exam2_sim

Tianchu Ye

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Setup

For more accurate result, each simulation will run for 10000 (nsim) times. The self-defined function is to calculate the mode of sets.

```
rm(list = ls())
options(warn=-1)
nsim <- 10000
mode <- function(list){
  myhist <- hist.default(list,plot = FALSE)
  return(myhist$breaks[which.max(myhist$density)+1])}
```

Drugs

```
price = 3.7; OnetimeCost = 16; CapCost = 0.4; ProdCost = 0.2; t = 10
```

1.

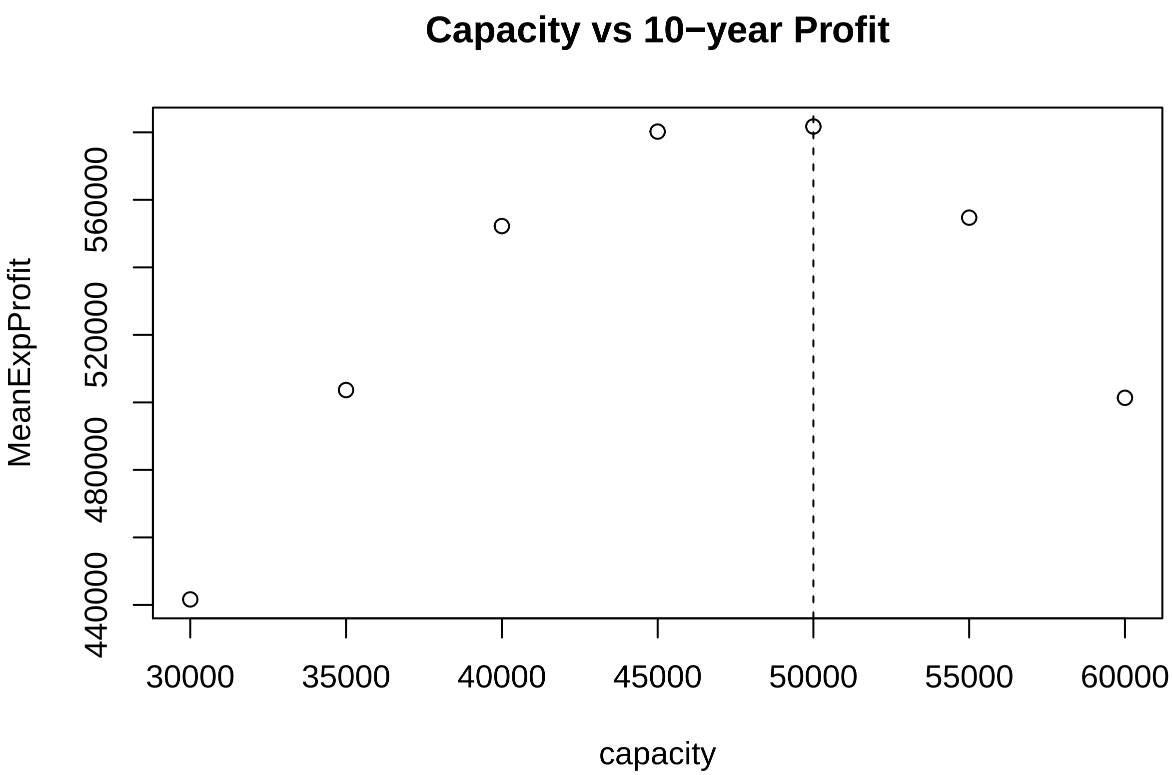
Below is the simulation for the problem. The **suggested capacity level is 50K.**

```
capacity <- c(30,35,40,45,50,55,60)*1000
ExpProfit <- matrix(ncol = length(capacity), nrow = nsim)
for (r in 1:nsim){
  profit <- rep(0,length(capacity))
  demand <- round(rnorm(t,50000,12000))
  for (i in 1:length(capacity)){
    my_capacity <- capacity[i]
    produce <- min(c(demand[1],my_capacity))
    profit_ <- produce*(price - ProdCost) - my_capacity*(OnetimeCost+CapCost)
    for (j in 2:t){
      produce <- min(c(demand[j],my_capacity))
      profit_ <- profit_+ produce*(price - ProdCost) - my_capacity*CapCost}
    profit[i] <- profit_
    ExpProfit[r,i] <- profit_}
}
MeanExpProfit <- c()
for (i in 1:length(capacity)){
  MeanExpProfit[i] <- mean(ExpProfit[,i])}
maximized <- capacity[which.max(MeanExpProfit)]
paste("The suggested capacity level is",maximized)
```

```
## [1] "The suggested capacity level is 50000"
```

