Lösungen / Statistik 1/14

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

1.

```
<< Graphics`Graphics`
```

```
<< Statistics`DescriptiveStatistics`
```

```
tb = {{153, 1}, {154, 1}, {155, 2}, {156, 3}, {157, 3},
  {158, 5}, {159, 6}, {160, 4}, {161, 5}, {162, 7}, {163, 5}, {164, 5},
  {165, 6}, {166, 7}, {167, 5}, {168, 5}, {169, 6}, {170, 5}, {171, 6},
  {172, 4}, {173, 3}, {174, 2}, {175, 3}, {176, 1}, {177, 1}, {178, 1}}
```

```
{{153, 1}, {154, 1}, {155, 2}, {156, 3}, {157, 3}, {158, 5}, {159, 6}, {160, 4}, {161, 5},
 {162, 7}, {163, 5}, {164, 5}, {165, 6}, {166, 7}, {167, 5}, {168, 5}, {169, 6}, {170, 5},
 {171, 6}, {172, 4}, {173, 3}, {174, 2}, {175, 3}, {176, 1}, {177, 1}, {178, 1}}
```

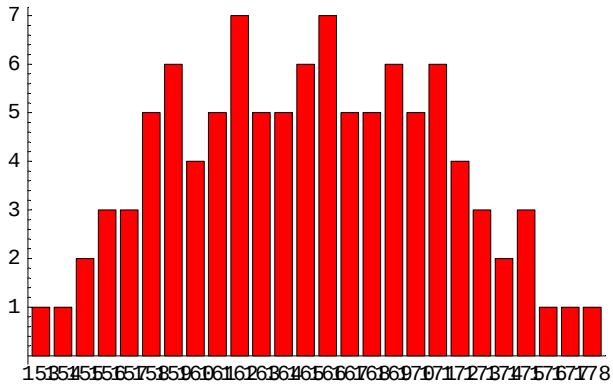
```
s = Sum[tb[[n]][[2]], {n, 1, Length[tb]}]
```

```
102
```

```
tb1 = Table[{tb[[k]][[2]], tb[[k]][[1]]}, {k, 1, Length[tb]}]
```

```
{{1, 153}, {1, 154}, {2, 155}, {3, 156}, {3, 157}, {5, 158}, {6, 159}, {4, 160}, {5, 161},
 {7, 162}, {5, 163}, {5, 164}, {6, 165}, {7, 166}, {5, 167}, {5, 168}, {6, 169}, {5, 170},
 {6, 171}, {4, 172}, {3, 173}, {2, 174}, {3, 175}, {1, 176}, {1, 177}, {1, 178}}
```

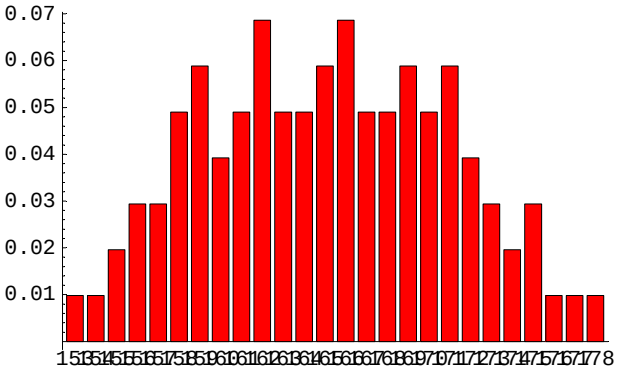
```
BarChart[tb1];
```



```
tb2 = Table[{tb[[k]][[2]] / s // N, tb[[k]][[1]]}, {k, 1, Length[tb]}]
```

```
{{0.00980392, 153}, {0.00980392, 154}, {0.0196078, 155},
 {0.0294118, 156}, {0.0294118, 157}, {0.0490196, 158}, {0.0588235, 159},
 {0.0392157, 160}, {0.0490196, 161}, {0.0686275, 162}, {0.0490196, 163},
 {0.0490196, 164}, {0.0588235, 165}, {0.0686275, 166}, {0.0490196, 167},
 {0.0490196, 168}, {0.0588235, 169}, {0.0490196, 170}, {0.0588235, 171},
 {0.0392157, 172}, {0.0294118, 173}, {0.0196078, 174}, {0.0294118, 175},
 {0.00980392, 176}, {0.00980392, 177}, {0.00980392, 178}}
```

```
BarChart[tb2];
```




```
Remove[p]
```

```
p[n_] := 0;
p[n_] := tb2[[n]][[1]] /; IntegerQ[n] && 0 < n < 178 - 152
```

