Problem Set 5

QTM 200: Applied Regression Analysis

Due: March 4, 2020

Instructions

- Please show your work! You may lose points by simply writing in the answer. If the problem requires you to execute commands in R, please include the code you used to get your answers. Please also include the .R file that contains your code. If you are not sure if work needs to be shown for a particular problem, please ask.
- Your homework should be submitted electronically on the course GitHub page in .pdf form.
- This problem set is due at the beginning of class on Wednesday, March 4, 2020. No late assignments will be accepted.
- Total available points for this homework is 100.

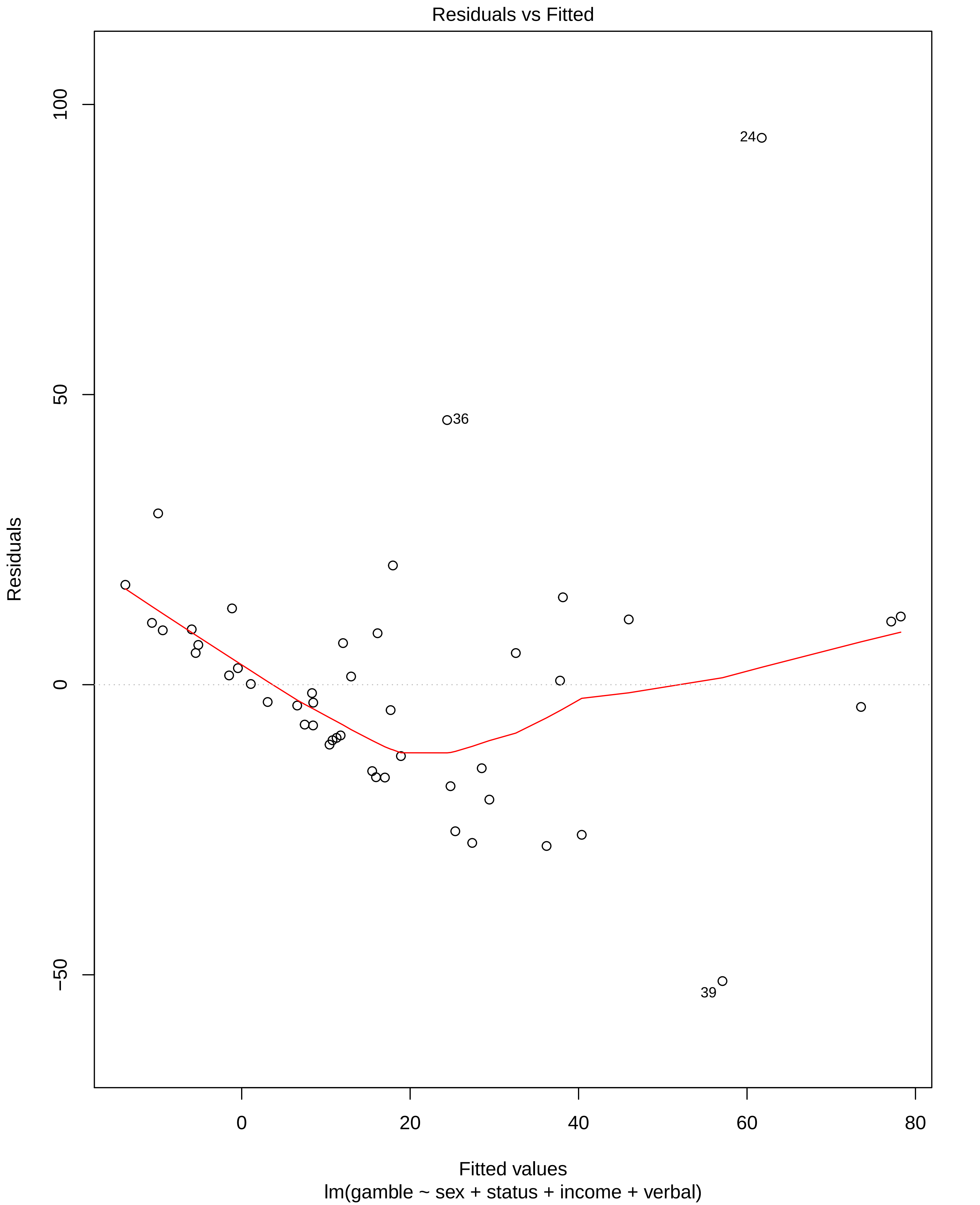
Using the teengamb dataset, fit a model with gamble as the response and the other variables as predictors.

```
# load data
gamble <- (data=teengamb)
# run regression on gamble with specified predictors
model1 <- lm(gamble ~ sex + status + income + verbal, gamble)
```

Answer the following questions:

(a) Check the constant variance assumption for the errors by plotting the residuals versus the fitted values.

