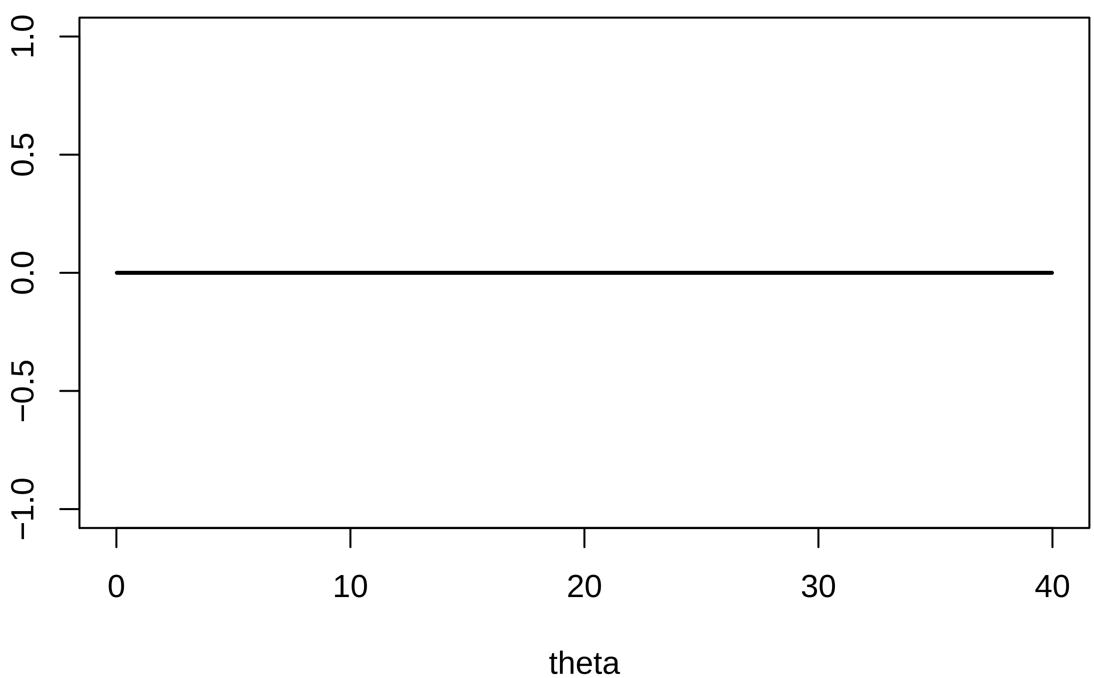
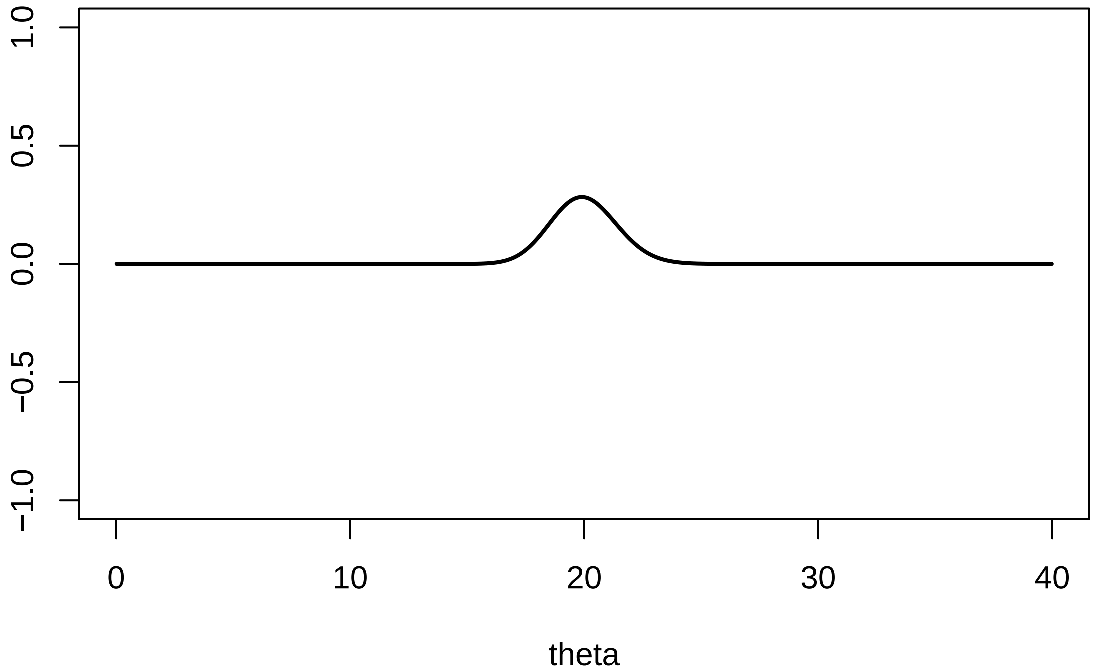
Question 7 and 10

Question 7

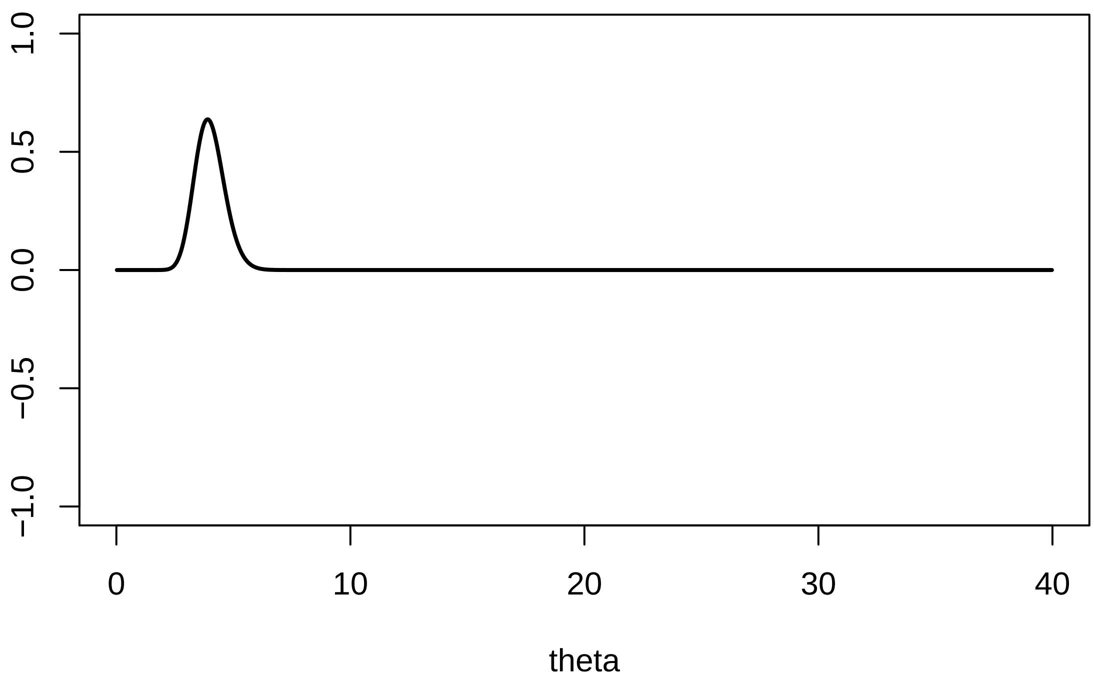
```r
#####
#Question 7
#####

#a
data <- read.table("data/planes.txt",header=T)
attach(data)
sumfatal <- sum(fatal)
n <- length(fatal)
##### looking at different Gamma priors #####
theta <- ppoints(1000)*40
gammaprior1 <- dgamma(theta,shape=0,rate=0)
minplot <- min(gammaprior1)
maxplot <- max(gammaprior1)
plot(theta,gammaprior1,type="l",ylim=c(minplot,maxplot),lwd=2,ylab="")
```




```r
#set the prior to be stronger
gammaprior1 <- dgamma(theta,shape=200,rate=10)
plot(theta,gammaprior1,type="l",ylim=c(minplot,maxplot),lwd=2,ylab="")
```

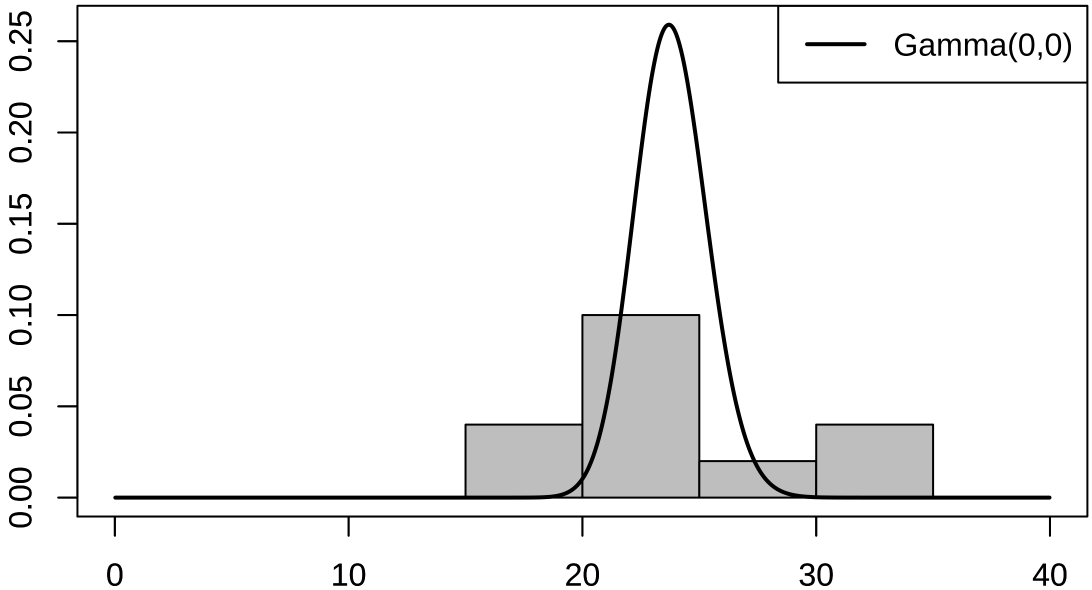



```
