

Number of Children - Poisson Models with Polynomial Terms

December 4, 2025

First of all, the children data is loaded:

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

A log-linear Poisson 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.

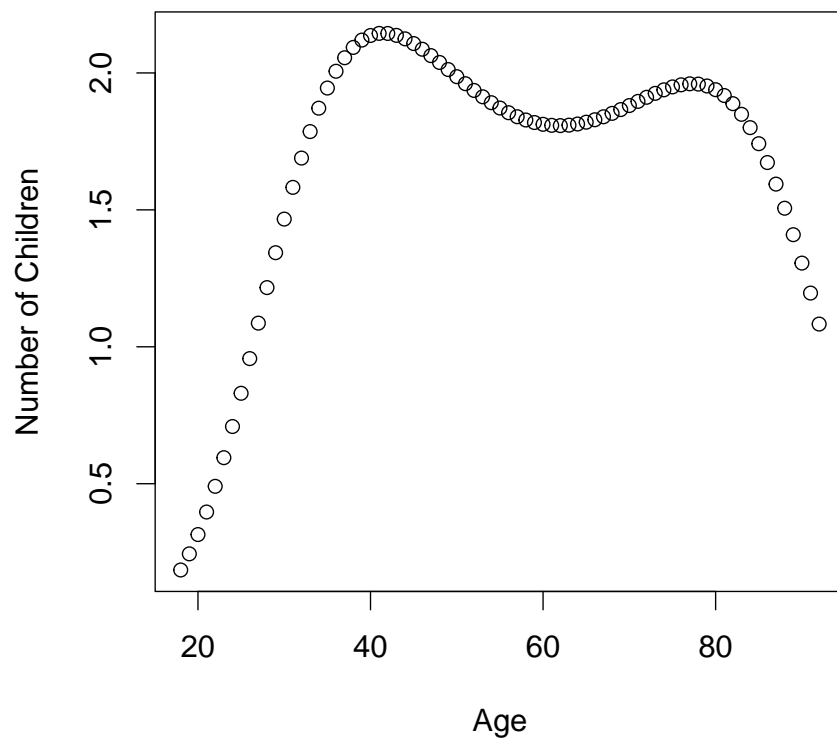
```
pois <- glm(child ~ age+I(age^2)+I(age^3)+I(age^4)+dur+I(dur^2)+nation+god+univ,
             data = children, family = poisson(link=log))
summary(pois)
```

```
##
## 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)
##
## 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.

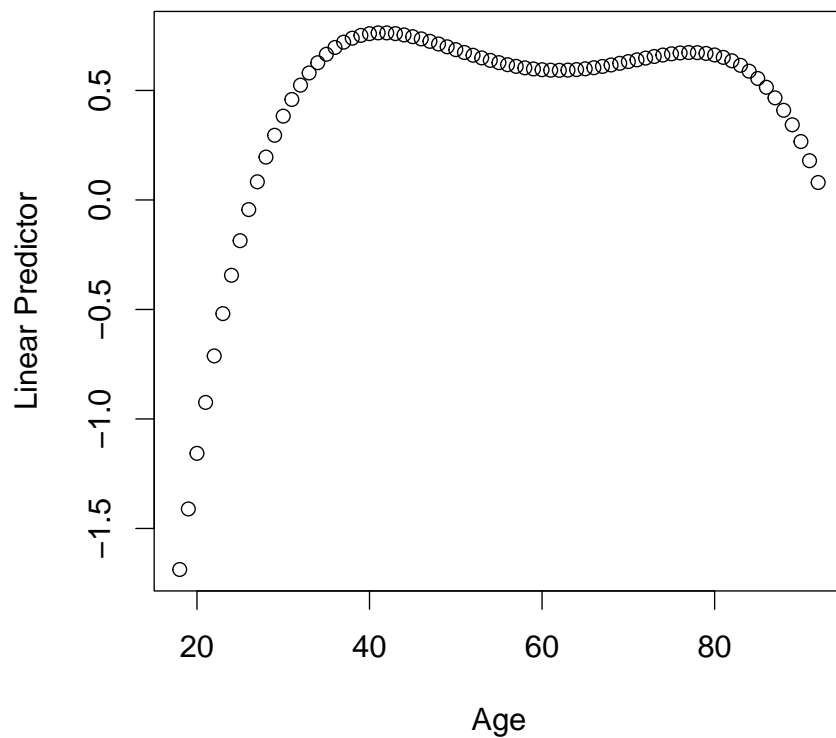
```
x <- min(age):max(age)
y <- exp(pois$coef[1]+pois$coef["age"]*x+pois$coef["I(age^2)"]*x^2+
  pois$coef["I(age^3)"]*x^3+pois$coef["I(age^4)"]*x^4+pois$coef["dur"]*10+
  pois$coef["I(dur^2)"]*100)
par(cex=1.4)
plot(x, y, ylab="Number of Children", xlab="Age")
```



```

y <- (pois$coef[1]+pois$coef["age"]*x+pois$coef["I(age^2)"]*x^2+
      pois$coef["I(age^3)"]*x^3+pois$coef["I(age^4)"]*x^4+pois$coef["dur"]*10+
      pois$coef["I(dur^2)"]*100)
par(cex=1.4)
plot(x, y, ylab="Linear Predictor", xlab="Age")

