

Name \_\_\_\_\_

## Final exam, numerical methods, MET 431 Computer exercises

Use Excel, Matlab, or FORTRAN to solve the following problems. Run and show the solutions to me by videoconference or in the lab; or email me the spreadsheet; or email me the software, input, and output. All questions are worth 20 points.

- 1) Fit a third-order polynomial  $V_{max} = a_0 + a_1 p_c + a_2 p_c^2 + a_3 p_c^3$  to the assigned tropical cyclone data.
- 2) a. Run a linear interpolator on the provided data and interpolate at  $x=7.2$  .  
b. Run a PCHIP, Akima, or Steffen spline on the provided data and interpolate at  $x=7.2$  .
- 3) Perform numerical integration to compute Ocean Heat Content (OHC) in the top 700 meters from an Argo float using the assigned data. The equation is:

$$OHC = \rho c_p \int_0^{700} T dz$$

where  $\rho = 1025 \text{ kg m}^{-3}$  and  $c_p = 4000 \text{ J kg}^{-1}$  are sea water density and ocean heat capacity.

- 4) Numerically solve for  $\psi$  using the assigned algorithm:

$$\frac{d\psi}{dt} = \psi - t^2 + 1; \quad \psi = 0.5 \quad \text{at} \quad t = 0$$

at  $t=0.3$ . Use  $\Delta t = 0.1$  . Compare to the analytical solution  $\psi = (t + 1)^2 - 0.5e^t$ .

- 5) Compile and run the FORTRAN programs leap.f and cour\_leap.f . Vary the Courant number  $< 1$ ,  $1$ , and  $> 1$  in cour\_leap.f . What happens?