Uebung 1

Computational Statistics

Sommersemester 2019

April 15, 2019

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Name:

A 1

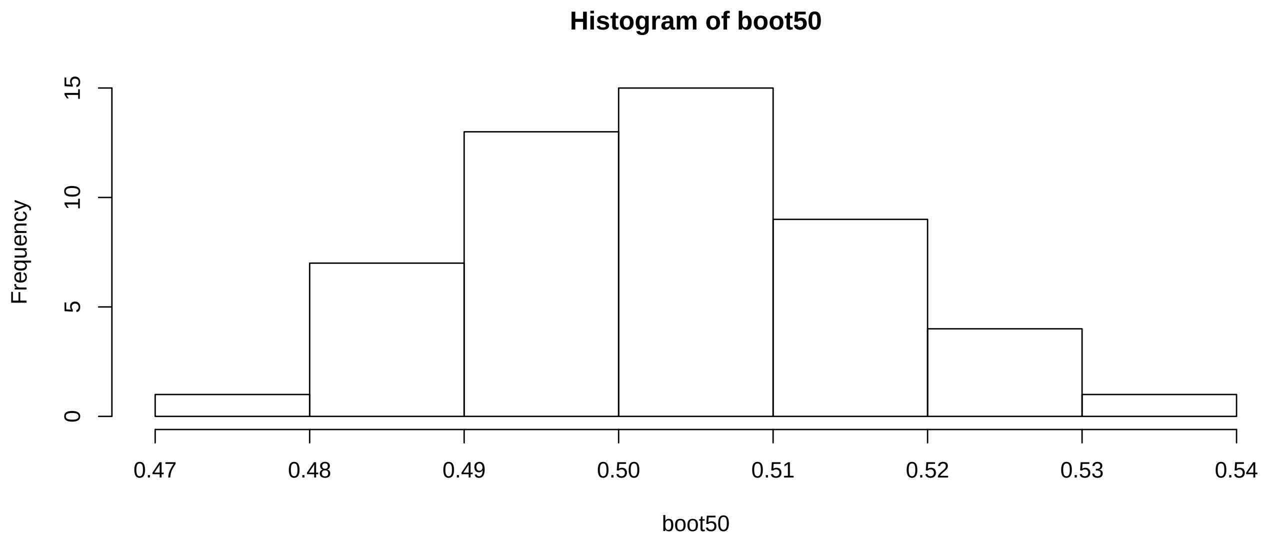
a)

```
means50 = matrix(NA, nrow = 50, ncol = 1)
for (i in 1:50){
  summe = runif(500,0,1)
  means50[i,] = mean(summe)
}

means1000 = matrix(NA, nrow = 1000, ncol = 1)
for (i in 1:1000){
  summe = runif(500,0,1)
  means1000[i,] = mean(summe)
}
head(means1000)
#>           [,1]
#> [1,] 0.5105131
#> [2,] 0.5307648
#> [3,] 0.4928003
#> [4,] 0.5220423
#> [5,] 0.5010289
#> [6,] 0.5011775
```

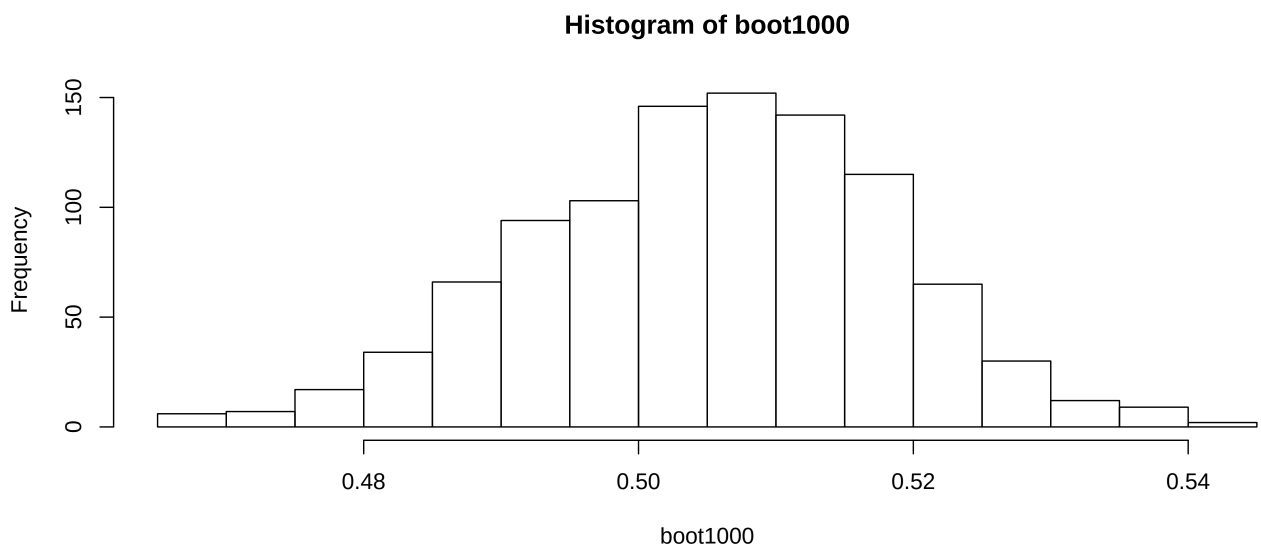
b) & c)

```
packageTest('boot')
bootdata <- runif(500,0,1)
bootfunc <- function(data,i) {
  d <- data[i]
  return(mean(d))
}

boot50 <- boot(bootdata, bootfunc, R = 50)
boot50 <- boot50$t
boot50
#>            [,1]
#>  [1,] 0.4918514
#>  [2,] 0.5279156
#>  [3,] 0.4803178
```

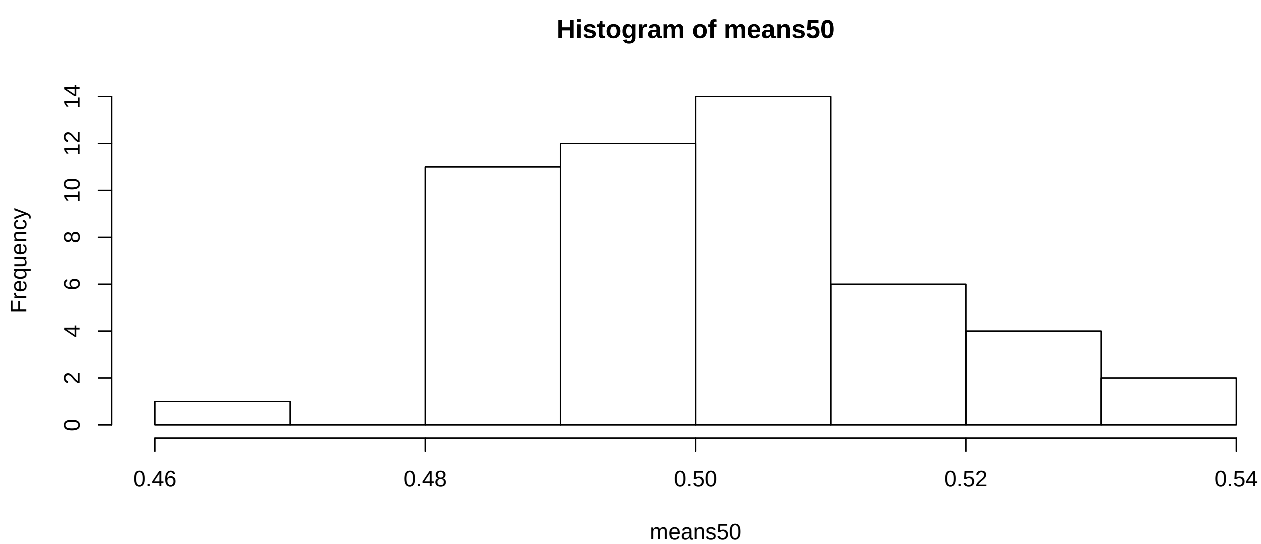
```
#>  [4,] 0.5042523
#>  [5,] 0.5061138
#>  [6,] 0.5271964
#>  [7,] 0.5105327
#>  [8,] 0.5149845
#>  [9,] 0.4968841
#> [10,] 0.5044391
#> [11,] 0.5016429
#> [12,] 0.5042793
#> [13,] 0.4829672
#> [14,] 0.5146130
#> [15,] 0.5135885
#> [16,] 0.4907198
#> [17,] 0.5015716
#> [18,] 0.5036529
#> [19,] 0.4946387
#> [20,] 0.5030223
#> [21,] 0.4818555
#> [22,] 0.4983441
#> [23,] 0.4938380
#> [24,] 0.5010635
#> [25,] 0.5176984
#> [26,] 0.5182599
#> [27,] 0.5261590
#> [28,] 0.4773310
#> [29,] 0.5319165
#> [30,] 0.5107439
#> [31,] 0.4906796
#> [32,] 0.5152901
#> [33,] 0.4869851
#> [34,] 0.4905178
#> [35,] 0.4953782
#> [36,] 0.4998178
#> [37,] 0.4864389
#> [38,] 0.5237425
#> [39,] 0.5029100
#> [40,] 0.5050920
#> [41,] 0.4869317
#> [42,] 0.5060462
#> [43,] 0.4949028
#> [44,] 0.5038300
#> [45,] 0.4978510
#> [46,] 0.4913176
#> [47,] 0.5170787
#> [48,] 0.5019557
#> [49,] 0.5037893
#> [50,] 0.4859601

boot1000 <- boot(bootdata, bootfunc, R = 1000)
boot1000 <- boot1000$t

hist(boot50)
```



