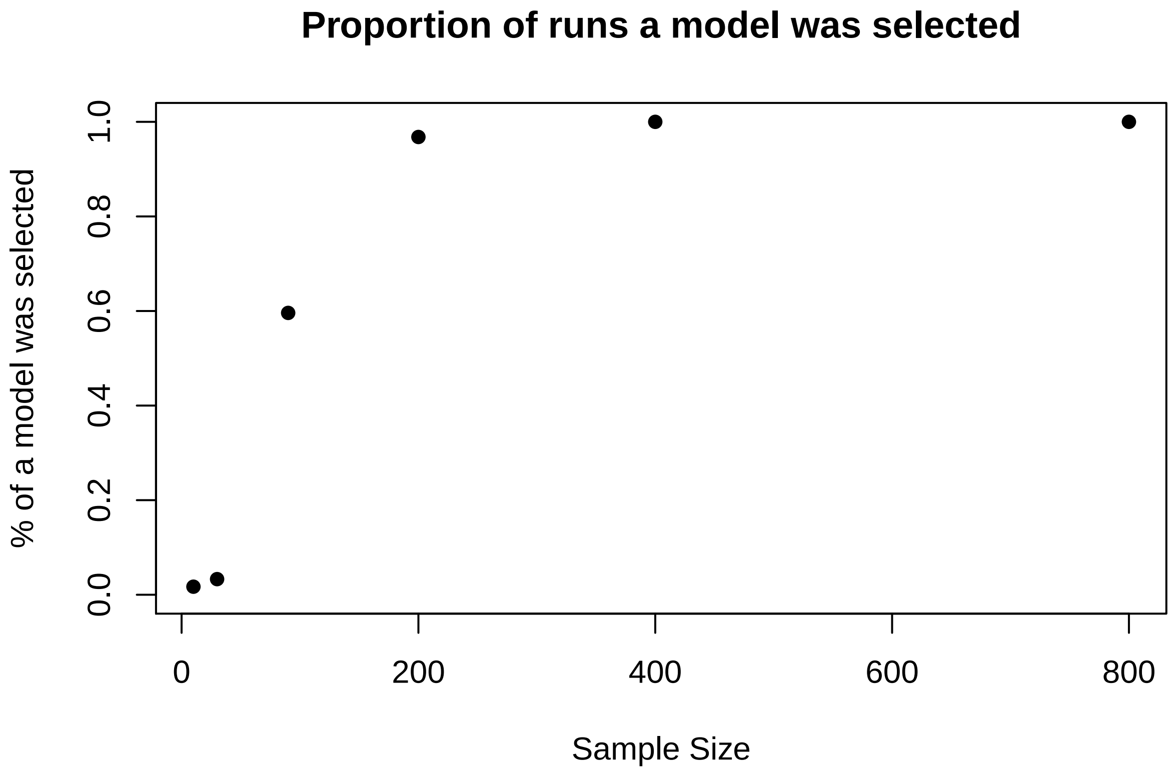
Bernoulli_Asymp_TrueModInSet

This simulation generates data from a Ber(p=0.65) distribution and observes the asymptotic behavior of ECIC using the model set $\mathcal{M} = \{Ber(p = 0.48), Ber(p = 0.65), Ber(p = 0.75)\}$

