> rm(list = ls())

>

> #Question 2

> #(b)

>

> #Let S(p,y,n)=Score function=(y/p)-(n-y)/(1-p)

> S=function(p,y,n){

+ res=(y/p)-(n-y)/(1-p)

+ return(res)

+ }

>

> #Hessian matirxb

> H=function(p,y,n){

+ res=-(y/p^2)-(n-y)/(1-p)^2

+ return(res)

+ }

>

> #Newton-Raphson Function

> #t=iterition times

> #p0=starting value

> NR=function(p0,y,n,t){

+ p=p0

+ for(i in 1:t){

+ p=p-H(p,y,n)^(-1)\*S(p,y,n)

+ cat("p=",p,"t=",t,"\n")

+ }

+ return(p)

+ }

>

> #(c)

> #p\_hat=0.3 n=10 implies y=3

> #p0=(0.1,0.2,...,0.9)

> #t=6

>

> NR(0.1,3,10,6)

p= 0.172 t= 6

p= 0.2525236 t= 6

p= 0.2947439 t= 6

p= 0.299946 t= 6

p= 0.3 t= 6

p= 0.3 t= 6

[1] 0.3

> NR(0.2,3,10,6)

p= 0.2727273 t= 6

p= 0.2983957 t= 6

p= 0.2999951 t= 6

p= 0.3 t= 6

p= 0.3 t= 6

p= 0.3 t= 6

[1] 0.3

> NR(0.3,3,10,6)

p= 0.3 t= 6

p= 0.3 t= 6

p= 0.3 t= 6

p= 0.3 t= 6

p= 0.3 t= 6

p= 0.3 t= 6

[1] 0.3

> NR(0.4,3,10,6)

p= 0.2909091 t= 6

p= 0.2998355 t= 6

p= 0.2999999 t= 6

p= 0.3 t= 6

p= 0.3 t= 6

p= 0.3 t= 6

[1] 0.3

> NR(0.5,3,10,6)

p= 0.3 t= 6

p= 0.3 t= 6

p= 0.3 t= 6

p= 0.3 t= 6

p= 0.3 t= 6

p= 0.3 t= 6

[1] 0.3

> NR(0.6,3,10,6)

p= 0.36 t= 6

p= 0.2952809 t= 6

p= 0.2999566 t= 6

p= 0.3 t= 6

p= 0.3 t= 6

p= 0.3 t= 6

[1] 0.3

> NR(0.7,3,10,6)

p= 0.472973 t= 6

p= 0.2932591 t= 6

p= 0.2999105 t= 6

p= 0.3 t= 6

p= 0.3 t= 6

p= 0.3 t= 6

[1] 0.3

> NR(0.8,3,10,6)

p= 0.626087 t= 6

p= 0.3847662 t= 6

p= 0.2923753 t= 6

p= 0.2998851 t= 6

p= 0.3 t= 6

p= 0.3 t= 6

[1] 0.3

> NR(0.9,3,10,6)

p= 0.8052632 t= 6

p= 0.6349771 t= 6

p= 0.3940117 t= 6

p= 0.2914389 t= 6

p= 0.2998545 t= 6

p= 0.3 t= 6

[1] 0.3

>

> #(d)

> #The more starting value get closed to true value, the faster speed of

> #convergence is

>

> #(e)

> #when pi\_hat=0, implies that y/n=0, y=0

> #Score function is -10/(1-p)

> #Hessian matrix is -10/(1-p)^2

> #p(t)=2\*p(t-1)-1

>

> #when pi\_hat=1, implies that y/n=1, y=10

> #Score function is 10/p

> #Hessian matrix is -10/p^2

> #p(t)=2\*p(t-1)

>

> #Thus, we can not have correct result because there is no convergence

>

> #Question 5

> #(a)

>

> A=cbind(c(8,7,6,6,3,4,7,2,3,4),rep(0,10))

> B=cbind(c(9,9,8,14,8,13,11,5,7,6),rep(1,10))

> data=data.frame(rbind(A,B))

> colnames(data)=c("Y","X")

> model1=glm(Y~X,family = poisson(),data = data)

> summary(model1)

Call:

glm(formula = Y ~ X, family = poisson(), data = data)

Deviance Residuals:

Min 1Q Median 3Q Max

-1.5280 -0.7622 -0.1699 0.6938 1.5399

Coefficients:

Estimate Std. Error z value Pr(>|z|)

