# Computational Statistics

Lab 5

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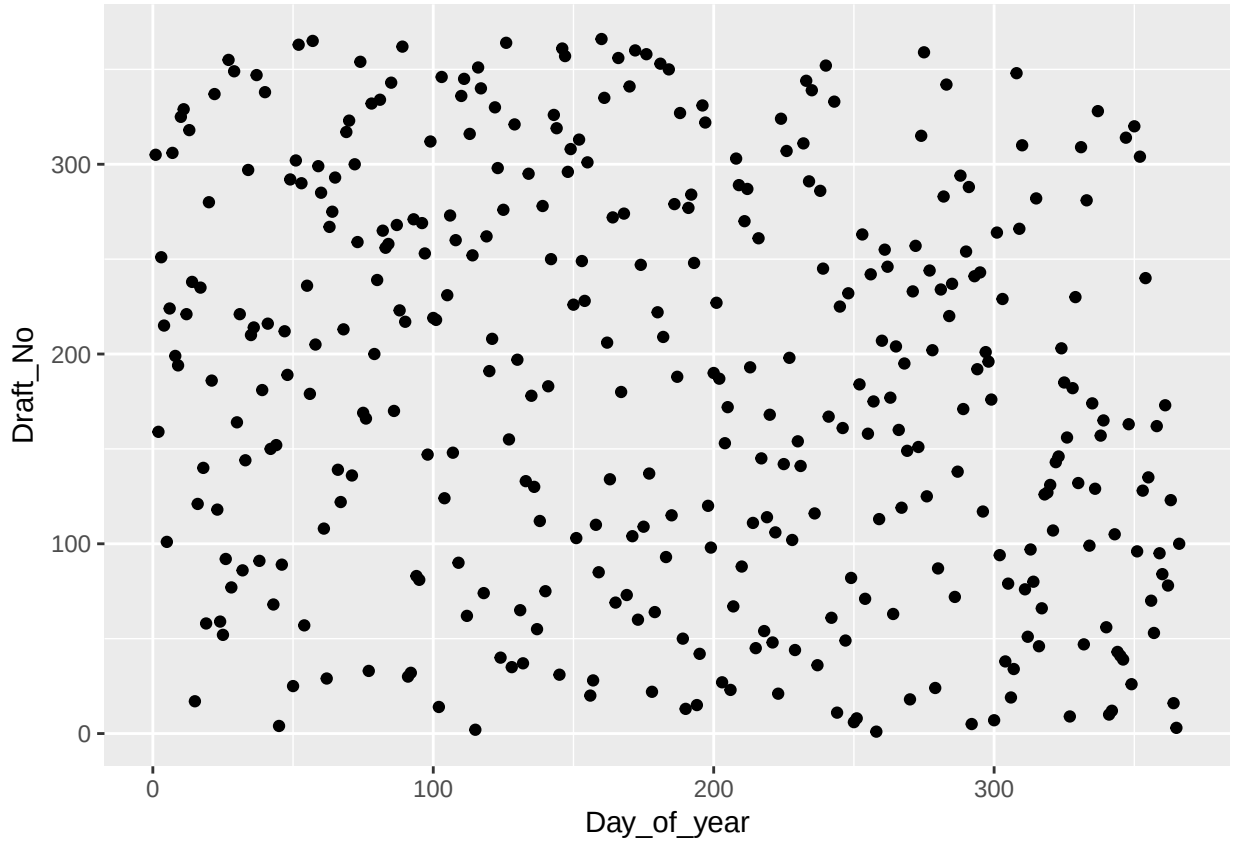
## Question 1

### 1.1

```
library(ggplot2)

lottery <- read.csv2("../data/lottery.csv")

q11 <- ggplot(lottery, aes(x = Day_of_year, y = Draft_No)) + geom_point()
plot(q11)
```



