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An Applied Divided Difference Interpolation Method for Recover Arbitrarily Missing values in Data Mining

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Abstract: Data cleansing is a significant step for data research. The values misplaced in the database are an ordinary difficulty faced by data analysts. A value which is misplaced in data mining is repetitive difficulty that can produce errors in data analysis. Arbitrarily missing elements in the dataset create data analysis complex and also influenced to related result. It affects the correctness of the result and intermediary queries. By using numerical techniques, one can improve the absent data and reduce the suspiciousness in the database. The existing paper provides an applied divided difference Interpolation techniques to recuperate the misplaced/missing values.

Keywords: Data mining, missing values, Divided difference Interpolation, Arbitrarily.

I. INTRODUCTION

Usually, Information and data in the database are kept in the tabular arrangement. Data set are essentially attributes of the connected table while the records set are rows of the table. Data in the dataset reside as essential part and are used for advance reports and query. Whereas dataset is imperfect or include values which are missing, it directly has an outcome on the finishing reports. In data mining, arbitrarily missing values recognition and revival is till nowadays very essential problem. Missing values everlastingly reason of uncertainty and its effect on final results. It degrades accurateness of query and deducts decision making capability of authorities. It is essential to determine such crisis before than affecting for report preparation and query. To defeat such circumstances there is necessitate of numerical methods to recuperate the arbitrarily values which is missing.

An Applied Divided Difference Interpolation is numerical technique that can be applied to create non-natural values in connection of accessible data. The current paper is an attempt to produce non-natural value at the position of value which is missing to as recuperation technique. Its mechanism as closest fit approach through applied Divided Difference Interpolation to recuperate missing value. This is essentially a request of the idea of Divided Difference Interpolation approach which is used to recuperate the values which is missing.

II. FORMULATION OF PROBLEM

The estimated numerical technique is an easy approach for obtaining arbitrarily missing value in dataset. It gives a way to work in direction of closest fit approach for recovery of missing data. In this, we first look at the complete attribute element for missing value cases. Subsequent to missing and observed values, attribute is separated in two parts as mentioned as observed and missing values. Although both are remaining in the same attribute, it is only logical demarcation.

Now looking for the missing values in attribute and search begin. At this point, we have two variable X and Y in proportion titled as year and data set value. Variable X (year) is fixed for other attributes Y, which have missing values. Attributes for Y are changeable whereas X is stable for present study and Y, has missing value. Here randomly missing values are available in the attribute Y. At this point the variable X is corresponding variable of Y, which does not have any missing values.

Construct loop, for $i = 1$ to $i \leq n$.

$$X_0 = \text{value}(X_{i-1}) \dots \dots \dots (2.1)$$

X_0 previous value from X_i

$$X_1 = \text{value}(X_{i+1}) \dots \dots \dots (2.2)$$

X_1 first succeeding from X_i

$$X_2 = \text{value}(X_{i+2}) \dots \dots \dots (2.3)$$



X_2 second succeeding from X_i

$$Y_0 = \text{value}(Y_{i-1}) \dots \dots \dots (2.4)$$

Y_0 previous value from Y_i

$$Y_1 = \text{value}(Y_{i+1}) \dots \dots \dots (2.5)$$

Y_1 first succeeding from Y_i

$$Y_2 = \text{Value}(Y_{i+2}) \dots \dots \dots (2.6)$$

Y_2 second succeeding from Y_i

$$X = \text{value}(X_i) \dots \dots \dots (2.7)$$

X is the consequent value from Y_i .

Whereas $X_0, X_1, X_2, Y_0, Y_1, Y_2, X \neq \text{„NULL“}$.

Now, initialize the variables $\text{Sum} = 0, \text{Multi}, X, i, j, n \dots \dots \dots (2.8)$

Now, initialize first two dimensional arrays for difference assign to zero value, therefore

$$\text{diff}(1)(1) = 0 \dots \dots \dots (2.9)$$

Here, loop encountered for attribute. Thus for $j=1$ to $n-1$, the inner loop get activated in Ascending order.

for $i=1$ to $(n-j)$ then applied this approach for calculating difference table. Then condition is checked if $(j = 1)$ then

$$\text{value}(\text{diff}_i)(\text{diff}_j) = \text{value}(Y_{i+1}) - \text{value}(Y_0) / \text{value}(X_{i+1}) - \text{value}(X_0) \dots \dots (2.10)$$

otherwise

$$\text{value}(\text{diff}_i)(\text{diff}_j) = \text{value}(\text{diff}_{i+1})(\text{diff}_{j-1}) - \text{value}(\text{diff}_i)(\text{diff}_{j-1}) /$$

$$\text{value}(X_{i+j}) - \text{value}(X_0) \dots \dots \dots (2.11)$$

then make increment in i counter, thus $i = i + 1$, then inner loop encountered till $i < (n-j)$.

