~~equation~~

Ch [2] interpolation

equal interval ← نفس الفرق طول
ولا نفس دالة كبيرة المدى

a) Newton Forward → قريبة من بداية الجدول

b) Newton back ward → قريبة من نهاية الجدول

X	x_0	x_1	x_2	x_3	x_4
$y = F(x)$	y_0	y_1	y_2	y_3	y_4

لو نقطة في منتصف الجدول نقسمها بـ Backward أو Forward

$$\frac{\text{Back} + \text{For}}{2}$$ أو

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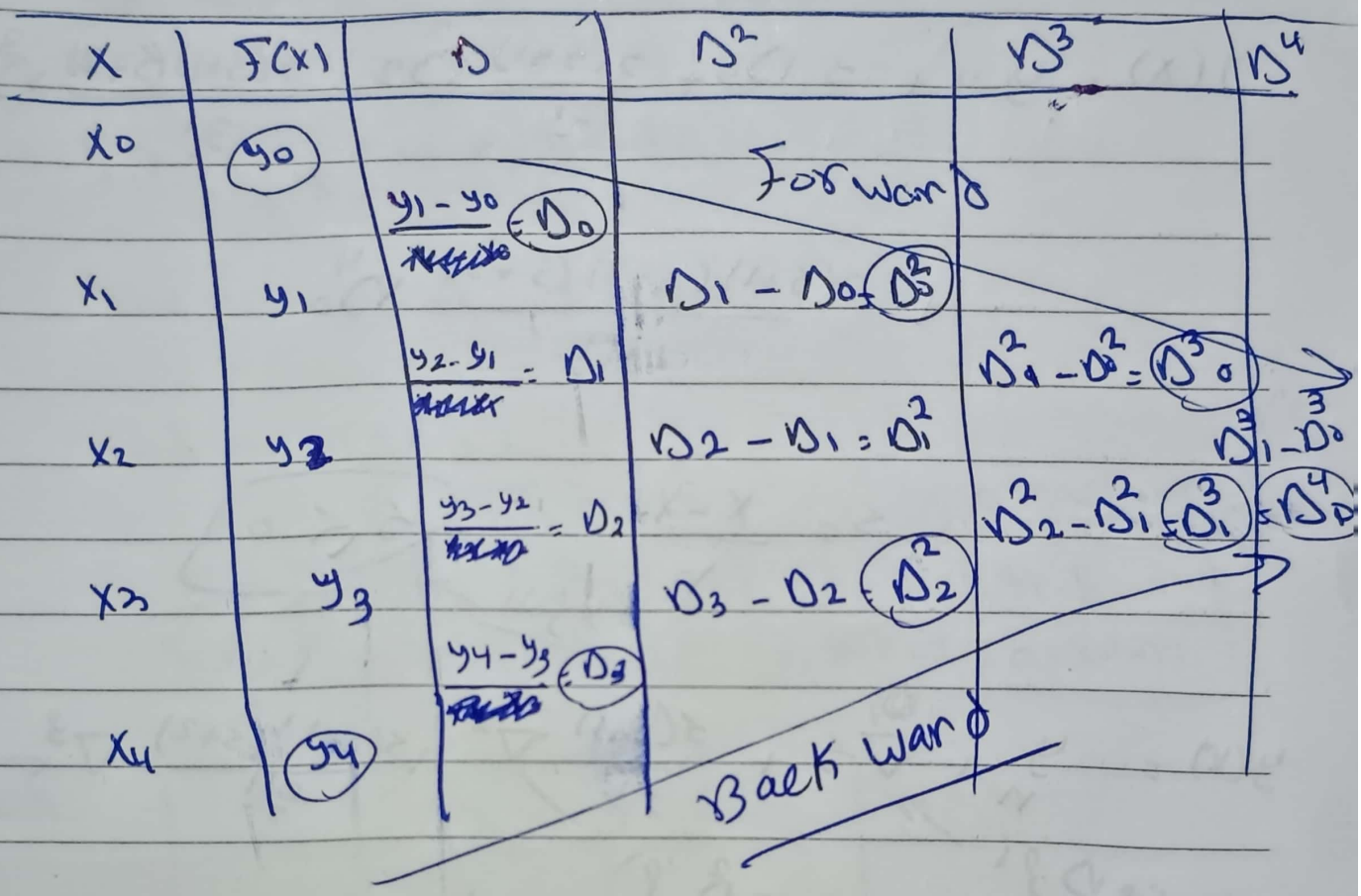
difference table



Newton Forward :-

$$y(x) = y_0 + s\Delta_0 + \frac{s(s-1)}{2!}\Delta_0^2 + \frac{s(s-1)(s-2)}{3!}\Delta_0^3 + \frac{s(s-1)(s-2)(s-3)}{4!}\Delta_0^4$$

$$s = \frac{x - x_0}{h} \qquad (s \geq 0)$$

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Back word

$$y(x) = y_4 + s\nabla_3 + \frac{s(s+1)}{2!}\nabla^2_2 + \frac{s(s+1)(s+2)}{3!}\nabla^3_1$$

$$+ \frac{s(s+1)(s+2)(s+3)}{4!}\nabla^4_0$$

$$s = \frac{x - x_0}{h}$$

$s \leq 0$ ← الشرط

$$y(x) = y_n + \nabla_3 s + \frac{s(s+1)}{2!}\nabla^2 + s\frac{(s+1)(s+2)}{3!}\nabla^3 +$$