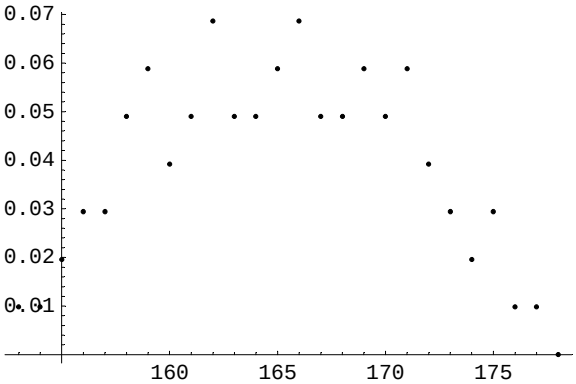
```
{p[0], p[0.5], p[1], p[2], p[3.1]}
```

```
{0, 0, 0.00980392, 0.00980392, 0}
```

```
plotTab = Table[{tb2[[n]][[2]], p[n]}, {n, 1, Length[tb2]}]
```

```
{{153, 0.00980392}, {154, 0.00980392}, {155, 0.0196078},
 {156, 0.0294118}, {157, 0.0294118}, {158, 0.0490196},
 {159, 0.0588235}, {160, 0.0392157}, {161, 0.0490196}, {162, 0.0686275},
 {163, 0.0490196}, {164, 0.0490196}, {165, 0.0588235}, {166, 0.0686275},
 {167, 0.0490196}, {168, 0.0490196}, {169, 0.0588235}, {170, 0.0490196},
 {171, 0.0588235}, {172, 0.0392157}, {173, 0.0294118}, {174, 0.0196078},
 {175, 0.0294118}, {176, 0.00980392}, {177, 0.00980392}, {178, 0}}
```

```
ListPlot[plotTab];
```

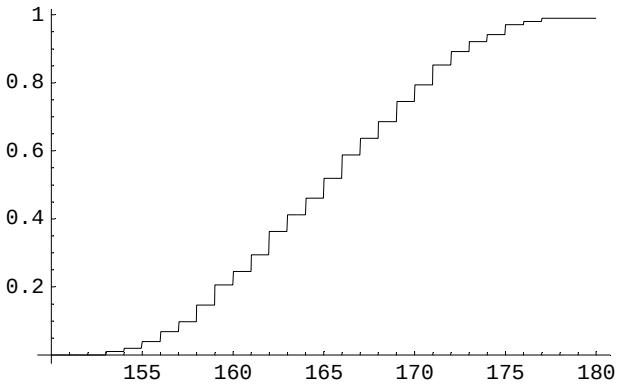



```
Remove[F]
```

```
F[x_] := 0;
F[x_] := Sum[p[n - 152], {n, 153, Floor[x]}] /; Floor[x] > 152

{F[-1], F[1], F[152], F[153], F[154], F[200]}
```

```
{0, 0, 0, 0.00980392, 0.0196078, 0.990196}
```

```
Plot[F[x], {x, 150, 180}];
```