Here inner loop is closed, after that increment j loop encountered, thus $j = j + 1$, loop is finished till $j \leq n-1$. here loop is completed.

Now, initialize first value of missing value subscript to Sum using

$$\text{Sum} = Y_0 \dots \dots \dots (2.12)$$

Here, loop encountered for attribute. Thus for $i=1$ to n , the inner loop get activated n

Ascending order. Now, initialize Multiplication variable to 1 using

$$\text{Multi} = 1 \dots \dots \dots (2.13)$$

For $j=0$ to $i-1$ then sub loop is created for calculating estimated value. Then subtract value of X from the value of X_0 assign it to Multi variable.

$$\text{Multi} = \text{Multi} * ((X - \text{value}(X_0)) \dots \dots \dots (2.14)$$

Then assign Multi value to the value of $\text{value}(\text{diff}_i)(\text{diff}_j)$ and finally it added to Sum variable and assigned final value to Sum .

$$\text{Sum} = \text{Sum} + \text{value}(\text{diff}_i)(\text{diff}_j) * \text{Multi} \dots \dots \dots (2.15)$$

Then make increment in j counter, thus $j = j + 1$, then inner loop encountered till

$j \leq i-1$. Then second inner loop closed.

Then make increment in i counter, thus $i = i + 1$, then inner loop encountered till

$i \leq n$. Then loop closed.

After these process estimated value is obtained $Y_{\text{est}} = \text{Sum}$. Assigning estimated value to missing value place.

$$\text{value}(Y_i) = Y_{\text{est}} \dots \dots \dots (2.16)$$

Assigning estimated value to missing value place. Then encounter loop $i, i = i + 1$. Here main loop get finished.

III. ALGORITHM

Attribute $X = \{X_1, \dots, X_n\}, Y = \{Y_1, \dots, Y_n\}$

Where $X = X_{\text{obs}} + X_{\text{mis}}$

$X_{\text{obs}} = \{X_1, \dots, X_k\}$ // Observed Attribute values

$X_{\text{mis}} = \{X_{k+1}, \dots, X_n\}$ // Missing Attribute values

$Y = Y_{\text{obs}} + Y_{\text{mis}}$

$Y_{\text{obs}} = \{Y_1, \dots, Y_k\}$ // Observed Attribute values

$Y_{\text{mis}} = \{Y_{k+1}, \dots, Y_n\}$ // Attribute values missing

$\text{array}(Y) = \text{array}(X)$

Read $X = \{X_1, \dots, X_n\}, Y = \{Y_1, \dots, Y_n\}$ // missing data place detection.

for $i=1$ to n , do // initialization of loop



```
If ( value (Yi) == NULL) then
X0 = value(Xi-1) //preceding of Xi.
X1 = value(Xi+1) // first succeeding from Xi.
X2 = value(Xi+2) //second succeeding from Xi.
Y0 = value(Yi-1) // preceding of Yi.
Y1 = value(Yi+1) // first succeeding from Yi.
Y2 = Value(Yi+2) // second succeeding from Yi.
X = value(Xi) // corresponding value of missing value of Yi.
where X0, X1, X2, Y0, Y1, Y2, X ≠ „NULL“
Sum = 0, Multi, X, i, j, n // Initialize the variables.
diff (1)(1) = 0 // Initialize first two dimensional array.
for j=1 to n-1, do // create loop
for i=1 to (n-j) do // create sub loop
if ( j = 1)
value(diffi)( diffj) = value((Yi+1)- value(Y0) / value(Xi+1)- value(X0))
// calculating difference table.
else
value(diffi)( diffj)= value(diffi+1)( diffj-1)- value(diffi)( diffj-1) /
value(Xi+j)- value(X0)
// calculating difference table
i = i + 1 // increase the i counter
endfor // second inner loop closed .
j = j + 1 // increase in j loop
repeat-until (j <= n-1),
end for //loop closed.
Sum = Y0 // initialize first value of missing value subscript.
for i=1 to n, do // create loop
Multi = 1
for j=0 to i-1 do // create sub loop
Multi = Multi * (( X - value(X0))
Sum = Sum + value(diffi)( diffj) * Multi
j = j + 1 // increase in j loop
endfor // second inner loop closed .
i = i + 1 // increase the i counter
repeat-until (i <= n), end for // loop finish
Yest = Sum // predicted value
value (Yi) = Yest
i = i+1
repeat-until (i <= n),
endfor
stop.
```

