```
ClearAll["Global`*"]
(* 1.2 problem is the (3.3) in the Book *)
P[x_] := Exp[-m] * m^x / x!
Sum[P[x], {x, 0, Infinity}]
meanx = Sum[x * P[x], {x, 0, Infinity}]
meanx2 = Sum[x^2 * P[x], {x, 0, Infinity}]
sigmax = Sqrt[meanx2 - meanx^2]
```

1

m

$m + m^2$

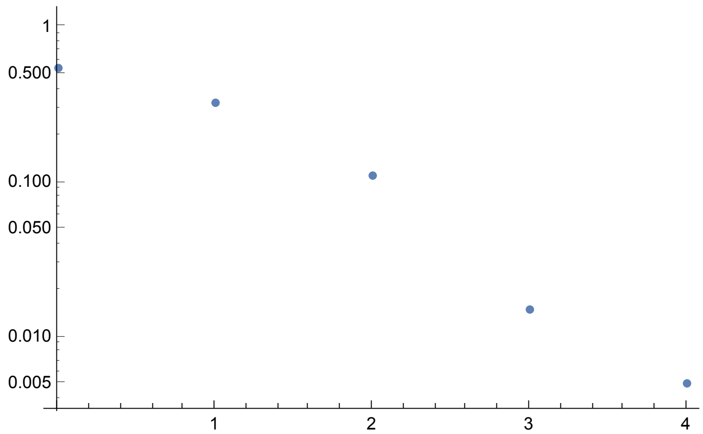
$\sqrt{m}$

```
(* now table of death in Prussian army normalized
  here is a small problem: bins numbered by i=1 to 5
   but deaths d=i-1 and thet are those we want to record
*)
events = {{0, 109. / 200}, {1, 65. / 200}, {2, 22. / 200}, {3, 3. / 200}, {4, 1. / 200}}
```

{{0, 0.545}, {1, 0.325}, {2, 0.11}, {3, 0.015}, {4, 0.005}}

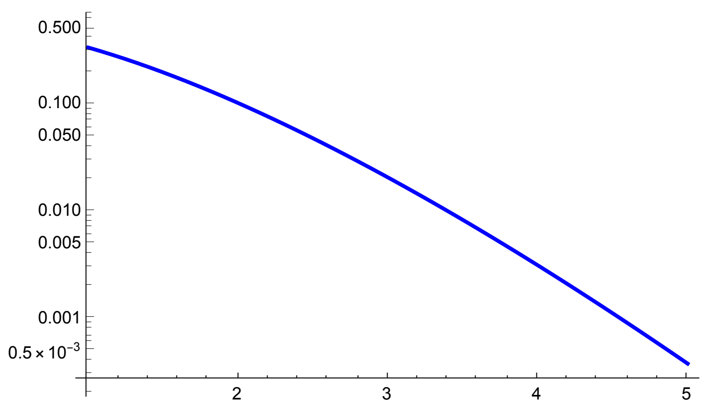
```
total = Sum[events[[i, 2]], {i, 1, 5}]
P[i_] := events[[i, 2]]
d = i - 1
Sum[P[i], {i, 1, 5}]
pevents = ListLogPlot[events]
meand = Sum[1. * d * P[i], {i, 1, 5}]
meand2 = Sum[1. * d^2 * P[i], {i, 1, 5}]
sigma = Sqrt[meand2 - meand^2]
```

```
1.
-1 + i
1.
```

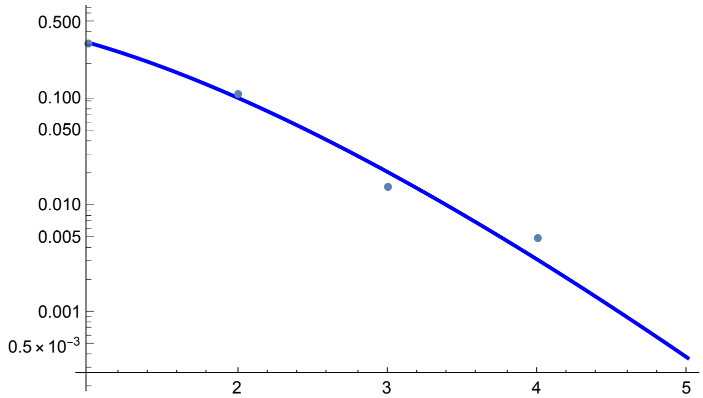



```
0.61
0.98
0.779679
```

```
poisson = LogPlot[Exp[-meand] * meand^i / i!, {i, 1, 5}, PlotStyle → {Blue, Thick}]
```



```
Show[poisson, pevents]
```




```
(* 1.5 the rubber problem *)
ClearAll["Global`*"]
Prob[nplus_, nminus_, n_] := (n!) / (nplus!) / (nminus!)

Solve[{X == (nplus - nminus) a, n == nplus + nminus}, {nplus, nminus}]
```

