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Example 8 - linear least squares

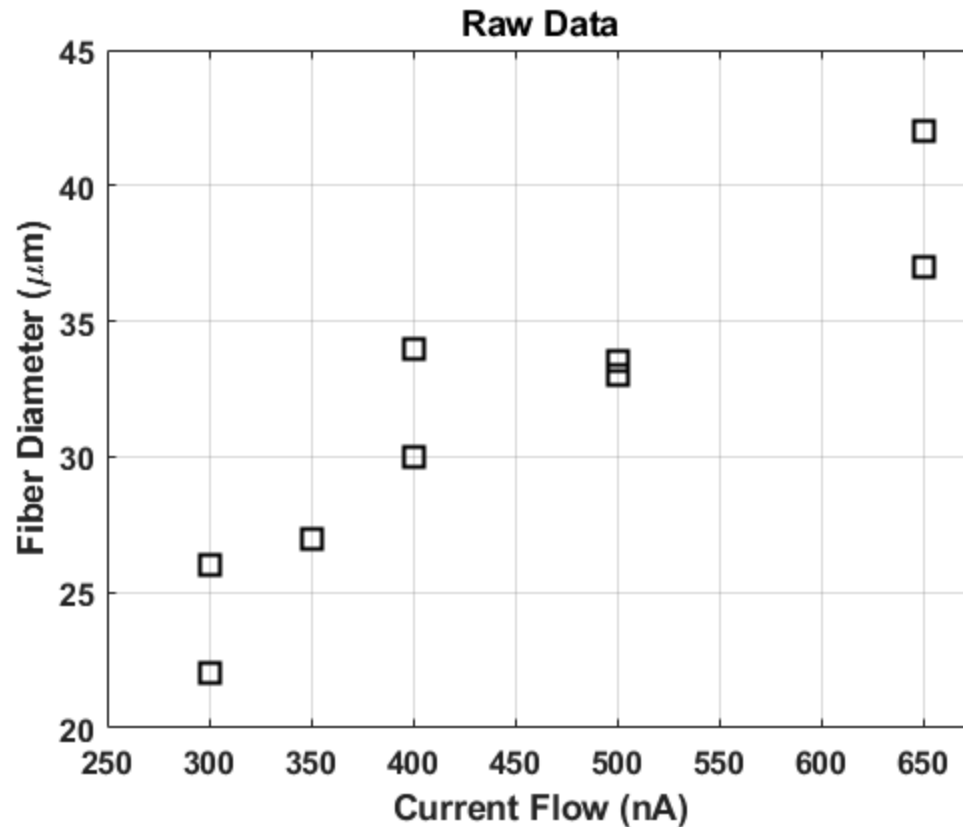
```
clear
clc
close 'all'
```

Input Data

```
I = [300 300 350 400 400 500 500 650 650]';
d = [22 26 27 30 34 33 33.5 37 42]';
```

Plot the data

```
figure(1)
plot(I,d,'sk','markersize',10,'linewidth',2);
title('Raw Data','fontsize',18,'fontweight','bold');
xlabel('Current Flow (nA)','fontsize',16,'fontweight','bold');
ylabel('Fiber Diameter (\num)','fontsize',16,'fontweight','bold');
grid on
set(gca,'fontsize',12,'fontweight','bold');
axis([250 675 20 45]);
```



