Sampling: HW7

Leslie Gains-Germain

1. The ratio B represents the true mean number of board feet found by measuring for every one board foot found using the eyeball estimate in the 45 acre timber stand. *Another interpretation: The ratio B represents the true average ratio of measured volume to eyeballed volume of timber in the 45-acre timber stand.* If this ratio is close to 1, the timber cruiser is very good at estimating plot volume by eyeball. t_y is the true total merchantable volume in the 45 acre timber stand in board feet, found by the measuring technique.

2. The estimate of B is 1.0458. My work is shown in the R code below.

```
Bhat <- with(data, mean(y)/mean(x))
```

3. The ratio estimate for t_y is 116085 board feet.

```
N <- 450
t.yhat <- Bhat*mean(data$x)*N
```

4. Because $\bar{x}_U$ is unknown, the estimated variance of $\hat{t}_{yr}$ is approximately 1221314. My work is shown below.

```
n <- 30
s.e <- sqrt(1/(n-1)*sum((data$y-(Bhat*data$x))^2))
var.t.yhat <- N*(N-n)*s.e^2/n
```

5. An approximate 95% t-based confidence interval for B is 1.0254 to 1.0662. My work is shown below.

```
tstar <- qt(0.975, 29)
var.bhat <- (N-n)/(N*mean(data$x)^2)*s.e^2/n
ci.l <- Bhat-tstar*sqrt(var.bhat)
ci.h <- Bhat+tstar*sqrt(var.bhat)
```

6. For every one board foot estimated by eyeball, we are 95% confident that the true mean number of board feet found by measuring is between 1.0254 and 1.0662 board feet. *Another interpretation: We are* 95% *confident that the measured volume is between* 2.54% *and* 6.62% *larger than the eyeballed volume on average.*

7. An approximate 95% t-based confidence interval for t_y is 113824.8 to 118345.2. My work is shown below.

```
ci <- c(t.yhat - tstar*sqrt(var.t.yhat), t.yhat + tstar*sqrt(var.t.yhat))
```

8. We are 95% confident that the true total merchantable volume in the 45 acre timber stand is between 113824.8 and 118345.2 board feet.

9. Yes, I would expect ratio estimation to be an improvement over estimation based on the SRS of y-values only because the plot shows a strong positive linear relationship between the eyeballed plot volume and the measured plot volume, and the relationship passes through the origin.

10. If the point $(300, 305)$ is removed, the new estimate of t_y is 115355.2 board feet, with a standard error of 1140.12.

```
data.remove <- data[-14,]
Bhat.remove <- with(data.remove, mean(y)/mean(x))
t.yhat.remove <- Bhat.remove*mean(data.remove$x)*N


n.new <- 29
s.e.remove <- sqrt(1/(n.new-1)*sum((data.remove$y-(Bhat.remove*data.remove$x))^2))
var.t.yhat.remove <- N*(N-n.new)*s.e.remove^2/n.new
se.t.yhat.remove <- sqrt(var.t.yhat.remove)
```

11. See attached handwritten sheet.