Project Linear Regression

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20 October 2017

```
library(psych)
library(car)
```

```
##
## Attaching package: 'car'
```

```
## The following object is masked from 'package:psych':
##
##     logit
```

```
#1.Describe data of response variable and predictors in terms of key summary statistic
s like mean, mode, median, standard deviation, range, skewness and kurtosis. Show hist
ogram and box plots also for each variables. [hint: describe command in R]
#Each variable to be explained in 30 words maximum.
```

```
grades<-read.csv(file.choose())
dim(grades)
```

```
## [1] 105  22
```

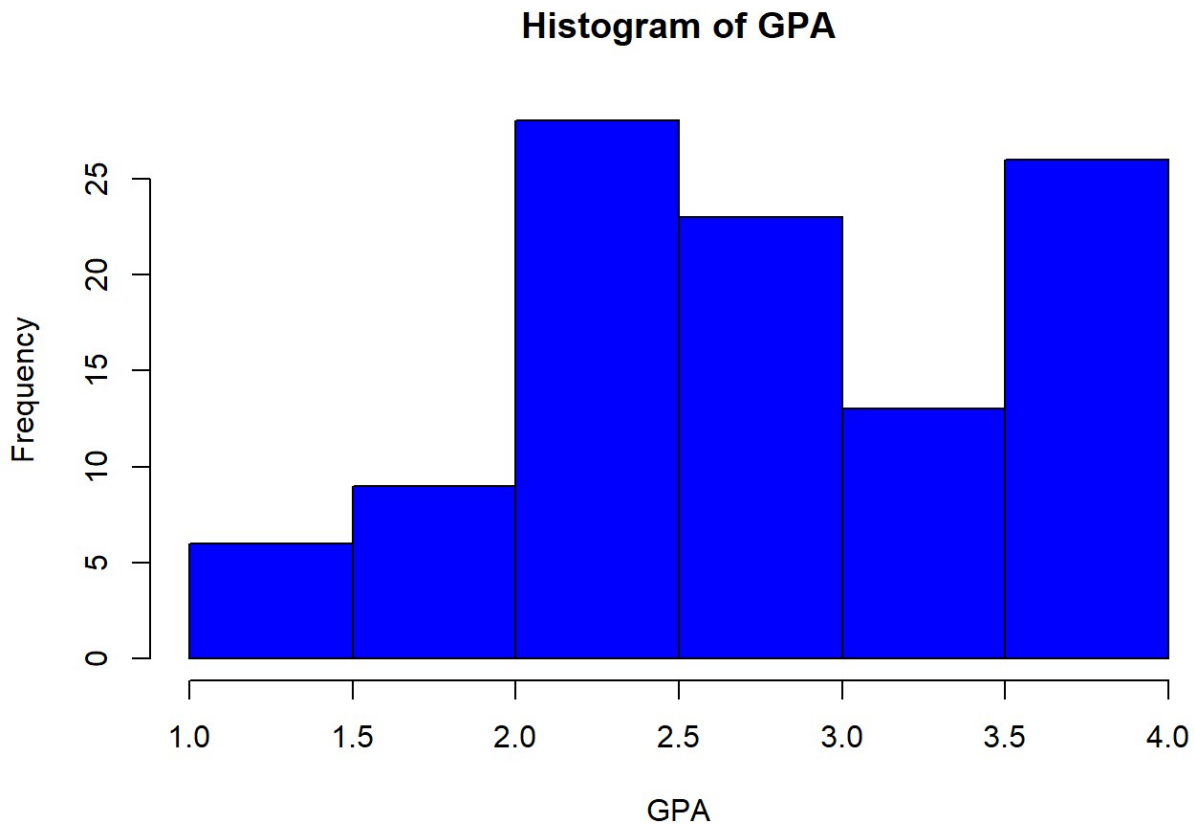
```
colnames(grades)
```

```
##  [1] "Sr_No"     "id"        "lastname"  "firstname" "gender"
##  [6] "ethnicity" "year"      "lowup"     "section"   "gpa"
## [11] "extrc"     "review"    "quiz1"     "quiz2"     "quiz3"
## [16] "quiz4"     "quiz5"     "final"     "total"     "percent"
## [21] "grade"     "passfail"
```

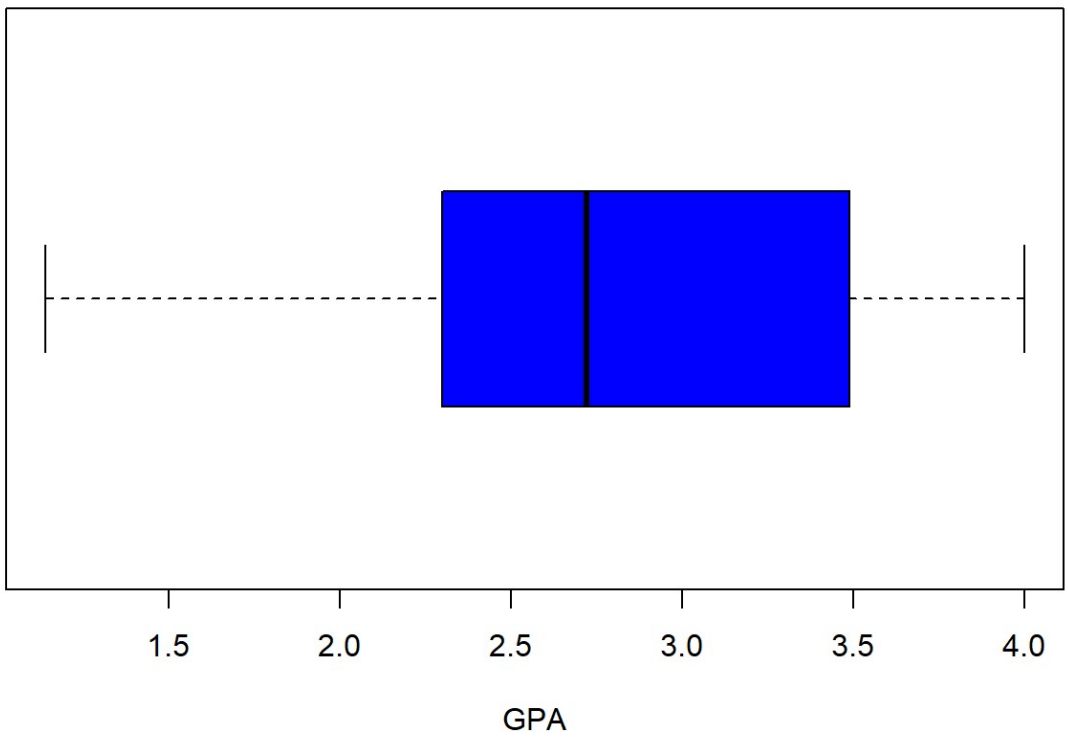
```
names(grades)
```

```
##  [1] "Sr_No"     "id"        "lastname"  "firstname" "gender"
##  [6] "ethnicity" "year"      "lowup"     "section"   "gpa"
## [11] "extrc"     "review"    "quiz1"     "quiz2"     "quiz3"
## [16] "quiz4"     "quiz5"     "final"     "total"     "percent"
## [21] "grade"     "passfail"
```

```
hist(grades$gpa, main = "Histogram of GPA", xlab = "GPA", ylab = "Frequency", col = "B
lue")
```




```
boxplot(grades$gpa,  main = "Box plot of GPA", xlab = "GPA", col = "Blue", horizontal
= T)
```




```
stem(grades$gpa)
```

```
##
##   The decimal point is 1 digit(s) to the left of the |
##
##   10 | 48
##   12 | 443
##   14 | 0
##   16 | 1677
##   18 | 04515
##   20 | 23919
##   22 | 1225780123445788
##   24 | 03356671446667
##   26 | 1623477
##   28 | 004480266
##   30 | 1256379
##   32 | 85
##   34 | 2599334778
##   36 | 460
##   38 | 4400000000000058
##   40 | 0
```

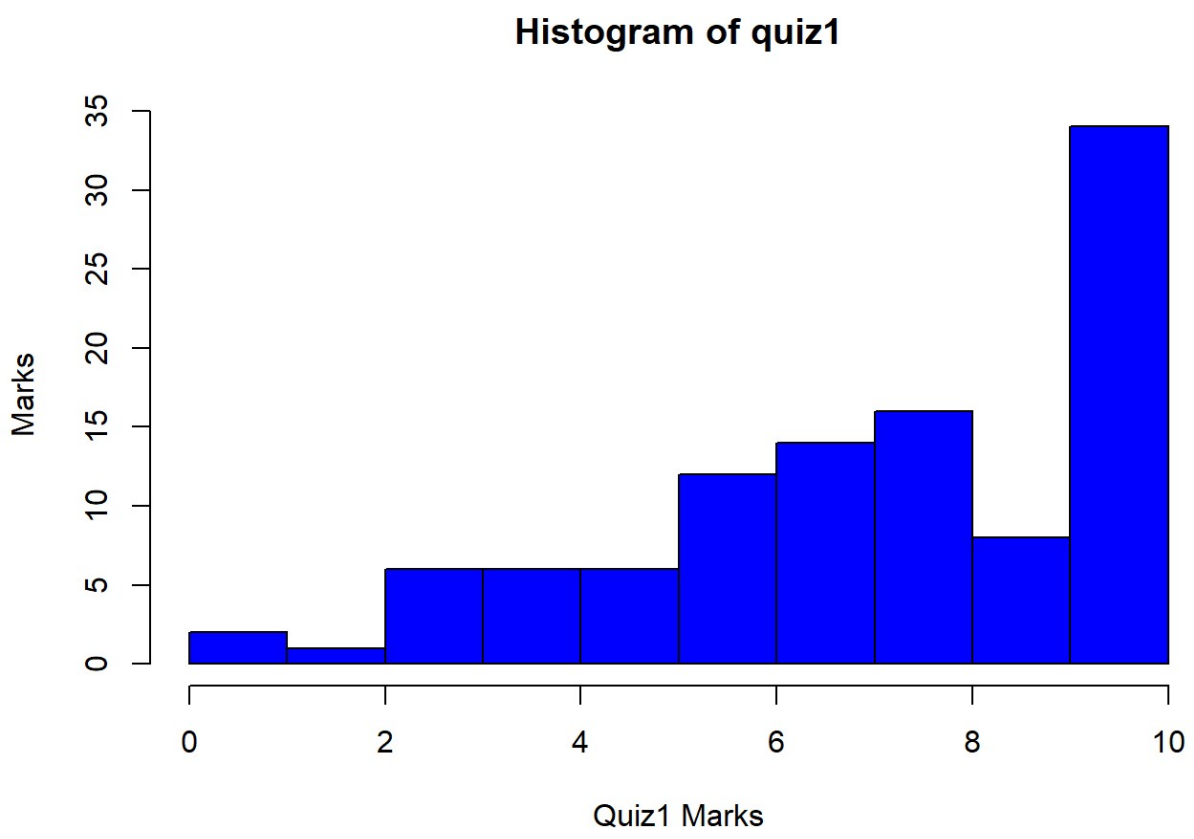
```
summary(grades$quiz1)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.000   6.000   8.000   7.467  10.000  10.000
```

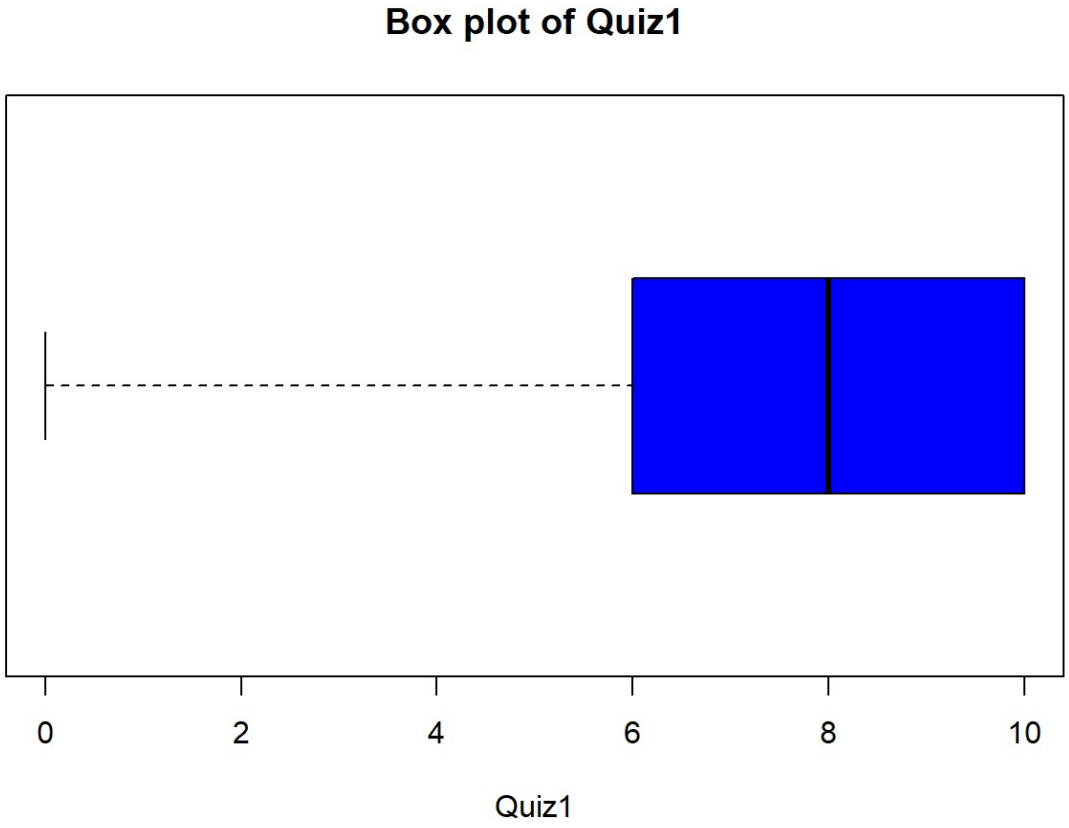
```
describe(grades$quiz1)
```

```
##    vars   n mean   sd median trimmed  mad min max range  skew kurtosis
## X1    1 105 7.47 2.48      8    7.76 2.97   0  10    10 -0.83     0.04
##      se
## X1 0.24
```

```
hist(grades$quiz1, main = "Histogram of quiz1", xlab = "Quiz1 Marks", ylab = "Marks",
col = "Blue")
```




```
boxplot(grades$quiz1,  main = "Box plot of Quiz1", xlab = "Quiz1", col = "Blue", horiz
ontal = T)
```




```
stem(grades$quiz1)
```

```
##
##   The decimal point is at the |
##
##    0 | 00
##    1 |
##    2 | 0
##    3 | 000000
##    4 | 000000
##    5 | 000000
##    6 | 000000000000
##    7 | 00000000000000
##    8 | 0000000000000000
##    9 | 00000000
##   10 | 00000000000000000000000000000000000
```

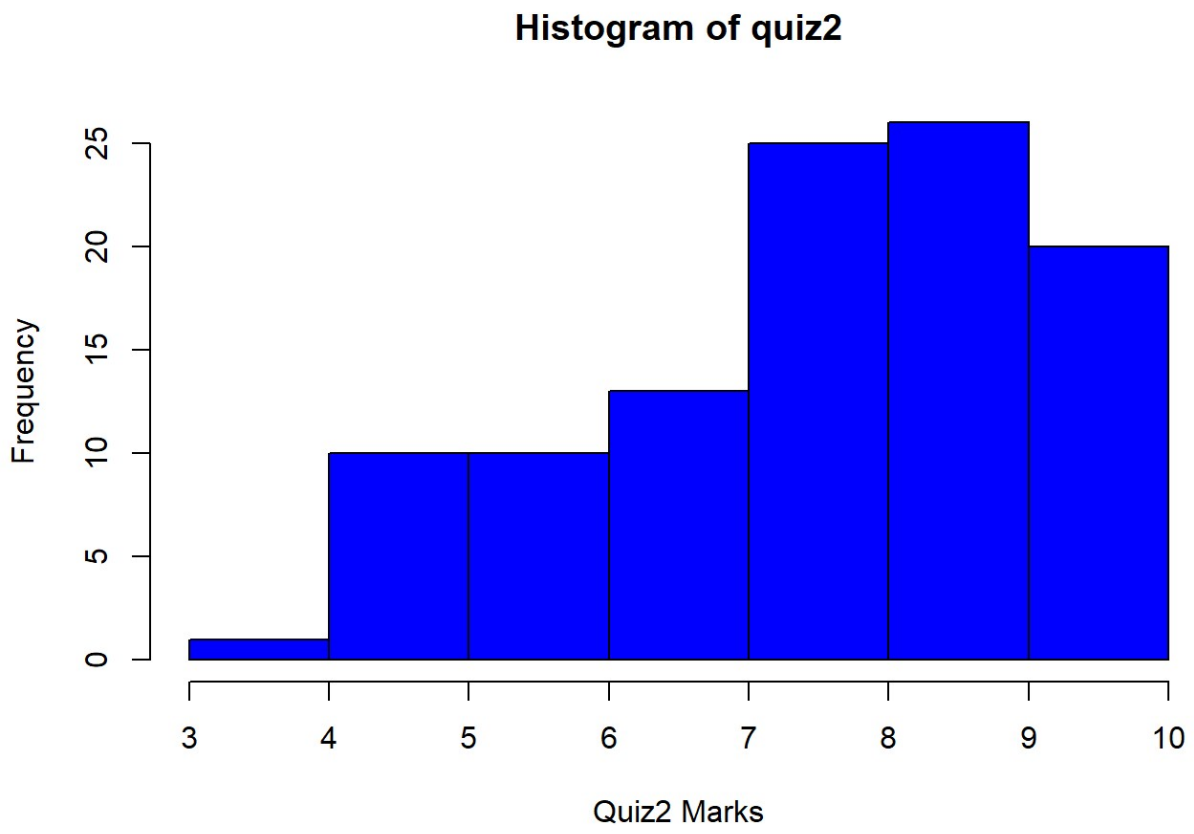
```
summary(grades$quiz2)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   3.000   7.000   8.000   7.981   9.000  10.000
```

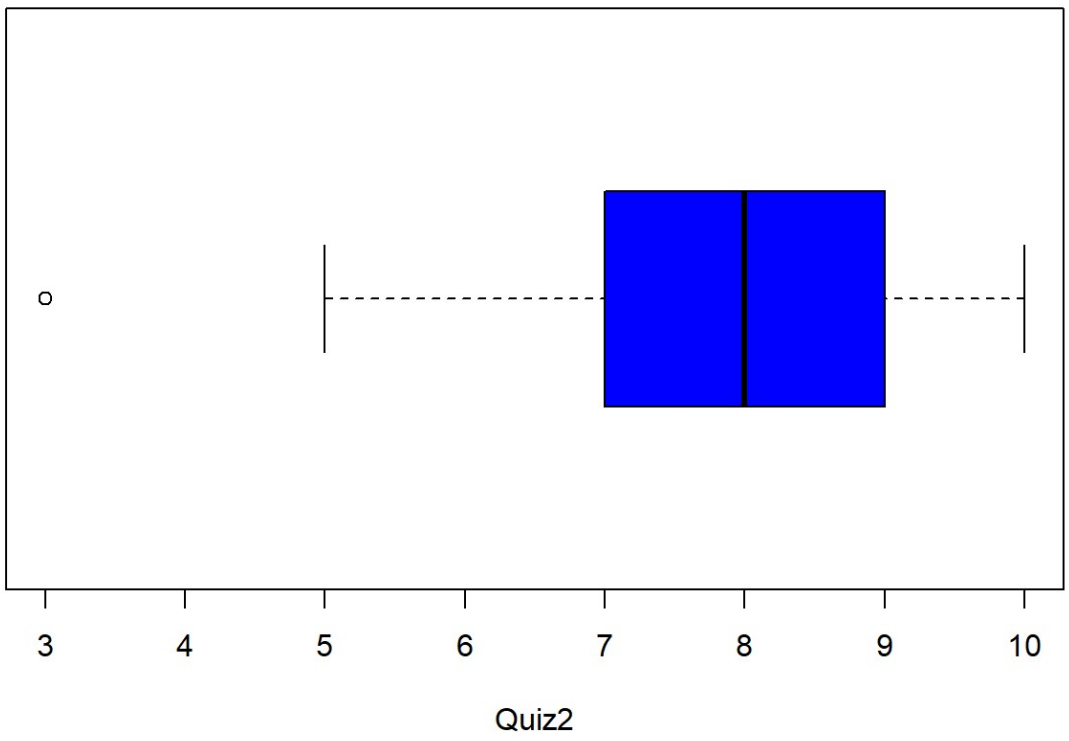
```
describe(grades$quiz2)
```

```
##    vars   n mean   sd median trimmed  mad min max range  skew kurtosis
## X1    1 105 7.98 1.62      8    8.12 1.48   3  10     7 -0.64    -0.35
##      se
## X1 0.16
```

```
hist(grades$quiz2, main = "Histogram of quiz2", xlab = "Quiz2 Marks", ylab = "Frequenc
y", col = "Blue")
```




```
boxplot(grades$quiz2,  main = "Box plot of Quiz2", xlab = "Quiz2", col = "Blue", horiz
ontal = T)
```




```
stem(grades$quiz2)
```

```
##
##   The decimal point is at the |
##
##    3 | 0
##    3 |
##    4 |
##    4 |
##    5 | 0000000000
##    5 |
##    6 | 0000000000
##    6 |
##    7 | 0000000000000
##    7 |
##    8 | 00000000000000000000000
##    8 |
##    9 | 000000000000000000000000
##    9 |
##   10 | 00000000000000000
```

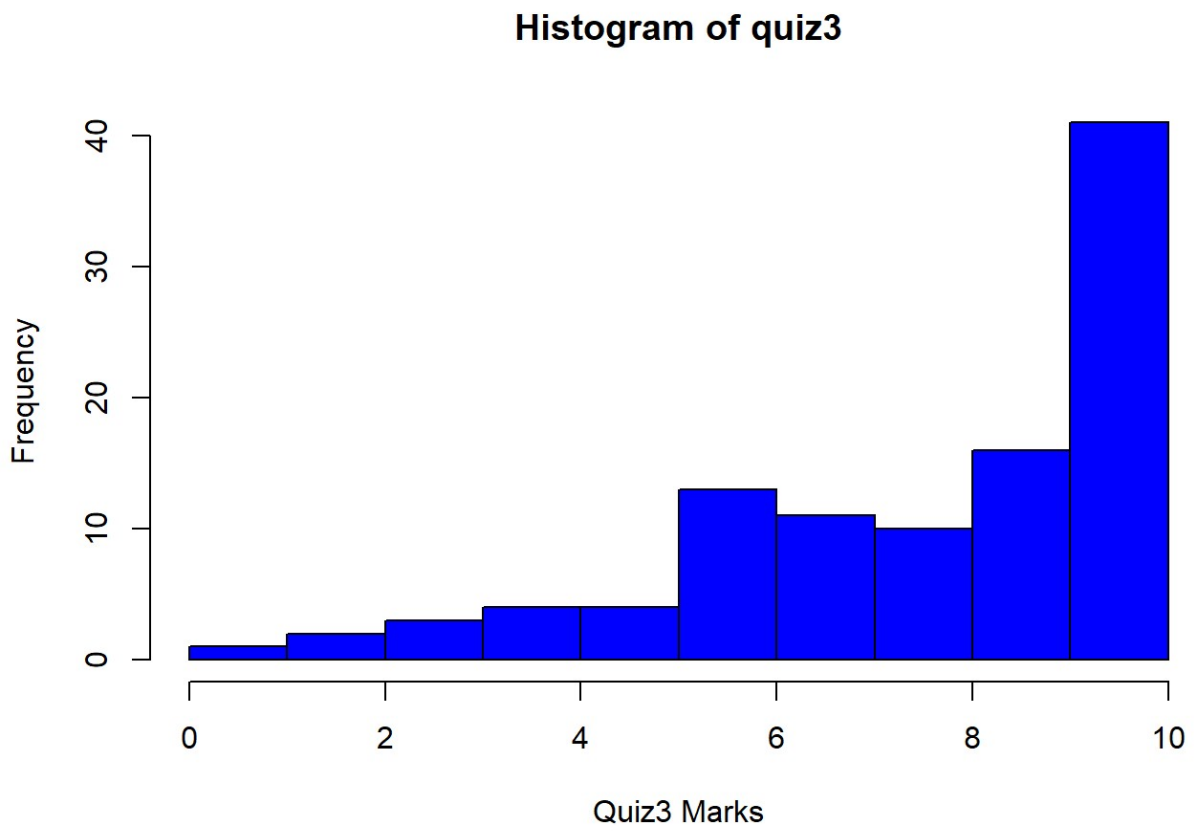
```
summary(grades$quiz3)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.000   6.000   9.000   7.981  10.000  10.000
```