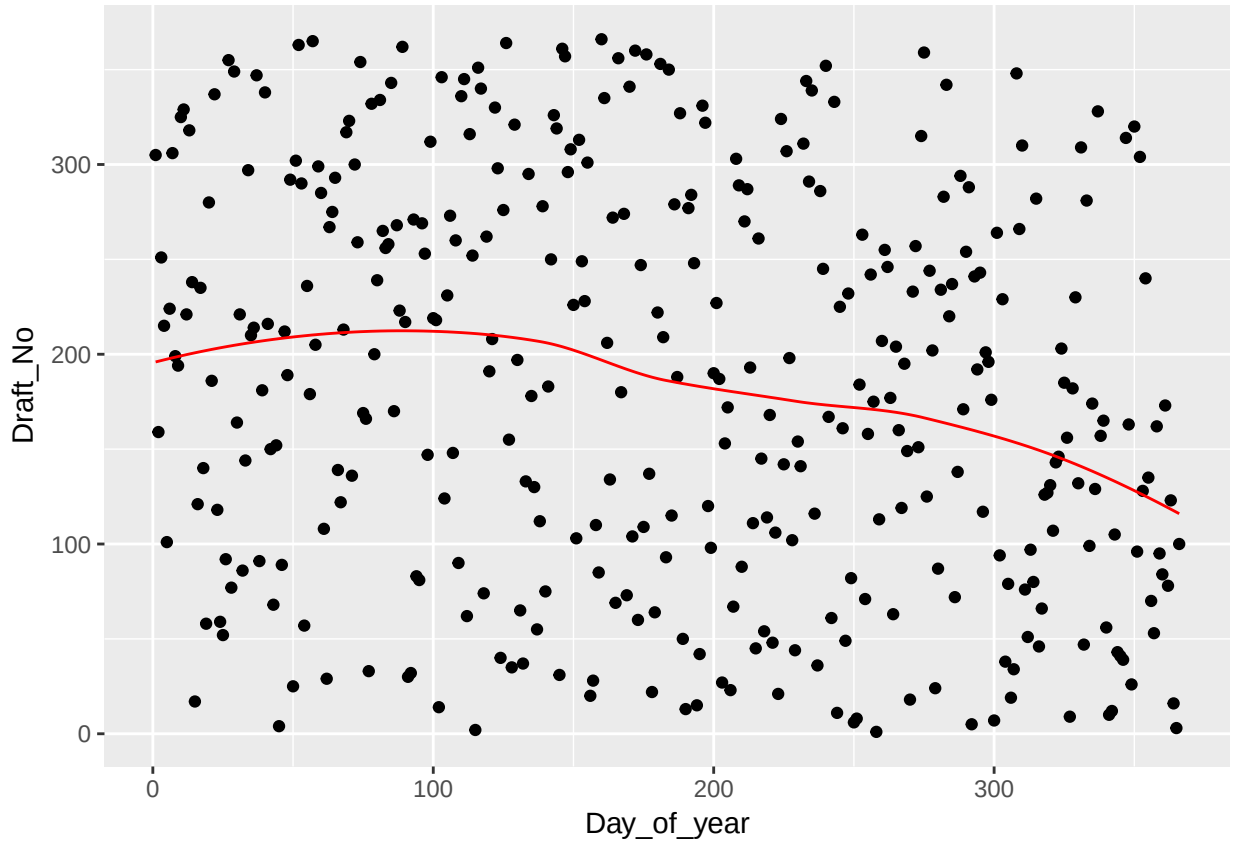

```
data <- data.frame(x=lottery$Day_of_year, y=lottery$Draft_No)
```

The data looks fairly random although there might be some sort of skewness in the right side of the graph were there are a lacking some observations and therefore having a lower probability of beeing selected.

### 1.2

```
loessfit <- loess(y ~ x, data=data)
data$pred <- predict(loessfit, data$x)

q12 <- q11 + geom_path(data = data, aes(x=x, y=pred), col = "red")
plot(q12)
```




The fit (line) doesn't seem straight and seems to have a decreasing trend which would support previous statements of people born on a days later on in a year has a lower probability of beeing selected.

