**ChE 320\_Spr\_17\_HW 10 Grading Rubric**

**Total: 100 pts.**(Please do not cut point more than once for the same mistake, e.g. If there are 3 parts in a question, answer was calculated wrong in the 1st part. But the method was correct for the 2nd and 3rd part; give student the points of 2nd and 3rd part*. If applicable, credits for the answersare also given for using correct units*)

[\*For every part with grading points, **-1** for correct method but incorrect answer]

**6-4 (40 pts)**

**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 *+****4*** *for correct answer*

**b)** 33.253

-2.686

11.253

10.622

-2.607

-88.565

-69.041

-75.934

-91.980

-34.116 *+3 for correct answer*

67.389

110.066

56.435

75.912

**c)** SSE = 54963

= 4580 *+3 for correct answer*

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

se() = 9.178 *+3 for correct answer*

**e)** SST = 92599

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

SST = SSR + SSE *+3 for correct answer*

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

*+3 for correct answer*

**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. *+3 for reasonable answer*

**h)** .

Analysis of Variance *+3 for correct table*

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. *+3 for correct comment*

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

β1: 26.3 ± 2.179(9.178); 6.30, 46.30 *+3 for correct CIs answer*

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. *+3 for reasonable comment*

**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. *+3 for reasonable answer*







**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. *+3 for reasonable answer*

**6-12 (20 pts)**



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

*+5 for correct answer*

**b)** (4.055, 5.312) *+5 for correct answer*

**c)** (1.844, 7.523) *+5 for correct answer*

**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. *+5 for correct answer*

**6-14 (20 pts)**

**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



 +4 *for correct answer*

**b)**  +4 *for correct answer*

**c)** 0.178(3) = 0.534 +4 *for correct answer*

**d)**  +2 *for correct answer*

 +2 *for correct answer*

**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.

+4 *for reasonable answer*

**6-15 (20 pts)**

**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

+7 *for all correct values (+1 per correct value)*



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)**  +1 *for correct answer*

**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. +2 *for reasonable comment*

**d)**



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

+2 *for reasonable comment*

**e)** The results from part (c) and (d) are the same whenever the confidence level = 1 – . +2 *for reasonable comment*

**f)**  +2 *for correct regression model*



 +1 *for correct residual*

**g)** 



95%CI:

 +1 *for correct CI*



95%PI:

+1 *for correct 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. +1 *for reasonable comment*