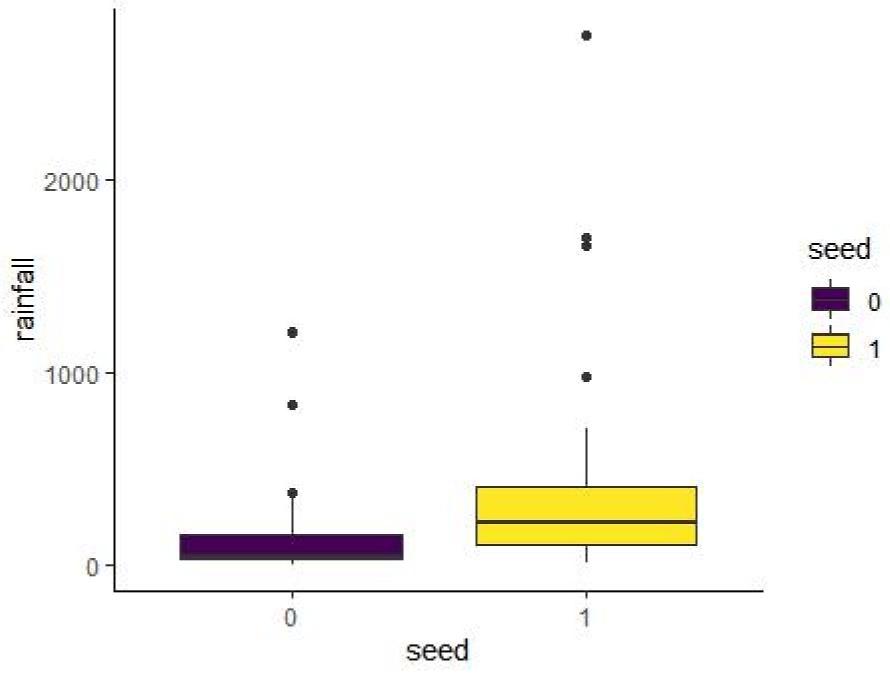
Assignment 03

1. Cloud Seeding

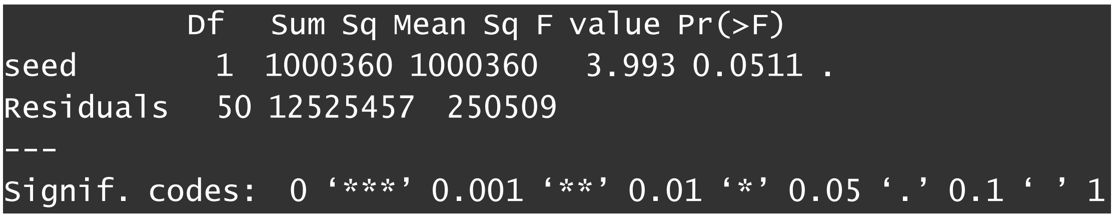
1.1 [5 points] Plot two box plots side-by-side of data from the two groups. Describe the distributions.

Answer: The second box has more dispersion degree than first box.



1.2 [5 points] Did cloud seeding have an effect on rainfall in this experiment? If so, how much?

Answer: According the result of anova, we find cloud seeing don't have significant effect on rainfall in this experiment (Pvalue>0.05)



```
            Df   Sum Sq Mean Sq F value Pr(>F)
seed         1  1000360 1000360   3.993 0.0511 .
