12.

(a)

In the equation(3.38), the slope of the linear model is：

The coefficients of the two models are same when sum of square of the x is equal to the sum of the square of y.

(b)

set.seed(1)  
x=sample(seq(1,50.5,0.1),100)  
y=5\*x  
m1=lm(y~x+0)  
m2=lm(x~y+0)  
summary(m1)

## Warning in summary.lm(m1): essentially perfect fit: summary may be  
## unreliable

##   
## Call:  
## lm(formula = y ~ x + 0)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -3.167e-14 -2.355e-15 -1.380e-15 -3.510e-16 2.626e-14   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## x 5.000e+00 3.757e-17 1.331e+17 <2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 1.115e-14 on 99 degrees of freedom  
## Multiple R-squared: 1, Adjusted R-squared: 1   
## F-statistic: 1.771e+34 on 1 and 99 DF, p-value: < 2.2e-16

summary(m2)

## Warning in summary.lm(m2): essentially perfect fit: summary may be  
## unreliable

##   
## Call:  
## lm(formula = x ~ y + 0)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -7.179e-15 -1.561e-15 -3.000e-17 6.770e-16 1.178e-13   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## y 2.000e-01 8.139e-18 2.457e+16 <2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 1.208e-14 on 99 degrees of freedom  
## Multiple R-squared: 1, Adjusted R-squared: 1   
## F-statistic: 6.038e+32 on 1 and 99 DF, p-value: < 2.2e-16

(c)

x2=c(1:100)  
y2=sample(x2,100)  
isTRUE(sum(x2^2)==sum(y2^2))

## [1] TRUE

fi=lm(y2~x2+0)  
fi2=lm(x2~y2+0)  
summary(fi)

##   
## Call:  
## lm(formula = y2 ~ x2 + 0)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -68.901 -9.913 12.768 35.991 93.993   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## x2 0.75163 0.06629 11.34 <2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 38.56 on 99 degrees of freedom  
## Multiple R-squared: 0.5649, Adjusted R-squared: 0.5605   
## F-statistic: 128.6 on 1 and 99 DF, p-value: < 2.2e-16

summary(fi2)

##   
## Call:  
## lm(formula = x2 ~ y2 + 0)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -68.91 -11.43 15.19 36.21 94.24   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## y2 0.75163 0.06629 11.34 <2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 38.56 on 99 degrees of freedom  
## Multiple R-squared: 0.5649, Adjusted R-squared: 0.5605   
## F-statistic: 128.6 on 1 and 99 DF, p-value: < 2.2e-16