Lösungen / Statistik 1/02

```
(* Remove["Global`*"] *)
```

1. Abfüllversuch 2008

Daten anlässlich des Abfüllens von etwa gleich grossen Rollen in etwa gleich grosse Schachteln: 3 Gruppen, je 10 Abzählversuche.

t1= Maximalzahl Rollen bei Gruppe 1 u.s.w.

```
gr1 = {68, 64, 67, 65, 68, 68, 68, 65, 68, 68}; t1 = 81;
gr2 = {65, 62, 63, 62, 63, 60, 62, 65, 62, 61}; t2 = 86;
gr3 = {62, 64, 64, 62, 59, 65, 65, 63, 63, 62}; t3 = 85;
```

Auswertung

Zusatzpakete laden

```
<< Statistics`DescriptiveStatistics`;
<< Graphics`Graphics`
```

Frequenztabellen

```
? Frequencies
```

```
Frequencies[list] gives a list of the distinct elements
   in list, together with the frequencies with which they occur. Mehr...
```

```
f1 = Frequencies[gr1]
```

```
{{1, 64}, {2, 65}, {1, 67}, {6, 68}}
```

```
f2 = Frequencies[gr2]
```

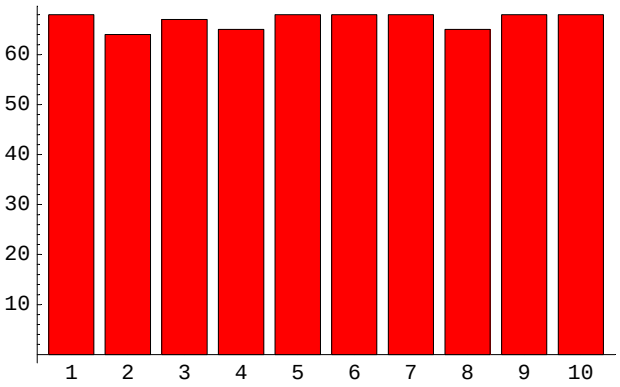
```
{{1, 60}, {1, 61}, {4, 62}, {2, 63}, {2, 65}}
```

```
f3 = Frequencies[gr3]
```

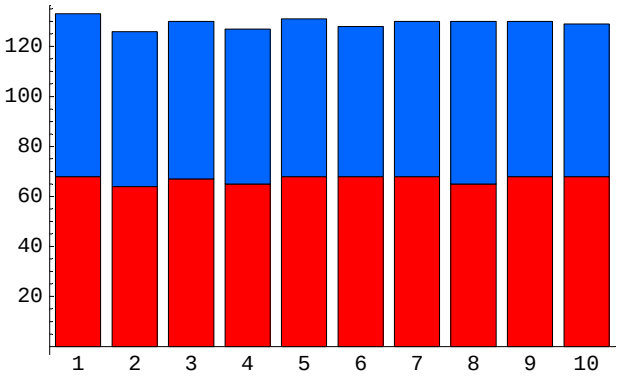
```
{{1, 59}, {3, 62}, {2, 63}, {2, 64}, {2, 65}}
```

Barcharts und Histogramme, etwas herumprobieren

```
BarChart[gr1];
```




```
StackedBarChart[gr1, gr2];
```