$$\left\{\left\{nplus \to -\frac{-a\,n - X}{2\,a},\ nminus \to -\frac{-a\,n + X}{2\,a}\right\}\right\}$$

```
(* only the leading term sterling used *)


LogSterling[n_] := n * Log[n] - n
```

$$S = \text{Simplify}\left[\text{LogSterling}[n] - \text{LogSterling}\left[-\frac{-a\,n - X}{2\,a}\right] - \text{LogSterling}\left[-\frac{-a\,n + X}{2\,a}\right]\right]$$

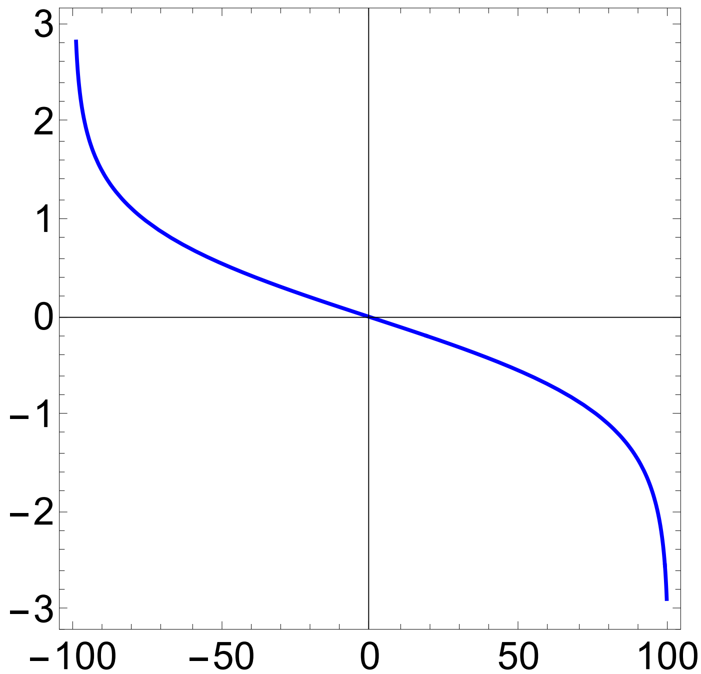
$$\frac{1}{2\,a}\left(a\,n\,\text{Log}[4] + 2\,a\,n\,\text{Log}[n] + (-a\,n + X)\,\text{Log}\left[n - \frac{X}{a}\right] - a\,n\,\text{Log}\left[n + \frac{X}{a}\right] - X\,\text{Log}\left[n + \frac{X}{a}\right]\right)$$

```
(* Note that in the problem the sign in the next line was wrong !
 The next line is derivative of S over X *)

Force = +Simplify[D[S, X]]
```

$$\frac{\text{Log}\left[n - \frac{X}{a}\right] - \text{Log}\left[n + \frac{X}{a}\right]}{2\,a}$$

```
Plot[Force /. {a → 1, n → 100}, {X, -100, 100}, PlotStyle → {Blue, Thick},
 AspectRatio → 1, Frame → True, LabelStyle → Directive[FontSize → 20]]
```



```
(* this is expansion in X at point 0 to 3-ed order
  (I only need the first) *)

Series[Force, {X, 0, 3}]
```

$$-\frac{X}{a^2 n}-\frac{X^3}{3\left(a^4 n^3\right)}+O[X]^4$$

```
Series[Force, {X, n * a, 3}]
```

$$\frac{\text{Log}\left[-\frac{1}{a}\right]-\text{Log}[2 n]+\text{Log}[-a n+X]}{2 a}-\frac{X-a n}{4\left(a^2 n\right)}+\frac{(X-a n)^2}{16 a^3 n^2}-\frac{(X-a n)^3}{48\left(a^4 n^3\right)}+O[X-a n]^4$$

```
Lesson : Hook ' s law of linear force at small X is entropic.
   A fight with entropy to reach full strech gets diverent (large)  force
```