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Existence of Solution of First order Differential Balance Equation in Interpolation

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Abstract- In this paper I derive the formula from the first order differential balance equation. In Numerical methods we are finding the missing values and derivativs from the available data by using different formula. One can solve problem directly using balance equation.

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EXISTENCEOFSOLUTIONOFFIRSTORDERDIFFERENTIALBALANCEEQUATIONININTERPOLATION

Existence of Solution of First order Differential Balance Equation in Interpolation

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Abstract- In this paper I derive the formula from the first order differential balance equation. In Numerical methods we are finding the missing values and derivativs from the available data by using different formula. One can solve problem directly using balance equation.

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I. Introduction

Interpolation is one of the concept in mathematics. In Numerical methods we are finding the missing values and derivatives from the available data by using different formula.

Here I have derived three formulae from the first order balance equation. The first two formulae denotes the process of computing the values of a function for any value of the Independent variable and also the value of a Independent variable for any value of a function either within an interval values from the available data.

Numerical differentiation is the process of computing the value of the derivatives for some particular value, from given data, when the actual relationship between X and Y is not known. The balance derivative formula to be used depends as usual on the particular value of X at which the value of first derivative is required.

II. Balance Differential Equation and an Application

The balance differential equation is $dp = k\sqrt{p}dt$ -----(I)

This is a seperable equation whose solution can be developed as follows.

Integrating (I), we get

$$2\sqrt{p} = kt + c \qquad \text{----------(i)}$$

where c is constant

When $p = p_1$, $t = t_1$, (i) becomes

$$2\sqrt{p_1} = kt_1 + c \qquad \text{-----------------(ii)}$$

When $= p_2$, $t = t_2$, (i) becomes

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$$2\sqrt{p_2} = kt_2 + c \qquad \text{-----------------(iii)}$$

(iii)-(ii) gives $k = \frac{2(\sqrt{p_2}-\sqrt{p_1})}{t_2-t_1}$

From (ii) $c = 2\sqrt{p_1} - \frac{2(\sqrt{p_2}-\sqrt{p_1})}{(t_2-t_1)} t_1$

Substituting 'k' and 'c' in (i), we get

$$P = \left\{\frac{(\sqrt{p_2} - \sqrt{p_1})(t - t_1)}{(t_2 - t_1)} + \sqrt{p_1}\right\}^2$$

From this formula we can find the dependent variable for any value of the independent variable. The other formula is as follows

$$t = \frac{(\sqrt{p} - \sqrt{p_1})(t_2 - t_1)}{(\sqrt{p_2} - \sqrt{p_1})} + t_1$$

From this formula we can calculate the independent variable for any value of the dependent variable.

III. Applications

The following are data from the steam table

Temperature(t)	140	150	160	170	180
Pressure(p)	3.685	4.854	6.302	8.076	10.225

The solution is as follows

t_1	t_2	p_1	p_2	t	p
140	160	3.685	6.302	When t=150	P=4.9 app
140	160	3.685	6.302	t=150 app	When p=4.854

Now, we consider the unequal interval data

t	5	6	9	11
p	12	13	14	16

The solution is as follows

t_1	t_2	p_1	p_2	t	p
5	9	12	14	When t=6	P=12.4 8app
5	9	12	14	t=6 app	When p=13
5	11	12	16	When t=9	P=14 app

IV. Balance Difference Formula to Compute the Derivatives

Consider

$$P = \left\{\frac{(\sqrt{p_2} - \sqrt{p_1})(t - t_1)}{(t_2 - t_1)} + \sqrt{p_1}\right\}^2$$

$$\acute{P} = \frac{2\sqrt{p}(\sqrt{p_2} - \sqrt{p_1})}{t_2 - t_1}$$

Consider the table of values

Notes

t	1.00	1.05	1.10	1.15
p	1.00	1.02470	1.04881	1.07238

Here, when $p_1 = 1.00$ $t = 1.00$ $p_2 = 1.04881$ $t_2 = 1.10$ P=1.02470 $(\acute{p}) at\ t = 1.05 =?$

By using the above formula $\acute{p}$=0.447

Notes

V. Conclusion

These formulae we have used are to find out the values of both equal and unequal intervals. This can be applied for all types of data.

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