The Plot:

```r
plot(capacity,MeanExpProfit,main = "Capacity vs 10-year Profit")
abline(v = maximized,lty = 2)
```



##2. Here, I ran another set of simulation with the chosen capacity level and the confidential interval of 95% is printed out in the end.

```r
totalProfit <- rep(0,nsim)
for (r in 1:nsim){
  demand <- round(rnorm(t,50000,12000))
  produce <- min(c(demand[1],maximized))
  profit_ <- produce *(price - ProdCost) - maximized*(CapCost + OnetimeCost)
  for (j in 2:t){
      produce <- min(c(demand[j],maximized))
      profit_ <- profit_+ produce*(price - ProdCost) -  maximized*CapCost}
  totalProfit[r] = profit_}
#The 95% condifential interval for profit is:
(quantile(totalProfit,c(0.025,0.975)))
```

```
##     2.5%    97.5%
## 409634.2 709481.5
```

Warranty

```
device_cost = 100; t2 = 6
```

The Simulation(s)

```
numOwned <- c(); Paid <- c()
for (r in 1:nsim){
  PaidDevice = 1 ; nsamp = 50
  brokeTime <- rgamma(nsamp,2,0.5)
  for (t in 1:nsamp){
    if(sum(brokeTime[1:t])>=t2){break}}
  myTime <- brokeTime[1:t]; PaidDevice = length(myTime[myTime>1])
  numOwned[r] <- t; Paid[r] <- PaidDevice}
```

3.

```
CostPlot <- Paid * device_cost
# round mean cost to nearest 100 due to integer device number
myCost <- round(mean(CostPlot)/device_cost)*device_cost
paste("My total cost is", myCost)
```

```
## [1] "My total cost is 200"
```

4.

```
inWarrantyPlot <- round(numOwned-Paid)
inWarranty <- round(mean(inWarrantyPlot))
paste("Number of failures during the warranty period is",inWarranty)
```

```
## [1] "Number of failures during the warranty period is 0"
```

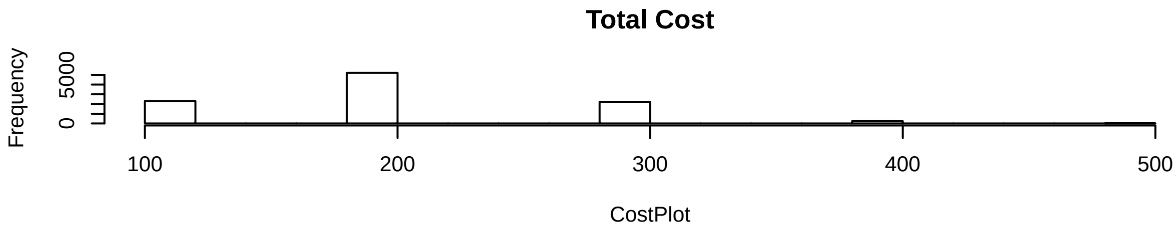
5.

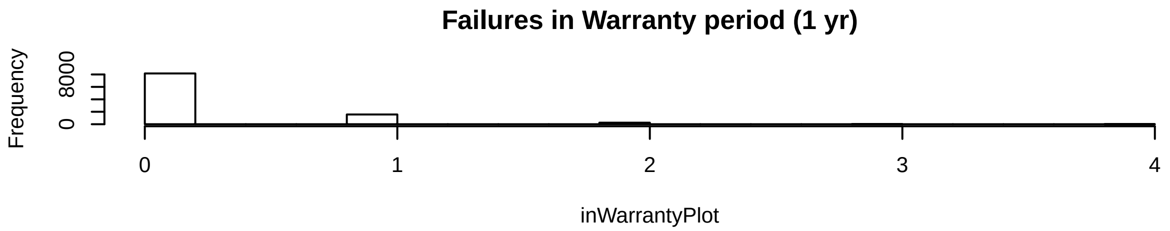
```
MeanOwned <- round(mean(numOwned))
paste("Number of devices owned during 6-year period is", MeanOwned)
```

