1 Som 15 kan met $\underline{\underline{663}}$ (op $\frac{3!}{2!} = \binom{3}{2} = 3$ manieren), $\underline{\underline{654}}$ (op $3! = 6$ manieren) en 555 (op 1 manier).
Dus totaal $3 + 6 + 1 = 10$ gunstige uitkomsten.

```
3 nCr 2+3!+1
            10
```

Dubbel onderstreept betekent: "niet alleen" in de genoteerde volgorde

+	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

2a $P(\text{som} \neq 5) = 1 - P(\text{som} = 5) = 1 - \frac{4}{36} = \frac{32}{36} (= \frac{8}{9})$.

2b $P(\text{som} \geq 4) = 1 - P(\text{som} < 4) = 1 - \frac{3}{36} = \frac{33}{36} (= \frac{11}{12})$.

2c $P(\text{som} \geq 10) = \frac{6}{36} (= \frac{1}{6})$.

2d $P(\text{som} \leq 10) = 1 - P(\text{som} > 10) = 1 - \frac{3}{36} = \frac{33}{36} (= \frac{11}{12})$.

3a $P(\text{som} \leq 22) = 1 - P(\text{som} > 22) = 1 - P(\text{som} = 23 \text{ of som} = 24) = 1 - \frac{5}{1296} = \frac{1291}{1296}$. (zie de uitleg hieronder)
Som 23 kan met $\underline{\underline{6665}}$ en som 24 met 6666. Dus totaal $\binom{4}{3} + 1 = 4 + 1 = 5$ gunstige uitkomsten.
Het aantal mogelijke uitkomsten met vier dobbelstenen is $6 \times 6 \times 6 \times 6 = 1296$.

```
4 nCr 3+1
             5
6^4
          1296
1-5/1296►Frac
     1291/1296
```

3b $P(\text{som} \geq 7) = 1 - P(\text{som} \leq 6) = 1 - P(\text{som} = 4 \text{ of som} = 5 \text{ of som} = 6) = 1 - \frac{15}{1296} = \frac{1281}{1296}$ (eventueel $= \frac{427}{432}$).
Som 4 met 1111, som 5 met $\underline{\underline{1112}}$ en som 6 met $\underline{\underline{1122}}$ en $\underline{\underline{1113}}$. Dus totaal $1 + \binom{4}{3} + \binom{4}{2} + \binom{4}{3} = 15$ gunstige uitkomsten.

```
1+4 nCr 3+4 nCr
2+4 nCr 3
            15
1-15/6^4►Frac
       427/432
```

4 De juiste formules zijn $P(\text{Elske pakt een rode}) = \frac{n+5}{m+5}$ en $P(\text{Elske pakt een zwarte}) = \frac{m-n}{m+5}$.

5a $P(\text{Rob pakt een rode knikker}) = \frac{a+4}{24}$ en $P(\text{Rob pakt een zwarte knikker}) = \frac{20-a}{24}$.

5b $P(\text{Lizzy pakt een rode}) = \frac{18}{p+q}$ en $P(\text{Lizzy pakt een zwarte}) = \frac{p+q-18}{p+q}$.

5c $P(\text{Paula pakt een rode knikker}) = \frac{m-5}{m+n-5}$ en $P(\text{Paula pakt een zwarte knikker}) = \frac{n}{m+n-5}$.

6a $P(\text{minstens één prijs}) = 1 - P(\text{geen prijs}) = 1 - P(0 \text{ euro}) = 1 - P(3 \times €\,0) = 1 - \frac{\binom{43}{3}}{\binom{50}{3}} \approx 0{,}370$.

```
1-43 nCr 3/50 nC
r 3
  .3703571429
```

6b $P(100 \text{ euro}) = P(1 \times €\,100) + P(2 \times €\,50) = \frac{\binom{1}{1} \cdot \binom{43}{2}}{\binom{50}{3}} + \frac{\binom{2}{2} \cdot \binom{43}{1}}{\binom{50}{3}} \approx 0{,}048$.

```
1*43 nCr 2+1*43
nCr 1
           946
Ans/50 nCr 3
   .0482653061
```

6c $P(\text{minstens 30 euro}) = 1 - P(\text{minder dan 30 euro}) = 1 - (P(3 \times €\,0) + P(1 \times €\,10) + P(2 \times €\,10))$

$$= 1 - \left(\frac{\binom{43}{3}}{\binom{50}{3}} + \frac{\binom{4}{1} \cdot \binom{43}{2}}{\binom{50}{3}} + \frac{\binom{4}{2} \cdot \binom{43}{1}}{\binom{50}{3}} \right) \approx 0{,}173.$$

```
43 nCr 3+4*43 nC
r 2+4 nCr 2*43
         16211
1-Ans/50 nCr 3
   .1729081633
```

7 $P(\text{afkeuren}) = 1 - P(\text{goedkeuren}) = 1 - \frac{\binom{37}{3}}{\binom{40}{3}} \approx 0{,}214$.

```
1-37 nCr 3/40 nC
r 3
    .213562753
```

8a $P(\text{geen uit Californië}) = \frac{\binom{98}{8}}{\binom{100}{8}} \approx 0{,}846$.

8b $P(\text{één uit Arizona en één uit Florida}) = \frac{\binom{2}{1} \cdot \binom{2}{1} \cdot \binom{96}{6}}{\binom{100}{8}} \approx 0{,}020$.

```
98 nCr 8/100 nCr
8
   .8456565657
2 nCr 1*2 nCr 1*
96 nCr 6/100 nCr
8
   .0199271061
```

	meisje	jongen	totaal
vwo	3	2	5
niet vwo	5	2	7
totaal	8	4	12

9a $P(\text{louter meisjes}) = \frac{\binom{8}{4}}{\binom{12}{4}} \approx 0{,}141$.

```
8 nCr 4/12 nCr 4
   .1414141414
```

9b $P(\text{precies 2 op het vwo}) = \frac{\binom{5}{2} \cdot \binom{7}{2}}{\binom{12}{4}} \approx 0{,}424$.

9c $P(\text{precies 1 jongen niet op het vwo}) = \frac{\binom{2}{1} \cdot \binom{10}{3}}{\binom{12}{4}} \approx 0{,}485$.

```
5 nCr 2*7 nCr 2/
12 nCr 4
   .4242424242
2 nCr 1*10 nCr 3
/12 nCr 4
   .4848484848
```

10a $P(\text{nummer 14 bij de eerste drie}) = \frac{\binom{1}{1} \cdot \binom{15}{2}}{\binom{16}{3}} \approx 0{,}188$.

10c $P(\text{nummers 3, 7, 8 en 9 bij de eerste acht}) = \frac{\binom{4}{4} \cdot \binom{12}{4}}{\binom{16}{8}} \approx 0{,}038$.

```
1 nCr 1*15 nCr 2
/16 nCr 3
         .1875
3 nCr 3/16 nCr 3
   .0017857143
```

```
4 nCr 4*12 nCr 4
/16 nCr 8
   .0384615385
```

10b $P(\text{nummers 1, 2 en 3 bij de laatste drie}) = \frac{\binom{3}{3}}{\binom{16}{3}} \approx 0{,}002$.

11a $P(\text{minstens één volleyballer moet wachten}) = 1 - P(\text{geen volleyballer moet wachten}) = 1 - \dfrac{\binom{46}{6}}{\binom{54}{6}} \approx 0,637.$

```
1-46 nCr 6/54 nC
r 6
     .6373268611
```

11b $P(\text{de heer Aalderink en zijn secretaresse hoeven niet te wachten}) = \dfrac{\binom{52}{6}}{\binom{54}{6}} \approx 0,788.$

```
52 nCr 6/54 nCr
6
     .7882599581
```

12a $P(\text{alle zes getallen kleiner dan 20}) = \dfrac{\binom{19}{6}}{\binom{44}{6}} \approx 0,004.$

```
19 nCr 6/44 nCr
6
     .0038435756
1 nCr 1*39 nCr 5
/44 nCr 6
     .0815629351
```

12b $P(\underline{\underline{\text{40 en vijf getallen kleiner dan 40}}}) = \dfrac{\binom{1}{1}\cdot\binom{39}{5}}{\binom{44}{6}} \approx 0,082.$

12c $P(\text{derde prijs}) = \dfrac{\binom{6}{4}\cdot\binom{38}{2}}{\binom{44}{6}} \approx 0,001.$

12d $P(\text{vierde prijs}) = \dfrac{\binom{6}{3}\cdot\binom{1}{1}\cdot\binom{37}{2}}{\binom{44}{6}} \approx 0,002.$

```
6 nCr 4*38 nCr 2
/44 nCr 6
     .0014938266
6 nCr 3*1 nCr 1*
37 nCr 2/44 nCr
6
     .0018869389
```

13a $P(\text{de Amerikanen in de middelste drie banen}) = \dfrac{\binom{3}{3}}{\binom{7}{3}} \approx 0,029.$

```
3 nCr 3/7 nCr 3
     .0285714286
```

13b $P(\text{één van de Duitsers in een buitenbaan}) = \dfrac{\binom{2}{1}\cdot\binom{5}{1}}{\binom{7}{2}} \approx 0,476.$

```
2 nCr 1*5 nCr 1/
7 nCr 2
     .4761904762
```

13c $P(\text{tenminste één van de niet-Amerikanen in een buitenbaan}) = 1 - P(\text{geen niet-Amerikanen in een buitenbaan})$

$= 1 - P(\text{Amerikanen in een buitenbaan}) = 1 - \dfrac{\binom{3}{2}}{\binom{7}{2}} \approx 0,857.$

```
1-3 nCr 2/7 nCr
2
     .8571428571
```

14a $\frac{2}{3}\cdot\frac{3}{10} = \frac{6}{30} = \frac{1}{5}.$

14b $\frac{5}{10} + \frac{1}{3} = \frac{15}{30} + \frac{10}{30} = \frac{25}{30} = \frac{5}{6}.$

14c $4\cdot\frac{1}{3}\cdot\frac{1}{2} = \frac{4}{6} = \frac{2}{3}.$

```
2/3*3/10▸Frac
              1/5
5/10+1/3▸Frac
              5/6
4*1/3*1/2▸Frac
              2/3
```

14d $3\cdot\left(\frac{2}{5}\right)^3 = 3\cdot\frac{8}{125} = \frac{24}{125}.$

14e $\frac{1}{3}\cdot\frac{5}{6} + \frac{2}{9}\cdot\frac{1}{2} = \frac{5}{18} + \frac{2}{18} = \frac{7}{18}.$

14f $1 - \frac{2}{5}\cdot 3\cdot\frac{1}{6} = 1 - \frac{6}{30} = 1 - \frac{1}{5} = \frac{4}{5}.$

```
3*(2/5)^3▸Frac
           24/125
1/3*5/6+2/9*1/2▸
Frac
             7/18
```

```
1-2/5*3*1/6▸Frac
              4/5
```

15a $\frac{2}{5}\cdot\frac{1}{3}\cdot\frac{3}{4} = \frac{6}{60} = \frac{1}{10}.$

15b $1 - \frac{2}{5}\cdot\frac{1}{3} - \frac{1}{4} = 1 - \frac{2}{15} - \frac{1}{4} = \frac{60}{60} - \frac{8}{60} - \frac{15}{60} = \frac{37}{60}.$

15c $\frac{3}{4}\cdot\frac{2}{3} + \frac{5}{8}\cdot\frac{1}{2} = \frac{6}{12} + \frac{5}{16} = \frac{1}{2} + \frac{5}{16} = \frac{8}{16} + \frac{5}{16} = \frac{13}{16}.$

15d $4\cdot\frac{1}{9} + \left(\frac{2}{3}\right)^3 = \frac{4}{9} + \frac{8}{27} = \frac{12}{27} + \frac{8}{27} = \frac{20}{27}.$

15e $\left(\frac{3}{4}\right)^2 + \frac{5}{8}\cdot\frac{1}{2} + \left(\frac{1}{2}\right)^4 = \frac{9}{16} + \frac{5}{16} + \frac{1}{16} = \frac{15}{16}.$

15f $\left(\frac{1}{6}\right)^2 + 3\cdot\left(\frac{1}{2}\right)^2\cdot\frac{1}{9} = \frac{1}{36} + 3\cdot\frac{1}{4}\cdot\frac{1}{9} = \frac{1}{36} + \frac{3}{36} = \frac{4}{36} = \frac{1}{9}.$

16a $P(rrw) = \frac{2}{4}\cdot\frac{2}{4}\cdot\frac{1}{4} = \frac{4}{64} = \frac{1}{16}.$

```
2/4*2/4*1/4▸Frac
             1/16
```

16b $P(\underline{\underline{rrw}}) = \binom{3}{2}\cdot\frac{2}{4}\cdot\frac{2}{4}\cdot\frac{1}{4} = 3\cdot\frac{2}{4}\cdot\frac{2}{4}\cdot\frac{1}{4} = \frac{12}{64} = \frac{3}{16}.$

```
3 nCr 2*2/4*2/4*
1/4▸Frac
             3/16
```

17a $P(33) = \frac{1}{4}\cdot\frac{1}{5} = 0,05.$

17b $P(\bar{1}\bar{1}) = \frac{3}{4}\cdot\frac{3}{5} = 0,45.$

```
1/4*1/5
              .05
3/4*3/5
              .45
```

17c $P(\underline{\underline{2\bar{2}}}) = P(2\bar{2}) + P(\bar{2}2) = \frac{2}{4}\cdot\frac{3}{5} + \frac{2}{4}\cdot\frac{2}{5} = 0,5.$

17d $P(\text{minstens één 2}) = 1 - P(\bar{2}\bar{2}) = 1 - \frac{2}{4}\cdot\frac{3}{5} = 0,7.$

```
2/4*3/5+2/4*2/5
               .5
1-2/4*3/5
               .7
```

18a $P(\underline{\underline{2\bar{2}\bar{2}\bar{2}\bar{2}\bar{2}\bar{2}\bar{2}}}) = \binom{8}{1}\cdot\frac{2}{5}\cdot\left(\frac{3}{5}\right)^7 \approx 0,090.$

```
8 nCr 1*2/5*(3/5
)^7
         .08957952
1-(3/5)^8
         .98320384
```

18b $P(\text{minstens een 1}) = 1 - P(\bar{1}\bar{1}\bar{1}\bar{1}\bar{1}\bar{1}\bar{1}\bar{1}) = 1 - \left(\frac{3}{5}\right)^8 \approx 0,983.$

