HW#3

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LMR 4.1

```
##
## Call:
## lm(formula = lpsa ~ ., data = prostate)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -1.7331 -0.3713 -0.0170  0.4141  1.6381
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  0.669337   1.296387   0.516  0.60693
## lcavol       0.587022   0.087920   6.677 2.11e-09 ***
## lweight      0.454467   0.170012   2.673  0.00896 **
## age         -0.019637   0.011173  -1.758  0.08229 .
## lbph         0.107054   0.058449   1.832  0.07040 .
## svi          0.766157   0.244309   3.136  0.00233 **
## lcp         -0.105474   0.091013  -1.159  0.24964
## gleason      0.045142   0.157465   0.287  0.77503
## pgg45        0.004525   0.004421   1.024  0.30886
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.7084 on 88 degrees of freedom
## Multiple R-squared:  0.6548, Adjusted R-squared:  0.6234
## F-statistic: 20.86 on 8 and 88 DF,  p-value: < 2.2e-16
```

a)

```
##        fit      lwr      upr
## 1 2.389053 2.172437 2.605669
```

```
##        fit       lwr      upr
## 1 2.389053 0.9646584 3.813447
```

```
## [1] 63.86598
```

b)

```
##       fit      lwr      upr
## 1 3.17454 2.270398 4.078682
```

```
##       fit      lwr      upr
## 1 3.17454 1.501384 4.847695
```

c)

```
##
## Call:
## lm(formula = lpsa ~ lcavol + lweight + svi, data = prostate)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -1.72964 -0.45764  0.02812  0.46403  1.57013
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -0.26809    0.54350  -0.493  0.62298
## lcavol       0.55164    0.07467   7.388  6.3e-11 ***
## lweight      0.50854    0.15017   3.386  0.00104 **
## svi          0.66616    0.20978   3.176  0.00203 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.7168 on 93 degrees of freedom
## Multiple R-squared:  0.6264, Adjusted R-squared:  0.6144
## F-statistic: 51.99 on 3 and 93 DF,  p-value: < 2.2e-16
```

```
##        fit      lwr      upr
## 1 2.372534 2.197274 2.547794
```

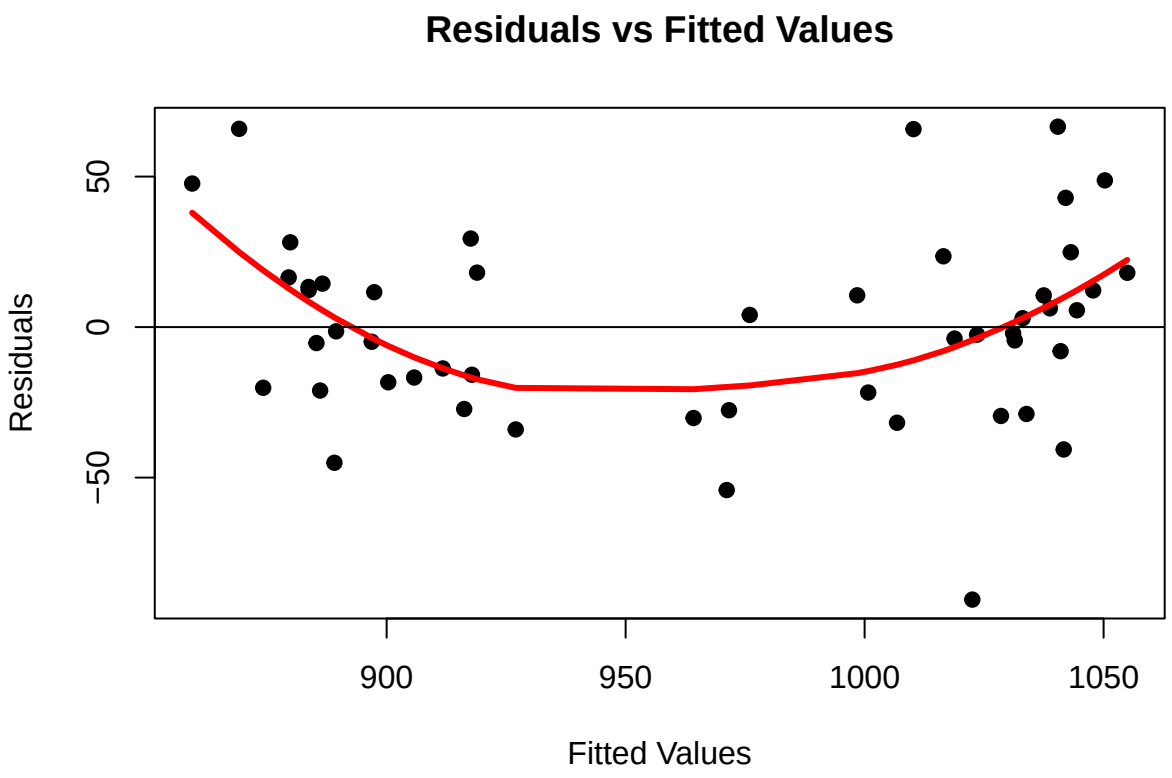
```
##        fit       lwr      upr
## 1 2.372534 0.9383436 3.806724
```

```
## Analysis of Variance Table
##
## Model 1: lpsa ~ lcavol + lweight + svi
## Model 2: lpsa ~ lcavol + lweight + age + lbph + svi + lcp + gleason +
##     pgg45
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1     93 47.785
## 2     88 44.163  5    3.6218 1.4434 0.2167
```

