Tutorübung am 05.07.2011 - Mathematik für das Studium Naturale, SS2011
Blatt 19: Brownsche Bewegung, Autoren: Gero Friesecke, Dominik Jüstel

```
with(plots):
with(Statistics):
with(RandomTools[MersenneTwister]):
```

Initialisierung
(T = 30, Samples = 500, h = 0.1)

```
T := 30;
Samples := 500;
h := 0.1;
N := floor(T/h);
s := sqrt(h):
```

$$30$$
$$500$$
$$0.1$$
$$300 \qquad \textbf{(1)}$$

Berechnung der zufälligen Richtung für jedes Sample und jeden Zeitpunkt

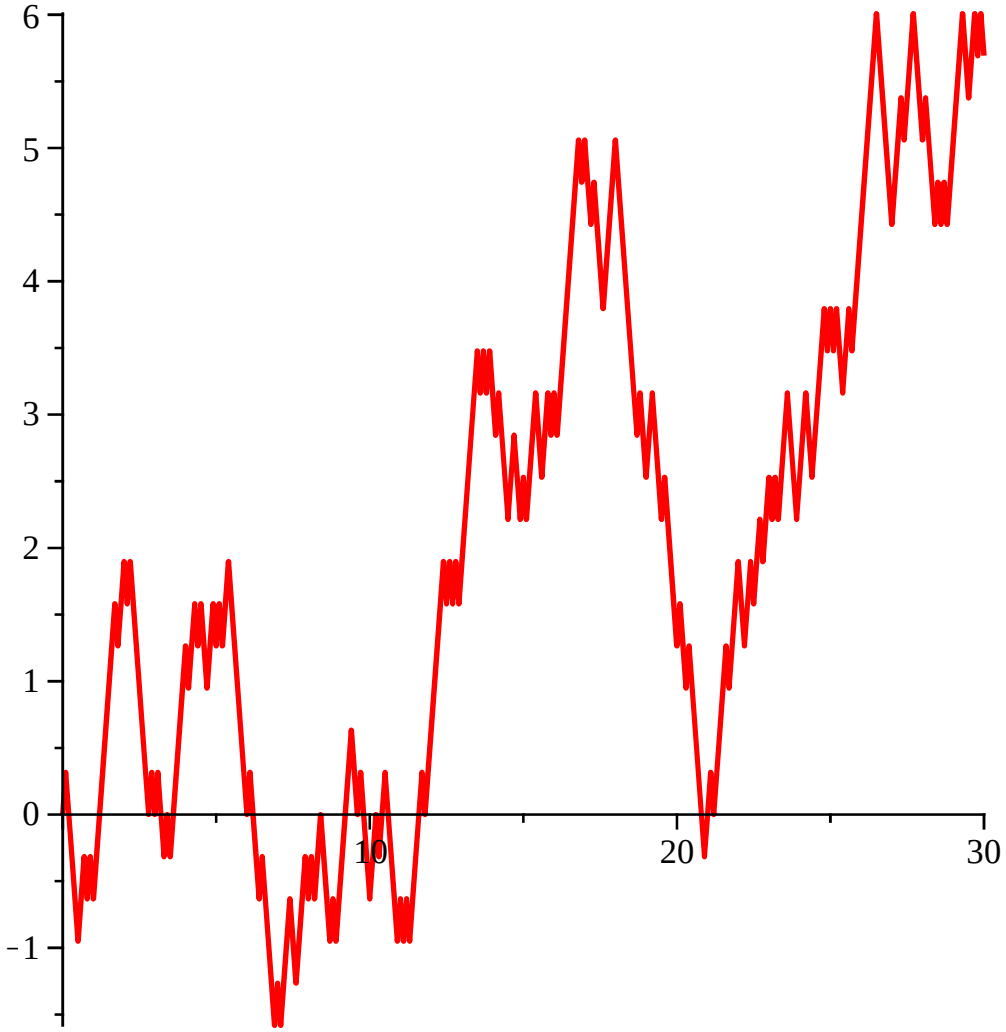
```
RX := array(1..Samples, 0..N):
for i from 1 to Samples do
  R := [seq(GenerateInteger(range = 0..1), j = 1..N)]:
  for j from 1 to N do
    RX[i, j] := R[j]:
  end:
end:
```

Berechnung der Positionen des Teilchens für jedes Sample und jeden Zeitpunkt

```
X := array(1..Samples, 0..N):
for i from 1 to Samples do
  X[i, 0] := 0:
  for j from 1 to N do
    X[i, j] := X[i, j - 1] + s·(2·RX[i, j] - 1):
  end:
end:
```

