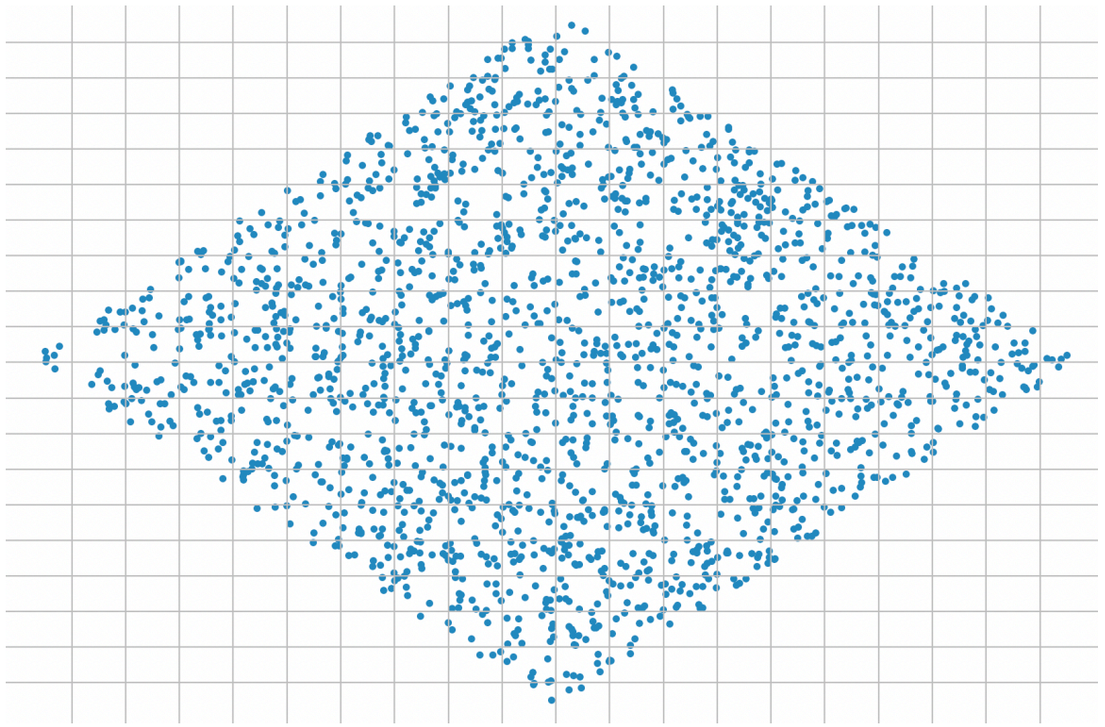
菱形正嗎？



步驟、匯入套裝

```
from shape2D2 import *
```

shape2D2.py

```
import matplotlib.pyplot as plt
import random
import numpy as np

def produce_sig(N): # 1A
    ...

def plot_sig(x_list,y_list): #1C
    ...

def plot_points(x_list,y_list,xticks, yticks): # 1D
    ...

def bin2ticks(x_bin):  # 1D2
    ...

def A_sig(A,x_list,y_list): # 2
    ...

def my_hitogram(x,n): #3B
    ...

def my_joint_histogram(x,y,n):  #3A
    ...

def calculate_D(joint,x2bin,y2bin): # 4
    ...

def my_analysis(x_list, y_list, bin_size): # 5
    ...
```

步驟一、旋轉$\frac{\pi}{4}$

$$A = \begin{bmatrix} sin(\frac{\pi}{4}) & cos(\frac{\pi}{4}) \\ cos(\frac{\pi}{4}) & -sin(\frac{\pi}{4}) \end{bmatrix}$$

A 矩陣乘以
點座標

```
A = np.matrix([[1/np.sqrt(2), 1/np.sqrt(2)], [1/np.sqrt(2), -1/np.sqrt(2)]])
```