LMR 6.1

```
##
## Call:
## lm(formula = total ~ expend + salary + ratio + takers, data = sat)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -90.531 -20.855  -1.746  15.979  66.571
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept) 1045.9715    52.8698  19.784  < 2e-16 ***
## expend         4.4626    10.5465   0.423    0.674
## salary         1.6379     2.3872   0.686    0.496
## ratio         -3.6242     3.2154  -1.127    0.266
## takers        -2.9045     0.2313 -12.559 2.61e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 32.7 on 45 degrees of freedom
## Multiple R-squared:  0.8246, Adjusted R-squared:  0.809
## F-statistic: 52.88 on 4 and 45 DF,  p-value: < 2.2e-16
```

a)



Results of the Breusch - Pagan Test

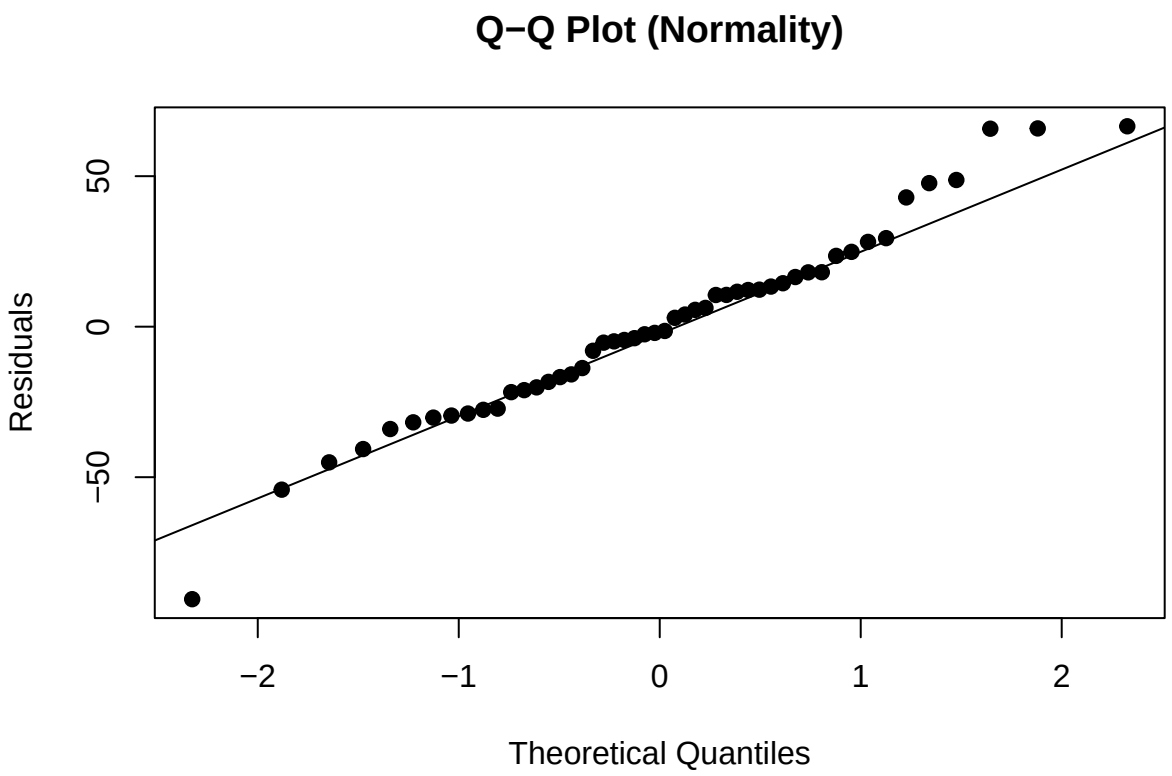
```
##
```

```
##  Breusch-Pagan test
##
## data:  sat_model1
## BP = 2.7234, df = 4, p-value = 0.6051
```

