

lecture_3

R Markdown

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When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
### Comparing Uniform Prior and Posterior for Theta_B ###
```

```
theta.b <- rpoints(1000)
```

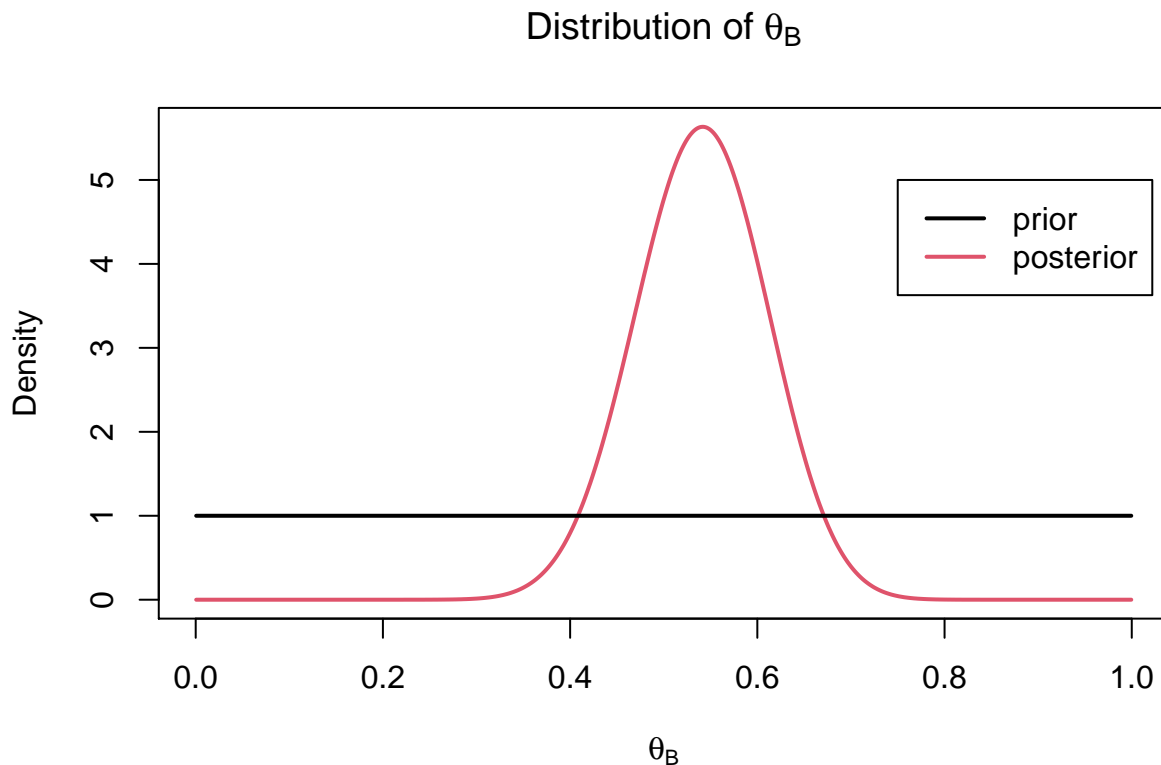
```
?dbeta
```

```
posterior <- dbeta(theta.b,27,23)
```

```
plot(theta.b,posterior,type="l",col=2,lwd=2,main=expression(paste("Distribution of ",theta[B])),xlab=exp
```