### 1.3

```
library(boot)

teststat <- function(model) {
    function(data) {
        xa <- data$x[which.min(data$y)]
        xb <- data$x[which.max(data$y)]

        fit <- model(y ~ x, data)

        ya <- predict(fit, xa)
        yb <- predict(fit, xb)
```

```
        (yb - ya) / (xb - xa)
    }
}

teststat_boot <- function(data, idx, stat) {
    data <- data[idx,]
    stat(data)
}
```

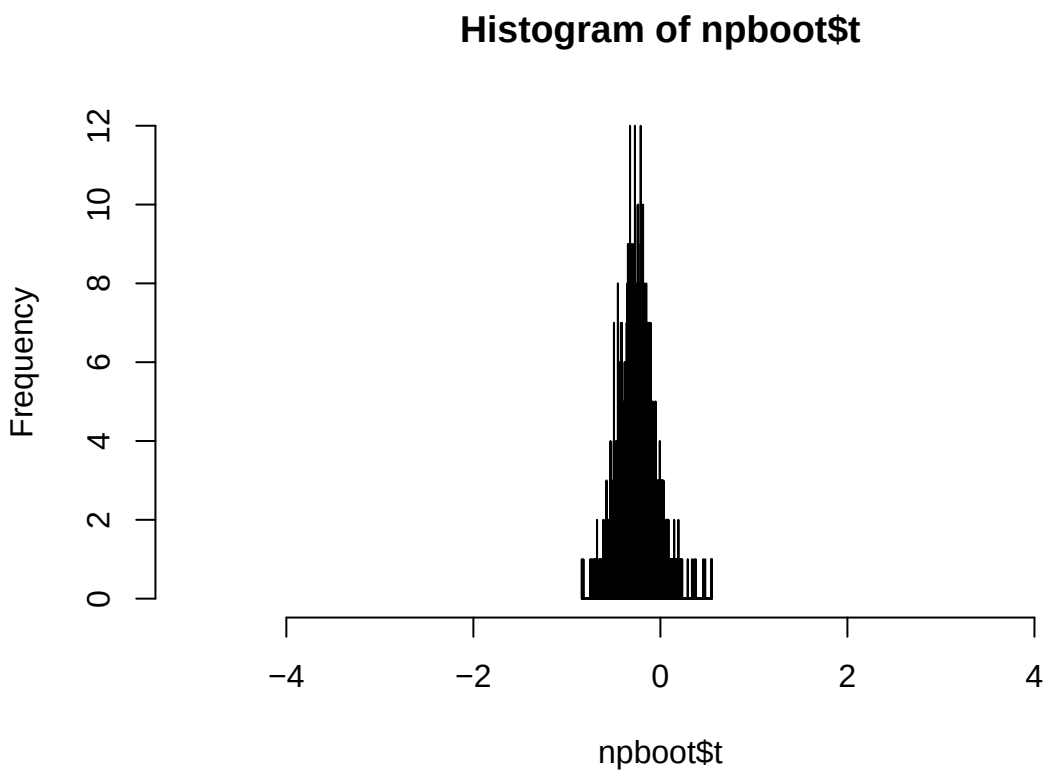
```
B <- 2000

set.seed(123456)
npboot <- boot(data=data, statistic=teststat_boot, R=B, stat=teststat(model=loess))
```

```
## Two-sided p-value?
sum(npboot$t > 0) / B
```

```
## [1] 0.0595
```

```
hist(npboot$t, xlim = c(-5,5), breaks = 1000)
```




```
## myT <- function(data, ind){
##     data <- data[ind,]
##     modelloess <-loess(Draft_No ~ Day_of_year, data)

##     Xb <- data$Draft_No[which.max(data$Day_of_year)]
##     Xa <- data$Draft_No[which.min(data$Day_of_year)]
```

```
##     YhatXb <- predict(modelloess,newdata = data.frame(Day_of_year = Xb))
##     YhatXa <- predict(modelloess,newdata = data.frame(Day_of_year = Xa))

##     ##YhatXa <- data$pred[which.min(data$Day_of_year)]

##     return( (YhatXb - YhatXa) / (Xb-Xa))
## }

## library(boot)

## Tboot <- boot(lottery[,c(4,5)],myT, R = 2000)
## hist(Tboot$t, xlim = c(-5,5), breaks = 1000)
## pt(Tboot$t0, df = nrow(lottery))

## mean(Tboot$t > 0)
```

### 1.4

```
teststat_permutation<- function(data, B, stat) {
    n <- nrow(data)

    statistics <- rep(0, B)
    for (b in 1:B) {
        newdata <- data.frame(x=data$x, y=sample(data$y, n))
        statistics[b] <- stat(newdata)
    }

    sum(statistics > 0) / B
}

set.seed(123456)
teststat_permutation(data, B, teststat(loess))
```

```
## [1] 0.514
```