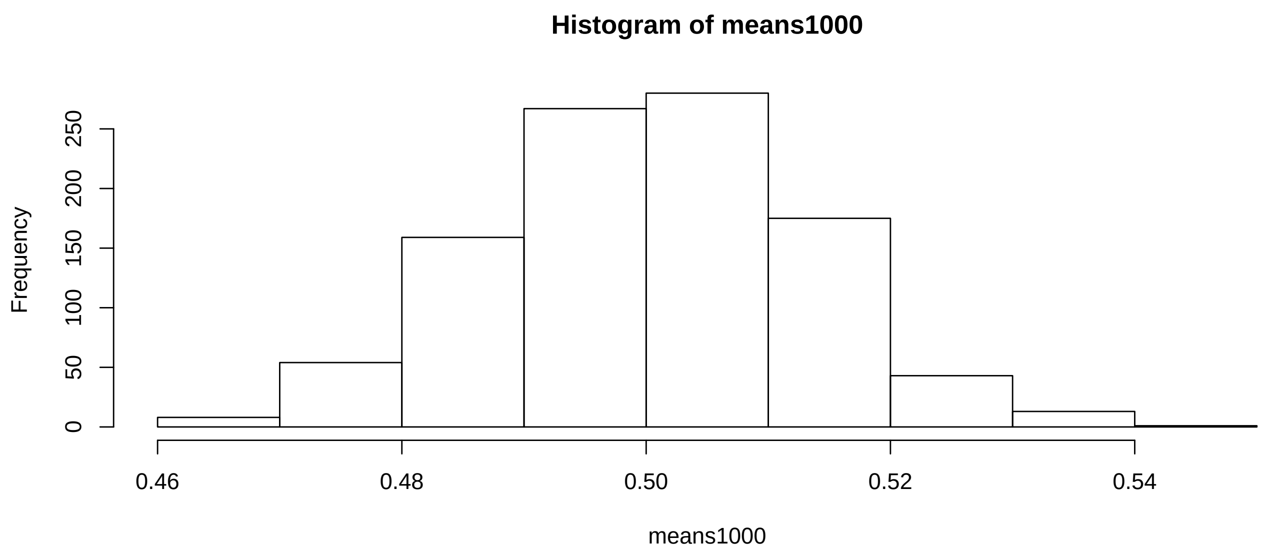

```
hist(boot1000)
```



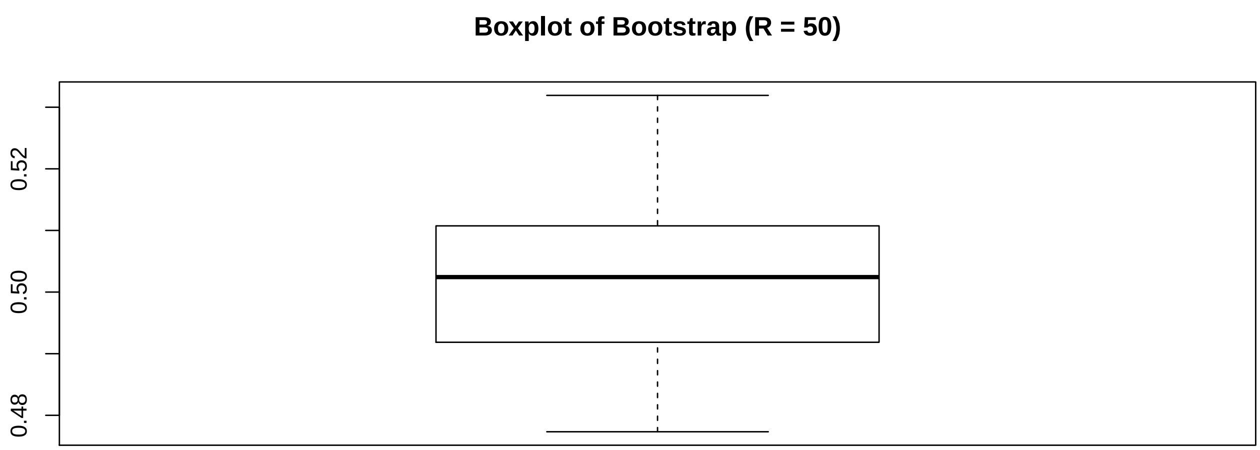

```
hist(means50)
```



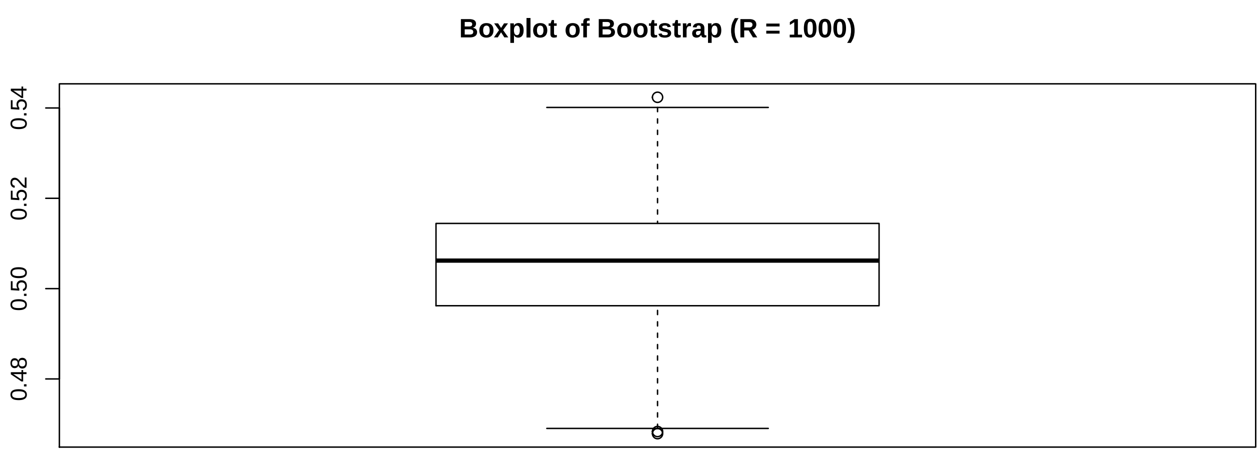
```r
hist(means1000)
```



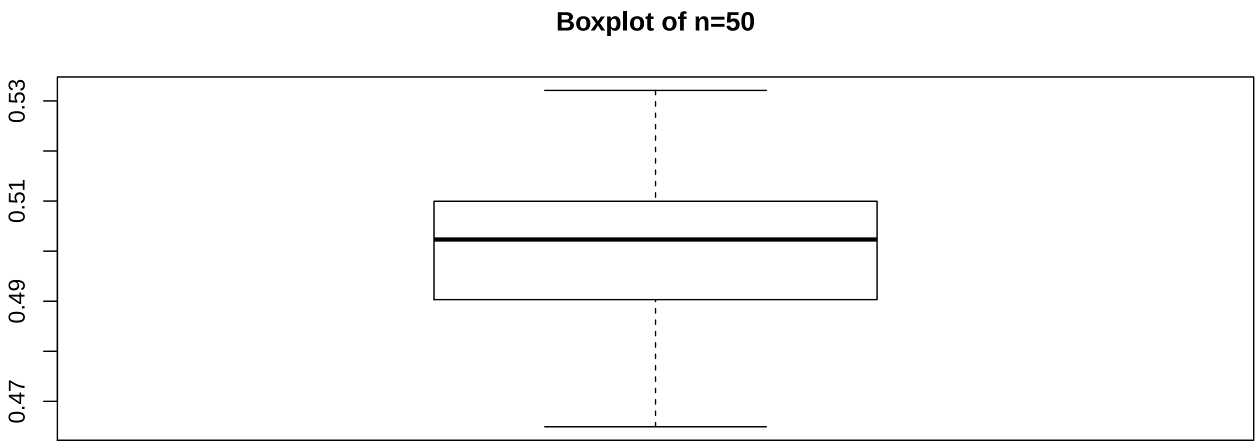

```r
boxplot(boot50, main='Boxplot of Bootstrap (R = 50)')
```



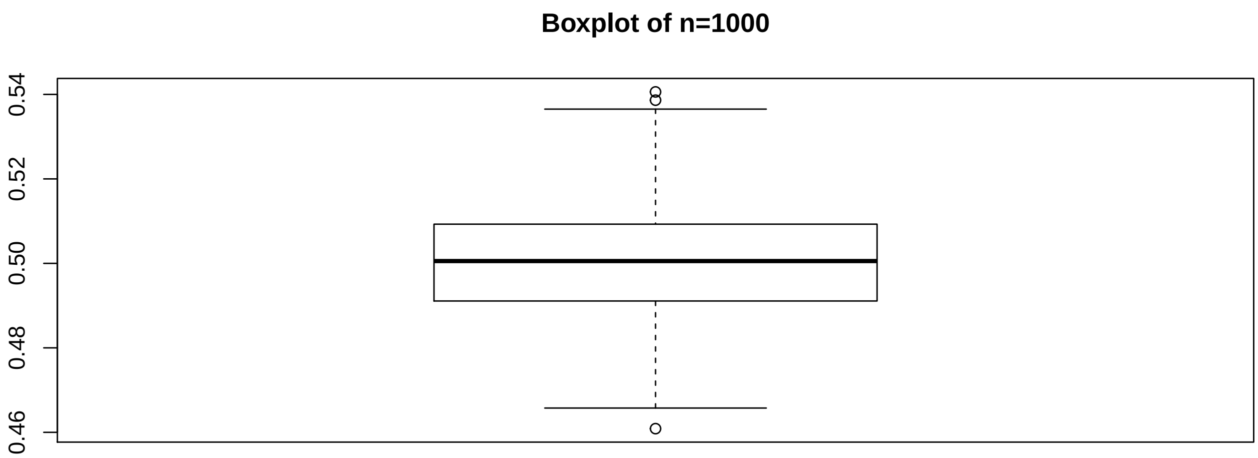

```r
boxplot(boot1000, main='Boxplot of Bootstrap (R = 1000)')
```



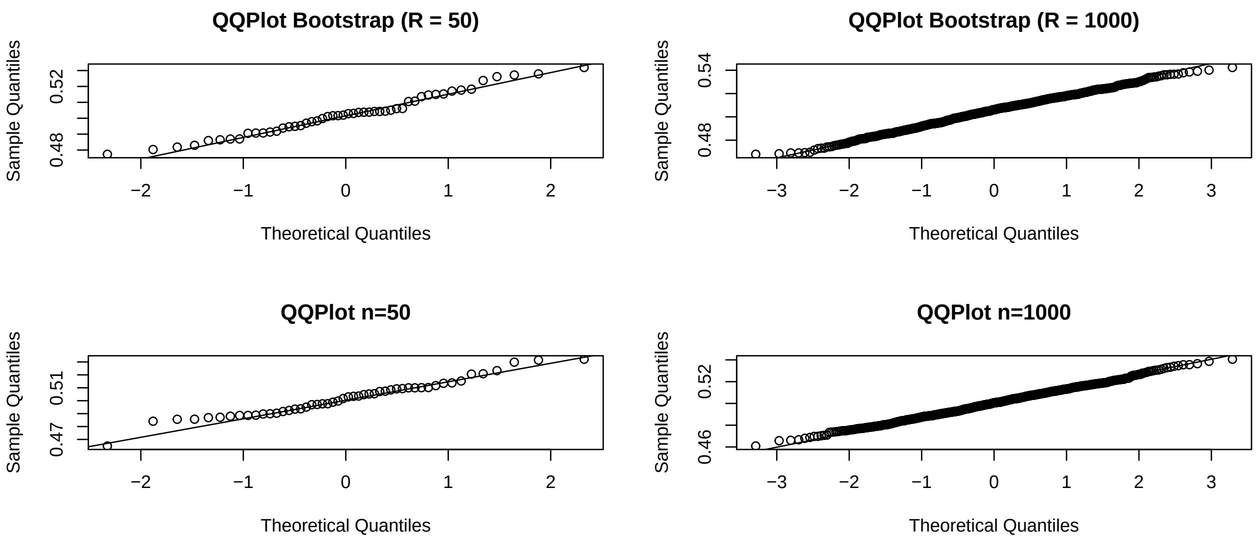
```r
boxplot(means50, main='Boxplot of n=50')
```




```r
boxplot(means1000, main='Boxplot of n=1000')
```




```r
par(mfrow=c(2,2))
qqnorm(boot50, main='QQPlot Bootstrap (R = 50)')
qqline(boot50)
qqnorm(boot1000, main='QQPlot Bootstrap (R = 1000)')
qqline(boot1000)
qqnorm(means50, main='QQPlot n=50')
qqline(means50)
qqnorm(means1000, main='QQPlot n=1000')
qqline(means1000)
```




```
shapiro.test(means50)
#>
#>  Shapiro-Wilk normality test
#>
#> data:  means50
#> W = 0.97052, p-value = 0.243
shapiro.test(means1000)
#>
#>  Shapiro-Wilk normality test
#>
#> data:  means1000
#> W = 0.99831, p-value = 0.4381
shapiro.test(boot50)
#>
#>  Shapiro-Wilk normality test
#>
#> data:  boot50
#> W = 0.97719, p-value = 0.4404
shapiro.test(boot1000)
#>
#>  Shapiro-Wilk normality test
#>
#> data:  boot1000
#> W = 0.99682, p-value = 0.04217
```