2.

```
Remove[u, v, w]

tab21 = Table[u + v + w, {u, 1, 6}, {v, 1, 6}, {w, 1, 6}] // Flatten
```

```
{3, 4, 5, 6, 7, 8, 4, 5, 6, 7, 8, 9, 5, 6, 7, 8, 9, 10, 6, 7, 8, 9, 10, 11, 7, 8, 9, 10, 11,
 12, 8, 9, 10, 11, 12, 13, 4, 5, 6, 7, 8, 9, 5, 6, 7, 8, 9, 10, 6, 7, 8, 9, 10, 11, 7, 8,
 9, 10, 11, 12, 8, 9, 10, 11, 12, 13, 9, 10, 11, 12, 13, 14, 5, 6, 7, 8, 9, 10, 6, 7, 8,
 9, 10, 11, 7, 8, 9, 10, 11, 12, 8, 9, 10, 11, 12, 13, 9, 10, 11, 12, 13, 14, 10, 11,
 12, 13, 14, 15, 6, 7, 8, 9, 10, 11, 7, 8, 9, 10, 11, 12, 8, 9, 10, 11, 12, 13, 9, 10,
 11, 12, 13, 14, 10, 11, 12, 13, 14, 15, 11, 12, 13, 14, 15, 16, 7, 8, 9, 10, 11, 12, 8,
 9, 10, 11, 12, 13, 9, 10, 11, 12, 13, 14, 10, 11, 12, 13, 14, 15, 11, 12, 13, 14, 15,
 16, 12, 13, 14, 15, 16, 17, 8, 9, 10, 11, 12, 13, 9, 10, 11, 12, 13, 14, 10, 11, 12,
 13, 14, 15, 11, 12, 13, 14, 15, 16, 12, 13, 14, 15, 16, 17, 13, 14, 15, 16, 17, 18}
```

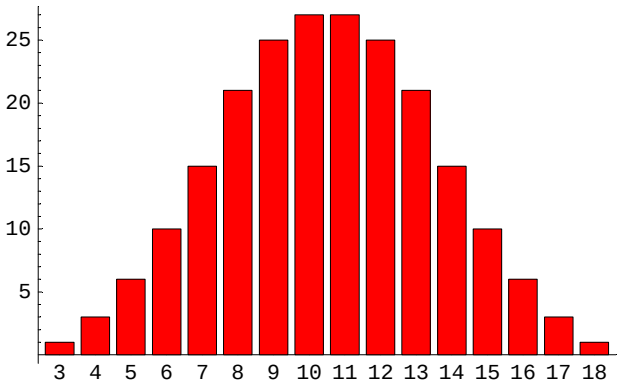
```
<< Statistics`DataManipulation`

freq = Frequencies[tab21]
```

```
{{1, 3}, {3, 4}, {6, 5}, {10, 6}, {15, 7}, {21, 8}, {25, 9}, {27, 10},
 {27, 11}, {25, 12}, {21, 13}, {15, 14}, {10, 15}, {6, 16}, {3, 17}, {1, 18}}
```

```
s = Sum[freq[[n]][[1]], {n, 1, Length[freq]}]
```

```
216
```

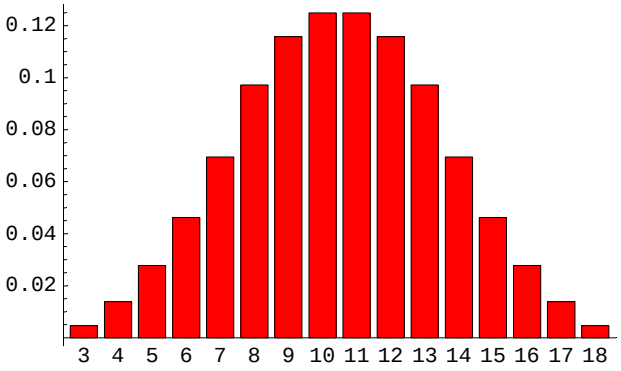
```
BarChart[freq];
```




```
freq2 = Table[{freq[[k]][[1]] / s // N, freq[[k]][[2]]}, {k, 1, Length[freq]}]
```

```
{{0.00462963, 3}, {0.0138889, 4}, {0.0277778, 5}, {0.0462963, 6},
 {0.0694444, 7}, {0.0972222, 8}, {0.115741, 9}, {0.125, 10},
 {0.125, 11}, {0.115741, 12}, {0.0972222, 13}, {0.0694444, 14},
 {0.0462963, 15}, {0.0277778, 16}, {0.0138889, 17}, {0.00462963, 18}}
```

```
BarChart[freq2];
```




```
Remove[p, F]
```

```
p[n_] := 0;
p[n_] := freq2[[n]][[1]] /; IntegerQ[n] && 0 < n < 18 - 2
```

