In [1]:
```
library(psych)
library(car)
library(dummies)
```

```
Attaching package: 'car'

The following object is masked from 'package:psych':

    logit

dummies-1.5.6 provided by Decision Patterns
```

In [2]:
```
Workingdirection = "C:/Users/Administrator/Documents/Master/MSIS-5223-70250 -
 Programming for Data Sci - 8282017 - 159 PM/Homework";
Path = paste(Workingdirection,"//splityield.txt",sep ="");
df = read.table (Path,header=T, sep='\t')
```

In [3]:
```
dfnew = df
```

In [4]:
```
df
```

yield	block	irrigation	density	fertilizer
90	A	control	low	N
95	A	control	low	P
107	A	control	low	NP
92	A	control	medium	N
89	A	control	medium	P
92	A	control	medium	NP
81	A	control	high	N
92	A	control	high	P
93	A	control	high	NP
80	A	irrigated	low	N
87	A	irrigated	low	P
100	A	irrigated	low	NP
121	A	irrigated	medium	N
110	A	irrigated	medium	P
119	A	irrigated	medium	NP
78	A	irrigated	high	N
98	A	irrigated	high	P
122	A	irrigated	high	NP
83	B	control	low	N
80	B	control	low	P
95	B	control	low	NP
98	B	control	medium	N
98	B	control	medium	P
106	B	control	medium	NP
74	B	control	high	N
81	B	control	high	P
74	B	control	high	NP
102	B	irrigated	low	N
109	B	irrigated	low	P
105	B	irrigated	low	NP
...	...	...	...	...
82	C	control	high	N

yield	block	irrigation	density	fertilizer
78	C	control	high	P
94	C	control	high	NP
60	C	irrigated	low	N
104	C	irrigated	low	P
114	C	irrigated	low	NP
90	C	irrigated	medium	N
118	C	irrigated	medium	P
113	C	irrigated	medium	NP
119	C	irrigated	high	N
122	C	irrigated	high	P
136	C	irrigated	high	NP
86	D	control	low	N
78	D	control	low	P
89	D	control	low	NP
79	D	control	medium	N
86	D	control	medium	P
87	D	control	medium	NP
85	D	control	high	N
89	D	control	high	P
83	D	control	high	NP
73	D	irrigated	low	N
114	D	irrigated	low	P
114	D	irrigated	low	NP
109	D	irrigated	medium	N
131	D	irrigated	medium	P
126	D	irrigated	medium	NP
116	D	irrigated	high	N
136	D	irrigated	high	P
133	D	irrigated	high	NP

In [4]:
```
attach(dfnew)
```

In [5]:
```
names(dfnew)
```

'yield' 'block' 'irrigation' 'density' 'fertilizer'

