



UNIT 4 INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL
INTEGRATION
LAGRANGE'S INTERPOLATION

$$\begin{aligned} &= \frac{(2)(1)(-1)}{(1)(-2)(-4)} (1) + \frac{(3)(1)(-1)}{(1)(-1)(-3)} (2) + \frac{(3)(2)(1)}{(2)(4)(-2)} (4) \\ &\quad + \frac{(3)(2)(1)}{(4)(3)(2)} (8) \\ &= \frac{1}{4} - 3 + \frac{27}{2} + \frac{81}{4} \\ &= 0.25 - 3 + 13.5 + 20.25 \\ &= 31. \end{aligned}$$

Inverse of Lagrange's interpolation formula.

$$x = f(y) = \frac{(y-y_1)(y-y_2)(y-y_3)\dots(y-y_n)}{(y_0-y_1)(y_0-y_2)(y_0-y_3)\dots(y_0-y_n)} x_0 +$$

$$\frac{(y-y_0)(y-y_2)\dots(y-y_1)}{(y_1-y_0)(y_1-y_2)\dots(y_1-y_n)} x_1 + \dots$$

$$+ \frac{(y-y_0)(y-y_1)\dots(y-y_{n-1})}{(y_n-y_0)(y_n-y_1)\dots(y_n-y_{n-1})} x_n$$



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① find the age corresponding to the annuity value 13.6 given table by using inverse lagrange's interpolation.

Age: x : 30 35 40 45 50

Annuity Value y : 15.9 14.9 14.1 13.3 12.5

$$x_0 = 30, x_1 = 35, x_2 = 40, x_3 = 45, x_4 = 50$$

$$y_0 = 15.9, y_1 = 14.9, y_2 = 14.1, y_3 = 13.3, y_4 = 12.5$$

$$\begin{aligned} x = f(y) &= \frac{(y-y_1)(y-y_2)(y-y_3)(y-y_4)}{(y_0-y_1)(y_0-y_2)(y_0-y_3)(y_0-y_4)} x_0 + \\ &\quad \frac{(y-y_0)(y-y_2)(y-y_3)(y-y_4)}{(y_1-y_0)(y_1-y_2)(y_1-y_3)(y_1-y_4)} x_1 + \\ &\quad \frac{(y-y_0)(y-y_1)(y-y_3)(y-y_4)}{(y_2-y_0)(y_2-y_1)(y_2-y_3)(y_2-y_4)} x_2 + \frac{(y-y_0)(y-y_1)(y-y_2)(y-y_4)}{(y_3-y_0)(y_3-y_1)(y_3-y_2)(y_3-y_4)} x_3 \\ &\quad + \frac{(y-y_0)(y-y_1)(y-y_2)(y-y_3)}{(y_4-y_0)(y_4-y_1)(y_4-y_2)(y_4-y_3)} x_4. \\ &= \frac{(y-14.9)(y-14.1)(y-13.3)(y-12.5)}{(15.9-14.9)(15.9-14.1)(15.9-13.3)(15.9-12.5)} (30) + \\ &\quad \frac{(y-15.9)(y-14.1)(y-13.3)(y-12.5)}{(14.9-15.9)(14.9-14.1)(14.9-13.3)(14.9-12.5)} (35) + \frac{(y-15.9)(y-14.9)(y-13.3)(y-12.5)}{(14.1-15.9)(14.1-14.9)(14.1-13.3)(14.1-12.5)} (40) \end{aligned}$$



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$$\begin{aligned}
 & + \frac{(y-15.9)(y-14.9)(y-14.1)(y-12.5)}{(13.3-15.9)(13.3-14.9)(13.3-14.1)(13.3-12.5)} (45) + \frac{(y-15.9)(y-14.9)(y-14.1)(y-13.3)}{(12.5-15.9)(12.5-14.9)(12.5-14.1)(12.5-13.3)} (50) \\
 & \text{At } y=13.6 \\
 & = \frac{(-1.3)(-0.5)(0.3)(1.1)}{(1)(1.8)(2.6)(3.4)} (30) + \frac{(-2.3)(-0.5)(0.3)(1.1)}{(-1)(0.8)(1.6)(2.4)} (3) + \frac{(-2.3)(-1.3)(0.3)(1.1)}{(-1.8)(-0.8)(0.3)(-0.6)} (4) \\
 & + \frac{(-2.3)(-1.3)(-0.5)(1.1)}{(-2.6)(-1.6)(-0.8)(0.8)} (45) + \frac{(-2.3)(-1.3)(-0.5)(0.3)}{(-3.4)(-2.4)(-1.6)(-0.8)} (50) \\
 & = \frac{6.435}{15.912} - \frac{13.283}{3.072} + \frac{39.468}{1.843} + \frac{74.003}{2.662} - \frac{22.425}{10.445} \\
 & = 0.404 - 4.324 + 21.415 + 27.800 - 2.147 \\
 & = 43.148
 \end{aligned}$$