ENGR 231 – Linear Engineering Systems
Lab 8: Curve Fitting and Global Mean Sea Levels

Your Name: Cole Bardin **Section**: 62
first *last*

As a convenience, this **answer template** is provided if you wish to easily submit your work. Be sure to save it as a PDF before submitting online! Only one submission is allowed.

Part A: Introduction to Curve Fitting

Question 1

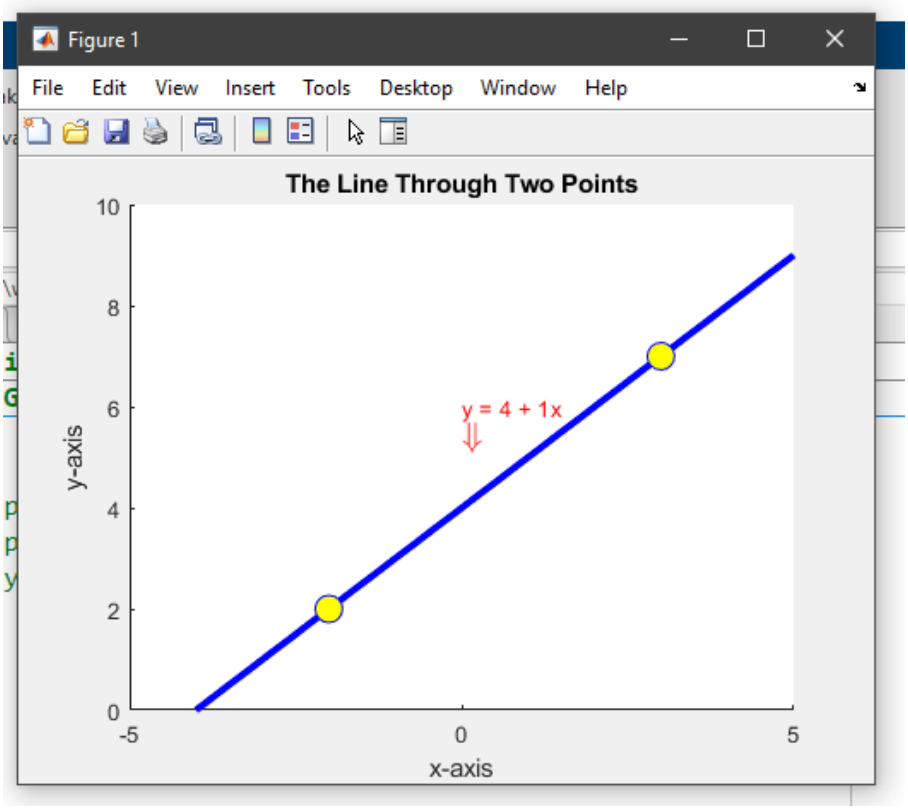
```
x1 = -2; y1 = 2;    % point #1
x2 = +3; y2 = 7;    % point #2

% Add more code here to enter y, D then find b.
% Observation vector y
y = [y1;y2];
% Design matrix D
D = [1, x1; 1, x2];
% Parameter vector b
b = inv(D)*y
```

The intercept for this line is $\beta_0 = \mathbf{4}$ The slope for this line is $\beta_1 = \mathbf{1}$

Question 2: Plot the two points and the line that goes through them in the same figure.
Label both axes, add an appropriate title, and show both points as yellow circles with blue edges.

Replace the sample plot
with your finished plot here.



Question 3: Paste your code here to find the parameter vector using: $\vec{\boldsymbol{\beta}} = (D^T D)^{-1} D^T \vec{\mathbf{y}}$

```
D2 = transpose(D) * D  % given for free

% Now solve for the parameter vector b using the least-squares equation
b = inv(D2*D)*transpose(D)*y
```

Are the intercept and slope the same as before? **Yes**

The intercept for this line is $\beta_0 =$ **4** The slope for this line is $\beta_1 =$ **1**

Question 4: Paste your reduced matrix *RAM* in here. You should be able to see the parameter vector in the last column.

$$\mathbf{RAM} = \begin{bmatrix} \mathbf{1} & \mathbf{0} & \mathbf{4} \\ \mathbf{0} & \mathbf{1} & \mathbf{1} \\ \mathbf{0} & \mathbf{0} & \mathbf{0} \end{bmatrix}$$

The intercept for this line is $\beta_0 =$ **4** The slope for this line is $\beta_1 =$ 1

Question 5: Paste your reduced matrix *RAM* in here.
Circle or highlight the pivot in the last column (poison pivot).

$$\mathbf{RAM} = \begin{bmatrix} \mathbf{1} & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \mathbf{1} & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \mathbf{1} \end{bmatrix}$$

Is the system consistent? No

Question 6: Record the intercept and slope for the best-fit line through the three non-collinear points. Also give the RMSE. See formula below. Give all answers to 3 decimals.

