

University of Babylon
College of Engineering
Department of Environmental Engineering
Engineering Analysis I (ENAN 103)



Polynomial Interpolation

Lagrange Interpolation

Undergraduate Level, 3th Stage

Mr. Waleed Ali Tameemi
Engineer/ College of Engineering/ Babylon University
M.Sc. Civil Engineering/ the University of Kansas/ USA

2016-2017

Lecture Outline

1.0 Introduction

2.0 Newton's Divided Difference Formula

2.1 Linear Interpolation

2.2 Quadratic Interpolation

2.3 General Formula

3.0 Gregory-Newton Polynomial Interpolation

4.0 Lagrange Interpolation

5.0 Summary

4.0 – Lagrange Interpolation

If the data set in the following table was obtained by experiments or by observation, the value corresponding to any x can be estimated as follows:

x_i	$f(x_i)$
x_0	$f(x_0)$
x_1	$f(x_1)$
x_2	$f(x_2)$
x_3	$f(x_3)$
.	.
.	.
x_{n-1}	$f(x_{n-1})$
x_n	$f(x_n)$

$$\begin{aligned} f(x) = & \frac{(x - x_1)(x - x_2) \dots (x - x_n)}{(x_0 - x_1)(x_0 - x_2) \dots (x_0 - x_n)} f(x_0) \\ & + \frac{(x - x_0)(x - x_2) \dots (x - x_n)}{(x_1 - x_0)(x_1 - x_2) \dots (x_1 - x_n)} f(x_1) + \dots \\ & + \frac{(x - x_0)(x - x_1) \dots (x - x_{n-1})}{(x_n - x_0)(x_n - x_1) \dots (x_n - x_{n-1})} f(x_n) \end{aligned}$$

Ex1: Find the value of $f(1.5)$ for the data set shown:

i	x	y
0	1	1
1	2	4
2	3	8

Solution:

$$f(1.5) = \frac{(1.5 - 2)(1.5 - 3)}{(1 - 2)(1 - 3)} \times 1 + \frac{(1.5 - 1)(1.5 - 3)}{(2 - 1)(2 - 3)} \times 4 + \frac{(1.5 - 1)(1.5 - 2)}{(3 - 1)(3 - 2)} \\ \times 8 = -0.375 + 3 + (-1) = 1.625$$

Homework 10

For the data set, shown in the following table, estimate $f(4.3)$ using Lagrange

Polynomial:

i	x	$f(x)$
1	0	0
2	1	0.569
3	2	0.791
4	3.8	0.224
5	5	-0.185