Computational Physics : Assignment 1 : Sumit Ghosh : 20201222

Q0. Solution

```
timus@timus-Vostro-3590:~/Desktop/Computational Physics/fprograms$ gfortran variables.f95
timus@timus-Vostro-3590:~/Desktop/Computational Physics/fprograms$ ./a.out
 My name:                        Sumit Ghosh
 A integer variable:             5
 A floating point variable:      3.14000010
 A double-precision variable:    2.7182800769805908
timus@timus-Vostro-3590:~/Desktop/Computational Physics/fprograms$
```

Q1a. Solution

10 random numbers between 0 and 1 on my screen:

```
timus@timus-Vostro-3590:~/Desktop/Computational Physics/fprograms$ gfortran random1.f90
timus@timus-Vostro-3590:~/Desktop/Computational Physics/fprograms$ ./a.out
   7.62939453125000E-006
  0.13153767585754395
  0.75560522079467773
  0.45865011215209961
  0.53276705741882324
  0.21895909309387207
   4.70445156097412E-002
  0.67886447906494141
  0.67929625511169434
  0.93469285964965820
timus@timus-Vostro-3590:~/Desktop/Computational Physics/fprograms$
```

Q1b,Q1c,Q1d. Solution

Change the seed, and print 10 new random number in the file test_ran.dat:

Open | test_ran.dat — ~/Desktop/Computational Physics/fprograms | Save

```
 1 0.0016591549
 2 0.8860108852
 3 0.1883282661
 4 0.2338278294
 5 0.9466543198
 6 0.4193472862
 7 0.9734585285
 8 0.9193198681
 9 0.0108380318
10 0.1548938751
11  Changing seed and generating 10 new random numbers
12 0.0235962868
13 0.5864310265
14 0.1500463486
15 0.8301477432
16 0.2932207584
17 0.1619467735
18 0.8395178318
19 0.7771213055
20 0.0786635876
21 0.0990810394
```

Q1d, Q1e. Solution

Create file “test_ran_10_seeds.dat” and store:

Change seed 10 times, generate 10 random numbers for each seed:

Calculate the average of 10 random numbers:

Open ▾ | test_ran_10_seeds.dat ~/Desktop/Computational Physics/fprograms | Save

```
 0.00086856  0.00173736  0.00260615  0.00347471  0.00434351  0.00521231  0.00608087  0.00694966  0.00781846  0.00868726
 0.60069442  0.20138884  0.80208325  0.40277791  0.00347233  0.60416675  0.20486116  0.80555582  0.40625024  0.00694466
 0.87219071  0.74438143  0.61657214  0.48876286  0.36095381  0.23314452  0.10533524  0.97752595  0.84971666  0.72190762
 0.91016459  0.82032919  0.73049378  0.64065838  0.55082321  0.46098781  0.37115240  0.28131700  0.19148159  0.10164642
 0.13716316  0.27432656  0.41148996  0.54865336  0.68581653  0.82297993  0.96014333  0.09730673  0.23447013  0.37163329
 0.30446959  0.60893917  0.91340899  0.21787858  0.52234840  0.82681799  0.13128757  0.43575740  0.74022698  0.04469681
 0.22195220  0.44390464  0.66585708  0.88780951  0.10976195  0.33171439  0.55366659  0.77561903  0.99757147  0.21952391
 0.35398340  0.70796704  0.06195068  0.41593409  0.76991773  0.12390137  0.47788477  0.83186841  0.18585205  0.53983569
 0.40190101  0.80380201  0.20570302  0.60760403  0.00950503  0.41140628  0.81330729  0.21520829  0.61710930  0.01901031
 0.75091124  0.50182271  0.25273418  0.00364566  0.75455713  0.50546861  0.25638008  0.00729156  0.75820303  0.50911427
NOW calculating average of 10 random numbers:
 0.45542989  0.51085989  0.46628993  0.42171991  0.37714996  0.43257999  0.38800993  0.44343998  0.49886999  0.25430002
```

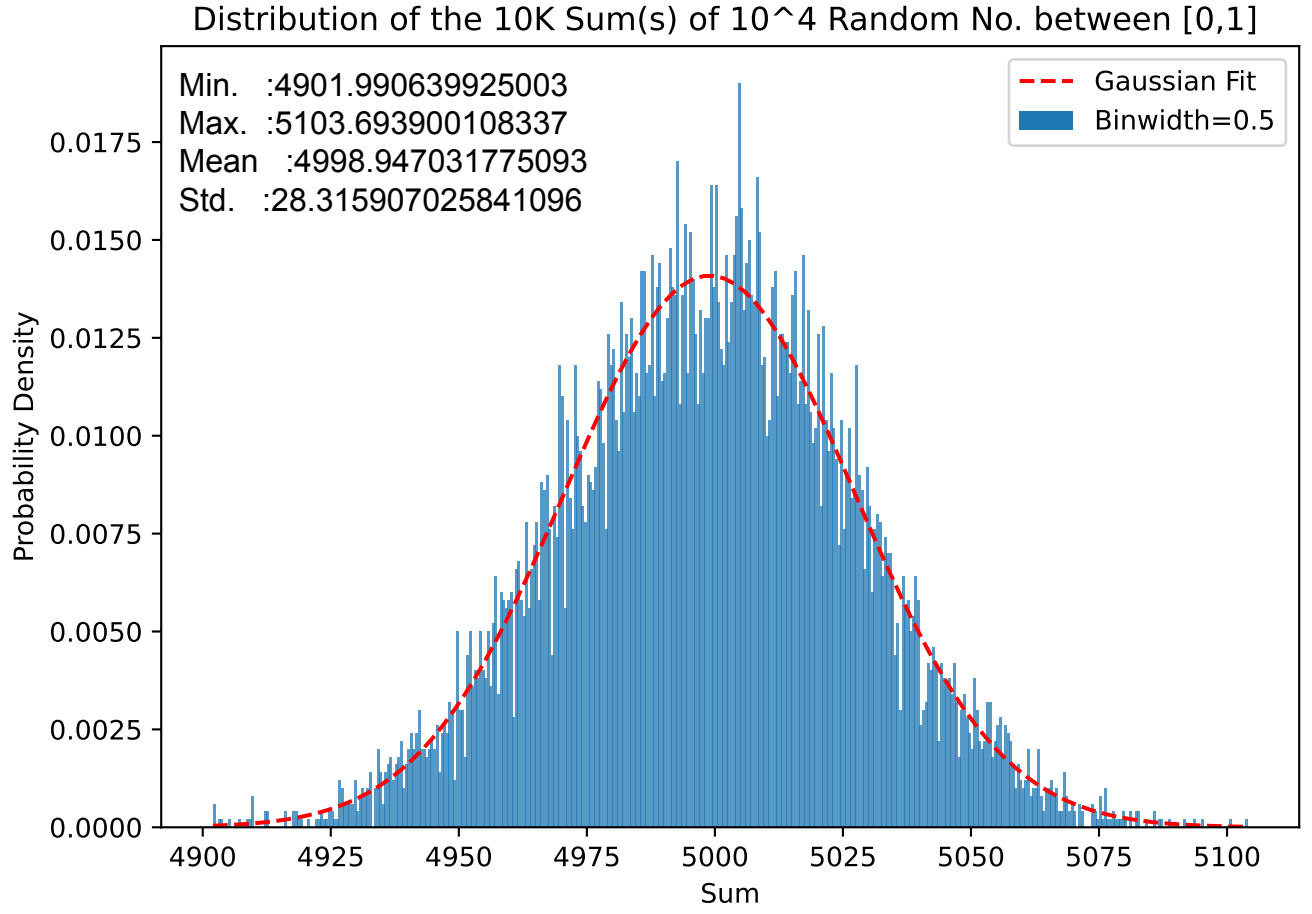
Q1f. Solution

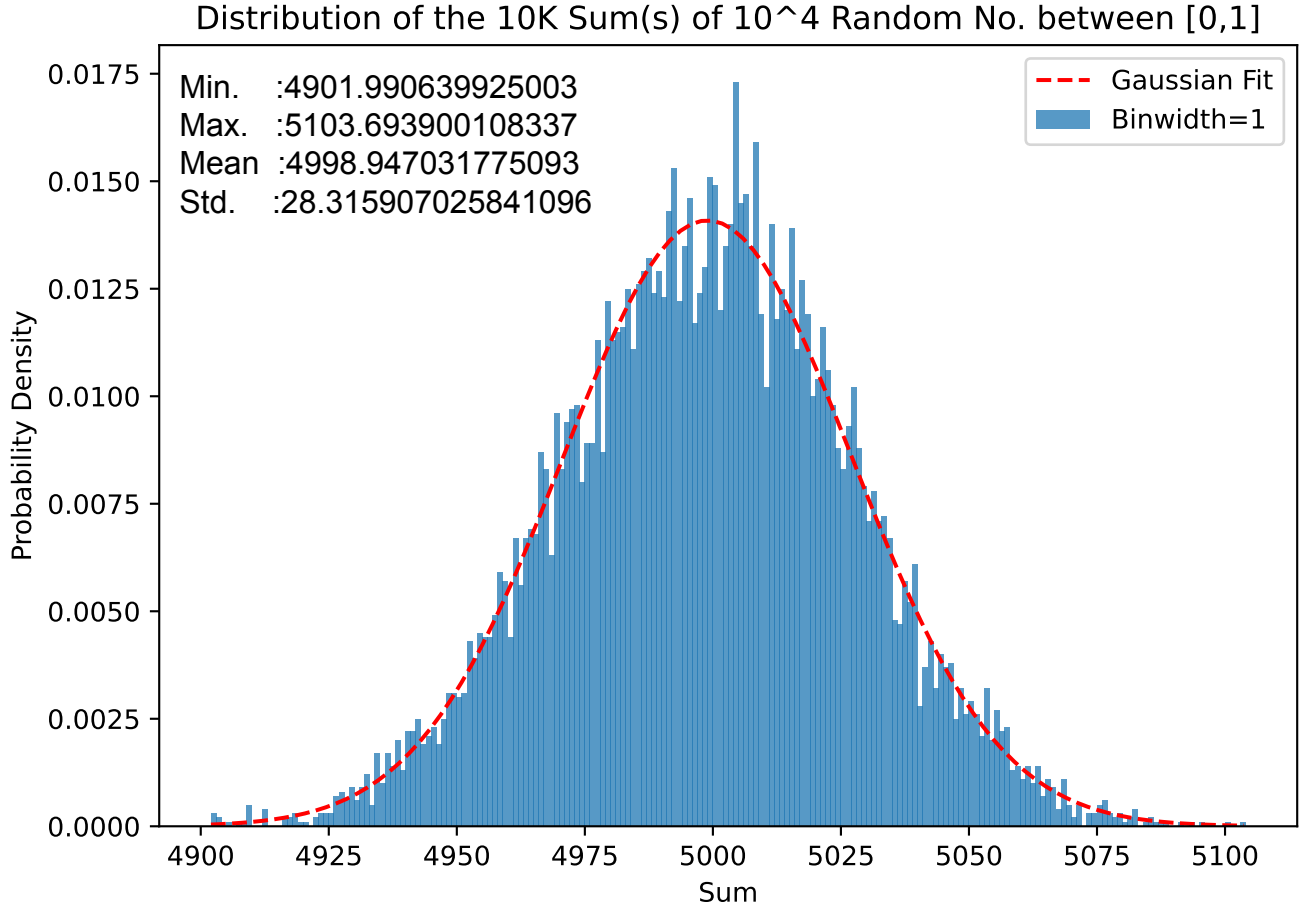
Calculate the average of 100, 10000, 1000000 random numbers:

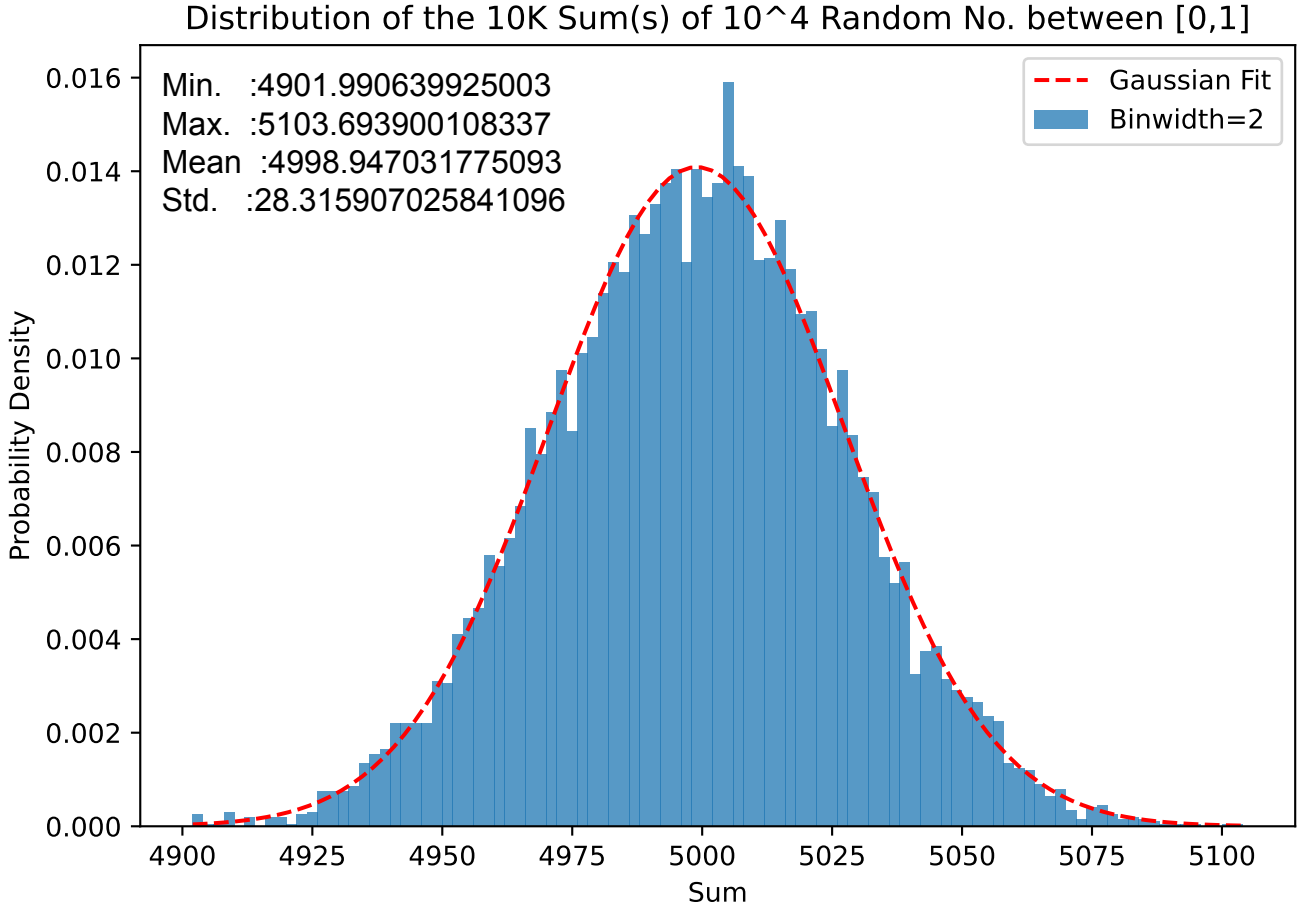
Calculate the difference between 0.50d0 and the mean values calculated:

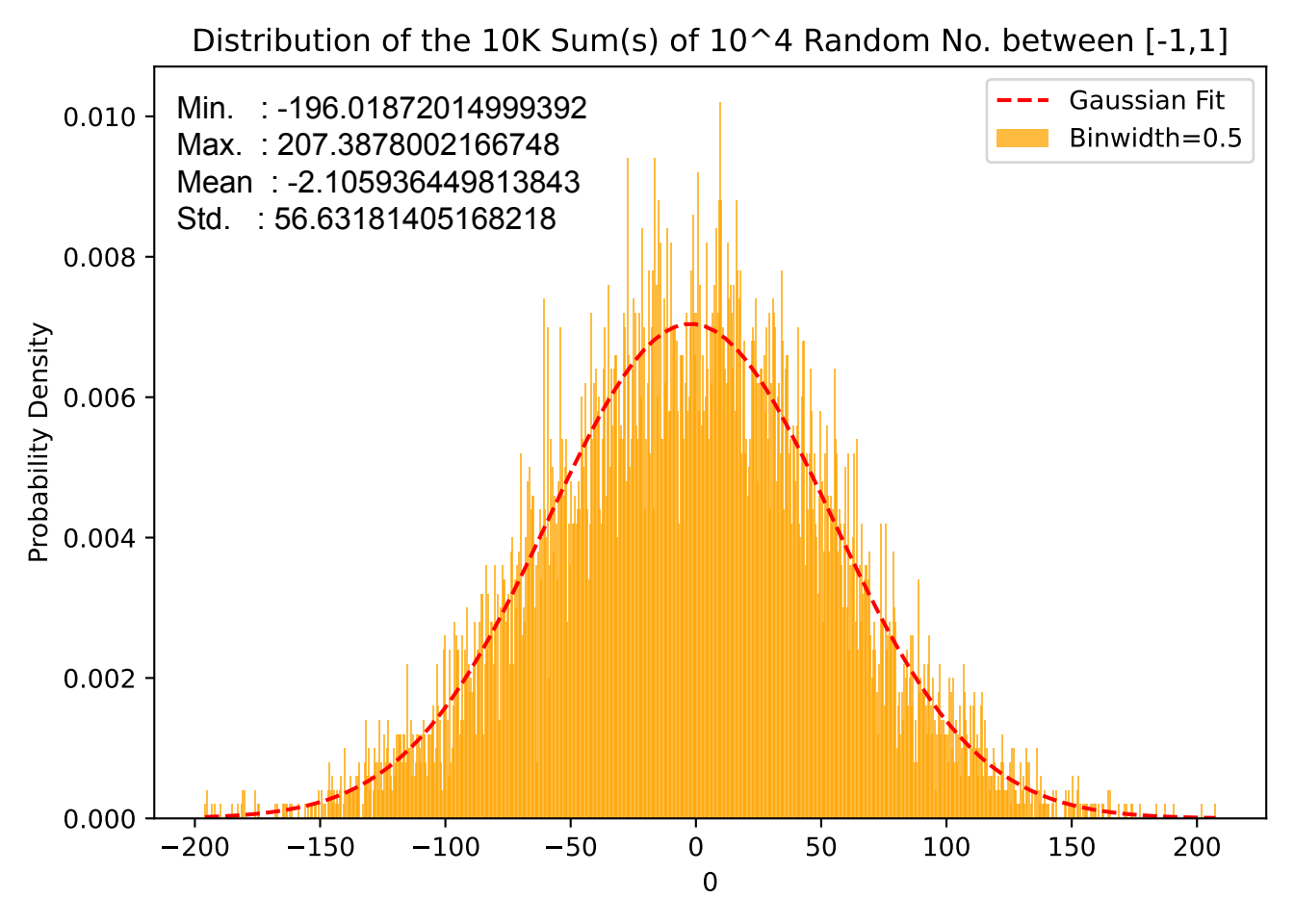
Open ▾ | test_ran_avg.dat ~/Desktop/Computational Physics/fprograms | Save

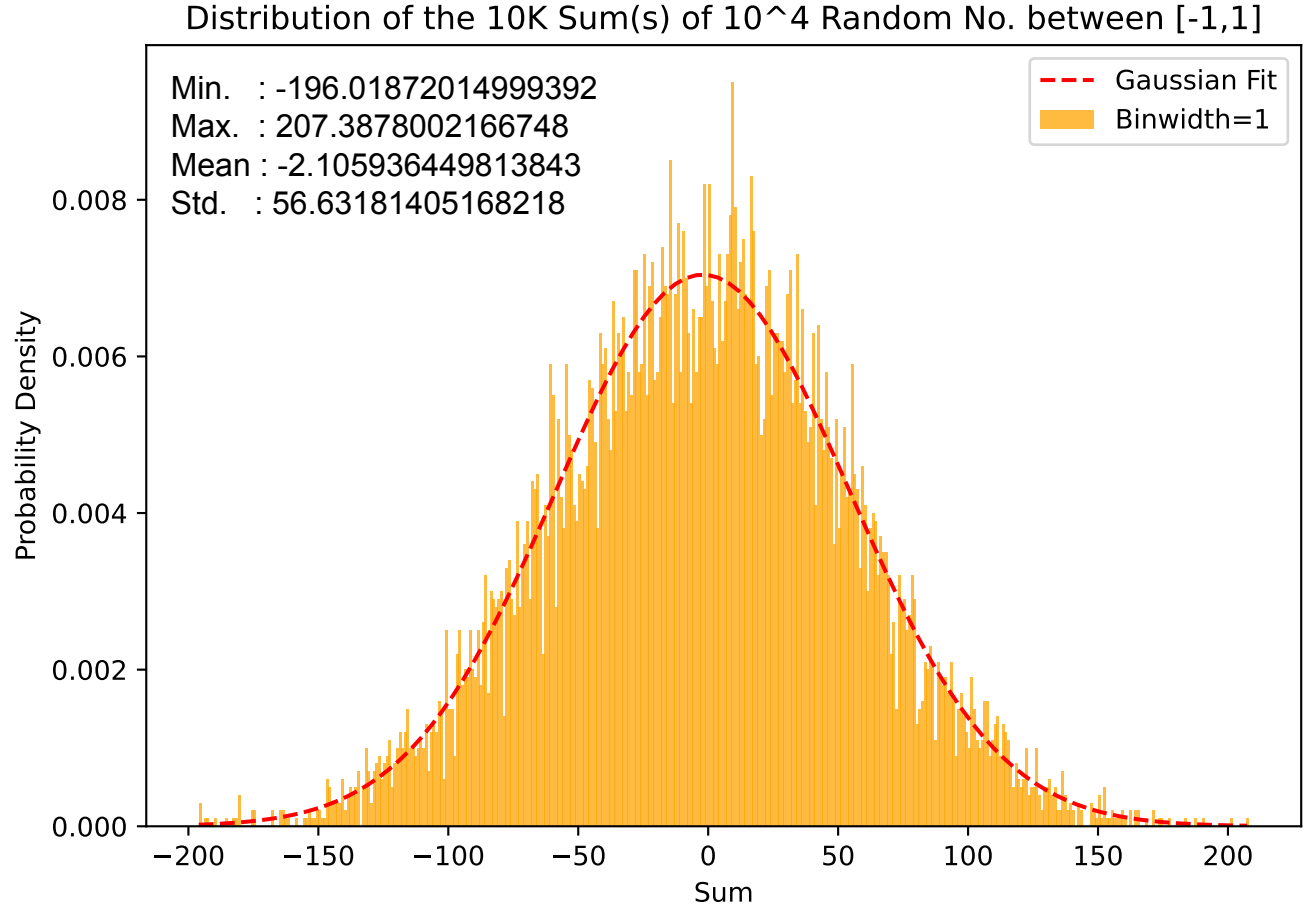
```
The average of 10^2 random numbers is:
0.5083604598
The difference between the mean value and 0.50d0 is:
0.0083604598

The average of 10^4 random numbers is:
0.4963144758
The difference between the mean value and 0.50d0 is:
0.0036855242

The average of 10^6 random numbers is:
0.5003424894
The difference between the mean value and 0.50d0 is:
0.0003424894
```

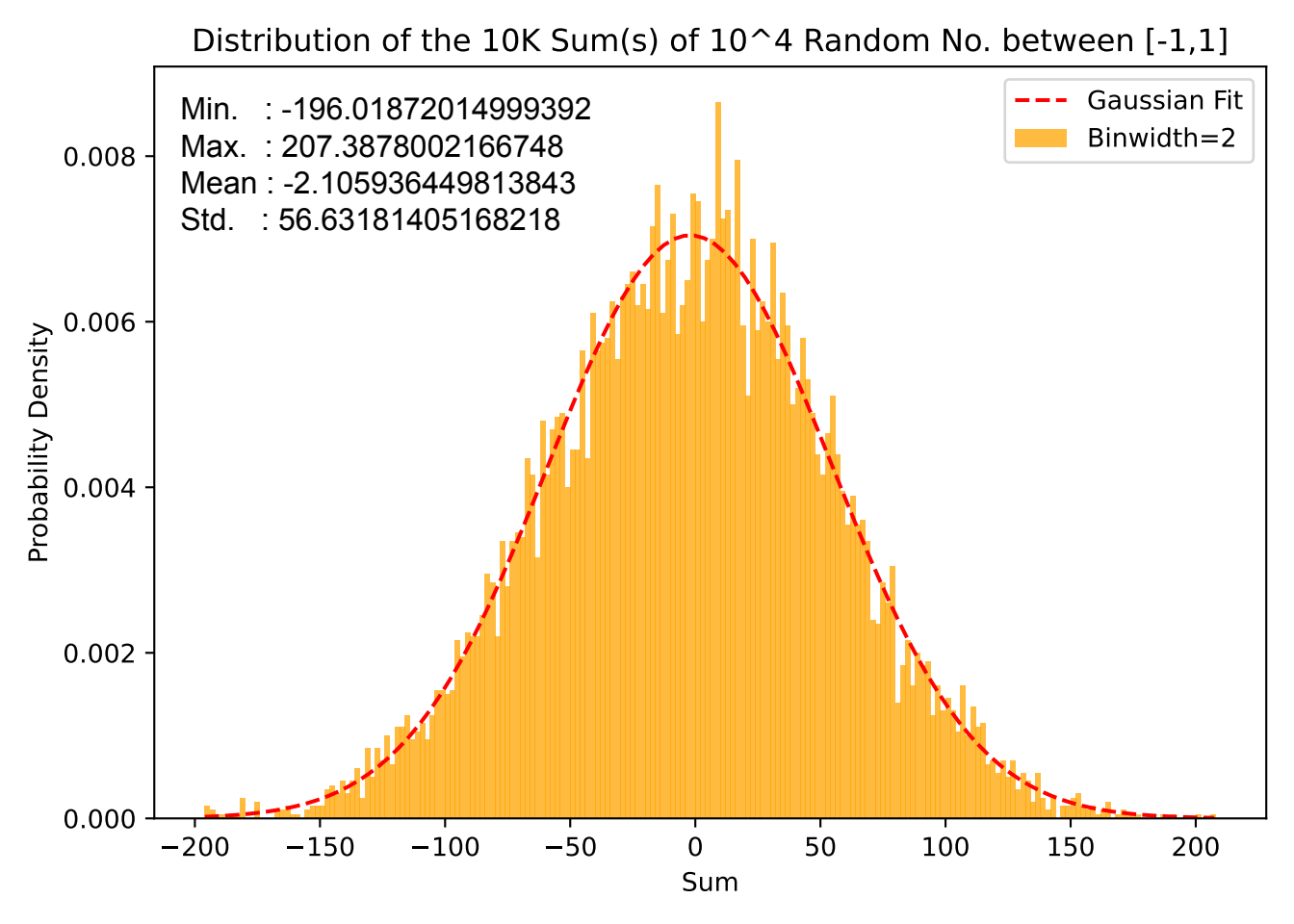

Distribution of the 10K Sum(s) of 10^4 Random No. between [0,1]
Min. :4901.990639925003
Max. :5103.693900108337
Mean :4998.947031775093
Std. :28.315907025841096
Gaussian Fit
Binwidth=0.5
Probability Density
0.0175
0.0150
0.0125
0.0100
0.0075
0.0050
0.0025
0.0000
4900
4925
4950
4975
5000
5025
5050
5075
5100
Sum