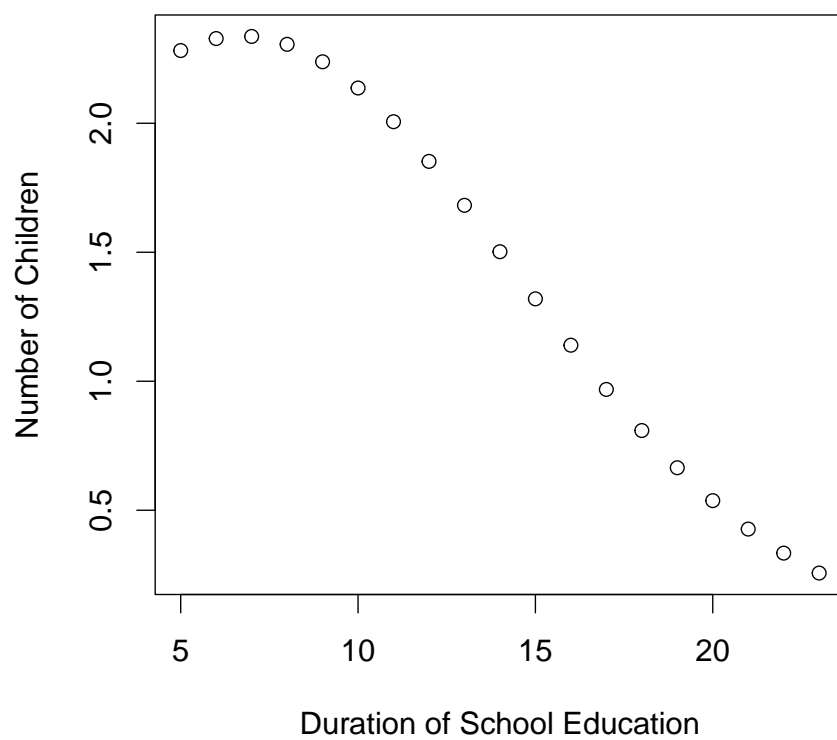
```



```

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)"]*40^3+pois$coef["I(age^4)"]*40^4+pois$coef["dur"]*x+
        pois$coef["I(dur^2)"]*x^2)
par(cex=1.4)
plot(x, y, ylab="Number of Children", xlab="Duration of School Education")

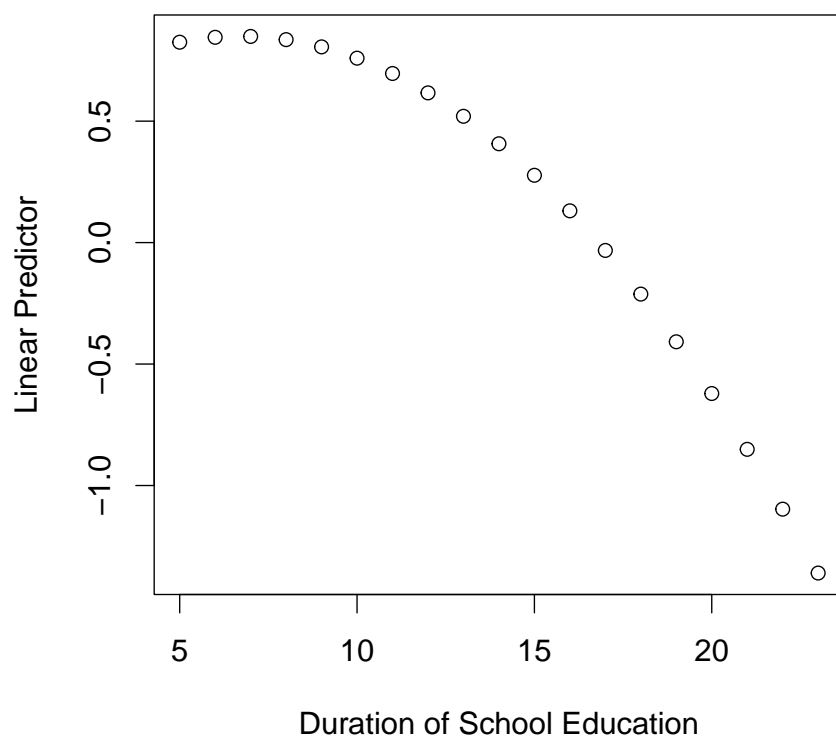
```



```

y <- (pois$coef[1]+pois$coef["age"]*40+pois$coef["I(age^2)"]*40^2+
      pois$coef["I(age^3)"]*40^3+pois$coef["I(age^4)"]*40^4+pois$coef["dur"]*x+
      pois$coef["I(dur^2)"]*x^2)
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	Pr(>Chi)
## NULL			1760	2067.4	
## age	1	93.596	1759	1973.8	< 2.2e-16 ***
## I(age^2)	1	108.618	1758	1865.2	< 2.2e-16 ***
## I(age^3)	1	68.198	1757	1797.0	< 2.2e-16 ***
## I(age^4)	1	26.290	1756	1770.7	2.938e-07 ***
## dur	1	30.730	1755	1740.0	2.966e-08 ***

```
## I(dur^2) 1 0.682 1754 1739.3 0.4090349
## nation 1 0.459 1753 1738.8 0.4980514
## god 5 6.729 1748 1732.1 0.2416035
## univ 1 13.489 1747 1718.6 0.0002399 ***
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```