```
lines(theta.b,rep(1,1000),type="l",col=1,lwd=2)
```

```
legend(0.75,5,c("prior","posterior"),col=c(1,2),lwd=2)
```



```
### Comparing Different Priors for Theta_B ###
```

```
density.unif <- dbeta(theta.b,1,1)
```

```
density.jeff <- dbeta(theta.b,1/2,1/2)
```

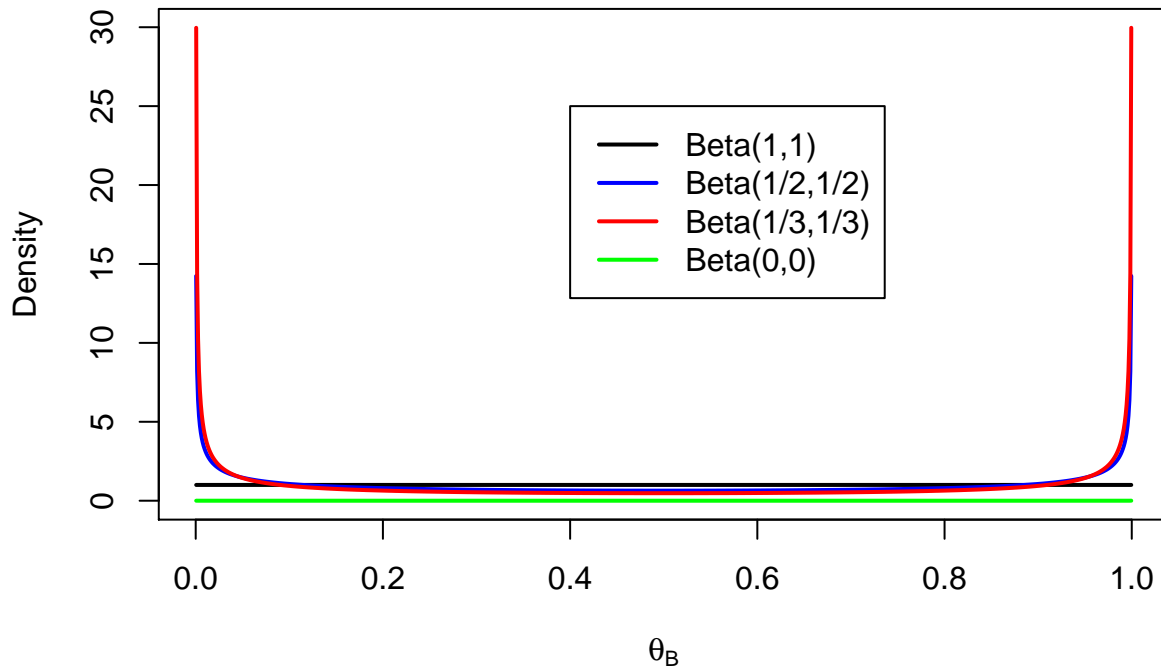
```
density.neut <- dbeta(theta.b,1/3,1/3)
```

```
density.impr <- dbeta(theta.b,0,0) ## error!
```

```
density.impr <- dbeta(theta.b,0.000001,0.000001)
```

```
mindensity <- min(density.unif,density.jeff,density.neut,density.impr)
maxdensity <- max(density.unif,density.jeff,density.neut,density.impr)
plot(theta.b,density.unif,type="l",col="black",lwd=2,main=expression(paste("Prior Distributions for ",theta.B)))
lines(theta.b,density.jeff,type="l",col="blue",lwd=2)
lines(theta.b,density.neut,type="l",col="red",lwd=2)
lines(theta.b,density.impr,type="l",col="green",lwd=2)
legend(0.4,25,c("Beta(1,1)", "Beta(1/2,1/2)", "Beta(1/3,1/3)", "Beta(0,0)"),col=c("black","blue","red","green"))
```

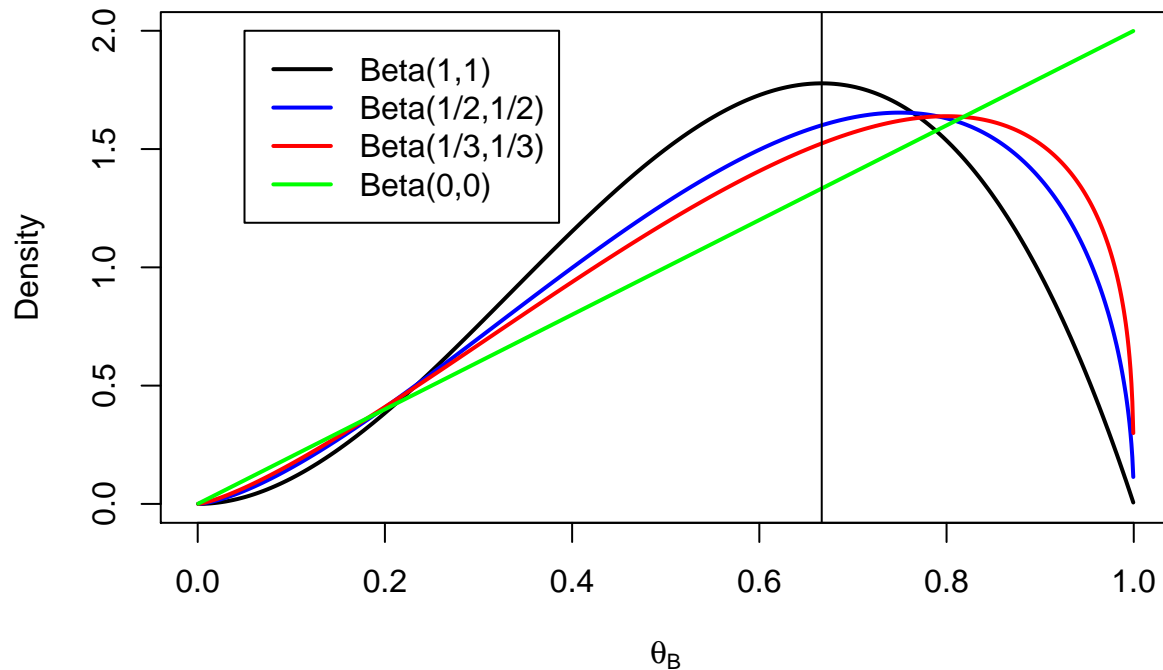
Prior Distributions for θ_B



