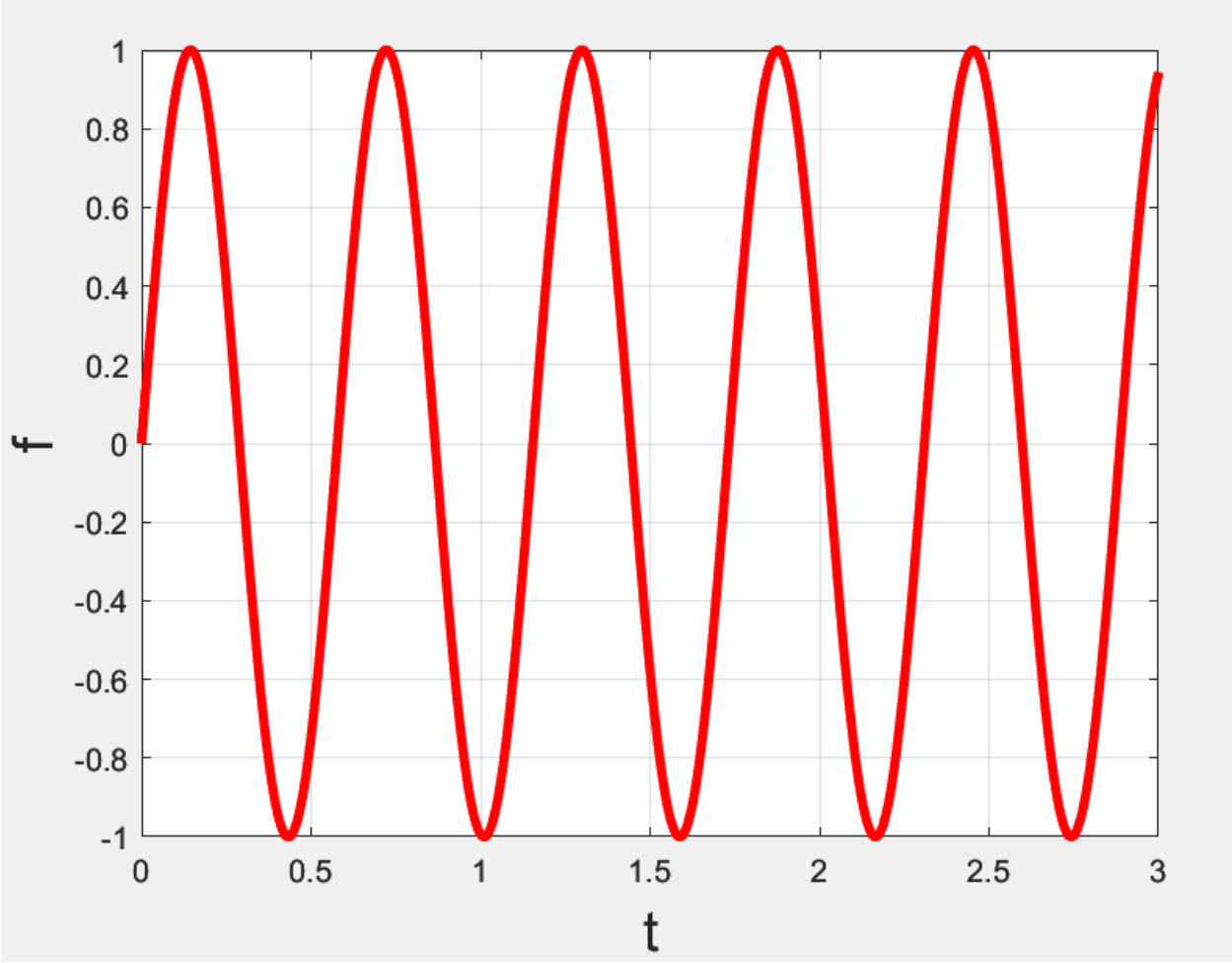