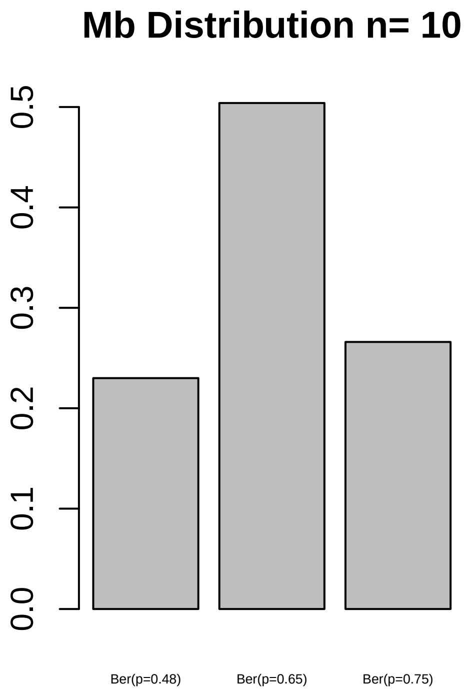
```
#####################################################################
#             Source Functions/Data Generation
#####################################################################

# source functions written in R
source("Simulation_R_Fns.R")
# define the model set
M <- c(0.48,0.65,0.75)
# cardinality of the model set
MLen <- length(M)
MNames <- paste("Ber(p=",M,")",sep="")
# set the true parameter
trueP <- 0.65
trueModel <- "Ber(p=0.65)"
# set different sample sizes
ns <- c(10,30,90,200,400,800)
# cardinality of the sample sizes
nsLen <- length(ns)
# set the number of draws for each sample size
noDraws <- 1000
# sample size for estimating the probability of choosing the observed best model
# under the assumption an
# alternative model is true (ECIC step 4b)
N1 <- 2000
# sample size for simulating the DGOF distribution
# under the assumption that an alternative model is true (ECIC step 4c)
N2 <- 3000
# pre-specified type 1 error rate
alpha <- 0.05
# list to hold generated data
datList <- list()
set.seed(222)
# generate Bernoulli data draws of different sample sizes
for(i in 1:nsLen)
{
  tempN <- ns[i]
  datList[[i]] <- generateData(tempN,noDraws,trueP,"Bernoulli")
}
names(datList) <- paste("True p=",trueP,",Draws of n=",ns,sep="")

#####################################################################
#                      Run ECIC
#####################################################################
```