```
#### Comparing Posterior for Different Priors for Small Dataset ###
#### Small Dataset: 2 successes, 1 failures

numsucc <- 2
numfail <- 1
theta.mle <- numsucc/(numsucc+numfail)
theta.b <- ppoints(1000)
posterior.unif <- dbeta(theta.b,numsucc+1,numfail+1)
posterior.jeff <- dbeta(theta.b,numsucc+1/2,numfail+1/2)
posterior.neut <- dbeta(theta.b,numsucc+1/3,numfail+1/3)
posterior.impr <- dbeta(theta.b,numsucc+0.000001,numfail+0.000001)
minpost <- min(posterior.unif,posterior.jeff,posterior.neut,posterior.impr)
maxpost <- max(posterior.unif,posterior.jeff,posterior.neut,posterior.impr)
plot(theta.b,posterior.unif,type="l",col="black",lwd=2,main=expression(paste("Posterior Distributions for ",theta.B)))
lines(theta.b,posterior.jeff,type="l",col="blue",lwd=2)
lines(theta.b,posterior.neut,type="l",col="red",lwd=2)
lines(theta.b,posterior.impr,type="l",col="green",lwd=2)
legend(0.05,2,c("Beta(1,1)", "Beta(1/2,1/2)", "Beta(1/3,1/3)", "Beta(0,0)"),col=c("black","blue","red","green"))
abline(v=theta.mle)
```

Posterior Distributions for θ_B



Comparing Posterior for Different Priors for Teal v. Connecticut Blacks Data

```
numsucc <- 26
numfail <- 22
```

```
theta.mle <- numsucc/(numsucc+numfail)
```

```
theta.b <- ppoints(1000)
```

```
posterior.unif <- dbeta(theta.b,numsucc+1,numfail+1)
```

```
posterior.jeff <- dbeta(theta.b,numsucc+1/2,numfail+1/2)
```

```
posterior.neut <- dbeta(theta.b,numsucc+1/3,numfail+1/3)
```

```
posterior.impr <- dbeta(theta.b,numsucc+0.000001,numfail+0.000001)
```

```
minpost <- min(posterior.unif,posterior.jeff,posterior.neut,posterior.impr)
```

```
maxpost <- max(posterior.unif,posterior.jeff,posterior.neut,posterior.impr)
```

```
plot(theta.b,posterior.unif,type="l",col="black",lwd=2,main=expression(paste("Posterior Distributions for")))
```

