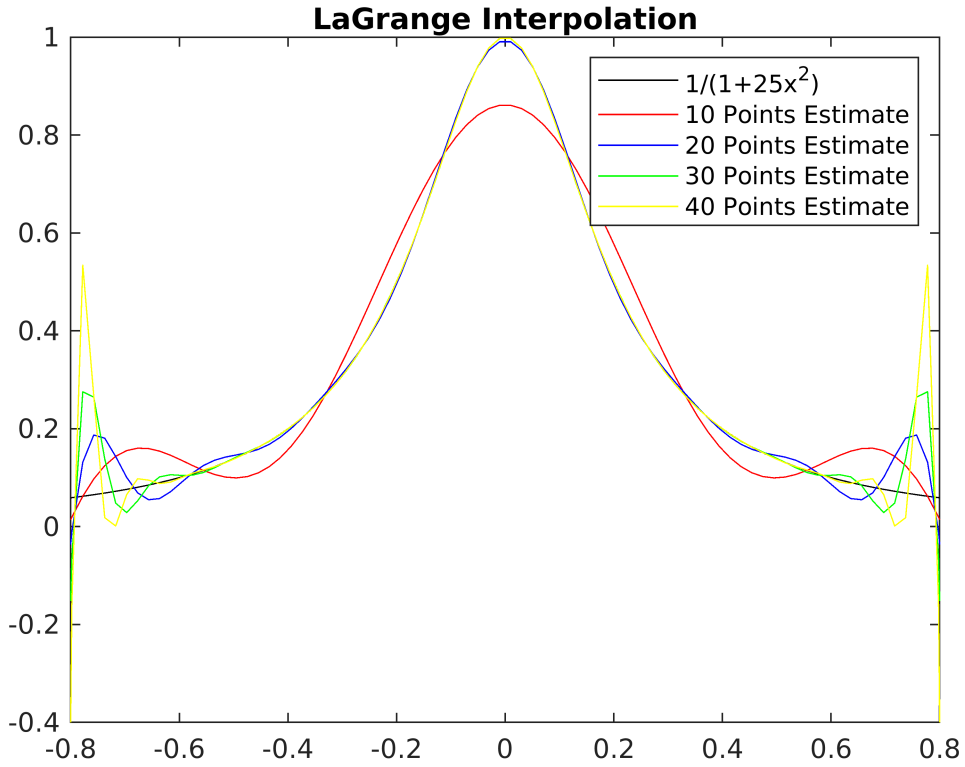
Question 1a

```
p = @(x) 1./(1+25*x.^2);
X = linspace(-1, 1, 100);
x10 = linspace(-1, 1, 10);
x20 = linspace(-1, 1, 20);
x30 = linspace(-1, 1, 30);
x40 = linspace(-1, 1, 40);
y10 = linterp(x10, p(x10), X);
y20 = linterp(x20, p(x20), X);
y30 = linterp(x30, p(x30), X);
y40 = linterp(x40, p(x40), X);
plot(X, p(X), 'k-', X, y10, 'r-', X, y20, 'b-', X, y30, 'g-', X, y40, 'y-');
title("LaGrange Interpolation");
legend("1/(1+25x^2)","10 Points Estimate", "20 Points Estimate", "30 Points Estimate",
xlim([-0.8, 0.8])
```