Plot der Ortskurve des ersten Samples

```
Tlist := [seq(h·(k - 1), k = 1..N + 1)]:
plot(Tlist, [seq(X[1, j], j = 0..N)], thickness = 2);
```

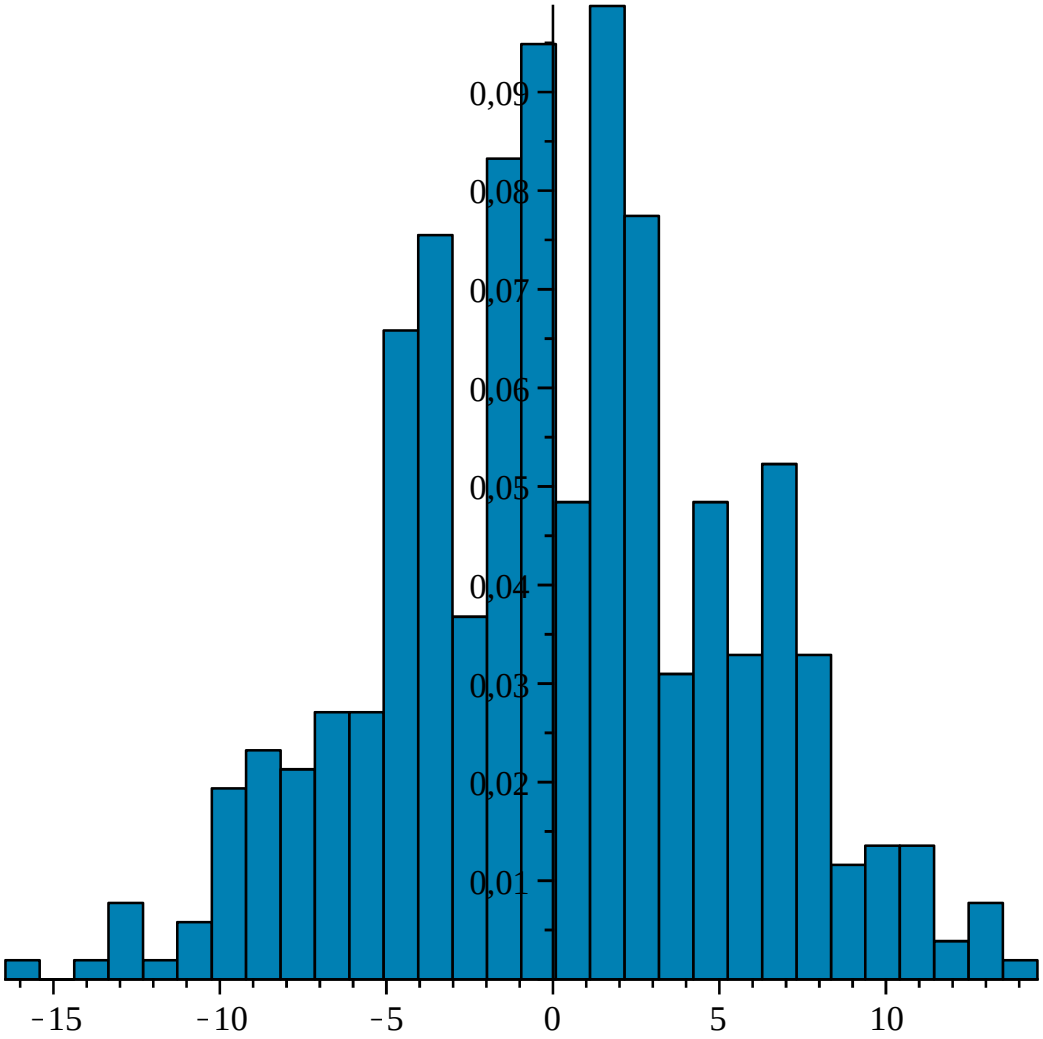


Auslesen der Positionen zum Zeitpunkt T (Endpunkte)

```
E := array(1..Samples) :
for i from 1 to Samples do
  E[i] := X[i, N] :
end:
```