18c $P(\underline{\underline{11111333}}) = \binom{8}{5}\cdot\left(\frac{2}{5}\right)^5\cdot\left(\frac{1}{5}\right)^3 \approx 0,005.$

18d $P(\underline{\underline{11113222}}) = \binom{8}{4}\cdot\binom{4}{1}\cdot\left(\frac{2}{5}\right)^4\cdot\frac{1}{5}\cdot\left(\frac{2}{5}\right)^3 \approx 0,092.$

```
8 nCr 5*(2/5)^5*
(1/5)^3
         .00458752
8 nCr 4*4 nCr 1*
(2/5)^4*1/5*(2/5
)^3
          .0917504
```

19a $P(\bar{v}\bar{v}\bar{v}\bar{v}\bar{v}) = \left(\frac{4}{5}\right)^5 \approx 0,328.$

```
(4/5)^5
           .32768
```

19b $P(\text{minstens één v}) = 1 - P(\text{geen v}) = 1 - P(\bar{v}\bar{v}\bar{v}\bar{v}\bar{v}\bar{v}) = 1 - \left(\frac{4}{5}\right)^6 \approx 0,738.$

```
1-(4/5)^6
          .737856
```

19c $P(\underline{\underline{v\bar{v}\bar{v}\bar{v}\bar{v}\bar{v}\bar{v}\bar{v}}}) = \binom{8}{1}\cdot\frac{1}{5}\cdot\left(\frac{4}{5}\right)^7 \approx 0,336.$

```
8 nCr 1*1/5*(4/5
)^7
         .33554432
```

20 $P(\text{afgekeurd}) = 1 - P(\text{goedgekeurd}) = 1 - P(gggg) = 1 - 0,98\cdot 0,70\cdot 0,95\cdot 0,92 \approx 0,400.$

```
1-0.98*0.7*0.95*
0.92
          .400436
```

21a $P(\text{minstens twee slagen}) = 1 - P(\bar{s}\bar{s}\bar{s}\bar{s}\bar{s}\bar{s}\bar{s}\bar{s}) - P(\underline{\underline{s\bar{s}\bar{s}\bar{s}\bar{s}\bar{s}\bar{s}\bar{s}}}) = 1 - 0{,}78^8 - \binom{8}{1}\cdot 0{,}22 \cdot 0{,}78^7 \approx 0{,}554.$

```
1-0.78^8-8 nCr 1
*0.22*0.78^7
      .5538345511
```

21b $P(\text{6 of 7 slagen}) = P(\underline{\underline{ssssss\bar{s}\bar{s}\bar{s}\bar{s}\bar{s}\bar{s}}}) + P(\underline{\underline{sssssss\bar{s}\bar{s}\bar{s}\bar{s}\bar{s}}}) = \binom{12}{6}\cdot 0{,}53^6 \cdot 0{,}47^6 + \binom{12}{7}\cdot 0{,}53^7 \cdot 0{,}47^5 \approx 0{,}434.$

21c $P(\text{hoogstens twee zakken}) = P(ssssssssss) + P(\underline{\underline{\bar{s}sssssssss}}) + P(\underline{\underline{\bar{s}\bar{s}ssssssss}})$
$= 0{,}71^{10} + \binom{10}{1}\cdot 0{,}29 \cdot 0{,}71^9 + \binom{10}{2}\cdot 0{,}29^2 \cdot 0{,}71^8 \approx 0{,}410.$

```
0.71^10+10 nCr 1
*0.29*0.71^9+10
nCr 2*0.29²*0.71
^8
      .4098985115
```

```
12 nCr 6*0.53^6*
0.47^6+12 nCr 7*
0.53^7*0.47^5
      .4341329198
```

22a $P(\underline{\underline{4\bar{4}\bar{4}}}) = \binom{3}{1}\cdot\frac{1}{4}\cdot\left(\frac{3}{4}\right)^2 = \frac{27}{64}.$

```
3 nCr 1*1/4*(3/4
)^2▸Frac
           27/64
```

22b $P(\text{minstens één 2}) = 1 - P(\bar{2}\bar{2}\bar{2}) = 1 - \left(\frac{3}{4}\right)^3 = \frac{37}{64}.$

```
1-(3/4)^3▸Frac
           37/64
```

23a $P(\bar{6}\bar{6}\bar{6}6) = \left(\frac{5}{6}\right)^3 \cdot \frac{1}{6} \approx 0{,}096.$

23b $P(\bar{6}\bar{6}\bar{6}\bar{6}) = \left(\frac{5}{6}\right)^4 \approx 0{,}482.$

```
(5/6)^3*1/6
      .0964506173
(5/6)^4
      .4822530864
```

23c $1 - P(\underbrace{\bar{6}\bar{6}\bar{6}\ldots\bar{6}}_{n \text{ keer}}) = 1 - \left(\frac{5}{6}\right)^n.$

```
 Plot1 Plot2 Plot3
\Y1=1-(5/6)^X
\Y2=0.95
\Y3=
```

X	Y_1	Y_2
13	.90654	.95
14	.92211	.95
15	.93509	.95
16	.94591	.95
17	[illegible]	.95
18	.96244	.95
19	.9687	.95

Y_1=.95492675589

23d $1 - \left(\frac{5}{6}\right)^n > 0{,}95$ (TABLE) $\Rightarrow n \geq 17$. Dus minstens 17 keer.

24a $P(\mathrm{I} = 0) = P(\bar{\mathrm{I}}\bar{\mathrm{I}}\bar{\mathrm{I}}\bar{\mathrm{I}}\bar{\mathrm{I}}\bar{\mathrm{I}}\bar{\mathrm{I}}\bar{\mathrm{I}}\bar{\mathrm{I}}\bar{\mathrm{I}}\bar{\mathrm{I}}\bar{\mathrm{I}}) = (1 - 0{,}14)^{12} = 0{,}86^{12} \approx 0{,}164.$

```
0.86^12
      .1636746477
```

24b $P(\mathrm{I} = 3) = P(\underline{\underline{\mathrm{III}\bar{\mathrm{I}}\bar{\mathrm{I}}\bar{\mathrm{I}}\bar{\mathrm{I}}\bar{\mathrm{I}}\bar{\mathrm{I}}\bar{\mathrm{I}}\bar{\mathrm{I}}\bar{\mathrm{I}}}}) = \binom{12}{3}\cdot 0{,}14^3 \cdot 0{,}86^9 \approx 0{,}155.$

24c $P(\mathrm{A} = 8 \text{ én } \mathrm{B} = 4) = P(\underline{\underline{\mathrm{AAAAAAAABBBB}}}) = \binom{12}{8}\cdot 0{,}37^8 \cdot 0{,}49^4 \approx 0{,}010.$

```
12 nCr 3*0.14^3*
0.86^9
      .1553434153
12 nCr 8*0.37^8*
0.49^4
      .0100231288
```

24d $P(\mathrm{B} \geq 2) = 1 - P(\mathrm{B} \leq 1) = 1 - P(\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}) - P(\underline{\underline{\mathrm{B}\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}\bar{\mathrm{B}}}}) = 1 - 0{,}51^{12} - \binom{12}{1}\cdot 0{,}49 \cdot 0{,}51^{11} \approx 0{,}996.$

```
1-0.51^12-12 nCr
1*0.49*0.51^11
      .9961205264
```

25a $P(\textit{kinderdagverblijf} = 2) = P(\underline{\underline{kk\bar{k}\bar{k}\bar{k}\bar{k}\bar{k}\bar{k}}}) = \binom{8}{2}\cdot 0{,}14^2 \cdot 0{,}86^6 \approx 0{,}222.$

25b $P(\textit{betaalde oppas} \geq 2) = 1 - P(\textit{betaalde oppas} < 2) = 1 - \left(P(\textit{betaalde oppas} = 0) + P(\textit{betaalde oppas} = 1)\right)$
$= 1 - \left(P(\bar{b}\bar{b}\bar{b}\bar{b}\bar{b}\bar{b}\bar{b}\bar{b}) + P(\underline{\underline{b\bar{b}\bar{b}\bar{b}\bar{b}\bar{b}\bar{b}\bar{b}}})\right) = 1 - \left(0{,}95^8 + \binom{8}{1}\cdot 0{,}05 \cdot 0{,}95^7\right) \approx 0{,}057.$

```
8 nCr 2*0.14²*0.
86^6
      .2220264986
1-(0.95^8+8 nCr
1*0.05*0.95^7)
      .0572446503
```

25c $P(\textit{geen oppas} > 6) = P(\textit{geen oppas} = 7) + P(\textit{geen oppas} = 8)$
$= P(\underline{\underline{ggggggg\bar{g}}}) + P(gggggggg) = \binom{8}{7}\cdot 0{,}74^7 \cdot 0{,}26 + 0{,}74^8 \approx 0{,}343.$

5% + 21% = 26% heeft oppas
(betaald dan wel onbetaald)

```
8 nCr 7*0.74^7*0
.26+0.74^8
      .3426661037
```

25d $P(\textit{geen opvang} = 6) = P(\underline{\underline{\bar{o}\bar{o}\bar{o}\bar{o}\bar{o}\bar{o}oooo}}) = \dfrac{\binom{12}{6}\cdot\binom{16}{4}}{\binom{28}{10}} \approx 0{,}128.$

28 − 12 = 16 met kinderopvang
(kinderdagverblijf of oppas)

```
12 nCr 6*16 nCr
4/28 nCr 10
      .1281464531
```

25e $P(\textit{kinderdagverblijf} \geq 2) = 1 - P(\textit{kinderdagverblijf} < 2) = 1 - \left(P(\textit{kinderdagverblijf} = 0) + P(\textit{kinderdagverblijf} = 1)\right)$
$= 1 - \left(P(\bar{k}\bar{k}\bar{k}\bar{k}\bar{k}\bar{k}\bar{k}\bar{k}\bar{k}\bar{k}) + P(\underline{\underline{k\bar{k}\bar{k}\bar{k}\bar{k}\bar{k}\bar{k}\bar{k}\bar{k}\bar{k}}})\right) = 1 - \left(\dfrac{\binom{20}{10}}{\binom{28}{10}} + \dfrac{\binom{8}{1}\cdot\binom{20}{9}}{\binom{28}{10}}\right) \approx 0{,}884.$

```
1-(20 nCr 10/28
nCr 10+8 nCr 1*2
0 nCr 9/28 nCr 1
0)
      .8835309618
```

26a $P(\text{Heleen pakt een rode}) = \frac{a}{10}$ en $P(\text{Heleen pakt een zwarte}) = \frac{10-a}{10}.$

26b $P(\text{Anton pakt een rode}) = \frac{b}{8}$ en $P(\text{Anton pakt een zwarte}) = \frac{8-b}{8}.$

27a $\frac{2}{3} + \frac{3}{10} = \frac{20}{30} + \frac{9}{30} = \frac{29}{30}.$

27b $\left(\frac{2}{3}\right)^3 + \left(\frac{1}{2}\right)^3 = \frac{8}{27} + \frac{1}{8} = \frac{64}{216} + \frac{27}{216} = \frac{91}{216}.$

27c $1 - \frac{1}{3}\cdot\frac{1}{4} = 1 - \frac{1}{12} = \frac{11}{12}.$

27d $6\cdot\left(\frac{3}{4}\right)^2 - \frac{3}{8}\cdot 5 = 6\cdot\frac{9}{16} - \frac{15}{8} = \frac{54}{16} - \frac{30}{16} = \frac{24}{16} = \frac{3}{2}.$

27e $8\cdot\frac{1}{3} - \frac{2}{3}\cdot\frac{4}{7} = \frac{8}{3} - \frac{8}{21} = \frac{56}{21} - \frac{8}{21} = \frac{48}{21} = \frac{16}{7}.$

27f $4\cdot\frac{2}{15} + 3\cdot\frac{1}{3}\cdot\left(\frac{1}{2}\right)^2 = \frac{8}{15} + 3\cdot\frac{1}{3}\cdot\frac{1}{4} = \frac{8}{15} + \frac{1}{4} = \frac{32}{60} + \frac{15}{60} = \frac{47}{60}.$

28a $5\cdot\left(\frac{3}{4}\right)^3 + 3\cdot\left(\frac{1}{4}\right)^3 = 5\cdot\frac{27}{64} + 3\cdot\frac{1}{64} = \frac{135}{64} + \frac{3}{64} = \frac{138}{64} = \frac{69}{32}.$

28 $4\cdot\frac{2}{3}\cdot\frac{1}{5} + 3\cdot\frac{1}{3}\cdot\frac{2}{5} = \frac{8}{15} + \frac{6}{15} = \frac{14}{15}.$

28c $1 - \frac{1}{3}\cdot\frac{3}{5} - 3\cdot\frac{1}{4}\cdot\frac{1}{3} = 1 - \frac{3}{15} - \frac{3}{12} = 1 - \frac{1}{5} - \frac{1}{4} = 1 - \frac{4}{20} - \frac{5}{20} = \frac{11}{20}.$

28d $\frac{3}{\frac{2}{5}} - 2\frac{1}{3} - 2\cdot\frac{1}{3} = 3\cdot\frac{5}{2} - \frac{7}{3} - \frac{2}{3} = \frac{15}{2} - \frac{9}{3} = 7\frac{1}{2} - 3 = 4\frac{1}{2}.$

29a $\frac{5}{p}+\frac{4}{q}=\frac{5q}{pq}+\frac{4p}{pq}=\frac{4p+5q}{pq}.$

29b $\frac{5}{p}\cdot\frac{4}{q}=\frac{20}{pq}.$

29c $1+\frac{5}{p}=\frac{p}{p}+\frac{5}{p}=\frac{p+5}{p}.$

29d $\frac{p}{3}\cdot\frac{2-p}{5}=\frac{p\cdot(2-p)}{15}=\frac{2p-p^2}{15}.$

29e $\frac{6-p}{\frac{2}{3}}=(6-p)\cdot\frac{3}{2}=\frac{18}{2}-\frac{3}{2}p=9-\frac{3}{2}p.$

29f $\frac{a-5}{a}\cdot\frac{8-a}{3}=\frac{(a-5)\cdot(8-a)}{3a}=\frac{8a-a^2-40+5a}{3a}=\frac{-a^2+13a-40}{3a}.$

