Chapter 10-Regression

10.1 Regression equation predicting infant mortality from income

Y = Infant mortality

X = Income

$\bar{Y}$ = 6.70 s_Y = 0.698 s_Y^2 = 0.487

$\bar{X}$ = 46.00 s_X = 6.289 s_X^2 = 39.553

cov_{XY} = 2.7245

$$b = \frac{cov_{XY}}{s_X^2} = \frac{2.7245}{39.553} = 0.069$$

$$a = \bar{Y} - b\bar{X} = 6.70 - (0.069)(46.00) = 3.53$$

$$\hat{Y} = 0.069(X) + 3.53$$

10.3 If the high risk fertility rate jumped to 70, we would predict that the incidence of birthweight < 2500gr would go to 8.35.

$$\hat{Y} = bX + a = 0.0689X + 3.53$$

$$= 0.0689 * 70 + 3.53 = 8.35$$

This assumes that there is a causal relationship, which is plausible in some ways, but not proven.

It may be trivial to point this out, but here we have a real world situation where we can say something about changing trends in society and their possible effects.

10.5 I would be more comfortable speaking about the effects on Senegal because it is already at approximately the mean income level and we are not extrapolating for an extreme country.

This may have little to do with a statistics course in psychology, but there have been some noticeable improvements in infant mortality in Senegal, and one device that has made a difference is a warm table on which newborn infants can be placed. This may interest students who probably think of advances in medicine in terms of MRIs. http://www.usaid.gov/stories/senegal/pc_sn_infant.html

10.7 Prediction of Symptoms score for a Stress score of 45:

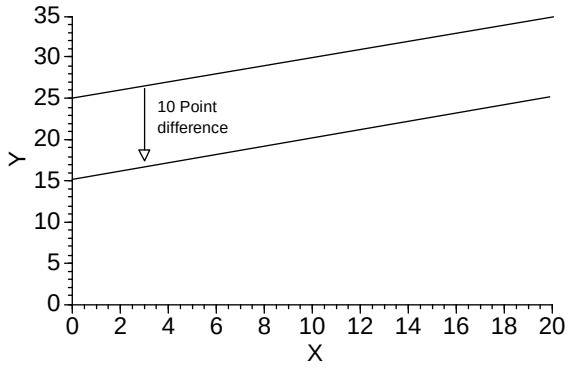
Regression equation: $\hat{Y}$ = 0.7831X + 73.891

If X = 45: = 0.7831*45 + 73.891

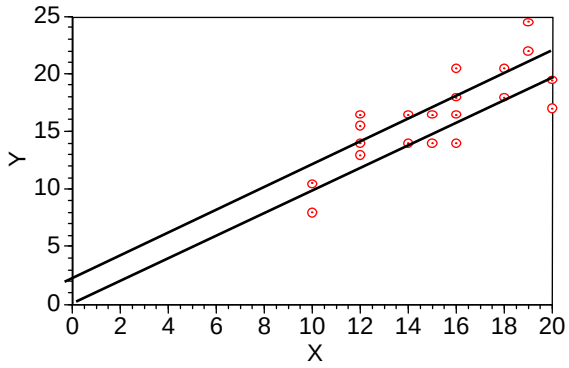
Predicted Symptoms = 109.13

10.9 Subtracting 10 points from every *X* or *Y* score would not change the correlation in the slightest. The relationship between *X* and *Y* would remain the same.

10.11 Diagram to illustrate Exercise 10.10:



10.13 Adding a constant to *Y*:



a) From this figure you can see that adding 2.5 to *Y* simply raised the regression line by 2.5 units.
b) The correlation would be unaffected.

10.15 Predicting GPA (*Y*) from ADDSC (*X*):

$$b = \frac{\text{cov}_{XY}}{s_X^2} = \frac{-6.580}{154.431} = -0.0426$$

$$a = \overline{Y} - b\overline{X} = 2.456 - 0.0426 * 52.602 = 4.699$$

$$\hat{Y} = -0.0426X + 4.699$$

When Hans Huessy and I first collected these data I was somewhat disheartened by how well we were doing (and to some extent I still am). We can take a measure in elementary school that is quickly filled out by the teacher, and make an excellent prediction about how the student will

do in high school. That may be nice statistically, but I don't think we like to feel that children are that locked in.

