



# SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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3 From the following table, obtain  $f(x)$  as a polynomial in powers of  $(x-5)$ .

$x$ : 0 2 3 4 5 6

$f(x)$ : 4 26 58 112 166 222

Using Newton's method.

Soln: we will form the divided difference table below.

$x$	$f(x)$	$\Delta f(x)$	$\Delta^2 f(x)$	$\Delta^3 f(x)$
0	4			
2	26	11		
3	58	32	7	1
4	112	54	11	1
5	166	78	16	1
6	222	112	22	1
			$\frac{p-228-b}{-2}$	$\frac{b-22}{1} = 1$
		$\frac{a-922-p}{-4}$	$\frac{9-p}{5-9} = d$	$\frac{d-b}{5-7} = 1$
		9		$\frac{k-d}{5-9} = 1$
			k	



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Since the third differences are constant (=1), we extend the table by introducing  $x=5$  three times and introducing unknowns from the last column.

$$\frac{b-22}{1} = 1 \Rightarrow b=23, \quad \frac{p-228}{2} = 23 \Rightarrow p=182$$

$$\frac{a-922}{-4} = 182 \Rightarrow a=194$$

$$\frac{d-b}{-2} = 1 \Rightarrow d=21; \quad \frac{q-p}{-4} = 21 \Rightarrow q=98$$

$$\frac{k-d}{1} = 1 \Rightarrow k=17$$

Now take 5 as the origin and proceed

$$\begin{aligned} f(x) &= f(5) + (x-5)f(x_0, x_1) + (x-5)(x-5)f(x_0, x_1, x_2) \\ &\quad + (x-5)^2 f(x_0, x_1, x_2, x_3) \\ &= a + (x-5)q + (x-5)^2 k + (x-5)^3 1 \\ &= 194 + 98(x-5) + 17(x-5)^2 + (x-5)^3 \end{aligned}$$

4. Find the function  $f(x)$  from the following table hence evaluate  $f(x)$ .

$$x: \quad 0 \quad 1 \quad 2 \quad 4 \quad 5 \quad 7$$

$$f(x): \quad 0 \quad 0 \quad -12 \quad 0 \quad 60 \quad 7308$$

Sol. Since 6 data are given, we assume the polynomial to be of degree 5.

Since  $f(0)=0$ ,  $f(1)=0$  &  $f(4)=0$ , it is clear  $x(x-1)(x-4)$  is a factor of  $f(x)$ ,

So, let  $f(x) = x(x-1)(x-4)Q(x)$  where  $Q(x)$  is a quadratic polynomial



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$$\text{Now, } \phi(x) = \frac{f(x)}{x(x-1)(x-4)}$$

$$\therefore \phi(2) = \frac{f(2)}{2(1)(-2)} = \frac{-12}{-4} = 3$$

$$\phi(5) = \frac{f(5)}{5(4)(1)} = \frac{600}{20} = 30$$

$$\phi(7) = \frac{f(7)}{7(6)(3)} = \frac{7308}{126} = 58$$

Now we will find  $\phi(x)$  using divided difference formula of Newton,

$x$	$\phi(x)$	$\Delta \phi(x)$	$\Delta^2 \phi(x)$
2	3		
5	30	9	
7	58	14	1

By Newton's formula,

$$\begin{aligned} \phi(x) &= \phi(x_0) + (x-x_0)\phi(x_0, x_1) + (x-x_0)(x-x_1)\phi(x_0, x_1, x_2) \\ &= 3 + (x-2)9 + (x-2)(x-5) \\ &= x^2 + 2x - 5 \end{aligned}$$

$$\text{Hence } f(x) = x(x-1)(x-4)(x^2+2x-5)$$



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