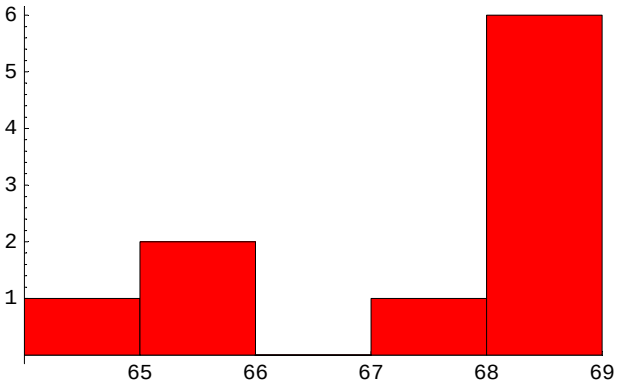


Diese Darstellungen oben sind nicht günstig

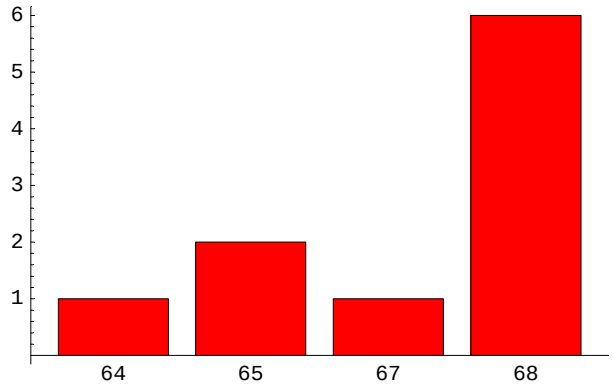
```
StackedBarChart[f2, f3];
```

Ergibt keinen Output.

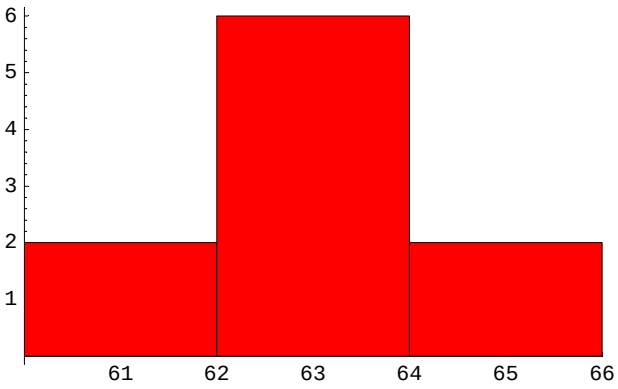
```
h1 = Histogram[gr1];
```



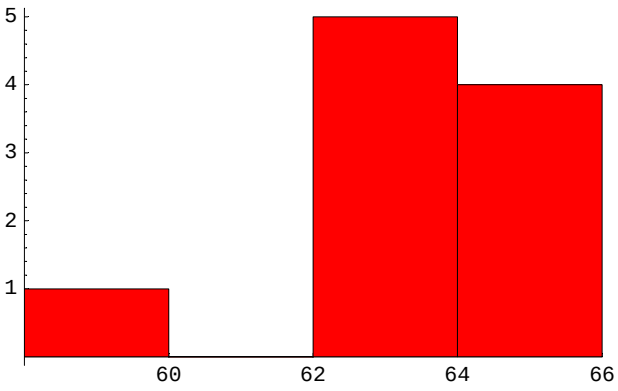
```
BarChart[f1];
```



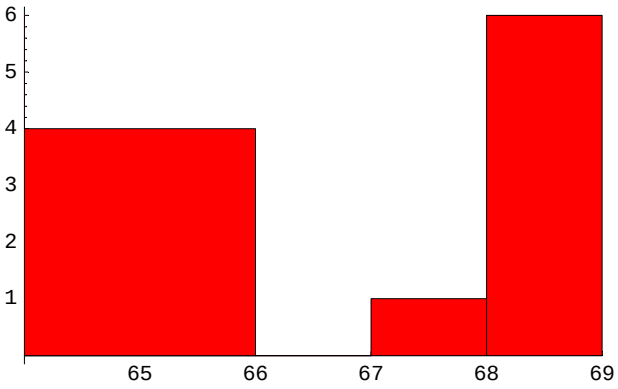

```
h2 = Histogram[gr2];
```




```
h3 = Histogram[gr3];
```




```
Show[h1, h2, h3];
```



Output überlagert, so nicht sehr sinnvoll, wegen den Ueberdeckungen.

```
GeneralizedBarChart[f2];
```

Ergibt keinen Output.

