Biostat 651 Homework 2

David (Daiwei) Zhang

February 6, 2017

Problem 2(c)

```
dat <- read.csv("hw2.csv", header = TRUE)
Y <- dat$Y
n <- length(Y)
X <- cbind(rep(1,n), dat$X1, dat$X2)
nu <- 3
b <- c(-1, -1, -1)

n.it <- 100
B <- matrix(0, n.it, length(b))

for(i in 1:n.it){
    B[i,] = b
    eta <- X %*% b
    mu <- -1/eta
    v <- c(mu^2)
    V <- diag(v)
    V.inv <- diag(1/v)
    Z <- eta + V.inv %*% (Y - mu)
    b <- solve(t(X) %*% V %*% X) %*% t(X) %*% V %*% Z
}

bhat <- tail(B, 1)
print(bhat)
```

```
##              [,1]       [,2]       [,3]
## [100,] -1.904169 -0.4798081 -0.6218624
```

Problem 2(d)

```
J <- nu * t(X) %*% V %*% X
bhat.se <- sqrt(diag(solve(J)))

# 95% CI for beta.hat.1
bhat[2] + c(-1,1) * 1.96 * bhat.se[2]
```

```
## [1] -1.02900885  0.06939268
```

```
# 95% CI for beta.hat.2
bhat[3] + c(-1,1) * 1.96 * bhat.se[3]
```

```
## [1] -1.22528203 -0.01844284
```

Problem 2(e)

```
lambda.null <- rep(mean(Y), n)
lambda.alt <- -1/eta

like <- function(lambda, y){
     -nu * sum(log(lambda)) - nu * sum(Y / lambda)
}

lr.stat <- 2 * (like(lambda.alt, Y) - like(lambda.null,Y))
lr.stat
```

```
## [1] 8.131797
```

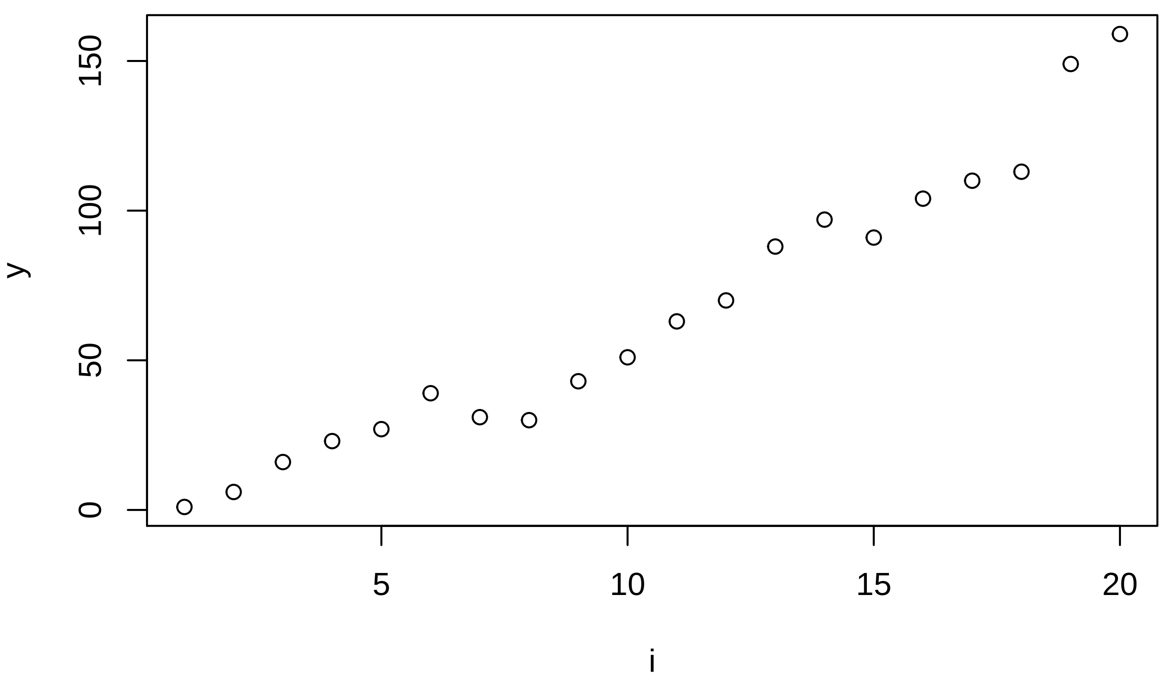
```
lr.pval <- 1 - pchisq(lr.stat, df = 2)
lr.pval
```

```
## [1] 0.01714757
```

We shoud reject H_0 since $p < 0.05$.

