EML3041 Computational Methods
Fall 2023
Week 9: Oct 16 - Oct 20

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

1. a) Show the full derivation of finding the general formula for regressing n data points $(x_1, y_1), (x_2, y_2), \dots\dots, (x_n, y_n)$ to $y = a$.
b) Did you forget to do the second derivative test and establish that the answer in part (a) in fact corresponds to a local minimum of the sum of square of residuals? If you did not, conduct the test now as you should have done this in part (a). Is this local minimum also the absolute minimum? If so, how do you reason that out?
c) Given the following data of *y* vs. *x*

x	1	2	3	4	5
y	1	1.1	0.9	0.96	0.96

The *y* vs. *x* data is regressed to a constant line given by $y = a$, where *a* is a constant. Find a.
d) Are you surprised by the formula in part (a)? If not, what would someone else find as surprising?

Answer: (a) $a = \frac{\sum_{i=1}^{n} y_i}{n}$ (b) Not given intentionally (c) 0.984 (d) Not given intentionally

2) Water is flowing through a circular pipe of 0.5 ft radius. Flow velocity (ft/s) measurements are made from the center $(r = 0)$ to the wall $(r = 0.5)$ of the pipe as follows.

Radial Location, $r\ (ft)$	0	0.08333	0.1667	0.2500	0.3333	0.4167	0.5000
Velocity, $V(r)$ (ft/s)	10.000	9.722	8.889	7.500	5.556	3.056	0.000

A scientist regresses the data to a straight line which is given by

$$V(r) = -19.999r + 11.389$$

a) What is the predicted value of the velocity at $r = 0$?
b) What is the residual at $r = 0$?
c) Estimate the flow rate $\dot{Q}$. if the velocity of the water flow is given by the above formula
Hint: $\dot{Q} = \int_0^a 2\pi r V(r) dr$, where *a* is the radius of the pipe.
d) Estimate the true error in the flow rate if the actual flow rate is 3.923 ft^3/s?
e) Estimate the absolute relative true error in the flow rate?
f) It looks like there is a large error in the calculation of the flow rate using the straight-line regression model. What would you do to address this issue?

Answer: a) $11.389\frac{ft}{s}$ b) $-1.389\frac{ft}{s}$ c) $3.709\frac{ft^3}{s}$ d) $0.214\frac{ft^3}{s}$ e) 5.455% f) Not given intentionally

What if I Finish the Work for Day?

1. Solve the free response questions from chapter 06.01, 06.03

2. Solve the problem-set questions at end of textbook chapters 06.03.
3. Finish any left-over work from previous weeks.

	The QR code is the link to textbook – use it for reference and solving more problems if finished. Alternatively use short link if you wish: https://bit.ly/3RMpaAe