# Math Programming Final Project

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Import Variables & Plot Data

```matlab
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');
```
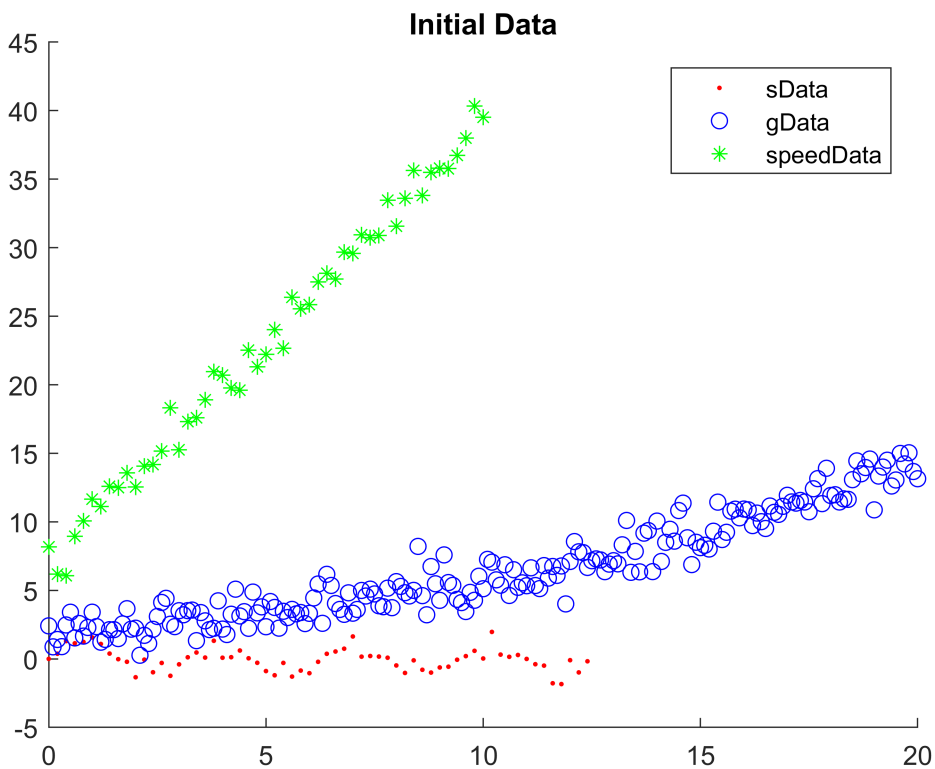
GData

I assume the form of a polynomial function for fitting this data. The functions 'ExpEval' and 'ExpError' accept a vector of variable length corrosponding 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);
```
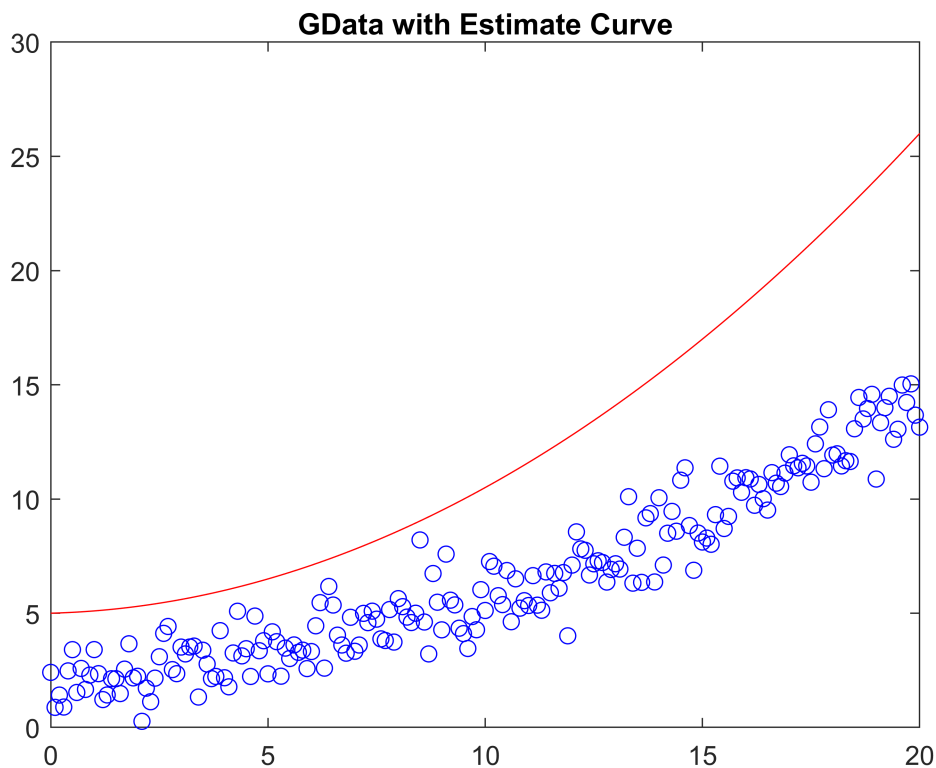
The error from these values was

