1a $P(\text{geen enkele keer 6}) = P(\bar{6}\,\bar{6}\,\bar{6}\,\bar{6}) = \frac{5}{6}\cdot\frac{5}{6}\cdot\frac{5}{6}\cdot\frac{5}{6} \approx 0{,}482.$

```
(5/6)^4
          .4822530864
```

1b $P(\text{geen enkele 6}) = P(\bar{6}\,\bar{6}\,\bar{6}\,\bar{6}) \approx 0{,}482.$

2a $P(\underline{\underline{a\,a\,a\,p\,p\,p}}) = \binom{6}{3}\cdot P(a\,a\,a\,p\,p\,p) = \binom{6}{3}\cdot(\frac{2}{5})^3\cdot(\frac{2}{5})^3 \approx 0{,}082.$

2b $P(a \geq 1) = 1 - P(a < 1) = 1 - P(a = 0) = 1 - P(\bar{a}\,\bar{a}\,\bar{a}\,\bar{a}\,\bar{a}\,\bar{a}) = 1 - (\frac{3}{5})^6 \approx 0{,}953.$

2c $P(b = 3) = P(\underline{\underline{b\,b\,b\,\bar{b}\,\bar{b}\,\bar{b}}}) = \binom{6}{3}\cdot P(b\,b\,b\,\bar{b}\,\bar{b}\,\bar{b}) = \binom{6}{3}\cdot(\frac{1}{5})^3\cdot(\frac{4}{5})^3 \approx 0{,}082.$

```
6 nCr 3*(2/5)^3*
(2/5)^3
               .08192
1-(3/5)^6
              .953344
6 nCr 3*(1/5)^3*
(4/5)^3
               .08192
```

3a $P(\underline{\underline{a\,b}}) = \binom{2}{1}\cdot P(a\,b) = \binom{2}{1}\cdot\frac{2}{5}\cdot\frac{1}{5} = 0{,}16.$

```
2 nCr 1*2/5*1/5
                  .16
```

3b $P(\bar{b}\,\bar{b}) = (\frac{4}{5})^2 = 0{,}64.$

3c $P(\text{twee verschillende vruchten}) = P(\underline{\underline{a\,b}}) + P(\underline{\underline{a\,p}}) + P(\underline{\underline{b\,p}}) = \binom{2}{1}\cdot\frac{2}{5}\cdot\frac{1}{5} + \binom{2}{1}\cdot\frac{2}{5}\cdot\frac{2}{5} + \binom{2}{1}\cdot\frac{1}{5}\cdot\frac{2}{5} = 0{,}64.$

```
(4/5)^2
                  .64
2 nCr 1*2/5*1/5+
2 nCr 1*2/5*2/5+
2 nCr 1*1/5*2/5
                  .64
```

4a $P(\bar{g}\,\bar{g}\,\bar{g}\,\bar{g}\,\bar{g}\,\bar{g}) = (\frac{3}{4})^6 \approx 0{,}178.$

```
(3/4)^6
          .1779785156
```

4b $P(\underline{\underline{g\,g\,\bar{g}\,\bar{g}\,\bar{g}\,\bar{g}}}) = \binom{6}{2}\cdot(\frac{1}{4})^2\cdot(\frac{3}{4})^4 \approx 0{,}297.$

4c $P(goed \geq 2) = 1 - P(goed \leq 1) = 1 - P(\bar{g}\,\bar{g}\,\bar{g}\,\bar{g}\,\bar{g}\,\bar{g}) - P(\underline{\underline{g\,\bar{g}\,\bar{g}\,\bar{g}\,\bar{g}\,\bar{g}}}) = 1 - (\frac{3}{4})^6 - \binom{6}{1}\cdot(\frac{1}{4})^1\cdot(\frac{3}{4})^5 \approx 0{,}466.$

```
6 nCr 2*(1/4)^2*
(3/4)^4
          .2966308594
1-(3/4)^6-6 nCr
1*(1/4)*(3/4)^5
          .4660644531
```

5a $P(\text{lukt}) = P(l) = 0{,}28 \Rightarrow P(\text{mislukt}) = P(m) = 1 - 0{,}28 = 0{,}72 \Rightarrow P(m\,m\,m) = 0{,}72^3 \approx 0{,}373.$

5b $P(\text{minstens één keer lukt}) = 1 - P(\text{geen keer lukt}) = 1 - P(m\,m\,m\,m\,m) = 1 - 0{,}72^5 \approx 0{,}807.$

```
0.72^3
              .373248
1-0.72^5
          .8065082368
```

5cd $P(\text{minstens één keer lukt bij } n \text{ proeven}) = 1 - P(\text{geen keer lukt bij } n \text{ proeven}) = 1 - 0{,}72^n > 0{,}95.$
$1 - 0{,}72^n = 0{,}95$ (intersect en zie plot of zie TABLE) $\Rightarrow n \geq 10$. Dus minstens 10 keer uitvoeren.

```
Plot1 Plot2 Plot3
\Y1=1-0.72^X
\Y2=0.95
\Y3=
\Y4=
\Y5=
\Y6=
\Y7=
```

X	Y1	Y2
6	.86069	.95
7	.89969	.95
8	.92778	.95
9	.948	.95
10	.96256	.95
11	.97304	.95
12	.98059	.95

Y1=.962560937574

6a $P(\underline{\underline{4\,4\,4\,\bar{4}\,\bar{4}\,\bar{4}}}) = \binom{6}{3}\cdot(\frac{1}{6})^3\cdot(\frac{5}{6})^3 \approx 0{,}054.$

6b $P(\text{minstens één 6}) = 1 - P(\text{geen 6}) = 1 - P(\bar{6}\,\bar{6}\,\bar{6}\,\bar{6}\,\bar{6}\,\bar{6}) = 1 - (\frac{5}{6})^6 \approx 0{,}665.$

```
6 nCr 3*(1/6)^3*
(5/6)^3
          .0535836763
1-(5/6)^6
          .6651020233
```

6c $P(\text{zes verschillende aantallen ogen}) = P(\underline{\underline{1\,2\,3\,4\,5\,6}}) = 6!\cdot P(1\,2\,3\,4\,5\,6) = 6!\cdot\frac{1}{6}\cdot\frac{1}{6}\cdot\frac{1}{6}\cdot\frac{1}{6}\cdot\frac{1}{6}\cdot\frac{1}{6} = 6!\cdot(\frac{1}{6})^6 \approx 0{,}015.$

6d $P(\text{twee keer 6 en geen 5}) = P(\underline{\underline{6\,6\,\overline{5\text{ of }6}\,\overline{5\text{ of }6}\,\overline{5\text{ of }6}\,\overline{5\text{ of }6}}}) = \binom{6}{2}\cdot(\frac{1}{6})^2\cdot(\frac{4}{6})^4 \approx 0{,}082.$

```
6!*(1/6)^6
          .0154320988
6 nCr 2*(1/6)^2*
(4/6)^4
          .0823045267
```

7a $P(som = 6) = P(6) = \frac{5}{36}$ (zie het rooster hiernaast).

7b $P(\underline{\underline{6\,6\,6\,6\,\bar{6}\,\bar{6}\,\bar{6}\,\bar{6}}}) = \binom{8}{4}\cdot(\frac{5}{36})^4\cdot(\frac{31}{36})^4 \approx 0{,}014.$

7c $P(som < 5) = P(<5) = \frac{6}{36} = \frac{1}{6}$ (zie het rooster hiernaast).
$P(\underline{\underline{<5\,<5\,<5\,\overline{<5}\,\overline{<5}\,\overline{<5}\,\overline{<5}\,\overline{<5}}}) = \binom{8}{3}\cdot(\frac{1}{6})^3\cdot(\frac{5}{6})^5 \approx 0{,}104.$

```
8 nCr 4*(5/36)^4
*(31/36)^4
          .0143220382
8 nCr 3*(1/6)^3*
(5/6)^5
          .1041904816
```

```
Plot1 Plot2 Plot3
\Y1=1-(35/36)^X
\Y2=0.75
\Y3=
\Y4=
\Y5=
\Y6=
\Y7=
```

X	Y1	Y2
46	.72634	.75
47	.73394	.75
48	.74133	.75
49	.74852	.75
50	.7555	.75
51	.76229	.75
52	.7689	.75

X=52

6	7	8	9	10	11	12
5	6	7	8	9	10	11
4	5	6	7	8	9	10
3	4	5	6	7	8	9
2	3	4	5	6	7	8
1	2	3	4	5	6	7
+	1	2	3	4	5	6

7d $P(som = 12) = P(12) = \frac{1}{36}$ (zie het rooster). $P(\text{minstens één keer 12}) = 1 - P(\overline{12}\,\overline{12}\,\overline{12}\,\overline{12}\,\overline{12}\ldots\overline{12}\,\overline{12}\,\overline{12}\,\overline{12}) = 1 - (\frac{35}{36})^n > 0{,}75.$
Bladeren in de tabel geeft $n \geq 50$. Dus Timo moet minstens 50 keer met twee dobbelstenen gooien.

8a $P(\text{minstens één keer 6}) = 1 - P(\text{geen 6}) = 1 - P(\bar{6}\,\bar{6}\,\bar{6}\,\bar{6}) = 1 - (\frac{5}{6})^4 \approx 0{,}518.$

```
1-(5/6)^4
          .5177469136
```

De berekening van de Meré klopt dus niet. (met 7 dobbelstenen gooien zou een kans geven die groter is dan 1 en dat kan niet)
Het is wél voordeliger om te wedden op minstens één 6.

8b $P(dubbel\ 6) = P(som = 12) = \frac{1}{36}$ (zie het rooster hierboven).
$P(dubbel\ 6 \geq 1) = 1 - P(dubbel\ 6 < 1) = 1 - P(dubbel\ 6 = 0) = 1 - P(\overline{12}\,\overline{12}\,\overline{12}\,\overline{12}\ldots\overline{12}\,\overline{12}\,\overline{12}) = 1 - (\frac{35}{36})^{24} \approx 0{,}491.$
De berekening van de Meré klopt weer niet. Het wedden op minstens één keer dubbel zes is zelfs nadeliger, want het wedden op geen enkele keer dubbel zes is $P(\text{dubbel } 6 = 0) \approx 1 - 0{,}491 = 0{,}509$.

```
1-(35/36)^24
          .4914038761
1-Ans
          .5085961239
```

9a $P(z\,z\,z\,z) = (\frac{18}{38})^4 \approx 0{,}050.$

9b $P(\underline{\underline{z\,z\,r\,r}}) = \binom{4}{2}\cdot P(z\,z\,r\,r) = \binom{4}{2}\cdot(\frac{18}{38})^2\cdot(\frac{18}{38})^2 \approx 0{,}302.$

```
(18/38)^4
          .0503449175
4 nCr 2*(18/38)^
4
          .3020695053
```

9c $P(wit \geq 1) = 1 - P(wit < 1) = 1 - P(wit = 0) = 1 - P(\bar{w}\,\bar{w}\,\bar{w}\,\bar{w}) = 1 - (\frac{36}{38})^4 \approx 0{,}194.$

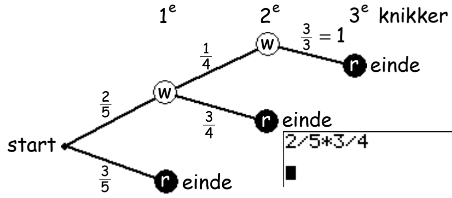
9d $P(uitkering = € 40) = P(rood = 2) = P(\underline{\underline{r\,r\,\bar{r}\,\bar{r}}}) = \binom{4}{2}\cdot P(r\,r\,\bar{r}\,\bar{r}) = \binom{4}{2}\cdot(\frac{18}{38})^2\cdot(\frac{20}{38})^2 \approx 0{,}373.$

```
1-(36/38)^4
          .1944813192
4 nCr 2*(18/38)²
*(20/38)²
          .3729253152
```

9e $P(\mathit{uitkering} > €\,50) = P(\mathit{uitkering} \geq €\,60) = P(\mathit{rood} \geq 3) = P(\underline{\underline{\mathrm{r\,r\,r\,\bar{r}\,\bar{r}}}}) + P(\underline{\underline{\mathrm{r\,r\,r\,r\,\bar{r}}}}) + P(\mathrm{r\,r\,r\,r\,r})$
$= \binom{5}{3} \cdot (\frac{18}{38})^3 \cdot (\frac{20}{38})^2 + \binom{5}{4} \cdot (\frac{18}{38})^4 \cdot \frac{20}{38} + (\frac{18}{38})^5 \approx 0,451.$

```
5 nCr 3*18^3*20²
+5 nCr 4*18^4*20
+18^5
         35715168
Ans/38^5
       .4507489402
```

10a Na de eerste keer een witte knikker gepakt te hebben, bevinden zich nog 3 rode en 1 witte knikker in de vaas. De kans op een witte is dan dus $\frac{1}{4}$.



10b Zie de kansboom hiernaast.

10c $P(\text{twee knikkers}) = P(\text{eerst wit en dan pas rood}) = P(\mathrm{w\,r}) = \frac{2}{5} \cdot \frac{3}{4} = 0,3.$

```
2/5*3/4
               .3
```

11a $P(\text{twee knikkers}) = P(\mathrm{\bar{w}\,w}) = \frac{5}{8} \cdot \frac{3}{7} \approx 0,268.$

11b $P(\text{vier knikkers}) = P(\mathrm{\bar{w}\,\bar{w}\,\bar{w}\,w}) = \frac{5}{8} \cdot \frac{4}{7} \cdot \frac{3}{6} \cdot \frac{3}{5} \approx 0,107.$

```
5*3/8/7
       .2678571429
5*4*3*3/8/7/6/5
       .1071428571
```

12a $P(\text{vierde sleutel is de eerste die past}) = P(\mathrm{\bar{p}\,\bar{p}\,\bar{p}\,p}) = \frac{8}{10} \cdot \frac{7}{9} \cdot \frac{6}{8} \cdot \frac{2}{7} \approx 0,133.$

12b $P(\text{zesde sleutel is de eerste die past}) = P(\mathrm{\bar{p}\,\bar{p}\,\bar{p}\,\bar{p}\,\bar{p}\,p}) = \frac{8}{10} \cdot \frac{7}{9} \cdot \frac{6}{8} \cdot \frac{5}{7} \cdot \frac{4}{6} \cdot \frac{2}{5} \approx 0,089.$

```
8*7*6*2/10/9/8/7
       .1333333333
8*7*6*5*4*2/10/9
/8/7/6/5
       .0888888889
```

12c $P(\text{vijfde ssleutel is de tweede die past}) = P(\underline{\underline{\mathrm{\bar{p}\,\bar{p}\,\bar{p}\,p}}}\,\mathrm{p}) = P(\underline{\underline{\mathrm{\bar{p}\,\bar{p}\,\bar{p}\,p}}}) \cdot P(\mathrm{p}) = \binom{4}{3} \cdot \frac{8}{10} \cdot \frac{7}{9} \cdot \frac{6}{8} \cdot \frac{2}{7} \cdot \frac{1}{6} \approx 0,089.$

```
4 nCr 3*8*7*6*2/
10/9/8/7/6
       .0888888889
```

13a $P(\text{Lotte wint in twee sets}) = P(\mathrm{L\,L}) = 0,6 \cdot 0,6 = 0,36.$

13b $P(\text{Gijs wint de eerste en Lotte de volgende twee sets}) = P(\mathrm{G\,L\,L}) = 0,4 \cdot 0,6 \cdot 0,6 = 0,144.$

```
0.6²
              .36
0.4*0.6²
             .144
```

13c $P(\text{de partij duurt drie sets}) = P(\underline{\underline{\mathrm{G\,L}}}\,\mathrm{L}) + P(\underline{\underline{\mathrm{G\,L}}}\,\mathrm{G}) = \binom{2}{1} \cdot 0,4 \cdot 0,6 \cdot 0,6 + \binom{2}{1} \cdot 0,4 \cdot 0,6 \cdot 0,4 = 0,48.$

```
2 nCr 1*0.4*0.6²
+2 nCr 1*0.4*0.6
*0.4
              .48
```

14a $P(\text{Barney wint in twee sets}) = P(\mathrm{B\,B}) = 0,65 \cdot 0,65 \approx 0,423.$

14b $P(\text{de partij is afgelopen in twee sets}) = P(\mathrm{B\,B}) + P(\mathrm{F\,F}) = 0,65 \cdot 0,65 + 0,35 \cdot 0,35 = 0,545.$

14c $P(\text{Barney wint}) = P(\mathrm{B\,B}) + P(\underline{\underline{\mathrm{B\,F}}}\,\mathrm{B}) = 0,65 \cdot 0,65 + \binom{2}{1} \cdot 0,65 \cdot 0,35 \cdot 0,65 \approx 0,718.$

```
0.65²
            .4225
Ans+0.35²
             .545
0.65²+2 nCr 1*0.
65*0.35*0.65
           .71825
```

15a $P(\text{bij de tweede herkansing slagen}) = P(\text{bij derde examen slagen}) = P(\mathrm{\bar{s}\,\bar{s}\,s}) = 0,4 \cdot 0,7 \cdot 0,3 = 0,084.$