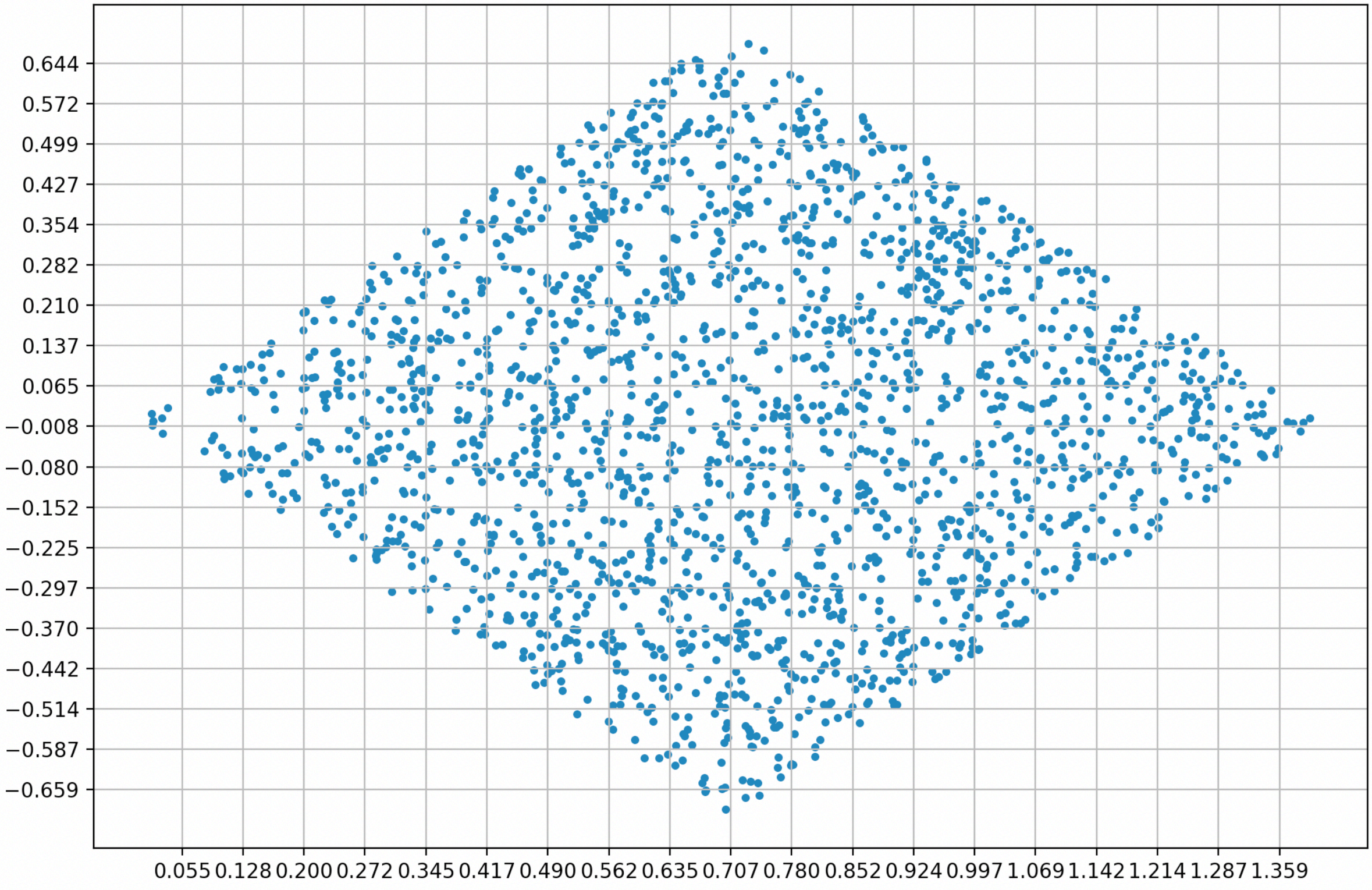
步驟二、產生菱形

```
from shape2D2 import *
N = 2000
n = 20
x, y = produce_sig(N)
A = np.matrix([[1/np.sqrt(2), 1/np.sqrt(2)], [1/np.sqrt(2), -1/np.sqrt(2)]])
DA = A_sig(A,x,y)
x_list = list(DA[:,0])
y_list = list(DA[:,1])
```