The results of the Non Constant Variance Test

```
## Non-constant Variance Score Test
## Variance formula: ~ fitted.values
## Chisquare = 0.6972119, Df = 1, p = 0.40372
```

b)

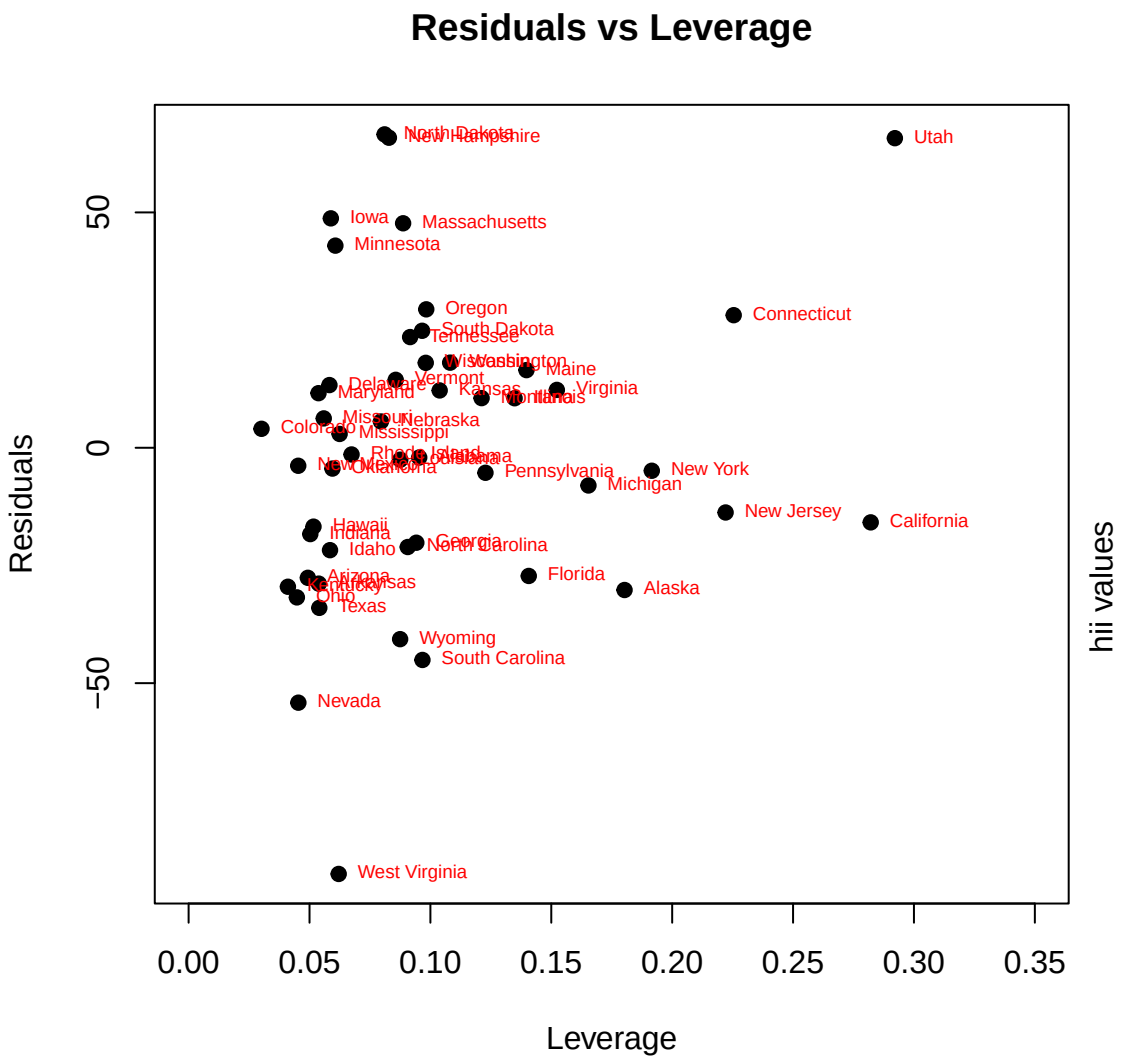


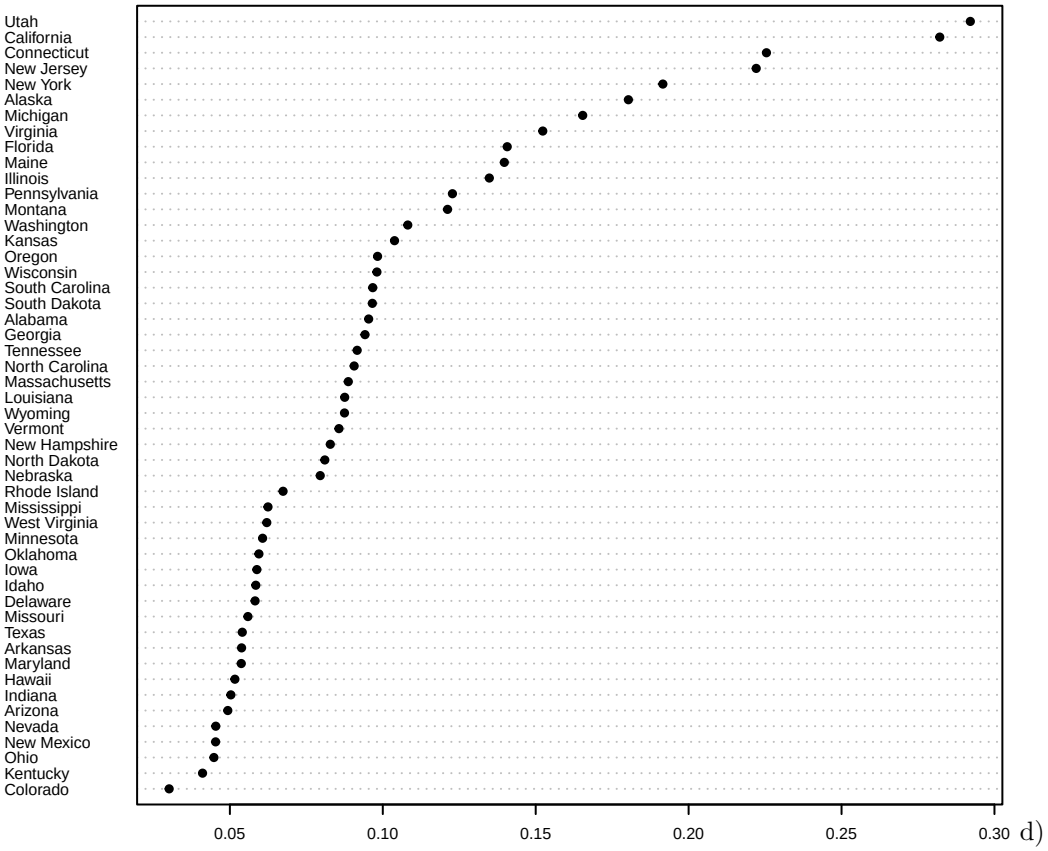
Results of the Shapiro and the Durbin-Watson Tests

```
##
##  Shapiro-Wilk normality test
##
## data:  sat_model1$residuals
## W = 0.97691, p-value = 0.4304
```

```
##
##  Durbin-Watson test
##
## data:  sat_model1
## DW = 2.4525, p-value = 0.9459
## alternative hypothesis: true autocorrelation is greater than 0
```