The intercept for this line is $\beta_0 =$ **4.6842** The slope for this line is $\beta_1 =$ **0.947**

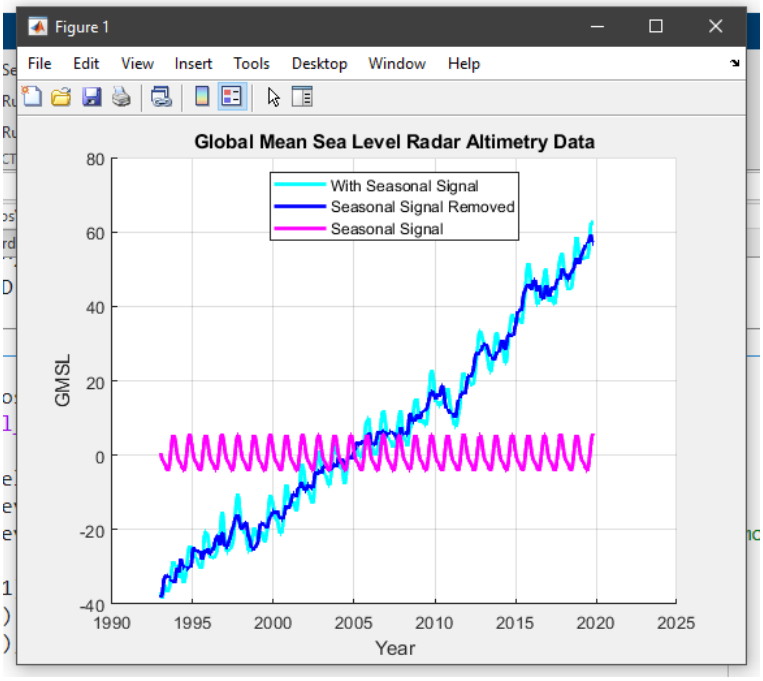
The RMSE for this is RMSE = **1.1547**

Question 7: Find the parameter vector $\vec{\boldsymbol{\beta}}$ for the best parabolic fit. One parameter is given for free.

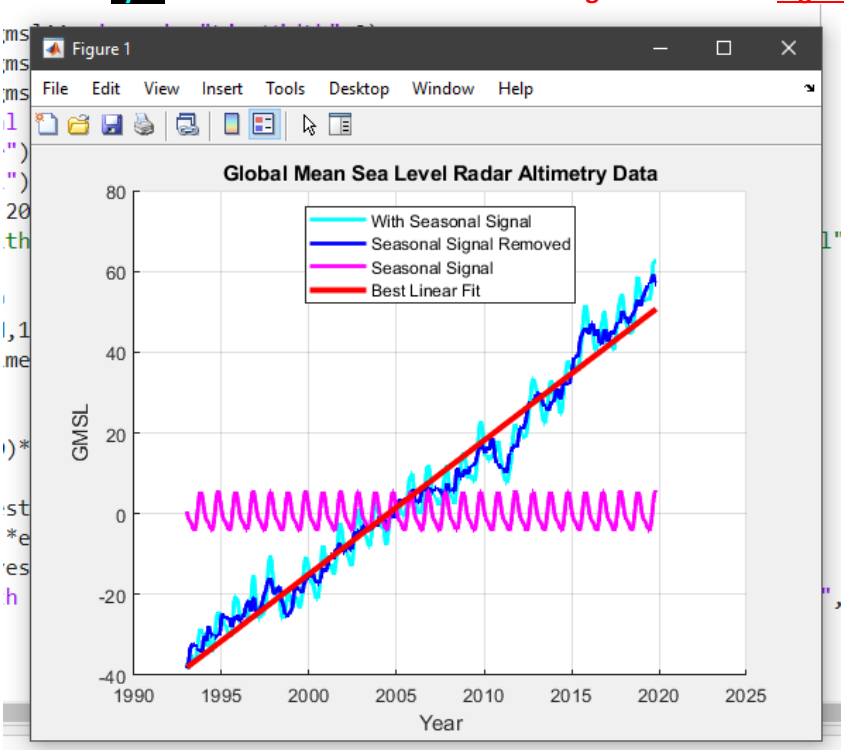
$$\vec{\boldsymbol{\beta}} = \begin{bmatrix} \beta_0 \\ \beta_1 \\ \beta_2 \end{bmatrix} = \begin{bmatrix} \mathbf{6} \\ \mathbf{+4/3} \\ \mathbf{-1/3} \end{bmatrix}$$

