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STA 6934
Problem 6.21(a)

(i) Figure 1 (left) shows that $\sigma = .7$ with acceptance rate $\approx .73$.
(ii) Figure 1 (right) shows that $\sigma = 5.9$. with mean squared error $\approx .89$. Simulations using values of σ greater than 6 showed sometimes smaller mean squared error, but still with fluctuations.

The R code used is shown below.

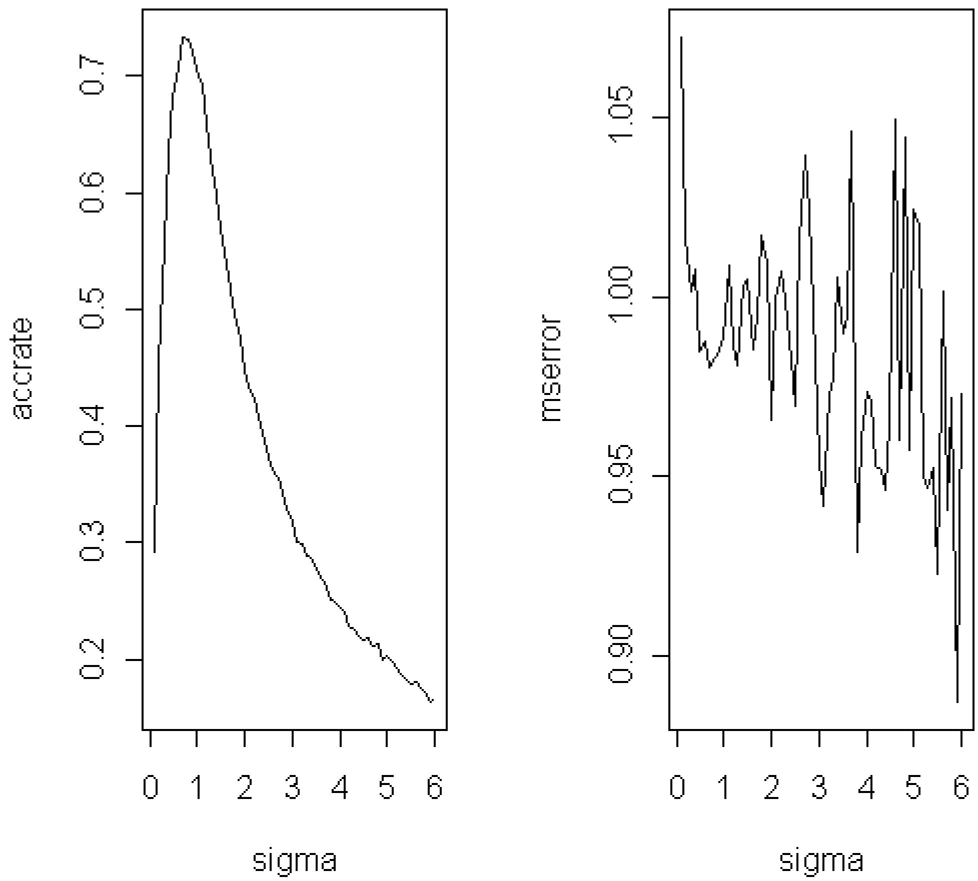

Figure 1 σ versus acceptance rate (left) and σ versus mean squared error (right)

```
#Problem 6.21

#target is a normal(0,1)
dtarget <- function(a)dnorm(a,0,1)

#define working variables and arrays
nsim <- 10000
nparms <- 60
sigma <- array(0,dim=c(nparms,1))
accrate <- array(0,dim=c(nparms,1))
mserror <- array(0,dim=c(nparms,1))
s <- 0

#generate rvs from candidate Cauchy(0,1)
#they will be reused as Cauchy(0,sigma) by multipliying by sigma
candstandard <- rcauchy(nsim-1,0,1)

#Cycle through possibles values of sigma
for (i in 1:nparms) {
        sigma[i] <- s + .1*i
        dcand <- function(b)dcauchy(b,0,sigma[i]) #define candidate
        candvars <- candstandard*sigma[i]        #candidate rvs
        rvars <- array(0,dim=c(nsim,1))
        rho <- array(0,dim=c(nsim,1))
        rvars[1] <- rnorm(1,0,1)    #start in the invariant dist'n
        rho[1] <- 0
        for (j in 2:nsim) {         #loop of Metropolis-Hasting
                cand <- candvars[j-1]
                test <- min(((dtarget(cand)/dcand(cand))*(dcand(rvars[j-1])/dtarget(rvars[j-1]))),1)
                rho[j] <- (runif(1) < test)
                rvars[j] <- cand*rho[j] + rvars[j-1]*(1-rho[j])
    }
        accrate[i] <- sum(rho)/(nsim-1)
        mserror[i] <- sum(rvars[2:nsim]^2)/(nsim-1)
}
par(mfrow=c(1,2))
plot(sigma,accrate,type="l")
plot(sigma,mserror,type="l")
```