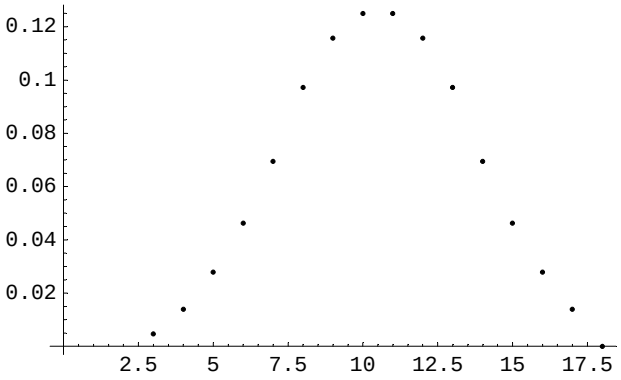
```
{p[0], p[0.5], p[1], p[2], p[3.1]}
```

```
{0, 0, 0.00462963, 0.0138889, 0}
```

```
plotTab = Table[{freq2[[n]][[2]], p[n]}, {n, 1, Length[freq2]}]
```

```
{{3, 0.00462963}, {4, 0.0138889}, {5, 0.0277778}, {6, 0.0462963},
 {7, 0.0694444}, {8, 0.0972222}, {9, 0.115741}, {10, 0.125},
 {11, 0.125}, {12, 0.115741}, {13, 0.0972222}, {14, 0.0694444},
 {15, 0.0462963}, {16, 0.0277778}, {17, 0.0138889}, {18, 0}}
```

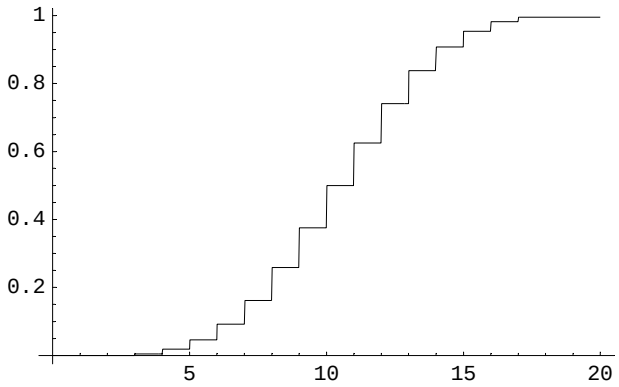
```
ListPlot[plotTab];
```




```
F[x_] := 0;
F[x_] := Sum[p[n - 2], {n, 3, Floor[x]}] /; Floor[x] > 2

{F[-1], F[1], F[2], F[3], F[4], F[200]}
```

```
{0, 0, 0, 0.00462963, 0.0185185, 0.99537}
```

```
Plot[F[x], {x, 0, 20}];
```



3.

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

```
λ = 6;
P[k_] := λ^k / k! E^(-λ) // N;
```

a

```
Table[{k, P[k]}, {k, 0, 20}] // TableForm
```

0	0.00247875
1	0.0148725
2	0.0446175
3	0.0892351
4	0.133853
5	0.160623
6	0.160623
7	0.137677
8	0.103258
9	0.0688385
10	0.0413031
11	0.022529
12	0.0112645
13	0.00519899
14	0.00222814
15	0.000891256
16	0.000334221
17	0.00011796
18	0.0000393201
19	0.0000124169
20	3.72506×10^{-6}

a

```
EW = λ
```

```
6
```

```
StAbw = Sqrt[λ] // N
```

```
2.44949
```

4.