```
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 funciton 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
```
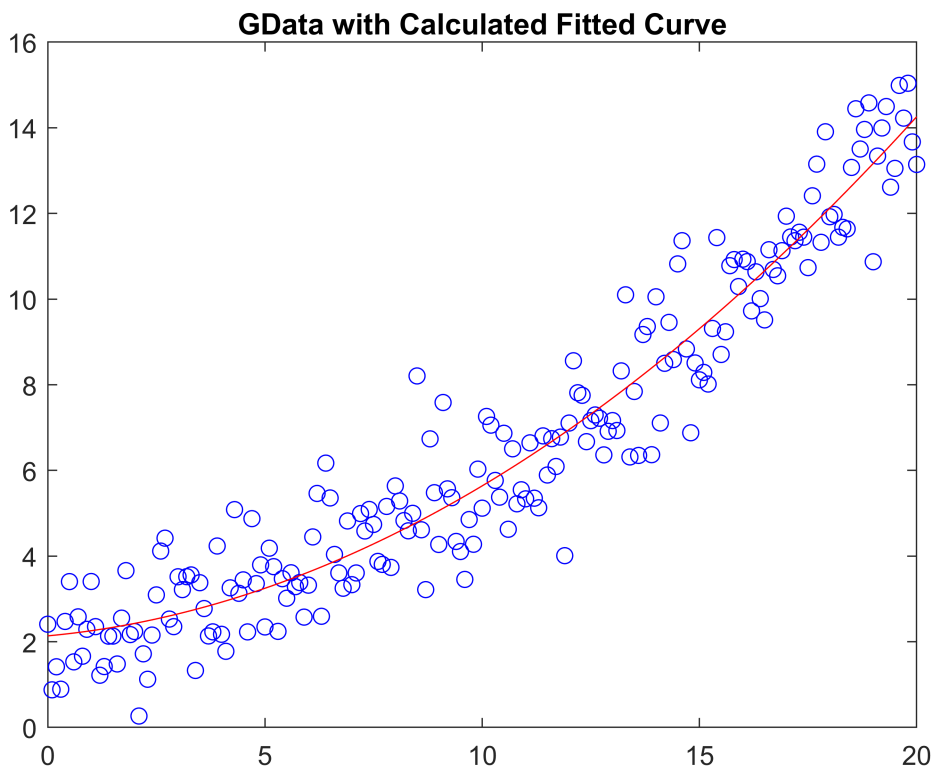
Notice this error is drastically smaller than our guess.

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 Curve');
```

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 corrospond to the amplitude, period and phase shift, respectively.

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

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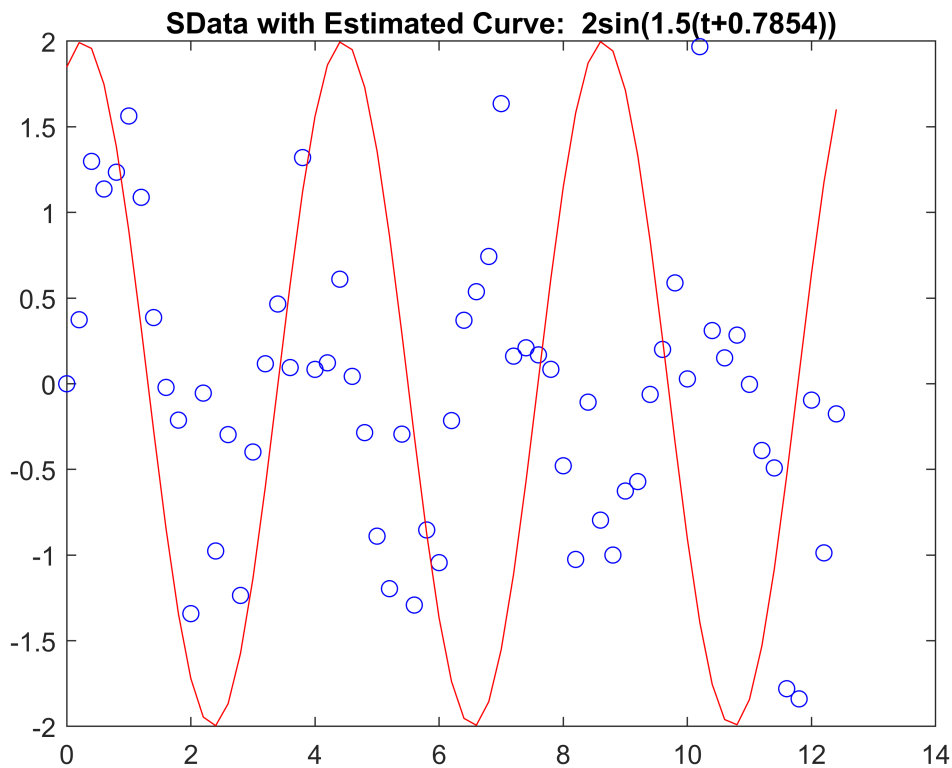
The error for this guess was

```
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+',num2st
```


SData with Estimated Curve: 2sin(1.5(t+0.7854))