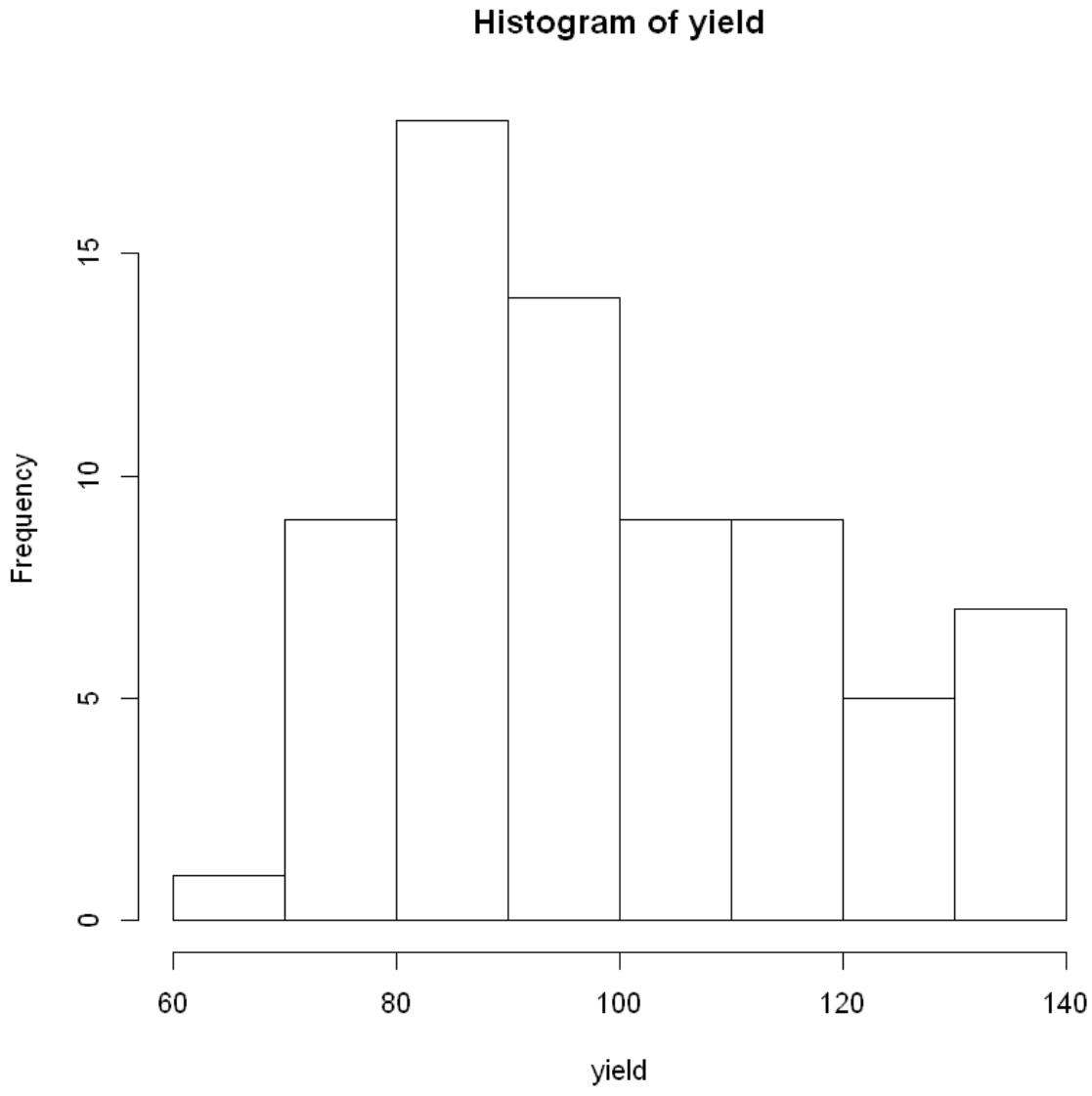
In [6]:
```
range(yield)
```

60 136

In [7]:
```
summary(dfnew)
```

```
     yield        block      irrigation   density   fertilizer
 Min.   : 60.00   A:18   control  :36   high  :24   N :24
 1st Qu.: 86.00   B:18   irrigated:36   low   :24   NP:24
 Median : 95.00   C:18                  medium:24   P :24
 Mean   : 99.72   D:18
 3rd Qu.:114.00
 Max.   :136.00
```

In [8]:
```
hist(yield)
```



In [9]:
```
str(dfnew)
```

```
'data.frame':   72 obs. of  5 variables:
 $ yield     : int  90 95 107 92 89 92 81 92 93 80 ...
 $ block     : Factor w/ 4 levels "A","B","C","D": 1 1 1 1 1 1 1 1 1 1 ...
 $ irrigation: Factor w/ 2 levels "control","irrigated": 1 1 1 1 1 1 1 1 1 2
 ...
 $ density   : Factor w/ 3 levels "high","low","medium": 2 2 2 3 3 3 1 1 1 2
 ...
 $ fertilizer: Factor w/ 3 levels "N","NP","P": 1 3 2 1 3 2 1 3 2 1 ...
```

In [29]:
```
dfnew.dummy = dfnew[c(2,3,4,5)]
head(dfnew.dummy)
```

block	irrigation	density	fertilizer
A	control	low	N
A	control	low	P
A	control	low	NP
A	control	medium	N
A	control	medium	P
A	control	medium	NP

In [30]:
```
dfnew.dummy <- dummy.data.frame(dfnew.dummy, sep = ".")
 names(dfnew.dummy)
```

'block.A' 'block.B' 'block.C' 'block.D' 'irrigation.control' 'irrigation.irrigated' 'density.high' 'density.low' 'density.medium' 'fertilizer.N' 'fertilizer.NP' 'fertilizer.P'

In [31]:
```
df1 = dfnew[c(1)];
```

In [32]:
```
dfnew.dummy = data.frame(df1, dfnew.dummy)
```

In [33]:
```
attach(dfnew.dummy)
```

```
The following objects are masked from dfnew.dummy (pos = 3):

    block.A, block.B, block.C, block.D, density.high, density.low,
    density.medium, fertilizer.N, fertilizer.NP, fertilizer.P,
    irrigation.control, irrigation.irrigated, yield

The following object is masked from dfnew:

    yield
```

In [15]:
```
dfnew_reg.fit = lm(yield ~.,data = dfnew.dummy)
```

In [16]:
```
summary(dfnew_reg.fit)
```

```
Call:
lm(formula = yield ~ ., data = dfnew.dummy)

Residuals:
    Min      1Q  Median      3Q     Max 
-36.833  -7.597   0.806   8.615  27.792 

Coefficients: (4 not defined because of singularities)
                     Estimate Std. Error t value Pr(>|t|)    
(Intercept)          116.2639     4.7869  24.288  < 2e-16 ***
block.A               -3.7778     4.5131  -0.837  0.40572    
block.B                0.4444     4.5131   0.098  0.92186    
block.C               -0.8889     4.5131  -0.197  0.84449    
block.D                   NA         NA      NA       NA    
irrigation.control   -21.4444     3.1912  -6.720 6.14e-09 ***
irrigation.irrigated      NA         NA      NA       NA    
density.high          -0.8333     3.9084  -0.213  0.83185    
density.low          -10.8750     3.9084  -2.782  0.00711 ** 
density.medium            NA         NA      NA       NA    
fertilizer.N          -7.6667     3.9084  -1.962  0.05424 .  
fertilizer.NP          5.0833     3.9084   1.301  0.19813    
fertilizer.P              NA         NA      NA       NA    
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 13.54 on 63 degrees of freedom
Multiple R-squared:  0.5139,    Adjusted R-squared:  0.4521 
F-statistic: 8.324 on 8 and 63 DF,  p-value: 1.259e-07
```