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

```
n = 30; p = 0.2; q = 1 - p;
kk = 10;
```

```
P[k_] := Binomial[n - 1, k - 1] p^(k - 1) q^(n - k) p // N;
```

a

```
P[kk] / p
```

```
0.0591182
```

```
P[kk]
```

```
0.0118236
```

b

```
EW = kk / p
```

```
50.
```

```
StAbw = Sqrt[kk (1 - p) / p^2] // N
```

```
14.1421
```

5.

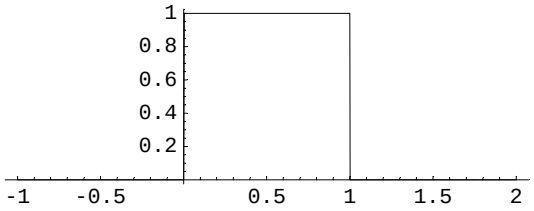
```
Remove["Global`*"]
```

```
a = 0; b = 1; h = 1 / (b - a);
```

```
f[x_] := 0 /; x < a;
f[x_] := h /; (x ≥ a && x ≤ b);
f[x_] := 0 /; x > b;
```

a

```
Plot[f[x], {x, -1, 2}, AspectRatio → Automatic];
```



b

```
EW = Integrate[x 0, {x, -Infinity, a}] +
  Integrate[x h, {x, a, b}] + Integrate[x 0, {x, b, Infinity}]
```

$$\frac{1}{2}$$

```
Integrate[x , {x, 0, 1}]
```

$$\frac{1}{2}$$

```
StAbw = Sqrt[(b - a)^2 / 12] // N
```

```
0.288675
```

6.

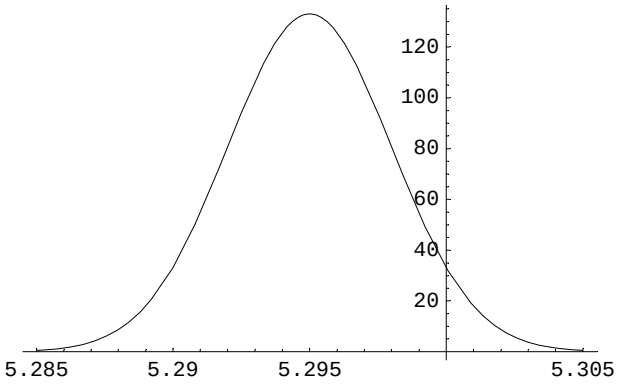
```
Remove["Global`*"]

μ = 5.295;
σ = 0.003;

NV[x_, μ_, σ_] := 1 / (σ Sqrt[2 Pi]) E^(-1 / 2 ((x - μ) / σ)^2);
NV[x, u, s]
```

$$\frac{e^{-\frac{(-u+x)^2}{2 s^2}}}{\sqrt{2 \pi}\ s}$$

```
NV[x, μ, σ]
```

$$132.981\ e^{-55555.6\ (-5.295+x)^2}$$

```
Plot[NV[x, μ, σ], {x, 5.285, 5.305}];
```




```
Integrate[Evaluate[NV[x, μ, σ]], {x, -100, 100}]
```

```
1.
```

a

```
Integrate[Evaluate[NV[x, μ, σ]], {x, 5.29, 5.30}]
```

```
0.904419
```

```
1 - Integrate[Evaluate[NV[x, μ, σ]], {x, 5.29, 5.30}]
```

```
0.0955807
```

b

```
Integrate[Evaluate[NV[x, μ, σ]], {x, 5.298, 7}]
```

```
0.158655
```

```
Integrate[Evaluate[NV[x, μ, σ]], {x, 5.298, 100}]
```

```
0.158648
```

c

```
Integrate[Evaluate[NV[x, μ, σ]], {x, 5.291, 5.297}]
```

```
0.656296
```

7.