```
lines(theta.b,posterior.jeff,type="l",col="blue",lwd=2)
```

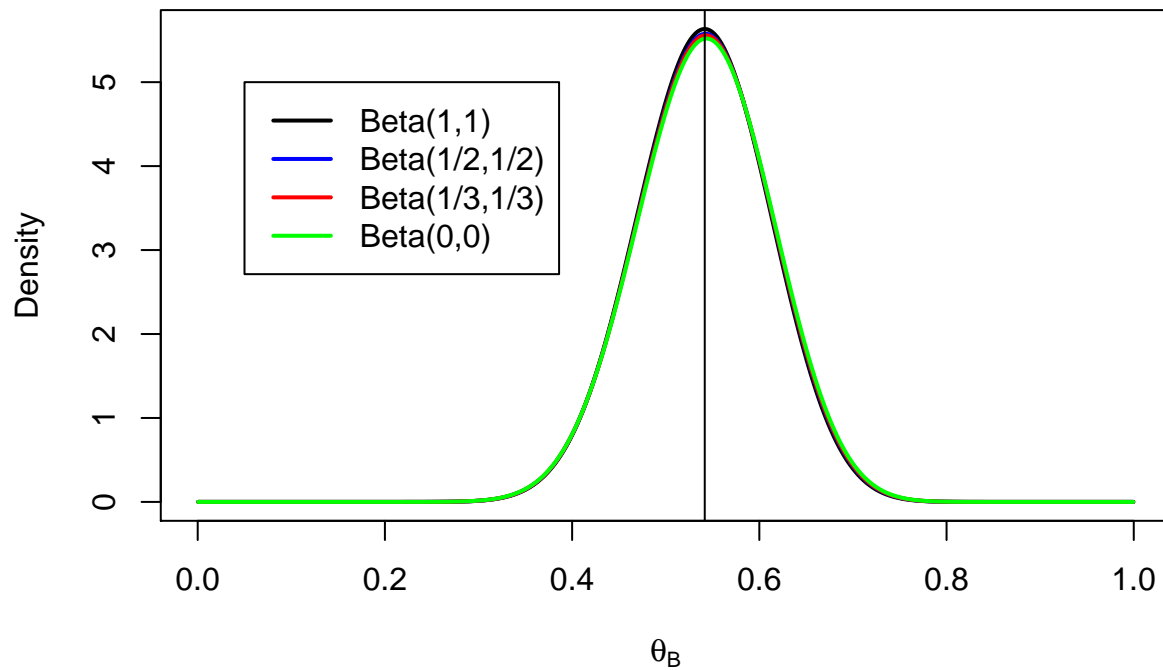
```
lines(theta.b,posterior.neut,type="l",col="red",lwd=2)
```

```
lines(theta.b,posterior.impr,type="l",col="green",lwd=2)
```

```
legend(0.05,5,c("Beta(1,1)","Beta(1/2,1/2)","Beta(1/3,1/3)","Beta(0,0)"),col=c("black","blue","red","green"))
```

```
abline(v=theta.mle)
```

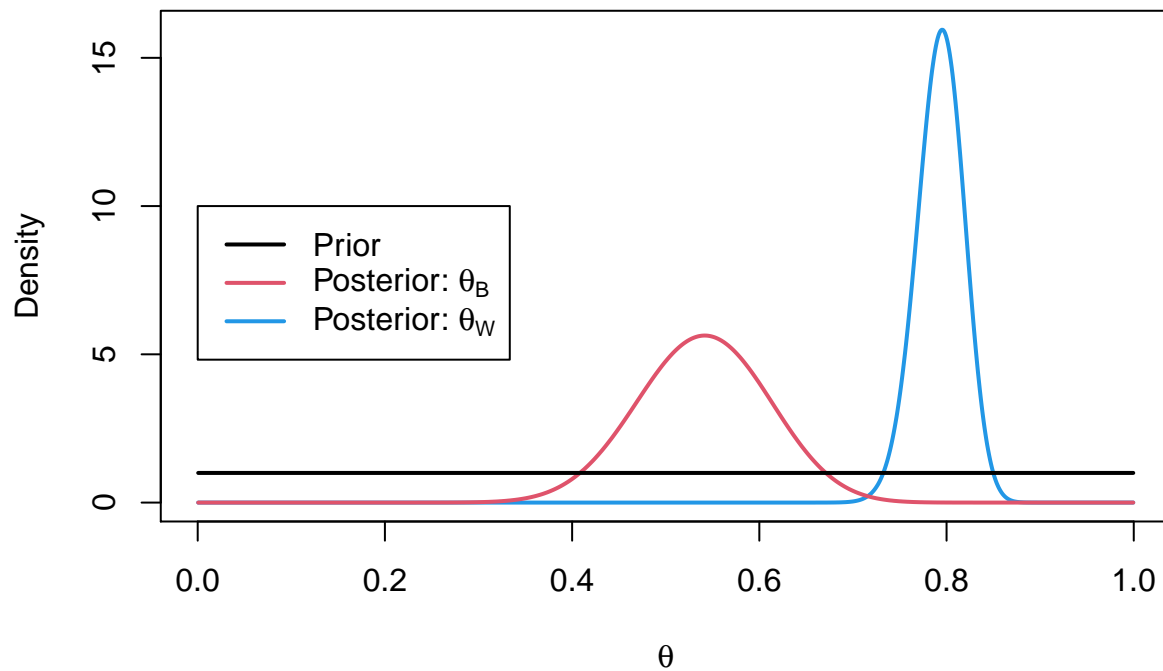
Posterior Distributions for θ_B



