LAB EXPERIMENT # 9: Find the value of a function at a given point from given data set using Newton's forward interpolation method.

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9.1 Objectives

- To find the value of a function at a given point from given data set using interpolation.
- To understand the excel implementation of the interpolation method
- To analyze of results using different values

9.2 Theory

Interpolation is a method of fitting data points to represent a function's value. It has a variety of uses in engineering and research, such as constructing new data points within the range of a discrete data set of existing data points or determining a formula of the function that will pass from the given set of points (x,y).

Newton's forward interpolation is a polynomial interpolation which depends on the initial value and degrees of Newton's forward operator. The degree of polynomial fitted is one less than the number of data points. This type of interpolation is only used for equally spaced data points.

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

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

9.3 Apparatus

- MATLAB

9.4 Algorithm

Step: 1 Start

Step: 2 Make a table for x and y to find $y = f(x)$

Step: 3 Determine $\Delta y, \Delta 2y, \Delta 3y, \Delta 4y, \Delta 5y, \Delta 6y$ *from* the table

Step: 4 Determine 'h' using equation, $h = (x0 - x1)$

Step: 5 Determine 'p' using equation, $h = \{(x - x0)/h\}$

Step: 6 Calculate $y = f(x) = y0 + p\Delta y0 + p(P-1)2!\Delta 2y0 + p(p-1)(P-2)3!\Delta 3y0 + \cdots$

Step: 7 Display the value of y

Step: 8 Stop

9.5 Excel Output

	A	B	C	D	E	F
1	x	y	d1	d2	d3	d4
2	3	2.7				
3			3.7			
4	4	6.4		2.4		
5			6.1		0.6	
6	5	12.5		3		0
7			9.1		0.6	
8	6	21.6		3.6		0
9			12.7		0.6	
10	7	34.3		4.2		0
11			16.9		0.6	
12	8	51.2		4.8		
13			21.7			
14	9	72.9				
15						
16						
17	x	4.5				
18	h	1				
19	p	1.5				
20						
21	y	9.1125				

9.6 Function & result

x =**B18**
h = **A4-A2**
p = **(B18-A2)/B19**
y = **B2+(B20*C3)+(((B20*(B20-1))/2)*D4)+(((B20*(B20-1)*(B20-2))/6)*E5)+(((B20*(B20-1)*(B20-2)*(B20-3))/24)*F6)+(((B20*(B20-1)*(B20-2)*(B20-3)*(B20-4))/120)*G7)+(((B20*(B20-1)*(B20-2)*(B20-3)*(B20-4)*(B20-5))/720)*H8)**

At, ***x*** = 2.2,
y = 5.222387

9.7 Discussion & Analysis

Using the formula of newton’s forward interpolation method, we take the initial values of each difference and get the approximated value at a data point. In this experiment, we used Microsoft Excel to implement the Newton forward interpolation method and examined the results.

We started by determining the differences between the data sets and then the differences between the differences. Then, using the Newton forward difference interpolation procedure, we calculated the value of 'y' at the position 'x = 2.2'.