

Q12

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```

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', false);
40 legend(legendEntries, 'Location', 'northeast');
41 xlabel('x');
42 ylabel('PDF: f(x)');

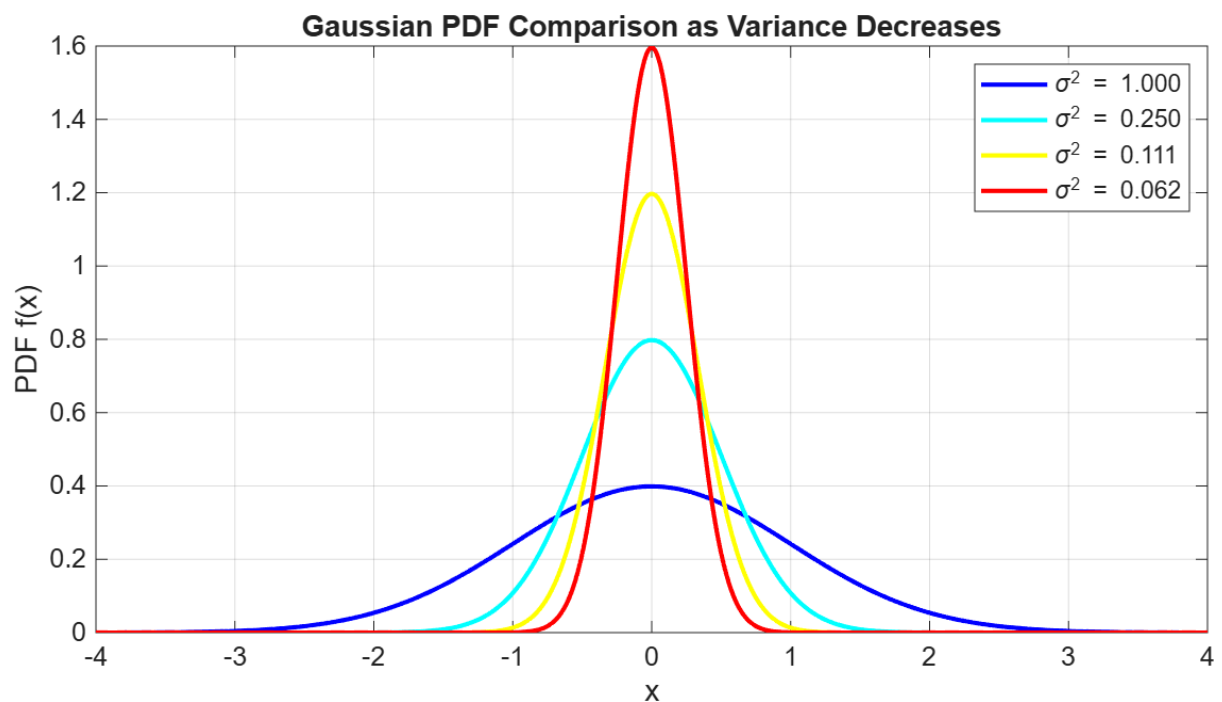
```

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```
39 legendEntries = arrayfun(@(v) sprintf('\sigma^2 = %.3f', v), varList, 'UniformOutput', false);
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]);
```

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```
75 for i = 2:numCurves
76     % Plot the PDF for the current variance
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: $\sigma^2 = 0.0050$