Datennormierungsversuch

```
gr1 / t1 // N
```

```
{0.839506, 0.790123, 0.82716, 0.802469,
 0.839506, 0.839506, 0.839506, 0.802469, 0.839506, 0.839506}
```

Diverse Reports mit wichtigen Kenngrössen von Daten

```
MinMax[x_] := {Min[x], Max[x]};
```

```
MinMax[gr1]
```

```
{64, 68}
```

```
LocationReport[gr1]
```

$$\left\{\text{Mean} \to \frac{669}{10}, \text{HarmonicMean} \to \frac{47382400}{708627}, \text{Median} \to 68\right\}$$

```
LocationReport[gr1] // N
```

```
{Mean → 66.9, HarmonicMean → 66.8651, Median → 68.}
```

```
DispersionReport[gr1]
```

$$\left\{\text{Variance} \to \frac{229}{90}, \text{StandardDeviation} \to \frac{\sqrt{\frac{229}{10}}}{3}, \text{SampleRange} \to 4,\right.$$
$$\left.\text{MeanDeviation} \to \frac{67}{50}, \text{MedianDeviation} \to 0, \text{QuartileDeviation} \to \frac{3}{2}\right\}$$

```
ShapeReport[gr1]
```

$$\left\{\text{Skewness} \to -\frac{3012}{229\sqrt{229}}, \text{QuartileSkewness} \to -1, \text{KurtosisExcess} \to -\frac{51746}{52441}\right\}$$

```
DispersionReport[gr1] // N
```

```
{Variance → 2.54444, StandardDeviation → 1.59513, SampleRange → 4.,
 MeanDeviation → 1.34, MedianDeviation → 0., QuartileDeviation → 1.5}
```

```
Rep[x_] := {MinMax[x], LocationReport[x], DispersionReport[x]} // N;
```

```
Rep[gr1]
```

```
{{64., 68.}, {Mean → 66.9, HarmonicMean → 66.8651, Median → 68.},
 {Variance → 2.54444, StandardDeviation → 1.59513, SampleRange → 4.,
  MeanDeviation → 1.34, MedianDeviation → 0., QuartileDeviation → 1.5}}
```

```
Rep[gr2]
```

```
{{60., 65.}, {Mean → 62.5, HarmonicMean → 62.4643, Median → 62.},
 {Variance → 2.5, StandardDeviation → 1.58114, SampleRange → 5.,
  MeanDeviation → 1.2, MedianDeviation → 1., QuartileDeviation → 0.5}}
```

```
Rep[gr3]
```

```
{{59., 65.}, {Mean → 62.9, HarmonicMean → 62.853, Median → 63.},
 {Variance → 3.21111, StandardDeviation → 1.79196, SampleRange → 6.,
  MeanDeviation → 1.32, MedianDeviation → 1., QuartileDeviation → 1.}}
```

```
Rep[gr1 / t1] // N
```

```
{{0.790123, 0.839506}, {Mean → 0.825926, HarmonicMean → 0.825495, Median → 0.839506},
 {Variance → 0.000387814, StandardDeviation → 0.019693, SampleRange → 0.0493827,
  MeanDeviation → 0.0165432, MedianDeviation → 0., QuartileDeviation → 0.0185185}}
```

```
Rep[gr2 / t2] // N
```

```
{{0.697674, 0.755814}, {Mean → 0.726744, HarmonicMean → 0.726329, Median → 0.72093},
 {Variance → 0.000338021, StandardDeviation → 0.0183853,
  SampleRange → 0.0581395, MeanDeviation → 0.0139535,
  MedianDeviation → 0.0116279, QuartileDeviation → 0.00581395}}
```

```
Rep[gr3 / t3] // N
```

```
{{0.694118, 0.764706}, {Mean → 0.74, HarmonicMean → 0.739447, Median → 0.741176},
 {Variance → 0.000444444, StandardDeviation → 0.0210819,
  SampleRange → 0.0705882, MeanDeviation → 0.0155294,
  MedianDeviation → 0.0117647, QuartileDeviation → 0.0117647}}
```

```
Rep[gr1 / Mean[gr1]] // N
```

```
{{0.956652, 1.01644}, {Mean → 1., HarmonicMean → 0.999478, Median → 1.01644},
 {Variance → 0.000568513, StandardDeviation → 0.0238435, SampleRange → 0.0597907,
  MeanDeviation → 0.0200299, MedianDeviation → 0., QuartileDeviation → 0.0224215}}
```

```
Rep[gr2 / Mean[gr2]] // N
```

```
{{0.96, 1.04}, {Mean → 1., HarmonicMean → 0.999428, Median → 0.992},
 {Variance → 0.00064, StandardDeviation → 0.0252982, SampleRange → 0.08,
  MeanDeviation → 0.0192, MedianDeviation → 0.016, QuartileDeviation → 0.008}}
```

```
Rep[gr3 / Mean[gr3]] // N
```

```
{{0.937997, 1.03339}, {Mean → 1., HarmonicMean → 0.999252, Median → 1.00159},
 {Variance → 0.000811622, StandardDeviation → 0.028489,
  SampleRange → 0.0953895, MeanDeviation → 0.0209857,
  MedianDeviation → 0.0158983, QuartileDeviation → 0.0158983}}
```

