1 (class Assignment)

- Prince Singh Tomar
- 2019101021

P_MEETING :

Calculated Formula : ${}^{2N}C_N/2^{2N}$

Sol:
Consider Left move as "-1" and right move as "+1" . Now For both the drunkers to meet they must have same number of "+1" and hence same number of "-1" as number of moves are N.
so Total moves are 2N .
let 1st drunker has x number of "+1" so it will have N-x number of "-1".
Possible ways = ${}^{N}C_X$
Total Ways = 2^N, So
$P(x) = {}^{N}c_x/2^N$
Now since they both drukers movement is independent of each other,
P(having x number of "+1") = P(x)*P(x).
and we know that x = 0,1,2 … N.

So P(of meeting of drunkers) = $P(0)^2 + P(1)^2 \dots + P(N)^2$.

Which Comes out to be ${}^{2N}C_N/2^{2N}$.

MEAN_DISPLACEMENT :

Calculated Formula : 0

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Sol:
Let $<S>$ be the mean displacement over many experiments performed, which is equal to sum of all moves, so :
$<S> = <A_1 + A_2 + \ldots + A_N>$
which further can be written as :
$<S> = <A_1> + <A_2> + \ldots + <A_N>$;
$<A_i>$ is the mean of i^{th} move, because if we repeated the experiment many many times, and A_1 has an equal probability of being “-1” or “+1”,hence we expect the average of A_1 to be 0 i.e. stays at the same place.
Hence
$<S> = 0 + 0 + \ldots + 0 = 0$

P_ORIGIN :

Calculated Formula : ${}^{N}C_{N/2}/2^{N}$; if N is even
0 ; if N is odd

Sol :
Consider forward walk as “+1” and backward walk as “-1”.
Now for the drunker to come back to Origin. Total Forward moves should equal to Total Backward moves i.e.
number of “+1” = number of “-1” -(i)
Case I : N is odd

Here N/2 != 0 , here eq (I) can not be satisfied so
Favorable cases = 0, hence
P(origin) = 0.

Case II : N is even

Favorable cases = ${}^{N}C_{N/2}$ (distributing N/2 “+1” over N blanks)
Total cases = 2^{N}

Hence,

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P(origin) = $^{N}C_{N/2}/2^{N}$; if N is even
0 ; if N is odd

MEAN_SQ_DISPLACEMENT:

Calculated Formula : N

Sol:
Just like the mean Displacement we have -
Consider Left move as “-1” and right move as “+1” and the path on the number line with drunker starting at origin. Using this it will be a lot easier to solve.
$<S^2>$ is the mean squared displacement over a large number of experiments. $a_1, a_2 \dots a_N$ are the moves taken by drunker.
$<a_i>$ represents mean of i^{th} move over all the experiments.
So,
$<S^2> = <(a_1 + a_2 + \dots + a_N)^2> = <(a_1 + a_2 + \dots + a_N)(a_1 + a_2 + \dots + a_N)> = (<a_1a_1> + <a_2a_2> + \dots <a_Na_N>) + 2(<a_1a_2> + <a_1a_3> + \dots)$

$<S^2> = (<a_1^2> + <a_2^2> + \dots + <a_N^2>) + 2(<a_1a_2> + <a_2a_3> + \dots) = (1 + 1 + 1 + \dots + 1) + 2(0 + 0 + \dots) = N$

Since $<a_1a_2>$ these terms will be zero but $<a_i^2>$ will be 1.
$<a_1a_2>$ is “+1” or “-1” with same probability i.e. ½.

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a_1	a_2	a_1a_2
1	1	1
1	-1	-1
-1	1	-1
-1	-1	1