18. The Grants' Finch Complete Beak Data. The data file ex0218 contains the beak depths (in mm) of all 751 finches captured by Peter and Rosemary Grant in 1976 and all 89 finches captured in 1978 (as described in Section 2.1.1). Use a statistical computer program for parts a–d: (a) Draw side-by-side box plots of the two groups of beak depths. (b) Use the two-sample t-test on these data to find the one-sided p-value for a test of the hypothesis of no difference in means against the alternative that the mean in 1978 is larger. (c) What is the two-sided p-value from the t-test? (d) Provide an estimate and a 95% confidence interval for the amount by which the 1978 mean exceeds the 1976 mean. (e) What is it about the finches in the two populations that might make you question the validity of the independence assumption upon which the two-sample t-test is derived?

19. Fish Oil and Blood Pressure. Reconsider the fish oil and blood pressure data of Chapter 1, Exercise 12. Since the measurements are the reductions in blood pressure for each man, it is of interest to know whether the mean reduction is zero for each group. For the regular oil diet group do the following:

- **(a)** Compute the average and the sample standard deviation. What are the degrees of freedom associated with the sample standard deviation, s_2?
- **(b)** Compute the standard error for the average from this group: $\text{SE}(Y_2) = s_2/\sqrt{n_2}$.
- **(c)** Construct a 95% confidence interval for μ_2 as $\overline{Y}_2 + t_d(.975)\text{SE}(\overline{Y}_2)$, where d is the degrees of freedom associated with s_2.
- **(d)** For the hypothesis that μ_2 is zero, construct the t-statistic $Y_2/\text{SE}(Y_2)$. Find the two-sided p-value as the proportion of values from a t_d-distribution farther from 0 than this value.

20. Fish Oil and Blood Pressure (One-Sample Analysis). Repeat Exercise 19 for the group of men who were given the fish oil diet and then answer these questions: Is there any evidence that the mean reduction for this group is different from zero? What is the typical reduction in blood pressure expected from this type of diet (for individuals like these men)? Provide a 95% confidence interval.

Data Problems

21. Bumpus Natural Selection Data. In 1899, biologist Hermon Bumpus presented as evidence of natural selection a comparison of numerical characteristics of moribund house sparrows that were collected after an uncommonly severe winter storm and which had either perished or survived as a result of their injuries. Display 2.15 shows the length of the humerus (arm bone) in inches for 59 of these sparrows, grouped according to whether they survived or perished. Analyze these data to summarize the evidence that the distribution of humerus lengths differs in the two populations. Write a brief paragraph of statistical conclusion, using the ones in Section 2.1 as a guide, including a

DISPLAY 2.15 Humerus lengths of moribund male house sparrows measured by Hermon Bumpus, grouped according to survival status

Humerus Lengths (inches) of 35 Males That *Survived*

0.687, 0.703, 0.709, 0.715, 0.721, 0.723, 0.723, 0.726, 0.728, 0.728, 0.728, 0.729, 0.730, 0.730, 0.733, 0.733, 0.735, 0.736, 0.739, 0.741, 0.741, 0.741, 0.741, 0.743, 0.749, 0.751, 0.752, 0.752, 0.755, 0.756, 0.766, 0.767, 0.769, 0.770, 0.780

Humerus Lengths (inches) of 24 Males That *Perished*

0.659, 0.689, 0.702, 0.703, 0.709, 0.713, 0.720, 0.720, 0.726, 0.726, 0.729, 0.731, 0.736, 0.737, 0.738, 0.738, 0.739, 0.743, 0.744, 0.745, 0.752, 0.752, 0.754, 0.765