Program Structures and Algorithms
Spring 2024

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GITHUB LINK: https://github.com/suchitadabir/INFO6205

Task: To find the relationship between *d* and *m*.

Relationship Conclusion:
On average, as the number of steps increases, the mean distance tends to increase. This means, they are directly proportional to each other with d being proportional to $\sqrt{m}$. Hence,

$$\mathbf{d} \propto \sqrt{m}$$

Evidence to support that conclusion:

- The following data is generated by running 26 iterations (n) for each value of 'm'.
- I chose 20 unique random values of number of random steps (m) between 20 to 200.
- Therefore, total number of experiments executed = m x n = 20 x 26 = 520

No of steps	Mean Distance
64	7.540613302
137	10.86913568
125	7.963056537
120	7.973086216
146	10.08470414
74	7.541056132
195	13.03672732
185	15.16319067
158	8.596256777
90	6.50902172
105	7.73512644
65	7.342057239
99	9.053863891
150	11.63260284
172	11.21796222
130	9.908536834
35	6.093899989
157	13.30720376
85	8.418164023
194	14.12802684

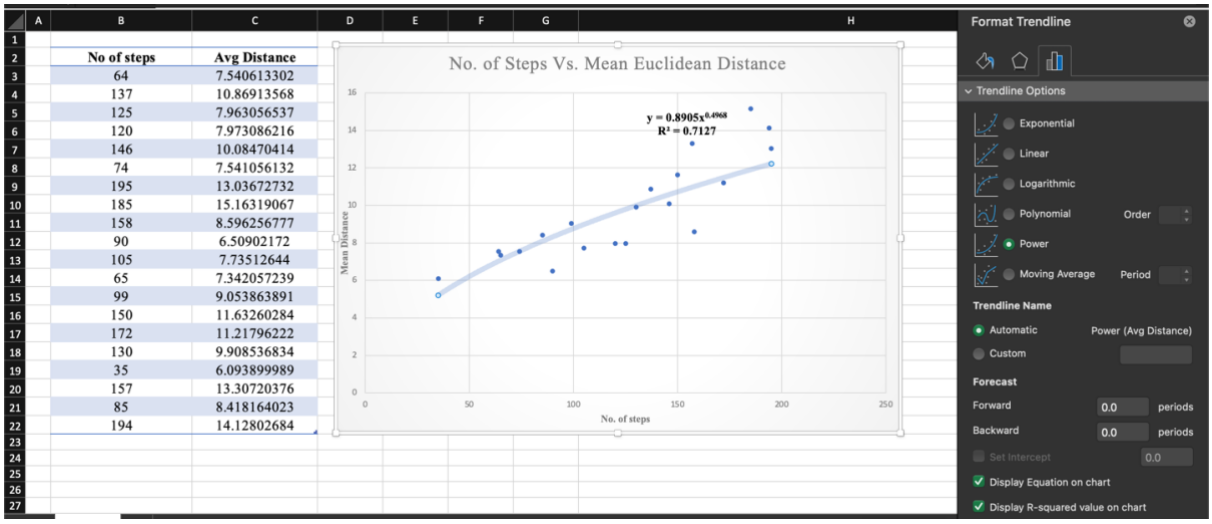
- Scatter graph below plots the no of steps (m) along X-axis and mean distance (d) along Y-axis.
- We use excel tool to deduce the mathematical relationship between m and d from the given data.
- Among the different mathematical functions, the power function is highly correlated with the input data points and yields high R^2 value as below:

  $$d = 0.8905\ (m^{0.4968})$$

  which can be simplified further as,

  $$d = 0.8905\ (m^{0.5}) = 0.8905\ (m^{\frac{1}{2}}) = 0.8905\ \sqrt{m}\ \approx \sqrt{m}$$

- Thus, Euclidian distance is proportional to square root of number of steps.



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Unit Test Screenshots: