

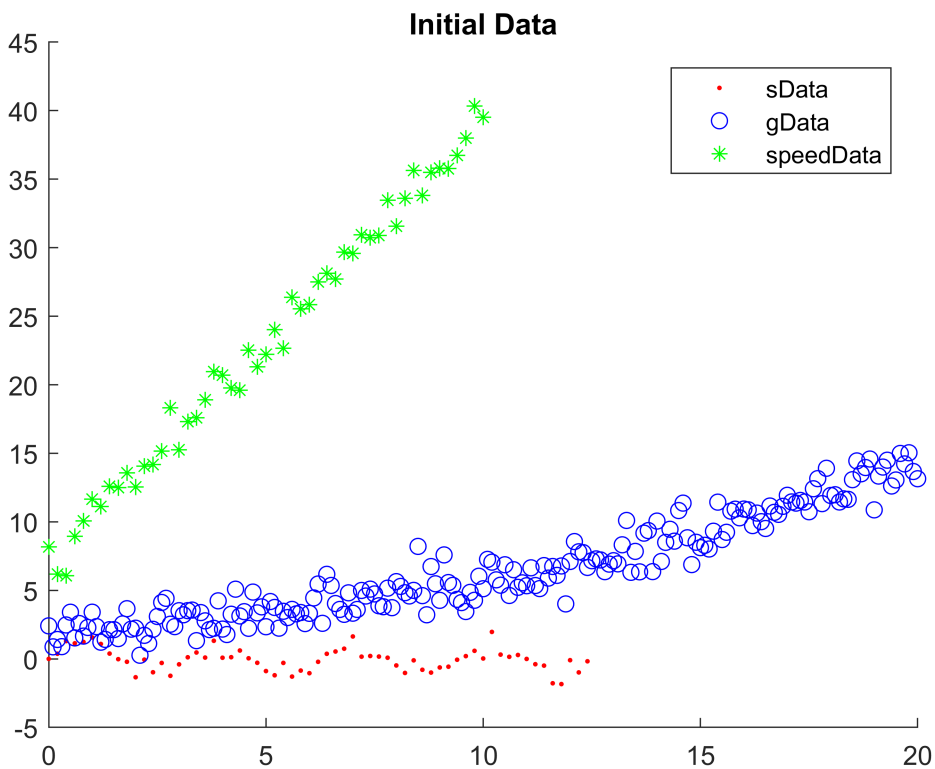
# Math Programming Final Project

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Wednesday, May 16th, 2018

## Import Variables & Plot Data

```
global sData gData speedData;  
sData = csvread('SData//sData.csv');  
gData = csvread('GData//gData.csv');  
speedData = csvread('speedData//speedData.csv');  
  
figure('Name','Plot of data'); hold on;  
plot(sData(:,1),sData(:,2),'r');  
plot(gData(:,1),gData(:,2),'ob');  
plot(speedData(:,1),speedData(:,2),'*g');  
title('Initial Data');  
hold off;  
legend('sData','gData','speedData');
```



## GData

I assume the form of a polynomial function for fitting this data. The functions 'ExpEval' and 'ExpError' accept a vector of variable length corresponding to the coefficients of each exponent of x in a polynomial function.

I start with a guess of a 2nd order polynomial:  $y = .05x^2 - .05x + 5$

```
evalNum = 2;           %Sets degree of polynomial to 2  
A = [5 .05 .05];       %Gives values for coefficients to evaluate estimate  
[error,value] = ExpEval(gData(:,1),gData(:,2),A);
```

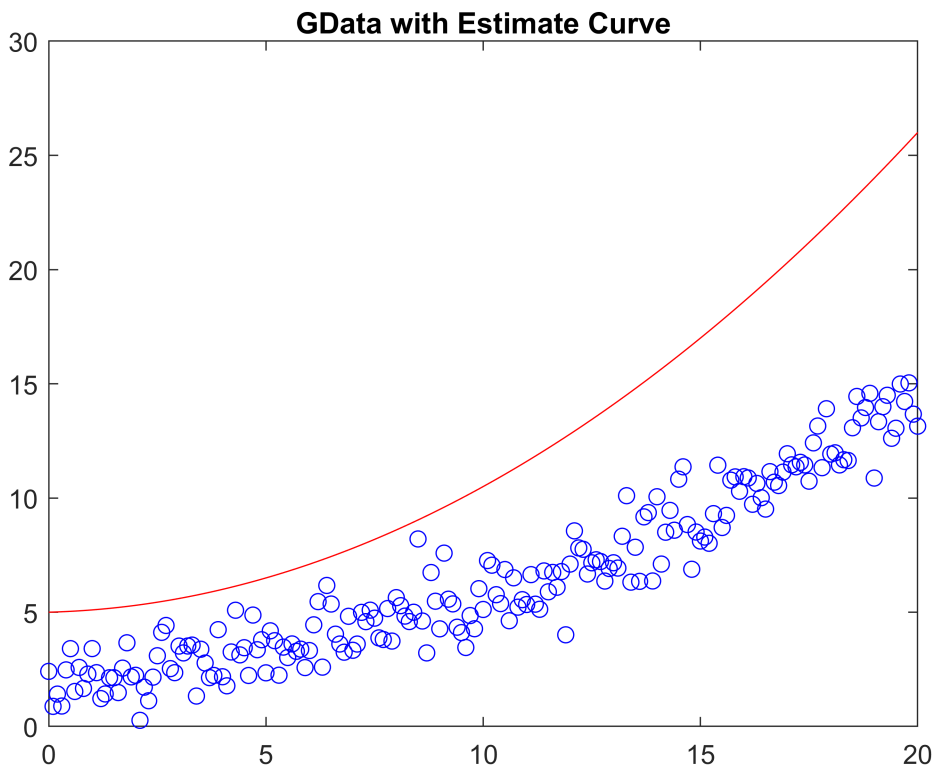
The error from these values was

```
error
```

```
error = 8.1433e+03
```

