

Bessel Function Zeros

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The Bessel function of order  $n$ , for  $n = 0, 1, 2, \dots$ , can be defined by the definite integral

$$J_n(x) = \frac{1}{\pi} \int_0^\pi \cos(x \sin \theta - n\theta) d\theta.$$

Compute the first five positive roots  $j_{n,k}$ , ( $k = 1, 2, \dots, 5$ ), of the first six Bessel functions  $J_n(x)$ , ( $n = 0, 1, \dots, 5$ ).

Script ?

Save

Reset

MATLAB Documentation (https://www.mathworks.com/help/)

```
1 num_roots=5; num_functions=6;
2 %initial guess for roots (from Wolfram MathWorld)
3 zeros_guess=[2.4,3.8,5.1,6,7.5,8.7;...
4     5.5,7,8.4,9.7,11,12;...
5     8.6 10,11.6,13,14,16;...
6     11.8,13,15,16,18,19;...
7     15,16.4,18,19.4,21,22];
8 %Compute first five roots of first six Bessel functions
9 %Put in variable bzeros with size(bzeros) = [5, 6]
10 J = @(theta,x,n) cos(x.*sin(theta)-n*theta) / pi; % parameterized function
11 bzeros = zeros(5,6);
12 for i=1:num_functions
13     for j=1:num_roots
14         bzeros(j,i) = fzero(@(x) integral(@(theta) J(theta, x, i-1), 0, pi), zeros_guess(j,i)); % parameterized function
15     end
16 end
17 %print table
18 fprintf('k      J0(x)      J1(x)      J2(x)      J3(x)      J4(x)      J5(x)\n')
19 for k=1:num_roots
20     fprintf('%i',k)
21     for n=0:num_functions-1
22         fprintf(' %10.4f',bzeros(k,n+1));
23     end
24     fprintf('\n');
25 end
26
```

Run Script ?

Assessment: All Tests Passed

Submit ?

✔ Test Bessel function zeros

Output

k	J0(x)	J1(x)	J2(x)	J3(x)	J4(x)	J5(x)
1	2.4048	3.8317	5.1356	6.3802	7.5883	8.7715
2	5.5201	7.0156	8.4172	9.7610	11.0647	12.3386
3	8.6537	10.1735	11.6198	13.0152	14.3725	15.7002
4	11.7915	13.3237	14.7960	16.2235	17.6160	18.9801
5	14.9309	16.4706	17.9598	19.4094	20.8269	22.2178