Residuals   50 12525457  250509
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

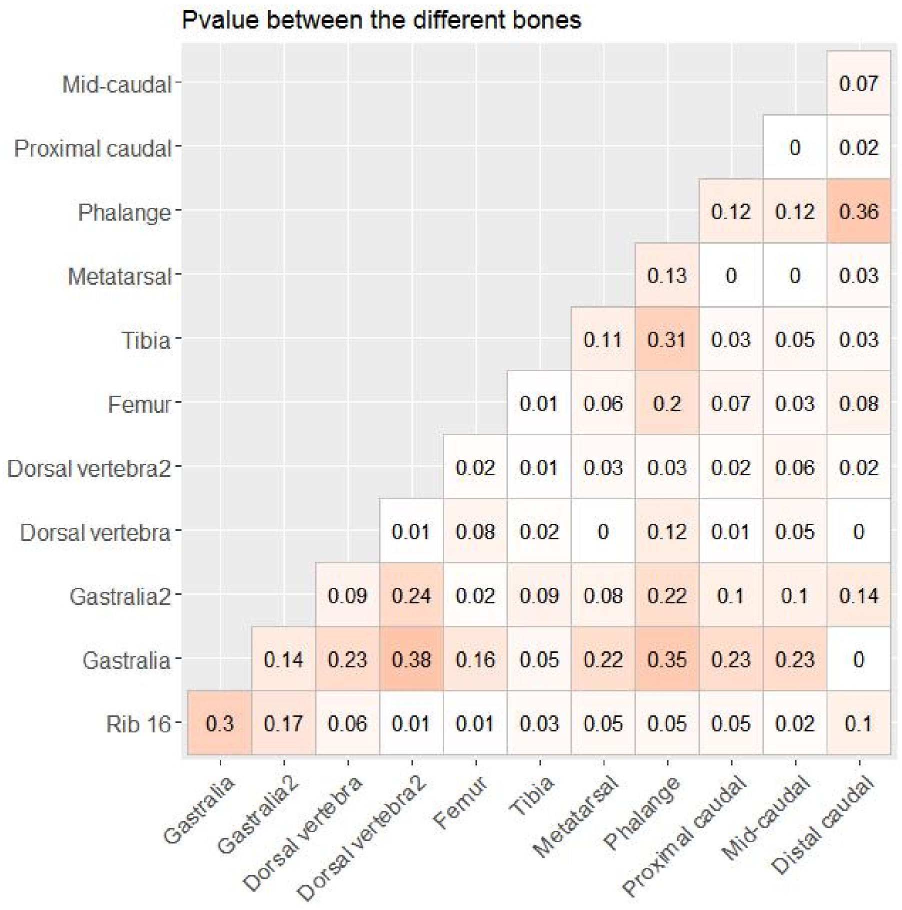
2. Was Tyrannosaurus Rex Warm-Blooded?

[10 points] Is there evidence that the means are different for the different bones? Does the dataset support Tyrannosaurus Rex is warm-blooded or not?

Answer2:

1, Yes, we can see the Pvalue from the Figure, the Pvalue between most two bone are less than 0.05.

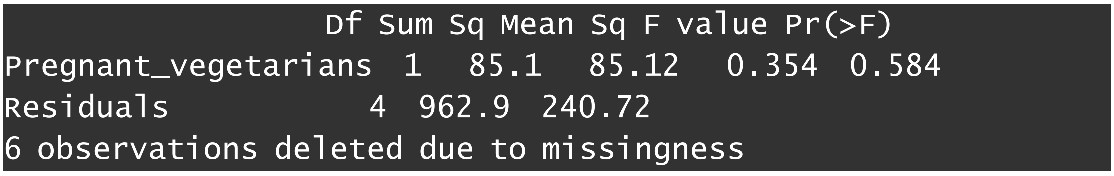
2, No, From the figure, we can draw a conclusion that different bones still have difference.



3. Vegetarians and Zinc

[10 points] What evidence is there that pregnant vegetarians tend to have lower zinc levels than pregnant nonvegetarians?

Answer3: No, according the pvalue of anova with pregnant vegetarians and pregnant nonvegetarians, they don't have significant(Pvalue=0.584) , so we think there no evidence can prove that pregnant vegetarians tend to have lower zinc levels than pregnant nonvegetarians.



