Program Structures and Algorithms
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GITHUB LINK: https://github.com/amarneu/INFO6205

**Task: To deduce the relationship between Random Walk experiment.**

**Output of custom inputs are as follows:**

1 steps: 1.0 over 10 experiments
6 steps: 2.3867759087201814 over 10 experiments
12 steps: 2.6210904837709434 over 10 experiments
18 steps: 4.428443072189011 over 10 experiments
24 steps: 4.099701306138333 over 10 experiments
30 steps: 3.5388801828457574 over 10 experiments

1 steps: 1.0 over 10 experiments
6 steps: 1.9556349186104047 over 10 experiments
12 steps: 3.3643180605264815 over 10 experiments
18 steps: 3.071484269858988 over 10 experiments
24 steps: 4.725017345701676 over 10 experiments
30 steps: 3.7826728022706533 over 10 experiments

1 steps: 1.0 over 10 experiments
6 steps: 2.1395623132202237 over 10 experiments
12 steps: 1.8567196007456048 over 10 experiments
18 steps: 3.3291333921131363 over 10 experiments
24 steps: 4.399681534816478 over 10 experiments
30 steps: 4.832584833997911 over 10 experiments

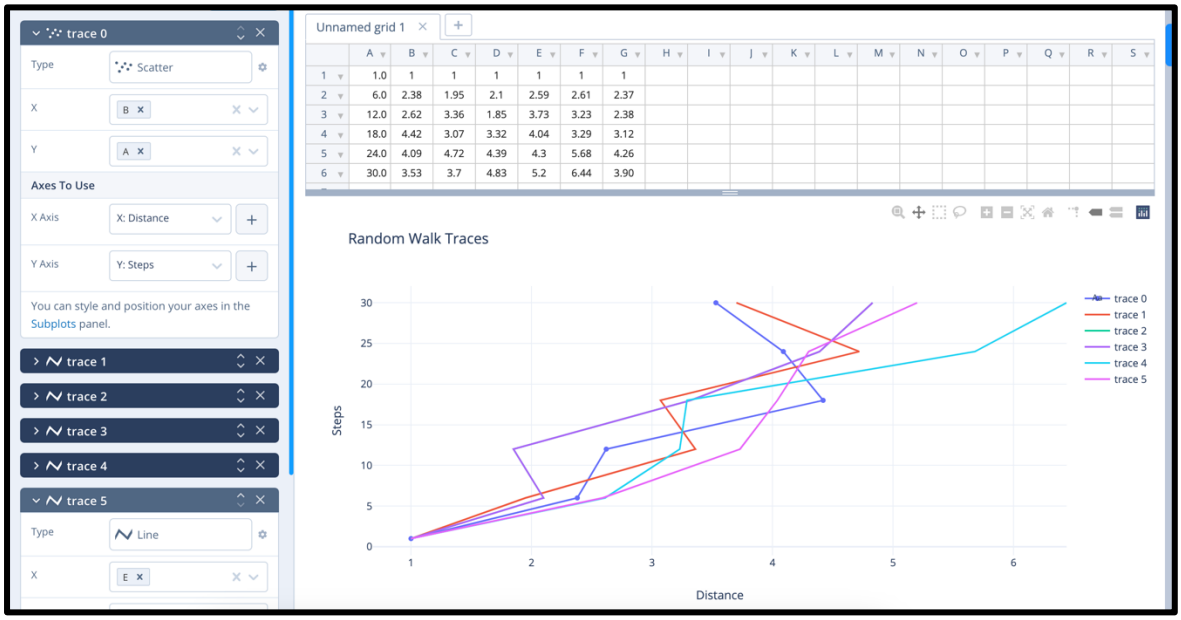
1 steps: 1.0 over 10 experiments
6 steps: 2.5958968935504716 over 10 experiments
12 steps: 3.7325264073166857 over 10 experiments
18 steps: 4.0412514460333435 over 10 experiments
24 steps: 4.304037118275918 over 10 experiments
30 steps: 5.2351671826874195 over 10 experiments

1 steps: 1.0 over 10 experiments
6 steps: 2.61103997743211 over 10 experiments
12 steps: 3.2353040461440385 over 10 experiments
18 steps: 3.2957483385709168 over 10 experiments
24 steps: 5.689855880353027 over 10 experiments
30 steps: 6.449546831385447 over 10 experiments

1 steps: 1.0 over 10 experiments
6 steps: 2.3729473667624426 over 10 experiments
12 steps: 2.3880904506440808 over 10 experiments

18 steps: 3.121630664812957 over 10 experiments
24 steps: 4.260504238879372 over 10 experiments
30 steps: 3.909576880528656 over 10 experiments

Below graph denotes the steps and distance deduced from random walk experiment.
The expected distance for a random walk in a 2D plane is given by the square root of the number of steps multiplied by the step length. The resulting distances are plotted against the number of steps showing how the Euclidean distance tends to increase with the square root of the number of steps.




**Relationship Conclusion:** The relationship between the number of steps (m) and the Euclidean distance (d) in a random walk experiment, where each step is of length 1 meter and the direction is randomly chosen from North, South, East, or West, can be described by the formula:
$\sqrt{m}=d$
This relationship is based on the properties of random walks, and the Euclidean distance - grows proportional to the square root of the number of steps.

**Evidence to support that conclusion:**

| Y-axis M | X-axis d |
|---|---|
| 1 | 1 |
| 6 | 1.95 |
| 12 | 3.36 |
| 18 | 3.07 |
| 24 | 4.72 |
| 30 | 3.7 |

After analyzing above relation, we can come on equation m – (x2-x1) which calculates as:

m - 1
m - 4.07
m - 10.5
m - 14.09
m - 18.44
m - 24.3

Further solving we conclude that,

m - (x2-x1) ^2=0
m - Δd^2=0
m = d^2

**√m = d**

**Hence as per graph plotted, we can now tell how the Euclidean distance tends to increase with the square root of the number of steps.**

**Unit Test Screenshots:**