Plot the data to visualize the guess curve.

```
plot(gData(:,1),gData(:,2),'ob',gData(:,1),value,'-r'); title('GData with Estimate Curve');
```



Now, I find the function with a minimum error.

```
x0 = zeros(evalNum+1);
optInputs = fminsearch(@ExpError,x0);
[optError,optValue] = ExpEval(gData(:,1),gData(:,2),optInputs);
```

The error for the optimized inputs values is

```
optError
```

```
optError = 210.9412
```

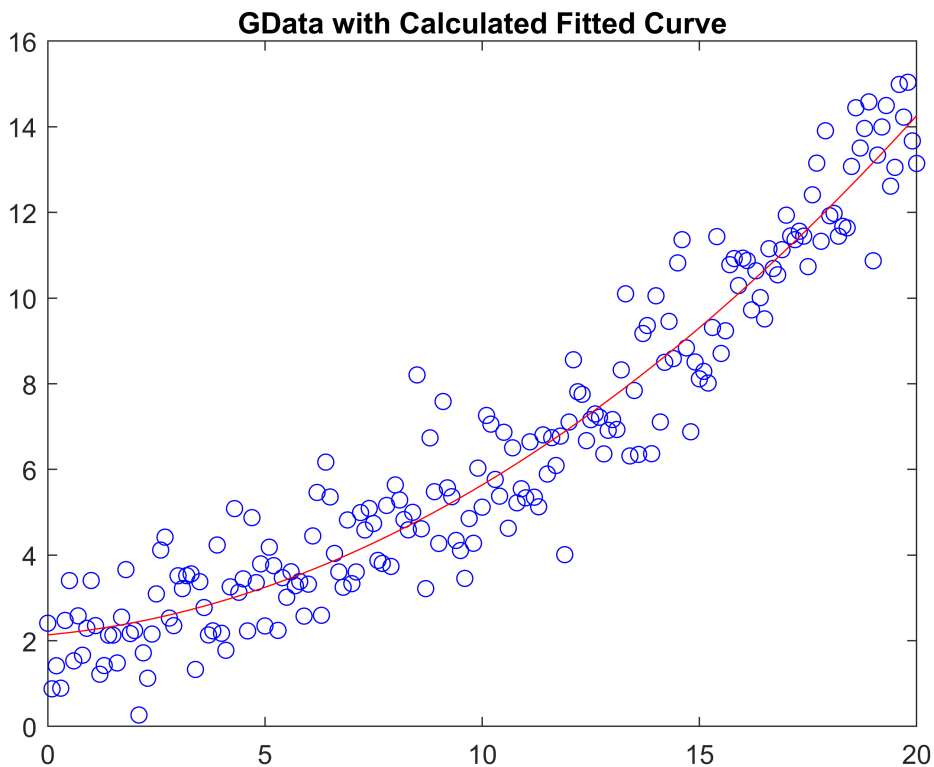
Notice this error is drastically smaller than our guess.

Our optimum values were:

```
optInputs(:,1)
```

```
ans =
    2.1374
    0.0944
    0.0256
```

```
plot(gData(:,1),gData(:,2),'ob',gData(:,1),optValue,'-r'); title('GData with Calculated Fitted
```



SData

I assume the form of a sin function for fitting this data. The functions 'SinEval' and 'SinError' accept a vector of length 3, which correspond to the amplitude, period and phase shift, respectively.