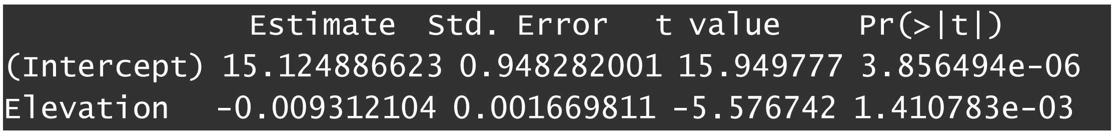
```
                       Df Sum Sq Mean Sq F value Pr(>F)
Pregnant_vegetarians  1   85.1   85.12   0.354  0.584
Residuals             4  962.9  240.72
6 observations deleted due to missingness
```

4. Atmospheric Lapse Rate

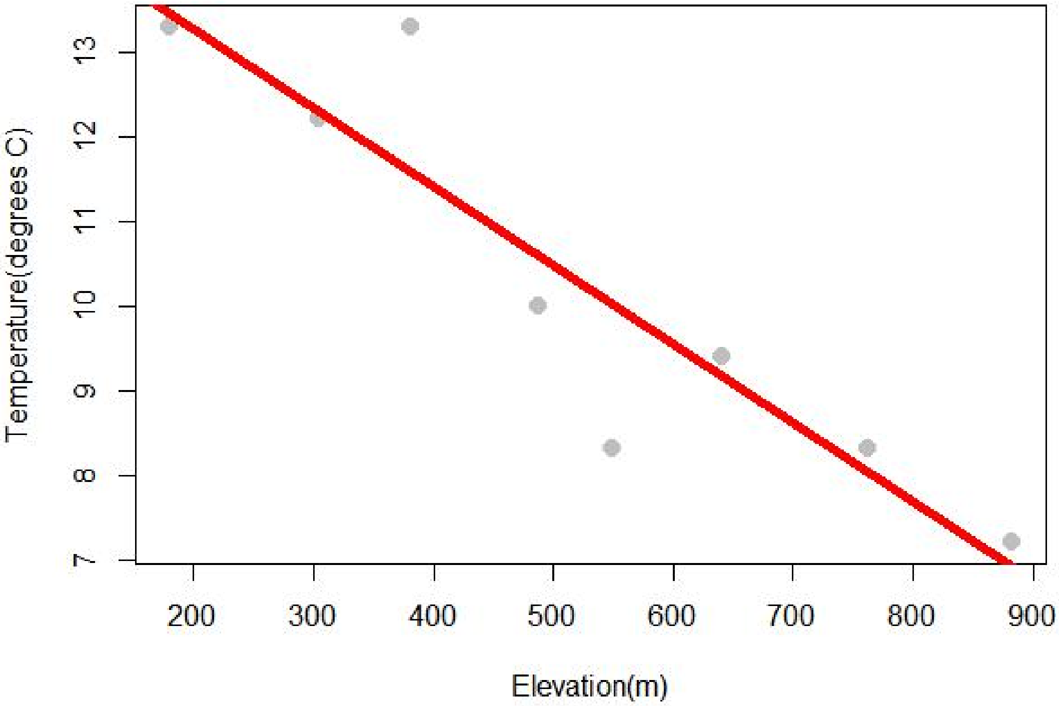
[15 points] Draw a scatter plot with regression line, and investigate if the lapse rate is 9.8 degrees C km^{-1}.

Answer4:

From the function " summary(fit)$coefficients", we find that : The lapse rate is 9.312degrees C km^{-1}, there is a bit different with 9.8 degrees C km^{-1}



```
                Estimate  Std. Error   t value     Pr(>|t|)
(Intercept) 15.124886623 0.948282001 15.949777 3.856494e-06
Elevation   -0.009312104 0.001669811 -5.576742 1.410783e-03
```

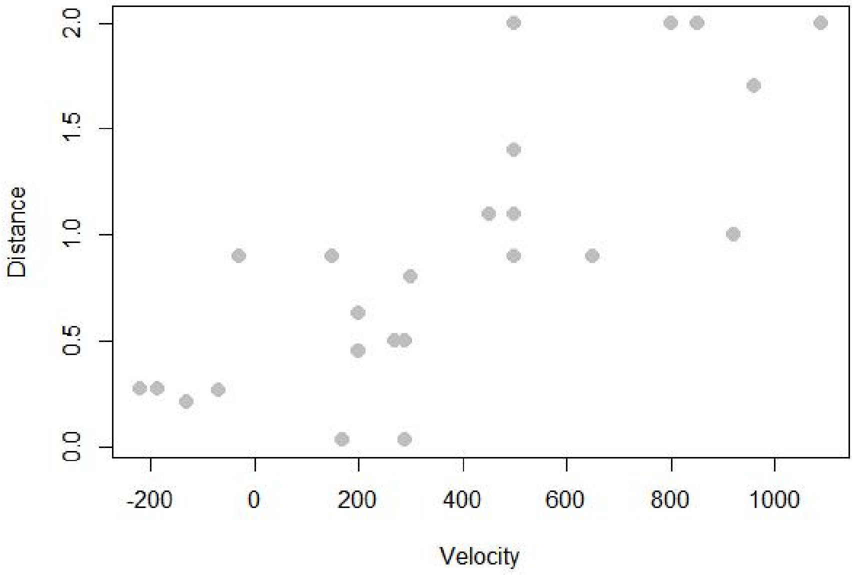


5. The Big Bang Theory

5.1 [5 points] Make a scatter plot with distance as the Y-axis and recession velocity as the X-axis. Describe what you see.

