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CLOSEST FIT APPROACH TO HANDLE ODD SIZE MISSING BLOCK VALUES

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ABSTRACT

C ompleteness, quality and real world data preparation is a key pre-requirement for efficient data mining. Database or Table with missing values complicates analysis and data mining. To overcome this situation, certain statistical techniques are required to be employed during the data preparation. With the help of statistical methods and techniques, we can recover incompleteness of missing data and reduce ambiguities. In this paper, we introduce a method by which odd size missing block values are recovered. Whole study comprises numerical variables of time series data.

Key Words: Missing Values, Attribute, Data preparation, Incompleteness, Missing Block, Closest fit, Intermediate value.

MSC (2010) Subject Classification: 62-07,62N02, 62Q99.

1. INTRODUCTION

Missing block values in database is solitary of the biggest problems faced in data analysis and in data mining applications. The effects of these missing block values are highly reflected on the final results. Our prime goal is to achieve the final result in the consolidated form on which we are taking decisions. There are various forms of missing values in the database, among those, missing block values case is one of the harder cases to recover, despite the single missing value. In this study, two algorithms of statistical methods are introduced and discussed which provides an approach to find out pattern to recover missing block values from a real world imbalanced database with missing values. Therefore, the objective of this study is to find out closest fit methods to recover missing values and to fill them for further applications.

2. ODD BLOCK FITTING APPROACH

In the proposed method, we first find out the range of block of missing values in the attribute. Here proposed maximum range is 10% of the used dataset. Therefore, maximum three consecutive values may be taken as odd block of missing values.

Now the searches of block missing case in the attribute get start. The first missing value case is pointed by the subscript of the attribute and denoted by the variable (X_i) , second and third are denoted from (x_{i+1}) and (x_{i+2}) respectively.

Now find average from the values of preceding subscript (X_{i-1}) and succeeding subscript value (X_{i+3}) . This average value is replaced at the subscript (x_{i+1}) which is second or centered missing subscript.

 $x_p = \text{value}(x_{i-1})$ $x_s = \text{value}(x_{i+3})$

where $x_{p} \neq x_{s}$ and x_{p} or $x_{s} \neq \text{NULL}$

value $(x_{i+1}) = (x_p + x_s) / 2$

At the next step calculate average from the values of subscripts (x_{i+1}) and (x_{i-1}) , it fill the subscript X_i . Therefore, here the vales of succeeding variable (x_s) get change where preceding (x_p) remain fixed as previous value.

 $x_p = \text{value}(x_{i-1})$ $x_s = \text{value}(x_{i+1})$

where $x_p \neq x_s$ and x_p or $x_s \neq \text{NULL}$

value $(x_i) = (x_p + x_s) / 2$

Similarly calculate average from the values of subscripts (x_{i+1}) and (x_{i+3}) , it fills the subscript X_{i+2} . Thus the equations to fill the value of subscript (x_{i+2}) is formed as:

 $x_p = \text{value}(x_{i+1})$ $x_s = \text{value}(x_{i+3})$

where $x_p \neq x_s$ and x_p or $x_s \neq \text{NULL}$

value $(x_{i+2}) = (x_p + x_s) / 2$

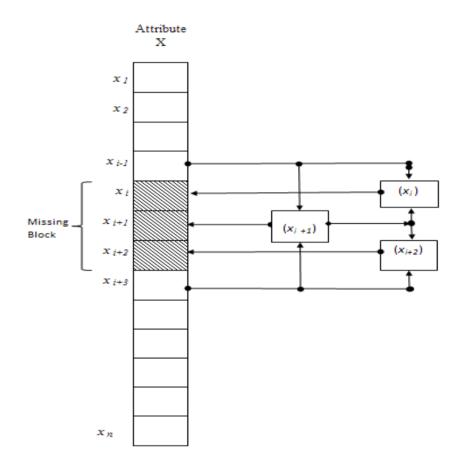


Figure: Block Diagram of Odd Size Block Fitting Approach (Three Values)

3. ALGORITHM

Read $X = \{x_1, \dots, x_n\}$ // Attribute with observed and missing values where $X = X_{obs} + X_{mis}$

 $\begin{array}{l} X_{obs} = \ \{x_1, \ldots, x_k\} // \text{ Attribute values observed} \\ X_{mis} = \ \{x_{k+1}, \ldots, x_n\} // \text{ Attribute values missing} \end{array}$

For i = 1 to n do

If (value $(x_i) ==$ NULL && value (x_{i+1})) == NULL && value (x_{i+2})) == NULL) then

 $x_p = \text{value}(x_{i-1}) // \text{Value of preceding}$

 $x_s = \text{value}(x_{i+3}) // \text{Value of succeeding}$ $\text{value}(x_{i+1}) = (x_p + x_s) / 2 / \text{Replacing the value for } x_{i+1}$ (Second (Centered) missed subscript) $x_s = \text{value}(x_{i+1})$ $\text{value}(x_i) = (x_p + x_s) / 2 // \text{Replacing the value for xi}$ (First missed subscript) $x_p = \text{value}(x_{i+1})$ $x_s = \text{value}(x_{i+3})$ $\text{value}(x_{i+2}) = (x_p + x_s) / 2 // \text{Replacing the value for } x_{i+2}$ (Third missed subscript) endif i = i + 1 repeat until (i >=n)Stop

4. DISCUSSION OF RESULTS

Table-1 given in appendix shows the world wide emission of carbon dioxide (CO2) from the consumption of Coal, Oil and Natural Gas respectively for the years 1960 to 2009. The mean emission of carbon dioxide (CO2) due to Coal, Oil and Natural Gas are 2109, 2262 and 879 respectively.