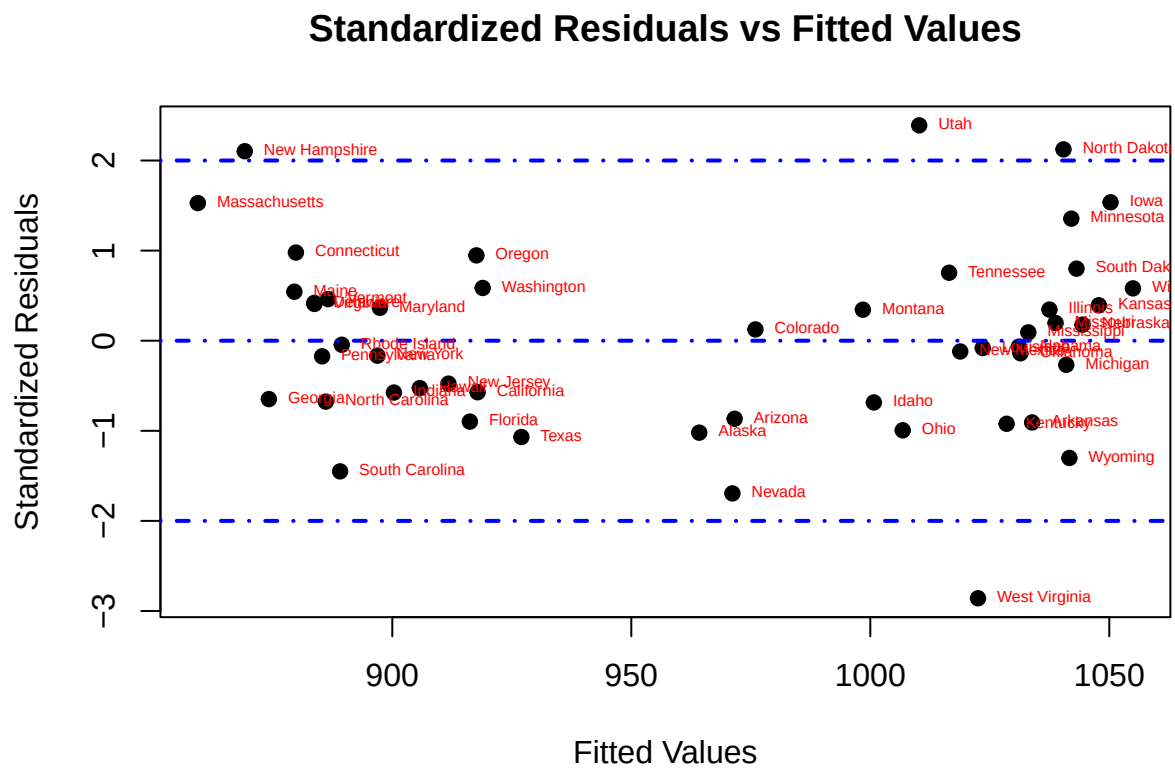
c)