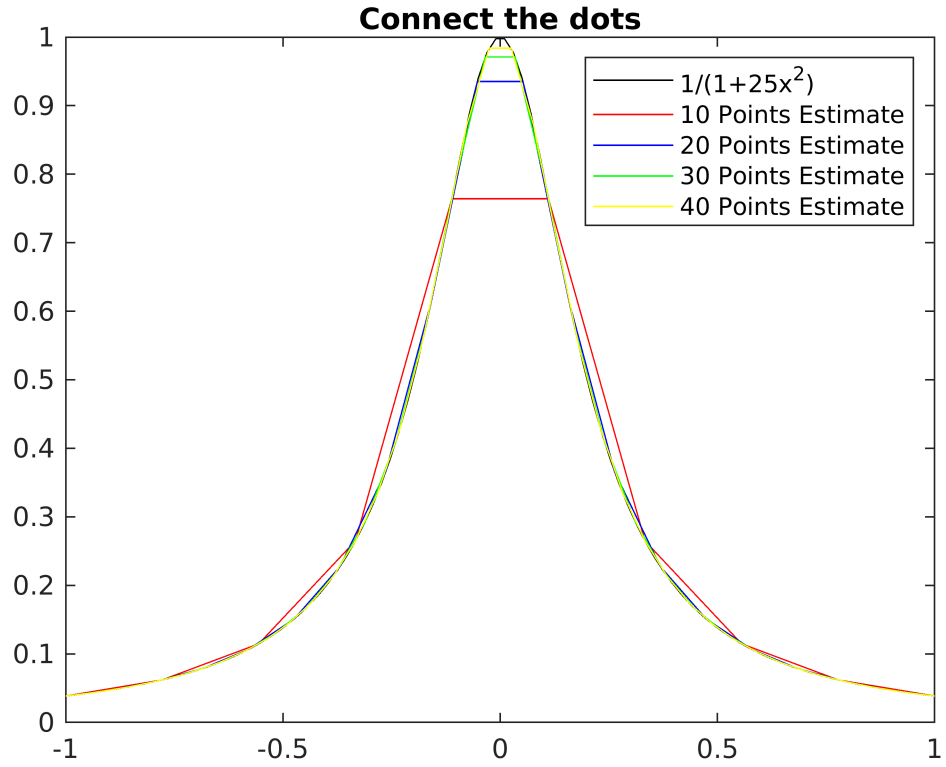


Increasing the number of sample points does give a better LOCAL approximation, but increases error around the ends as it tends to follow a much stronger sinusoidal wave.

Question 1b

```
[x10, y10] = plinterp(x10, p(x10));
[x20, y20] = plinterp(x20, p(x20));
[x30, y30] = plinterp(x30, p(x30));
[x40, y40] = plinterp(x40, p(x40));
```

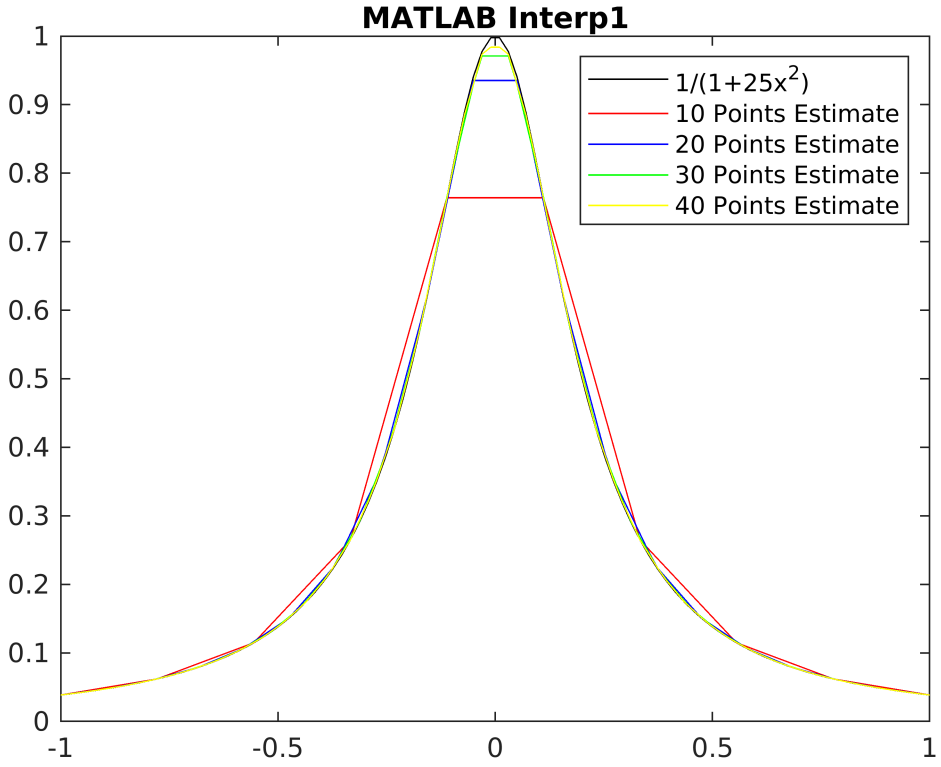
```
plot(X, p(X), 'k-', x10, y10, 'r-', x20, y20, 'b-', x30, y30, 'g-', x40, y40, 'y-');
title("Connect the dots");;
legend("1/(1+25x^2)","10 Points Estimate", "20 Points Estimate", "30 Points Estimate",
```



Yes it seems like these are better approximations than the previous implementation.

