

## R Material for Chapter 10

```
> bill.data
  bill income persons sqft
1   228   3220      2 1160
2   156   2750      1 1080      ## the data
3   648   3620      2 1720
4   528   3940      1 1840
5   552   4510      3 2240
6   636   3990      4 2190
7   444   2430      1  830
8   144   3070      1 1150
9   744   3750      2 1570
10 1104   4790      5 2660
11  204   2490      1  900
12  420   3600      3 1680
13  876   5370      1 2550
14  840   3180      7 1770
15  876   5910      2 2960
16  276    320      2 1190
17 1236   5920      3 3130
18  372   3520      2 1560
19  276   3720      1 1510
20  450   4840      1 2190

> reg <- lm(bill~persons+sqft)      ## the model
> summary(reg)

Call:
lm(formula = bill ~ persons + sqft)

Residuals:
    Min       1Q   Median       3Q      Max
-196.20 -107.63  -59.41  106.15  300.46

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -202.67048  102.66502  -1.974  0.0648 .
persons      54.87364   24.05689   2.281  0.0357 *
sqft         0.35101    0.05667   6.194 9.81e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 155.3 on 17 degrees of freedom
Multiple R-squared:  0.7835,    Adjusted R-squared:  0.758
F-statistic: 30.75 on 2 and 17 DF,  p-value: 2.250e-06

> res <- residuals(reg)
> plot(sqft,res)      ## residuals plotted against X2=sqft

> fit <- fitted(reg)
> plot(fit,res)      ## residuals plotted against the fitted values

> reg1 <- lm(bill~persons)      ## regression of bill on persons
> res1 <- residuals(reg1)      ## residuals from that fit
> reg2 <- lm(sqft~persons)      ## regression of sqft on persons
> res2 <- residuals(reg2)      ## residuals from that fit
> plot(res2,res1)      ## added variable plot for sqft using the model that
                        ## already contains persons
```

```

> library(MASS)                ## Special Library that needs to be installed and loaded
                                ## for computing studentized residuals

> studres(reg)                  ## studentized residuals function
      1          2          3          4          5          6          7
-0.5733757 -0.5052639  0.9022550  0.1963851 -1.3459247 -1.0260706  2.3897372
      8          9         10         11         12         13         14
-0.7539856  2.0695466  0.7158439  0.2435172 -0.8723188  0.9239828  0.3680857
     15         16         17         18         19         20
-0.5075693 -0.3211904  1.3447489 -0.5363516 -0.7040709 -1.1936146

> imreg <- influence.measures(reg)  ## influence measures function applied to the model
> imreg
Influence measures of
      lm(formula = bill ~ persons + sqft) :

      dfb.1_ dfb.prsn dfb.sqft  dffit cov.r  cook.d  hat inf
1  -0.16180 -0.02652  0.1314 -0.1897 1.252 0.01249 0.0986
2  -0.17133  0.05416  0.1031 -0.1860 1.299 0.01206 0.1194
3   0.09635 -0.02695 -0.0122  0.2102 1.090 0.01489 0.0515
4   0.01972 -0.04111  0.0177  0.0618 1.309 0.00135 0.0901
5   0.10516 -0.08132 -0.1698 -0.3873 0.941 0.04773 0.0765
6   0.09533 -0.23962 -0.0521 -0.3724 1.121 0.04609 0.1164
7   1.02208 -0.17759 -0.7382  1.0531 0.573 0.28947 0.1626  *
8  -0.23798  0.08770  0.1326 -0.2654 1.214 0.02409 0.1102
9   0.31503 -0.02031 -0.1447  0.5037 0.624 0.07088 0.0559
10 -0.20610  0.25636  0.1342  0.3970 1.427 0.05409 0.2352
11  0.09790 -0.02036 -0.0679  0.1018 1.394 0.00366 0.1488
12 -0.08029 -0.11847  0.0751 -0.2369 1.120 0.01897 0.0687
13 -0.11588 -0.30222  0.3569  0.4646 1.286 0.07258 0.2018
14 -0.02611  0.42815 -0.1573  0.4473 2.897 0.07028 0.5963  *
15  0.15119  0.11137 -0.2566 -0.2886 1.513 0.02904 0.2444
16 -0.08744 -0.01350  0.0697 -0.1035 1.299 0.00377 0.0940
17 -0.52486 -0.09065  0.6977  0.7987 1.177 0.20300 0.2608
18 -0.08328  0.00454  0.0395 -0.1312 1.205 0.00599 0.0564
19 -0.14150  0.11523  0.0254 -0.2131 1.195 0.01560 0.0839
20  0.00853  0.31360 -0.2732 -0.4581 1.065 0.06825 0.1284

      ## hat column contains the hii diagonal elements from the hat matrix

> library(car)                  ## special library

> vif(reg)                       ## variance inflation function
      persons      sqft
1.146224 1.146224

> reg2 <- lm(bill~income+persons+sqft)
> vif(reg2)
      income persons      sqft
4.897692 1.366039 5.524919

```