#set the prior to be  off
gammaprior1 <- dgamma(theta,shape=40,rate=10)
plot(theta,gammaprior1,type="l",ylim=c(minplot,maxplot),lwd=2,ylab="")
```

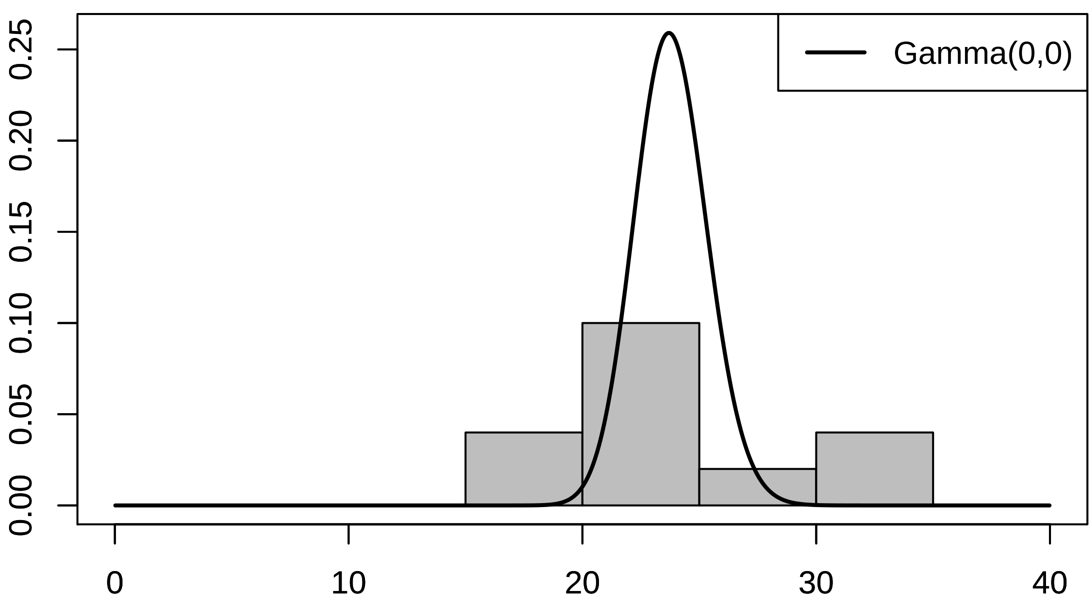



```
## now plot the posterior distribution
gammaposterior1 <- dgamma(theta,shape=(sumfatal+0),rate=(n+0))
minplot <- min(gammaposterior1)
maxplot <- max(gammaposterior1)
hist(fatal,xlim=c(0,40),ylim=c(minplot,maxplot),prob=T,col="gray",xlab="",ylab="",main="")
par(new=T)
plot(theta,gammaposterior1,type="l",xlim=c(0,40),ylim=c(minplot,maxplot),lwd=2,xlab="",ylab="",main="")
```

```r
legend("topright",c("Gamma(0,0)"),col=c(1:4),lwd=2)
```




```r
#b
###use samples from the posterior distribution to obtain samples from the
#posterior predictive distribution
