Regression Models - Quiz 02

Utkarsh Ashok Pathrabe

Quiz 02

Attempts	Score
1/3	10/10

Question 01

Consider the following data with x as the predictor and y as as the outcome.

```
x <- c(0.61, 0.93, 0.83, 0.35, 0.54, 0.16, 0.91, 0.62, 0.62)
y <- c(0.67, 0.84, 0.6, 0.18, 0.85, 0.47, 1.1, 0.65, 0.36)
```

Give a P-value for the two sided hypothesis test of whether β_1 from a linear regression model is 0 or not.

Answer

0.05296

Explanation

```
f <- lm(y ~ x)
summary(f)
```

```
##
## Call:
## lm(formula = y ~ x)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.27636 -0.18807  0.01364  0.16595  0.27143
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   0.1885     0.2061   0.914    0.391
## x             0.7224     0.3107   2.325    0.053 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.223 on 7 degrees of freedom
## Multiple R-squared:  0.4358, Adjusted R-squared:  0.3552
## F-statistic: 5.408 on 1 and 7 DF,  p-value: 0.05296
```

Question 02

Consider the previous problem, give the estimate of the residual standard deviation.

Answer

0.223

Explanation

```r
summary(f)
```

```
##
## Call:
## lm(formula = y ~ x)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.27636 -0.18807  0.01364  0.16595  0.27143
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   0.1885     0.2061   0.914    0.391
## x             0.7224     0.3107   2.325    0.053 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.223 on 7 degrees of freedom
## Multiple R-squared:  0.4358, Adjusted R-squared:  0.3552
## F-statistic: 5.408 on 1 and 7 DF,  p-value: 0.05296
```

Question 03

In the `mtcars` data set, fit a linear regression model of weight (predictor) on mpg (outcome). Get a 95% confidence interval for the expected mpg at the average weight. What is the lower endpoint?

Answer

18.991

Explanation

```r
data(mtcars)
x <- mtcars$wt
y <- mtcars$mpg
fit <- lm(y ~ x)
predict(fit, data.frame(x = mean(x)), interval = "confidence")
```

```
##        fit      lwr      upr
## 1 20.09062 18.99098 21.19027
```

Question 04

Refer to the previous question. Read the help file for `mtcars`. What is the weight coefficient interpreted as?

Answer

The estimated expected change in mpg per 1,000 lb increase in weight.

Explanation

```
help(mtcars)
```

Question 05

Consider again the `mtcars` data set and a linear regression model with mpg as predicted by weight (1,000 lbs). A new car is coming weighing 3000 pounds. Construct a 95% prediction interval for its mpg. What is the upper endpoint?

Answer

27.57

Explanation

```
predict(fit, data.frame(x = mean(3)), interval = "prediction")
```

```
##        fit      lwr      upr
## 1 21.25171 14.92987 27.57355
```

Question 06

Consider again the `mtcars` data set and a linear regression model with mpg as predicted by weight (in 1,000 lbs). A "short" ton is defined as 2,000 lbs. Construct a 95% confidence interval for the expected change in mpg per 1 short ton increase in weight. Give the lower endpoint.

Answer

-12.973

Explanation

```
fit2 <- lm(y ~ I(x / 2))
tbl2 <- summary(fit2)$coefficients
mean <- tbl2[2,1]
se <- tbl2[2,2]
df <- fit2$df
#Two sides T-Test
mean + c(-1,1) * qt(0.975, df = df) * se
```

```
## [1] -12.97262  -8.40527
```

Question 07

If my X from a linear regression is measured in centimeters and I convert it to meters what would happen to the slope coefficient?

Answer

It would get multiplied by 100.

Explanation

```
summary(fit)$coefficients[2, 1]
```

```
## [1] -5.344472
```

```
fit3 <- lm(y ~ I(x / 100))
summary(fit3)$coefficients[2, 1]
```

```
## [1] -534.4472
```

Question 08

I have an outcome, Y, and a predictor, X and fit a linear regression model with $Y = \beta_0 + \beta_1 X + \epsilon$ to obtain $\hat{\beta}_0$ and $\hat{\beta}_1$. What would be the consequence to the subsequent slope and intercept if I were to refit the model with a new regressor, $X + c$ for some constant, c?

Answer

The new intercept would be $\hat{\beta}_0 - c\hat{\beta}_1$.

Question 09

Refer back to the mtcars data set with mpg as an outcome and weight (wt) as the predictor. About what is the ratio of the the sum of the squared errors, $\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2$ when comparing a model with just an intercept (denominator) to the model with the intercept and slope (numerator)?

Answer

0.25

Explanation

```
fitRes <- fit$residuals ^ 2
fitIntercept <- lm(mpg ~ 1, mtcars)
fitInterceptRes <- fitIntercept$residuals ^ 2
sum(fitRes) /sum(fitInterceptRes)
```

```
## [1] 0.2471672
```

Question 10

Do the residuals always have to sum to 0 in linear regression?

Answer

If an intercept is included, then they will sum to 0.