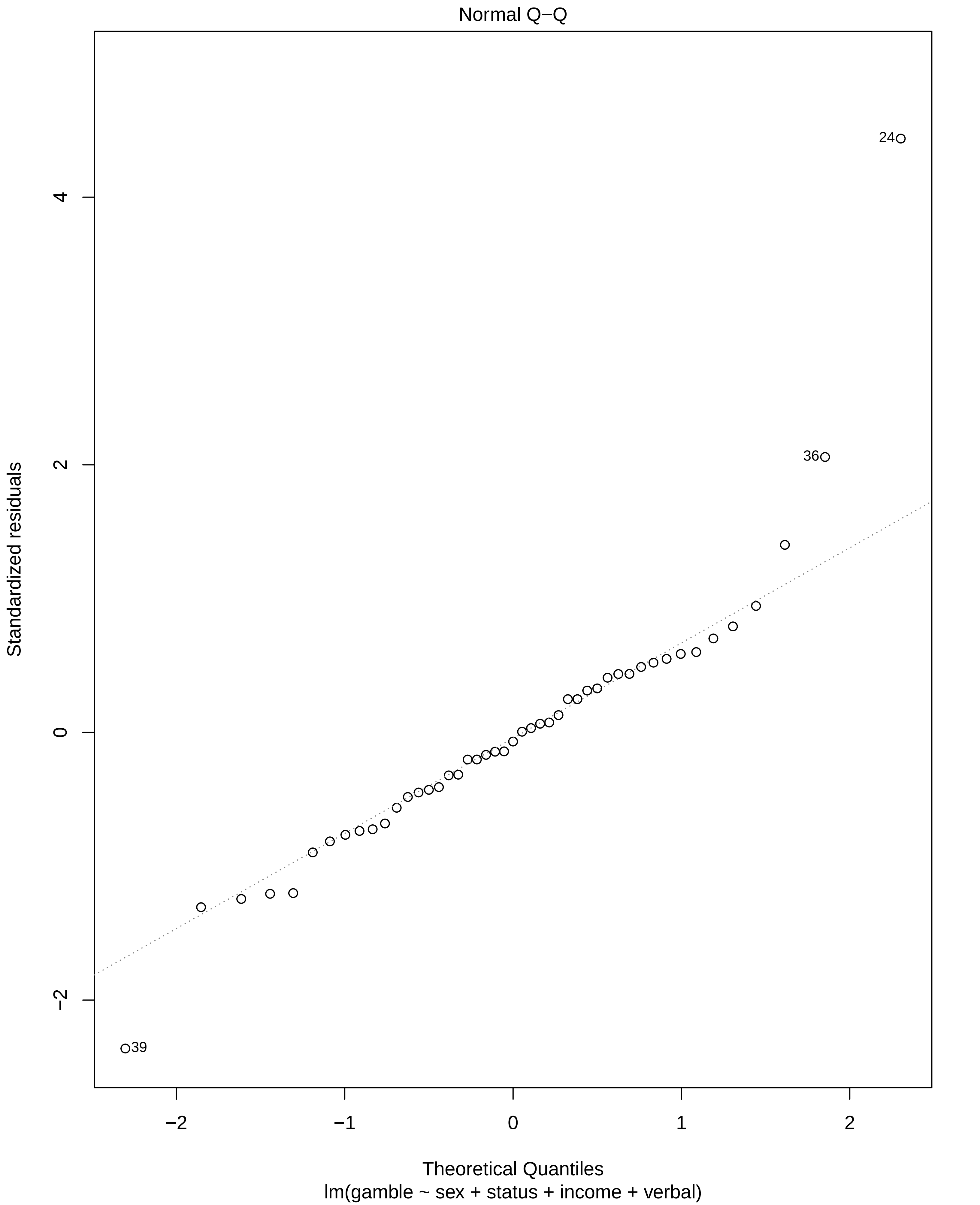
```r
plot(model1)
#The variance is more or less constant, as evidenced by the fact that the residuals average to about 0 at each fitted value. However, it is not perfect. There also appear to be three notable outliers.
```



Residuals vs Fitted
Residuals
Fitted values
lm(gamble ~ sex + status + income + verbal)
100
50
0
−50
0
20
40
60
80
24
36
39

(b) Check the normality assumption with a Q-Q plot of the studentized residuals.