Aus den Reports wird ersichtlich,dass aus Plausibilitätsgründen eine Vermischung der 3 Gruppen praktikabel ist, wenn die Gruppen auf den Mittelwert 1 normiert sind. Weitere Unterwuchungen zu diesem Thema werden hier aber noch nicht angestellt.

```
new = Join[gr1, gr2, gr3]
```

```
{68, 64, 67, 65, 68, 68, 68, 65, 68, 68, 65, 62, 63, 62,
 63, 60, 62, 65, 62, 61, 62, 64, 64, 62, 59, 65, 65, 63, 63, 62}
```

```
Rep[new / Mean[new]] // N
```

```
{{0.920437, 1.06084}, {Mean → 1., HarmonicMean → 0.998444, Median → 0.99844},
 {Variance → 0.00161721, StandardDeviation → 0.0402146,
  SampleRange → 0.140406, MeanDeviation → 0.0329693,
  MedianDeviation → 0.0312012, QuartileDeviation → 0.0234009}}
```

2.

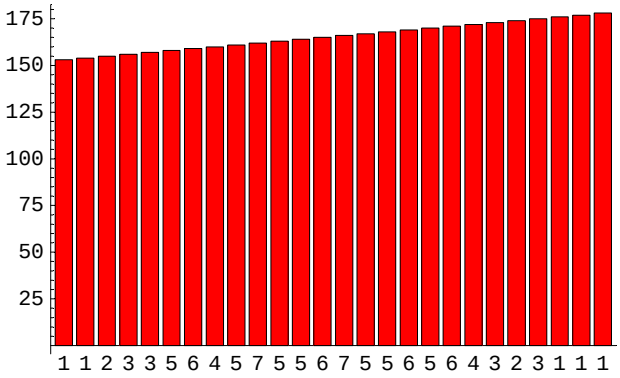
```
<< Graphics`Graphics`
```

```
<< 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}}
```

```
BarChart[tb];
```



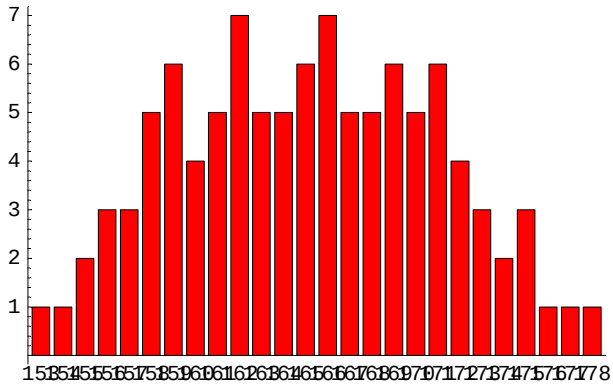

```
unbrauchbar / inutilisable
```

$$\frac{\text{unbrauchbar}}{\text{inutilisable}}$$

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

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

```
tb3 = Flatten[tb2]
```