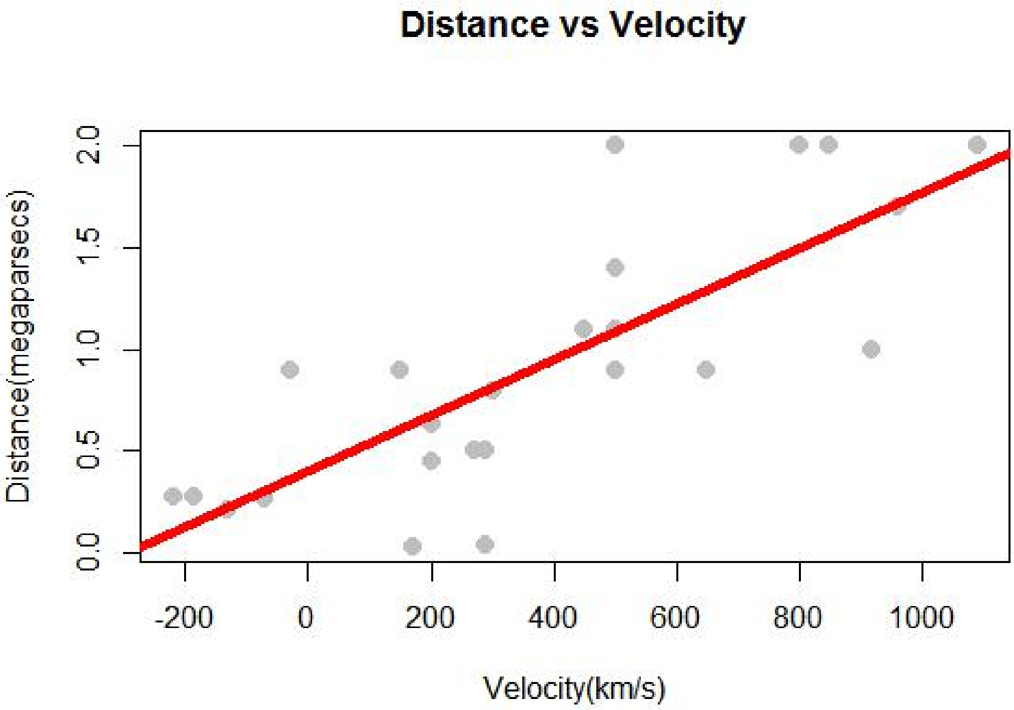
Answer5.1:

There many outliers distribute around the regression line, so I can't find the obvious tendency of distance and velocity.



5.2 [5 points] Add a simple linear regression line to the above scatter plot.

Answer5.2:



5.3 [15 points] If Hubble's *Big Bang Theory* is correct, explain why the following two assumptions about the regression line you made in 5.2 need to be true:

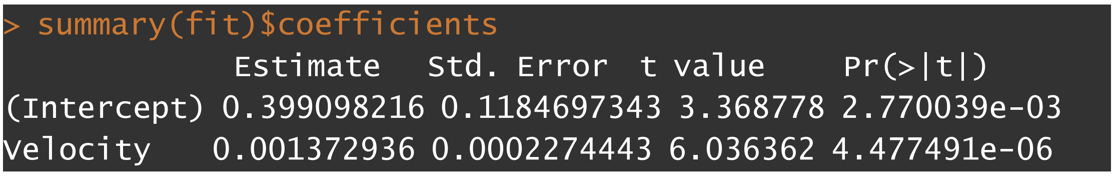
- The intercept should be zero
- And the slope is the age of the universe

Address the first assumption with your regression results; and estimate the age of the universe.