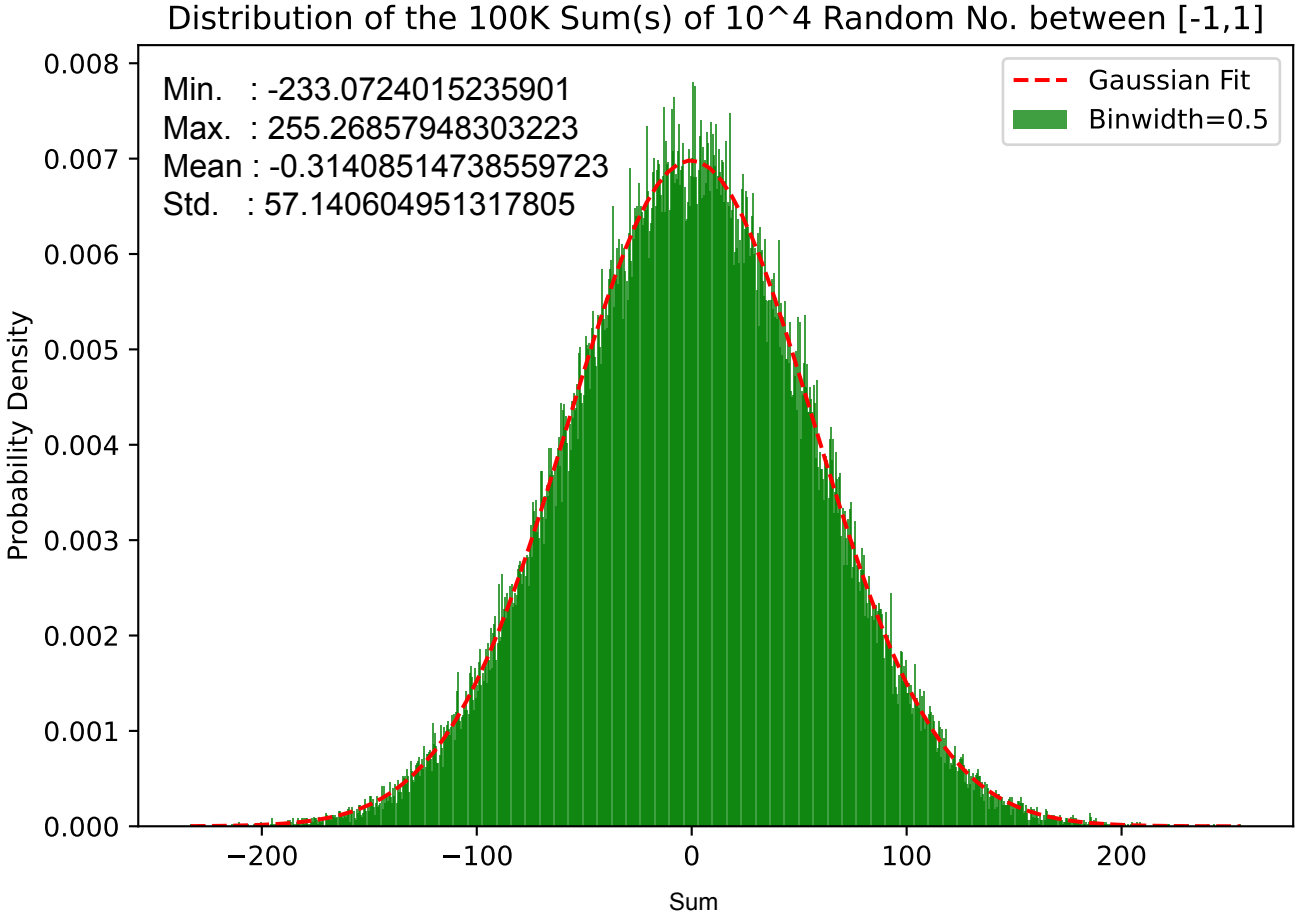

Distribution of the 10K Sum(s) of 10^4 Random No. between [0,1]
Min. :4901.990639925003
Max. :5103.693900108337
Mean :4998.947031775093
Std. :28.315907025841096
Gaussian Fit
Binwidth=1
Probability Density
0.0175
0.0150
0.0125
0.0100
0.0075
0.0050
0.0025
0.0000
4900
4925
4950
4975
5000
5025
5050
5075
5100
Sum

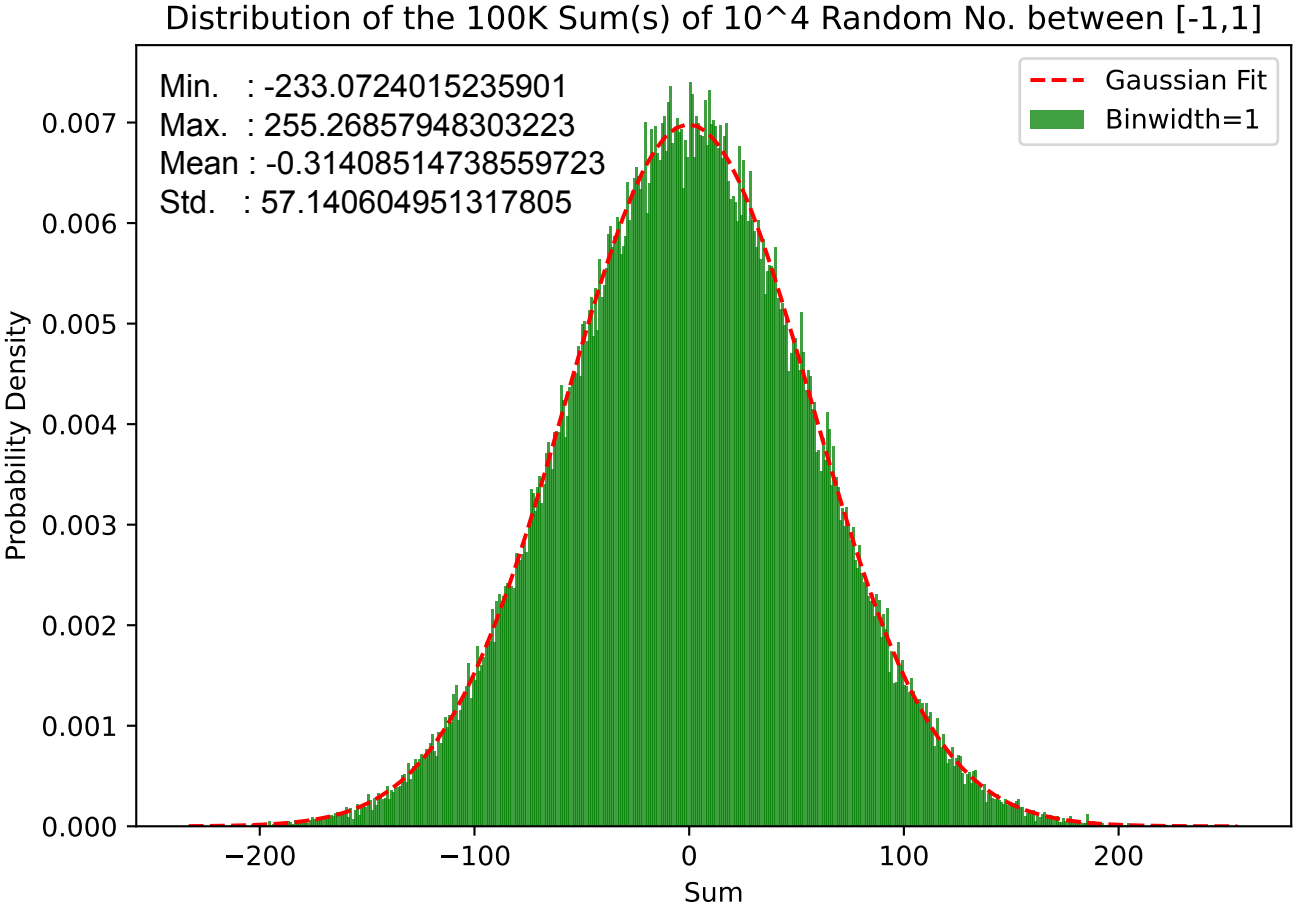

Distribution of the 10K Sum(s) of 10^4 Random No. between [0,1]
Min. :4901.990639925003
Max. :5103.693900108337
Mean :4998.947031775093
Std. :28.315907025841096
Gaussian Fit
Binwidth=2
Probability Density
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
4900
4925
4950
4975
5000
5025
5050
5075
5100
Sum


Distribution of the 10K Sum(s) of 10^4 Random No. between [-1,1]
Min. : -196.01872014999392
Max. : 207.3878002166748
Mean : -2.105936449813843
Std. : 56.63181405168218
Gaussian Fit
Binwidth=0.5
Probability Density
0.010
0.008
0.006
0.004
0.002
0.000
−200
−150
−100
−50
0
50
100
150
200
0


Distribution of the 10K Sum(s) of 10^4 Random No. between [-1,1]
Min. : -196.01872014999392
Max. : 207.3878002166748
Mean : -2.105936449813843
Std. : 56.63181405168218
Gaussian Fit
Binwidth=1
Probability Density
0.000
0.002
0.004
0.006
0.008
−200
−150
−100
−50
0
50
100
150
200
Sum


Distribution of the 10K Sum(s) of 10^4 Random No. between [-1,1]
Min. : -196.01872014999392
Max. : 207.3878002166748
Mean : -2.105936449813843
Std. : 56.63181405168218
Gaussian Fit
Binwidth=2
Probability Density
0.000
0.002
0.004
0.006
0.008
−200
−150
−100
−50
0
50
100
150
200
Sum


Distribution of the 100K Sum(s) of 10^4 Random No. between [-1,1]
Min. : -233.0724015235901
Max. : 255.26857948303223
Mean : -0.31408514738559723
Std. : 57.140604951317805
Gaussian Fit
Binwidth=0.5
Probability Density
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
0.008
−200
−100
0
100
200
Sum