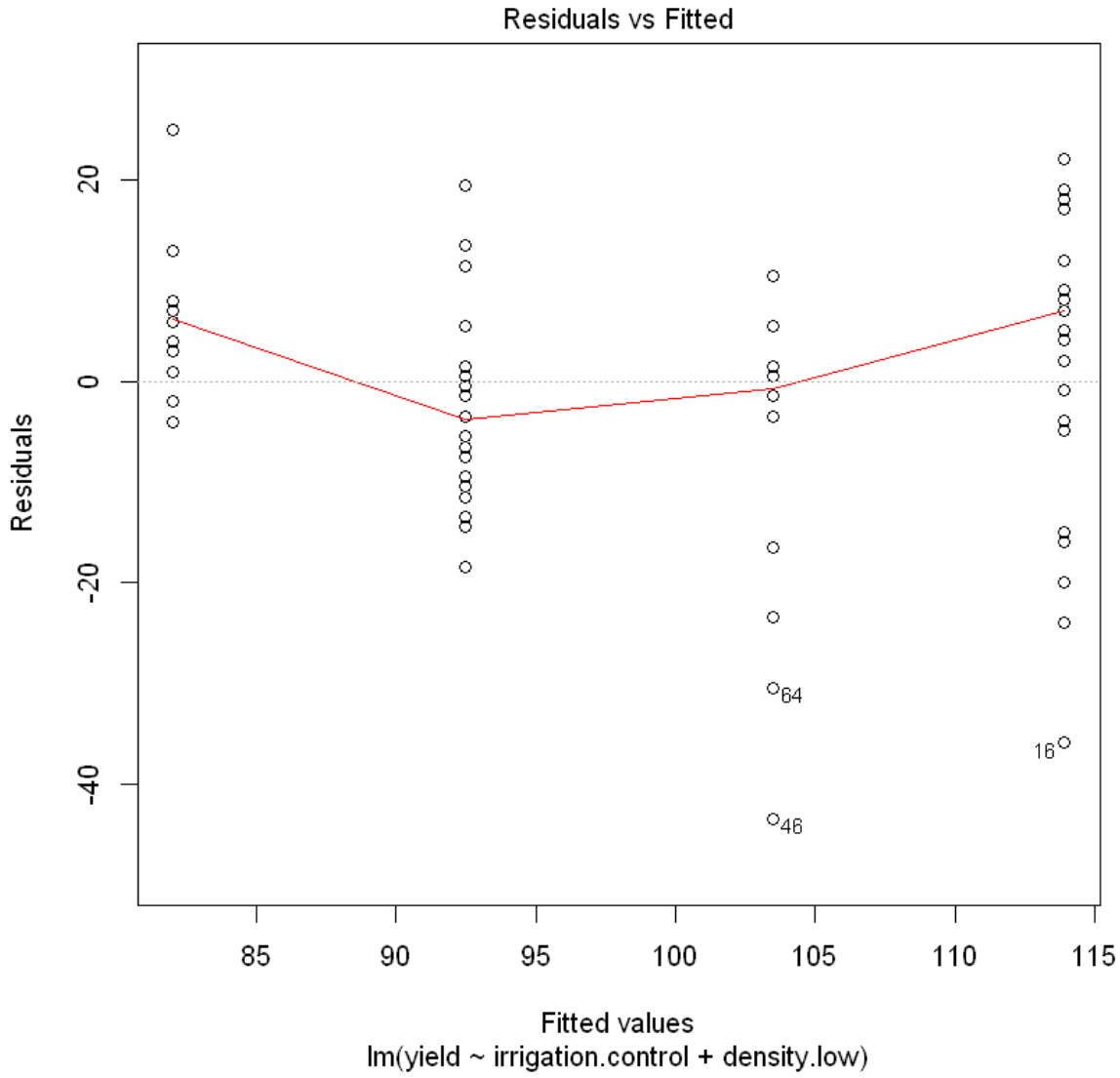
In [17]:
```
#Model1: yield= 116.2639 - 21.4444 * irrigation.control -10.8750 * density.low
# P-value is appreance O hence the model is significant.
#P-values for coefficients of irrigation.control,density.low  are all less tha
n 0.05.
#This means that the relationship between the dependent and these independent
 variables is significant at the 95% certainty level
```

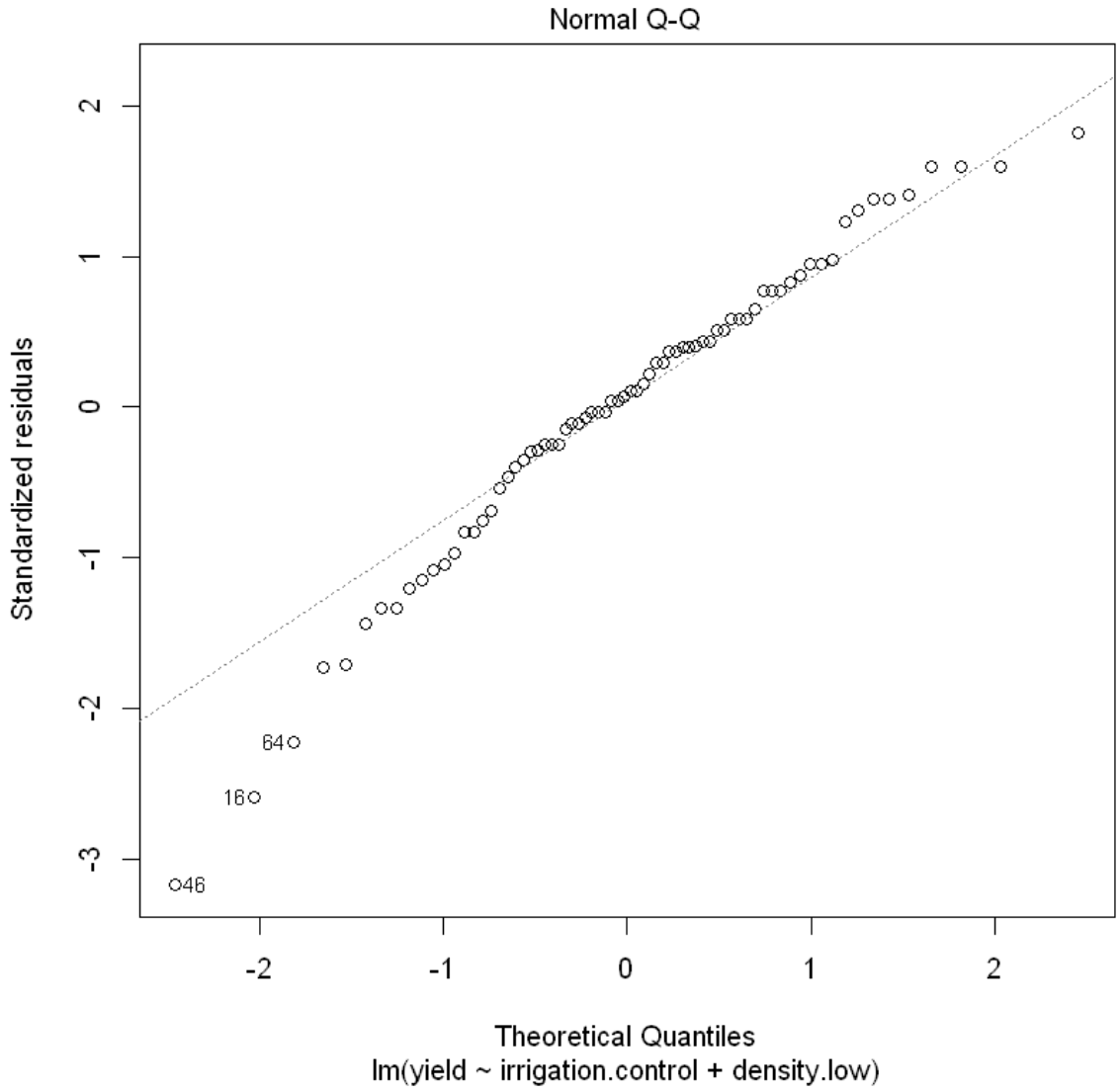
In [25]:
```
dfnew_reg.fit = lm(yield ~irrigation.control+density.low,data = dfnew.dummy)
```

