CMSC 23200 HW 6

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Part 1

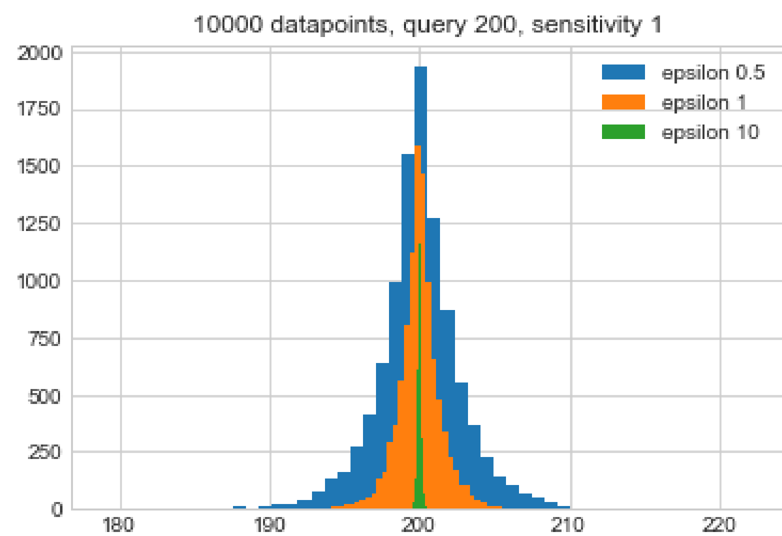
Problem 1.1

32560 could be uniquely identified and three could not.

Problem 1.2

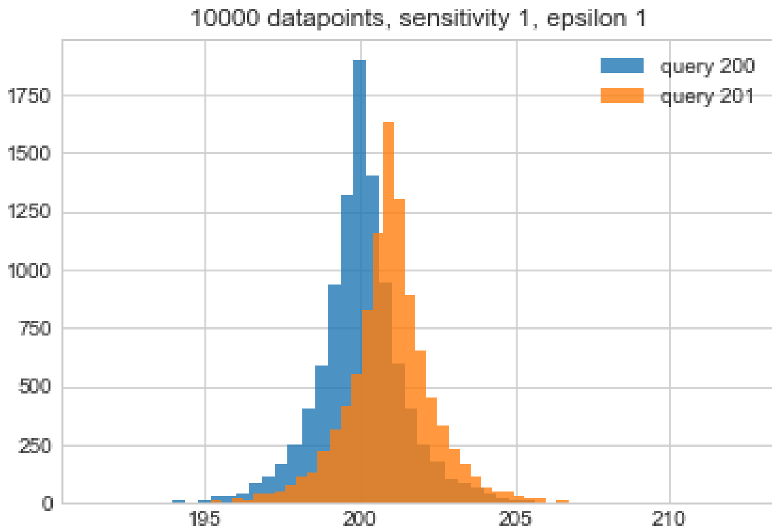
Suppose the number of rows is N, my algorithm will run in $O(N)$. My approach is to group by the given columns and count the number of unique tuples in each group. Then if the group with the smallest number of tuples has $>= k$ tuples, the table is k-anonymous. Otherwise it is not.

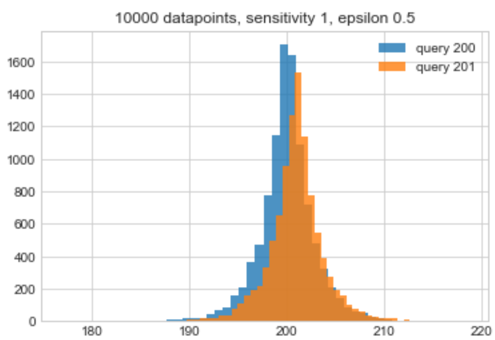
Problem 1.3

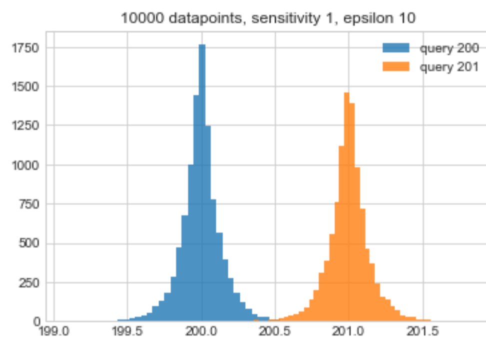


`num_bachelors` returned 5355. The sensitivity of `num_bachelors` is 1. $\Delta f = max_{D,D'\,neighboring}|f(D) - f(D^{'})| = 1$ when a person with a Bachelor's degree is in D but not in $D^{'}$.

Problem 1.4

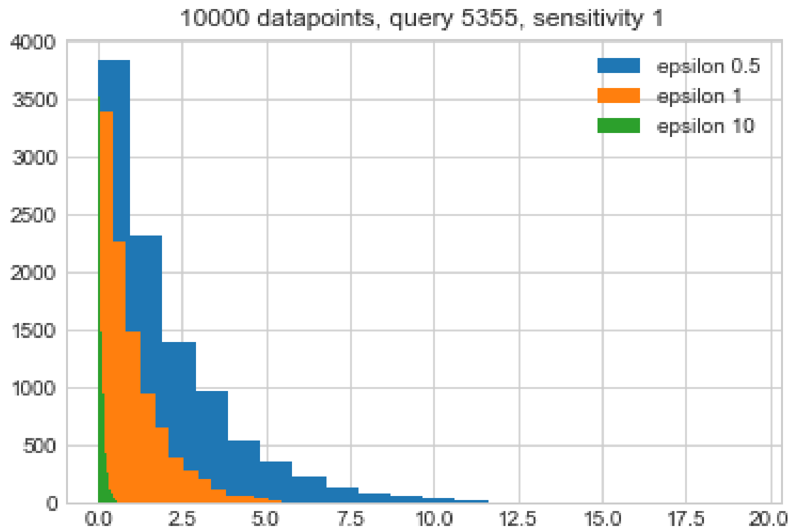






The greater amount of overlap between the histograms, the better privacy an individual in the dataset has. A lower epsilon value means more privacy, and by contrasting the plots of epsilons set to 0.5, 1, and 10, we observe that as epsilon decreases, there is more overlap.

Problem 1.5



As epsilon increases, the error decreases. The security/privacy of an individual in the dataset also decreases. We would want an epsilon value that is low enough to guarantee some privacy but high enough to preserve some accuracy of the query. In this problem setting, 1 might be the best candidate among 0.5, 1, and 10. We might devise some statistical tests and require that the error/noise in the query results be bounded according to some measures of the original data values. We might also bound the variance of the errors.

Part 2

$Pr[m(D) \in S] \leq e^{\epsilon} Pr[m(D^{'}) \in S]$ no longer holds true since it's now possible that $Pr[m(D^{'}) \in S] = 0$. The implemented Laplace distribution would be missing some values because U doesn't output all possible doubles.

Instead of testing "any x $\in U$" as the writeup specifies, I found that I could more effectively drive down false positives from `1.+my_laplace(1)` by testing the membership of both $x = e^{y/s}$ and $x_2 = e^{\log x}$ (if $s * \log x_2 = -abs(y)$). I tested the membership of an element x in U by checking whether x is an integer multiple of 2^{-53}, as the paper states. I compute a double `x / (2 ** -53)` and an integer `x // (2 ** -53)` and return $x \in U$ if these two values are equal. My algorithm is very simple: return True if `x in U and s * log(x2) == -abs(y) and x2 in U` and False otherwise.

In one run, there were 850 true positives from `my_laplace(1)` and 337 false positives from `1.+my_laplace(1)`.