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

```
p = 3 / 10; q = 1 - p; n = 100000;
```

```
EW = n p
```

```
30000
```

```
StAbw = Sqrt[n p q]
```

$$10\sqrt{210}$$

```
StAbw // N
```

```
144.914
```

```
μ = EW;
σ = StAbw ;
```

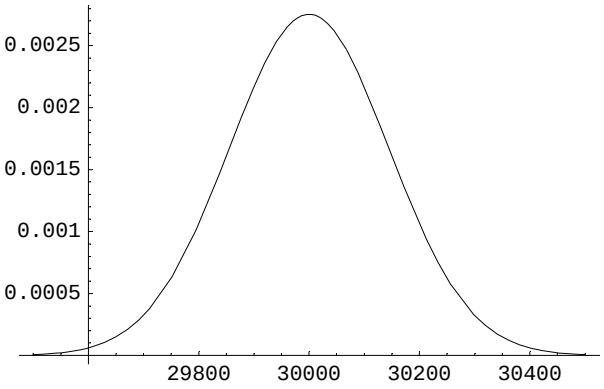
```
NV[x_, μ_, σ_] := 1 / (σ Sqrt[2 Pi]) E^(-1 / 2 ((x - μ) / σ)^2);
NV[x, u, s]
```

$$\frac{e^{-\frac{(-u+x)^2}{2 s^2}}}{\sqrt{2\pi}\ s}$$

```
NV[x, μ, σ]
```

$$\frac{e^{-\frac{(-30000+x)^2}{42000}}}{20\sqrt{105\pi}}$$

```
Plot[NV[x, μ, σ], {x, 29500, 30500}];
```



a

```
μ
```

```
30000
```

```
σ // N
```

```
144.914
```

"sigma grösser 3" ist erfüllt! > Approximation zulässig.

b

```
Integrate[Evaluate[NV[x, μ - 1 / 2, σ] - NV[x, μ + 1 / 2, σ]], {x, -Infinity, a}]
```

$$\frac{1}{2}\left(\text{Erfc}\left[\frac{59999-2\,a}{40\sqrt{105}}\right]-\text{Erfc}\left[\frac{60001-2\,a}{40\sqrt{105}}\right]\right)$$

```
result1 = Integrate[Evaluate[NV[x, μ - 1 / 2, σ]], {x, -Infinity, 90000}] -
  Integrate[Evaluate[NV[x, μ + 1 / 2, σ]], {x, -Infinity, 10000}]
```

$$\frac{1}{2}\left(1+\text{Erf}\left[\frac{17143\sqrt{\frac{7}{15}}}{40}\right]\right)-\frac{1}{2}\,\text{Erfc}\left[\frac{40001}{40\sqrt{105}}\right]$$

```
N[result1, 100]
```

```
1.0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
 0000000000000000000
```

c

```
Integrate[Evaluate[NV[x, μ, σ]], {x, -Infinity, a}]
```

$$\frac{1}{2}\left(1+\text{Erf}\left[\frac{-30000+a}{20\sqrt{105}}\right]\right)$$

```
Integrate[Evaluate[NV[x, μ, σ]], {x, 10000, 90000}]
```

$$\frac{1}{2}\left(\text{Erf}\left[200\sqrt{\frac{5}{21}}\right]+\text{Erf}\left[200\sqrt{\frac{15}{7}}\right]\right)$$

```
result2 = N[Integrate[Evaluate[NV[x, μ, σ]], {x, 10000, 90000}], 100]
```

```
1.0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
 0000000000000000000
```

```
result1 - result2
```

$$0.\times 10^{-101}$$

Die Abweichung ist bei 100 Stellen nicht feststellbar ==> Keine praktisch feststellbare Abweichung!!