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

```
DispersionReport[tb3]
```

$$\left\{\text{Variance} \to \frac{58150}{1717},\ \text{StandardDeviation} \to 5\sqrt{\frac{2326}{1717}},\ \text{SampleRange} \to 25,\right.$$
$$\left.\text{MeanDeviation} \to \frac{1401}{289},\ \text{MedianDeviation} \to \frac{9}{2},\ \text{QuartileDeviation} \to \frac{9}{2}\right\}$$

```
LocationReport[tb3]
```

$$\left\{\text{Mean} \to \frac{2807}{17},\ \text{HarmonicMean} \to \frac{68318429896406670946044366275073605520 0}{41426543231309608513279313493164679 61},\ \text{Median} \to 165\right\}$$

```
LocationReport[tb3] // N
```

```
{Mean → 165.118, HarmonicMean → 164.915, Median → 165.}
```

```
ShapeReport[tb3]
```

$$\left\{\text{Skewness} \to \frac{30477\sqrt{\frac{3}{1163}}}{29075},\ \text{QuartileSkewness} \to \frac{1}{9},\ \text{KurtosisExcess} \to -\frac{134815368}{169071125}\right\}$$

```
ShapeReport[tb3] // N
```

```
{Skewness → 0.0532382, QuartileSkewness → 0.111111, KurtosisExcess → -0.797388}
```

3.

```
p[x_] := Floor[6 Random[] + 1];
w[n_] = Table[p[x_], {i, 1, n}];
{"Test ", p[2], w[5]}
```

```
{Test , 1, {4, 1, 5, 4, 2}}
```

```
a = w[30]
```

```
{4, 3, 2, 2, 3, 6, 3, 3, 6, 2, 1, 2, 5, 4, 1, 2, 1, 5, 2, 5, 6, 5, 5, 5, 3, 3, 3, 3, 6, 3}
```

```
b = w[100]; c = w[10000];
```

```
N[LocationReport[a]]
```

```
{Mean → 3.46667, HarmonicMean → 2.6393, Median → 3.}
```

```
N[LocationReport[b]]
```

```
{Mean → 3.36, HarmonicMean → 2.21893, Median → 3.}
```

```
N[LocationReport[c]]
```

```
{Mean → 3.4932, HarmonicMean → 2.44167, Median → 3.}
```

```
N[DispersionReport[a]]
```

```
{Variance → 2.53333, StandardDeviation → 1.59164, SampleRange → 5.,
 MeanDeviation → 1.36, MedianDeviation → 1., QuartileDeviation → 1.5}
```

```
N[DispersionReport[b]]
```

```
{Variance → 3.26303, StandardDeviation → 1.80639, SampleRange → 5.,
 MeanDeviation → 1.6072, MedianDeviation → 2., QuartileDeviation → 1.5}
```

```
N[DispersionReport[c]]
```

```
{Variance → 2.92005, StandardDeviation → 1.70881, SampleRange → 5.,
 MeanDeviation → 1.50147, MedianDeviation → 2., QuartileDeviation → 1.5}
```

4.

Künstliches Beispiel / Exemple Artificiel

Tabelle / Tableau

```
u1 = Table[6 + Random[], {n, 1, 30}]
```

```
{6.18014, 6.38536, 6.73966, 6.1108, 6.33438, 6.34845, 6.85364,
 6.14171, 6.90979, 6.62896, 6.90371, 6.58308, 6.75448, 6.29989,
 6.1988, 6.69164, 6.30165, 6.82006, 6.09286, 6.1434, 6.22535, 6.99115,
 6.56688, 6.82136, 6.04521, 6.60579, 6.82722, 6.71056, 6.71083, 6.25734}
```

```
u2 = Table[
  {IntegerPart[u1[[n]]], "h", FractionalPart[u1[[n]]] 60 / 100}, {n, 1, Length[u1]}]
```

```
{{6, h, 0.108084}, {6, h, 0.231219}, {6, h, 0.443798}, {6, h, 0.0664821},
 {6, h, 0.200627}, {6, h, 0.209069}, {6, h, 0.512185}, {6, h, 0.0850285},
 {6, h, 0.545875}, {6, h, 0.377376}, {6, h, 0.542224}, {6, h, 0.349845}, {6, h, 0.45269},
 {6, h, 0.179933}, {6, h, 0.119278}, {6, h, 0.414981}, {6, h, 0.18099}, {6, h, 0.492038},
 {6, h, 0.0557142}, {6, h, 0.0860376}, {6, h, 0.135207}, {6, h, 0.59469},
 {6, h, 0.340127}, {6, h, 0.492816}, {6, h, 0.0271235}, {6, h, 0.363472},
 {6, h, 0.496329}, {6, h, 0.426334}, {6, h, 0.426496}, {6, h, 0.154402}}
```