產生獨立訊號

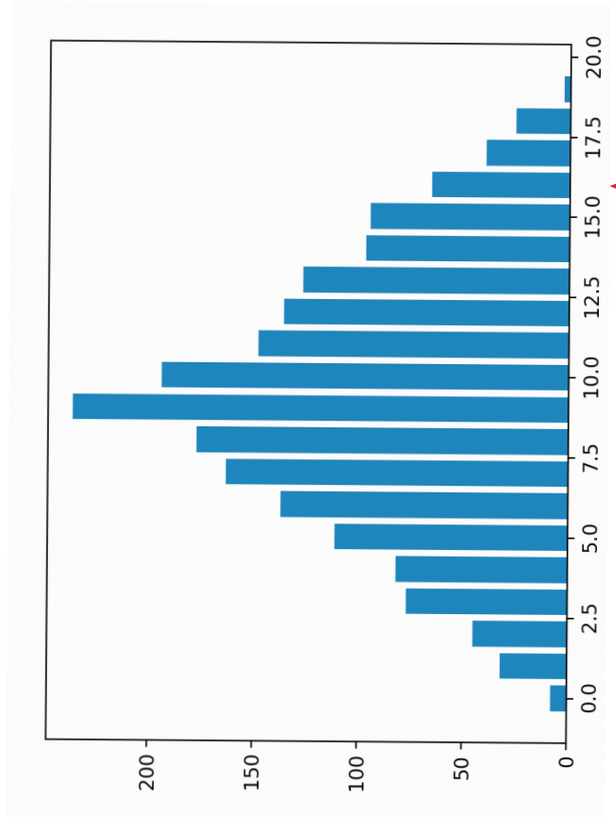
旋轉$\frac{\pi}{4}$

```
xbin = np.linspace(np.max(x_list), np.min(x_list), n)
ybin = np.linspace(np.max(y_list), np.min(y_list), n)
plot_points(x_list,y_list,bin2ticks(xbin), bin2ticks(ybin))
```

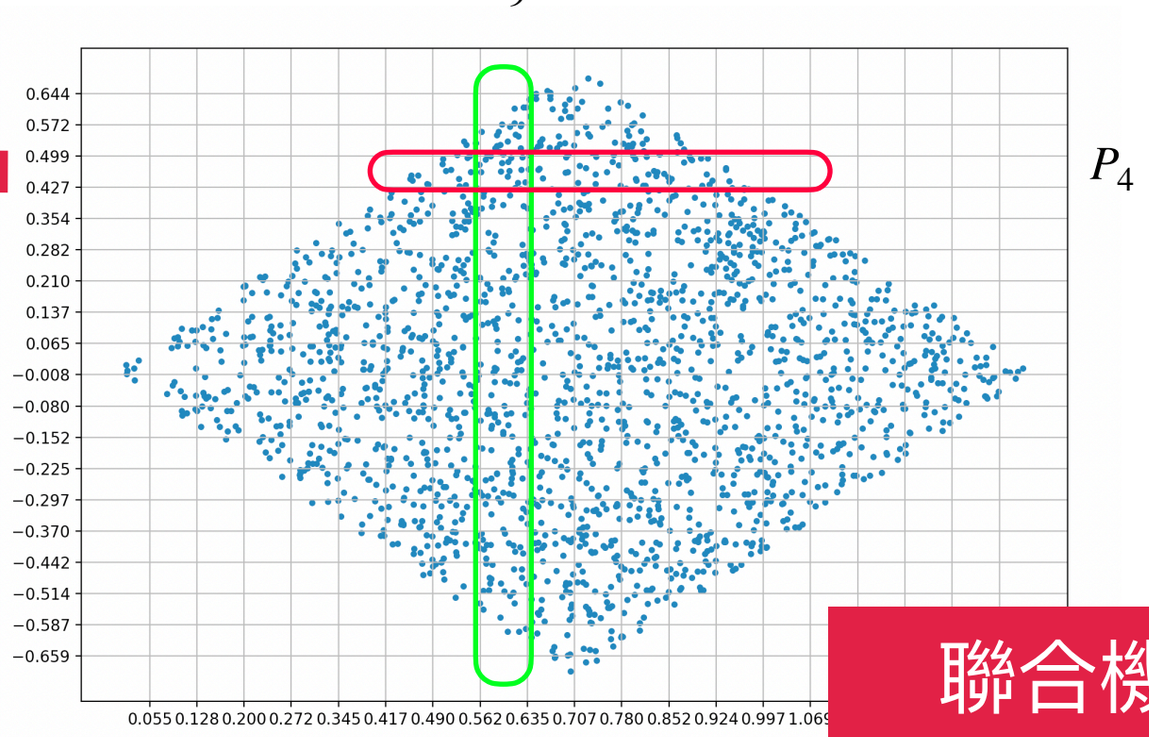

0.644
0.572
0.499
0.427
0.354
0.282
0.210
0.137
0.065
−0.008
−0.080
−0.152
−0.225
−0.297
−0.370
−0.442
−0.514
−0.587
−0.659
0.055
0.128
0.200
0.272
0.345
0.417
0.490
0.562
0.635
0.707
0.780
0.852
0.924
0.997
1.069
1.142
1.214
1.287
1.359

