PRINTOUT FOR QUESTION 2

```
names(bird)
```

```
## [1] "name"       "extinct"    "nest.pair"  "size"       "mig.status"
```

```
levels(bird$size)
```

```
## [1] "S" "L"
```

```
levels(bird$mig.status)
```

```
## [1] "R" "M"
```

```
bird.lm <- lm(extinct ~ nest.pair + size + mig.status, data = bird)
```

```
summary(bird.lm)
```

```
## Call:
## lm(formula = extinct ~ nest.pair + size + mig.status, data = bird)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -14.056  -5.578  -2.485   2.942  48.313
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -0.9062     3.2696  -0.277 0.782898
## nest.pair     2.2534     0.6361   3.543 0.000921 ***
## sizeL         6.1217     2.9401   2.082 0.042923 *
## mig.statusM  -4.9136     3.2467  -1.513 0.137017
## ---
## Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

```
vcov(bird.lm)  # Variance-covariance matrix
```

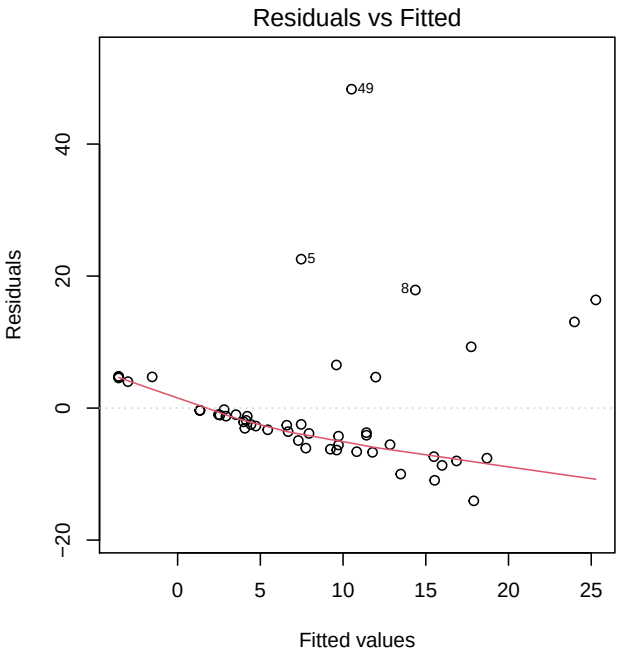
```
##             (Intercept)   nest.pair       sizeL mig.statusM
## (Intercept)   10.690611 -1.50199817 -4.43874764  -4.4050888
## nest.pair     -1.501998  0.40457802  0.06605802   0.3360600
## sizeL         -4.438748  0.06605802  8.64447634   0.2193219
## mig.statusM   -4.405089  0.33606004  0.21932190  10.5409041
```

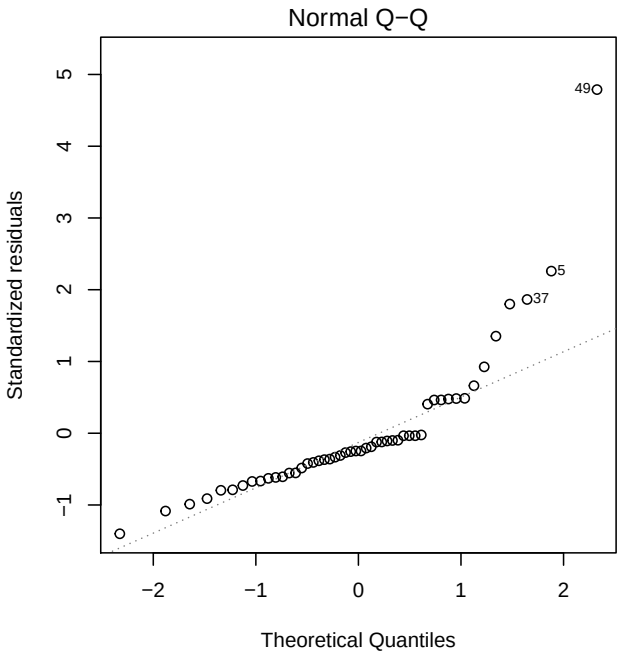
```
anova(bird.lm)
```

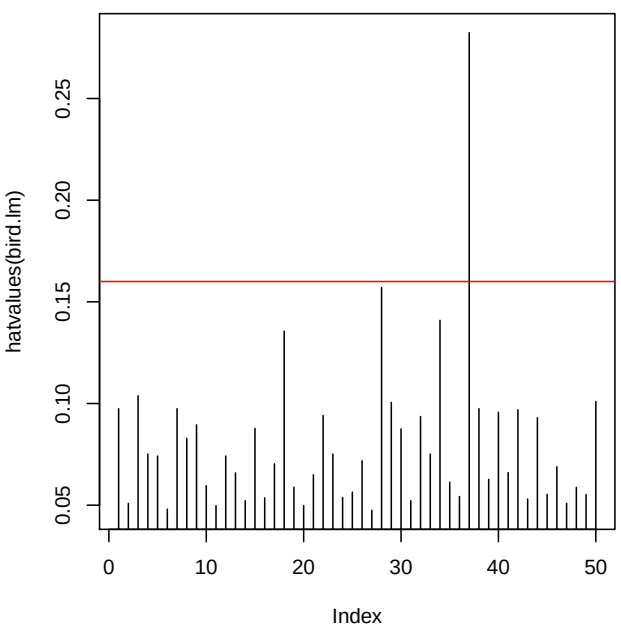
```
## Analysis of Variance Table
##
## Response: extinct
##            Df Sum Sq Mean Sq F value    Pr(>F)
## nest.pair   1 1534.4 1534.42 14.2451 0.0004581 ***
## size        1  482.9  482.95  4.4835 0.0396600 *
## mig.status  1  246.7  246.71  2.2904 0.1370167
## Residuals  46 4954.9  107.72
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

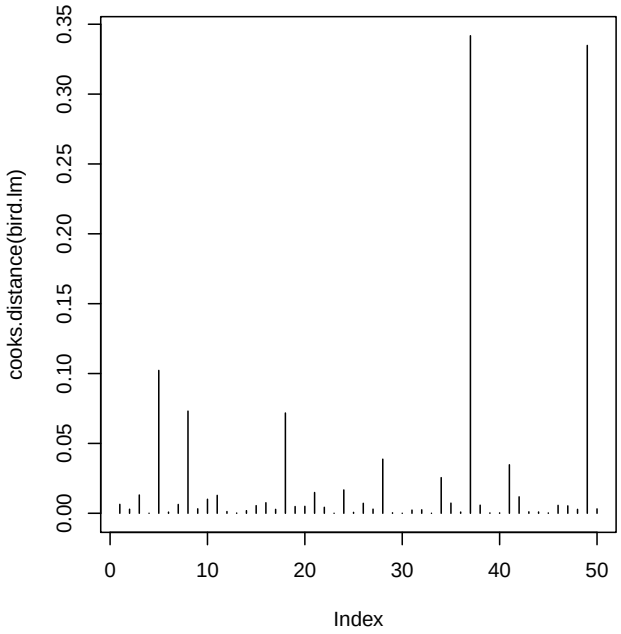
```
par(mfrow = c(2, 2))
plot(bird.lm, which = 1)
plot(bird.lm, which = 2)
plot(hatvalues(bird.lm), type = "h")
```

```
abline(h = 8/length(bird$name), col = "red")
plot(cooks.distance(bird.lm), type = "h")
```










```
cbind(dffits(bird.lm), dfbetas(bird.lm)[, 2:4])
```

```
