Lösungen / Statistik 2/01

```
Remove["Global`*"]
```

1.

```
<< Statistics`DiscreteDistributions`
```

▪ a Kurs / Script

▪ b

```
berdist = BernoulliDistribution[0.3]
```

```
BernoulliDistribution[0.3]
```

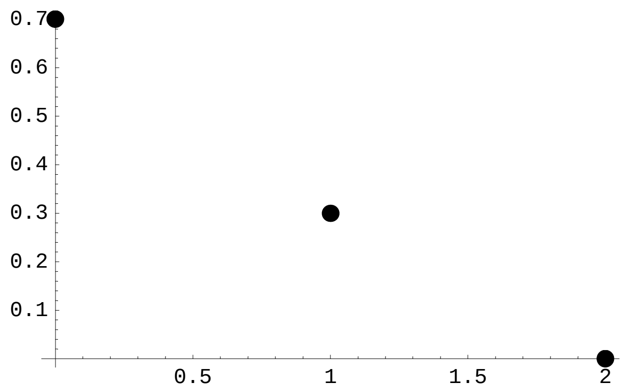
```
PDF[berdist, x]
```

$$\begin{cases} 0.7 & x == 0 \\ 0.3 & x == 1 \end{cases}$$

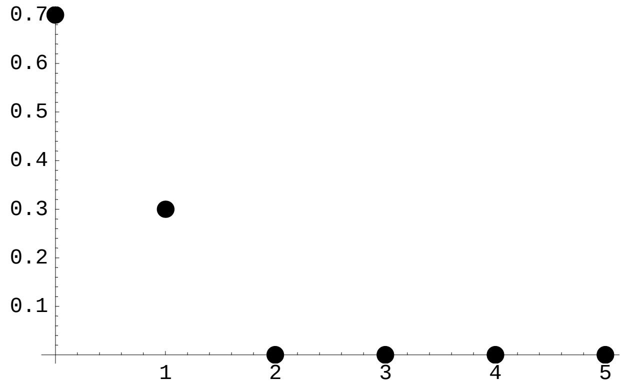
```
f[x_] := PDF[berdist, x]; f[z]
```

$$\begin{cases} 0.7 & z == 0 \\ 0.3 & z == 1 \end{cases}$$

```
ListPlot[Table[{x, f[x]}, {x, 0, 2}], PlotStyle → {PointSize[0.03]}];
```



```
ListPlot[Table[{x, PDF[berdist, x]}, {x, 0, 5}], PlotStyle → {PointSize[0.03]}];
```



■ c

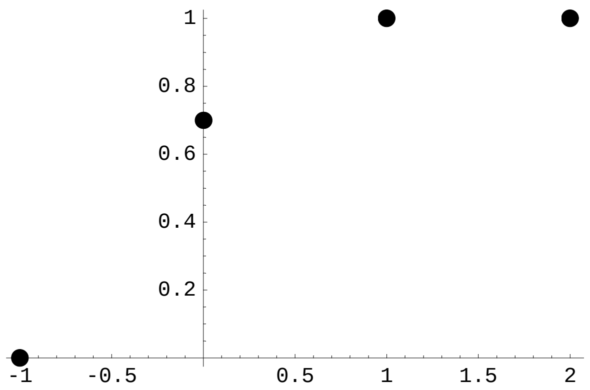
```
CDF[berdist, x]
```

$$\begin{cases} 0.7 & 0 \le x < 1 \\ 1 & x \ge 1 \end{cases}$$

```
{CDF[berdist, -1], CDF[berdist, 0], CDF[berdist, 1], CDF[berdist, 2]}
```

{0, 0.7, 1, 1}

```
ListPlot[Table[{x, CDF[berdist, x]}, {x, -1, 2}], PlotStyle → {PointSize[0.03]}];
```



■ d

```
Mean[berdist]
```

0.3

```
Mean[BernoulliDistribution[q]]
```

q

```
Variance[BernoulliDistribution[0.3]]
```

0.21

```
Variance[BernoulliDistribution[q]]
```

$(1-q)\,q$

```
StandardDeviation[BernoulliDistribution[0.3]]
```

0.458258

```
StandardDeviation[BernoulliDistribution[q]]
```

$\sqrt{(1-q)\,q}$

```
Quantile[berdist, 0.5]
```

0

```
Quantile[berdist, 0]
```

0

```
Quantile[berdist, 0.7]
```

0

```
Quantile[berdist, 0.75]
```

1

```
Quantile[berdist, 1]
```

1

```
Quantile[berdist, 2]
```

Quantile::frac : Quantile specification 2 is expected to be between 0 and 1.

