

**Homework #5 (Due Tuesday, February 19)**Turn in the following (Please show work!):

1. (Data taken from 4.1 #26 and 4.2 #20) The lengths of the right humerus and right tibia in 11 rats randomly selected from those sent to space on Spacelab Life Sciences 2 are listed in the accompanying table. Use the length of the right humerus as the explanatory variable, and the length of the right tibia as the response variable. (You may use the worksheet on the other side. *You should keep as many decimal places as possible for all numbers computed in each intermediate step.*)

Right Humerus (mm) $x$	Right Tibia (mm) $y$
24.80	36.05
24.59	35.57
24.59	35.57
24.29	34.58
23.81	34.20
24.87	34.73
25.90	37.38
26.11	37.96
26.63	37.46
26.31	37.75
26.84	38.50

- (A) Prepare a scatter diagram neatly.  
 (B) Compute  $\bar{x}$  and  $\bar{y}$ .  
 (C) Compute the standard deviations  $s_x$  and  $s_y$ , using the formula

$$s_x = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}} \text{ and a similar formula for } s_y.$$

- (D) Compute  $s_x$  and  $s_y$  again, using the formula  $s_x = \sqrt{\frac{\sum x^2 - \frac{(\sum x)^2}{n}}{n-1}}$  and a similar formula for  $s_y$ . (Your answer should agree with that in the previous part.)

- (E) Compute the sample linear correlation coefficient  $r$  using the formula

$$r = \frac{\sum \left( \frac{x - \bar{x}}{s_x} \right) \left( \frac{y - \bar{y}}{s_y} \right)}{n-1}$$

- (F) Compute the sample linear correlation coefficient  $r$  again, using the formula

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{n(\sum x^2) - (\sum x)^2} \sqrt{n(\sum y^2) - (\sum y)^2}}$$

- (G) Consult Table VIII in page A-14 to determine whether there is a linear relation. If so, are the two variables positively associated or negatively associated?

- (H) Find the least-squares regression line in the form  $\hat{y} = b_1x + b_0$ .

- (I) Identify the slope of the least-squares regression line.

- (J) Plot the least-squares regression line on the scatter diagram previously sketched.

- (K) Determine the residual if the length of the right humerus is 26.11 mm and the actual length of the right tibia is 37.96 mm. Also determine if the length of this particular tibia is above or below average for a rat with a right humerus 26.11 mm in length?

- (L) On the scatter diagram with regression line, label clearly the residual corresponding to part (K).

- (M) Suppose that one of the rats sent to space experienced a broken right tibia due to a severe landing. The length of the right humerus is determined to be 25.31 mm. Use the least-squares regression you obtained to estimate the length of the right tibia.

- (N) Determine  $R^2$  (the coefficient of determination), expressing it in percentage.

- (O) Give an interpretation of the value you obtained in (N).

2. Section 4.1, Problems 11, 12, 13, 14, 15, 16.

3. Section 4.2, Problems 9, 10.

4. Section 4.3, Problems 3, 4, 5, 6.