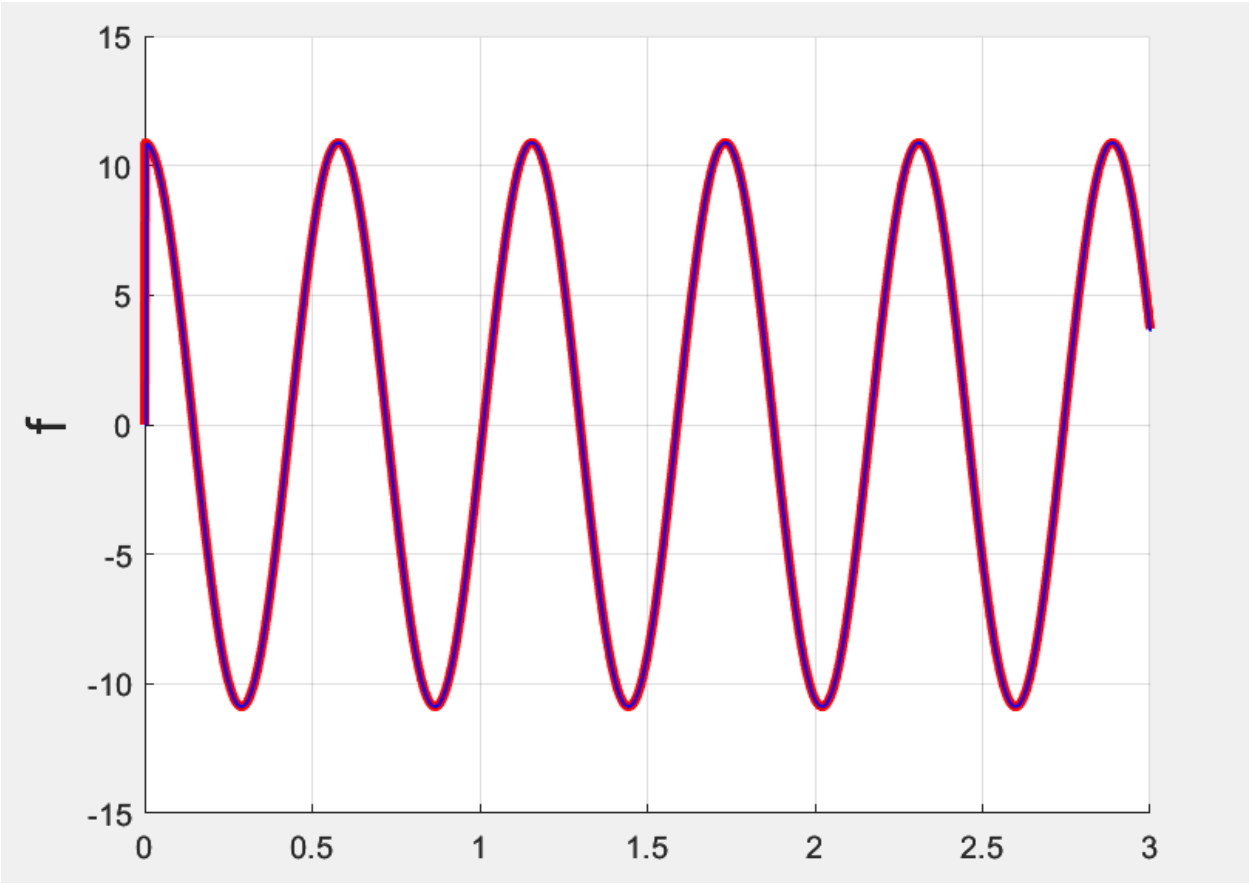
Homework 6

