

EML3041 Computational Methods

Fall 2023

Week 10: Oct 23 - Oct 27

Answer the free-response questions on a fresh sheet of paper. Solve the problem as if you were submitting them for a test. Identify each part separately. Submit #1.

1) The following y vs. x data is regressed to a straight line and is given by

$$y = -1.47 + 0.314x.$$

x	5	6	7	8	9
y	0.3	0.4	0.57	0.6	1.77

- Find the sum of the square of the residuals.
- Find the sum of the square of differences between the y values and the average.
- Find the coefficient of determination.
- Find the correlation coefficient. What is the basis for the sign of the number?
- Find the standard error of estimate.
- Find the scaled residual at $x = 5$.

Answer: a) 0.4319 b) 1.4179 c) 0.6954 d) 0.8339 e) 0.3794 f) 0.5271

2. You are working for Valdez Spill Proof Oil Company as a petroleum engineer. Your boss is asking you to estimate the life of an oil well. The analysis used in the industry is called the decline curve analysis where the barrels of oil produced per unit time are plotted against time, and the curve is extrapolated. One of the standard curves used is the harmonic decline model, that is

$$q = \frac{b}{1 + at}$$

Where q is the rate of production and t is the time, a and b are the constants of the regression model. You are asked to transform the data.

Time, t (months)	2	6	10	11	20.1
Rate of production, q (barrels per day)	260	189	120	87	75

If 5 barrels per day is considered the production at which the field needs to be abandoned for further production, what is the total predicted life of the oil field?

Answer: $t = 351.0$ days

3. To choose the best order of polynomial to use for modeling the behavior of data, the following data

(200, 40235.8), (250, 62855.7), (300, 90328.3), (350, 123059), (400, 160588), (450, 203263), (500, 250850) is regressed to different order polynomials. The sum of the square of the residuals is given below for the different order polynomials.

Order of polynomial	1	2	3	4	5	6
S_r	5.24×10^8	5.21×10^4	4.97×10^4	3.36×10^4	1.12×10^4	0

a) Which order of polynomial would you choose and why? You need to answer this question quantitatively.

b) Why is S_r equal to zero for 6th order polynomial?

Answer: Order of 2 or 3 is reasonable.