The Experiment of K-anonymity

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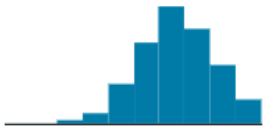
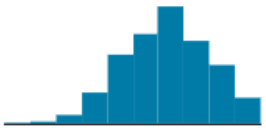
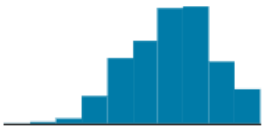
1. Dataset

We use the dataset “**Students Performance in Exams**” from Kaggle. There are a total of 8 attributes. The first 5 attributes are quasi-identifier, and the last 3 attributes are target identifiers.

gender		race/ethnicity		parental level of e...		lunch	
female	52%	group C	32%	some college	23%	standard	65%
male	48%	group D	26%	associate's degree	22%	free/reduced	36%
		Other (419)	42%	Other (552)	55%		

test preparation c...		math score	reading score	writing score
none	64%			
completed	36%	0 100	17 100	10 100

2. K-anonymity Algorithm

In the "race/ethnicity" attribute, there are a total of 5 categories, namely "group A" to "group E." Among them, "group C" and "group D" are the most frequent, accounting for 32% and 26%, respectively. As a result, we have modified the remaining 3 categories to "other" to achieve anonymity.

There are 6 different categories in attribute “ parental level of education”. “some college” appears the most frequently(23%), “associate's degree” is the second, it has about 22%. We combine the rest of categories into two combinations. “some high school” and “high school” to “before college”. “bachelor's degree” and “master's degree” to “bachelor's and master's degree”.

3. Result Data

The value of K is 9.

	gender	race_ethnicity	parental_level_of_education	lunch	test_preparation_course
0	female	group B	bachelor's degree	standard	none
1	female	group C	some college	standard	completed
2	female	group B	master's degree	standard	none
3	male	group A	associate's degree	free/reduced	none
4	male	group C	some college	standard	none
5	female	group B	associate's degree	standard	none

(a) original data

	gender	race_ethnicity	parental_level_of_education	lunch	test_preparation_course
0	female	other	bachelor's and master's degree	standard	*
1	female	group C	some college	standard	*
2	female	other	bachelor's and master's degree	standard	*
3	male	other	associate's degree	free/reduced	*
4	male	group C	some college	standard	*
5	female	other	associate's degree	standard	*

(b) anonymized data

4. Machine Learning Models

In the preprocessing phase, we first drop the attributes “math score” and “test preparation course”. After dropping, we map the attributes “race/ethnicity” and “gender” by one-hot encoding method. We then map the attribute “parental level of education” from 1 to 5 according to the corresponding levels of education. Next, we map the attribute “lunch” with boolean values. Last, we map two “score” attributes to 3 categories each, the bottom 33%, the middle 33%, and the top 33%, with values 1, 2, 3, respectively.

We tried 3 ML algorithms to predict the attribute “writing_score”, the figure below shows the results of original data and data after anonymization.

5. Results

predict target : writing score

		Accuracy	F1-Score	Recall
SVM	original	81.50%	81.52%	81.50%
	after	81.50%	81.52%	81.50%
Random Forest	original	77.60%	77.66%	77.60%
	after	78.70%	78.69%	78.70%
MLP	original	81.30%	81.39%	81.30%
	after	81.30%	81.35%	81.30%