Homework 2

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Question 1

(1)Using Monte Carlo methods to estimate the density funciton of normal distribution. (2)Repeat the experiment 100 times. Draw box plots of the bias at all t

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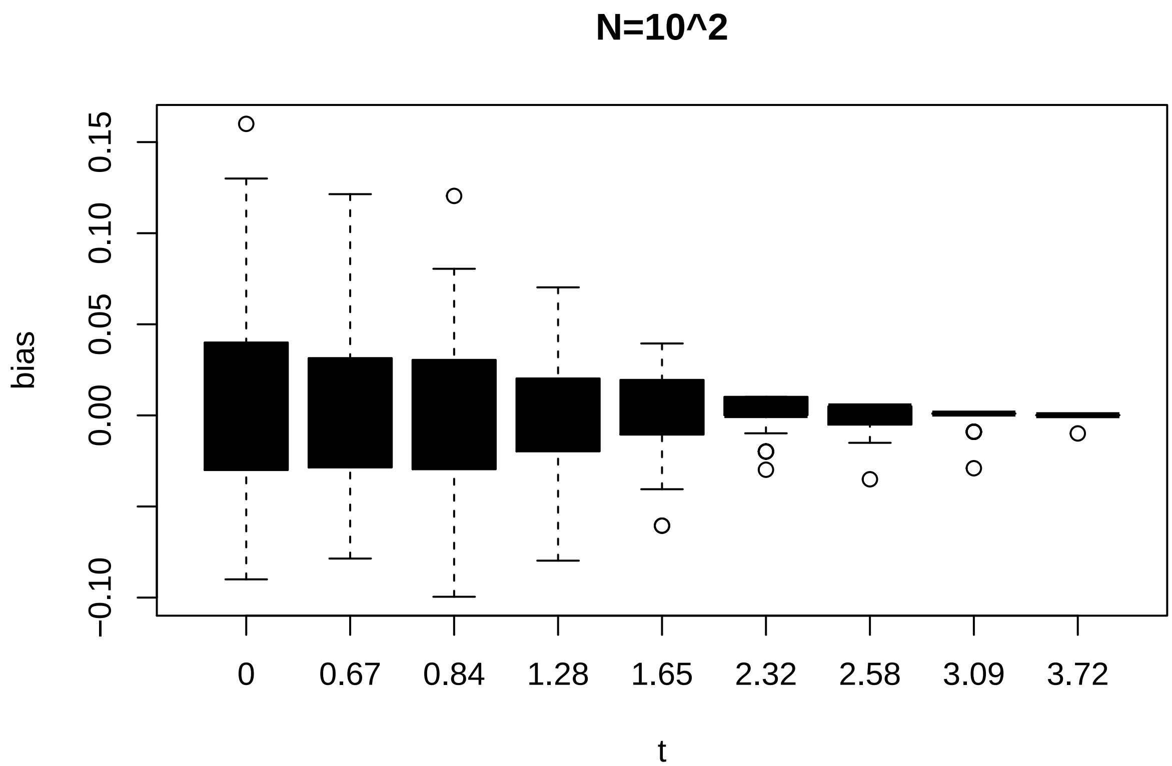
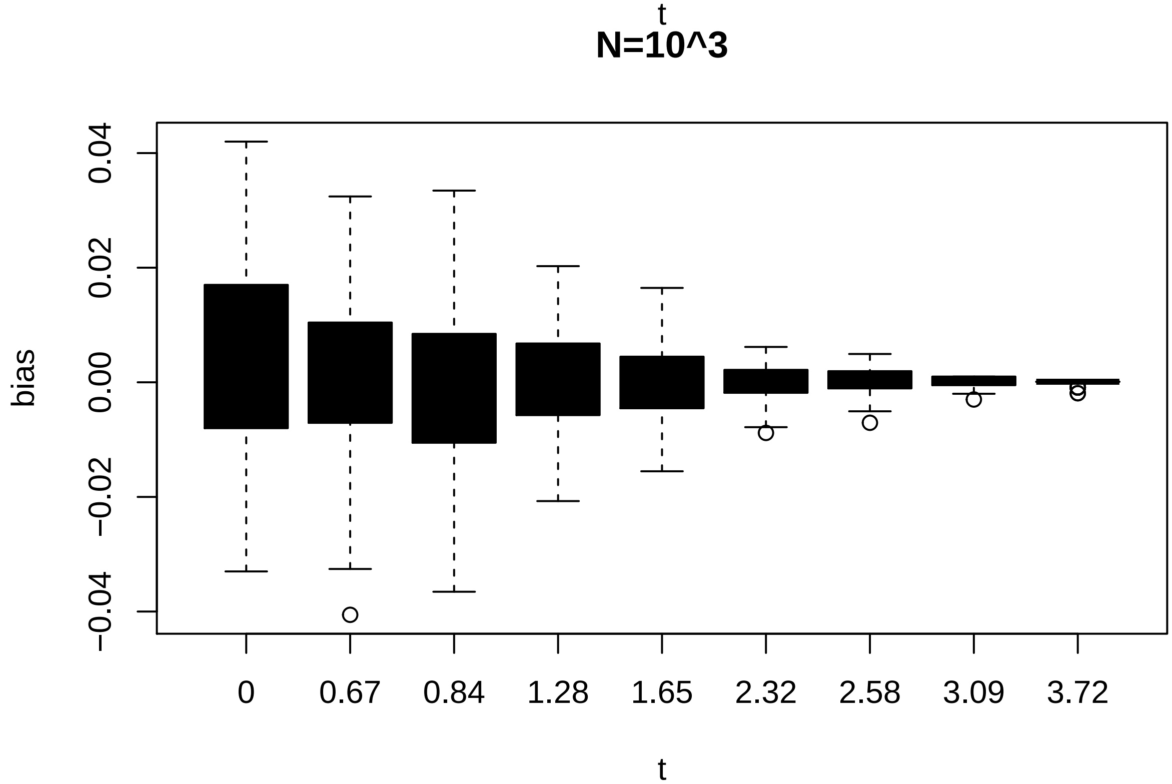
```r
#code

n <- c(100, 1000, 10000)
t <- c(0.0, 0.67, 0.84, 1.28, 1.65, 2.32, 2.58, 3.09, 3.72)
truevalue <- pnorm(t)

ap1<- NA
ap2<- NA
ap3<- NA

a<- rnorm(100, 0, 1)
for (i in 1:length(t))
  {
  ap1[i]<- sum(a<=t[i])/100
  }

b<- rnorm(1000, 0, 1)
for (i in 1:length(t))
  {
  ap2[i]<- sum(b<=t[i])/1000
  }

c<- rnorm(10000, 0, 1)
for (i in 1:length(t))
  {
  ap3[i]<- sum(c<=t[i])/10000
  }


x<-matrix(c(ap1,ap2,ap3,truevalue), ncol=9,byrow=TRUE)
rownames(x)<-c("10^2","10^3","10^4","truevalue")
colnames(x)<-c(t)
x <- as.table(x)
x
```