```
### Comparing Posterior for Theta_B and Posterior for Theta_W ###
### Using Uniform(0,1) = Beta(1,1) Prior
```

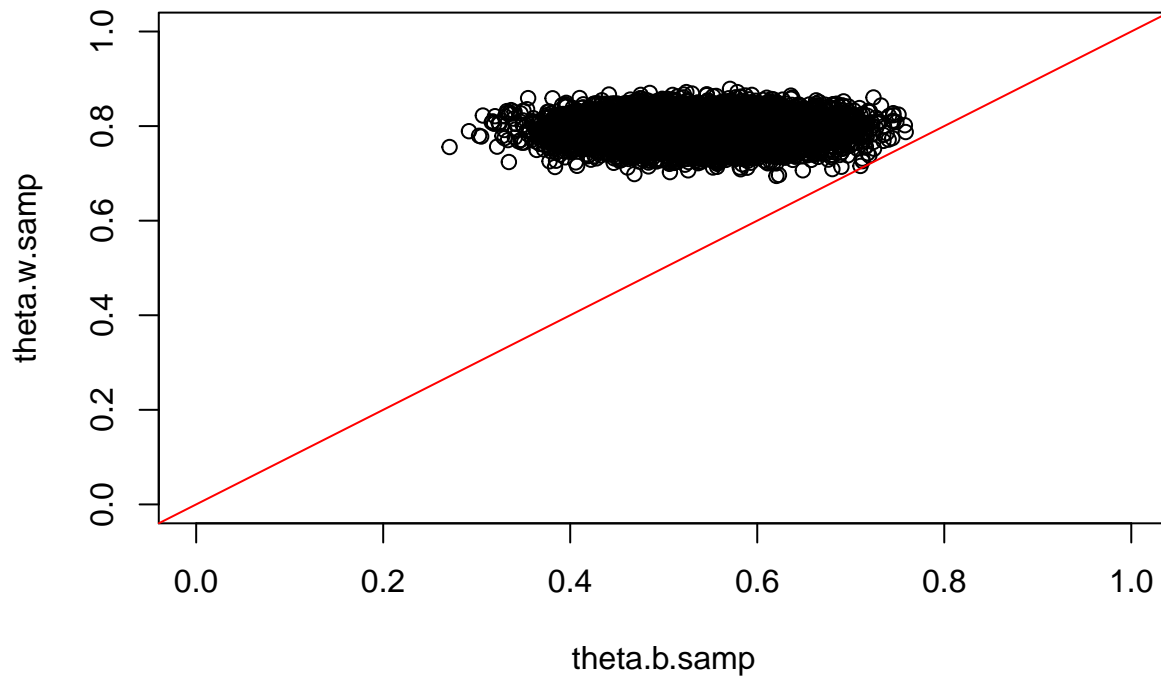
```
theta <- ppoints(1000)
posterior.theta.b <- dbeta(theta,27,23)
posterior.theta.w <- dbeta(theta,207,54)
plot(theta,posterior.theta.w,type="l",col=4,lwd=2,main=expression(paste("Comparing Posteriors of ",theta[B]
lines(theta,posterior.theta.b,type="l",col=2,lwd=2)
lines(theta,rep(1,1000),type="l",col=1,lwd=2)
legend(0,10,c("Prior",expression(paste("Posterior: ",theta[B])),expression(paste("Posterior: ",theta[W]
```

Comparing Posteriors of θ_B to θ_W



