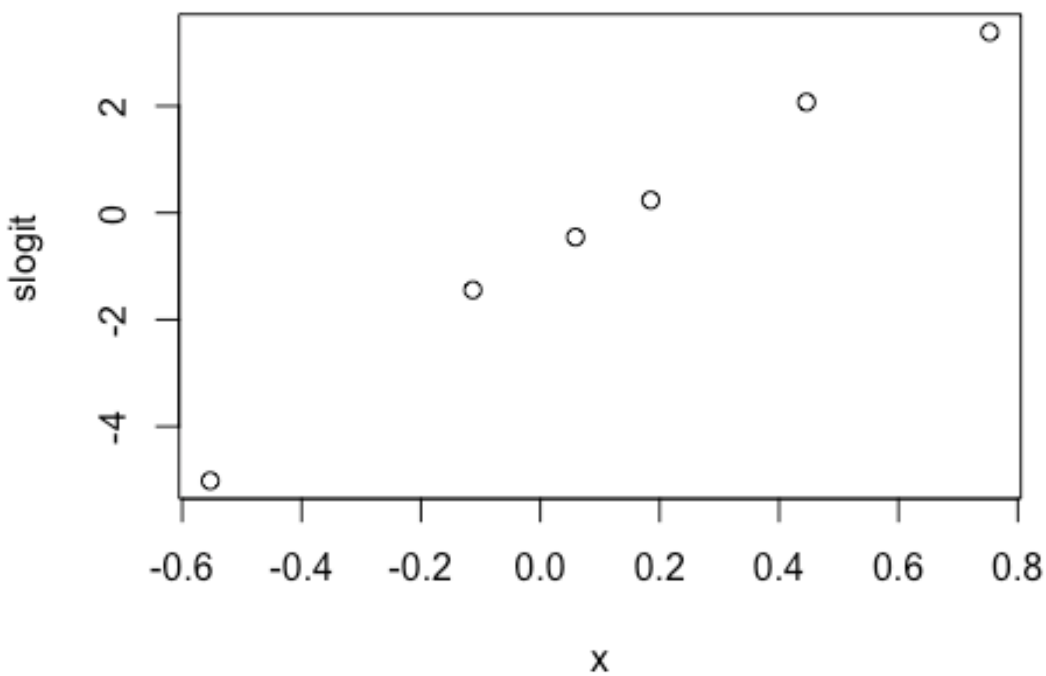
HW#9, Nan Deng

(1)

(a)

```r
y <- c(0,14,29,42,67,73)
n <- rep(75,6)
x <- c(-0.553,-0.113,0.059,0.185,0.446,0.753)
slogit <- log((y+0.5)/(n-y+0.5))
plot(x,slogit)
```




```r
ymat <- cbind(y,n-y)
m1 <- glm(ymat~x,family=binomial)
summary(m1)

##
## Call:
## glm(formula = ymat ~ x, family = binomial)
##
## Deviance Residuals:
##       1        2        3        4        5        6
## -1.3203   0.4464   0.1400  -0.3365   0.3237  -0.5155
##
## Coefficients:
##             Estimate Std. Error z value Pr(>|z|)
## (Intercept)  -0.8758     0.1565  -5.597 2.18e-08 ***
## x             6.4616     0.6373  10.139  < 2e-16 ***
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 279.2881  on 5  degrees of freedom
## Residual deviance:   2.4458  on 4  degrees of freedom
## AIC: 26.626
##
## Number of Fisher Scoring iterations: 4
```

```
fitted.values(m1)
```

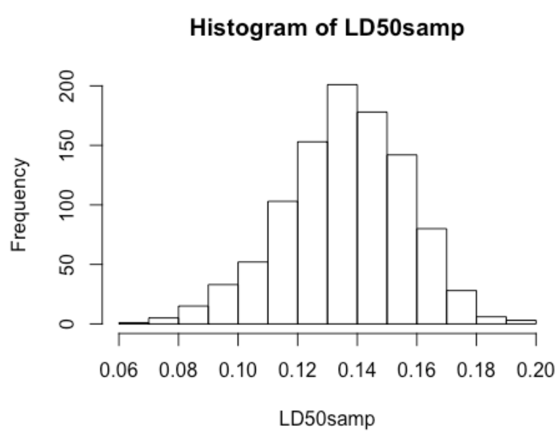
```
##          1          2          3          4          5          6
## 0.01155421 0.16714746 0.37881402 0.57922099 0.88143121 0.98183211
```

Parameter	Estimate	Std Error
α	-0.8758	0.1565
β	6.4616	0.6373

The Residual deviance is 2.4458 on 4 degrees of freedom.

(b)

```
phat <- fitted.values(m1)
nmat <- matrix(0,nrow=2,ncol=1000)
for(i in 1:1000) {
  ynew <- rbinom(6,n,phat)
  ymatnew <- cbind(ynew,n-ynew)
  m2 <- glm(ymatnew~x,family=binomial)
  nmat[,i] <- m2$coef
}
LD50samp <- -nmat[1,]/nmat[2,]
hist(LD50samp)
```




```
mean(LD50samp)
```

```
## [1] 0.1360096
```

```
sd(LD50samp)
```

```
## [1] 0.02063743
```

The mean of LD50 through using bootstrap is 0.1360096, while the corresponding standard error is 0.02063743.

(c)

untitled2

```
model {
    for(i in 1:N) {
       y[i]~dbin(p[i],n[i])
       logit(p[i]) <- alpha + beta * x[i]
    }
    alpha~dnorm(0.0,1.0E-6)
    beta~dnorm(0.0,1.0E-6)
    LD50 <- -alpha/beta
}
list(y=c(0,14,29,42,67,73),n=c(75,75,75,75,75,75),N=6,
x=c(-0.553,-0.113,0.059,0.185,0.446,0.753))

list(alpha=0,beta=0)
```

Node statistics

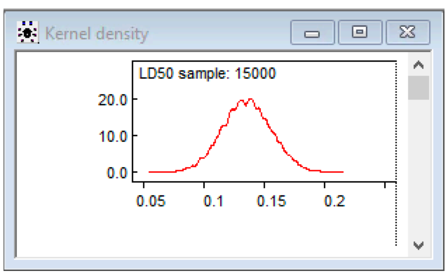
node	mean	sd	MC error	2.5%	median	97.5%	start	sample
alpha	-0.887	0.1566	0.001656	-1.2	-0.883	-0.5878	5001	15000

Node statistics

node	mean	sd	MC error	2.5%	median	97.5%	start	sample
beta	6.555	0.6446	0.0068	5.348	6.534	7.859	5001	15000

The mean of α estimated by WinBUGS is -0.887, and the standard error is 0.1566. The mean of β estimated by WinBUGS is 6.555, and the standard error is 0.6446. The result is quite similar to that calculated by bootstrap.

(d)



Node statistics

node	mean	sd	MC error	2.5%	median	97.5%	start	sample
LD50	0.1354	0.02048	1.656E-4	0.09568	0.1353	0.176	5001	15000

The mean and standard deviation of LD50 estimated by WinBUGS are 0.1354 and 0.02048 respectively, which is similar to that calculated in part b).

(e)

```
vec <- c(-1/m1$coef[2],m1$coef[1]/m1$coef[2]^2)
sqrt(vec %*% vcov(m1) %*% vec)

##            [,1]
## [1,] 0.02061732
```

The standard error estimated by Delta Method is 0.02061732. The results got through these three methods are all similar.