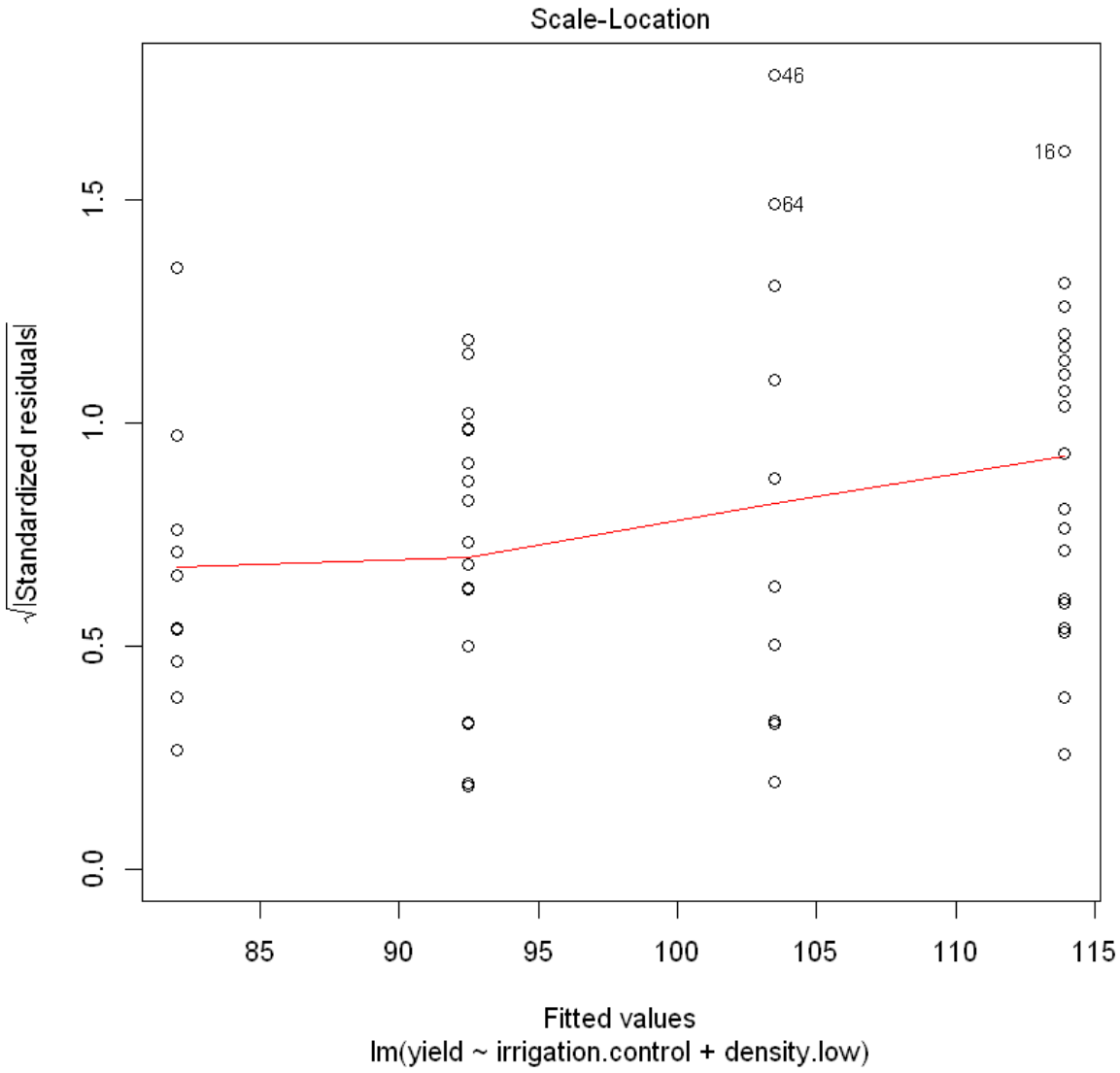
In [26]:
```
summary(dfnew_reg.fit)
```

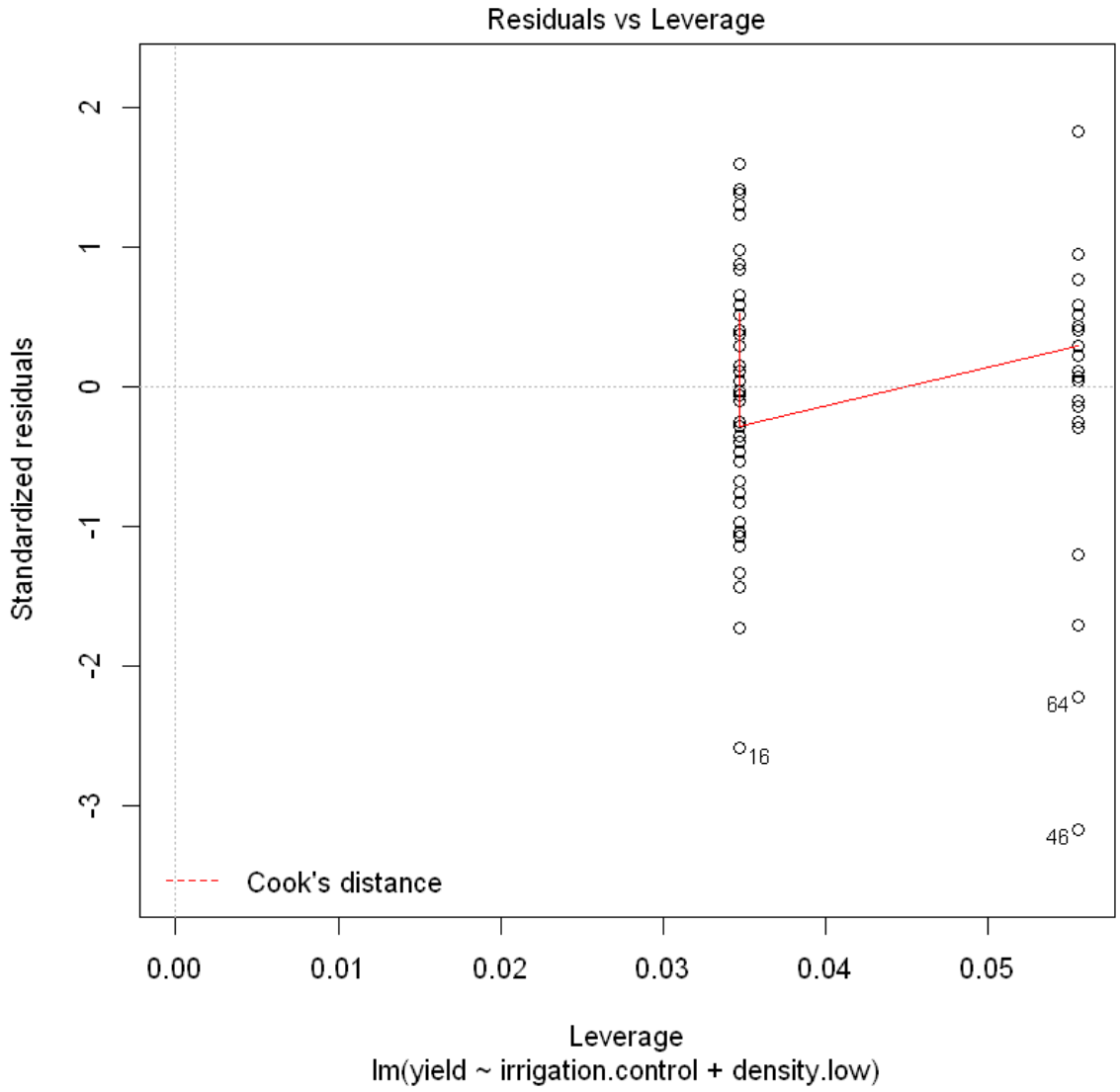
```
Call:
lm(formula = yield ~ irrigation.control + density.low, data = dfnew.dummy)

Residuals:
    Min      1Q  Median      3Q     Max 
-43.472  -6.736   1.243   8.319  24.972 

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)    
(Intercept)         113.931      2.628  43.345  < 2e-16 ***
irrigation.control  -21.444      3.325  -6.450  1.3e-08 ***
density.low         -10.458      3.526  -2.966  0.00414 ** 
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 14.11 on 69 degrees of freedom
Multiple R-squared:  0.4221,    Adjusted R-squared:  0.4053 
F-statistic:  25.2 on 2 and 69 DF,  p-value: 6.08e-09
```

In [20]:
```
plot(dfnew_reg.fit)
```


Residuals vs Fitted
Residuals
20
0
-20
-40
64
16
46
85
90
95
100
105
110
115
Fitted values
lm(yield ~ irrigation.control + density.low)


Normal Q-Q
Standardized residuals
Theoretical Quantiles
lm(yield ~ irrigation.control + density.low)
64
16
46
2
1
0
-1
-2
-3


Scale-Location
46
16
64
√|Standardized residuals|
0.0
0.5
1.0
1.5
85
90
95
100
105
110
115
Fitted values
lm(yield ~ irrigation.control + density.low)


Residuals vs Leverage
Standardized residuals
2
1
0
-1
-2
-3
0.00
0.01
0.02
0.03
0.04
0.05
Leverage
lm(yield ~ irrigation.control + density.low)
Cook's distance
64
16
46

In [34]:
```
dfnew_model.fit = lm(log(yield) ~.,data = dfnew.dummy)
summary(dfnew_model.fit)
```