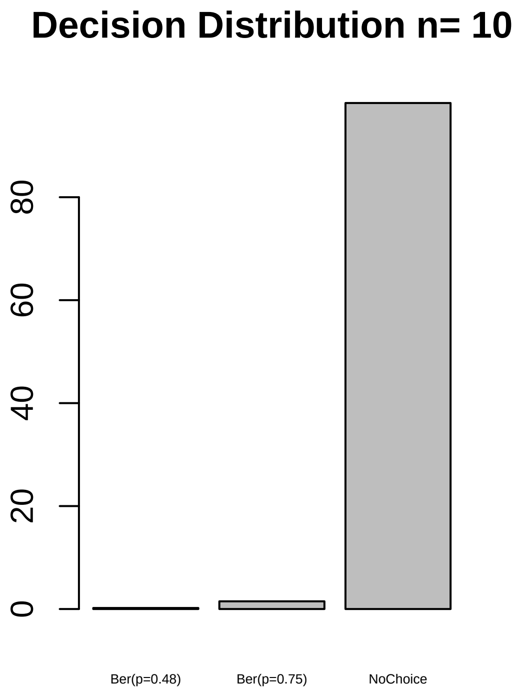
```r
# ECIC step #1
# compute the -LL for each draw,
# under each model in the model set for each sample size
ICComps <- list()
for(i in 1:nsLen)
{
  ICComps[[i]] <- ICComputations(datList[[i]],M,MLen,noDraws,"BernoulliNegLL",
                                 MNames)
}
names(ICComps) <- paste("True Model:",trueModel,",Draws of n=",ns,sep="")

# ECIC step #2
# determine the observed best models for each draw of each sample size
MbList <- list()
for(i in 1:nsLen)
{
  MbList[[i]] <- MbComputations(ICComps[[i]],MNames)
}
names(MbList) <- paste("Mbs for ","Draws of n=",ns,sep="")

# ECIC step #3
# compute the observed DGOFs for each draw of each sample size
obsDGOFs <- list()
obsDGOFs <- obsDGOFsComputations(ICComps,nsLen)

# ECIC step #4
# simulate the two data sets necessary for this step
simDat1List <- list() # used to estimate probabilities
simDat2List <- list() # used to estimate DGOF distribution
# initialize the above lists' elements as lists
for(i in 1:nsLen)
{
  simDat1List[[i]] <- list()
  simDat2List[[i]] <- list()
}
set.seed(19)
# simulate data
for(i in 1:nsLen) #  j indexes the assumed true probability
{
  tempN <- ns[i]
  for(j in 1:MLen)
  {
    tempM <- M[j]
    simDat1List[[i]][[j]] <- generateData(tempN,N1,tempM,"Bernoulli")
    simDat2List[[i]][[j]] <- generateData(tempN,N2,tempM,"Bernoulli")
  }
  names(simDat1List[[i]]) <- paste("True Mod:",MNames,sep="")
  names(simDat2List[[i]]) <- paste("True Mod:",MNames,sep="")
}
names(simDat1List) <- paste("Draws of n=",ns)
names(simDat2List) <- paste("Draws of n=",ns)

# each element in these lists will hold matrices of the -LL's under the
# probabilities in the model sets for all draws of each sample size and
# generating probability
ICsSimDat1 <- list()
ICsSimDat2 <- list()
# initialize the above lists' elements as lists
for(i in 1:nsLen)
{
  ICsSimDat1[[i]] <- list()
  ICsSimDat2[[i]] <- list()
}

for(i in 1:nsLen) # i indexes sample sizes
{
  tempN <- ns[i]
  for(j in 1:MLen) # j indexes the assumed true probability
  {
    ICsSimDat1[[i]][[j]] <- ICComputations(simDat1List[[i]][[j]],M,MLen,N1,
                                           "BernoulliNegLL",MNames)
    ICsSimDat2[[i]][[j]] <- ICComputations(simDat2List[[i]][[j]],M,MLen,N2,
                                           "BernoulliNegLL",MNames)
  }
  names(ICsSimDat1[[i]]) <- paste("True Mod:",MNames,sep="")
  names(ICsSimDat2[[i]]) <- paste("True Mod:",MNames,sep="")
}
names(ICsSimDat1) <- paste("Draws of n=",ns,sep="")
names(ICsSimDat2) <- paste("Draws of n=",ns,sep="")

# determine the models with the minimum IC for each set of draws
minICList <- list()
for(i in 1:nsLen)
{
  minICList[[i]] <- list()
}

for(i in 1:nsLen) # i indexes sample size
{
  for(j in 1:MLen) # j indexes assumed true parameter
  {
    minICList[[i]][[j]] <- MbComputations(ICsSimDat1[[i]][[j]],MNames)
  }
  names(minICList[[i]]) <- paste("True Mod=",MNames,sep="")
}
names(minICList) <- paste("Draws of n=",ns,sep="")

# ECIC step #4b
# create a list of matrices that hold P_i(g(F)=M_b)
piHatList <- list()
for(i in 1:nsLen)
{
  piHatList[[i]] <- piHatMatComputations(minICList[[i]],MLen,N1,MNames)
}
names(piHatList) <- paste("Draws of n=",ns,sep="")
```

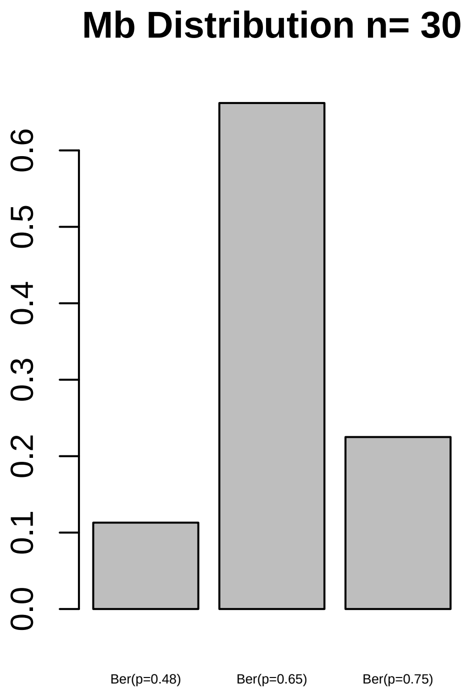
```
# ECIC step #4c
DGOFList <- list()
for(i in 1:nsLen)
{
  DGOFList[[i]] <- DGOFSimComputations(ICsSimDat2[[i]],mLen,N2,MNames)
  names(DGOFList[[i]]) <- paste("True Model:",MNames,sep="")
}
names(DGOFList) <- paste("Draws of n=",ns,sep="")

# ECIC steps 4d, 5, and 6
resultList <- ECICDecisions(MbList,obsDGOFs,piHatList,DGOFList,alpha,MNames,
                            nsLen,MLen,noDraws)

#####################################################################
#                      Plot Results
#####################################################################

# list to store the decision thresholds
thresholds <- resultList[[1]]
# decision list
aOrRList <- resultList[[2]]

# assess observed best model with ECIC choice
assessList <- list()
for(i in 1:nsLen)
{
  assessList[[i]] <- rbind(MbList[[i]],aOrRList[[i]])
}

DecisionRates <- sapply(X=assessList,FUN=function(x) sum(as.numeric(x[2,]))/
                          noDraws)
plot(x=ns,y=DecisionRates,main="Proportion of runs a model was selected",
     xlab="Sample Size",ylab="% of a model was selected",pch=16,ylim = c(0,1))
```