### 1.5

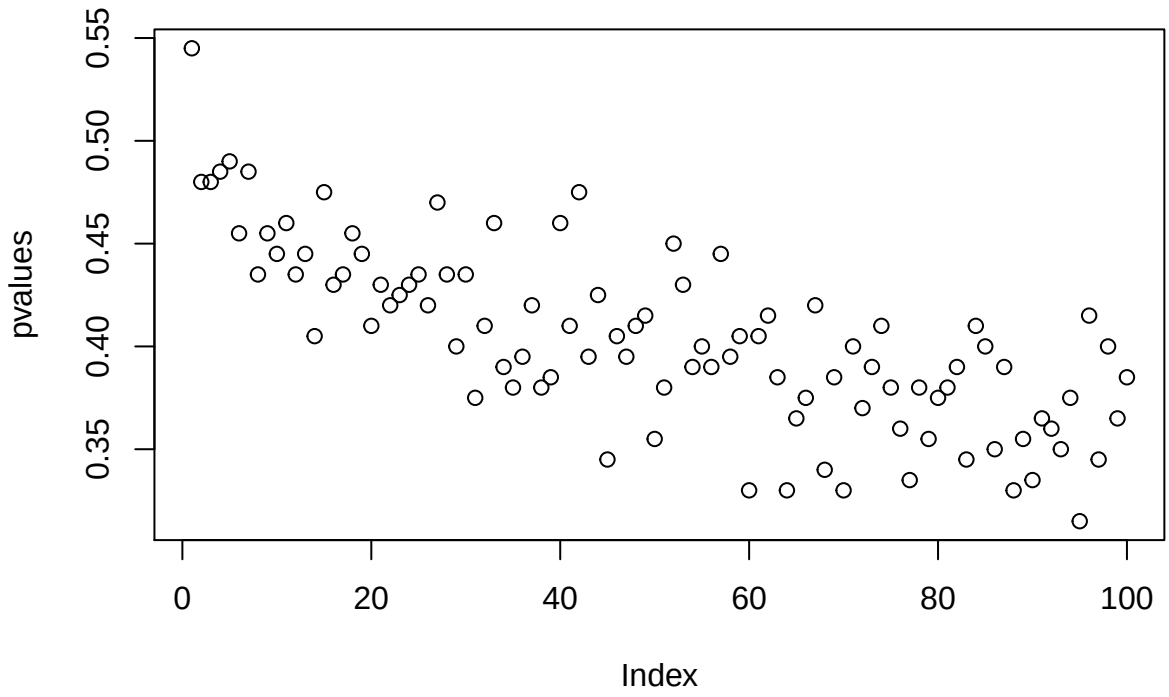
```
genranddata <- function(x, alpha) {
    data.frame(x=x, y=pmax(0, pmin(alpha * x + rnorm(length(x), mean=183, sd=10), 366)))
}

alphas <- seq(0.1, 10, by=0.1)
pvalues <- rep(0, length(alphas))

set.seed(123456)

for (i in 1:length(alphas)) {
    newdata <- genranddata(data$x, alphas[i])
    pvalues[i] <- teststat_permutation(newdata, 200, teststat(loess))
}
```

```r
plot(pvalues)
```




```r
print(sum(pvalues <= 0.05))
```

```
## [1] 0
```

```r
## for (aha in seq(0.1,10, by= 0.1)){

##     YandNum<- cbind(lottery[,4]*aha + rnorm(1,183,10),366)
##     Ymin <-apply(YandNum, MARGIN = 1, FUN = min)
##     Yx <- apply(cbind(0,Ymin), MARGIN = 1, FUN = max)
##     newLotto <- data.frame(cbind(lottery[,4],Yx))
##     colnames(newLotto) <- colnames(lottery[,c(4,5)])

##     newres<-perm_test(newLotto, B = 200)

##     ## hist(newres,breaks = 200, xlim = c(-5,5))
## }
```

```r
## perm_test <- function(data){
## #Assuming the data first column is labels and second is data.
##   lables<- data[,1]
##   data[,1]<- sample(lables, size = nrow(data), replace = FALSE)
##   return(aggregate(data, by = list(unique(data[,1])), FUN = mean  ))
## }

## perm_test <- function(data,B){
```

```
##     myPermT <- function(data){

##         data[,1]<- sample(data[,1], size = nrow(data), replace = FALSE)
##         data$pred <- predict(loess(Draft_No ~ Day_of_year, data))

##         Xb <- data$Draft_No[which.max(data$Day_of_year)]
##         Xa <- data$Draft_No[which.min(data$Day_of_year)]

##         YhatXb <- data$pred[which.max(data$Day_of_year)]
##         YhatXa <- data$pred[which.min(data$Day_of_year)]

##         return( (YhatXb - YhatXa) / (Xb-Xa))
##     }

##     res <- c()

##     for (i in 1:B){
##         res[i] <- myPermT(data)
##     }

##     return(res)
## }


## mres<-perm_test(lottery[,c(4,5)], B = 1000)
## hist(mres,breaks = 1000, xlim = c(-5,5))

## abline(v = myT(data = lottery[,c(4,5)]), col = "red")
```