Datenmanipulation / Manipuler les données

```
<< Statistics`DataManipulation`

(* Intervallmitten / Centres des Intervalles *)
rang = Range[6.05, 7, 0.1]
```

```
{6.05, 6.15, 6.25, 6.35, 6.45, 6.55, 6.65, 6.75, 6.85, 6.95}
```

```
binc = BinCounts[u1, {6, 7, 0.1}]
```

```
{2, 5, 3, 4, 0, 2, 3, 4, 4, 3}
```

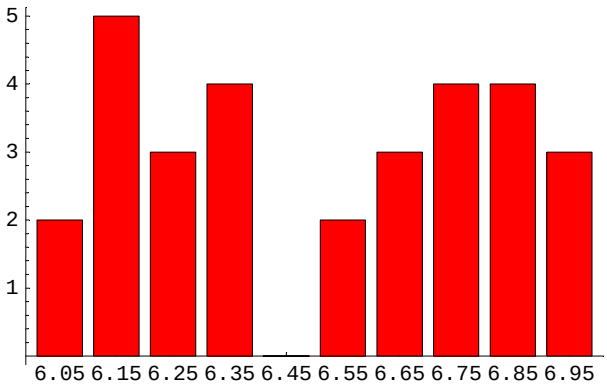
```
u3 = Transpose[{binc, rang}]
```

```
{{2, 6.05}, {5, 6.15}, {3, 6.25}, {4, 6.35},
 {0, 6.45}, {2, 6.55}, {3, 6.65}, {4, 6.75}, {4, 6.85}, {3, 6.95}}
```

Datenmanipulation / Manipuler les données

```
<< Graphics`Graphics`

BarChart[u3];
```



100 Werte, 20 Klassen / 100 valeurs 20 classes

```
v1 = Table[6 + Random[], {n, 1, 100}]
```

```
{6.97357, 6.56884, 6.80104, 6.62838, 6.06987, 6.98577, 6.04655, 6.32849, 6.87107,
 6.29413, 6.7449, 6.50842, 6.77821, 6.15074, 6.51956, 6.51727, 6.21133, 6.32938,
 6.47435, 6.91149, 6.38412, 6.61882, 6.76352, 6.65415, 6.41055, 6.04997,
 6.96249, 6.02577, 6.34068, 6.06421, 6.91594, 6.69729, 6.46961, 6.77008,
 6.17103, 6.18886, 6.69139, 6.61934, 6.65147, 6.67159, 6.48006, 6.28996,
 6.17712, 6.7601, 6.09594, 6.67115, 6.4136, 6.10595, 6.68539, 6.62117, 6.45111,
 6.08017, 6.34471, 6.55696, 6.53517, 6.38289, 6.87511, 6.78689, 6.36414,
 6.19403, 6.18371, 6.16755, 6.71267, 6.52244, 6.70365, 6.87759, 6.53555,
 6.76234, 6.60772, 6.20644, 6.12195, 6.6564, 6.92232, 6.58527, 6.67084,
 6.57622, 6.57761, 6.02831, 6.13566, 6.19333, 6.7025, 6.24142, 6.77152,
 6.99931, 6.51879, 6.07387, 6.05885, 6.47687, 6.81513, 6.19629, 6.52331,
 6.71452, 6.20742, 6.98985, 6.40136, 6.05813, 6.2851, 6.40458, 6.73052, 6.4819}
```

```
<< Statistics`DataManipulation`
```

```
(* Intervallmitten / Centres des Intervalles *)
newRang = Range[6.025, 7, 0.05]
```

```
{6.025, 6.075, 6.125, 6.175, 6.225, 6.275, 6.325, 6.375, 6.425, 6.475,
 6.525, 6.575, 6.625, 6.675, 6.725, 6.775, 6.825, 6.875, 6.925, 6.975}
```

```
Length[newRang]
```

```
20
```

```
newBinc = BinCounts[v1, {6, 7, 0.05}]
```

```
{4, 7, 3, 9, 4, 3, 4, 3, 4, 6, 8, 5, 5, 9, 6, 7, 2, 3, 3, 5}
```