Distribution of the 100K Sum(s) of 10^4 Random No. between [-1,1]
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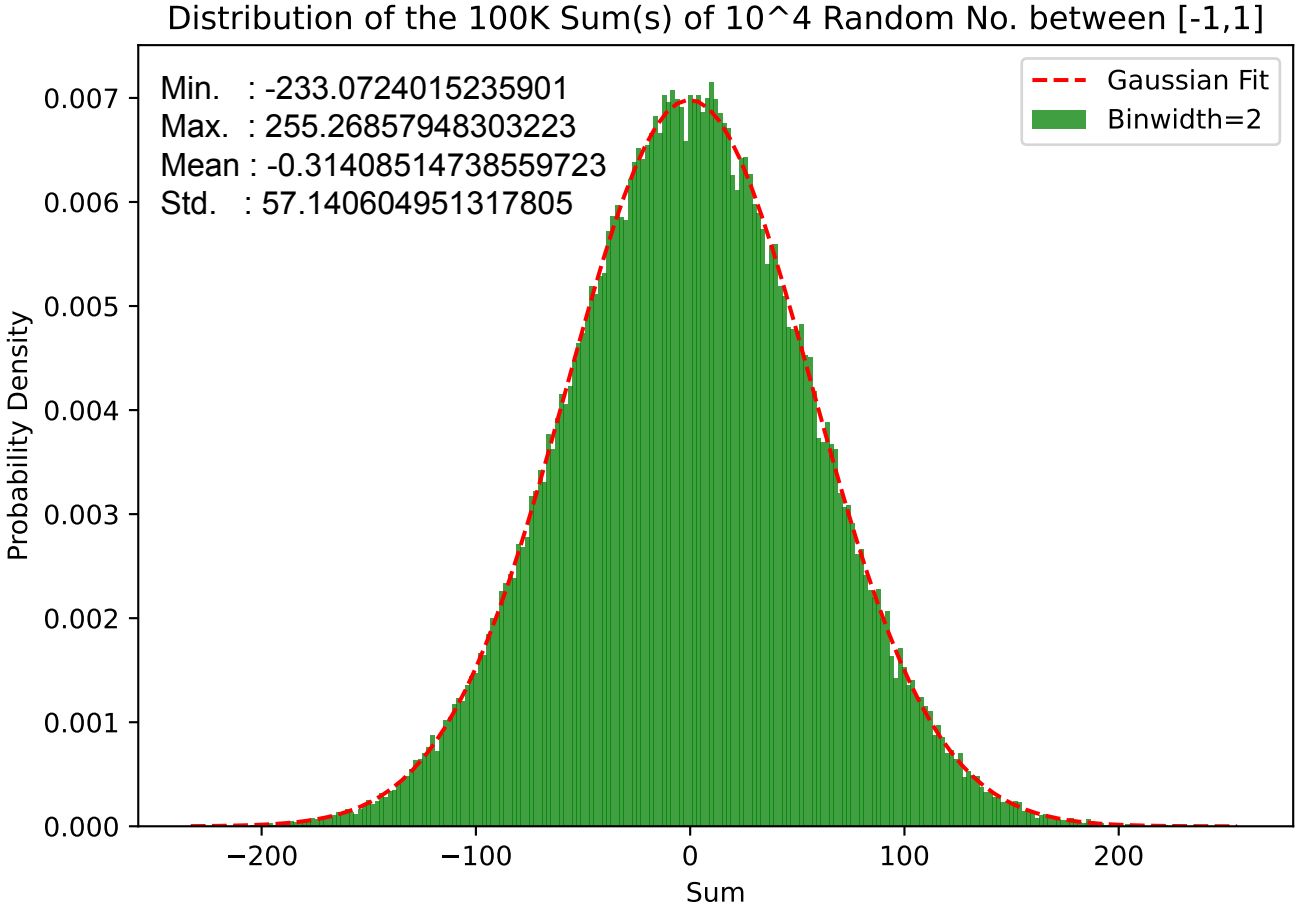
Max. : 255.26857948303223
Mean : -0.31408514738559723
Std. : 57.140604951317805
Gaussian Fit
Binwidth=1
Probability Density
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
−200
−100
0
100
200
Sum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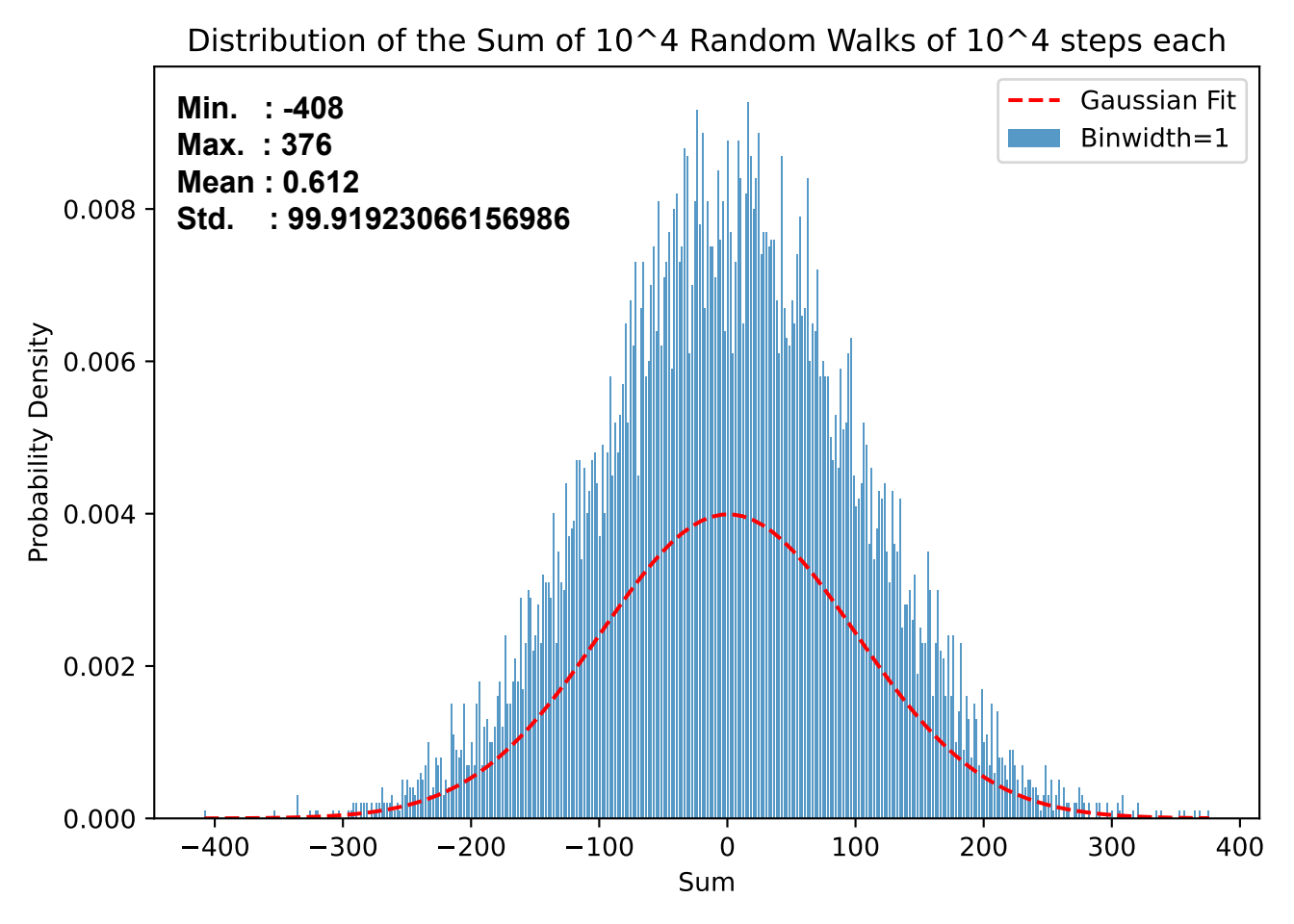
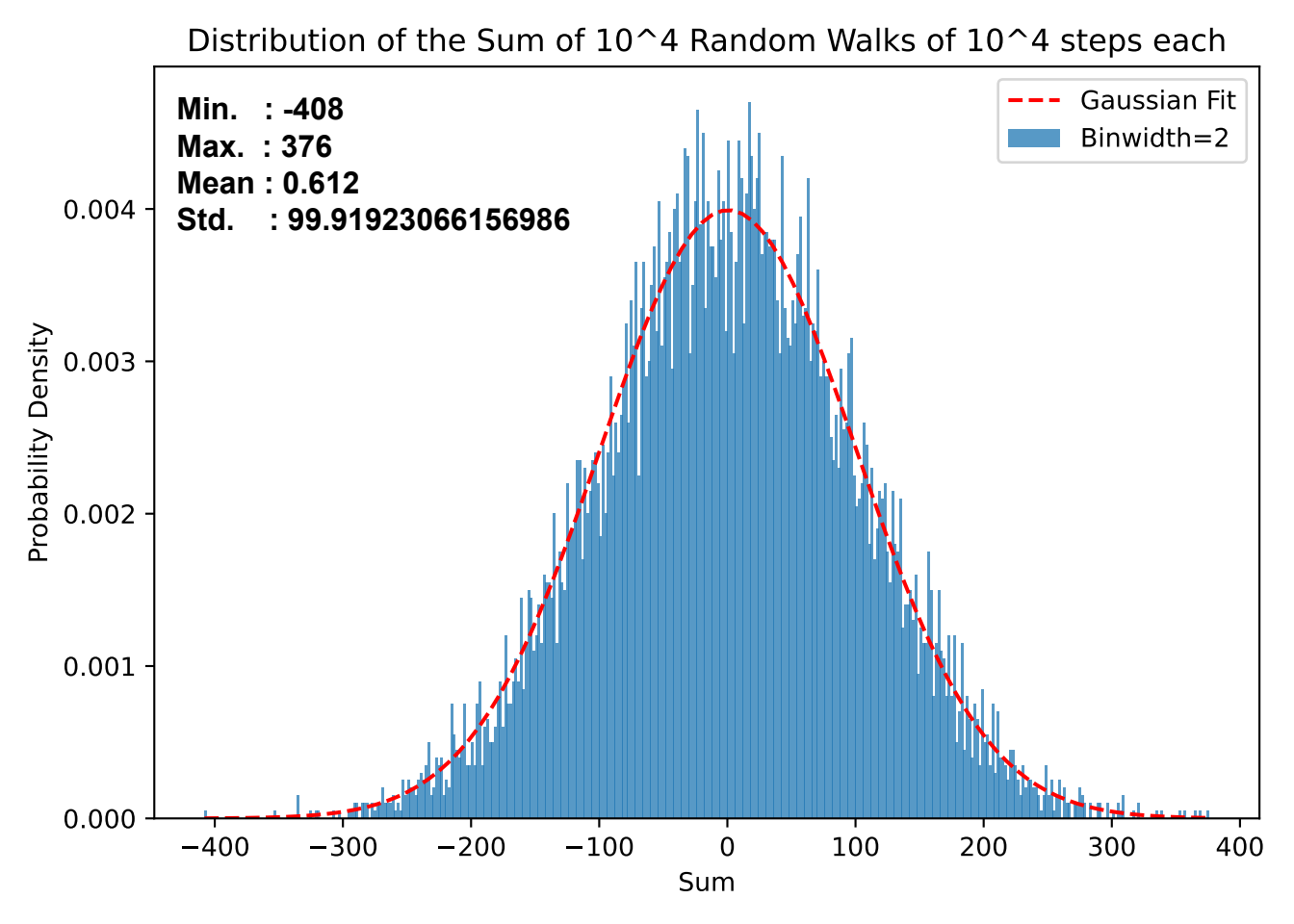
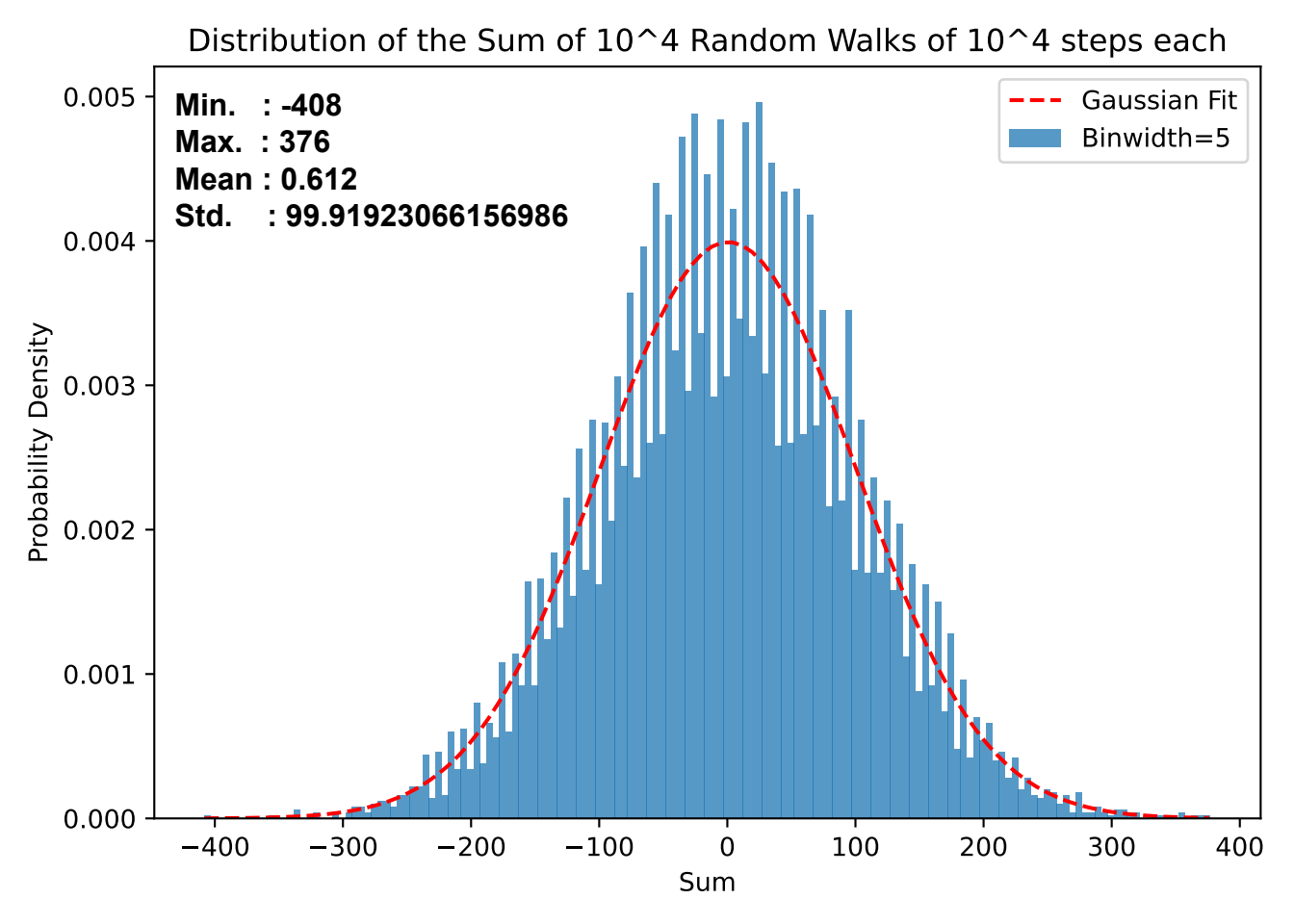
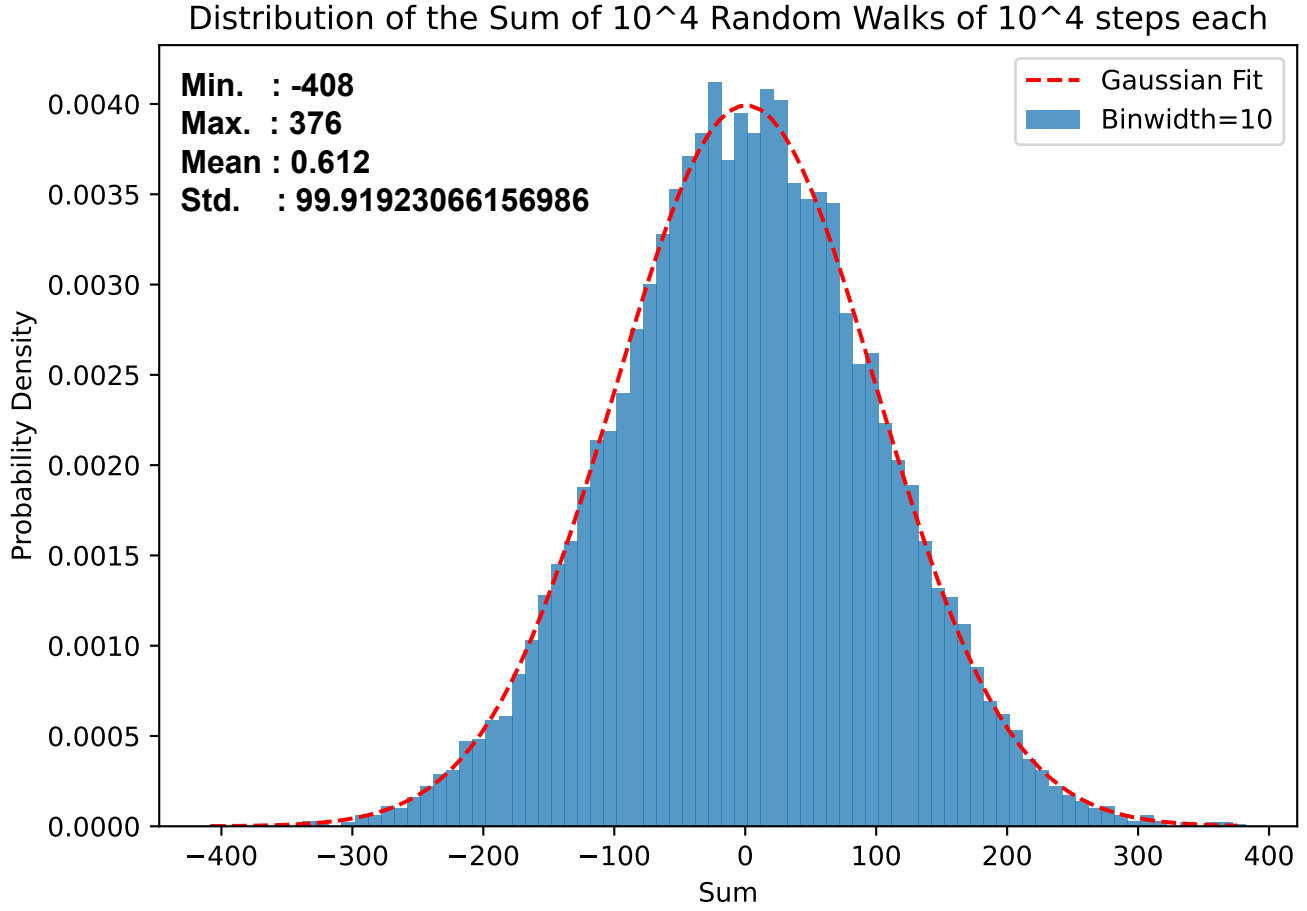
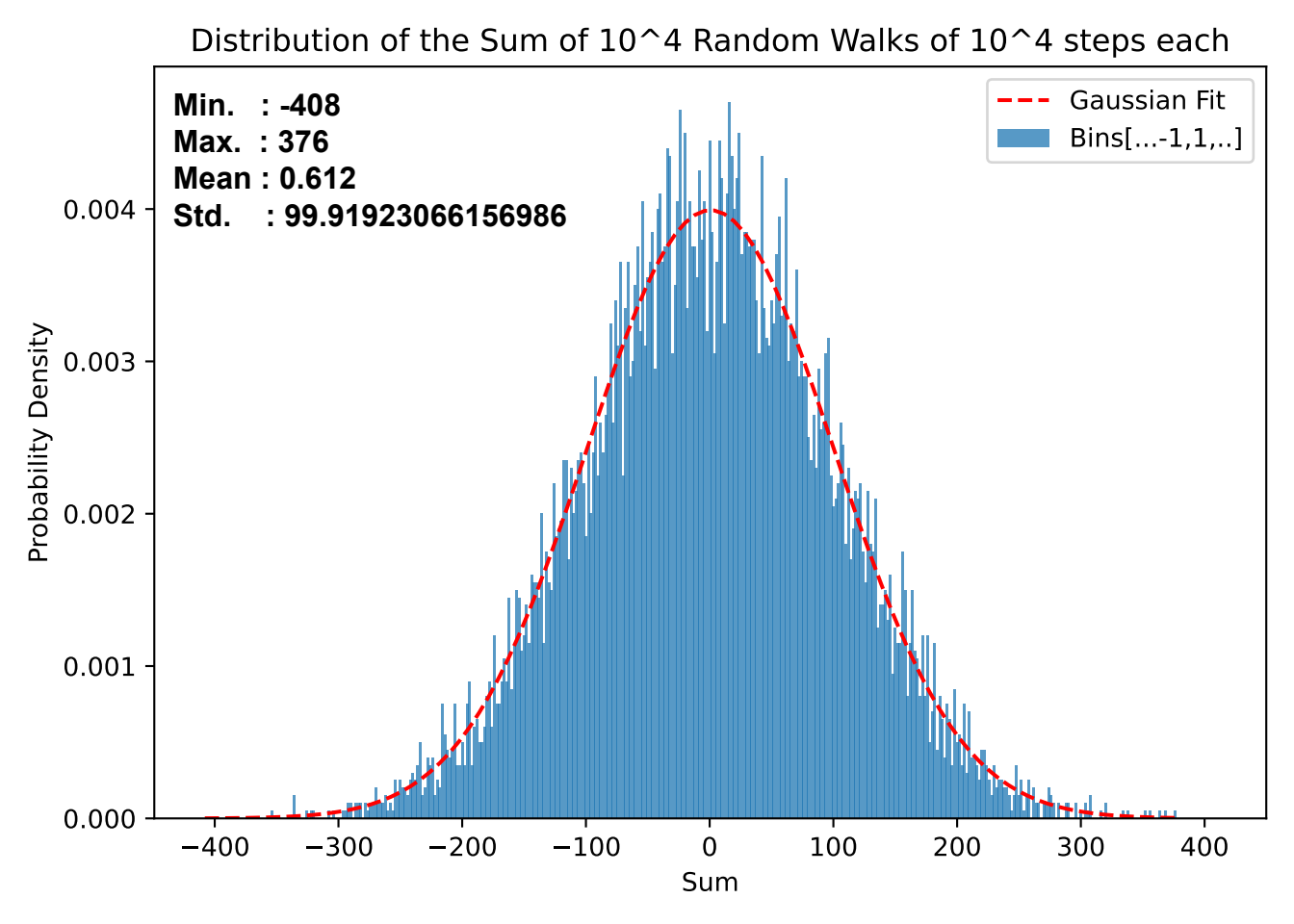
Max. : 255.26857948303223
Mean : -0.31408514738559723
Std. : 57.140604951317805
Gaussian Fit
Binwidth=2
Probability Density
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
−200
−100
0
100
200
Sum

