

16.3 X : tulosten "summa" lkm 300 kolikon heitolla

$$\mu = n \cdot p = 300 \cdot \frac{1}{2} = 150$$

$$\sigma = \sqrt{n \cdot p \cdot (1-p)} = \sqrt{300 \cdot \frac{1}{2} \cdot \frac{1}{2}} = \sqrt{75}$$

$X \sim N(150, \sqrt{75})$ likimain

$$P(140 \leq X \leq 160) = P(139,5 \leq X \leq 160,5) = 0,77465418$$

jatkumääräys $= 0,775$

$X \sim \text{Bin}(300, \frac{1}{2})$

$$\Rightarrow P(140 \leq X \leq 160) = \binom{300}{140} \left(\frac{1}{2}\right)^{140} \left(\frac{1}{2}\right)^{160} + \binom{300}{141} \left(\frac{1}{2}\right)^{141} \left(\frac{1}{2}\right)^{159}$$

$$+ \binom{300}{142} \left(\frac{1}{2}\right)^{142} \left(\frac{1}{2}\right)^{158} + \dots + \binom{300}{160} \left(\frac{1}{2}\right)^{160} \left(\frac{1}{2}\right)^{140}$$

$$= \sum_{k=140}^{160} \binom{300}{k} \left(\frac{1}{2}\right)^k \left(\frac{1}{2}\right)^{300-k} \approx 0,7747144 \approx 0,775$$

a) $X = 168,0 : Z = \frac{168,0 - 162,4}{6,1} = 0,918033 \approx 0,92$

$$P(X < 168,0) = P(Z < 0,92) = \Phi(0,92) = 0,8212 = 82\%$$

b) $X = 155,0 : Z = \frac{155,0 - 162,4}{6,1} = -1,213115 \approx -1,21$

$P(X < 155,0) = P(Z < -1,21) = P(Z > 1,21)$ (symmetria)

$$= 1 - P(Z \leq 1,21) = 1 - \Phi(1,21) = 1 - 0,8869 = 0,1131 = 11\%$$

c) $P(155,0 \leq X \leq 168,0) = P(X \leq 168,0) - P(X \leq 155,0)$

$$= 0,8212 - 0,1131 = 0,7081 = 71\%$$

16.4 X : tulosten "6" lkm 2000 nopan heitolla

$$\mu = n \cdot p = 2000 \cdot \frac{1}{6} = \frac{1000}{3}$$

$$\sigma = \sqrt{n \cdot p \cdot (1-p)} = \sqrt{2000 \cdot \frac{1}{6} \cdot \frac{5}{6}} = \frac{50}{3}$$

$X \sim N(\frac{1000}{3}, \frac{50}{3})$ likimain

a) $P(300 \leq X \leq 320) = P(299,5 \leq X \leq 320,5) = 0,19947168$

jatkumääräys $= 0,1995$

b) $P(380 \leq X \leq 400) = P(379,5 \leq X \leq 400,5) = 0,00222457$

$= 0,0028$

$X \sim \text{Bin}(2000, \frac{1}{6})$

a) $P(300 \leq X \leq 320) = \binom{2000}{300} \left(\frac{1}{6}\right)^{300} \left(\frac{5}{6}\right)^{1700} + \binom{2000}{301} \left(\frac{1}{6}\right)^{301} \left(\frac{5}{6}\right)^{1699}$

$$+ \dots + \binom{2000}{320} \left(\frac{1}{6}\right)^{320} \left(\frac{5}{6}\right)^{1680} \approx 0,201369 \approx 0,2014$$

b) $P(380 \leq X \leq 400) = \sum_{k=380}^{400} \binom{2000}{k} \left(\frac{1}{6}\right)^k \left(\frac{5}{6}\right)^{2000-k} \approx 0,0031417$

$= 0,0031$

17.4 $Z \sim N(0,1)$

a) $P(Z \leq a) = 0,75 \Rightarrow \Phi(a) = 0,75 \Rightarrow a \approx 0,67$

b) $P(Z \leq a) = 0,20 \Rightarrow P(Z \geq -a) = 0,20$ (symmetria)

$\Rightarrow P(Z \leq -a) = \Phi(-a) = 1 - 0,20 = 0,80$

$\Rightarrow -a \approx 0,84 \Rightarrow a \approx -0,84$

K47. X : pelaajan pituus, $X \sim N(\mu; 4,8)$

$$P(X > 200) = P\left(\frac{X - \mu}{4,8} > \frac{200 - \mu}{4,8}\right) = P(Z > \frac{200 - \mu}{4,8})$$

$Z \sim N(0,1) \Rightarrow 0,0480$

$\Rightarrow a = \frac{200 - \mu}{4,8} = 1,66456$

$\Rightarrow \mu = 200 - 1,66456 \cdot 4,8 \approx 192,010 \approx 192 \text{ (cm)}$

16.8 $P(2 \text{ nojalla summa} > 8) = \frac{10}{36} = \frac{5}{18}$

X : tulosten "summa" lkm 100 heitolla

$$\mu = n \cdot p = 100 \cdot \frac{5}{18} = \frac{250}{9}$$

$$\sigma = \sqrt{n \cdot p \cdot (1-p)} = \sqrt{100 \cdot \frac{5}{18} \cdot \frac{13}{18}} = \frac{5\sqrt{65}}{9}$$

$\Rightarrow X \sim N(\frac{250}{9}, \frac{5\sqrt{65}}{9})$ likimain

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 jatkumääräys

$$P(X \geq 40) = P(X \geq 39,5) = 0,004433627 \approx 0,0044$$

$X \sim \text{Bin}(100, \frac{5}{18}) \Rightarrow P(X \geq 40) = \sum_{k=40}^{100} \binom{100}{k} \left(\frac{5}{18}\right)^k \left(\frac{13}{18}\right)^{100-k}$

$= 0,00553418 \approx 0,0055$

16.9 myyjään 379 lipua, $P(\text{saapuu lennolle}) = 0,95$

X : lennolle saapuvien lkm

$$\mu = n \cdot p = 379 \cdot 0,95 = 360,05$$

$$\sigma = \sqrt{n \cdot p \cdot (1-p)} = \sqrt{379 \cdot 0,95 \cdot 0,05} = 4,242935$$

$\Rightarrow X \sim N(360,05; 4,242935)$ likimain

$$P(X \leq 370) = P(X \leq 370,5) = 0,993109417 \approx 0,993$$

jatkumääräys

$X \sim \text{Bin}(379; 0,95) \Rightarrow P(X \leq 370) = \sum_{k=0}^{370} \binom{379}{k} 0,95^k \cdot 0,05^{379-k}$

$= 0,996642303 \approx 0,997$

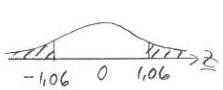
17.1 $Z \sim N(0,1)$

a) $P(Z \leq 1,34) = \Phi(1,34) = 0,9099$

b) $P(Z \geq 1,34) = 1 - P(Z \leq 1,34) = 1 - 0,9099 = 0,0901$

c) $P(Z \leq -1,06) = P(Z \geq 1,06)$

$$= 1 - P(Z \leq 1,06) = 1 - \Phi(1,06)$$

$$= 1 - 0,8554 = 0,1446$$


d) $P(-1,06 \leq Z \leq 1,34) = P(Z \leq 1,34) - P(Z < -1,06)$

$$= 0,9099 - 0,1446 = 0,7653$$

17.2 X : 14-uotiaan työn pituus, $X \sim N(162,4; 6,1)$