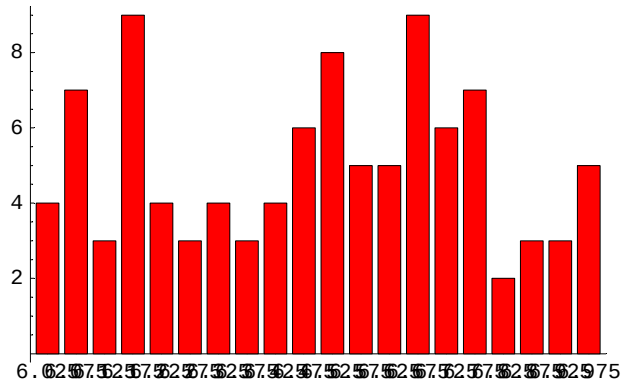
```
Length[newBinc]
```

```
20
```

```
v3 = Transpose[{newBinc, newRang}]
```

```
{{4, 6.025}, {7, 6.075}, {3, 6.125}, {9, 6.175}, {4, 6.225}, {3, 6.275}, {4, 6.325},
 {3, 6.375}, {4, 6.425}, {6, 6.475}, {8, 6.525}, {5, 6.575}, {5, 6.625}, {9, 6.675},
 {6, 6.725}, {7, 6.775}, {2, 6.825}, {3, 6.875}, {3, 6.925}, {5, 6.975}}
```

```
BarChart[v3];
```




```
(* Achsenbeschriftung korrigieren! / Corriger le texte aux axes *)
```

```
s1 = Table[newRang[[n]], {n, 1, Length[newRang], 4}]
```

```
{6.025, 6.225, 6.425, 6.625, 6.825}
```

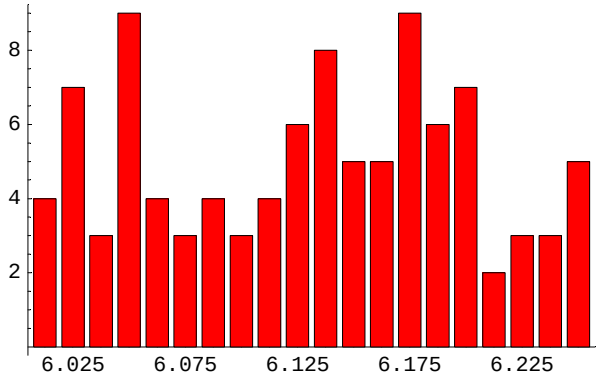
```
sTest = Flatten[Table[{".", newRang[[n]], ".", "."}, {n, 1, Length[newRang]}]]
```

```
{., 6.025, ., ., ., 6.075, ., ., ., 6.125, ., ., ., 6.175, ., ., ., 6.225, ., .,
 ., 6.275, ., ., ., 6.325, ., ., ., 6.375, ., ., ., 6.425, ., ., ., 6.475, ., .,
 ., 6.525, ., ., ., 6.575, ., ., ., 6.625, ., ., ., 6.675, ., ., ., 6.725, ., .,
 ., 6.775, ., ., ., 6.825, ., ., ., 6.875, ., ., ., 6.925, ., ., ., 6.975, ., .}
```

```
s2 = Flatten[Table[{" ", newRang[[n]], " ", " "}, {n, 1, Length[newRang]}]]
```

```
{ , 6.025,  ,  ,  , 6.075,  ,  ,  , 6.125,  ,  ,  , 6.175,  ,  ,  , 6.225,  ,  ,
  , 6.275,  ,  ,  , 6.325,  ,  ,  , 6.375,  ,  ,  , 6.425,  ,  ,  , 6.475,  ,  ,
  , 6.525,  ,  ,  , 6.575,  ,  ,  , 6.625,  ,  ,  , 6.675,  ,  ,  , 6.725,  ,  ,
  , 6.775,  ,  ,  , 6.825,  ,  ,  , 6.875,  ,  ,  , 6.925,  ,  ,  , 6.975,  ,  }
```

```
BarChart[v3, BarLabels → s2];
```