29g $\frac{5}{a}+\frac{7-a}{3}=\frac{15}{3a}+\frac{a\cdot(7-a)}{3a}=\frac{15}{3a}+\frac{7a-a^2}{3a}=\frac{-a^2+7a+15}{3a}.$

29h $3\cdot\frac{5}{n}\cdot\frac{2-n}{n}+\frac{5}{n}\cdot\frac{n-1}{n}=\frac{15\cdot(2-n)}{n^2}+\frac{5\cdot(n-1)}{n^2}=\frac{30-15n+5n-5}{n^2}=\frac{-10n+25}{n^2}.$

30a $\frac{1}{a}+\frac{1}{b}=\frac{b}{ab}+\frac{a}{ab}=\frac{a+b}{ab}.$

30b $\frac{1}{a}+2=\frac{1}{a}+\frac{2a}{a}=\frac{2a+1}{a}.$

30c $\frac{1}{a}\cdot 2\cdot\frac{b}{4}=\frac{2b}{4a}=\frac{b}{2a}.$

30d $3\cdot\frac{a-3}{5}\cdot\frac{2-a}{a}+2\cdot\frac{(3-a)^2}{5a}=\frac{3\cdot(a-3)\cdot(2-a)}{5a}+\frac{2\cdot(3-a)\cdot(3-a)}{5a}=\frac{3\cdot(2a-a^2-6+3a)}{5a}+\frac{2\cdot(9-3a-3a+a^2)}{5a}$

$=\frac{3\cdot(-a^2+5a-6)}{5a}+\frac{2\cdot(a^2-6a+9)}{5a}=\frac{-3a^2+15a-18}{5a}+\frac{2a^2-12a+18}{5a}=\frac{-a^2+3a}{5a}=\frac{a\cdot(-a+3)}{5\cdot a}=\frac{-a+3}{5}.$

30e $5\cdot\frac{3}{8-a}\cdot\frac{2-a}{a}+\frac{a}{8-a}\cdot\frac{a-2}{a}=\frac{15\cdot(2-a)}{a\cdot(8-a)}+\frac{a\cdot(a-2)}{a\cdot(8-a)}=\frac{30-15a}{8a-a^2}+\frac{a^2-2a}{8a-a^2}=\frac{a^2-17a+30}{8a-a^2}.$

30f $5\cdot\frac{3-a}{a^2}-2\cdot\frac{6-a}{a^2}=\frac{5\cdot(3-a)}{a^2}-\frac{2\cdot(6-a)}{a^2}=\frac{15-5a}{a^2}-\frac{12-2a}{a^2}=\frac{15-5a-(12-2a)}{a^2}=\frac{15-5a-12+2a}{a^2}=\frac{-3a+3}{a^2}.$

31a Als er van de totaal 10 knikkers a rood zijn en de rest zwart, dan zijn er $10-a$ zwart.

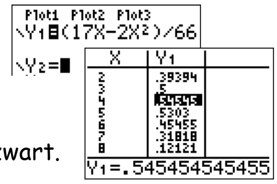
31b $P(\text{een zwarte uit II})=\frac{\text{aantal gunstige uitkomsten}}{\text{aantal mogelijke uitkomsten}}(\text{Laplace})=\frac{\text{aantal zwarte knikkers in II}}{\text{totaal aantal knikkers in II}}=\frac{a}{a+6}.$

31c $P(\text{uit beide vazen een zwarte})=P(\text{een zwarte uit I én een zwarte uit II})=\frac{10-a}{10}\cdot\frac{a}{a+6}=\frac{(10-a)\cdot a}{10\cdot(a+6)}=\frac{10a-a^2}{10a+60}.$

32a $P(\text{een rode uit I én een rode uit II})=\frac{x}{11}\cdot\frac{x}{6}=\frac{x^2}{66}.$

32b $P(\underline{\underline{\text{een rode én een zwarte}}})=P(\text{rode uit I én zwarte uit II})+P(\text{zwarte uit I én rode uit II})$

$=\frac{x}{11}\cdot\frac{6-x}{6}+\frac{11-x}{11}\cdot\frac{x}{6}=\frac{x\cdot(6-x)}{66}+\frac{x\cdot(11-x)}{66}=\frac{6x-x^2}{66}+\frac{11x-x^2}{66}=\frac{17x-2x^2}{66}.$

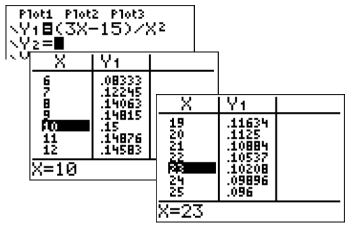


32c $P(\underline{\underline{\text{een rode én een zwarte}}})=\frac{17x-2x^2}{66}$ (zie 26b) is maximaal (zie TABLE) voor $x=4$.
$x=4\Rightarrow$ in vaas I zijn er 4 rood en 7 zwart en in vaas II zijn er 4 rood, dus 2 zwart.

33a $P(\text{uit beide vazen een rode})=P(\text{een rode uit I én een rode uit II})=\frac{5}{a}\cdot\frac{3}{a}=\frac{15}{a^2}.$

33b $P(\underline{\underline{\text{een rode én een witte}}})=P(\text{een rode uit I én een witte uit II})=\frac{5}{a}\cdot\frac{a-3}{a}=\frac{5a-15}{a^2}.$

33c $P(\underline{\underline{\text{een rode én een zwarte}}})=P(\text{een zwarte uit I én een rode uit II})=\frac{a-5}{a}\cdot\frac{3}{a}=\frac{3a-15}{a^2}.$

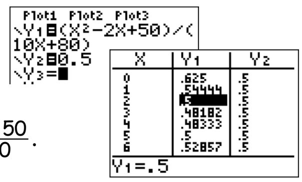


33d $P(\underline{\underline{\text{een rode én een zwarte}}})=\frac{3a-15}{a^2}$ is maximaal 0,15 (zie TABLE) voor $a=10$.
Er zitten dan 5 rode knikkers, dus $10-5=5$ zwarte in vaas I.

33e $P(\underline{\underline{\text{een rode én een zwarte}}})=\frac{3a-15}{a^2}>0{,}1$ (zie TABLE) voor $a=7$ tot en met $a=23$.
Er zitten 7 of 8 of 9 of ... of 22 of 23 knikkers in vaas I.

34a $P(\text{uit beide vazen een rode})=P(\text{een rode uit I én een rode uit II})=\frac{3}{8}\cdot\frac{10-a}{10}=\frac{30-3a}{80}.$

34b $P(\text{uit beide vazen een witte})=P(\text{een witte uit I én een witte uit II})=\frac{5}{8}\cdot\frac{a}{10}=\frac{5a}{80}=\frac{a}{16}.$



34c $P(\underline{\underline{\text{een rode én een witte}}})=P(\text{rode uit I én witte uit II})+P(\text{witte uit I én rode uit II})$

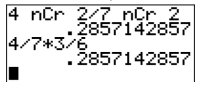
$=\frac{3+a}{8+a}\cdot\frac{a}{10}+\frac{5}{8+a}\cdot\frac{10-a}{10}=\frac{a\cdot(3+a)}{10\cdot(8+a)}+\frac{5\cdot(10-a)}{10\cdot(8+a)}=\frac{3a+a^2}{80+10a}+\frac{50-5a}{80+10a}=\frac{a^2-2a+50}{10a+80}.$

34d $P(\underline{\underline{\text{een rode én een witte}}})=\frac{a^2-2a+50}{10a+80}=0{,}5$ (TABLE) $\Rightarrow a=2$ of $a=5$. Dus 2 of 5 rode knikkers toevoegen aan vaas I.

35a $P(\text{uit beide vazen een witte})=P(\text{een witte uit I én een witte uit II})=\frac{6}{q}\cdot\frac{12-q}{12}=\frac{12-q}{q}\cdot\frac{6}{12}=\frac{12-q}{q}\cdot\frac{1}{2}=\frac{12-q}{2q}.$

35b $P(\underline{\underline{\text{een witte én een zwarte}}})=P(\text{witte uit I én zwarte uit II})+P(\text{zwarte uit I én witte uit II})$

$=\frac{6}{q}\cdot\frac{q}{12}+\frac{q-6}{q}\cdot\frac{12-q}{12}=\frac{6q}{12q}+\frac{(q-6)\cdot(12-q)}{12q}=\frac{6q}{12q}+\frac{12q-q^2-72+6q}{12q}=\frac{-q^2+24q-72}{12q}.$

36 De beweringen I en III zijn beide waar. 

37a $P(\text{rr}) = \frac{p}{50} \cdot \frac{p-1}{49} = \frac{p \cdot (p-1)}{50 \cdot 49} = \frac{p^2-p}{2450}$.

```
50*49
                2450
```

37b $P(\underline{\underline{\text{rw}}}) = \binom{2}{1} \cdot P(\text{rw}) = \binom{2}{1} \cdot \frac{p}{50} \cdot \frac{50-p}{49} = \frac{2p \cdot (50-p)}{50 \cdot 49} = \frac{p \cdot (50-p)}{25 \cdot 49} = \frac{50p-p^2}{1225}$.

```
2 nCr 1
                   2
25*49
                1225
```

37c $P(\underline{\underline{\text{rw}}}) = \frac{50p-p^2}{1225} > 0{,}5$ (TABLE) $\Rightarrow p = 22 \vee p = 23 \vee p = 24 \vee \ldots \vee p = 28$.
Er zitten dus $50 - 22 = 28$ of 27 of 26 of 25 of 24 of 23 of 22 witte knikkers in de vaas.

```
Plot1 Plot2 Plot3
\Y1=(50X-X²)/1225
\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

38a $P(\text{rr}) = \frac{10}{a} \cdot \frac{9}{a-1} = \frac{90}{a \cdot (a-1)} = \frac{90}{a^2-a}$.

38b $P(\underline{\underline{\text{rz}}}) = \binom{2}{1} \cdot P(\text{rz}) = \binom{2}{1} \cdot \frac{10}{a} \cdot \frac{a-10}{a-1} = \frac{2 \cdot 10 \cdot (a-10)}{a \cdot (a-1)} = \frac{20 \cdot (a-10)}{a^2-a} = \frac{20a-200}{a^2-a}$.

38c $P(\underline{\underline{\text{rz}}}) = \frac{20a-200}{a^2-a} > 0{,}5$ (TABLE) $\Rightarrow a = 17 \vee a = 18 \vee a = 19 \vee \ldots \vee a = 24$.
Er zitten dus 17 of 18 of 19 of 20 of 21 of 22 of 23 of 24 knikkers in de vaas.

```
Plot1 Plot2 Plot3
\Y1=(20X-200)/(X²-X)
\Y2=0.5
\Y3=
```

X	Y1	Y2
16	.5	.5
17	.51471	.5
18	.52288	.5
19	.52632	.5
20	.52632	.5
21	.52381	.5
22	.51948	.5

X=22

39a $P(\text{tweede knikker is pas rood}) = P(\text{zr}) = \frac{8-a}{8} \cdot \frac{a}{7} = \frac{a \cdot (8-a)}{8 \cdot 7} = \frac{8a-a^2}{56}$.

39b $P(\text{zr}) = \frac{8a-a^2}{56} = 0{,}125$ (TABLE) $\Rightarrow a = 1 \vee a = 7$. Er zitten dus 1 of 7 rode knikkers in de vaas.

```
Plot1 Plot2 Plot3
\Y1=(8X-X²)/56
\Y2=0.125
\Y3=
```

X	Y1	Y2
1	.125	.125
2	.21429	.125
3	.26786	.125
4	.28571	.125
5	.26786	.125
6	.21429	.125
7	.125	.125

X=7

40a $P(\text{tweede knikker is pas zwart}) = P(\text{rz}) = \frac{8}{a} \cdot \frac{a-8}{a-1} = \frac{8 \cdot (a-8)}{a \cdot (a-1)} = \frac{8a-64}{a^2-a}$.

40b $P(\text{derde knikker is pas zwart}) = P(\text{rrz}) = \frac{8}{a} \cdot \frac{7}{a-1} \cdot \frac{a-8}{a-2} = \frac{56 \cdot (a-8)}{a \cdot (a-1) \cdot (a-2)}$.

$P(\text{rrz}) = \frac{56 \cdot (a-8)}{a \cdot (a-1) \cdot (a-2)} > 0{,}16$ (TABLE) $\Rightarrow a = 11 \vee a = 12 \vee a = 13$. Er zitten dus 11 of 12 of 13 knikkers in de vaas.

```
Plot1 Plot2 Plot3
\Y1=56(X-8)/(X(X-1)(X-2))
\Y2=0.16
\Y3=
```

X	Y1	Y2
8	0	.16
9	.11111	.16
10	.15556	.16
11	.1697	.16
12	[illegible]	.16
13	.16317	.16
14	.15385	.16

Y1=.16969696969697

41 $P(\text{minstens één waardebon}) = 1 - P(\text{geen waardebon}) = 1 - P(\bar{w}\,\bar{w}\,\bar{w}\,\bar{w}) = 1 - \frac{\binom{17}{4}}{\binom{20}{4}} \approx 0{,}509$ *of* $1 - \frac{17}{20} \cdot \frac{16}{19} \cdot \frac{15}{18} \cdot \frac{14}{17} = \frac{29}{57}$.

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

```
1-17/20*16/19*15/18*14/17
        .5087719298
Ans▸Frac
              29/57
```

42 $p = P(\text{succes}) = P(\text{minstens één prijs}) = 1 - P(\text{geen prijs}) = 1 - \frac{\binom{45}{3}}{\binom{50}{3}} \approx 0{,}276$.

```
1-45 nCr 3/50 nCr 3
        .2760204082
```

43a $p = P(\text{succes}) = P(6\,6) = \frac{1}{36} \approx 0{,}028$.

43b $p = P(\text{dubbel}) = \frac{6}{36} = \frac{1}{6} \approx 0{,}167$.

43c $p = P(\text{som} > 10) = \frac{3}{36} = \frac{1}{12} \approx 0{,}083$.

