Post-Processing Approach for Avoiding Discrimination in Data Mining

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Abstract— Data mining is a technique of automatically searching data for patterns, predictions, descriptions, rules, summary, and classification. It is hidden knowledge used for making decisions and comparison of many different attributes. While gathering helpful data some negative impacts on data use can be happen. Treating people unfairly in some situations is called discrimination. But this is not always against the law. As price discrimination is not a crime but selection of employees may be a crime. In this paper, Post-processing approach which is used to prevent discrimination and to avoid loss of data is applied to adult dataset and evaluated.

Keywords— Data mining, Knowledge discovery in databases (KDD), Direct and Indirect Discrimination, Anti-discrimination, Sensitive attributes, Rules, Classification,

INTRODUCTION

Data mining is the process of discovering knowledge which will help to make rules and take decisions on data classification. The automatic decision support system in medical, educational system and industries deals with large amount of data to make fast and correct decisions using data mining which handle such datasets, having very sensitive information with sensitive attributes which may cause direct or indirect discrimination or both at the same time.

In processing discrimination, identification and checking of presence of discrimination is one part and another part is discrimination prevention. In social life, discrimination affects people. So to prevent discrimination rules are made and are called as anti-discrimination laws. For ex. in Europe, The European Union Legislation where anti-discrimination rules for avoiding discrimination against color, race, age are used [5]. In US, UK, laws exist about Fair Housing Act, US Equal Pay Act [9, 2].

Discrimination is of two types, direct and indirect. The prevention techniques named as Pre-processing method, In-processing method and Post-processing method can be applied to avoid discrimination.

Direct discrimination: Direct discrimination consists of rules or procedures that explicitly mention minority or negative groups based on sensitive discriminatory attributes related to group membership as given below:

{Foreign Worker= Yes, Gender=Female}→Hire= No
{Foreign Worker=Yes, Gender= Male} → Hire= Yes
　　　　Here, priority given to female so direct discrimination takes place [6].

Indirect discrimination: Indirect discrimination occurs when decisions are made based on non-sensitive attributes which are strongly correlated with biased sensitive ones. The rules are like below:

{Zip =413513}→Hire = no
{Zip =104523}→ Hire = Yes
　　　　From zip code of city we get information about area from which we decide conditions of people or behavior of people. Again partiality can be recognized indirectly [6, 9].

Finding discrimination is critical task. The dataset is consisting of some potential discriminated and potentially non-discriminated attributes, then a presence of discrimination is checked and prevention is applied to it.

RELEATED WORK

Discrimination Aware Data Mining (DADM) deals with finding methods to discover or prevent discrimination using data mining techniques. The research in this area has been started from 2008 by D. Pedreschi. The approach is based on classification rules and reasoning on them by measuring discrimination. Then Pedreschi, Ruggieri explained about discovery of in/ direct discrimination and methods to prevent discrimination in [13].

S. Haijan, J. Domingo explained in [4], gave 3 major methods to prevent discrimination which are Pre-processing, In-processing, Post-processing. Where Pre-processing method is used to remove discriminated data due to this data loss can take place. In-processing method the standard data mining algorithms are changed to avoid discrimination. The Post-processing method helps to remove discrimination by changing results of data mining tasks but no loss of data here.

Discrimination can cause due to decisions so modification deals with decision trees like Navie Bays decision tree used for making decisions. S. Hajian, J. D Ferrer, A. Balleste, represented that this uses the In-processing and the Post-processing to avert discrimination [3].

The possibilities of discrimination can take place in credit card application [4], adult dataset [4], crime and intrusions detection [2], project funding [14].

Here, increase in research is done by keeping step on automation tools. The tools are designed such as discrimination discovery and prevention can be done automatically. Pedreschi, Ruggieri, and Turini designed a tool named LP2DD, helps to detect discrimination in automatic decision support system [10].