Laut Shapiro-Wilks-Test kann f??r keine der vier Stichproben die Nullhypothese (Stichprobe ist normalverteilt) verworfen werden, auch wenn die Histogramme von boot50 und means50 nicht nach Normalverteilung aussehen.

d)

```
packageTest('car')

levene50 <- c(means50,boot50)
levene1000 <- c(means1000,boot1000)
```

```r
levgroup50 <- as.factor(c(rep(1, length(means50)), rep(2, length(boot50))))
levgroup1000 <- as.factor(c(rep(1, length(means1000)), rep(2, length(boot1000))))

leveneTest(levene50, levgroup50)
#> Levene's Test for Homogeneity of Variance (center = median)
#>       Df F value Pr(>F)
#> group  1  0.1355 0.7136
#>       98
cat('\n')
leveneTest(levene1000, levgroup1000)
#> Levene's Test for Homogeneity of Variance (center = median)
#>         Df F value Pr(>F)
#> group    1  0.0052 0.9425
#>       1998

t.test(means50, boot50, var.equal = TRUE)
#>
#>  Two Sample t-test
#>
#> data:  means50 and boot50
#> t = -0.19178, df = 98, p-value = 0.8483
#> alternative hypothesis: true difference in means is not equal to 0
#> 95 percent confidence interval:
#>  -0.005832586  0.004804603
#> sample estimates:
#> mean of x mean of y
#> 0.5018642 0.5023782
cat('\n')
t.test(means1000, boot1000, var.equal = TRUE)
#>
#>  Two Sample t-test
#>
#> data:  means1000 and boot1000
#> t = -8.6714, df = 1998, p-value < 2.2e-16
#> alternative hypothesis: true difference in means is not equal to 0
#> 95 percent confidence interval:
#>  -0.006165050 -0.003890797
#> sample estimates:
#> mean of x mean of y
#> 0.5002819 0.5053098
```

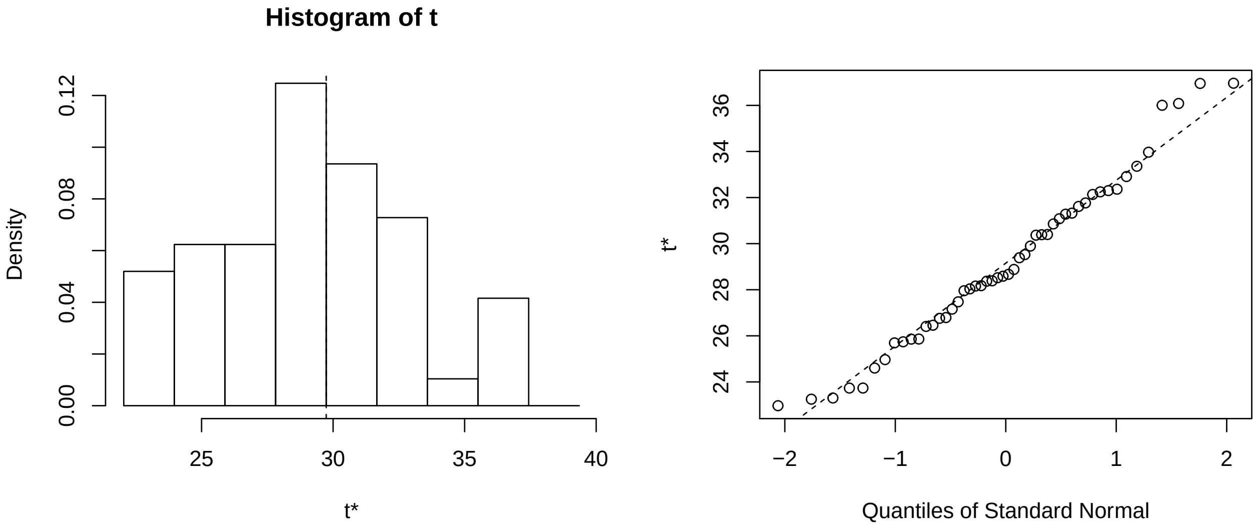
FRAU GROOS FRAGEN, STIMMT DAS SO?

Aufgabe 2

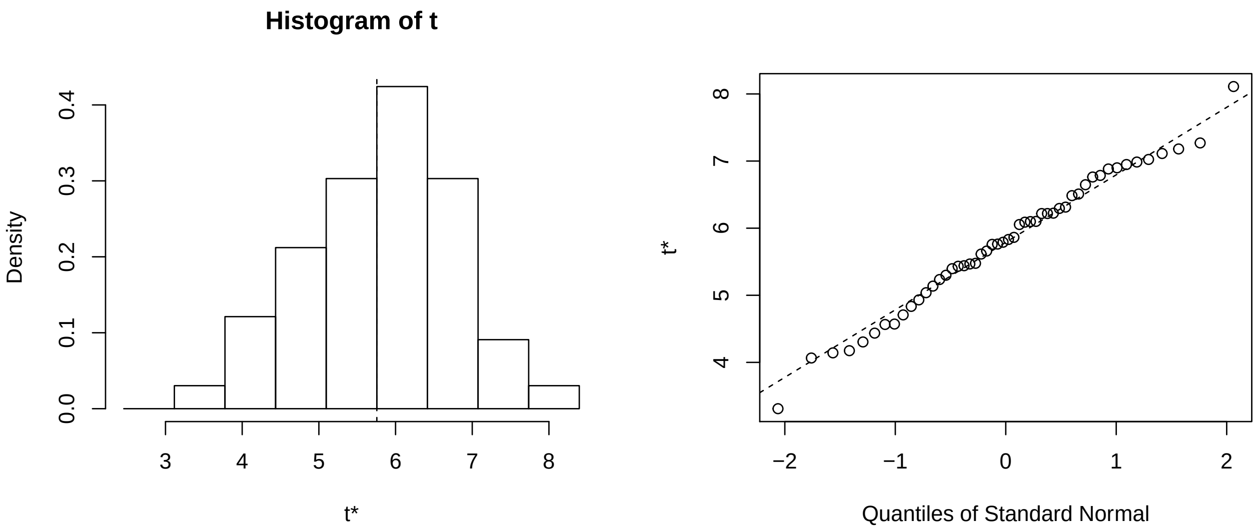
a)

```r
load("Donald.RData")

vergleich <- lm(data = Donald_1, Trump ~ Geschlecht + Alter + Minderheit + Fremdenfeindlich + IQ)

theta <- function(formula, data, indices){
```

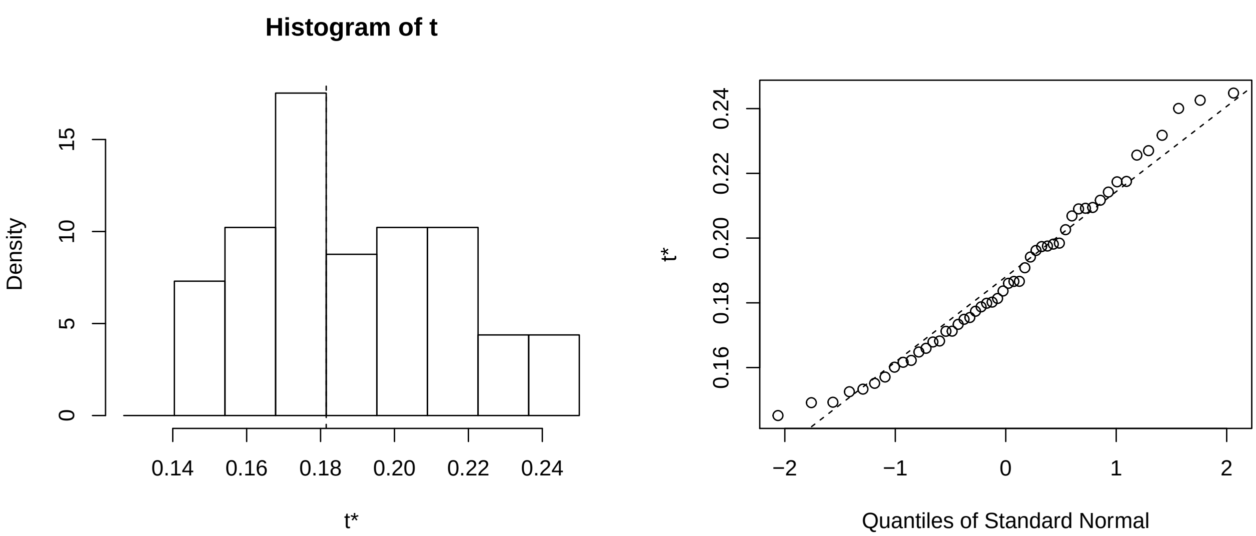
```r
  d <- data[indices,]
  fit <- lm(formula, data = d)
  return(coef(fit))
}

boot50_1 <- boot(data=Donald_1, statistic=theta, R=50, formula=Trump~.)
par(mfrow=c(1,2))
for (i in 1:6){
plot(boot50_1, index=i, main=substitute(paste('boot_50: Coefficient ', i)))
print(t.test(boot50_1$t[,i], mu=vergleich$coefficients[1]))
}
```




```
#>
#>  One Sample t-test
#>
#> data:  boot50_1$t[, i]
#> t = -1.1499, df = 49, p-value = 0.2558
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  28.13126 30.17565
#> sample estimates:
#> mean of x
#>  29.15346
```

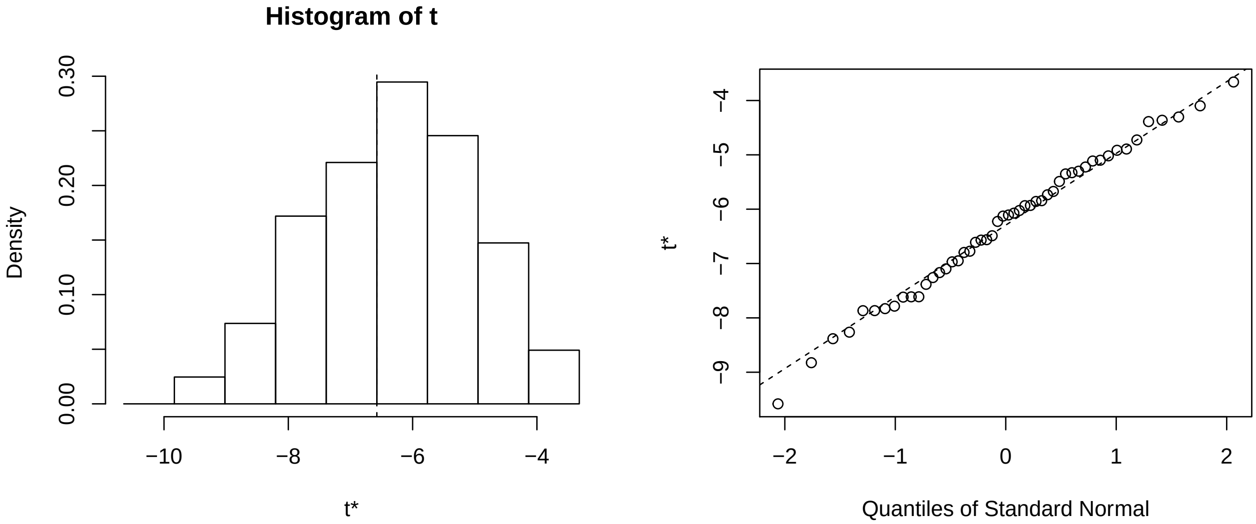



```
#>
#>  One Sample t-test
#>
#> data:  boot50_1$t[, i]
#> t = -168.35, df = 49, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  5.503144 6.074898
#> sample estimates:
#> mean of x
#>  5.789021
```

