PMDS HW1

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Random Walk Simulation

```
Simulation process (Use 2D case as an example)
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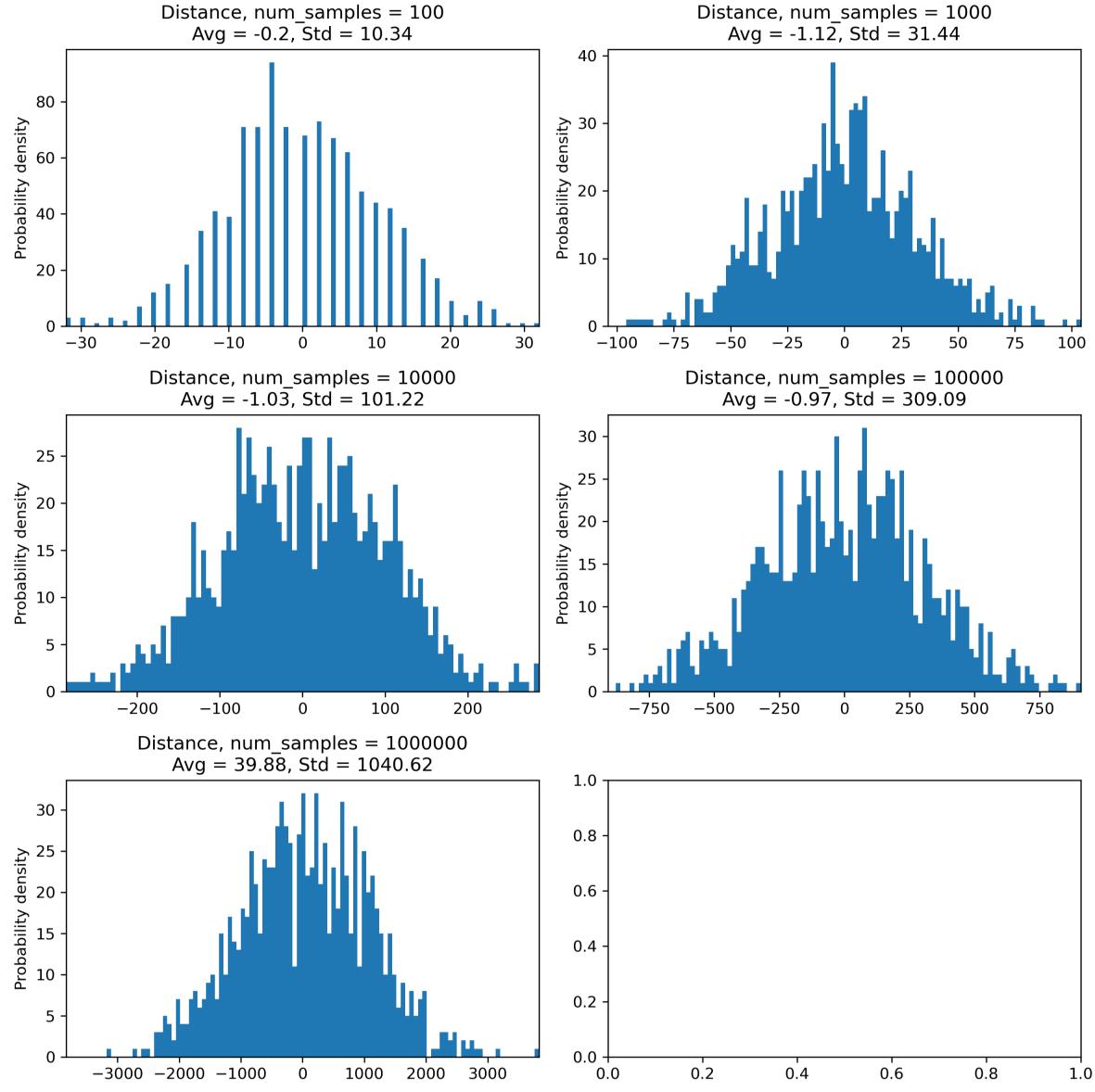
```
Import the packages
 import random
 import numpy as np
 import matplotlib.pyplot as plt
Define the function to randomly generate 1 & -1
 def generate_random_sign():
      n = random.choice([-1, 1])
      return n
```