Answer5.3:

1) Because universe is come from the exploded of singular point according to Hubble's Big Bang Theory, so the Distance must be zero at the beginning, which is the intercept.

2) According to the assumption of "And the slope is the age of the universe", so the age of universe equal to the slope, which can be calculated by: 30.9 * 10^6 *10^{12} = 3.09 * 10^{19} (S) , 3.09 * 10^{19} / (60 * 60 * 24 * 365) * 0.001372936 =~ 1.35 billion years. The age of the universe is about : 1.35 billion years



```
> summary(fit)$coefficients
               Estimate   Std. Error  t value     Pr(>|t|)
(Intercept) 0.399098216 0.1184697343 3.368778 2.770039e-03
Velocity    0.001372936 0.0002274443 6.036362 4.477491e-06
```

5.4 [5 points] Explain why improved measurement of distance would lead to more precise estimates of the regression coefficients.

Answer5.4:

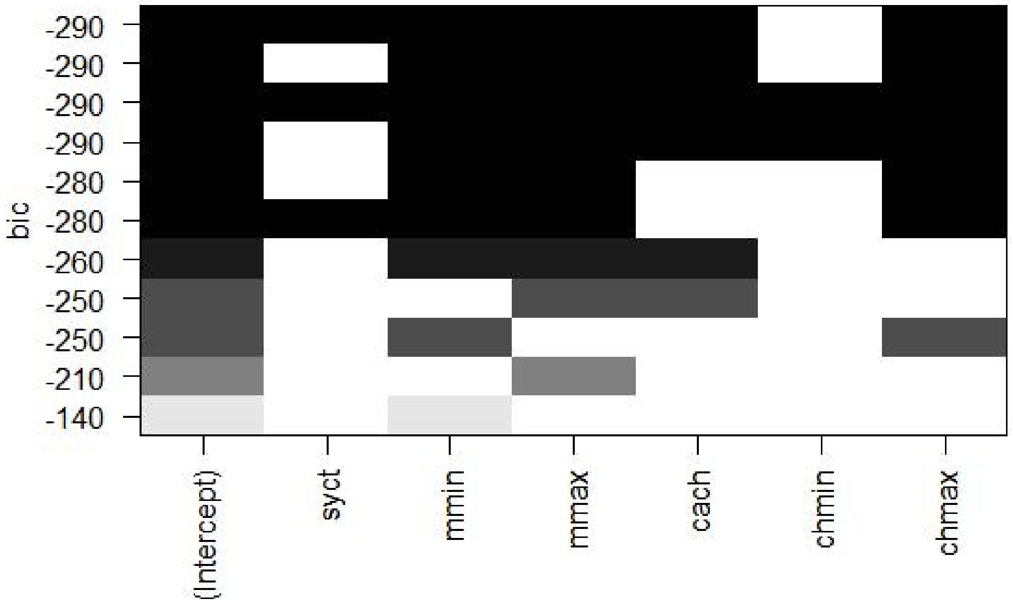
Because the improved measurement of distance are closed to the true value, so the model , which used the improved measurement of distance will fit better than before, so lead to more precise estimates of the regression coefficients.

6. CPU Performance

6.1 [5 points] For the train set, fit the best subset regression between predictor variable `perf` and response variables including `syct`, `mmin`, `mmax`, `cach`, `chmin`, and `chmax`.

