Biostat 682 Hw 2

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2(c)

```
# Density functions
post.a <- function(mu,sd,y){
    ldens <- 0
    for (i in 1:length(y)) ldens <- ldens +
    log(dnorm(y[i],mu,sd))
    ldens
}
post.b <- function(mu,sd,y){
    ldens <- 0
    for (i in 1:length(y)) ldens <- ldens +
    log(pnorm(y[i]+0.5,mu,sd) - pnorm(y[i]-0.5,mu,sd))
    ldens
}

# Display the summary
summ <- function(x){
    result <- c(mean(x),sqrt(var(x)), quantile(x, seq(0.1, 0.9, 0.1)))
    round(result, 2)
}

# Input data
y <- c(10,10,12,11,9)

# Descriptive statistics
n <- length(y)
ybar <- mean(y)
s2 <- sum((y-mean(y))^2)/(n-1)
nsim <- 1e4
print(ybar)
```

```
## [1] 10.4
```

```
print(s2)
```

```
## [1] 1.3
```

```
# Create the grid for simulation
mugrid.lo <- 0
mugrid.hi <- 20
mugrid.n <- 1e3
mugrid <- seq(mugrid.lo,mugrid.hi,length=mugrid.n)
logsdgrid.lo <- -5
logsdgrid.hi <- 5
logsdgrid.n <- 1e3
logsdgrid <- seq(logsdgrid.lo,logsdgrid.hi,length=logsdgrid.n)
```

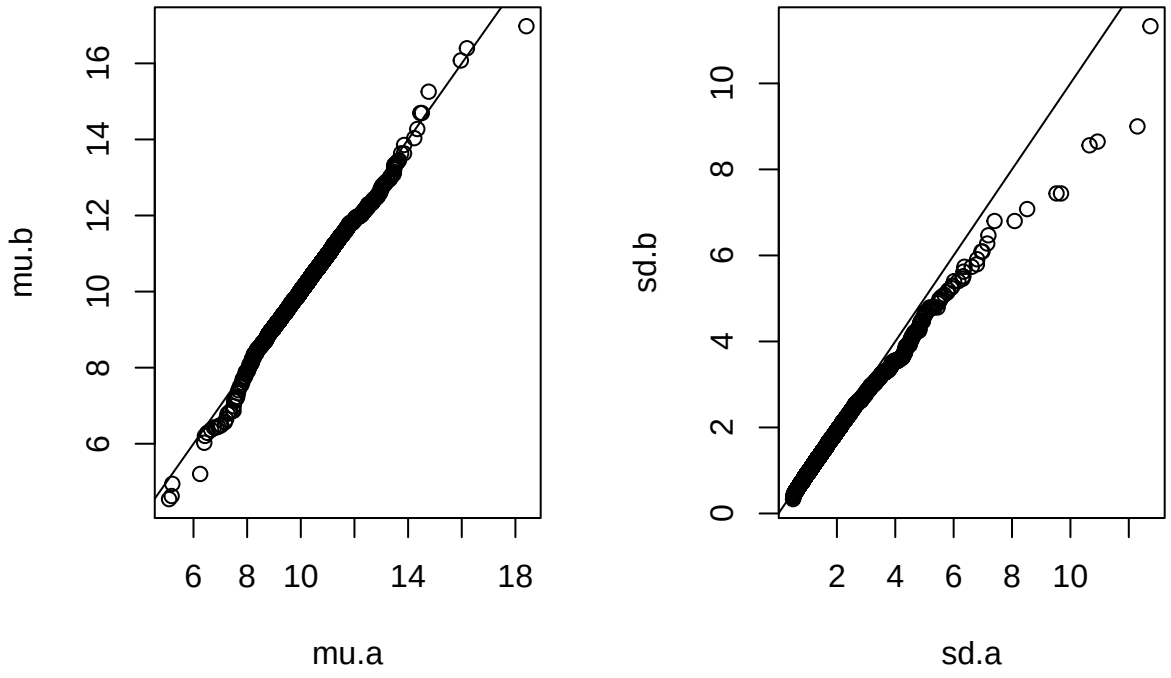
```
# Grid sim for unrounded data
logdens <- outer (mugrid, exp(logsdgrid), post.a, y)
dens <- exp(logdens - max(logdens))
sd.a <- sqrt((n-1)*s2/rchisq(nsim,n-1))
mu.a <- rnorm(nsim,ybar,sd.a/sqrt(n))
print (rbind (summ(mu.a),summ(sd.a)))
```

```
##                  10%  20%   30%   40%   50%   60%   70%   80%   90%
## [1,] 10.40 0.72 9.61 9.92 10.11 10.27 10.40 10.54 10.70 10.89 11.18
## [2,]  1.43 0.74 0.82 0.93  1.03  1.14  1.25  1.38  1.55  1.77  2.20
```

```
# Grid sim for rounded data
logdens <- outer (mugrid, exp(logsdgrid), post.b, y)
dens <- exp(logdens - max(logdens))
dens.mu <- apply(dens,1,sum)
muindex <- sample (1:length(mugrid), nsim, replace=T,
prob=dens.mu)
mu.b <- mugrid[muindex]
sd.b <- rep (NA,nsim)
for (i in (1:nsim)){
    sd.b[i] <- exp (sample (logsdgrid, 1, prob=dens[muindex[i],]))
}
print (rbind (summ(mu.b),summ(sd.b)))
```

```
##                  10%  20%   30%   40%   50%   60%   70%   80%   90%
## [1,] 10.40 0.69 9.65 9.93 10.11 10.27 10.41 10.53 10.69 10.87 11.15
## [2,]  1.35 0.67 0.75 0.87  0.97  1.07  1.18  1.32  1.47  1.69  2.11
```

```
# Compare the two posteriors
par(mfrow=c(1,2))
qqplot(mu.a, mu.b)
abline(0,1)
qqplot(sd.a, sd.b)
abline(0,1)
```



2(d)

```
# Compute (z_1 - z_2)^2 given the rounded data
z <- matrix (NA, nsim, n)
for (i in 1:length(y)){
    lower <- pnorm (y[i]-.5, mu.b, sd.b)
    upper <- pnorm (y[i]+.5, mu.b, sd.b)
    z[,i] <- qnorm (lower + runif(nsim)*(upper-lower), mu.b, sd.b)
}
mean ((z[,1]-z[,2])^2)
```

```
## [1] 0.1608107
```