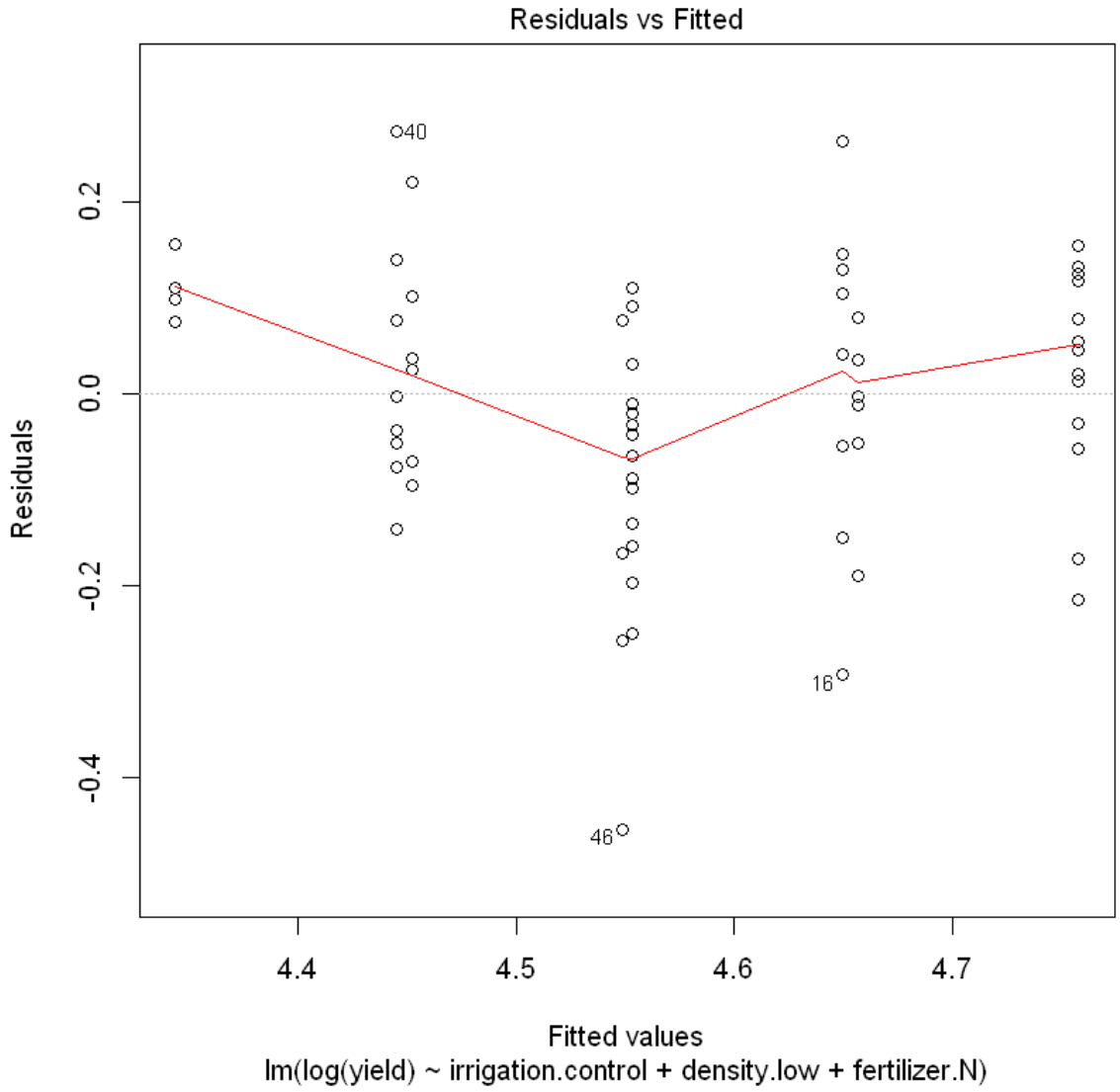
```
Call:
lm(formula = log(yield) ~ ., data = dfnew.dummy)

Residuals:
     Min       1Q   Median       3Q      Max 
-0.45410 -0.07741  0.00902  0.09779  0.26121 

Coefficients: (4 not defined because of singularities)
                     Estimate Std. Error t value Pr(>|t|)    
(Intercept)          4.750917   0.049163  96.637  < 2e-16 ***
block.A             -0.026669   0.046351  -0.575  0.56709    
block.B              0.007532   0.046351   0.163  0.87143    
block.C             -0.006411   0.046351  -0.138  0.89044    
block.D                    NA         NA      NA       NA    
irrigation.control  -0.204339   0.032775  -6.235 4.22e-08 ***
irrigation.irrigated       NA         NA      NA       NA    
density.high        -0.023482   0.040141  -0.585  0.56064    
density.low         -0.113179   0.040141  -2.820  0.00642 ** 
density.medium             NA         NA      NA       NA    
fertilizer.N        -0.082883   0.040141  -2.065  0.04307 *  
fertilizer.NP        0.050268   0.040141   1.252  0.21510    
fertilizer.P               NA         NA      NA       NA    
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1391 on 63 degrees of freedom
Multiple R-squared:  0.4859,    Adjusted R-squared:  0.4206 
F-statistic: 7.444 on 8 and 63 DF,  p-value: 6.26e-07
```

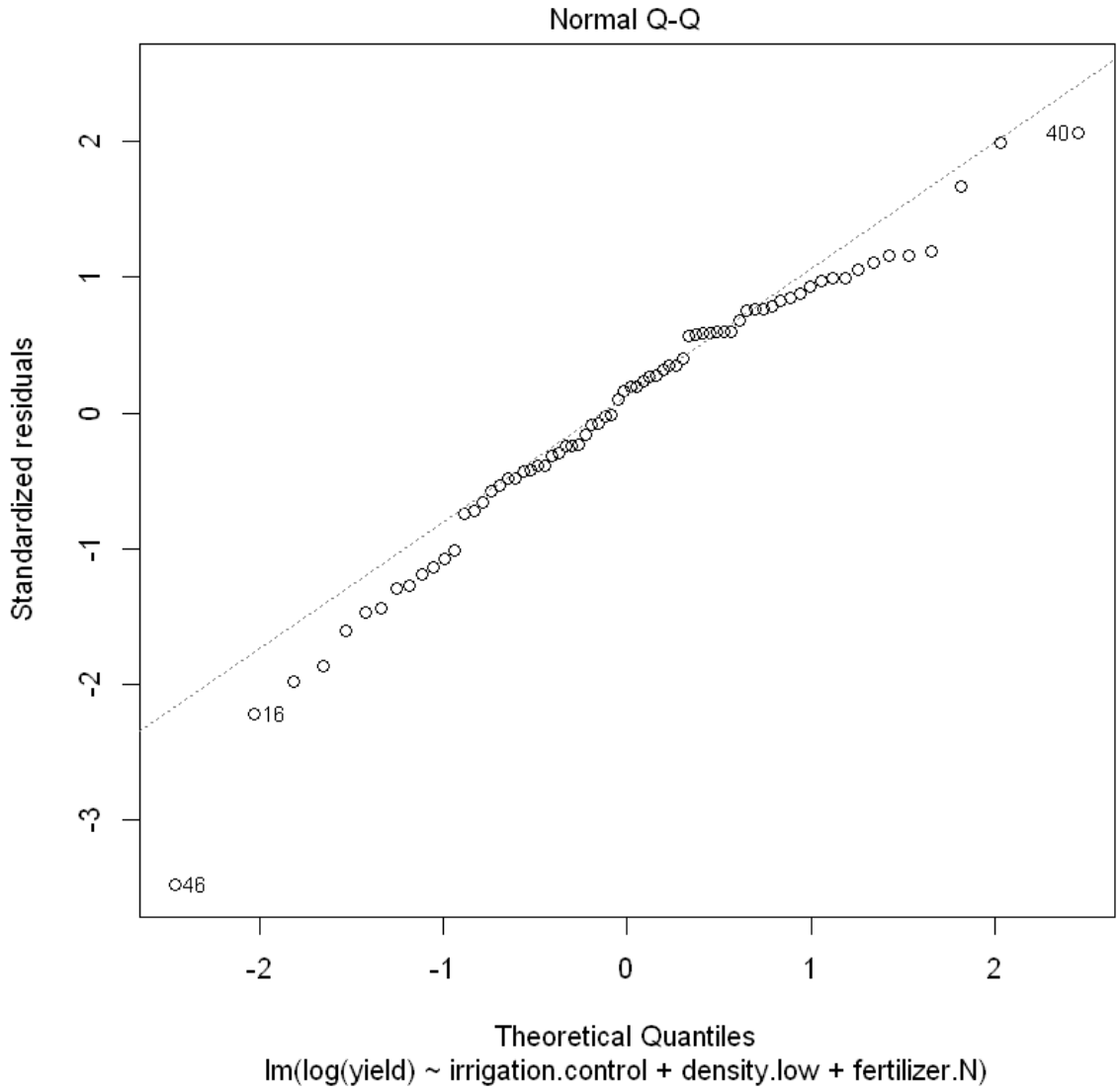
In [22]:
```
#model 2:yield = 4.75 - 0.204339*irrigation.control - 0.113179*density.low -
 0.082883*fertilizer.N
```