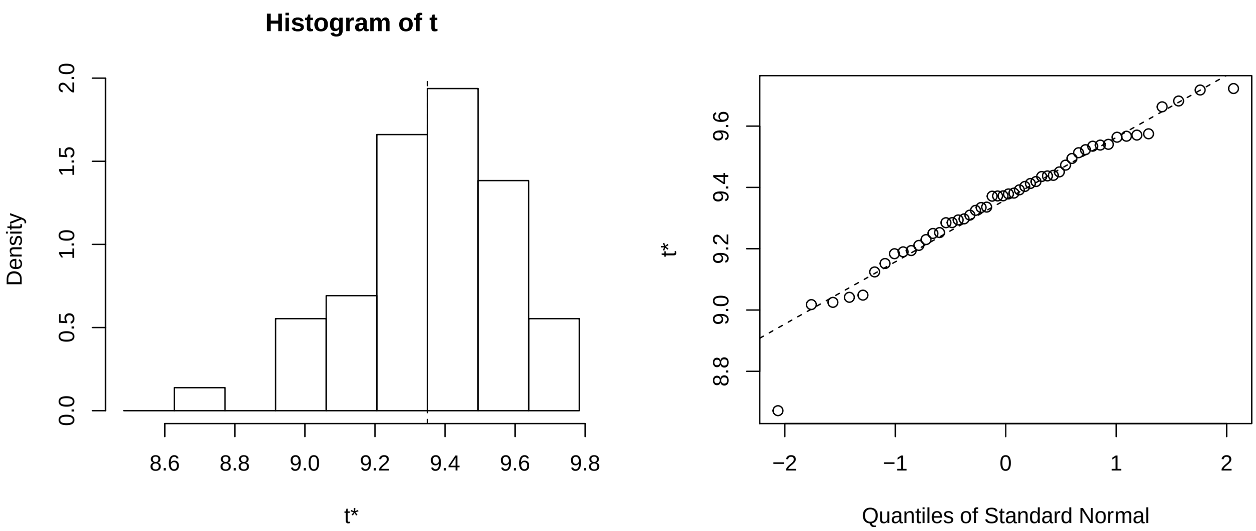



```
#>
#>  One Sample t-test
#>
#> data:  boot50_1$t[, i]
#> t = -7936.6, df = 49, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  0.1805527 0.1955171
#> sample estimates:
```

```
#> mean of x
#> 0.1880349
```

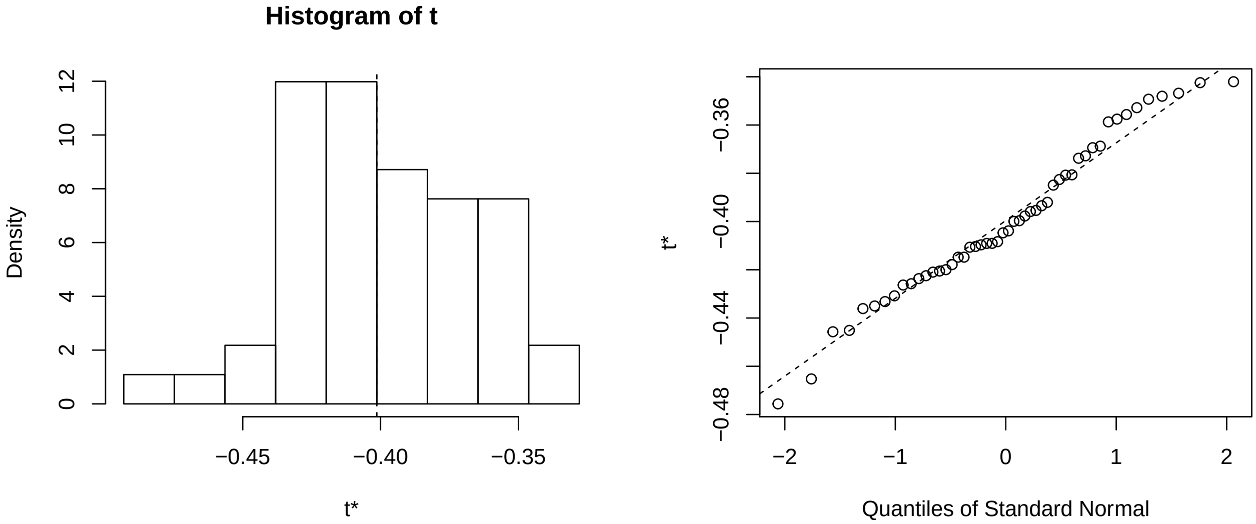



```
#>
#>  One Sample t-test
#>
#> data:  boot50_1$t[, i]
#> t = -192.99, df = 49, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  -6.668653 -5.918275
#> sample estimates:
#> mean of x
#> -6.293464
```



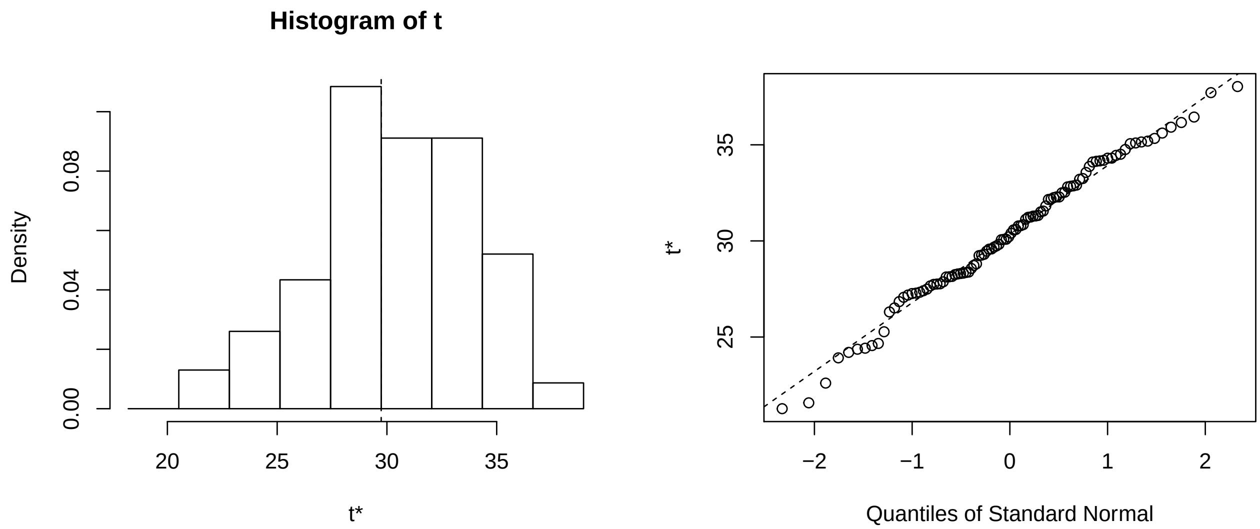

```
#>
#>  One Sample t-test
#>
#> data:  boot50_1$t[, i]
#> t = -710.07, df = 49, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
```

```
#> 95 percent confidence interval:
#>  9.302384 9.417730
#> sample estimates:
#> mean of x
#>  9.360057
```

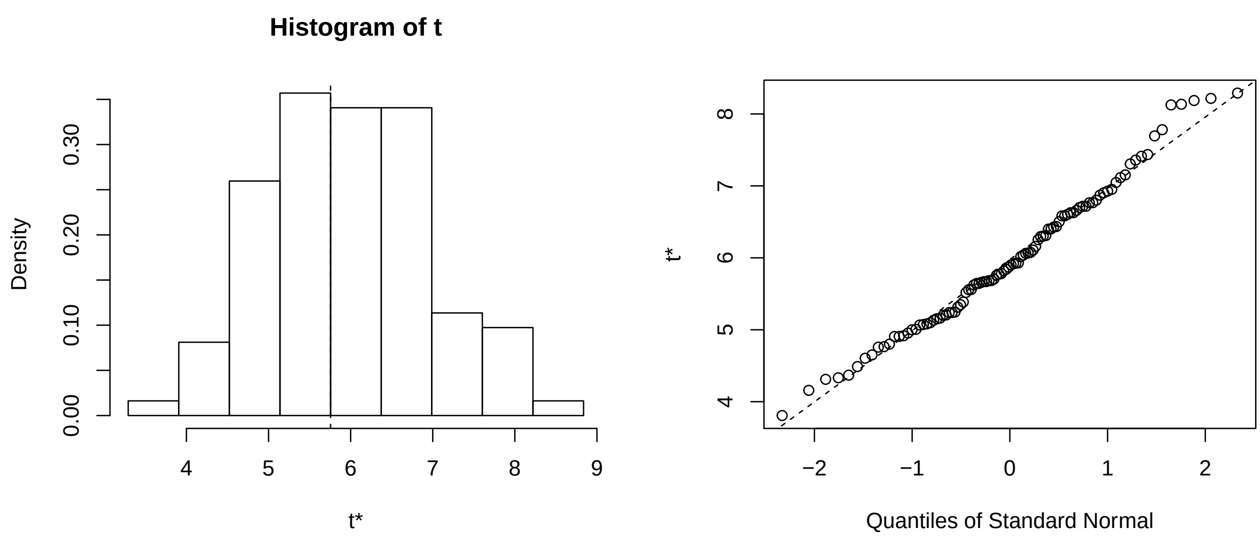



```
#>
#>  One Sample t-test
#>
#> data:  boot50_1$t[, i]
#> t = -6610.5, df = 49, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  -0.4087766 -0.3904530
#> sample estimates:
#>  mean of x
#> -0.3996148
```

```
boot100_1 <- boot(data=Donald_1, statistic=theta, R=100, formula=Trump~.)
par(mfrow=c(1,4))
for (i in 1:6){
plot(boot100_1, index=i, main= )
print(t.test(boot100_1$t[,i], mu=vergleich$coefficients[1]))
}
```

