Practice Final Exam
Question - Regression Analysis

The Director of Management Information Systems at a conglomerate must prepare his long-range forecasts for the company's 3-year budget. In particular, he must develop staffing ratios to predict the number of managers (Y) based on the number of programmers (X). The results of a sample of the electronic data processing staffs of 10 companies within the industry and the regression output obtained from Excel are given below.

X	Y
15	6
7	2
20	10
12	4
16	7
20	8
10	4
9	6
18	7
15	9

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.837775
R Square	0.70186695
Adjusted R Square	0.66460032
Standard Error	1.41990307
Observations	10

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	37.97100213	37.9710021	18.8336572	0.002479133
Residual	8	16.12899787	2.01612473		
Total	9	54.1			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-0.0884861	1.539033513	-0.0574946	0.95556132	-3.637506081	3.4605338
x	0.44989339	0.103667418	4.33977617	0.00247913	0.210835741	0.68895104

(a) Write down the equation of the estimated regression line.
(b) Is there sufficient evidence to conclude statistically that there is a linear relationship between the number of programmers (X) and the number of managers (Y)? Use α=.05.
   i. State the null and alternative hypothesis.
   ii. Calculate the value of the test statistic. Show your workings.
   iii. Sketch the rejection region. Mark in the critical value(s).
   iv. Decision and conclusion.
(c) What percent of the total variation in Y is explained by the regression model?
(d) If the number of programers is 7, using your model in part (a), predict the number of managers needed.
(e) Find a 95% confidence interval for the slope of the line and interpret it.

Answer Key

(a) $\hat{y} = \hat{\beta}_0 + \hat{\beta}_1 x = -0.08849 + 0.44989\,x$

(b) H_0: $\beta_1 = 0$
H_a: $\beta_1 \neq 0$
t = 4.34, reject H_0 since p-value < 0.05.

(c) 70.19%

(d) 3.0607

(e) 95% CI for β_1: $b_1 \pm t_{\alpha/2,\,n-2}\, s_{b_1} = 0.45 \pm t_{8,\,0.05/2}\,(0.1037) = (0.21, 0.69)$.