3.8

c)

R code:

sum\_y = 16/(16+58) + 9/(9+90) + 10/(10+48) + 13/(13+57) + 19/(19+103) + 20/(20+57) + 18/(18+86) + 17/(17+112) + 35/(35+273) + 55/(55+64)

sum\_z = 12/(12+113) + 1/(1+18) + 2/(2+14) + 4/(4+44) + 9/(9+208) + 7/(7+67) + 9/(9+29) + 8/(8+154)

ny\_prod = (16+58) \* (9+90) \* (10+48) \* (13+57) \* (19+103) \* (20+57) \* (18+86) \* (17+112) \* (35+273) \* (55+64)

nz\_prod = (12+113) \* (1+18) \* (2+14) \* (4+44) \* (9+208) \* (7+67) \* (9+29) \* (8+154)

ny = c((16+58),(9+90), (10+48), (13+57), (19+103), (20+57), (18+86), (17+112), (35+273), (55+64))

nz = c((12+113), (1+18), (2+14), (4+44), (9+208), (7+67), (9+29), (8+154))

y = c(16/(16+58), 9/(9+90), 10/(10+48), 13/(13+57), 19/(19+103), 20/(20+57), 18/(18+86), 17/(17+112), 35/(35+273), 55/(55+64))

z = c(12/(12+113), 1/(1+18), 2/(2+14), 4/(4+44), 9/(9+208), 7/(7+67), 9/(9+29), 8/(8+154))

posterior\_theta\_y <- (rbeta(1000,sum\_y+0.5, sum(ny-y)+0.5))

posterior\_theta\_z <- (rbeta(1000, sum\_z+0.5, sum(nz-z)+0.5))

hist(posterior\_theta\_y,col = 'blue', xlab = ('Posterior distribution of theta\_y given y'))

hist(posterior\_theta\_z,col = 'red', xlab = ('Posterior distribution of theta\_z given z'))



d)

Rcode:

diff\_post\_thetay\_thetaz <- posterior\_theta\_y - posterior\_theta\_z

hist(diff\_post\_thetay\_thetaz, col = 'green', xlab = ('Posterior mu\_y - mu\_z'))



3.12

b)

Rcode:

t = seq(1,10,by=1)

y = c(24,25,31,31,22,21,26,20,16,22)

mod <- lm(y~t)

summary(mod)

alpha\_mean <- mod$coefficients[1]

alpha\_sd <- coef(summary(mod))[1, 2]

beta\_mean <- mod$coefficients[2]

beta\_sd <- coef(summary(mod))[2, 2]

# alpha and beta follow independent normal distribution

alpha.grid=seq(alpha\_mean-3\*alpha\_sd, alpha\_mean+3\*alpha\_sd, length=100)

beta.grid=seq(beta\_mean-3\*beta\_sd, beta\_mean+3\*beta\_sd, length=100)

p=matrix(NA, 100, 100)

evaluate\_dist=function(alpha, beta){

product\_alpha\_beta\_dist = dnorm(alpha, alpha\_mean, alpha\_sd)\*dnorm(beta, beta\_mean, beta\_sd)

return(product\_alpha\_beta\_dist)

}

for (i in 1:100){

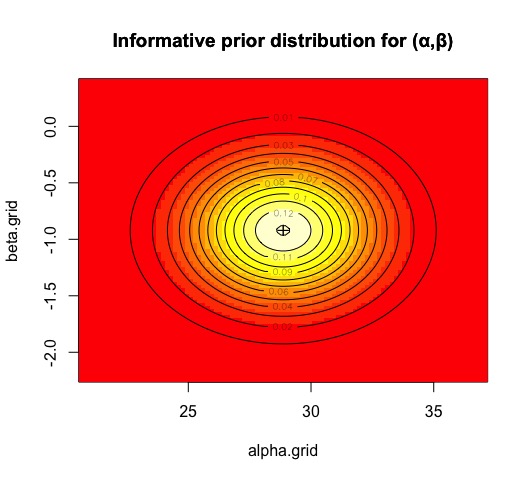
for (j in 1:100){

p[i,j]=evaluate\_dist(alpha.grid[i], beta.grid[j])}}

image(alpha.grid,beta.grid,p)

points(alpha\_mean,beta\_mean,pch=3)

contour(alpha.grid, beta.grid, p,xlab = "alpha",ylab = "beta",add=TRUE)



f)