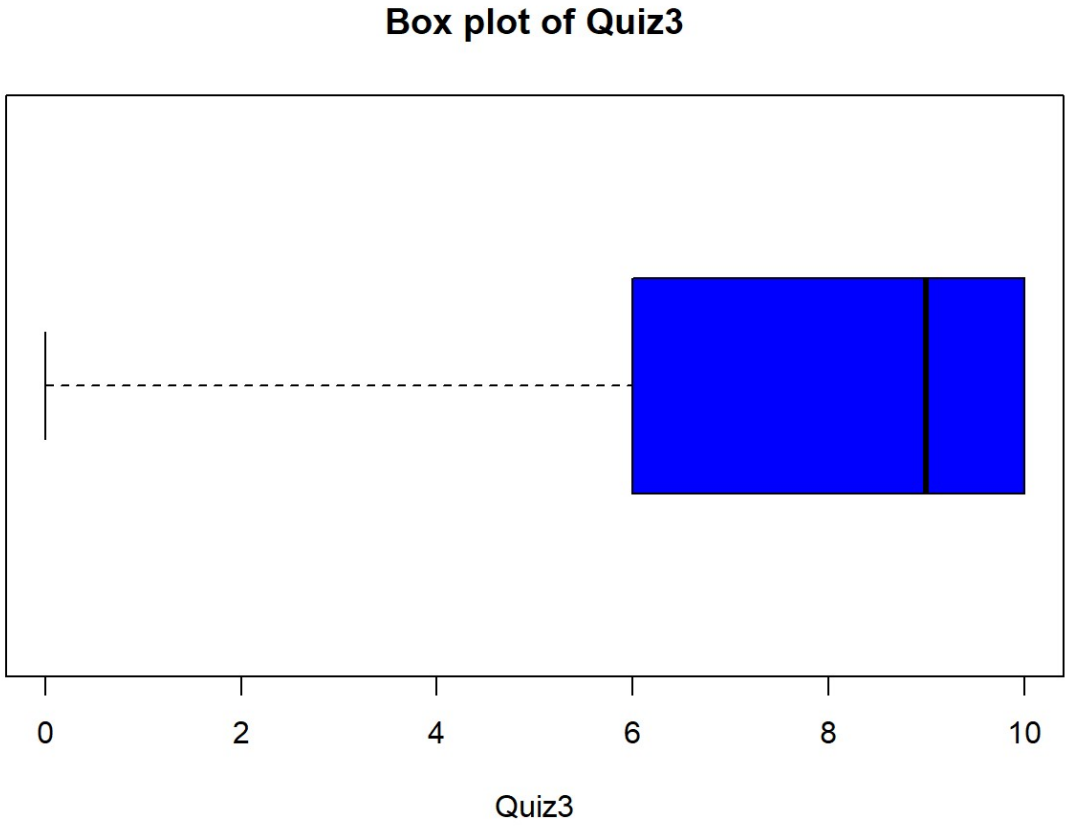
```
describe(grades$quiz3)
```

```
##    vars   n mean   sd median trimmed  mad min max range skew kurtosis   se
## X1    1 105 7.98 2.31      9    8.34 1.48   0  10    10 -1.1     0.59 0.23
```

```
hist(grades$quiz3, main = "Histogram of quiz3", xlab = "Quiz3 Marks", ylab = "Frequenc
y", col = "Blue")
```




```
boxplot(grades$quiz3,  main = "Box plot of Quiz3", xlab = "Quiz3", col = "Blue", horiz
ontal = T)
```




```
stem(grades$quiz3)
```

```
##
##   The decimal point is at the |
##
##    0 | 0
##    1 |
##    2 | 00
##    3 | 000
##    4 | 0000
##    5 | 0000
##    6 | 0000000000000
##    7 | 00000000000
##    8 | 0000000000
##    9 | 0000000000000000
##   10 | 00000000000000000000000000000000000000000
```

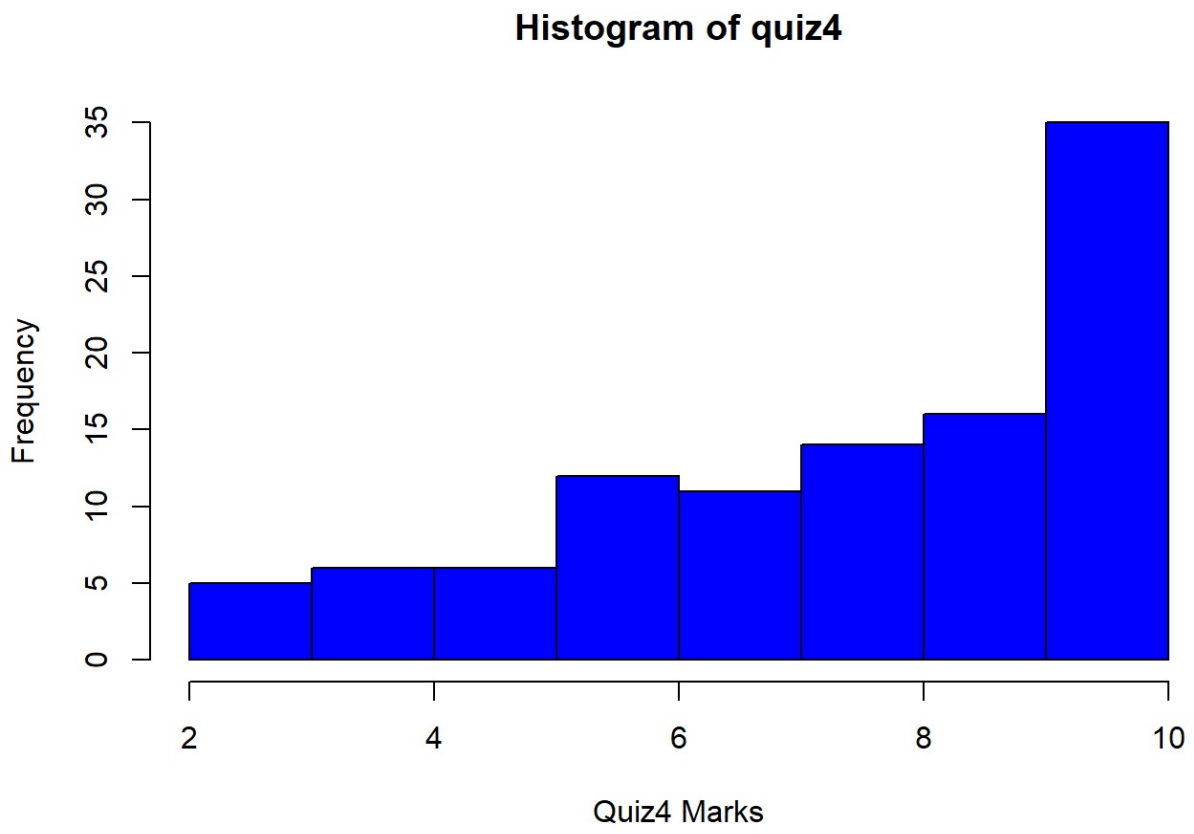
```
summary(grades$quiz4)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##     2.0     6.0     8.0     7.8    10.0    10.0
```

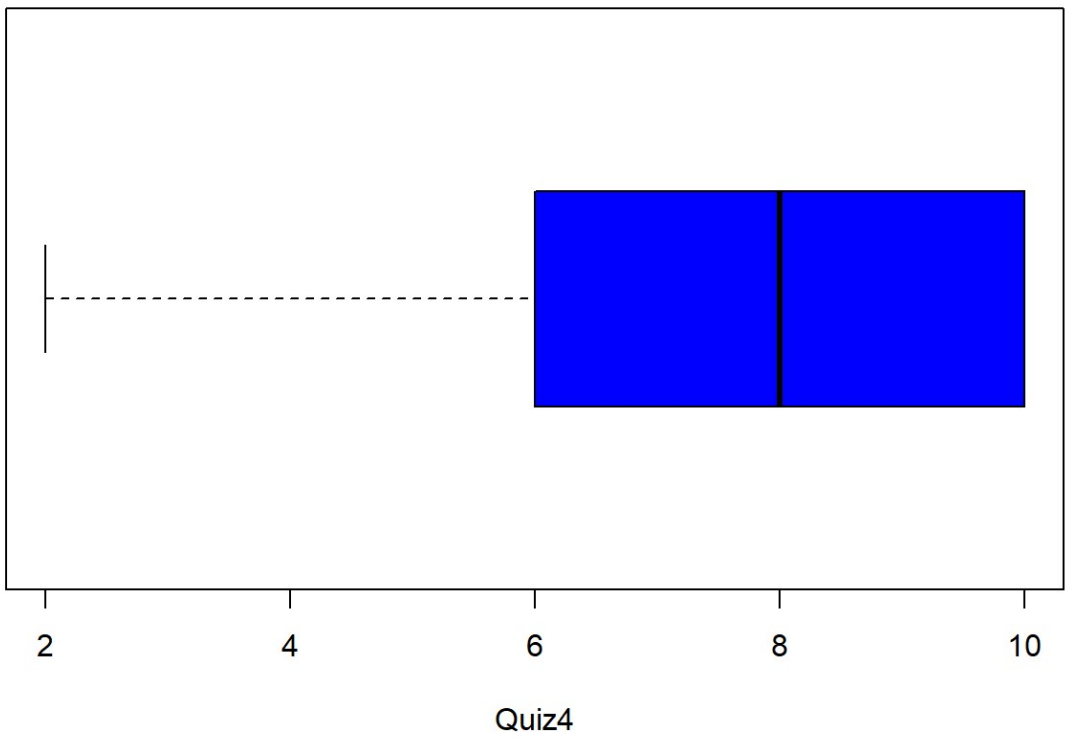
```
describe(grades$quiz4)
```

```
##    vars   n mean   sd median trimmed  mad min max range  skew kurtosis
## X1    1 105  7.8 2.28      8    8.11 2.97   2  10     8 -0.89    -0.09
##      se
## X1 0.22
```

```
hist(grades$quiz4, main = "Histogram of quiz4", xlab = "Quiz4 Marks", ylab = "Frequenc
y", col = "Blue")
```




```
boxplot(grades$quiz4,  main = "Box plot of Quiz4", xlab = "Quiz4", col = "Blue", horiz
ontal = T)
```




```
stem(grades$quiz4)
```

```
##
##   The decimal point is at the |
##
##    2 | 00000
##    2 |
##    3 |
##    3 |
##    4 | 000000
##    4 |
##    5 | 000000
##    5 |
##    6 | 000000000000
##    6 |
##    7 | 00000000000
##    7 |
##    8 | 00000000000000
##    8 |
##    9 | 0000000000000000
##    9 |
##   10 | 00000000000000000000000000000000000
```

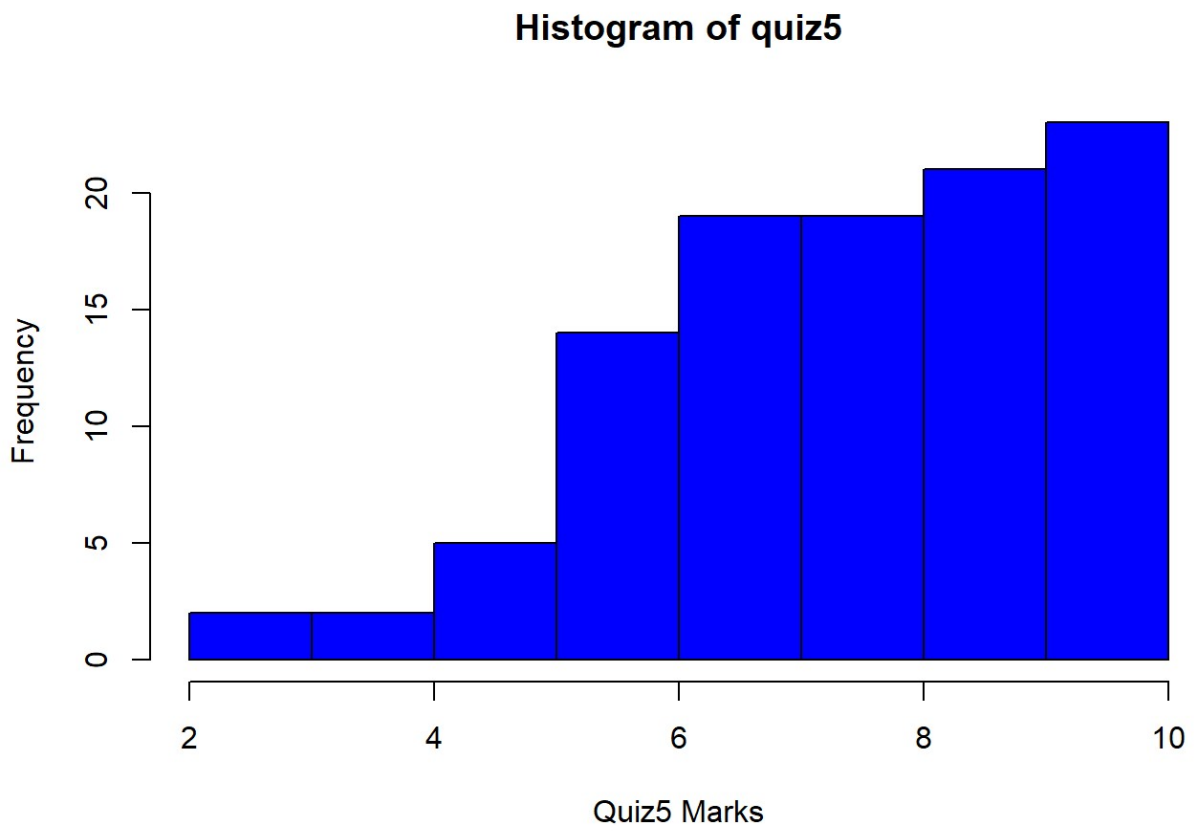
```
summary(grades$quiz5)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   2.000   7.000   8.000   7.867   9.000  10.000
```

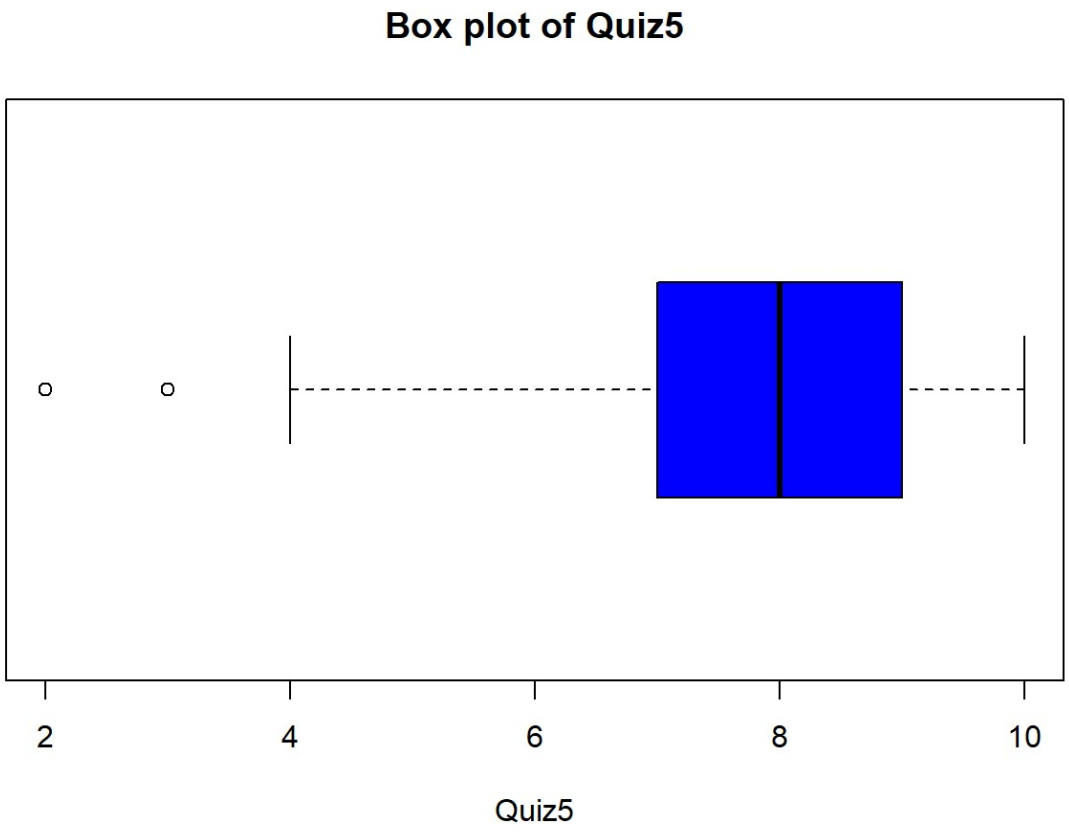
```
describe(grades$quiz5)
```

```
##    vars   n mean   sd median trimmed  mad min max range  skew kurtosis
## X1    1 105 7.87 1.77      8    8.02 1.48   2  10     8 -0.69     0.16
##      se
## X1 0.17
```

```
hist(grades$quiz5, main = "Histogram of quiz5", xlab = "Quiz5 Marks", ylab = "Frequenc
y", col = "Blue")
```




```
boxplot(grades$quiz5,  main = "Box plot of Quiz5", xlab = "Quiz5", col = "Blue", horiz
ontal = T)
```




```
stem(grades$quiz5)
```

```
##
##   The decimal point is at the |
##
##    2 | 0
##    2 |
##    3 | 0
##    3 |
##    4 | 00
##    4 |
##    5 | 00000
##    5 |
##    6 | 00000000000000
##    6 |
##    7 | 0000000000000000000
##    7 |
##    8 | 0000000000000000000
##    8 |
##    9 | 00000000000000000000
##    9 |
##   10 | 00000000000000000000000
```

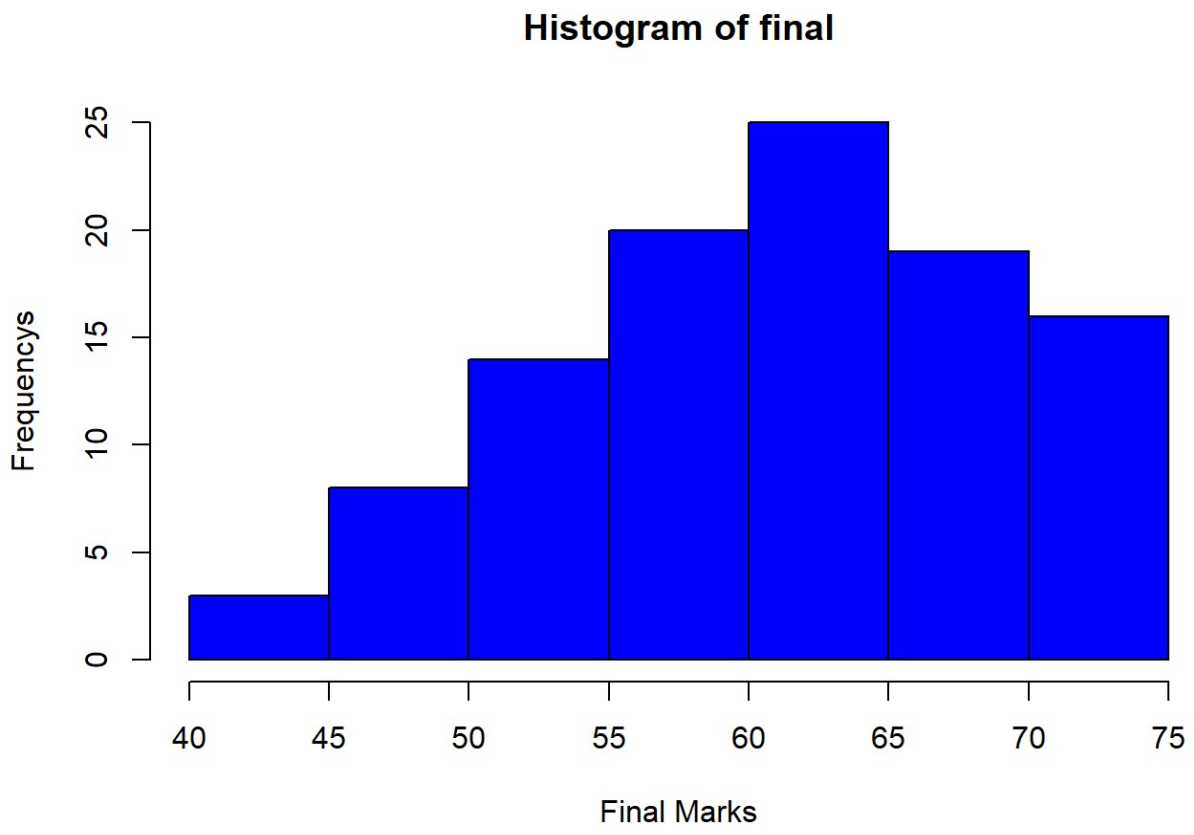
```
summary(grades$final)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   40.00   57.00   62.00   61.48   68.00   75.00
```

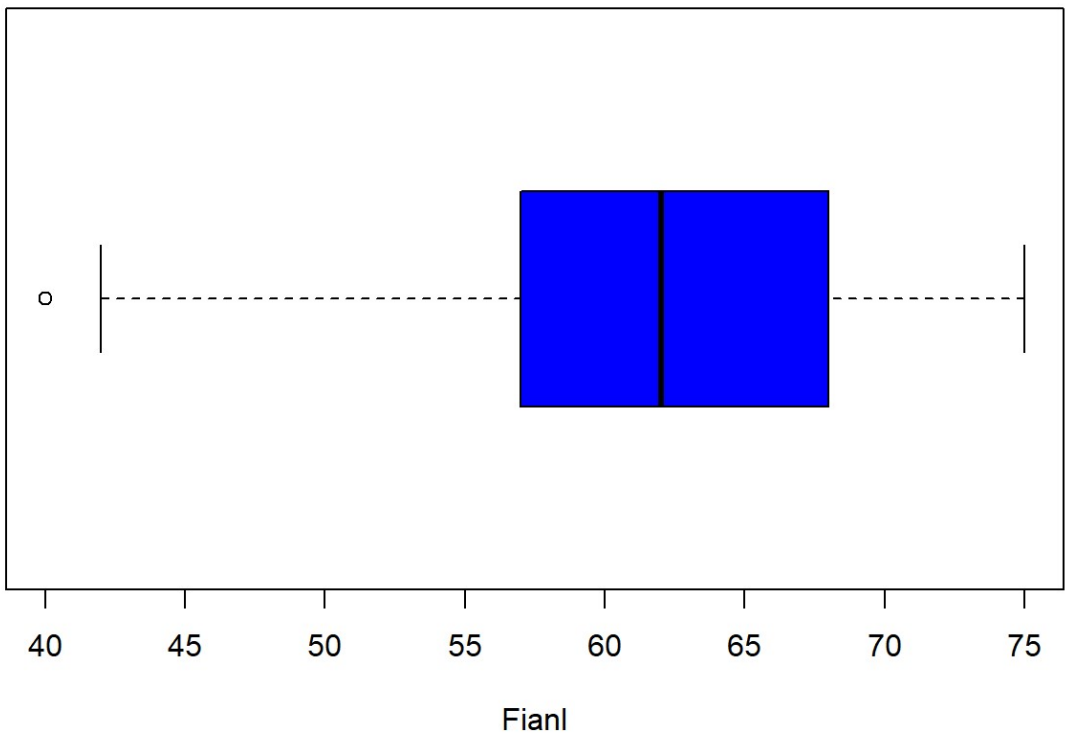
```
describe(grades$final)
```

```
##    vars   n  mean   sd median trimmed mad min max range  skew kurtosis
## X1    1 105 61.48 7.94     62   61.74 8.9  40  75    35 -0.33    -0.42
##      se
## X1 0.78
```

```
hist(grades$final, main = "Histogram of final", xlab = "Final Marks", ylab = "Frequencys", col = "Blue")
```




```
boxplot(grades$final,  main = "Box plot of Final", xlab = "Fianl", col = "Blue", horizontal = T)
```




```
stem(grades$final)
```

```
##
##   The decimal point is at the |
##
##   40 | 0
##   42 | 00
##   44 |
##   46 |
##   48 | 00000
##   50 | 000
##   52 | 000000000
##   54 | 00000
##   56 | 0000000
##   58 | 000000
##   60 | 000000000000
##   62 | 00000000000000
##   64 | 000000
##   66 | 0000000
##   68 | 0000000000
##   70 | 000000
##   72 | 00000
##   74 | 0000000
```

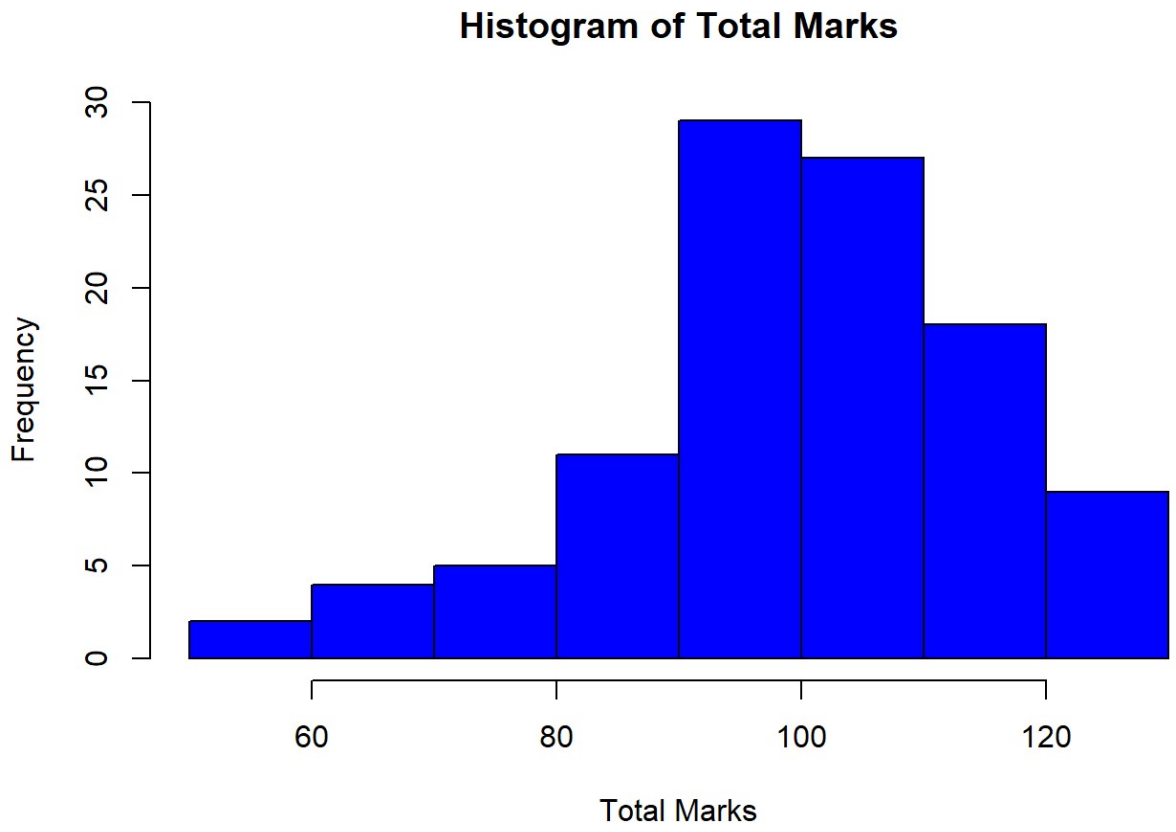
```
summary(grades$total)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##    51.0    92.0   103.0   100.6   111.0   124.0
```