```
### Simulating values to calculate posterior probability ###
```

```
theta.b.samp <- rbeta(10000,27,23)  
theta.w.samp <- rbeta(10000,207,54)  
plot(theta.b.samp,theta.w.samp,xlim=c(0,1),ylim=c(0,1))  
abline(0,1,col="red")
```



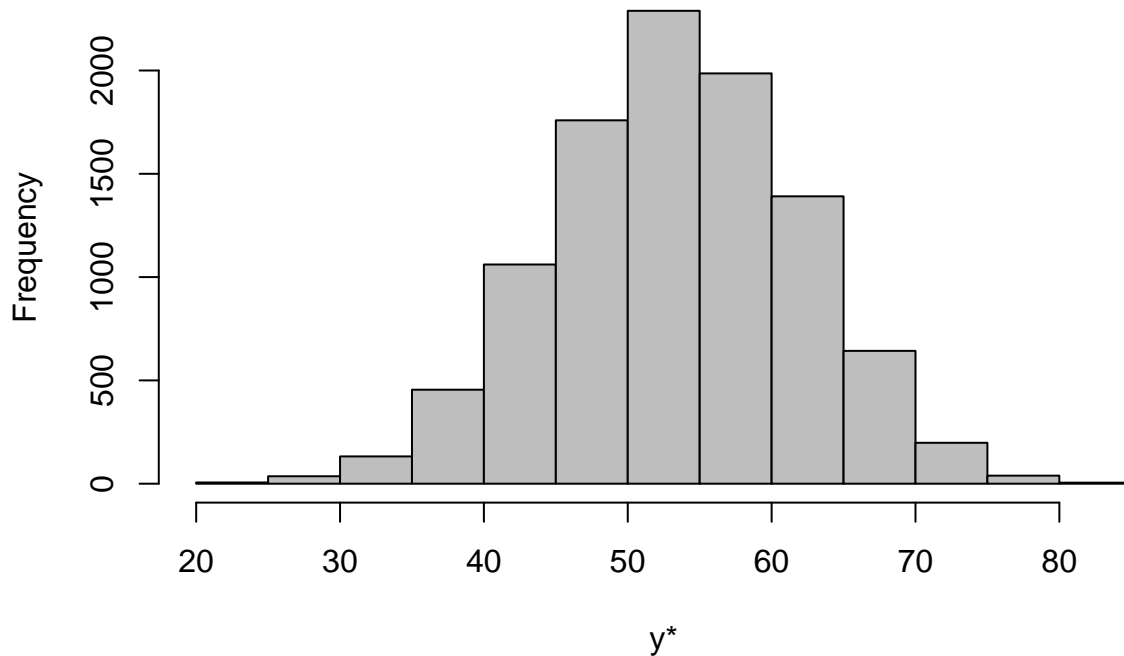
```
postprob <- sum(theta.b.samp < theta.w.samp)/10000
postprob
```

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