Plot des Histogramms der Endpunkte

```
Histogram(E);
```

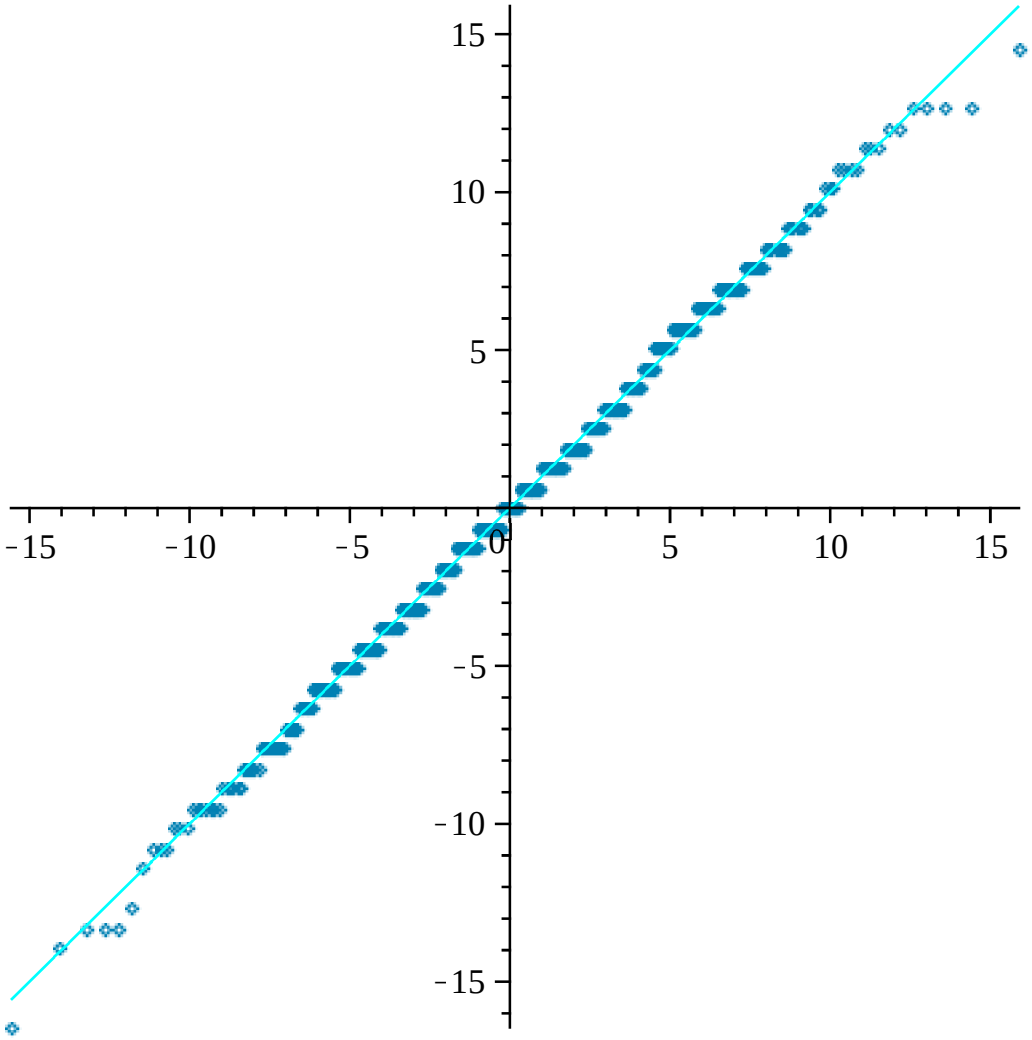


Berechnung von Mittelwert und Standardabweichung von E und Test der Verteilung

$m := Mean(E);$
$s := StandardDeviation(E);$
$ProbabilityPlot(E, Normal(m, s));$