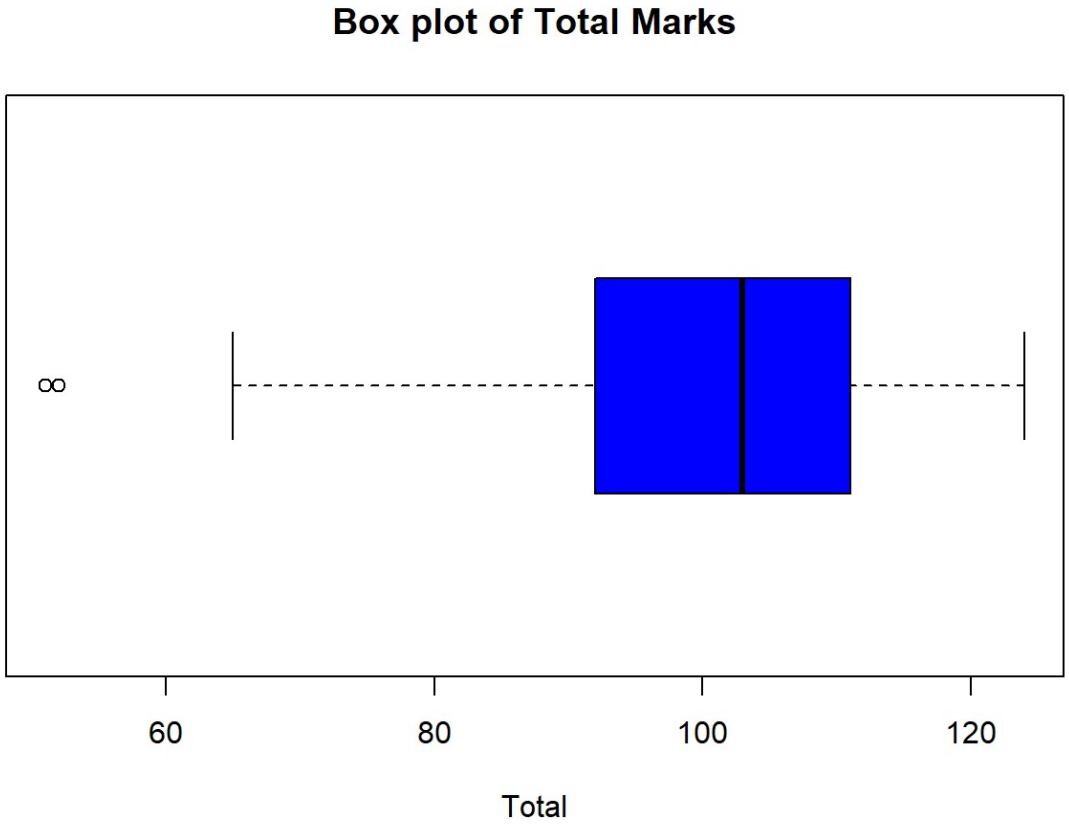
```
describe(grades$total)
```

```
##    vars   n   mean   sd median trimmed   mad min max range  skew kurtosis
## X1    1 105 100.57 15.3    103   101.8 13.34  51 124    73 -0.81     0.77
##      se
## X1 1.49
```

```
hist(grades$total, main = "Histogram of Total Marks", xlab = "Total Marks", ylab = "Fr
equency", col = "Blue")
```




```
boxplot(grades$total,  main = "Box plot of Total Marks", xlab = "Total", col = "Blu
e", horizontal = T)
```



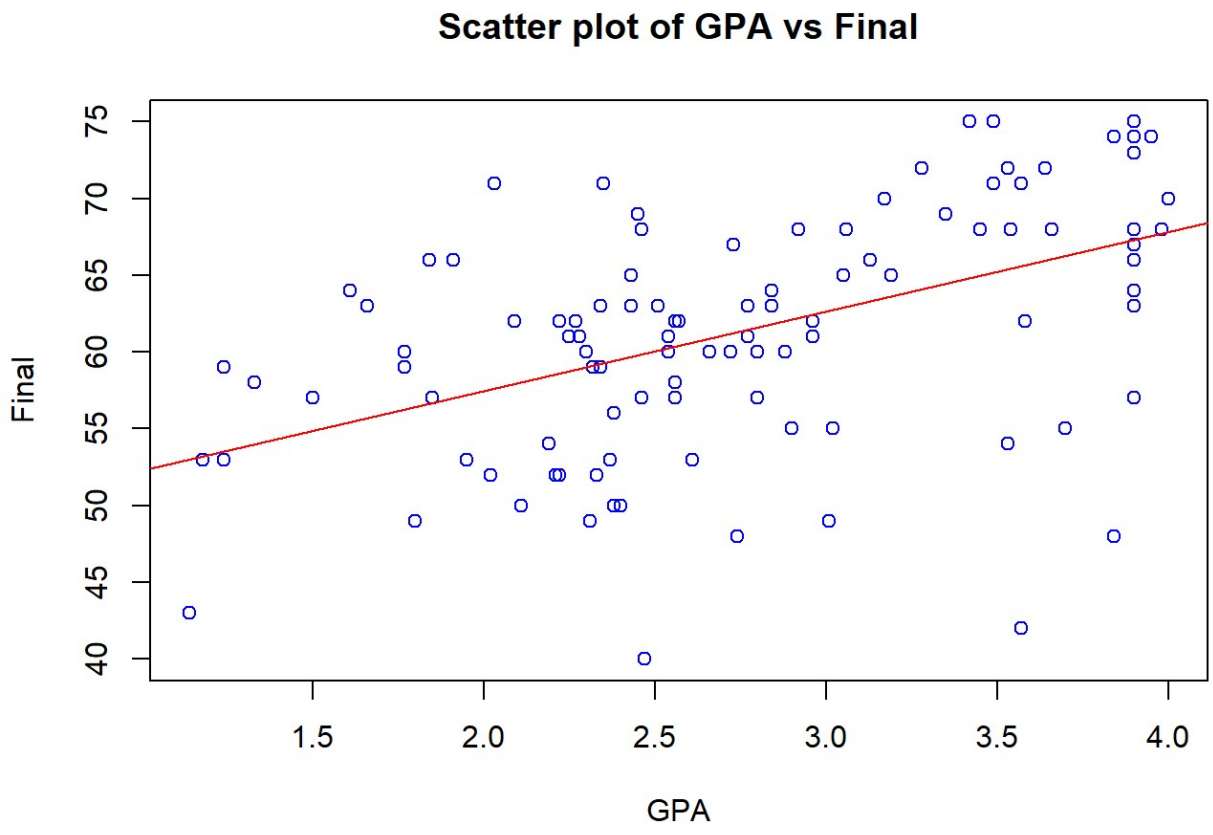

```
stem(grades$total)
```

```
##
##   The decimal point is 1 digit(s) to the right of the |
##
##    5 | 12
##    5 |
##    6 |
##    6 | 56
##    7 | 00
##    7 | 5789
##    8 | 01444
##    8 | 7888
##    9 | 00022222334
##    9 | 56666777778888888999
##   10 | 0133344
##   10 | 556666777788888999999
##   11 | 11123334
##   11 | 5678888
##   12 | 000122233344
```

```
#2. How predictor/s is related to response variable (final)? [hint: first plat scatter diagram followed by correlation test]
#Present diagram/s and correlations in the following space. Before diagrams explain relationship in 3 or 4 lines.
cor.test(grades$final, grades$gpa)
```

```
##
##  Pearson's product-moment correlation
##
## data:  grades$final and grades$gpa
## t = 5.8291, df = 103, p-value = 6.44e-08
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.3387243 0.6296171
## sample estimates:
##      cor
## 0.498055
```

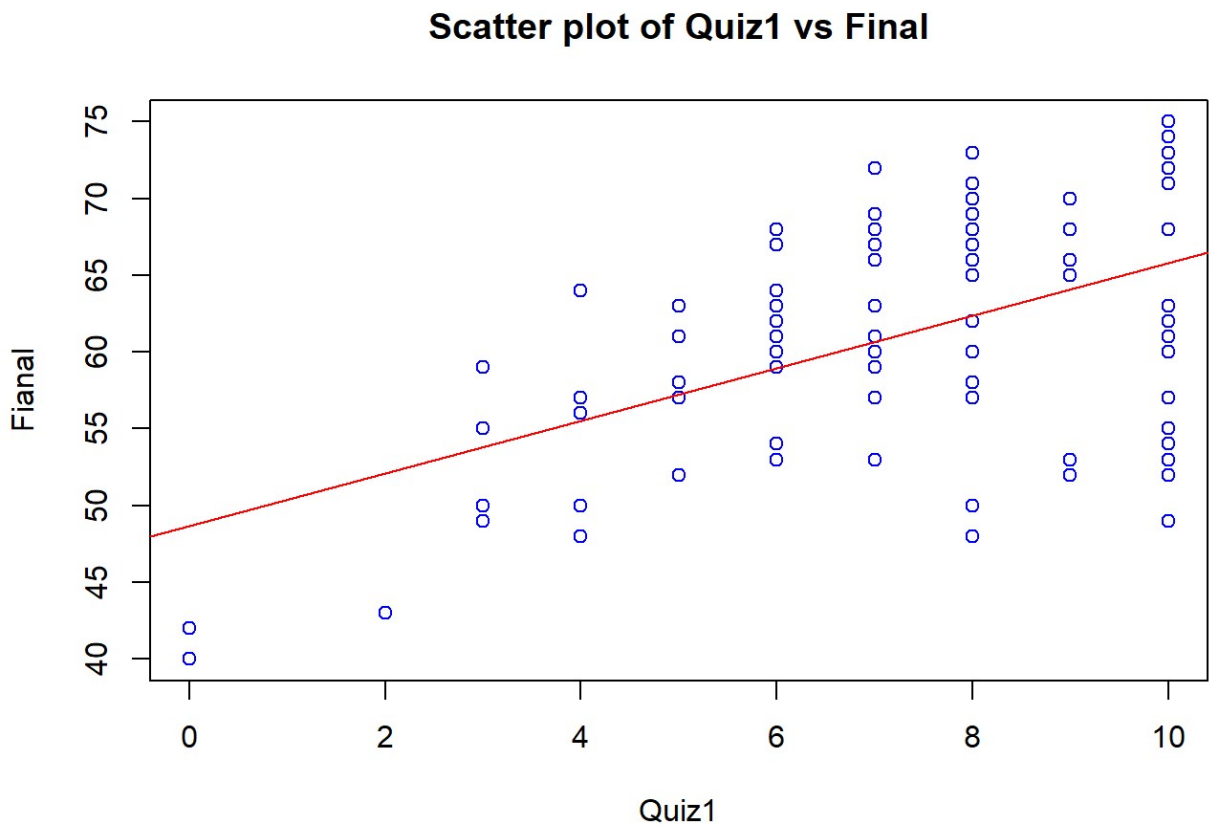
```
plot(final~gpa, data = grades, main= "Scatter plot of GPA vs Final", col= 'blue', xlab = 'GPA', ylab="Final")
abline(lm(grades$final~grades$gpa), col="red")
```



```
cor.test(grades$final, grades$quiz1)
```

```
##
##  Pearson's product-moment correlation
##
## data:  grades$final and grades$quiz1
## t = 6.428, df = 103, p-value = 4.094e-09
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.3826533 0.6591421
## sample estimates:
##       cor
## 0.5350754
```

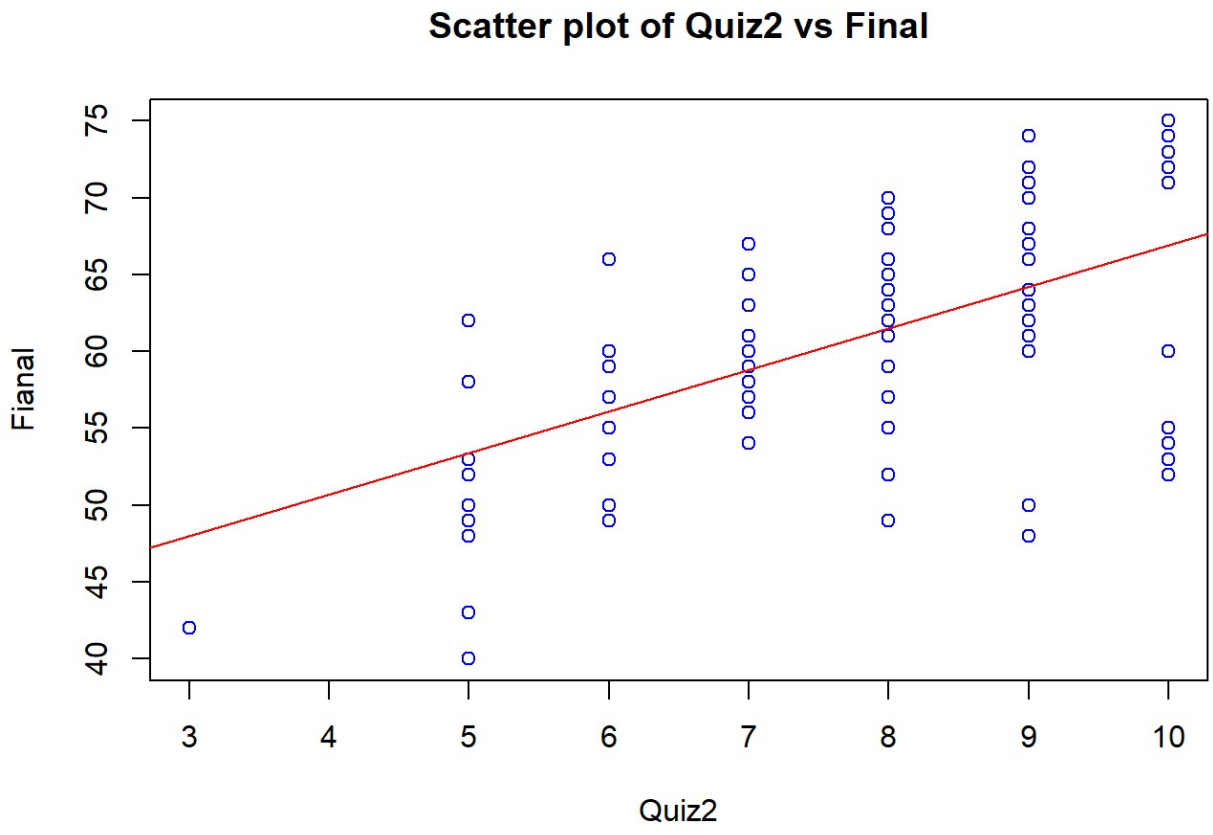
```
plot(final~quiz1, data = grades, main= "Scatter plot of Quiz1 vs Final",col= 'blue', y
lab= 'Fianal', xlab="Quiz1")
abline(lm(grades$final~grades$quiz1), col="red")
```




```
cor.test(grades$final, grades$quiz2)
```

```
##
##  Pearson's product-moment correlation
##
## data:  grades$final and grades$quiz2
## t = 6.7162, df = 103, p-value = 1.047e-09
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.4028080 0.6724089
## sample estimates:
##       cor
## 0.5518668
```

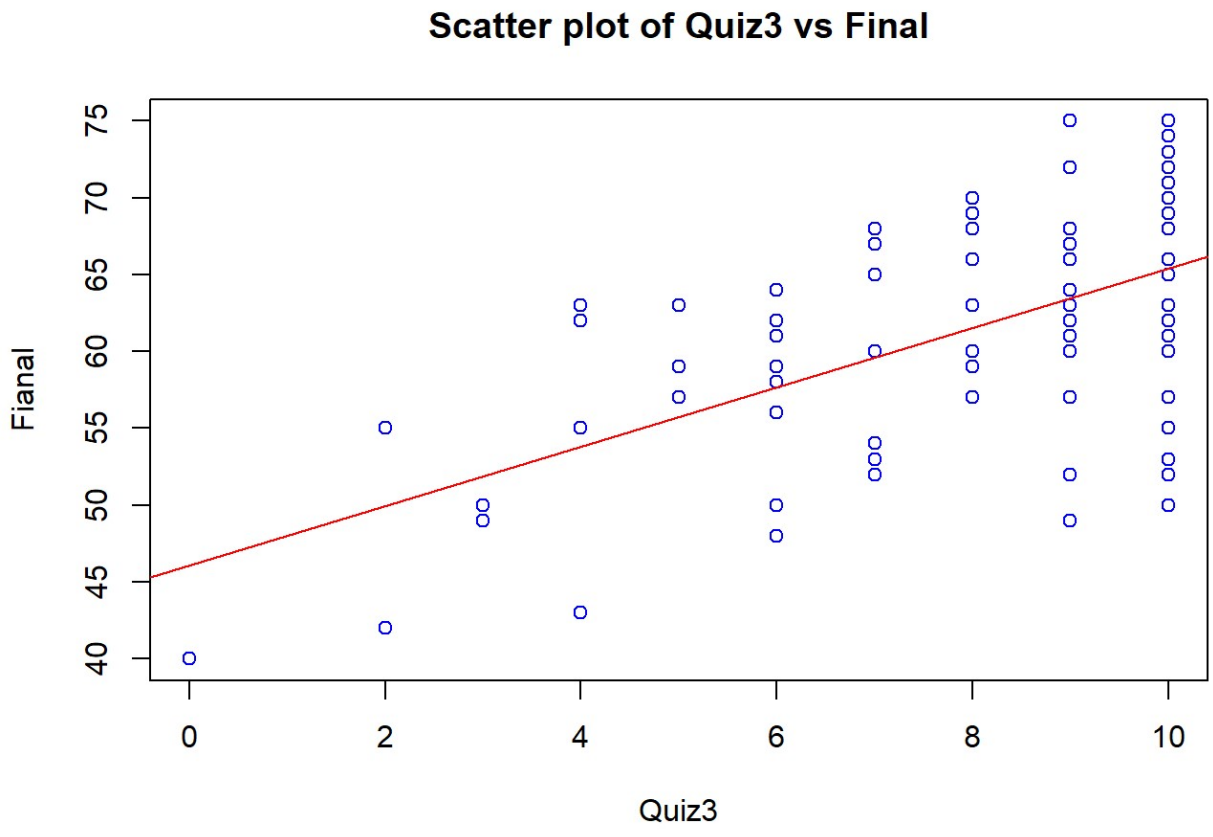
```
plot(final~quiz2, data = grades, main= "Scatter plot of Quiz2 vs Final",col= 'blue', y
lab= 'Fianal', xlab="Quiz2")
abline(lm(grades$final~grades$quiz2), col="red")
```




```
cor.test(grades$final, grades$quiz3)
```

```
##
##  Pearson's product-moment correlation
##
## data:  grades$final and grades$quiz3
## t = 6.8809, df = 103, p-value = 4.758e-10
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.4140461 0.6797318
## sample estimates:
##       cor
## 0.5611773
```

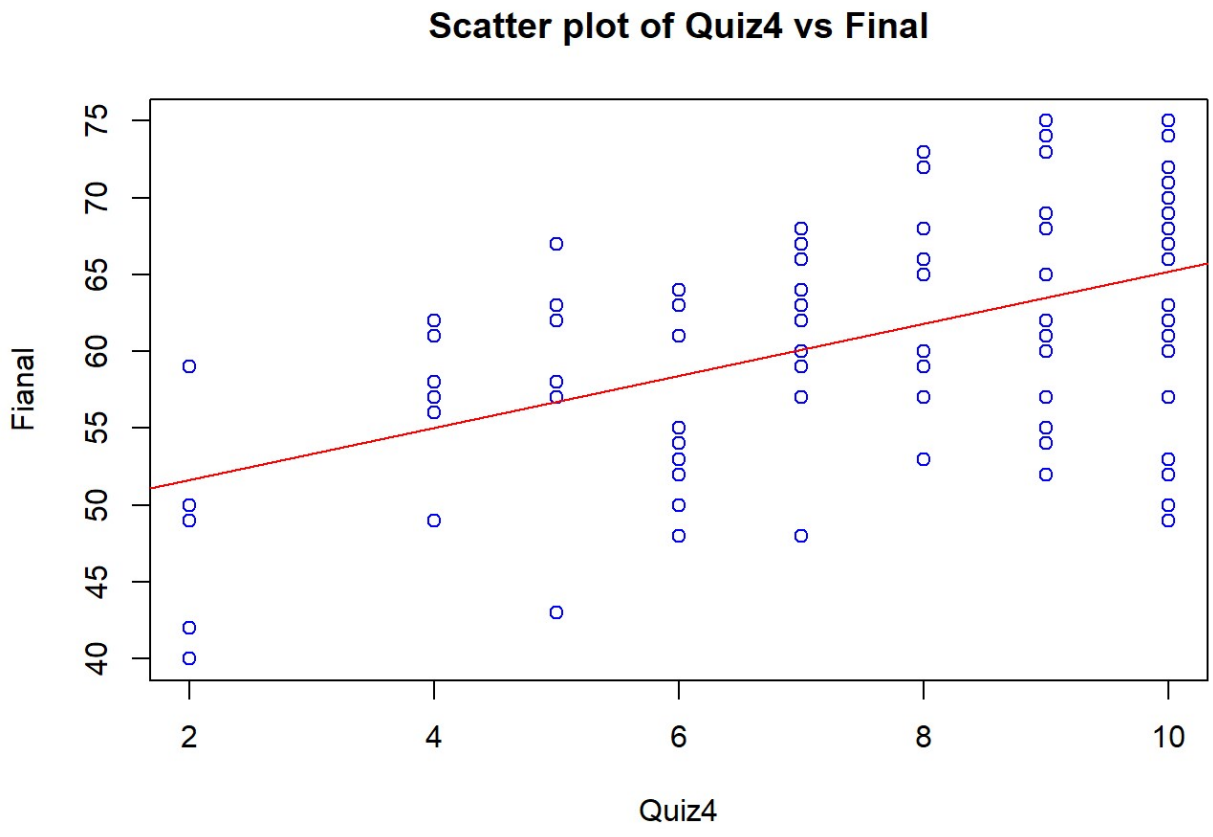
```
plot(final~quiz3, data = grades, main= "Scatter plot of Quiz3 vs Final",col= 'blue', y
lab= 'Fianal', xlab="Quiz3")
abline(lm(grades$final~grades$quiz3), col="red")
```




```
cor.test(grades$final, grades$quiz4)
```

```
##
##  Pearson's product-moment correlation
##
## data:  grades$final and grades$quiz4
## t = 5.6716, df = 103, p-value = 1.303e-07
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.3267180 0.6213986
## sample estimates:
##       cor
## 0.4878348
```

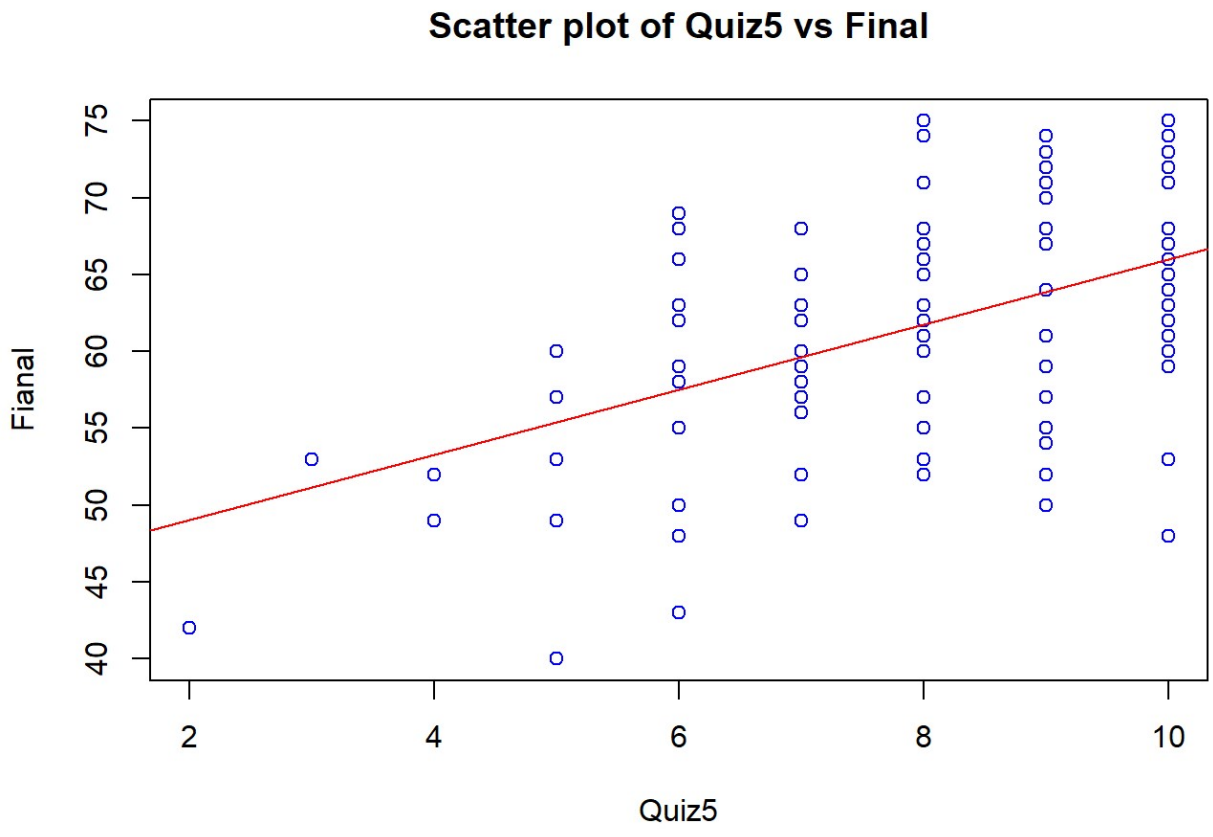
```
plot(final~quiz4, data = grades, main= "Scatter plot of Quiz4 vs Final",col= 'blue', y
lab= 'Fianal', xlab="Quiz4")
abline(lm(grades$final~grades$quiz4), col="red")
```




```
cor.test(grades$final, grades$quiz5)
```

```
##
##  Pearson's product-moment correlation
##
## data:  grades$final and grades$quiz5
## t = 5.4264, df = 103, p-value = 3.834e-07
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.3076485 0.6082107
## sample estimates:
##       cor
## 0.4715109
```

