

### Approximation 1 - FORWARD DIFFERENCES (FD)

→ Take the slope between  $P_i$  and  $P_{i+1}$  as being approximately  $(\frac{dP}{dx})_i$  at  $x_i$  to get:

$$\left(\frac{dP}{dx}\right)_{ifd} = \frac{P_{i+1} - P_i}{\Delta x}$$

### Approximation 2 - BACKWARD DIFFERENCES (BD)

→ Take the slope between  $P_{i-1}$  &  $P_i$  as being approximately  $(\frac{dP}{dx})_i$  at  $x_i$  to obtain:

$$\left(\frac{dP}{dx}\right)_{ibd} = \frac{P_i - P_{i-1}}{\Delta x}$$

### Approximation 3 - CENTRAL DIFFERENCES (CD)

→ Average the forward difference and the backward difference to give  $(\frac{dP}{dx})_i$  at  $x_i$

$$\therefore \left(\frac{dP}{dx}\right)_{icd} = \frac{1}{2} \left[ \left(\frac{dP}{dx}\right)_{ifd} + \left(\frac{dP}{dx}\right)_{ibd} \right] = \frac{1}{2} \left[ \frac{P_{i+1} - P_i}{\Delta x} + \frac{P_i - P_{i-1}}{\Delta x} \right]$$

$$\therefore \left(\frac{dP}{dx}\right)_{icd} = \left[ \frac{P_{i+1} - P_{i-1}}{2 \cdot \Delta x} \right]$$