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PART1

A)

metin, el yazısı, defter, kağıt içeren bir resim

Açıklama otomatik olarak oluşturuldu

B)

metin, el yazısı, defter, menü içeren bir resim

Açıklama otomatik olarak oluşturuldumetin, el yazısı, kağıt, kağıt ürünü içeren bir resim

Açıklama otomatik olarak oluşturuldu

metin, el yazısı, defter, kağıt içeren bir resim

Açıklama otomatik olarak oluşturuldu

PART 2

1. Actual histogram from get\_histogram function, you may uncomment the lines in the get\_histogram to get this histogram.

metin, ekran görüntüsü, diyagram, çizgi içeren bir resim

Açıklama otomatik olarak oluşturuldu

This is dp-histogram which is taken from get\_dp\_histogram, again you may uncomment the line, it will give the noise added version of actual histogram for that run.

metin, ekran görüntüsü, diyagram, öykü gelişim çizgisi; kumpas; grafiğini çıkarma içeren bir resim

Açıklama otomatik olarak oluşturuldu

D)

|  |  |
| --- | --- |
| **ε** | **AvgError** |
| 0.0001 | 22606.6088 |
| 0.001 | 1651.7742 |
| 0.005 | 457.0912 |
| 0.01 | 171.3679 |
| 0.05 | 40.0969 |
| 0.1 | 19.9123 |
| 1.0 | 2.0477 |

N is fixed to 2. As observed from the result table; when **ε** increases, average error decreases since increasing **ε,** decrease the Laplace so there is less noise to add, this leads to more accurate results.

E)

|  |  |
| --- | --- |
| **N** | **AvgError** |
| 1 | 1.8343 |
| 2 | 4.4732 |
| 4 | 8.6953 |
| 8 | 16.2208 |

**ε** is fixed to 0.5 and our calculations will change according to N. As observed from the result table, when N increases average error increases too since N and Laplace are proportional, as N increases, Laplace meanly noise to add also increases, this results in less accuracy higher error (higher difference).

G) Exponential mechanism

|  |  |
| --- | --- |
| **ε** | **Accuracy %** |
| 0.0001 | 8.32 |
| 0.001 | 9.49 |
| 0.01 | 19.95 |
| 0.05 | 87.56 |
| 0.1 | 99.16 |
| 1.0 | 100.0 |

As observed from result table, when **ε** increases, accuracy is increasing too because higher **ε** leads to less noise addition so higher accuracy!

PART 3

|  |  |  |  |
| --- | --- | --- | --- |
| **ε** | **GRR Error** | **RAPPOR Error** | **OUE Error** |
| 0.1 | 26105.66 | 14984.62 | 14234.28 |
| 0.5 | 3806.85 | 2532.78 | 2131.22 |
| 1.0 | 1483.25 | 1179.55 | 933.72 |
| 2.0 | 456.75 | 520.73 | 441.19 |
| 4.0 | 130.92 | 213.47 | 178.67 |
| 6.0 | 37.58 | 155.77 | 123.22 |

I ran my code five times and took their average.

In every case (GRR, RAPPOR and OUE), we observe that average error is decreasing when **ε** increases because by the decrease of **ε**, the noise to add will be decreased this will lead to more accuracy meanly less error. OUE has less errors for small **ε** values (like less than 1). GRR has less errors for higher **ε** values like **ε**=4.0, 6.0. RAPPOR is like in the middle. As we understand this situation, for specific **ε** value, the protocol to use may change, so **ε** meanly epsilon is an important parameter to think when deciding to protocol.