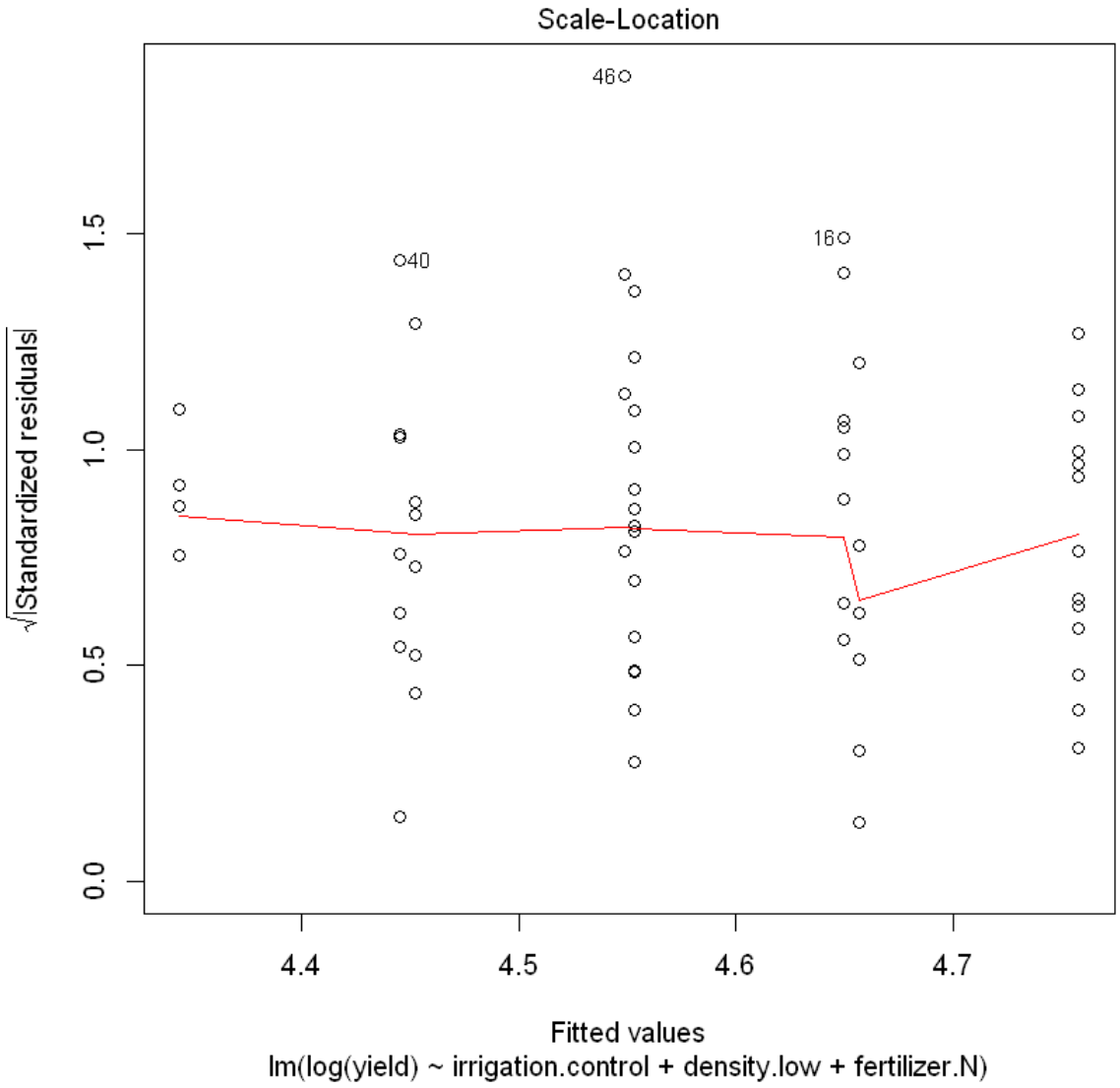
In [35]:
```
dfnew_reg.fit = lm(log(yield) ~irrigation.control+density.low+fertilizer.N,dat
a = dfnew.dummy)
summary(dfnew_reg.fit)
```