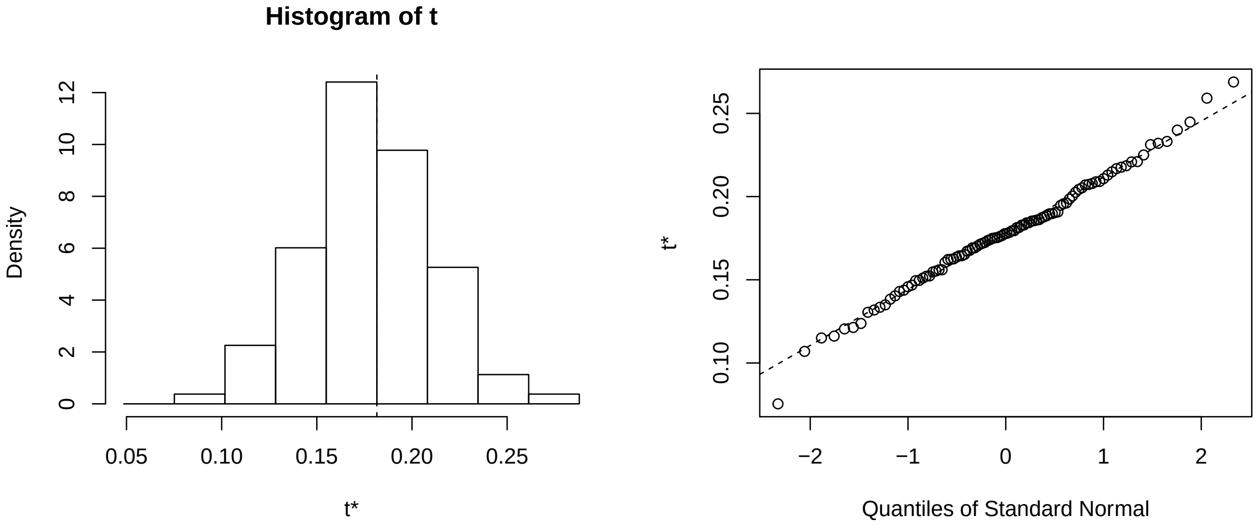



```
#>
#>  One Sample t-test
#>
#> data:  boot100_1$t[, i]
#> t = 1.7239, df = 99, p-value = 0.08784
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  29.64540 31.06252
#> sample estimates:
#> mean of x
#>  30.35396
```

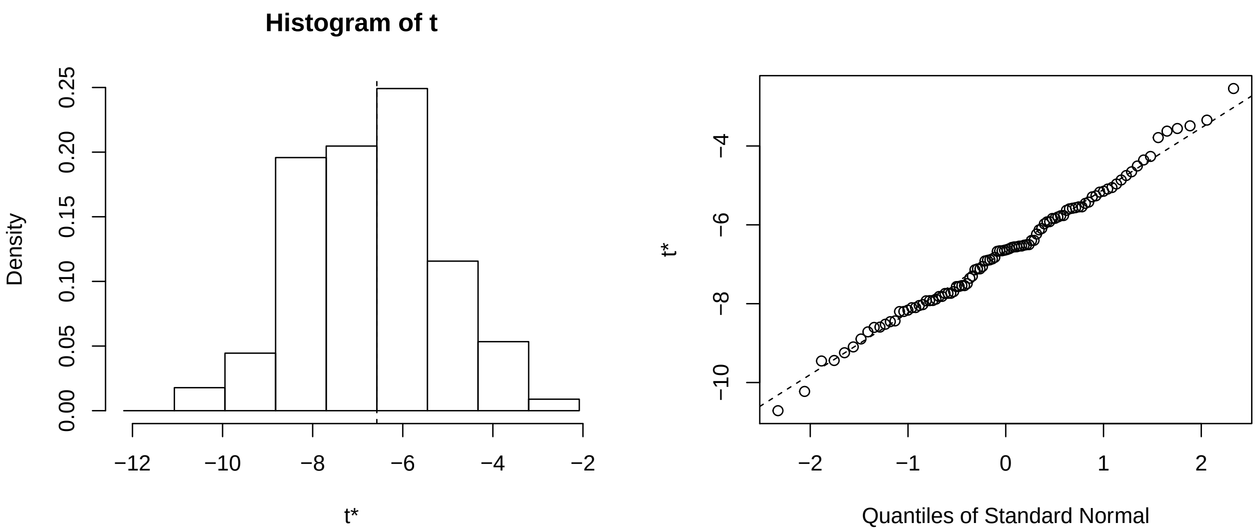



```
#>
#>  One Sample t-test
#>
#> data:  boot100_1$t[, i]
#> t = -240.09, df = 99, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  5.780898 6.173650
#> sample estimates:
```

```
#> mean of x
#>  5.977274
```

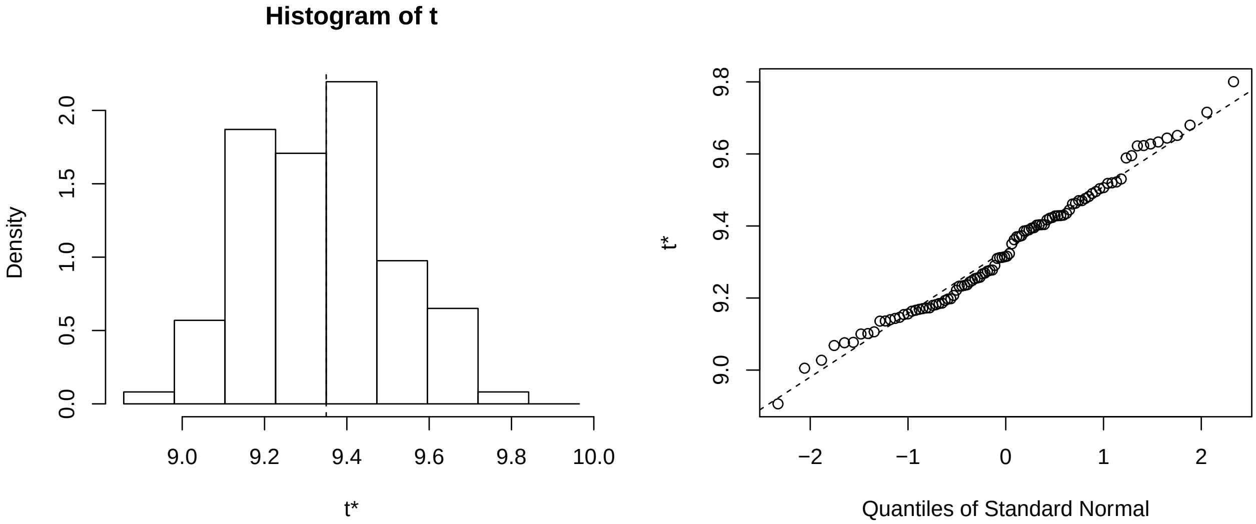



```
#>
#>  One Sample t-test
#>
#> data:  boot100_1$t[, i]
#> t = -8772.1, df = 99, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  0.1712778 0.1846506
#> sample estimates:
#> mean of x
#> 0.1779642
```

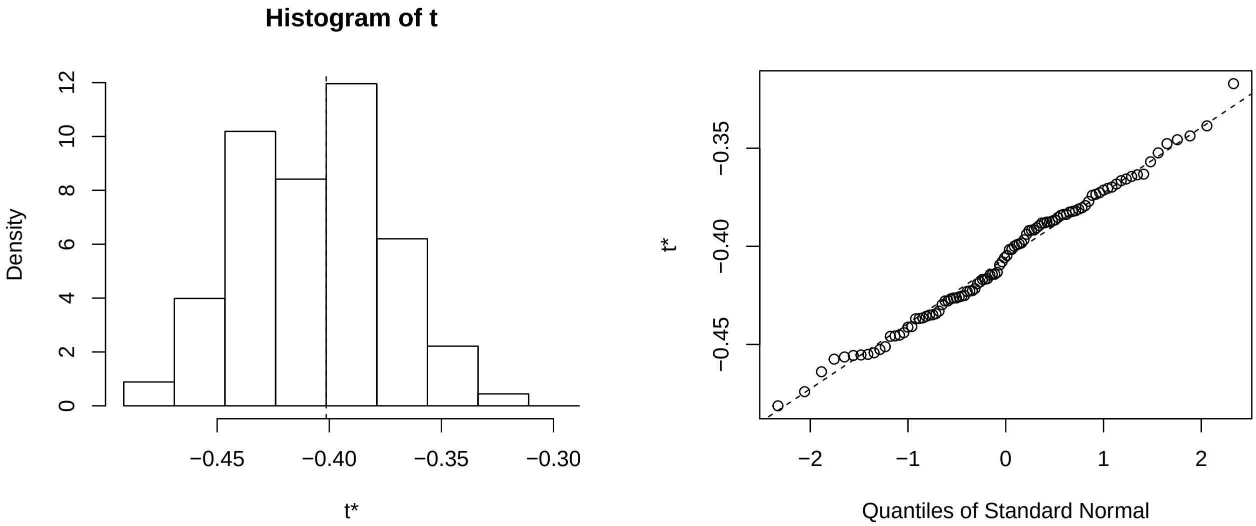



```
#>
#>  One Sample t-test
#>
#> data:  boot100_1$t[, i]
#> t = -232.65, df = 99, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
```

```
#> 95 percent confidence interval:
#>  -6.979361 -6.358339
#> sample estimates:
#> mean of x
#>  -6.66885
```



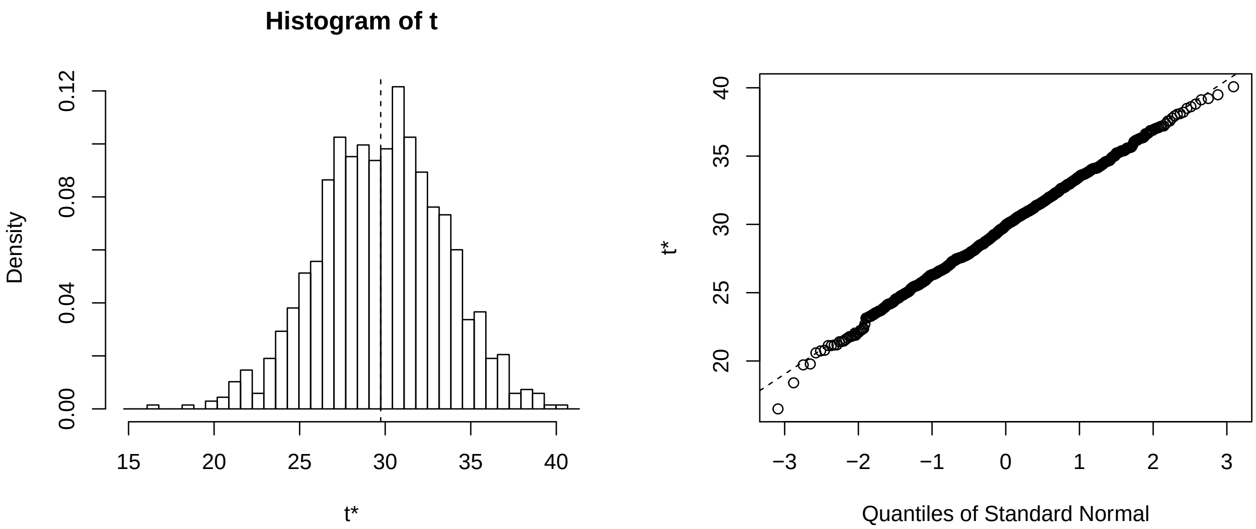

```
#>
#>  One Sample t-test
#>
#> data:  boot100_1$t[, i]
#> t = -1157.2, df = 99, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  9.298257 9.368232
#> sample estimates:
#> mean of x
#>  9.333245
```