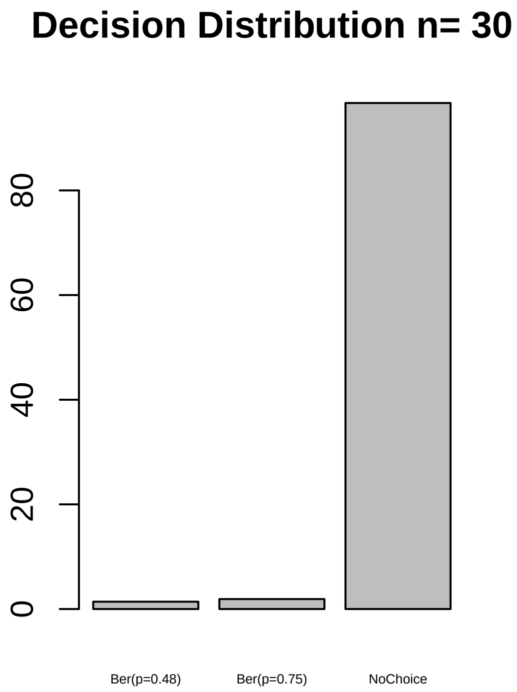


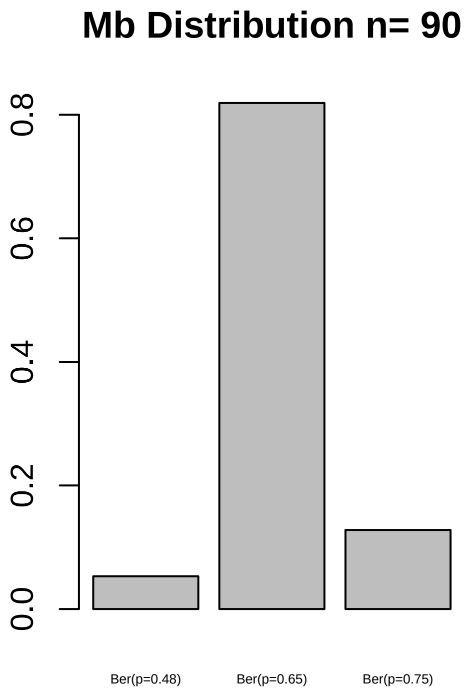
```r
# take a look at type 1 error rate
# subset assess list by only when a decision was made i.e. second row = 1
decAssessList <- lapply(X=assessList,FUN=function(x) x[,x[2,]==1])
# plot the model decision distribution
# make barplots for the percentage of the time each model was chosen as best
# for each sample size
par(mfrow = c(1, 2))
for(i in 1:nsLen)
{
  # get the frequencies of models selected as best
  tempTable <- table(MbList[[i]])
  barplot(tempTable/noDraws,main=paste("Mb Distribution n=",ns[i]),
          cex.names=0.45)
  chosenModelRate <- table(decAssessList[[i]][1,])/noDraws*100
  unChosenModelRate <- (noDraws-ncol(decAssessList[[i]]))/noDraws*100
  decDist <- c(chosenModelRate,"NoChoice"=unChosenModelRate)
  decDist <- sort(decDist)
  barplot(decDist,main=paste("Decision Distribution n=",ns[i]),cex.names=0.45)
}
```

