```r
set.seed(1234)
##Linear Regression
#Generate the independent variable and the error
x1=rnorm(100,2,1)
x2=rpois(100, 4)
error=rnorm(100,0,1)
#Generate the dependent variable
y1=1+(1*x1)+(-2*x2)+error
```

```r
m1=lm(y1~x1+x2)
summary(m1)
```

```
##
## Call:
## lm(formula = y1 ~ x1 + x2)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.3381 -0.5658  0.0122  0.5346  2.8751
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  1.19168    0.36463   3.268   0.0015 **
## x1           0.95508    0.11139   8.574 1.59e-13 ***
## x2          -1.99306    0.06233 -31.976  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.098 on 97 degrees of freedom
## Multiple R-squared:  0.9264, Adjusted R-squared:  0.9248
## F-statistic:   610 on 2 and 97 DF,  p-value: < 2.2e-16
```

```r
vcov(m1, complete = TRUE)
```

```
##             (Intercept)           x1           x2
## (Intercept)  0.13295197 -0.027453594 -0.017617790
## x1          -0.02745359  0.012408167  0.001148468
## x2          -0.01761779  0.001148468  0.003884935
```

```r
x1=rnorm(100,2,6)
x2=rpois(100, 4)
error=rnorm(100,0,1)
y2=1+(1*x1)+(-2*x2)+error
m2=lm(y2~x1+x2)
summary(m2)
```

```
##
## Call:
## lm(formula = y2 ~ x1 + x2)
##
## Residuals:
```

```
##     Min      1Q  Median      3Q     Max
## -2.7220 -0.8371 -0.0038  0.7088  3.2342
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  0.92849    0.24110   3.851 0.000211 ***
## x1           1.00389    0.02102  47.766  < 2e-16 ***
## x2          -1.98961    0.05160 -38.560  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.128 on 97 degrees of freedom
## Multiple R-squared:  0.9775, Adjusted R-squared:  0.977
## F-statistic:  2108 on 2 and 97 DF,  p-value: < 2.2e-16
```

```r
vcov(m2, complete = TRUE)
```

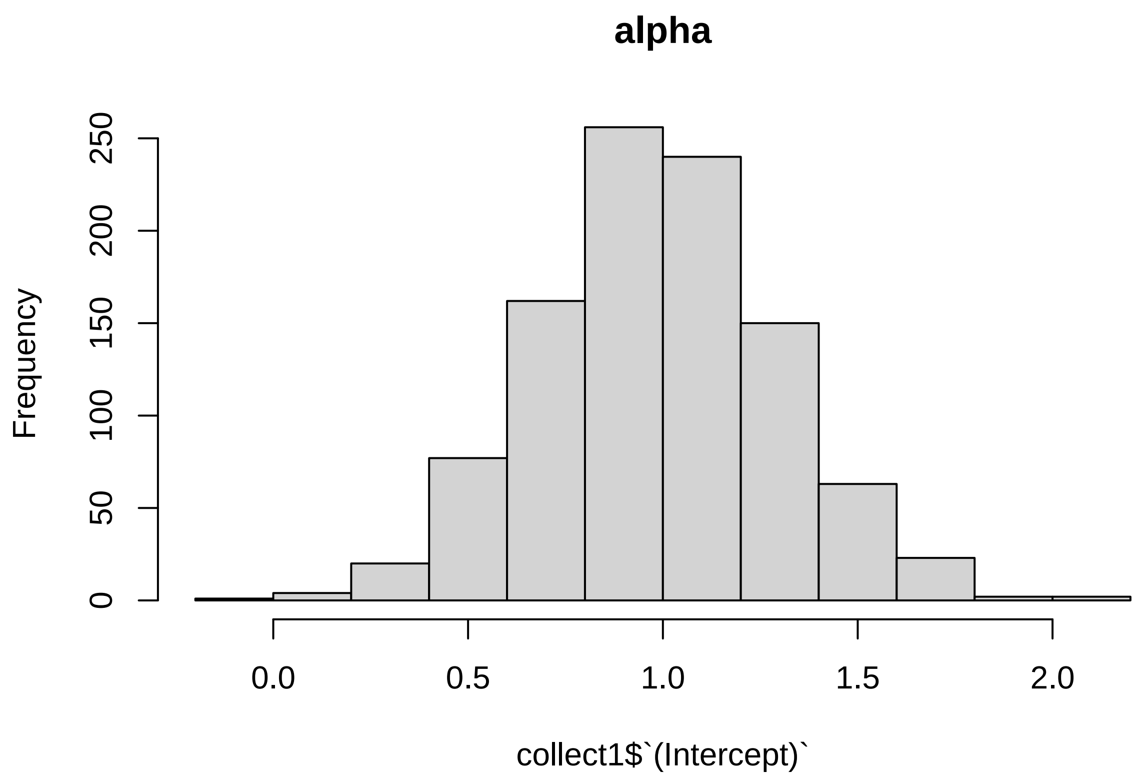
```
##              (Intercept)            x1            x2
## (Intercept)  0.058127527 -0.0014828925 -0.0107077759
## x1          -0.001482893  0.0004417108  0.0001172626
## x2          -0.010707776  0.0001172626  0.0026622799
```