I start with a guess of a sin function:  $y = 2\sin(1.5(x + \frac{\pi}{4}))$ .

```
guess = [2 1.5 pi/4]; %Gives values for coefficients to evaluate estimate of the form [amp,per,phs]
[error,value] = SinEval(sData,guess);
```

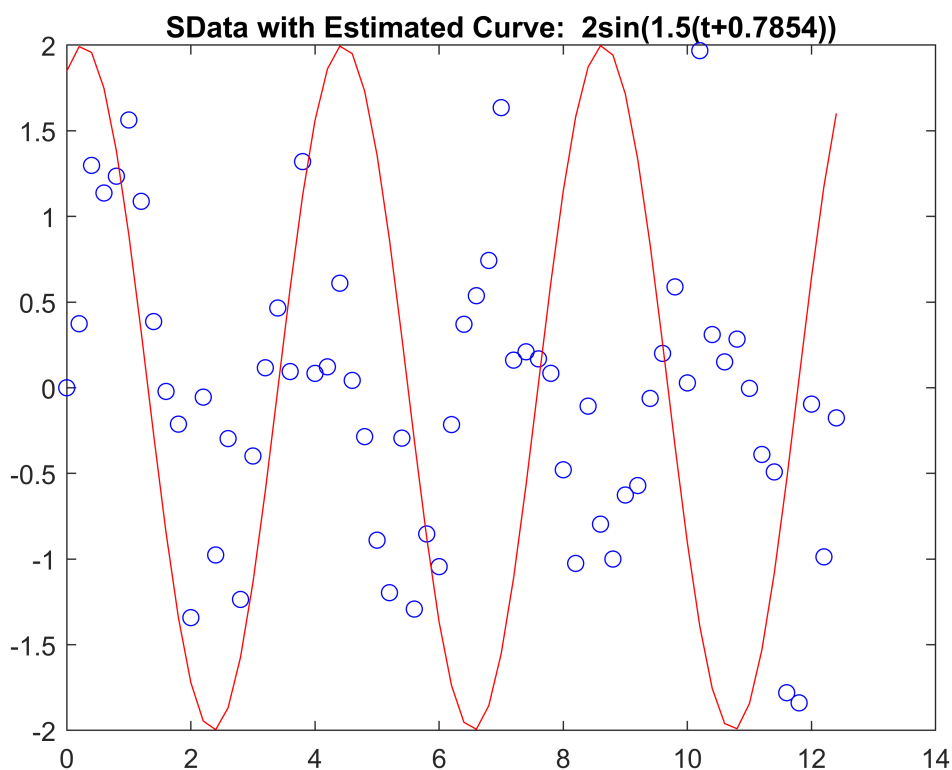
The error for this guess was

```
error
```

```
error = 163.4848
```

Plot the data to visualize the guess curve.

```
plot(sData(:,1),sData(:,2),'ob',sData(:,1),value,'-r');
title(['SData with Estimated Curve: ',num2str(guess(1)), 'sin(',num2str(guess(2)), '(t+',num2str(guess(3)),')']);
```



Now, I find the function with a minimum error.

```
x0 = [1 2 0];
optInputs = fminsearch(@SinError,x0);
```

```
[optError,optValue] = SinEval(sData,optInputs);
```

The error for the optimized inputs values is

```
optError
```

```
optError = 12.9819
```

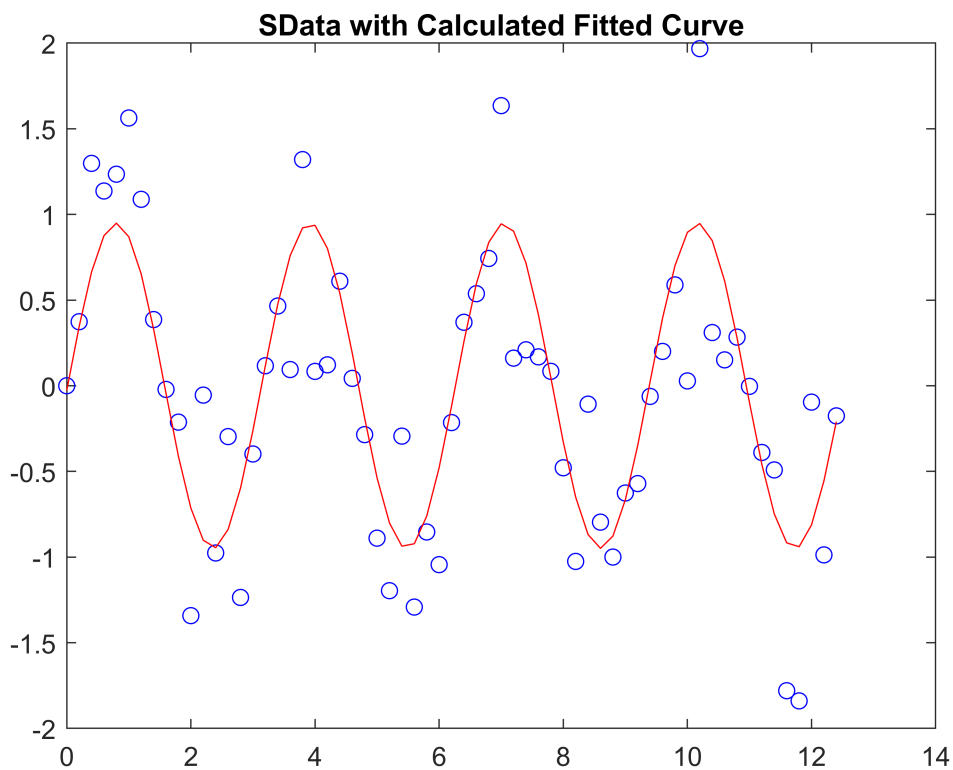
Notice this error is drastically smaller than our guess.

