NEWTON'S FORWARD & NEWTON'S BACKWARD INTERPOLATION

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NEWTON'S FORWARD INTERPOLATION

- Formula of Newton's Forward Interpolation

$$y_n(x) = y_0 + p\Delta y_0 + \frac{p(p-1)}{2!}\Delta^2 y_0 + \frac{p(p-1)(p-2)}{3!}\Delta^3 y_0 + \cdots$$

$$+ \frac{p(p-1)(p-2)\ldots(p-n+1)}{n!}\Delta^n y_0$$

Here :- $p = \frac{x - x_0}{h}$

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EXAMPLE

- *Find The value Of tan 0.12*

x	0.10	0.15	0.20	0.25	0.30
$y = tan\,x$	0.1003	0.1511	0.2027	0.2553	0.3093

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SOLUTION

X	Y	Δ	Δ²	Δ³	Δ⁴
0.10	0.1003				
		0.0508			
0.15	0.1511		0.0008		
		0.0516		0.0002	
0.20	0.2027		0.0010		0.0002
		0.0526		0.0004	
0.25	0.2553		0.0014		
		0.0540			
0.30	0.3093				

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Applying Newton's Forward Difference Interpolation Formula.

$$y_n(x) = y_0 + p\Delta y_0 + \frac{p(p-1)}{2!}\Delta^2 y_0 + \frac{p(p-1)(p-2)}{3!}\Delta^3 y_0 + \frac{p(p-1)(p-2)(p-3)}{4!}\Delta^4 y_0$$

Here $y_n(x) = \tan(0.12)$

$$\therefore p = \frac{x - x_0}{h} = \frac{0.12 - 0.10}{0.05} = \frac{0.02}{0.05} = 0.4$$

$$\therefore y_n(x) = 0.1003 + 0.4(0.0508) + \frac{0.4(0.4-1)}{2}0.0008 + \frac{0.4(0.4-1)(0.4-2)}{6}0.0002 + \frac{0.4(0.4-1)(0.4-2)(0.4-3)}{24}0.0002$$

$$y_n(x) = 0.1205$$

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NEWTON'S BACKEARD INTERPOLATION

- Formula of Newton's Backward Interpolation

$$y_n(x) = y_n \; _+ p\nabla y_n + \frac{p(p+1)}{2!}\nabla^2 y_n + \cdots + \frac{p(p-1) \; \ldots \; (p+n-1)}{n!}\nabla^n y_n$$

Here :- $p = \frac{x - xn}{h}$

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EXAMPLE

Consider Following Tabular Values Determine y (300)

x	50	100	150	200	250
y	618	724	805	906	1032

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SOLUTION

X	Y	∇	∇^2	∇^3	∇^4
50	618				
		106			
100	724		-25		
		81		45	
150	805		20		-40
		101		5	
200	906		5		
		126			
250	1032				

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Applying Newton's Backward Difference interpolation Formula.

$$y_n(x) = y_0 + p\nabla y_n + \frac{p(p-1)}{2!}\nabla^2 y_n + \frac{p(p-1)(p-2)}{3!}\nabla^3 y_n + \frac{p(p-1)(p-2)(p-3)}{4!}\nabla^4 y_n$$

Here:- $y_n(x) = yn(300)$

$$\therefore p = \frac{x-xn}{h} = \frac{300-250}{50} = 1$$

$$\therefore y_n(x) = 1032 + 126 + \frac{1(1+1)}{2!}25 + \frac{1(1+1)(1+2)}{3!}5 + \frac{1(1+1)(1+2)(1+3)}{4!}(-40)$$

$$= 1032 + 126 + 25 + 5 - 4$$

$$y_n(300) = 1148$$

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