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National University Of Computer & Emerging Sciences **Peshawar Campus** O Differentiation by I.E Numerical Differenciation Newton Forward 1. Formula x0/00 y(x)=y0+PDY0+P(P-1)B2y0+ x1 / 70 x2 g2. P(P-1)(P-2) B340 +---23 73 14 1 9 u x=xi, y'(xi), y"(xi) where P= x-20 => x= xo+ Ph -> Equal interval -> Unequal interval. => y(x0+Ph)= y0+PAY0+(P2-P) 12y0+(P3-3P3+2P) 13y0 Differentiating wort 'p' => dy. h = y(x) = Dy + (2P-1) 2y + (3P2-6P+2) 03y + => 1(x) = dx = 1 [Dy + (3P-1) 2y + (3P2-6P+3) D3y+ This is the numerical differential formula

derived from Newton forward I. Formula. Differentiating again

$$\frac{3\lambda^{2}}{3\lambda^{2}} = \lambda(x) = \frac{1}{7} \left[\nabla_{5} \lambda^{0} + (\delta - 1) \nabla_{3} \lambda^{0} + \cdots \right]$$



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Question:

Find dy at x=1.5 from following table.

7 337570 3.65 3.6 3.65 59

Sal

The forward difference table for given

×0=1-5	3.375	DY	12-A	13°4	L'Y
3.0 3.5 4.0	7.0 13.625 24 38.875 59	-046=3.625 - 6.625 - 10.375 - 14.875 - 20.135	-3.75 - 4.5 - 3.25	- 37 = 0.75 - 0.75 - 0.75	- 0

Given: $x_0 = 1.5$, x = 1.5, h = 0.5, P = 0 $\Rightarrow \frac{dy}{dx} = 4(x) = \frac{1}{h} \left(\frac{hy}{h} + \frac{2P-1}{2l} \frac{h^2y}{h^2} + \frac{3P^2-6P+1}{3l} \frac{h^3y}{h^3} \right)$ $\Rightarrow \left(\frac{dy}{dx} \right)_{x=1.5} = \frac{1}{0.5} \left[\frac{3.635+(-\frac{1}{5})(3)+\frac{2}{6}(0.75)}{3l} \right]$ = 4.75 Ans



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For unequal interval.

rest, we will find f(x) then we differentiate f(x) for f'(x).

At
$$x = x_0 =$$
 $= 1$

$$\frac{9x_{3}}{9x_{3}} = \frac{1}{7} \left[\frac{5}{7} - \frac{3}{7} \frac{7}{7} - \frac{3}{7} - \frac{3}{7} \frac{7}{7} - \frac{3}{7} \frac{7}{7} - \frac{3}{7} \frac{7}{7} - \frac{3}{7} - \frac{3}{7} \frac{7}{7} - \frac{3}{7} \frac{7}{7} - \frac{3}{7} \frac{7}{7} - \frac{3}{7} - \frac{3}{7}$$

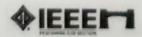


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Here
$$x_{0}=2.00$$
; $p=0$; $h=0.20$
 $y'(2.00) = \frac{1}{0.2}(0.0953 - \frac{1}{3}(-0.0083) + \frac{1}{3}(0.0013))$
 $= 0.4994$.
 $y''(2.00) = \frac{1}{(0.2)^{2}}(-0.0083 - 0.0013)$
 $= -0.24$

 $y(x) = y_0 + P \nabla y_0 + \frac{P(P+1)}{2} \nabla^2 y_0 + \dots$ $P = \frac{x - x_0}{h} \text{ or } x = x_0 + Ph$ $\frac{dP}{dx} = \frac{1}{h}$ $\frac{dy}{dx} = \frac{1}{h} \frac{d^2y}{dx}$ $\frac{d^2y}{dx} = \frac{1}{h} \frac{d^2y}{dx}$ $\frac{d^2y}{dx} = \frac{1}{h} \frac{d^2y}{dx}$ $\frac{d^2y}{dx} = \frac{1}{h} \frac{d^2y}{dx} + \frac{1}{h} \frac{d^2y}{dx}$





Newton Backward









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$$\frac{dy}{dx} = \frac{1}{h} \left[\nabla y_{0} + \frac{3P^{2} + 6P + 2}{2} \nabla^{3} y_{0} + \frac{3P^{2} + 6P + 2}{6} \nabla^{3} y_{0} + \frac{2P^{3} + 9P^{2} + 11P + 3}{12} \nabla^{4} y_{0} + \cdots \right]$$

$$\frac{2P^{3} + 9P^{2} + 11P + 3}{12} \nabla^{4} y_{0} + \frac{6P^{2} + 18P + 11}{12} \nabla^{4} y_{0} + \frac{6P^$$

$$\frac{3x^{2}}{3^{2}} = \frac{13}{12} \left[\Delta_{3}\lambda^{0} + (b+1)\Delta_{3}\lambda^{0} + \frac{6b_{5} + 18b + 11}{12} \Delta_{4}\lambda^{1} + \dots \right]$$

the formula reduces to,
$$\frac{dy}{dx} = \frac{1}{4} \left(\frac{7y}{3} + \frac{1}{4} \frac{7^3y}{3} + \frac{1}{4} \frac{7^$$