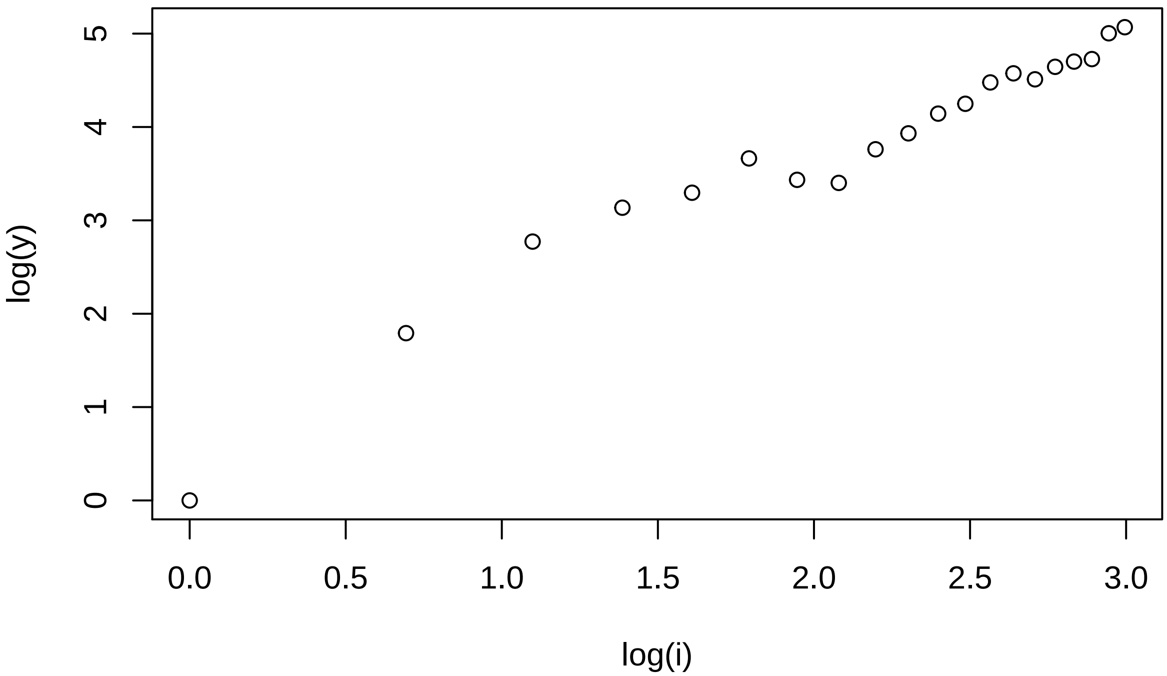
Problem 3(a)

```
dat <- read.csv("aids.csv", skip = 2, header = TRUE)
dat$period <- c(1:20)
i <- dat$period
y <- dat$cases
plot(i, y)
```



Problem 3(b)

```
plot(log(i), log(y))
```



Problem 3(c)

```
tt <- log(i) - log(10)
summary(glm(y ~ tt, family = poisson))
```

```
##
## Call:
## glm(formula = y ~ tt, family = poisson)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.0568  -0.8302  -0.3072   0.9279   1.7310
##
## Coefficients:
##             Estimate Std. Error z value Pr(>|z|)
## (Intercept)  4.05063    0.03331  121.61   <2e-16 ***
## tt           1.32661    0.06463   20.52   <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: 677.264  on 19  degrees of freedom
## Residual deviance:  21.755  on 18  degrees of freedom
## AIC: 138.05
##
## Number of Fisher Scoring iterations: 4
```

Thus $\beta_0 = 4.051$, $\beta_1 = 1.327$. Here, β_0 is the expected number of cases in the 10^{th} period. As for β_1, it is expected to take $2^{\frac{1}{\beta_1}}$ periods for the number of cases to double.