

STAT W4201 001, Homework 5

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Code is attached here and also posted at <https://github.com/BrianWeinstein/advanced-data-analysis>. Where relevant, code snippets and output are included in-line.

Problem 1: Ramsey 7.18

- (a) Find the standard error of prediction for the prediction of pH at 5 hours after slaughter.

The calculations in Display 7.12 give us $\hat{\beta}_0 = 6.9836$, $\hat{\beta}_1 = -0.7257$, $\hat{\sigma} = 0.08226$, $n = 10$, $\bar{X} = 1.190$, $s_X^2 = 0.6344$.

Therefore, the standard error of prediction for the pH at 5 hours is

$$\begin{aligned}\text{SE}[\text{Pred}\{Y|X_0 = \log(5) = 1.609438\}] &= \hat{\sigma} \sqrt{1 + \frac{1}{n} + \frac{(X_0 - \bar{X})^2}{(n-1)s_X^2}} \\ &= (0.08226) \sqrt{1 + \frac{1}{10} + \frac{(1.609438 - 1.190)^2}{9 \cdot 0.6344}} \\ &= 0.0875\end{aligned}$$

- (b) Construct a 95% prediction interval at 5 hours after slaughter.

The prediction of pH level at 5 hours is,

$$\begin{aligned}\text{Pred}\{Y|X_0 = \log(5) = 1.609438\} &= \beta_0 + \beta_1 \cdot \log(5) \\ &= 6.9836 - 0.7257 \cdot 1.609438 \\ &= 5.8156.\end{aligned}$$

A 95% prediction confidence interval at 5 hours is given by

$$\begin{aligned}5.8156 \pm t_8(0.975) \cdot \text{SE}[\text{Pred}\{Y|X_0 = \log(5)\}] \\ 5.8156 \pm 2.3060 \cdot 0.0875 \\ 5.8156 \pm 0.2017 \\ \Rightarrow [5.6139, 6.0173].\end{aligned}$$

Problem 2: Ramsey 7.24

- (a) Confirming the estimates and standard errors from Display 7.17:

- i. Denmark

```
> lmDenmark <- lm(formula=Denmark~Year, data=birthData)
> summary(lmDenmark)$coefficients
              Estimate Std. Error t value Pr(>|t|)
(Intercept) 0.59872329381 0.0408047207 14.672893 2.395722e-18
Year        -0.00004288538 0.0000206916 -2.072598 4.423828e-02
```

ii. The Netherlands

```
> lmNetherlands <- lm(formula=Netherlands~Year, data=birthData)
> summary(lmNetherlands)$coefficients
```

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	0.67239837505	0.0279195810	24.083398	1.365923e-26
Year	-0.00008084321	0.0000141577	-5.710196	9.636921e-07

iii. Canada

```
> lmCanada <- lm(formula=Canada~Year, data=birthData)
> summary(lmCanada)$coefficients
```

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	0.7337857143	0.05480068278	13.390083	3.983523e-11
Year	-0.0001111688	0.00002767698	-4.016653	7.375947e-04

iv. United States

```
> lmUsa <- lm(formula=USA~Year, data=birthData)
> summary(lmUsa)$coefficients
```

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	0.62008571429	0.018598766807	33.340152	2.523643e-18
Year	-0.00005428571	0.000009393273	-5.779212	1.439109e-05

Problem 3: [Ramsey 7.28](#)

Problem 4: [Ramsey 8.17](#)

Problem 5: [Ramsey 8.20](#)

Problem 6: [Ramsey 9.12](#)