```
1/36
        .0277777778
6/36
        .1666666667
3/36
        .0833333333
```

6						66
5						
4						
3						
2						
1						
	1	2	3	4	5	6

6						66
5					55	
4				44		
3			33			
2		22				
1	11					
	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
+	1	2	3	4	5	6

44a $P(3\,3\,\bar{3}\,\bar{3}\,\bar{3}\,\bar{3}) = \frac{1}{4} \cdot \frac{1}{4} \cdot \frac{3}{4} \cdot \frac{3}{4} \cdot \frac{3}{4} \cdot \frac{3}{4} = (\frac{1}{4})^2 \cdot (\frac{3}{4})^4 \approx 0{,}020$.

```
(1/4)²*(3/4)^4
        .0197753906
```

44b $P(3\,\bar{3}\,3\,\bar{3}\,\bar{3}\,\bar{3}) = \frac{1}{4} \cdot \frac{3}{4} \cdot \frac{1}{4} \cdot \frac{3}{4} \cdot \frac{3}{4} \cdot \frac{3}{4} \approx 0{,}020$.

38c $\underline{\underline{3\,3\,\bar{3}\,\bar{3}\,\bar{3}\,\bar{3}}}$ heeft $\binom{6}{2} = 15$ rijtjes.

```
6 nCr 2
                  15
```

38d $P(\underline{\underline{3\,3\,\bar{3}\,\bar{3}\,\bar{3}\,\bar{3}}}) = \binom{6}{2} \cdot (\frac{1}{4})^2 \cdot (\frac{3}{4})^4 \approx 0{,}297$.

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

45a $n = 6,\ p = P(\text{succes}) = P(\text{r}) = \frac{8}{20} = \frac{4}{10} = 0{,}4$ en $P(X = 4) = P(\underline{\underline{\text{rrrr}\bar{\text{r}}\bar{\text{r}}}}) = \binom{6}{4} \cdot 0{,}4^4 \cdot 0{,}6^2 \approx 0{,}138$.

```
6 nCr 4*0.4^4*0.6²
              .13824
```

45b $n = 12,\ p = P(\text{succes}) = P(\bar{\text{w}}) = \frac{18}{20} = \frac{9}{10} = 0{,}9$ en $P(Y = 10) = P(\underline{\underline{\bar{\text{w}}\bar{\text{w}}\bar{\text{w}}\bar{\text{w}}\bar{\text{w}}\bar{\text{w}}\bar{\text{w}}\bar{\text{w}}\bar{\text{w}}\bar{\text{w}}\text{ww}}}) = \binom{12}{10} \cdot 0{,}9^{10} \cdot 0{,}1^2 \approx 0{,}230$.

```
12 nCr 10*0.9^10*0.1²
        .2301277705
```

46a X, het aantal keer slag (s), is binomiaal verdeeld met $n = 10$ en $p = 0{,}3$.

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

46b $P(\bar{\text{s}}\bar{\text{s}}\bar{\text{s}}\bar{\text{s}}\text{s}) = 0{,}7^4 \cdot 0{,}3 \approx 0{,}072$.

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

47a X, het aantal personen waarbij NATURA G3 succes (s) heeft, is binomiaal verdeeld met $n = 12$ en $p = 0{,}8$.

$P(X = 8) = P(\underline{\underline{\text{ssssssss}\bar{\text{s}}\bar{\text{s}}\bar{\text{s}}\bar{\text{s}}}}) = \binom{12}{8} \cdot 0{,}8^8 \cdot 0{,}2^4 \approx 0{,}133$.

47b $P(X = 6) = P(\underline{\underline{\text{ssssss}\bar{\text{s}}\bar{\text{s}}\bar{\text{s}}\bar{\text{s}}\bar{\text{s}}\bar{\text{s}}}}) = \binom{12}{6} \cdot 0{,}8^6 \cdot 0{,}2^6 \approx 0{,}016$.

```
12 nCr 8*0.8^8*0.2^4
        .1328755507
12 nCr 6*0.8^6*0.2^6
        .0155021476
```

48a $P(X \le 2) = P(X = 0) + P(X = 1) + P(X = 2) = 0{,}512 + 0{,}384 + 0{,}096 = 0{,}992$.

48b $P(X \le 3) = P(X = 0) + P(X = 1) + P(X = 2) + P(X = 3) = 1$. (er zijn geen andere waarden voor X mogelijk)

48c $P(X \le 0) = P(X = 0)$. (er zijn geen waarden voor X met $X < 0$)

48d 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 12 door.** (uitwerkingen aan het eind)

49a $P(B = 5) = \text{binompdf}(10, \frac{1}{5}, 5) \approx 0{,}026$. ($B$ = het aantal keer banaan)

```
binompdf(10,1/5,
5)
      .0264241152
```

49b $P(A = 3) = \text{binompdf}(18, \frac{2}{5}, 3) \approx 0{,}025$. ($A$ = het aantal keer appel)

```
binompdf(18,2/5,
3)
      .0245549406
```

49c $P(A \le 2) = \text{binomcdf}(20, \frac{2}{5}, 2) \approx 0{,}004$.

```
binomcdf(20,2/5,
2)
      .0036114721
```

49d $P(B = 4) = \text{binompdf}(5, \frac{1}{5}, 4) \approx 0{,}006$.

```
binompdf(5,1/5,4
)
            .0064
```

50a $P(B = 4) = \text{binompdf}(6, 0.75, 4) \approx 0{,}297$. ($B$ = het aantal kinderen met bruine ogen van ouders met bruine ogen)

```
binompdf(6,0.75,
4)
      .2966308594
```

50b $P(B \le 4) = \text{binomcdf}(6, 0.75, 4) \approx 0{,}466$.

```
binomcdf(6,0.75,
4)
      .4660644531
```

51a $P(X = 10) = \text{binompdf}(60, 0.16, 10) \approx 0{,}136$. ($X$ = het aantal auto's dat harder dan 120 km/u rijdt)

51b $P(Y \le 2) = \text{binomcdf}(60, \frac{1}{4} \times 0.16, 2) \approx 0{,}568$. ($Y$ = het aantal auto's dat harder dan 140 km/u rijdt)

```
binompdf(60,0.16
,10)
      .1356753885
binomcdf(60,1/4*
0.16,2)
      .5675865672
```

51c $P(Z = \frac{1}{4} \times 60) = \text{binompdf}(60, \frac{3}{4} \times 0.16, \frac{1}{4} \times 60) \approx 0{,}003$. ($Z$ = het aantal auto's dat tussen 120 km/u en 140 km/u rijdt)

```
binompdf(60,3/4*
0.16,1/4*60)
      .0026019702
```

52a Marianne moet van de 8 vragen, die ze gokt, er nog 4 goed gokken. ($12 \times \frac{1}{2} + 4 \times \frac{1}{2} = 6 + 2 = 8$)
$P(X = 4) = \text{binompdf}(8, \frac{1}{5}, 4) \approx 0{,}046$.

52b Linda mag van de 10 vragen, die ze gokt, er hoogstens 2 goed gokken. ($10 \times \frac{1}{2} + 2 \times \frac{1}{2} = 5 + 1 = 6$)
$P(X \le 2) = \text{binomcdf}(10, \frac{1}{5}, 2) \approx 0{,}678$.

```
binompdf(8,1/5,4
)
        .0458752
binomcdf(10,1/5,
2)
        .677799526
```

53a $P(\text{in } B \text{ uitkomen}) = P(X = 2) = \text{binompdf}(8, \frac{1}{6}, 2) \approx 0{,}260$. ($X$ = het aantal keer in richting oost)

```
binompdf(8,1/6,2
)
      .2604762041
```

53b $P(\text{in } C \text{ uitkomen}) = P(X = 4) = \text{binompdf}(8, \frac{1}{6}, 4) \approx 0{,}026$.

```
binompdf(8,1/6,4
)
      .0260476204
```

53c $P(\text{via } A \text{ naar } B) = P(\text{in } A \text{ uitkomen}) \cdot P(\text{in } B \text{ uitkomen}) = \text{binompdf}(5, \frac{1}{6}, 1) \cdot \text{binompdf}(3, \frac{1}{6}, 1) \approx 0{,}140$.

```
binompdf(5,1/6,1
)*binompdf(3,1/6
,1)
      .1395408236
```

53d $P(\text{boven de lijn } AC \text{ uitkomen}) = P(X \le 3) = \text{binomcdf}(8, \frac{1}{6}, 3) \approx 0{,}969$. (5 keer of vaker naar het noorden)

```
binomcdf(8,1/6,3
)
      .9693435881
```

54a 1. $P(X \le 5)$.
2. $P(X = 4)$.
3. $P(X \ge 7)$.

54b 1. $P(X \ge 10) = 1 - P(X \le 9)$.
2. $P(X > 5) = 1 - P(X \le 5)$.
3. $P(X < 7) = P(X \le 6)$.
4. $P(X \ge 6) = 1 - P(X \le 5)$.

x	0	1	2	3	4	5	6	7	8	9	10	11	12	...
54a1														
54a2														
54a3	-	-	-	-	-	-	-							
54b1	-	-	-	-	-	-	-	-	-	-				
54b2	-	-	-	-	-	-								
54b3														
54b4	-	-	-	-	-	-								

55a $P(4 < X < 9) = P(X \le 8) - P(X \le 4)$.

55b $P(1 < X < 7) = P(X \le 6) - P(X \le 1)$.

55c $P(5 \le X \le 10) = P(X \le 10) - P(X \le 4)$.
$P(4 < X < 9) = P(X \le 8) - P(X \le 4)$. (zie 55a)

x	0	1	2	3	4	5	6	7	8	9	10	...
55a	-	-	-	-	-							
55b	-	-										
55c	-	-	-	-	-							

56a $P(X > 2) = 1 - P(X \le 2)$.

56b $P(X \ge 10) = 1 - P(X \le 9)$.

56c $P(3 < X < 8) = P(X \le 7) - P(X \le 3)$.

56d $P(2 < X < 11) = P(X \le 10) - P(X \le 2)$.

56e $P(X \ge 8) = 1 - P(X \le 7)$.

56f $P(2 \le X \le 9) = P(X \le 9) - P(X \le 1)$.

x	0	1	2	3	4	5	6	7	8	9	10	11	12	...
56a	-	-	-											
56b	-	-	-	-	-	-	-	-	-	-				
56c	-	-	-	-										
56d	-	-	-											
56e	-	-	-	-	-	-	-	-						
56f	-	-												

57a $P(X < 10) = P(X \le 9) = \text{binomcdf}(25{,}0.42{,}9) \approx 0{,}347.$

57b $P(X \ge 8) = 1 - P(X \le 7) = 1 - \text{binomcdf}(25{,}0.42{,}7) \approx 0{,}889.$

57c $P(9 < X < 16) = P(X \le 15) - P(X \le 9) = \text{binomcdf}(25{,}0.42{,}15) - \text{binomcdf}(25{,}0.42{,}9) \approx 0{,}631.$

57d $P(X \ge 6) = 1 - P(X \le 5) = 1 - \text{binomcdf}(25{,}0.42{,}5) \approx 0{,}982.$

57e $P(7 < X < 12) = P(X \le 11) - P(X \le 7) = \text{binomcdf}(25{,}0.42{,}11) - \text{binomcdf}(25{,}0.42{,}7) \approx 0{,}550.$

57f $P(8 \le X \le 10) = P(X \le 10) - P(X \le 7) = \text{binomcdf}(25{,}0.42{,}10) - \text{binomcdf}(25{,}0.42{,}7) \approx 0{,}394.$

58a $P(X \ge 4) = 1 - P(X \le 3) = 1 - \text{binomcdf}(50{,}0.13{,}3) \approx 0{,}904.$

58b $P(X > 4) = 1 - P(X \le 4) = 1 - \text{binomcdf}(50{,}0.13{,}4) \approx 0{,}796.$

58c $P(X = 5 \text{ of } X = 6) = P(X \le 6) - P(X \le 4) = \text{binomcdf}(50{,}0.13{,}6) - \text{binomcdf}(50{,}0.13{,}4) \approx 0{,}317.$

58d $P(7 < X < 14) = P(X \le 13) - P(X \le 7) = \text{binomcdf}(50{,}0.13{,}13) - \text{binomcdf}(50{,}0.13{,}7) \approx 0{,}318.$

59a $P(A \ge 5) = 1 - P(A \le 4) = 1 - \text{binomcdf}(10,\frac{3}{6},4) \approx 0{,}623.$

59b $P(10 < A < 20) = P(A \le 19) - P(A \le 10) = \text{binomcdf}(25,\frac{3}{6},19) - \text{binomcdf}(25,\frac{3}{6},10) \approx 0{,}786.$

59c $P(B > 40) = 1 - P(B \le 40) = 1 - \text{binomcdf}(100,\frac{2}{6},40) \approx 0{,}066.$

59d $P(K = 7) = \text{binompdf}(35,\frac{1}{6},7) \approx 0{,}146.$

59e $P(K = 0) = \text{binompdf}(10,\frac{1}{6},0) \text{ of } \left(\frac{5}{6}\right)^{10} \approx 0{,}162.$

60a $P(E > 10) = 1 - P(E \le 10) = 1 - \text{binomcdf}(16,\frac{3}{6},10) \approx 0{,}105.$

60b $P(D < 2) = P(D \le 1) = \text{binomcdf}(16,\frac{1}{6},1) \approx 0{,}227.$

60c $P(Z = 5) = \text{binompdf}(16,\frac{1}{6},5) \approx 0{,}076.$

61 De kans dat Rob de baan krijgt is $P(G \ge 7) = 1P(G \le 6) = 1 - \text{binomcdf}(9,\frac{9}{10},6) \approx 0{,}947.$

62a $p = P(\text{succes}) = P(\text{rr}) = \dfrac{\binom{12}{2}}{\binom{25}{2}} = 0{,}22.$ De gevraagde kans is $P(X = 3) = \text{binompdf}(15{,}0.22{,}3) \approx 0{,}246.$

62b $p = P(\text{succes}) = P(\underline{\underline{z\bar{z}}}) = \dfrac{\binom{8}{1}\cdot\binom{17}{1}}{\binom{25}{2}} \approx 0{,}453...$

Gevraagd: $P(Y \ge 10) = 1 - P(Y \le 9) = 1 - \text{binomcdf}(15,\text{Ans},9) \approx 0{,}081.$

62c $p = P(\text{twee van dezelfde kleur}) = P(\text{rr}) + P(\text{zz}) + P(\text{ww}) = 0{,}22 + \dfrac{\binom{8}{2}}{\binom{25}{2}} + \dfrac{\binom{5}{2}}{\binom{25}{2}} = \dfrac{26}{75}.$

Gevraagde: $P(Z < 6) = P(Z \le 5) = \text{binomcdf}(15,\frac{26}{75},5) \approx 0{,}575.$

62d $p = P(\text{minstens één rode}) = 1 - P(\bar{r}\bar{r}) = 1 - \dfrac{\binom{13}{2}}{\binom{25}{2}} = 0{,}74.$ Dus $P(R \ge 8) = 1 - P(R \le 7) = 1 - \text{binomcdf}(15{,}0.74{,}7) \approx 0{,}978.$

63a $P(S > 0{,}6 \times 120) = P(S > 72) = 1 - P(E \le 72) = 1 - \text{binomcdf}(120,1-\frac{1}{3},72) \approx 0{,}925.$

63b $P(V \ge \frac{1}{2} \times 6) = P(V \ge 3) = 1 - P(V \le 2) = 1 - \text{binomcdf}(6{,}0.40{,}2) \approx 0{,}456.$

64a $P(N \ge 20) = 1 - P(N \le 19) = 1 - \text{binomcdf}(80{,}0.22{,}19) \approx 0{,}298.$

64b $P(16 < B < 24) = P(B \le 23) - P(B \le 16) = \text{binomcdf}(80{,}0.36{,}23) - \text{binomcdf}(80{,}0.36{,}16) \approx 0{,}106.$

64c $P(16 < N < 24) = \text{binomcdf}(80{,}0.28{,}23) - \text{binomcdf}(80{,}0.28{,}16) \approx 0{,}547.$

64d $P(\underline{\underline{NNBBBBnnnn}}) = \binom{10}{2}\cdot\binom{8}{4}\cdot P(NNBBBBnnnn) = \binom{10}{2}\cdot\binom{8}{4}\cdot 0{,}22^2 \cdot 0{,}36^4 \cdot 0{,}28^4 \approx 0{,}016.$

65a $P(10 < M < 15) = P(M \le 14) - P(M \le 10) = \text{binomcdf}(25,\frac{1}{2},14) - \text{binomcdf}(25,\frac{1}{2},10) \approx 0{,}576.$

