% Question 2

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% Note:

% Insert your question 2 code in this m-file.

%% Q2a

%% Import data from text file.

% Importing the race\_data file into matlab

filename = 'LightTransmit.txt';

% Opening the file in read only mode

file\_id = fopen(filename ,'r');

% Importing the data under corresponding variables

%L = length

%Intensity = Intensity of light transmitted through specimens of a transparent solid

values = importdata('LightTransmit.txt');

L=values.data(1:end,1);

Intensity=values.data(1:end,3);

%Filtering the noisy data

for i= 1:length(Intensity)

if Intensity(i)>10

noisy(i)=i;

end

end

%Removing the unwanted noisy data

noisy(noisy==0)=[];

%Removing noisy data from the Intesity matrix and its corresponding L data value

Intensity(noisy) = [];

L(noisy) = [];

%Creating a matrix named 'transmission\_data' with the filtered data

transmission\_data = [L ,Intensity;];

%Converting Length from centimeter (cm) to meter(m)

for i = 1:length(L)

L\_meter(i) = L(i)/100;

end

%Transposing the matrix

L\_meter = (L\_meter)';

% Creating a new figure window to subplot (\*\*\*Changing the default figure size so that all the data points can be seen clearly\*\*\*)

FigHandle = figure('position',[100,100,1049,895]);

% Subplot for Intensity of light transmission vs Thickness

subplot(2,2,1)

%Plotting the scatter plot

scatter(L\_meter,Intensity);

%Adding a title and labeling the axis

title('Intensity of Light Transmission vs Thickness (in metres)');

xlabel('Thickness(m)')

ylabel('Intensity of Light Transmission(watts/m2)')

%Adding a legend

legend('Data Points','location','NorthEast')

%Holding on to the graph

hold all

% Pausing the command until key press before starting next part

pause

%% Q2b

%Using polyfit to calculate the coefficents of the thrid order polynomial fit equation

p = polyfit(L\_meter,Intensity,3);

%Creating a matrix for the x axis interpolated 50 data points

L\_interpolated = linspace(min(L\_meter), max(L\_meter), 50);

%Using polyval to find the Interpolated Intesity data points that are

%corresponding to the L\_inter data points

Intensity\_interpolated = polyval(p,L\_interpolated);

%Plotting the interpolated data points on the previous graph in q1a

plot(L\_interpolated,Intensity\_interpolated,'r.')

%Updating the legend

legend('Data Points','Interpolated Data Points');

%Holding off the graph

hold off

% Calculating the extrapolated L\_meter data points upto 0.16 m

L\_extra = linspace(min(L\_meter), 0.16, 50);

%Using the extrapolated L\_meter data points and plyval function calculate

%the Extrapolated Intensity data points

Intensity\_extrapolated = polyval(p,L\_extra);

%Creating a subplot to plot the extrapolated data points

subplot(2,2,2)

%Plotting the scatter plot

scatter(L\_meter,Intensity);

%Holding on to the graph

hold all

%Plotting the Extrapolated line

plot(L\_extra,Intensity\_extrapolated,'r.')

%Adding a title and labeling the axis

title('Intensity of Light Transmission vs Thickness (in metres)');

xlabel('Thickness(m)')

ylabel('Intensity of Light Transmission(watts/m2)')

%Adding a legend

legend('Data Points','Extrapolated Data Points','location','NorthEast');

%Usig fprintf to print the conclusion

fprintf('Q2b) As the curve fitted is a 2nd order polynomial (quadratic function)\n the intensity decreases with the thickness and again increases after a certain point. \n There is a problem as the intensity cannot increase, so using polyfit we cannot get an accurate best fit line.\n')

%Holding off the graph

hold off

% Pausing the command until key press before starting next part

pause

%% Q2c

%Defining the variables

%I0 = Intensity of the incident beam

Io = 5;

%Using linear regression to get the two coefficents

[a1,a0] = LinearRegression(L\_meter,transmission\_data(:,2));

%Calculating the unknown variables beta and R using the coefficents

beta = -a1; %Calculating beta

R = 1 - sqrt(exp(a0)/Io); %Calculating R

%Using fprintf to print the beta and R values on the command window

fprintf('Q2c) The absorption coefficient is %g\n The fraction of light which is reflected at the interface is %g\n ',beta,R)

%% Q2d

%Defining the function for the transmission of light through a transparent

%solid

IT = @(L) Io\*(1-R)^2\*exp(-beta\*L);

%Creating a subplot to plot the fitted the curve

subplot(2,2,3)

%Plotting the graph for the fitted curve

plot(L\_meter,IT(L\_meter),'r-')

%Holding on to the graph

hold on

%Scatter plot of the data points in q1a

scatter(L\_meter,transmission\_data(:,2));

%Adding a title and labeling the axis

title('Intensity of Light Transmission vs Thickness (in metres)');

xlabel('Thickness(m)')

ylabel('Intensity of Light Transmission(watts/m2)')

%Adding a legend

legend('Interpolated Data','Data Points','location','NorthEast');

%Calculating coefficient of determination

x = L\_meter;

y = Intensity;

alpha1=exp(a0);

beta1=a1;

st=sum((y-mean(y)).^2);

sr=sum((y-(alpha1\*exp(beta1\*x))).^2);

r2=(st-sr)/st;

%Using text label to display the coefficient on the graph

r2\_string = num2str(r2); %Converting number to string

text(0.02,4.0,'Coefficient of Determination'); %Using text to print the label on the graph

text(0.03,3.9,r2\_string); %Using text to print the value on the graph

%Holding off the graph

hold off

%Using subplot to plot the extrapolated plot for the fitted curve

subplot(2,2,4)

%Plotting the scatter plot

scatter(L\_meter,Intensity);

%Holding on to the graph

hold all

%Plotting the extrapolated points using the points created in q2b

plot(L\_extra,IT(L\_extra),'r-')

%Adding a title and labeling the axis

title('Intensity of Light Transmission vs Thickness (in metres)');

xlabel('Thickness(m)')

ylabel('Intensity of Light Transmission(watts/m2)')

%Adding a legend

legend('Data Points','Extrapolated Data','location','NorthEast');