

P2

Missing

100 Points Possible

3/14/2025

Attempt 1



In Progress

NEXT UP: Submit Assignment

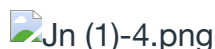
Add Comment

Unlimited Attempts Allowed

1/13/2025 to 3/14/2025

Details**P2: Bessel Functions**

This definite integral can define the Bessel function of order n : (check announcement/bottom of this page if the below figure doesn't load)



The zeros of the Bessel function play an essential role in the solution of partial differential equations in cylindrical coordinates. The goal of this project is to compute the first five positive roots $J_{n,k}$ ($k = 1, 2, 3, 4, 5$) of the first three Bessel functions $J_n(x)$ ($n = 0, 1, 2$) using numerical methods.

Before you start computing the roots, plot the Bessel functions $J_n(x)$ versus x for $x = 0$ to 20 for $n = 0, 1, 2$ using different colors. You can visualize the roots from the plot and determine their approximate values.

You can find the roots of the Bessel functions using built-in functions in NumPy or SciPy. Initial guesses for the roots can be obtained from the Bessel function plots (input by hand the initial guesses accurate to no more than one decimal place).

Plot the five roots for each value of n using different colors on a single graph. Label the axes and have a legend for the colors.

Browse papers in the Astrophysical Journal or Physical Review to get a feel of the writing style that we are expecting. You will be submitting a single paper for your group. We have enclosed the LaTeX template that you have to use. Here is the outline of your paper:

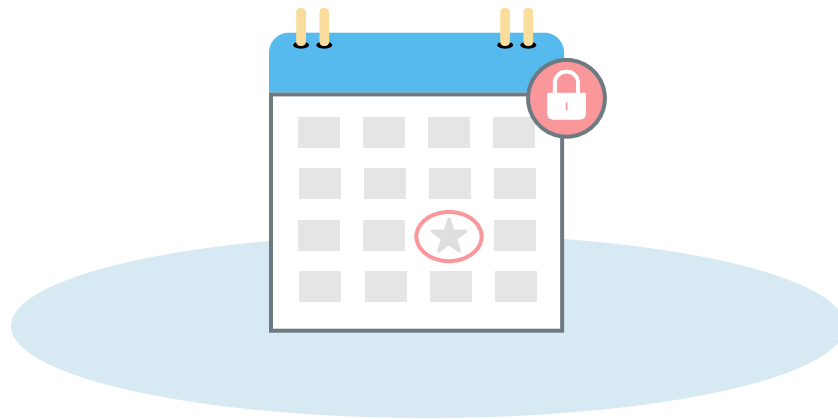
- Title
- Authors' Names
- Affiliation Name (The University of Texas at Austin)
- Abstract
- Keywords
- In your introduction, state the Bessel differential equations and define all the terms.
- Discuss actual physical situations (at least three) described by the Bessel differential equation.

- Discuss how you obtained the roots of the Bessel function.
- Summarize how you can use the roots to interpret the solution of the Bessel function for the three situations you discussed above.
- Discuss any future work you could have done to extend your work and contribute to our understanding of Bessel functions.
- Acknowledgment - acknowledge any help that you got from your classmates or the TAs.
- References

Use the templates APJ_Template.pdf and apj_template.tex in Files-> Projects.

(In case the figure above doesn't show up)

$$J_n(x) = \frac{1}{\pi} \int_0^\pi \cos(x \sin \theta - n \theta) d\theta \quad \text{for } n = 0, 1, 2, \dots$$



Availability Dates

1/13/2025 to 3/14/2025