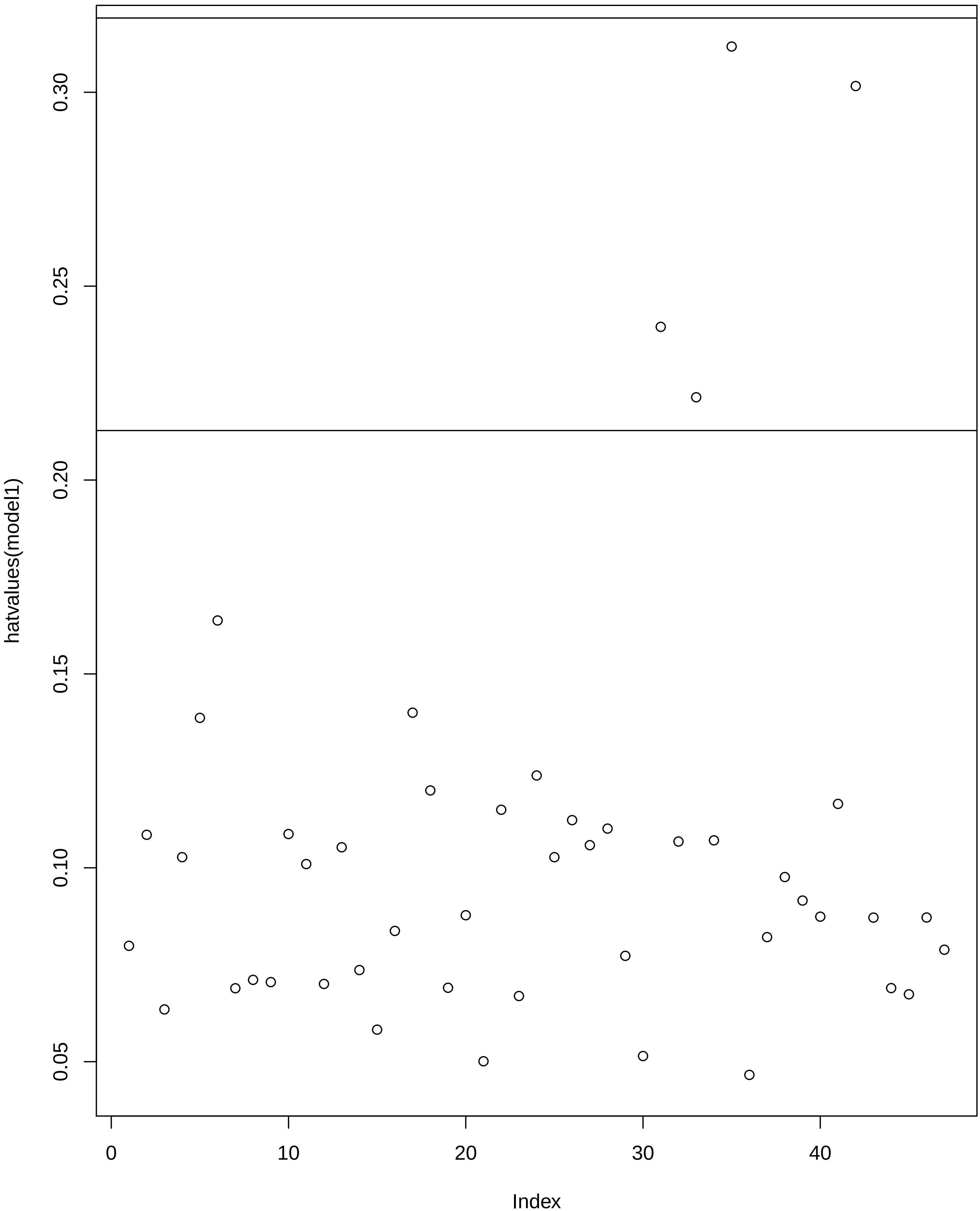
```r
plot(model1)
#The data appears to be generally normally distributed at each value of x,
    but the same three outliers appear again.
```


Normal Q−Q
Standardized residuals
Theoretical Quantiles
lm(gamble ~ sex + status + income + verbal)
24
36
39
−2
0
2
4
−2
−1
0
1
2