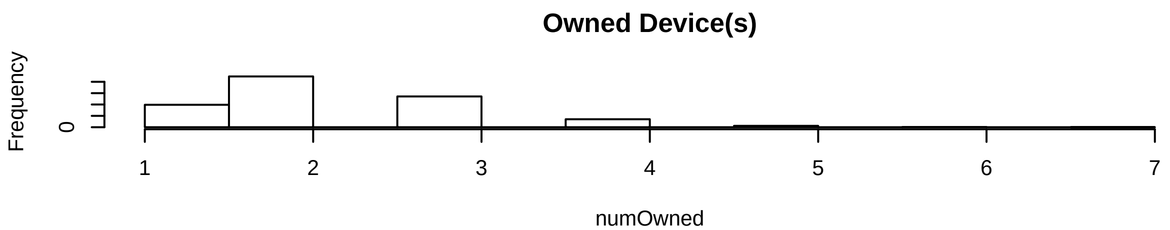
```
## [1] "Number of devices owned during 6-year period is 2"
```

Plots for Question 3,4,5:

```
par(mfrow = c(3,1))
hist(CostPlot,main = "Total Cost")
hist(inWarrantyPlot,main = "Failures in Warranty period (1 yr)");
hist(numOwned,main = "Owned Device(s)")
```







