Fall 2019: MATH 347 Bayesian Statistics

## R Script for the All-nighters Problem

Here we use R for the Bayesian posterior distribution with Binomial data and a discrete prior. A script to estimate the posterior distribution has been created and provided here. You can copy this directly into R and it will run all the commands.

```
priorvalues <- c(0, .1, .2, .3, .4, .5, .6, .7, .8, .9, 1)
priorprob <- c(1/23, 1/23, 7/23, 7/23, 3/23, 3/23, 1/23, 0/23, 0/23, 0/23, 0/23)

n <- 10
y <- 3
```

### Step 1: Load the prior and data.

```
#vector for storing results
jointprob <- numeric(length = length(priorvalues))

for(i in 1:length(priorvalues))
{

  #compute Binomial probability given value of p - likelihood
  binomprob <- dbinom(y, n, p = priorvalues[i])

  #compute joint probability - posterior
  jointprob[i] <- binomprob * priorprob[i]

}

#compute marginal probability of y
pofy <- sum(jointprob)

#compute posterior probabilities
posteriorprob <- jointprob/pofy
```

### Step 2: Calculating the likelihood probabilities and posterior probabilities.

```
#put posterior probabilities in one matrix object for easy viewing
allnighterposterior <- as.data.frame(cbind(priorvalues, priorprob, posteriorprob))
names(allnighterposterior) <- c("p", "prior", "posterior")

#list the final posterior distribution, based on our prior derived in class
allnighterposterior
```

### Step 3: Present and visualize results.

```
##      p      prior   posterior
## 1  0.0 0.04347826 0.000000000
## 2  0.1 0.04347826 0.013123561
## 3  0.2 0.30434783 0.322234525
## 4  0.3 0.30434783 0.427073101
## 5  0.4 0.13043478 0.147473543
## 6  0.5 0.13043478 0.080385077
## 7  0.6 0.04347826 0.009710192
## 8  0.7 0.00000000 0.000000000
## 9  0.8 0.00000000 0.000000000
## 10 0.9 0.00000000 0.000000000
## 11 1.0 0.00000000 0.000000000
```

```
#plot the prior and posterior probabilities
require(ggplot2)
```

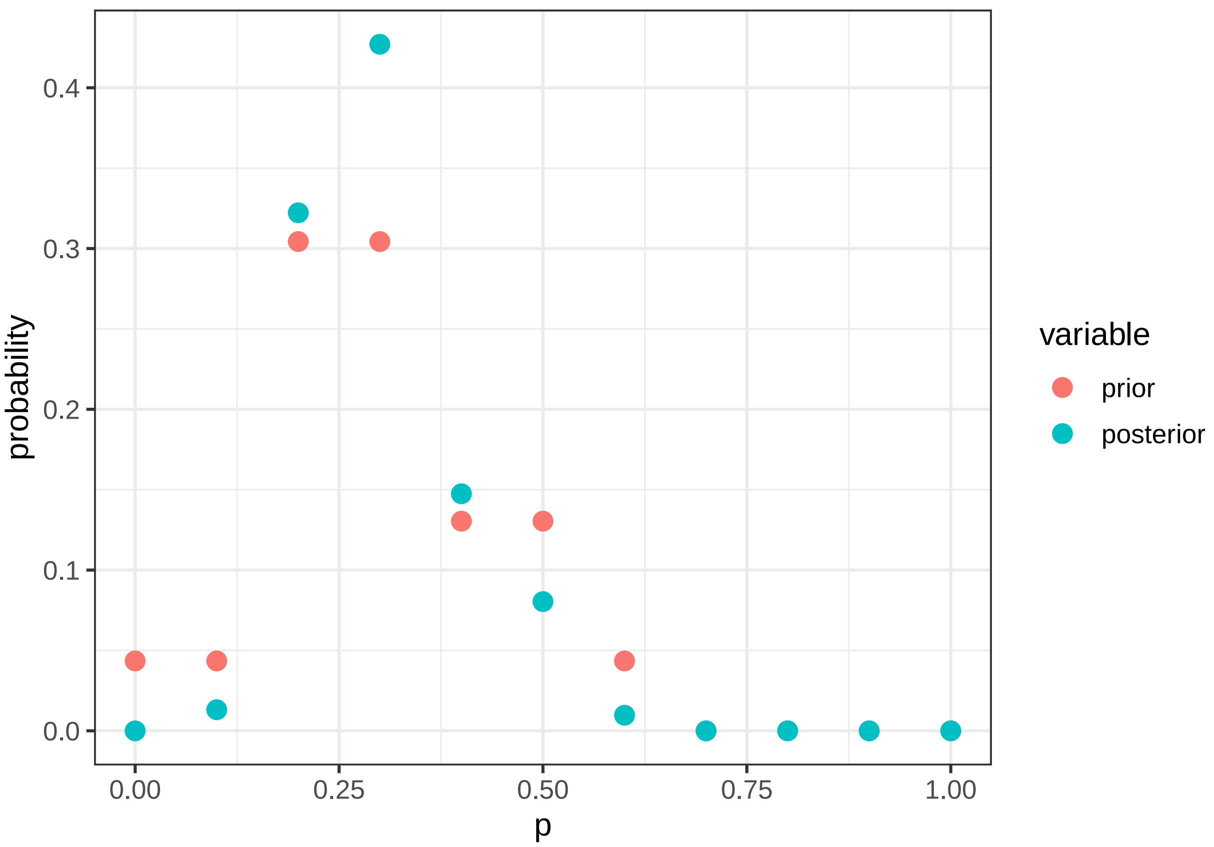
```
## Loading required package: ggplot2
```

```
require(reshape2)
```

```
## Loading required package: reshape2
```

```
allnighterposterior_all <- melt(allnighterposterior, id = "p")

ggplot(allnighterposterior_all, aes(x = p, y = value, colour = variable)) +
  geom_point(size = 3) +
  xlab("p") + ylab("probability") +
 theme_bw(base_size = 12, base_family = "")
```


probability
0.0
0.1
0.2
0.3
0.4
p
0.00
0.25
0.50
0.75
1.00
variable
● prior
● posterior