

Show All Work!

Problem 1 (25 pts)

The data points (x_i, y_i) in the table below are to be approximated by a second order polynomial $\hat{y} = a_0 + a_1x + a_2x^2$.

- a) Find the Normal Equations which are used to solve for the least squares coefficients a_0, a_1, a_2 .

x_i	y_i	\hat{y}_i	$e_i = y_i - \hat{y}_i$	e_i^2
0	-1			
1	-1			
2	-1			
3	2			
4	7			
5	15			

- b) Solve the Normal Equations to find the Least Squares quadratic through the data points.
c) Fill in the table and find the SSE.

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Problem 2 (25 pts)

- a) Fit a 3rd order Newton Divided Difference polynomial $f_3(x)$ through the data points (x_i, y_i) from an unknown function $f(x)$. Complete the divided-difference table below and express the coefficients $b_i, i=0,1,2,3$ to 4 places after the decimal point.

x_i	$y_i = f(x_i)$	Δ	Δ^2	Δ^3
0.0	0.0000			
0.2	0.1176			
0.4	0.3804			
0.6	0.5706			

- b) Use $f_3(0.5)$ to estimate $f(0.5)$ to 4 places after the decimal point.
- c) Find the true error E_T (to 4 places after the decimal point) in $f_3(0.5)$ if the data points belong to the function $f(x) = x \sin \pi x$.

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Problem 3 (25 pts)

Consider the definite integral $I = \int_1^{e^2} \frac{dx}{x}$

- a) Numerical integration using $n = 10$ intervals is to be used to approximate I . Fill in the table below where $f(x)$ is the integrand, i.e. the function being integrated.

i	x_i	$f_i = f(x_i)$
0	1.0000	1.0000
1		
2		
3		
4		
5		
6		
7		
8		
9		
10	7.3891	

- b) Use Trapezoidal Integration to estimate I .
c) Use Simpson's Formula to estimate I .

Round all calculations to 4 places after the decimal point.

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Problem 4 (25 pts)

Fit a saturation growth curve to the (x_i, y_i) data below. Use the table for intermediate calculations. Round all results to 4 places after the decimal point.

x_i	y_i	u_i	z_i	u_i^2	$u_i z_i$
0.5000	0.3000				
1.0000	0.5000				
2.0000	0.9000				
5.0000	1.2000				
10.0000	1.5000				
25.0000	1.8000				