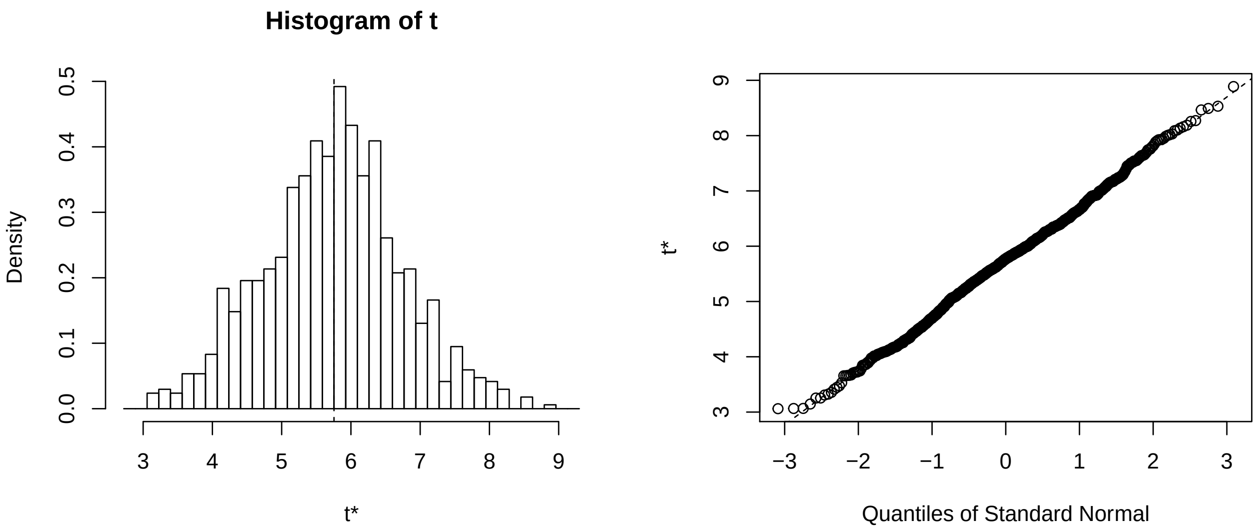

```
#>
#>  One Sample t-test
#>
```

```
#> data:  boot100_1$t[, i]
#> t = -9051.8, df = 99, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  -0.4126399 -0.3994242
#> sample estimates:
#> mean of x
#> -0.406032
```

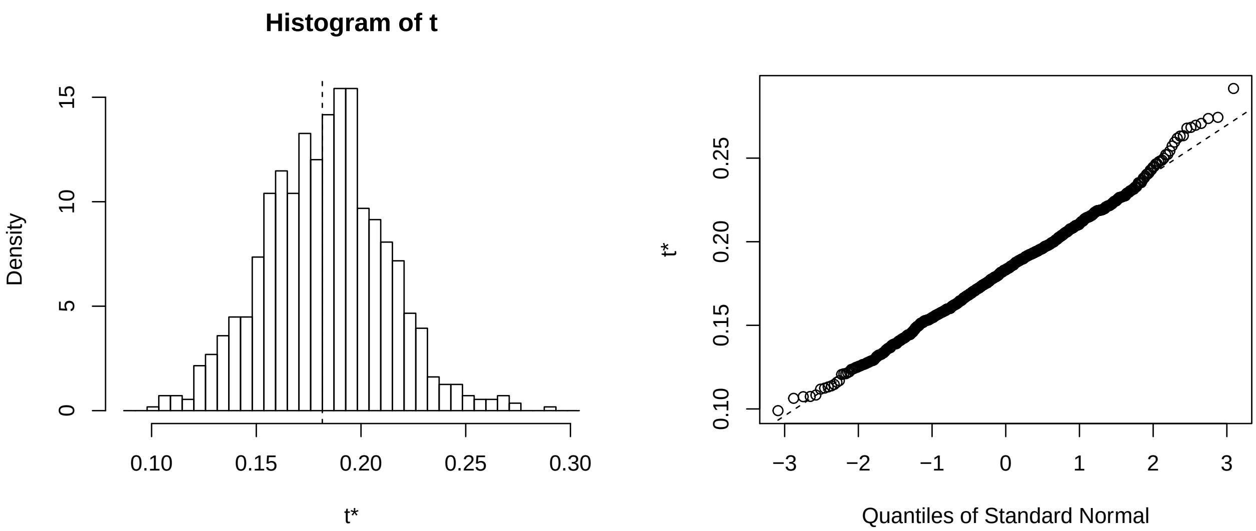
```
boot1000_1 <- boot(data=Donald_1, statistic=theta, R=1000, formula=Trump~.)
par(mfrow=c(1,4))
for (i in 1:6){
plot(boot1000_1, index=i)
print(t.test(boot1000_1$t[,i], mu=vergleich$coefficients[1]))
}
```




```
#>
#>  One Sample t-test
#>
#> data:  boot1000_1$t[, i]
#> t = 0.55418, df = 999, p-value = 0.5796
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  29.57863 30.02377
#> sample estimates:
#> mean of x
#>   29.8012
```

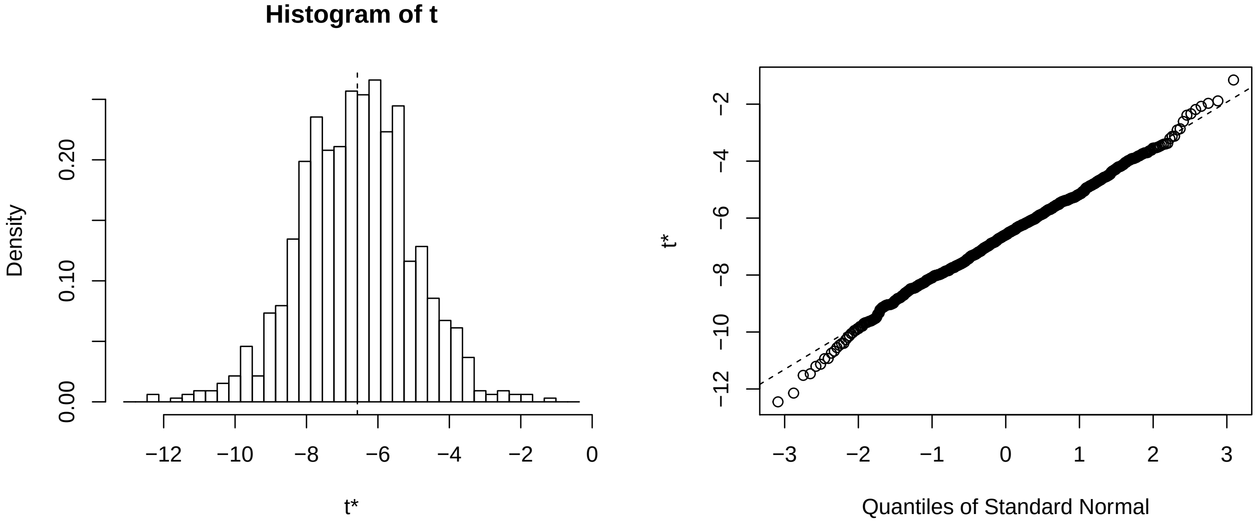



```
#>
#>  One Sample t-test
#>
#> data:  boot1000_1$t[, i]
#> t = -768.21, df = 999, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  5.672561 5.795196
#> sample estimates:
#> mean of x
#>  5.733879
```

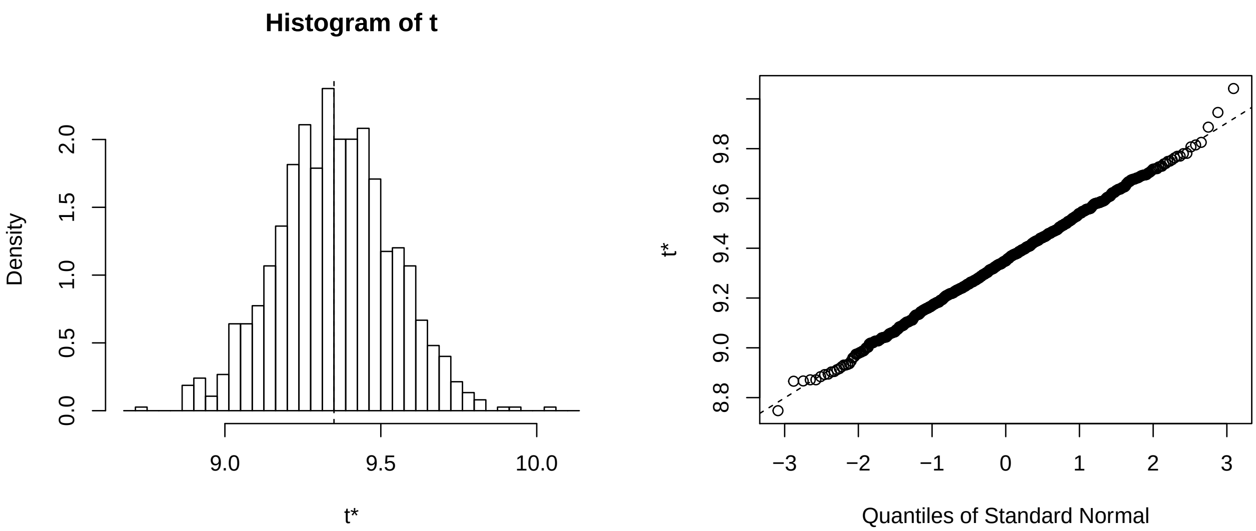



```
#>
#>  One Sample t-test
#>
#> data:  boot1000_1$t[, i]
#> t = -32261, df = 999, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  0.1810316 0.1846272
#> sample estimates:
```

```
#> mean of x
#> 0.1828294
```

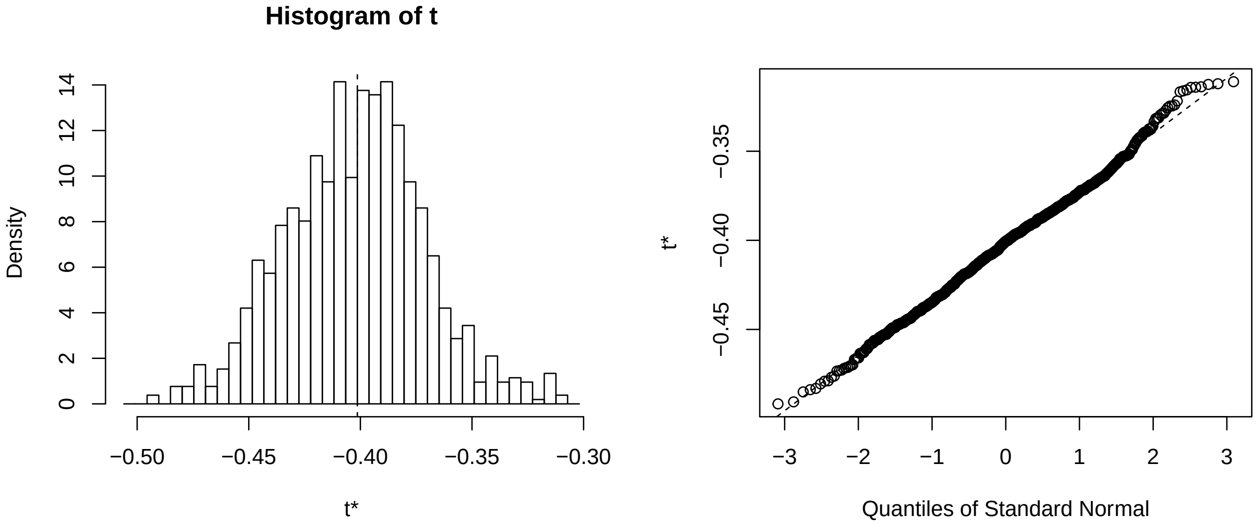



```
#>
#>  One Sample t-test
#>
#> data:  boot1000_1$t[, i]
#> t = -735.23, df = 999, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  -6.715782 -6.521706
#> sample estimates:
#> mean of x
#> -6.618744
```