```
### Simulating values from posterior predictive distribution ###
```

```
theta.b.samp <- rbeta(10000,27,23)
ystar.b.samp <- rbinom(10000,100,theta.b.samp)
hist(ystar.b.samp,main="Posterior Predictive Distribution of y*",xlab="y*",col="gray")
```

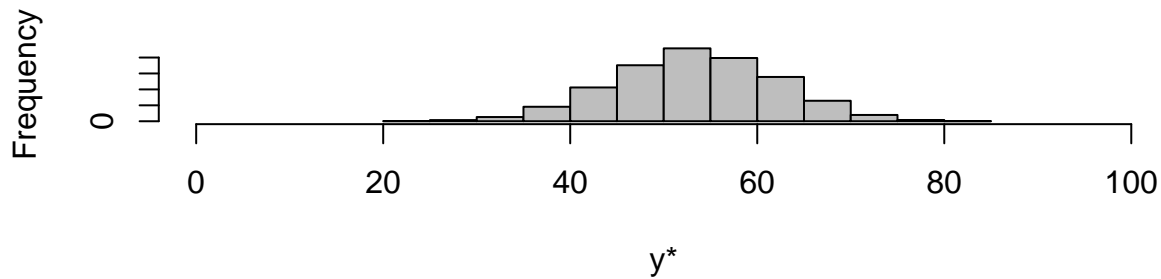
Posterior Predictive Distribution of y^*



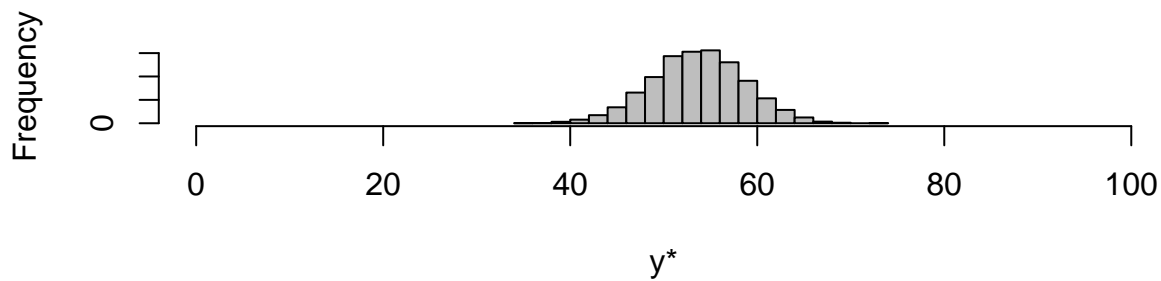
```
### Comparing posterior predictive distribution to Binomial based on MLE ###
```

```
theta.b.mle <- 26/48
ystar.alt.samp <- rbinom(10000,100,theta.b.mle)
par(mfrow=c(2,1))
hist(ystar.b.samp,main="Posterior Predictive Distribution of y*",xlim=c(0,100),col="gray",xlab="y*")
hist(ystar.alt.samp,main="Parametric Bootstrap Distribution of y*",xlim=c(0,100),col="gray",xlab="y*")
```

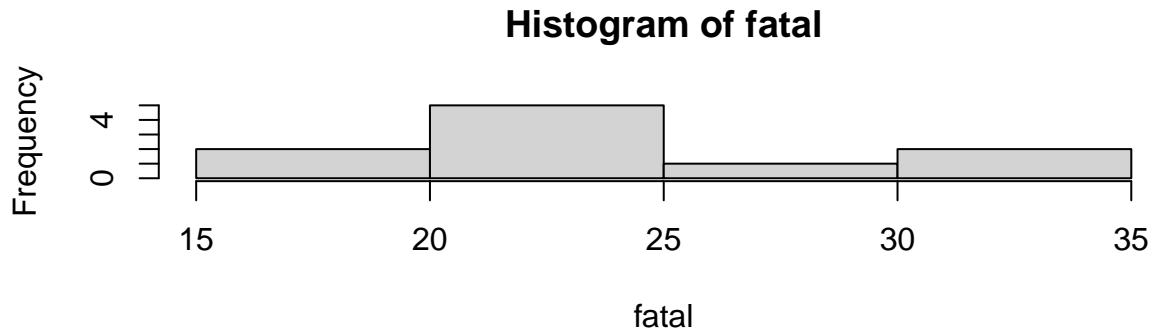
Posterior Predictive Distribution of y^*



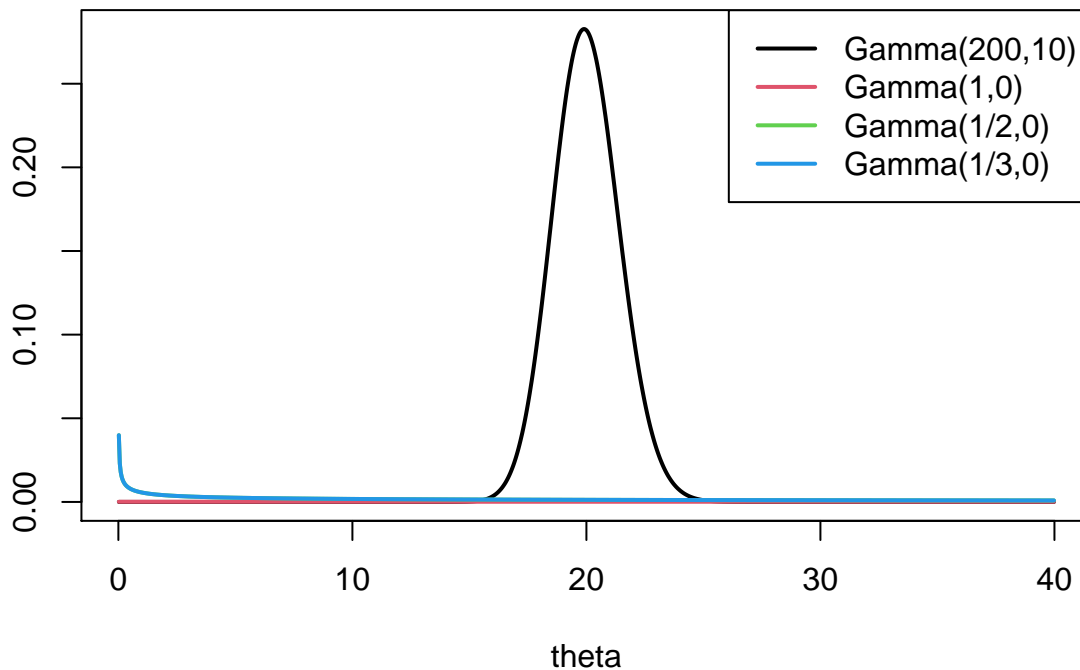
Parametric Bootstrap Distribution of y^*