步驟三、投影至橫坐標與縱座標，求長方累計圖

```
x2bin, xbin = my_hitogram(x_list, n)
y2bin, ybin = my_hitogram(y_list, n)
```



P_9



P_4

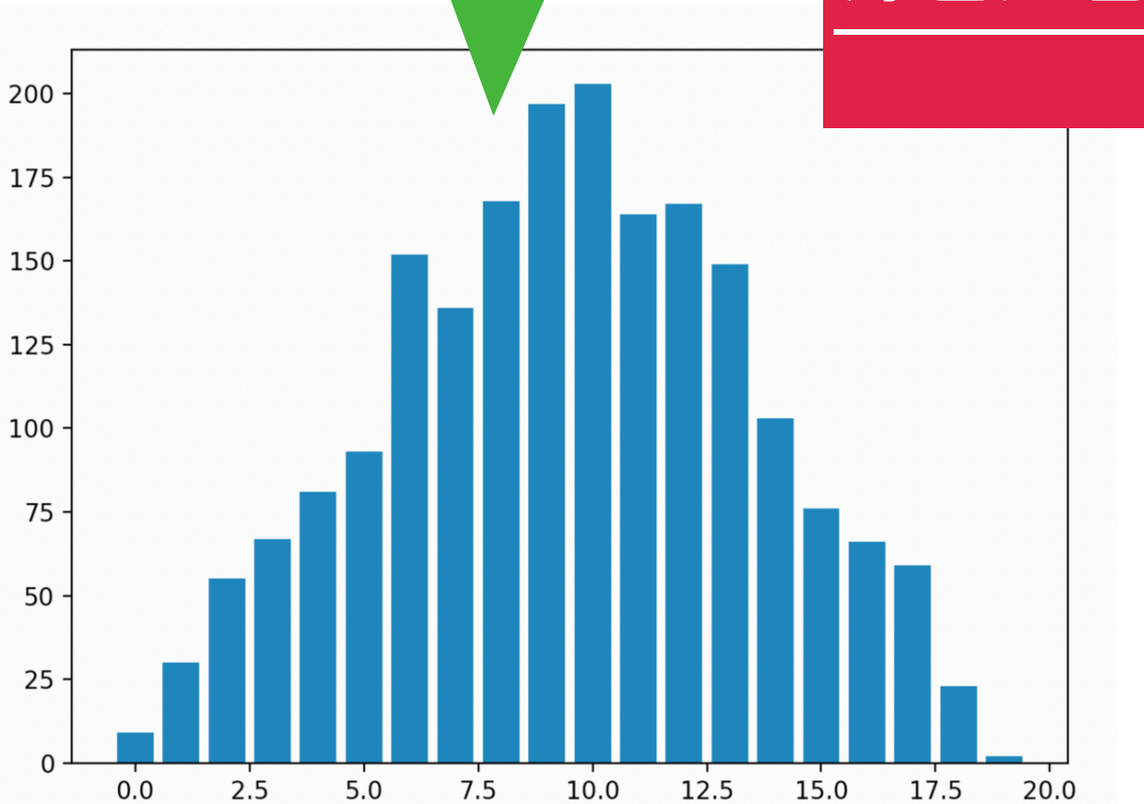
聯合機率 $= P_{49}$

$$\frac{\text{綠色紅色交叉框點數}}{N}$$

個別機率乘積 $=$

