

Name: _____
 MAT 222
 Spring 2019
 Chapter 10, 11 Worksheet

“It’s not easy being drunk all the time. If it were, everyone would do it.”
 – Tyrion Lannister, *Game of Thrones*

Problem 1: Concrete is a commonly used material in Civil Engineering. Comprehensive strength measures the ability of concrete materials to endure various strains. Researchers examined 1,030 concrete samples and attempted to try to predict the comprehensive strength of various mixtures of concrete using the cement amount, blast furnace slag, fly ash, water, superplasticizer, coarse aggregate, and fine aggregate used in the construction as well as the age of the concrete.¹ Fill in the missing entries from the analysis of their model in the table below.

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Regression	_____	176745	_____	204.27	0.000
Cement	_____	21533	21533.3	199.09	0.000
BF	_____	11353	11352.5	_____	0.000
FlyAsh	_____	5281	5281.3	48.83	0.000
Water	_____	_____	1513.4	13.99	0.000
SP	_____	1046	1046.3	9.67	0.000
CoarseAg	_____	398	_____	3.68	0.000
FineAg	_____	384	383.5	3.55	0.000
Age	_____	47905	47905.2	442.92	0.000
Error	_____	_____	_____	_____	_____
Total	_____	_____	_____	_____	_____

Model Summary

S	R-sq	R-sq (adj)	R-sq (pred)
_____	_____%	_____%	60.68%

Coefficients

Term	Coef	SE Coef	T-Value	P-Value	VIF
Constant	_____	26.6	-0.87	0.384	
Cement	0.11979	0.00849	14.11	0.000	7.49
BF	0.1038	_____	10.28	0.000	7.28
FlyAsh	0.0879	0.0126	6.99	0.000	6.17
Water	-0.1503	0.0402	-3.74	_____	7.00
SP	0.2907	0.0935	3.11	0.002	2.97
CoarseAg	0.01803	0.00939	_____	0.055	5.08
FineAg	0.0201	0.0107	1.88	0.060	7.01
Age	_____	0.00543	21.05	0.000	1.12

The regression equation is

$$\text{Compression Strength} = -23.2 + 0.11979C + 0.1038B + 0.0879F - 0.1503W + 0.2907S + 0.01803CA + 0.0201FAg + 0.11423A$$

¹I-Cheng, Yeh, “Modeling of strength of high performance concrete using artificial neural networks.”, *Cement and Concrete Research*, Vol. 28, No. 12, pp.1797–1808 (1998).

Furthermore, based on the data from the table, answer the following questions:

- (a) What is the correlation coefficient?

- (b) What is the coefficient of determination? What does it mean?

- (c) Give a 95% confidence interval for β_5 . Interpret the result in the context of the problem.

- (d) For which variables do there seem to be a (linear) association between comprehensive strength and the given variable? For which does there not seem to be? Explain. [Use a significance of $\alpha = 0.05$.]

- (e) Use the data in the table to perform an F -test for this model. State the null and alternative hypothesis, test statistic, p -value, and state your conclusion. [Use $\alpha = 0.10$.]

- (f) If one were to perform a t -test on one of the coefficients, what is the associated degrees of freedom? What about if one were to perform the F -test 'by hand', what are the degrees of freedom of the numerator and denominator?