15b $P(\text{defintief afgewezen}) = P(\text{bij vierde examen niet slagen}) = P(\mathrm{\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}}) = 0,4 \cdot 0,7 \cdot 0,7 \cdot 0,7 \approx 0,137.$

```
0.4*0.7*0.3
             .084
0.4*0.7^3
            .1372
```

16a $P(\text{vier keer gooien}) = P(\bar{4}\,\bar{4}\,\bar{4}\,4) = \frac{3}{4} \cdot \frac{3}{4} \cdot \frac{3}{4} \cdot \frac{1}{4} \approx 0,105.$

16b $P(\text{zes keer gooien}) = P(\bar{4}\,\bar{4}\,\bar{4}\,\bar{4}\,\bar{4}\,4) = (\frac{3}{4})^5 \cdot \frac{1}{4} \approx 0,059.$

16c $P(\text{minder dan drie keer gooien}) = P(4) + P(\bar{4}\,4) = \frac{1}{4} + \frac{3}{4} \cdot \frac{1}{4} \approx 0,438.$

```
(3/4)^3*1/4
       .10546875
(3/4)^5*1/4
     .0593261719
1/4+3/4*1/4
           .4375
```

16d $P(\text{minstens drie keer gooien}) = 1 - P(\text{minder dan drie keer gooien}) = 1 - P(4) - P(\bar{4}\,4) \approx 1 - 0,438 = 0,562.$

```
1-1/4-3/4*1/4
            .5625
```

17a 25% van $28 = \frac{1}{4} \cdot 28 = 7 \Rightarrow P(\mathit{lid} = 2) = P(\mathrm{l\,l}) = \dfrac{\binom{7}{2}}{\binom{28}{2}} \approx 0,056.$

```
7 nCr 2/28 nCr 2
      .0555555556
```

17b Nee, in 17b kan twee keer dezelfde sector worden aangewezen. (bij 17a kies je niet twee keer dezelfde leerling)

18a $P(\mathit{groen} = 2) = P(\underline{\underline{\mathrm{g\,g\,\bar{g}}}}) = \dfrac{\binom{16}{2} \cdot \binom{24}{1}}{\binom{40}{3}} \approx 0,291.$

```
16 nCr 2*24 nCr
1/40 nCr 3
      .2914979757
```

18b $P(\mathit{blauw} \geq 1) = 1 - P(\mathit{blauw} = 0) = 1 - P(\mathrm{\bar{b}\,\bar{b}\,\bar{b}}) = 1 - \dfrac{\binom{16}{3}}{\binom{40}{3}} \approx 0,943.$

```
1-16 nCr 3/40 nC
r 3
      .9433198381
```

18c $P(\mathit{groen} = 2) = P(\underline{\underline{\mathrm{g\,g\,\bar{g}}}}) = \binom{3}{2} \cdot P(\mathrm{g\,g\,\bar{g}}) = \binom{3}{2} \cdot \frac{16}{40} \cdot \frac{16}{40} \cdot \frac{24}{40} = 0,288.$

18d $P(\mathit{blauw} \geq 1) = 1 - P(\mathit{blauw} = 0) = 1 - P(\mathrm{\bar{b}\,\bar{b}\,\bar{b}}) = 1 - \frac{16}{40} \cdot \frac{16}{40} \cdot \frac{16}{40} = 0,936.$

```
3 nCr 2*(16/40)²
*24/40
             .288
1-(16/40)^3
             .936
```

19a $P(\mathit{meisjes} = 4) = P(\mathrm{m\,m\,m\,m}) = (\frac{12}{22})^4 \approx 0,089.$

19b $P(\mathit{meisjes} = 4) = P(\mathrm{m\,m\,m\,m}) = \dfrac{\binom{12}{4}}{\binom{22}{4}} \approx 0,068.$

```
(12/22)^4
      .0885185438
12 nCr 4/22 nCr
4
      .0676691729
```

20a $P(vrouwen=3)=P(\text{v v v})=\dfrac{\binom{38}{3}}{\binom{60}{3}}\approx 0{,}247.$

20b $P(vrouwen=3)=P(\text{v v v})=\dfrac{38}{60}\cdot\dfrac{38}{60}\cdot\dfrac{38}{60}\approx 0{,}254.$

```
38 nCr 3/60 nCr
3
         .2465225015
(38/60)^3
          .254037037
```

21 De eerste en de derde bewering zijn waar. (de tweede hoort bij het trekken met terugleggen van twee keer één knikker)

rood	wit	totaal
p	$50-p$	50

22a $P(\text{rr})=\dfrac{p}{50}\cdot\dfrac{p-1}{49}=\dfrac{p\cdot(p-1)}{50\cdot 49}=\dfrac{p^2-p}{2450}.$

22b $P(\underline{\underline{\text{rw}}})=\binom{2}{1}\cdot P(\text{rw})=2\cdot\dfrac{p}{50}\cdot\dfrac{50-p}{49}=\dfrac{2p\cdot(50-p)}{2450}=\dfrac{p\cdot(50-p)}{1225}=\dfrac{50p-p^2}{1225}.$

22c $P(\underline{\underline{\text{rw}}})=\dfrac{50p-p^2}{1225}>0{,}5$ (met $p\le 50$ en p geheel $\Rightarrow$ TABLE) $\Rightarrow p=22,\ 23,\ 24,\ 25,\ 26,\ 27,\ 28.$

```
Plot1 Plot2 Plot3
\Y1=2*X/50*(50-X
)/49
\Y2=0.5
\Y3=
```

X	Y1	Y2
22	.50286	.5
23	.50694	.5
24	.50939	.5
25	.5102	.5
26	.50939	.5
27	.50694	.5
28	.50286	.5

X=28

rood	blauw	totaal
10	$10-a$	a

23a $P(\text{rr})=\dfrac{10}{a}\cdot\dfrac{9}{a-1}=\dfrac{10\cdot 9}{a\cdot(a-1)}=\dfrac{90}{a^2-a}.$

23b $P(\underline{\underline{\text{rb}}})=\binom{2}{1}\cdot P(\text{rb})=2\cdot\dfrac{10}{a}\cdot\dfrac{a-10}{a-1}=\dfrac{20\cdot(a-10)}{a\cdot(a-1)}=\dfrac{20a-200}{a^2-a}.$

23c $P(\underline{\underline{\text{rb}}})=\dfrac{20a-200}{a^2-a}=\dfrac{10}{21}$ (met $a\ge 10$ en a geheel $\Rightarrow$ TABLE) $\Rightarrow a=15$ en $a=28.$

```
Plot1 Plot2 Plot3
\Y1=(20X-200)/(X
²-X)
\Y2=10/21
\Y3=
```

X	Y1	Y2
12	.30303	.47619
13	.38462	.47619
14	.43956	.47619
15	.47619	.47619
16	.5	.47619
17	.51471	.47619
18	.52288	.47619

X=15

X	Y1	Y2
24	.50725	.47619
25	.5	.47619
26	.49231	.47619
27	.48433	.47619
28	.47619	.47619
29	.46798	.47619
30	.45977	.47619

X=28

24a $P(\text{rr})=\dfrac{15}{n}\cdot\dfrac{14}{n-1}<0{,}1$ (met $n\ge 15$ en n geheel $\Rightarrow$ TABLE) $\Rightarrow n\ge 47.$

24b $P(\underline{\underline{\text{rw}}})=\binom{2}{1}\cdot P(\text{rw})=2\cdot\dfrac{15}{n}\cdot\dfrac{n-15}{n-1}=\dfrac{30\cdot(n-15)}{n\cdot(n-1)}=\dfrac{30n-450}{n^2-n}$
is maximaal (met $n\ge 15$ en n geheel $\Rightarrow$ TABLE) voor $n=29$ en $n=30.$

```
Plot1 Plot2 Plot3
\Y1=15*14/X/(X-1
)
\Y2=0.1
\Y3=
```

X	Y1	Y2
45	.10606	.1
46	.10145	.1
47	.09713	.1
48	.09309	.1
49	.08929	.1
50	.08571	.1
51	.08235	.1

X=47

```
Plot1 Plot2 Plot3
\Y1=2*15*(X-15)/
X/(X-1)
\Y2=
\Y3=
\Y4=
\Y5=
\Y6=
```

X	Y1
25	.5
26	.50769
27	.51282
28	.51587
29	.51724
30	.51724
31	.51613

X=30

25a $P(rood=2)=P(\underline{\underline{\text{r r}\,\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}}})=\dfrac{\binom{3}{2}\cdot\binom{7}{3}}{\binom{10}{5}}\approx 0{,}417.$

25b $P(rood=2)=\dfrac{\binom{30}{2}\cdot\binom{70}{3}}{\binom{100}{5}}\approx 0{,}316.$

```
3 nCr 2*7 nCr 3/
10 nCr 5
         .4166666667
30 nCr 2*70 nCr
3/100 nCr 5
         .3162795109
```

25c $P(rood=2)=\dfrac{\binom{300}{2}\cdot\binom{700}{3}}{\binom{1000}{5}}\approx 0{,}309.$

25d $P(rood=2)=\dfrac{\binom{3000}{2}\cdot\binom{7000}{3}}{\binom{10000}{5}}\approx 0{,}309.$

```
300 nCr 2*700 nC
r 3/1000 nCr 5
         .3094372232
3000 nCr 2*7000
nCr 3/10000 nCr
5
         .3087735222
```

25e $P(rood=2)=P(\underline{\underline{\text{r r}\,\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}}})=\binom{5}{2}\cdot P(\text{r r}\,\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}})=\binom{5}{2}\cdot 0{,}3^2\cdot 0{,}7^3\approx 0{,}309.$

(N.B.: $\frac{3}{10}=\frac{30}{100}=\frac{300}{1000}=\frac{3000}{10000}=0{,}3$ en $\frac{7}{10}=\frac{70}{100}=\frac{700}{1000}=\frac{7000}{10000}=0{,}7$)

```
5 nCr 2*0.3²*0.7
^3
               .3087
```

26a $P(e\text{-}winkelen=0)=P(\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}})=(1-0{,}30)^{15}=0{,}70^{15}\approx 0{,}005.$

26b $P(e\text{-}winkelen=2)=P(\underline{\underline{\text{e e}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}}})=\binom{15}{2}\cdot 0{,}30^2\cdot 0{,}70^{13}\approx 0{,}092.$

```
0.7^15
         .0047475615
15 nCr 2*0.3²*0.
7^13
         .0915601148
```

26c $P(e\text{-}winkelen\ge 2)=1-P(e\text{-}winkelen<2)=1-P(e\text{-}winkelen=0)-P(e\text{-}winkelen=1)=1-0{,}70^{15}-\binom{15}{1}\cdot 0{,}30\cdot 0{,}70^{14}\approx 0{,}965.$

```
1-0.7^15-15 nCr
1*0.3*0.7^14
         .9647324002
```

27a $P(bijtend=0)=P(\overline{\text{by}}\,\overline{\text{by}}\,\overline{\text{by}}\,\overline{\text{by}}\,\overline{\text{by}}\,\overline{\text{by}}\,\overline{\text{by}}\,\overline{\text{by}}\,\overline{\text{by}}\,\overline{\text{by}})=(1-0{,}15)^{10}=0{,}85^{10}\approx 0{,}197.$

27b $P(brandbaar=8 \text{ én } bijtend=2)=P(\underline{\underline{\text{br br br br br br br br by by}}})=\binom{10}{2}\cdot 0{,}60^8\cdot 0{,}15^2\approx 0{,}017.$

27c $P(brandbaar\ge 9)=P(brandbaar=9)+P(brandbaar=10)=\binom{10}{1}\cdot 0{,}60^9\cdot 0{,}40+0{,}60^{10}\approx 0{,}046.$

```
0.85^10
         .1968744043
10 nCr 2*0.6^8*0
.15²
          .017006112
10 nCr 1*0.6^9*0
.4+0.6^10
         .0463574016
```

28a $P(linkshandig=1)=P(\underline{\underline{\text{l r}}})=\binom{2}{1}\cdot P(\text{l r})=\binom{2}{1}\cdot 0{,}18\cdot 0{,}82\approx 0{,}295.$

```
2 nCr 1*0.18*0.8
2
               .2952
```

28b $P(linkshandig\le 1)=P(linkshandig=0)+P(linkshandig=1)=P(\text{r r r r r})+P(\underline{\underline{\text{l r r r r}}})=0{,}82^5+\binom{5}{1}\cdot 0{,}18\cdot 0{,}82^4\approx 0{,}778.$

```
0.82^5+5 nCr 1*0
.18*0.82^4
         .7776494272
```

28c $P(linkshandig\ge 1)=1-P(linkshandig<1)=1-P(linkshandig=0)=1-P(\text{r r r}\ldots\text{r r})=1-0{,}82^n>0{,}99.$
Bladeren in de tabel $\Rightarrow n\ge 24\Rightarrow$ gezelschap moet uit minstens 24 personen bestaan.

```
Plot1 Plot2 Plot3
\Y1=1-0.82^X
\Y2=0.99
\Y3=
\Y4=
\Y5=
\Y6=
\Y7=
```

X	Y1	Y2
20	.98111	.99
21	.98451	.99
22	.9873	.99
23	.98958	.99
24	.99146	.99
25	.993	.99
26	.99426	.99

X=24

28d $P(linkshandig=2)=P(\text{l l})=\dfrac{\binom{9}{2}}{\binom{50}{2}}\approx 0{,}029.$

```
9 nCr 2/50 nCr 2
         .0293877551
```

29a $P(succes = 0) = P(\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}) = (1 - 0{,}06)^{12} = 0{,}94^{12} \approx 0{,}476.$

```
0.94^12
      .4759203148
```

(succes is hier "klagers buiten een straal van 30 km van Schiphol")

29b $P(succes = 2) = P(\underline{\underline{s\,s\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}}}) = \binom{12}{2} \cdot P(s\,s\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}) = \binom{12}{2} \cdot 0{,}09^2 \cdot 0{,}91^{10} \approx 0{,}208.$

```
0.15-0.06
              .09
1-Ans
              .91
12 nCr 2*0.09²*0
.91^10
      .2081818567
```

(succes is hier "klagers in een straal van tussen 20 en 30 km van Schiphol")

29c $P(succes = 2 \text{ en } binnen = 10) = P(\underline{\underline{s\,s\,b\,b\,b\,b\,b\,b\,b\,b\,b\,b}}) = \binom{12}{2} \cdot P(s\,s\,b\,b\,b\,b\,b\,b\,b\,b\,b\,b) = \binom{12}{2} \cdot 0{,}06^2 \cdot 0{,}85^{10} \approx 0{,}047.$

```
12 nCr 2*0.06²*0
.85^10
      .0467773585
```

(succes is hier "klagers buiten een straal van 30 km van Schiphol" en binnen is "klagers binnen een straal van 20 km")

30a $P(eenoudergezin = 0) = P(\bar{e}\,\bar{e}\,\bar{e}\,\bar{e}\,\bar{e}\,\bar{e}\,\bar{e}\,\bar{e}\,\bar{e}\,\bar{e}\,\bar{e}) = (1 - 0{,}12)^{11} = 0{,}88^{11} \approx 0{,}245.$

```
0.88^11
      .2450808589
```

30b $P(eenoudergezin \le 2) = P(eenoudergezin = 0) + P(eenoudergezin = 1) + P(eenoudergezin = 2)$
$= P(\bar{e}\,\bar{e}\,\bar{e}\,\bar{e} \ldots \bar{e}) + P(\underline{\underline{e\,\bar{e}\,\bar{e}\,\bar{e} \ldots \bar{e}}}) + P(\underline{\underline{e\,e\,\bar{e}\,\bar{e} \ldots \bar{e}}}) = 0{,}88^{22} + \binom{22}{1} \cdot 0{,}12 \cdot 0{,}88^{21} + \binom{22}{2} \cdot 0{,}12^2 \cdot 0{,}88^{20} \approx 0{,}498.$

```
0.88^22+22 nCr 1
*0.12*0.88^21+22
 nCr 2*0.12²*0.8
8^20
      .4982633863
```

30c $P(eenoudergezin = 2) = \dfrac{\binom{5}{2} \cdot \binom{30}{4}}{\binom{35}{6}} \approx 0{,}169.$

```
5 nCr 2*30 nCr 4
/35 nCr 6
      .1688373297
```

31a $P(lopen \ge 2) = 1 - P(lopen < 2) = 1 - P(lopen = 0) - P(lopen = 1) = 1 - P(\bar{r}\,\bar{r}\,\bar{r}\,\bar{r} \ldots \bar{r}) - P(\underline{\underline{r\,\bar{r}\,\bar{r}\,\bar{r} \ldots \bar{r}}})$ (hier is r "de rest" $\Rightarrow$ lopend)
$= 1 - P(\bar{r}\,\bar{r}\,\bar{r}\,\bar{r} \ldots \bar{r}) - \binom{18}{1} \cdot P(r\,\bar{r}\,\bar{r}\,\bar{r} \ldots \bar{r}) = 1 - 0{,}95^{18} - \binom{18}{1} \cdot 0{,}05 \cdot 0{,}95^{17} \approx 0{,}226.$

```
1-0.95^18-18 nCr
 1*0.05*0.95^17
      .2264773798
```

