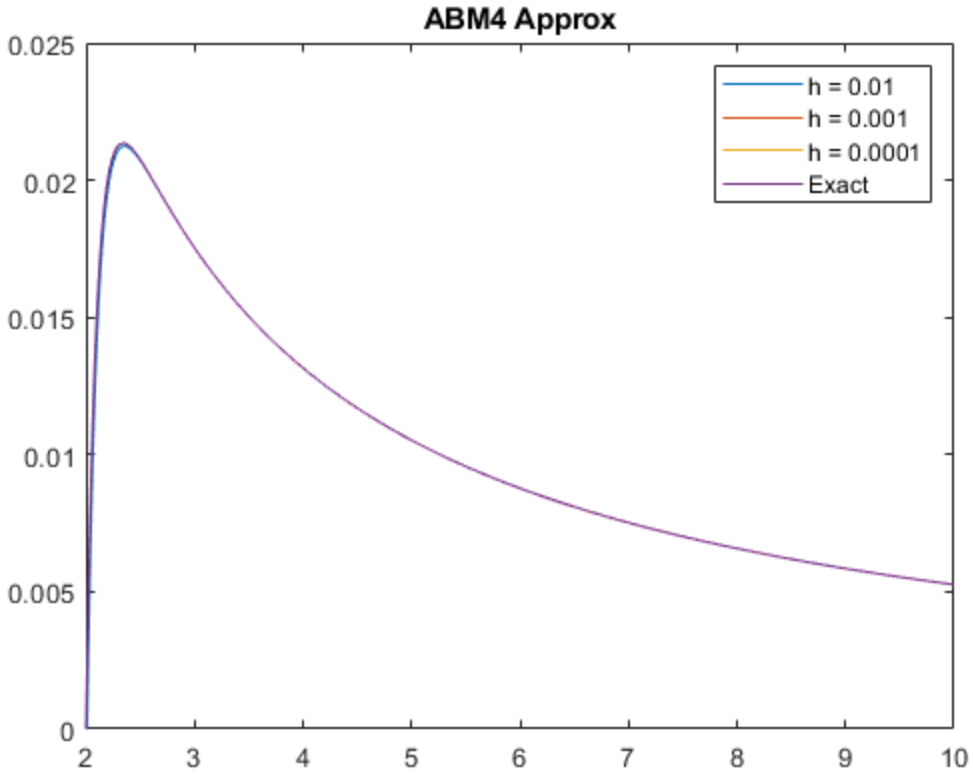
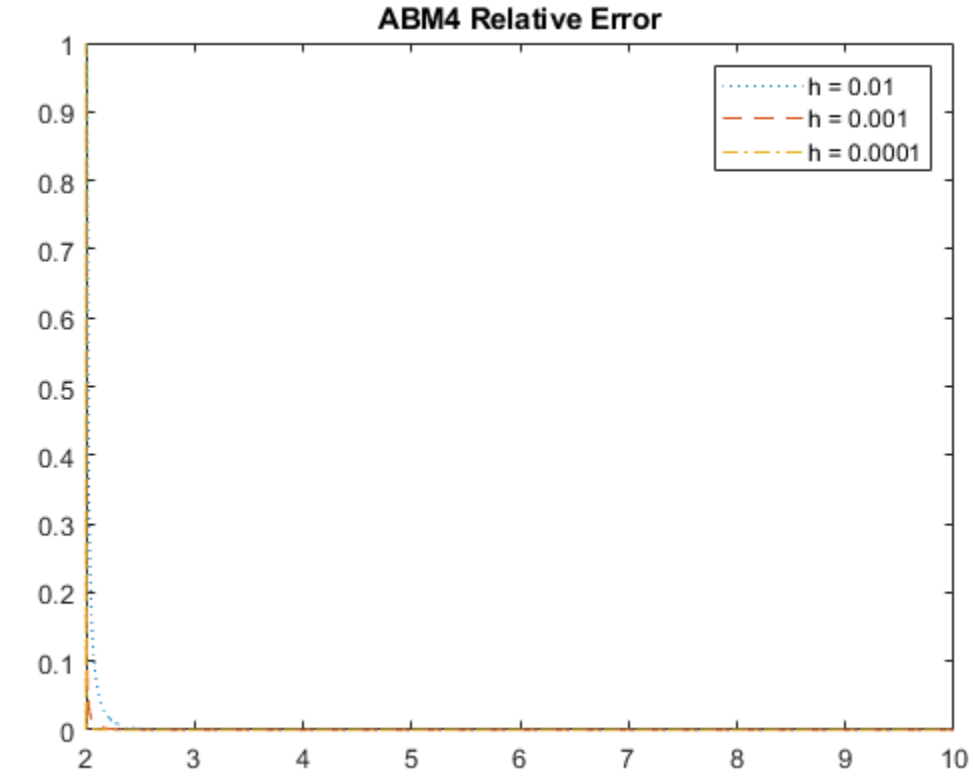
```
% Matt McDade
% ANM 2
% HW 4 problem 2

function hw_4_2
    close all;

    f = @(x, y) (1-20*x*y)./(x.^2);
    f_ex = @(x) (1./(19*x)) - (524288./(19*x.^20));
    a = 2; b = 10; ya = 0;

    [T1,Y1] = abm4(f, a, b, ya, 0.01);
    [T2,Y2] = abm4(f, a, b, ya, 0.001);
    [T3,Y3] = abm4(f, a, b, ya, 0.0001);

    figure(); plot(T1,Y1,T2,Y2,T3,Y3,T3,f_ex(T3))
    title("ABM4 Approx"); legend("h = 0.01","h = 0.001","h =
 0.0001","Exact")

    relerr1 = relerr(f_ex, T1, Y1);
    relerr2 = relerr(f_ex, T2, Y2);
    relerr3 = relerr(f_ex, T3, Y3);
    figure(); plot(T1, relerr1, ':', T2, relerr2, '--', T3,
 relerr3, '-.')
    title("ABM4 Relative Error"); legend("h = 0.01","h = 0.001","h =
 0.0001")

    function [t, y] = abm4(f, a, b, ya, h)
        t = a:h:b;
        N = length(t);
        y(a) = ya;
        for i = a:N-1
            p(i+1) = y(i) + h*f(t(i), y(i));
            y(i+1) = y(i) + (h./2)*(f(t(i),y(i)) + f(t(i+1),p(i+1)));
        end
    end

    function relerr = relerr(f_ex, x, y)
        y_ex = f_ex(x);
        relerr = abs(y_ex - y) ./ (abs(y_ex) + eps);
    end

end
```


ABM4 Approx
0.025
0.02
0.015
0.01
0.005
0
2
3
4
5
6
7
8
9
10
h = 0.01
h = 0.001
h = 0.0001
Exact


ABM4 Relative Error
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2
3
4
5
6
7
8
9
10
h = 0.01
h = 0.001
h = 0.0001

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