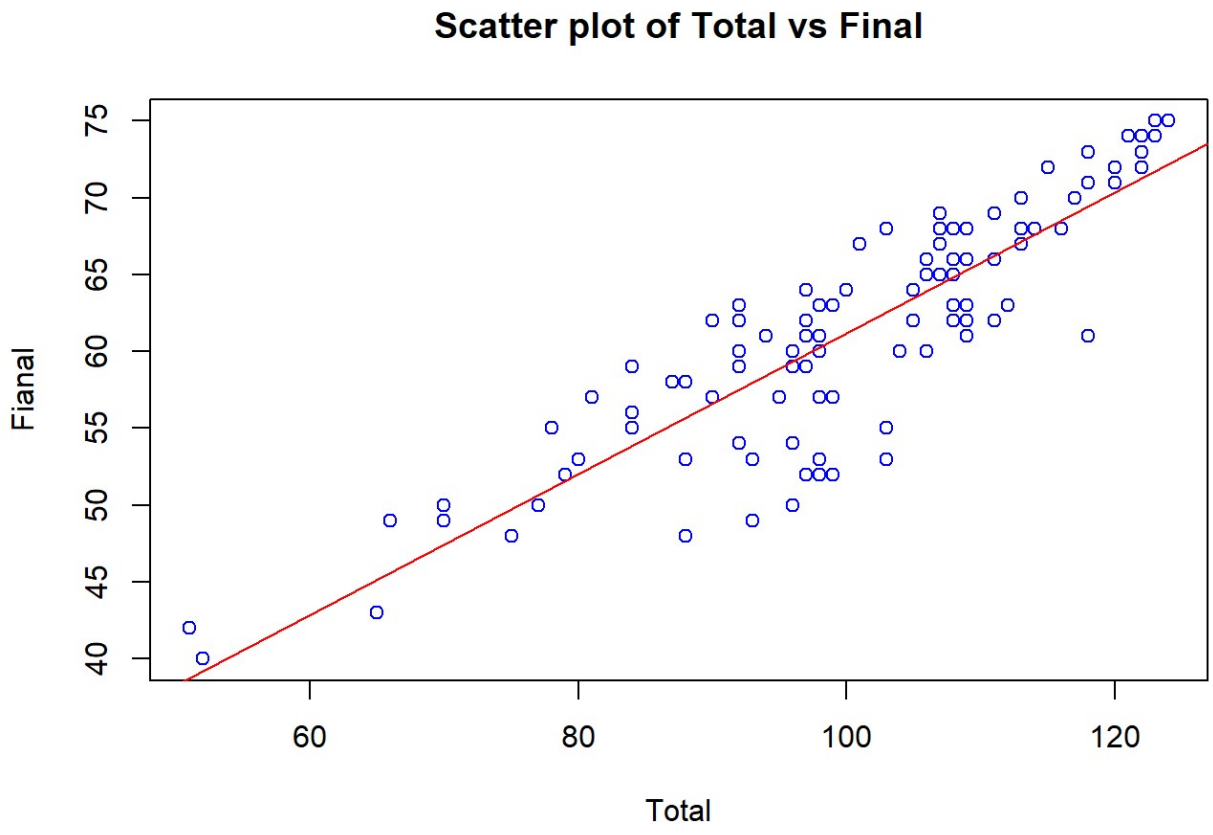
```
plot(final~quiz5, data = grades, main= "Scatter plot of Quiz5 vs Final",col= 'blue', y
lab= 'Fianal', xlab="Quiz5")
abline(lm(grades$final~grades$quiz5), col="red")
```




```
cor.test(grades$final, grades$total)
```

```
##
##  Pearson's product-moment correlation
##
## data:  grades$final and grades$total
## t = 19.054, df = 103, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  0.8316264 0.9188386
## sample estimates:
##       cor
## 0.8826091
```

```
plot(final~total, data = grades, main= "Scatter plot of Total vs Final",col= 'blue', y
lab= 'Fianal', xlab="Total")
abline(lm(grades$final~grades$total), col="red")
```




```
#After correlation test start with buliding regression models and validate
model1<- lm(final ~ gpa+quiz1+quiz2+quiz3+quiz4+quiz5+total, data=grades)
model1
```

```
##
## Call:
## lm(formula = final ~ gpa + quiz1 + quiz2 + quiz3 + quiz4 + quiz5 +
##     total, data = grades)
##
## Coefficients:
## (Intercept)          gpa        quiz1        quiz2        quiz3
##      2.2504       0.2851      -0.9128      -0.8394      -0.8627
##       quiz4        quiz5        total
##     -0.9338      -0.8095       0.9196
```

```
summary(model1)
```

```
##
## Call:
## lm(formula = final ~ gpa + quiz1 + quiz2 + quiz3 + quiz4 + quiz5 +
##     total, data = grades)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -9.2806 -0.2002  0.0674  0.3430  8.1334
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  2.25044    1.05481   2.133   0.0354 *
## gpa          0.28514    0.19778   1.442   0.1526
## quiz1       -0.91284    0.12206  -7.478 3.38e-11 ***
## quiz2       -0.83941    0.14401  -5.829 7.30e-08 ***
## quiz3       -0.86271    0.12707  -6.789 9.03e-10 ***
## quiz4       -0.93377    0.11052  -8.449 2.95e-13 ***
## quiz5       -0.80947    0.10964  -7.383 5.37e-11 ***
## total        0.91960    0.02192  41.943  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.34 on 97 degrees of freedom
## Multiple R-squared:  0.9735, Adjusted R-squared:  0.9715
## F-statistic: 508.3 on 7 and 97 DF,  p-value: < 2.2e-16
```

```
#Lets check variance inflation factor and durbin watson statistics to check for inflat
ion of r- square and auto correlation.
vif(model1)
```

```
##      gpa    quiz1    quiz2    quiz3    quiz4    quiz5    total
## 1.322065 5.312639 3.164871 4.982488 3.679254 2.170517 6.518202
```

```
durbinWatsonTest(model1)
```

```
##  lag Autocorrelation D-W Statistic p-value
##    1     -0.02699258      2.050631   0.802
##  Alternative hypothesis: rho != 0
```

```
#In Model1, variable GPA does not have significant slope with response variable, varia
nce inflation factor results not allowing to build a model with total as one of the pr
edictor. Lets build one more model by removing total alone.
model2<- lm(final ~ gpa+quiz1+quiz2+quiz3+quiz4+quiz5, data=grades)
model2
```

```
##
## Call:
## lm(formula = final ~ gpa + quiz1 + quiz2 + quiz3 + quiz4 + quiz5,
##     data = grades)
##
## Coefficients:
## (Intercept)          gpa        quiz1        quiz2        quiz3
##     32.8658       3.6271       0.2986       0.8004       0.9063
##       quiz4        quiz5
##     -0.1428       0.4823
```

```
summary(model2)
```

```
##
## Call:
## lm(formula = final ~ gpa + quiz1 + quiz2 + quiz3 + quiz4 + quiz5,
##     data = grades)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -13.6580  -2.7187   0.7985   3.9664  11.4979
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  32.8658     3.3141   9.917  < 2e-16 ***
## gpa           3.6271     0.7879   4.604 1.25e-05 ***
## quiz1         0.2986     0.5162   0.578   0.5643
## quiz2         0.8004     0.6032   1.327   0.1876
## quiz3         0.9063     0.5217   1.737   0.0855 .
## quiz4        -0.1428     0.4739  -0.301   0.7638
## quiz5         0.4823     0.4580   1.053   0.2948
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 5.831 on 98 degrees of freedom
## Multiple R-squared:  0.4922, Adjusted R-squared:  0.4611
## F-statistic: 15.83 on 6 and 98 DF,  p-value: 1.224e-12
```

```
vif(model2)
```

```
##      gpa    quiz1    quiz2    quiz3    quiz4    quiz5
## 1.107509 5.015198 2.931613 4.433567 3.572136 1.999252
```

```
durbinWatsonTest(model2)
```

```
##  lag Autocorrelation D-W Statistic p-value
##    1      -0.1175758      2.224256   0.244
##  Alternative hypothesis: rho != 0
```

```
#From Model2, VIF result it concluded that quiz1 is increasing corelation artificiall
y, hence it will be removed from model an new model is constructed as follows
model3<- lm(final ~ gpa+quiz2+quiz3+quiz4+quiz5, data=grades)
model3
```

```
##
## Call:
## lm(formula = final ~ gpa + quiz2 + quiz3 + quiz4 + quiz5, data = grades)
##
## Coefficients:
## (Intercept)          gpa        quiz2        quiz3        quiz4
##    32.49410      3.62466      0.82825      1.06375     -0.02019
##       quiz5
##     0.50431
```

```
summary(model3)
```

```
##
## Call:
## lm(formula = final ~ gpa + quiz2 + quiz3 + quiz4 + quiz5, data = grades)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -13.5494  -2.7210   0.5787   4.0927  11.5517
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) 32.49410    3.24023  10.028  < 2e-16 ***
## gpa          3.62466    0.78519   4.616 1.17e-05 ***
## quiz2        0.82825    0.59928   1.382   0.1701
## quiz3        1.06375    0.44360   2.398   0.0184 *
## quiz4       -0.02019    0.42244  -0.048   0.9620
## quiz5        0.50431    0.45486   1.109   0.2702
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 5.812 on 99 degrees of freedom
## Multiple R-squared:  0.4904, Adjusted R-squared:  0.4647
## F-statistic: 19.06 on 5 and 99 DF,  p-value: 3.089e-13
```

```
vif(model3)
```

```
##      gpa    quiz2    quiz3    quiz4    quiz5
## 1.107478 2.912966 3.227419 2.857258 1.985498
```

```
durbinWatsonTest(model3)
```

```
##  lag Autocorrelation D-W Statistic p-value
##    1      -0.1288976      2.247614   0.202
##  Alternative hypothesis: rho != 0
```

```
#From model3 summary and VIF Out put, it was decided that though no inflators in model 3.variables quiz2, quiz4 and quiz5 does not have significant pvalue they were removed and model as follows
model4<- lm(final ~ gpa+quiz3, data=grades)
model4
```

```
##
## Call:
## lm(formula = final ~ gpa + quiz3, data = grades)
##
## Coefficients:
## (Intercept)          gpa        quiz3
##      37.541        3.993        1.609
```

```
summary(model4)
```

```
##
## Call:
## lm(formula = final ~ gpa + quiz3, data = grades)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -14.5260  -3.2000  -0.0803   4.7388  12.3955
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  37.5415     2.6802  14.007  < 2e-16 ***
## gpa           3.9926     0.7850   5.086 1.67e-06 ***
## quiz3         1.6088     0.2598   6.193 1.26e-08 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 5.929 on 102 degrees of freedom
## Multiple R-squared:  0.4535, Adjusted R-squared:  0.4428
## F-statistic: 42.32 on 2 and 102 DF,  p-value: 4.133e-14
```

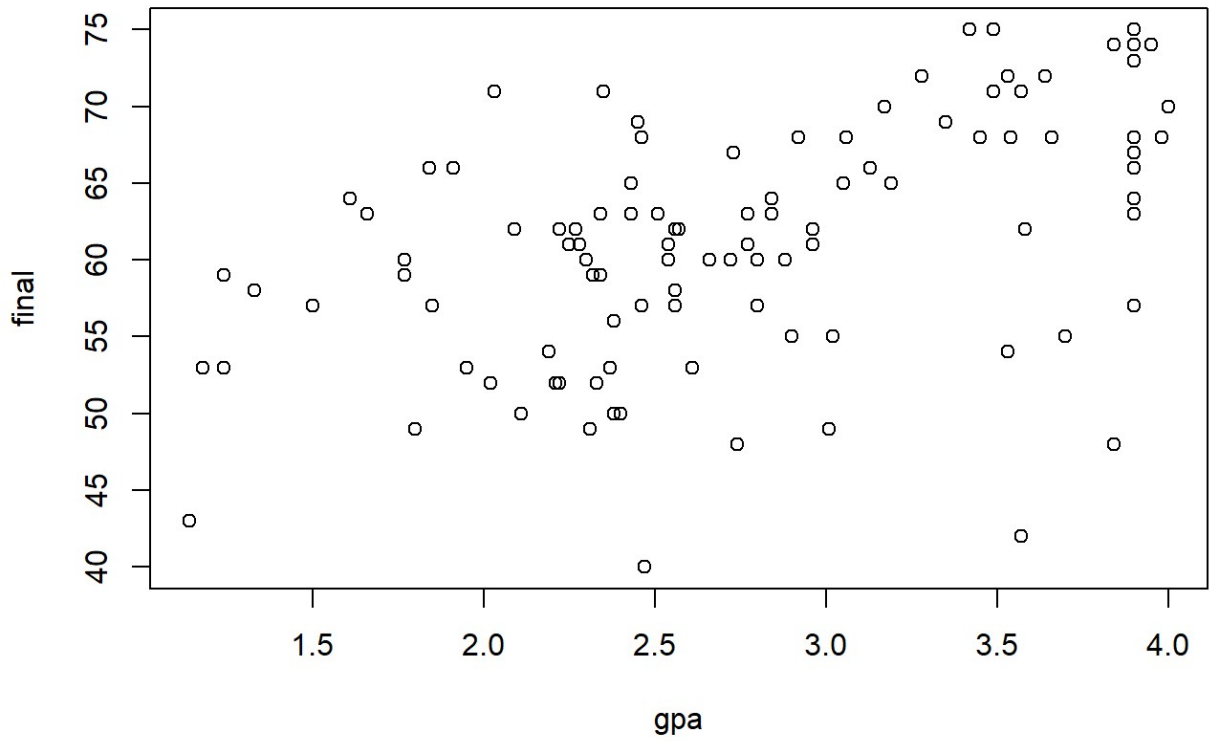
```
vif(model4)
```

```
##     gpa   quiz3
## 1.06341 1.06341
```

```
durbinWatsonTest(model4)
```

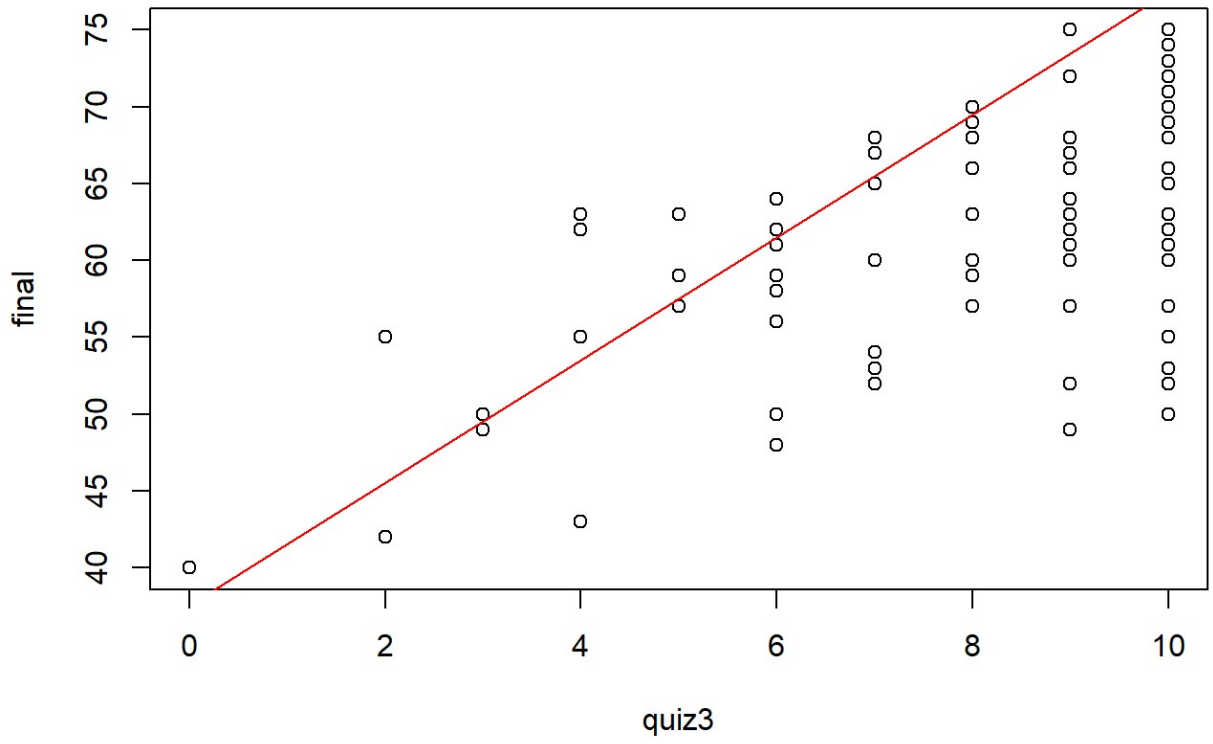
```
##  lag Autocorrelation D-W Statistic p-value
##    1     -0.09929107      2.194562    0.31
##  Alternative hypothesis: rho != 0
```

```
#from model4 out put and vif, both predictors can be used for regression, lets plot fi
nal vs predictors of GPA and quiz3
plot(final~gpa+quiz3, data = grades)
```

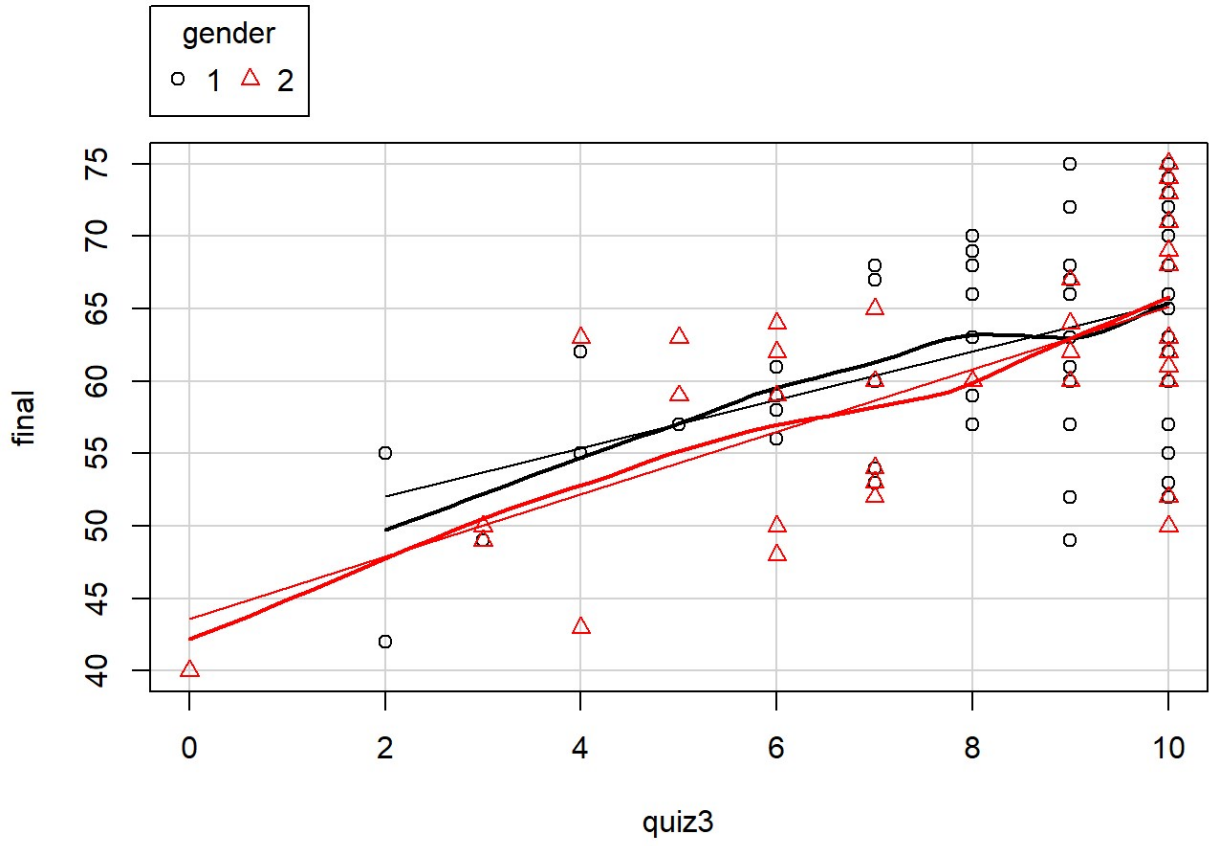



```
abline(lm(grades$final~grades$gpa+grades$quiz3), col="red")
```

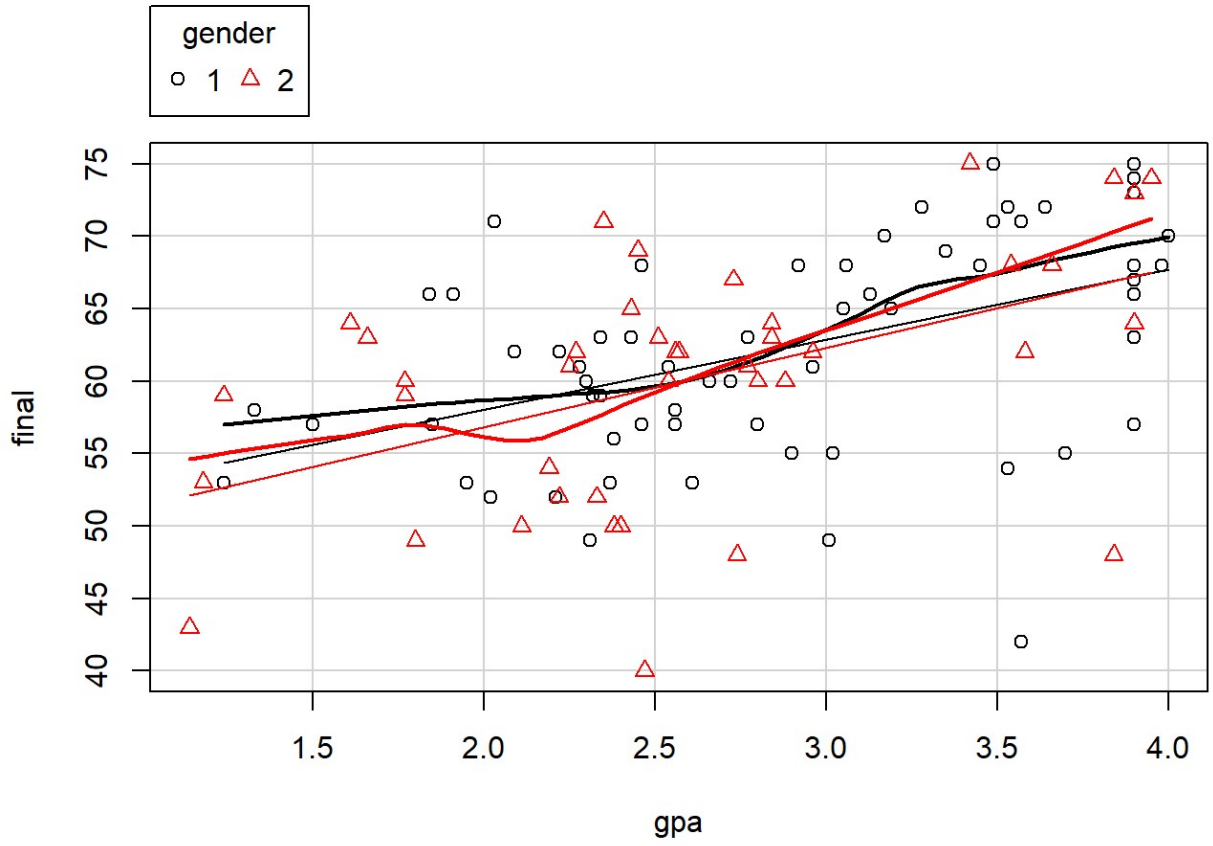
```
## Warning in abline(lm(grades$final ~ grades$gpa + grades$quiz3), col =
## "red"): only using the first two of 3 regression coefficients
```