∇_3 أخذ من أول الجدول

∇^2 أخذ من أول الجدول

لو طلب دالة كثيرة حدود دخل بـ Newton divided او Lagrange

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Ex (6)

For the following data given

$f(x) = \sin x$ estimate

the value of $\sin(30.2^\circ)$

and $\sin(31.3^\circ)$

30.2 forward 31.3 backward

x	30	30.5	31	31.5
f(x)	0.5	0.507 54	0,515 04	0.5225

x	y	Δ	Δ^2	Δ^3
30	0.5		forward	
		0,00754		
30.5	0.507 54		-0,00004	
		0,0075		0
31	0,515 04		-0,00004	
		0,00746		
31.5	0,5225		backward	

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$h = 0.5$

$$s = \frac{30.2 - 30}{0.5} = 0.4$$

$$y(30.2) = 0.5 + 0.4 * 0,00754 + \frac{0.4(0.4-1)}{2!}(-0,00004)$$

$$+ \frac{0.4(0.4-1)(0.4-2)}{3!}(0)$$

$$y(30.2) = 0.50302$$

$$s = \frac{31.3 - 30}{0.5} = -0.4$$

$$y(31.3) = 0.5225 + (-0.4) * 0.00746 + \frac{(-0.4)(-0.4+1)}{2!}(-0,00004)$$

$$+0$$

$$y(31.3) = \checkmark$$

Interpolation with Spline Functions

x	x_0	x_1	x_2	x_3
f(x)	y_0	y_1	y_2	y_3

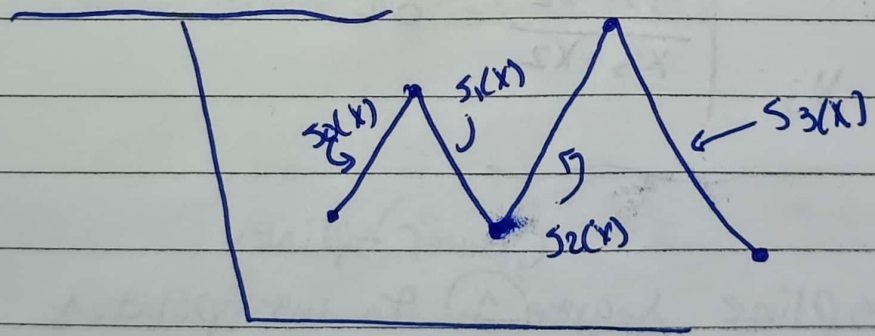
$S_0(x)$ $S_1(x)$ $S_2(x)$

$S_i(x)$ ← عدد الشرائح

تقوم بتكوين $S_i(x)$ عند كل نقطتين

تشوف النقطه اللى جايزها موجودة فى اى شريحه واروح اعوض فيها

Linear spline :- (1)ST degree spline



كل ما أعلى الـ degree كل ما الدالة أصعب كثيرة العدود

عدد الشرائح = عدد القراءات - 1

$S_i(x) = y_i + y_{i+1} - y_i$

ليشتغل على الـ equal والـ unequal عادى

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$$S_i(x) = y_i + \frac{y_{i+1} - y_i}{x_{i+1} - x_i}(x - x_i)$$

$$= y_i + \delta_i (x - x_i)$$

x	y	δ
x_0	y_0	
		$\frac{y_1 - y_0}{x_1 - x_0} = \delta_0$
x_1	y_1	
		$\frac{y_2 - y_1}{x_2 - x_1} = \delta_1$
x_2	y_2	
		$\frac{y_3 - y_2}{x_3 - x_2} = \delta_2$
x_3	y_3	

Ex

Find spline degree (1) (linear spline) to interpolate data

$F(2.2) = ?$ $\quad S_i(x)$ Linear

x	1	1.5	2	2.5	3
f(x)	1	3	7	10	15

$S_0(x)$ $S_1(x)$ $S_2(x)$ $S_3(x)$

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x	y	δ
1	1	
		4
1.5	3	
		8
2	7	
		6
2.5	10	
		10
3	15	

$i = 0, 1, 2, 3$

~~$S_2(x) = (y_2 + \delta_2 (x - x_2))$~~

~~$S_2(x) = 7 + 6(2.2 - 2) = 11.2$~~

$i = 0$

$S_0(x) = y_1 + 4(x - 1)$

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$i = 0$

$S_0(x) = 1 + (4(x-1)) = 4x - 3$

$i = 1$

$S_1(x) = 3 + 8(x - 1.5) = 8x - 9$

$i = 2$

$S_2(x) = 7 + 6(x - 2) = 6x - 5$

$i = 3$

$S_3(x) = 10 + 10(x - 2.5) = 10x - 15$

$S_i(x)$ →

- $4x - 3$ | $1 \leq x < 1.5$
- $8x - 9$ | $1.5 \leq x \leq 2$
- $6x - 5$ | $2 \leq x \leq 2.5$
- $10x - 15$ | $2.5 \leq x \leq 3$

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$F(2.2) = 6x - 5 = 6 \times 2.2 - 5 = 8.2$

$7 \leq 8.2 \leq 10$

Home work

$F(x) = x^3 + 2$

at $x = 0, 0.2, 0.4, 0.6, 0.8, 1.0$

Linear spline

to find at $x = 0.1, 0.3, 0.5$

$0.7, 0.9$

$S_i(x) = ??$