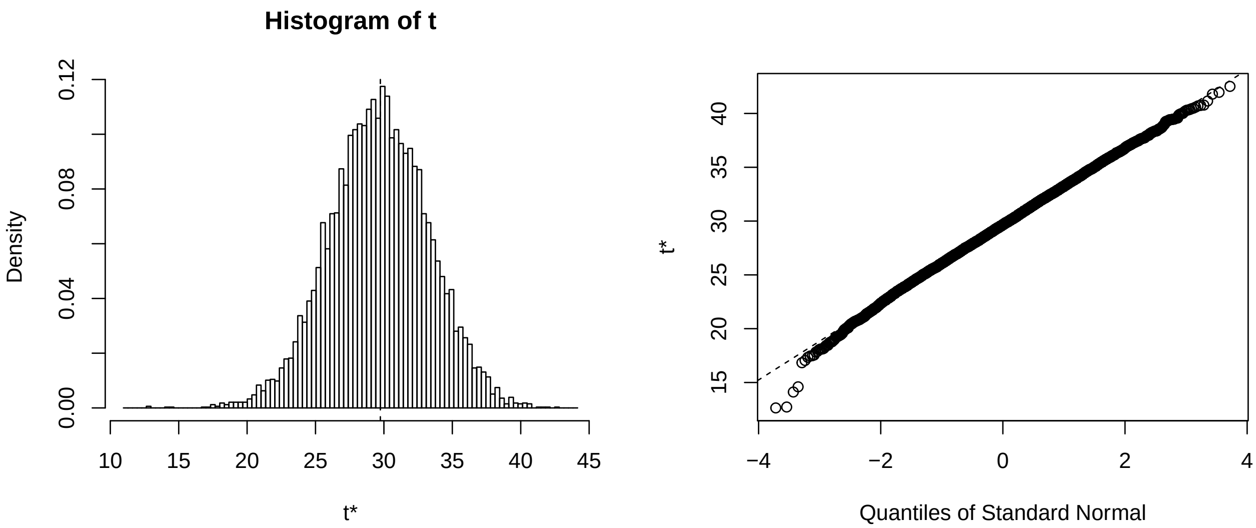

```
#>
#>  One Sample t-test
#>
#> data:  boot1000_1$t[, i]
#> t = -3501.6, df = 999, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
```

```
#> 95 percent confidence interval:
#>  9.339718 9.362569
#> sample estimates:
#> mean of x
#>  9.351143
```

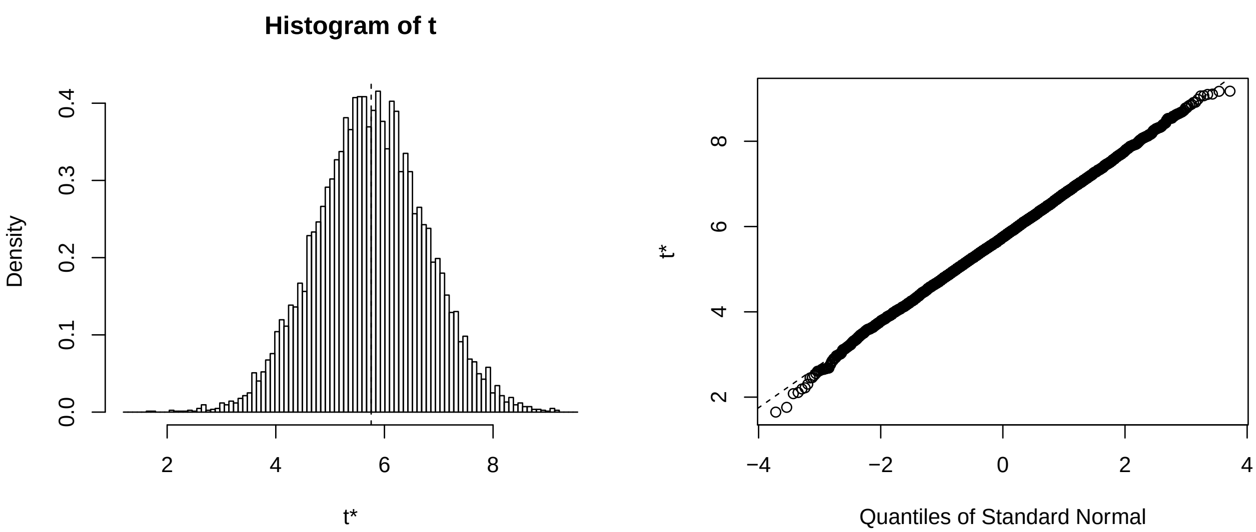



```
#>
#>  One Sample t-test
#>
#> data:  boot1000_1$t[, i]
#> t = -30641, df = 999, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  -0.4042033 -0.4003426
#> sample estimates:
#>  mean of x
#> -0.4022729
```

```
boot10000_1 <- boot(data=Donald_1, statistic=theta, R=10000, formula=Trump~.)
par(mfrow=c(1,4))
for (i in 1:6){
plot(boot10000_1, index=i)
print(t.test(boot10000_1$t[,i], mu=vergleich$coefficients[1]))
}
```

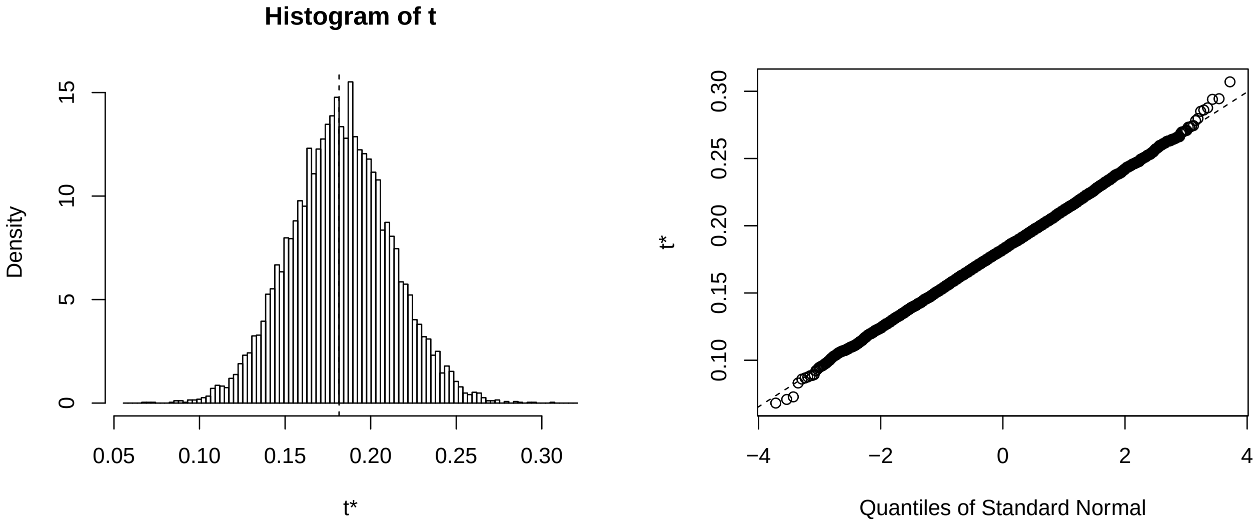



```
#>
#>  One Sample t-test
#>
#> data:  boot10000_1$t[, i]
#> t = -2.4243, df = 9999, p-value = 0.01536
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  29.58034 29.72162
#> sample estimates:
#> mean of x
#>  29.65098
```

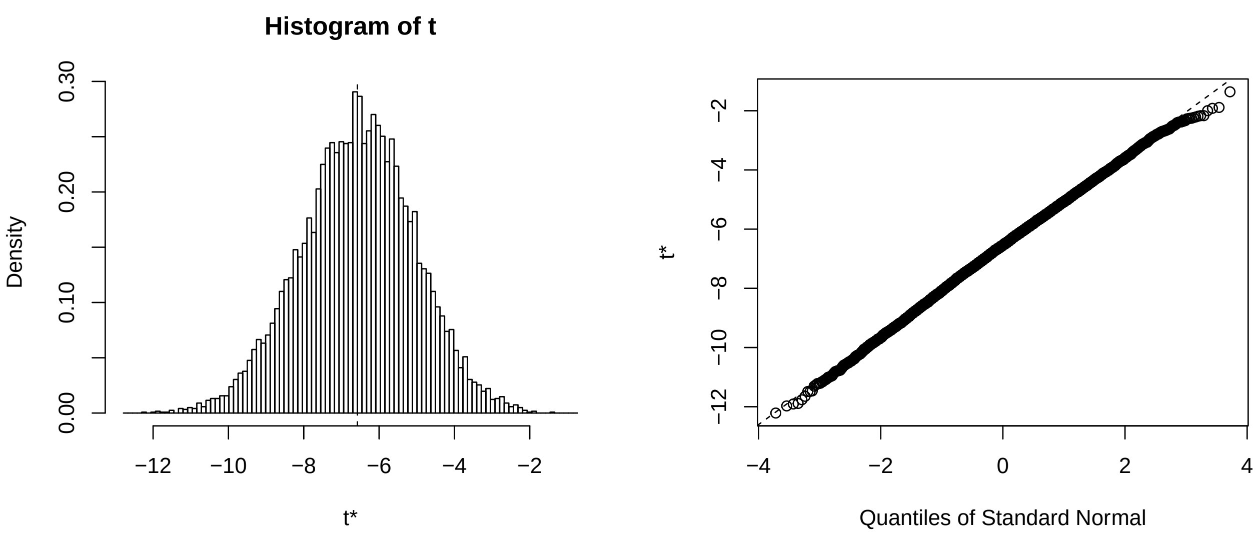



```
#>
#>  One Sample t-test
#>
#> data:  boot10000_1$t[, i]
#> t = -2395.2, df = 9999, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  5.736572 5.775825
#> sample estimates:
```

```
#> mean of x
#>  5.756198
```

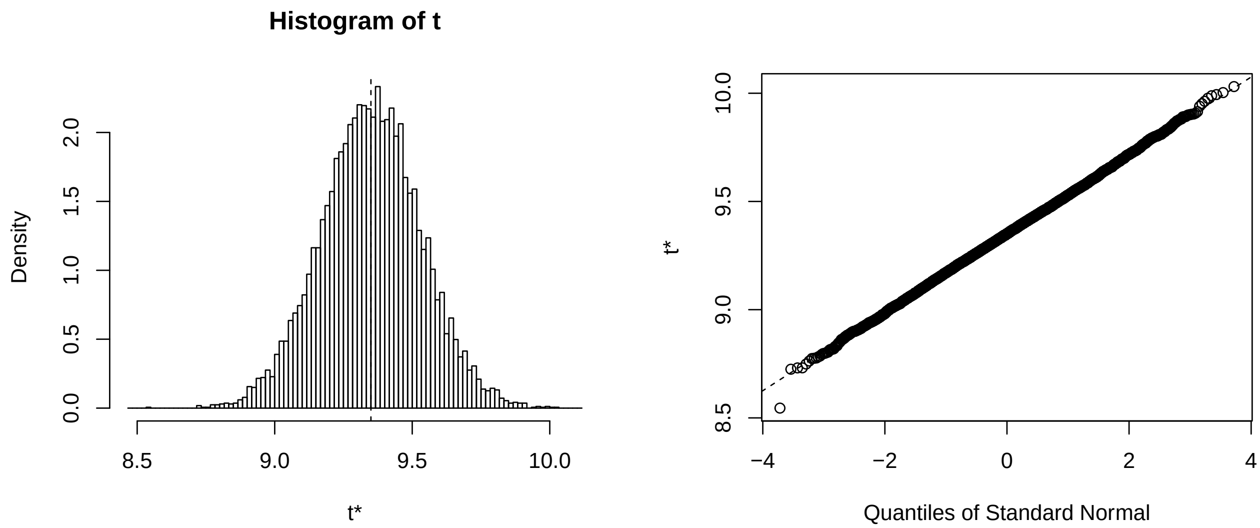



```
#>
#>  One Sample t-test
#>
#> data:  boot10000_1$t[, i]
#> t = -101030, df = 9999, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  0.1818826 0.1830295
#> sample estimates:
#> mean of x
#> 0.1824561
```