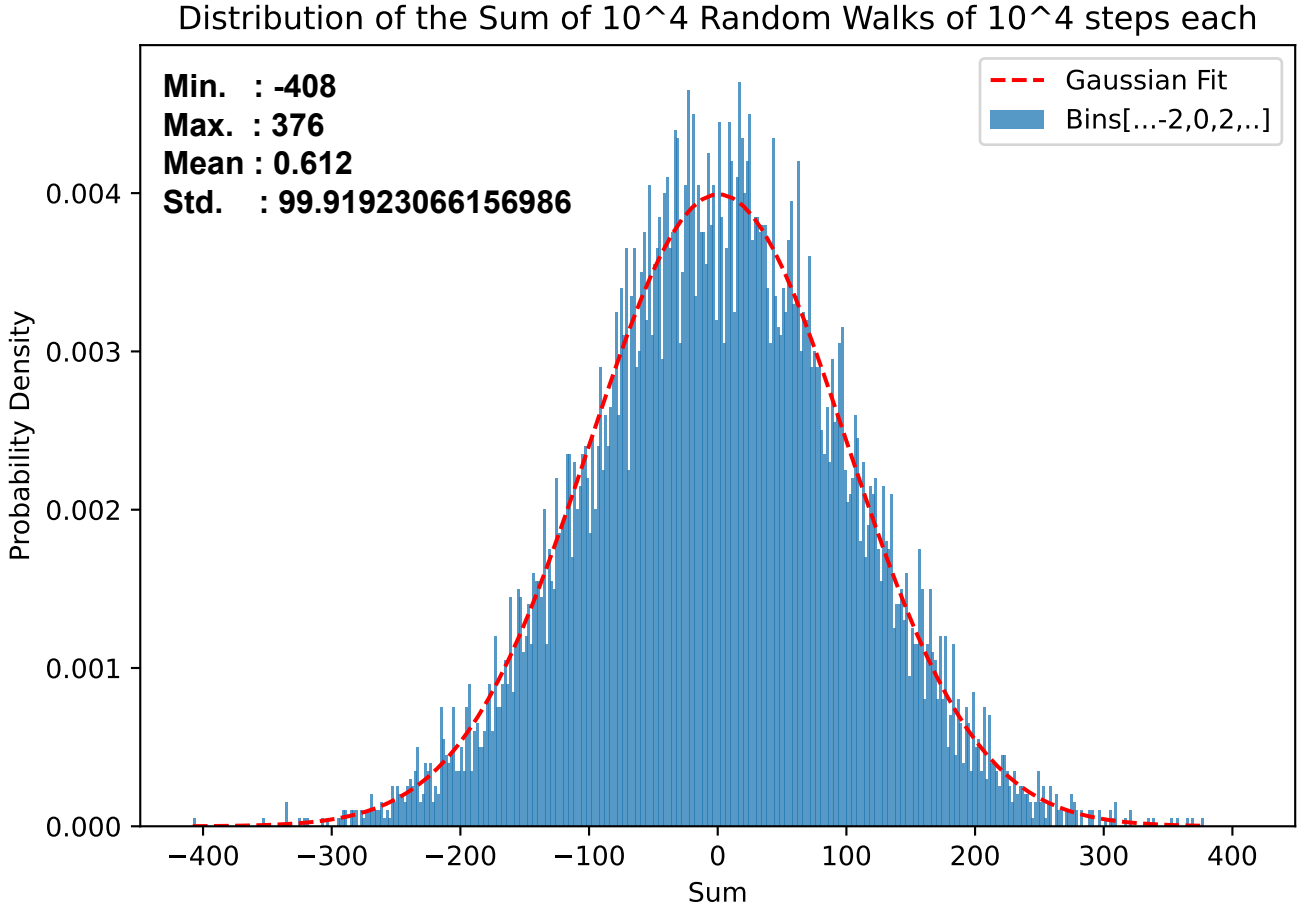

Distribution of the Sum of 10^4 Random Walks of 10^4 steps each
Min. : -408
Max. : 376
Mean : 0.612
Std. : 99.91923066156986
Gaussian Fit
Binwidth=1
Probability Density
0.000
0.002
0.004
0.006
0.008
−400
−300
−200
−100
0
100
200
300
400
Sum

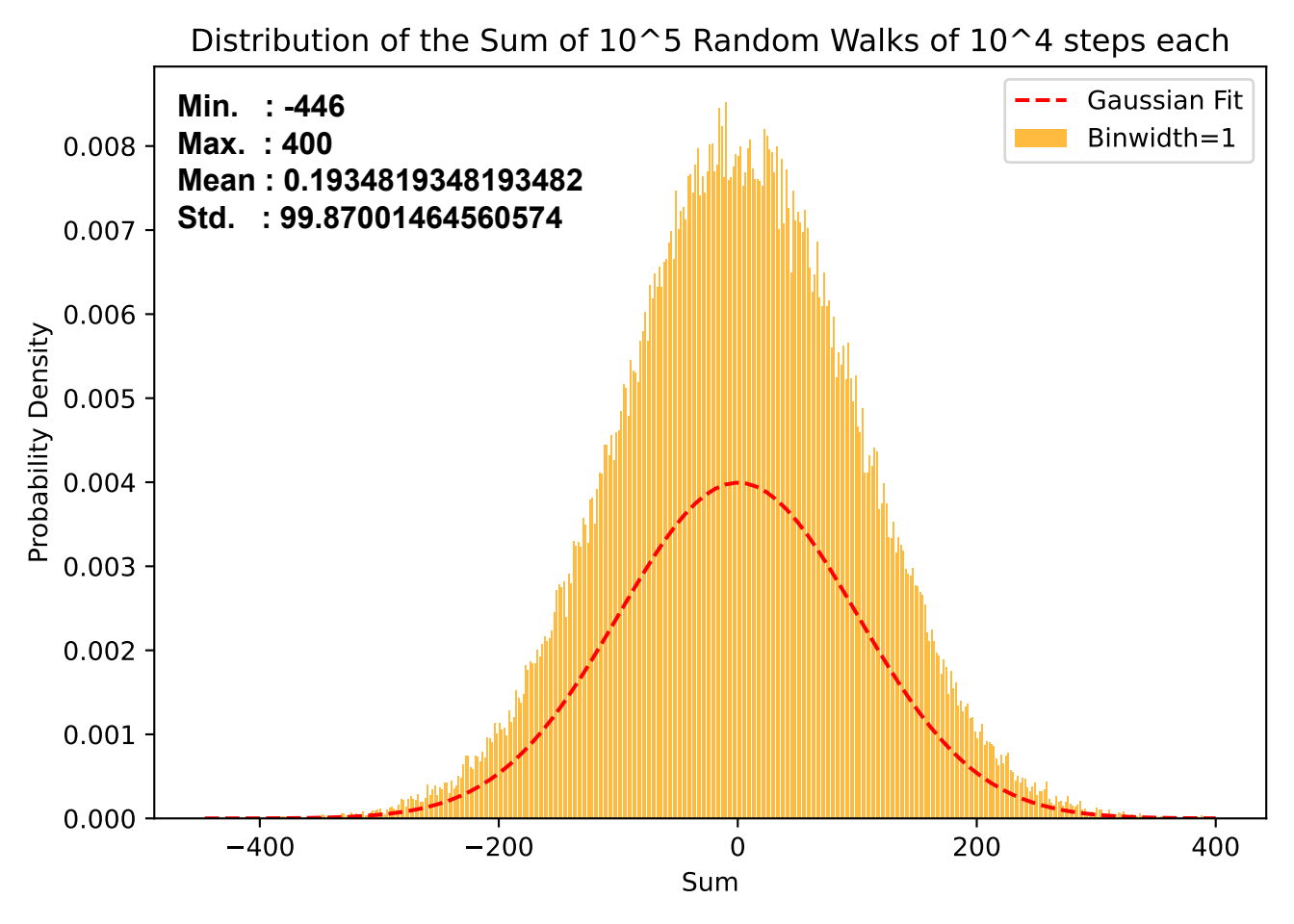

Distribution of the Sum of 10^4 Random Walks of 10^4 steps each
Min. : -408
Max. : 376
Mean : 0.612
Std. : 99.91923066156986
Gaussian Fit
Binwidth=2
Probability Density
0.000
0.001
0.002
0.003
0.004
−400
−300
−200
−100
0
100
200
300
400
Sum

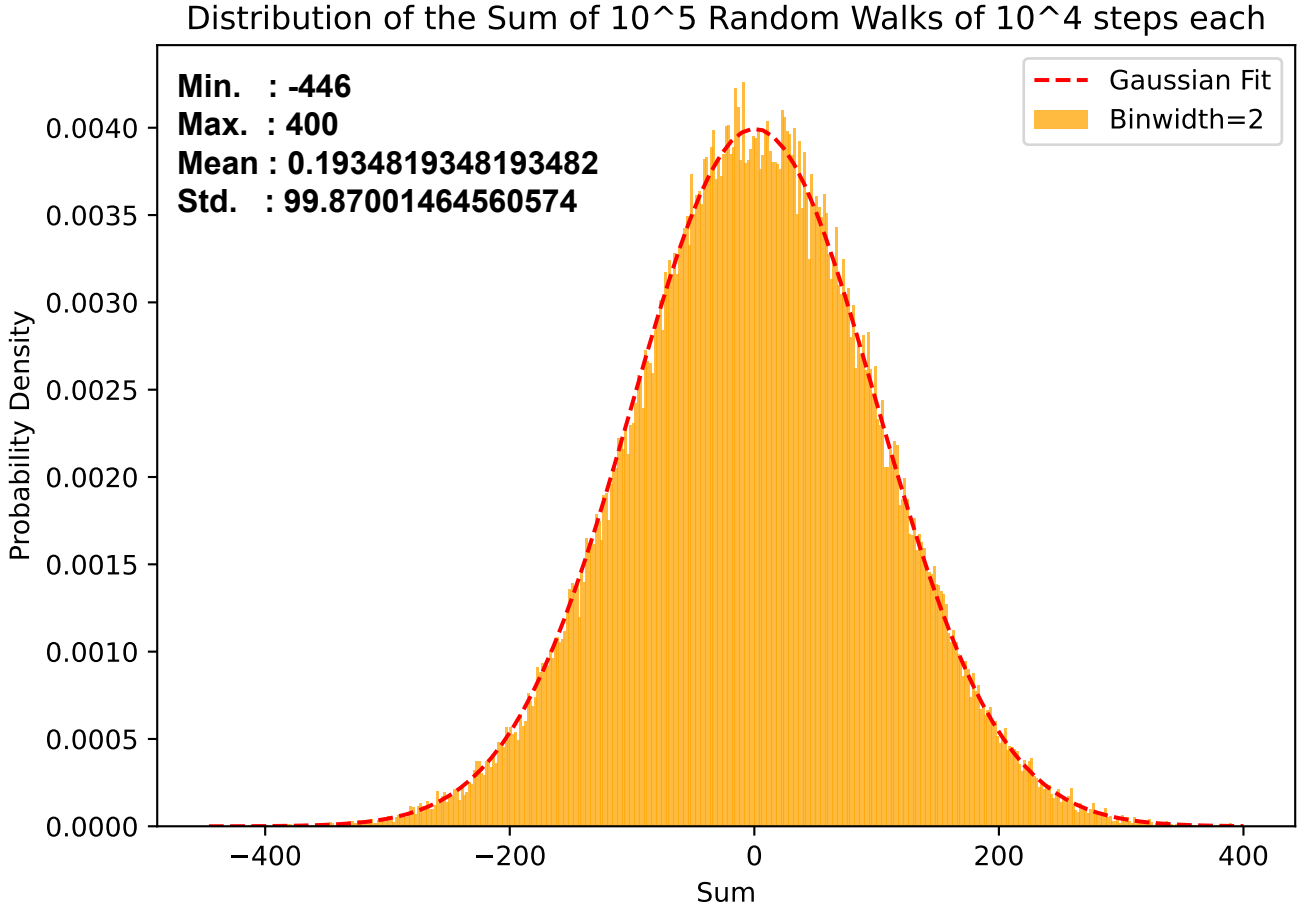

Distribution of the Sum of 10^4 Random Walks of 10^4 steps each
Min. : -408
Max. : 376
Mean : 0.612
Std. : 99.91923066156986
Gaussian Fit
Binwidth=5
Probability Density
0.005
0.004
0.003
0.002
0.001
0.000
−400
−300
−200
−100
0
100
200
300
400
Sum