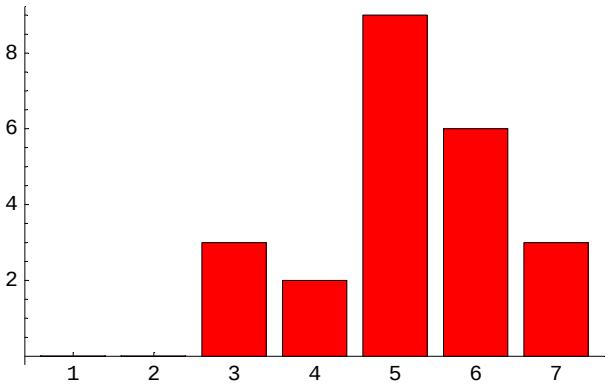


5.

```
aL = {0, 0, 3, 2, 9, 6, 3}
```

```
{0, 0, 3, 2, 9, 6, 3}
```

```
BarChart[aL];
```



====> Unbrauchbar! / Inutilisable!

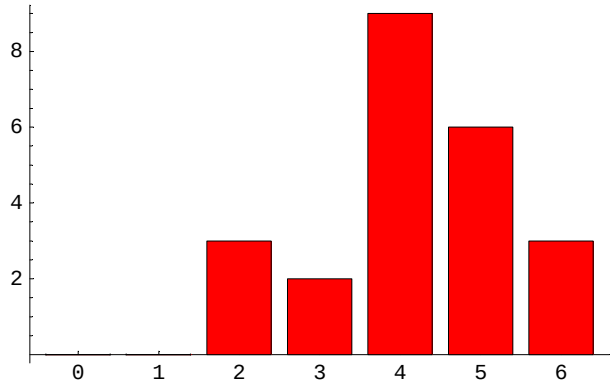
```
u = {0, 1, 2, 3, 4, 5, 6}
```

```
{0, 1, 2, 3, 4, 5, 6}
```

```
tr = Transpose[{aL, u}]
```

```
{{0, 0}, {0, 1}, {3, 2}, {2, 3}, {9, 4}, {6, 5}, {3, 6}}
```

```
BarChart[tr];
```



6.

Fakultäten / Factorielles

```
{0!, 1!, 2!, 3!, 4!, 5!, 6!}
```

```
{1, 1, 2, 6, 24, 120, 720}
```

Binomialkoeffizienten / coefficients binomials

```
?Bin*
```

System`

```
BinaryFormat BinaryRead     BinaryWrite
BinaryGet    BinaryReadList Binomial
```

Statistics`DataManipulation`

```
BinCounts BinLists
```

```
?Binomial
```

```
Binomial[n, m] gives the binomial coefficient. Mehr...
```

```
1 / Binomial[39, 6]
```

$$\frac{1}{3262623}$$

```
1 / Binomial[40, 6]
```

$$\frac{1}{3838380}$$

```
1 / Binomial[41, 6]
```

$$\frac{1}{4496388}$$

```
1 / Binomial[42, 6]
```

$$\frac{1}{5245786}$$

```
1 / Binomial[100, 6]
```

$$\frac{1}{1192052400}$$