Number of Children - Poisson Models with Polynomial Terms

February 1, 2012

First of all, the children data is loaded:

```
> library(catdata)
> data(children)
> attach(children)
```

A log-linear Poission model with the number of children as dependent variable
is fitted. Since one cannot expect that the metric predictors have linear effects,
polynomial terms are included in the predictors.

```
> pois <- glm(child ~ age+I(age^2)+I(age^3)+I(age^4)+dur+I(dur^2)+nation+god+univ, data =
> summary(pois)

Call:
glm(formula = child ~ age + I(age^2) + I(age^3) + I(age^4) +
    dur + I(dur^2) + nation + god + univ, family = poisson(link = log),
    data = children)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.1514  -0.7559   0.0102   0.4832   3.6715

Coefficients:
              Estimate Std. Error z value Pr(>|z|)
(Intercept) -1.228e+01  1.484e+00  -8.277  < 2e-16 ***
age          9.359e-01  1.239e-01   7.553 4.26e-14 ***
I(age^2)    -2.490e-02  3.786e-03  -6.577 4.80e-11 ***
I(age^3)     2.842e-04  4.915e-05   5.781 7.42e-09 ***
I(age^4)    -1.180e-06  2.297e-07  -5.137 2.80e-07 ***
dur          1.118e-01  6.652e-02   1.680 0.092904 .
I(dur^2)    -8.328e-03  2.997e-03  -2.779 0.005454 **
nation1      5.686e-02  1.386e-01   0.410 0.681599
god2        -1.025e-01  5.903e-02  -1.736 0.082599 .
god3        -1.448e-01  6.780e-02  -2.136 0.032683 *
god4        -1.279e-01  7.088e-02  -1.805 0.071128 .
god5        -3.621e-02  6.695e-02  -0.541 0.588569
god6        -9.241e-02  7.505e-02  -1.231 0.218239
univ1        6.372e-01  1.729e-01   3.686 0.000228 ***
```

```
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

    Null deviance: 2067.4  on 1760  degrees of freedom
