A3Q3

Akash Gupta

2023-10-27

Problem 1.

```r
#Define the values of the predictor variables X1, X2
X1 <- c(-1,-1,0,1,1)
X2 <- c(-1,0,0,0,1)
#Define the dependent variables
Y <- c(7.2, 8.1, 9.8, 12.3, 12.9)

#Now we have to test the hypothesis H0: beta1 = 2*beta2 vs beta1 != 2*beta2
#The new equation would be Y = beta0 + 2*X1*beta2 + X2*beta2 + epsilon
# Y = beta0 + (2*X1 + X2)beta2 + epsilon
#Z = (1, 2*X1 + X2)

Z <- matrix(c(1,1,1,1,1,-3,-2,0,-2,-3), ncol = 2)

#Solving the alpha
alpha <- solve(t(Z) %*% Z) %*% (t(Z) %*% Y)
alpha
```

```
##             [,1]
## [1,]  9.89333333
## [2,] -0.08333333
```

```r
#Calculating the value of new Sum of squared of errors
SSE_new <- t(Y)%*%Y - (t(alpha)%*%t(Z))%*%Y
SSE_new
```

```
##          [,1]
## [1,] 25.13033
```

```r
#Sum of square of errors given
SSE <- 0.107

#Dof is defined in the question and there is only one restriction hence q = 1
p <- 2
q <- 1
n <- 5

#Calculating the F-test
F_test_stat <- ((SSE_new - SSE) / q) / (SSE / (n - p - 1))
F_test_stat
```

```
##          [,1]
## [1,] 467.7259
```

```r
# Setting significance level
alpha_level <- 0.05

# Calculate critical value
critical_value <- qf(1 - alpha_level, q, n - p - 1, lower.tail = FALSE)
critical_value
```

```
## [1] 0.005012531
```

```r
#Printing the result
if (F_test_stat > critical_value) { cat("Reject the null hypothesis")
} else {
  cat("Do not reject the null hypothesis")
}
```

```
## Reject the null hypothesis
```

```r
#Hence reject the null Hypothesis
```