$$P_4 \times P_9$$

$$\frac{\text{綠色框點數} \times \text{紅色框點數}}{N^2}$$



獨立訊號的判斷條件：

聯合機率與個別機率乘積間的差距越小越好

$$D_{49} = P_{49} \frac{P_{49}}{P_4 \times P_9}$$

$$\mathbf{D} = \sum_{i,j} D_{ij}$$

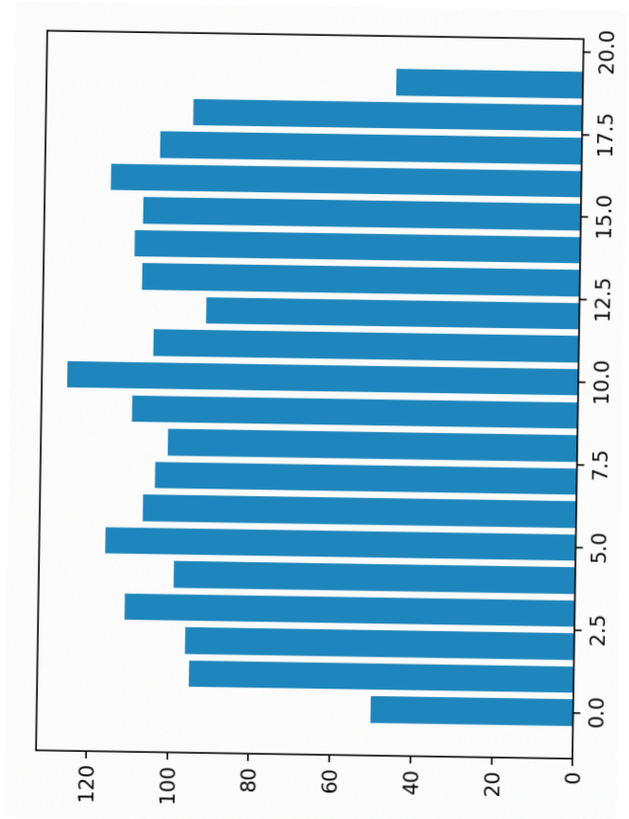
獨立條件判斷：聯合機率與個別機率乘積的差距

步驟四、計算所有D_{ij}與D

```
D = my_analysis(x_list, y_list, n)
print("旋轉後 D值：", D)
```

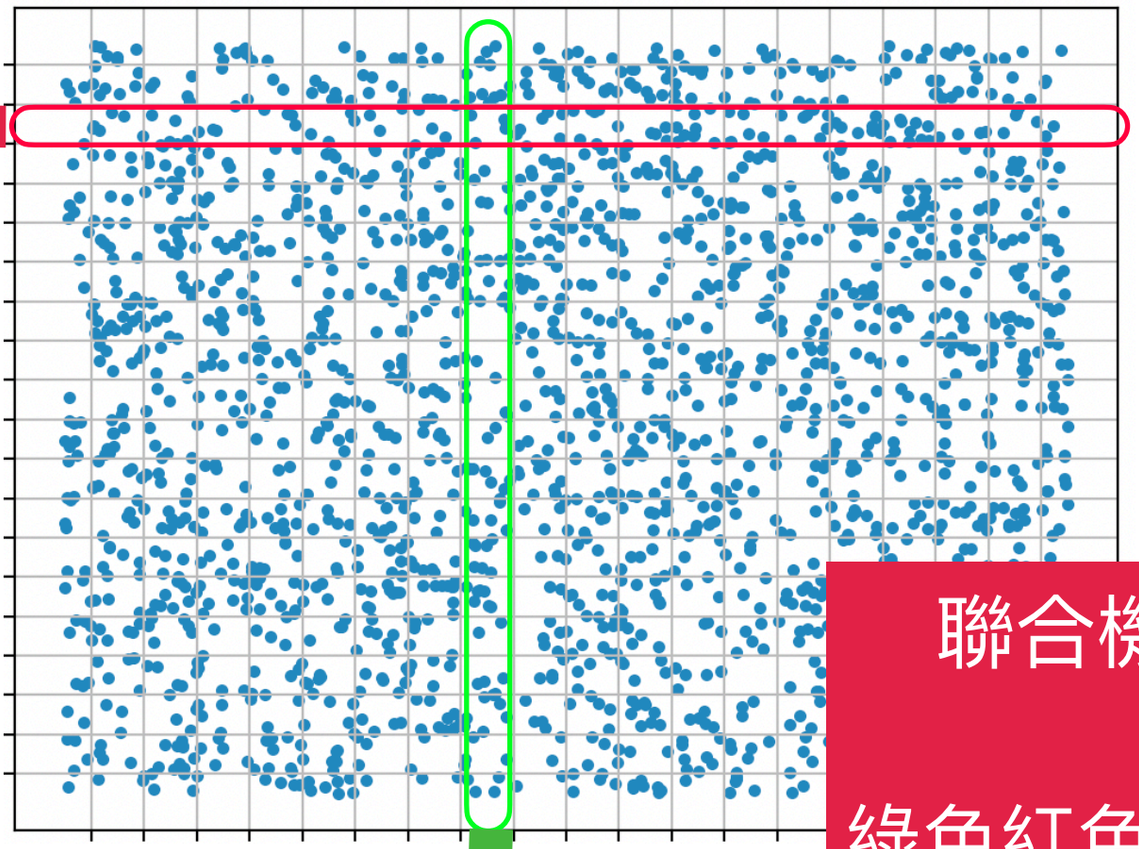
```
旋轉後 D值： 3.0604680765971493
```

步驟五、比較看看