gammaposterior1 <- dgamma(theta,shape=(sumfatal+0),rate=(n+0))
minplot <- min(gammaposterior1)
maxplot <- max(gammaposterior1)
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="")
legend("topright",c("Gamma(0,0)"),col=c(1:4),lwd=2)
```




```r
##compute a 95% interval

theta <- rgamma(1000, 238)/10
```

```
y1986 <- rpois(1000,theta)
print(sort(y1986)[c(25,976)])
```

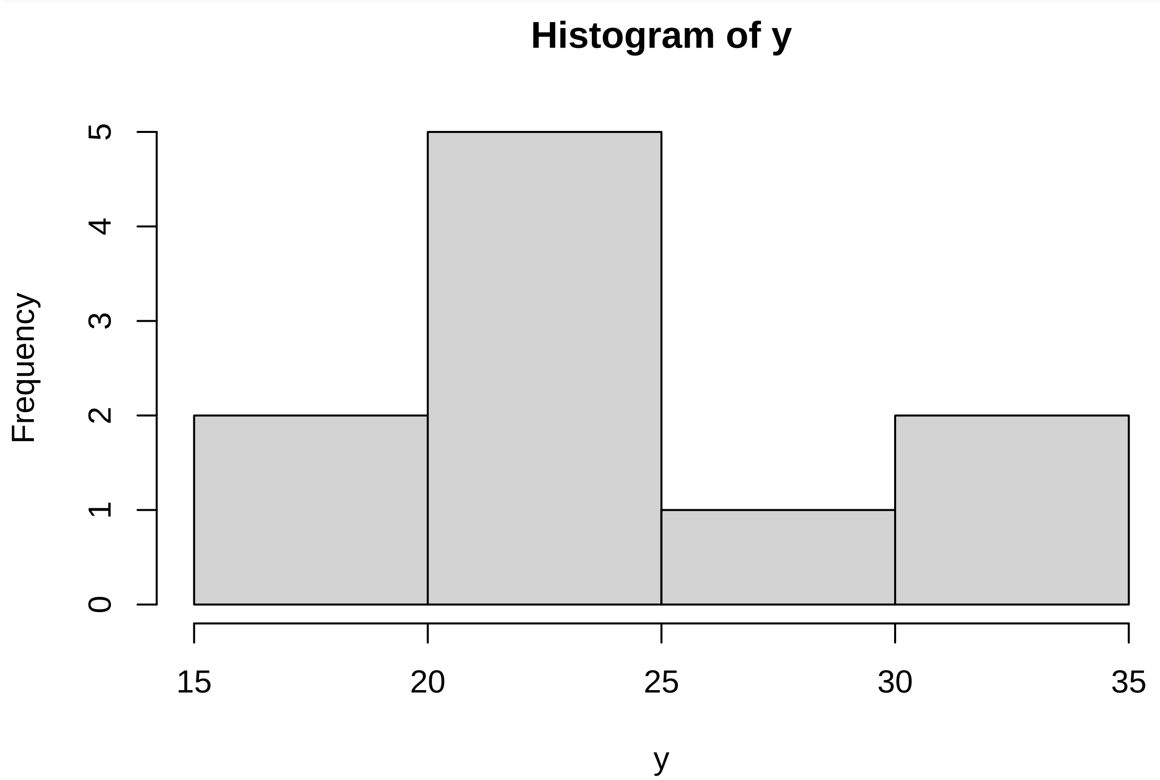
```
## [1] 14 34
```

Question 10

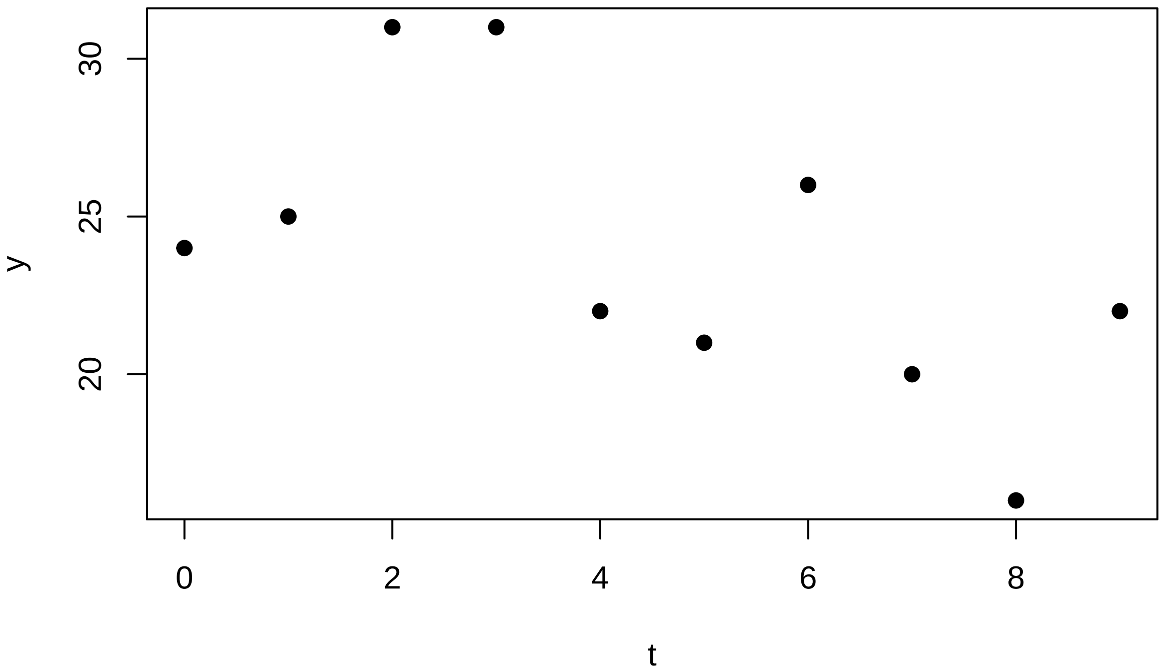
```
data <- read.table("data/planes.txt",header=T)
attach(data)
```

```
## The following objects are masked from data (pos = 3):
##
##     deaths, fatal, rate, year
```

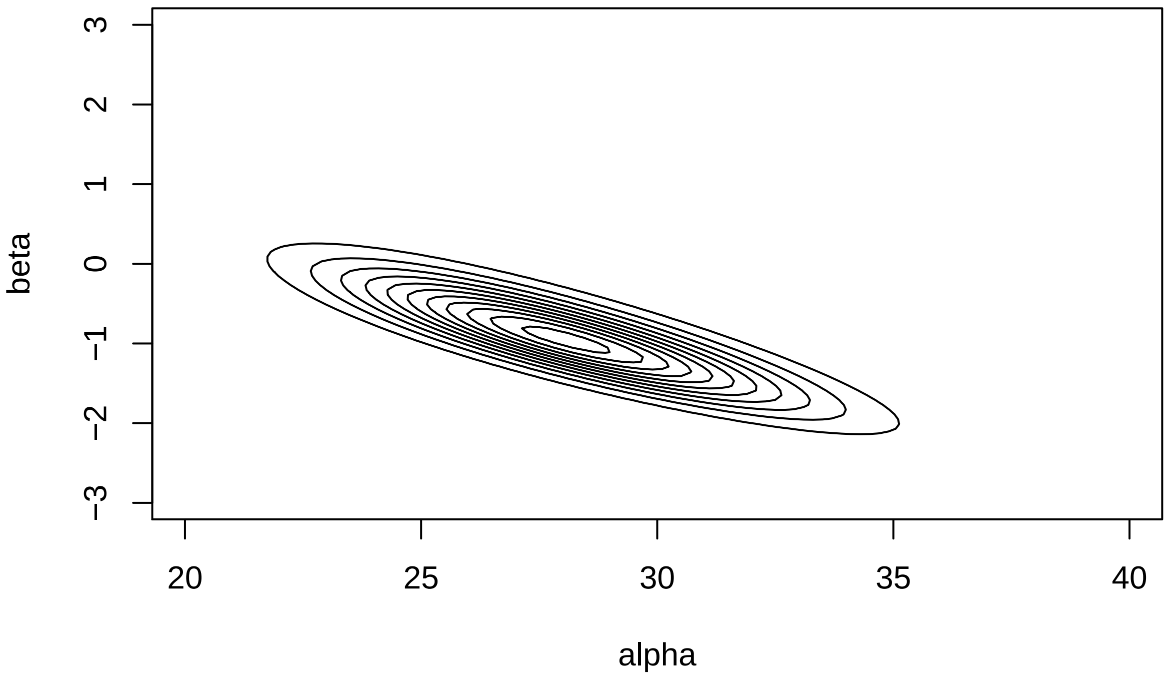
```
sumfatal <- sum(fatal)