It is to be noted that in the planned way odd block of the values are missing in the random manner for all the variables. The means calculated from incomplete data sets are 2097, 2238 for Coal, Oil and 897 for Natural Gas. After recovery of the missing block values the mean of Coal, Oil and Gas are 2107, 2263 and 878 respectively. It is observed that recovered mean values are varying close to means of standard dataset. Same are true for Standard deviation and Coefficient of Variance.

5. CONCLUSION

It is universally known that there is not 100 % efficient technique of handling missing attribute values. The proposed Odd size block fitting approach is useful for numerical attribute, having minor deviation from the mean. The method is appropriate for the consolidated report, also more appropriate and suitable to small size block missing values.

6. REFERENCE

[1] Buck, S.F., A method of estimation of missing values in multivariate data suitable for use with an electronic computer, J. Royal Statistical Society, Series B, Vol-2, pp. 302-306(1960).

[2] Chen, L., Drane, M.T., Valois, R.F., and Drane, J.W., Multiple imputation for missing ordinal data, Journal of Modern Applied Statistical Methods, Vol.-4, No.1, pp. 288-299(2005).

[3] Gaur, Sanjay and Dulawat, M.S., Univariate Analysis for Data Preparation in context of Missing Values ,Journal of Computer and Mathematical Sciences, Vol.-1, No. 5, pp. 628-635(2010).

[4] Gaur, Sanjay and Dulawat, M.S., A Closest Fit Approach to Missing Attribute Values in Data Mining,, International Journal of advances in Science and Technology, Vol.-2, issue-4, (2011).

[5] Gaur, Sanjay and Dulawat, M.S., Improved Closest fit Techniques to handle missing Attribute values, Journal of Computer and Mathematical Sciences, Vol.-2, No.25, pp. 384-390(2011).

[6] Kim, J.O., and Curry, J., The treatment of missing data in multivariate analysis, Social Methods and Research, Vol.-6, pp. 215-240(1977).

[7] Qin, Y.S., Semi-parametric optimization for missing data imputation, Applied Intelligence, Vol.-27, No. 1, pp. 79-88(2007).

[8] Rubin, D.B., Inference and missing data, Biometrika, 63, pp. 581-592(1976).

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Table : 1

lobal Carbon Dioxide Emissions from Fossil Fuel Burning by Fuel Type, 1960-2009 (In Million Tones of Carbon