The related work helps to understand different discrimination methods of discovery and prevention with its advantages and limitations from paper [15].
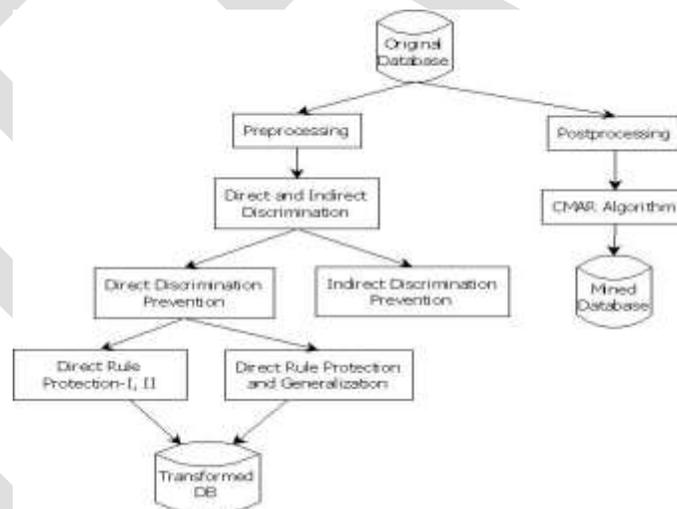
PROPOSED SYSTEM

A] System overview:

Fig 1: System Overview

Data preprocessing: In data preprocessing dataset is uploaded and records with missing values are removed. The frequent item sets are created with Apriori algorithm . The Apriori is significant algorithm for mining regular item set for Boolean association rules.

Pre Processing Method: In this module the user avoids discrimination by using preprocessing method. In this method user gives alpha value and PD and PND rules are created. Four algorithms are designed for avoiding discrimination are named as Direct Rule Protection-1,2, Rule generation and Indirect Rule protection for direct and indirect discrimination respectively.

Post Preprocessing Method: In this module, Post-preprocessing method with CMAR algorithm is used to prevent data from discrimination.

B] Algorithms used

Input: a dataset.

Output: discrimination free rules

First phase: Rule Generation
Step1: Scan of database for finding item sets.
Step2: Sort in descending applied on attributes to construct frequent pattern tree
Step3: Generate a subset of CARs based on F-list without overlapping
Step4: Prune the FP-tree by distributing class label
Step5: CR-tree is constructed to index the rules and potential sharing of rules and saving space since the rules that have common frequent items share the part of path
Step6: Prune the rules with high and low confidence to select subset of rules based on database coverage

Second phase: classification based on multiple rules (CMAR).
Step1: Divide the rules into groups according to class labels
Step2: Measure the combined effect of each group to compare the strength of the groups, is very tough, CMAR adopted weighted $X2$ measure.

   In this way we get the strong rules free from discrimination.

RESULT AND DISCUSSION

A] Dataset
       Here, adult dataset is used which contains nine attributes and 200 records. The dataset contains general information about the individual: sex, training, marital status, race, nation, education, salary. Rules are generated from the dataset by using the CMAR algorithm are discrimination free.

B] Results

  The Fig. 2 is line graph comparision for the output of Alpha Table in the Table. 1 where ,

- DRPM I – Direct Rule Protection Method 1
- DRPM II – Direct Rule Protection Method 2
- RG- Rule Generalisation
- IRP- Indirect Rule Protection

α- values	DRPM-I	DRPM-II	RG	IRP
0.2	181	81	84	83
0.3	184	79	85	86
0.6	80	80	83	86
0.7	81	81	85	86
0.9	78	80	86	84

**Table 1.:** No. of Records Changed with α in the Pre-processing Method
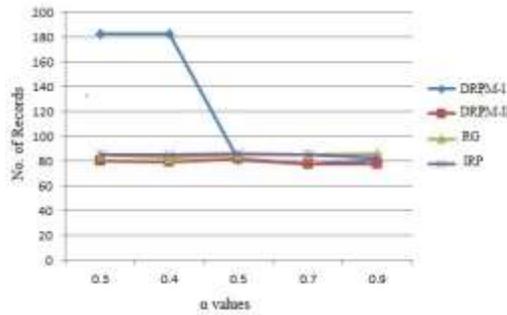
Fig. 2.: No. of Records Changed with α in the Pre-processing Method

The Fig. 3 is line graph comparision for the output of the Table. 2 where , no. of rules are constant or less which makes discrimination free classification.