```
binomcdf(25,1/2,
14)-binomcdf(25,
1/2,10)
        .5756437765
```

65b $p = P(\text{mm}) = \frac{1}{2}\cdot\frac{1}{2} = \frac{1}{4}$ en $P(X \le 5) = \text{binomcdf}(30,\frac{1}{4},5) \approx 0{,}203.$

65c $p = P(\text{5 of 6}) = \frac{2}{6}$ en $P(Y \le 10) = \text{binomcdf}(15,\frac{2}{6},10) \approx 0{,}998.$

```
binomcdf(30,1/4,
5)
        .2025980742
binomcdf(15,2/6,
10)
         .998192824
```

65d $p = P(som > 7) = \frac{15}{36}$ (zie het rooster op het voorblad) en $P(Z = 5) = \text{binompdf}(18,\frac{15}{36},5) \approx 0{,}097.$

```
binompdf(18,15/3
6,5)
        .0974409638
```

66 $P(X \le 92) = \text{binomcdf}(100, 1-0.12, 92) \approx 0{,}924.$

```
binomcdf(100,0.8
8,92)
        .9238639014
```

67a $P(O \ge 2) = 1 - P(O \le 1) = 1 - \text{binomcdf}(8, 0.05, 1) \approx 0{,}057.$

67b $P(O = 3) = \text{binompdf}(8, 0.05, 3) \approx 0{,}005.$

```
1-binomcdf(8,0.0
5,1)
        .0572446503
binompdf(8,0.05,
3)
        .0054164666
```

68a $P(N \ge 1) = P(H \le 24) = \text{binomcdf}(25, 0.85, 24) \approx 0{,}983.$

68b $P(H > 15) = 1 - P(H \le 15) = 1 - \text{binomcdf}(25, 0.85, 15) \approx 0{,}998.$

```
binomcdf(25,0.85
,24)
        .9828021901
1-binomcdf(25,0.
85,15)
        .9978587329
```

68c $P(H \ge 0{,}85 \times 25) = P(H \ge 21{,}25) = P(H \ge 22) = 1 - P(H \le 21) = 1 - \text{binomcdf}(25, 0.85, 21) \approx 0{,}471.$

```
0.85*25
              21.25
1-binomcdf(25,0.
85,21)
        .4711212853
```

69a $P(M \ge 5) = 1 - P(M \le 4) = 1 - \text{binomcdf}(n,\frac{1}{2},4) > 0{,}99$ (TABLE) $\Rightarrow n \ge 19.$

```
Plot1 Plot2 Plot3
\Y1=1-binomcdf(X
,1/2,4)
\Y2=0.99
\Y3=
```

X	Y1	Y2
17	.97548	.99
18	.98456	.99
19	.99039	.99
20	.99409	.99
21	.9964	.99
22	.99783	.99
23	.9987	.99

Y1=.990394592285

69b $p = P(\text{minstens één munt}) = 1 - P(\overline{m}\,\overline{m}) = 1 - \frac{1}{2}\cdot\frac{1}{2} = 1 - \frac{1}{4} = \frac{3}{4}.$

$P(X \ge 2) = 1 - P(X \le 1) = 1 - \text{binomcdf}(n,\frac{3}{4},1) \ge 0{,}98$ (TABLE) $\Rightarrow n \ge 5.$

```
Plot1 Plot2 Plot3
\Y1=1-binomcdf(X
,3/4,1)
\Y2=0.98
\Y3=
```

X	Y1	Y2
1	0	.98
2	.5625	.98
3	.84375	.98
4	.94922	.98
5	.98438	.98
6	.99536	.98
7	.99866	.98

Y1=.984375

70 $P(S \ge 5) = 1 - P(S \le 4) = 1 - \text{binomcdf}(n, 0.40, 4) > 0{,}90$ (TABLE) $\Rightarrow n \ge 18.$

```
Plot1 Plot2 Plot3
\Y1=1-binomcdf(X
,0.4,4)
\Y2=0.90
\Y3=
```

X	Y1	Y2
12	.56182	.9
13	.64696	.9
14	.72074	.9
15	.78272	.9
16	.83343	.9
17	.874	.9
18	.90583	.9

Y1=.905831351289

71 $p = P(\text{succes}) = P(\text{ww}) = \dfrac{\binom{6}{2}}{\binom{10}{2}} = \frac{1}{3}.$

```
6 nCr 2/10 nCr 2
        .3333333333
Ans▶Frac
                1/3
```

$P(X \ge 3) = 1 - P(X \le 2) = 1 - \text{binomcdf}(n,\frac{1}{3},2) > 0{,}95$ (TABLE) $\Rightarrow n \ge 17.$

```
Plot1 Plot2 Plot3
\Y1=1-binomcdf(X
,1/3,2)
\Y2=0.95
\Y3=
```

X	Y1	Y2
14	.89467	.95
15	.92064	.95
16	.94062	.95
17	.95585	.95
18	.96735	.95
19	.97598	.95
20	.98241	.95

X=17

72a Opp. $= \text{normalcdf}(13, 19, 15, 2.8) \approx 0{,}686.$

```
normalcdf(13,19,
15,2.8)
        .6859110411
```

72c Opp. $= \text{normalcdf}(21.3, 10^{99}, 15, 2.8) \approx 0{,}012.$

```
normalcdf(21.3,1
0^99,15,2.8)
        .0122244334
```

72b Opp. $= \text{normalcdf}(-10^{99}, 20.4, 15, 2.8) \approx 0{,}973.$

```
normalcdf(-10^99
,20.4,15,2.8)
        .9731080245
```

73a $p = P(\text{groot}) = \text{normalcdf}(80, 10\,\hat{}\,99, 75, 18) \approx 0{,}391.$

73b $P(G = 5) = \text{binompdf}(5, p, 5)$ of $p^5 \approx 0{,}009.$

```
normalcdf(80,10^
99,75,18)
         .390591536
Ans^5
         .009091052
```

```
normalcdf(80,10^
99,75,18)
         .390591536
binompdf(5,Ans,5
)
         .009091052
```

74a $p = P(G < 125) = \text{normalcdf}(-10^{99}, 125, 130, 5) \approx 0{,}158...$
$P(X \le 4) = \text{binomcdf}(50, p, 4) \approx 0{,}085.$

```
normalcdf(-10^99
,125,130,5)
        .1586552596
binomcdf(50,Ans,
4)
        .0845058784
```

74b $p = P(G < 128) = \text{normalcdf}(-10^{99}, 128, 130, 5) \approx 0{,}344...$
$P(Y \ge 8) = 1 - P(Y \le 7) = 1 - \text{binomcdf}(50, p, 7) \approx 0{,}999.$

```
normalcdf(-10^99
,128,130,5)
        .3445783029
1-binomcdf(50,An
s,7)
         .998961392
```

74c $p = P(G > 132) = \text{normalcdf}(132, 10^{99}, 130, 5) \approx 0{,}344...$
$P(Z = 8) = \text{binompdf}(50, p, 8) \approx 0{,}002.$

```
normalcdf(132,10
^99,130,5)
        .3445783029
binompdf(50,Ans,
8)
        .0020991997
```

75a $p = P(D < 14{,}15) = \text{normalcdf}(-10^{99}, 14.15, 14.31, 0.12) \approx 0{,}091...$
$P(X \le 5) = \text{binomcdf}(100, p, 5) \approx 0{,}097.$

```
normalcdf(-10^99
,14.15,14.31,0.1
2)
        .0912112819
binomcdf(100,Ans
,5)
        .0974990032
```

75b $p = P(G > 14{,}50) = \text{normalcdf}(14.50, 10^{99}, 14.31, 0.12) \approx 0{,}056...$
$P(Y \ge 10) = 1 - P(Y \le 9) = 1 - \text{binomcdf}(100, p, 9) \approx 0{,}057.$

```
normalcdf(14.50,
10^99,14.31,0.12
)
        .0566727574
1-binomcdf(100,A
ns,9)
         .057373702
```

76a $p = P(T > 2 \times 60) = P(T > 120) = \text{normalcdf}(120, 10^{99}, 112, 5) \approx 0{,}054...$
$P(X \ge 4) = 1 - P(X \le 3) = 1 - \text{binomcdf}(22, p, 3) \approx 0{,}030.$

```
normalcdf(120,10
^99,112,5)
        .0547992894
1-binomcdf(22,An
s,3)
        .0298532024
```

76b $p = P(T < 60 + 3 \times 15) = P(T < 105) = \text{normalcdf}(-10^{99}, 105, 112, 5) \approx 0{,}080...$
Je verwacht dat er $120 \times p \approx 10$ optredens korter duren dan één uur en drie kwartier.

```
normalcdf(-10^99
,105,112,5)
        .0807567112
Ans*120
         9.69080534
```

77a $p = P(T > 3\times 60) = P(T > 180) = \text{normalcdf}(180,10^{99},2\times 60+40,15) \approx 0{,}091...$
$P(X \ge 10) = 1 - P(X \le 9) = 1 - \text{binomcdf}(80,p,9) \approx 0{,}192.$

```
normalcdf(180,10
^99,160,15)
          .0912112819
1-binomcdf(80,An
s,9)
          .1916743537
```

77b $p = P(T < 2{,}5\times 60) = P(T < 150) = \text{normalcdf}(-10^{99},150,160,15) \approx 0{,}369...$
Je verwacht $180 \times p \approx 45$ keer dat deze handeling minder dan twee en een halve minuut duurt.

```
normalcdf(-10^99
,150,160,15)
          .252492467
Ans*180
          45.44864406
```

77c $p = P(T > 2\times 60+45) = P(T > 165) = \text{normalcdf}(165,10^{99},2\times 60+40,15) \approx 0{,}369...$
$P(X \ge 5) = 1 - P(X \le 4) = 1 - \text{binomcdf}(n,p,4) > 0{,}99$ (TABLE) $\Rightarrow n \ge 28$.
De werknemer moet minstens 28 remmen instellen.

```
normalcdf(165,10
^99,160,15)
          .3694414037
Ans→P
          .3694414037
```

```
Plot1 Plot2 Plot3
\Y1=1-binomcdf(X
,P,4)
\Y2=0.99
\Y3=
```

X	Y1	Y2
24	.97239	.99
25	.97961	.99
26	.98503	.99
27	.98907	.99
28	.99206	.99
29	.99426	.99
30	.99587	.99

Y1=.992056732212

78 $\textit{Winst} = \textit{Opbrengst} - \textit{Kosten} = 1000\times 5 - 2\,000 - 100\times 20 = 5\,000 - 2\,000 - 2\,000 = 1\,000$ (€).
Gemiddeld maakt Excelsior $\frac{1000}{1000} = 1$ euro winst per lot.

79a $P(U=50) = \frac{1}{100}$ en $P(U=10) = \frac{3}{100}$. Niet nodig: $P(U=0) = 1 - \frac{1}{100} - \frac{3}{100} = \frac{96}{100}$.
$E(U) = 50\times 0{,}01 + 10\times 0{,}03 + 0\times ... = 0{,}80$ (€).
$E(W) = E(U) - \text{inzet}$ (per lot) $= 0{,}80 - 2 = -1{,}20$ (€).

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

```
50*0.01+10*0.03
                .8
Ans-2
              -1.2
```

79b Eerlijk spel $\Rightarrow E(W) = 0 \Rightarrow E(U) - \text{inzet} = 0 \Rightarrow E(U) = \text{inzet} \Rightarrow \text{inzet} = 0{,}80$ (€).

80 $P(U=25) = P(\text{r}) = \frac{1}{20} = 0{,}05$ en $P(U=10) = P(\text{b}) = \frac{2}{20} = 0{,}10$.
$E(U) = 25\times 0{,}05 + 10\times 0{,}10 + 0\times ... = 2{,}25$ (€).

u	25	10	0
$P(U=u)$	0,05	0,1	...

```
1/20
               .05
2/20
                .1
25*1/20+10*2/20
              2.25
```

81a $P(U=100) = \frac{1}{1000}$; $P(U=50) = \frac{5}{1000}$; $P(U=25) = \frac{10}{1000}$ en $P(U=10) = \frac{25}{1000}$.
$E(U) = 100\times\frac{1}{1000} + 50\times\frac{5}{1000} + 25\times\frac{10}{1000} + 10\times\frac{25}{1000} + 0\times ... = 0{,}85$ (\$).
$E(W) = E(U) - \text{inzet} = 0{,}85 - 1 = -0{,}15$ (\$).

u	100	50	25	10	0
$P(U=u)$	0,001	0,005	0,010	0,025	...