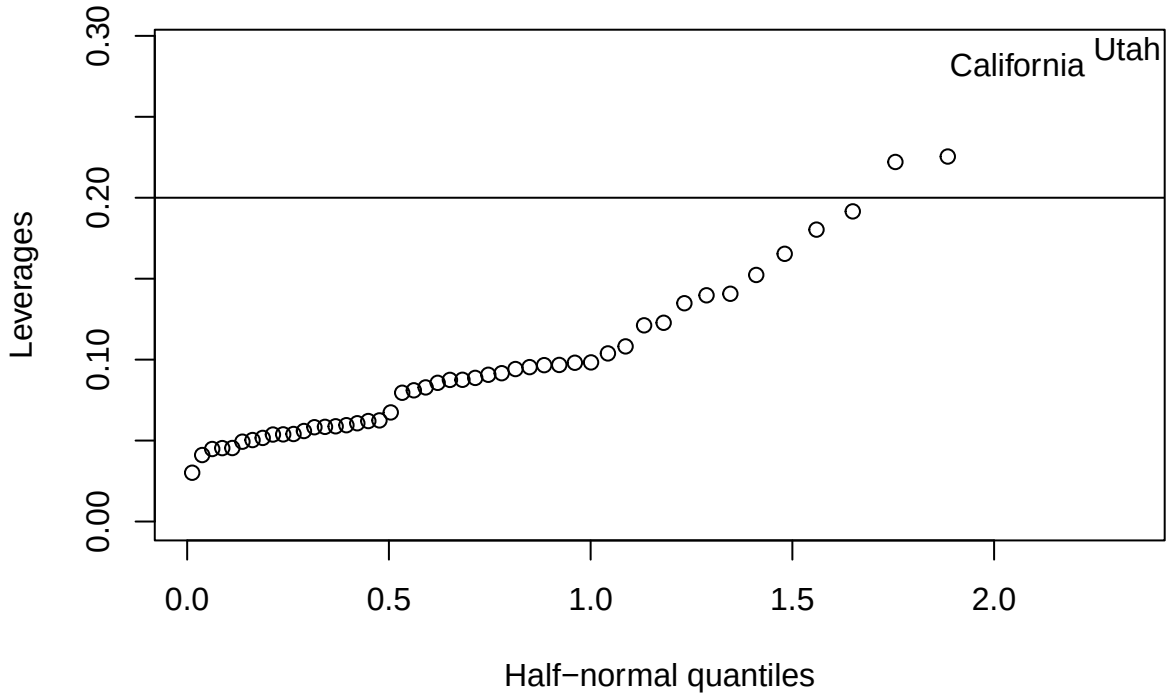

Residuals vs Leverage
Residuals
Leverage
hii values
North Dakota
New Hampshire
Utah
Iowa
Massachusetts
Minnesota
Oregon
Connecticut
South Dakota
Tennessee
Maine
Vermont
Virginia
Maryland
Nebraska
Mississippi
Pennsylvania
New York
Michigan
New Jersey
California
Hawaii
Indiana
Idaho
Florida
Alaska
Texas
Wyoming
South Carolina
Nevada
West Virginia
Alabama
Arkansas
Arizona
Colorado