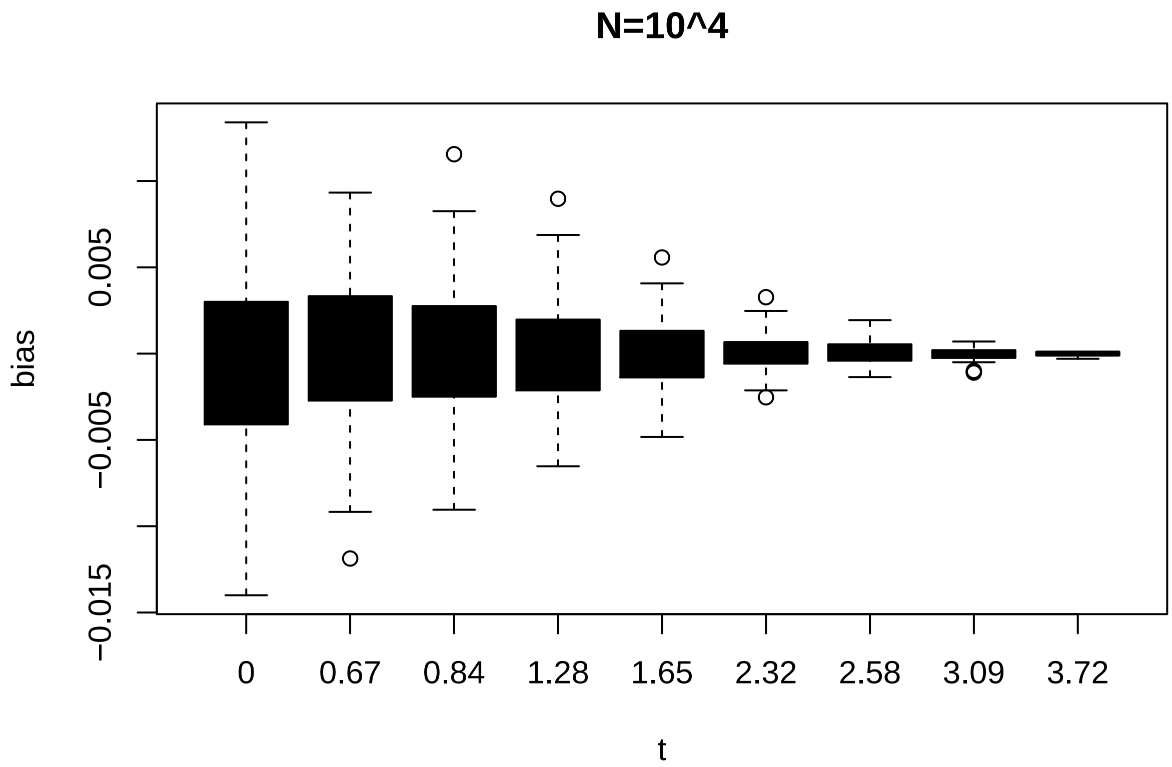
```
##                   0      0.67      0.84      1.28      1.65      2.32
## 10^2      0.3500000 0.6700000 0.7300000 0.8700000 0.9500000 0.9800000
## 10^3      0.4920000 0.7400000 0.7930000 0.8810000 0.9460000 0.9900000
## 10^4      0.4956000 0.7448000 0.7988000 0.9001000 0.9511000 0.9897000
## truevalue 0.5000000 0.7485711 0.7995458 0.8997274 0.9505285 0.9898296
##                2.58      3.09      3.72
```

```
## 10^2      0.9900000 0.9900000 1.0000000
## 10^3      0.9980000 1.0000000 1.0000000
## 10^4      0.9946000 0.9995000 0.9999000
## truevalue 0.9950600 0.9989992 0.9999004
```

Box plots of the bias







Conclusion

From the plot, we can see that the bias become smaller when n increasing. However, when we choose the bigger sample size, even though the bias is smaller, the process is more expensive.