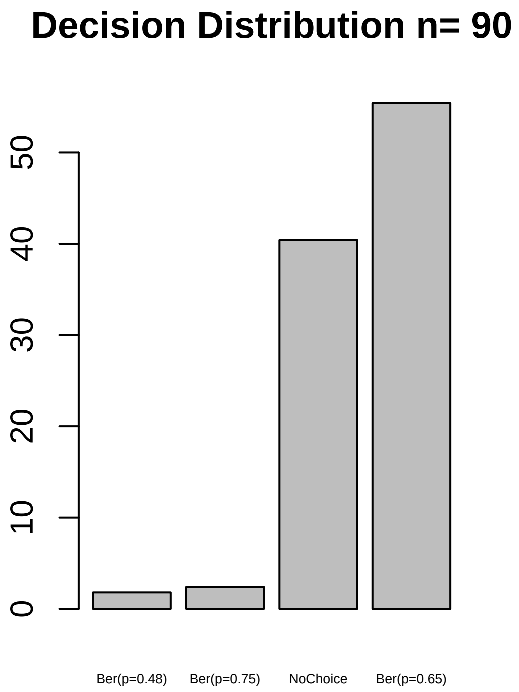

Mb Distribution n= 10

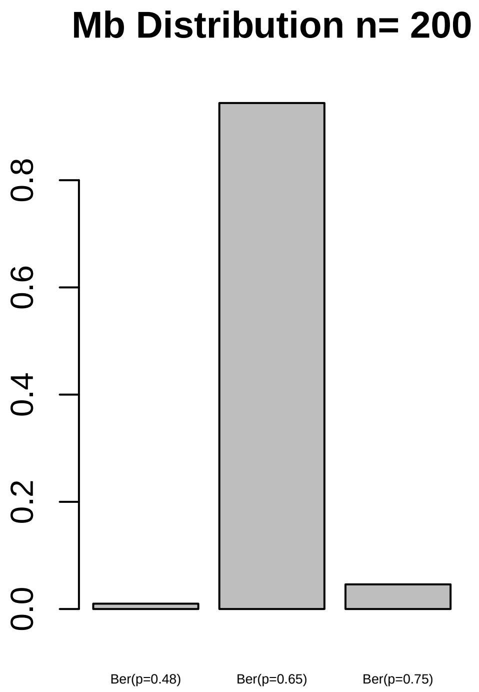

Decision Distribution n= 10


Mb Distribution n= 30
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Ber(p=0.48)
Ber(p=0.65)
Ber(p=0.75)

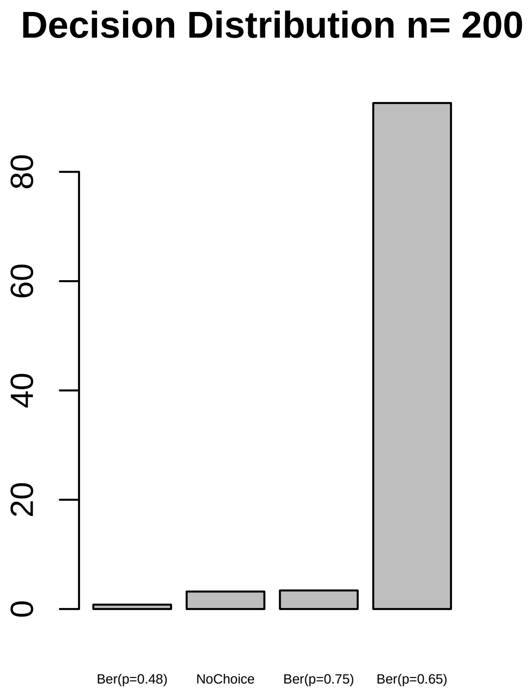

Decision Distribution n= 30
0
20
40
60
80
Ber(p=0.48)
Ber(p=0.75)
NoChoice


Mb Distribution n= 90
0.0
0.2
0.4
0.6
0.8
Ber(p=0.48)
Ber(p=0.65)
Ber(p=0.75)