```
100*0.001+50*0.0
05+25*0.010+10*0
.025
               .85
Ans-1
              -.15
```

81b Deze winkelier kon op een dag $500\times 0{,}15 = 75$ (\$) winst verwachten.

```
500*0.15
                75
```

82a $P(U=10\,000) = \frac{1}{10\cdot 9\cdot 8\cdot 7} = \frac{1}{5040}$.

82b $E(U) = 10\,000\times\frac{1}{5040} + 0\times ... \approx 1{,}98$ (\$).
$E(W) = E(U) - \text{inzet} \approx 1{,}98 - 2{,}50 = -0{,}52$ (\$).

u	10000	0
$P(U=u)$	$\frac{1}{5040}$	...

```
10*9*8*7
              5040
10000/5040
       1.984126984
Ans-2.5
       -.5158730159
```

82c De staat Maine kan die week $20\,000\times -E(W) - 7\,500 \approx 2\,817{,}46$ (\$) winst verwachten.

```
-Ans
       .5158730159
Ans*20000
       10317.46032
Ans-7500
       2817.460317
```

83a $P(\underline{\underline{5\,\bar{5}\,\bar{5}}}) = P(U=1) = \text{binompdf}(3,\frac{1}{6},1) = \frac{25}{72}$ of $\binom{3}{1}\cdot\frac{1}{6}\cdot(\frac{5}{6})^2 = \frac{75}{216} = \frac{25}{72}$.

83b $P(\underline{\underline{5\,5\,\bar{5}}}) = P(U=2) = \text{binompdf}(3,\frac{1}{6},2) = \frac{5}{72}$ of $\binom{3}{2}\cdot(\frac{1}{6})^2\cdot\frac{5}{6} = \frac{15}{216} = \frac{5}{72}$.

83c $P(\underline{\underline{\bar{5}\,\bar{5}\,\bar{5}}}) = P(U=0) = \text{binompdf}(3,\frac{1}{6},0)$ of $(\frac{5}{6})^3 = \frac{125}{216}$.

83d $P(\underline{\underline{5\,5\,5}}) = P(U=3) = \text{binompdf}(3,\frac{1}{6},3) = \frac{1}{216}$ of $(\frac{1}{6})^3 = \frac{1}{216}$.
$E(U) = 1\times\frac{25}{72} + 2\times\frac{5}{72} + 3\times\frac{1}{216} + 0\times ... = 0{,}50$ (\$).
Het levert $500\cdot(1 - E(U)) = 500\cdot(1 - 0{,}50) = 500\cdot 0{,}50 = 250$ (\$) op.

```
binompdf(3,1/6,1
)
      .3472222222
Ans▸Frac
            25/72
```

```
3 nCr 1*1/6*(5/6
)²▸Frac
            25/72
3 nCr 2*(1/6)²*5
/6▸Frac
             5/72
```

```
binompdf(3,1/6,2
)▸Frac
             5/72
```

```
binompdf(3,1/6,0
)▸Frac
          125/216
binompdf(3,1/6,3
)▸Frac
            1/216
```

```
(5/6)^3▸Frac
          125/216
(1/6)^3▸Frac
            1/216
```

```
1*25/72+2*5/72+3
*1/216
               .5
```

u	1	2	3	0
$P(U=u)$	$\frac{25}{72}$	$\frac{5}{72}$	$\frac{1}{216}$	...

84a $P(U=20) = P(\textit{som} = 5 \text{ of } \textit{som} = 6) = P(\underline{\underline{1\,1\,3}}) + P(\underline{\underline{1\,2\,2}}) + P(\underline{\underline{1\,1\,4}}) + P(\underline{\underline{1\,2\,3}}) + P(2\,2\,2)$
$= \binom{3}{2}\cdot(\frac{1}{6})^3 + \binom{3}{1}\cdot(\frac{1}{6})^3 + \binom{3}{2}\cdot(\frac{1}{6})^3 + 3!\cdot(\frac{1}{6})^3 + (\frac{1}{6})^3 = \frac{3}{216} + \frac{3}{216} + \frac{3}{216} + \frac{6}{216} + \frac{1}{216} = \frac{16}{216}$.

```
3 nCr 2
                3
3 nCr 1
                3
3!
                6
```

```
6^3
              216
```

84b $P(\text{geen enkele keer 20 euro}) = (1 - \frac{16}{216})^5 = (\frac{200}{216})^5 \approx 0{,}681$.

84c $P(\text{bij de zesde keer voor het eerst 20 euro}) = (\frac{200}{216})^5\cdot\frac{16}{216} \approx 0{,}050$.

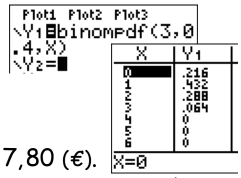
```
(200/216)^5
        .680583197
Ans*16/216
       .0504135702
```

u	20	100	30	0
$P(U=u)$	$\frac{16}{216}$	$\frac{3}{216}$	$\frac{10}{216}$	...

84d $P(U=100) = P(\textit{som} = 4) = P(\underline{\underline{1\,1\,2}}) = \binom{3}{2}\cdot(\frac{1}{6})^3 = \frac{3}{216}$.
$P(U=30) = P(\textit{som} = 16 \text{ of } \textit{som} = 17 \text{ of } \textit{som} = 18) = P(\underline{\underline{6\,6\,4}}) + P(\underline{\underline{6\,5\,5}}) + P(\underline{\underline{6\,6\,5}}) + P(6\,6\,6)$
$= \binom{3}{2}\cdot(\frac{1}{6})^3 + \binom{3}{1}\cdot(\frac{1}{6})^3 + \binom{3}{2}\cdot(\frac{1}{6})^3 + (\frac{1}{6})^3 = \frac{3}{216} + \frac{3}{216} + \frac{3}{216} + \frac{1}{216} = \frac{10}{216}$.
$E(U) = 20\times\frac{16}{216} + 100\times\frac{3}{216} + 30\times\frac{10}{216} + 0\times ... = \frac{920}{216}$ (€).
Het spel levert de organisator $800\cdot(5 - E(U)) = 800\cdot(5 - \frac{920}{216}) \approx 592{,}59$ (€) op.

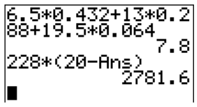
```
20*16+100*3+30*1
0
              920
800*(5-920/216)
       592.5925926
```

85a $P(U=13)=P(\underline{\underline{ss}}\bar{s})=\text{binompdf}(3,0.4,2)=0{,}288.$



u	0	6,5	13	19,5
$P(U=u)$	0,216	0,432	0,288	0,064

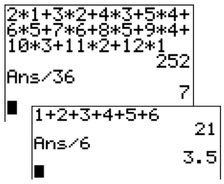
85b $P(U=0)=P(\bar{s}\bar{s}\bar{s})=\text{binompdf}(3,0.4,0)=0{,}216.$
$P(U=6{,}5)=P(\underline{s}\bar{s}\bar{s})=\text{binompdf}(3,0.4,1)=0{,}432.$
$P(U=19{,}5)=P(sss)=\text{binompdf}(3,0.4,3)=0{,}064.$
$E(U)=0\times 0{,}216+6{,}5\times 0{,}432+13\times 0{,}288+19{,}5\times 0{,}064=7{,}80$ (€).
In juni verwacht hij $228\times(20-7{,}80)=2\,781{,}60$ (€) op de kaarten te verdienen.



86a $P(Z=4)=\frac{3}{36}$. (zie figuur 10.12)

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

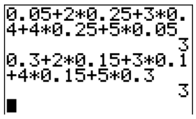
86b Zie de kansverdeling van Z hiernaast.
$E(Z)=2\cdot\frac{1}{36}+3\cdot\frac{2}{36}+4\cdot\frac{3}{36}+5\cdot\frac{4}{36}+6\cdot\frac{5}{36}+7\cdot\frac{6}{36}+8\cdot\frac{5}{36}+9\cdot\frac{4}{36}+10\cdot\frac{3}{36}+11\cdot\frac{2}{36}+12\cdot\frac{1}{36}=7.$



86c Zie de kansverdeling van X (Y dezelfde) hiernaast.
$E(X)=E(Y)=1\cdot\frac{1}{6}+2\cdot\frac{1}{6}+3\cdot\frac{1}{6}+4\cdot\frac{1}{6}+5\cdot\frac{1}{6}+6\cdot\frac{1}{6}=3{,}5.$
$E(X+Y)=E(Z)=7$ en $E(X)+E(Y)=3{,}5+3{,}5=7.$
Inderdaad is $E(X+Y)=E(X)+E(Y)$.

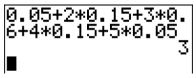
x	1	2	3	4	5	6
$P(X=x)$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$

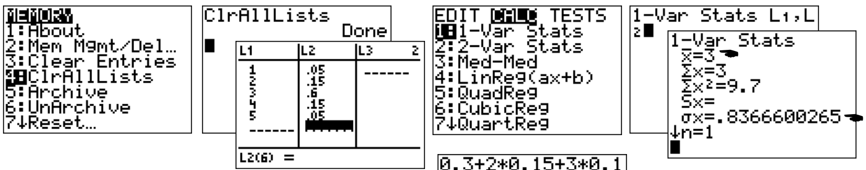
87a $E(X)=1\cdot 0{,}05+2\cdot 0{,}25+3\cdot 0{,}4+4\cdot 0{,}25+5\cdot 0{,}05=3.$ $(0{,}05+0{,}25+0{,}4+0{,}25+0{,}05=1)$
$E(Y)=1\cdot 0{,}3+2\cdot 0{,}15+3\cdot 0{,}1+4\cdot 0{,}15+5\cdot 0{,}3=3.$ $(0{,}3+0{,}15+0{,}1+0{,}15+0{,}3=1)$

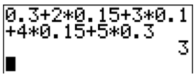


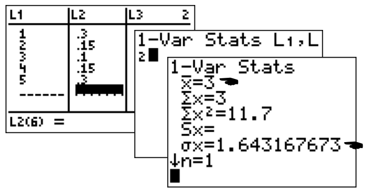
87b De spreiding is het grootst in het histogram bij Y.

88a $E(X)=1\cdot 0{,}05+2\cdot 0{,}15+3\cdot 0{,}6+4\cdot 0{,}15+5\cdot 0{,}05=3$ en $\sigma_X\approx 0{,}84$ (1-Var Stats L1,L2).





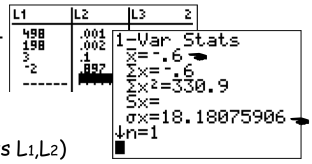




88b $E(Y)=3$ en $\sigma_Y\approx 1{,}64$ (1-Var Stats L1,L2).

89 Zie de kansverdeling van X hiernaast.
$P(X=498)=\frac{1}{1000}$; $P(X=198)=\frac{2}{1000}$; $P(X=3)=\frac{100}{1000}$
en $P(X=-2)=1-\left(\frac{1}{1000}+\frac{2}{1000}+\frac{100}{1000}\right)=1-\frac{103}{1000}=\frac{897}{1000}$.

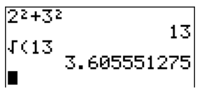
x	498	198	3	-2
$P(X=x)$	$\frac{1}{1000}$	$\frac{2}{1000}$	$\frac{100}{1000}$	$\frac{897}{1000}$



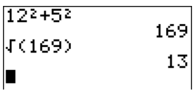
$E(X)=498\times\frac{1}{1000}+198\times\frac{2}{1000}+3\times\frac{100}{1000}-2\times\frac{897}{1000}=-0{,}60$ (€) en $\sigma_X\approx 18{,}18$ (€). (1-Var Stats L1,L2)

90a $E(T)=E(X+Y)=E(X)+E(Y)=16+30=46$ (sec).

90b $\sigma_T=\sigma_{X+Y}=\sqrt{(\sigma_X)^2+(\sigma_Y)^2}=\sqrt{2^2+3^2}=\sqrt{13}\approx 3{,}6$ (sec).



90 $E(B)=E(N)+E(T)=230+30=260$ (gram).
$\sigma_B=\sqrt{(\sigma_N)^2+(\sigma_T)^2}=\sqrt{12^2+5^2}=\sqrt{169}=13$ (gram).



91a De som $X+Y=7\Rightarrow$ de standaardafwijking $\sigma_{X+Y}=0$.

91b X en Y zijn niet onafhankelijk, dus afhankelijk (want er geldt: $X+Y=7\Rightarrow Y=7-X$).

Diagnostische toets

D1a Som 6 kan met $\underline{\underline{\underline{114}}}$ (op $\binom{3}{2} = 3$ manieren), $\underline{\underline{\underline{123}}}$ (op $3! = 6$ manieren) en 222 (op 1 manier).

$P(\text{som} \neq 6) = 1 - P(\text{som} = 6) = 1 - \frac{3+6+1}{6 \times 6 \times 6} = 1 - \frac{10}{216} \approx 0{,}954.$

D1b $P(\text{som} \geq 7) = 1 - P(\text{som} < 7) = 1 - \frac{1+3+3+3+3+6+1}{6 \times 6 \times 6} = 1 - \frac{20}{216} \approx 0{,}907.$

Som 3 met 111, som 4 met $\underline{\underline{112}}$, som 5 met $\underline{\underline{122}}$ en $\underline{\underline{113}}$ en som 6 met $\underline{\underline{\underline{114}}}$, $\underline{\underline{\underline{123}}}$ en 222.