10.17 The correlation dropped to -.478 when I added and subtracted .04 from each *Y* value. This drop was caused by the addition of error variance.

One way to solve for the point at which they become equal is to plot a few predicted values and draw regression lines. Where the lines cross is the point at which they are equal. A more exact way of to set the two equations equal to each other and solve for *X*.

$0.9X + 31 = 1.5X + 18$

Collecting terms we get

$31 - 18 = 1.5X - 0.9X$

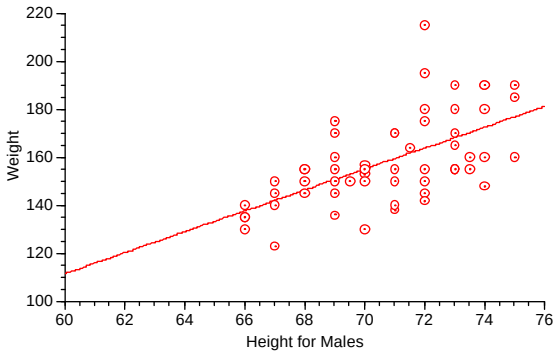
$13 = 0.6X$

$X = 13/0.6 = 21.67$

To check this, substitute 21.67 in both equations

$0.9 * 21.67 + 31 = 50.503 = 1.5 * 21.67 + 18$

10.19 Weight as a function of height for males:



The regression solution that follows is a modification of printout from SPSS.

```
Equation Number 1    Dependent Variable..   WEIGHT
Variable(s) Entered on Step Number
   1..    HEIGHT
Multiple R           .60368
R Square             .36443
Adjusted R Square    .35287
Standard Error     14.99167

Analysis of Variance
                    DF      Sum of Squares      Mean Square
Regression           1          7087.79984       7087.79984
Residual            55         12361.25279        224.75005

F =      31.53637       Signif F =  .0000

------------------ Variables in the Equation ------------------
Variable             B        SE B       Beta         T  Sig T
```

HEIGHT	4.355868	.775656	.603680	5.616	.0000
(Constant)	-149.933617	54.916943		-2.730	.0085

b) The intercept is given as the "constant" and is -149.93, which has no interpretable meaning with these data. The slope of 4.356 tells us that a one-unit increase in height is associated with a 4.356 increase in weight.
c) The correlation is .60, telling us that for females 36% of the variability in weight is associated with variability in height.
d) Both the correlation and the slope are significantly different from 0, as shown by an F of 31.54 and a (equivalent) t of 5.616.

10.21 Predicting my own weight, for which I use the equation from Exercise 10.19:

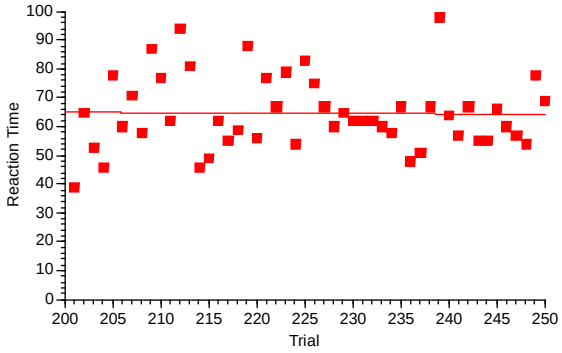
$\hat{Y}$ = 4.356*height - 149.93
$\hat{Y}$ = 4.356*68 - 149.93 = 146.28

a) The residual is Y - $\hat{Y}$ = 156 - 146.28 = 9.72. (I have gained some weight since I last used this example.)
b) If the students who supplied the data gave biased responses, then, to the degree that the data are biased, the coefficients are biased and the prediction will not apply accurately to me.

