

STA101 Problem Set 8

Summer I, 2021, Duke University

Exercises from the OpenIntro book

Chapter 8 exercises 8.4, 8.21, 8.29, 8.35, 8.42.

Additional problems

Problem 5

The `crabs` dataset¹ (available in the R package `MASS`) includes 5 morphological measurements on 200 crabs of the species *Leptograpsus variegatus* collected at Fremantle, West Australia. In particular, frontal lobe sizes and rear widths were measured, both in millimeters. The mean frontal lobe size is 15.58mm with a standard deviation of 3.495mm. The mean rear width is 12.74mm with a standard deviation of 2.573mm. The correlation between frontal lobe size and rear width is 0.91.

- (a) Write the equation of the regression line for predicting frontal lobe size from rear width.
- (b) Interpret the slope and the intercept in this context.
- (c) Calculate R^2 of the regression line for predicting frontal lobe size from rear width, and interpret it in the context of the application.
- (d) A randomly selected *Leptograpsus* crab from Fremantle, West Australia has a rear width of 14.5mm. Predict the frontal lobe size of this crab using this linear regression model.
- (e) The crab from part (d) has a frontal lobe size of 16.8mm. Calculate the residual, and explain what this residual means.
- (f) Another *Leptograpsus* crab has a rear width of 2.69mm. Would it be appropriate to use this linear model to predict the frontal lobe size of this crab?

Problem 6

Below is the output of a linear regression model on predicting distance (feet) it takes to stop a car from the speed (MPH) of a car based on trial results of 50 cars.

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	-17.5791	6.7584	-2.6011	0.0123
speed	3.9324	0.4155	9.4640	0.0000

¹Source: Campbell, N.A. and Mahon, R.J. (1974) A multivariate study of variation in two species of rock crab of genus *Leptograpsus*. *Australian Journal of Zoology* 22, 417–425.

$$s = 15.38 \quad R^2 = 0.6511 \quad R^2_{\text{adj}} = 0.6438$$

- (a) What are the hypotheses for evaluating whether car speed is a significant predictor of distance taken to stop?
- (b) State the conclusion of the hypothesis test from part (a) in context of the data.
- (c) Calculate a 95% confidence interval for the slope of speed, and interpret it in context of the data.
- (d) Do your results from the hypothesis test and the confidence interval agree? Explain.