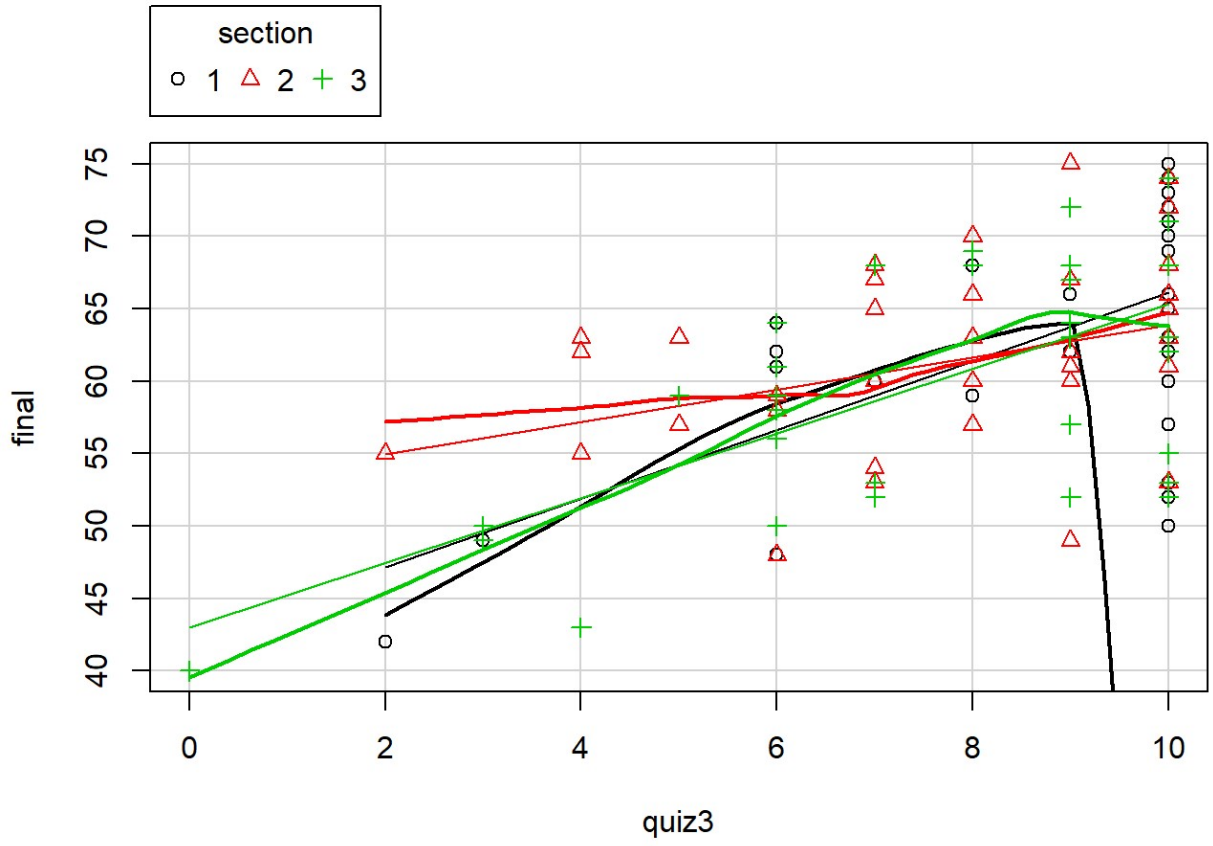

```
scatterplot(final~quiz3|gender, data=grades)
```



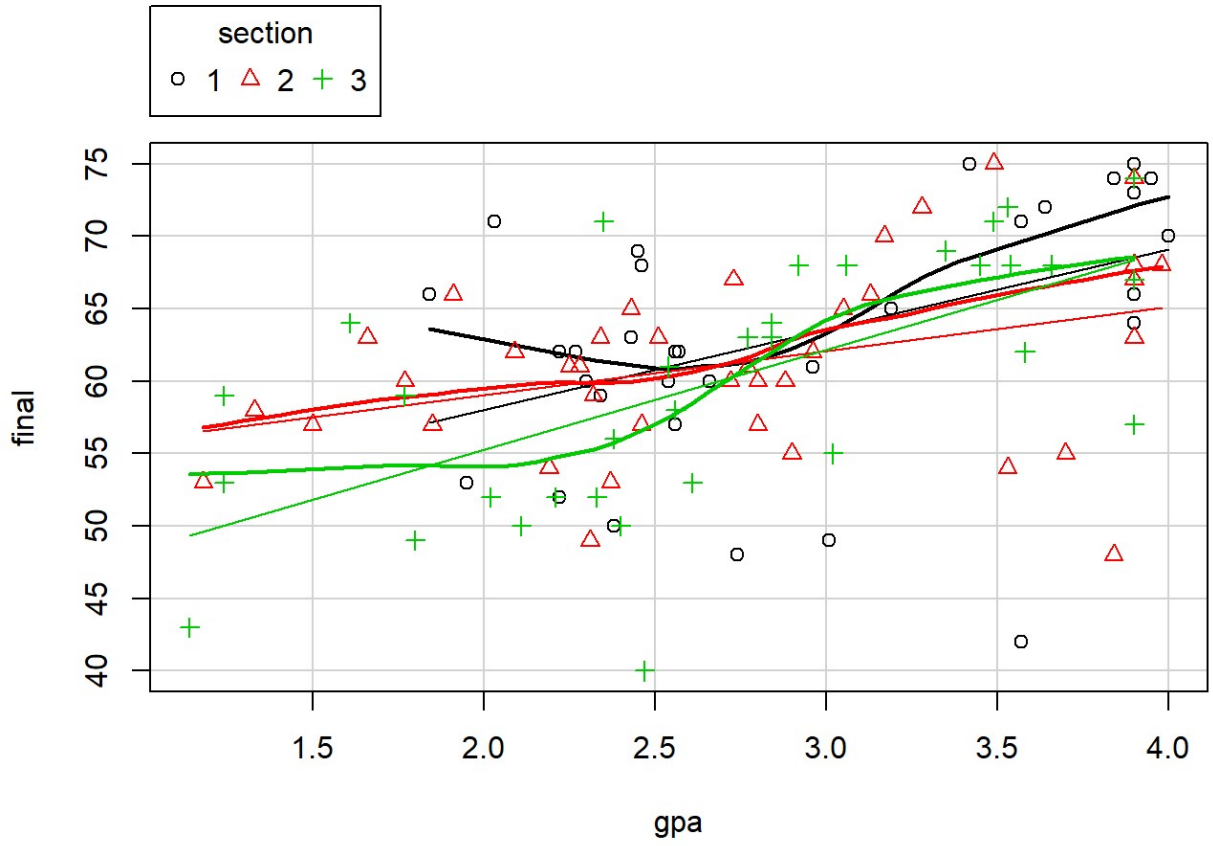

```
scatterplot(final~gpa|gender, data=grades)
```



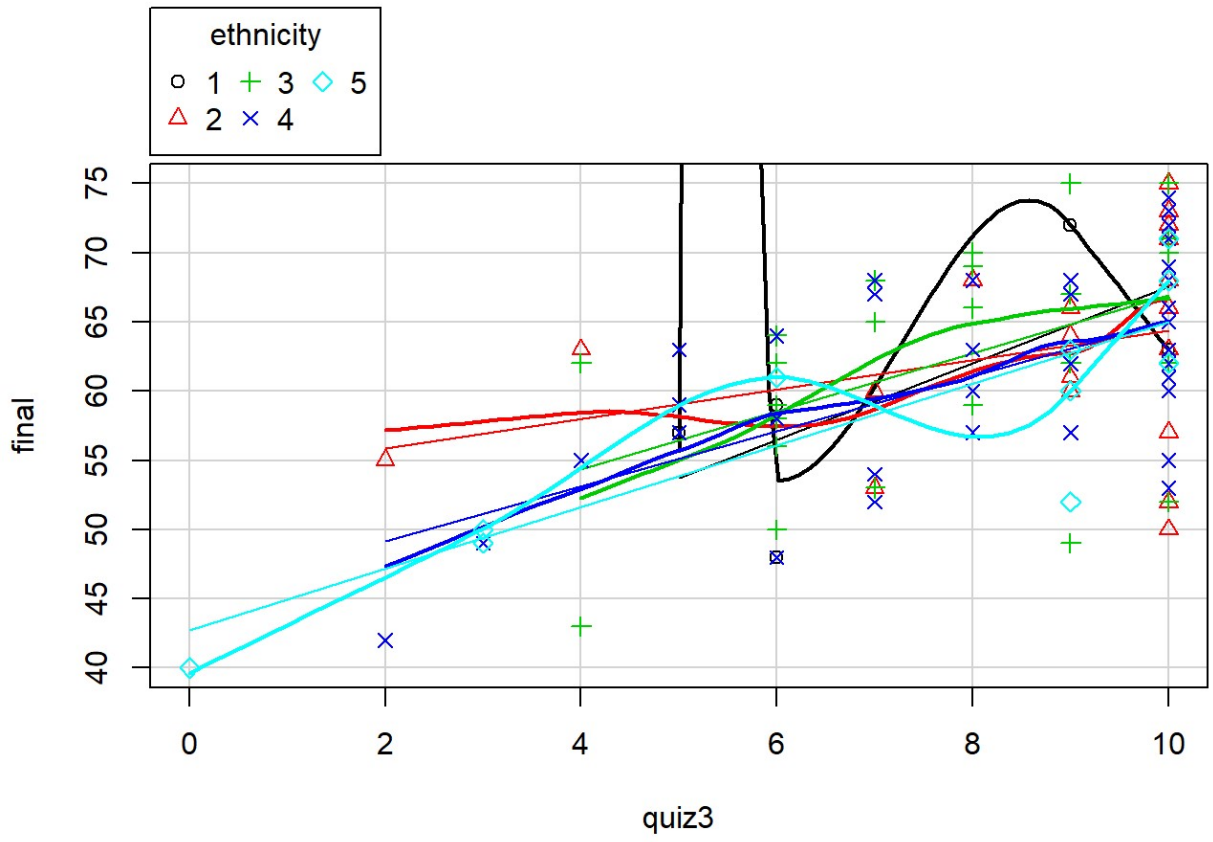

```
scatterplot(final~quiz3|section, data=grades)
```



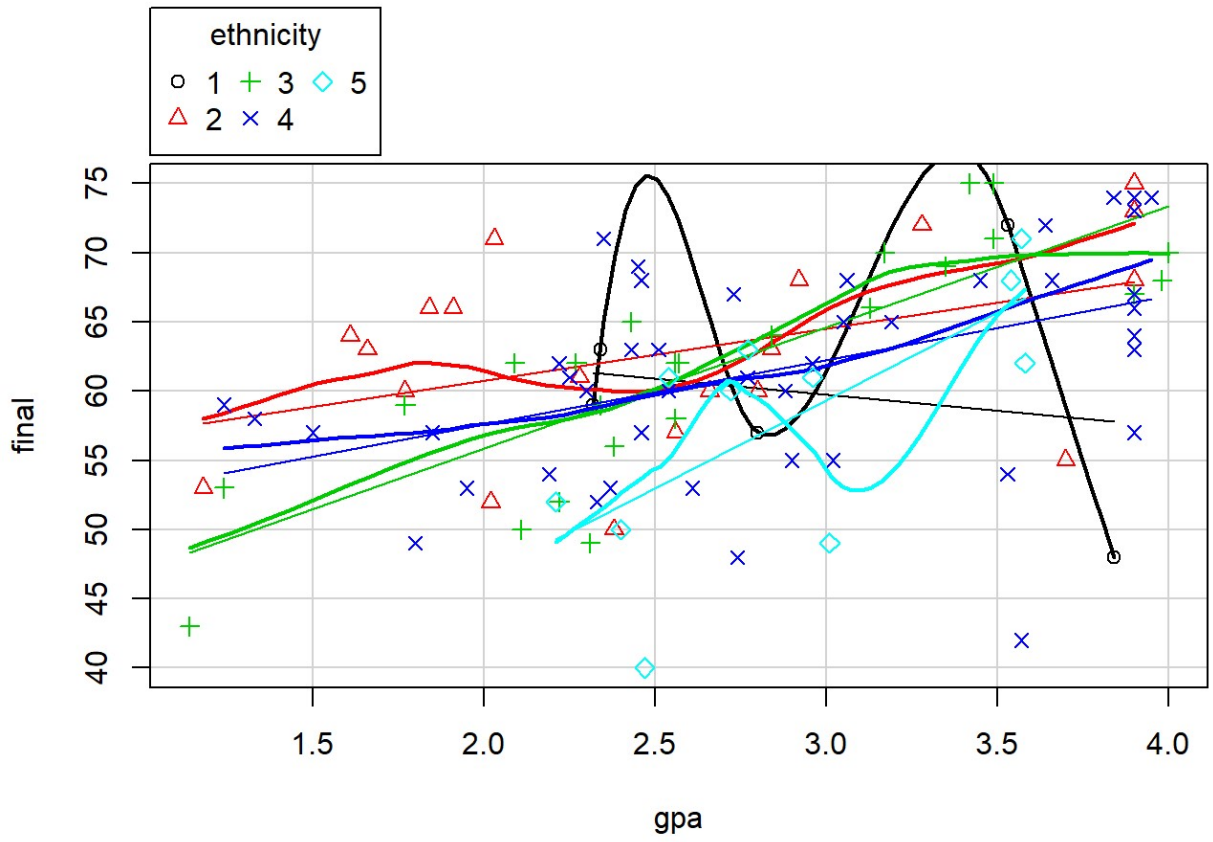

```
scatterplot(final~gpa|section, data=grades)
```



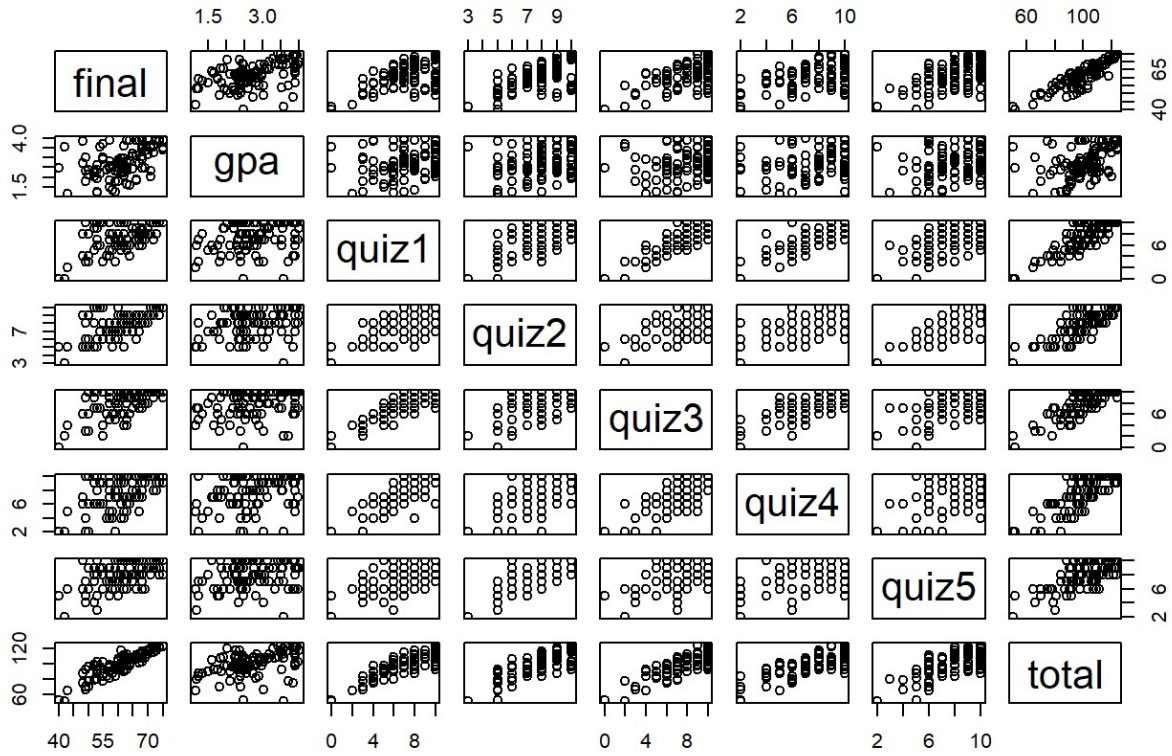

```
scatterplot(final~quiz3|ethnicity, data=grades)
```




```
scatterplot(final~gpa|ethnicity, data=grades)
```




```
#visualize association of predictors and response variable.
pairs(~final+gpa+quiz1+quiz2+quiz3+quiz4+quiz5+total, data=grades, main= "scatter plo
t matrix")
```




```
#Model4 is having R-squred value less when comapred with model3.. so, model3 will be s
elected as final model
#4.How do you interpret significance value of F-statistics? Mention in 4 lines and sho
w R Output. [Fitness of model]
anova(model3)
```

```
## Analysis of Variance Table
##
## Response: final
##           Df Sum Sq Mean Sq F value    Pr(>F)
## gpa        1 1627.8 1627.81 48.1944 4.077e-10 ***
## quiz2      1 1226.1 1226.12 36.3016 2.898e-08 ***
## quiz3      1  322.7  322.75  9.5555  0.002589 **
## quiz4      1    0.2    0.18  0.0054  0.941762
## quiz5      1   41.5   41.52  1.2293  0.270235
## Residuals 99 3343.8   33.78
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
anova(model4)
```

```
## Analysis of Variance Table
##
## Response: final
##            Df Sum Sq Mean Sq F value    Pr(>F)
## gpa         1 1627.8 1627.81  46.300 7.096e-10 ***
## quiz3       1 1348.3 1348.28  38.349 1.255e-08 ***
## Residuals 102 3586.1   35.16
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

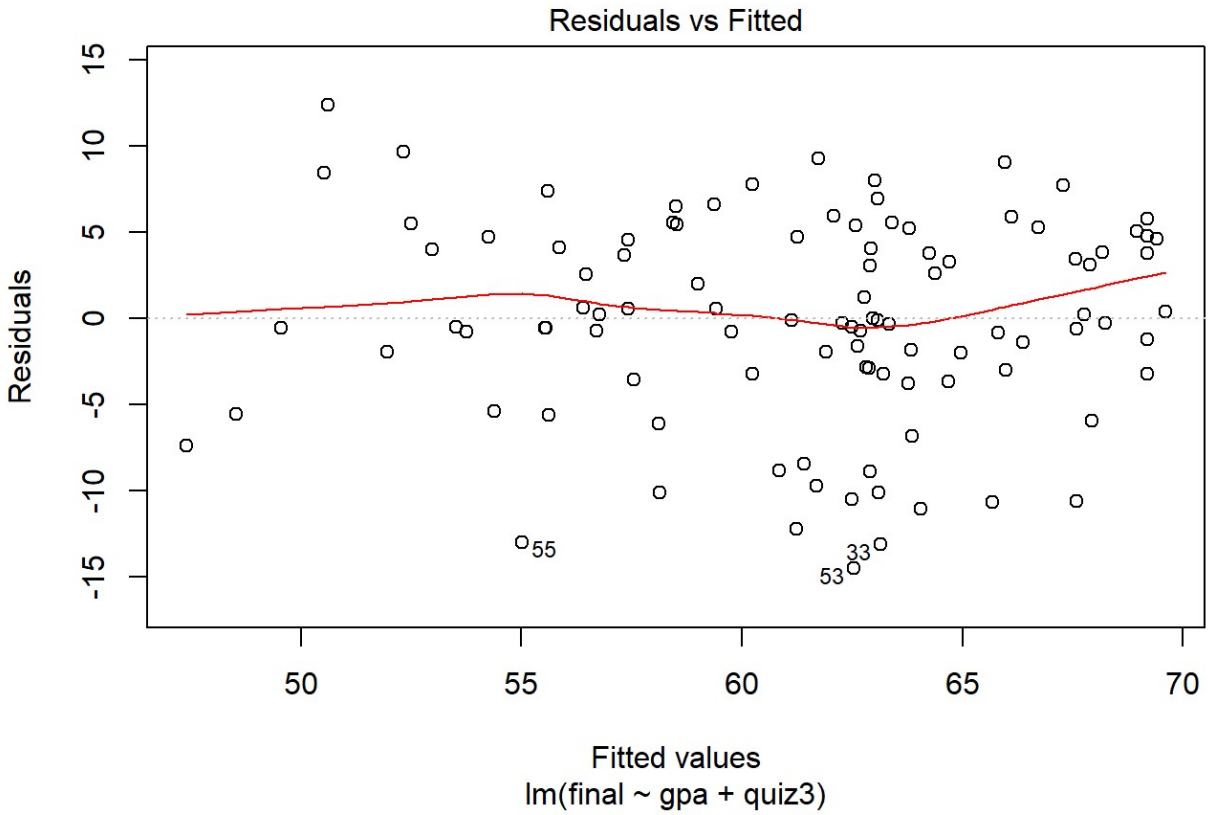
```
#From anova test p value it can conclude that quiz2, quiz4 and quiz5 are not having si
gnificant slope with response variable fianl So, lets Check durbin watson statistic te
st to check auto corrrlation among variables.
durbinWatsonTest(model3)
```

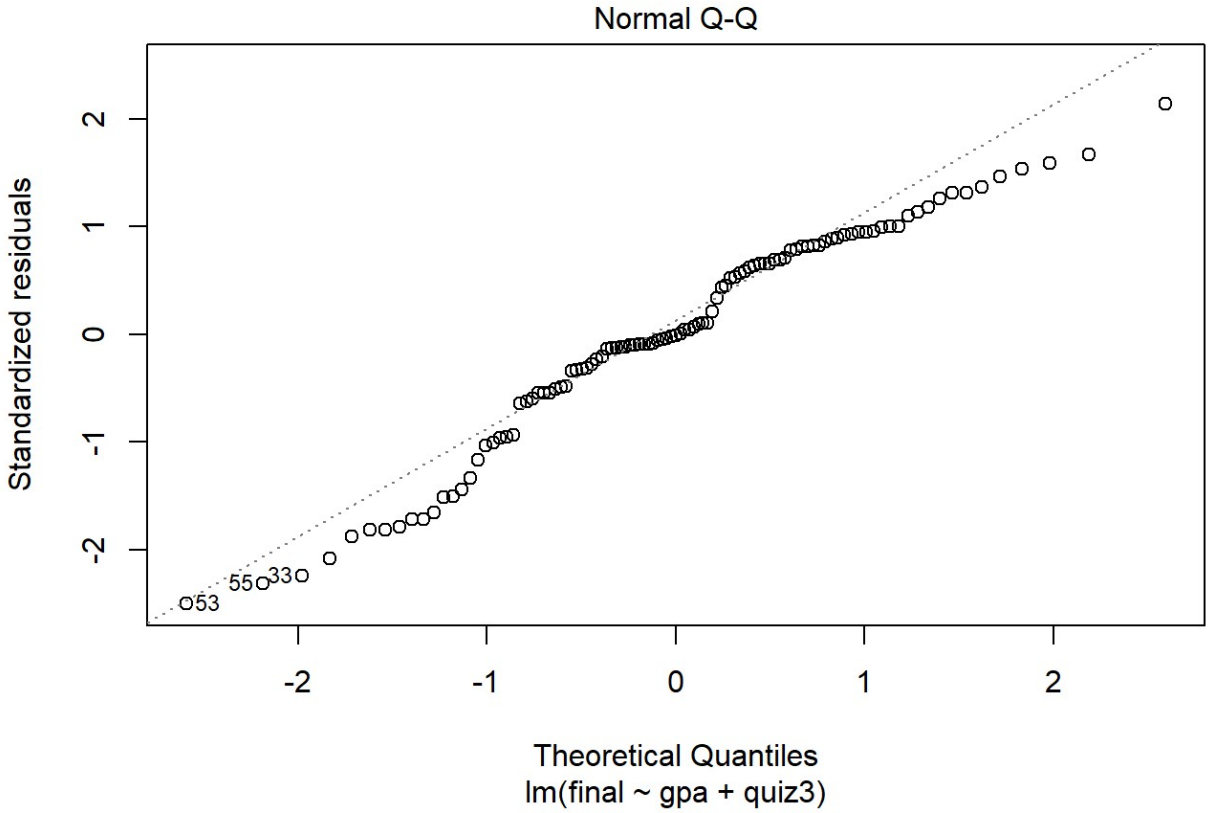
```
##  lag Autocorrelation D-W Statistic p-value
##    1      -0.1288976      2.247614   0.232
##  Alternative hypothesis: rho != 0
```

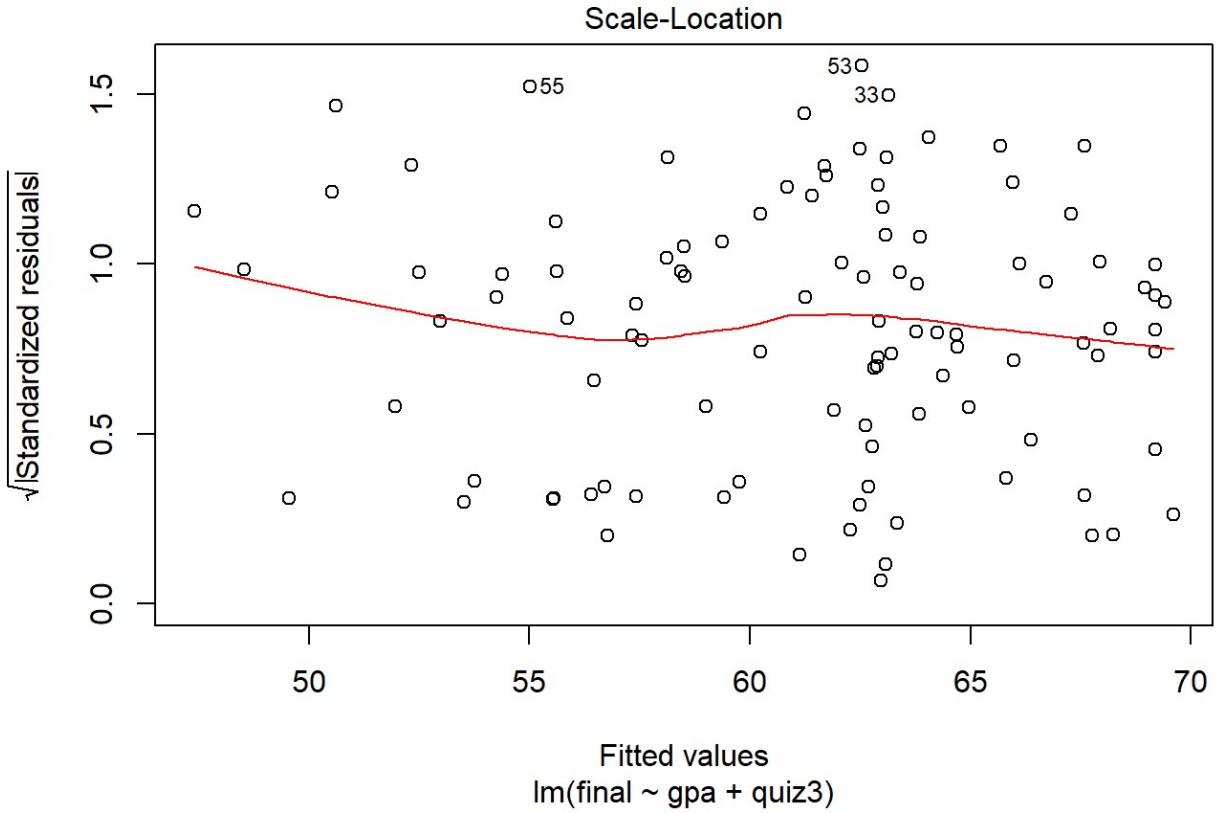
```
durbinWatsonTest(model4)
```

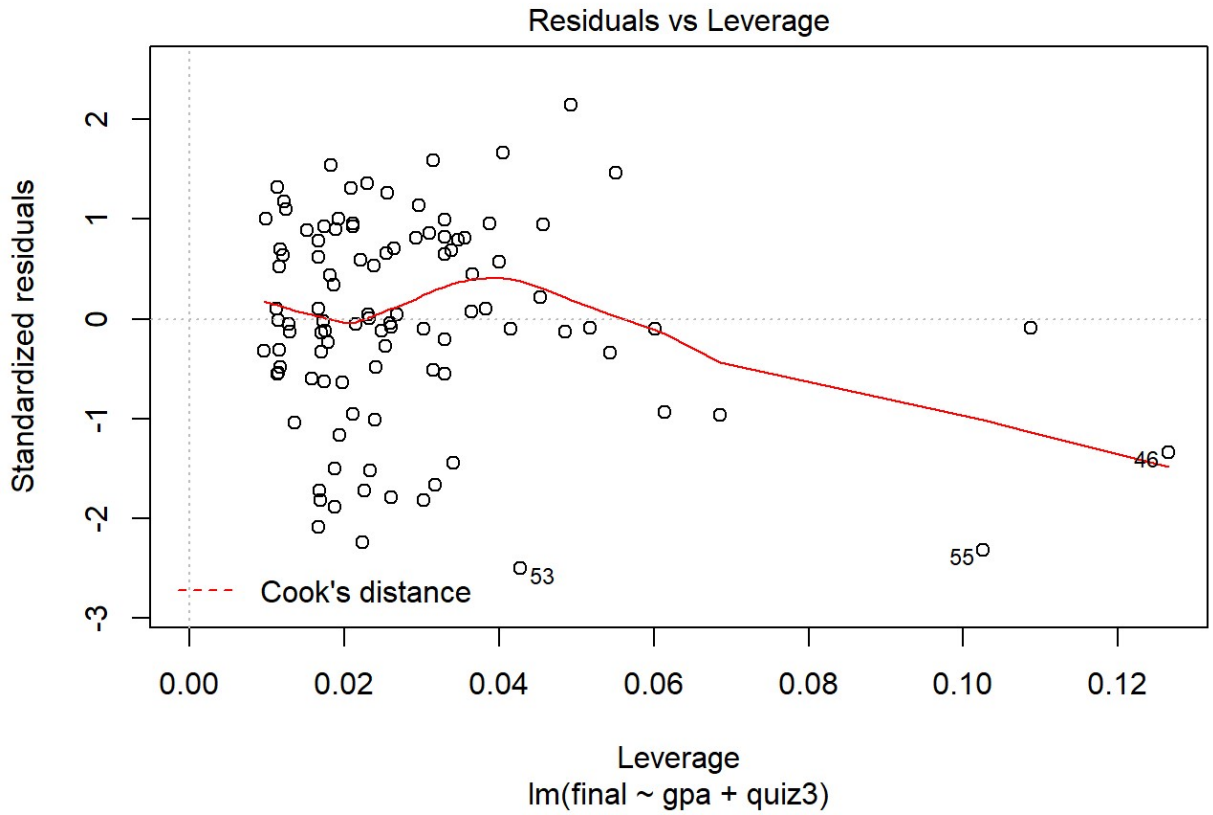
```
##  lag Autocorrelation D-W Statistic p-value
##    1     -0.09929107      2.194562    0.35
##  Alternative hypothesis: rho != 0
```