K value	No. of rules
1	6
4	4
5	3
6	3
7	3

Table 2.: No. of Rules Generated with K values in the Post-processing Method
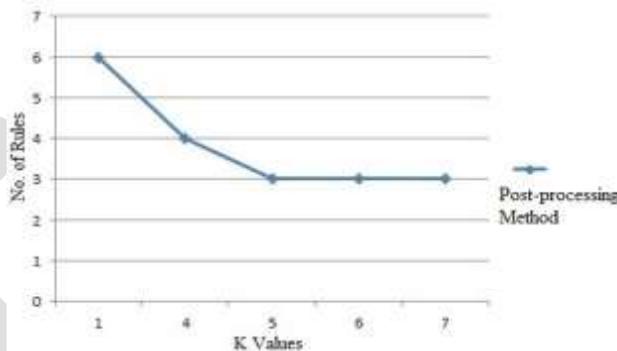
Fig. 3.: No. of Rules Generated with K values in the Post-processing Method

CONCLUSION

Mining rules which are used for taking decisions can cause discrimination. Discrimination is the research subject in financial aspects, laws and sociologies. Here, in this paper distinct approaches to find and avoid discrimination algorithms are discussed.

The system for Post-processing discrimination preventing technique is implemented to overcome the disadvantages of data loss and one-class rules of the Pre-processing. The post processing method produces stronger rules with adult dataset which can be further used in applications like employment selection, validation for issue of credit card.

REFERENCES:

[1] T. Calders, S. T.Verwer, Three Naive Bayes Approaches forprejudice-Free Classification, Data Mining and Knowledge Discovery,vol. 21, no.2, pp.277-292, 2010.

[2] S. Hajian, J. Domingo-Ferrer, A. Martinez Balleste, DiscreminationPrevention in Data Mining for Intrusion and Crime Detection, Proc. IEEESymp. Computational Intelligence in Cyber Security (CICS 11), pp. 47-54, 2011.

[3] S. Hajian, J. Domingo-Ferrer, A. Balleste, Rule Protection for Indirect Discrimination Prevention in Data Mining, Proc. Eighth Intl Conf. Modeling Decisions for Artificial Intelligence, pp. 211-222, Springer-Verlag 2011.

[4] S. Hajian and J. Domingo-Ferrer, A Methodology for Direct and Indirect Discrimination Prevention in Data Mining, IEEE Transactions onKnowledge and data Engineering, Vol. 25, No.7, July 2013.

[5] Sara Hajian, J.Domingo-Ferrer, Oriol Farras, Generalization-based privacy preservation and Discrimination prevention in data and mining publishing,Data Min Knowledge Disc 28:11581188 DOI 10.1007//10618-014-0346-1,2014.

[6] F. Kamiran and T. Calders, Classification without Discremination, Proc.IEEE Second Intl Conf. Computer, Control and Comm., (IC4 09), 2009.

[7] F. Kamiran and T. Calders, Classification with no Discremination by Preferential Sampling, Proc. 19th Machine Learning Conf. Belgium andthe Netherlands, 2010.

[8] Binh Loung, Ruggieri, Tuini, K-NN as an Implementation of SituationTesting for Discremination Discovery and Prevention, KDD ACM - 978-1-4503-0813, 2011.

[9] D. Pedreschi, S. Ruggieri, F. Turini, Discremination-aware data mining,in Proceedings of the Fourteenth ACM SIGKDD International Conferenceon Knowledge Discovery and Data Mining, 2008.

[10] D. Pedreschi, S. Ruggieri, and F. Turini, Integrating Induction and Deduction for Finding Evidence of Discremination, Proc. 12th ACM IntlConf. Artificial Intelligence and Law, pp. 157-166, 2009.

[11] D. Pedreschi, S. Ruggieri, F. Turini, Measuring Discrimination in Socially-Sensitive Decision Records, Proc. Ninth SIAM Data MiningConf , pp. 581-592, 2009.

[12] S. Ruggieri, D. Pedreschi, F. Turini, DCUBE: Discrimination Discoveryin Databases, Proc. ACM Intl Conf. Management of Data (SIGMOD 10),pp. 1127-1130, 2010.

[13] S. Ruggieri, D. Pedreschi, F. Turini, Data Mining for DiscreminationDiscovery, ACM Trans. Knowledge Discovery from Data, vol. 4, no. 2,article 9, 2010.

[14] Andrea Romei , Salvatore Ruggieri , Franco Turini, Discrimination Discovery in scientific Projects : A Case Study, Expert Systems withApplications 60646079, Elsevier Ltd, 2013.

[15] V. Mane, A. R. Deshpande, A Survey on Discrimination Prevention inData Mining, International Journal of Science and Research, 2014.