n <- length(fatal)


## a. Choose a non-informative prior
## input data:
data <- read.table("data/planes.txt",skip=1)
y <- data[,2]
t <- data[,1]-1976
n <- length(y)
hist(y)
```



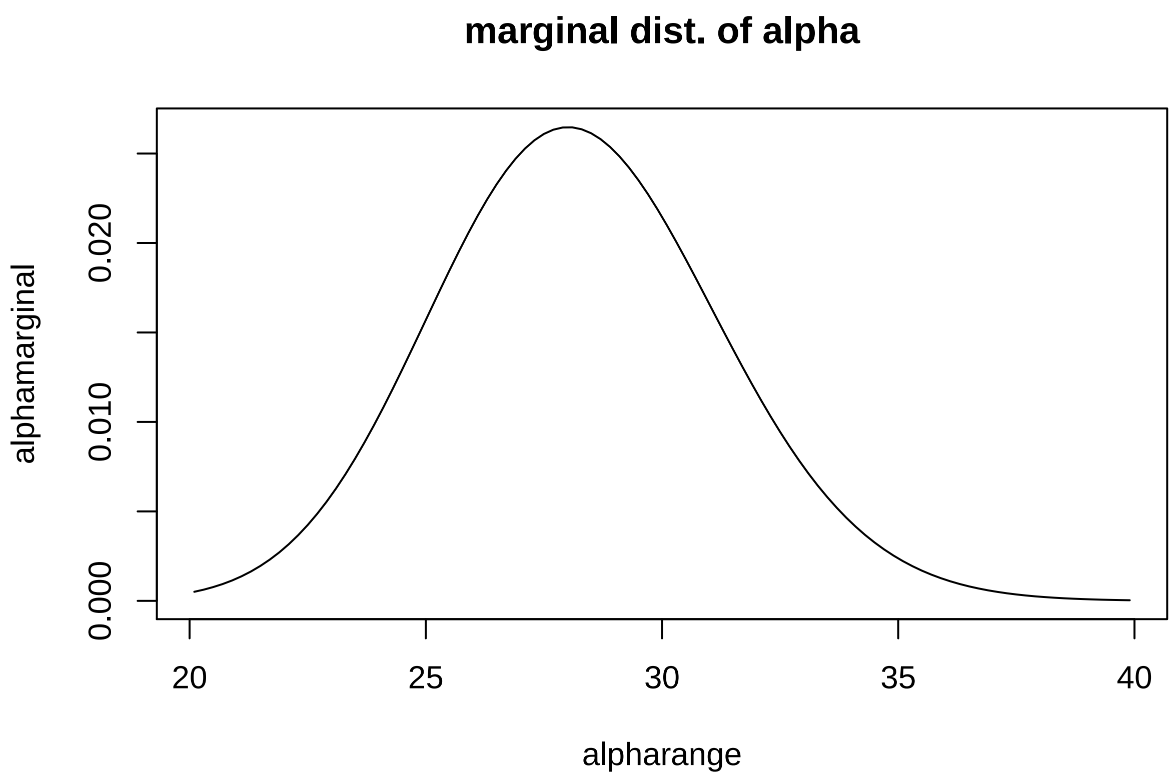

```
plot(t,y,pch=19)
```




```
## graphing posterior over range of alpha and beta:
posteriorplanes <- function(alpha,beta){
  logpost <- -Inf
  if (alpha + beta*max(t) > 0){
    logpost <- 0
    for (i in 1:n){
      logpost <- logpost + y[i]*log(alpha+beta*t[i])
      logpost <- logpost - (alpha+beta*t[i])
    }
  }
  logpost
}

numgrid <- 100
alpharange <- ppoints(numgrid)*20   # alpha between 0 and 20
betarange <- ppoints(numgrid)*6  # beta between 0 and 6

numgrid <- 100
alpharange <- ppoints(numgrid)*20+20   # alpha between 20 and 40
