**ChE 320\_Spr\_17\_HW 10 Solution**

**6-4**

**a)** The regression equation is

Turbidity = - 511 + 26.3 Temperature

Predictor Coef StDev T P

Constant -510.7 228.2 -2.24 0.045

Temperat 26.308 9.178 2.87 0.014

S = 67.68 R-Sq = 40.6% R-Sq(adj) = 35.7%

Analysis of Variance

Source DF SS MS F P

Regression 1 37636 37636 8.22 0.014

Residual Error 12 54963 4580

Total 13 92599

y=-510.7+26.3x

**b)** 33.253

-2.686

11.253

10.622

-2.607

-88.565

-69.041

-75.934

-91.980

-34.116

67.389

110.066

56.435

75.912

**c)** SSE = 54963 = 4580

**d)** se() = 228.2, se() = 9.178

**e)** SST = 92599

SSR = 37636, SSE = 54963, and SSR + SSE = 92599

SST = SSR + SSE

**f)** R2 = 40.6%. This is interpreted as 40.6% of the total variability in turbidity can be explained by the fitted regression model.

**g)** See the Minitab output given in part a).

Based on the t-tests, we conclude that the slope and intercept are significantly different from zero.

Based on P-values, the test for the intercept has P-value = 0.045 and the test for the slope has P-value = 0.014 which are less than α = 0.05. We can conclude that the intercept and slope are significantly different from zero.

**h)** .

Analysis of Variance

Source DF SS MS F P

Regression 1 37636 37636 8.22 0.014

Residual Error 12 54963 4580

Total 13 92599

Based on the analysis of variance, we can reject the null hypothesis and conclude that the regression is significant because the P-value is 0.014 < α = 0.05.

**i)** β0: -510.7 ± 2.179(228.2); 13.45, 1007.95

β1: 26.3 ± 2.179(9.178); 6.30, 46.30

Zeros are not included in CIs, so both intercept and slope are significantly different from zero. The conclusions from part (g), (h) and (i) are the same.

**j)** The normal probability plot of residuals appears reasonable. The plots of residuals against and  seem to have funnel pattern, so the model does not provide an adequate fit.







**k)** r = 0.638, P-value = 0.014. Based on this test there is a significant correlation between temperature and turbidity. However, the residual plots indicate the model might not be valid and then these tests are invalid. Because the slope is significantly different from zero based on the conclusions from parts (g) and (h), the correlation coefficient is also significantly different from zero.

**6-12**



Predictor Coef StDev T P

Constant -10.132 1.995 -5.08 0.000

x 0.17429 0.02383 7.31 0.000

S = 1.318 R-Sq = 74.8% R-Sq(adj) = 73.4%

Analysis of Variance

Source DF SS MS F P

Regression 1 92.934 92.934 53.50 0.000

Residual Error 18 31.266 1.737

Total 19 124.200

An estimate of = 1.737

**a)** The regression equation is: y = - 10.132 + 0.174x, mean permeability = 4.683

**b)** (4.055, 5.312)

**c)** (1.844, 7.523)

**d)** The prediction interval is wider than the confidence interval because it predicts a range for a future observation whereas the confidence interval predicts a range for the mean response.

**6-14**

**a)** The regression equation is

BOD = 0.658 + 0.178 Time

Predictor Coef SE Coef T P

Constant 0.6578 0.1657 3.97 0.003

Time 0.17806 0.01400 12.72 0.000

S = 0.287281 R-Sq = 94.7% R-Sq(adj) = 94.1%

Analysis of Variance

Source DF SS MS F P

Regression 1 13.344 13.344 161.69 0.000

Residual Error 9 0.743 0.083

Total 10 14.087





**b)** 

**c)** 0.178(3) = 0.534

**d)** 



**e)** Fitted :

0.83585

1.01391

1.37002

1.72613

2.08225

2.43836

2.79447

3.15058

3.50670

3.86281

4.21892



All the points would lie along the 45 degree line. That is, the regression model would estimate the values exactly. At this point, the graph of observed vs. predicted indicates that the simple linear regression model provides a reasonable fit to the data.

**6-15**

**a)**

Predictor Coef SE Coef T P

Constant 0.6649 0.1594 4.17 0.001

x 0.83075 0.08552 9.71 0.000

S = 0.197 R-Sq = 88.7% R-Sq(adj) = 87.8%

Analysis of Variance

Source DF SS MS F P

Regression 1 3.6631 3.6631 94.37 0.000

Residual Error 12 0.4658 0.0388

Total 13 4.1289



P-valuex = 2\*P(t > |9.71|): for degrees of freedom of 12 we obtain 2\*(P-value < 0.0005) = P-value < 0.001













**b)** 

**c)** Based on the P-values from the F-test in the ANOVA table and the t-test for X in the output in part (a), β1 is significantly different from zero. There P-values are always the same for simple linear regression.

**d)**



Because zero is not included in the 95%CI, the estimated coefficient (β1) is significantly different from zero.

**e)** The results from part (c) and (d) are the same whenever the confidence level = 1 – .

**f)** 





**g)** 



95%CI:





95%PI:



The prediction interval is wider than the confidence interval because it predicts a range for a future observation whereas the confidence interval predicts a range for the mean response.