

CHAPTER 7

THE RELATIONSHIP BETWEEN TWO VARIABLES

7.18. Not necessarily. Blood pressure and income both tend to increase with age. (10 points)

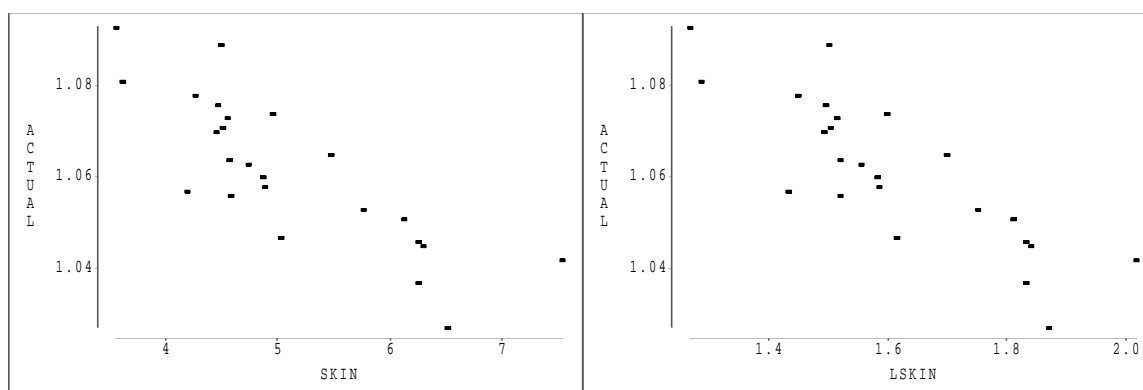
7.22. We have

$$\hat{\beta}_1 = r \frac{s_Y}{s_X} = r = 0.90 \text{ (5points)}$$

$$\hat{\beta}_0 = \bar{y} - \hat{\beta}_1 \bar{x} = 13.07 - (0.90)(12.82) = 1.532 \text{ (5points)}$$

$$\hat{Y} = 1.532 + 0.90X$$

7.28. (a) (10 points) Shown are the graphs of ACTUAL versus SKIN and LSKIN.



Both plots show a decreasing linear relation. There does not seem to be a reason to prefer one over the other.

(b) (10 points) Both fits appear adequate with the regression of ACTUAL on LSKIN being preferred because of a slightly larger r^2 (0.6930 versus 0.6736) and slightly lower MSE (0.0093 versus 0.0096). There is little to choose from in graphs of the fits or in the residual plots.

(c) (10 points) The fitted slope of the regression of ACTUAL on LSKIN is -0.0725 . This means that for each unit increase in LSKIN, we lower our prediction of ACTUAL by 0.0725 units.

(d) (10 points) Possibly. An LSKIN value of 0 corresponds to a SKIN value of 1, so if it is possible to have a skinfold measurement of 1, then the intercept, $\hat{\beta}_0 = 1.1781$, is the prediction of body density at that skinfold value. Caution must be taken, however, in extrapolating beyond the range of the data.

For the regression of ACTUAL on SKIN, not only is a skinfold value of 0 not in the data set, but, in fact, makes no sense. So the intercept has no interpretation in this case.

7.38. (a) $\widehat{VOLUME} = -36.9435 + 5.0659 \cdot DIAM$. The intercept has no physical meaning (what is a negative volume?). The slope of 5.0659 means that the model predicts that a tree with 1 inch greater diameter will have 5.0659 ft^3 more volume. (10 points)

(b) The model under-predicts volume for large and small diameters and over-predicts for intermediate diameters. A transformation of the response and/or predictor might make the relation more linear. (10 points)

(c) The uncertainty is reduced 93.53 ($= 100 \times 0.9671^2$) percent. (10 points)

7.50. (a) The fit looks adequate. The line seems to fit the data pattern well, the residuals show no patterns and the normal quantile plot is reasonably linear. (10 points)

(b) The fitted line is

$$\widehat{HEIGHT} = 0.2533 + 1.0073 \cdot ARMSPAN.$$

The intercept has no interpretation, since $ARMSPAN = 0$ has no meaning. The slope is 1.0073, which we may interpret as the change in predicted response per unit increase in $ARMSPAN$. (10 points)

(c) 93.37% (5 points)

(d) 0.9663 (5 points)

(e) (10 points) The prediction of her height is $\hat{y}_{new} = 0.2533 + (1.0073)(67) = 67.72$. The estimated standard error of prediction is

$$\hat{\sigma}(y_{new} - \hat{y}_{new}) = \sqrt{(1.0025) \left[1 + \frac{1}{51} + \frac{(67 - 65.44)^2}{(50)(22.67)} \right]} = 1.012$$

Since $t_{49,0.975} \doteq 2.01$, a 95% prediction interval for your sister's height is

$$67.72 \pm (2.01)(1.012) = (65.71, 69.78).$$

7.56. Table 1 shows overall, row and column percentages. Row percentages show that for husbands of all heights, around half the wives are of medium height. For both tall and short(!!!) husbands, slightly more wives are tall than are short, while the opposite is true for husbands of medium height. Column percentages show that about half of both short and medium wives have medium-height husbands. Roughly a quarter of medium-height wives have short husbands and another quarter have tall husbands, while the respective percentages for short wives are 18 and 27%. The percentages for tall wives are more uniform, with 36, 40 and 24% having tall, medium and short husbands. (10 points)

The χ^2 test gives the value 2.907 for the test statistic, which compared with the χ^2_4 distribution, gives a p -value 0.574. Thus, there is little evidence of a relation between heights of husbands and wives. (10 points)

(10 points) for table

Frequency Percent Row Pct. Col Pct. Husband	Wife			
	Tall	Medium	Short	Total
Tall	18 8.78 30.00 36.00	28 13.66 46.67 26.92	14 6.83 23.33 27.45	60 29.27
Medium	20 9.76 20.20 40.00	51 24.88 51.52 49.04	28 13.66 28.28 54.90	99 48.29
Short	12 5.85 26.09 24.00	25 12.20 54.35 24.04	9 4.39 19.57 17.65	46 22.44
Total	50 24.39	104 50.73	51 24.88	205 100.00

Table 1: *Pairing of spouses by height*