31b $P(fietsen = 4 \text{ of } fietsen = 5) = P(\underline{\underline{f\,f\,f\,f\,\bar{f}\,\bar{f}\,\bar{f} \ldots \bar{f}}}) + P(\underline{\underline{f\,f\,f\,f\,f\,\bar{f}\,\bar{f} \ldots \bar{f}}}) = \binom{18}{4} \cdot P(f\,f\,f\,f\,\bar{f}\,\bar{f}\,\bar{f} \ldots \bar{f}) + \binom{18}{5} \cdot P(f\,f\,f\,f\,f\,\bar{f}\,\bar{f} \ldots \bar{f})$
$= \binom{18}{4} \cdot 0{,}25^4 \cdot 0{,}75^{14} + \binom{18}{5} \cdot 0{,}25^5 \cdot 0{,}75^{13} \approx 0{,}412.$

```
18 nCr 4*0.25^4*
0.75^14+18 nCr 5
*0.25^5*0.75^13
      .4117616424
```

31c $P(auto = 12 \text{ én } fietsen = 6) = P(\underline{\underline{a\,a\,a\,a \ldots a\,f\,f\,f\,f\,f\,f}}) = \binom{18}{12} \cdot P(a\,a\,a\,a \ldots a\,f\,f\,f\,f\,f\,f) = \binom{18}{12} \cdot 0{,}60^{12} \cdot 0{,}25^6 \approx 0{,}010.$

```
18 nCr 12*0.6^12
*0.25^6
      .0098656707
```

31d $P(\text{"}fietsen \text{ of } lopen\text{"} = 4) = P(\underline{\underline{s\,s\,s\,s\,\bar{s}\,\bar{s}\,\bar{s} \ldots \bar{s}}}) = \binom{18}{4} \cdot P(s\,s\,s\,s\,\bar{s}\,\bar{s}\,\bar{s} \ldots \bar{s}) = \binom{18}{4} \cdot 0{,}30^4 \cdot 0{,}70^{14} \approx 0{,}168.$

```
18 nCr 4*0.3^4*0
.7^14
      .1681043708
```

31e $P(7{,}2 < auto < 10{,}8) = P(auto = 8) + P(auto = 9) + P(auto = 10)$
$= \binom{18}{8} \cdot 0{,}60^8 \cdot 0{,}40^{10} + \binom{18}{9} \cdot 0{,}60^9 \cdot 0{,}40^9 + \binom{18}{10} \cdot 0{,}60^{10} \cdot 0{,}40^8 \approx 0{,}379.$

```
0.4*18
              7.2
0.6*18
             10.8
```

```
18 nCr 8*0.6^8*0
.4^10+18 nCr 9*0
.6^9*0.4^9+18 nC
r 10*0.6^10*0.4^
8
      .3789118137
```

32a $P(X = 17) = \frac{5}{25} = 0{,}2.$ 32b $P(Y = 1) = \frac{8}{25} = 0{,}32.$ 32c $P(X = 16 \text{ én } Y = 1) = \frac{7}{25} = 0{,}28.$

```
5/25
               .2
8/25
              .32
7/25
              .28
```

33a $P(X \ge 3) = 1 - P(X \le 2).$

33b $P(X \ge 3) = P(X = 3) + P(X = 4) + P(X = 5).$

33c $P(X < 2) = P(X \le 1) = P(X = 0) + P(X = 1).$

33d $P(\text{minstens één rode}) = P(X \ge 1).$

33e $P(\text{hoogstens drie rode}) = P(X \le 3).$

33f $P(\text{minder dan twee rode}) = P(X < 2).$

34a $P(X = 2) = \dfrac{\binom{5}{2} \cdot \binom{5}{2}}{\binom{10}{4}} \approx 0{,}476.$ 34b $P(X \ge 1) = 1 - P(X < 1) = 1 - P(X = 0) = 1 - \dfrac{\binom{5}{4}}{\binom{10}{4}} \approx 0{,}976.$

```
5 nCr 2*5 nCr 2/
10 nCr 4
      .4761904762
1-5 nCr 4/10 nCr
 4
      .9761904762
```

35a • $X > 10$. • $X \ge 10$. • $X \le 10$.

35b $P(X = 3) = \frac{2}{36} \approx 0{,}056$ (zie het rooster hiernaast).
$P(X \ge 10) = \frac{6}{36} \approx 0{,}167$ (zie het rooster hiernaast).

```
2/36
      .0555555556
6/36
      .1666666667
```

6	7	8	9	10	11	12
5	6	7	8	9	10	11
4	5	6	7	8	9	10
3	4	5	6	7	8	9
2	3	4	5	6	7	8
1	2	3	4	5	6	7
+	1	2	3	4	5	6

36a $P(X = 20) = \dfrac{\binom{8}{2}}{\binom{20}{2}} \approx 0{,}147.$

```
8 nCr 2/20 nCr 2
      .1473684211
```

36b $P(X > 0) = 1 - P(X = 0) = 1 - \dfrac{\binom{12}{2}}{\binom{20}{2}} \approx 0{,}653.$

```
1-12 nCr 2/20 nC
r 2
      .6526315789
```

37a $P(X = 16) = \frac{25}{83} \approx 0{,}301.$

```
25/83
      .3012048193
```

37b $P(X = 16) + P(X = 17) + P(X = 18) = \frac{25}{83} + \frac{40}{83} + \frac{18}{83} = \frac{83}{83} = 1.$

38a $P(X = 2) = P(\underline{\underline{w\,w\,\bar{w}\,\bar{w}\,\bar{w}}}) = \dfrac{\binom{5}{2} \cdot \binom{10}{3}}{\binom{15}{5}} \approx 0{,}400.$

```
5 nCr 2*10 nCr 3
/15 nCr 5
      .3996003996
```

38b $P(Y = 0) = P(\bar{r}\,\bar{r}\,\bar{r}\,\bar{r}) = (\frac{7}{15})^4 \approx 0{,}047.$

38c $P(Y \le 3) = 1 - P(Y > 3) = 1 - P(Y = 4) = 1 - P(r\,r\,r\,r) = 1 - (\frac{8}{15})^4 \approx 0{,}919.$

```
(7/15)^4
      .0474271605
1-(8/15)^4
       .919091358
```

39 $P(X=1)=P(\text{r})=\frac{6}{10}=0{,}6.$
$P(X=2)=P(\bar{\text{r}}\,\text{r})=\frac{4}{10}\cdot\frac{6}{9}\approx 0{,}267.$
$P(X=3)=P(\bar{\text{r}}\,\bar{\text{r}}\,\text{r})=\frac{4}{10}\cdot\frac{3}{9}\cdot\frac{6}{8}=0{,}1.$
$P(X=4)=P(\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}\,\text{r})=\frac{4}{10}\cdot\frac{3}{9}\cdot\frac{2}{8}\cdot\frac{6}{7}\approx 0{,}029.$
$P(X=5)=P(\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}\,\text{r})=\frac{4}{10}\cdot\frac{3}{9}\cdot\frac{2}{8}\cdot\frac{1}{7}\cdot\frac{6}{6}\approx 0{,}005.$

```
6/10
                .6
4/10*6/9
       .2666666667
4/10*3/9*6/8
                .1
```

```
4/10*3/9*2/8*6/7
       .0285714286
4/10*3/9*2/8*1/7
*6/6
       .0047619048
```

Kansverdeling van toevalsvariabele X.

x	1	2	3	4	5
$P(X=x)$	0,6	0,267	0,1	0,029	0,005

40a $P(X=3)=P(\text{CCC})+P(\text{NNN})=0{,}6^3+0{,}4^3=0{,}28.$

40b $P(X=4)=P(\underline{\text{CCN}}\,\text{C})+P(\underline{\text{NNC}}\,\text{N})=\binom{3}{2}\cdot 0{,}6^2\cdot 0{,}4\cdot 0{,}6+\binom{3}{2}\cdot 0{,}4^2\cdot 0{,}6\cdot 0{,}4\approx 0{,}374.$
$P(X=5)=P(\underline{\text{CCNN}}\,\text{C})+P(\underline{\text{NNCC}}\,\text{N})=\binom{4}{2}\cdot 0{,}6^2\cdot 0{,}4^2\cdot 0{,}6+\binom{4}{2}\cdot 0{,}4^2\cdot 0{,}6^2\cdot 0{,}4\approx 0{,}346.$
Hiernaast de kansverdeling van toevalsvariabele X.

```
0.6^3+0.4^3
               .28
3 nCr 2*0.6^3*0.
4+3 nCr 2*0.4^3*
0.6
             .3744
```

```
4 nCr 2*0.6^3*0.
4²+4 nCr 2*0.4^3
*0.6²
             .3456
1-0.28-0.3744
             .3456
```

x	3	4	5
$P(X=x)$	0,28	0,374	0,346

41a $P(X=2)=P(\underline{\text{r r}\,\bar{\text{r}}})=\binom{3}{2}\cdot P(\text{r r}\,\bar{\text{r}})=\binom{3}{2}\cdot(\frac{8}{18})^2\cdot\frac{10}{18}\approx 0{,}329.$

41b $P(Y=3)=P(\underline{\text{r b w}})=3!\cdot P(\text{r b w})=3!\cdot\frac{8}{18}\cdot\frac{4}{18}\cdot\frac{6}{18}\approx 0{,}198.$

```
3 nCr 2*(8/18)²*
10/18
       .329218107
3!*8/18*4/18*6/1
8
      .1975308642
```

42a Alle staven van het kanshistogram zijn even lang.

43b $X=\begin{cases}0 \text{ bij kop}\\ 1 \text{ bij munt}\end{cases}\Rightarrow P(X=0)=P(X=1)=\frac{1}{2}.$

42c Vier even grote sectoren met de getallen 1, 2, 3 en 4 $\Rightarrow P(X=1)=P(X=2)=P(X=3)=P(X=4)=\frac{1}{4}.$

43a $P(X=8)=P(\underline{\text{z z z z z z z z}\,\bar{\text{z}}\,\bar{\text{z}}})=\binom{10}{8}\cdot P(\text{z z z z z z z z}\,\bar{\text{z}}\,\bar{\text{z}})=\binom{10}{8}\cdot 0{,}8^8\cdot 0{,}2^2\approx 0{,}302.$

43b $P(X<9)=1-P(X\geq 9)=1-P(X=9)-P(X=10)=1-P(\underline{\text{z z z z z z z z z}\,\bar{\text{z}}})-P(\text{z z z z z z z z z z})$
$=1-\binom{10}{9}\cdot P(\text{z z z z z z z z z}\,\bar{\text{z}})-P(\text{z z z z z z z z z z})=1-\binom{10}{9}\cdot 0{,}8^9\cdot 0{,}2-0{,}8^{10}\approx 0{,}624.$

```
10 nCr 8*0.8^8*0
.2²
       .301989888
1-10 nCr 9*0.8^9
*0.2-0.8^10
      .6241903616
```

44a $P(X=7)=P(\underline{\text{e e e e e e e}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}})=\binom{12}{7}\cdot P(\text{e e e e e e e}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}}\,\bar{\text{e}})=\binom{12}{7}\cdot 0{,}58^7\cdot 0{,}42^5\approx 0{,}229.$

44b $P(Y=4)=P(\underline{\text{m m m m}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}})=\binom{12}{4}\cdot P(\text{m m m m}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}})=\binom{12}{4}\cdot 0{,}32^4\cdot 0{,}68^8\approx 0{,}237.$

```
12 nCr 7*0.58^7*
0.42^5
      .2285428235
12 nCr 4*0.32^4*
0.68^8
      .2372883486
```

44c $P(Y\geq 2)=1-P(Y<2)=1-P(Y=0)-P(Y=1)=1-P(\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\ldots\bar{\text{m}})-P(\underline{\text{m}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\ldots\bar{\text{m}}})$
$=1-P(\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\ldots\bar{\text{m}})-\binom{12}{1}\cdot P(\text{m}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\,\bar{\text{m}}\ldots\bar{\text{m}})=1-0{,}68^{12}-\binom{12}{1}\cdot 0{,}32\cdot 0{,}68^{11}\approx 0{,}935.$

44d $P(X=8 \text{ en } Y=4)=P(\underline{\text{e e e e e e e e m m m m}})=\binom{12}{8}\cdot P(\text{e e e e e e e e m m m m})=\binom{12}{8}\cdot 0{,}58^8\cdot 0{,}32^4\approx 0{,}066.$

```
1-0.68^12-12 nCr
 1*0.32*0.68^11
      .9350264682
12 nCr 8*0.58^8*
0.32^4
      .0664705176
```

45a $P(X=0)=\frac{17}{24}\approx 0{,}708$ en $P(X=1)=\frac{6}{24}=0{,}25.$

```
17/24
      .7083333333
6/24
              .25
```

45b $P(X=1\mid Y=0)=\frac{X=1 \text{ én } Y=0}{Y=0}=\frac{2}{8}.$

45c $P(X=1\mid Y=0)=\frac{X=1 \text{ én } Y=0}{Y=0}=\frac{2}{8}=\frac{1}{4}$ en $P(X=1)=\frac{6}{24}$ (zie 45a) $=\frac{1}{4}\Rightarrow P(X=1\mid Y=0)=P(X=1).$
$P(X=1\mid Y=1)=\frac{X=1 \text{ én } Y=1}{Y=1}=\frac{4}{16}=\frac{1}{4}$ en $P(X=1)=\frac{6}{24}$ (zie 45a) $=\frac{1}{4}\Rightarrow P(X=1\mid Y=1)=P(X=1).$

45de $P(X=0\mid Y=0)=\frac{X=0 \text{ én } Y=0}{Y=0}=\frac{5}{8}$ en $P(X=0)=\frac{17}{24}$ (zie 45a) $\neq\frac{5}{8}=\frac{15}{24}\Rightarrow P(X=0\mid Y=0)\neq P(X=0).$

46a $P(X=15\mid Y=0)=\frac{X=15 \text{ én } Y=0}{Y=0}=\frac{25}{50}=\frac{1}{2}.$

46c $P(X=15\mid Y=1)=\frac{X=15 \text{ én } Y=1}{Y=1}=\frac{0}{25}=0.$

46b $P(X=17\mid Y=0)=\frac{X=17 \text{ én } Y=0}{Y=0}=\frac{0}{50}=0.$

46d $P(X=15)=\frac{25}{80}\neq 0\Rightarrow X$ en Y zijn (niet on)afhankelijk .

47a $P(X=2)=\frac{1}{36}.$

47b $P(X=2\mid Y=3)=\frac{X=2 \text{ én } Y=3}{Y=3}=\frac{0}{2}=0.$

47c $P(X=2\mid Y=3)\neq P(X=2)\Rightarrow X$ en Y zijn (niet on)afhankelijk.

48 Winst (/week) = opbrengst − kosten $=1000\cdot 5-2\,000-100\cdot 20=1000$ (€). Dus de winst per lot is gemiddeld 1 euro.

49a Zie de kansverdeling van U (= de uitbetaling per lot) hiernaast.

u	50	10	0
$P(U=u)$	0,01	0,03	0,96

De kansverdeling

49b $E(U)=50\cdot 0{,}01+10\cdot 0{,}03+0\cdot 0{,}96=0{,}80$ (€/lot).
$E(W)=E(U)-2=0{,}80-2=-1{,}20$ (€/lot).

```
50*0.01+10*0.03
               .8
```

49c Om van een eerlijke loterij (geen winst en geen verlies) te kunnen spreken moet een lot 0,80 (€) kosten.

50 U is de uitbetaling per klant. $P(U=100)=P(\text{rr})=\frac{2}{20}\cdot\frac{1}{19}=\frac{1}{190}$;
$P(U=20)=P(\underline{\underline{\text{rb}}})=2\cdot P(\text{rb})=2\cdot\frac{2}{20}\cdot\frac{4}{19}=\frac{8}{190}$ en $P(U=0)=1-\frac{1}{190}-\frac{8}{190}=\frac{181}{190}$.
$E(U)=100\cdot\frac{1}{190}+20\cdot\frac{8}{190}+0\cdot\frac{181}{190}\approx 1{,}37$ (€/klant).

```
100*1/190+20*8/1
90
      1.368421053
```

u	100	20	0
$P(U=u)$	$\frac{1}{190}$	$\frac{8}{190}$	$\frac{181}{190}$

De kansverdeling

51a $W=U-1$ is de winst (voor een deelnemer) per spel.
situatie 1 $P(W=1)=P(\text{som}<7)=\frac{15}{36}$ (zie het rooster) $\Rightarrow P(W=-1)=\frac{21}{36}$.
$E(W)=1\cdot\frac{15}{36}-1\cdot\frac{21}{36}=\frac{15}{36}-\frac{21}{36}=-\frac{6}{36}$ (€/spel).
situatie 2 $P(W=1)=P(\text{som}>7)=\frac{15}{36}$ (zie het rooster) $\Rightarrow P(W=-1)=\frac{21}{36}$.
$E(W)=1\cdot\frac{15}{36}-1\cdot\frac{21}{36}=\frac{15}{36}-\frac{21}{36}=-\frac{6}{36}$ (€/spel).
situatie 3 $P(W=4)=P(\text{som}=7)=\frac{6}{36}$ (zie het rooster) $\Rightarrow P(W=-1)=\frac{30}{36}$.
$E(W)=4\cdot\frac{6}{36}-1\cdot\frac{30}{36}=\frac{24}{36}-\frac{30}{36}=-\frac{6}{36}$ (€/spel).

w	1	-1
$P(W=w)$	$\frac{15}{36}$	$\frac{21}{36}$

w	1	-1
$P(W=w)$	$\frac{15}{36}$	$\frac{21}{36}$

w	4	-1
$P(W=w)$	$\frac{6}{36}$	$\frac{30}{36}$

6	7	8	9	10	11	12
5	6	7	8	9	10	11
4	5	6	7	8	9	10
3	4	5	6	7	8	9
2	3	4	5	6	7	8
1	2	3	4	5	6	7
+	**1**	**2**	**3**	**4**	**5**	**6**

51b $E(W)=(u-1)\cdot\frac{6}{36}-1\cdot\frac{30}{36}=0\Rightarrow u-1=5\Rightarrow u=6$. De uitbetaling (bij de som van het aantal ogen is 7) moet 6 euro zijn.