```
plot(model4)
```


Residuals vs Fitted
Residuals
15
10
5
0
-5
-10
-15
50
55
60
65
70
55
33
53
Fitted values
lm(final ~ gpa + quiz3)


Normal Q-Q
Standardized residuals
2
1
0
-1
-2
53
55
33
-2
-1
0
1
2
Theoretical Quantiles
lm(final ~ gpa + quiz3)


Scale-Location
√|Standardized residuals|
0.0
0.5
1.0
1.5
55
53
33
50
55
60
65
70
Fitted values
lm(final ~ gpa + quiz3)



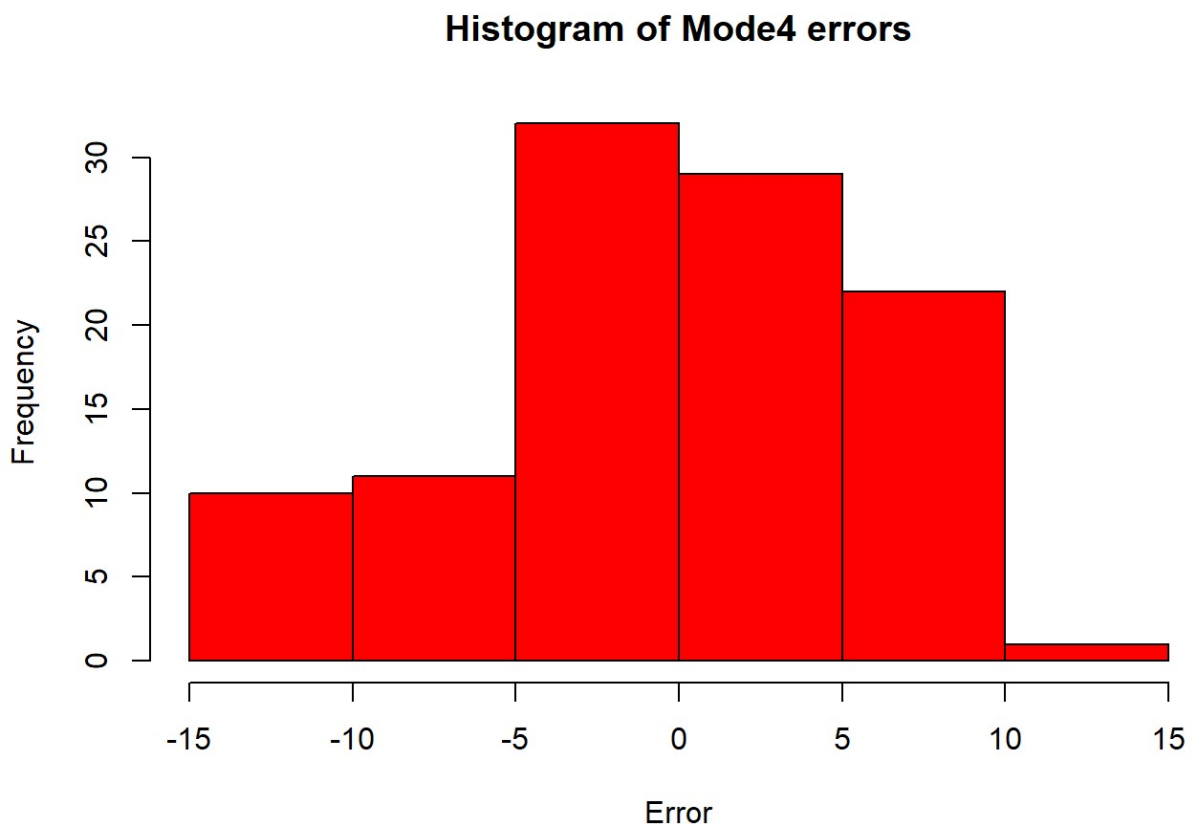

```
#9. Test the assumption of Normality and interpret your findings. [hint: histogram of residuals/errors]
#Show histogram and interpret in maximum 3 lines.
#Lets find error/residual term of model3 as below
residual<-residuals(model4)
residual
```

```
##           1           2           3           4           5
##  -0.51437366  -3.54694323  -3.23375140   3.30622554   6.63289284
##           6           7           8           9          10
##   4.79925345  -1.96854482   3.11682569   4.59962129   9.04503165
##          11          12          13          14          15
##   2.54280767   7.98785032   5.58858601  -0.55533632  -6.10591327
##          16          17          18          19          20
##   3.66442618  12.39554117 -10.13410245   7.39299999  -3.77075188
##          21          22          23          24          25
##  -0.53186180  -1.20074655  -8.84438513   7.76624860  -5.52828439
##          26          27          28          29          30
##   9.67870462   0.02777675   9.26549612   0.23513348  -1.61288537
##          31          32          33          34          35
##  -0.12387015 -10.68722058 -13.13192897   4.74461330  -8.89708504
##          36          37          38          39          40
## -11.05023690  -3.20004458   0.57651449  -0.08026529   5.03881204
##          41          42          43          44          45
##  -0.69675092  -0.75463422   6.93147197   7.71572216  -2.88063313
##          46          47          48          49          50
##  -7.40332171   5.49552438  -2.98315752   4.79925345   1.98751606
##          51          52          53          54          55
##   5.79925345   5.21279621 -14.52600990   5.42232641 -13.01281820
##          56          57          58          59          60
##  -0.80699988  -0.75393225   4.73876140   3.83734067   0.58457332
##          61          62          63          64          65
##   8.46365678   0.59918602  -0.59195203  -5.92310074   5.55120076
##          66          67          68          69          70
##   4.12996688  -0.28173666  -1.83886748   3.09117770 -10.59195203
##          71          72          73          74          75
##  -0.69273823   6.49482241  -1.91066152  -1.95022024  -5.38573255
##          76          77          78          79          80
##   3.79925345   0.39998914  -0.49310607   4.58457332  -8.41509242
##          81          82          83          84          85
##  -3.20074655   0.23660498  -0.24251219  -6.85060474   5.92963276
##          86          87          88          89          90
##   3.79925345 -12.24364944  -3.68905980   5.46663324   4.02814446
##          91          92          93          94          95
##   3.43623714 -10.49310607   5.27469220   4.07944044  -9.69457744
##          96          97          98          99         100
##   5.88532593   2.62563700  -2.81251752 -10.09200254  -1.36596992
##         101         102         103         104         105
##   1.23443151  -0.55463435  -5.61873727  -0.33156113   3.76186820
```

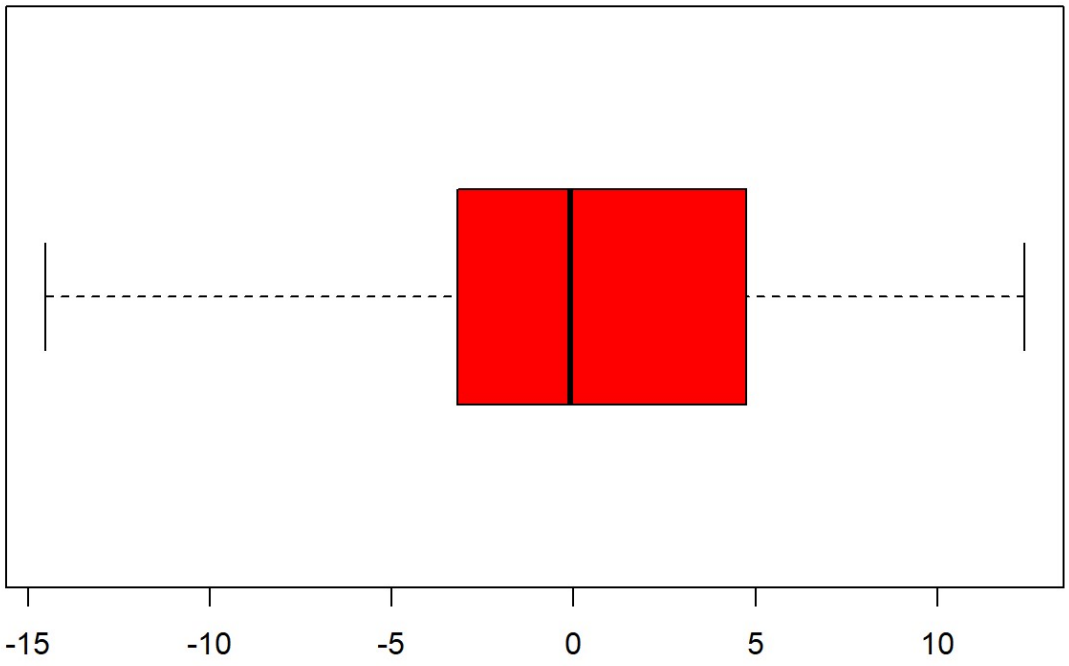
```
summary(residual)
```

```
##      Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
## -14.52601  -3.20004  -0.08027   0.00000   4.73876  12.39554
```

```
hist(residual, col="red", main = "Histogram of Mode4 errors", xlab = "Error", ylab =
"Frequency")
```




```
boxplot(residual, col="red", horizontal = T)
```




```
#10.    Test the assumption of Independent of observations and interpret in maximum 3 lines [hint: draw scatter plot between residuals/errors (y-axis) and observation numbers (x-axis)]
grades$residual=NULL
grades$residual=residual
obs_no<-c(1:105)
grades$obs_no=NULL
grades$obs_no=obs_no
grades
```

```
##     Sr_No     id   lastname  firstname gender ethnicity year lowup section
## 1       1 106484  VILLARRUZ     ALFRED      2         2    2     1       2
## 2       2 108642  VALAZQUEZ      SCOTT      2         4    3     2       2
## 3       3 127285     GALVEZ     JACKIE      1         4    4     2       2
## 4       4 132931    OSBORNE        ANN      1         3    2     1       2
## 5       5 140219     GUADIZ    VALERIE      1         2    4     2       1
## 6       6 142630    RANGIFO    TANIECE      1         4    3     2       3
## 7       7 153964   TOMOSAWA     DANIEL      2         2    3     2       3
## 8       8 154441       LIAN      JENNY      1         5    2     1       1
## 9       9 157147     BAKKEN       KREG      2         4    3     2       1
## 10     10 164605   LANGFORD       DAWN      1         3    3     2       2
## 11     11 164842 VALENZUELA      NANCY      1         1    4     2       2
## 12     12 167664      SWARM       MARK      2         4    3     2       3
## 13     13 175325     KHOURY     DENNIS      2         4    3     2       1
## 14     14 192627    MISCHKE     ELAINE      1         4    1     1       2
## 15     15 211239     AUSTIN    DERRICK      2         4    3     2       3
## 16     16 219593     POTTER     MICKEY      1         5    3     2       3
## 17     17 237983        LEE   JONATHAN      2         2    4     2       2
## 18     18 245473      DAYES     ROBERT      2         4    3     2       1
## 19     19 249586      STOLL    GLENDON      2         4    3     2       2
## 20     20 260983     CUSTER      JAMES      2         4    4     2       1
## 21     21 273611         WU    VIDYUTH      1         2    2     1       2
## 22     22 280440      CHANG       RENE      1         2    3     2       2
## 23     23 287617   CUMMINGS     DAVENA      1         5    3     2       3
## 24     24 289652    BRADLEY    SHANNON      1         4    3     2       1
## 25     25 302400      JONES     ROBERT      2         3    4     2       3
## 26     26 307894   TORRENCE       GWEN      1         3    2     1       2
## 27     27 337908    UYEYAMA  VICTORINE      1         1    3     2       2
## 28     28 354601     CARPIO       MARY      1         2    2     1       1
## 29     29 378446   SAUNDERS     TAMARA      1         1    2     1       2
## 30     30 380157       LUTZ    WILLIAM      2         4    3     2       2
## 31     31 390203      SHIMA    MIHAELA      1         2    3     2       2
## 32     32 392464    DOMINGO     MONIKA      1         4    3     2       3
## 33     33 414775     RATANA      JASON      2         2    3     2       1
## 34     34 417003 EVANGELIST      NIKKI      1         2    3     2       2
## 35     35 419891   DE CANIO      PAULA      1         4    3     2       2
## 36     36 420327     BADGER    SUZANNA      1         4    3     2       3
## 37     37 434571       SURI     MATHEW      2         2    3     2       2
## 38     38 436413       PANG    SUZANNE      1         2    3     2       1
## 39     39 447659 GALANVILLE       DANA      1         5    4     2       3
## 40     40 463276     HANSEN        TIM      2         4    3     2       1
## 41     41 466407  PICKERING      HEIDI      1         3    3     2       3
## 42     42 467806     DEVERS       GAIL      1         3    3     2       1
## 43     43 473303       PARK     SANDRA      1         3    4     2       2
## 44     44 479547   LANGFORD      BLAIR      2         3    3     2       1
## 45     45 490016    STEPHEN       LIZA      1         5    3     2       2
## 46     46 498900      HUANG        JOE      2         5    3     2       3
## 47     47 506467 SCARBROUGH     CYNTHE      1         4    3     2       2
```

```
## 48     48 515586    FIALLOS     LAUREL      1         4    2     1        2
## 49     49 519444    RATHBUN      DAWNE      1         4    4     2        2
## 50     50 546022     HAMIDI   KIMBERLY      1         5    3     2        1
## 51     51 553919       KWON     SHELLY      1         2    3     2        1
## 52     52 554809      JONES       LISA      1         3    3     2        3
## 53     53 574170     HURRIA      WAYNE      2         1    2     1        2
## 54     54 576008   BULMERKA     HUSIBA      1         4    4     2        3
## 55     55 576141  MISHALANY       LUCY      1         4    3     2        1
## 56     56 594463    CRUZADO   MARITESS      1         4    4     2        2
## 57     57 595177   WILLIAMS    OLIMPIA      1         3    3     2        3
## 58     58 615115   VASENIUS       RUSS      2         3    3     2        3
## 59     59 616095   SPRINGER   ANNELIES      1         4    3     2        1
## 60     60 623857     CORTEZ      VIKKI      1         3    4     2        3
## 61     61 664653       KHAN       JOHN      2         4    3     2        3
## 62     62 681855   GRISWOLD       TAMMY      1         4    3     2        2
## 63     63 700978    WEBSTER     DEANNA      1         3    2     1        3
## 64     64 703740      SUNYA       DALE      2         5    3     2        3
## 65     65 721311       SONG       LOIS      2         2    3     2        3
## 66     66 725987   BATILLER       FRED      2         2    2     1        2
## 67     67 737728    BELTRAN        JIM      2         3    3     2        1
## 68     68 755724   LANGFORD     TREVOR      2         4    3     2        2
## 69     69 756097     KURSEE     JACKIE      1         3    3     2        2
## 70     70 762308       GOUW     BONNIE      1         4    2     1        3
## 71     71 762813       DAEL       IVAN      2         3    2     1        1
## 72     72 765360   ROBINSON       ERIC      2         3    3     2        2
## 73     73 768995 DUMITRESCU      STACY      2         4    4     2        2
## 74     74 777683   ANDERSON       ERIC      2         5    4     2        3
## 75     75 779481     AHGHEL     BRENDA      1         5    3     2        1
## 76     76 780028   ROBINSON    CLAYTON      2         4    3     2        1
## 77     77 781676    WATKINS     YVONNE      1         3    4     2        1
## 78     78 798931      ZUILL      RENAE      1         4    3     2        1
## 79     79 807963      LEWIS       CARL      2         3    2     1        1
## 80     80 818528 CARRINGTON       JYLL      1         4    3     2        1
## 81     81 822485 VALENZUELA    KATHRYN      1         4    1     1        1
## 82     82 843472      PRADO        DON      2         5    3     2        3
## 83     83 870810      REYNO   NICHOLAS      2         4    3     2        3
## 84     84 896972      HUANG      MIRNA      1         2    3     2        1
## 85     85 897606   GENOBAGA JACQUELINE      1         2    3     2        3
## 86     86 898766        RAO       DAWN      1         2    3     2        1
## 87     87 899529    HAWKINS  CARHERINE      1         3    4     2        2
## 88     88 900485    COCHRAN      STACY      2         4    3     2        2
## 89     89 905109    JENKINS       ERIC      2         3    2     1        3
## 90     90 908754    MARQUEZ   CHYRELLE      1         4    1     1        2
## 91     91 911355      LESKO    LETICIA      1         3    2     1        3
## 92     92 915457    SHEARER      LUCIO      2         3    3     2        1
## 93     93 920656       LIAO   MICHELLE      1         2    2     1        2
## 94     94 921297     KINZER    RICHARD      2         4    3     2        2
## 95     95 938666 SUAREZ-TAN      KHANH      1         2    3     2        3
## 96     96 938881        YEO     DENISE      1         1    3     2        3
```

