Numerical Computing Methods
Assignment (4)
First Semester 2022/2023

Grade

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2. Apply Gauss's backward formula to find the value of $(1.06)^{19}$ if $(1.06)^{10} = 1.79085$, $(1.06)^{15} = 2.39656$, $(1.06)^{20} = 3.20714$, $(1.06)^{25} = 4.29187$ and $(1.06)^{30} = 5.74349$.

$a = (1.06)^{20}$, $h = 5$, $u = -0.2$, $x = (1.06)^{19}$

ρ	x	y	Δy	$\Delta^2 y$	$\Delta^3 y$	$\Delta^4 y$
-2	10	1.79085				
			0.60571			
-1	15	2.39656		0.20487		
			0.81058		0.06928	
0	20	3.20714		0.27415		0.02346
			1.08473		0.09274	
1	25	4.29187		0.36689		
			1.45162			
2	30	5.74349				

$f_{(u)} = (3.20714) + (-0.2)(0.81058) + \dfrac{(-0.2)(-0.2+1)}{2!}(0.27415) + \dfrac{(0.2-1)(-0.2)(-0.2+1)}{3!}(0.06928)$

$+ \dfrac{(-0.2+2)(-0.2+1)(-0.2)(-0.2-1)}{4!}(0.02346)$

$= 3.20714 + (-0.162116) + (-0.021932) + (2.21696 \times 10^{-3}) + (3.37824 \times 10^{-4})$

$= \boxed{3.02564}$

4. Interpolate by means of Gauss's backward formula, the population of a town for the year 1974 given that:

Year:	1939	1949	1959	1969	1979	1989
Population: (in thousands)	12	15	20	27	39	52

$a = 1979$, $h = 10$, $u = -0.5$, $X = 1974$

p	x	y	Δy	$\Delta^2 y$	$\Delta^3 y$	$\Delta^4 y$	$\Delta^5 y$
-4	1939	12					
			3				
-3	1949	15		2			
			5		0		
-2	1959	20		2		-3	
			7		3		-4
-1	1969	27		5		-7	
			12		-4		
0	1979	39		1			
			13				
1	1989	52					

$$f_{(u)} = f_{(0)} + u \Delta f_{(-1)} + \frac{(u+1)u}{2!} \Delta^2 f_{(-1)} + \frac{(u+1)u(u-1)}{3!} \Delta^3 f_{(-2)} + \frac{(u+2)(u+1)(u)(u-1)}{4!} \Delta^4 f_{(-2)}$$

$$= 39 + (-0.5)(12) + \frac{(-0.5+1)(-0.5)}{2!}(1) + \frac{(-0.5+1)(-0.5)(-0.5-1)}{3!}(-4)$$

$$= 39 + (-6) + (-0.125) + (-0.25)$$

$$= \boxed{32.6}$$

5. Apply Gauss's backward formula to find sin 45° from the following table:

θ°:	20	30	40	50	60	70	80
sin θ:	0.34202	0.502	0.64279	0.76604	0.86603	0.93969	0.98481

$a = 50$, $h = 10$, $u = -0.5$, $x = 45$

P	X	y	Δy	$\Delta^2 y$	$\Delta^3 y$	$\Delta^4 y$	$\Delta^5 y$	$\Delta^6 y$
-3	20	0.34202						
			0.15998					
-2	30	0.502		-0.01919				
			0.14079		0.00165			
-1	40	0.64279		-0.01754		-0.00737		
			0.12325		-0.00572		0.00942	
0	50	0.76604		-0.02326		0.00205		-0.01001
			0.09999		-0.00367		-0.00659	
1	60	0.86603		-0.02633		0.00146		
			0.07366		-0.00221			
2	70	0.93969		-0.02854				
			0.04512					
3	80	0.98481						

$$f_{(u)} = f(0.76604) + (-0.5)(0.12325) + \frac{(-0.5+1)(-0.5)}{2!}(-0.02326) +$$

$$\frac{(-0.5+1)(0.5)(0.5-1)}{3!}(-0.00572) + \frac{(0.5+2)(-0.5+1)(-0.5)(-0.5-1)}{4!}(0.00205) +$$

$$\frac{(-0.5+2)(-0.5+1)(0.5)(-0.5-1)(-0.5-2)}{5!}(0.00942) + \frac{(-0.5+3)(-0.5+2)(-0.5+1)(-0.5)(-0.5-1)(-0.5-2)}{6!}(-0.01001)$$

$$= 0.76604 + (-0.061625) + (0.0029075) + (-0.0003575) +$$

$$(4.80469 \times 10^{-5}) + (-0.000110391) + (4.8877 \times 10^{-5})$$

$$= 0.706952$$