52a $W=u-10$. (in de ogen van de organisatoren)
$P(W=-90)=P(\text{drie gelijke})=P(ggg)=1\cdot\frac{1}{6}\cdot\frac{1}{6}=\frac{1}{36}$.
$P(W=-5)=P(\text{twee gelijke})=P(\underline{\underline{gg\bar{g}}})=\binom{3}{2}\cdot P(gg\bar{g})=3\cdot 1\cdot\frac{1}{6}\cdot\frac{5}{6}=\frac{15}{36}$.
$P(W=10)=1-\frac{1}{36}-\frac{15}{36}=\frac{20}{36}$.
$E(W)=-90\cdot\frac{1}{36}-5\cdot\frac{15}{36}+10\cdot\frac{20}{36}=\frac{35}{36}$ (€/spel).

w	-90	-5	10
$P(W=w)$	$\frac{1}{36}$	$\frac{15}{36}$	$\frac{20}{36}$

```
-90*1-5*15+10*20
               35
Ans/36
      .9722222222
```

```
100+15*15
              325
3930/325
      12.09230769
```

52b Stel n prijzen van € 100. Daarbij horen $15n$ prijzen van € 15.
$100n+15\cdot 15n=3\,930\Rightarrow 325n=3\,930\Rightarrow n=\frac{3930}{325}\approx 12{,}1$. Dus 12 prijzen van € 100 is het meest waarschijnlijk.

53a In **situatie 2** is: $P(O=1039)=0{,}20$ en $P(O=1039-250)=P(O=789)=0{,}80$.
$E(O)=1039\cdot 0{,}20+789\cdot 0{,}8=839$ (€/fiets).
Omdat $839<889$ zal hij de fietsen tegen de adviesprijs van € 889,- verkopen.

o	1039	789
$P(O=o)$	0,2	0,8

53b Stel het percentage kopers dat de € 250,- euro komt opeisen p.
Los nu op: $E(O)=1039\cdot(1-0{,}01p)+789\cdot 0{,}01p=889$. Dit geeft:
$1039-0{,}250p=889\Rightarrow -2{,}50p=-150\Rightarrow p=60$.
Hij verwacht minder dan 60% van de klanten na twee jaar terug.

```
(-1039+789)*0.01
             -2.5
889-1039
             -150
150/2.5
               60
```

o	1039	789
$P(O=o)$	$1-0{,}01p$	$0{,}01p$

54a $P(X=1)=0{,}99^{25}$ en $P(X=26)=1-P(X=1)=1-0{,}99^{25}$.
$E(X)=1\cdot 0{,}99^{25}+26\cdot(1-0{,}99^{25})\approx 6{,}55$ (tests/groep van 25 personen).

```
1*0.99^25+26*(1-
0.99^25)
      6.554466015
Ans*1000/25
      262.1786406
```

54b 1000 personen zijn $\frac{1000}{25}=40$ groepen van 25 personen.
Je verwacht (ongeveer) 262 tests. Dit is een besparing van 738 tests $\Rightarrow$ een besparing van 73,8%.

54c $P(X=1)=0{,}99^{20}$ en $P(X=21)=1-0{,}99^{20}$.
$E(X)=1\cdot 0{,}99^{20}+21\cdot(1-0{,}99^{20})\approx 4{,}64$ (tests/groep van 20 personen).
Je verwacht nu (ongeveer) 232 tests.

```
1*0.99^20+21*(1-
0.99^20)
      4.641861248
Ans*1000/20
      232.0930624
```

54d $Y=1$ en $Y=n+1$ met als kansverdeling: $P(Y=1)=0{,}99^n$ en $P(Y=n+1)=1-0{,}99^n$.

54e $E(Y)=1\cdot 0{,}99^n+(n+1)\cdot(1-0{,}99^n)=0{,}99^n+n-n\cdot 0{,}99^n+1-0{,}99^n=n+1-n\cdot 0{,}99^n$ (tests/groep van n personen).
Je verwacht $\frac{1000\cdot(n+1-n\cdot 0{,}99^n)}{n}=\frac{1000n}{n}+\frac{1000}{n}-\frac{1000n\cdot 0{,}99^n}{n}=1000+\frac{1000}{n}-1000\cdot 0{,}99^n$ tests.

54f $1000+\frac{1000}{n}-1000\cdot 0{,}99^n$ is minimaal (met $n\geq 1$ en n geheel $\Rightarrow$ TABLE) voor $n=11$.
Bij $n=11$ horen ongeveer 196 test.
Dit is een besparing van 804 test (ten opzichte van iedereen afzonderlijk testen).

```
Plot1 Plot2 Plot3
\Y1=1000+1000/X-
1000*0.99^X
\Y2=
```

X	Y1
7	210.79
8	202.26
9	197.59
10	195.62
11	195.57
12	196.95
13	199.4

Y1=195.57083665

55 $P(\text{minstens één waardebon})=1-P(\text{geen waardebon})=1-P(\bar{w}\,\bar{w}\,\bar{w}\,\bar{w})=1-\frac{\binom{17}{4}}{\binom{20}{4}}\approx 0{,}509$.

```
1-17 nCr 4/20 nC
r 4
      .5087719298
```

56 $p=P(\text{succes})=P(\text{minstens één prijs})=1-P(\text{geen prijs})=1-\frac{\binom{45}{3}}{\binom{50}{3}}\approx 0{,}276$.

57a $p = P(66) = \frac{1}{6}\cdot\frac{1}{6} = \frac{1}{36}$. (of zie het rooster hiernaast)

57b $p = P(\text{twee gelijke}) = P(\text{willekeurig aantal})\cdot P(\text{hetzelfde aantal}) = 1\cdot\frac{1}{6} = \frac{1}{6}$.

57c $p = P(\text{som} > 10) = P(\text{som is 11 of 12}) = \frac{3}{36}$. (zie het rooster hiernaast)

6	7	8	9	10	11	12
5	6	7	8	9	10	11
4	5	6	7	8	9	10
3	4	5	6	7	8	9
2	3	4	5	6	7	8
1	2	3	4	5	6	7
+	**1**	**2**	**3**	**4**	**5**	**6**

58a $p = P(\text{één kleur}) = P(\text{rrr}) + P(\text{www}) + P(\text{ggg}) = \dfrac{\binom{3}{3}}{\binom{10}{3}} + \dfrac{\binom{3}{3}}{\binom{10}{3}} + \dfrac{\binom{4}{3}}{\binom{10}{3}} = 0{,}05.$

```
(1+1+4)/10 nCr 3
                .05
```

58b $P(\text{geen keer succes}) = P(\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}) = 0{,}95^5 \approx 0{,}774.$

58c $P(\text{alleen de eerste keer susses}) = P(s\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}) = 0{,}05\cdot 0{,}95^4 \approx 0{,}041.$

58d $P(\text{één keer susses}) = P(\underline{\underline{s\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}}}) = \binom{5}{1}\cdot P(s\,\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}) = \binom{5}{1}\cdot 0{,}05\cdot 0{,}95^4 \approx 0{,}204.$

```
0.95^5
       .7737809375
0.05*0.95^4
       .0407253125
Ans*5
       .2036265625
```

59a $n = 6$ en $p = \frac{8}{20} = 0{,}4$ (kort: binom(6, 0.4)) $\Rightarrow P(X=4) = P(\underline{\underline{\text{rrrr}\bar{\text{r}}\bar{\text{r}}}}) = \binom{6}{4}\cdot 0{,}4^4\cdot 0{,}6^2 \approx 0{,}138.$

59b $n = 12$ en $p = \frac{18}{20} = 0{,}9 \Rightarrow P(Y=10) = P(\underline{\underline{\bar{w}\bar{w}\bar{w}\bar{w}\bar{w}\bar{w}\bar{w}\bar{w}\bar{w}\bar{w}ww}}) = \binom{12}{10}\cdot 0{,}9^{10}\cdot 0{,}1^2 \approx 0{,}230.$

```
6 nCr 4*0.4^4*0.
6²
            .13824
12 nCr 10*0.9^10
*0.1²
      .2301277705
```

59c Nee, ze pakt zonder terugleggen dus ze voert niet telkens hetzelfde experiment uit.
$P(Z=3) = P(\underline{\underline{ggg\bar{g}}}) = \binom{4}{3}\cdot P(ggg\bar{g}) = \binom{4}{3}\cdot\frac{10}{20}\cdot\frac{9}{19}\cdot\frac{8}{18}\cdot\frac{10}{17} \approx 0{,}248.$ OF: $\dfrac{\binom{10}{3}\cdot\binom{10}{1}}{\binom{20}{4}} \approx 0{,}248$

```
4*10*9*8*10/20/1
9/18/17
       .2476780186
10 nCr 3*10/20 n
Cr 4
       .2476780186
```

60a $\text{binom}(10, 0.3) \Rightarrow P(X=5) = P(\underline{\underline{sssss\bar{s}\bar{s}\bar{s}\bar{s}\bar{s}}}) = \binom{10}{5}\cdot 0{,}3^5\cdot 0{,}7^5 \approx 0{,}103.$

60b $\text{binom}(5, 0.3) \Rightarrow P(\bar{s}\,\bar{s}\,\bar{s}\,\bar{s}\,s) = 0{,}7^4\cdot 0{,}3 \approx 0{,}072.$

```
10 nCr 5*0.3^5*0
.7^5
       .1029193452
0.7^4*0.3
            .07203
```

61a De letter b, want $P(X=k) = \binom{n}{k}\cdot p^k\cdot(1-p)^{n-k}$.

61b $P(\text{succes}) = b$ en $P(\text{mislukking}) = a \Rightarrow a + b = 1$. Hieruit volgt $(a+b)^n = 1^n = 1$.
Rechts van het $=$-teken in het binomium van Newton staan de kansen op alle mogelijke uitkomstens bij een binomiaal kansexperiment. Dus de som van alle kansen is 1.

62a $P(X \le 2) = P(X=0) + P(X=1) + P(X=2) = 0{,}512 + 0{,}384 + 0{,}096 = 0{,}992.$

62b $P(X \le 3)$ is de kans op alle mogelijke uitkomsten bij dit experiment en deze kans is 1.

62c Er zijn geen waarden kleiner dan 0 mogelijk.

62d Zie de tabel hiernaast.

x	0	1	2	3
$P(X \le x)$	0,512	0,896	0,992	1

```
0.512+0.384
              .896
Ans+0.096
              .992
Ans+0.008
                 1
```

✻✻✻ **Neem GR - practicum 2 door.** (zie aan het eind van deze uitwerkingen)

63a $P(W=3) = \text{binompdf}(10, \frac{1}{6}, 3) \approx 0{,}155.$

63b $P(R \le 5) = \text{binomcdf}(12, \frac{2}{6}, 5) \approx 0{,}822.$

```
binomcdf(10,1/6,
3)
       .9302721577
binomcdf(12,2/6,
5)
       .8222775424
```

de toets met de komma is de toets boven de 7-toets

63c $P(B \ge 1) = 1 - P(B=0) = 1 - \text{binompdf}(9, \frac{3}{6}, 0) \approx 0{,}998.$

63d $P(\underline{\underline{\text{bbbbbrrr}}}) = \binom{8}{5}\cdot(\frac{3}{6})^5\cdot(\frac{2}{6})^3 \approx 0{,}065.$

```
1-binomcdf(9,3/6
,0)
        .998046875
8 nCr 5*(3/6)^5*
(2/6)^3
       .0648148148
```

heb je een cijfer fout ingetoetst of wil je enkele cijfers wijzigen roep dan de vorige regel op met 2nd ENTER

63e $P(\underline{\underline{\text{bbbbbbbbrrrrrwww}}}) = \binom{16}{8}\cdot\binom{8}{5}\cdot(\frac{3}{6})^8\cdot(\frac{2}{6})^5\cdot(\frac{1}{6})^3 \approx 0{,}054.$

```
16 nCr 8*8 nCr 5
*(3/6)^8*(2/6)^5
*(1/6)^3
       .0536372599
```

64a $P(E=5) = \text{binompdf}(10, 0.55, 5) \approx 0{,}234.$

64b $P(\bar{e}\,\bar{e}\,eeee) = 0{,}45^2\cdot 0{,}55^4 \approx 0{,}019.$

```
binompdf(10,0.55
,5)
       .2340327076
0.45²*0.55^4
       .0185300156
```

65a X is het aantal keer twee rode knikkers. $p = P(\text{rr}) = \frac{6}{9}\cdot\frac{5}{8} = \frac{30}{72} = \frac{5}{12}$.
$P(X=3) = \text{binompdf}(8, \frac{5}{12}, 3) \approx 0{,}274.$

```
6/9*5/8▶Frac
              5/12
binompdf(8,5/12,
3)
       .2736139726
```

65b $p = P(\text{ww}) = \frac{3}{9}\cdot\frac{2}{8} = \frac{6}{72} = \frac{1}{12} \Rightarrow P(Y \le 2) = \text{binomcdf}(8, \frac{1}{12}, 2) \approx 0{,}976.$

65c $p = 1 - P(\text{rr}) - P(\text{ww}) = 1 - \frac{5}{12} - \frac{1}{12} = \frac{6}{12} = \frac{1}{2} \Rightarrow P(Z=4) = \text{binompdf}(8, \frac{1}{2}, 4) \approx 0{,}273.$

```
binomcdf(8,1/12,
2)
       .9764600701
binompdf(8,1/2,4
)
          .2734375
```

65d $P(\underline{\underline{R=4 \text{ en } Z=4}}) = \binom{8}{4}\cdot(\frac{5}{12})^4\cdot(\frac{1}{2})^4 \approx 0{,}132.$

```
8 nCr 4*(5/12)^4
*(1/2)^4
       .1318660783
```

66a $P(X=10) = \text{binompdf}(60, 0.16, 10) \approx 0{,}136.$

66b $P(Y \le 2) = \text{binomcdf}(60, \frac{1}{4} \times 0.16, 2) \approx 0{,}568.$

66c $P(Z = \frac{1}{4} \times 60) = \text{binompdf}(60, \frac{3}{4} \times 0.16, \frac{1}{4} \times 60) \approx 0{,}003.$

67 X is het aantal ondeugdelijke accu's. $P(X \le 3) = \text{binomcdf}(54, 0.20, 3) \approx 0{,}003.$

68a $p = P(\text{ogen} > 5) = \frac{2}{6} \Rightarrow P(X \le 10) = \text{binomcdf}(15, \frac{2}{6}, 10) \approx 0{,}998.$

68b $p = P(\text{som} > 7) = \frac{15}{36}$ (zie het rooster) $\Rightarrow P(Y = 5) = \text{binompdf}(18, \frac{15}{36}, 5) \approx 0{,}097.$

+	1	2	3	4	5	6
6	7	8	9	10	11	12
5	6	7	8	9	10	11
4	5	6	7	8	9	10
3	4	5	6	7	8	9
2	3	4	5	6	7	8
1	2	3	4	5	6	7

69a $P(X \ge 4).$

69b $P(X < 8).$

69c $P(X > 5) = 1 - P(X \le 5).$

69d $P(X \ge 10) = 1 - P(X < 10) = 1 - P(X \le 9).$

69e $P(X < 7) = P(X \le 6).$

69f $P(12 \le X \le 20) = P(X \le 20) - P(X \le 11).$

69g $P(4 < X < 12) = P(X \le 11) - P(X \le 4).$

69h $P(2 \le X < 5) = P(X \le 4) - P(X \le 1).$

69i $P(4 < X \le 8) = P(X \le 8) - P(X \le 4).$

69j $P(X$ <u>tussen</u> 8 en 20$) = P(8 < X < 20) = P(X \le 19) - P(X \le 8).$

70a $P(X < 10) = P(X \le 9) = \text{binomcdf}(25, 0.42, 9) \approx 0{,}347.$

70b $P(X \ge 8) = 1 - P(X \le 7) = 1 - \text{binomcdf}(25, 0.42, 7) \approx 0{,}889.$

70c $P(X > 12) = 1 - P(X \le 12) = 1 - \text{binomcdf}(25, 0.42, 12) \approx 0{,}208.$

70d $P(9 < X < 16) = \text{binomcdf}(25, 0.42, 15) - \text{binomcdf}(25, 0.42, 9) \approx 0{,}631.$

70e $P(X \ge 6) = 1 - P(X \le 5) = 1 - \text{binomcdf}(25, 0.42, 5) \approx 0{,}982.$

70f $P(X = 9) + P(X = 10) = \text{binompdf}(25, 0.42, 9) + \text{binompdf}(25, 0.42, 10) \approx 0{,}294.$