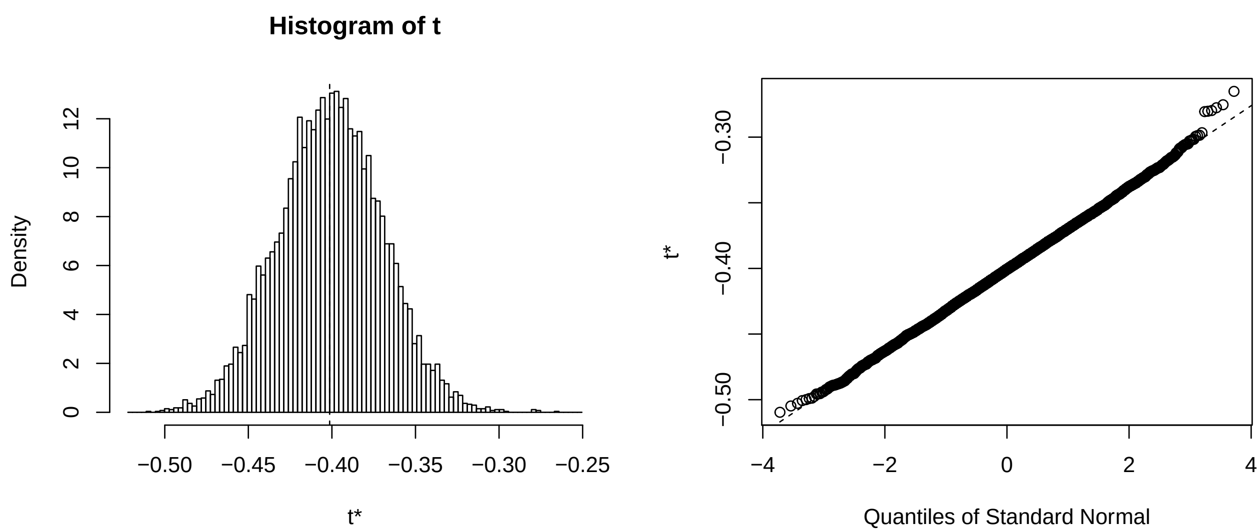



```
#>
#>  One Sample t-test
#>
#> data:  boot10000_1$t[, i]
#> t = -2406.5, df = 9999, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
```

```
#> 95 percent confidence interval:
#>  -6.597539 -6.538394
#> sample estimates:
#> mean of x
#> -6.567966
```




```
#>
#>  One Sample t-test
#>
#> data:  boot10000_1$t[, i]
#> t = -11255, df = 9999, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  9.346706 9.353808
#> sample estimates:
#> mean of x
#>  9.350257
```




```
#>
#>  One Sample t-test
#>
```

```
#> data:  boot10000_1$t[, i]
#> t = -96614, df = 9999, p-value < 2.2e-16
#> alternative hypothesis: true mean is not equal to 29.73834
#> 95 percent confidence interval:
#>  -0.4014698 -0.4002468
#> sample estimates:
#>  mean of x
#> -0.4008583
```

b)

```
Konfi50 <- matrix(NA,6,2)
rownames(Konfi50) <- c("Intercept","Geschlecht","Alter","Minderheit","Fremdenfeindlich","IQ")
colnames(Konfi50) <- c("2,5","97,5")

for(i in 1:6)
{
    Konfi50[i,1] <- boot.ci(boot50_1, type="basic", index = i)$basic[4]
    Konfi50[i,2] <- boot.ci(boot50_1, type="basic", index = i)$basic[5]
}
Konfi100 <- matrix(NA,6,2)
rownames(Konfi100) <- c("Intercept","Geschlecht","Alter","Minderheit","Fremdenfeindlich","IQ")
colnames(Konfi100) <- c("2,5","97,5")

for(i in 1:6)
{
    Konfi100[i,1] <- boot.ci(boot100_1, type="basic", index = i)$basic[4]
    Konfi100[i,2] <- boot.ci(boot100_1, type="basic", index = i)$basic[5]
}
Konfi1000 <- matrix(NA,6,2)
rownames(Konfi1000) <- c("Intercept","Geschlecht","Alter","Minderheit","Fremdenfeindlich","IQ")
colnames(Konfi1000) <- c("2,5","97,5")

for(i in 1:6)
{
    Konfi1000[i,1] <- boot.ci(boot1000_1, type="basic", index = i)$basic[4]
    Konfi1000[i,2] <- boot.ci(boot1000_1, type="basic", index = i)$basic[5]
}
Konfi10000 <- matrix(NA,6,2)
rownames(Konfi10000) <- c("Intercept","Geschlecht","Alter","Minderheit","Fremdenfeindlich","IQ")
colnames(Konfi10000) <- c("2,5","97,5")
for(i in 1:6)
{
    Konfi10000[i,1] <- boot.ci(boot10000_1, type="basic", index = i)$basic[4]
    Konfi10000[i,2] <- boot.ci(boot10000_1, type="basic", index = i)$basic[5]
}
Konfi50
#>                         2,5       97,5
#> Intercept        22.5184241 36.4133808
#> Geschlecht        3.6848169  7.9463833
#> Alter             0.1190041  0.2165262
#> Minderheit       -9.3443496 -3.8251713
#> Fremdenfeindlich  8.9786910  9.9112550
```

```
#> IQ                -0.4605168 -0.3306015
Konfi100
#>                         2,5       97,5
#> Intercept         22.4812933 37.3189333
#> Geschlecht         3.3121834  7.2667820
#> Alter              0.1120515  0.2515150
#> Minderheit        -9.7259934 -3.3638260
#> Fremdenfeindlich   9.0042067  9.6819829
#> IQ                -0.4611898 -0.3343833
Konfi1000
#>                         2,5       97,5
#> Intercept         22.6128829 37.2159550
#> Geschlecht         3.7553528  7.7237071
#> Alter              0.1202946  0.2370037
#> Minderheit        -9.5232719 -3.3502610
#> Fremdenfeindlich   8.9929961  9.7164341
#> IQ                -0.4654710 -0.3394534
Konfi10000
#>                         2,5       97,5
#> Intercept         22.8489632 36.9531461
#> Geschlecht         3.7826102  7.6931125
#> Alter              0.1224300  0.2376156
#> Minderheit        -9.4877229 -3.5712765
#> Fremdenfeindlich   8.9888542  9.7058668
#> IQ                -0.4635636 -0.3408012
```

c)

```
confint(vergleich,level=0.95)
#>                         2.5 %     97.5 %
#> (Intercept)        22.6034487 36.8732397
#> Geschlecht          3.7795957  7.7318438
#> Alter               0.1212600  0.2417933
#> Minderheit        -10.1898944 -2.9618306
#> Fremdenfeindlich    9.0271567  9.6725195
#> IQ                 -0.4609559 -0.3417435
Konfi50
#>                         2,5       97,5
#> Intercept         22.5184241 36.4133808
#> Geschlecht         3.6848169  7.9463833
#> Alter              0.1190041  0.2165262
#> Minderheit        -9.3443496 -3.8251713
#> Fremdenfeindlich   8.9786910  9.9112550
#> IQ                -0.4605168 -0.3306015
Konfi100
#>                         2,5       97,5
#> Intercept         22.4812933 37.3189333
#> Geschlecht         3.3121834  7.2667820
#> Alter              0.1120515  0.2515150
#> Minderheit        -9.7259934 -3.3638260
#> Fremdenfeindlich   9.0042067  9.6819829
#> IQ                -0.4611898 -0.3343833
```

```
Konfi1000
#>                        2,5       97,5
#> Intercept        22.6128829 37.2159550
#> Geschlecht        3.7553528  7.7237071
#> Alter             0.1202946  0.2370037
#> Minderheit       -9.5232719 -3.3502610
#> Fremdenfeindlich  8.9929961  9.7164341
#> IQ               -0.4654710 -0.3394534
Konfi10000
#>                        2,5       97,5
#> Intercept        22.8489632 36.9531461
#> Geschlecht        3.7826102  7.6931125
#> Alter             0.1224300  0.2376156
#> Minderheit       -9.4877229 -3.5712765
#> Fremdenfeindlich  8.9888542  9.7058668
#> IQ               -0.4635636 -0.3408012
```

d)

```
Konfi1000perc <- matrix(NA,6,2)
rownames(Konfi1000perc) <- c("Intercept","Geschlecht","Alter","Minderheit","Fremdenfeindlich","IQ")
colnames(Konfi1000perc) <- c("2,5","97,5")

for(i in 1:6)
{
    Konfi1000perc[i,1] <- boot.ci(boot1000_1, type="perc", index = i)$perc[4]
    Konfi1000perc[i,2] <- boot.ci(boot1000_1, type="perc", index = i)$perc[5]
}

Konfi1000bca <- matrix(NA,6,2)
rownames(Konfi1000bca) <- c("Intercept","Geschlecht","Alter","Minderheit","Fremdenfeindlich","IQ")
colnames(Konfi1000bca) <- c("2,5","97,5")

for(i in 1:6)
{
    Konfi1000bca[i,1] <- boot.ci(boot1000_1, type="bca", index = i)$bca[4]
    Konfi1000bca[i,2] <- boot.ci(boot1000_1, type="bca", index = i)$bca[5]
}

Konfi1000
#>                        2,5       97,5
#> Intercept        22.6128829 37.2159550
#> Geschlecht        3.7553528  7.7237071
#> Alter             0.1202946  0.2370037
#> Minderheit       -9.5232719 -3.3502610
#> Fremdenfeindlich  8.9929961  9.7164341
#> IQ               -0.4654710 -0.3394534
Konfi1000perc
#>                        2,5       97,5
#> Intercept        22.2607334 36.8638055
#> Geschlecht        3.7877324  7.7560868
#> Alter             0.1260496  0.2427587
```

```
#> Minderheit        -9.8014640 -3.6284532
#> Fremdenfeindlich  8.9832421  9.7066801
#> IQ                -0.4632460 -0.3372284
Konfi1000bca
#>                         2,5       97,5
#> Intercept        22.3297795 36.8833535
#> Geschlecht        3.7402325  7.7323257
#> Alter             0.1237283  0.2353549
#> Minderheit       -9.8039293 -3.6347743
#> Fremdenfeindlich  8.9866019  9.7108741
#> IQ               -0.4700202 -0.3414887
```