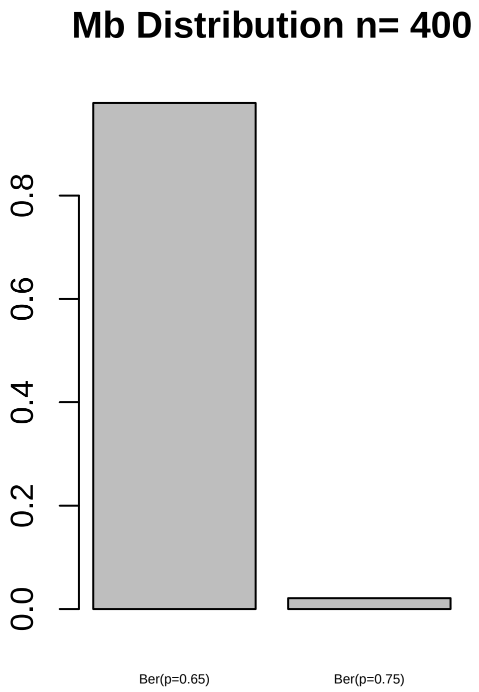

Decision Distribution n= 90
0
10
20
30
40
50
Ber(p=0.48)
Ber(p=0.75)
NoChoice
Ber(p=0.65)



