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Homework 5
ECON 586

1(a). Regression without heteroskedasticity-robust standard errors

```
t test of coefficients:

              Estimate Std. Error t value  Pr(>|t|)
(Intercept) -2.6824347 24.2207299 -0.1107   0.91184
lcigpric    -0.8509044  5.7823214 -0.1472   0.88305
lincome      0.8690144  0.7287636  1.1925   0.23344
restaurn    -2.8656213  1.1174059 -2.5645   0.01051 *
white       -0.5592363  1.4594610 -0.3832   0.70169
educ        -0.5017533  0.1671677 -3.0015   0.00277 **
age          0.7745021  0.1605158  4.8251 1.676e-06 ***
agesq       -0.0090686  0.0017481 -5.1878 2.699e-07 ***
```

Regression with heteroskedasticity-robust standard error

```
t test of coefficients:

              Estimate Std. Error t value  Pr(>|t|)
(Intercept) -2.6824347 25.7732316 -0.1041  0.917133
lcigpric    -0.8509044  6.0243117 -0.1412  0.887712
lincome      0.8690144  0.5950006  1.4605  0.144538
restaurn    -2.8656213  1.0122202 -2.8310  0.004756 **
white       -0.5592363  1.3714344 -0.4078  0.683548
educ        -0.5017533  0.1616027 -3.1049  0.001971 **
age          0.7745021  0.1373458  5.6391 2.372e-08 ***
agesq       -0.0090686  0.0014517 -6.2469 6.799e-10 ***
```

The Price and income variables are not significant either with or without heteroskedasticity-robust standard errors.

(b). Now estimate a Poisson regression model

```
Deviance Residuals:
   Min      1Q  Median      3Q     Max
-6.329  -4.224  -3.275   2.245  13.976

Coefficients:
              Estimate Std. Error z value Pr(>|z|)
(Intercept)  3.964e-01  6.139e-01   0.646    0.518
lcigpric    -1.060e-01  1.434e-01  -0.739    0.460
lincome      1.037e-01  2.028e-02   5.115 3.14e-07 ***
restaurn    -3.636e-01  3.122e-02 -11.646  < 2e-16 ***
white       -5.520e-02  3.742e-02  -1.475    0.140
educ        -5.942e-02  4.256e-03 -13.961  < 2e-16 ***
age          1.143e-01  4.969e-03  22.994  < 2e-16 ***
agesq       -1.371e-03  5.695e-05 -24.070  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for poisson family taken to be 1)

    Null deviance: 15821  on 806  degrees of freedom
Residual deviance: 14752  on 799  degrees of freedom
AIC: 16239

Number of Fisher Scoring iterations: 6
```

The price variable is still insignificant but the income variable is very significant.
Interpretation: a one percent increase in price level will decrease the number of cigarettes consumed per day by .001060; a one percent increase in income level will increase the number of cigarettes consumed per day by .001037.

(c). Find the dispersion parameter.

```
Deviance Residuals:
   Min      1Q  Median      3Q     Max
-6.329  -4.224  -3.275   2.245  13.976

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.3964494  2.7673851   0.143  0.88612
lcigpric    -0.1059607  0.6463348  -0.164  0.86982
lincome      0.1037275  0.0914154   1.135  0.25685
restaurn    -0.3636059  0.1407348  -2.584  0.00995 **
white       -0.0552011  0.1686704  -0.327  0.74355
educ        -0.0594225  0.0191852  -3.097  0.00202 **
age          0.1142571  0.0223981   5.101 4.22e-07 ***
agesq       -0.0013708  0.0002567  -5.340 1.21e-07 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for quasipoisson family taken to be 20.31782)

    Null deviance: 15821  on 806  degrees of freedom
Residual deviance: 14752  on 799  degrees of freedom
AIC: NA

Number of Fisher Scoring iterations: 6
```

The dispersion parameter (phi) is 20.31782 which is greater than 1. It is an indication of over dispersion. The t statistics on lcigprice and lincome still remains very small suggesting that they are still insignificant.

(d). At what point does the effect of *age* on expected cigarette consumption become negative?

To solve for this part we take the expectation of cigarette and take the FOC with respect to age and age squared

$E\{cigs\}= \alpha\ age+\beta\ age^2$

Taking FOC

$d\ E\{cigs\}/d\ age= \alpha +2\ \beta\ age=0$

$age= -\alpha/2\beta$

from the test in part b $\alpha= 0.1143$ and $\beta=-.001371$

$age=0.1143/2(-0.001371)=41.68$

Therefore, the expected consumption of cigarette become negative at the age of 41.68.