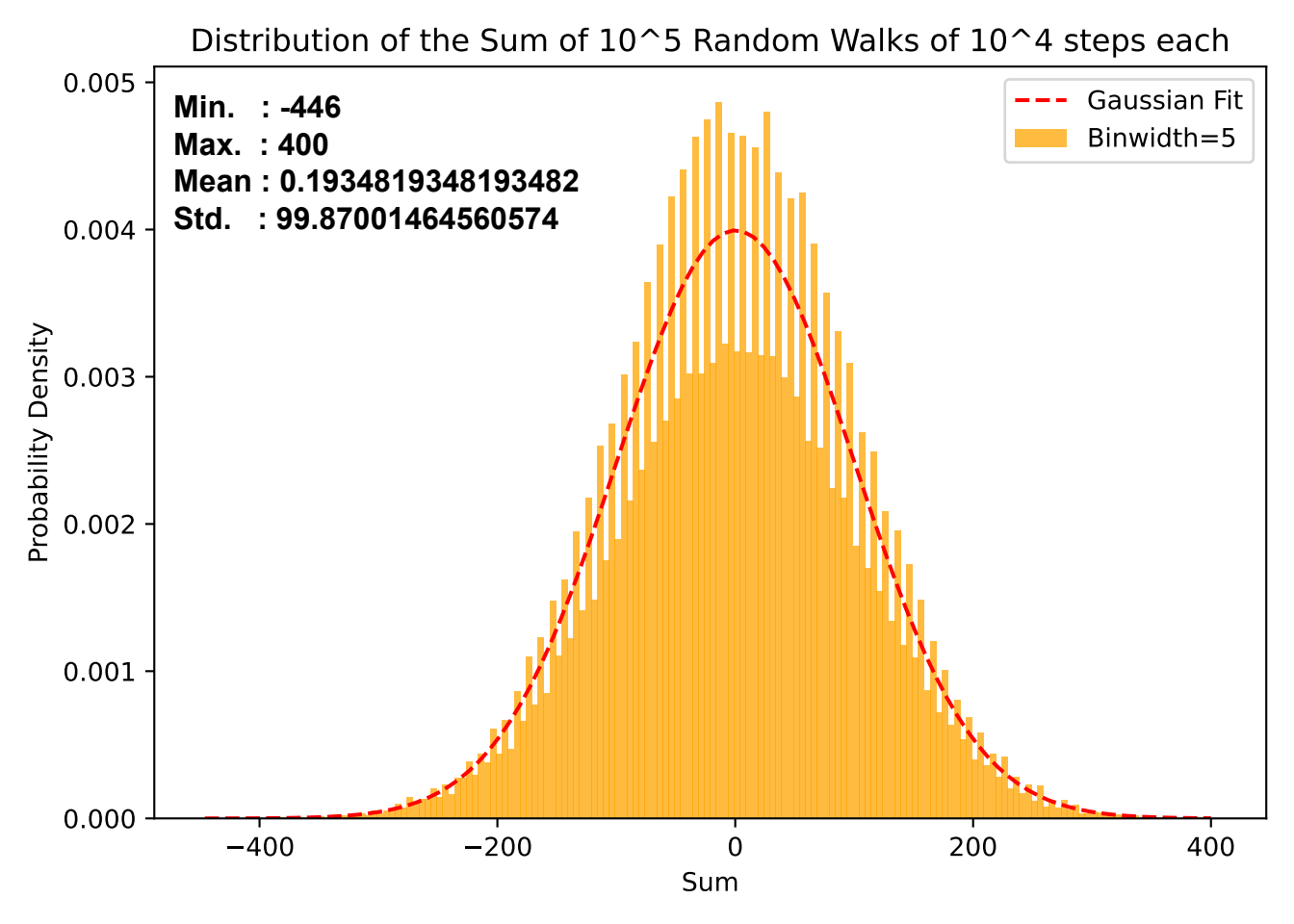

Distribution of the Sum of 10^4 Random Walks of 10^4 steps each
Min. : -408
Max. : 376
Mean : 0.612
Std. : 99.91923066156986
Gaussian Fit
Binwidth=10
Probability Density
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
−400
−300
−200
−100
0
100
200
300
400
Sum

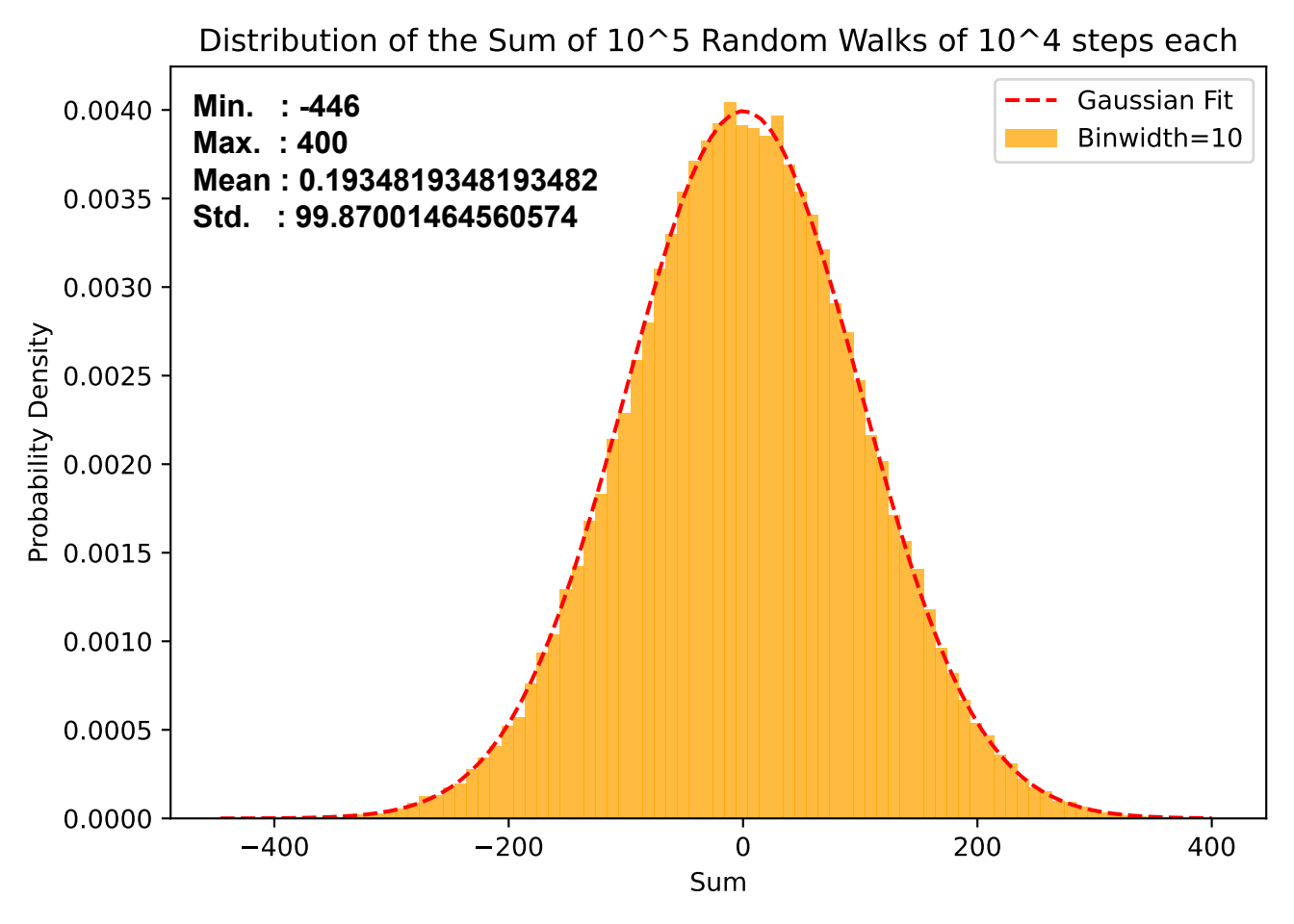

Distribution of the Sum of 10^4 Random Walks of 10^4 steps each
Min. : -408
Max. : 376
Mean : 0.612
Std. : 99.91923066156986
Gaussian Fit
Bins[...-1,1,..]
Probability Density
0.000
0.001
0.002
0.003
0.004
−400
−300
−200
−100
0
100
200
300
400
Sum

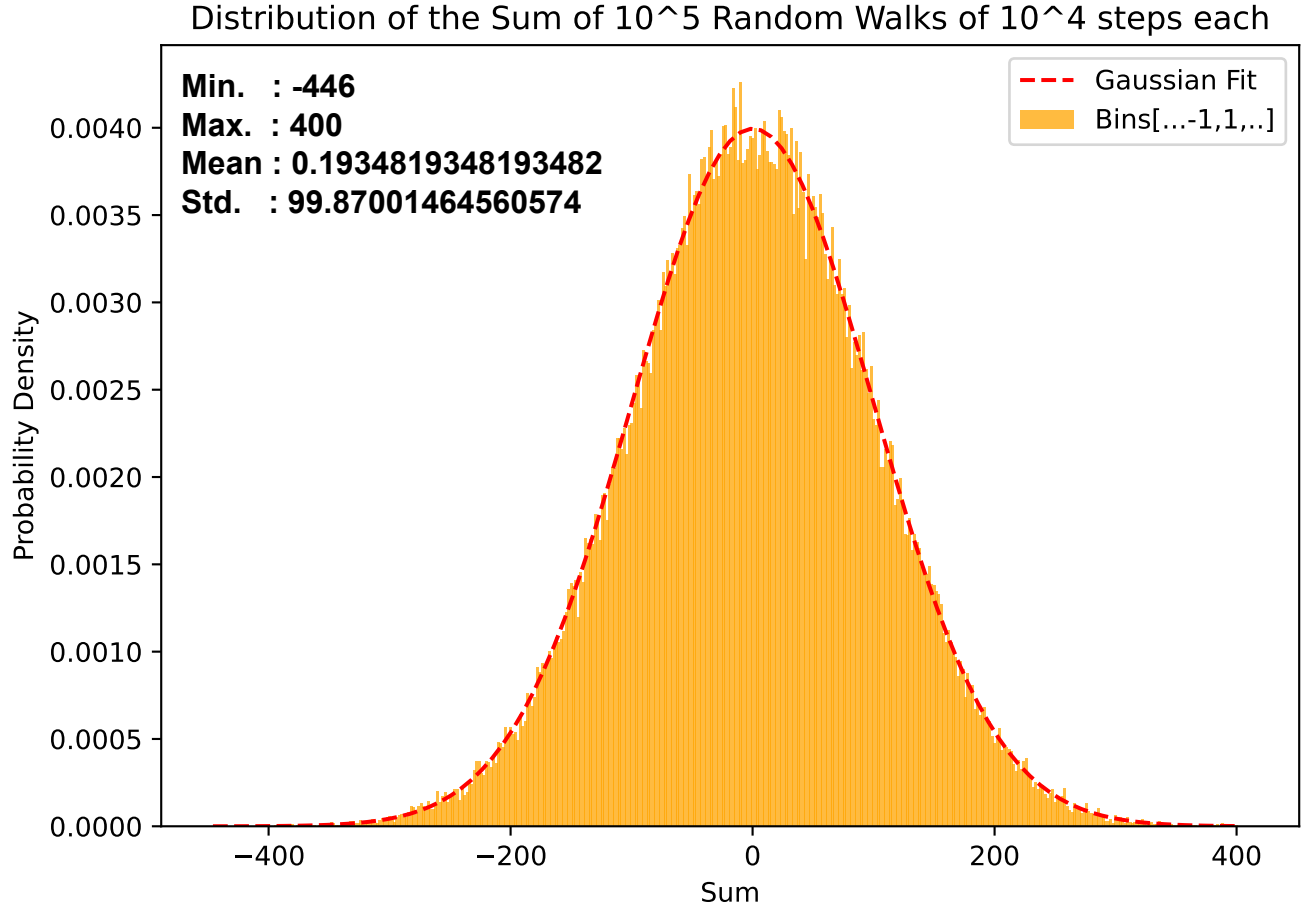

Distribution of the Sum of 10^4 Random Walks of 10^4 steps each
Min. : -408
Max. : 376
Mean : 0.612
Std. : 99.91923066156986
Gaussian Fit
Bins[...-2,0,2,..]
Probability Density
0.000
0.001
0.002
0.003
0.004
−400
−300
−200
−100
0
100
200
300
400
Sum