```
##### reading in Poisson data #####  
  
data <- read.table("data/planes.txt",header=T)  
attach(data)  
  
hist(fatal)  
  
sumfatal <- sum(fatal)  
n <- length(fatal)  
  
##### looking at different Gamma priors #####  
theta <- ppoints(1000)*40  
gammaprior1 <- dgamma(theta,shape=200,rate=10)  
gammaprior2 <- dgamma(theta,shape=1,rate=0.0001)  
gammaprior3 <- dgamma(theta,shape=1/2,rate=0.0001)  
gammaprior4 <- dgamma(theta,shape=1/3,rate=0.0001)  
minplot <- min(gammaprior1,gammaprior2,gammaprior3,gammaprior4)  
maxplot <- max(gammaprior1,gammaprior2,gammaprior3,gammaprior4)  
par(mfrow=c(1,1))
```



```
plot(theta,gammaprior1,type="l",ylim=c(minplot,maxplot),lwd=2,ylab="")
lines(theta,gammaprior2,col=2,lwd=2)
lines(theta,gammaprior3,col=3,lwd=2)
lines(theta,gammaprior3,col=4,lwd=2)
legend('topright',c("Gamma(200,10)", "Gamma(1,0)", "Gamma(1/2,0)", "Gamma(1/3,0)"),col=c(1,2,3,4),lwd=2)
```



```
##### looking at posterior for all these different priors #####
gammaposterior1 <- dgamma(theta,shape=(sumfatal+200),rate=(n+10))
gammaposterior2 <- dgamma(theta,shape=(sumfatal+1),rate=(n+0.0001))
gammaposterior3 <- dgamma(theta,shape=(sumfatal+1/2),rate=(n+0.0001))
gammaposterior4 <- dgamma(theta,shape=(sumfatal+1/3),rate=(n+0.0001))
minplot <- min(gammaposterior1,gammaposterior2,gammaposterior3,gammaposterior4)
maxplot <- max(gammaposterior1,gammaposterior2,gammaposterior3,gammaposterior4)
hist(fatal,xlim=c(0,40),ylim=c(minplot,maxplot),prob=T,col="gray",xlab="",ylab="",main="")
par(new=T)
plot(theta,gammaposterior1,type="l",xlim=c(0,40),ylim=c(minplot,maxplot),lwd=2,xlab="",ylab="",main="")
lines(theta,gammaposterior2,col=2,lwd=2)
lines(theta,gammaposterior3,col=3,lwd=2)
lines(theta,gammaposterior4,col=4,lwd=2)
legend("topright",c("Gamma(200,10)", "Gamma(1,0)", "Gamma(1/2,0)", "Gamma(1/3,0)"),col=c(1:4),lwd=2)
```