Calculate the L1 distance (Manhattan distance) and L2 distance (Euclidean distance)

$$L1 = |x| + |y|$$
 $L2 = \sqrt{x^2 + y^2}$

```
## Define the number of trials of simulation
## and the samples of random walks in the single trials
num_trial, num_samples = 1000, 10000
l1_dist = []
12_dist = []
for i in range(num_trial):
   x, y = 0, 0
   for i in range(num_samples):
       x1 = generate_random_sign()
       y1 = generate_random_sign()
       x += x1
       y += y1
   ## Distance calculation
   ### L1 distance
   11 = abs(x) + abs(y)
    l1_dist.append(l1)
   ### L2 distance
   12 = np.sqrt(x**2 + y**2)
   12_dist.append(12)
```

1D Cases



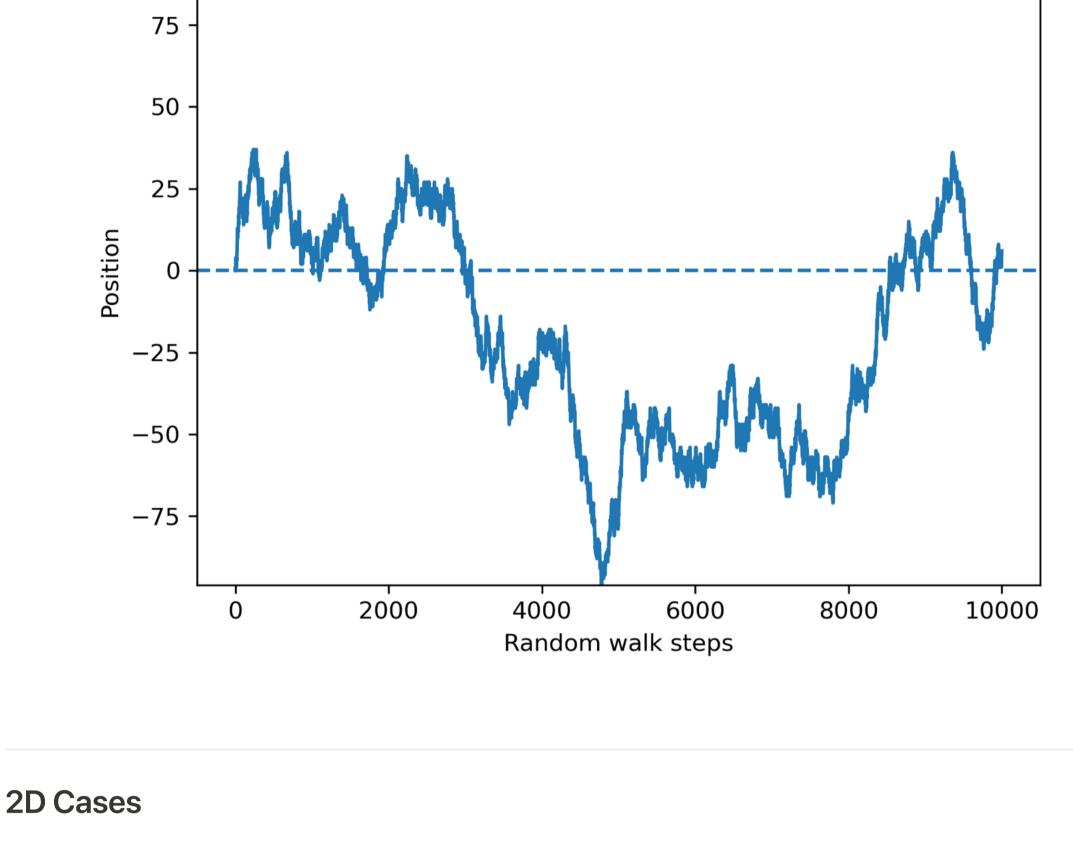
Final position: 6 How many times the dot comes back to the origin: 93

1D Preview

A simulation process of 1D random walk process

1D Random walk preview

L1 Distance, num_samples = 100Avg = 15.84, Std = 8.72



density

L2 Distance, num_samples = 100Avg = 12.44, Std = 6.63