betarange <- ppoints(numgrid)*6-3  # beta between -3 and 3
full <- matrix(NA,nrow=numgrid,ncol=numgrid)
for (i in 1:numgrid){
  for (j in 1:numgrid){
    full[i,j] <- posteriorplanes(alpharange[i],betarange[j])
  }
}
full <- exp(full - max(full))
full <- full/sum(full)
contour(alpharange,betarange,full,xlab="alpha",ylab="beta",drawlabels=F)
```




```r
## calculating probabilities for grid sampler:

alphamarginal <- rep(NA,numgrid)
for (i in 1:numgrid){
  alphamarginal[i] <- sum(full[i,])
}
betaconditional <- matrix(NA,nrow=numgrid,ncol=numgrid)
for (i in 1:numgrid){
  for (j in 1:numgrid){
    betaconditional[i,j] <- full[i,j]/sum(full[i,])
  }
}

## plotting marginal distribution of alpha
par(mfrow=c(1,1))
plot(alpharange,alphamarginal,type="l",main="marginal dist. of alpha")
```




```
## plotting conditional distribution of beta given alpha
alpharange[25]
```

```
## [1] 24.9
```

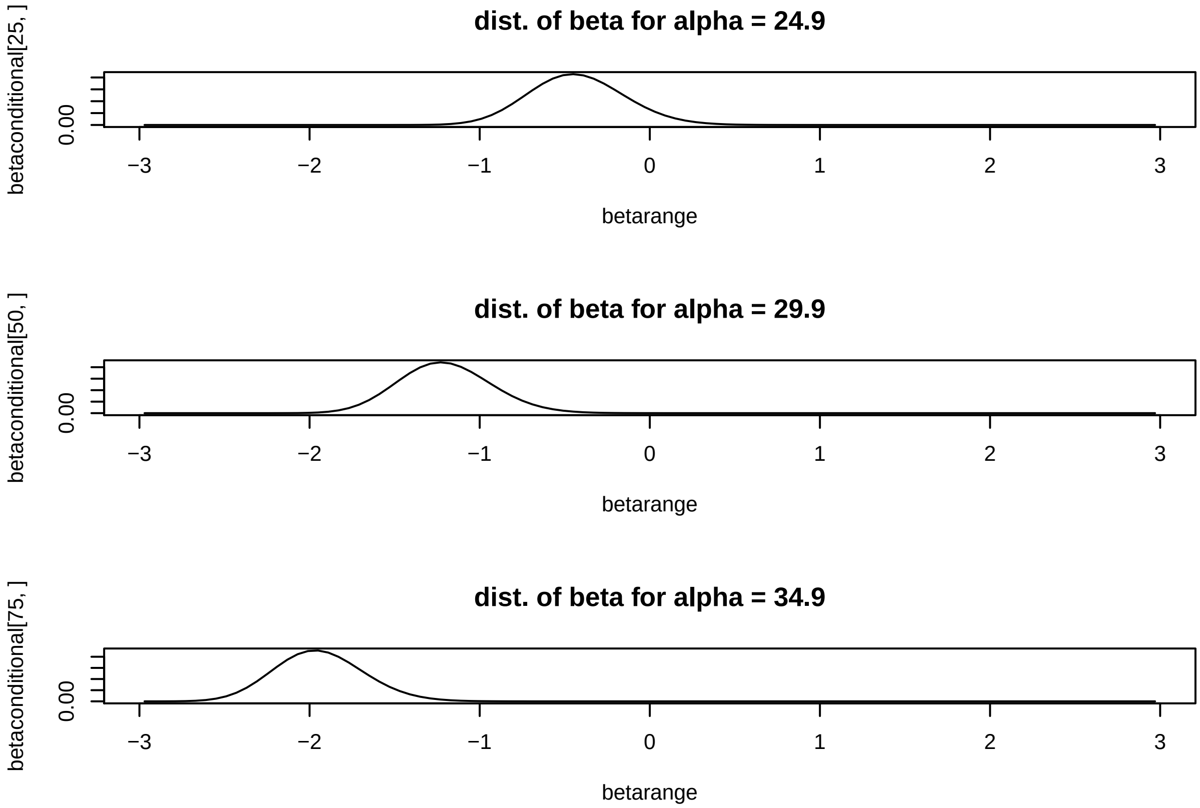
```
alpharange[50]
```

```
## [1] 29.9
```

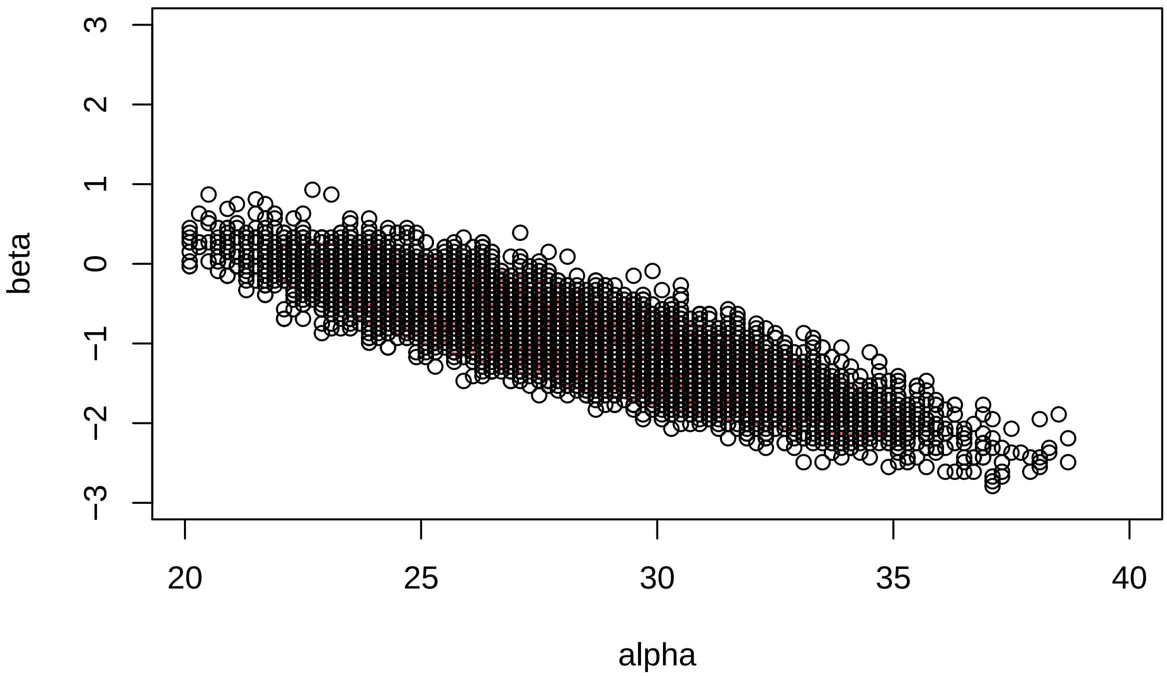
```
alpharange[75]
```

```
## [1] 34.9
```

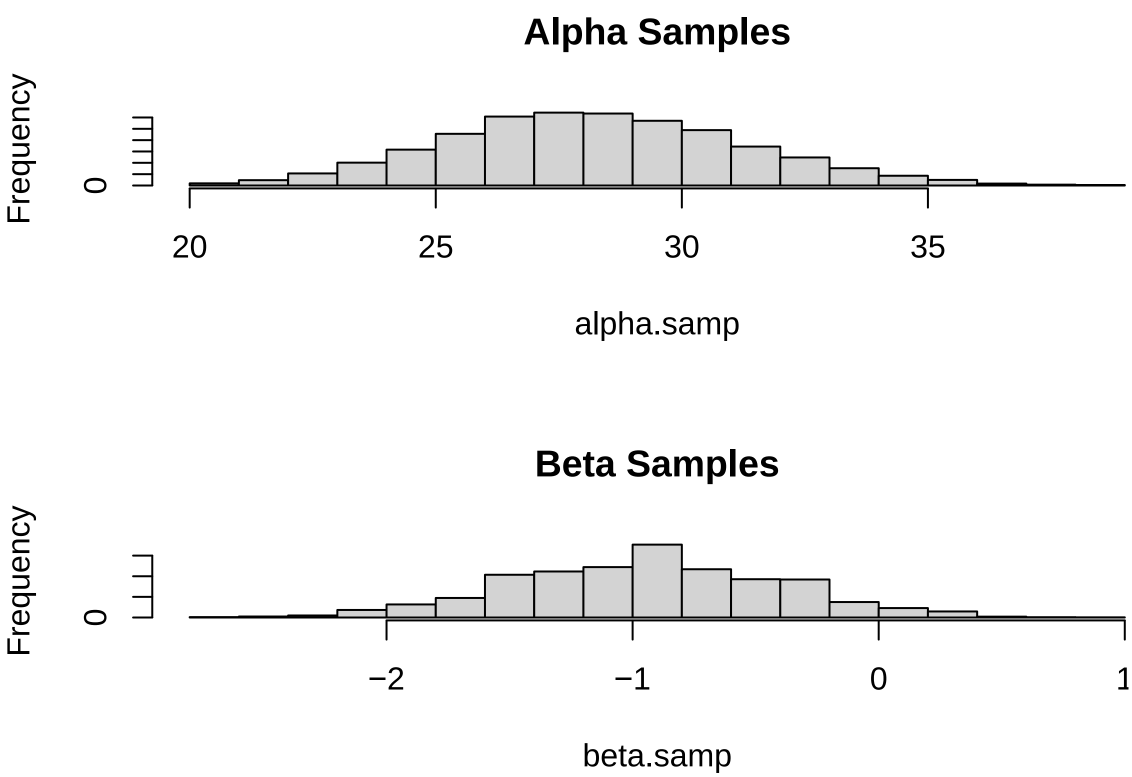
```
par(mfrow=c(3,1))
plot(betarange,betaconditional[25,],type="l",main="dist. of beta for alpha = 24.9")
plot(betarange,betaconditional[50,],type="l",main="dist. of beta for alpha = 29.9")
plot(betarange,betaconditional[75,],type="l",main="dist. of beta for alpha = 34.9")
```




```
## sampling grid values:

alpha.samp <- rep(NA,10000)