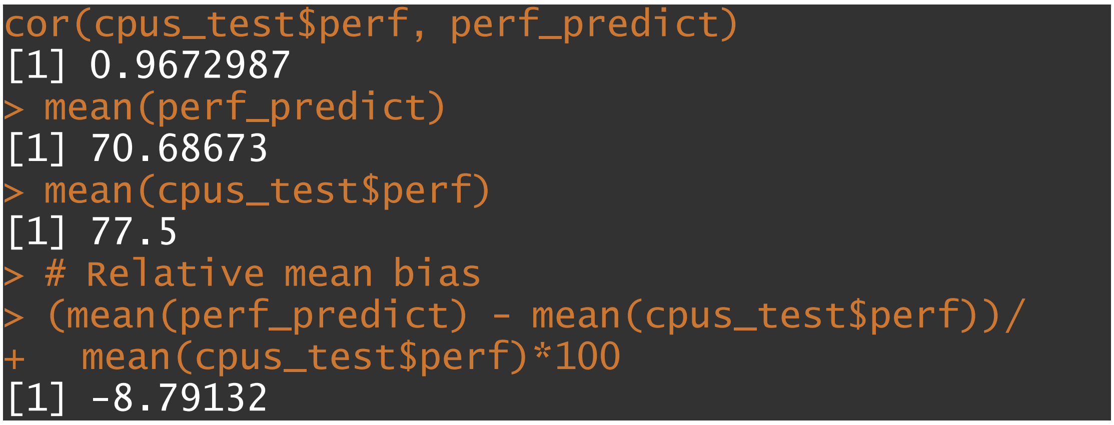
Answer6.1:

The best model is " model_log <- lm(perf ~ syct+mmin+mmax+cach+chmax, data=cpus_train)", which is remove "chmin" in this model.

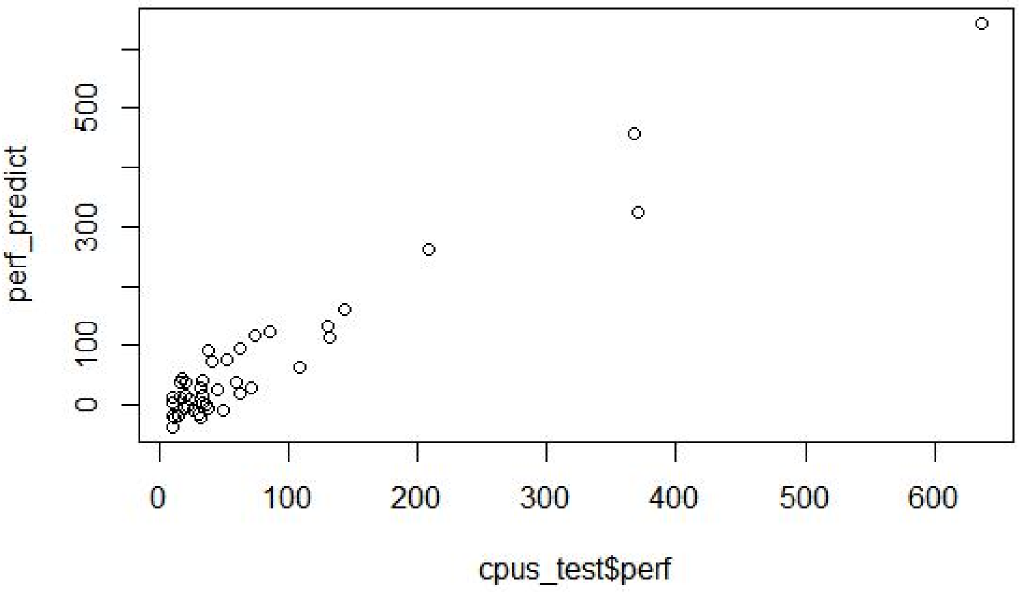


6.2 [5 points] Apply the best regression model to the test set, and compare your predicted `perf` values with the actual values that provided in the test set. Quantify the mean bias between predicted `perf` values and provided `perf` values.

Answer6.2:



```
cor(cpus_test$perf, perf_predict)
[1] 0.9672987
> mean(perf_predict)
[1] 70.68673
> mean(cpus_test$perf)
[1] 77.5
> # Relative mean bias
> (mean(perf_predict) - mean(cpus_test$perf))/
+   mean(cpus_test$perf)*100
[1] -8.79132
```



7. Analysis of Data Sets from Your Group

7.1 [5 points] Define a simple research question that can be tested with the t-test. Test your question with R, and describe your findings.

Answer7.1:

Question: Can gene "Q9HBB8" be potential biomarker in detection of cancer of "PDAC"

Answer: No, it can't. Because the p-value between Normal and PDAC is more than 0.05, so there not significant of the gene.

