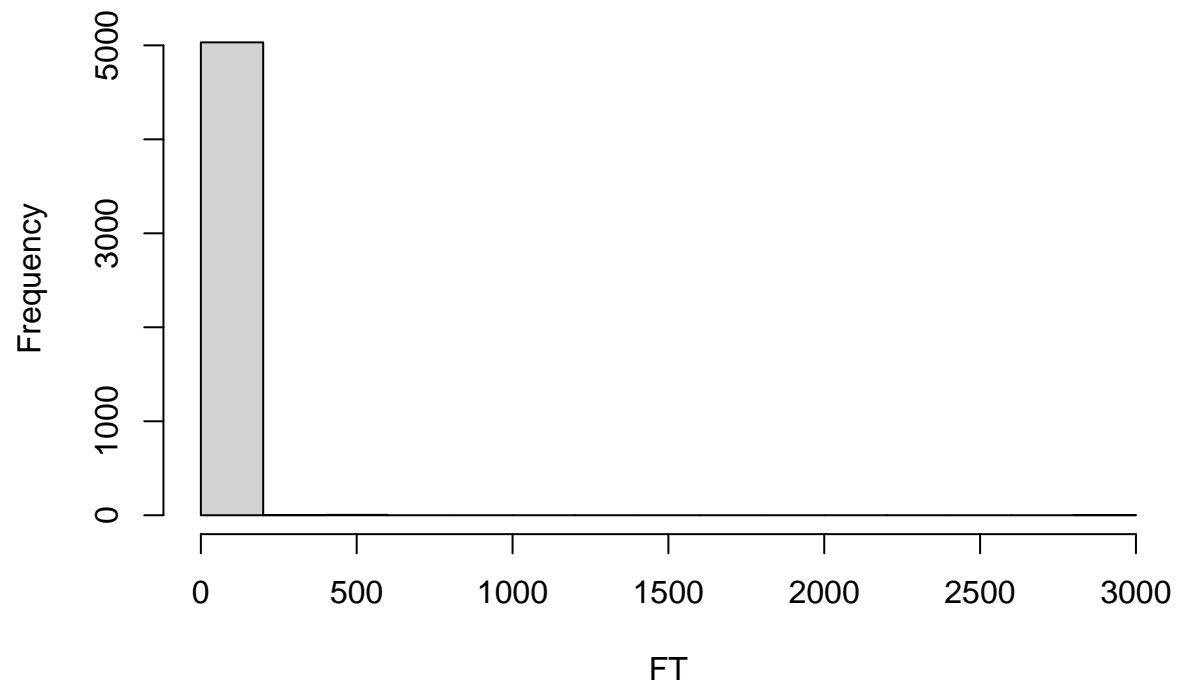
#exact test
T=c(75,83,85,85,92,97,99)
W=c(16,20,25,27,32,48,48)
TMG=c(1.85,1.25,1.5,1.75,1.15,1.75,1.6)
df=data.frame(T=c(75,83,85,85,92,97,99),W=c(16,20,25,27,32,48,48),
              TMG=c(1.85,1.25,1.5,1.75,1.15,1.75,1.6))
n = length(T)
nr=fact(n) #number of rearrangements to be examined
FT=numeric(nr)
FTMG=numeric(nr)

for (i in 1:nr){
  newW<- permn(W)
  newW
  model1<- lm(newW[[i]]~ T+TMG, data=df)
  an1<-anova(model1)
  FT[i]<-an1$"F value"[1]
  FTMG[i]<-an1$"F value"[2]
}

hist(FT, main = " Histogram of the FT")

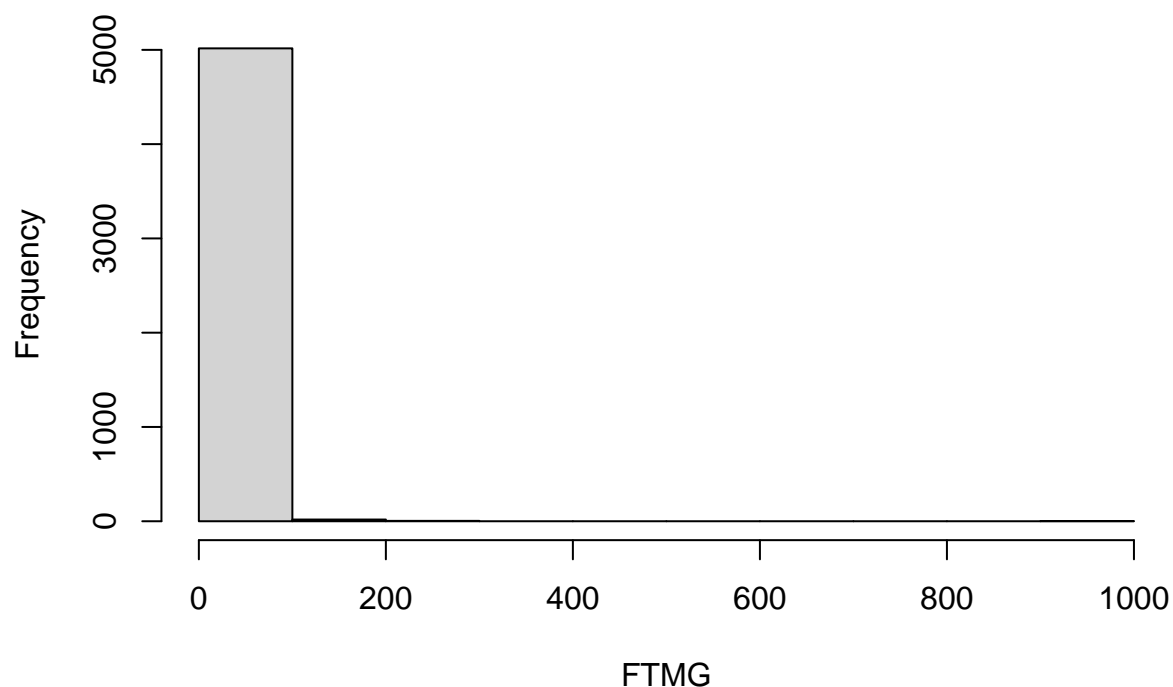
```

Histogram of the FT



```
hist(FTMG, main = " Histogram of the FTMG")
```

Histogram of the FTMG



```
an1
```

```
## Analysis of Variance Table
##
## Response: newW[[i]]
##          Df Sum Sq Mean Sq F value    Pr(>F)
## T          1 815.03   815.03  115.124 0.0004276 ***
## TMG         1 133.51   133.51   18.858 0.0122283 *
## Residuals   4  28.32     7.08
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# F value of T after permutation test
FT1<-an1$"F value"[1]    #gives the significance between T and W
# F value of TMG after permutation test
FTMG1<-an1$"F value"[2]  #gives the significance between TMG and W
FT1
```

```
## [1] 115.124
```

```
FTMG1
```

```
## [1] 42.02869
```

*#the f-values are same for the variable TMG for both exact test and
#from multiple linear regression model, but for the variable T
#F values are different after in exact test and regression model*