Our optimum values were:

```
optInputs(:,1)
```

```
ans = 0.9490
```

```
plot(sData(:,1),sData(:,2),'ob',sData(:,1),optValue,'-r'); title('SData with Calculated Fitted
```



## SpeedData

I assume the form of a polynomial function for fitting this data. The functions 'LinEval' and 'LinError' accept a vector of variable length corresponding to the coefficients of each exponent of  $x$  in a polynomial function.

I start with a guess of a 1st order polynomial:  $y = 10x + 5$

```
evalNum = 1;           %Sets degree of polynomial to 1
guess = [5 10];        %Gives values for coefficients to evaluate estimate
[error,value] = LinEval(speedData(:,1),speedData(:,2),guess);
```

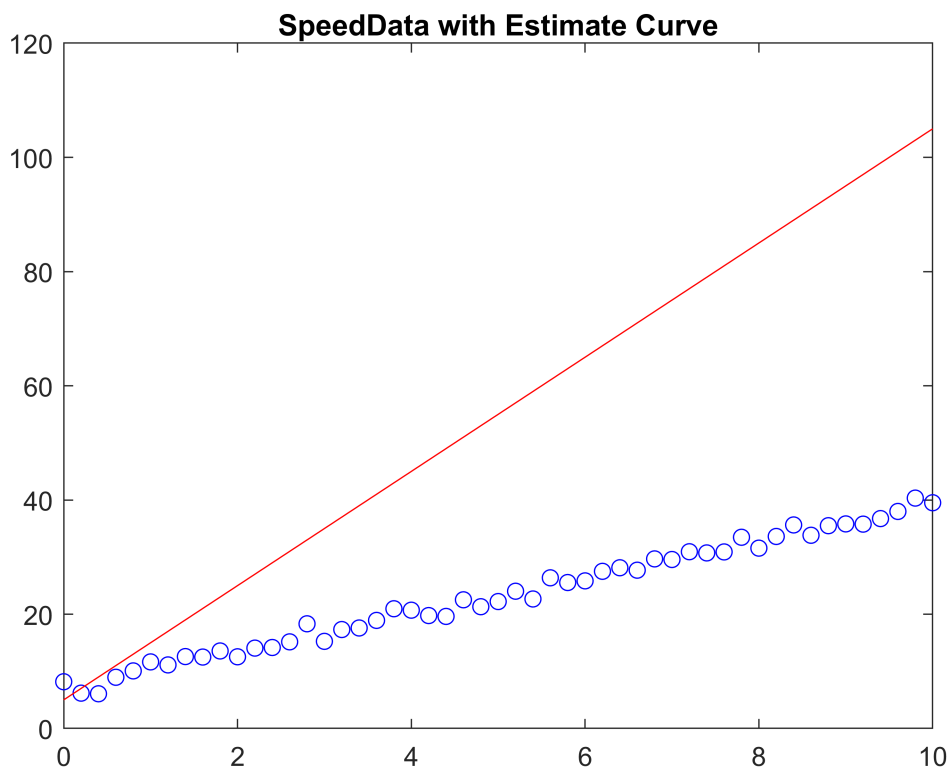
The error from these values was

```
error
```

```
error = 7.2033e+04
```

Plot the data to visualize the guess curve.

```
plot(speedData(:,1),speedData(:,2),'ob',speedData(:,1),value,'-r'); title('SpeedData with Est
```



Now, I find the function with a minimum error.

```
x0 = zeros(evalNum+1);
optInputs = fminsearch(@LinError,x0);
[optError,optValue] = ExpEval(speedData(:,1),speedData(:,2),optInputs);
```

The error for the optimized inputs values is

```
optError
```

```
optError = 48.7744
```

Notice this error is drastically smaller than our guess.

Our optimum values were:

```
optInputs(:,1)
```

```
ans =  
6.9871  
3.2323
```

```
plot(speedData(:,1),speedData(:,2),'ob',speedData(:,1),optValue,'-r'); title('SpeedData with C
```