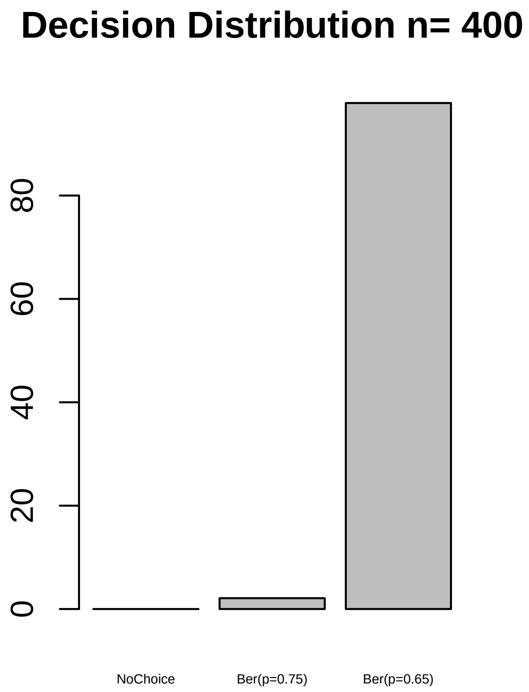
Mb Distribution n= 200



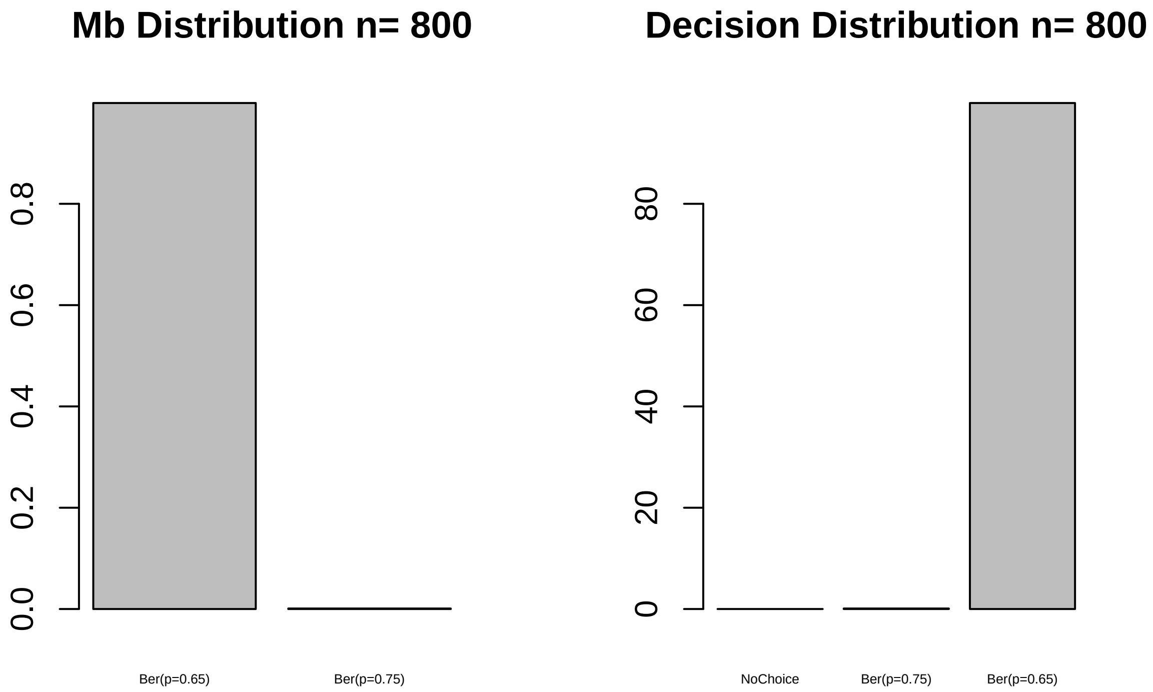
Decision Distribution n= 200



Mb Distribution n= 400

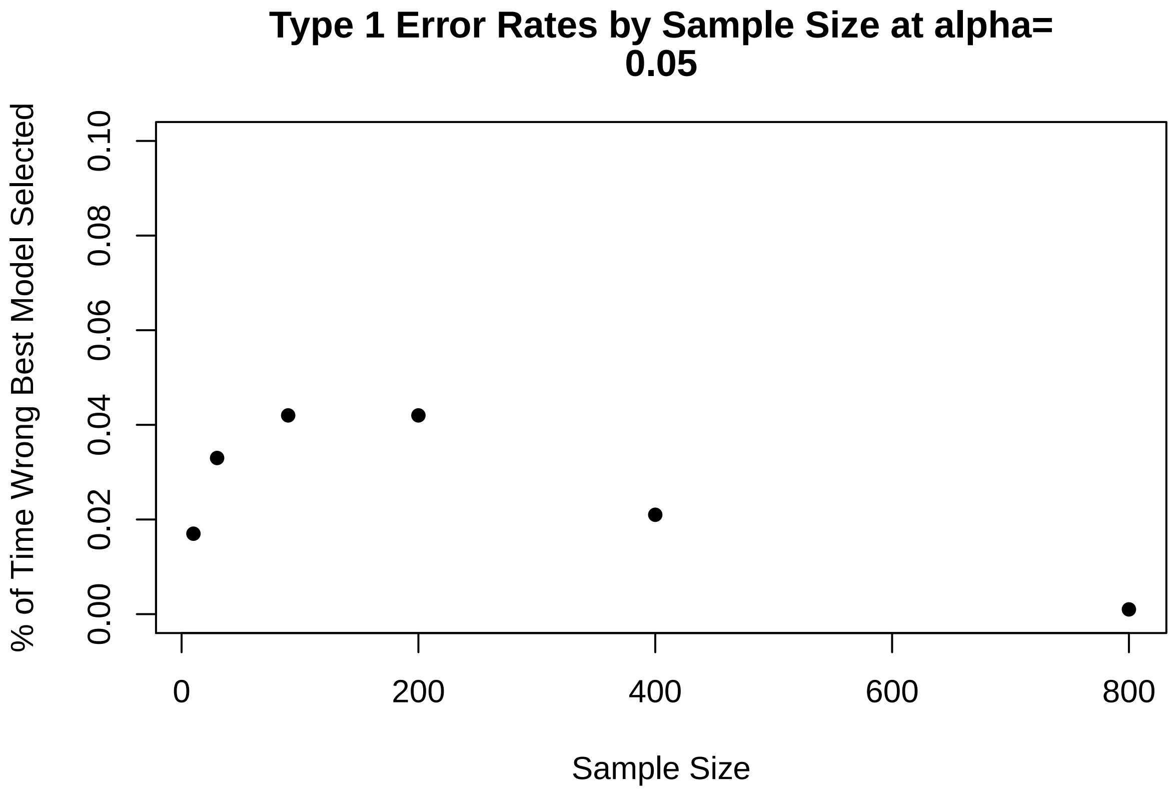


Decision Distribution n= 400

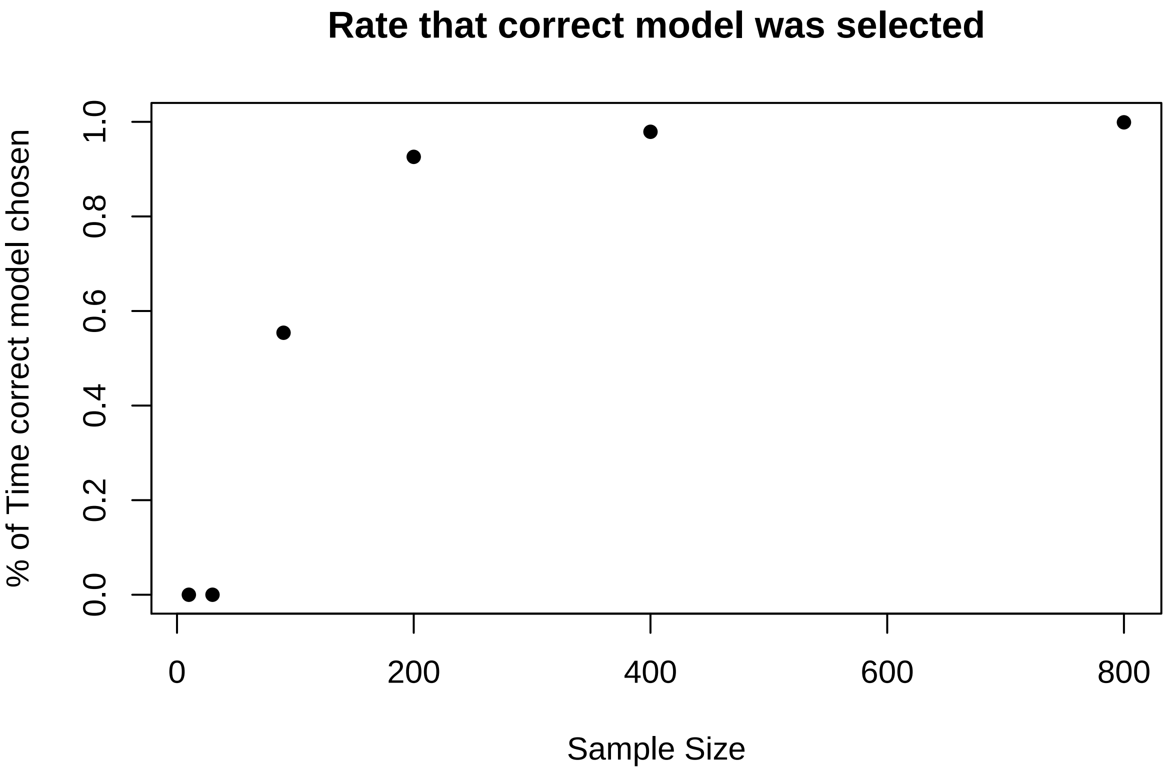

Mb Distribution n= 800

Decision Distribution n= 800

```
par(mfrow = c(1, 1))
# compute type 1 error rate
t1ErrorRates <- sapply(X=decAssessList,FUN=function(x) sum(x[1,]!=trueModel)/
                        noDraws)
plot(x=ns,y=t1ErrorRates,main=c("Type 1 Error Rates by Sample Size at alpha=",
                               alpha),
     xlab="Sample Size",ylab="% of Time Wrong Best Model Selected",pch=16,
     ylim = c(0,2*alpha))
```



```
CorrectRates <- sapply(X=decAssessList,FUN=function(x) sum(x[1,]==trueModel)
                       /noDraws)
plot(x=ns,y=CorrectRates,main="Rate that correct model was selected",
     xlab="Sample Size",ylab="% of Time correct model chosen",pch=16,
     ylim = c(0,1))
```


Rate that correct model was selected
% of Time correct model chosen
0.0
0.2
0.4
0.6
0.8
1.0
0
200
400
600
800
Sample Size