Tutorial 9

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Q2

```
data <- read.table('Data.txt', header=T)
set.seed(8027)
x <- data$age
y <- data$fledged

mll <- function(beta, y, x){
    sum(dpois(y, lambda=exp(beta[1]+x*beta[2]+x^2*beta[3]),log=TRUE))
}
(out <- optim(c(1,1,1), mll, hessian = TRUE,
      control=list(fnscale=-1), method="BFGS", y=y, x=x))
```

```
## $par
## [1]  0.2757469  0.6825819 -0.1346644
##
## $value
## [1] -96.38849
##
## $counts
## function gradient
##      152       36
##
## $convergence
## [1] 0
##
## $message
## NULL
##
## $hessian
##             [,1]      [,2]       [,3]
## [1,]  -125.0064  -361.015  -1241.054
## [2,]  -361.0150 -1241.001  -4719.142
## [3,] -1241.0537 -4719.142 -19113.182
```

```
beta0 <- out$par[1]
beta1 <- out$par[2]
beta2 <- out$par[3]
```

So $\hat{\beta}_0 = 0.2757469, \ \hat{\beta}_1 = 0.6825819, \ \hat{\beta}_2 = -0.1346644$.

The estimated asymptotic variances are:

```
diag(solve(-out$hessian))
```

```
## [1] 0.195518108 0.114552207 0.003346105
```

```
n <- nrow(data)
B <- 1000
```

```r
beta0.hat <- rep(0, B)
beta1.hat <- rep(0, B)
beta2.hat <- rep(0, B)

for (b in 1:B){
    data.star <- data[sample(1:n,replace=TRUE),]
    x <- data.star$age
    y <- data.star$fledged
    mll <- function(beta, y, x){
        sum(dpois(y, lambda=exp(beta[1]+x*beta[2]+x^2*beta[3]),log=TRUE))
        }
    out <- optim(c(1,1,1), mll, hessian = TRUE,
      control=list(fnscale=-1), method="BFGS", y=y, x=x)
    beta0.hat[b] <- out$par[1]
    beta1.hat[b] <- out$par[2]
    beta2.hat[b] <- out$par[3]
}

(bias.beta0.hat <- mean(beta0.hat)-beta0)
```

```
## [1] -0.06317356
```

```r
(bias.beta1.hat <- mean(beta1.hat)-beta1)
```

```
## [1] 0.03495636
```

```r
(bias.beta2.hat <- mean(beta2.hat)-beta2)
```

```
## [1] -0.005032503
```

```r
var(beta0.hat)
```

```
## [1] 0.2829929
```

```r
var(beta1.hat)
```

```
## [1] 0.1393406
```

```r
var(beta2.hat)
```

```
## [1] 0.003514416
```