71a $P(A \ge 5) = 1 - P(A \le 4) = 1 - \text{binomcdf}(10, \frac{3}{6}, 4) \approx 0{,}623.$

71b $P(10 < A < 20) = \text{binomcdf}(25, \frac{3}{6}, 19) - \text{binomcdf}(25, \frac{3}{6}, 10) \approx 0{,}786.$

71c $P(A > 60) = 1 - P(A \le 60) = 1 - \text{binomcdf}(100, \frac{3}{6}, 60) \approx 0{,}018.$

71d $P(K = 7) = \text{binompdf}(35, \frac{1}{6}, 7) \approx 0{,}146.$

72a $P(X > 20) = 1 - P(X \le 20) = 1 - \text{binomcdf}(80, 0.137, 20) \approx 0{,}002.$

72b $P(Y \le 15) = \text{binomcdf}(80, 0.286, 15) \approx 0{,}030.$

72c $P(16 < Z < 32) = \text{binomcdf}(80, 0.332, 31) - \text{binomcdf}(80, 0.332, 16) \approx 0{,}872.$

73a X is het aantal keer twee rode knikkers. $p = P(\text{rr}) = \frac{12}{25} \cdot \frac{11}{24} = \frac{11}{50}.$
$P(X = 3) = \text{binompdf}(15, \frac{11}{50}, 3) \approx 0{,}246.$

73b Y is het aantal keer één zwarte knikker. $p = P(\underline{\underline{z\bar{z}}}) = \binom{2}{1} P(z\bar{z}) = 2 \cdot \frac{8}{25} \cdot \frac{17}{24} = \frac{34}{75}.$
$P(Y \ge 10) = 1 - P(Y \le 9) = 1 - \text{binomcdf}(15, \frac{34}{75}, 9) \approx 0{,}081.$

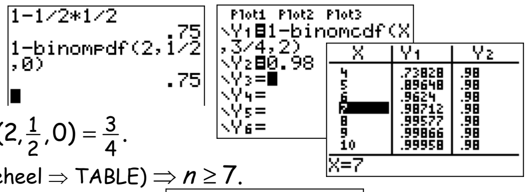
73c Z is het aantal keer twee knikkers van dezelfde kleur. $p = P(\text{rr}) + P(\text{zz}) + P(\text{ww}) = \frac{12}{25} \cdot \frac{11}{24} + \frac{8}{25} \cdot \frac{7}{24} + \frac{5}{25} \cdot \frac{4}{24} = \frac{26}{75}.$
$P(Z < 6) = P(Z \le 5) = \text{binomcdf}(15, \frac{26}{75}, 5) \approx 0{,}575.$

73d W is het aantal keer minstens één rode knikkers. $p = 1 - P(\bar{r}\bar{r}) = 1 - \frac{13}{25} \cdot \frac{12}{24} = \frac{37}{50}.$
$P(W \ge 8) = 1 - P(W \le 7) = 1 - \text{binomcdf}(15, \frac{37}{50}, 7) \approx 0{,}978.$

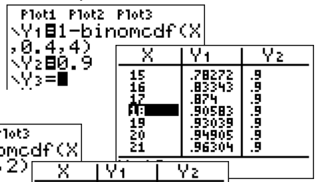
74a X is het aantal keer twee keer munt. $p = P(\text{mm}) = \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{4}.$
$P(X \le 5) = \text{binomcdf}(30, \frac{1}{4}, 5) \approx 0{,}203.$

74b Y is het aantal keer som ≥ 7. $p = P(\text{som} \ge 7) = \frac{21}{36}$ (zie het rooster naast 51a). $P(Y = 5) = \text{binompdf}(18, \frac{21}{36}, 5) \approx 0{,}007.$

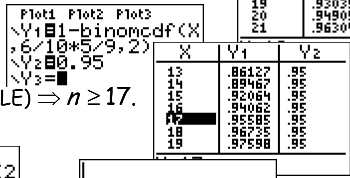
75a X is het aantal keer munt. $P(X \ge 5) = 1 - P(X \le 4) = 1 - \text{binomcdf}(n, \frac{1}{2}, 4).$
$1 - \text{binomcdf}(n, \frac{1}{2}, 4) > 0{,}99$ (met $n \ge 5$ en n geheel $\Rightarrow$ TABLE) $\Rightarrow n \ge 19.$



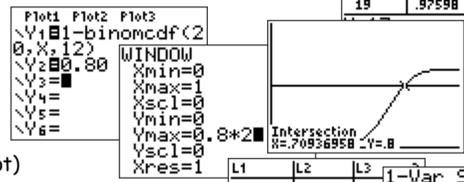
75b $p = P(\text{minstens één munt}) = 1 - P(\text{geen munt}) = 1 - P(\text{kk}) = 1 - \frac{1}{2} \cdot \frac{1}{2} = \frac{3}{4}$.
Of: $p = P(\text{minstens één munt}) = P(X \geq 1) = 1 - P(X = 0) = 1 - \text{binompdf}(2, \frac{1}{2}, 0) = \frac{3}{4}$.
$P(Y > 2) = 1 - P(Y \leq 2) = 1 - \text{binomcdf}(n, \frac{3}{4}, 2) > 0{,}98$ (met $n > 2$ en n geheel $\Rightarrow$ TABLE) $\Rightarrow n \geq 7$.



76 $P(X \geq 5) = 1 - P(X \leq 4) = 1 - \text{binomcdf}(n, 0.4, 4) > 0{,}9$ (n geheel $\Rightarrow$ TABLE) $\Rightarrow n \geq 18$.
Hij moet minstens 18 vrije worpen nemen.

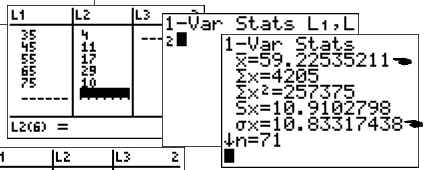


77 $P(\text{ww}) = \frac{6}{10} \cdot \frac{5}{9}$. X is het aantal keer twee wit.
$P(X \geq 3) = 1 - P(X \leq 2) = 1 - \text{binomcdf}(n, \frac{6}{10} \cdot \frac{5}{9}, 2) > 0{,}95$ (n geheel $\Rightarrow$ TABLE) $\Rightarrow n \geq 17$.



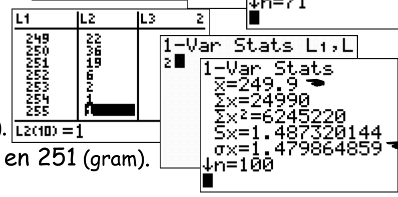
78 $P(X > 12) = 1 - P(X \leq 12) = 1 - \text{binomcdf}(20, p, 12)$.
$1 - \text{binomcdf}(20, p, 12) \geq 0{,}80$ (intersect) $\Rightarrow p \geq 0{,}71$.

79 De volgorde is V5a, V5d, V5b, V5c.
(denk aan een hoeveelheid zand die op een hoop wordt gekiept)



✻✻✻ **Neem GR - practicum 3 door.** (zie aan het eind van deze uitwerkingen)

80 1-Var Stats L1,L2 geeft $\overline{x} \approx 59{,}2$ en $\sigma \approx 10{,}8$.



81a Maak lijsten op de GR. (in L1 de gewichten en in L2 de frequenties)
1-Var Stats L1, L2 $\Rightarrow \overline{x} = 249{,}9$ (gram) en $\sigma \approx 1{,}5$ (gram).

81b $\overline{x} - \sigma \approx 249{,}9 - 1{,}5 = 248{,}4$ (gram) en $\overline{x} + \sigma \approx 249{,}9 + 1{,}5 = 251{,}4$ (gram).
Tussen deze grenzen liggen de pakken met een gewicht van 249, 250 en 251 (gram).
Dus $22 + 36 + 19 = 77$ pakken.

82a Het meest waarschijnlijk is 8 cm. 8b Het meest waarschijnlijk is 1,8.

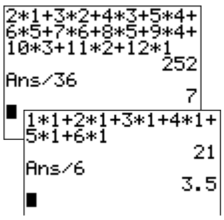
r 6	7	8	9	10	11	12
o 5	6	7	8	9	10	11
o 4	5	6	7	8	9	10
d 3	4	5	6	7	8	9
2	3	4	5	6	7	8
1	2	3	4	5	6	7
+	**1 g**	**2 r**	**3 o**	**4 e**	**5 n**	**6**

83a $P(Z = 4) = \frac{3}{36}$ (zie het rooster hiernaast).

83b De kansverdeling van het aantal ogen bij het gooien met twee dobbelstenen.

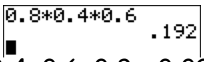
z	2	3	4	5	6	7	8	9	10	11	12
$Z = z$	$\frac{1}{36}$	$\frac{2}{36}$	$\frac{3}{36}$	$\frac{4}{36}$	$\frac{5}{36}$	$\frac{6}{36}$	$\frac{5}{36}$	$\frac{4}{36}$	$\frac{3}{36}$	$\frac{2}{36}$	$\frac{1}{36}$

$E(Z) = 2 \cdot \frac{1}{36} + 3 \cdot \frac{2}{36} + 4 \cdot \frac{3}{36} + 5 \cdot \frac{4}{36} + 6 \cdot \frac{5}{36} + \ldots + 12 \cdot \frac{1}{36} = 7$.

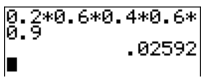


83c $E(X) = E(Y) = 1 \cdot \frac{1}{6} + 2 \cdot \frac{1}{6} + 3 \cdot \frac{1}{6} + 4 \cdot \frac{1}{6} + 5 \cdot \frac{1}{6} + 6 \cdot \frac{1}{6} = 3{,}5$.
$$\left.\begin{array}{l} E(X+Y) = E(Z) = 7 \\ E(X) + E(Y) = 3{,}5 + 3{,}5 = 7 \end{array}\right\} \Rightarrow E(X+Y) = E(X) + E(Y).$$

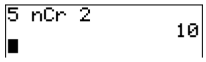
84a $P(\text{ma, di en wo droog}) = 0{,}80 \cdot 0{,}40 \cdot 0{,}60 = 0{,}192$.



84b $P(\text{ma, di en wo regen en do en vr droog}) = 0{,}2 \cdot 0{,}6 \cdot 0{,}4 \cdot 0{,}6 \cdot 0{,}9 \approx 0{,}026$.

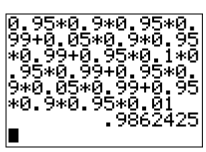


84c $X = 2$ betekent dat het op twee van de 5 dagen regent. Dus $\binom{5}{2} = 10$ kansen te berekenen.



84d $X = X_{ma} + X_{di} + X_{wo} + X_{do} + X_{vr}$ is het aantal dagen dat het de periode regent. Met $X = 0$, $X = 1$, $X = 2$, ... $X = 5$.
Zo is bijvoorbeeld $X = 1 + 0 + 1 + 0 + 1 = 3$ als $X_{ma} = X_{wo} = X_{vr} = 1$ en $X_{di} = X_{do} = 0$ (het alleen ma, wo en vr regent).

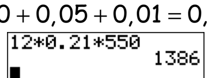
84e $E(X) = E(X_{ma} + X_{di} + X_{wo} + X_{do} + X_{vr}) = E(X_{ma}) + E(X_{di}) + E(X_{wo}) + E(X_{do}) + E(X_{vr}) = 0{,}2 + 0{,}6 + 0{,}4 + 0{,}4 + 0{,}1 = 1{,}7$.

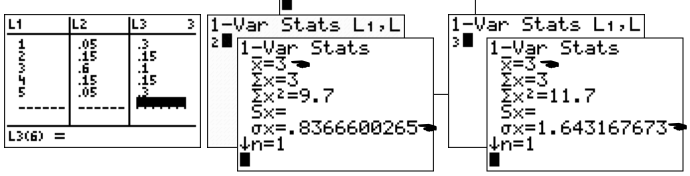


85a $P(\text{hoogstens één}) = P(\text{geen}) + P(\text{één}) = 0{,}95 \cdot 0{,}9 \cdot 0{,}95 \cdot 0{,}99 + 0{,}05 \cdot 0{,}9 \cdot 0{,}95 \cdot 0{,}99$
$+ 0{,}95 \cdot 0{,}1 \cdot 0{,}95 \cdot 0{,}99 + 0{,}95 \cdot 0{,}9 \cdot 0{,}05 \cdot 0{,}99 + 0{,}95 \cdot 0{,}9 \cdot 0{,}95 \cdot 0{,}01 \approx 0{,}986$.

85b $E(\text{aantal}_1 + \text{aantal}_2 + \text{aantal}_3 + \text{aantal}_4) = E(\text{aantal}_1) + \ldots + E(\text{aantal}_4) = 0{,}05 + 0{,}10 + 0{,}05 + 0{,}01 = 0{,}21$.

85c De te verwachten reparatiekosten per jaar zijn $12 \cdot 0{,}21 \cdot 550 = 1386$ euro.





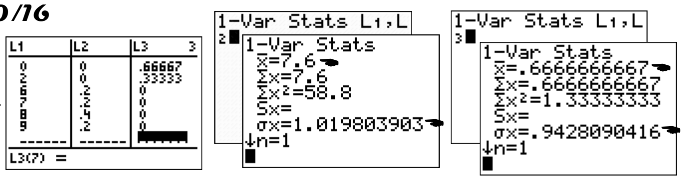
86a 1-Var Stats L1,L2 geeft $E(X) = 3$ en $\sigma_X \approx 0{,}84$.

86b 1-Var Stats L1,L3 geeft $E(Y) = 3$ en $\sigma_Y \approx 1{,}64$.

87a Kansverdeling van X

x	6	7	8	9
$X = x$	$\frac{1}{5}$	$\frac{1}{5}$	$\frac{2}{5}$	$\frac{1}{5}$

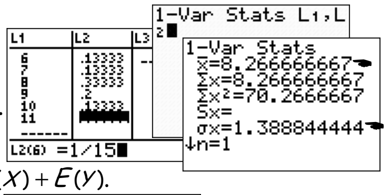
1-Var Stats L1,L2 geeft $E(X) = 7{,}6$ en $\sigma_X \approx 1{,}020$.



87b Kansverdeling van Y

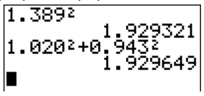
y	0	2
$Y = y$	$\frac{2}{3}$	$\frac{1}{3}$

1-Var Stats L1,L3 geeft $E(Y) \approx 0{,}667$ en $\sigma_Y \approx 0{,}943$.



87c Bijvoorbeeld bij $S = 8$ horen de kaartjes 6 2 en 8 0, dat zijn er 5 van de 15.
1-Var Stats L1,L2 geeft $E(S) \approx 8{,}267$ en $\sigma_S \approx 1{,}389$.

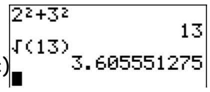
87d $E(X+Y) = E(S) \approx 8{,}267$ en $E(X) + E(Y) \approx 7{,}6 + 0{,}667 = 8{,}267 \Rightarrow E(X+Y) = E(X) + E(Y)$.
$\sigma_{X+Y} = \sigma_Z \approx 1{,}389$ en $\sigma_X + \sigma_Y \approx 1{,}020 + 0{,}943 = 1{,}963 \Rightarrow \sigma_{X+Y} \neq \sigma_X + \sigma_Y$.



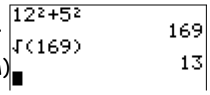
87e $\sigma^2_{X+Y} = \sigma^2_Z \approx 1{,}389^2 \approx 1{,}93$ en $\sigma^2_X + \sigma^2_Y \approx 1{,}020^2 + 0{,}943^2 \approx 1{,}93$. Dit klopt.

88a $E(T) = E(X+Y) = E(X) + E(Y) = 16 + 30 = 46$ (sec).

88b $\sigma_T = \sigma_{X+Y} = \sqrt{\sigma^2_X + \sigma^2_Y} = \sqrt{2^2 + 3^2} = \sqrt{13} \approx 3{,}6$ (sec)



89 $E(B) = E(N+T) = E(N) + E(T) = 230 + 30 = 260$ (gram).
$\sigma_B = \sigma_{N+T} = \sqrt{\sigma^2_N + \sigma^2_T} = \sqrt{12^2 + 5^2} = \sqrt{169} = 13$ (gram)



90a De som $X + Y$ is steeds 7, dus de standaardafwijking is 0.

90b X en Y zijn (niet on)afhankelijk.

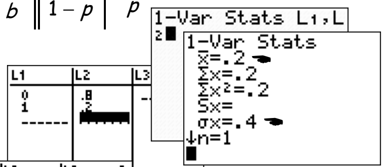
91a $p = P(\text{succes}) = P(B = 1) \Rightarrow P(\text{mislukking}) = P(B = 0) = 1 - p$. (zie de tabel hiernaast)

b	0	1
$B = b$	$1-p$	p

91b $E(B) = 0 \cdot (1-p) + 1 \cdot p = p$.

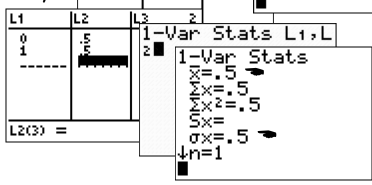
91c $E(Z) = \underbrace{E(B) + E(B) + E(B) + \ldots + E(B)}_{n \text{ keer}} = n \cdot p = np$.