Comparing the result in 2 and 3, we can find that both the variance and covariance are smaller. This result is not surprising because the limiting distribution of $\sqrt{n}(\hat{\beta}-\beta)$ is $N(0,\sigma_e^2 E(X_i X_i')^{-1})$

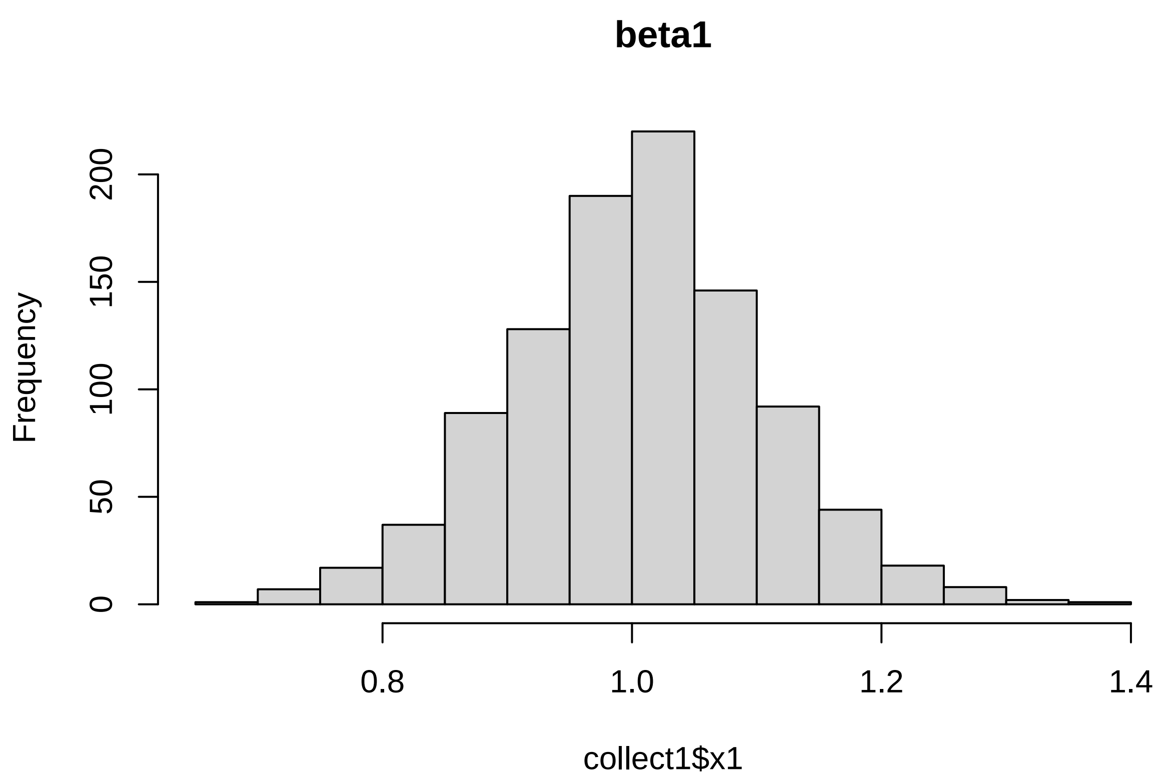
```r
collect1 <- data.frame(aalpha = numeric(0), bbeta1 = numeric(0), bbeta2 = numeric(0))
for(i in c(1:1000)){
  x1=rnorm(100,2,1)
  x2=rpois(100, 4)
  error=rnorm(100,0,1)
  #Generate the dependent variable
  y1=1+(1*x1)+(-2*x2)+error
  #create the model
  m1=lm(y1~x1+x2)
  dataframe_coef <- as.data.frame(summary(m1)$coefficients[ , 1])
  dataframe_coef =  t(dataframe_coef)
  collect1 <- rbind(collect1,dataframe_coef)
}
```

The limiting distribution of $\sqrt{n}(\hat{\beta} - \beta)$ is $N(0, \sigma_e^2 E(X_i X_i')^{-1})$.
The following figures show that they will be the distribution expected.

```
hist(collect1$`(Intercept)`,main = "alpha")
```



```
hist(collect1$x1,main = "beta1")
```



```r
hist(collect1$x2,main = "beta2")
```