```
1-10/216
          .9537037037
1-20/216
          .9074074074
```

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

```
3 nCr 1
                    3
```

D2 $P(\text{Bert pakt een rode knikker}) = \frac{r-1}{r+b-3}$ en $P(\text{Bert pakt een zwarte knikker}) = \frac{b-2}{r+b-3}$.

D3 $P(\text{minstens twee uit R}) = 1 - P(\text{geen of een uit R}) = 1 - \left(P(\overline{R}\,\overline{R}\,\overline{R}\,\overline{R}\,\overline{R}) + P(\underline{\underline{\underline{R\overline{R}\,\overline{R}\,\overline{R}\,\overline{R}}}})\right) = 1 - \frac{\binom{20}{5}}{\binom{26}{5}} - \frac{\binom{6}{1} \cdot \binom{20}{4}}{\binom{26}{5}} \approx 0{,}322.$

```
1-20 nCr 5/26 nC
r 5-6 nCr 1*20 n
Cr 4/26 nCr 5
         .3223776224
```

D4a $\frac{2}{5} \cdot \frac{1}{6} \cdot \frac{3}{7} + 4 \cdot \frac{1}{5} \cdot \frac{4}{7} = \frac{6}{210} + \frac{16}{35} = \frac{1}{35} + \frac{16}{35} = \frac{17}{35}.$

```
2/5*1/6*3/7+4*1/
5*4/7▸Frac
               17/35
```

D4b $\left(\frac{3}{8}\right)^2 + 3 \cdot \frac{1}{8} \cdot \frac{5}{8} = \frac{3}{8} \cdot \frac{3}{8} + \frac{15}{64} = \frac{9}{64} + \frac{15}{64} = \frac{24}{64} = \frac{3}{8}.$

```
(3/8)²+3*1/8*5/8
▸Frac
                 3/8
```

D4c $3 \cdot \frac{1}{6} \cdot \left(\frac{5}{6}\right)^2 + \left(\frac{5}{6}\right)^3 = 3 \cdot \frac{1}{6} \cdot \frac{25}{36} + \frac{125}{216} = \frac{75}{216} + \frac{125}{216} = \frac{200}{216} = \frac{25}{27}.$

```
3*1/6*(5/6)²+(5/
6)^3▸Frac
               25/27
```

D5a $P(\text{minstens twee keer 6}) = 1 - P(\text{geen of één 6}) = 1 - P(\overline{6}\,\overline{6}\,\overline{6}\,\overline{6}\,\overline{6}\,\overline{6}\,\overline{6}\,\overline{6}) - P(\underline{\underline{6\overline{6}\,\overline{6}\,\overline{6}\,\overline{6}\,\overline{6}\,\overline{6}\,\overline{6}}}) = 1 - \left(\frac{5}{6}\right)^8 - \binom{8}{1} \cdot \frac{1}{6} \cdot \left(\frac{5}{6}\right)^7 \approx 0{,}395.$

```
1-(5/6)^8-8 nCr
1*1/6*(5/6)^7
         .3953230977
1-binomcdf(8,1/6
,1)
         .3953230977
```

D5b $P(\underline{\underline{\underline{33444(5\text{of}6)(5\text{of}6)(5\text{of}6)}}}) = \binom{8}{2} \cdot \binom{6}{3} \cdot \left(\frac{1}{6}\right)^2 \cdot \left(\frac{1}{6}\right)^3 \cdot \left(\frac{2}{6}\right)^3 \approx 0{,}003.$

```
8 nCr 2*6 nCr 3*
(1/6)^5*(2/6)^3
         .0026672763
```

D6a 20% van de 35% buitenlandse bezoekers komt uit de VS $\Rightarrow 0{,}2 \cdot 35\% = 7\%$ van de bezoekers komt uit de VS.

.$P(\underline{\underline{V\overline{V}\,\overline{V}\,\overline{V}\,\overline{V}\,\overline{V}\,\overline{V}\,\overline{V}\,\overline{V}\,\overline{V}}}) = \binom{10}{1} \cdot 0{,}07 \cdot 0{,}93^9 \approx 0{,}364.$

```
0.2*35
                   7
10 nCr 1*0.07*0.
93^9
         .3642877581
```

D6b $0{,}4 \cdot 35\% = 14\%$ van de bezoekers is EU uit Ander land dan Nederland.

$P(\underline{\underline{\underline{NNNNNNNAAA}}}) = \binom{10}{7} \cdot 0{,}65^7 \cdot 0{,}14^3 \approx 0{,}016.$

```
0.4*35
                  14
10 nCr 7*0.65^7*
0.14^3
          .016142056
```

D7a $5 + \frac{3}{a} = 5 \cdot \frac{a}{a} + \frac{3}{a} = \frac{5a}{a} + \frac{3}{a} = \frac{5a+3}{a}.$

D7c $\frac{4}{a} + \frac{8-a}{5} = \frac{4 \cdot 5}{a \cdot 5} + \frac{(8-a) \cdot a}{5 \cdot a} = \frac{20 + 8a - a^2}{5a} = \frac{-a^2 + 8a + 20}{5a}.$

D7b $\frac{a-3}{a} \cdot \frac{5-a}{4} = \frac{(a-3) \cdot (5-a)}{4a} = \frac{5a - a^2 - 15 + 3a}{4a} = \frac{-a^2 + 8a - 15}{4a}.$

D8a $P(rr) = \frac{x}{10} \cdot \frac{x+2}{15} = \frac{x \cdot (x+2)}{10 \cdot 15} = \frac{x^2 + 2x}{150}.$

D8b $P(\underline{\underline{rw}}) = P(rw) + P(wr) = \frac{x}{10} \cdot \frac{15-(x+2)}{15} + \frac{10-x}{10} \cdot \frac{x+2}{15} = \frac{x \cdot (13-x)}{150} + \frac{(10-x) \cdot (x+2)}{150}$

$= \frac{13x - x^2 + 10x + 20 - x^2 - 2x}{150} = \frac{-2x^2 + 21x + 20}{150}.$

```
 Plot1 Plot2 Plot3
\Y1■(-2X²+21X+20
)/150
\Y2■0.45
\Y3=■
```

```
   X   |  Y1    |  Y2
   3   | .43333 | .45
   4   | .48    | .45
   5   | .5     | .45
   6   | .49333 | .45
   7   | .46    | .45
   8   | .4     | .45
   9   | .31333 | .45
X=7
```

D8c $P(\underline{\underline{rw}}) = \frac{-2x^2 + 21x + 20}{150} > 0{,}45$ (TABLE) $\Rightarrow x = 4 \vee x = 5 \vee x = 6 \vee x = 7.$

Er zitten dus in vaas I en vaas II respectievelijk 4 en 6 of 5 en 7 of 6 en 8 of 7 en 9 rode knikkers.

```
 Plot1 Plot2 Plot3
\Y1■5/X*4/(X-1)*
(X-5)/(X-2)
\Y2■0.15
\Y3=■
```

```
   X   |  Y1    |  Y2
   4   | -.8333 | .15
   5   | 0      | .15
   6   | .16667 | .15
   7   | .19048 | .15
   8   | .17857 | .15
   9   | .15873 | .15
   10  | .13889 | .15
X=10
```

D9a $P(\overline{w}w) = \frac{5}{a} \cdot \frac{a-5}{a-1} = \frac{5 \cdot (a-5)}{a \cdot (a-1)} = \frac{5a - 25}{a^2 - a}.$

D9b $P(\overline{w}\,\overline{w}w) = \frac{5}{a} \cdot \frac{4}{a-1} \cdot \frac{a-5}{a-2} > 0{,}15$ (TABLE) $\Rightarrow a = 6 \vee a = 7 \vee a = 8 \vee a = 9.$

D10a $P(AAAAAAAAA\overline{A}) = 0{,}78^9 \cdot (1 - 0{,}78) = 0{,}78^9 \cdot 0{,}22 \approx 0{,}024.$

```
0.78^9*0.22
          .0235111626
```

D10b $P(A \geq 9) = 1 - P(A \leq 8) = 1 - \text{binomcdf}(10, 0.78, 8) \approx 0{,}318.$ (A = het aantal keer dat hij alles omver werpt)

OF: $P(A \geq 9) = P(A = 9) + P(A = 10) = \text{binompdf}(10, 0.78, 9) + \text{binompdf}(10, 0.78, 10) \approx 0{,}318.$

```
1-binomcdf(10,0.
78,8)
         .3184693845
binompdf(10,0.78
,9)+binompdf(10,
0.78,10)
         .3184693843
```

D11a $P(A = 5) = \text{binompdf}(15, 0.42, 5) \approx 0{,}169.$

```
binompdf(15,0.42
,5)
         .1690759046
```

D11b $P(X \leq 10) = \text{binomcdf}(15, 0.42 + 0.07, 10) \approx 0{,}949.$ (X = het aantal keer "A of C")

```
binomcdf(15,0.49
,10)
         .9493934471
```

D11c $P(X = 8 \text{ of } X = 9) = \text{binompdf}(15, 0.42 + 0.07, 8) + \text{binompdf}(15, 0.42 + 0.07, 9) \approx 0{,}335.$

```
binompdf(15,0.49
,8)+binompdf(15,
0.49,9)
         .3353282225
```

D11d $P(C = 0) = \text{binompdf}(15, 0.07, 0) \approx 0{,}337.$

```
binompdf(15,0.07
,0)
         .3367008621
```

D12a $P(E > 10) = 1 - P(E \le 10) = 1 - \text{binomcdf}(16, \frac{1}{2}, 10) \approx 0{,}105.$

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

D12b $P(Z < 3) = P(Z \le 2) = \text{binomcdf}(16, \frac{1}{6}, 2) \approx 0{,}487.$

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

D12c $P(5 < X < 10) = P(X \le 9) - P(X \le 5) = \text{binomcdf}(16, \frac{2}{6}, 9) - \text{binomcdf}(16, \frac{2}{6}, 5) \approx 0{,}437.$ (X = het aantal keer "1 of 2")

D13 $P(T \ge 5) = 1 - P(T \le 4) = 1 - \text{binomcdf}(n, \frac{3}{36}$ (zie rooster op voorblad)$, 4) > 0{,}90$ (TABLE) $\Rightarrow n \ge 94.$
Dus minstens 94 keer gooien. (door de tabel bladeren kost wel even wat tijd)

```
Plot1 Plot2 Plot3
\Y1=1-binomcdf(X
,3/36,4)
\Y2=0.90
```

X	Y1	Y2
92	.89014	.9
93	.89545	.9
94	.90053	.9
95	.9054	.9
96	.91006	.9
97	.91451	.9
98	.91877	.9

X=94

D14 $p = P(L > 7) = \text{normalcdf}(7, 10^{99}, 8, 1.3) \approx 0{,}779...$ en $P(X = 5) = \text{Ans}^5 \approx 0{,}287.$
OF: $P(X = 5) = \text{binompdf}(5, \text{Ans}, 5) \approx 0{,}287.$

```
normalcdf(7,10^9
9,8,1.3)
       .7791219069
Ans^5
       .2870959584
```

```
normalcdf(7,10^9
9,8,1.3)
       .7791219069
binompdf(5,Ans,5
)
       .2870959584
```

D15 $P(U = 100) = P(18 \text{ ogen}) = P(666) = (\frac{1}{6})^3 = \frac{1}{216}.$
$P(U = 15) = P(17 \text{ ogen}) = P(\underline{\underline{665}}) = \binom{3}{2} \cdot (\frac{1}{6})^2 \cdot \frac{1}{6} = 3 \cdot (\frac{1}{6})^3 = \frac{3}{216}.$
$P(U = 5) = P(16 \text{ ogen}) = P(\underline{\underline{664}}) + P(\underline{\underline{655}}) = \binom{3}{2} \cdot (\frac{1}{6})^2 \cdot \frac{1}{6} + \binom{3}{1} \cdot \frac{1}{6} \cdot (\frac{1}{6})^2 = 6 \cdot (\frac{1}{6})^3 = \frac{6}{216}.$
$E(U) = 100 \cdot \frac{1}{216} + 15 \cdot \frac{3}{216} + 5 \cdot \frac{6}{216} + 0 \cdot ... = \frac{175}{216} \approx 0{,}81$ (€).
De winstverwachting per spel is $E(W) = E(U) - 1 \approx -0{,}19$ (€).

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

u	100	15	5	0
$P(U = u)$	$\frac{1}{216}$	$\frac{3}{216}$	$\frac{6}{216}$	...

```
100*1+15*3+5*6
                175
Ans/216
       .8101851852
Ans-1
      -.1898148148
```

Gemengde opgaven 10. Kansverdelingen

G9a $P(\text{mm}) = \frac{x}{30} \cdot \frac{x-1}{29} > 0{,}3$ (TABLE) $\Rightarrow x = 7 \vee x = 8 \vee ... \vee x = 30.$
Dus er zijn minstens 17 meisjes in de klas van 30 leerlingen.

```
Plot1 Plot2 Plot3
\Y1=X/30*(X-1)/2
9
\Y2=0.3
\Y3=
```

X	Y1	Y2
15	.24138	.3
16	.27586	.3
17	.31264	.3
18	.35172	.3
19	.3931	.3
20	.43678	.3
21	.48276	.3

Y1=.312643678161

X	Y1	Y2
26	.74713	.3
27	.8069	.3
28	.86897	.3
29	.93333	.3
30	1	.3
31	1.069	.3
32	1.1402	.3

Y1=1

G9b $P(\text{mmj}) = \frac{x}{30} \cdot \frac{x-1}{29} \cdot \frac{30-x}{28}$ (TABLE) $\Rightarrow P(\text{mmj})$ is maximaal 0,156 voor $x = 20.$
Deze kans is maximaal 0,156 als er 20 meisjes en 10 jongens in de klas zitten.

```
Plot1 Plot2 Plot3
\Y1=X/30*(X-1)/2
9*(30-X)/28
\Y2=
```

X	Y1
15	.12931
16	.13793
17	.14516
18	.15074
19	.15443
20	.15599
21	.15517

Y1=.155993431856

```
1-binomcdf(10,1/
6,2)
       .2247732022
1-binomcdf(12,6/
36,3)
       .1251780927
```

G10a $p = P(6) = \frac{1}{6}$ en $P(A > 2) = 1 - P(A \le 2) = 1 - \text{binomcdf}(10, \frac{1}{6}, 2) \approx 0{,}225.$

G10b $p = P(som > 9) = \frac{6}{36}$ (zie het rooster) en $P(B \ge 4) = 1 - P(B \le 3) = 1 - \text{binomcdf}(12, \frac{6}{36}, 3) \approx 0{,}125.$

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

G10c $p = P(som \le 5) = P(som = 3 \text{ of } som = 4 \text{ of } som = 5) = P(111) + P(\underline{\underline{112}}) + P(\underline{\underline{113}}) + P(\underline{\underline{122}})$
$= (\frac{1}{6})^3 + \binom{3}{2} \cdot (\frac{1}{6})^3 + \binom{3}{2} \cdot (\frac{1}{6})^3 + \binom{3}{1} \cdot (\frac{1}{6})^3 = \frac{1}{216} + \frac{3}{216} + \frac{3}{216} + \frac{3}{216} = \frac{10}{216}.$
De gevraagde kans is $P(C \le 2) = \text{binomcdf}(20, \frac{10}{216}, 2) \approx 0{,}937.$

```
6^3
                216
3 nCr 2
                  3
3 nCr 1
                  3
```

```
binomcdf(20,10/2
16,2)
       .9372051399
```

G10d $p = P(1) = \frac{1}{6}$ en $P(D \ge 3) = 1 - P(D \le 2) = 1 - \text{binomcdf}(n, \frac{1}{6}, 2) > 0{,}95$ (TABLE) $\Rightarrow n \ge 36.$
Dus minstens 36 keer gooien.