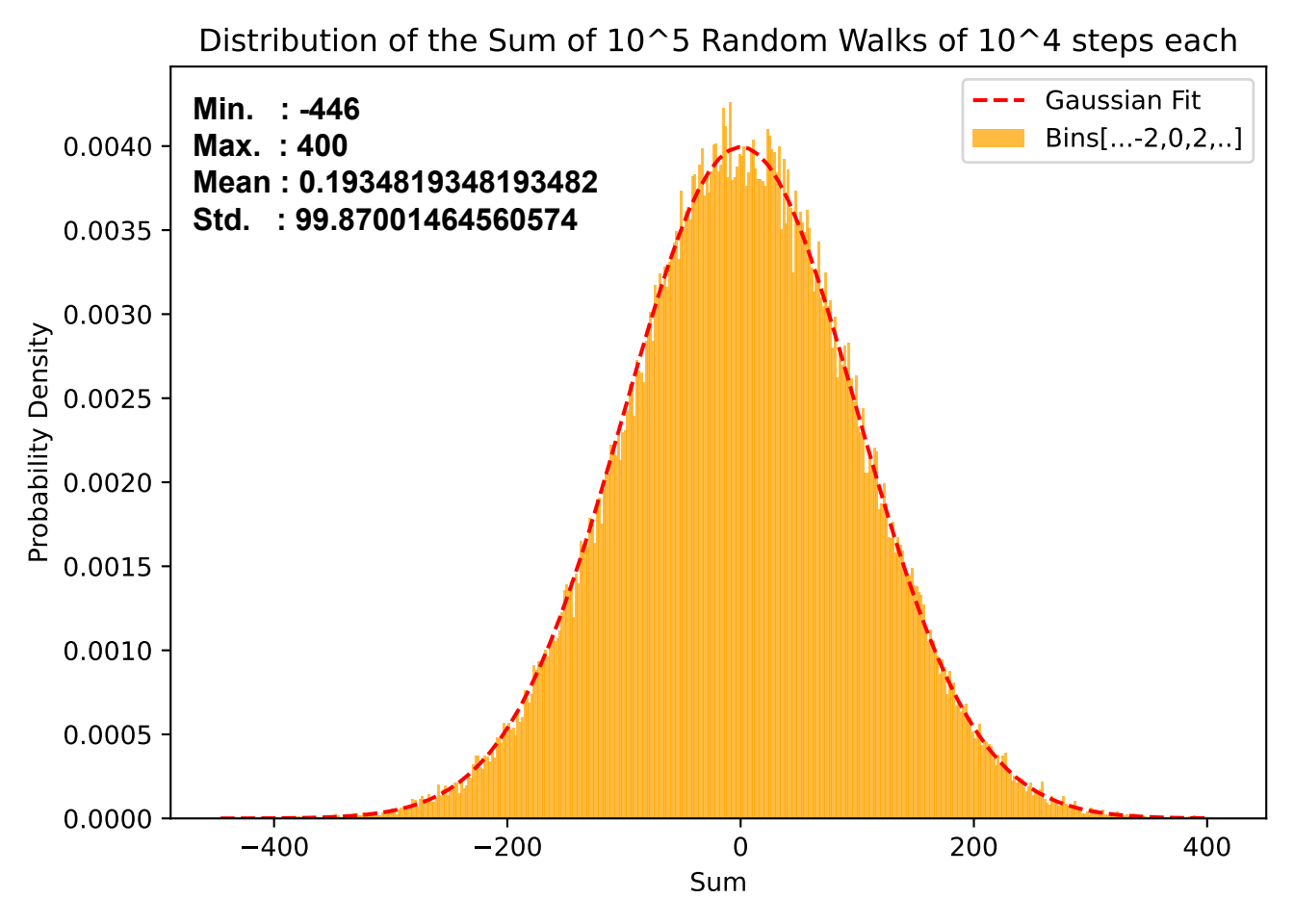

Distribution of the Sum of 10^5 Random Walks of 10^4 steps each
Min. : -446
Max. : 400
Mean : 0.1934819348193482
Std. : 99.87001464560574
Gaussian Fit
Binwidth=1
Probability Density
0.000
0.001
0.002
0.003
0.004
0.005
0.006
0.007
0.008
−400
−200
0
200
400
Sum

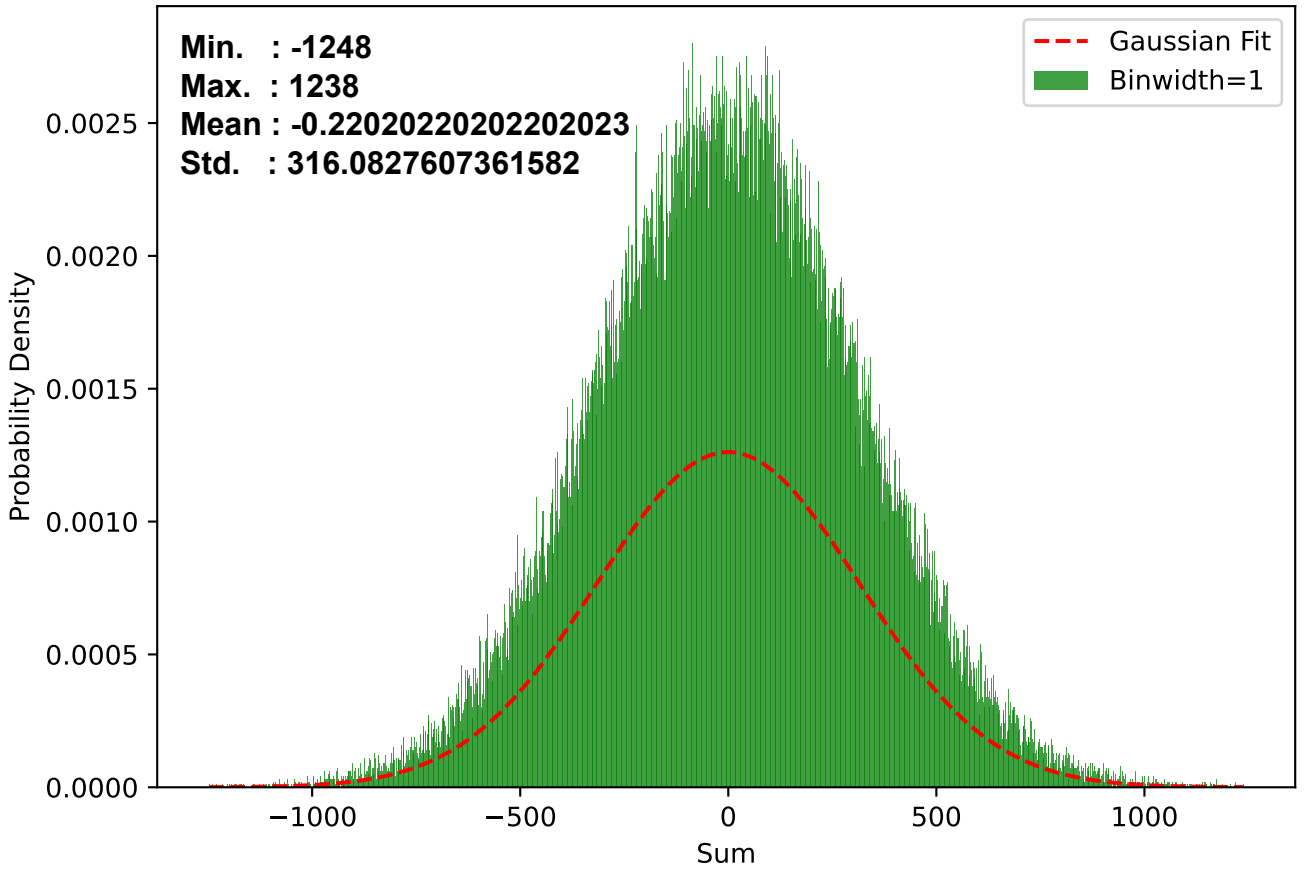

Distribution of the Sum of 10^5 Random Walks of 10^4 steps each
Min. : -446
Max. : 400
Mean : 0.1934819348193482
Std. : 99.87001464560574
Gaussian Fit
Binwidth=2
Probability Density
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
−400
−200
0
200
400
Sum

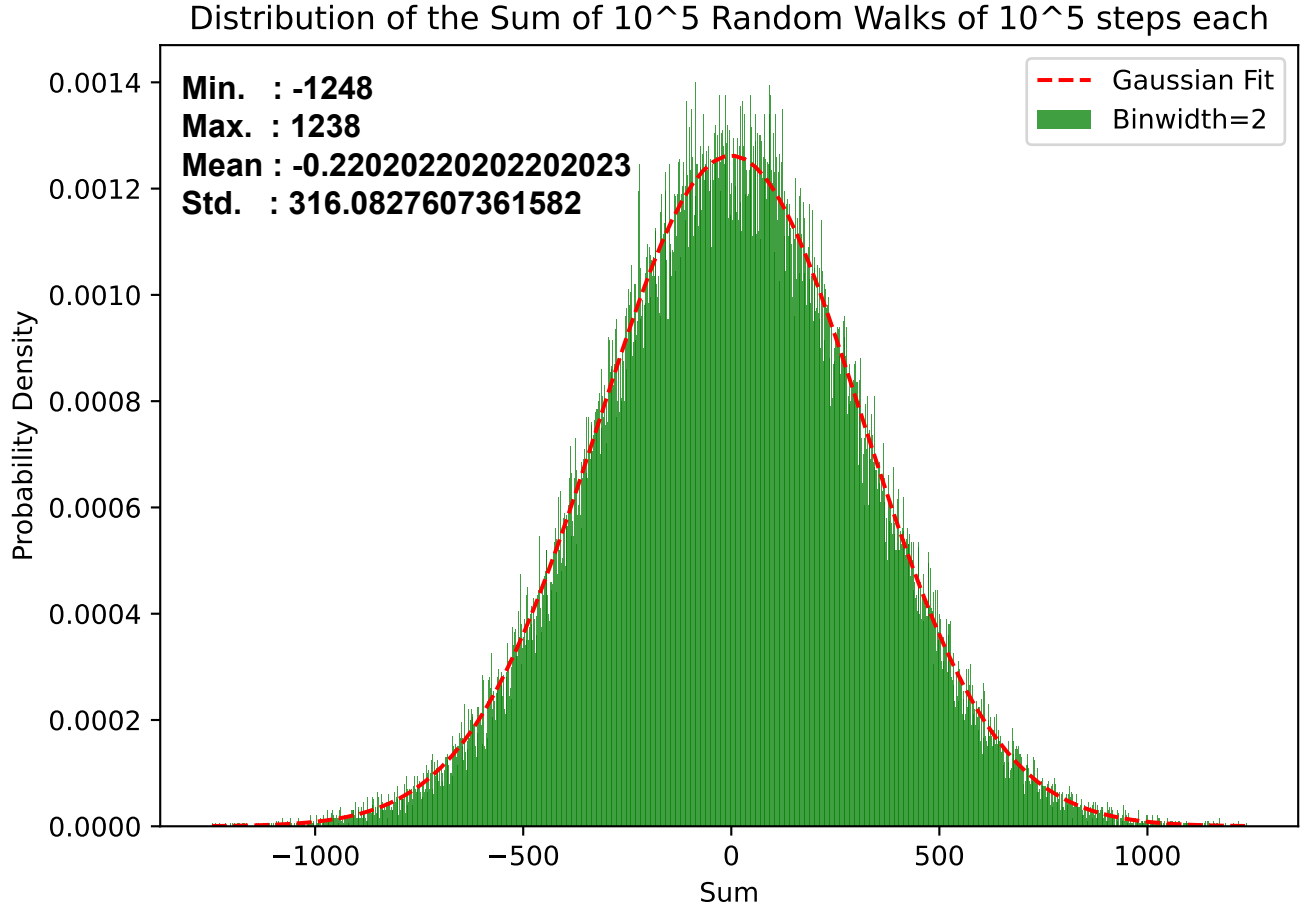

Distribution of the Sum of 10^5 Random Walks of 10^4 steps each
Min. : -446
Max. : 400
Mean : 0.1934819348193482
Std. : 99.87001464560574
Gaussian Fit
Binwidth=5
Probability Density
0.005
0.004
0.003
0.002
0.001
0.000
−400
−200
0
200
400
Sum

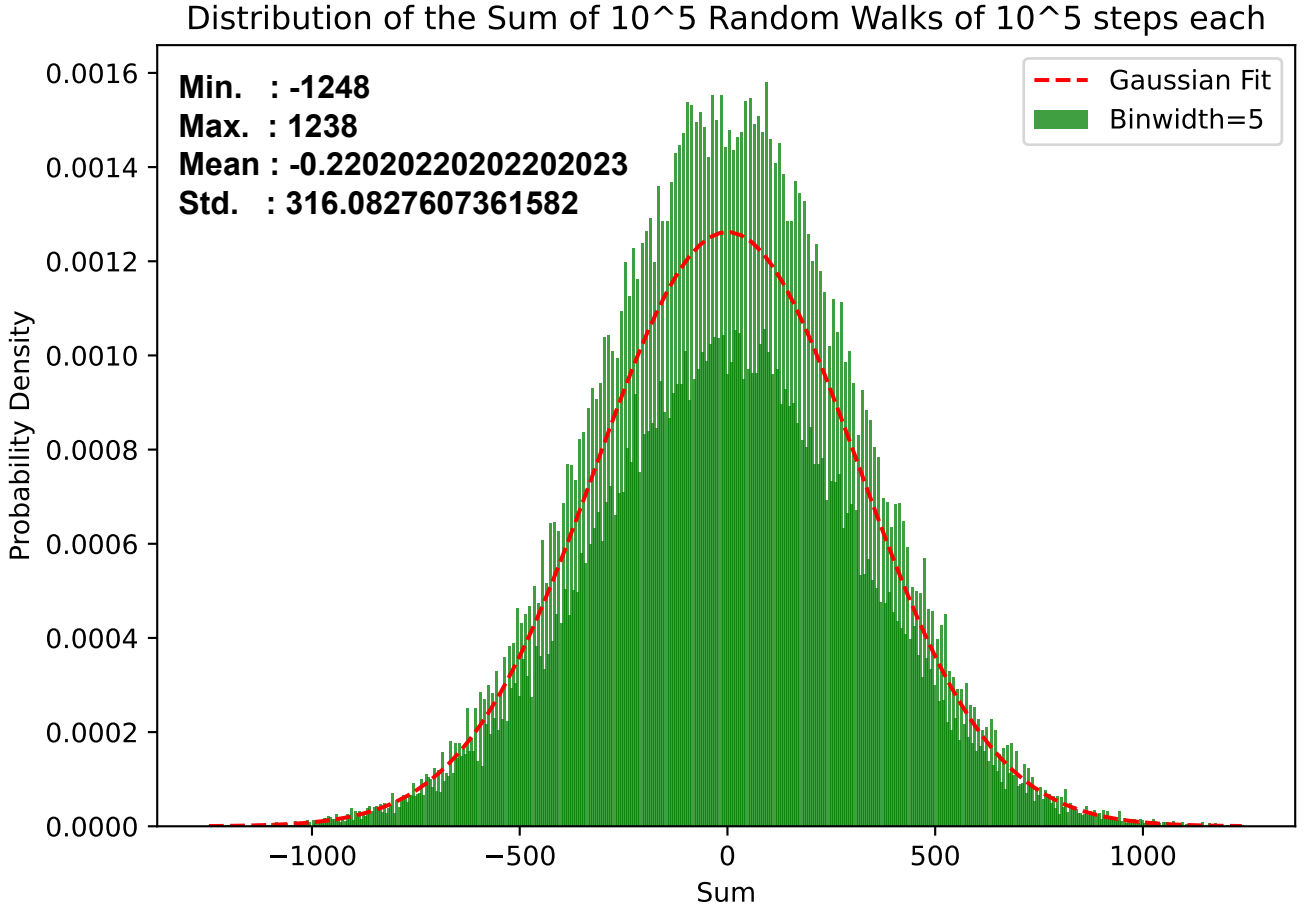

Distribution of the Sum of 10^5 Random Walks of 10^4 steps each
Min. : -446
Max. : 400
Mean : 0.1934819348193482
Std. : 99.87001464560574
Gaussian Fit
Binwidth=10
Probability Density
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
−400
−200
0
200
400
Sum