##                   nest.pair        sizeL  mig.statusM
## 1   0.158479248 -0.058558514 -0.069108602  0.097519683
## 2   0.106531771 -0.015893473  0.068144741 -0.044526900
## 3  -0.227400617 -0.084424830 -0.109505637 -0.166017788
## 4  -0.009803451  0.005946269  0.005125687  0.004319411
## 5   0.670816690 -0.384797862  0.344796479 -0.281391735
## 6  -0.057027630  0.006099956  0.035975322  0.025375671
## 7   0.157416517 -0.058165832 -0.068645173  0.096865734
## 8   0.554734574  0.362372808 -0.252097995 -0.121651626
## 9  -0.112045810 -0.002557150 -0.056602362 -0.081202042
```

```
## 10 -0.199511930 -0.081025299 -0.121776354  0.059403702
## 11 -0.226324663 -0.007504613 -0.147800813  0.088839434
## 12 -0.069260179  0.039729436 -0.035599391  0.029053007
## 13 -0.025683188  0.013569405  0.014231861  0.011585430
## 14 -0.085561401  0.018348475 -0.053859727  0.036259301
## 15  0.146522780 -0.029765359 -0.066363447  0.099445876
## 16 -0.172616336 -0.046182807 -0.110113422  0.058705582
## 17 -0.104662867  0.056581756 -0.055430748  0.044264531
## 18  0.540748846  0.430227829  0.228860696 -0.060415019
## 19 -0.137696397  0.053921760 -0.080733146  0.059219726
## 20 -0.140050962 -0.030285614  0.085167659  0.053872865
## 21  0.243404038  0.117689747  0.143122486 -0.065676988
## 22  0.129431473 -0.042192434 -0.057194031  0.082081009
## 23 -0.009803451  0.005946269  0.005125687  0.004319411
## 24 -0.259010562 -0.070567545 -0.165037566  0.087739094
## 25 -0.050054522  0.019921618  0.029664098  0.022988688
## 26 -0.167711792  0.092961358 -0.087761999  0.070705198
## 27 -0.107451499  0.002190768  0.067830835  0.046554481
## 28 -0.392707923 -0.257599488 -0.158639710 -0.255693470
## 29 -0.035696116  0.011856144 -0.016567435 -0.022353007
## 30 -0.007402054 -0.001454069  0.003252686 -0.005512499
## 31 -0.094631138  0.020293462 -0.059569002  0.040102884
## 32 -0.098692356  0.020731085 -0.047946839 -0.066214842
## 33 -0.009803451  0.005946269  0.005125687  0.004319411
## 34 -0.318090926 -0.259013572  0.107302924  0.037253110
## 35 -0.169320991 -0.080372769  0.091151023  0.051008140
## 36 -0.058720002  0.020742571  0.035378704  0.026999040
## 37  1.202715763  1.096932725 -0.272316000 -0.033591763
## 38  0.150843266 -0.055736998 -0.065778753  0.092820906
## 39 -0.031152205  0.015345362  0.017640104  0.014155588
## 40 -0.032579967  0.008316963 -0.015598132 -0.021364587
## 41 -0.376677429 -0.186928466 -0.219898328  0.099783106
## 42  0.215588002  0.059696522  0.106619300  0.159116207
## 43 -0.063233586  0.020410040  0.038466595  0.029058426
## 