91d $p = 0{,}2$ 1-Var Stats L1,L2 geeft $\sigma_B = 0{,}4$
$\sqrt{0{,}2 \cdot (1 - 0{,}2)} = \sqrt{0{,}2 \cdot 0{,}8} = \sqrt{0{,}16} = 0{,}4$ $\Rightarrow$ de regel klopt voor $p = 0{,}2$.



$p = 0{,}5$ 1-Var Stats L1,L2 geeft $\sigma_B = 0{,}5$
$\sqrt{0{,}5 \cdot (1 - 0{,}5)} = \sqrt{0{,}5 \cdot 0{,}5} = 0{,}5$ $\Rightarrow$ de regel klopt voor $p = 0{,}5$.

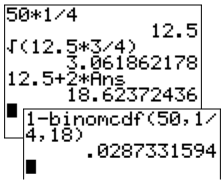
$p = 0{,}8$ 1-Var Stats L1,L2 geeft $\sigma_B = 0{,}4$
$\sqrt{0{,}8 \cdot (1 - 0{,}8)} = \sqrt{0{,}8 \cdot 0{,}2} = 0{,}4$ $\Rightarrow$ de regel klopt voor $p = 0{,}8$.



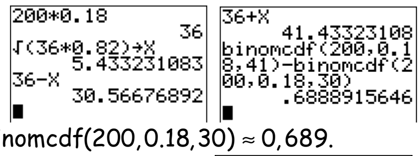
91e $\sigma_Z = \sigma_{\underbrace{B+B+B+\ldots+B}_{n \text{ keer}}} = \sqrt{\underbrace{\sigma^2_B + \sigma^2_B + \sigma^2_B + \ldots + \sigma^2_B}_{n \text{ keer}}} = \sqrt{\underbrace{p(1-p) + p(1-p) + p(1-p) + \ldots + p(1-p)}_{n \text{ keer}}} = \sqrt{n \cdot p \cdot (1-p)}$.

92a X is het aantal juist beantwoorde vragen.
$E(X) = n \cdot p = 50 \cdot \frac{1}{4} = 12{,}5$ en $\sigma_X = \sqrt{n \cdot p \cdot (1-p)} = \sqrt{50 \cdot \frac{1}{4} \cdot \frac{3}{4}} \approx 3{,}06$.
$P(X = 12{,}5) = 0$. (je kunt geen halve vragen juist beantwoorden)

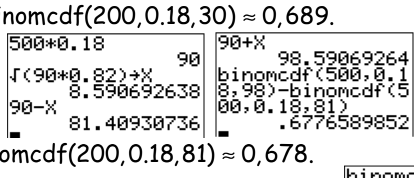
92b $E(X) + 2\sigma_X \approx 12{,}5 + 2 \cdot 3{,}06 \approx 18{,}62$.
$P(X \geq 18{,}62) = 1 - P(X \leq 18) = 1 - \text{binomcdf}(50, \frac{1}{4}, 18) \approx 0{,}029$.



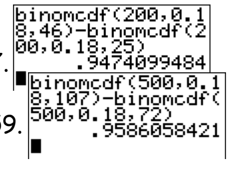
93a X is het aantal ondervraagden met een voorkeur voor partij A.
$E(X) = n \cdot p = 200 \cdot 0{,}18 = 36$ en $\sigma_X = \sqrt{n \cdot p \cdot (1-p)} = \sqrt{36 \cdot 0{,}82} \approx 5{,}43$.
$E(X) - \sigma_X \approx 36 - 5{,}43 = 30{,}57$ en $E(X) + \sigma_X \approx 36 + 5{,}43 = 41{,}43$.
$P(30{,}57 < X < 41{,}43) = P(X \leq 41) - P(X \leq 30) = \text{binomcdf}(200, 0.18, 41) - \text{binomcdf}(200, 0.18, 30) \approx 0{,}689$.



93b Y is het aantal ondervraagden met een voorkeur voor partij A.
$E(y) = n \cdot p = 500 \cdot 0{,}18 = 90$ en $\sigma_Y = \sqrt{n \cdot p \cdot (1-p)} = \sqrt{90 \cdot 0{,}82} \approx 8{,}59$.
$E(y) - \sigma_Y \approx 90 - 8{,}59 = 81{,}41$ en $E(y) + \sigma_Y \approx 90 + 8{,}59 = 98{,}59$.
$P(81{,}41 < Y < 98{,}58) = P(Y \leq 98) - P(Y \leq 81) = \text{binomcdf}(500, 0.18, 98) - \text{binomcdf}(200, 0.18, 81) \approx 0{,}678$.



93c $E(X) - 2 \cdot \sigma_X \approx 36 - 2 \cdot 5{,}43 = 25{,}14$ en $E(X) + 2 \cdot \sigma_X \approx 36 + 2 \cdot 5{,}43 = 46{,}86$.
$P(25{,}14 < X < 46{,}48) = P(X \leq 46) - P(X \leq 25) = \text{binomcdf}(200, 0.18, 46) - \text{binomcdf}(200, 0.18, 25) \approx 0{,}947$.
$E(y) - 2 \cdot \sigma_Y \approx 90 - 2 \cdot 8{,}59 = 72{,}82$ en $E(y) + 2 \cdot \sigma_Y \approx 90 + 2 \cdot 8{,}59 = 107{,}18$.
$P(72{,}82 < Y < 107{,}18) = P(Y \leq 107) - P(Y \leq 72) = \text{binomcdf}(500, 0.18, 107) - \text{binomcdf}(200, 0.18, 72) \approx 0{,}959$.



94a $p = P(\text{minstens 9 met twee dobbelstenen}) = \frac{10}{36}$. (zie de tabel hiernaast)
X is het aantal keer minstens 9 ogen.
$P(X \le 90) = \text{binomcdf}(360, \frac{10}{36}, 90) \approx 0{,}131$.

```
binomcdf(360,10/
36,90)
         .1312960534
```

6	7	8	9	10	11	12
5	6	7	8	9	10	11
4	5	6	7	8	9	10
3	4	5	6	7	8	9
2	3	4	5	6	7	8
1	2	3	4	5	6	7
+	1	2	3	4	5	6

94b $E(X) = n \cdot p = 360 \cdot \frac{10}{36} = 100$ en $\sigma_X = \sqrt{n \cdot p \cdot (1-p)} = \sqrt{100 \cdot \frac{26}{36}} \approx 8{,}50$.
$E(X) + \sigma_X \approx 108{,}50$.
$P(X \ge 108{,}50) = 1 - P(X \le 108) = 1 - \text{binomcdf}(360, \frac{10}{36}, 108) \approx 0{,}159$.

```
360*10/36
                 100
√(100*26/36)
         8.498365856
1-binomcdf(360,1
0/36,108)
         .1585813167
```

Diagnostische toets

D1a $P(r=2) = P(\underline{\underline{r\,r\,\bar{r}\,\bar{r}\,\bar{r}\,\bar{r}\,\bar{r}}}) = \binom{7}{2} \cdot P(r\,r\,\bar{r}\,\bar{r}\,\bar{r}\,\bar{r}\,\bar{r}) = \binom{7}{2} \cdot (\frac{3}{6})^2 \cdot (\frac{3}{6})^5 \approx 0{,}164$.

D1b $P(\underline{\underline{r\,r\,r\,r\,r\,w\,w}}) = \binom{7}{5} \cdot P(r\,r\,r\,r\,r\,w\,w) = \binom{7}{5} \cdot (\frac{3}{6})^5 \cdot (\frac{2}{6})^2 \approx 0{,}073$.

```
7 nCr 2*(3/6)^7
            .1640625
7 nCr 5*(3/6)^5*
(2/6)^2
          .0729166667
```

D1c $P(\bar{b} \ge 6) = P(\bar{b} = 6) + P(\bar{b} = 7) = P(\underline{\underline{\bar{b}\,\bar{b}\,\bar{b}\,\bar{b}\,\bar{b}\,\bar{b}\,b}}) + P(\bar{b}\,\bar{b}\,\bar{b}\,\bar{b}\,\bar{b}\,\bar{b}\,\bar{b}) = \binom{7}{6} \cdot (\frac{5}{6})^6 \cdot \frac{1}{6} + (\frac{5}{6})^7 \approx 0{,}670$.

D1d $P(r \le 5) = 1 - P(r=6) - P(r=7) = P(\underline{\underline{r\,r\,r\,r\,r\,r\,\bar{r}}}) - P(r\,r\,r\,r\,r\,r\,r) = 1 - \binom{7}{6} \cdot (\frac{3}{6})^6 \cdot \frac{3}{6} - (\frac{3}{6})^7 \approx 0{,}938$.

```
7 nCr 6*(5/6)^6*
1/6+(5/6)^7
         .6697959534
1-7 nCr 6*(3/6)^
7-(3/6)^7
               .9375
```

D2a $P(\text{twee knikkers pakken}) = P(\text{eerst blauw en dan pas groen}) = P(b\,g) = \frac{5}{12} \cdot \frac{7}{11} \approx 0{,}265$.

D2b $P(\text{vijf knikkers pakken}) = P(b\,b\,b\,b\,g) = \frac{5}{12} \cdot \frac{4}{11} \cdot \frac{3}{10} \cdot \frac{2}{9} \cdot \frac{7}{8} \approx 0{,}009$.

```
5*7/12/11
         .2651515152
5*4*3*2*7/12/11/
10/9/8
         .0088383838
```

D3 $P(som = 17) = P(\underline{6\,6\,5}) = \binom{3}{2} \cdot \frac{1}{6} \cdot \frac{1}{6} \cdot \frac{1}{6} = \frac{1}{72}$.

```
3 nCr 2*(1/6)^3▶
Frac
                1/72
```

$P(\text{minstens één van de } n \text{ keer } som = 17) = 1 - P(\text{geen van de } n \text{ keer } som = 17) = 1 - P(\overline{17}\ \overline{17}\ \ldots\ \overline{17}) = 1 - (\frac{71}{72})^n > 0{,}4$.
Bladeren in de tabel $\Rightarrow n \ge 37 \Rightarrow$ Jeroen moet minstens 37 keer met drie dobbelstenen gooien.

```
Plot1 Plot2 Plot3
\Y1=1-(71/72)^X
\Y2=0.4
\Y3=
```

X	Y1	Y2
33	.36969	.4
34	.37845	.4
35	.38708	.4
36	.39559	.4
37	.40399	.4
38	.41226	.4
39	.42043	.4

X=37

D4a $P(vrouwen = 3) = P(\underline{\underline{v\,v\,v\,m\,m}}) = \frac{\binom{7}{3} \cdot \binom{9}{2}}{\binom{16}{5}} \approx 0{,}288$.

```
7 nCr 3*9 nCr 2/
16 nCr 5
         .2884615385
```

D4b $P(vrouwen = 3) = P(\underline{\underline{v\,v\,v\,m\,m}}) = \binom{5}{3} \cdot P(v\,v\,v\,m\,m) = \binom{5}{3} \cdot (\frac{7}{16})^3 \cdot (\frac{9}{16})^2 \approx 0{,}265$.

```
5 nCr 3*(7/16)^3
*(9/16)²
         .2649593353
```

```
6 nCr 3*7 nCr 2/
13 nCr 5
         .3263403263
```

D5a $P(X = 3) = P(\underline{\underline{r\,r\,r\,\bar{r}\,\bar{r}}}) = \frac{\binom{6}{3} \cdot \binom{7}{2}}{\binom{13}{5}} \approx 0{,}326$.

D5c $P(Y \ge 3) = P(Y = 3) + P(Y 4) = \frac{\binom{4}{3} \cdot \binom{9}{2}}{\binom{13}{5}} + \frac{\binom{4}{4} \cdot \binom{9}{1}}{\binom{13}{5}} \approx 0{,}119$.

```
6 nCr 4*7 nCr 1+
6 nCr 5
                 111
Ans/13 nCr 5
         .0862470862
```

D5b $P(X > 3) = P(X = 4) + P(X = 5) = \frac{\binom{6}{4} \cdot \binom{7}{1}}{\binom{13}{5}} + \frac{\binom{6}{5}}{\binom{13}{5}} \approx 0{,}086$.

```
4 nCr 3*9 nCr 2+
1*9 nCr 1
                 153
Ans/13 nCr 5
         .1188811189
```

D6 $P(\text{Gerben pakt 1 keer}) = P(\text{b}) = \frac{10}{14} \approx 0{,}714.$

$P(\text{Gerben pakt 2 keer}) = P(\text{rb}) = \frac{4}{14} \cdot \frac{10}{13} \approx 0{,}220.$

$P(\text{Gerben pakt 3 keer}) = P(\text{rrb}) = \frac{4}{14} \cdot \frac{3}{13} \cdot \frac{10}{12} \approx 0{,}055.$

$P(\text{Gerben pakt 4 keer}) = P(\text{rrrb}) = \frac{4}{14} \cdot \frac{3}{13} \cdot \frac{2}{12} \cdot \frac{10}{11} \approx 0{,}010.$

$P(\text{Gerben pakt 5 keer}) = P(\text{rrrrb}) = \frac{4}{14} \cdot \frac{3}{13} \cdot \frac{2}{12} \cdot \frac{1}{11} \cdot \frac{10}{10} \approx 0{,}001.$

Zie de kansverdeling hieronder.

aantal keer pakken	1	2	3	4	5
kans	0,714	0,220	0,055	0,010	0,001

```
10/14
          .7142857143
4/14*10/13
          .2197802198
4/14*3/13*10/12
          .0549450549
```

```
4/14*3/13*2/12*10/11
             .00999001
4/14*3/13*2/12*1/11*10/10
         9.99000999E-4
```

D7 $P(X=6 \mid Y=1) = \frac{X=6 \text{ én } Y=1}{Y=1} = \frac{0}{10} = 0$ en $P(X=6) = \frac{1}{36} \neq 0.$
Dus X en Y zijn (niet on)afhankelijk.

8	11	12	13	14	15	16
7	10	11	12	13	14	15
6	9	10	11	12	13	14
5	8	9	10	11	12	13
4	7	8	9	10	11	12
3	6	7	8	9	10	11
x	**3**	**4**	**5**	**6**	**7**	**8**

8	5	4	3	2	1	0
7	4	3	2	1	0	1
6	3	2	1	0	1	2
5	2	1	0	1	2	3
4	1	0	1	2	3	4
3	0	1	2	3	4	5
y	**3**	**4**	**5**	**6**	**7**	**8**

D8 $P(W = €99) = P(\text{18 ogen}) = P(666) = (\tfrac{1}{6})^3 = \frac{1}{216}.$

$P(W = €14) = P(\text{17 ogen}) = P(\underline{\underline{665}}) = \binom{3}{2} \cdot (\tfrac{1}{6})^2 \cdot \frac{1}{6} = 3 \cdot (\tfrac{1}{6})^3 = \frac{3}{216}.$

$P(W = €4) = P(\text{16 ogen}) = P(\underline{\underline{664}}) + P(\underline{\underline{655}}) = \binom{3}{2} \cdot (\tfrac{1}{6})^2 \cdot \frac{1}{6} + \binom{3}{1} \cdot (\tfrac{1}{6})^2 \cdot \frac{1}{6} = 6 \cdot (\tfrac{1}{6})^3 = \frac{6}{216}.$

$P(W = -€1) = P(\text{minder dan 16 ogen}) = 1 - \frac{1}{216} - \frac{3}{216} - \frac{6}{216} = \frac{206}{216}.$

De winstverwachting per spel is: $99 \cdot \frac{1}{216} + 14 \cdot \frac{3}{216} + 4 \cdot \frac{6}{216} - 1 \cdot \frac{206}{216} \approx -0{,}19$ (€).

```
6^3
                  216
3 nCr 2
                    3
```

w	99	14	4	-1
$P(W=w)$	$\frac{1}{216}$	$\frac{3}{216}$	$\frac{6}{216}$	$\frac{206}{216}$

```
99*1+14*3+4*6-1*206
                  -41
Ans/216
         -.1898148148
```

D9a X is het aantal keer dat hij alle kegels omver werpt.
$P(X=8) = \text{binompdf}(10{,}0.78{,}8) \approx 0{,}298.$

```
binompdf(10,0.78,8)
          .2984109099
```

D9b $P(\text{alleen laatste keer niet alle kegels omver}) = P(AAAAAAAAA\bar{A}) = 0{,}78^9 \cdot 0{,}22 \approx 0{,}024.$

$P(X \geq 9) = P(X=9) + P(X10) = \text{binompdf}(10{,}0.78{,}9) + \text{binompdf}(10{,}0.78{,}10)$

```
0.78^9*0.22
          .0235111626
binompdf(10,0.78,9)+binompdf(10,0.78,10)
          .3184693843
```

D10a $P(X > 60) = 1 - P(X \leq 60) = 1 - \text{binomcdf}(100{,}0.65{,}60) \approx 0{,}828.$

D10b $P(X \geq 68) = 1 - P(X \leq 67) = 1 - \text{binomcdf}(100{,}0.65{,}67) \approx 0{,}303.$

D10c $P(X = 65 \text{ of } X = 66) = P(X=65) + P(X=66) = \text{binompdf}(100{,}0.65{,}65) + \text{binompdf}(100{,}0.65{,}66) \approx 0{,}166.$

D10d $P(X \text{ \underline{tussen} 62 en 70}) = P(X \leq 69) - P(X \leq 62) = \text{binomcdf}(100{,}0.65{,}69) - \text{binomcdf}(100{,}0.65{,}62) \approx 0{,}529.$

```
1-binomcdf(100,0.65,60)
          .8275849877
1-binomcdf(100,0.65,67)
           .302878552
```

```
binompdf(100,0.65,65)+binompdf(100,0.65,66)
          .1655456779
```

```
binomcdf(100,0.65,69)-binomcdf(100,0.65,62)
          .5294295226
```

D11a E is het aantal keer even.
$P(E > 10) = 1 - P(E \leq 10) = 1 - \text{binomcdf}(16{,}0.5{,}10) \approx 0{,}105.$

D11b X is het aantal keer 6.
$P(X < 3) = P(X \leq 2) = \text{binomcdf}(16, \frac{1}{6}, 2) \approx 0{,}487.$

```
1-binomcdf(16,0.5,10)
          .1050567627
binomcdf(16,1/6,2)
          .4867910368
```

D11c Y is het aantal keer 5 of 6 $\Rightarrow P(Y=5) = \text{binompdf}(16, \frac{2}{6}, 5) \approx 0{,}208.$

D11d Z is het aantal keer 1 of 2.
$P(5 < Z < 10) = P(Z \leq 9) - P(Z \leq 5) = \text{binomcdf}(16, \frac{2}{6}, 9) - \text{binomcdf}(16, \frac{2}{6}, 5) \approx 0{,}437.$

```
binompdf(16,2/6,5)
          .2078129017
binomcdf(16,2/6,9)-binomcdf(16,2/6,5)
          .4371183582
```

D11e $P(X \geq 4) = 1 - P(X \leq 3) = 1 - \text{binomcdf}(n, \frac{1}{6}, 3) > 0{,}90$ (met $n \geq 4$ en n geheel $\Rightarrow$ TABLE) $\Rightarrow n \geq 39.$

```
Plot1 Plot2 Plot3
\Y1=1-binomcdf(X,1/6,3)
\Y2=0.90
\Y3=
\Y4=
\Y5=
\Y6=
```

X	Y1	Y2
35	.85752	.9
36	.87229	.9
37	.88572	.9
38	.8979	.9
39	.90892	.9
40	.91887	.9
41	.92783	.9

X=39

D12a 1-Var Stats L1,L2 geeft $\bar{x} \approx 3230$ (kWh) en $\sigma \approx 690$ (kWh).