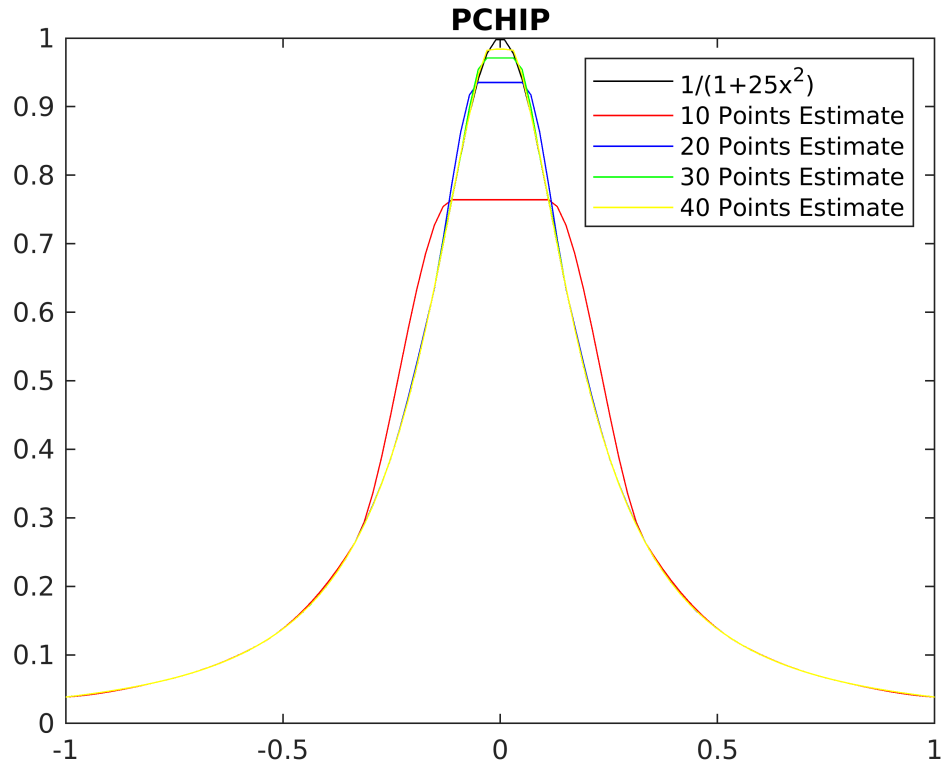
Question 1c

```
x10 = linspace(-1, 1, 10);
x20 = linspace(-1, 1, 20);
x30 = linspace(-1, 1, 30);
x40 = linspace(-1, 1, 40);
y10 = interp1(x10, p(x10), X);
y20 = interp1(x20, p(x20), X);
y30 = interp1(x30, p(x30), X);
y40 = interp1(x40, p(x40), X);
plot(X, p(X), 'k-', X, y10, 'r-', X, y20, 'b-', X, y30, 'g-', X, y40, 'y-');
title("MATLAB Interp1");
legend("1/(1+25x^2)","10 Points Estimate", "20 Points Estimate", "30 Points Estimate",
```



Question 1d

```
y10 = pchip(x10, p(x10), X);
y20 = pchip(x20, p(x20), X);
y30 = pchip(x30, p(x30), X);
y40 = pchip(x40, p(x40), X);
plot(X, p(X), 'k-', X, y10, 'r-', X, y20, 'b-', X, y30, 'g-', X, y40, 'y-');
title("PCHIP");
legend("1/(1+25x^2)","10 Points Estimate", "20 Points Estimate", "30 Points Estimate",
```



Although it looks smoother, it does seem to deviate more in some lines, such as 10 points, it deviates more as the slope increasaes or decreases dramatically.

```
function y = linterp(X, Y, x)
    y = 0;
    for i = 1:numel(X)
        yy = Y(i);
        for j = 1:numel(X)
            if i ~= j
                yy = yy .* (x - X(j)) / (X(i) - X(j));
            end
        end
        y = y + yy;
    end
end

function [bigX, bigY] = plinterp(X, Y)
    bigX = [];
    bigY = [];
    for i = 1:numel(X)-1
        xx = linspace(X(i), X(i+1), 5);
        yy = linterp([X(i) X(i+1)], [Y(i) Y(i+1)], xx);
        bigX = [bigX xx];
        bigY = [bigY yy];
    end
```

```
end
```