Quantile[BernoulliDistribution[0.3], 2]

2.

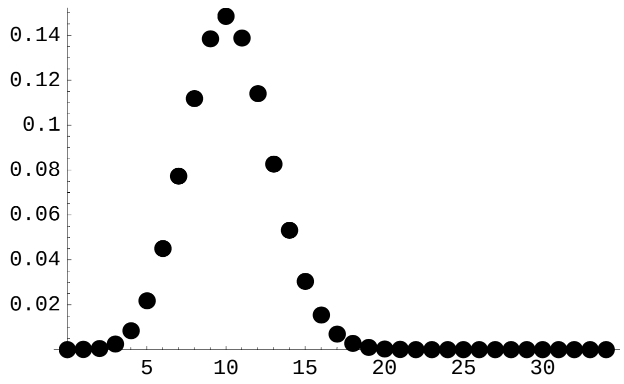
```
bdist = BinomialDistribution[34, 0.3]
```

BinomialDistribution[34, 0.3]

```
PDF[bdist, x]
```

$0.3^{x}\,0.7^{34-x}$ Binomial[34, x]

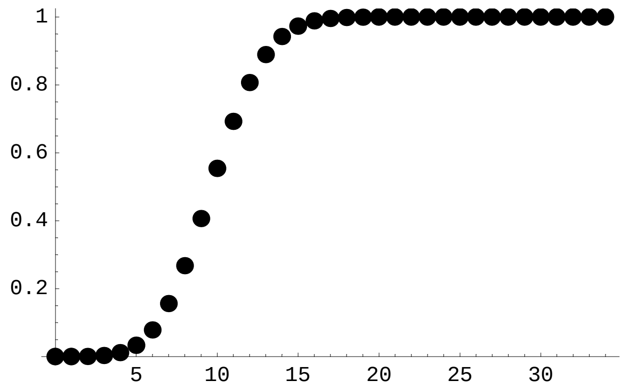
```
ListPlot[Table[{x, PDF[bdist, x]}, {x, 0, 34}], PlotStyle → {PointSize[0.03]}];
```




```
CDF[bdist, x]
```

```
BetaRegularized[0.7, 34 - Floor[x], 1 + Floor[x]]
```

```
ListPlot[Table[{x, CDF[bdist, x]}, {x, 0, 34}], PlotStyle → {PointSize[0.03]}];
```




```
Mean[bdist]
```

```
10.2
```

```
Mean[BinomialDistribution[n, p]]
```

```
n p
```

```
Variance[bdist]
```

```
7.14
```

```
Variance[BinomialDistribution[n, p]]
```

```
n (1 - p) p
```

```
StandardDeviation[bdist]
```

```
2.67208
```

```
StandardDeviation[BinomialDistribution[n, p]]
```

$\sqrt{n\,(1-p)\,p}$

```
Quantile[bdist, 0.5]
```

```
10
```

```
ExpectedValue[x^3, bdist, x]
```

```
1282.55
```

```
RandomArray[bdist, {2, 3}]
```

```
{{16, 14, 16}, {10, 9, 9}}
```

3.

```
P = Sum[ Binomial[10, k] (4 / 32) ^k (1 - 4 / 32) ^ (10 - k), {k, 6, 10}]
```

$$\frac{273823}{536870912}$$

```
N[%]
```

```
0.000510035
```

```
bdist3 = BinomialDistribution[10, 4 / 32]
```

$\text{BinomialDistribution}\left[10, \frac{1}{8}\right]$

```
1 - CDF[bdist3, 5]
```

$1 - \text{BetaRegularized}\left[\frac{7}{8}, 5, 6\right]$

```
N[%]
```

```
0.000510035
```

4.