```
Plot1 Plot2 Plot3
\Y1=1-binomcdf(X
,1/6,2)
\Y2=0.95
\Y3=
```

X	Y1	Y2
34	.93856	.95
35	.94616	.95
36	.95288	.95
37	.9588	.95
38	.96402	.95
39	.96862	.95
40	.97265	.95

Y1=.952878228488

G10e $p = P(\text{minstens één 6}) = \frac{11}{36}$ (zie de grijze vakjes in het rooster) of $1 - P(\text{geen 6}) = 1 - P(\bar{6}\bar{6}) = 1 - (\frac{5}{6})^2.$

```
1-(5/6)²►Frac
              11/36
```

$P(---+) = (\frac{25}{36})^3 \cdot \frac{11}{36} \approx 0{,}102.$

```
(25/36)^3*11/36
       .1023299373
```

G11a R = het aantal reizigers; $P(R \le 1250) = \text{binomcdf}(1350, 0.92, 1250) \approx 0{,}802.$

```
binomcdf(1350,0.
92,1250)
        .802063237
```

G11b $P(R > 1250) = 1 - P(R \le 1250) = 1 - \text{binomcdf}(n, 0.92, 1250) \le 0{,}05$ (TABLE) $\Rightarrow n \le 1341.$
Dus maximaal 1341 zitplaatsen verkopen. (het bladeren door de tabel is erg tijdrovend)

```
Plot1 Plot2 Plot3
\Y1=1-binomcdf(X
,0.92,1250)
\Y2=0.05
\Y3=
```

X	Y1	Y2
1337	.01729	.05
1338	.02201	.05
1339	.02777	.05
1340	.03469	.05
1341	.04293	.05
1342	.05266	.05
1343	.064	.05

Y1=.042934490895

G12a $E(U) = 5\,000 \times \frac{1}{10000} + 1\,000 \times \frac{2}{10000} + 50 \times \frac{7}{10000} + 5 \times \frac{490}{10000} = 0{,}98$ (€).
$E(W) = E(U) - 2{,}50 = 0{,}98 - 2{,}50 = -1{,}52$ (€).

u	5000	1000	50	5	0
$P(U=u)$	$\frac{1}{10000}$	$\frac{2}{10000}$	$\frac{7}{10000}$	$\frac{490}{10000}$	...

G12b $P(\text{minstens één prijs}) = 1 - P(\text{geen prijs}) = 1 - \frac{\binom{9500}{7}}{\binom{10000}{7}} \approx 0{,}302.$

G12c $P(\text{minstens één prijs}) = 1 - P(\text{geen prijs}) = 1 - \frac{\binom{9500}{14}}{\binom{10000}{14}} \approx 0{,}513 \neq 2 \cdot 0{,}302.$

G12d $P(\text{minstens één prijs}) = 1 - P(\text{geen prijs}) = 1 - \frac{\binom{9500}{n}}{\binom{10000}{n}} > 2 \cdot \left(1 - \frac{\binom{9500}{7}}{\binom{10000}{7}}\right)$ (TABLE) $\Rightarrow n \geq 19.$
Dus Amalia moet minstens 19 loten kopen.

G13a $P(J=2) = \text{binompdf}(4{,}0.5{,}2) = 0{,}375$ of $P(J=2) = P(\underline{\underline{jjmm}}) = \binom{4}{2} \cdot 0{,}5^2 \cdot 0{,}5^2 = 0{,}375.$
$P(J=2) = \text{binompdf}(4{,}0.51{,}2) \approx 0{,}3747$ of $P(J=2) = P(\underline{\underline{jjmm}}) = \binom{4}{2} \cdot 0{,}51^2 \cdot 0{,}49^2 \approx 0{,}3747.$
De kansen verschillen ongeveer 0,0003.

G13b $P(J \geq 285) = 1 - P(J \leq 284) = 1 - \text{binompdf}(500{,}0.51{,}284) \approx 0{,}004.$

G13c Het totaal aantal geboortes is $4\,073 + 2\,048 + 4\,018 = 10\,139$.
Het totaal aantal meisjes is $2767 + 962 + 1257 = 4\,986$.
Het totaal aantal jongens is $10\,139 - 4\,986 = 5\,153$.
$P(J \geq 285) = \frac{5153}{10139} \approx 0{,}508.$

G13d $P(\text{jongen bij zeer dominante moeder}) = 0{,}75 \Rightarrow P(\text{meisje bij zeer dominante moeder}) = 1 - 0{,}75 = 0{,}25.$
Dan zou $P(\text{meisje bij zeer meegaande moeder}) = 5 \cdot 0{,}25 = 1{,}25 > 1$ en dat kan niet.

G13e Stel $P(\text{meisje bij zeer meegaande moeder}) = 0{,}75 \Rightarrow P(\text{jongen bij zeer meegaande moeder}) = 1 - 0{,}75 = 0{,}25.$
Er geldt dan $P(\text{meisje bij zeer dominante moeder}) = \frac{1}{5} \cdot 0{,}75 = 0{,}15 \Rightarrow P(\text{jongen bij zeer dominante moeder}) = 1 - 0{,}15 = 0{,}85.$
NIET geldt: $P(\text{jongen bij zeer dominante moeder}) = 5 \cdot P(\text{jongen bij zeer meegaande moeder})$, want $0{,}85 \neq 5 \cdot 0{,}25$.

G14a $P(V=1) = \text{binompdf}(10, \frac{1}{3}, 1) \approx 0{,}0867$ of $P(V=1) = P(\underline{\underline{V\bar{V}\bar{V}\bar{V}\bar{V}\bar{V}\bar{V}\bar{V}\bar{V}\bar{V}}}) = \binom{10}{1} \cdot \frac{1}{3} \cdot \left(\frac{2}{3}\right)^9 \approx 0{,}0867.$

G14b $P(\text{strafpunt}) = P(\text{Hot Spot}) + P(\text{Vraag en fout}) = \frac{1}{3} + \frac{1}{3} \cdot \frac{1}{2} = \frac{1}{3} + \frac{1}{6} = \frac{2}{6} + \frac{1}{6} = \frac{1}{2}.$

G14c $P(S \leq 2) = \text{binomcdf}(10, \frac{1}{2}, 2) \approx 0{,}0547.$

G14d $P(S \leq 2) = \text{binomcdf}(10, \frac{1}{3}, 2) \approx 0{,}2991$ met $E(\text{geldprijs bij } S \leq 2) \approx 0{,}2991 \times 10\,000 = 2\,991$ (£).
$P(S \leq 3) = \text{binomcdf}(10, \frac{1}{3}, 3) \approx 0{,}5593$ met $E(\text{geldprijs bij } S \leq 3) \approx 0{,}5593 \times 7\,000 = 3\,915$ (£).
$P(S \leq 4) = \text{binomcdf}(10, \frac{1}{3}, 4) \approx 0{,}7869$ met $E(\text{geldprijs bij } S \leq 4) \approx 0{,}7869 \times 5\,000 = 3\,934$ (£).
N.B.: $P(\text{strafpunt}) = P(\text{Hot Spot}) = \frac{1}{3}$ (vragen gaann goed). Speel voor maximaal 4 strafpunten.

G15a Hij kan $0{,}25 \cdot 20 = 5$ goede antwoorden verwachten, dus 5 punten.

G15b De verwachtingswaarde is $0{,}25 \cdot 1 + 0{,}75 \cdot -0{,}5 = -0{,}125$.

G15c Invullen in $score = 1 - (p_A^2 + (1 - p_B)^2 + p_C^2 + p_D^2)$ geeft: $score = 1 - (0{,}2^2 + (1 - 0{,}7)^2 + 0^2 + 0{,}1^2) = 0{,}86.$

G15d $p_A = 1,\ p_B = 0,\ p_C = 0$ en $p_D = 0$ of $p_A = 0,\ p_B = 1,\ p_C = 0$ en $p_D = 0$ of $p_A = 0,\ p_B = 0,\ p_C = 0$ en $p_D = 1$.

G15e II Als het juiste antwoord er bij zit (3 mogelijkheden) is de score: $1 - \left((\frac{1}{2})^2 + (\frac{1}{2})^2\right) = 0{,}5.$
Als het juiste antwoord er niet bij zit (3 mogelijkheden) is de score: $1 - \left((\frac{1}{2})^2 + (\frac{1}{2})^2 + 1^2\right) = -0{,}5.$
De verwachte score bij II is dus $0{,}5 \cdot 0{,}5 + 0{,}5 \cdot -0{,}5 = 0$.
III Als het juiste antwoord er bij zit (3 mogelijkheden) is de score: $1 - \left((\frac{1}{3})^2 + (\frac{1}{3})^2 + (\frac{2}{3})^2\right) = \frac{1}{3}.$
Als het juiste antwoord er niet bij zit (1 mogelijkheid) is de score: $1 - \left((\frac{1}{3})^2 + (\frac{1}{3}) + (\frac{1}{3})^2 + 1^2\right) = -\frac{1}{3}.$
De verwachte score bij III is dus $\frac{3}{4} \cdot \frac{1}{3} + \frac{1}{4} \cdot -\frac{1}{3} = \frac{3}{13} - \frac{1}{12} = \frac{2}{12} = \frac{1}{6} \approx 0{,}167.$
CONCLUSIE: mogelijkheid IV is de meest verstandige strategie.

G16a $P(C=0) = \text{binompdf}(5{,}0.03{,}0) \approx 0{,}8587$ of $P(C=0) = P(\underline{\underline{\bar{C}\,\bar{C}\,\bar{C}}}) = 0{,}97^5 \approx 0{,}8587.$

G16b Alle 5 keuringen goed uitgevoerd $\Rightarrow 5 \cdot 0{,}4 = 2.$
4 keuringen goed uitgevoerd en 1 keuring niet goed $\Rightarrow 4 \cdot 0{,}4 + 1 \cdot -1{,}5 = 0{,}1.$
3 keuringen goed uitgevoerd en 2 keuringen niet goed $\Rightarrow 3 \cdot 0{,}4 + 2 \cdot -1{,}5 = -1{,}8.$
Er mag dus hoogstens 1 keuring niet goed zijn uitgevoerd.
$P(\bar{G} \le 1) = \text{binomcdf}(5{,}0.20{,}1) \approx 0{,}7373.$

G16c De verwachtingswaarde per controle is $0{,}4 \cdot 0{,}90 - 1{,}5 \cdot 0{,}10 = 0{,}21.$
Na 8 controles is dee verwachtingswaarde van het aantal punten $8 \cdot 0{,}21 = 1{,}68.$

G16d De klassenmiddens zijn 2,5; 7,5; 12,5; 17,5 en 22,5. De percentages zijn 3; 10; 68; 18 en 1.
Dit levert het gemiddelde van 12,7 jaar.

G17a $P(F \ge 40) = 1 - P(F \le 39) = 1 - \text{binomcdf}(200{,}0.25{,}3) \approx 0{,}9595.$

G17b Van de 16 leugenaars worden naar verwachting $0{,}75 \cdot 16 = 12$ correct herkend.
Van de 84 eerlijke mensen worden naar verwachting $\frac{11}{12} \cdot 84 = 77$ correct herkend.
De betrouwbaarheid is $\frac{12+77}{100} \cdot 100\% = 89\%.$

G17c Van de 1000 mensen worden 86 $(8{,}3\% + 0{,}3\%)$ door de leugendetector bestempeld als leugenaar.
Van deze 86 zijn er 3 werkelijk leugenaar. De gevraagde kans is $\frac{3}{86} \approx 0{,}0349.$

G18a Aantal manieren $= 8 \cdot 7 \cdot 6 = 336.$

G18b $P(E=0) = \text{binompdf}(10, \frac{18}{38}, 5) \approx 0{,}243$ of $\binom{10}{5} \cdot \left(\frac{18}{38}\right)^5 \cdot \left(\frac{20}{38}\right)^5 \approx 0{,}243.$

G18c $P(\text{verlies}) = P(\text{10 keer niet op 12}) = \text{binompdf}(10, \frac{37}{38}, 10) = \left(\frac{37}{38}\right)^{10} \approx 0{,}766$ of $\left(\frac{37}{38}\right)^{10} \approx 0{,}766.$
$P(\text{winst}) = 1 - P(\text{verlies}) \approx 1 - 0{,}766 = 0{,}234.$

G18d $E(\text{straight up bet}) = 1000 \cdot \frac{37}{38} - 35\,000 \cdot \frac{1}{38} \approx 52{,}63$ (dollar).
$E(\text{split bet}) = 1000 \cdot \frac{36}{38} - 17\,000 \cdot \frac{2}{38} \approx 52{,}63$ (dollar).
(voor de winstverwachting maakt het niet uit of een speler inzet op 'straight up bet' of op 'split bet')

TI-84 12. 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 $P(X=3) + P(X=4) = \text{binompdf}(18{,}0.38{,}3) + \text{binompdf}(18{,}0.38{,}4) \approx 0{,}114.$
OF: $P(X=3) + P(X=4) = P(X \le 4) - P(X \le 2)$
$= \text{binomcdf}(18{,}0.38{,}4) - \text{binomcdf}(18{,}0.38{,}2) \approx 0{,}114.$

1d $P(X \le 5) = \text{binomcdf}(18{,}0.38{,}5) \approx 0{,}262.$

1e $1 - P(X \le 6) = 1 - \text{binomcdf}(18{,}0.38{,}6) \approx 0{,}558.$

1f $P(X \le 6) - P(X \le 2) = \text{binomcdf}(18{,}0.38{,}6) - \text{binomcdf}(18{,}0.38{,}2) \approx 0{,}430.$