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#### DEPARTMENT OF MATHEMATICS UNIT - IV INTERPOLATION, NUMERICAL DIFFERENTIATION & INTEGRATION

NEWTON'S FORWARD AND BACKWARD DIFFERENCE

(EQUAL ENTERVALS)

Let the function y = f(n) takes the values  $y_0, y_1, \dots, y_n$  at the points  $x_0, x_1, \dots, x_n$  where  $x_t = x_0 + ih$ . Then Newton's Jouward interpolation polynomial is  $y_{in}(n) = P_n(n) = f(n)$   $= y_0 + \frac{u}{1!} Ay_0 + \frac{u(u-1)}{2!} \Delta^2 y_0 + \frac{u(u-1)(u-2)}{3!} \Delta^3 y_0 + \frac{u(u-1)(u-2)}{3!} \Delta^3 y_0 + \frac{u(u-1)(u-2)\cdots(u-(n-1))}{3!} \Delta^n y_0$ where  $u = \frac{\pi - \pi_0}{-h}$ ; these the difference between two entervals.



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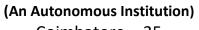
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Then Newton's Backward interpolation polynomial  
is given by  

$$y(x) = P_n(x) = \frac{1}{2}(x)$$
  
 $= \frac{y_n + \frac{u}{1!}}{y_1} \frac{\nabla y_n + \frac{u(u+1)}{2!}}{\sum_{i=1}^{2} \nabla_{y_n}^2 + \frac{u(u+1)(u+2)}{3!}} \sum_{i=1}^{3} \sum_{j=1}^{3} \sum_{j=1}^{3} \sum_{j=1}^{3} \sum_{i=1}^{3} \sum_{j=1}^{3} \sum_{i=1}^{3} \sum_{j=1}^{3} \sum_{i=1}^{3} \sum_{j=1}^{3} \sum_{i=1}^{3} \sum_{j=1}^{3} \sum_{j=1}^{3} \sum_{j=1}^{3} \sum_{i=1}^{3} \sum_{j=1}^{3} \sum_{i=1}^{3} \sum_{j=1}^{3} \sum_{i=1}^{3} \sum_{j=1}^{3} \sum_{i=1}^{3} \sum_{j=1}^{3} \sum_{j=1}^{3$ 

23MAT204–STATISTICS & NUMERICAL METHODS







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Nising Newton's Forward Interpolation & Backward  
Interpolation formula, find the polynomial fine  
satisfying the following data. Hence evaluate  
y at 
$$x = 5$$
.  
 $x = 4 + 6 = 8 = 10$   
 $y = 1 = 3 = 8 = 10$ .  
 $2 = 4 + 6 = 10$   
 $y = 1 = 3 = 10$ .  
 $2 = (5-2)^{2}$   
 $6 = 3 - (8-3) = 3$   
 $5 = (2-5)$   
 $8 = 8 = (10-8)$   
 $10 = 10$ 



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Jorward Enterpolation: Here  $N_0 = 4$ ;  $y_0 = 1$ ; h = 2. u = 2k - 4;  $y_0 = 1$ ; h = 2.  $y(n) = y_0 + \frac{u}{n!} \Delta y_0 + \frac{u(u-i)\Delta^2 y_0}{2!} + \frac{u(u-i)(u-2)}{3!} \Delta^3 y_0$  $= 1 + \left(\frac{\chi - 4}{2}\right)(2) + \left(\frac{\chi - 4}{2}\right)\left(\frac{\chi - 4}{2} - 1\right)\frac{(3)}{2!} + \frac{(\chi - 4)}{2!}$  $\left(\frac{2(-4)}{2}\right)\left(\frac{2(-4)}{2}\right)\left(\frac{2(-4)}{2}\right)\left(\frac{2(-4)}{2}\right)$ = 1+  $\pi - 4 + (\pi - 4)(\pi - 6)_{x} \frac{3}{2} + (\pi - 4)(\pi - 6)(\pi - 8)_{t}$ =  $\chi - 3' + (\chi^2 - 10\chi + 24) \frac{3}{2} + \chi^3 - 8\chi^2 + 104\chi - 192\chi - \frac{1}{8}$  $=\frac{1}{8}\left(8n-24+3n^{2}-30n+72+(-n^{3}+18n^{2}-104n+192)\right)$  $=\frac{1}{2}\left(-x^{3}+21n^{2}-126n+240\right)$  $y(5) = \frac{1}{6} (-(5)^3 + 21 (5)^2 - 126(5) + 240) = 125$ Backward Enterpolation: Here xn=10; yn=10; n=2.  $U = \frac{\alpha - 10}{2}$ 



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|--|
| $y(x) = y_n + \frac{u}{1!} \nabla y_n + \frac{u(u+1)}{2!} \nabla^2 y_n + u(u+1)(u+2) \nabla^3 y_n$   |
| $\frac{11}{11}$ $\frac{1}{21}$ $\frac{1}{21}$ $\frac{1}{21}$ $\frac{1}{21}$ $\frac{1}{21}$ $\frac{1}{21}$ $\frac{1}{21}$ $\frac{1}{21}$  |
| the lotter is the the second of the  |
| -10 + (n-10)(3) + (n-10)(n-10)(-3)   |
| -14 (  |
| (m-10, 1 m-10) (m-10) (-6)   |
| $\left(\frac{n+1}{2}\right)\left(\frac{n+1}{2}+1\right)\left(\frac{n+1}{2}+2\right)\frac{1}{21}$   |
|  |
| $= 10 + \left(\frac{n-10}{2}\right)(2) + \left(\frac{n-10}{2}\right)\left(\frac{n-10}{2}+1\right)\left(-\frac{3}{2}\right) + \left(\frac{n+10}{2}\right)\left(\frac{n-10}{2}+1\right)\left(\frac{n-10}{2}+2\right)\left(\frac{-6}{3}\right)$ |