D12b $\bar{x} - \sigma \approx 3230 - 690 = 2540$ (kWh) en $\bar{x} - \sigma \approx 3230 + 690 = 3920$ (kWh).
Aantal $= \frac{460}{500} \cdot 134 + 182 + \frac{420}{500} \cdot 135 \approx 419.$
Dat is $\frac{419}{642} \times 100\% \approx 65\%.$

```
460/500*134+182+420/500*135
               418.68
419/642*100
          65.26479751
```

```
3230-690
                 2540
3230+690
                 3920
```

L1	L2
1750	35
2250	60
2750	134
3250	182
3750	135
4250	96

```
1-Var Stats L1,L2
```

```
1-Var Stats
 x̄=3225.077882
 Σx=2070500
 Σx²=6979125000
 Sx=685.9422458
 σx=685.4078147
↓n=642
```

D13 $E(T) = E(X+Y) = E(X) + E(Y) = 2{,}75 + 1{,}85 = 4{,}60$ (cm).
$\sigma_T = \sigma_{X+Y} = \sqrt{\sigma_X^2 + \sigma_Y^2} = \sqrt{0{,}15^2 + 0{,}08^2} = 0{,}17$ (cm).

```
2.75+1.85
                  4.6
√(0.15²+0.08²)
                  .17
```

D14 X is het aantal prijzen.
$E(X) = n \cdot p = 100 \cdot 0{,}25 = 25$ en $\sigma_X = \sqrt{n \cdot p \cdot (1-p)} = \sqrt{25 \cdot 0{,}75} \approx 4{,}33.$
$E(X) + \sigma_X \approx 29{,}33.$
$P(X > 29{,}33) = 1 - P(X \leq 29) = 1 - \text{binomcdf}(100{,}0.25{,}29) \approx 0{,}150.$

```
100*0.25
                   25
√(25*0.75)
          4.330127019
1-binomcdf(100,0.25,29)
          .1495410473
```

Gemengde opgaven 3. Kansverdelingen

G24a $P(\text{w}) = 1-0{,}3-0{,}5 = 0{,}2 \Rightarrow P(\bar{\text{w}}\,\bar{\text{w}}\,\bar{\text{w}}\,\bar{\text{w}}\,\bar{\text{w}}\,\bar{\text{w}}\,\bar{\text{w}}\,\bar{\text{w}}\,\bar{\text{w}}\,\bar{\text{w}}) = 0{,}8^{10} \approx 0{,}107.$

```
0.8^10
          .1073741824
10 nCr 6*0.5^6*0
.2^4
               .00525
```

G24b $P(\underline{\underline{\text{pppppp wwww}}}) = \binom{10}{6}\cdot P(\text{pppppp wwww}) = \binom{10}{6}\cdot 0{,}5^6\cdot 0{,}2^4 \approx 0{,}005.$

G24c $P(\textit{rood} \geq 2) = 1 - P(\textit{rood} < 2) = 1 - P(\textit{rood} = 0) - P(\textit{rood} = 1)$
$= 1 - P(\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}) - P(\underline{\underline{\text{r}\,\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}}}) = 1 - 0{,}7^{10} - \binom{10}{1}\cdot 0{,}3\cdot 0{,}7^9 \approx 0{,}851.$

```
1-0.7^10-10 nCr
1*0.3*0.7^9
          .8506916541
10 nCr 5*0.5^10
           .24609375
```

G24d $P(\underline{\underline{\text{ppppp}\,\bar{\text{p}}\,\bar{\text{p}}\,\bar{\text{p}}\,\bar{\text{p}}\,\bar{\text{p}}}}) = \binom{10}{5}\cdot P(\text{ppppp}\,\bar{\text{p}}\,\bar{\text{p}}\,\bar{\text{p}}\,\bar{\text{p}}\,\bar{\text{p}}) = \binom{10}{5}\cdot 0{,}5^5\cdot 0{,}5^5 \approx 0{,}246.$

```
13 nCr 10*0.68^1
0*0.32^3
          .1981094057
```

G25a $P(\underline{\underline{\text{vvvvvvvvvv}\,\bar{\text{v}}\,\bar{\text{v}}\,\bar{\text{v}}}}) = \binom{13}{10}\cdot P(\text{vvvvvvvvvv}\,\bar{\text{v}}\,\bar{\text{v}}\,\bar{\text{v}}) = \binom{13}{10}\cdot 0{,}68^{10}\cdot 0{,}32^3 \approx 0{,}198.$

```
1-0.81^13-13 nCr
 1*0.19*0.81^12-
13 nCr 2*0.19²*0
.81^11
          .4610742761
```

G25b $P(\text{h} \geq 3) = 1 - P(\text{h} < 3) = 1 - P(\text{h}=0) - P(\text{h}=1) - P(\text{h}=2) = 1 - P(\bar{\text{h}}\,\bar{\text{h}}\,\bar{\text{h}}\ldots\bar{\text{h}}) - P(\underline{\underline{\text{h}\,\bar{\text{h}}\,\bar{\text{h}}\ldots\bar{\text{h}}}}) - P(\underline{\underline{\text{h}\,\text{h}\,\bar{\text{h}}\ldots\bar{\text{h}}}})$
$= 1 - P(\bar{\text{h}}\,\bar{\text{h}}\,\bar{\text{h}}\ldots\bar{\text{h}}) - \binom{13}{1}\cdot P(\text{h}\,\bar{\text{h}}\,\bar{\text{h}}\ldots\bar{\text{h}}) - \binom{13}{2}\cdot P(\text{h}\,\text{h}\,\bar{\text{h}}\ldots\bar{\text{h}}) = 1 - 0{,}81^{13} - \binom{13}{1}\cdot 0{,}19\cdot 0{,}81^{12} - \binom{13}{2}\cdot 0{,}19^2\cdot 0{,}81^{11} \approx 0{,}461.$

G25c $P(\underline{\underline{\text{vvvvvvvvv hhhh}}}) = \binom{13}{9}\cdot P(\text{vvvvvvvvv hhhh}) = \binom{13}{9}\cdot 0{,}68^9\cdot 0{,}19^4 \approx 0{,}029.$

```
13 nCr 9*0.68^9*
0.19^4
          .0289668093
```

G26a $P(\text{twee of drie goed}) = P(\underline{\underline{\text{g g}\,\bar{\text{g}}\,\bar{\text{g}}\ldots\bar{\text{g}}}}) + P(\underline{\underline{\text{g g g}\,\bar{\text{g}}\ldots\bar{\text{g}}}}) = \binom{18}{2}\cdot P(\text{g g}\,\bar{\text{g}}\,\bar{\text{g}}\ldots\bar{\text{g}}) + \binom{18}{3}\cdot P(\text{g g g}\,\bar{\text{g}}\ldots\bar{\text{g}})$
$= \binom{18}{2}\cdot 0{,}25^2\cdot 0{,}75^{16} + \binom{18}{3}\cdot 0{,}25^3\cdot 0{,}75^{15} \approx 0{,}266.$

```
18 nCr 2*0.25²*0
.75^16+18 nCr 3*
0.25^3*0.75^15
          .2662251998
```

G26b Van de resterende 13 vragen dus minder dan 3 goed gokken (5 kan hij er zonder te gokken goed invullen).
$P(g < 3) = P(g=0) + P(g=1) + P(g=2) = 0{,}75^{13} + \binom{13}{1}\cdot 0{,}25\cdot 0{,}75^{12} + \binom{13}{2}\cdot 0{,}25^2\cdot 0{,}75^{11} \approx 0{,}333.$

```
0.75^13+13 nCr 1
*0.25*0.75^12+13
 nCr 2*0.25²*0.7
5^11
          .3326016963
```

G26c Van de resterende 8 vragen er dus nog maar hoogstens 2 goed raden.
$P(g \leq 2) = P(g=0) + P(g=1) + P(g=2) = 0{,}75^8 + \binom{8}{1}\cdot 0{,}25\cdot 0{,}75^7 + \binom{8}{2}\cdot 0{,}25^2\cdot 0{,}75^6 \approx 0{,}679.$

```
0.75^8+8 nCr 1*0
.25*0.75^7+8 nCr
 2*0.25²*0.75^6
          .6785430908
```

G27a $P(\underline{\underline{\text{rrrbbb}}}) = \binom{6}{3}\cdot(\frac{5}{12})^3\cdot(\frac{3}{12})^3 \approx 0{,}023.$

```
6 nCr 3(5/12)^3*
(3/12)^3
          .0226056134
```

G27b $P(\text{succes}) = P(\text{s}) = P(\bar{\text{r}}\,\bar{\text{r}}\,\bar{\text{r}}) = \dfrac{\binom{7}{3}}{\binom{12}{3}} = \dfrac{7}{44} \Rightarrow P(\underline{\underline{\text{s s}\,\bar{\text{s}}\,\bar{\text{s}}\,\bar{\text{s}}\,\bar{\text{s}}}}) = \binom{6}{2}\cdot(\frac{7}{44})^2\cdot(\frac{37}{44})^4 \approx 0{,}190.$

```
7 nCr 3/12 nCr 3
▸Frac
                 7/44
6 nCr 2*(7/44)²*
(37/44)^4
          .1898358261
```

```
binompdf(6,7/44,
2)
          .1898358261
```

G27c $P(\underline{\underline{\text{wrrr}}}) + P(\underline{\underline{\text{wwbr}}}) = \dfrac{\binom{4}{1}\cdot\binom{5}{3}}{\binom{12}{4}} + \dfrac{\binom{4}{2}\cdot\binom{3}{1}\cdot\binom{5}{1}}{\binom{12}{4}} \approx 0{,}263.$

```
4 nCr 1*5 nCr 3+
4 nCr 2*3 nCr 1*
5 nCr 1
                  130
Ans/12 nCr 4
          .2626262626
```

G28a $P(X=100) = P(3\,3\,3) = \frac{1}{4}\cdot\frac{1}{5}\cdot\frac{1}{6} = \frac{1}{120}\ (\approx 0{,}008).$

```
1/4/5/6▸Frac
                1/120
4/4/5/6▸Frac
                 1/30
12/4/5/6▸Frac
                 1/10
```

Kansverdeling van toevalsvariabele X.

x	0	5	20	100
$P(X=x)$	$\frac{103}{120}$	$\frac{12}{120}$	$\frac{4}{120}$	$\frac{1}{120}$

G28b $P(X=20) = P(4\,4\,4) = \frac{1}{4}\cdot\frac{2}{5}\cdot\frac{2}{6} = \frac{4}{120} = \frac{1}{30}.$
$P(X=5) = P(5\,5\,5) = \frac{2}{4}\cdot\frac{2}{5}\cdot\frac{3}{6} = \frac{12}{120} = \frac{1}{10}.$
$P(X=0) = 1 - P(X=100) - P(X=20) - P(X=5) = 1 - \frac{1}{120} - \frac{4}{120} - \frac{12}{120} = 1 - \frac{17}{120} = \frac{103}{120}.$

G28c $P(Y=10) = P(\underline{\underline{3\,3\,4}}) = P(3\,3\,4) + P(3\,4\,3) + P(4\,3\,3) = \frac{1}{4}\cdot\frac{1}{5}\cdot\frac{2}{6} + \frac{1}{4}\cdot\frac{2}{5}\cdot\frac{1}{6} + \frac{1}{4}\cdot\frac{1}{5}\cdot\frac{1}{6} = \frac{2+2+1}{120} = \frac{5}{120} = \frac{1}{24}\ (\approx 0{,}042).$

G28d $P(\underline{\underline{3\,3\,\bar{3}}}) = P(3\,3\,\bar{3}) + P(3\,\bar{3}\,3) + P(\bar{3}\,3\,3) = \frac{1}{4}\cdot\frac{1}{5}\cdot\frac{5}{6} + \frac{1}{4}\cdot\frac{4}{5}\cdot\frac{1}{6} + \frac{3}{4}\cdot\frac{1}{5}\cdot\frac{1}{6} = \frac{5+4+3}{120} = \frac{12}{120} = \frac{1}{10}.$
$P(\underline{\underline{3\,3\,\bar{3}}}\ \underline{\underline{3\,3\,\bar{3}}}\ \underline{\underline{3\,3\,\bar{3}}}\ \underline{\underline{3\,3\,\bar{3}}}) = (\frac{1}{10})^4 = 0{,}0001.$

```
Plot1 Plot2 Plot3
\Y1=1-(119/120)^
X
\Y2=0.3
\Y3=
\Y4=
\Y5=
\Y6=
```

```
X     Y1      Y2
40    .28447  .3
41    .29043  .3
42    .29634  .3
43    .30221  .3
44    .30802  .3
45    .31379  .3
46    .31951  .3
Y1=.302208363503
```

G28e $P(\text{hoofdprijs}) = P(\text{h}) = P(X=100) = \frac{1}{120}$ (zie G28a) $\Rightarrow P(\bar{\text{h}}) = \frac{119}{120}.$
$P(\bar{\text{h}}\,\bar{\text{h}}\,\bar{\text{h}}\,\bar{\text{h}}\,\bar{\text{h}}\,\bar{\text{h}}\,\bar{\text{h}}\,\text{h}) + P(\bar{\text{h}}\,\bar{\text{h}}\,\bar{\text{h}}\,\bar{\text{h}}\,\bar{\text{h}}\,\bar{\text{h}}\,\bar{\text{h}}\,\bar{\text{h}}\,\text{h}) = (\frac{119}{120})^7\cdot\frac{1}{120} + (\frac{119}{120})^8\cdot\frac{1}{120} \approx 0{,}016.$

```
(119/120)^7*1/12
0+(119/120)^8*1/
120
          .0156529218
```

G28f $P(\text{minstens één van de } n \text{ keer spelen de hoofdprijs}) = 1 - P(n \text{ keer niet de hoofdprijs}) = 1 - P(\bar{\text{h}}\,\bar{\text{h}}\,\bar{\text{h}}\ldots\bar{\text{h}}) = 1 - (\frac{119}{120})^n > 0{,}3.$
Bladeren in de tabel geeft $n \geq 43 \Rightarrow$ Jantine moet minstens 43 keer spelen.

G29a
- Kosten $K = 4\cdot 2 + 8 = 16$ (€) en $P(\text{negatief}) = P(K=16) = (\frac{19}{20})^4.$
- Kosten $K = 4\cdot 2 + 8 + 4\cdot 8 = 4\cdot 2 + 5\cdot 8 = 48$ (€) en $P(\text{positief}) = P(K=48) = 1 - (\frac{19}{20})^4.$
- $E(K) = 16\cdot(\frac{19}{20})^4 + 48\cdot\left(1 - (\frac{19}{20})^4\right) \approx 21{,}94$ (€). Per monster: $E = \frac{Ans}{4} \approx 5{,}48$ (€).

```
16*(19/20)^4+48*
(1-(19/20)^4)
              21.9358
Ans/4
              5.48395
```

G29b ∗ Kosten $K = 5\cdot 2 + 8 = 18$ (€) en $P(\text{negatief}) = P(K=18) = (\frac{19}{20})^5$.