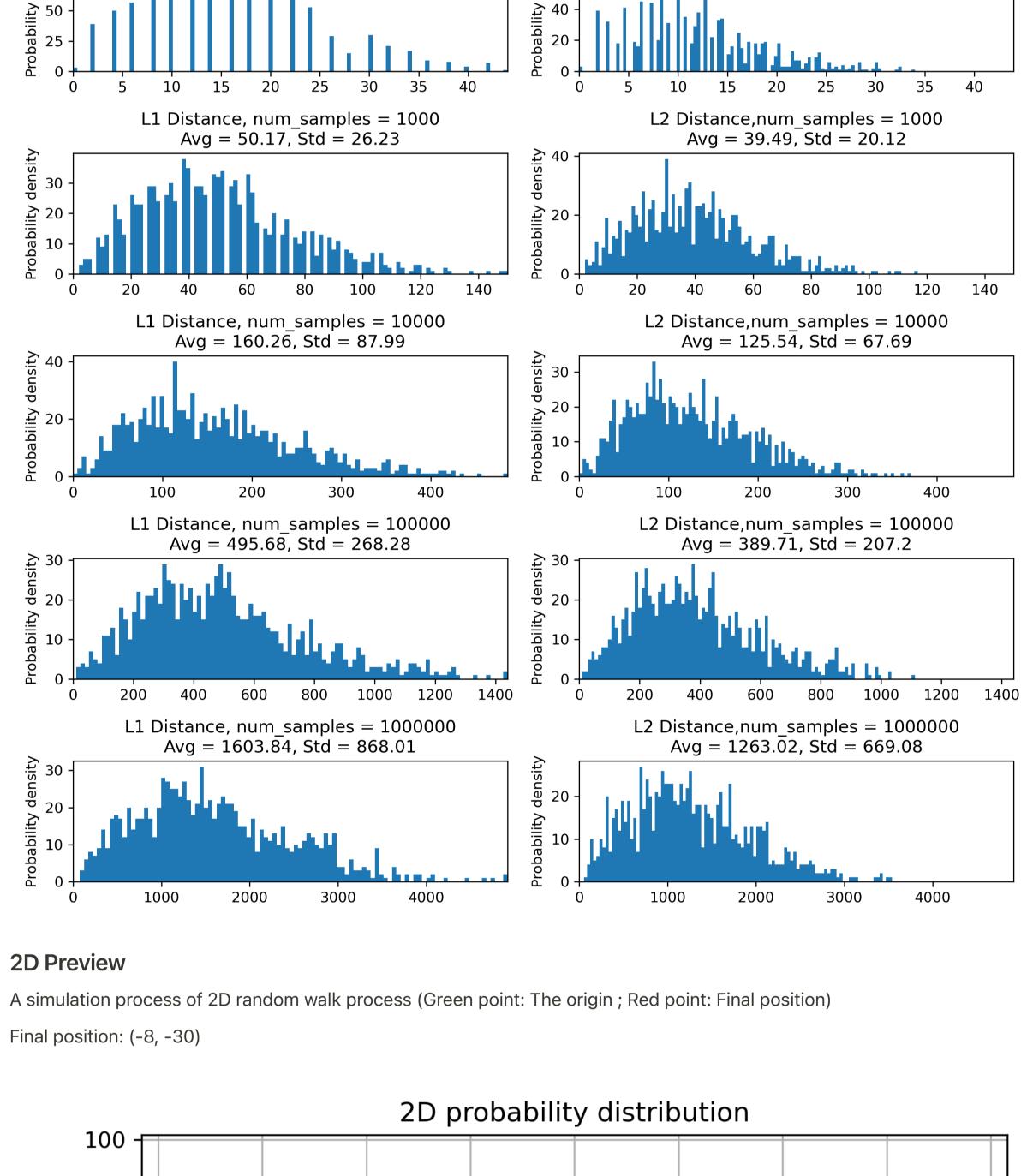
Probability density 0 22 0

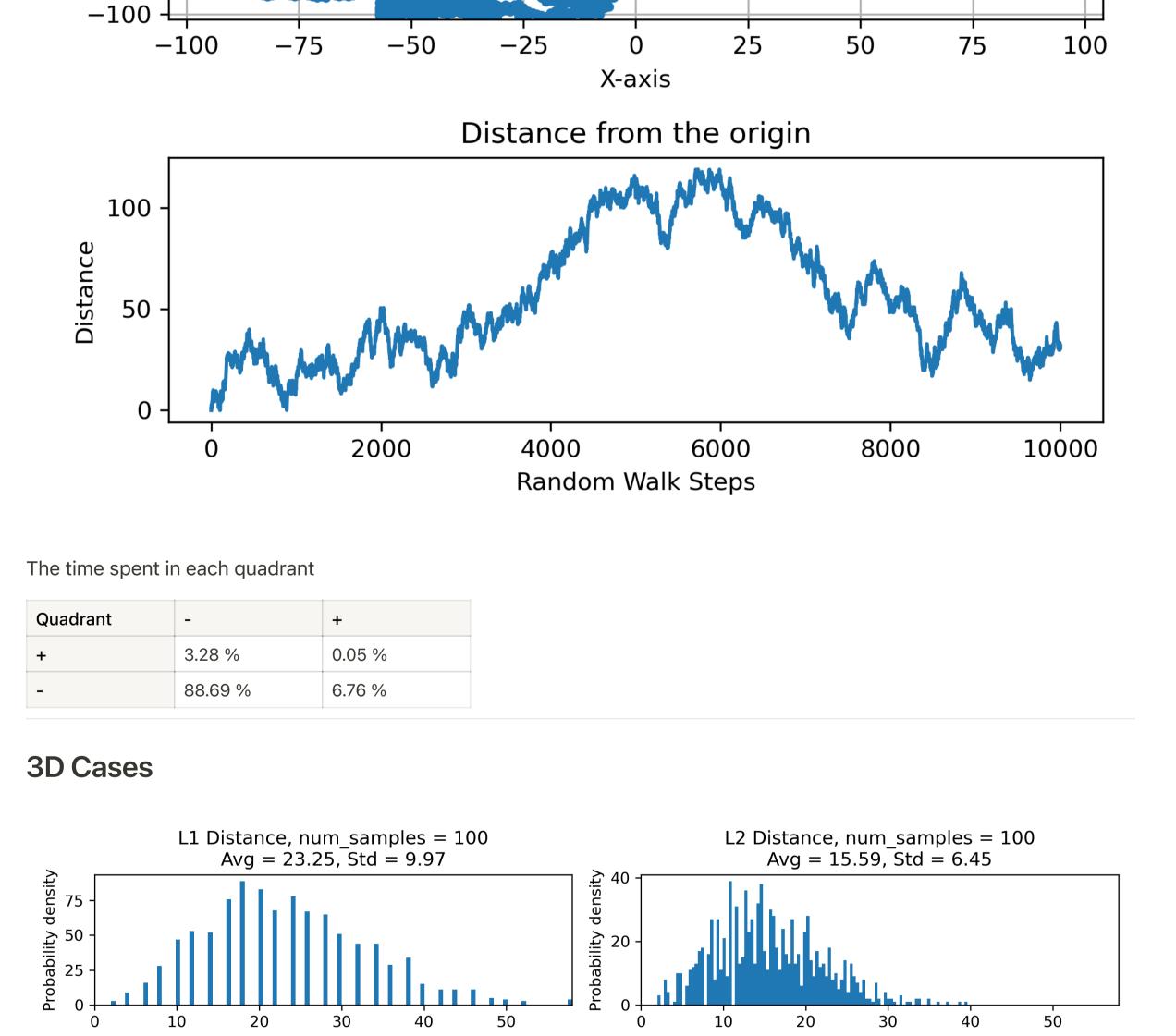
50

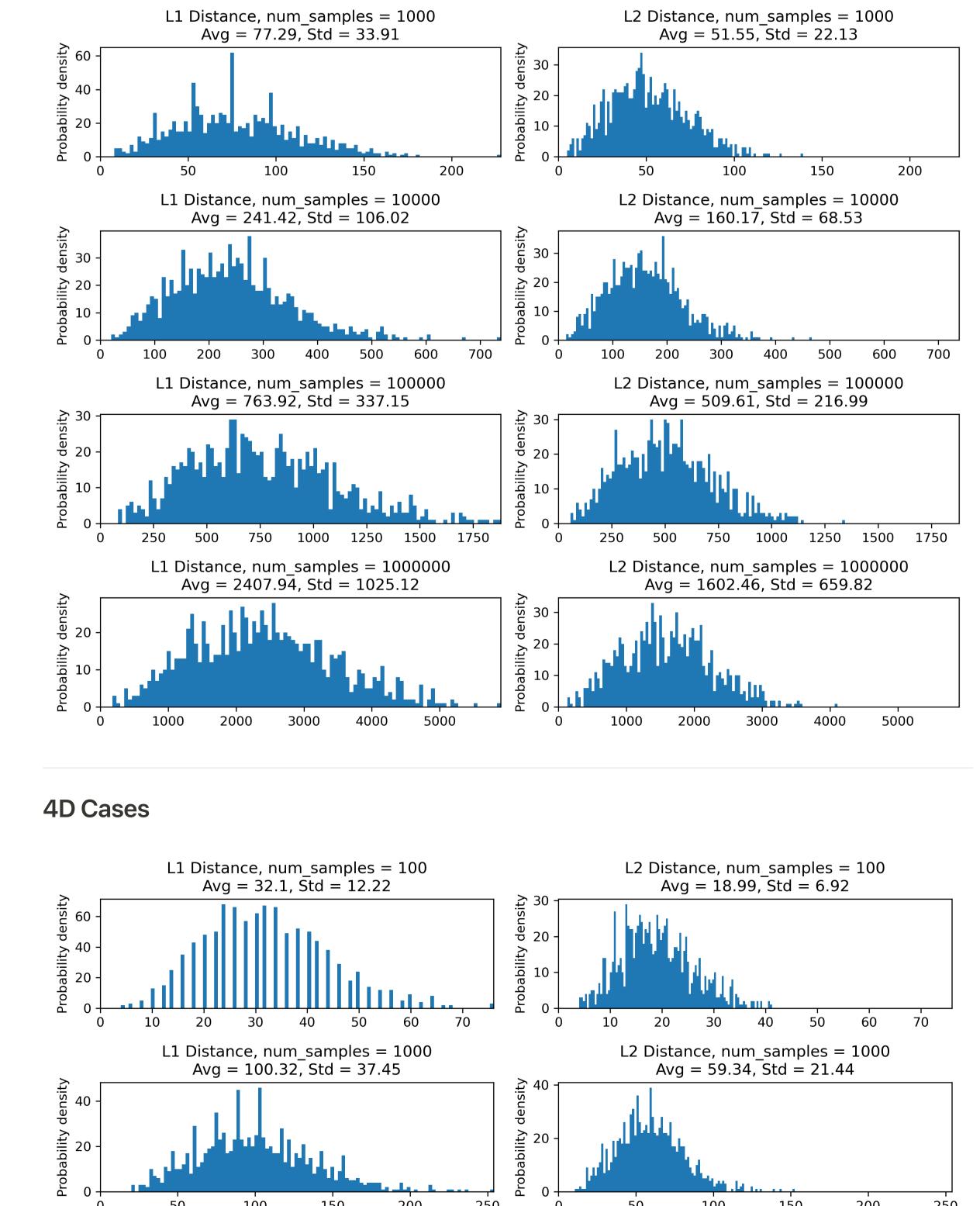
0

-50

Y-axis







200

600

2000

6000

7000

700

2500

150

L1 Distance, num_samples = 10000

Avg = 321.68, Std = 119.74

400

1500

L1 Distance, num_samples = 1000000 Avg = 3141.99, Std = 1115.41

4000

5000

L1 Distance, num_samples = 100000 $Avg = 1014.2\overline{4}$, Std = 377.23

500

100

300

1000

3000

50

100

500

1000

2000

200

Probability density
0
0
0

250

density 20 -

Probability 0

Probability density

20 -

0

50

200

100

500

1000

2000

200

600

2000

6000

500

700

2500

7000

250

150

L2 Distance, num_samples = 10000 Avg = 188.78, Std = 67.63

400

1500

L2 Distance, num_samples = 1000000 Avg = 1844.83, Std = 641.98

4000

5000

L2 Distance, num_samples = 100000 Avg = 597.95, Std = 215.11

100

300

1000

3000