Numerical Derivatives:

Forward derivative:

$$f'_i = (f_{i+1} - f_i) / (x_{i+1} - x_i)$$

Backward derivative:

$$f'_i = (f_i - f_{i-1}) / (x_i - x_{i-1})$$

Centered derivative:

$$f'_i = (f_{i+1} - f_{i-1}) / (x_{i+1} - x_{i-1})$$

5 point derivative:

$$f'_i = (f_{i-2} - 8 f_{i-1} + 8 f_{i+1} - f_{i+2}) / (3 (x_{i+2} - x_{i-2}))$$

To do

xmin = 0
xmax = 20;
N = 50, 100, 500;

f(x) = (sin(1.2x))^2 + (cos(0.8x))^2

1) f1(x) = d/dx f(x) : analytic derivative;
2) f2(x) = d/dx f(x) : numerical derivative: forward;
3) f3(x) = d/dx f(x) : numerical derivative: backward;
4) f4(x) = d/dx f(x) : numerical derivative: centered;
5) f5(x) = d/dx f(x) : numerical derivative: 5 point ;

figure(1) : N = 50
figure(2) : N = 100
figure(3) : N = 200
figure(4) : N = 1000

Plot on each figure:

subplot(2,2,k);

k =

1) (f2-f1)
2) (f3-f1)
3) (f4-f1)
4) (f5-f1)