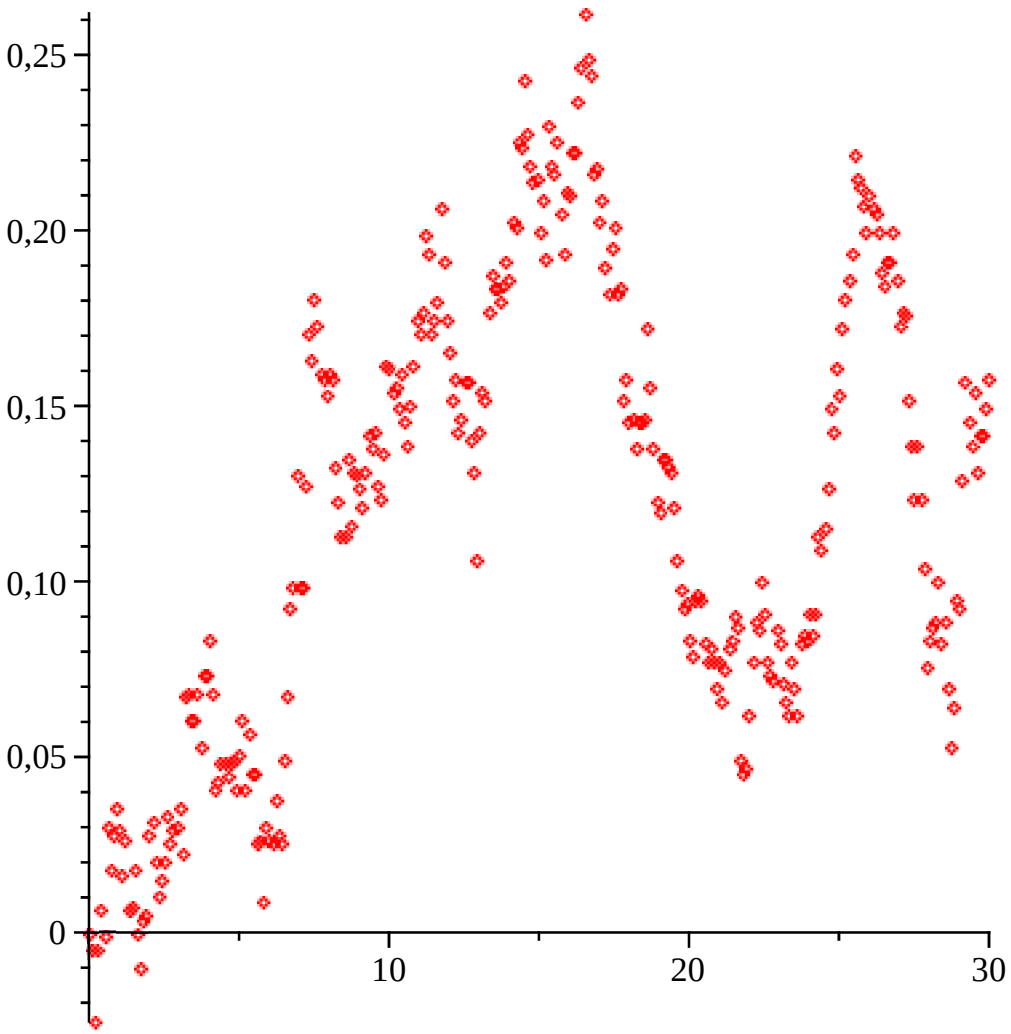
0.1581138830

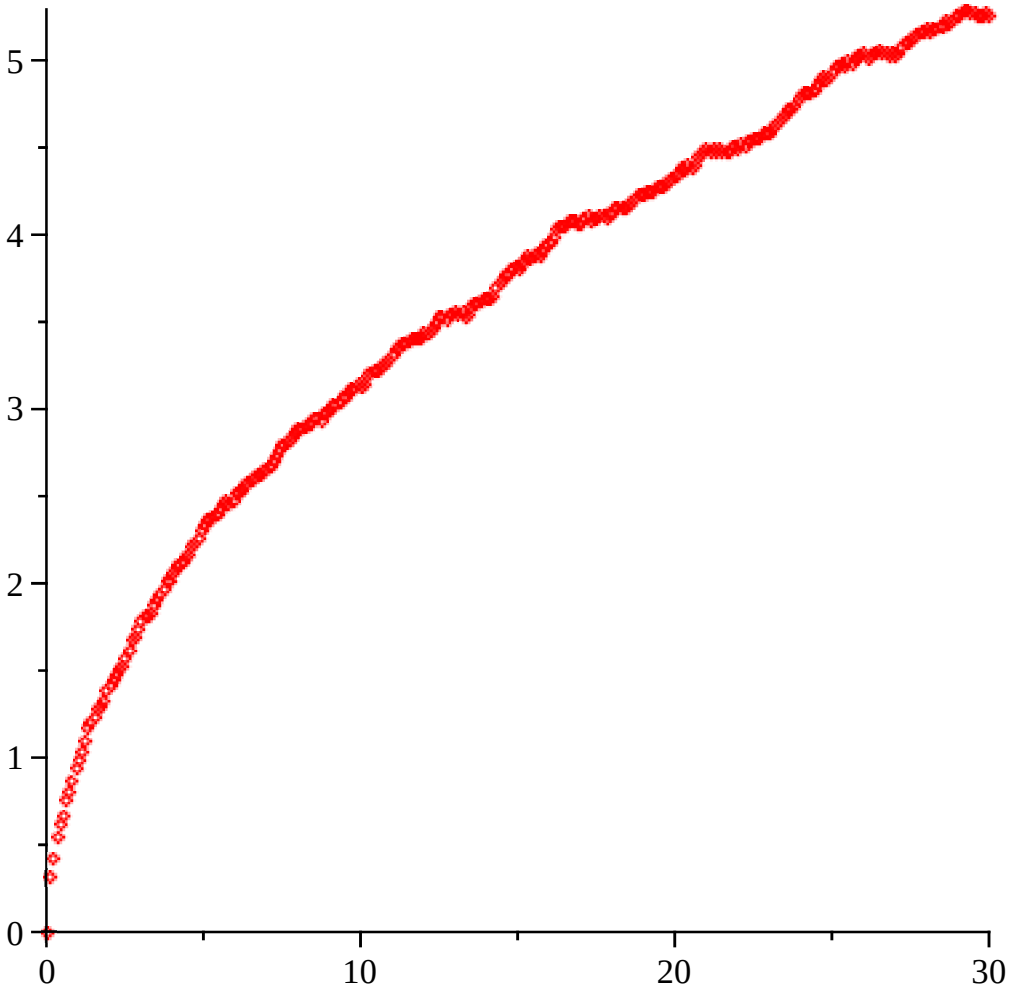
5.259117479



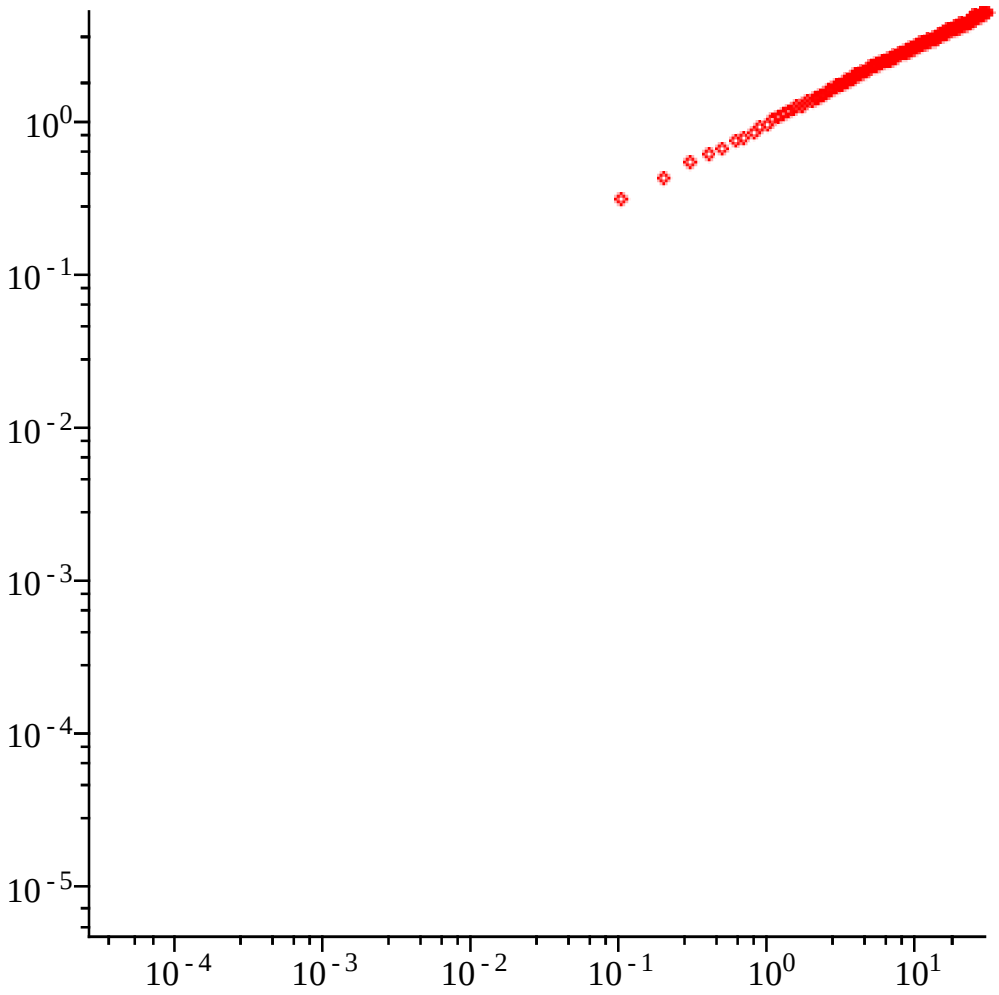
Berechnung der Standardabweichung der Position zu allen Zeitpunkten, Vergleich mit sqrt(t)

```
M := array(0..N):
for j from 0 to N do
   M[j] := Mean([seq(X[i,j], i=1..Samples)]):
end:
 SD := array(0..N):
for j from 0 to N do
   SD[j] := StandardDeviation([seq(X[i,j], i=1..Samples)]):
end:
Mlist := convert(M, listlist):
SDlist := convert(SD, listlist):
plot(Tlist, Mlist, style=point);
plot(Tlist, SDlist, style=point);
```