Problem 2

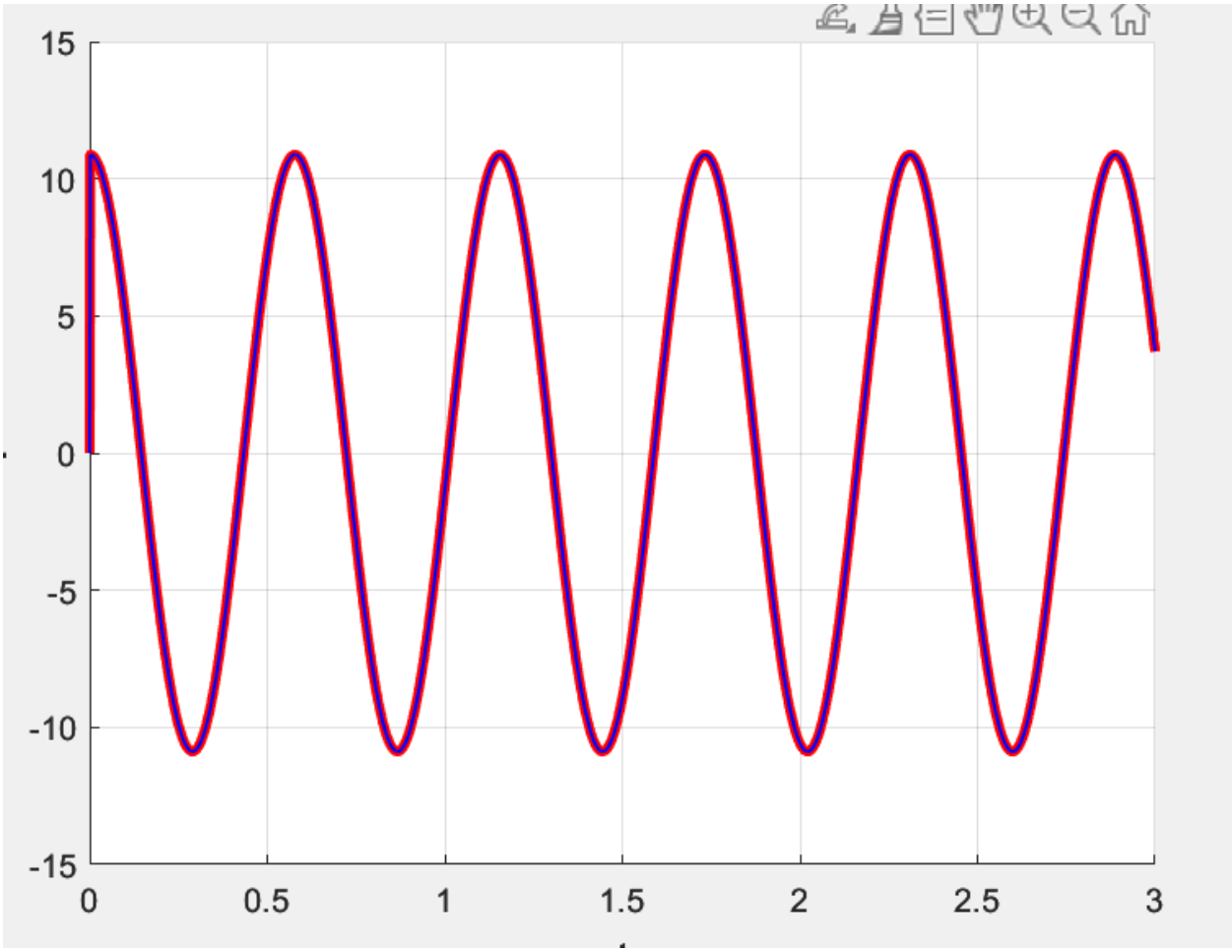
Original Function:



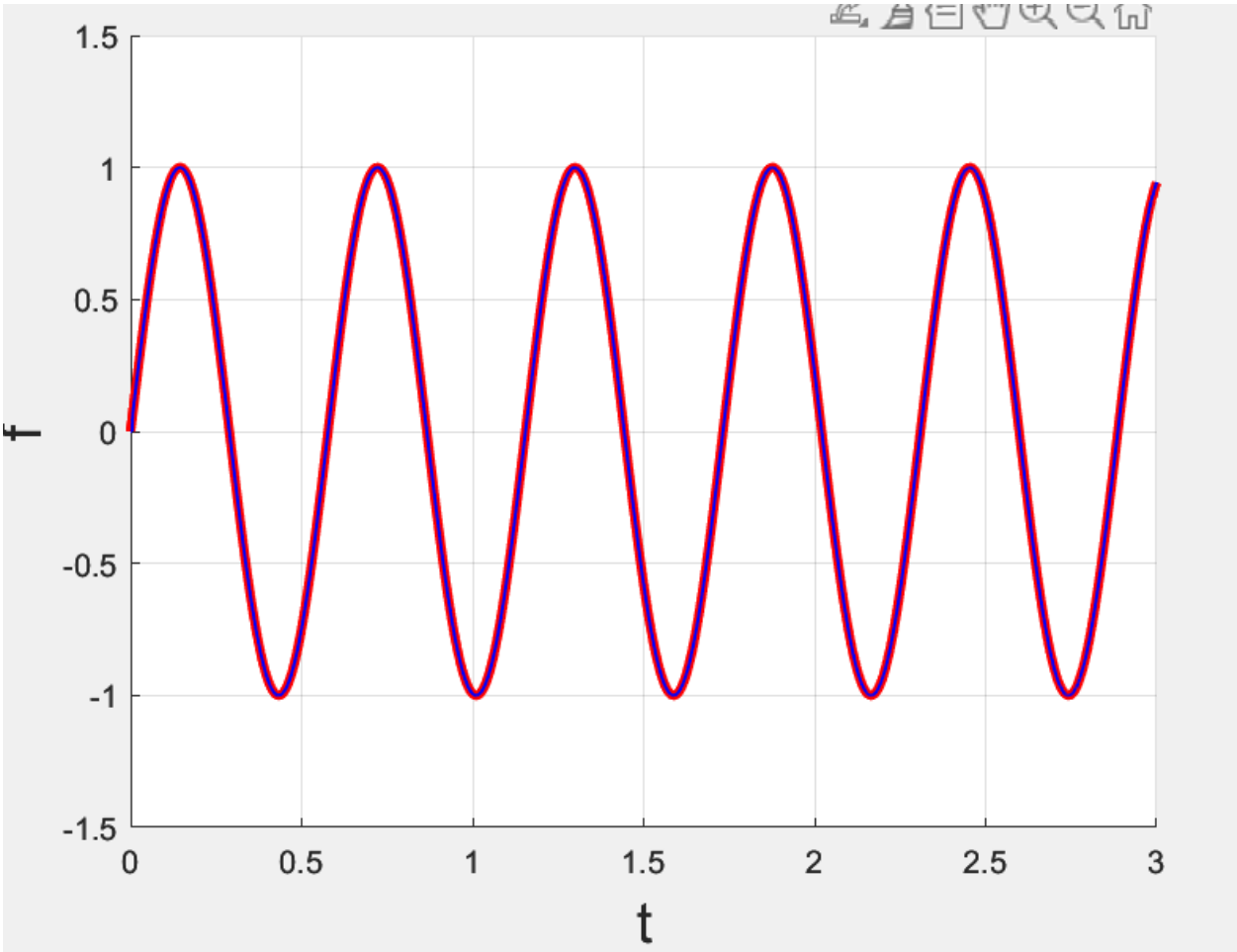
Naive derivative vs original derivative



Regression derivative vs original



Regression vs original



Code:

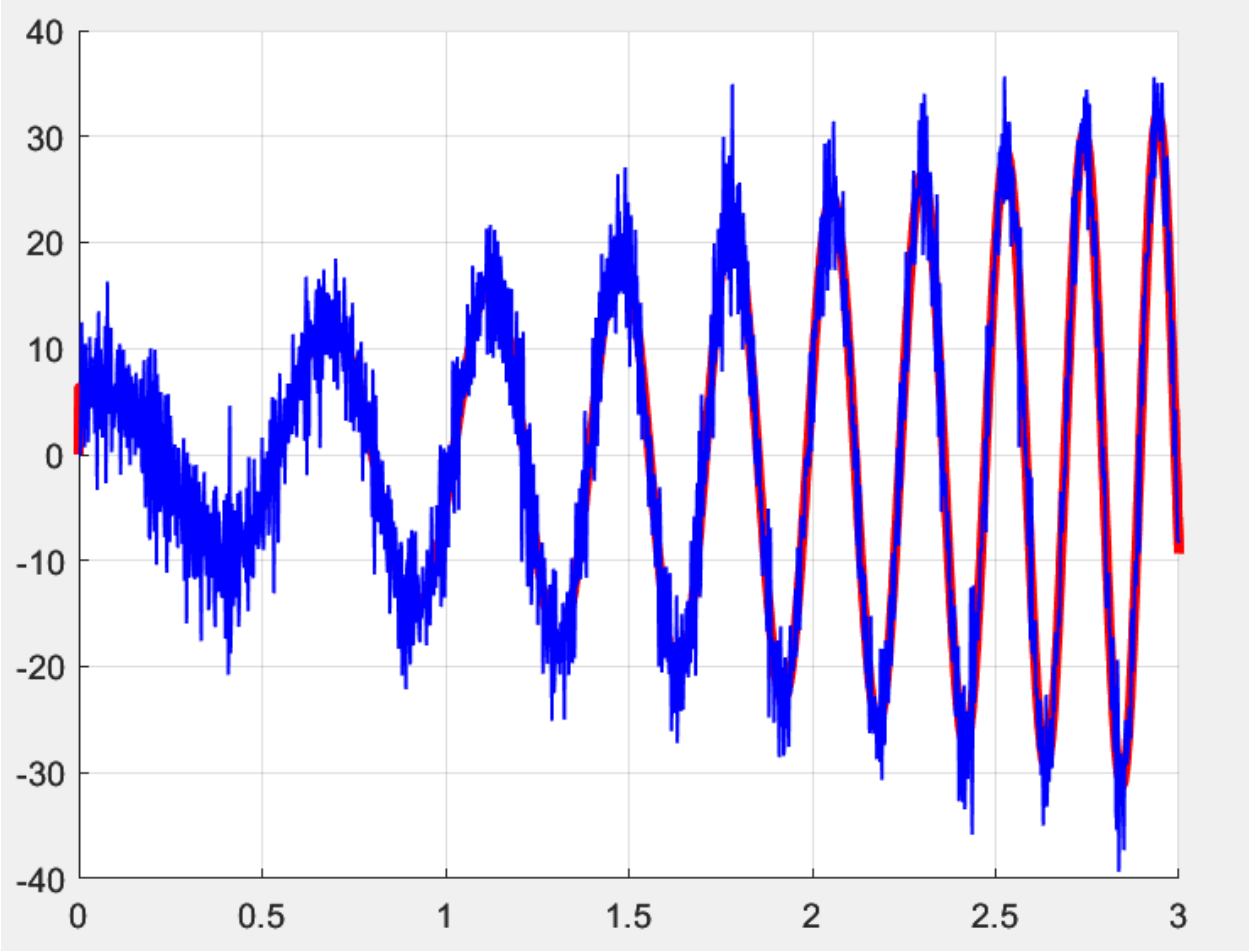
```
load ./data/DataHW06_Prob2
fig1 = figure();
plot(t,y,'r','linewidth',3);
grid on
xlabel('t','FontSize',18);
ylabel('f','FontSize',18);
dy_dt = naive_der(y,t);
[y_regress,dy_dt_regress] = do_regress(y,t);
fig2 = figure();
hold on
plot(t,dy,'r','linewidth',3);
plot(t,dy_dt,'b','linewidth',1);
grid on
xlabel('t','FontSize',18);
ylabel('f','FontSize',18);
hold off
fig3 = figure();
hold on
plot(t,y,'r','linewidth',3);
plot(t,y_regress,'b','linewidth',1);
grid on
xlabel('t','FontSize',18);
ylabel('f','FontSize',18);
hold off
fig4 = figure();
hold on
plot(t,dy,'r','linewidth',3);
plot(t,dy_dt_regress,'b','linewidth',1);
grid on
xlabel('t','FontSize',18);
ylabel('f','FontSize',18);
hold off

function [y_regress,dy_dt_regress] = do_regress(y,t)
dy_dt_regress = zeros(1, length(y));
y_regress = zeros(1, length(y));
for i = 4 : length(y)
   y_window = [y(i - 3) ;y(i - 2); y(i - 1); y(i)];
   moving_window = [t(i-3); t(i-2); t(i-1); t(i)];
   A = [ones(4,1), moving_window, moving_window.^2];
   alpha_hat = inv(A' * A)*A'*y_window;
   dy_dt_regress(i) = alpha_hat(2) + 2*alpha_hat(3) * t(i);
   y_regress(i) = alpha_hat(1) + alpha_hat(2)*(t(i)) + alpha_hat(3) *
(t(i)^2);
end
end
```

```
function dy_dt = naive_der(y,t)
%NAOVE_DER Summary of this function goes here
%   Detailed explanation goes here
dy_dt = t;
for i=2:length(t)
   dy_dt(i) = ((y(i)-y(i-1))/(t(i)-t(i-1)));
end
end
```

