Q12

```matlab
1    %Aayank Singhai
2
3    clear all;
4    close all;
5    clc;
6
7    domain = linspace(-4, 4, 1000);
8    varList = [1, 0.25, 1/9, 1/16];
9    numCurves = numel(varList);
10
11   pdfData = zeros(numCurves, numel(domain));
12
13   gaussianPDF = @(x_vec, v) (1./sqrt(2*pi*v)) .* exp(-(x_vec.^2)./(2*v));
14
15   integralAreas = zeros(numCurves, 1);
16   for i = 1:numCurves
17       currentVar = varList(i);
18       pdfData(i, :) = gaussianPDF(domain, currentVar);
19       integralAreas(i) = trapz(domain, pdfData(i, :));
20   end
21
22   disp('--- Numerical Integration Check ---');
23   disp('Variance    | Area');
24   disp('-------------------------------');
25   for i = 1:numCurves
26       fprintf('Var: %-7.4f | Area: %-7.6f\n', varList(i), integralAreas(i));
27   end
28
29   figure(1);
30   set(gcf, 'Color', 'w', 'Position', [100 100 900 450]);
31   colorMap = jet(numCurves);
32
33   hold on;
34   for i = 1:numCurves
35       plot(domain, pdfData(i, :), 'LineWidth', 2, 'Color', colorMap(i,:));
36   end
37   hold off;
38
39   legendEntries = arrayfun(@(v) sprintf('\\sigma^2 = %.3f', v), varList, 'UniformOutput', fal
40   legend(legendEntries, 'Location', 'northeast');
41   xlabel('x');
42   ylabel('PDF f(x)');
```

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39    legendEntries = arrayfun(@(v) sprintf('\\sigma^2 = %.3f', v), varList, 'UniformOutput', fal
40    legend(legendEntries, 'Location', 'northeast');
41    xlabel('x');
42    ylabel('PDF f(x)');
43    title('Gaussian PDF Comparison as Variance Decreases');
44    grid on;
45    box on;
46    set(gca,'FontSize',12);
47
48    figure(2);
49    set(gcf, 'Color', 'w', 'Position', [200 200 700 450]);
50
51    animVarList = [linspace(1, 0.1, 15), 0.08, 0.05, 0.02, 0.01, 0.005];
52
53    for v = animVarList
54        y_anim = gaussianPDF(domain, v);
55
56        plot(domain, y_anim, 'LineWidth', 2.5, 'Color', 'r');
57
58        ylim([0 max(pdfData(:))*1.1]);
59        xlim([domain(1) domain(end)]);
60
61        title(sprintf('Approaching the Impulse: \\sigma^2 = %.4f', v), 'FontSize', 14);
62        xlabel('x');
63        ylabel('PDF f(x)');
64        grid on;
65
66        drawnow;
67        pause(0.25);
68    end
69
70    figure(3);
71    set(gcf, 'Color', 'w', 'Position', [300 300 700 450]);
72
73    plot(domain, pdfData(1,:), 'LineWidth', 1.5, 'Color', [0.7 0.7 0.7]);
74    hold on;
75    for i = 2:numCurves
76        plot(domain, pdfData(i,:), 'LineWidth', 2, 'Color', colorMap(i,:));
77    end
78    hold off;
79
80    xlim([-0.5 0.5]);
```
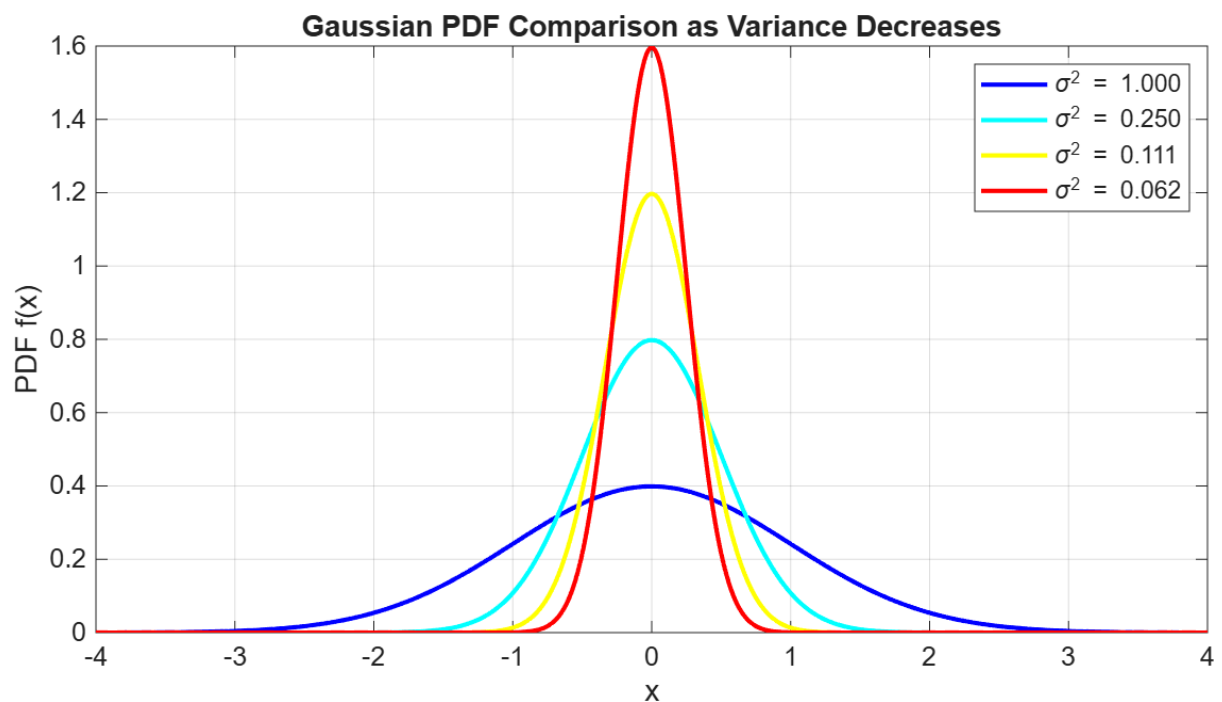
```matlab
75    for i = 2:numCurves

77    end
78    hold off;
79
80    xlim([-0.5 0.5]);
81    legend(legendEntries, 'Location', 'northeast');
82    xlabel('x');
83    ylabel('PDF f(x)');
84    title('Zoomed View: Spike Formation at x=0');
85    grid on;
86    box on;
87    set(gca,'FontSize',12);
88
89    figure(4);
90    set(gcf, 'Color', 'w', 'Position', [400 400 700 450]);
91
92    smallestVarIdx = numCurves;
93    y_smallest = pdfData(smallestVarIdx, :);
94
95    plot(domain, y_smallest, 'k', 'LineWidth', 1.5);
96    hold on;
97
98    fill(domain, y_smallest, [0.8 1 0.8], 'EdgeColor', 'none');
99
100   xlabel('x');
101   ylabel('PDF f(x)');
102   title(sprintf('Area for \\sigma^2 = %.3f is %.6f', ...
103       varList(smallestVarIdx), integralAreas(smallestVarIdx)), 'FontSize', 12);
104   grid on;
105   set(gca,'FontSize',12);
```

Approaching the Impulse: $\sigma^2 = 0.0050$

Zoomed View: Spike Formation at x=0

$\sigma^2 = 1.000$	
$\sigma^2 = 0.250$	
$\sigma^2 = 0.111$	
$\sigma^2 = 0.062$	

Area for $\sigma^2 = 0.062$ is 1.000000