P_9

P_4



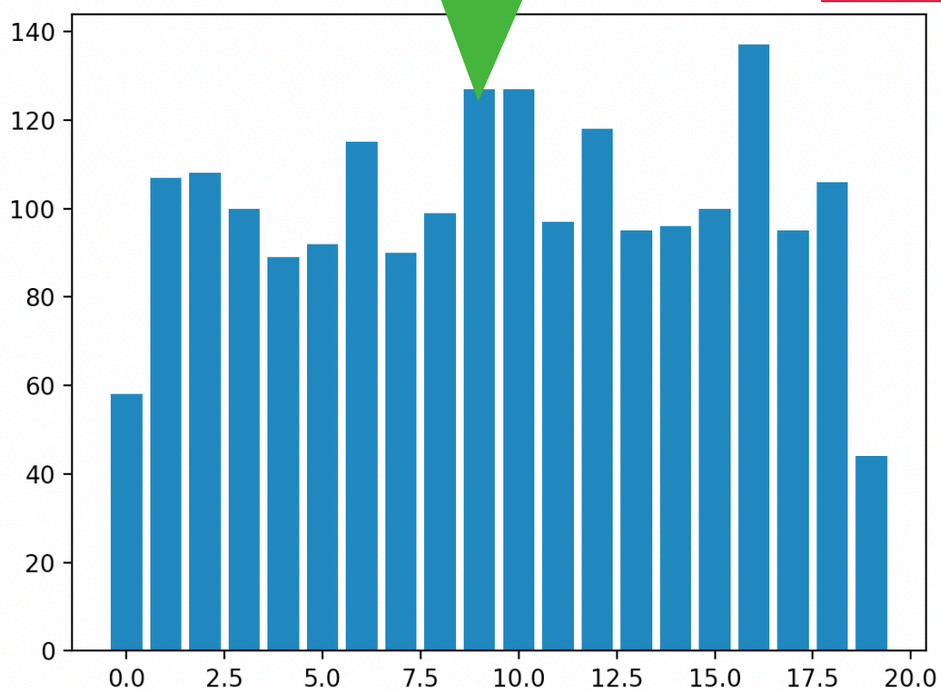
聯合機率＝P_{49}

$$\frac{\text{綠色紅色交叉框點數}}{N}$$

個別機率乘積＝

$P_4 \times P_9$

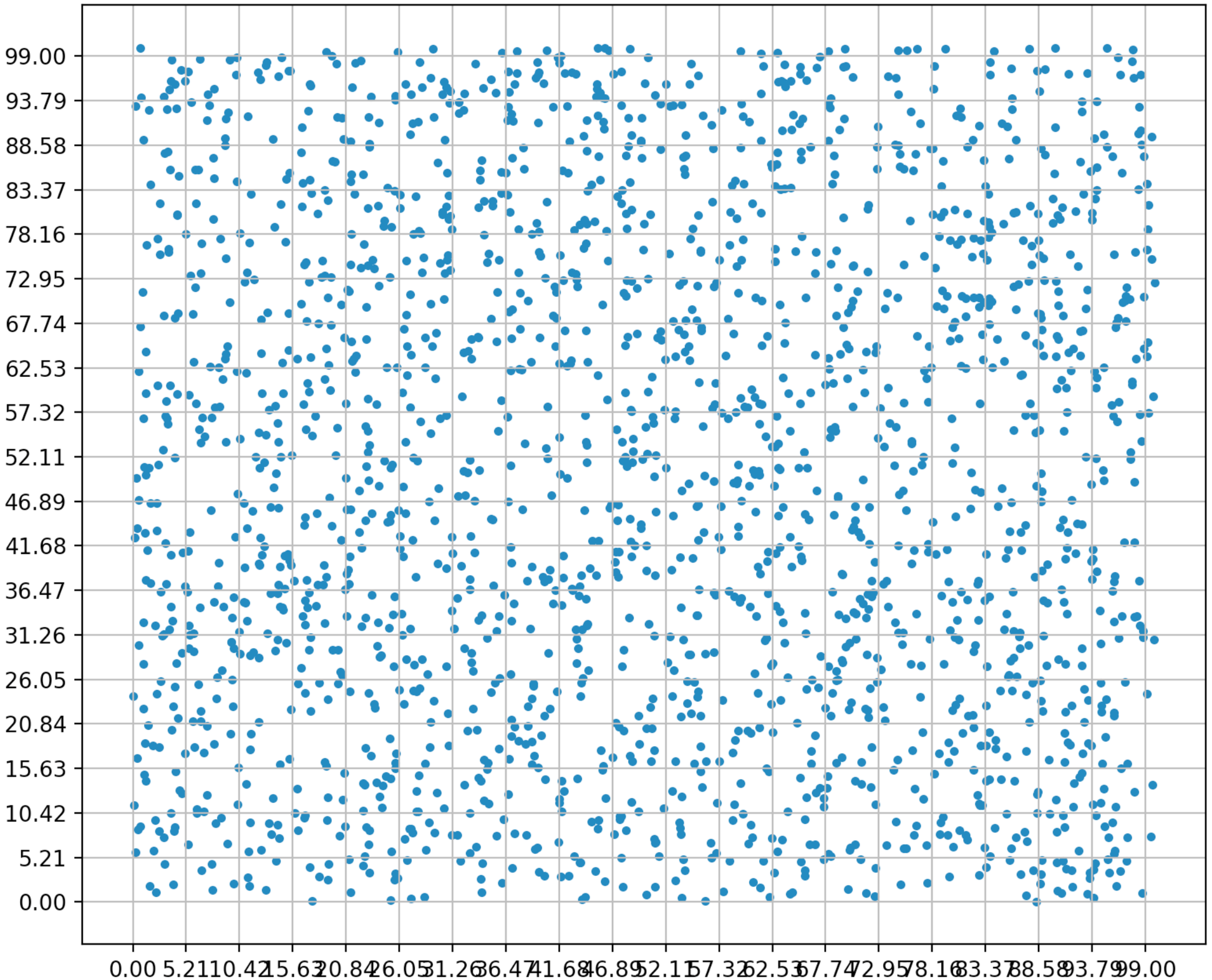
$$\frac{\text{綠色框點數} \times \text{紅色框點數}}{N^2}$$