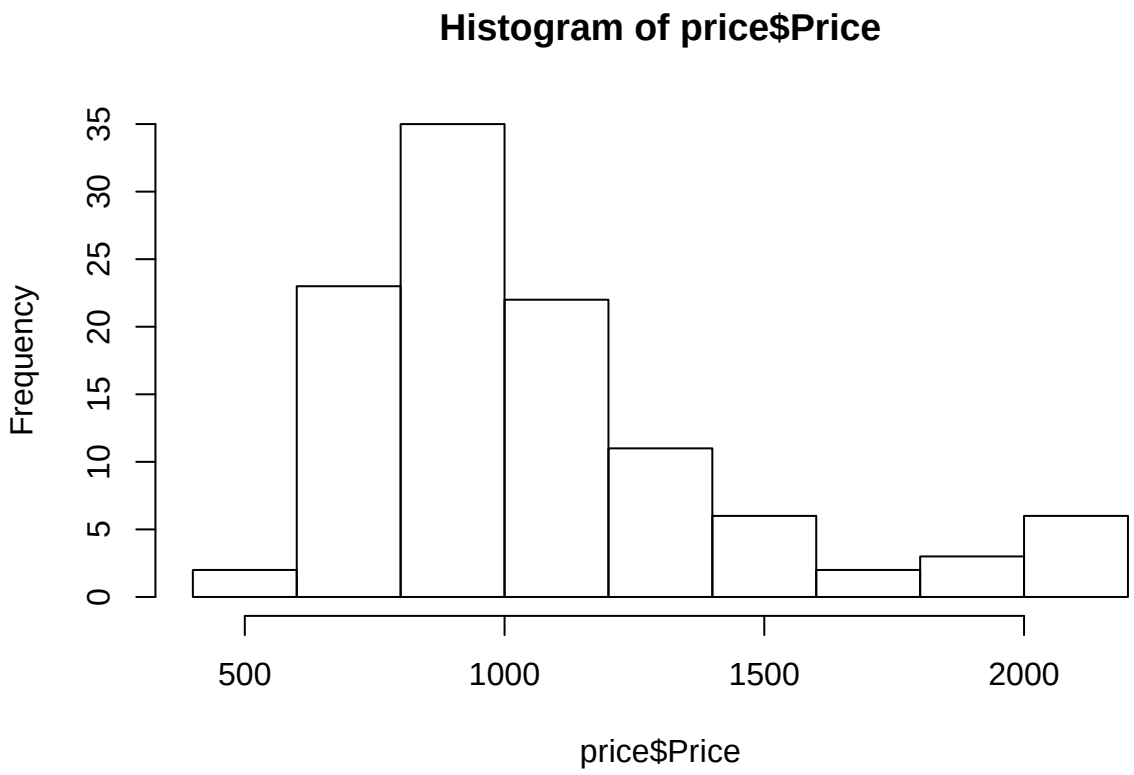
## Question 2

### 2.1

```
price <- read.csv("../data/prices1.csv", sep=";")
mean(price$Price)
```

```
## [1] 1080
```

```
hist(price$Price)
```




Looks like a Gamma distribution.

### 2.2

### 2.3

### 2.4