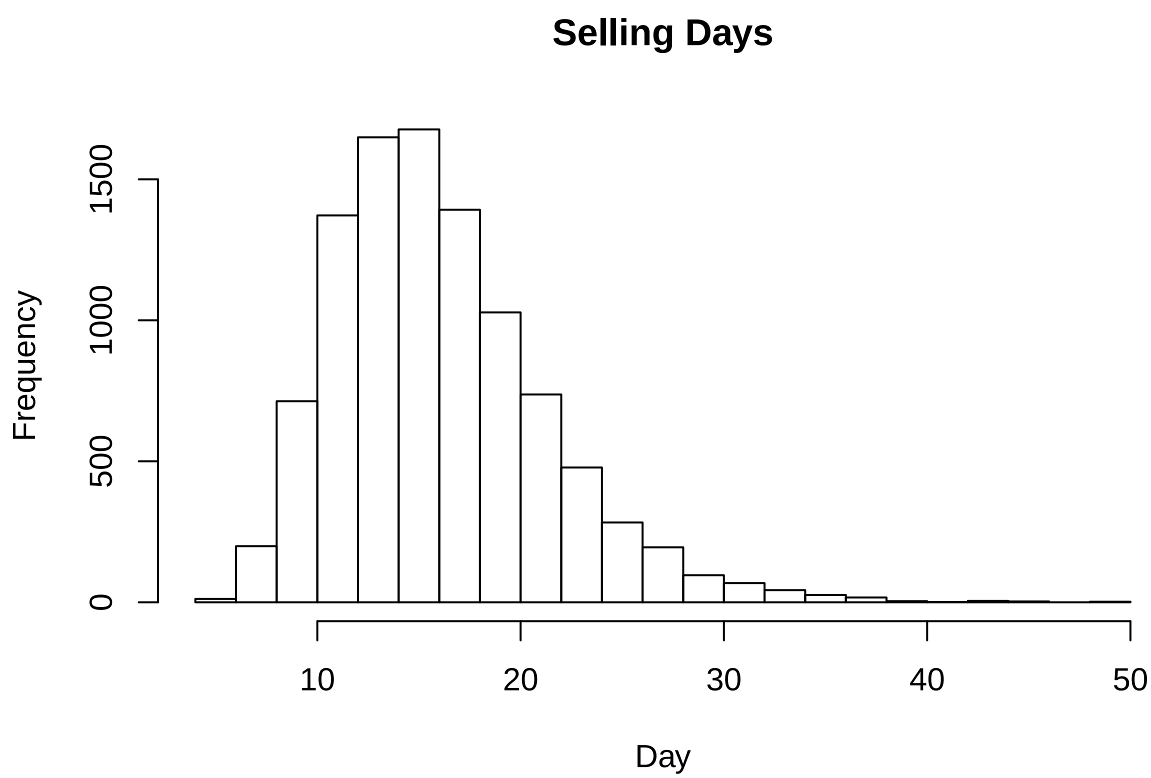

```
par(mfrow = c(1,1))
```

Clearance

6.

```
Day <- rep(0,nsim);n_samp <- 100
for (r in 1:nsim){
Arrivals <- sample(x=0:4, size=n_samp, prob=c(.15,.25,.3,.2,.1), replace=TRUE)
#Given Information
pNotbuy <- 1-.6 #denoted as 0
pTop <- 0.6*0.4 #denoted as 1
pRegular <- .6*.35  #denoted as 2
pExtra <- .6*.25  #denoted as 3
machineAmounts <- c(5,4,3)
#Generate Demand for each coming customer
Demand <- sample(x = 0:3, size = n_samp,prob = c(pNotbuy,pTop,pRegular,pExtra),
                 replace = TRUE)
#"-1" denotes that the customer actually buys a machine;
#"0" means no demand or desired machine is sold out.
for (nppl in 1:n_samp){
  if (sum(machineAmounts) == 0){break}
  for (c in 1:3){if (Demand[nppl] == c){
      if(machineAmounts[c]>0)
```

```
        {Demand[nppl] <- -1; machineAmounts[c]<- machineAmounts[c]-1}
      else{Demand[nppl] =0}}}}
for(day in 1:n_samp){if(sum(Arrivals[1:day])>=nppl){break}}
Day[r] <- day}
hist(Day,main = "Selling Days",breaks = 30) #larger breaks for more details
```



The histogram shows that the distribution is skewed to right. Therefore, the result is chosen as the mode value of set "Day" using self-defined function mode() in set-up section.
My answer:

```
result3 <- mode(Day)
paste("It will take WTF", result3,"days to sell all 12 washers (mode chosen).")
```

```
## [1] "It will take WTF 15 days to sell all 12 washers (mode chosen)."
```

```
paste("The mean value for Selling Days is rounded as",round(mean(Day)))
```

```
## [1] "The mean value for Selling Days is rounded as 16"
```

Waiting Room

7.

$$SampleMean = \frac{\Sigma sample}{n}$$

$$SampleS.D = \sqrt{\frac{\Sigma(t-\bar{t})^2}{n-1}}$$

```
SampleTime <- c(8,12,26,10,23,21,16,22,18,17,36,9)
paste("The sample mean is", round(mean(SampleTime),digits = 2))
```

```
## [1] "The sample mean is 18.17"
```

```
a <- sum((SampleTime - mean(SampleTime))^2)/(length(SampleTime)-1)
paste("The sample standard deviation is", round(sqrt(a),digits = 2))
```

```
## [1] "The sample standard deviation is 8.11"
```

8.

The confidence interval is:

$$\bar{x} \pm \frac{c \times s}{\sqrt{n}}$$

After calculation, my answer is:

$$18.17 \pm 7.27 = [-4.17, 10.38]$$

9.

SUggested sample size is:

$$n = \frac{c_{99\%}^2 \times s^2}{E^2} \approx 79$$

Scenarios

10.

Use time series to predict the trends and then pick the top ones.

MultiChoice

11. c) Heteroscedasticity

12. c) density plot

13. b) lag

14. c) B(500,0.08)

15. c) pbinom(50,500,.08,lower.tail = F)

16. d) 40

17. d) 7

1693 Corp.

18.

Approximately 2%.

```
round(pnorm(460,mean = 480, sd = 10,lower.tail = T),digits = 2)
```

```
## [1] 0.02
```

19.

$$\mu_{2X} = \mu_1 + \mu_2 = 920 grams$$

$$\sigma_{2X} = \sqrt{\sigma_1^2 + \sigma_2^2 + 2 \cdot \sigma \cdot \sigma_1 \cdot_2 CORR(X_1, X_2)} \approx 18.81 grams$$

20.

$$2X = N(920, 18.81)$$

$$P(2X < 920) = 0.5$$

The probability is 50%.
##21. The suggested μ is 477.

```
for (mu in 450:500){
if(pnorm(460,mu,10,lower.tail = FALSE) >= .95){break}}
mu
```

```
## [1] 477
```