

Assignment Set for Laboratory 1

ATSC 409: Hand-in answers to questions 1, 2 and 3.

EOSC 511/ATSC 506: Hand-in answers to questions 1, 3 and 4.

1. Given the following four (x,y) points (-5,-1), (0,0), (5,1), (8,4) find the y-value at x=3 using

- (a) Linear Interpolation
- (b) Cubic Interpolation

2. Given the equation

$$\frac{\partial y}{\partial t} = y(y + t) \quad (1)$$

write down

- (a) forward Euler difference formula
- (b) backward Euler difference formula
- (c) centered difference formula

3. The equation

$$\frac{\partial y}{\partial t} + c \frac{\partial y}{\partial x} = 0, \quad y = \cos(x) \text{ at } t = 0, \quad \frac{\partial y}{\partial t} = c \sin(x) \text{ at } t = 0 \quad (2)$$

has a solution $y = \cos(x - ct)$.

- (a) Expand both derivatives as centred differences.
- (b) Show that the algebraic solution is an exact solution of the difference formula if we choose $\Delta x = c\Delta t$.

4. Given

$$\frac{\partial y}{\partial t} = -\alpha y, \quad y = 1 \text{ at } t = 0 \quad (3)$$

- (a) Show that the forward Euler method gets a smaller answer than the backward Euler method for all $t > 0$, provided that $0 < \alpha^2 \Delta t^2 < 1$.
- (b) Solve the equation analytically.
- (c) Show that the forward Euler always under-estimates the answer provided that $\alpha \Delta t < 1$ and $\alpha \Delta t \neq 0$.