MATH 598: TOPICS IN STATISTICS

MCMC FOR NEURAL NETWORK MODELS

A simple multi-layer neural network model can be written as follows: suppose we have

- **STAGE 1:** n observations on K_1 input variables $X_1, \ldots, X_{K_1}$.
- **STAGE 2:** K_2 derived variables $X_1^{(2)}, \ldots, X_{K_2}^{(2)}$ where

$$X_k^{(2)} = s\left(\beta_{k0}^{(2)} + \sum_{j=1}^{K_1} X_j \beta_{kj}^{(2)}\right) \qquad k = 1, \ldots, K_2$$

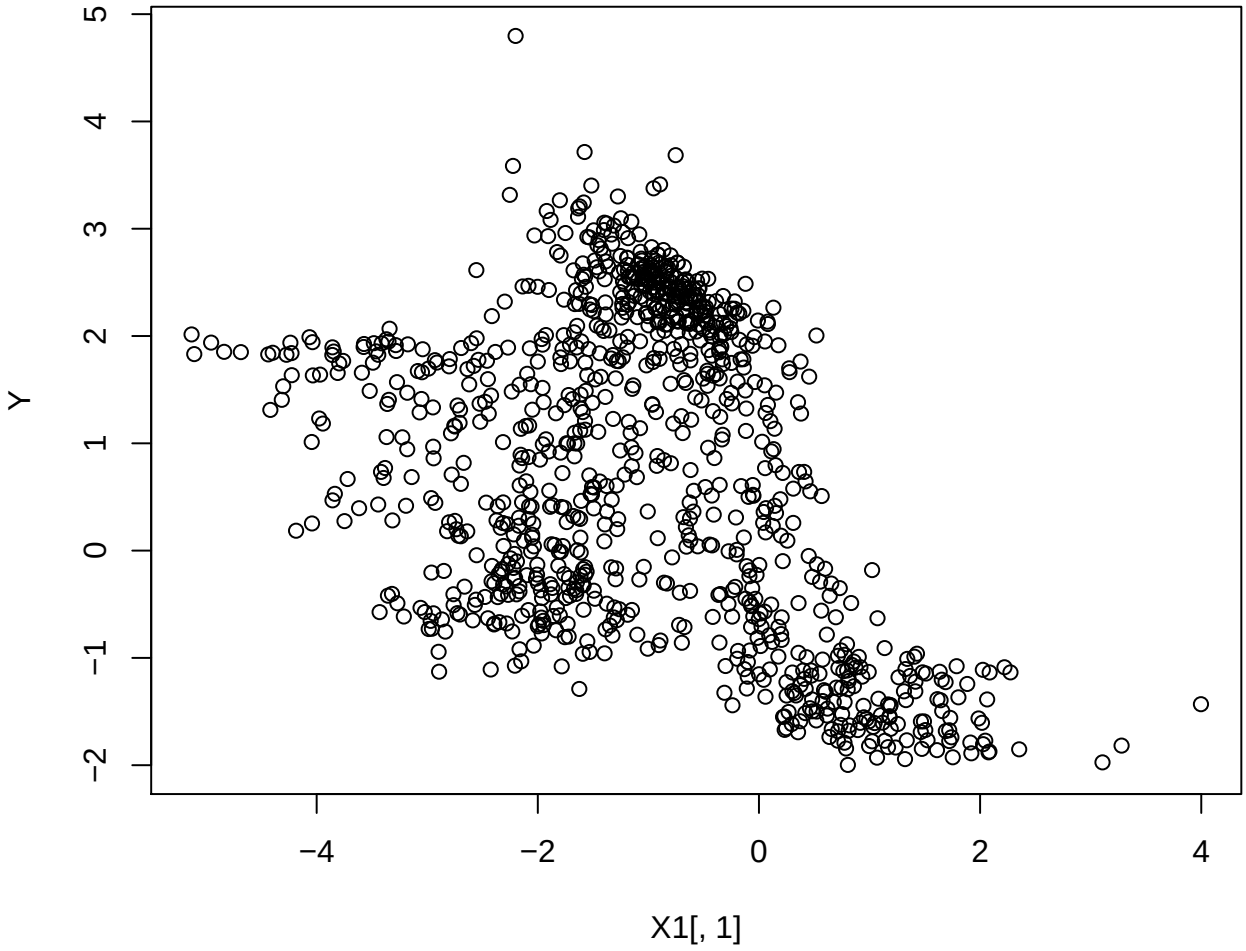
  for some transformation $s(.)$

- **STAGE 3:** A response variable Y where

$$Y = g\left(\beta_0 + \sum_{j=1}^{K_2} X_j^{(2)} \beta_j\right) + \epsilon$$

  for some link function $g(.)$

```
L<-3                  #Levels
K<-c(4,5,1)           #Nodes
n<-1000
library(mvnfast)
set.seed(34)
muv<-c(-1,2,0,2)
sigmat<-2.0*0.8^abs(outer(1:K[1],1:K[1],'-'))
sigval<-0.1
sfunc<-function(x){return(tanh(x))}
gfunc<-function(x){return(x)}
#Inputs
X1<-rmvn(n,muv,sigmat)
be1<-matrix(rnorm(K[1]*K[2]),nrow=K[1],ncol=K[2])
X2<-sfunc(X1 %*% be1)
be2<-matrix(rnorm(K[2]*K[3]),nrow=K[2],ncol=K[3])
mu<-gfunc(X2 %*% be2)
Y<-mu+rnorm(n)*sigval
plot(X1[,1],Y)
```


Y
5
4
3
2
1
0
−1
−2
−4
−2
0
2
4
X1[, 1]