44 -0.059852021 -0.018500143  0.025259222 -0.044387757
## 45 -0.029464756  0.011077293  0.017610878  0.013543899
## 46 -0.149330574 -0.083247898  0.075247037  0.039765309
## 47 -0.144737703 -0.037637165  0.086813494  0.053975803
## 48 -0.104738677  0.041015553 -0.061409616  0.045045447
## 49  1.616461338 -0.505786783  0.983506786 -0.693579346
## 50 -0.110853903 -0.045285964  0.044462311 -0.080920828
```

```
cbind(rstandard(bird.lm), rstudent(bird.lm))
```

```
##           [,1]        [,2]
## 1   0.48644645  0.48237223
## 2   0.46399389  0.46000048
## 3  -0.67235260 -0.66829616
## 4  -0.03477943 -0.03439977
## 5   2.25922219  2.36987389
## 6  -0.25650766 -0.25388585
## 7   0.48320105  0.47913753
## 8   1.79952466  1.84602051
## 9  -0.36078519 -0.35734802
```

```
## 10 -0.79572094 -0.79249738
## 11 -0.98858938 -0.98834022
## 12 -0.24722304 -0.24468367
## 13 -0.09777917 -0.09672057
## 14 -0.36818292 -0.36469671
## 15  0.47649181  0.47245149
## 16 -0.72903825 -0.72527256
## 17 -0.38413384 -0.38054638
## 18  1.35254678  1.36518597
## 19 -0.55519224 -0.55097348
## 20 -0.61589519 -0.61169119
## 21  0.92496606  0.92348518
## 22  0.40524674  0.40153509
## 23 -0.03477943 -0.03439977
## 24 -1.08450031 -1.08662906
## 25 -0.20686947 -0.20470378
## 26 -0.60702066 -0.60280554
## 27 -0.48523633 -0.48116606
## 28 -0.91157315 -0.90986588
## 29 -0.10792307 -0.10675706
## 30 -0.02416786 -0.02390388
## 31 -0.40707742 -0.40335554
## 32 -0.31019521 -0.30712638
## 33 -0.03477943 -0.03439977
## 34 -0.78870274 -0.78541136
## 35 -0.66671856 -0.66264124
## 36 -0.24771679 -0.24517300
## 37  1.86404796  1.91751830
## 38  0.46312011  0.45913016
## 39 -0.12176477 -0.12045338
## 40 -0.10124404 -0.10014867
## 41 -1.40137235 -1.41662565
## 42  0.66227036  0.65817754
## 43 -0.27002298 -0.26728373
## 44 -0.18889644 -0.18690444
## 45 -0.12311276 -0.12178730
## 46 -0.55321318 -0.54899628
## 47 -0.62902220 -0.62484052
## 48 -0.42290415 -0.41909763
## 49  4.78905369  6.68928292
## 50 -0.33402512 -0.33077585
```

```
bird$size <- relevel(bird$size, ref = "L")
bird$mig.status <- relevel(bird$mig.status, ref = "M")
bird.lm2 <- lm(extinct ~ nest.pair + size + mig.status, data = bird)
coef(bird.lm2)
```

```
(Intercept)   nest.pair    sizeS    mig.statusR
    ?             ?         ?          ?
```