6205 Assignment1 RandomWalk Report

Conclusion: D=L*sqrt(N)

(On the one hand,I take the mathematical deducing process as a reference. On the other hand, I draw this conclusion about the relation among D, L and N from those tests below, although there is some deviations between theoretical values and tests values.)

Mathematical Deducing process:

Step1:

$$D = \frac{1}{p}\left(\sum_{i=1}^{p} | d_{i1} + d_{i2} + \ldots + d_{in} |\right)$$

Step2:

$$R^2 = \frac{1}{p}\left(\sum_{i=1}^{p} \left((X_{i1} + X_{i2} + \ldots + X_{in})^2 + (Y_{i1} + Y_{i2} + \ldots + Y_{in})^2 \right)\right)$$

$$= \frac{1}{p}\left(\sum_{i=1}^{p} \left(X_{i1}^2 + X_{i1} X_{i2} + X_{i1} X_{i3} + \ldots + X_{i2}^2 + X_{i1} X_{i2} + \ldots + X_{in}^2 \right.\right.$$

$$\left.\left. + Y_{i1}^2 + Y_{i1} Y_{i2} + Y_{i1} Y_{i3} + \ldots + Y_{i2}^2 + Y_{i1} Y_{i2} + \ldots + Y_{in}^2\right)\right)$$

Step3:

$$R^2 = \frac{1}{p}\left(\sum_{i=1}^{p} \left(X_{i1}^2 + X_{i2}^2 + \ldots + X_{in}^2 + Y_{i1}^2 + Y_{i2}^2 + \ldots + Y_{in}^2\right)\right)$$

$$= \frac{1}{p}\left(\sum_{i=1}^{p} \left(X_{i1}^2 + Y_{i1}^2 + X_{i2}^2 + Y_{i2}^2 + \ldots + X_{in}^2 + Y_{in}^2\right)\right)$$

$$= \frac{1}{p}\left(\sum_{i=1}^{p} n\right) = n$$

Test:

n=10

n	l	experiments	mean distance(test result)
10	1	100	2.751201551746113
10	1	100	2.854891522120799
10	1	100	2.797984709240848
10	1	100	2.8250342256470997
10	1	100	2.821594441776777
ideal value of mean distance:			3.162

n=50

n	l	experiments	mean distance(test result)
50	1	1000	6.2337542590137565
50	1	1000	6.218567282239115
50	1	1000	6.4977515347394545
50	1	1000	6.294447460766475
50	1	1000	6.319889214636539
ideal value of mean distance:			7.071

n=100

n	l	experiments	mean distance(test result)
100	1	1000	8.874095093986684
100	1	1000	8.975755435374252
100	1	1000	8.827020931417291
100	1	1000	8.810492062276019
100	1	1000	8.805001700690092
ideal value of mean distance:			10.000

n=500

n	l	experiments	mean distance(test result)
500	1	10000	19.621778618335746
500	1	10000	19.877408144542894
500	1	10000	19.709620211423264
500	1	10000	19.771177979807913
500	1	10000	19.831775818335178
ideal value of mean distance:			22.361

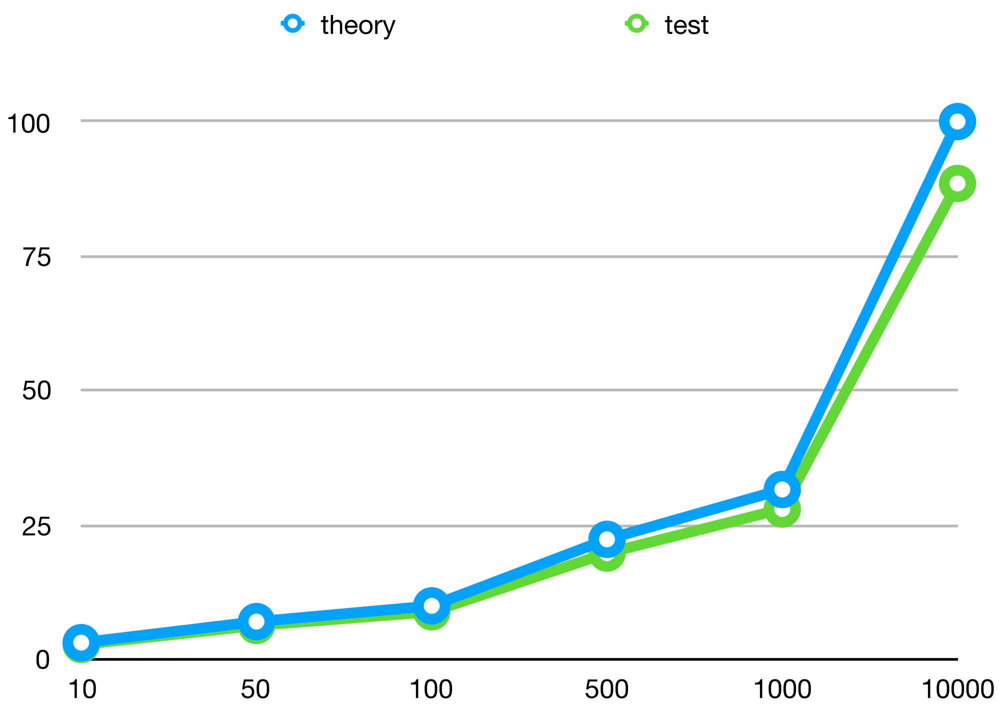
n=1000

n	l	experiments	mean distance(test result)
1000	1	100000	28.000172747980795
1000	1	100000	28.021365283021705
1000	1	100000	27.998374993115952
1000	1	100000	28.011684381207445
1000	1	100000	28.131520707071241
ideal value of mean distance:			31.623

n=10000

n	l	experiments	mean distance(test result)
10000	1	100000	88.57535155172059
10000	1	100000	88.74109840482195
10000	1	100000	88.56158364051107
10000	1	100000	88.53370488756981
10000	1	100000	88.59790833558492
ideal value of mean distance:			100.000

Graph: horizontal axis —N (steps)
vertical axis —D (distance)



summary:

As we can see from the tests data in the tables and the graph, there is some deviations between theoretical value and tests value. Besides the graph we drew are not as smoothing as a square curve line, probably because the data samples we tested are discrete and sparse. However, the test results are basically fitting the mathematical ideal result.Thus the relation can be described as D=L*sqrt(N) in this random walk problem.