Part B: Curve Fitting Applied to Global Sea Levels

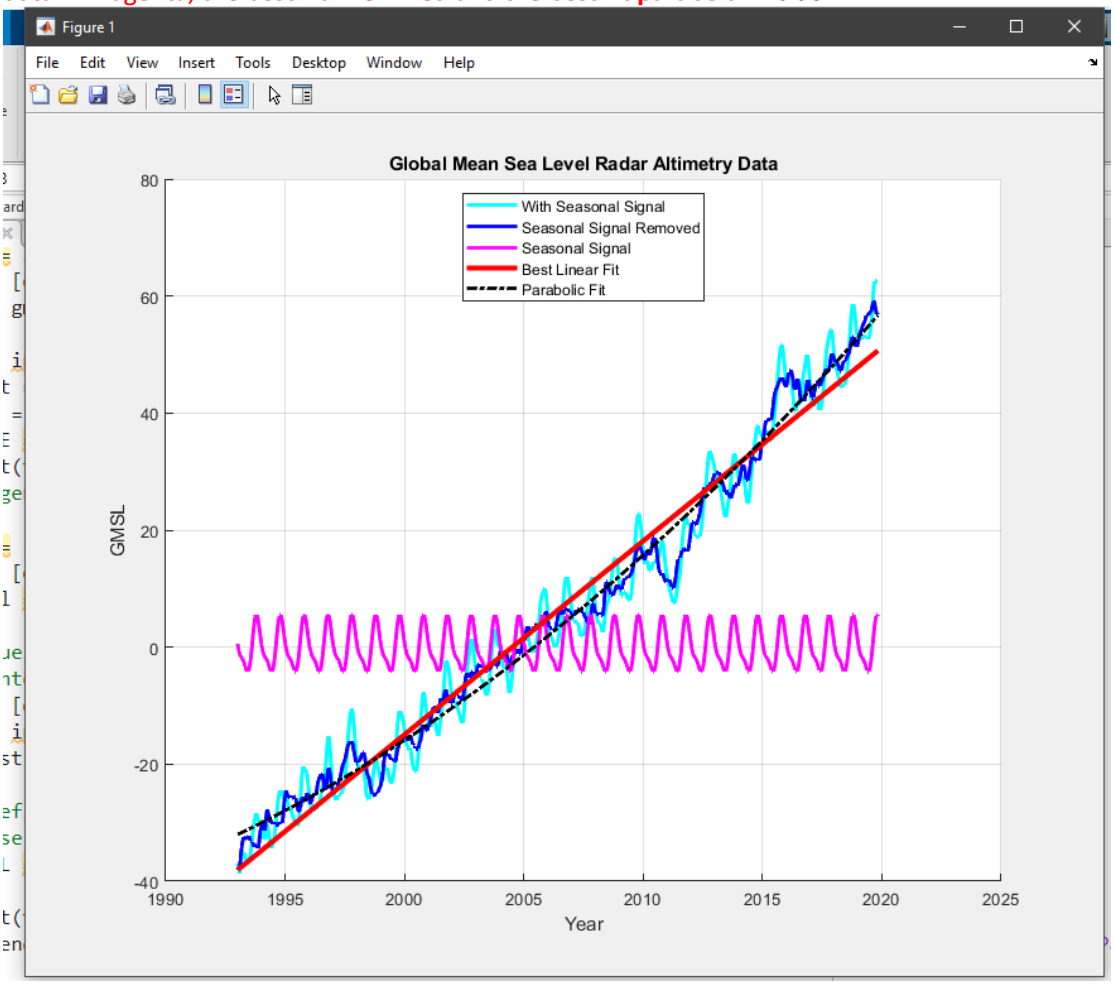
Question 8: Plot the Global Mean Sea Level Data from column 11 against time in **cyan**. Plot the Global Mean Sea Level Data from column 12 against time in **blue**. Add the seasonal component in **magenta**.
Paste your completed plot here.



Question 9: Replace the sample with your completed figure showing the best-fit line in red, and the GMSL data in blue and cyan. Also show the seasonal data in magenta. Include a legend as shown.



Question 10: Replace the sample with your completed graph showing the gmsl data in **blue** and **cyan**, the seasonal data in magenta, the best-fit line in **red** and the best-fit **parabola** in **black**.



Ready to Submit?

Be sure all ten questions are answered. When your lab is complete, be sure to submit three files:

1. Your **completed Answer Template** as a PDF file
2. A copy of your **MATLAB Live Script**
3. A **PDF** copy of your **MATLAB Live Script** (Save-Export to PDF…)

The due date is the day after your lab section by **11:59pm** to receive full credit. You have one more day, to submit the lab (but with a small penalty), and then the window closes for good and your grade will be zero.

The future?