(Intercept) 1.6094 0.1414 11.380 < 2e-16 \*\*\*

X 0.5878 0.1764 3.332 0.000861 \*\*\*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for poisson family taken to be 1)

Null deviance: 27.857 on 19 degrees of freedom

Residual deviance: 16.268 on 18 degrees of freedom

AIC: 94.349

Number of Fisher Scoring iterations: 4

>

> #When x=0

> #ua=e^a

>

> #When x=1

> #ub=e^(a+b)

>

> #So ub/ua=e^b

> exp(model1$coefficients[2])

X

1.8

> ua=exp(model1$coefficients[1])

> ub=exp(model1$coefficients[1]+model1$coefficients[2])

> exp(model1$coefficients[2])==ub/ua

X

TRUE

>

> #Interpretion

> #The coefficient for the intercept is 1.6094379. Thus the estimated

> #expectation for the number of seizures in Treatment A is e^1.6094379=5

> #The estimated expectation for the number of seizures in Treatment B

> #is e^(1.6094379+0.5877867)=9

>

> #(c)

> library(AER)

> dispersiontest(model1,trafo = 1)

Overdispersion test

data: model1

z = -1.1189, p-value = 0.8684

alternative hypothesis: true alpha is greater than 0

sample estimates:

alpha

-0.1977778

>

> #Result shows that we can not reject c=0 for Var(y)=u+c\*f(u)

> #Which means Var(y)=u=E(y). There is no dispersion

>

> #(e)

> library(MASS)

> model2=glm.nb(Y~X,data = data,link = log)

> summary(model2)

Call:

glm.nb(formula = Y ~ X, data = data, link = log, init.theta = 113420.3107)

Deviance Residuals:

Min 1Q Median 3Q Max

-1.5280 -0.7622 -0.1699 0.6937 1.5398

Coefficients:

Estimate Std. Error z value Pr(>|z|)

(Intercept) 1.6094 0.1414 11.380 < 2e-16 \*\*\*

X 0.5878 0.1764 3.332 0.000861 \*\*\*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for Negative Binomial(113420.3) family taken to be 1)

Null deviance: 27.855 on 19 degrees of freedom

Residual deviance: 16.267 on 18 degrees of freedom

AIC: 96.349

Number of Fisher Scoring iterations: 1

Theta: 113420

Std. Err.: 4076965

Warning while fitting theta: iteration limit reached

2 x log-likelihood: -90.349

>

>

>

> #(f)

>

> #Poisson

> model1$coefficients[2]

X

0.5877867

>

> #standard error is 0.1746

>

> #Negative Binomial

> model2$coefficients[2]

X

0.5877867

>

> #standard error is 0.1746

>

> #(g)

> model3=glm(Y~1,family = poisson(),data = data)

> summary(model3)

Call:

glm(formula = Y ~ 1, family = poisson(), data = data)

Deviance Residuals:

Min 1Q Median 3Q Max

-2.2336 -0.9063 0.0000 0.4580 2.3255

Coefficients:

Estimate Std. Error z value Pr(>|z|)

(Intercept) 1.94591 0.08451 23.02 <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: 27.857 on 19 degrees of freedom

Residual deviance: 27.857 on 19 degrees of freedom

AIC: 103.94

Number of Fisher Scoring iterations: 4

>

> model4=glm.nb(Y~1,data = data,link = log)

> summary(model4)

Call:

glm.nb(formula = Y ~ 1, data = data, link = log, init.theta = 18.2073559)

Deviance Residuals:

Min 1Q Median 3Q Max

-1.9810 -0.7836 0.0000 0.3859 1.9033

Coefficients:

Estimate Std. Error z value Pr(>|z|)

(Intercept) 1.94591 0.09944 19.57 <2e-16 \*\*\*

---

Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for Negative Binomial(18.2074) family taken to be 1)

Null deviance: 20.279 on 19 degrees of freedom

Residual deviance: 20.279 on 19 degrees of freedom

AIC: 104.77

Number of Fisher Scoring iterations: 1

Theta: 18.2

Std. Err.: 21.0

2 x log-likelihood: -100.767

>

> #(h)

> dispersiontest(model3,trafo = 1)

Overdispersion test

data: model3

z = 0.96575, p-value = 0.1671

alternative hypothesis: true alpha is greater than 0

sample estimates:

alpha

0.3857143

>

> #Result shows that we can not reject c=0 for Var(y)=u+c\*f(u)

> #Which means Var(y)=u=E(y). There is no dispersion