Random Walk

File: *RandomWalk.nb*

Show the path and distance of last position from first

```
(* determine points of path *)
SeedRandom[]
x = x0 = 0;
y = y0 = 0;
n = 25; (* number of steps *)
lst = {{0, 0}};
Do[
 If[Random[Integer] == 0, x++, x--];
 If[Random[Integer] == 0, y++, y--];
 lst = Append[lst, {x, y}],
 {n}]

(* display points in blue *)
lp1 = ListPlot[lst,
   AxesOrigin → {0, 0},
    PlotStyle → {PointSize[0.03], RGBColor[0, 0, 1]},
   DisplayFunction → Identity];

(* plot lines connecting points *)
lp2 = ListPlot[lst,
   AxesOrigin → {0, 0},
   PlotJoined → True,      (* connect the dots *)
   DisplayFunction → Identity];

(* display first and last points in larger in blue *)
lastPoint = ListPlot[{{0, 0}, {x, y}},
   AxesOrigin → {0, 0},
    PlotStyle → {PointSize[0.04], RGBColor[0, 0, 1]},
   DisplayFunction → Identity];

(* show points and lines of path *)
Show[{lp1, lp2, lastPoint},
  DisplayFunction → $DisplayFunction
 ];

(* distance between first and last points *)
√((x - x0)^2 + (y - y0)^2) // N
```

Average over many runs to find average distance between first and last points

```
(* set up *)
SeedRandom[]
numTests = 100;  (* number of runs *)
x0 = 0;
y0 = 0;
n = 25;       (* number of steps  *)
sumDist = 0; (* sum of distances *)

(* generate numTests number of random paths *)
Do[
  x = x0;
  y = y0;

  (* generate a random path *)
  Do[
   If [Random[Integer] == 0, x++, x--];
   If [Random[Integer] == 0, y++, y--],
   {n}];

  (* distance between first and last points *)
  sumDist += Sqrt[(x - x0)^2 + (y - y0)^2],
  {numTests}];

(* average distance between first and last points *)
N[sumDist / numTests]
```

Generate list of average distances in *n* steps, where *n* varies from 1 to 50

```
(* set up *)
SeedRandom[]
numTests = 100; (* number of runs *)
x0 = 0;
y0 = 0;
Clear[n]        (* n is number of steps *)
listDist = {}; (* list of distances *)

(* travel n steps for n from 1 to 50 *)
Do[

 (* generate numTests random paths of n steps each *)
 sumDist = 0;
 Do[
  x = x0;
  y = y0;

  (* generate a random path *)
  Do[
   If[Random[Integer] == 0, x++, x--];
   If[Random[Integer] == 0, y++, y--],
   {n}];

  (* distance between first and last points *)
  sumDist += Sqrt[(x - x0)^2 + (y - y0)^2],
  {numTests}];

 (* append average distance traveled in n steps *)
 listDist = Append[listDist, N[sumDist / numTests]],
 {n, 50}]

(* return list of distances *)
listDist
```

Determine the relationship of distance to *n*, the number of steps by discovering an empirical model to fit the data.

```
lp = ListPlot[listDist, AxesLabel → {"n", "avg. dist."}];
```