

1. The Comprehensive Test of Basic Skills (CTBS) is used by school districts to assess student progress. Two of the areas tested are math and reading. A random sample of 20 students' results was reviewed to determine if there is an association between math and reading scores on the CTBS. The regression analysis of the data is below.

Dependent variable: Reading				
R squared = 79.2%		R squared (adjusted) = 78.1%		
s = 6.574				
Source	Sum of Squares	df	Mean Square	F-ratio
Regression	2969.3	1	2969.3	68.7
Residual	777.905	18	43.2169	
Variable	Coefficient	s.e. of Coeff	t-ratio	probability
Constant	5.23273	5.971	0.876	0.3924
Math	0.8658	0.1045	8.29	<0.0001

$b_1$        $s_{b_1}$        $t$        $p$ -value

- A) Is there evidence of an association between math and reading scores on the CTBS? Test an appropriate hypothesis and state your conclusion in the proper context. (Assume that all appropriate conditions for inference have been met.)

$\beta_1$  = true average change in READING score for each increase of 1 in MATH score on the CTBS.

$H_0: \beta_1 = 0$        $H_A: \beta_1 \neq 0$   
 (math and reading scores are not associated)      (math and reading scores ARE associated)

$df = 20 - 2 = 18$

★ t-test for regression slope

$t = \frac{b_1 - 0}{s_b} = \frac{0.8658 - 0}{0.1045} = 8.2852$

calculator:

$2 \times \text{tcdf}(8.2852, 99, 18)$

$p\text{-value} = 1.4829 \times 10^{-7}$

★  $p\text{-value} < 0.0001$

With our  $p$ -value which is  $\lll 0.001$ , (less than  $\alpha = 0.05$  or even  $0.01$ ), we reject  $H_0$ . We have sufficient evidence to show that math and reading scores are associated. (or linearly related)

- B) Create and interpret a 90% confidence interval for the slope of the regression line.

$CI = b_1 \pm t_{18}^* \cdot s_b = 0.8658 \pm (1.734)(0.1045)$

$= (0.6846, 1.0470)$

★ We are 90% confident that average reading score increases between 0.68 to 1.05 points for each increase of 1 point in math score.

2. It is plausible that workers are less likely to quit their jobs when wages are high than when they are low. During 1999 data was gathered from each of 15 companies which gave the average hourly wage and the quit rate (number of employees per 100 who left jobs during 1999). The regression analysis of the data is below.

Dependent variable: Quit rate				
R squared = 72.9%		R squared (adjusted) = 70.8%		
s = 0.4862				
Source	Sum of Squares	df	Mean Square	F-ratio
Regression	8.2507	1	8.2507	34.9
Residual	3.0733	13	0.2364	
Variable	Coefficient	s.e. of Coeff	t-ratio	probability
Wage	-0.3466	0.0586	-5.91	<0.0001
Constant	4.8615	0.5201	9.35	<0.0001

- A) Is there evidence of an association between a average hourly salary and quit rate? Test an appropriate hypothesis and state your conclusion in the proper context. (Assume that all appropriate conditions for inference have been met)

Slope t-test       $df = 15 - 2 = 13$

$H_0$ : There is NO linear association between hourly wage and quit rate.

$H_A$ : There IS a linear ...

$$t = -5.91$$

$$p < 0.0001 \quad \alpha = 0.05$$

\* Since  $p < \alpha$ , we reject  $H_0$ .

We have sufficient evidence to show that hourly wage and quit rate are associated.

- B) Create and interpret a 90% confidence interval for the slope of the regression line.

$$\begin{aligned} CI &= b_1 \pm t_{13}^* \cdot s_b \\ &= -0.3466 \pm 1.771(0.0586) \\ &= (-0.450, -0.243) \end{aligned}$$

\* We are 90% confident that average quit rate decreases between 24.3% and 45% for each increase of one unit (dollar???) in hourly salary.