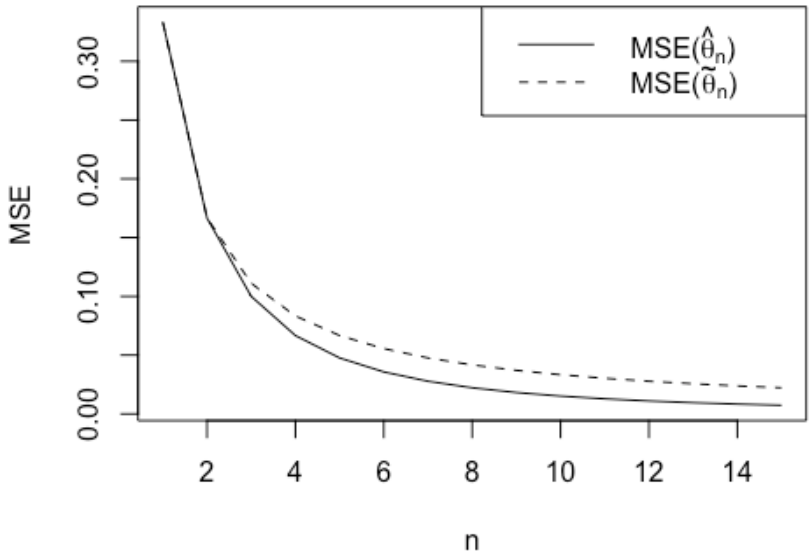
HW1 R code and plots sheet

1 (d)

R code:

```
n <- 1:15
plot(x = n, y = 2/((n+1)*(n+2)), xlab = "n", ylab = "MSE", type = "l")
lines(x = n, y = 1/(3*n), lty = 2)
legend("topright", legend = c(expression(paste("MSE(",hat(theta)[n],")", sep = "")),
                              expression(paste("MSE(",tilde(theta)[n],")", sep = ""))), lty = 1:2)
```

Plot:



From the plot above, it is clear that I would prefer the estimator with smaller overall MSE, which is $\tilde{\theta}_n$.

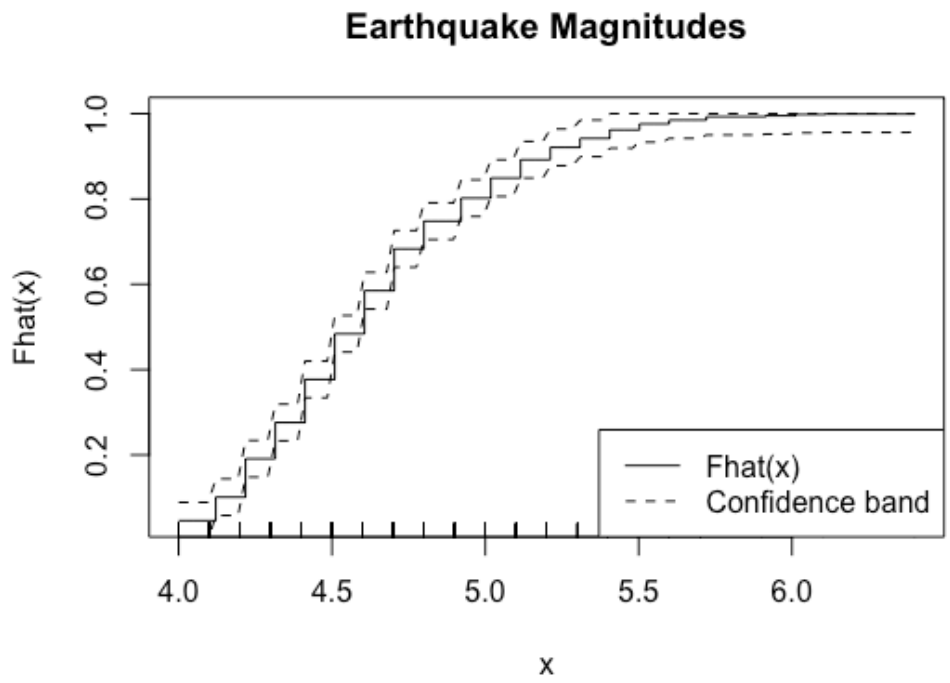
5.

R code:

```
quakes <- read.table(file = "~/Documents/STAT_201_B/Homework/HW1/fijiquakes.dat.txt", header =
TRUE)
x <- quakes$mag
xsample <- seq(min(x), max(x), length = 100) # Take 100 samples for x.
Fhat <- apply(outer(x, xsample, "<="), 2, mean) # Calculate the ECDF.
n <- length(x)
# Calculate L(x) and U(x).
epsilon_n <- sqrt(log(2/0.05)/(2*n))
L <- sapply(Fhat, FUN=function(x) max(x - epsilon_n, 0))
U <- sapply(Fhat, FUN=function(x) min(x + epsilon_n, 1))
# Plot the ECDF and a 95% confidence interval for F.
```

```
plot(xsample, Fhat, xlab = "x", ylab = "Fhat(x)", type = "s", main = "Earthquake Magnitudes")
rug(x)
lines(xsample, L, lty = 2)
lines(xsample, U, lty = 2)
legend("bottomright", legend = c("Fhat(x)", "Confidence band"), lty = 1:2)
```

Plot:



6.

At first, I searched on Google and found an R package named “boot”. So, I tried to follow the syntax introduced online and get the R code as follow. But to be honest, I cannot understand all of the following codes because some of them can only be used in “boot” package.

R code:

```
library(boot)
clouds <- read.table("~/Documents/STAT_201_B/Homework/HW1/clouds.dat", header = TRUE)
seeded <- clouds$Seeded
unseeded <- clouds$Unseeded
theta_hat <- median(seeded) - median(unseeded)
sample_median <- function(x, d){return (median(x[d]))}
N <- 100
seeded_boot <- boot(seeded, sample_median, N)
unseeded_boot <- boot(unseeded, sample_median, N)
se_hat = sqrt(var(seeded_boot$t) + var(unseeded_boot$t))
CI <- c(theta_hat + qnorm(0.025) * se_hat, theta_hat - qnorm(0.025) * se_hat)
```

```
print(CI)
```

Result:

After the first run of this code, I got $se(\hat{\theta}_n) = 68.44,\ Confidence\ interval: (43.26, 311.54)$.

Then I tried to make the bootstrap work without using the "boot" package.

R code:

```
clouds <- read.table("~/Documents/STAT_201_B/Homework/HW1/clouds.dat", header = TRUE)
seeded <- clouds$Seeded
unseeded <- clouds$Unseeded
theta_hat <- median(seeded) - median(unseeded)
bootstrap <- function(data, B) {
   resample <- lapply(1 : B, function(i) sample(data, replace = TRUE))
   sample_median <- sapply(resample, FUN = function(x) median(x))
   variance <- var(sample_median)
   list(resample = resample, median = sample_median, variance = variance)
}
seeded_boot <- bootstrap(seeded, 10000)
unseeded_boot <- bootstrap(unseeded, 10000)
se_hat = sqrt(seeded_boot$variance + unseeded_boot$variance)
CI <- c(theta_hat + qnorm(0.025)*se_hat, theta_hat - qnorm(0.025)*se_hat)
print(CI)
```

Result:

After the first run of this code, I got $se(\hat{\theta}_n) = 62.57,\ Confidence\ interval: (54.77, 300.03)$.