Problem Set 3
Optimizing a Logit Model

For this problem set, please find a political science data set that has a binary response variable, y_i and two covariates, x_1 and x_2. At least one of the covariates should be continuous. Using R, please write the log-likelihood function for your model and then solve for the MLE one iteration at a time (i.e. doing what I did in the lecture slides). For each iteration, please show the relevant model matrices (score vector, var-cov matrix, direction vector, and update vector). When the model achieves convergence, please present the results in tabular form (coefficients, standard errors, and z-ratios). Interpret the results by answering the following questions/doing the following calculations: Are the parameters significantly different from 0? What is the probability $y = 1$ for three different covariate profiles? Give an odds ratio interpretation for at least one of the covariates. To get you started, below is the R code I used to estimate a one-variable model. Finally, rerun your model using "canned" R routines to verify your estimates are equivalent to the "canned" estimates. You will have to modify the code to account for two variables and you will need to figure out how to back out the relevant matrices. As a hint, the score vector is given by $\mathbf{U} = \mathbf{X}'(\mathbf{y} - \mathbf{m})$, where $\mathbf{m} = n_i\Lambda_i$.

```
y<-cbind(d)
x<-cbind(x1)
cons <- rep(1, length(x[,1]))

llk.logit<- function(param,y,x) {
cons <- rep(1, length(x[,1]))
      x<-cbind(cons, x)
      b<-param[1 : ncol(x) ]
     xb<-x%*%b
  sum( y*log(1+exp(-xb)) + (1-y)*log(1+exp(xb)))
}

ols.result <- lm(y~x); ols.result

stval <-ols.result$coeff

logit.result<-optim(stval, llk.logit, method="BFGS",
control= list(maxit=10), hessian=TRUE, y=y, x=x)

parm.est<-logit.result$par; parm.est
log.like<- -logit.result$value; log.like
```