

Q3

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Assignment 2: Question 3

```
# Only change this following line, remove 261 and put your student id
student_id=1001145664
# do not change anything below
set.seed(student_id)
Group1= round(rnorm(15,mean=10,sd=4),2)
Group2= round(rnorm(12,mean=7,sd=4),2)
```

A) Fit a least square regression line and calculate the intercept and the slope.

- $\bar{x} = 0.5555556$
- $\bar{y} = 7.665185$
- $\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y}) = 39.06222$
- $\sum_{i=1}^n (x_i - \bar{x})^2 = 6.666667$
- $b_2 = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sum_{i=1}^n (x_i - \bar{x})^2} = \frac{39.06222}{6.666667} = 5.859333$
- $b_1 = \bar{y} - b_2 \bar{x} = 7.665185 - 5.859333 * 0.5555556 = 4.41$
- $y = 4.41 + 5.859333x$

```
y=c(Group1,Group2)
x=c(rep(1,length(Group1)),rep(0,length(Group2)))
cbind(y,x)
```

```
##           y x
## [1,] 11.98 1
## [2,] 17.87 1
## [3,] 13.14 1
## [4,]  9.82 1
## [5,] 10.40 1
## [6,]  9.37 1
## [7,] 13.22 1
## [8,] 10.08 1
## [9,]  5.29 1
## [10,]  7.88 1
## [11,]  5.86 1
## [12,]  9.88 1
## [13,] 14.02 1
## [14,]  8.94 1
## [15,]  6.29 1
## [16,]  3.61 0
## [17,]  7.28 0
## [18,]  1.30 0
## [19,]  2.96 0
## [20,] -0.20 0
## [21,] -0.06 0
## [22,] 12.81 0
## [23,]  8.47 0
## [24,] -7.25 0
## [25,]  6.17 0
## [26,]  9.56 0
## [27,]  8.27 0
```

```
b2 = sum((x-mean(x))*(y-mean(y))) / sum((x-mean(x))^2)
b1 = mean(y) - b2 * mean(x)
```

```
b1
```

```
## [1] 4.41
```

```
b2
```

```
## [1] 5.859333
```

B) At 5% level of significance, test that the true slope parameter is zero

- $CriticalValue = t_{1-\alpha/2, df} = t_{0.975, 25} = qt(0.975, df = 25) = 2.059539$
- $SE(B_2) = \sqrt{\frac{S^2}{\sum_{i=1}^n (x_i - \bar{x})^2}} = 1.714427$
- $B_2 = 5.859333$

$$\bullet T = \frac{B_2 - \beta_2}{\sqrt{\frac{s^2}{\sum_{i=1}^n (x_i - \bar{x})^2}}} = \frac{5.859333 - 0}{1.714427} = 3.417663$$

```
y_pred = 4.41 + 5.859333*x
df = length(Group1) + length(Group2) - 2
S2 = sum((y-y_pred)^2)/df
SE_B2 = sqrt(S2/sum((x-mean(x))^2))
SE_B2
```

```
## [1] 1.714427
```

```
testStatistic = b2 / SE_B2
testStatistic
```

```
## [1] 3.417662
```

From our calculation, we see that the the test statistic is 3.417662, which is greater than the critical value of 2.05953.

Therefore, we reject the null hypothesis $H_0 : \beta_2 = 0$

C) Match your answer from part (b) to your answers from Question 2. Describe briefly any similarity that you see.

- We see that the level of significance, critical value, and the test statistic are identical in both Q2 part A, ii and Q3 part b.
- Which indicates there is a equal correlationship between true slope parameter and the true mean.