Rcode:

alpha.grid=seq(20, 40, length=100)

beta.grid=seq(-2.0, 0.5, length=100)

evaluate\_postdist=function(alpha, beta){

post\_dist = exp(-(10\*alpha+sum(beta\*t)) + sum(y\*log(alpha+beta\*t)))

return(post\_dist)}

z=matrix(NA, 100, 100)

for (i in 1:100){

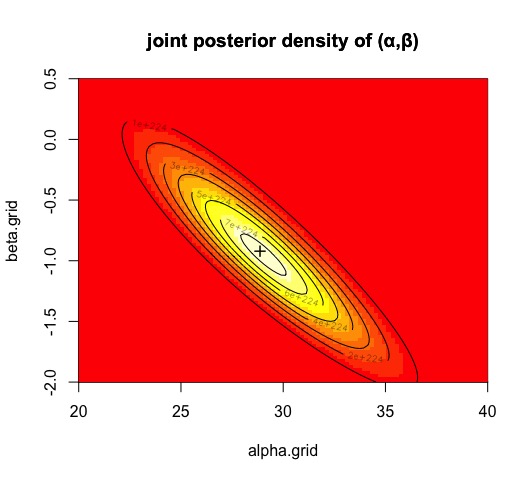
for (j in 1:100){

z[i,j]=evaluate\_postdist(alpha.grid[i], beta.grid[j])}}

image(alpha.grid,beta.grid,z,xlim=c(20, 40), ylim=c(-2.0, 0.5))

points(alpha\_mean,beta\_mean,pch=3)

contour(alpha.grid, beta.grid, z,xlab = "alpha",ylab = "beta", add=TRUE)



#1000 draws from posterior

pa <- rowSums(z) # marginal on alpha

ns <- 1000 # #samples

alpha.s <- beta.s <- numeric(ns)

for (s in 1:ns) {

ia <- sample.int(100, 1, prob=pa) # sample alpha

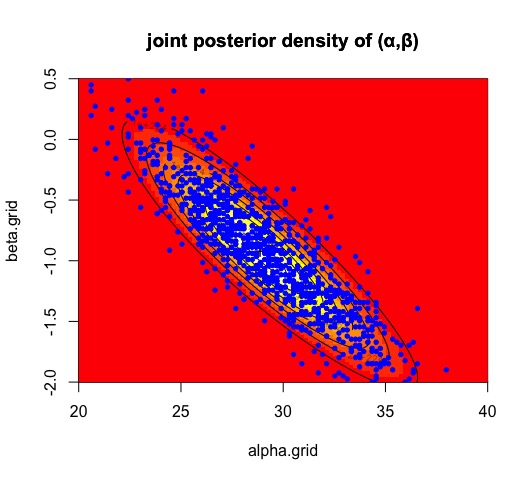
ib <- sample.int(100, 1, prob=z[ia,]) # sample beta | alpha

alpha.s[s] <- alpha.grid[ia]; beta.s[s] <- beta.grid[ib]

}

# add to plot

points(alpha.s, beta.s, pch=19, col='blue', cex=.6, xlim=c(20, 40), ylim=c(-2.0, 0.5))



g)

Rcode:

t1 <- 11

post\_theta <- alpha.s+ t1\*beta.s

hist(post\_theta, col = 'blue')



h)

Rcode:

postpred\_y <- rpois(1000,alpha.s+ t1\*beta.s)

sort\_postpred <- sort(postpred\_y)

conf\_interval\_95 <- sort\_postpred[c(25,975)]

print(conf\_interval\_95)

95% predictive interval for the number of fatal

accidents in 1986: [10, 30]