10.23 Predictions for a 5'6" male and female

For the male, $\hat{Y}$ = 4.356*66 - 149.93 = 137.57
For a female, $\hat{Y}$ = 2.578*66 - 44.859 = 125.29
Difference = 12.28 pounds

10.25 Plot of Reaction Time against Trials for only the Yes/5-stimuli trials:

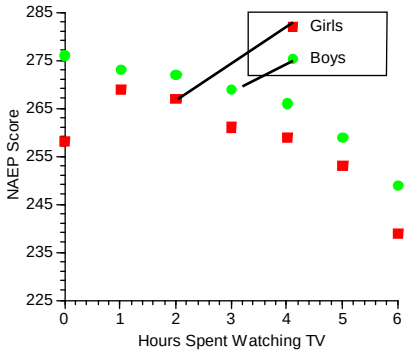


The following regression solution is a modification of SPSS printout.

```
Equation Number 1    Dependent Variable..   RXTIME
Variable(s) Entered on Step Number
   1..    TRIAL

Multiple R           .01640
R Square             .00027
Adjusted R Square   -.02056
Standard Error     12.76543

Analysis of Variance
                    DF      Sum of Squares      Mean Square
Regression           1            2.10363          2.10363
Residual            48         7821.89637        162.95617

F =        .01291       Signif F =  .9100

------------------ Variables in the Equation ------------------

Variable              B        SE B       Beta         T  Sig T

TRIAL          -.014214     .125100   -.016397     -.114  .9100
(Constant)    67.805186   28.267795                2.399  .0204
```

The slope is only -0.014, and it is not remotely significant. For this set of data we can conclude that there is not a linear trend for reaction times to change over time. From the scatterplot above we can see no hint that there is any nonlinear pattern, either.

10.27 The evils of television:



Regression equations:

Boys $\hat{Y} = -4.821X + 283.61$

Girls $\hat{Y} = -3.460X + 268.39$

b) The slopes are roughly equal, given the few data points we have, with a slightly greater decrease with increased time for boys. The difference in intercepts reflects the fact that the line for the girls is about 9 points below that for boys.

c) Television can not be used as an explanation for poorer scores in girls, because we see that girls score below boys even when we control for television viewing.

10.29 Draw a scattering of 10 data points and drop your pencil on it.

b) As you move the pencil vertically you are changing the intercept.

c) As you rotate the pencil you are changing the slope.

d) You can come up with a very good line simply by rotating and raising or lowering your pencil so as to make the deviations from the lines as small as possible. (We really minimize squared deviations, but I don't expect anyone's eyes to be good enough to do that.)

10.31 Galton's data

a) The correlation is .459 and the regression equation is $\hat{Y}$ = .646×midparent + 23.942. (Remember to weight cases by "freq".)

b) I reran the regression requesting that SPSS save the Unstandardized prediction and residual.

c)

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
child	1.00	392	67.1247	2.24664	.11347	66.9017	67.3478	61.70	72.20
	2.00	219	68.0196	2.24030	.15139	67.7213	68.3180	61.70	73.20
	3.00	183	68.7055	2.46458	.18219	68.3460	69.0649	63.20	73.70
	4.00	134	70.1776	2.26850	.19597	69.7900	70.5652	61.70	73.70
	Total	928	68.0885	2.51794	.08266	67.9263	68.2507	61.70	73.70
midparent	1.00	392	66.6633	1.06808	.05395	66.5572	66.7693	64.00	67.50
	2.00	219	68.5000	.00000	.00000	68.5000	68.5000	68.50	68.50
	3.00	183	69.5000	.00000	.00000	69.5000	69.5000	69.50	69.50
	4.00	134	71.1791	.78617	.06791	71.0448	71.3134	70.50	73.00
	Total	928	68.3082	1.78733	.05867	68.1930	68.4233	64.00	73.00

d) The children in the lowest quartile slightly exceed their parents mean (67.12 vs 66.66) and those in the highest quartile average slightly shorter than their parents (68.09 vs 68.31).

e) It is easiest if you force both axes to have the same range and specify that the regression line is $\hat{Y}$ = 1×X + 0. (If you prefer, you can use an intercept of 0.22 to equate the means of the parents and children.)