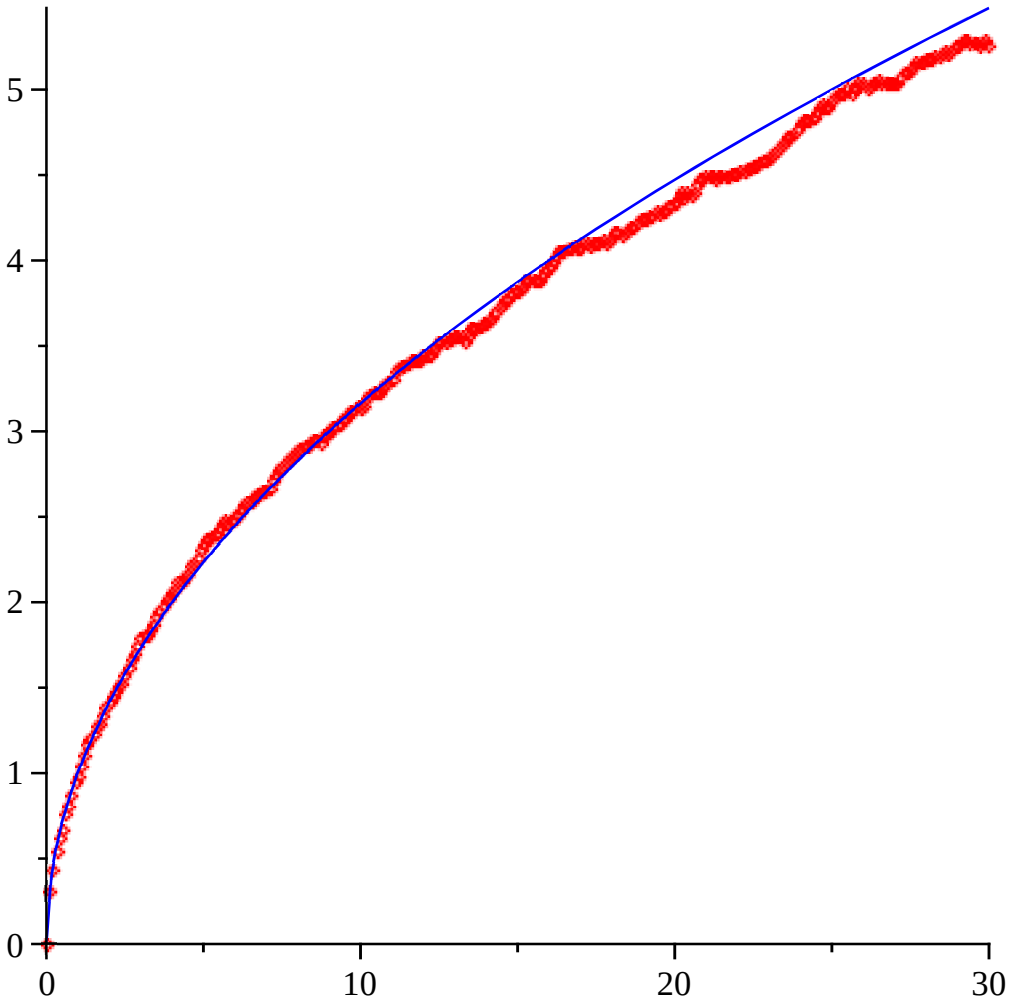

0,25
0,20
0,15
0,10
0,05
0
10
20
30



loglogplot(*Tlist, SDlist, style* = *point, thickness* = 2);



P1 := *plot*(*Tlist*, *SDlist*, *thickness* = 3, *style* = *point*) :
P2 := *plot*(sqrt(*t*), *t* = 0 ..*T*, *color* = *blue*) :
display(*P1*, *P2*);


5
4
3
2
1
0
0
10
20
30