Q1)

```
install.packages("readxl")
library(readxl)

d<- read_excel("C:/Users/ch4ex1.xlsx")
d

i=d$i
i
y=d$y
y

#Plot the number of cases y against time period i ( i= 1,...,20)
plot(i,y,pch=16)

# plot logi against logy
plot(log(i),log(y))

# Fit the model
model<-glm(y~log(i),family=poisson(link="log"),data=d)
summary(model)

# an approximate 95% confidence interval for beta1 and beta 2
CI_of_beta <- confint.default(model,level=0.95)
CI_of_beta

# The variance-covariance matrix of the MLE
```

```
Tauinver<-vcov(model)
Tauinver

#  use the iterative formula to fit model

# Initial values b0
beta<-c(1,1)
beta

#Design matrix (X)
X=matrix(c(rep(1,20),log(i)),nrow=20,ncol = 2,byrow = F)
X



#Transform Design matrix (Xt)
Xt<-t(X)
Xt

#Working weights matrix (W )

W<-exp(beta[1])*diag(c(i^beta[2]),nrow = 20,ncol = 20)
W

#Information matrix, Tau= Xt*W*X
# Multiply the matrices.
tau<- Xt%*%W%*%X
tau
```

```
#The score statistics are: (U1 and U2)

U1<-sum(y-exp(beta[1]+beta[2]*log(i)))

U2<-sum(y*log(i)-log(i)*exp(beta[1]+beta[2]*log(i)))

#The vector of scores (U)

U<-matrix(c(U1,U2))

U

##iterative equation to find an approximate estimate of beta: b1, b2

b<-beta+solve(tau)%*%U

b
```

Q2)

```
#Design matrix (X) :

X=matrix(c(rep(1,17),xi),nrow=17,ncol = 2,byrow = F)

X

#Transpose of design matrix :

Xt<-t(X)

Xt

#The matrix of working weights (W) is :

W<-diag(c(rep(1,17)),nrow = 17,ncol = 17)

W
```

```
##Information matrix, Tau= Xt*W*X (Multiply the matrices):
tau<- Xt%*%W%*%X
tau

#The score statistics are: (U1 and U2
U1<-sum(-1+(yi/exp(beta[1]+beta[2]*xi)))
U2<-sum(-xi+(yi*xi/exp(beta[1]+beta[2]*xi)))

U<-matrix(c(U1,U2))
U

#We make the following Calculation: (to compute b
b<-beta+solve(tau)%*%U
b

#Fit the model described in (c) using statistical software
model<-glm(yi~xi ,family =Gamma(link = "log"))
summary(model, dispersion =1)

#Find the 95% confidence interval
CI_of_beta <- confint.default(model,level=0.95)
CI_of_beta

#The variance-covariance matrix of the MLE
Tauinver<-vcov(model, dispersion =1)
Tauinver
```

```
#Find approximate of the information matrix evaluated at b
Tau_at_b<-solve(vcov(model, dispersion =1))
Tau_at_b

#the model fitted
yhat<-exp(8.4775-1.1093*xi)  #or yhat=fitted.values(m,dispersion =1)
yhat

#residuals
ri<-(yi-yhat)/yhat
ri

#test statistics
test_statistc<- sum(ri^2)
test_statistc

#table value
chi_table<-qchisq(1-0.05,17-2)
chi_table
```