(c) Check for large leverage points by plotting the h values.

```
plot(hatvalues(model1))
abline(h=2*5/47)
abline(h=3*5/47)

#There are four points with high hat values that have high leverage and
    thus potential to influence the model
```


hatvalues(model1)
0.05
0.10
0.15
0.20
0.25
0.30
0
10
20
30
40
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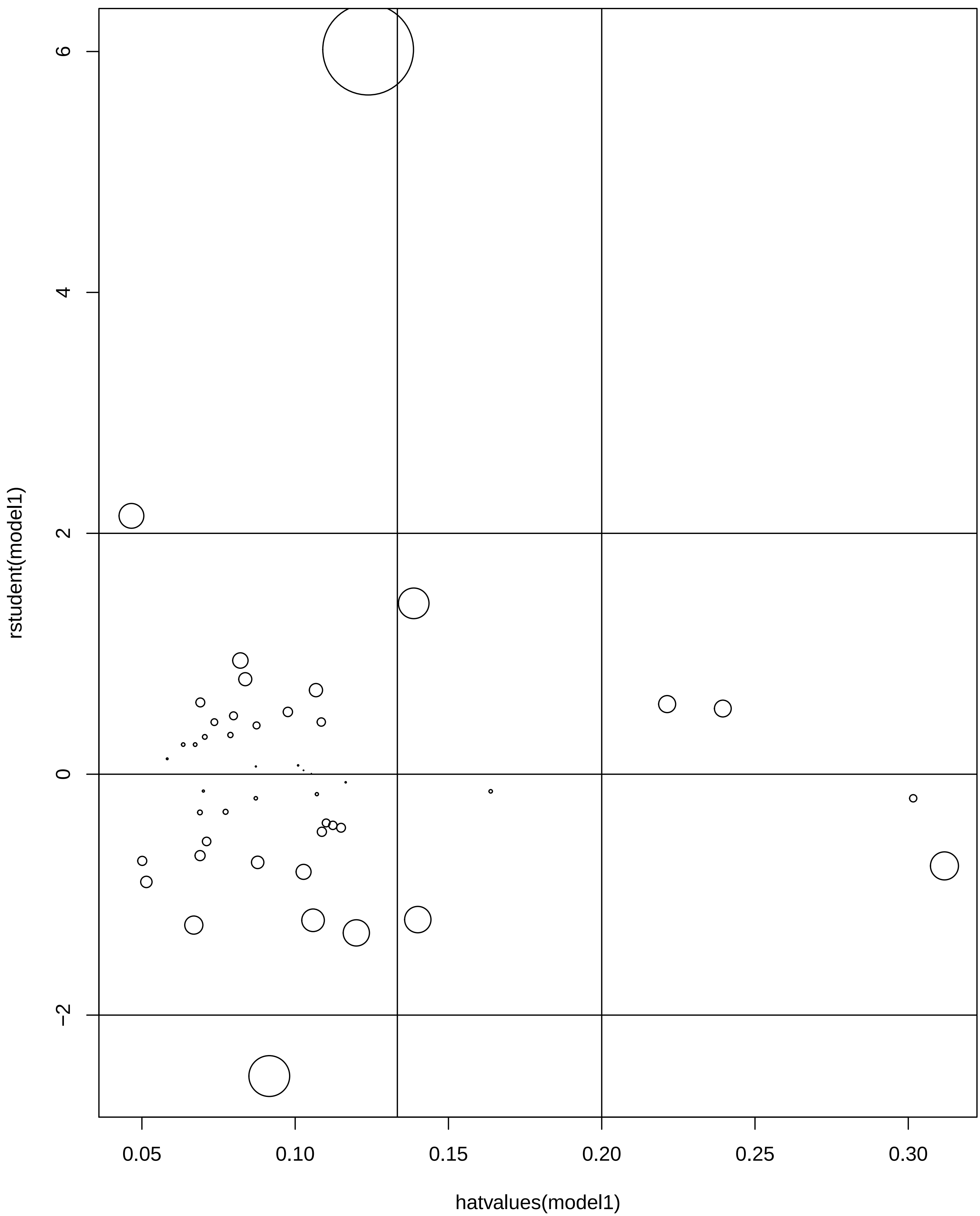
(d) Check for outliers by running an `outlierTest`.

```
outlierTest(model1)
#Given the very small Bonferroni p value (1.9289*10^-5), it we reject the
   null hypothesis that there are no outliers, because the probability of
   getting these results if there were no outliers is extremely low
```

(e) Check for influential points by creating a "Bubble plot" with the hat-values and studentized residuals.

```
plot(hatvalues(model1),rstudent(model1),type="n")
cook<-sqrt(cooks.distance(model1))
points(hatvalues(model1),rstudent(model1),cex=10*cook/max(cook))
abline(h=c(-2,0,2))
abline(v=c(2,3)*3/45)
#There is point with a very large large Cook's distance and studentized
   residual, indicating that despite its relatively unremarkable hat value
    it is quite influential. Otherwise, there are several other points
   that have either a large studentized residual or a large hat value but
   never both (and usually a fairly reasonable Cook's distance),
   indicating that none of these outliers is highly influential.
```



6
4
2
0
−2
rstudent(model1)
0.05
0.10
0.15
0.20
0.25
0.30
hatvalues(model1)