```
data:  sample1$Q9HBB8 and sample2$Q9HBB8
t = 0.20847, df = 25.621, p-value = 0.8365
```

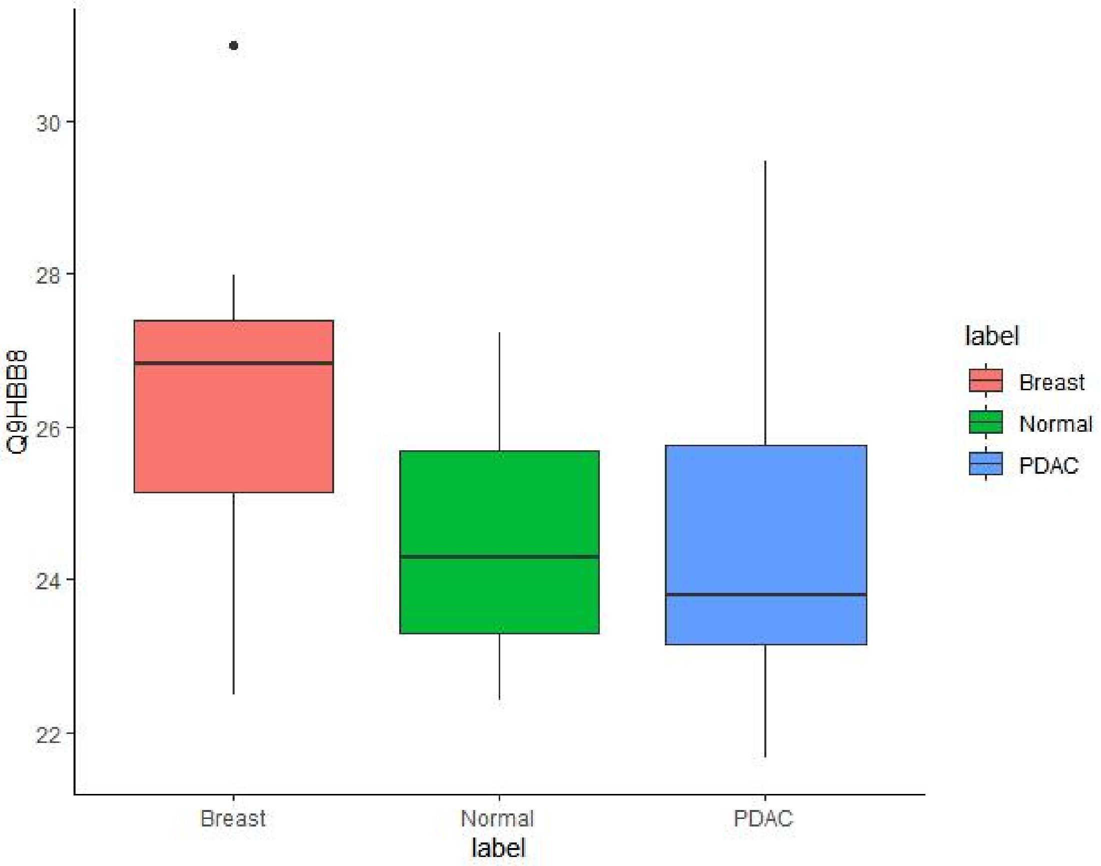
7.2 [5 points] Define a simple research question that can be tested with the ANOVA. Test your question with R, and describe your findings.

Answer7.2:

Question: Can gene " Q9HBB8" used to detect cancers of "PDAC" or "Breast cancer"?