Linear Least Squares

```
fprintf('\n\n Linear Least Squares \n');
X = [ I.^0 I.^1];
b = d;

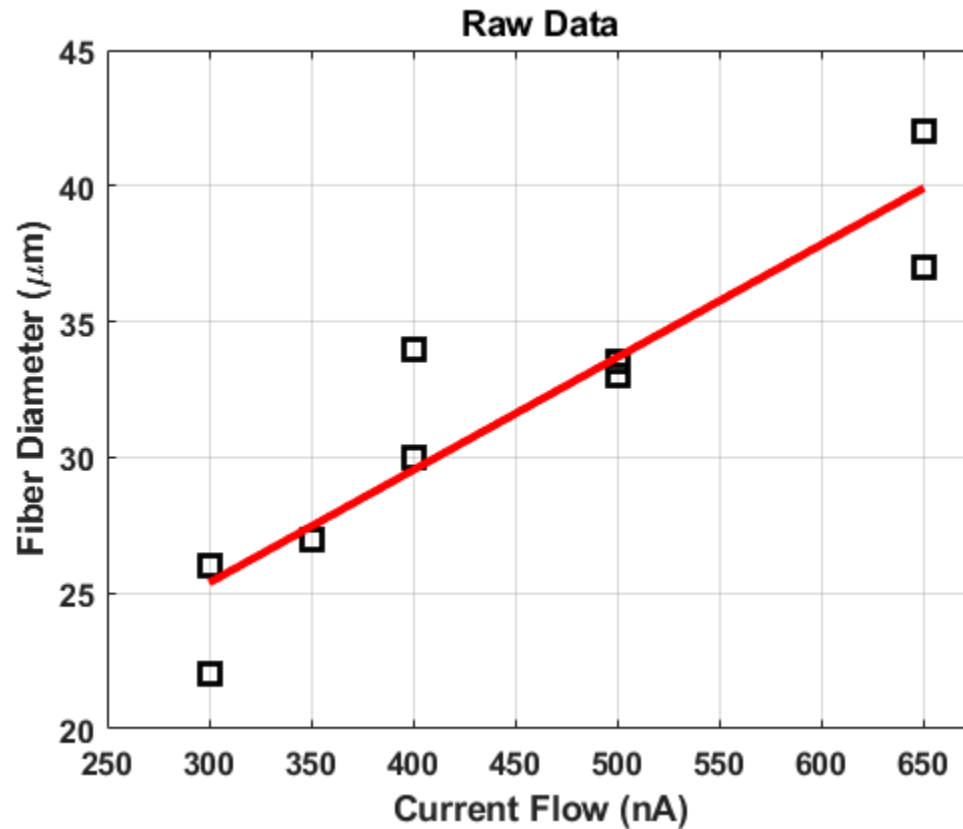
c = (X'*X)\(X'*b);

fprintf('b = %g \n',c(1));
fprintf('m = %g \n',c(2));

linEst = @(x) c(1) + c(2)*x;
% plot the fit line
figure(2)
plot(I,d,'sk',...
     I,linEst(I),'-r','linewidth',3,'markersize',10);
title('Raw Data','fontsize',18,'fontweight','bold');
xlabel('Current Flow (nA)','fontsize',16,'fontweight','bold');
ylabel('Fiber Diameter (\num)','fontsize',16,'fontweight','bold');
grid on
set(gca,'fontsize',12,'fontweight','bold');
axis([250 675 20 45]);
```

Linear Least Squares

$b = 12.9128$
 $m = 0.0415517$



Least squares - second order

```
fprintf('\n\n Quadratic Least Squares \n');
X = [I.^0 I.^1 I.^2];
b = d;

c = (X'*X)\(X'*b);

fprintf('a = %g \n',c(1));
fprintf('b = %g \n',c(2));
fprintf('c = %g \n',c(3));

quadEst = @(x) c(1) + c(2)*x + c(3)*x.^2;
% plot the fit line
figure(3)
plot(I,d,'sk',...
     I,linEst(I),'-r',...
     I,quadEst(I),'-g','linewidth',3,'markersize',10);
title('Raw Data','fontsize',18,'fontweight','bold');
xlabel('Current Flow (nA)','fontsize',16,'fontweight','bold');
ylabel('Fiber Diameter (\um)','fontsize',16,'fontweight','bold');
grid on
set(gca,'fontsize',12,'fontweight','bold');
```

