Aerospace Computing

Assignment 6

Due: 2/23/24

Using the Prandtl-Meyer function.

1. Analytically find the first and second derivative with respect to Mach number. Do it however you like.
2. Use the finite difference methods listed below to estimate BOTH the first and second derivative of ν from $1 \leq M \leq 5$. Using at least 15 different Mach numbers, plot each derivative approximation separately along with the exact derivative. (There should be 6 total plots.)
    a. Central differences
    b. Forward one-sided first-order differences
    c. Forward one-sided second-order differences
3. Redo the above derivative calculations, but this time plot the total error, i.e., the difference between the exact solution and the finite difference approximations. Use the same Mach number range as part 2, but use different $\Delta M = 0.1, 0.01, 0.001, \ldots, 1e-14$ for the finite difference approximation.
    a. Plot each method/derivative combination on a separate plot, using a different color for each ΔM. (6 total plots)
4. Consider the single Mach number, M=1.3,
    a. On a single figure, plot the error versus ΔM for all 3 first derivative approximations.
    b. On a second single figure, plot the error versus ΔM for all 3 second derivative approximations.
    c. Write a small paragraph describing the optimum ΔM based on your results.