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Contents

Due 3/16/25

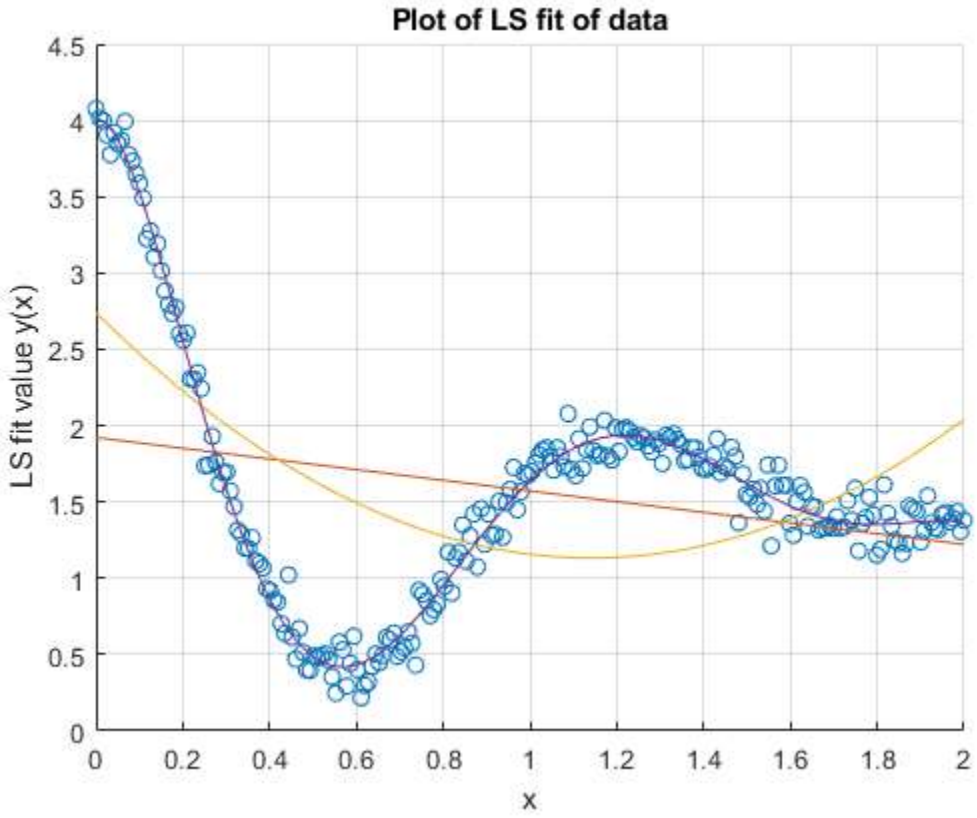
Project 6

```
clc, clear, close all;

% Read in the x- y-data
x = importdata('X_DATA_SP2025.DAT');
y = importdata('Y_DATA_SP2025.DAT');

% plot the data
figure
scatter(x, y);
hold on

% Loop through the order of the leas squares fit
for order = [1, 2, 7]
    M = order + 1; % number of polynomial terms
    N = length(x);

    [coeffs] = LeastSquares(x, y, M);

    % Display the coefficients
    fprintf("\n=========================================\n")
    fprintf('Number of data points = %5i\n', N)
    fprintf('Number of least-squares coefficients = %5i\n', M)
    fprintf('Order of least-squares polynomial fit = %5i\n\n', order)

    if order == 1
        fprintf('Linear\n');
    elseif order == 2
        fprintf('Quadratic\n');
    elseif order == 7
        fprintf('7th order\n');
    end

    % Evaluate the least squares fit at x = 0.55
    y_eval = polyval(coeffs, 0.55);

    % Sum of squares of errors
    y_fit = polyval(coeffs, x);  % Evaluates for all xs
    SSE = sum((y - y_fit).^2);

    % Standard error
    std_error = sqrt(SSE/(N - M));

    % R squared
    y_mean = 1/(N + 1)*sum(y);
    S0 = sum((y - y_mean).^2);
```

```
    r2 = (S0 - SSE) / S0;

    fprintf('Sum of Squares of Errors (SSE) = %12.5e \n', SSE)
    fprintf('Mean= %12.5e \n', y_mean)
    fprintf('R square = %.6f \n', r2)
    fprintf('Standard error= %12.5e \n\n', std_error)

    % Print answers!!
    fprintf('\nEvaluating the LS fit at x = %.6e\n', 0.55)
    fprintf(' SE = %.6e\n',std_error)
    fprintf(' y = %.6e\n',y_eval)
    fprintf('y+SE = %.6e\n',y_eval+std_error)
    fprintf('y-SE = %.6e\n',y_eval-std_error)
    fprintf('y+SE = %.6e\n',y_eval+2*std_error)
    fprintf('y-SE = %.6e\n',y_eval-2*std_error)

% Plot the LS fit, original data, and LS point on the same plot
f = @(x) polyval(coeffs, x);
x_range = 0: 0.01:2;
y_range = f(x_range);

grid on
title('Plot of LS fit of data')
xlabel('x')
ylabel('LS fit value y(x)')
plot(x_range, y_range)

end

function coeffs = LeastSquares(x, y, M);

    coeffs = polyfit(x, y, M - 1);

end
```

```
=========================================
Number of data points =   240
Number of least-squares coefficients =     2
Order of least-squares polynomial fit =     1

Linear
Sum of Squares of Errors (SSE) =  1.46879e+02
Mean=  1.56529e+00
R square = 0.063019
Standard error=  7.85582e-01


Evaluating the LS fit at x = 5.500000e-01
 SE = 7.855818e-01
 y = 1.729204e+00
y+SE = 2.514785e+00
y-SE = 9.436219e-01
y+SE = 3.300367e+00
y-SE = 1.580401e-01

=========================================
Number of data points =   240
```

```
Number of least-squares coefficients =     3
Order of least-squares polynomial fit =     2

Quadratic
Sum of Squares of Errors (SSE) =  1.13897e+02
Mean=  1.56529e+00
R square = 0.273421
Standard error=  6.93237e-01


Evaluating the LS fit at x = 5.500000e-01
 SE = 6.932368e-01
 y = 1.564444e+00
y+SE = 2.257680e+00
y-SE = 8.712068e-01
y+SE = 2.950917e+00
y-SE = 1.779701e-01

========================================
Number of data points =   240
Number of least-squares coefficients =     8
Order of least-squares polynomial fit =     7

7th order
Sum of Squares of Errors (SSE) =  2.91615e+00
Mean=  1.56529e+00
R square = 0.981397
Standard error=  1.12114e-01


Evaluating the LS fit at x = 5.500000e-01
 SE = 1.121143e-01
 y = 4.235875e-01
y+SE = 5.357017e-01
y-SE = 3.114732e-01
y+SE = 6.478160e-01
y-SE = 1.993590e-01
```



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