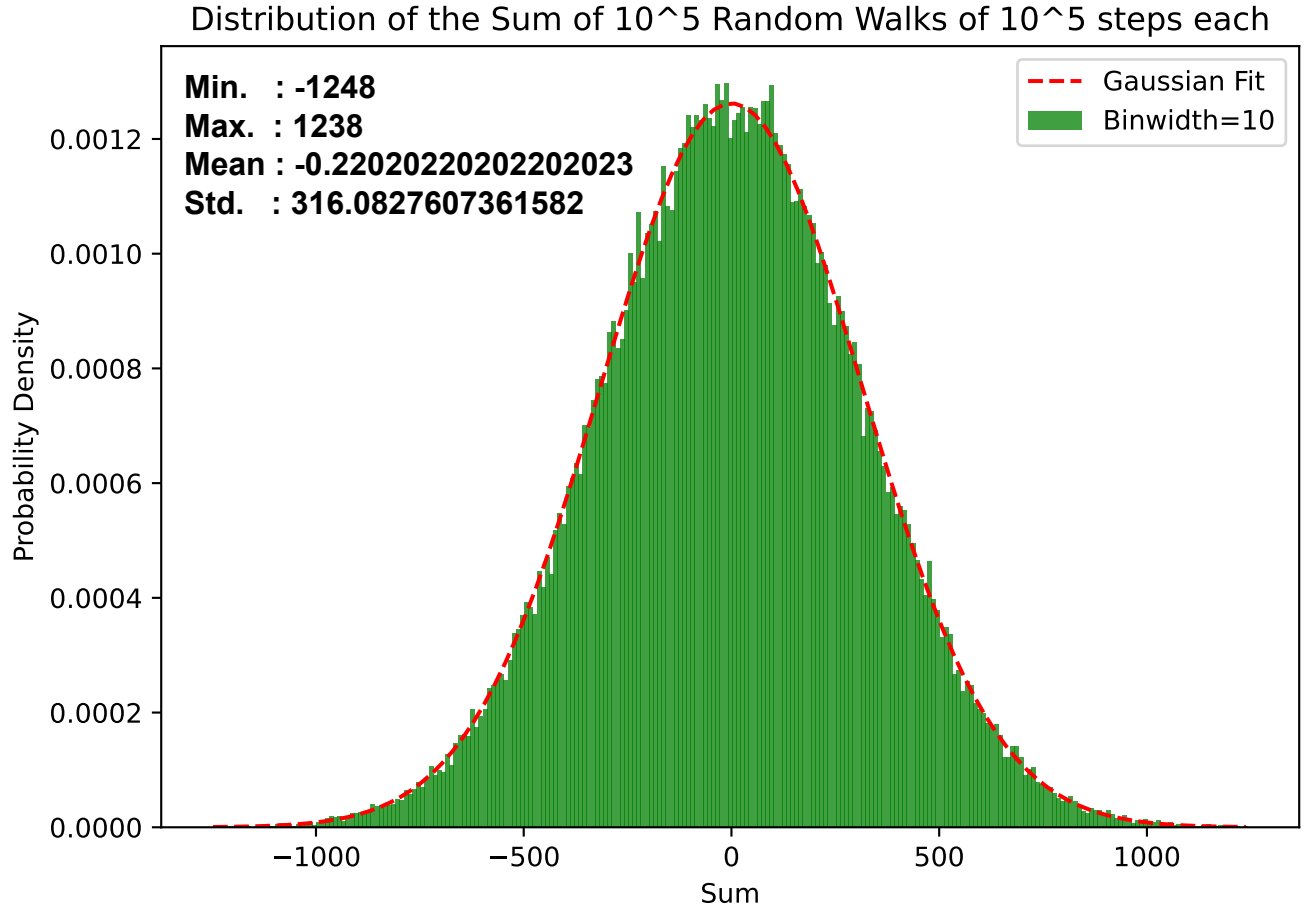

Distribution of the Sum of 10^5 Random Walks of 10^4 steps each
Min. : -446
Max. : 400
Mean : 0.1934819348193482
Std. : 99.87001464560574
Gaussian Fit
Bins[...-1,1,..]
Probability Density
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
−400
−200
0
200
400
Sum

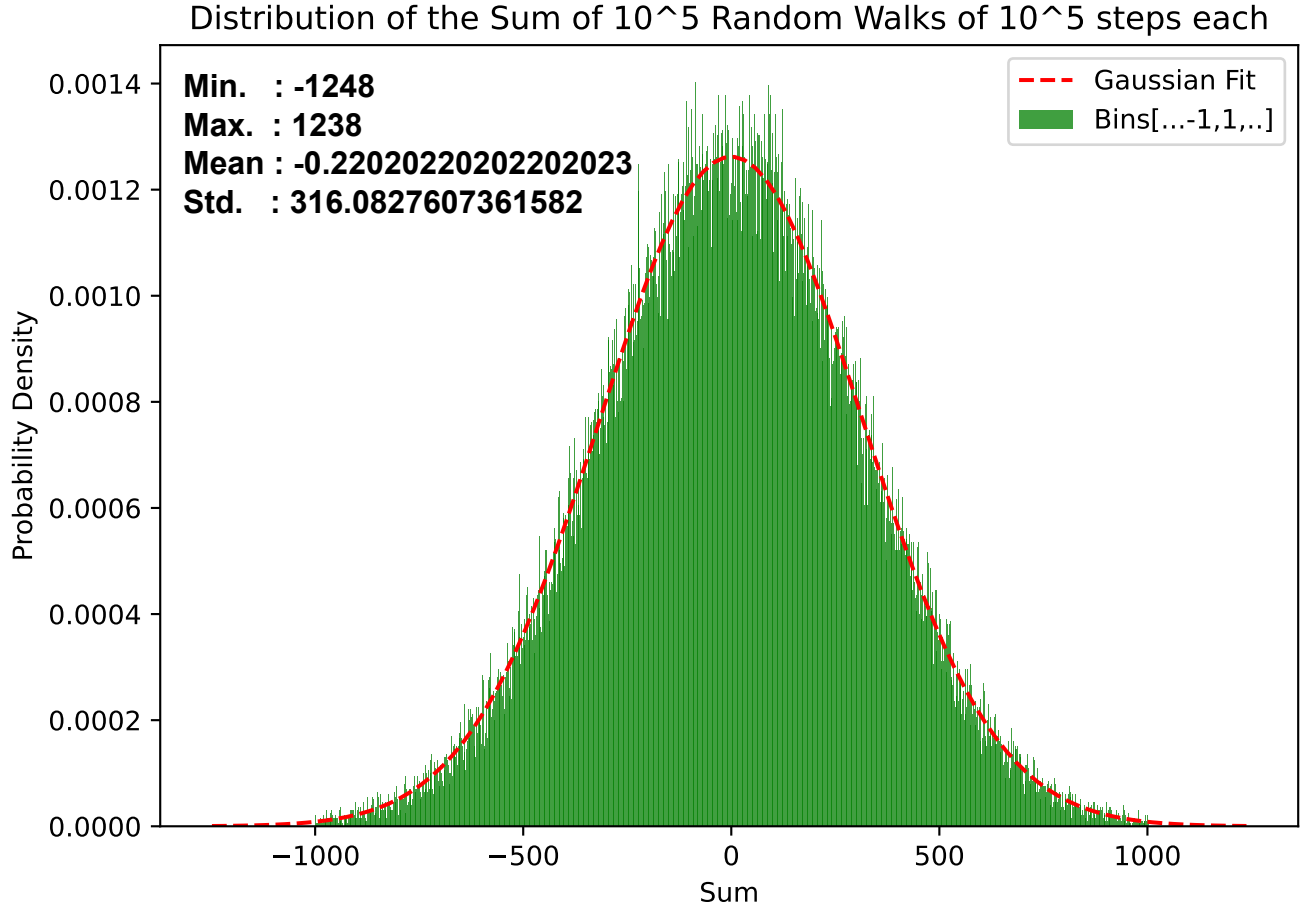

Distribution of the Sum of 10^5 Random Walks of 10^4 steps each
Min. : -446
Max. : 400
Mean : 0.1934819348193482
Std. : 99.87001464560574
Gaussian Fit
Bins[...-2,0,2,..]
Probability Density
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
−400
−200
0
200
400
Sum

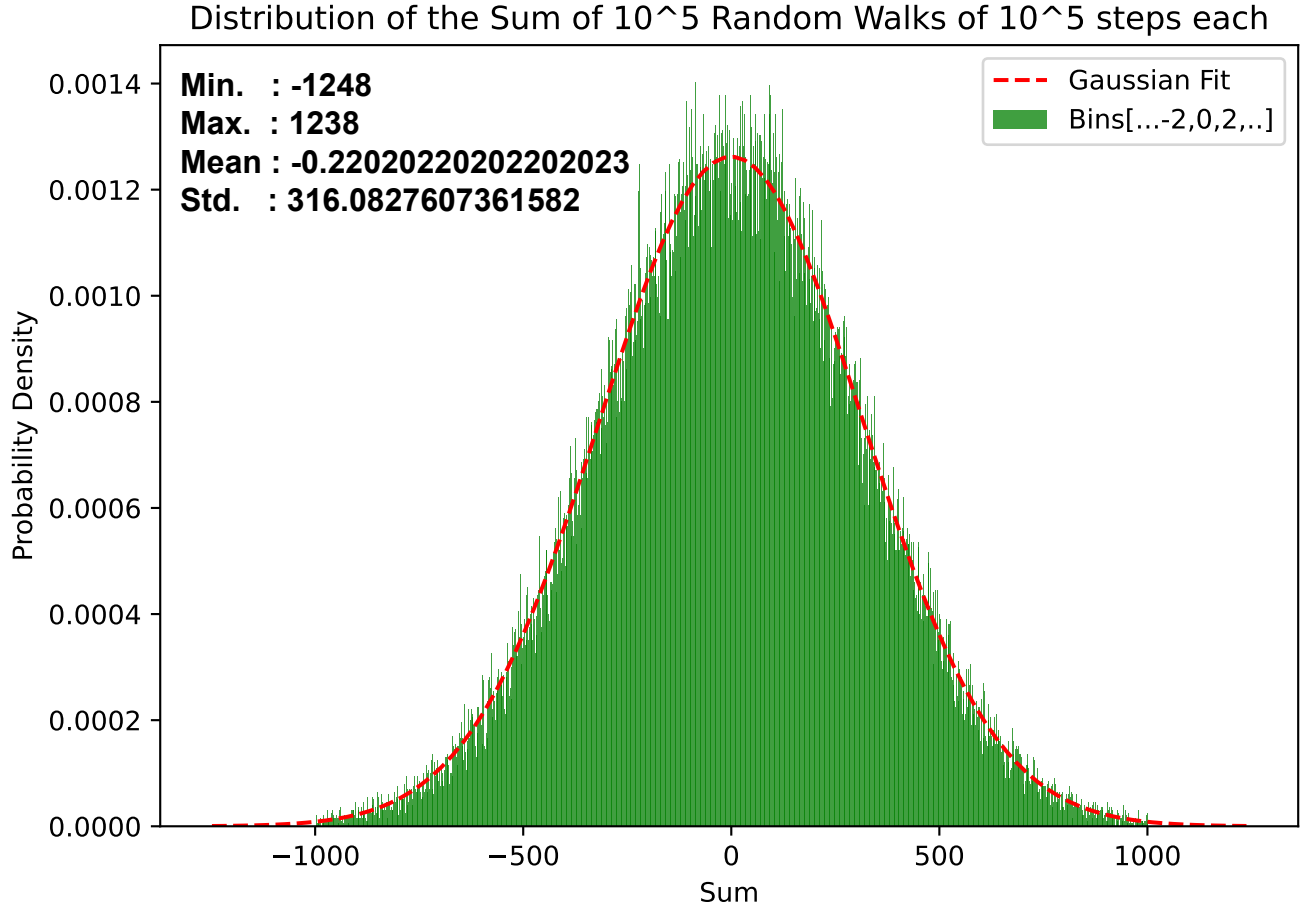

Distribution of the Sum of 10^5 Random Walks of 10^5 steps each
Min. : -1248
Max. : 1238
Mean : -0.22020220202202023
Std. : 316.0827607361582
Gaussian Fit
Binwidth=1
Probability Density
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
−1000
−500
0
500
1000
Sum


Distribution of the Sum of 10^5 Random Walks of 10^5 steps each
Min. : -1248
Max. : 1238
Mean : -0.22020220202202023
Std. : 316.0827607361582
Gaussian Fit
Binwidth=2
Probability Density
0.0014
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
−1000
−500
0
500
1000
Sum


Distribution of the Sum of 10^5 Random Walks of 10^5 steps each
Min. : -1248
Max. : 1238
Mean : -0.22020220202202023
Std. : 316.0827607361582
Gaussian Fit
Binwidth=5
Probability Density
0.0016
0.0014
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
−1000
−500
0
500
1000
Sum


Distribution of the Sum of 10^5 Random Walks of 10^5 steps each
Min. : -1248
Max. : 1238
Mean : -0.22020220202202023
Std. : 316.0827607361582
Gaussian Fit
Binwidth=10
Probability Density
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
−1000
−500
0
500
1000
Sum


Distribution of the Sum of 10^5 Random Walks of 10^5 steps each
Min. : -1248
Max. : 1238
Mean : -0.22020220202202023
Std. : 316.0827607361582
Gaussian Fit
Bins[...-1,1,..]
Probability Density
0.0014
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
−1000
−500
0
500
1000
Sum


Distribution of the Sum of 10^5 Random Walks of 10^5 steps each
Min. : -1248
Max. : 1238
Mean : -0.22020220202202023
Std. : 316.0827607361582
Gaussian Fit
Bins[...-2,0,2,..]
Probability Density
0.0014
0.0012
0.0010
0.0008
0.0006
0.0004
0.0002
0.0000
−1000
−500
0
500
1000
Sum