

Corey Capooci
cvcapooc@ncsu.edu
HW2

1

a

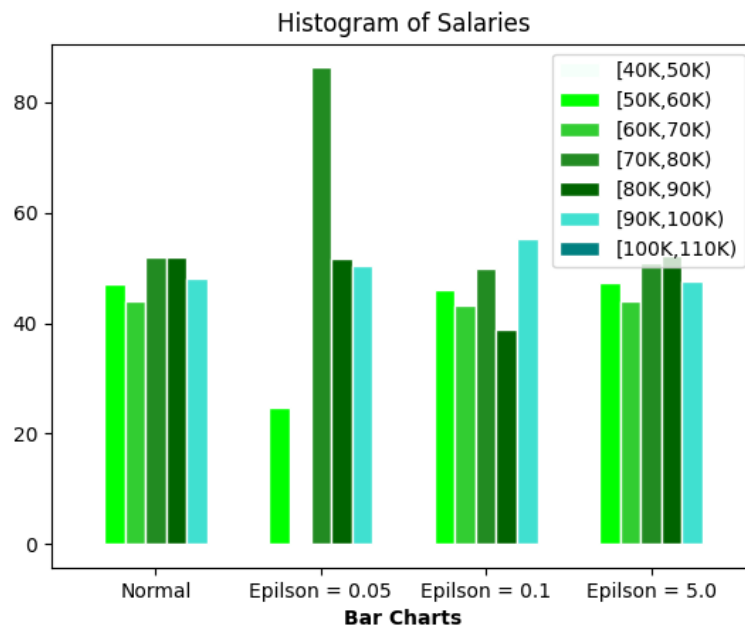
To calculate the global sensitivity of the mean function, let's assume m is the mean of the dataset D . To find the global sensitivity, remove the value $y \in D$ such that $|m - y| \geq |m - z|, \forall z \in D$. Then, recalculate the mean, $\frac{(m * \mathbf{N}) - y}{\mathbf{N} - 1}$ and call it m_1 . Hence, the global sensitivity is $|m - m_1|$.

b

λ is equal to the sensitivity divided by ϵ . Therefore, $\lambda = \frac{|m - m_1|}{\epsilon}$.
 $pdf(x) = \frac{\epsilon}{2 * |m - m_1|} * \exp\left(\frac{-\epsilon * |x|}{|m - m_1|}\right)$

2

a



Figur 1: Histograms of Salary Data based on Epsilon

b

As you increase ϵ , the histogram becomes much more like the original dataset.

3

First, note that the data in each server is a 4 by 4 grid with row 0 as 0110, row 1 as 0101, row 2 as 1001, and row 3 1011. As such,

0110
0101
1001
1011

We choose a random query string of 4-bits. 4-bits because that is the bit size of a row of data in the server.

We will choose 1001.

We send the query string to Server 1. Server 1 returns a 4-bit string which contains a bit for each row. Each bit is calculated by considering only bits where the query string is 1, all other bit positions can then be 0. Then, taking the bit-wise XOR of those bits. For example,

For row 0, 1001 and 0110 $\Rightarrow 0 \oplus 0 \oplus 0 \oplus 0 = 0$

For row 1, 1001 and 0101 $\Rightarrow 0 \oplus 0 \oplus 0 \oplus 1 = 1$

For row 2, 1001 and 1001 $\Rightarrow 1 \oplus 0 \oplus 0 \oplus 1 = 0$

For row 3, 1001 and 1011 $\Rightarrow 1 \oplus 0 \oplus 0 \oplus 1 = 0$

Therefore, server 1 return 0100.

For the next server, the query string is bit-wise XOR'd by 4-bit string with only one 1 in the 0th position, which corresponds to the column that contains the value we are looking for.

This computation looks like $1001 \oplus 1000 = 0001$.

The steps are the same as when we sent the first query string to Server 1. We now send the new query string to Server 2.

Server 2 returns a 4-bit string which contains a bit for each row. Each bit is calculated by considering only bits where the query string is 1, all other bit positions can then be 0. Then, taking the bit-wise XOR of those bits. For example,

For row 0, 0001 and 0110 $\Rightarrow 0 \oplus 0 \oplus 0 \oplus 0 = 0$

For row 1, 0001 and 0101 $\Rightarrow 0 \oplus 0 \oplus 0 \oplus 1 = 1$

For row 2, 0001 and 1001 $\Rightarrow 0 \oplus 0 \oplus 0 \oplus 1 = 1$

For row 3, 0001 and 1011 $\Rightarrow 0 \oplus 0 \oplus 0 \oplus 1 = 1$

Therefore, server 2 returns 0111.

Taking the two 4-bit strings from both servers, we take the 2nd index of both strings and XOR the values. The 2nd index is taken because the 2nd row is where the 8th value resides.

2nd value of Server 1's return string is 0. 2nd value of Server 2's return string is 1.
 $0 \oplus 1 = 1$. Therefore the 8th value is 1.