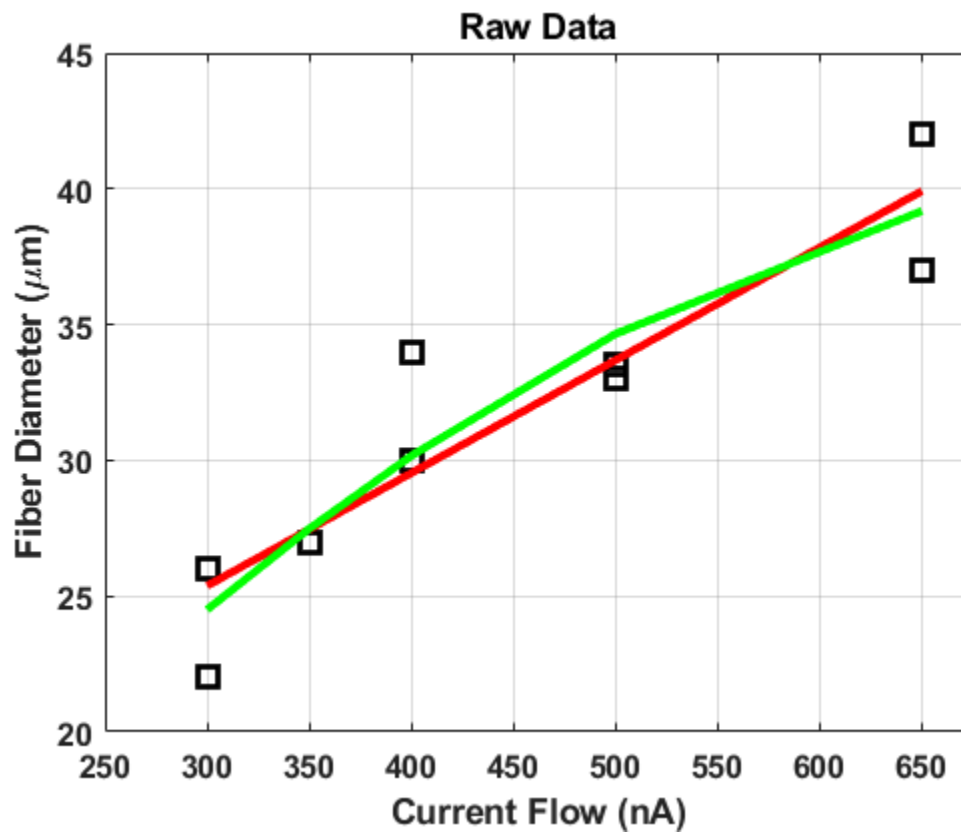
```
axis([250 675 20 45]);
```

Quadratic Least Squares

$a = 0.436382$

$b = 0.0978683$

$c = -5.88533e-05$



Least Squares - (problem 6.9)

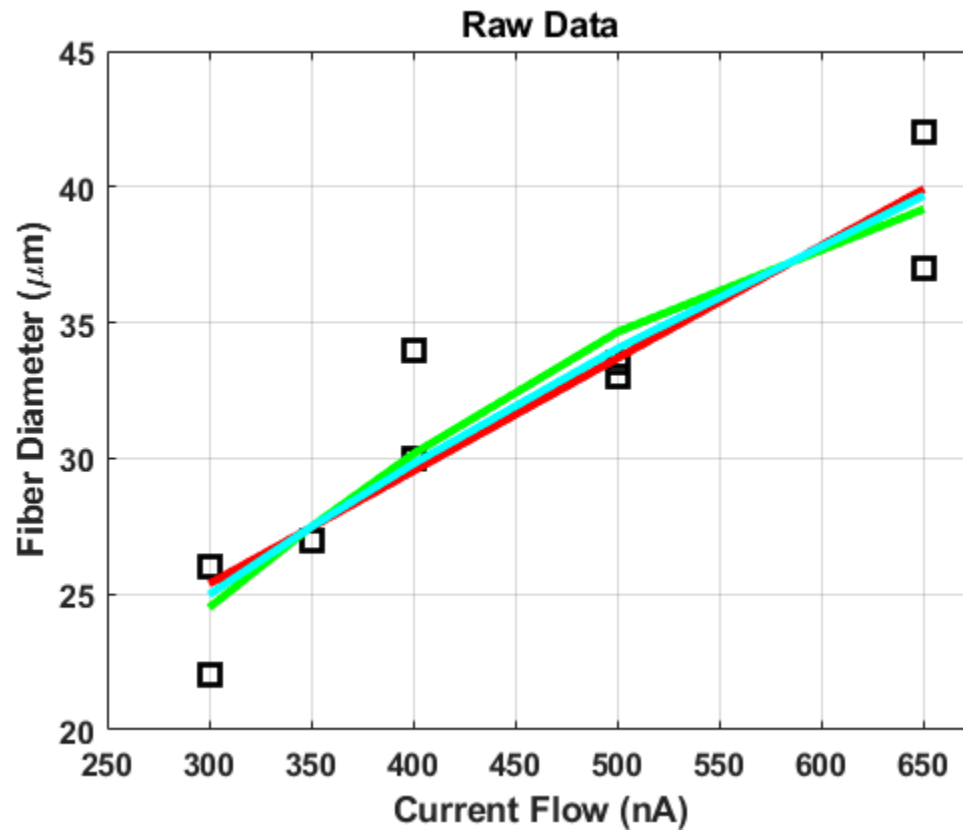
```
fprintf('\n\n Least Squares - non-monomial \n');
X = [I.^0 I.^0.5];
b = d;
c = (X'*X)\(X'*b);
fprintf('a = %g \n',c(1));
fprintf('b = %g \n',c(2));

est3 = @(x) c(1) + c(2)*x.^0.5;

% plot the fit line
figure(4)
plot(I,d,'sk',...
     I,linEst(I),'-r',...
     I,quadEst(I),'-g',...
     I,est3(I),'-c','linewidth',3,'markersize',10);
```

```
title('Raw Data','fontsize',18,'fontweight','bold');
xlabel('Current Flow (nA)','fontsize',16,'fontweight','bold');
ylabel('Fiber Diameter (\u00b5m)','fontsize',16,'fontweight','bold');
grid on
set(gca,'fontsize',12,'fontweight','bold');
axis([250 675 20 45]);
```

Least Squares - non-monomial
 $a = -6.19674$
 $b = 1.79979$



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