Residual deviance: 1718.6  on 1747  degrees of freedom
AIC: 5196.8

Number of Fisher Scoring iterations: 5
```
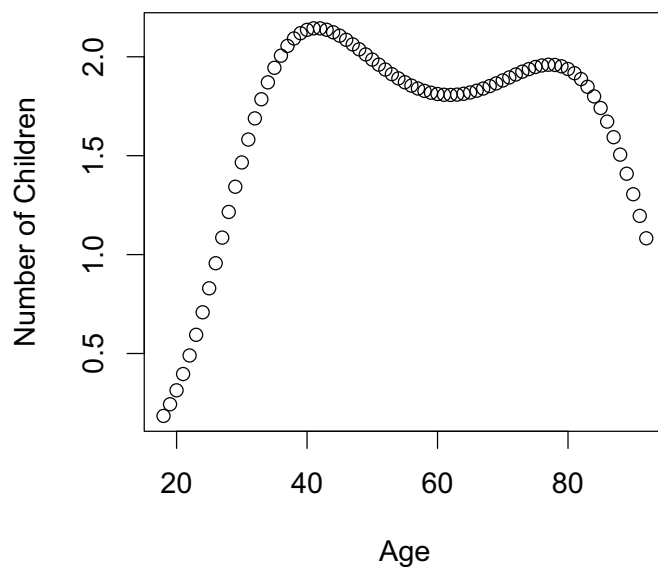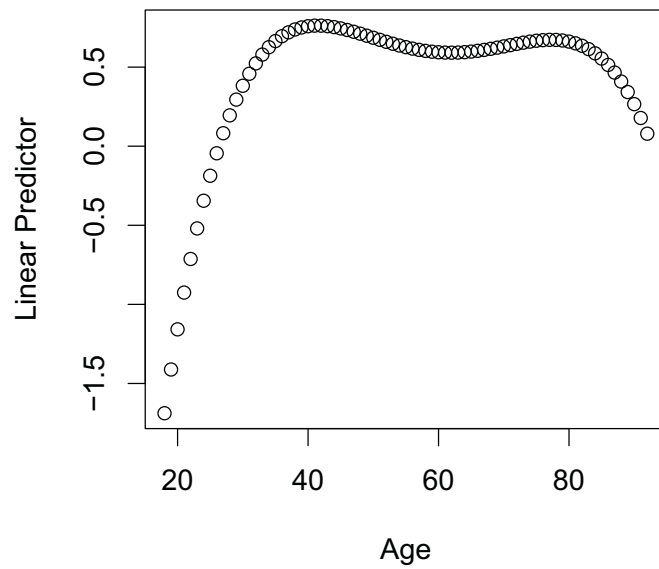
Visualizing the effect of age and duration for education.

```
> x <- min(age):max(age)
> y <- exp(pois$coef[1]+pois$coef["age"]*x+pois$coef["I(age^2)"]*x^2+pois$coef["I(age^3)"]
> par(cex=1.4)
> plot(x, y, ylab="Number of Children", xlab="Age")
```



```
> y <- (pois$coef[1]+pois$coef["age"]*x+pois$coef["I(age^2)"]*x^2+pois$coef["I(age^3)"]*x^
> par(cex=1.4)
> plot(x, y, ylab="Linear Predictor", xlab="Age")
```

```
> x <- min(dur):max(dur)
> y <- exp(pois$coef[1]+pois$coef["age"]*40+pois$coef["I(age^2)"]*40^2+pois$coef["I(age^3)
> par(cex=1.4)
> plot(x, y, ylab="Number of Children", xlab="Duration of School Education")
```
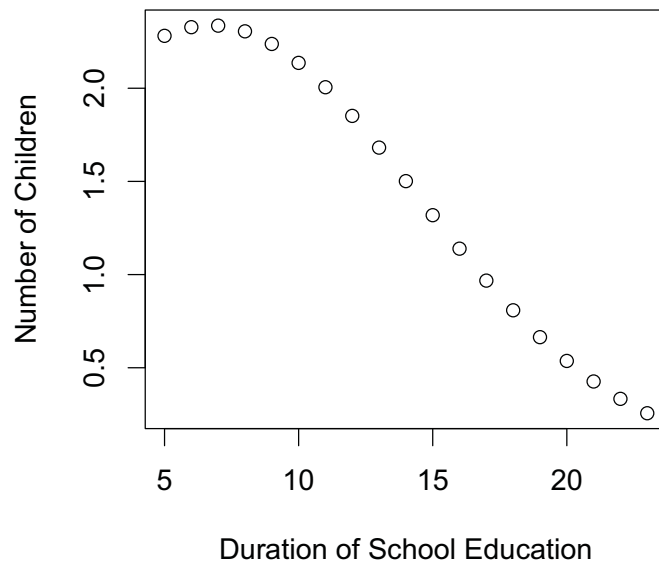
```
> y <- (pois$coef[1]+pois$coef["age"]*40+pois$coef["I(age^2)"]*40^2+pois$coef["I(age^3)"]*
> par(cex=1.4)
> plot(x, y, ylab="Linear Predictor", xlab="Duration of School Education")
```
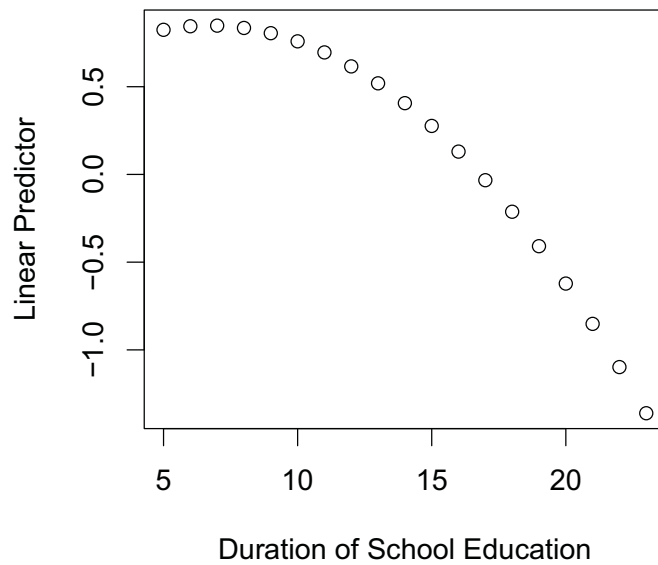
Calculate the deviance of the Poisson model.

```
> anova(pois)

Analysis of Deviance Table

Model: poisson, link: log

Response: child

Terms added sequentially (first to last)


          Df Deviance Resid. Df Resid. Dev
NULL                      1760      2067.4
age        1   93.596    1759      1973.8
I(age^2)   1  108.618    1758      1865.2
I(age^3)   1   68.198    1757      1797.0
I(age^4)   1   26.290    1756      1770.7
dur        1   30.730    1755      1740.0
I(dur^2)   1    0.682    1754      1739.3
nation     1    0.459    1753      1738.8
god        5    6.729    1748      1732.1
univ       1   13.489    1747      1718.6
```