The below TABLE I indicates the Deviation Anomaly Method using real database. The real data set is taken from www.earth_policy.com

TABLE-1											
An Applied Divided Difference Interpolation Method											
Global Carbon Dioxide Emission from Fossil burning by Fuel Type 1960-2009 (Carbon Emission in Million Tones)											
Standard Dataset				Missing Value Dataset				Recovered Dataset			
SN	Year	Coal	Oil	Natural Gas	Coal	Oil	Natural Gas	Coal	Oil	Natural Gas	
1	1960	1,410	849	235	1,410	849	235	1,410	849	235	
2	1961	1349	904	254	1349	---	254	1349	913	254	
3	1962	1351	980	277	1351	980	277	1351	980	277	
4	1963	1396	1,052	300	1396	1,052	300	1396	1,052	300	
5	1964	1435	1,137	328	1435	1,137	---	1435	1,137	325	
6	1965	1460	1,219	351	1460	1,219	351	1460	1,219	351	
7	1966	1478	1,323	380	---	1,323	380	1440	1,323	380	
8	1967	1448	1,423	410	1448	---	410	1448	1,434	410	
9	1968	1448	1,551	446	1448	1,551	446	1448	1,551	446	
10	1969	1486	1,673	487	1486	1,673	487	1486	1,673	487	
11	1970	1556	1,839	516	1556	1,839	---	1556	1,839	523	
12	1971	1559	1,946	554	1559	1,946	554	1559	1,946	554	
13	1972	1576	2,055	583	---	2,055	583	1574	2,055	583	
14	1973	1581	2,240	608	1581	---	608	1581	2,219	608	
15	1974	1579	2,244	618	1579	2,244	618	1579	2,244	618	
16	1975	1673	2,131	623	1673	2,131	623	1673	2,131	623	
17	1976	1710	2,313	650	1710	2,313	---	1710	2,313	631	
18	1977	1766	2,395	649	1766	2,395	649	1766	2,395	649	
19	1978	1793	2,392	677	---	2,392	677	1827	2,392	677	
20	1979	1887	2,544	719	1887	---	719	1887	2,456	719	
21	1980	1947	2,422	740	1947	2,422	740	1947	2,422	740	
22	1981	1921	2,289	756	1921	2,289	756	1921	2,289	756	
23	1982	1992	2,196	746	1992	2,196	---	1992	2,196	727	
24	1983	1995	2,177	745	1995	2,177	745	1995	2,177	745	
25	1984	2094	2,202	808	---	2,202	808	2135	2,202	808	
26	1985	2237	2,182	836	2237	---	836	2237	2,257	836	
27	1986	2300	2,290	830	2300	2,290	830	2300	2,290	830	
28	1987	2364	2,302	893	2364	2,302	893	2364	2,302	893	
29	1988	2414	2,408	936	2414	2,408	---	2414	2,408	928	
30	1989	2457	2,455	972	2457	2,455	972	2457	2,455	972	
31	1990	2409	2,517	1,026	---	2,517	1,026	2387	2,517	1,026	
32	1991	2341	2,627	1,069	2341	2,627	1,069	2341	2,627	1,069	
33	1992	2318	2,506	1,101	2318	2,506	1,101	2318	2,506	1,101	
34	1993	2,265	2,537	1,119	2,265	2,537	1,119	2,265	2,537	1,119	
35	1994	2,331	2,562	1,132	2,331	2,562	---	2,331	2,562	1,081	
36	1995	2,414	2,586	1,153	2,414	2,586	1,153	2,414	2,586	1,153	
37	1996	2,451	2,624	1,208	---	2,624	1,208	2504	2,624	1,208	
38	1997	2,480	2,707	1,211	2,480	2,707	1,211	2,480	2,707	1,211	
39	1998	2,376	2,763	1,245	2,376	2,763	1,245	2,376	2,763	1,245	
40	1999	2,329	2,716	1,272	2,329	2,716	1,272	2,329	2,716	1,272	
41	2000	2,342	2,831	1,291	2,342	2,831	1,291	2,342	2,831	1,291	
42	2001	2,460	2,842	1,314	2,460	2,842	1,314	2,460	2,842	1,314	
43	2002	2,487	2,819	1,349	2,487	2,819	1,349	2,487	2,819	1,349	
44	2003	2,638	2,928	1,399	2,638	2,928	1,399	2,638	2,928	1,399	
45	2004	2,850	3,032	1,436	2,850	3,032	1,436	2,850	3,032	1,436	
46	2005	3,032	3,079	1,479	3,032	3,079	1,479	3,032	3,079	1,479	
47	2006	3,193	3,092	1,527	3,193	3,092	1,527	3,193	3,092	1,527	
48	2007	3,295	3,087	1,551	3,295	3,087	1,551	3,295	3,087	1,551	
49	2008	3,401	3,079	1,589	3,401	3,079	1,589	3,401	3,079	1,589	
50	2009	3,393	3,019	1,552	3,393	3,019	1,552	3,393	3,019	1,552	
MEAN		2,109	2,262	879	2,129	2,307	901	2,111	2,261	877	
S.D		567.89	621.13	400.27	586.60	606.41	410.80	568.93	619.65	399.97	
C.V		0.27	0.27	0.46	0.28	0.26	0.46	0.27	0.27	0.46	