```
## 97     97 944702    LEDESMA    MARTINE      1         4    3     2       2
## 98     98 958384      RONCO     SHERRY      1         4    2     1       1
## 99     99 972678      KAHRS       JANN      1         4    4     2       2
## 100   100 973427       ROSS      MARIA      1         4    4     2       1
## 101   101 978889    ZIMCHEK    ARMANDO      2         4    4     2       1
## 102   102 979028   NEUHARTH        JIM      2         4    3     2       3
## 103   103 983522      SLOAT      AARON      2         3    3     2       3
## 104   104 985700        CHA       LILY      1         4    2     1       1
## 105   105 988808   MCCONAHA       CORA      1         4    3     2       3
##      gpa extrc review quiz1 quiz2 quiz3 quiz4 quiz5 final total percent
## 1   1.18     1      2     6     5     7     6     3    53    80      64
## 2   2.19     2      1    10    10     7     6     9    54    96      77
## 3   2.46     2      2    10     7     8     9     7    57    98      78
## 4   3.98     1      1     7     8     7     7     6    68   103      82
## 5   1.84     1      1     7     8     9     8    10    66   108      86
## 6   3.90     1      2    10    10    10     9     9    74   122      98
## 7   2.84     2      1    10     9    10    10    10    63   112      90
## 8   3.57     1      2    10     9    10    10    10    71   120      96
## 9   3.95     2      2    10    10    10    10     9    74   123      98
## 10  3.49     2      1    10    10     9    10    10    75   124      99
## 11  2.32     1      1     7     8     6     7    10    59    97      78
## 12  2.35     1      2     8    10    10    10     9    71   118      94
## 13  2.45     1      1     8     8    10    10     6    69   111      89
## 14  2.90     1      1     3     8     4     6     8    55    84      67
## 15  2.33     1      2     5     5     7     6     4    52    79      63
## 16  2.54     1      2     5     8     6     4    10    61    94      75
## 17  1.66     2      2     5     7     4     7     6    63    92      74
## 18  2.74     1      1     8     9     6     7    10    48    88      70
## 19  2.51     1      1     5     9     5     6    10    63    98      78
## 20  2.54     1      1    10     9    10    10     7    60   106      85
## 21  3.70     1      2     3     6     2     6     6    55    78      62
## 22  3.90     1      2    10     8    10    10     8    68   114      91
## 23  2.21     1      2     9    10     9     9     9    52    98      78
## 24  2.46     1      2     6     9     8     9     9    68   109      87
## 25  1.14     1      2     2     5     4     5     6    43    65      52
## 26  2.09     2      2     6     5     4     7     6    62    90      72
## 27  2.34     2      1    10     8    10    10     7    63   108      86
## 28  2.03     1      2    10    10    10    10     9    71   120      96
## 29  2.80     1      2     4     6     5     4     5    57    81      65
## 30  2.25     2      2    10     9    10    10     8    61   118      86
## 31  2.28     1      2     6     7     9     6     8    61    97      78
## 32  3.02     2      1    10    10    10     9     9    55   103      82
## 33  2.38     1      2     8     9    10    10     9    50    96      77
## 34  1.91     1      2     9     8    10    10     6    66   109      87
## 35  3.53     1      2     6     7     7     9     9    54    92      74
## 36  2.61     1      2    10    10    10    10    10    53   103      82
## 37  2.80     1      1     7     6     9     8     8    60    98      78
## 38  2.66     1      2     8     6     7     8     7    60    96      77
## 39  2.77     1      1     6     8     9     5     8    63    99      79
```

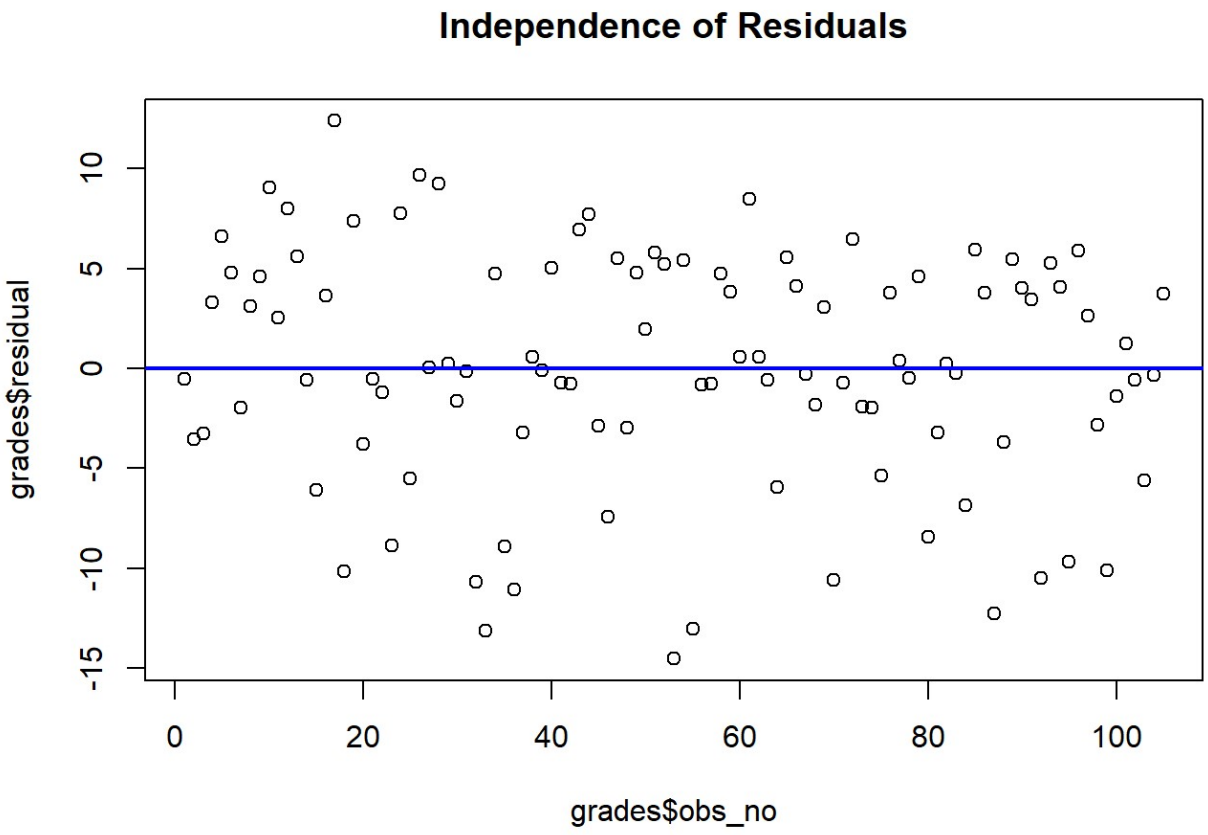
```
## 40  3.84     2      2    10    10    10     9    10    74   123      98
## 41  2.38     1      1     4     7     6     4     7    56    84      67
## 42  2.34     1      1     7     6     8     7     9    59    96      77
## 43  3.17     1      2     8     8     8    10     9    70   113      90
## 44  3.42     2      2    10    10    10     9    10    75   124      99
## 45  2.72     1      2     8     9     9     8    10    60   104      83
## 46  2.47     1      1     0     5     0     2     5    40    52      42
## 47  1.33     1      2     8     5     6     4     7    58    88      70
## 48  3.90     1      1     7     8     8     6     6    63    98      78
## 49  3.90     1      1    10     9    10    10     8    74   121      97
## 50  2.96     1      1     7     7     6     9     8    61    98      78
## 51  3.90     2      2    10    10    10    10     8    75   123      98
## 52  3.35     1      1     7     8     8     9     6    69   107      86
## 53  3.84     1      1     4     5     6     6     6    48    75      60
## 54  3.45     2      1    10     8     7     9     7    68   109      87
## 55  3.57     1      2     0     3     2     2     2    42    51      41
## 56  3.05     1      2     9     8    10     8     8    65   108      86
## 57  1.24     1      1     7     6     7    10     5    53    88      70
## 58  1.77     1      2     6     7     6     8     6    59    92      74
## 59  3.64     1      2    10    10    10    10    10    72   122      98
## 60  2.56     1      2     5     7     6     5     6    58    87      70
## 61  1.24     1      2     3     8     5     2     7    59    84      67
## 62  1.50     1      2     5     7     8     5     8    57    90      72
## 63  3.90     1      2     8     9     9    10    10    67   113      90
## 64  3.58     1      2    10     9    10    10     7    62   108      86
## 65  1.61     1      1     6     9     9     7    10    64   105      84
## 66  1.77     1      2     6     7     7     7     5    60    92      74
## 67  2.57     1      1     6     8     9     5     7    62    97      78
## 68  2.96     1      2     8     9     9     9     8    62   105      84
## 69  3.13     1      2     9     6     8     7    10    66   106      85
## 70  3.90     1      2     8     7     9    10     8    57    99      79
## 71  2.27     2      2    10     9    10    10    10    62   111      89
## 72  2.43     1      2     8     8     7     8    10    65   106      85
## 73  2.88     1      1     7    10     8     9    10    60   104      83
## 74  2.40     1      1     3     6     3     2     6    50    70      56
## 75  3.01     1      2     3     5     3     2     4    49    66      53
## 76  3.90     1      2    10    10    10     9    10    73   122      98
## 77  4.00     1      2     9     9    10    10     9    70   117      94
## 78  2.22     2      2    10     9    10    10     8    62   109      87
## 79  2.56     2      1     8     5     6     4     7    62    92      74
## 80  1.95     1      2     9    10    10     8     8    53    98      78
## 81  3.90     1      2     8     9    10    10     8    66   111      89
## 82  3.54     1      2     9     9    10     8     9    68   113      90
## 83  3.66     2      1    10     8    10    10    10    68   116      93
## 84  2.56     1      1     7     6    10     8     7    57    95      76
## 85  2.92     1      2     8     9     8     8     7    68   108      86
## 86  3.90     1      2     8    10    10     8     9    73   118      94
## 87  2.31     1      1    10     8     9    10     7    49    93      74
## 88  2.77     2      2    10     9    10    10     9    61   109      87
```

```
## 89  2.84     1      1     6     8     6     6    10    64   100      80
## 90  1.85     1      2     4     8     5     7     9    57    90      72
## 91  3.49     1      2    10     9    10    10     8    71   118      94
## 92  2.22     1      2    10    10    10     9     8    52    99      79
## 93  3.28     2      2    10     9    10    10     9    72   120      96
## 94  2.73     1      2     7     9     9     7     8    67   107      86
## 95  2.02     2      2    10     8    10    10     7    52    97      78
## 96  3.53     1      2     7    10     9     8     9    72   115      92
## 97  3.90     1      2     6     7     7     5     9    67   101      81
## 98  2.30     1      2    10     9    10    10     7    60   106      85
## 99  2.37     1      2    10    10    10    10    10    53    93      74
## 100 3.19     1      2     9     7    10     9     7    65   107      86
## 101 3.90     1      2     4     8     6     6     9    64    97      78
## 102 1.80     1      2     3     6     3     4     5    49    70      56
## 103 2.11     1      1     4     5     6     6     6    50    77      62
## 104 2.43     2      2    10     9    10    10     7    63   109      87
## 105 3.06     1      2     7     8     9     8     7    68   107      86
##     grade passfail     residual obs_no
## 1       D        P  -0.51437366      1
## 2       C        P  -3.54694323      2
## 3       C        P  -3.23375140      3
## 4       B        P   3.30622554      4
## 5       B        P   6.63289284      5
## 6       A        P   4.79925345      6
## 7       A        P  -1.96854482      7
## 8       A        P   3.11682569      8
## 9       A        P   4.59962129      9
## 10      A        P   9.04503165     10
## 11      C        P   2.54280767     11
## 12      A        P   7.98785032     12
## 13      B        P   5.58858601     13
## 14      D        P  -0.55533632     14
## 15      D        P  -6.10591327     15
## 16      C        P   3.66442618     16
## 17      C        P  12.39554117     17
## 18      C        P -10.13410245     18
## 19      C        P   7.39299999     19
## 20      B        P  -3.77075188     20
## 21      D        P  -0.53186180     21
## 22      A        P  -1.20074655     22
## 23      C        P  -8.84438513     23
## 24      B        P   7.76624860     24
## 25      F        F  -5.52828439     25
## 26      C        P   9.67870462     26
## 27      B        P   0.02777675     27
## 28      A        P   9.26549612     28
## 29      D        P   0.23513348     29
## 30      B        P  -1.61288537     30
## 31      C        P  -0.12387015     31
```

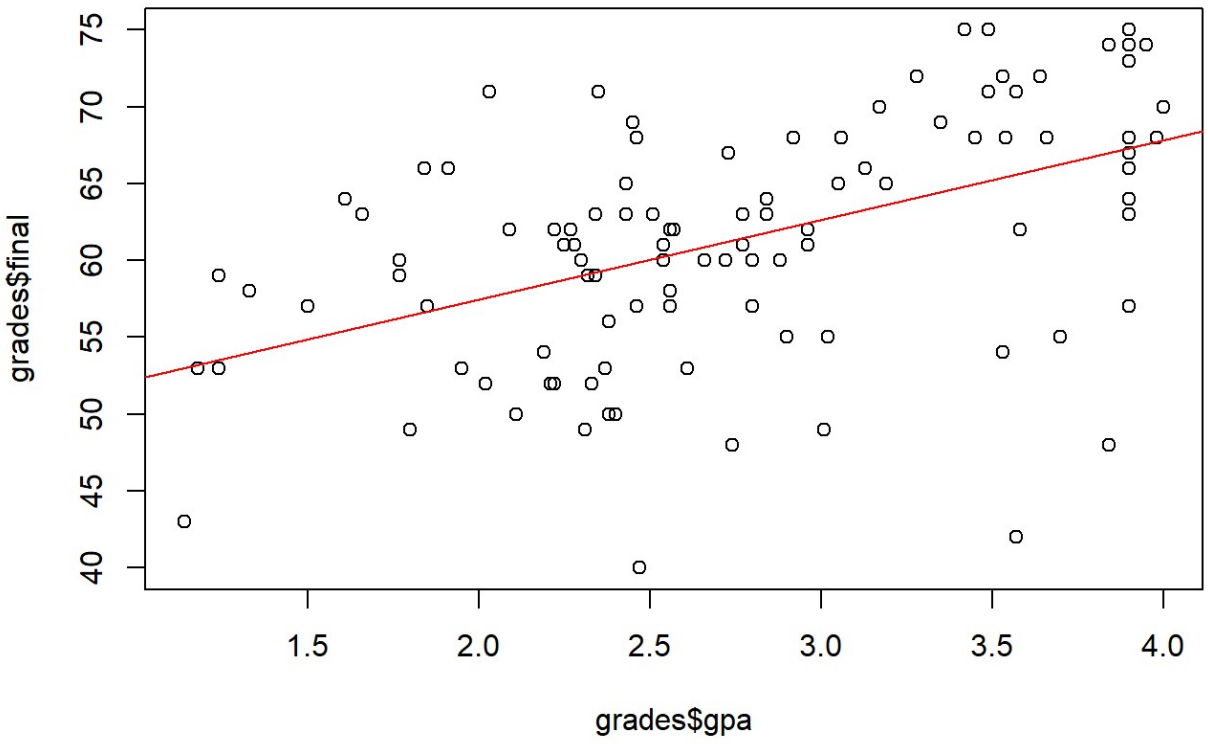
```
## 32      B        P -10.68722058     32
## 33      C        P -13.13192897     33
## 34      B        P   4.74461330     34
## 35      C        P  -8.89708504     35
## 36      B        P -11.05023690     36
## 37      C        P  -3.20004458     37
## 38      C        P   0.57651449     38
## 39      C        P  -0.08026529     39
## 40      A        P   5.03881204     40
## 41      D        P  -0.69675092     41
## 42      C        P  -0.75463422     42
## 43      A        P   6.93147197     43
## 44      A        P   7.71572216     44
## 45      B        P  -2.88063313     45
## 46      F        F  -7.40332171     46
## 47      C        P   5.49552438     47
## 48      C        P  -2.98315752     48
## 49      A        P   4.79925345     49
## 50      C        P   1.98751606     50
## 51      A        P   5.79925345     51
## 52      B        P   5.21279621     52
## 53      D        P -14.52600990     53
## 54      B        P   5.42232641     54
## 55      F        F -13.01281820     55
## 56      B        P  -0.80699988     56
## 57      C        P  -0.75393225     57
## 58      C        P   4.73876140     58
## 59      A        P   3.83734067     59
## 60      C        P   0.58457332     60
## 61      D        P   8.46365678     61
## 62      C        P   0.59918602     62
## 63      A        P  -0.59195203     63
## 64      B        P  -5.92310074     64
## 65      B        P   5.55120076     65
## 66      C        P   4.12996688     66
## 67      C        P  -0.28173666     67
## 68      B        P  -1.83886748     68
## 69      B        P   3.09117770     69
## 70      C        P -10.59195203     70
## 71      B        P  -0.69273823     71
## 72      B        P   6.49482241     72
## 73      B        P  -1.91066152     73
## 74      F        F  -1.95022024     74
## 75      F        F  -5.38573255     75
## 76      A        P   3.79925345     76
## 77      A        P   0.39998914     77
## 78      B        P  -0.49310607     78
## 79      C        P   4.58457332     79
## 80      C        P  -8.41509242     80
```

```
## 81      B        P  -3.20074655     81
## 82      A        O   0.23660498     82
## 83      A        P  -0.24251219     83
## 84      C        P  -6.85060474     84
## 85      B        P   5.92963276     85
## 86      A        P   3.79925345     86
## 87      C        P -12.24364944     87
## 88      B        P  -3.68905980     88
## 89      B        P   5.46663324     89
## 90      C        P   4.02814446     90
## 91      A        P   3.43623714     91
## 92      C        P -10.49310607     92
## 93      A        P   5.27469220     93
## 94      B        P   4.07944044     94
## 95      C        P  -9.69457744     95
## 96      A        P   5.88532593     96
## 97      B        P   2.62563700     97
## 98      B        P  -2.81251752     98
## 99      C        P -10.09200254     99
## 100     B        P  -1.36596992    100
## 101     C        P   1.23443151    101
## 102     F        F  -0.55463435    102
## 103     D        P  -5.61873727    103
## 104     B        P  -0.33156113    104
## 105     B        P   3.76186820    105
```

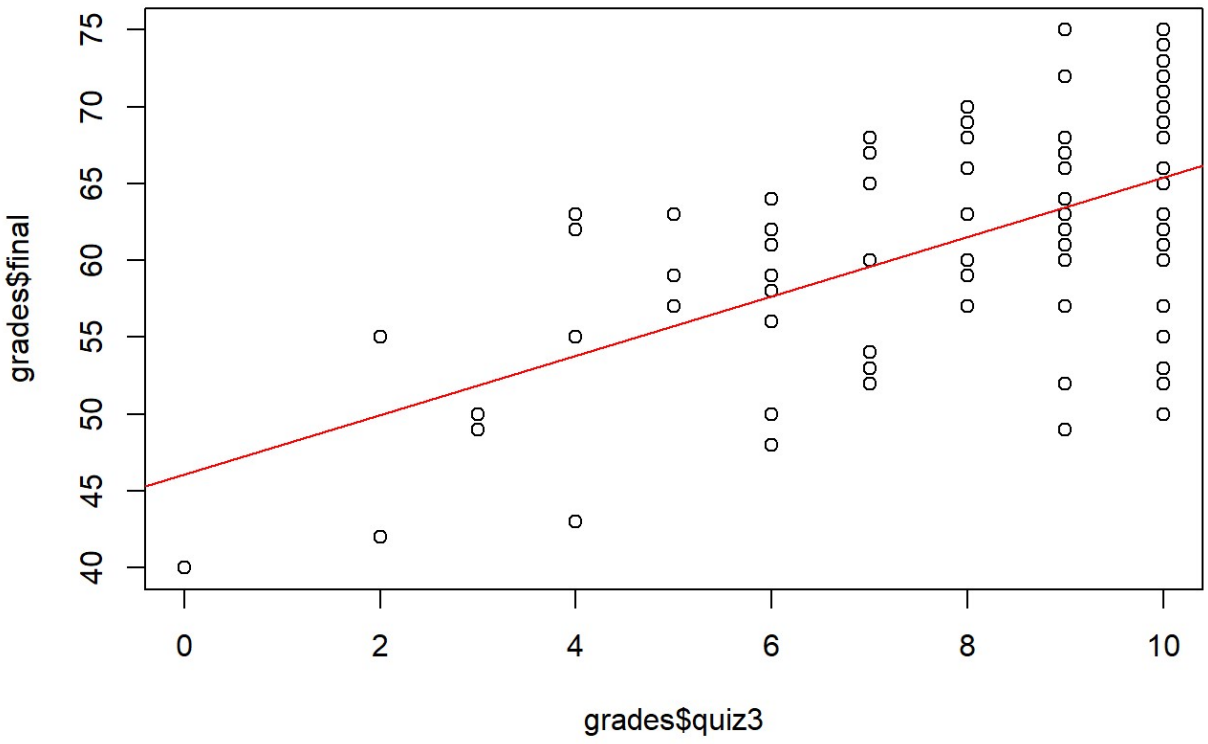
```
#lets plot independent obseration numbers vs error
plot(grades$obs_no, grades$residual, main="Independence of Residuals")
abline(h = 0, col = "blue", lwd=2)
```



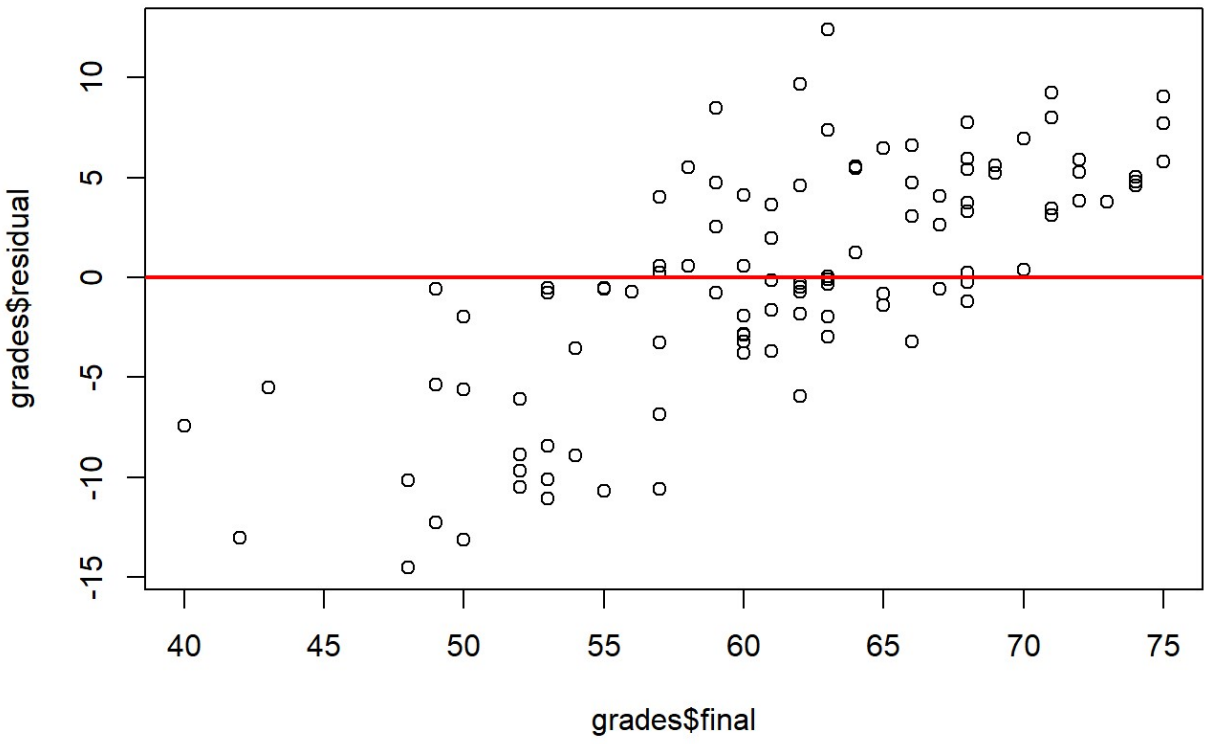

```
#11.    Test the assumption of linear relationship and interpret in maximum 3 lines fo
r each predictor [hint: draw scatter plot between response variable, final (y-axis) an
d predictor/s (x-axis). If more than one predictor is used in model then more scatter
plots would be required]
plot(grades$gpa, grades$final)
abline(lm(grades$final~grades$gpa), col="red")
```




```
plot(grades$quiz3, grades$final)
abline(lm(grades$final~grades$quiz3), col="red")
```




```
plot(grades$final, grades$residual)
abline(h = 0, col = "red", lwd=2)
```




```
#12.     Test the assumption of Constant Error Variance and interpret in maximum 3 lin
es [hint: draw scatter plot between residuals/errors (y-axis) and predicted values (x
-axis)]
pred<-predict(model4)
grades$pred<-NULL
grades$pred<-pred
grades
```

```
##     Sr_No     id   lastname  firstname gender ethnicity year lowup section
## 1       1 106484  VILLARRUZ     ALFRED      2         2    2     1       2
## 2       2 108642  VALAZQUEZ      SCOTT      2         4    3     2       2
## 3       3 127285     GALVEZ     JACKIE      1         4    4     2       2
## 4       4 132931    OSBORNE        ANN      1         3    2     1       2
## 5       5 140219     GUADIZ    VALERIE      1         2    4     2       1
## 6       6 142630    RANGIFO    TANIECE      1         4    3     2       3
## 7       7 153964   TOMOSAWA     DANIEL      2         2    3     2       3
## 8       8 154441       LIAN      JENNY      1         5    2     1       1
## 9       9 157147     BAKKEN       KREG      2         4    3     2       1
## 10     10 164605   LANGFORD       DAWN      1         3    3     2       2
## 11     11 164842 VALENZUELA      NANCY      1         1    4     2       2
## 12     12 167664      SWARM       MARK      2         4    3     2       3
## 13     13 175325     KHOURY     DENNIS      2         4    3     2       1
## 14     14 192627    MISCHKE     ELAINE      1         4    1     1       2
## 15     15 211239     AUSTIN    DERRICK      2         4    3     2       3
## 16     16 219593     POTTER     MICKEY      1         5    3     2       3
## 17     17 237983        LEE   JONATHAN      2         2    4     2       2
## 18     18 245473      DAYES     ROBERT      2         4    3     2       1
## 19     19 249586      STOLL    GLENDON      2         4    3     2       2
## 20     20 260983     CUSTER      JAMES      2         4    4     2       1
## 21     21 273611         WU    VIDYUTH      1         2    2     1       2
## 22     22 280440      CHANG       RENE      1         2    3     2       2
## 23     23 287617   CUMMINGS     DAVENA      1         5    3     2       3
## 24     24 289652    BRADLEY    SHANNON      1         4    3     2       1
## 25     25 302400      JONES     ROBERT      2         3    4     2       3
## 26     26 307894   TORRENCE       GWEN      1         3    2     1       2
## 27     27 337908    UYEYAMA  VICTORINE      1         1    3     2       2
## 28     28 354601     CARPIO       MARY      1         2    2     1       1
## 29     29 378446   SAUNDERS     TAMARA      1         1    2     1       2
## 30     30 380157       LUTZ    WILLIAM      2         4    3     2       2
## 31     31 390203      SHIMA    MIHAELA      1         2    3     2       2
## 32     32 392464    DOMINGO     MONIKA      1         4    3     2       3
## 33     33 414775     RATANA      JASON      2         2    3     2       1
## 34     34 417003 EVANGELIST      NIKKI      1         2    3     2       2
## 35     35 419891   DE CANIO      PAULA      1         4    3     2       2
## 36     36 420327     BADGER    SUZANNA      1         4    3     2       3
## 37     37 434571       SURI     MATHEW      2         2    3     2       2
## 38     38 436413       PANG    SUZANNE      1         2    3     2       1
## 39     39 447659 GALANVILLE       DANA      1         5    4     2       3
## 40     40 463276     HANSEN        TIM      2         4    3     2       1
## 41     41 466407  PICKERING      HEIDI      1         3    3     2       3
## 42     42 467806     DEVERS       GAIL      1         3    3     2       1
## 43     43 473303       PARK     SANDRA      1         3    4     2       2
## 44     44 479547   LANGFORD      BLAIR      2         3    3     2       1
## 45     45 490016    STEPHEN       LIZA      1         5    3     2       2
## 46     46 498900      HUANG        JOE      2         5    3     2       3
## 47     47 506467 SCARBROUGH     CYNTHE      1         4    3     2       2
```

