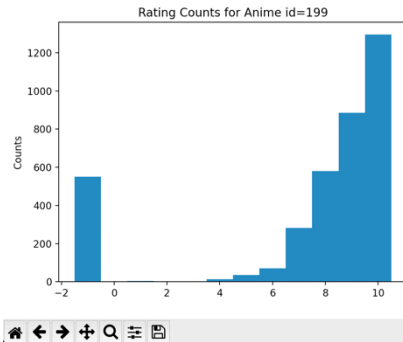


## Comp430 HW#2 Report Burak Yıldırım 72849

### Part-2



It's the histogram for anime id = 199.

```
**** LAPLACE EXPERIMENT RESULTS ****
**** AVERAGE ERROR ****
eps = 0.0001 error = 20653.014367026684
eps = 0.001 error = 2090.4593023476345
eps = 0.005 error = 415.8383160289476
eps = 0.01 error = 205.8666720047655
eps = 0.05 error = 41.03527604254054
eps = 0.1 error = 19.45160245429958
eps = 1.0 error = 1.8717714548580306
**** MEAN SQUARED ERROR ****
eps = 0.0001 error = 826829822.2767125
eps = 0.001 error = 8329802.463034582
eps = 0.005 error = 348312.3404803104
eps = 0.01 error = 85992.53795061605
eps = 0.05 error = 3216.9445220576763
eps = 0.1 error = 753.4891691429194
eps = 1.0 error = 6.862193745142591
```

This table shows the laplace experiment results. It can be observed that when epsilon increases error decreases in terms of average and mean squared error. Since we set the  $b$  in the laplace distribution as  $S(q)/\epsilon$ , sensitivity is fixed, and epsilon is getting larger due to the formula of the laplace distribution it will give samples closer to the actual values. Hence, error gets lower.

```
**** EXPONENTIAL EXPERIMENT RESULTS ****
eps = 0.001 accuracy = 0.113
eps = 0.005 accuracy = 0.372
eps = 0.01 accuracy = 0.665
eps = 0.03 accuracy = 0.99
eps = 0.05 accuracy = 0.999
eps = 0.1 accuracy = 1.0
```

This table shows the exponential experiment results. It can be observed that when epsilon increases accuracy also increases. Since the probability of  $r_{\text{star}}$  getting selected is correlated with epsilon as the epsilon gets larger due to the formula of exponential mechanism it's becoming more probable

to select the actual value. Hence, error gets lower.

### Part-3

```
GRR EXPERIMENT
e=0.1, Error: 19666.24
e=0.5, Error: 19120.47
e=1.0, Error: 18079.18
e=2.0, Error: 14453.88
e=4.0, Error: 4806.00
e=6.0, Error: 808.59
*****
RAPPOR EXPERIMENT
e=0.1, Error: 214977.41
e=0.5, Error: 193102.06
e=1.0, Error: 166537.59
e=2.0, Error: 118609.12
e=4.0, Error: 52507.76
e=6.0, Error: 20963.12
*****
OUE EXPERIMENT
e=0.1, Error: 8548.26
e=0.5, Error: 1921.15
e=1.0, Error: 1257.29
e=2.0, Error: 488.54
e=4.0, Error: 170.03
e=6.0, Error: 138.21
```

These are the results for GRR, RAPPOR, and OUE experiments. In all of the protocols, when epsilon increases error decreased. The OUE protocol is always outperformed other protocols in terms of error. It generated less error for each epsilon value compared to the other protocols. Since all of the protocols uses estimator functions that involves epsilon parameter when epsilon gets larger the estimation becomes closer to the actual value. Thus, error gets lower. The OUE protocol generates less error that might because of it has different probabilities for each case which means it treats unevenly for 1 bit and 0 bits. Moreover, it's estimation formula is different.