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**Program Structures & Algorithms**

**Fall 2021**

**Assignment 1**

**Tasks:**

1. Conclusion about the relationship between d and n;
2. Evidence to support that relationship (screen shot and/or graph and/or spreadsheet);
3. Code Output (RandomWalk.java)
4. A screen shot of the unit tests all passing.

**Task 1: Conclusion about the relationship between d & N**

If d is the Euclidean distance of the man after moving *n* random steps from the lamp-post. The relationship between them can be deduced as follows:

If, d = a1 + a2 + a3 + … + aN

where a1,a2,a3… aN denote the distance travelled at each step.

d2 = (a1 + a2 + a3 + … + aN)2

Considering the average on both sides using the symbol <> to denote the average when the experiment is done repeatedly.

<d2> = <(a1 + a2 + a3 + ….. + aN)2>

<d2> = <(a1 + a2 + a3 + ... + aN) (a1 + a2 + a3 + ... + aN)>

= (<a12> + <a22> + <a32> + ... + <aN2>) + 2 (<a1a2> + <a1a3> +

...<a1aN> + <a2a3> + ... <a2aN> + ...)

Since a1a2 can be either +1 or -1, upon repeating the experiment multiple times the average <a1a2> = 0, the same applies for all the other terms with two steps.

Hence,

<d2> = ( 1 + 1 + 1 + …… + 1) + 2 (0 + 0 + 0 + ….. + 0 ) = N

<d2> = N

√<d2> = √N

Hence concluding,

D = √N

**Task 2: Evidence to support that relationship**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Value of m** | **Value of d** | **Value of n** |
| **1** | **5** | **2.015839436** | **500** |
| **2** | **10** | **2.875623137** | **500** |
| **3** | **15** | **3.50249343** | **500** |
| **4** | **20** | **4.427239** | **500** |
| **5** | **25** | **4.656317893** | **500** |
| **6** | **50** | **6.107206377** | **500** |

**Graphical user interface, text

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**Task 3:** Code Output (RandomWalk.java)

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**Task 4:** Screen shot of the unit tests all passing.

**Text

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