

Answers to selected exercises

2.8.1

$$\begin{aligned}\hat{\tau}_X &= 51,473 \\ \widehat{\text{Var}} \hat{\tau}_X &= 3,315.5^2 \\ \mathbb{P}\left(-\frac{\tau}{10} < \hat{\tau}_X - \tau < \frac{\tau}{10}\right) &\approx 0.8792\end{aligned}$$

2.8.2 (a)

$$\begin{aligned}\hat{\tau}_Y &= 19,887.9 \\ 80\%CI &= (18,103.8, 21,672.1)\end{aligned}$$

(b) Want $\text{Var} \bar{y} = 0.7547^2$ whence $n = 253$.

3.2.1

$$\begin{aligned}\widehat{\text{Var}} \hat{p}_{srs} &= 0.0034 \\ \widehat{\text{Var}} \hat{p}_{sy} &= 0.0014\end{aligned}$$

4.8.2 (a) $n_1/n = 1/3$, $n_2/n = 2/3$

(b) $n = 264$

(c) cost is 1,936

(d) new cost is 2,288

(e) $n_1/n \approx 0.45$, $n_2/n \approx 0.55$, $n = 298$, cost is 2,235

4.8.3

$$\hat{\mu}_{st} = 59.64, \quad \hat{\tau}_{st} = 10,139, \quad \widehat{\text{Var}} \hat{\tau}_{st} = 170^2 \widehat{\text{Var}} \hat{\mu}_{st}$$

4.8.4

$$n_1 = 614, \quad n_2 = 263, \quad n_3 = 123$$

5.6.1

$$\begin{aligned}\hat{p}_{clr} &= 22/104 \\ \widehat{\text{Var}} \hat{p}_{clr} &= 0.00184\end{aligned}$$

Binomial estimate of variance is 0.001619 (which wrongly assumes all samples are independent)

5.6.3 (b)

$$\begin{aligned}\hat{p} &= 0.40 \\ \widehat{\text{Var}} \hat{p} &= 0.003393\end{aligned}$$

6.4.1 (i)

$$\begin{aligned}\hat{\tau}_{ratio} &= 63,963 \\ \widehat{\text{Var}} \hat{\tau}_{ratio} &= 1,181.3^2\end{aligned}$$

(ii)

$$\begin{aligned}\hat{\tau}_{lr} &= 63,846 \\ \widehat{\text{Var}} \hat{\tau}_{lr} &= 1,184.9^2\end{aligned}$$

6.4.2

$$\begin{aligned}\hat{\tau}_Y &= 5,042 \\ \widehat{\text{Var}} \hat{\tau}_Y &= 67.84^2 \\ \widehat{\text{Var}} \hat{\tau}_{lr}(\hat{\beta}) &= 68.59^2 \text{ slightly worse!}\end{aligned}$$

6.4.5 (a)

$$\begin{aligned}\hat{\theta}_g &= 15.46 & \hat{\theta}_p &= 12.75 \\ \widehat{\text{Var}} \hat{\theta}_g &= 0.7366 & \widehat{\text{Var}} \hat{\theta}_p &= 0.6715\end{aligned}$$

(d) (i)

$$\hat{\tau}_g = 251 \times 2024/54 = 9,407.85, \quad \widehat{\text{Var}} \hat{\tau}_g = 780^2$$

(ii)

$$\hat{\tau}_g = 9,470$$