▪ a

```
p = 0.5;
P = Sum[ Binomial[120, k] (0.5) ^k (1 - 0.5) ^ (120 - k), {k, 50, 120}]
```

```
0.97261
```

```
bdist4 = BinomialDistribution[120, 0.5];
1 - CDF[bdist4, 49]
```

```
0.97261
```

▪ b

```
p = 0.5;
P = Sum[ Binomial[120, k] (0.5) ^k (1 - 0.5) ^ (120 - k), {k, 0, 60}]
```

```
0.536342
```

```
bdist4 = BinomialDistribution[120, 0.5];
CDF[bdist4, 60]
```

0.536342

```
bdist4 = BinomialDistribution[120, 0.5];
CDF[bdist4, 50]
```

0.0412037

5.

```
P = Sum[ Binomial[10, k] (5 / 60) ^k (1 - 5 / 60) ^ (10 - k), {k, 0, 3}]
```

$$\frac{5125125973}{5159780352}$$

```
N[%]
```

0.993284

```
bdist5 = BinomialDistribution[10, 5 / 60];
CDF[bdist5, 3]
```

$\text{BetaRegularized}\left[\frac{11}{12}, 7, 4\right]$

```
N[%]
```

0.993284

```
Sum[ Binomial[10, k] (5 / 60) ^k (1 - 5 / 60) ^ (10 - k), {k, 4, 10}] // N
```

0.00671625

Chance, dass mindestens 4 das Gerät brauchen ist klein!

```
Sum[ Binomial[10, k] (5 / 60) ^k (1 - 5 / 60) ^ (10 - k), {k, 0, 2}] // N
```

0.955516

```
Sum[ Binomial[10, k] (5 / 60) ^k (1 - 5 / 60) ^ (10 - k), {k, 0, 1}] // N
```

0.799726

```
Sum[ Binomial[10, k] (5 / 60) ^k (1 - 5 / 60) ^ (10 - k), {k, 0, 0}] // N
```

0.418904

6.

■ Alles

```
a = 104.36; Δa = 0.02;
b = 96.28; Δb = 0.02;
γ = (52 + 12 / 60) Degree; Δγ = 10 / 60 Degree;
c[a_, b_, γ_] := Sqrt[a^2 + b^2 - 2 a b Cos[γ]]
```

```
c[a, b, γ]
```

```
88.5671
```

```
Δc = (Abs[D[c[a1, b1, γ1], a1]] Δa + Abs[D[c[a1, b1, γ1], b1]] Δb +
    Abs[D[c[a1, b1, γ1], γ1]] Δγ) /. {a1 → a, b1 → b, γ1 → γ}
```

```
0.278295
```

■ Einzelteile

```
(Abs[D[c[a1, b1, γ1], a1]] Δa +
  Abs[D[c[a1, b1, γ1], b1]] Δb + Abs[D[c[a1, b1, γ1], γ1]] Δγ)
```

$$0.01\,\mathrm{Abs}\left[\frac{2\,b1 - 2\,a1\,\mathrm{Cos}[\gamma1]}{\sqrt{a1^2 + b1^2 - 2\,a1\,b1\,\mathrm{Cos}[\gamma1]}}\right] + 0.01\,\mathrm{Abs}\left[\frac{2\,a1 - 2\,b1\,\mathrm{Cos}[\gamma1]}{\sqrt{a1^2 + b1^2 - 2\,a1\,b1\,\mathrm{Cos}[\gamma1]}}\right] + \frac{1}{6}\,{}^\circ\,\mathrm{Abs}\left[\frac{a1\,b1\,\mathrm{Sin}[\gamma1]}{\sqrt{a1^2 + b1^2 - 2\,a1\,b1\,\mathrm{Cos}[\gamma1]}}\right]$$

```
(Abs[D[c[a1, b1, γ1], a1]] Δa ) /. {a1 → a, b1 → b, γ1 → γ}
```

```
0.0102407
```

```
(Abs[D[c[a1, b1, γ1], b1]] Δb ) /. {a1 → a, b1 → b, γ1 → γ}
```

```
0.00729775
```

```
( Abs[D[c[a1, b1, γ1], γ1]] Δγ) /. {a1 → a, b1 → b, γ1 → γ}
```

```
0.260757
```

Der Hauptteil des Fehlers kommt von γ !