Yes, it can. Because there significant between group of "Normal", "PDAC" or "Breast cancer"

```
            Df Sum Sq Mean Sq F value Pr(>F)  
label        2  36.66  18.328   4.829 0.0129 *
Residuals   42 159.39   3.795                 
```

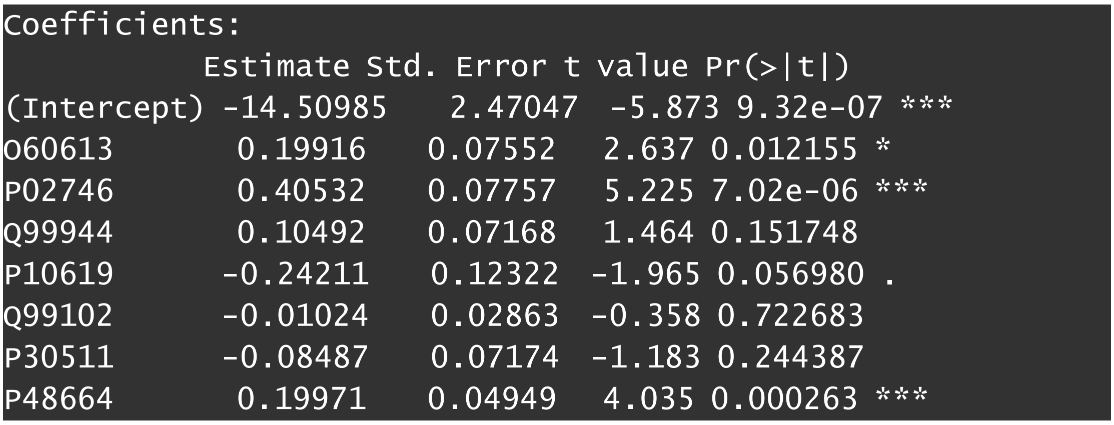


7.3 [5 points] Define a simple research question that can be tested with a simple linear regression model. Test your question with R, and describe your findings.

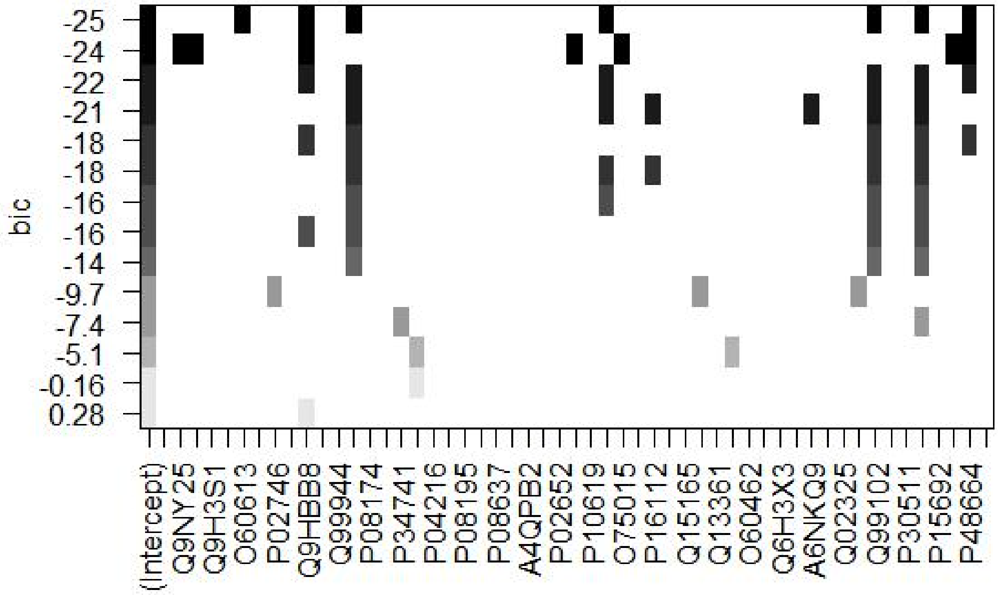
Answer7.3:

Question: Which genes can we select to detect the cancer?

Answer: We can select "O60613 ; P02746; P48664" to detect the development of cancer.



```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -14.50985    2.47047  -5.873 9.32e-07 ***
O60613        0.19916    0.07552   2.637 0.012155 *
P02746        0.40532    0.07757   5.225 7.02e-06 ***
Q99944        0.10492    0.07168   1.464 0.151748
P10619       -0.24211    0.12322  -1.965 0.056980 .
Q99102       -0.01024    0.02863  -0.358 0.722683
P30511       -0.08487    0.07174  -1.183 0.244387
P48664        0.19971    0.04949   4.035 0.000263 ***
```


bic
-25
-24
-22
-21
-18
-18
-16
-16
-14
-9.7
-7.4
-5.1
-0.16
0.28
(Intercept)
Q9NY25
Q9H3S1
O60613
P02746
Q9HBB8
Q99944
P08174
P34741
P04216
P08195
P08637
A4QPB2
P02652
P10619
O75015
P16112
Q15165
Q13361
O60462
Q6H3X3
A6NKQ9
Q02325
Q99102
P30511
P15692
P48664