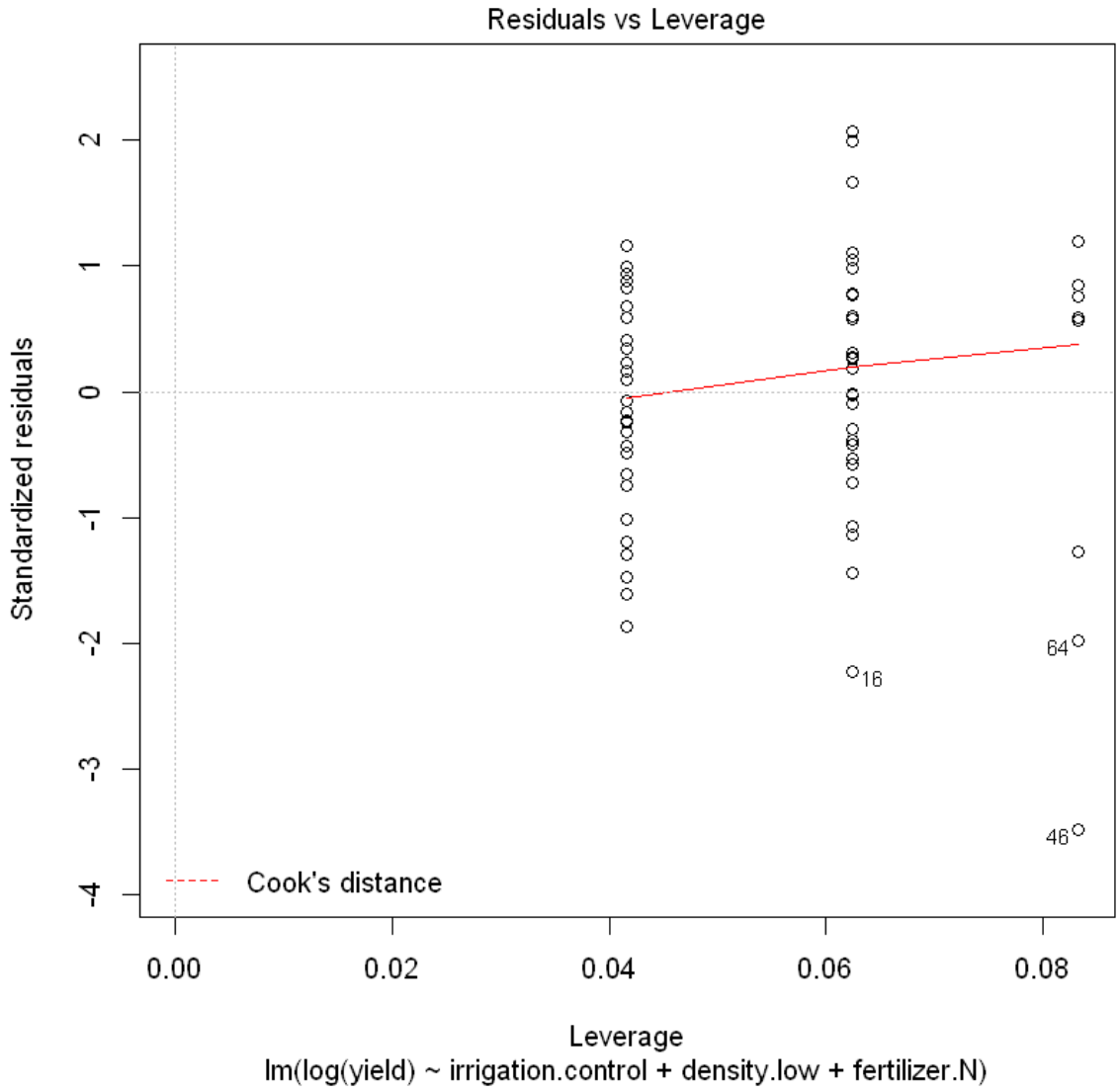
```
Call:
lm(formula = log(yield) ~ irrigation.control + density.low + 
    fertilizer.N, data = dfnew.dummy)

Residuals:
     Min       1Q   Median       3Q      Max 
-0.45412 -0.06624  0.02320  0.09932  0.27293 

Coefficients:
                   Estimate Std. Error t value Pr(>|t|)    
(Intercept)         4.75792    0.02786 170.780  < 2e-16 ***
irrigation.control -0.20434    0.03217  -6.352 2.04e-08 ***
density.low        -0.10144    0.03412  -2.973  0.00408 ** 
fertilizer.N       -0.10802    0.03412  -3.166  0.00232 ** 
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1365 on 68 degrees of freedom
Multiple R-squared:  0.4654,    Adjusted R-squared:  0.4418 
F-statistic: 19.74 on 3 and 68 DF,  p-value: 2.606e-09
```

In [24]:
```
plot(dfnew_reg.fit)
```


Residuals vs Fitted
Residuals
0.2
0.0
-0.2
-0.4
40
16
46
4.4
4.5
4.6
4.7
Fitted values
lm(log(yield) ~ irrigation.control + density.low + fertilizer.N)


Normal Q-Q
Standardized residuals
Theoretical Quantiles
lm(log(yield) ~ irrigation.control + density.low + fertilizer.N)
40
16
46
2
1
0
-1
-2
-3
-2
-1
0
1
2


Scale-Location
46
40
16
√|Standardized residuals|
0.0
0.5
1.0
1.5
4.4
4.5
4.6
4.7
Fitted values
lm(log(yield) ~ irrigation.control + density.low + fertilizer.N)


Residuals vs Leverage
Standardized residuals
2
1
0
-1
-2
-3
-4
Cook's distance
16
64
46
0.00
0.02
0.04
0.06
0.08
Leverage
lm(log(yield) ~ irrigation.control + density.low + fertilizer.N)