

## Computer Output Example: Age &amp; Range of Motion (POD 5.11)

Predictor	Coef	StDev	T	P
Constant	107.58	11.12	9.67	0.000
Age	0.8710	0.4146	2.10	0.062

S = 10.42      R-Sq = 30.6%      R-Sq(adj)=23.7%

## Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	479.2	479.2	4.41	0.062
Residual Error	10	1085.7	108.6		
Total	11	1564.9			

From the example of computer output, find

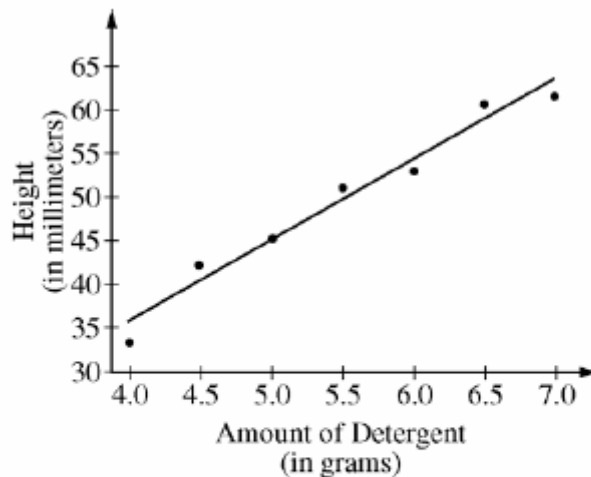
- Equation of least squares regression line
- Correlation coefficient & interpret
- the slope
- S
- If there is a useful linear relationship between age and range of motion



The following essay is from 2006 exam. You have 12 minutes to answer questions a, b, and c.

1. A manufacturer of dish detergent believes the height of soapsuds in the dishpan depends on the amount of detergent used. A study of the suds' heights for a new dish detergent was conducted. Seven pans of water were prepared. All pans were of the same size and type and contained the same amount of water. The temperature of the water was the same for each pan. An amount of dish detergent was assigned at random to each pan, and that amount of detergent was added to the pan. Then the water in the dishpan was agitated for a set amount of time, and the height of the resulting suds was measured.

A plot of the data and the computer output from fitting a least squares regression line to the data are shown below.



Predictor	Coef	SE Coef	T	P
Constant	-2.679	4.222	-0.63	0.554
Amount	9.5000	0.7553	12.58	0.000

S = 1.99821 R-Sq = 96.9% R-Sq(adj) = 96.3%

- (a) Write the equation of the fitted regression line. Define any variables used in this equation.
- (b) Note that  $s = 1.99821$  in the computer output. Interpret this value in the context of this study.
- (c) Identify and interpret the standard error of the slope.

Other questions that could be asked from the computer output:

d. Is it reasonable to use this equation to predict the height of the soapsuds if 3.25g of detergent is used?

e. Find the average height of soapsuds if 5.3g of detergent is used.

f. Find a 95% confidence interval for the population slope.

g. The manufacturer believes that the true slope of the regression line is 9.0. Run a hypothesis test with  $H_0: \beta = 9$  against  $H_a: \beta > 9$

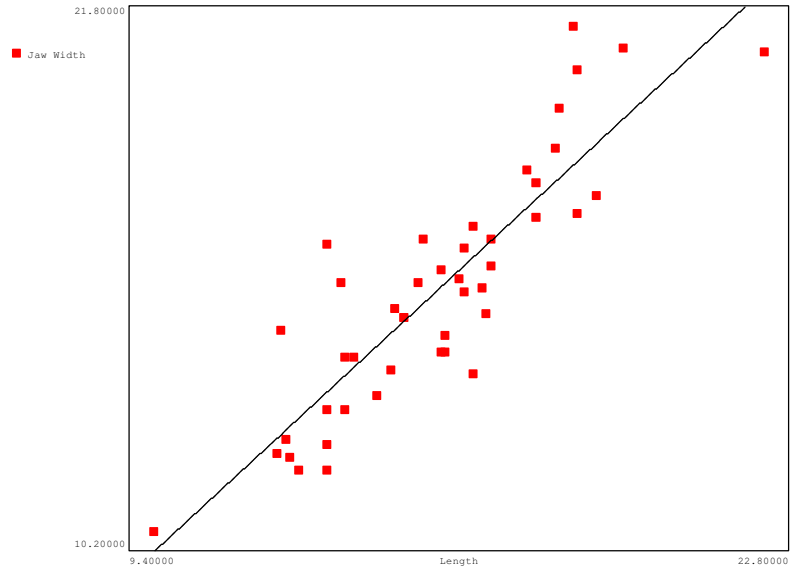
h. Interpret the slope in context of the problem.

i. Identify and interpret the correlation coefficient.

j. Identify and interpret the coefficient of determination.

Practice Problems

FR 1. (POD 13.11) Physical characteristics of sharks are of interest to surfers and scuba divers, as well as marine researchers. The data on  $x = \text{length (ft)}$  and jaw width (in) for 44 sharks shown in the following graphs and computer output was found in articles appearing in the magazines Skin Diver and Scuba News. Because it is difficult to measure jaw width in living sharks, researchers would like to determine whether it is possible to estimate jaw width from body length, which is more easily measured.



Below is the MINITAB output:

Predictor	Coef	StDev	T	P
Constant	0.688	1.299	0.53	0.599
Length	0.96345	0.08228	11.71	0.000

S = 1.376      R-Sq = 76.6%      R-Sq(adj) = 76.0%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	259.33	259.33	137.12	0.000
Residual Error	42	79.49			
Total	43	339.02			

Answer the following questions about the shark data from the graph and computer output:

1. Are there any outliers or influential observations?
2. Write the linear regression equation.
3. Is there a useful linear relationship between body length and jaw width?
4. Find a 90% confidence interval for the slope of the population regression line.
5. Find a point estimate for the jaw width of a shark 11.4 feet long.
6. What is the correlation coefficient?



FR2. (POD 13.41) According to “Reproductive Biology of the Aquatic Salamander” (1999), the size of a female salamander’s snout is correlated with the number of eggs in her clutch. The following computer output of 14 salamanders is consistent with summary quantities reported in the article.

Predictor	Coef	StDev	T	P
Constant	-133.02	64.30	-2.07	0.061
Snout-Vent Length	5.919	1.127	5.25	0.000

S = 33.90    R-Sq = 69.7%    R-sq(adj) = 67.2%

Addition summary statistics are:

N = 14             $\bar{x} = 56.5$              $\bar{y} = 201.4$

$\text{Sum}(x^2) = 45,958$          $\text{Sum}(y^2) = 613,550$          $\text{Sum}(xy) = 164,969$

a. What is the equation of the regression line?

b. Interpret the slope of the regression line.

c. Find and interpret the correlation coefficient.

d. Find and interpret the coefficient of determination.

e. Find and interpret the standard deviation of the residuals.

f. Estimate the size of a clutch for a salamander with snout-vent length of 61.

g. Test the hypothesis that the slope of the population line is positive.

h. Find a 95% confidence interval for the slope of the population regression line.