∗ Kosten $K = 5\cdot 2 + 8 + 5\cdot 8 = 5\cdot 2 + 6\cdot 8 = 58$ (€) en $P(\text{positief}) = P(K=48) = 1-(\frac{19}{20})^5$.

∗ $E(K) = 18\cdot(\frac{19}{20})^5 + 58\cdot\left(1-(\frac{19}{20})^5\right) \approx 27{,}05$ (€). Per monster: $E = \frac{Ans}{5} \approx 5{,}41$ (€).

```
18*(19/20)^5+58*
(1-(19/20)^5)
      27.0487625
Ans/5
       5.4097525
```

G29c • Kosten $K = n\cdot 2 + 8 = 2n+8$ (€) en $P(\text{negatief}) = P(K = 2n+8) = (\frac{19}{20})^4 = 0{,}95^n$.

• Kosten $K = n\cdot 2 + 8 + n\cdot 8 = 10n + 8 = 48$ (€) en $P(\text{positief}) = P(K = 10n+8) = 1 - 0{,}95^n$.

• $E(K) = (2n+8)\cdot 0{,}95^n + (10n+8)\cdot(1-0{,}95^n)$
$= 2n\cdot 0{,}95^n + 8\cdot 0{,}95^n + 10n - 10n\cdot 0{,}95^n + 8 - 8\cdot 0{,}95^n = 10n - 8n\cdot 0{,}95^n + 8$ (€).

Per monster: $E = \frac{10n - 8n\cdot 0{,}95^n + 8}{n} = \frac{10n}{n} - \frac{8n\cdot 0{,}95^n}{n} + \frac{8}{n} = 10 - 8\cdot 0{,}95^n + \frac{8}{n}$ (€).

```
Plot1 Plot2 Plot3
\Y1=10-8*0.95^X+
8/X
\Y2=
\Y3=
\Y4=
\Y5=
\Y6=
```

X	Y1
1	10.4
2	6.78
3	5.8077
4	5.484
5	5.4098
6	5.4526
7	5.5562

X=5

G29d $10 - 8\cdot 0{,}95^n + \frac{8}{n}$ (met $n \geq 1$ en n geheel ⇒ TABLE) is minimaal voor $n = 5$.

G30a Ja, als de een bloedgroep A heeft en de ander bloedgroep B.

G30b $P(\text{dezelfde bloedgroep}) = P(0\,0) + P(A\,A) + P(B\,B) + P(AB\,AB) = 0{,}46^2 + 0{,}43^2 + 0{,}08^2 + 0{,}03^2 = 0{,}4038$.

G30c $P(\text{"0"} \geq 1) = 1 - (\text{"0"} < 1) = 1 - (\text{"0"} = 0) = 1 - P(\bar{0}\,\bar{0}\,\bar{0}\,\bar{0}\,\ldots\,\bar{0}) = 1 - 0{,}54^{12} \approx 0{,}9994$.

G30d $P(\text{dezelfde resusfactor}) = P(+\;+) + P(-\;-) = 0{,}85^2 + 0{,}15^2 = 0{,}745$ en $P(\text{dezelfde bloedgroep}) = 0{,}4038$ (zie G30b).
$P(\text{hetzelfde bloedtype}) = P(\text{dezelfde resusfactor en dezelfde bloedgroep}) = 0{,}745\cdot 0{,}4038 \approx 0{,}3$.

```
0.85²+0.15²
            .745
Ans*0.4038
         .300831
```

G31a Het aantal volgordes is $\binom{5}{2} = 10$.

```
5 nCr 2
              10
```

G31b $P(X \geq 16) = 1 - P(X \leq 15) = 1 - \text{binomcdf}(900, 0.01783, 15) \approx 0{,}539$.

```
3328/186701
    .0178252928
1-binomcdf(900,0
.01783,15)
    .5388443688
```

G31c $P(\text{een jongen en een meisje}) = \frac{2}{3}\cdot\frac{1}{2} = \frac{1}{3}$; $P(2\text{ jongens}) = \frac{1}{3}\cdot\frac{1}{2} + \frac{2}{3}\cdot\frac{1}{4} = \frac{1}{3}$; $P(2\text{ meisles}) = \frac{1}{3}\cdot\frac{1}{2} + \frac{2}{3}\cdot\frac{1}{4} = \frac{1}{3}$.
Omdat de kansen gelijk zijn komen de samenstellingen gemiddeld even vaak voor.

```
2/3*1/2▸Frac
             1/3
1/3*1/2+2/3*1/4▸
Frac
             1/3
```

G31d $P(\text{tweeling is prematuur}) = \text{normalcdf}(-10^{99}, 38, 36.2, \frac{12}{7}) \approx 0{,}853$. Dit is ongeveer 85%.
Of: $P(\text{tweeling is prematuur}) = \text{normalcdf}(-10^{99}, 266, 253, 12) \approx 0{,}861$. Dit is ongeveer 86%.

```
normalcdf(-10^99
,38,36.2,12/7)
    .8531409193
normalcdf(-10^99
,266,253,12)
    .8606697172
```

G32a De laagste totaalscore (alle vragen fout worden beantwoord) is $30 - 10\cdot\frac{3}{4} - 10\cdot 1 - 10\cdot\frac{5}{4} = 0$.

G32b De totaalscore is $30 + 7\cdot 3 + 4\cdot 4 + 1\cdot 5 - 1\cdot\frac{3}{4} - 3\cdot 1 - 3\cdot\frac{5}{4} = 64\frac{1}{2}$.

```
30-10*3/4-10*1-1
0*5/4
               0
30+7*3+4*4+1*5-1
*3/4-3*1-3*5/4
            64.5
```

G32c $P(X \leq 5) = \text{binomcdf}(30, \frac{1}{6}, 5) \approx 0{,}62$.

```
binomcdf(30,1/6,
5)
    .6164470145
```

G32d $E(\text{score}) = 30 + \frac{1}{6}\cdot 10\cdot 3 - \frac{4}{6}\cdot 10\cdot\frac{3}{4} + \frac{1}{6}\cdot 10\cdot 4 - \frac{4}{6}\cdot 10\cdot 1 + \frac{1}{6}\cdot 10\cdot 5 - \frac{4}{6}\cdot 10\cdot\frac{5}{4} = 30$.

```
30+1/6*10*3-4/6*
10*3/4+1/6*10*4-
4/6*10*1+1/6*10*
5-4/6*10*5/4
              30
```

G33a X is het aantal testen.
$P(X=1) = 0{,}3$; $P(X=2) = 0{,}7\cdot 0{,}3 = 0{,}21$ en $P(X=3) = 1 - P(X=1) - P(X=2) = 0{,}49$.
$E(X) = 1\cdot 0{,}3 + 2\cdot 0{,}21 + 3\cdot 0{,}49 = 2{,}19$.

```
0.7*0.3
             .21
1-0.3-0.21
             .49
1*0.3+2*0.21+3*0
.49
            2.19
```

G33b Per proefpersoon zijn de gemiddelde kosten $100 + 2{,}19\cdot 50 = 209{,}50$ euro.
Omdat $\frac{10000}{209{,}50} \approx 47{,}7$ kunnen er maximaal 47 personen meedoen.

```
100+2.19*50
           209.5
10000/209.50
      47.7326969
```

G33c Y is het aantal personen dat na drie keer testen nog geen succes heeft.
$P(\text{geen succes na drie keer testen}) = 0{,}7^3 = 0{,}343$.
$P(Y > \frac{1}{2}\cdot 10) = P(Y > 5) = 1 - P(Y \leq 5) = 1 - \text{binomcdf}(10, 0.343, 5) \approx 0{,}087$.

```
0.7^3
            .343
1-binomcdf(10,0.
343,5)
     .086899131
```

G34a Waaghals:
$P(€\,0) = P(-) + P(-+) = \frac{1}{3} + \frac{2}{3}\cdot\frac{1}{2} = \frac{2}{3}$ en $P(€\,6) = P(+\;+) = \frac{2}{3}\cdot\frac{1}{2} = \frac{1}{3}$.
$E(\text{uitkering waaghals}) = 0\cdot\frac{2}{3} + 6\cdot\frac{1}{3} = 2$ (€/lot).

```
1/3+2/3*1/2▸Frac
             2/3
2/3*1/2▸Frac
             1/3
```

Angsthaas:
$P(€\,0) = P(-) = \frac{1}{3}$ en $P(€\,3) = P(+) = \frac{2}{3}$.
$E(\text{uitkering angsthaas}) = 0\cdot\frac{1}{3} + 3\cdot\frac{2}{3} = 2$ (€/lot).

G34b Waaghals: $P(€\,0) = \frac{2}{3}$ en angsthaas: $P(€\,0) = \frac{1}{3}$.
Naar verwachting krijgen $\frac{2}{3}\cdot 0{,}65\cdot 500 + \frac{1}{3}\cdot 0{,}35\cdot 500 = 275$ mensen niets uitbetaald.

```
2/3*0.65*500+1/3
*0.35*500
             275
```

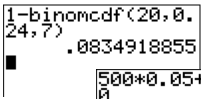
G34c Een angsthaas krast altijd precies één vakje open ⇒ Alle 35 angsthazen krassen precies één vakje open.
W is het aantal waaghalzen dat precies één (als eerste vakje een MIN) vakje openkrast
$P(W > 60 - 35) = P(W > 25) = 1 - P(W \leq 25) = 1 - \text{binomcdf}(65, \frac{1}{3}, 25) \approx 0{,}157$.

```
1-binomcdf(65,1/
3,25)
    .1565535804
```

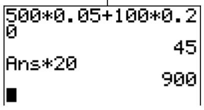
```
1-0.95*0.80
             .24
```

G35a $P(\text{minstens één prijs}) = 1 - P(\text{geen prijs}) = 1 - (1-0{,}05)\cdot(1-0{,}20) = 1 - 0{,}95 \cdot 0{,}80 = 0{,}24.$

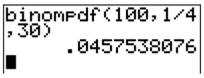
G35b X is het aantal leden dat in de prijzen valt.
$P(X \geq 8) = 1 - P(X \leq 7) = 1 - \text{binomcdf}(20{,}0.24{,}7) \approx 0{,}08.$



G35c Y is het prijzengeld per student.
$E(Y) = 500 \cdot 0{,}05 + 100 \cdot 0{,}20 = 45$ (€).
De studentenvereniging verwacht $20 \cdot 45 = 900$ euro te winnen.

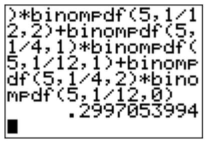


G36a V is het aantal vrouwen met osteoporose.
$P(V = 30) = \text{binompdf}(100, \frac{1}{4}, 30) \approx 0{,}046.$

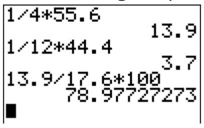


G36b M is het aantal mannen met osteoporose.

$$P(\text{2 met osteoporose}) = P(V=0 \text{ en } M=2) + P(V=1 \text{ en } M=1) + P(V=2 \text{ en } M=0)$$
$$= P(V=0)\cdot P(M=2) + P(V=1)\cdot P(M=1) + P(V=2)\cdot P(M=0)$$
$$= \text{binompdf}(5,\tfrac{1}{4},0)\cdot \text{binompdf}(5,\tfrac{1}{12},2) + \text{binompdf}(5,\tfrac{1}{4},1)\cdot \text{binompdf}(5,\tfrac{1}{12},1)$$
$$+ \text{binompdf}(5,\tfrac{1}{4},2)\cdot \text{binompdf}(5,\tfrac{1}{12},0) \approx 0{,}300.$$

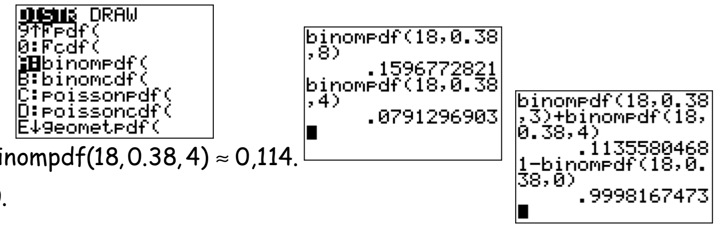


G36c Van de osteoporose-patiënten in de risicogroep was
$\frac{13{,}9}{17{,}6} \times 100\% = 79{,}0\%$ vrouw.
(zie de tabel hiernaast)



	osteoporose	geen osteoporose	
vrouw	13,9%		55,6%
man	3,7%		44,4%
	17,6%		100%

TI-84 2. De binomiale verdeling

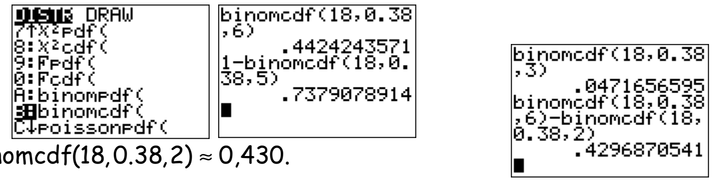


1a $P(X=8)=\text{binompdf}(18, 0.38, 8)\approx 0{,}160$.

1b $P(X=4)=\text{binompdf}(18, 0.38, 4)\approx 0{,}079$.

1c $P(X=3)+P(X=4)=\text{binompdf}(18, 0.38, 3)+\text{binompdf}(18, 0.38, 4)\approx 0{,}114$.

1d $1-P(X=0)=1-\text{binompdf}(18, 0.38, 0)\approx 1{,}000$.



2a $P(X\le 6)=\text{binomcdf}(18, 0.38, 6)\approx 0{,}442$.

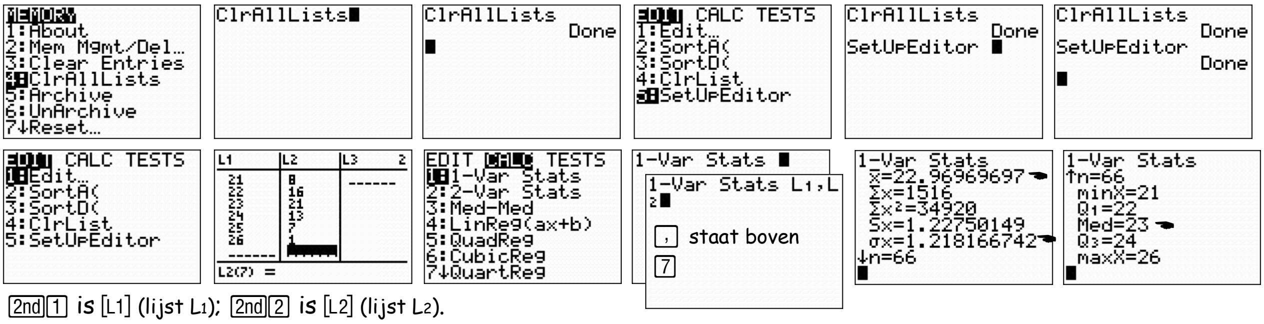
2b $1-P(X\le 5)=1-\text{binomcdf}(18, 0.38, 5)\approx 0{,}738$.

2c $P(X\le 3)=\text{binomcdf}(18, 0.38, 3)\approx 0{,}047$.

2d $P(X\le 6)-P(X\le 2)=\text{binomcdf}(18, 0.38, 6)-\text{binomcdf}(18, 0.38, 2)\approx 0{,}430$.

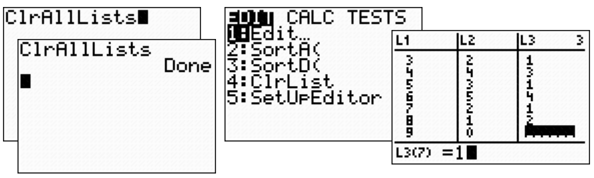
TI-84 3. Centrum- en spreidingsmaten

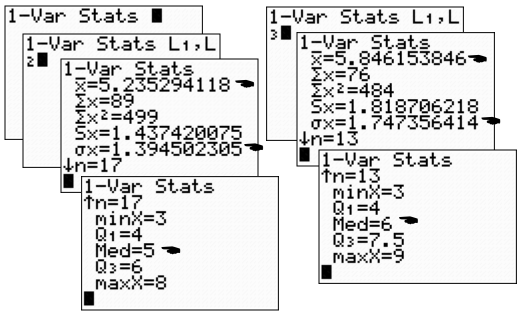
1 Gemiddelde is $\overline{x}\approx 23{,}0$ de standaardafwijking is $\sigma\approx 1{,}2$ en de mediaan is Med $=23$.
(zie de laatste twee schermen op de tweede rij hieronder)
De schermen op de eerste rij hieronder zijn om bestaande lijsten schoon te vegen en
om de 6 oorspronkelijke lijsten (bij verlies) in de oorspronkelijke volgorde te plaatsen.



2nd 1 is [L1] (lijst L_1); 2nd 2 is [L2] (lijst L_2).

2a





$\overline{x}\approx 5{,}2$ $\sigma\approx 1{,}4$ en Med $=5$ (zie de schermen hiernaast).

2b $\overline{x}\approx 5{,}8$ $\sigma\approx 1{,}7$ en Med $=6$ (zie de schermen hiernaast).

2c $\overline{x}\approx 5{,}5$ $\sigma\approx 1{,}6$ en Med $=6$ (zie de schermen hieronder).