beta.samp <- rep(NA,10000)
for (m in 1:10000){
  a <- sample(1:100,size=1,replace=T,prob=alphamarginal)
  b <- sample(1:100,size=1,replace=T,prob=betaconditional[a,])
  alpha.samp[m] <- alpharange[a]
  beta.samp[m] <- betarange[b]
}

par(mfrow=c(1,1))
contour(alpharange,betarange,full,xlab="alpha",ylab="beta",drawlabels=F,col=2)
points(alpha.samp,beta.samp)
```




```
## calculating posterior means/intervals for alpha and beta

par(mfrow=c(2,1))
hist(alpha.samp,main="Alpha Samples")
hist(beta.samp,main="Beta Samples")
```



```r
mean(alpha.samp)
```

```
## [1] 28.26966
```

```r
mean(beta.samp)
```

```
## [1] -0.943464
```

```r
alpha.sampsort <- sort(alpha.samp)
beta.sampsort <- sort(beta.samp)

alpha.sampsort[250]
```

```
## [1] 22.5
```

```r
alpha.sampsort[9750]
```

```
## [1] 34.3
```

```r
beta.sampsort[250]
```

```
## [1] -2.01
```

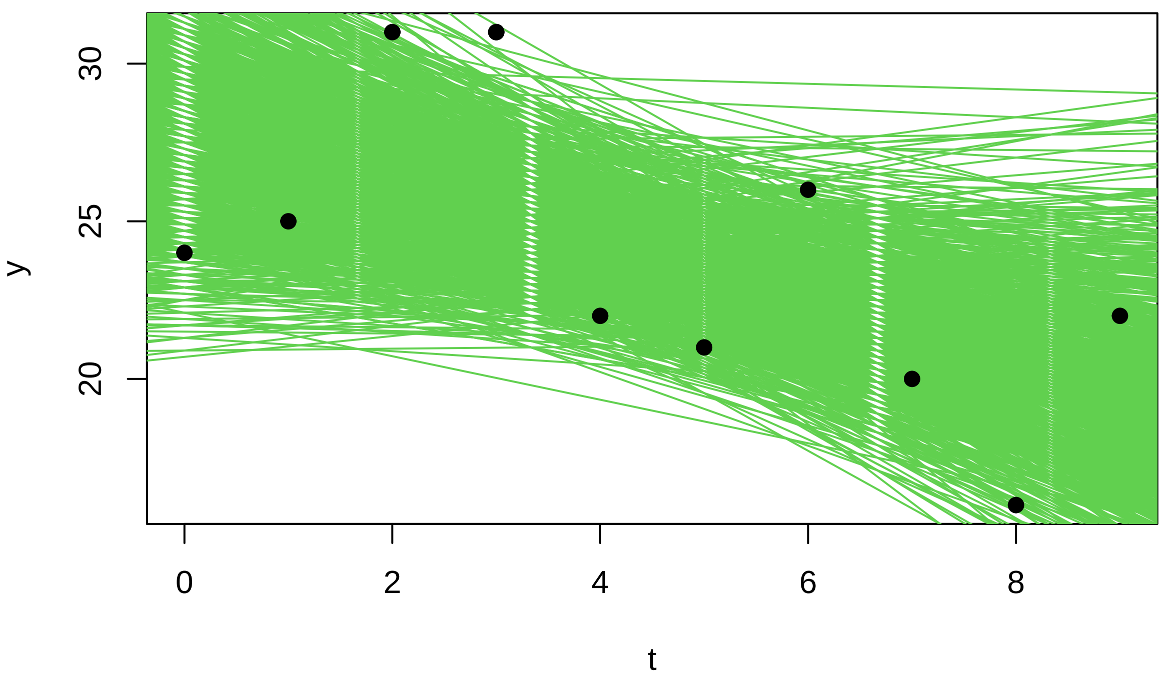
```r
beta.sampsort[9750]
```

```
## [1] 0.09
```

```r
sum(beta.samp >= 0)/10000
```

```
## [1] 0.0408
```

```r
par(mfrow=c(1,1))
plot(t,y,pch=19)
for (i in 1:1000){
  abline(alpha.samp[i],beta.samp[i],col=3)
}
points(t,y,pch=19)
```



```
##b. Use grid sampling to obtain 1000 samples from the joint posterior distribution. Give the 2D countou

##c. Use the samplies from (b) to obtain 1000 samples from the posterior predictive distribution for y*

##d. Calculate a 95% posterior predictive interval for y* and compare it to the interval found in Questi
## now plot the posterior distribution
```