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
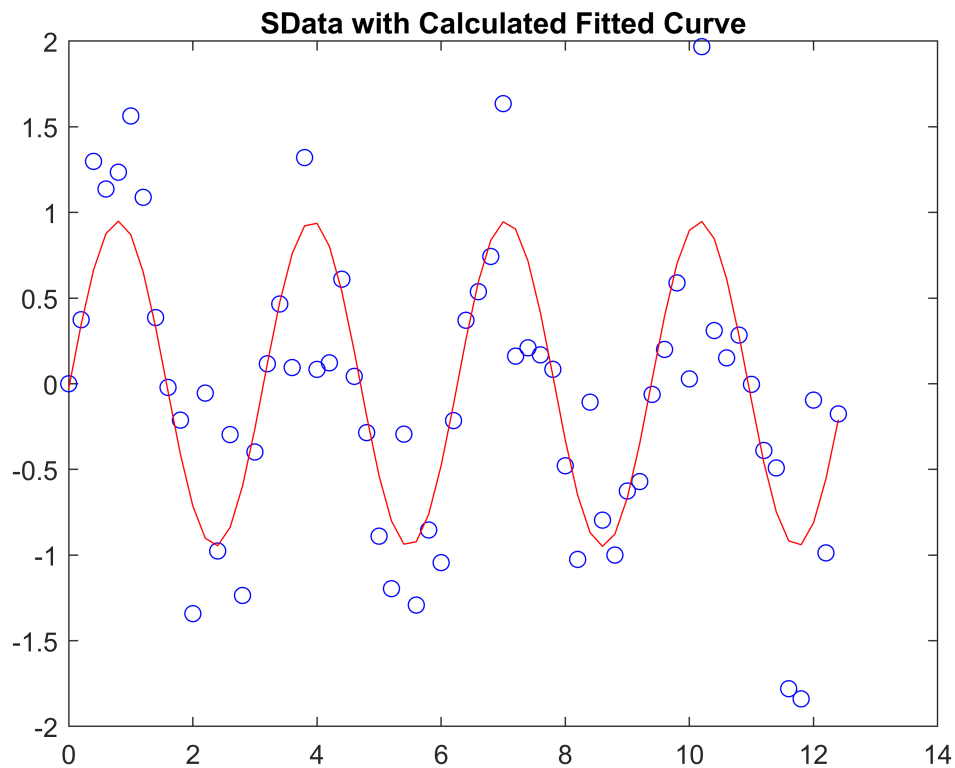
```
optError
```

```
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 Curve');
```

SpeedData

I assume the form of a polynomial function for fitting this data. The functions 'LinEval' and 'LinError' accept a vector of variable length corrosponding 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);
```
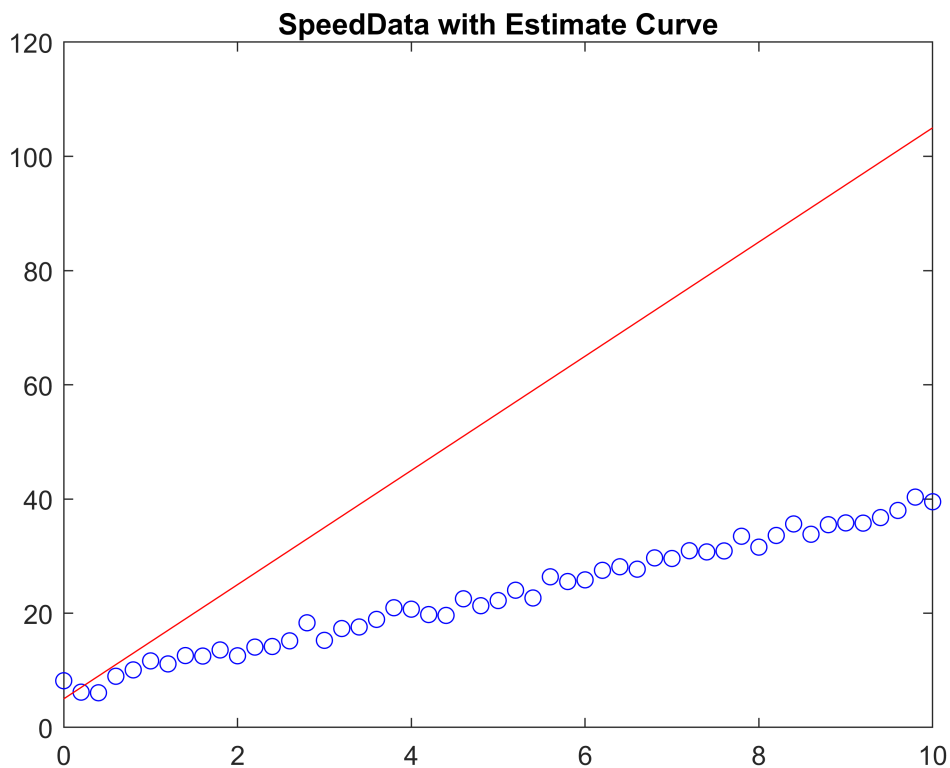
The error from these values was

```
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 Estimate Curve');
```

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 Calculated Fitted Curve');
```


SpeedData with Calculated Fitted Curve