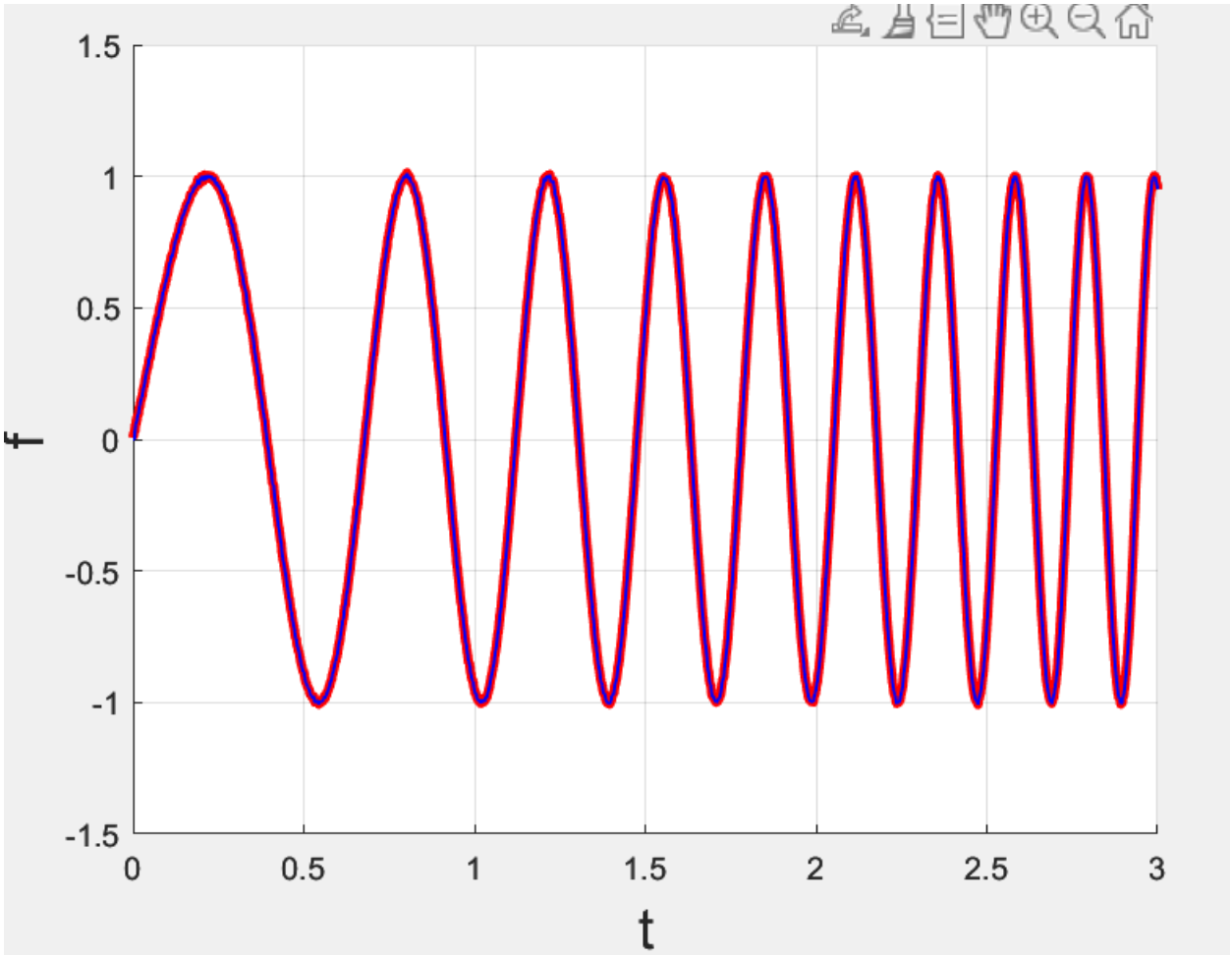
Question 3:

RMSE value is 3.9919