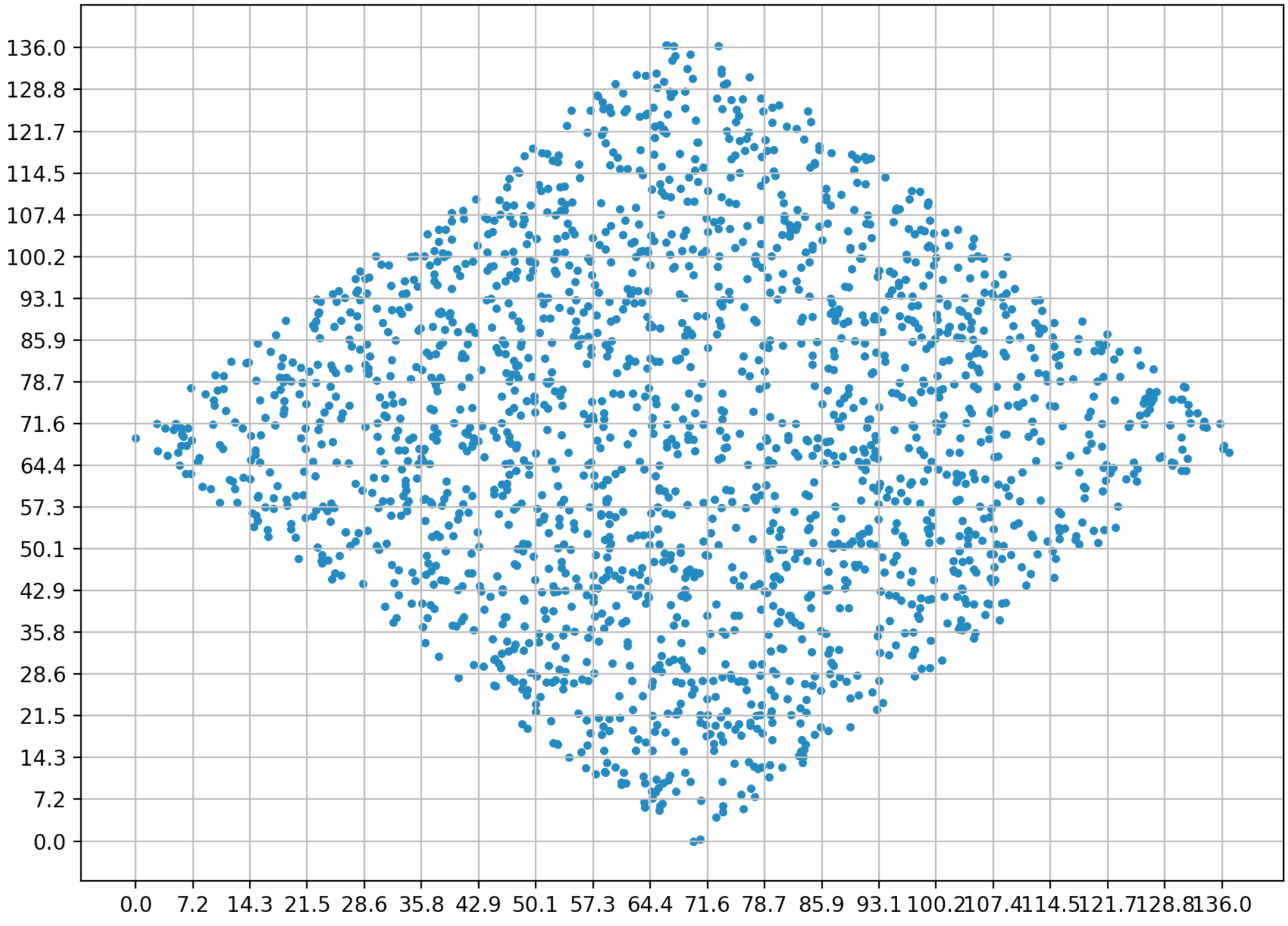


```
from shape2D2 import *


N = 2000
n = 20
x, y = produce_sig(N)
A = np.matrix([[1/np.sqrt(2), 1/np.sqrt(2)], [1/np.sqrt(2), -1/
np.sqrt(2)]])
DA = A_sig(A,x,y)
x_list = list(DA[:,0])
v = min(x_list)
x_list = [x - v for x in x_list]
y_list = list(DA[:,1])
v = min(y_list)
y_list = [y - v for y in y_list]

D = my_analysis(x_list, y_list, n)
print("旋轉後 D值：", D)

D = my_analysis(x, y, n)
print("旋轉前 D值：", D)
plt.show()
```

test 6

```
旋轉後 D值： 0.2918865732351983
旋轉前 D值： 0.10410541762413007
```


99.00
93.79
88.58
83.37
78.16
72.95
67.74
62.53
57.32
52.11
46.89
41.68
36.47
31.26
26.05
20.84
15.63
10.42
5.21
0.00
0.00 5.21 10.42 15.63 20.84 26.05 31.26 36.47 41.68 46.89 52.11 57.32 62.53 67.74 72.95 78.16 83.37 88.58 93.79 99.00


136.0
128.8
121.7
114.5
107.4
100.2
93.1
85.9
78.7
71.6
64.4
57.3
50.1
42.9
35.8
28.6
21.5
14.3
7.2
0.0
0.0
7.2
14.3
21.5
28.6
35.8
42.9
50.1
57.3
64.4
71.6
78.7
85.9
93.1
100.2
107.4
114.5
121.7
128.8
136.0