```
## 48     48 515586    FIALLOS     LAUREL      1         4    2     1        2
## 49     49 519444    RATHBUN      DAWNE      1         4    4     2        2
## 50     50 546022     HAMIDI   KIMBERLY      1         5    3     2        1
## 51     51 553919       KWON     SHELLY      1         2    3     2        1
## 52     52 554809      JONES       LISA      1         3    3     2        3
## 53     53 574170     HURRIA      WAYNE      2         1    2     1        2
## 54     54 576008   BULMERKA     HUSIBA      1         4    4     2        3
## 55     55 576141  MISHALANY       LUCY      1         4    3     2        1
## 56     56 594463    CRUZADO   MARITESS      1         4    4     2        2
## 57     57 595177   WILLIAMS    OLIMPIA      1         3    3     2        3
## 58     58 615115   VASENIUS       RUSS      2         3    3     2        3
## 59     59 616095   SPRINGER   ANNELIES      1         4    3     2        1
## 60     60 623857     CORTEZ      VIKKI      1         3    4     2        3
## 61     61 664653       KHAN       JOHN      2         4    3     2        3
## 62     62 681855   GRISWOLD       TAMMY      1         4    3     2        2
## 63     63 700978    WEBSTER     DEANNA      1         3    2     1        3
## 64     64 703740      SUNYA       DALE      2         5    3     2        3
## 65     65 721311       SONG       LOIS      2         2    3     2        3
## 66     66 725987   BATILLER       FRED      2         2    2     1        2
## 67     67 737728    BELTRAN        JIM      2         3    3     2        1
## 68     68 755724   LANGFORD     TREVOR      2         4    3     2        2
## 69     69 756097     KURSEE     JACKIE      1         3    3     2        2
## 70     70 762308       GOUW     BONNIE      1         4    2     1        3
## 71     71 762813       DAEL       IVAN      2         3    2     1        1
## 72     72 765360   ROBINSON       ERIC      2         3    3     2        2
## 73     73 768995 DUMITRESCU      STACY      2         4    4     2        2
## 74     74 777683   ANDERSON       ERIC      2         5    4     2        3
## 75     75 779481     AHGHEL     BRENDA      1         5    3     2        1
## 76     76 780028   ROBINSON    CLAYTON      2         4    3     2        1
## 77     77 781676    WATKINS     YVONNE      1         3    4     2        1
## 78     78 798931      ZUILL      RENAE      1         4    3     2        1
## 79     79 807963      LEWIS       CARL      2         3    2     1        1
## 80     80 818528 CARRINGTON       JYLL      1         4    3     2        1
## 81     81 822485 VALENZUELA    KATHRYN      1         4    1     1        1
## 82     82 843472      PRADO        DON      2         5    3     2        3
## 83     83 870810      REYNO   NICHOLAS      2         4    3     2        3
## 84     84 896972      HUANG      MIRNA      1         2    3     2        1
## 85     85 897606   GENOBAGA JACQUELINE      1         2    3     2        3
## 86     86 898766        RAO       DAWN      1         2    3     2        1
## 87     87 899529    HAWKINS  CARHERINE      1         3    4     2        2
## 88     88 900485    COCHRAN      STACY      2         4    3     2        2
## 89     89 905109    JENKINS       ERIC      2         3    2     1        3
## 90     90 908754    MARQUEZ   CHYRELLE      1         4    1     1        2
## 91     91 911355      LESKO    LETICIA      1         3    2     1        3
## 92     92 915457    SHEARER      LUCIO      2         3    3     2        1
## 93     93 920656       LIAO   MICHELLE      1         2    2     1        2
## 94     94 921297     KINZER    RICHARD      2         4    3     2        2
## 95     95 938666 SUAREZ-TAN      KHANH      1         2    3     2        3
## 96     96 938881        YEO     DENISE      1         1    3     2        3
```

```
## 97     97 944702    LEDESMA    MARTINE      1         4    3     2       2
## 98     98 958384      RONCO     SHERRY      1         4    2     1       1
## 99     99 972678      KAHRS       JANN      1         4    4     2       2
## 100   100 973427       ROSS      MARIA      1         4    4     2       1
## 101   101 978889    ZIMCHEK    ARMANDO      2         4    4     2       1
## 102   102 979028   NEUHARTH        JIM      2         4    3     2       3
## 103   103 983522      SLOAT      AARON      2         3    3     2       3
## 104   104 985700        CHA       LILY      1         4    2     1       1
## 105   105 988808   MCCONAHA       CORA      1         4    3     2       3
##      gpa extrc review quiz1 quiz2 quiz3 quiz4 quiz5 final total percent
## 1   1.18     1      2     6     5     7     6     3    53    80      64
## 2   2.19     2      1    10    10     7     6     9    54    96      77
## 3   2.46     2      2    10     7     8     9     7    57    98      78
## 4   3.98     1      1     7     8     7     7     6    68   103      82
## 5   1.84     1      1     7     8     9     8    10    66   108      86
## 6   3.90     1      2    10    10    10     9     9    74   122      98
## 7   2.84     2      1    10     9    10    10    10    63   112      90
## 8   3.57     1      2    10     9    10    10    10    71   120      96
## 9   3.95     2      2    10    10    10    10     9    74   123      98
## 10  3.49     2      1    10    10     9    10    10    75   124      99
## 11  2.32     1      1     7     8     6     7    10    59    97      78
## 12  2.35     1      2     8    10    10    10     9    71   118      94
## 13  2.45     1      1     8     8    10    10     6    69   111      89
## 14  2.90     1      1     3     8     4     6     8    55    84      67
## 15  2.33     1      2     5     5     7     6     4    52    79      63
## 16  2.54     1      2     5     8     6     4    10    61    94      75
## 17  1.66     2      2     5     7     4     7     6    63    92      74
## 18  2.74     1      1     8     9     6     7    10    48    88      70
## 19  2.51     1      1     5     9     5     6    10    63    98      78
## 20  2.54     1      1    10     9    10    10     7    60   106      85
## 21  3.70     1      2     3     6     2     6     6    55    78      62
## 22  3.90     1      2    10     8    10    10     8    68   114      91
## 23  2.21     1      2     9    10     9     9     9    52    98      78
## 24  2.46     1      2     6     9     8     9     9    68   109      87
## 25  1.14     1      2     2     5     4     5     6    43    65      52
## 26  2.09     2      2     6     5     4     7     6    62    90      72
## 27  2.34     2      1    10     8    10    10     7    63   108      86
## 28  2.03     1      2    10    10    10    10     9    71   120      96
## 29  2.80     1      2     4     6     5     4     5    57    81      65
## 30  2.25     2      2    10     9    10    10     8    61   118      86
## 31  2.28     1      2     6     7     9     6     8    61    97      78
## 32  3.02     2      1    10    10    10     9     9    55   103      82
## 33  2.38     1      2     8     9    10    10     9    50    96      77
## 34  1.91     1      2     9     8    10    10     6    66   109      87
## 35  3.53     1      2     6     7     7     9     9    54    92      74
## 36  2.61     1      2    10    10    10    10    10    53   103      82
## 37  2.80     1      1     7     6     9     8     8    60    98      78
## 38  2.66     1      2     8     6     7     8     7    60    96      77
## 39  2.77     1      1     6     8     9     5     8    63    99      79
```

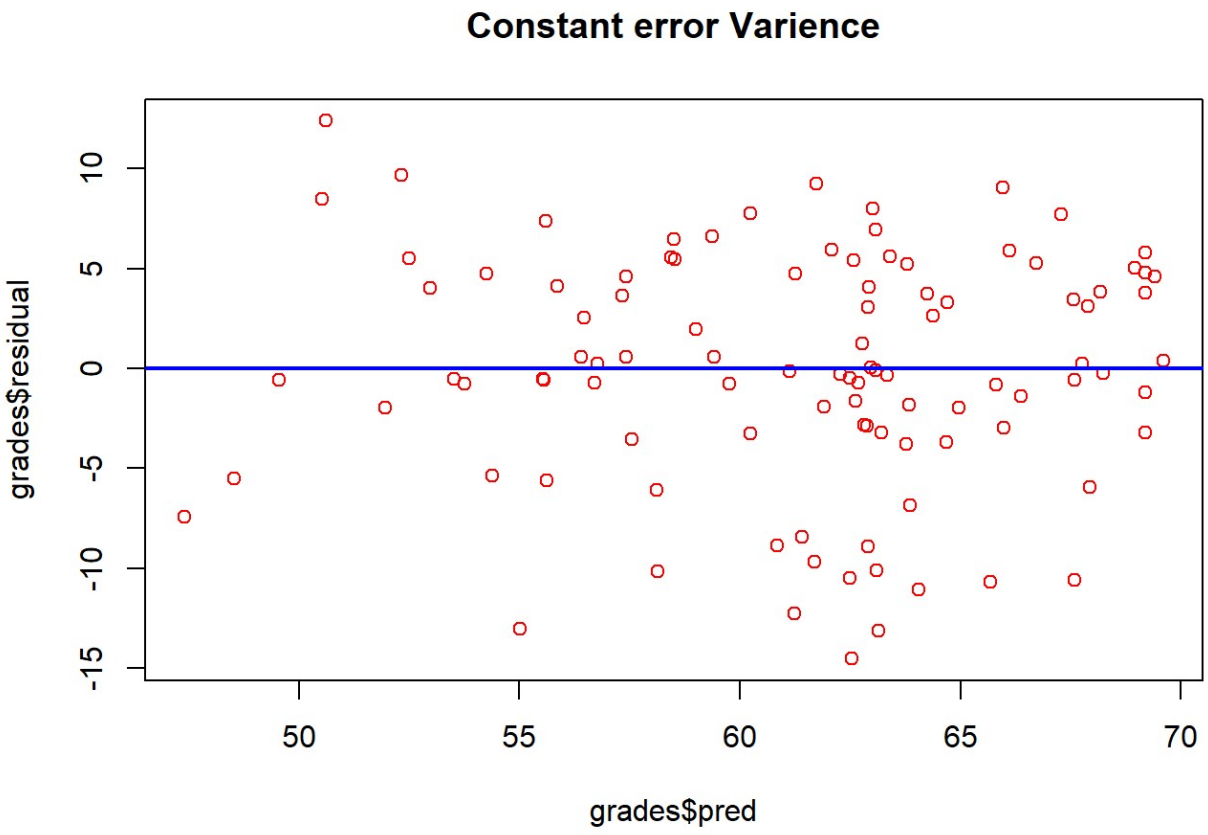
```
## 40  3.84     2      2    10    10    10     9    10    74   123      98
## 41  2.38     1      1     4     7     6     4     7    56    84      67
## 42  2.34     1      1     7     6     8     7     9    59    96      77
## 43  3.17     1      2     8     8     8    10     9    70   113      90
## 44  3.42     2      2    10    10    10     9    10    75   124      99
## 45  2.72     1      2     8     9     9     8    10    60   104      83
## 46  2.47     1      1     0     5     0     2     5    40    52      42
## 47  1.33     1      2     8     5     6     4     7    58    88      70
## 48  3.90     1      1     7     8     8     6     6    63    98      78
## 49  3.90     1      1    10     9    10    10     8    74   121      97
## 50  2.96     1      1     7     7     6     9     8    61    98      78
## 51  3.90     2      2    10    10    10    10     8    75   123      98
## 52  3.35     1      1     7     8     8     9     6    69   107      86
## 53  3.84     1      1     4     5     6     6     6    48    75      60
## 54  3.45     2      1    10     8     7     9     7    68   109      87
## 55  3.57     1      2     0     3     2     2     2    42    51      41
## 56  3.05     1      2     9     8    10     8     8    65   108      86
## 57  1.24     1      1     7     6     7    10     5    53    88      70
## 58  1.77     1      2     6     7     6     8     6    59    92      74
## 59  3.64     1      2    10    10    10    10    10    72   122      98
## 60  2.56     1      2     5     7     6     5     6    58    87      70
## 61  1.24     1      2     3     8     5     2     7    59    84      67
## 62  1.50     1      2     5     7     8     5     8    57    90      72
## 63  3.90     1      2     8     9     9    10    10    67   113      90
## 64  3.58     1      2    10     9    10    10     7    62   108      86
## 65  1.61     1      1     6     9     9     7    10    64   105      84
## 66  1.77     1      2     6     7     7     7     5    60    92      74
## 67  2.57     1      1     6     8     9     5     7    62    97      78
## 68  2.96     1      2     8     9     9     9     8    62   105      84
## 69  3.13     1      2     9     6     8     7    10    66   106      85
## 70  3.90     1      2     8     7     9    10     8    57    99      79
## 71  2.27     2      2    10     9    10    10    10    62   111      89
## 72  2.43     1      2     8     8     7     8    10    65   106      85
## 73  2.88     1      1     7    10     8     9    10    60   104      83
## 74  2.40     1      1     3     6     3     2     6    50    70      56
## 75  3.01     1      2     3     5     3     2     4    49    66      53
## 76  3.90     1      2    10    10    10     9    10    73   122      98
## 77  4.00     1      2     9     9    10    10     9    70   117      94
## 78  2.22     2      2    10     9    10    10     8    62   109      87
## 79  2.56     2      1     8     5     6     4     7    62    92      74
## 80  1.95     1      2     9    10    10     8     8    53    98      78
## 81  3.90     1      2     8     9    10    10     8    66   111      89
## 82  3.54     1      2     9     9    10     8     9    68   113      90
## 83  3.66     2      1    10     8    10    10    10    68   116      93
## 84  2.56     1      1     7     6    10     8     7    57    95      76
## 85  2.92     1      2     8     9     8     8     7    68   108      86
## 86  3.90     1      2     8    10    10     8     9    73   118      94
## 87  2.31     1      1    10     8     9    10     7    49    93      74
## 88  2.77     2      2    10     9    10    10     9    61   109      87
```

```
## 89  2.84     1      1     6     8     6     6    10    64   100       80
## 90  1.85     1      2     4     8     5     7     9    57    90       72
## 91  3.49     1      2    10     9    10    10     8    71   118       94
## 92  2.22     1      2    10    10    10     9     8    52    99       79
## 93  3.28     2      2    10     9    10    10     9    72   120       96
## 94  2.73     1      2     7     9     9     7     8    67   107       86
## 95  2.02     2      2    10     8    10    10     7    52    97       78
## 96  3.53     1      2     7    10     9     8     9    72   115       92
## 97  3.90     1      2     6     7     7     5     9    67   101       81
## 98  2.30     1      2    10     9    10    10     7    60   106       85
## 99  2.37     1      2    10    10    10    10    10    53    93       74
## 100 3.19     1      2     9     7    10     9     7    65   107       86
## 101 3.90     1      2     4     8     6     6     9    64    97       78
## 102 1.80     1      2     3     6     3     4     5    49    70       56
## 103 2.11     1      1     4     5     6     6     6    50    77       62
## 104 2.43     2      2    10     9    10    10     7    63   109       87
## 105 3.06     1      2     7     8     9     8     7    68   107       86
##     grade passfail     residual obs_no     pred
## 1       D        P  -0.51437366      1 53.51437
## 2       C        P  -3.54694323      2 57.54694
## 3       C        P  -3.23375140      3 60.23375
## 4       B        P   3.30622554      4 64.69377
## 5       B        P   6.63289284      5 59.36711
## 6       A        P   4.79925345      6 69.20075
## 7       A        P  -1.96854482      7 64.96854
## 8       A        P   3.11682569      8 67.88317
## 9       A        P   4.59962129      9 69.40038
## 10      A        P   9.04503165     10 65.95497
## 11      C        P   2.54280767     11 56.45719
## 12      A        P   7.98785032     12 63.01215
## 13      B        P   5.58858601     13 63.41141
## 14      D        P  -0.55533632     14 55.55534
## 15      D        P  -6.10591327     15 58.10591
## 16      C        P   3.66442618     16 57.33557
## 17      C        P  12.39554117     17 50.60446
## 18      C        P -10.13410245     18 58.13410
## 19      C        P   7.39299999     19 55.60700
## 20      B        P  -3.77075188     20 63.77075
## 21      D        P  -0.53186180     21 55.53186
## 22      A        P  -1.20074655     22 69.20075
## 23      C        P  -8.84438513     23 60.84439
## 24      B        P   7.76624860     24 60.23375
## 25      F        F  -5.52828439     25 48.52828
## 26      C        P   9.67870462     26 52.32130
## 27      B        P   0.02777675     27 62.97222
## 28      A        P   9.26549612     28 61.73450
## 29      D        P   0.23513348     29 56.76487
## 30      B        P  -1.61288537     30 62.61289
## 31      C        P  -0.12387015     31 61.12387
```

```
## 32      B        P -10.68722058     32 65.68722
## 33      C        P -13.13192897     33 63.13193
## 34      B        P   4.74461330     34 61.25539
## 35      C        P  -8.89708504     35 62.89709
## 36      B        P -11.05023690     36 64.05024
## 37      C        P  -3.20004458     37 63.20004
## 38      C        P   0.57651449     38 59.42349
## 39      C        P  -0.08026529     39 63.08027
## 40      A        P   5.03881204     40 68.96119
## 41      D        P  -0.69675092     41 56.69675
## 42      C        P  -0.75463422     42 59.75463
## 43      A        P   6.93147197     43 63.06853
## 44      A        P   7.71572216     44 67.28428
## 45      B        P  -2.88063313     45 62.88063
## 46      F        F  -7.40332171     46 47.40332
## 47      C        P   5.49552438     47 52.50448
## 48      C        P  -2.98315752     48 65.98316
## 49      A        P   4.79925345     49 69.20075
## 50      C        P   1.98751606     50 59.01248
## 51      A        P   5.79925345     51 69.20075
## 52      B        P   5.21279621     52 63.78720
## 53      D        P -14.52600990     53 62.52601
## 54      B        P   5.42232641     54 62.57767
## 55      F        F -13.01281820     55 55.01282
## 56      B        P  -0.80699988     56 65.80700
## 57      C        P  -0.75393225     57 53.75393
## 58      C        P   4.73876140     58 54.26124
## 59      A        P   3.83734067     59 68.16266
## 60      C        P   0.58457332     60 57.41543
## 61      D        P   8.46365678     61 50.53634
## 62      C        P   0.59918602     62 56.40081
## 63      A        P  -0.59195203     63 67.59195
## 64      B        P  -5.92310074     64 67.92310
## 65      B        P   5.55120076     65 58.44880
## 66      C        P   4.12996688     66 55.87003
## 67      C        P  -0.28173666     67 62.28174
## 68      B        P  -1.83886748     68 63.83887
## 69      B        P   3.09117770     69 62.90882
## 70      C        P -10.59195203     70 67.59195
## 71      B        P  -0.69273823     71 62.69274
## 72      B        P   6.49482241     72 58.50518
## 73      B        P  -1.91066152     73 61.91066
## 74      F        F  -1.95022024     74 51.95022
## 75      F        F  -5.38573255     75 54.38573
## 76      A        P   3.79925345     76 69.20075
## 77      A        P   0.39998914     77 69.60001
## 78      B        P  -0.49310607     78 62.49311
## 79      C        P   4.58457332     79 57.41543
## 80      C        P  -8.41509242     80 61.41509
```

```
## 81      B        P  -3.20074655     81 69.20075
## 82      A        O   0.23660498     82 67.76340
## 83      A        P  -0.24251219     83 68.24251
## 84      C        P  -6.85060474     84 63.85060
## 85      B        P   5.92963276     85 62.07037
## 86      A        P   3.79925345     86 69.20075
## 87      C        P -12.24364944     87 61.24365
## 88      B        P  -3.68905980     88 64.68906
## 89      B        P   5.46663324     89 58.53337
## 90      C        P   4.02814446     90 52.97186
## 91      A        P   3.43623714     91 67.56376
## 92      C        P -10.49310607     92 62.49311
## 93      A        P   5.27469220     93 66.72531
## 94      B        P   4.07944044     94 62.92056
## 95      C        P  -9.69457744     95 61.69458
## 96      A        P   5.88532593     96 66.11467
## 97      B        P   2.62563700     97 64.37436
## 98      B        P  -2.81251752     98 62.81252
## 99      C        P -10.09200254     99 63.09200
## 100     B        P  -1.36596992    100 66.36597
## 101     C        P   1.23443151    101 62.76557
## 102     F        F  -0.55463435    102 49.55463
## 103     D        P  -5.61873727    103 55.61874
## 104     B        P  -0.33156113    104 63.33156
## 105     B        P   3.76186820    105 64.23813
```

```
plot(grades$pred,grades$residual, main = "Constant error Varience", col="red")
abline(h = 0, col = "blue", lwd=2)
```




```
#What is Standard Error of Estimate of your model and how do you interpret the same. S
how with some hypothetical values of predictors. Maximum 300 words. [hint: Standard Er
ror of Estimate]
fitted(model4)
```

```
##        1        2        3        4        5        6        7        8
## 53.51437 57.54694 60.23375 64.69377 59.36711 69.20075 64.96854 67.88317
##        9       10       11       12       13       14       15       16
## 69.40038 65.95497 56.45719 63.01215 63.41141 55.55534 58.10591 57.33557
##       17       18       19       20       21       22       23       24
## 50.60446 58.13410 55.60700 63.77075 55.53186 69.20075 60.84439 60.23375
##       25       26       27       28       29       30       31       32
## 48.52828 52.32130 62.97222 61.73450 56.76487 62.61289 61.12387 65.68722
##       33       34       35       36       37       38       39       40
## 63.13193 61.25539 62.89709 64.05024 63.20004 59.42349 63.08027 68.96119
##       41       42       43       44       45       46       47       48
## 56.69675 59.75463 63.06853 67.28428 62.88063 47.40332 52.50448 65.98316
##       49       50       51       52       53       54       55       56
## 69.20075 59.01248 69.20075 63.78720 62.52601 62.57767 55.01282 65.80700
##       57       58       59       60       61       62       63       64
## 53.75393 54.26124 68.16266 57.41543 50.53634 56.40081 67.59195 67.92310
##       65       66       67       68       69       70       71       72
## 58.44880 55.87003 62.28174 63.83887 62.90882 67.59195 62.69274 58.50518
##       73       74       75       76       77       78       79       80
## 61.91066 51.95022 54.38573 69.20075 69.60001 62.49311 57.41543 61.41509
##       81       82       83       84       85       86       87       88
## 69.20075 67.76340 68.24251 63.85060 62.07037 69.20075 61.24365 64.68906
##       89       90       91       92       93       94       95       96
## 58.53337 52.97186 67.56376 62.49311 66.72531 62.92056 61.69458 66.11467
##       97       98       99      100      101      102      103      104
## 64.37436 62.81252 63.09200 66.36597 62.76557 49.55463 55.61874 63.33156
##      105
## 64.23813
```

R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see http://rmarkdown.rstudio.com (http://rmarkdown.rstudio.com).

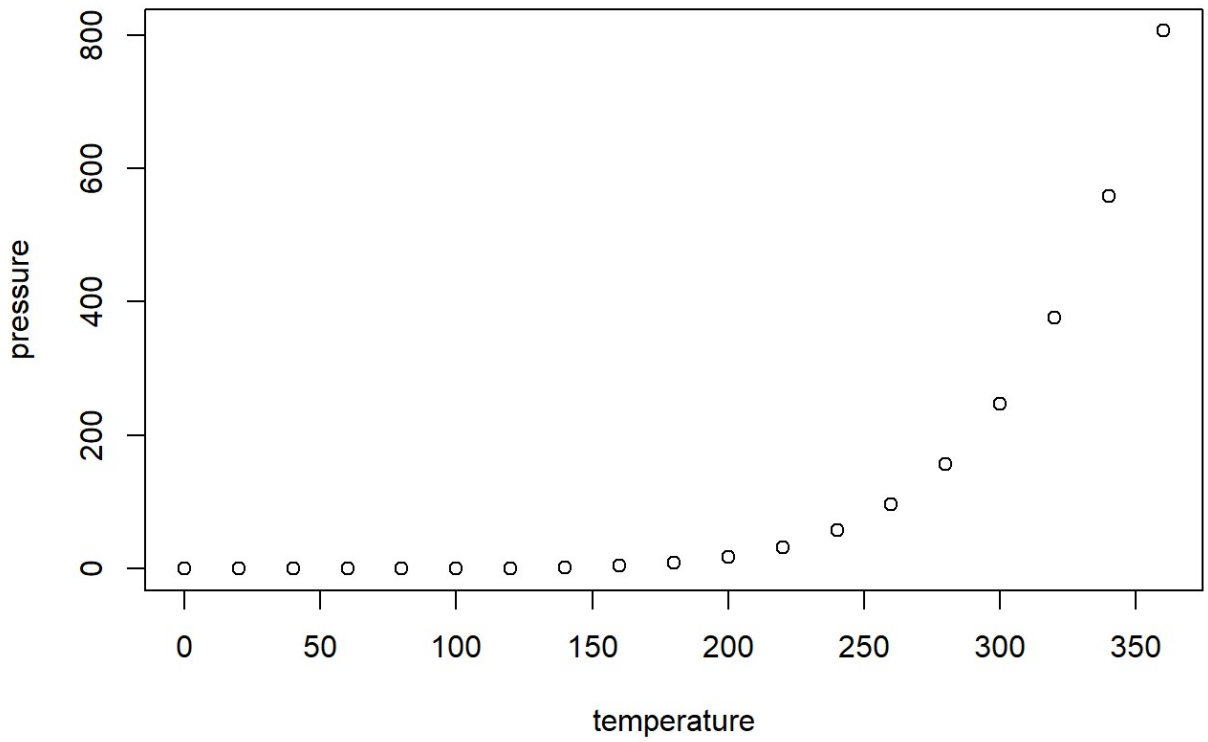
When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
summary(cars)
```

```
##      speed           dist
##  Min.   : 4.0   Min.   :  2.00
##  1st Qu.:12.0   1st Qu.: 26.00
##  Median :15.0   Median : 36.00
##  Mean   :15.4   Mean   : 42.98
##  3rd Qu.:19.0   3rd Qu.: 56.00
##  Max.   :25.0   Max.   :120.00
```

Including Plots

You can also embed plots, for example:



Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.