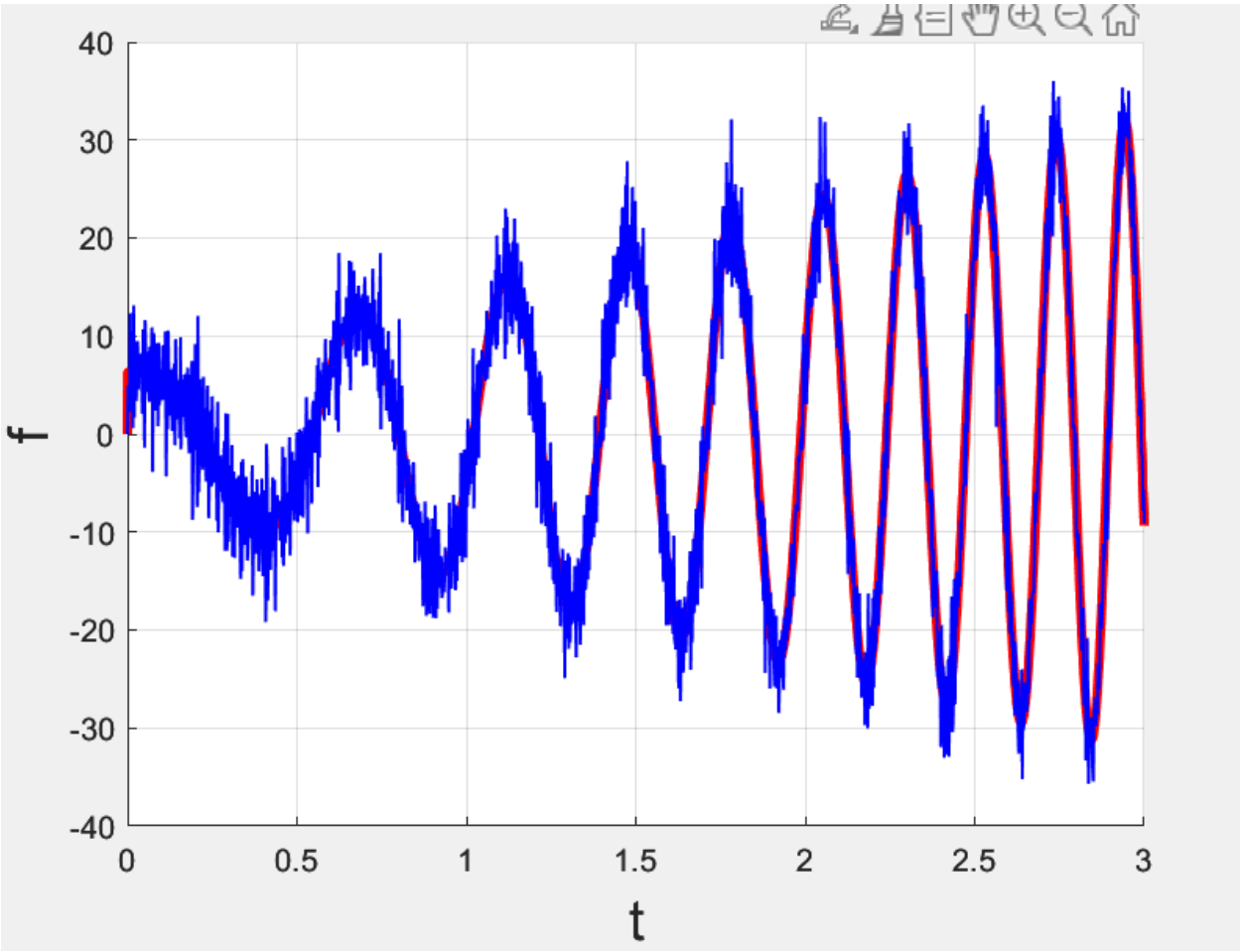
Regression derivative vs Original derivative