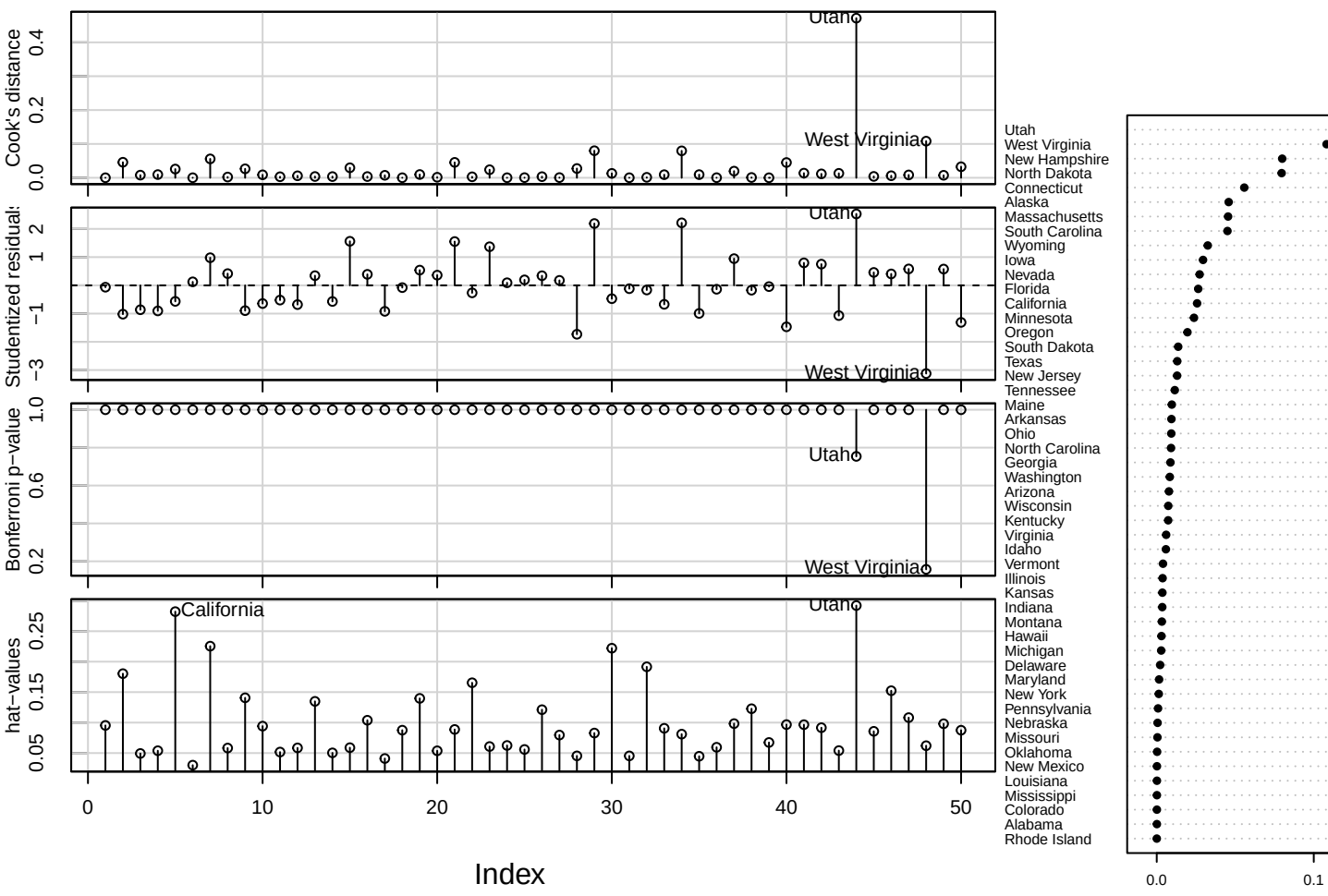
d)

```
## No Studentized residuals with Bonferroni p < 0.05
## Largest |rstudent|:
##                rstudent unadjusted p-value Bonferroni p
## West Virginia -3.124428         0.0031496      0.15748
```


Standardized Residuals vs Fitted Values
Standardized Residuals
Fitted Values
900
950
1000
1050
−3
−2
−1
0
1
2
Utah
New Hampshire
North Dakota
Massachusetts
Iowa
Minnesota
Connecticut
Oregon
Tennessee
South Dakota
Maine
Washington
Maryland
Montana
Kansas
Colorado
Michigan
New Jersey
California
Georgia
North Carolina
Idaho
Florida
Arizona
Texas
Alaska
Ohio
Arkansas
Wyoming
South Carolina
Nevada
West Virginia


Leverages
Half−normal quantiles
0.0
0.5
1.0
1.5
2.0
0.00
0.10
0.20
0.30
California
Utah

e)


Diagnostic Plots
Cook's distance
Studentized residuals
Bonferroni p−value
hat−values
Utah
West Virginia
California
0
10
20
30
40
50
Index
Utah
West Virginia
New Hampshire
North Dakota
Connecticut
Alaska
Massachusetts
South Carolina
Wyoming
Iowa
Nevada
Florida
California
Minnesota
Oregon
South Dakota
Texas
New Jersey
Tennessee
Maine
Arkansas
Ohio
North Carolina
Georgia
Washington
Arizona
Wisconsin
Kentucky
Virginia
Idaho
Vermont
Illinois
Kansas
Indiana
Montana
Hawaii
Michigan
Delaware
Maryland
New York
Pennsylvania
Nebraska
Missouri
Oklahoma
New Mexico
Louisiana
Mississippi
Colorado
Alabama
Rhode Island
0.0
0.1