Source: www.earth_policy.com

IV. DISCUSSION OF RESULTS

1) *Analysis [mean]*: According to Table: 1 the average value of carbon emissions from coal oil and Natural Gas are 2109 , 2262 and 879 respectively. In the missing value condition values are recorded as 2,129 for coal and 2,307 for oil and 901 for Natural Gas. After filling of missing values from the calculated estimated values the results are 2,111 for coal , 2,261 for oil and 877 Natural Gas for respectively. Here, it is found that after estimation of missing value by proposed method, values are very close to original value.

2) *Standard Deviation*: Here, it is originate that later than generation of missing value by proposed method, values are very close to original value and value of the standard deviation are almost equal to the standard deviation of original set values.

3) *Coefficient of Variation*: it is found that after estimation of missing value by proposed method, values of the coefficient of variation are not very or we can say CV are similar to CV of original dataset.

4) *Analysis of Variance*: We wish to test the hypothesis

H0: $\mu_1 = \mu_2 = \mu_3$ against the alternative

H1: at least two μ different

For testing the hypothesis following arrangement have been done:

A. ANOVA Test Result for Coal

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	10811.8	2	5405.902	0.016406	0.983729	3.060292
Within Groups	46459366	141	329499.1			
Total	46470178	143				

Observed value at 5% Level of Significance = .0164, the F critical value is 3.06, so hypothesis / assumption is accepted.

B. ANOVA Test Result for Oil

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	62654.52107	2	31327.26	0.082533	0.920825	3.059831
Within Groups	53898979.64	142	379570.3			
Total	53961634.17	144				

Observed value at 5% Level of Significance = .0825, the F critical value is 3.06, so hypothesis / assumption is accepted.

C. ANOVA Test Result for Natural Gas

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	16088.51	2	8044.254	0.049431	0.951787	3.060292
Within Groups	22945834	141	162736.4			
Total	22961922	143				

Observed value at 5% Level of Significance = .04943, the F critical value is 3.06, so hypothesis / assumption is accepted.

1) *Decision and Conclusion*: Given that F (Observed /Calculated) < 3.06 for Coal, Oil and Natural gas ANOVA (One way) test. In case hypotheses are accepted in all cases, therefore it is considerable that, no significant difference found between groups regarding mean value.



IV. CONCLUSIONS

In common, it is commonly recognized that there is no send percent competent method to handle all types of misplaced values. The estimated approach is important for the numeral values. This approach gives suitable result for the related report created by the database. in accordance with amount of central tendency, CV and SD result are important. One way ANOVA test also provides considerable result with acceptance of hypothesis. So it can be said that the outcome are statistically important. In conclusion it can be believed that proposed methods are important for small database which contains of linear type trends in the dataset.

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