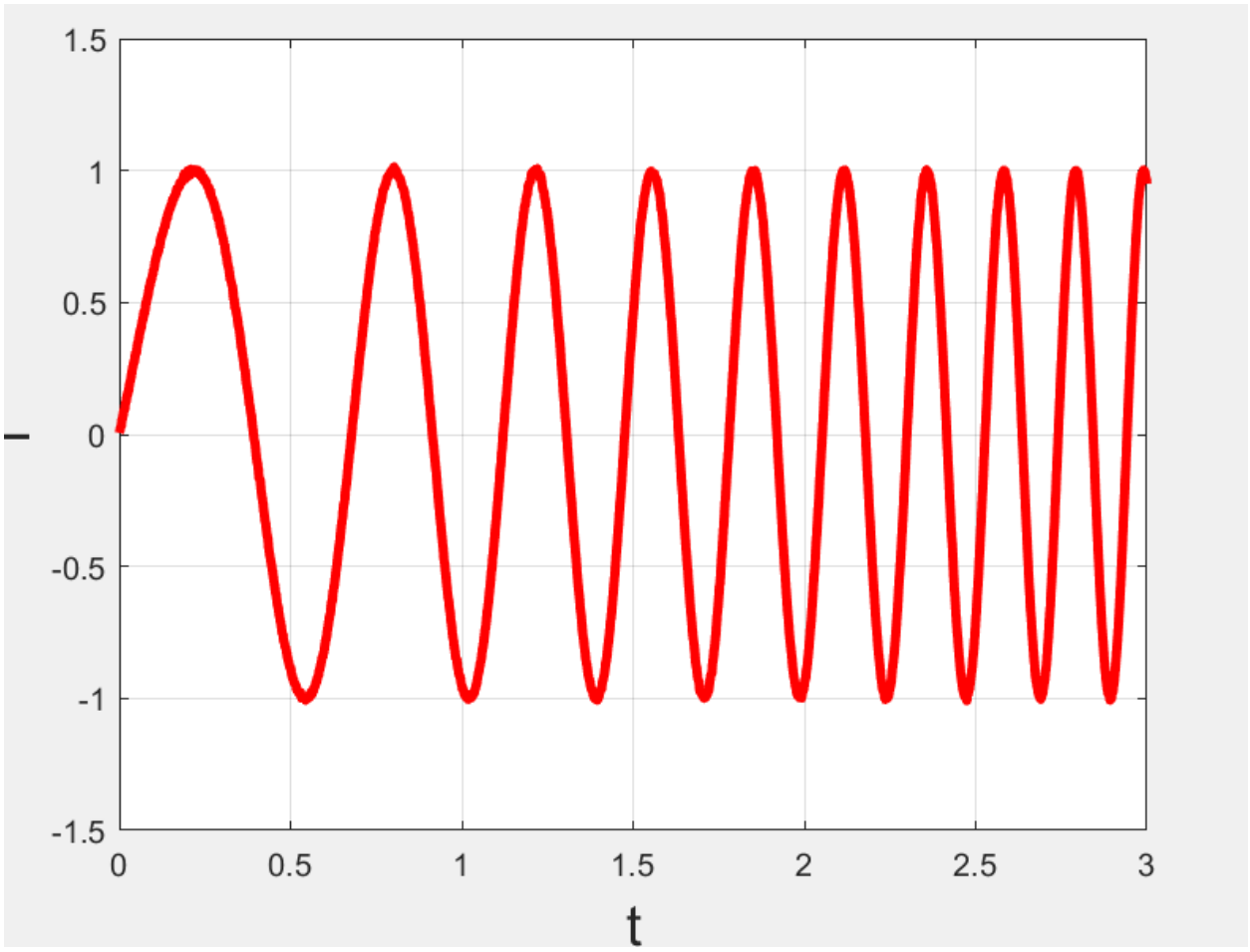
Regression vs function



Naive derivative vs original derivative



Original Function


1.5
1
0.5
0
-0.5
-1
-1.5
I
0
0.5
1
1.5
2
2.5
3
t

Code:

```
load ./data/DataHW06_Prob3
fig1 = figure();
plot(t,y,'r','linewidth',3);
grid on
xlabel('t','FontSize',18);
ylabel('f','FontSize',18);
dy_dt = naive_der(y,t);
[y_regress,dy_dt_regress, rmse_err] = do_regress(y,t, dy);
fig2 = figure();
hold on
plot(t,dy,'r','linewidth',3);
plot(t,dy_dt,'b','linewidth',1);
grid on
xlabel('t','FontSize',18);
ylabel('f','FontSize',18);
hold off
fig3 = figure();
hold on
plot(t,y,'r','linewidth',3);
plot(t,y_regress,'b','linewidth',1);
grid on
xlabel('t','FontSize',18);
ylabel('f','FontSize',18);
hold off
fig4 = figure();
hold on
plot(t,dy,'r','linewidth',3);
plot(t,dy_dt_regress,'b','linewidth',1);
grid on
xlabel('t','FontSize',18);
ylabel('f','FontSize',18);
hold off

function dy_dt = naive_der(y,t)
%NAOVE_DER Summary of this function goes here
%   Detailed explanation goes here
dy_dt = t;
for i=2:length(t)
   dy_dt(i) = ((y(i)-y(i-1))/(t(i)-t(i-1)));
end
end

function [y_regress,dy_dt_regress, err] = do_regress(y,t, dy)
dy_dt_regress = zeros(1, length(y));
y_regress = zeros(1, length(y));
err = 0;
```

```
count = 0;
for i = 4 : length(y)
   y_window = [y(i - 3) ;y(i - 2); y(i - 1); y(i)];
   moving_window = [t(i-3); t(i-2); t(i-1); t(i)];
   A = [ones(4,1), moving_window, moving_window.^2];
   alpha_hat = inv(A' * A)*A'*y_window;
   dy_dt_regress(i) = alpha_hat(2) + 2*alpha_hat(3) * t(i);
   y_regress(i) = alpha_hat(1) + alpha_hat(2)*(t(i)) + alpha_hat(3) * (t(i)^2);
   err = err + (dy_dt_regress(i) - dy(i))^2;
   count = count + 1;
end
err = sqrt(err/count);
end
```

Question 7

Code:

```
% Initialize values
A = diag([0.5, 1, 1, 0.5, 1]);
B = [3, 0, 2, 0, 1]';
C = 0.25;
D = B';
%% Function call
A_inv = inv(A);
output_matrix = matrix_lemma(A, B, C, D, A_inv)
req_ans = inv(A+(B*C*D))

function output_matrix = matrix_lemma(A, B, C, D, A_inv)
C_inv = inv(C);
E = inv((C_inv + (D*A_inv*B)));
output_matrix = A_inv - (A_inv*B*E*D*A_inv);
end
```

req_ans =

```
   0.6667         0   -0.4444         0   -0.2222
        0    1.0000         0         0         0
   -0.4444         0    0.8519         0   -0.0741
        0         0         0    2.0000         0
   -0.2222         0   -0.0741         0    0.9630
```

output_matrix =

```
   0.6667         0   -0.4444         0   -0.2222
        0    1.0000         0         0         0
   -0.4444         0    0.8519         0   -0.0741
        0         0         0    2.0000         0
   -0.2222         0   -0.0741         0    0.9630
```