

1.

1. mean:

$$\frac{1}{1} = 1$$

$$\frac{1+100}{2} = 50$$

$$\frac{1+100+200}{3} = \frac{301}{3} = 100$$

$$\frac{1+400}{2} = 200$$

$$\frac{1+200+800}{3} = 333$$

$$\frac{b-a}{N} = \frac{799}{3} = 266 \leftarrow \text{Sensitivity}$$

$$F(x) = f(x) + \text{Lap}\left(\frac{\text{sens}}{\text{epsilon}}\right)$$

→ a) Sensitivity = $\frac{b-a}{N}$

→ The global sensitivity of the mean function for our dataset which holds salaries in the range $[a, b]$ with N entries would be $\frac{b-a}{N}$ because the largest change in mean ~~mean~~ if we remove 1 entry from our database would be $\frac{b-a}{N}$.

→ b) $\lambda = \frac{\text{sensitivity}}{\text{epsilon}}$ where epsilon is our privacy parameter ϵ . Our sensitivity was $\frac{b-a}{N}$, so

$$\lambda = \left(\frac{b-a}{N}\right) / \epsilon$$

2.



- b. As I increase the epsilon value the resulting histogram becomes more similar to the unperturbed output, providing less privacy. At 5.0 epsilon value the privacy is almost non-existent. However, with an epsilon value of 0.05 there was typically a huge difference in the output compared to the unperturbed output.

3.

0	1	1	0
0	1	0	1
1	0	0	1
1	0	1	1

$i = 8$
 $k = (r, c) = (2, 0)$

$Q_1 = 0101$

$$\rightarrow 0 \cdot 0 \oplus 1 \cdot 1 \oplus 0 \cdot 1 \oplus 1 \cdot 0 = 1$$

$$0 \cdot 0 \oplus 1 \cdot 1 \oplus 0 \cdot 0 \oplus 1 \cdot 1 = 0$$

$$0 \cdot 1 \oplus 0 \cdot 1 \oplus 0 \cdot 0 \oplus 1 \cdot 1 = 1$$

$$0 \cdot 1 \oplus 0 \cdot 1 \oplus 0 \cdot 1 \oplus 1 \cdot 1 = 1$$

$$Q_2 = Q_1 \oplus \langle 1000 \rangle = 1101$$

$$1 \oplus 0 = 1$$

$$\rightarrow 0 \cdot 1 \oplus 1 \cdot 1 \oplus 0 \cdot 1 \oplus 0 \cdot 1 = 1$$

$$0 \cdot 1 \oplus 1 \cdot 1 \oplus 0 \cdot 0 \oplus 1 \cdot 1 = 0$$

$$1 \cdot 1 \oplus 0 \cdot 1 \oplus 0 \cdot 0 \oplus 1 \cdot 1 = 0$$

$$1 \cdot 1 \oplus 0 \cdot 1 \oplus 1 \cdot 0 \oplus 1 \cdot 1 = 0$$

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