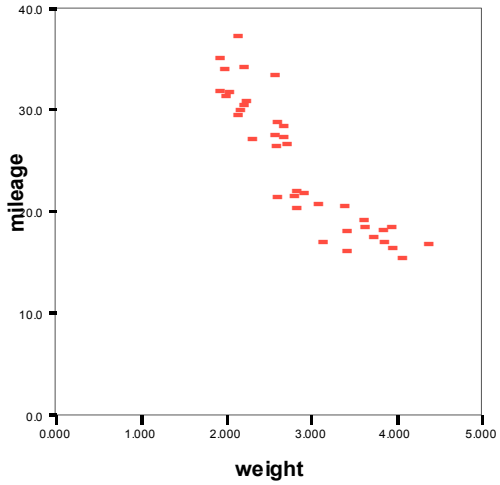
Simple Linear Regression Exercises (After Activity #13)

1. We began Activity #13 by examining the relationship between a car's weight and its mileage. Calculate the least squares regression line for this data.



	N	Minimum	Maximum	Mean	Std. Deviation
weight	38	1.915	4.360	2.86289	.706870
mileage	38	15.5	37.3	24.761	6.5473
Valid N (listwise)	38			Correlation = -0.93	

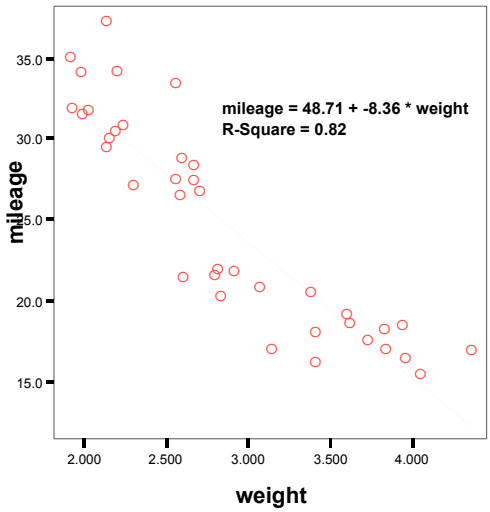
2. The following table reports the distance (in miles) from Baltimore to each of 12 cities along with the corresponding.airfare.

Destination	Distance	Airfare
Atlanta	576	178
Boston	370	138
Chicago	612	94
Dallas	1216	278
Detroit	409	158
Denver	1502	258
Miami	946	198
New Orleans	998	188
New York	189	98
Orlando	787	179
Pittsburgh	210	138
St. Louis	737	98
MEAN	712.7	166.9
STD. DEV.	402.7	59.5
Correlation	0.795	

A. Sketch a scatterplot of this data. Use distance to predict airfare.
B. Find the least squares regression line and sketch it on your scatterplot.
C. Calculate SSY, SSE, SSreg, and R-squared.

Solutions: (SPSS answers differ due to rounding error)

$$b_1 = r\frac{S_y}{S_x} = -0.93\left(\frac{6.5473}{0.706870}\right) = -8.614 \qquad b_0 = \overline{Y} - b_1\overline{X} = 24.761 - (-8.614)(2.86289) = 49.42$$



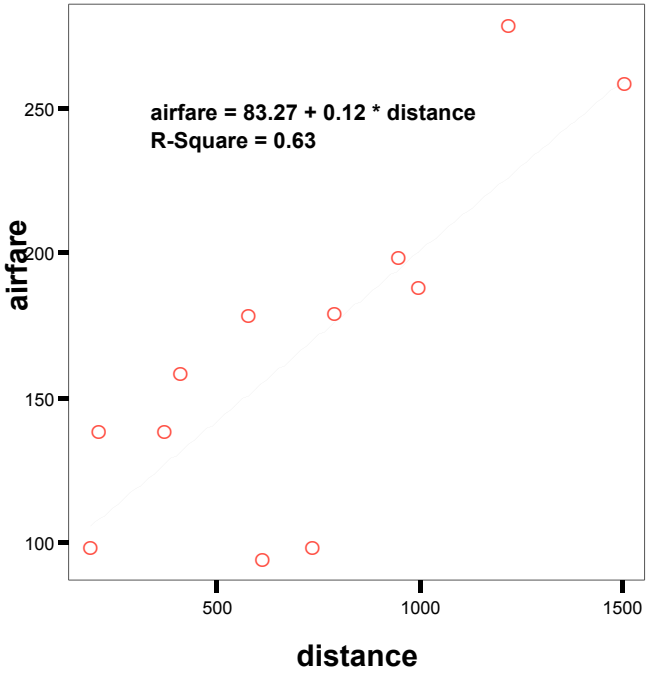
Weight accounts for 82% of the variance in mileage.

A cubic function fits the data slightly better (accounts for 86% of the variance). This cubic function is more difficult to interpret, however.

Destination	Distance	Airfare	Predicted	$(Y-\hat{Y})$	$(Y-\hat{Y})^2$	$(Y-\overline{Y})^2$
Atlanta	576	178	150.5	27.5	755.2	123.2
Boston	370	138	125.8	12.2	148.8	835.2
Chicago	612	94	154.8	-60.8	3701.5	5314.4
Dallas	1216	278	227.3	50.7	2568.5	12343.2
Detroit	409	158	130.5	27.5	757.4	79.2
Denver	1502	258	261.6	-3.6	13.2	8299.2
Miami	946	198	194.9	3.1	9.5	967.2
New Orleans	998	188	201.2	-13.2	173.2	445.2
New York	189	98	104.1	-6.1	37.0	4747.2
Orlando	787	179	175.8	3.2	10.0	146.4
Pittsburgh	210	138	106.6	31.4	986.0	835.2
St. Louis	737	98	169.8	-71.8	5161.0	4747.2
MEAN	712.7	166.9				
STD. DEV.	402.7	59.5		Sum:	14321.1	38882.9
Correlation	0.795					

$$b_1 = r\frac{S_y}{S_x} = 0.795\left(\frac{59.5}{402.7}\right) = 0.12 \qquad b_0 = \overline{Y} - b_1\overline{X} = 166.9 - (.12)(712.7) = 81.4$$

Regression Line: $Airfare = 0.12x + 81.4$



$$SSY = \sum\left(Y-\overline{Y}\right)^2 = 38882.9$$

$$SSE = \sum\left(Y-\hat{Y}\right)^2 = 14321.1 = SSY(1-R^2)$$

$$SSreg = SSY - SSE = 24561.8 = SSY(R^2)$$

$$R^2 = \frac{SSreg}{SSY} = \frac{24561.8}{38882.9} = 0.63 \qquad R^2 = (0.795)^2 = 0.63$$