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3 $1,581$ $2,240$ 608 $1,581$ $2,240$ $1,581$ 4 $1,579$ $2,244$ 618 $1,579$ $2,244$ $1,579$ 5 $1,673$ $2,131$ 623 $1,673$ $2,131$ 623 5 $1,710$ $2,313$ 650 $1,710$ $2,313$ 650 7 $1,766$ $2,395$ 649 $1,766$ $2,395$ 649 8 $1,793$ $2,392$ 677 $1,793$ $2,392$ 677 9 $1,887$ $2,544$ 719 $1,887$ $2,544$ 719 0 $1,947$ $2,422$ 740 $1,947$ $2,422$ 740 $1,921$ $2,289$ 756 $1,921$ $2,289$ 756 $2,1992$ $2,196$ 746 $1,992$ $2,196$ 746 3 $1,995$ $2,177$ 745 $1,995$ $2,177$ 4 $2,094$ $2,202$ 808 $2,094$ $2,202$ 803 $2,290$ 830 $2,290$ 830 7 $2,364$ $2,302$ 893 $2,302$ 893 3 $2,414$ $2,408$ 936 $2,414$ $2,408$ 936 $2,457$ $2,455$ 972 $2,457$ $2,455$ 972 $2,409$ $2,517$ $1,026$ $2,409$ $2,517$ $1,026$	1,946	1,559	554	1,946	1,559	554	1,946	1,559	1971	12
3 $1,581$ $2,240$ 608 $1,581$ $2,240$ $1,581$ 4 $1,579$ $2,244$ 618 $1,579$ $2,244$ $1,579$ 5 $1,673$ $2,131$ 623 $1,673$ $2,131$ 623 5 $1,710$ $2,313$ 650 $1,710$ $2,313$ 650 7 $1,766$ $2,395$ 649 $1,766$ $2,395$ 649 8 $1,793$ $2,392$ 677 $1,793$ $2,392$ 677 9 $1,887$ $2,544$ 719 $1,887$ $2,544$ 719 0 $1,947$ $2,422$ 740 $1,947$ $2,422$ 740 $1,921$ $2,289$ 756 $1,921$ $2,289$ 756 2 $1,992$ $2,196$ 746 $1,992$ $2,196$ 3 $1,995$ $2,177$ 745 $1,995$ $2,177$ 4 $2,094$ $2,202$ 808 $2,094$ $2,202$ 800 $2,290$ 830 $2,290$ 830 $2,290$ 5 $2,300$ $2,290$ 830 $2,290$ 830 $2,230$ 7 $2,457$ $2,455$ 972 $2,457$ $2,455$ 972 $2,457$ $2,455$ 972 $2,409$ $2,517$ $1,026$	2,055	1,576		2,055	1,576	583	2,055	1,576	1972	13
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$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		1,579							1974	15
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7 $1,766$ $2,395$ 649 $1,766$ $2,395$ 649 3 $1,793$ $2,392$ 677 $1,793$ $2,392$ 677 9 $1,887$ $2,544$ 719 $1,887$ $2,544$ 719 9 $1,947$ $2,422$ 740 $1,947$ $2,422$ 740 1 $1,921$ $2,289$ 756 $1,921$ $2,289$ 756 2 $1,992$ $2,196$ 746 $1,992$ $2,196$ 746 3 $1,995$ $2,177$ 745 $1,995$ $2,177$ 745 4 $2,094$ $2,202$ 808 $2,094$ $2,202$ 808 5 $2,237$ $2,182$ 836 $2,182$ 836 6 $2,300$ $2,290$ 830 $2,290$ 830 7 $2,364$ $2,302$ 893 $2,414$ $2,408$ 936 $2,457$ $2,455$ 972 $2,457$ $2,455$ 972 0 $2,409$ $2,517$ $1,026$ $2,409$ $2,517$ $1,026$		1,710							1976	17
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4 2,094 2,202 808 2,094 2,202 808 2,094 5 2,237 2,182 836 2,182 836 2,174 5 2,300 2,290 830 2,290 830 2,254 7 2,364 2,302 893 2,302 893 2,302 893 3 2,414 2,408 936 2,414 2,408 936 2,414 9 2,457 2,455 972 2,457 2,455 972 2,409 0 2,409 2,517 1,026 2,409 2,517 1,026 2,409									1982	23
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7 2,364 2,302 893 2,302 893 2,334 8 2,414 2,408 936 2,414 2,408 936 2,414 9 2,457 2,455 972 2,457 2,455 972 2,457 0 2,409 2,517 1,026 2,409 2,517 1,026 2,409	í í	<u>2,174</u>							1985	26
3 2,414 2,408 936 2,414 2,408 936 2,414 9 2,457 2,455 972 2,457 2,455 972 2,457 0 2,409 2,517 1,026 2,409 2,517 1,026 2,409									1986	27
2 2,457 2,455 972 2,457 2,455 972 2,457 0 2,409 2,517 1,026 2,409 2,517 1,026 2,409	<i>,</i>	<u>2,334</u>						,	1987	28
2,409 2,517 1,026 2,409 2,517 1,026 2,409		2,414							1988	29
		2,457			,				1989	30
	2,517	2,409	1,026	2,517	2,409	1,026	2,517	2,409	1990	31
2,341 2,627 1,069 2,341 2,627 1,069 2,341	2,627	2,341	1,069	2,627	2,341	1,069	2,627	2,341	1991	32
2 2,318 2,506 1,101 2,318 2,506 1,101 2,318	2,506	2,318	1,101	2,506	2,318	1,101	2,506	2,318	1992	33
3 2,265 2,537 1,119 2,265 2,537 1,119 2,265	2,537	2,265	1,119	2,537	2,265	1,119	2,537	2,265	1993	34
4 2,331 2,562 1,132 2,331 2,562 1,132 2,331	2,562	2,331	1,132	2,562	2,331	1,132	2,562	2,331	1994	35
5 2,414 2,586 1,153 2,414 1,153 2,414	<u>2,612</u>	2,414	1,153		2,414	1,153	2,586	2,414	1995	36
3 2,451 2,624 1,208 2,451 1,208 2,451	2,663	2,451	1,208		2,451	1,208	2,624	2,451	1996	37
		2,480							1997	
		2,376		2,763					1998	39
		2,329		,					1999	10
		2,342							2000	41
	· · ·	2,460							2001	12
		2,487								43
		2,407					,		2002	14
		2,850			,					44 45
								,	2004	+5 16
		3,032								
		3,193						,	2006	
		3,295							2007	48
		3,401						,	2008	
3 3,393 3,019 1,552 3,393 3,019 1,552 3,393	3,019	3,393	1,552	3,019	3,393	1,552	3,019	3,393	2009	50
n 2,109 2,262 879 2,097 2,238 897 2,107	2,263	2,107	897	2,238	2.097	879	2,262	2,109	Mean	
		567.11							SD	
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26.92 27.46 45.54 27.84 28.30 45.35 26.92	27.48	26.92	40.30	28.30	27.84	45.54	27.46	20.92	CV	

source: www.earth_policy.org

Source of support: Nil, Conflict of interest: None Declared