①

hod.	0	1	2	3	4	5	6	
čet. n_i	57	24	10	6	(2)	(0)	(1)	$n=100$
	1/2	1/4	....					

$p[X=x] = q^x(1-q)$

H_0 ... glob. π.; $q=1/2$ ... $T=0$ $\quad = \frac{1}{2^{x+1}}$

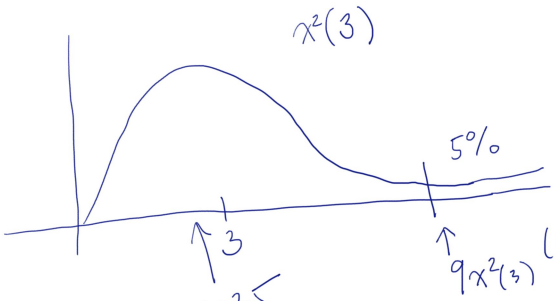
H_1 .. jiné π.; $T>0$

$T = \sum \frac{(n_i - np_i)^2}{np_i} \sim \chi^2(g-1)$

$\alpha = 5\%$

	0	1	2	3 a více	
n_i	57	24	10	9	... $n=100$
p_i	1/2	1/4	1/8	1/8	
np_i	50	25	12,5	12,5	
$n_i - np_i$	7	-1	-2,5	-3,5	
$(n_i-np_i)^2$	49	1	6,25	12,25	
$\frac{(n_i-np_i)^2}{np_i}$	$\frac{49}{50}$	$+\frac{1}{25}$	$+\frac{6,25}{12,5}$	$+\frac{12,25}{12,5}$	$= t = 2,5$

H_0 nezamítáme



②

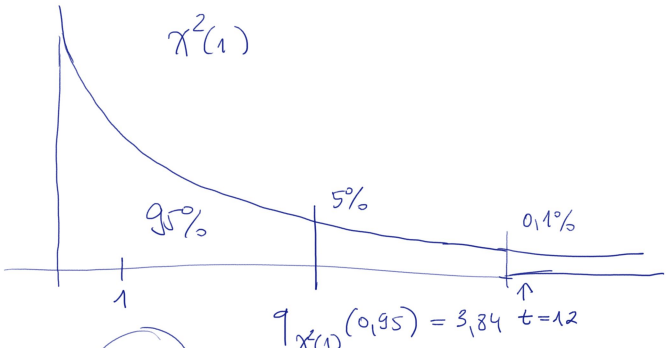
1	2	3	4	5	6	
8	(4)	7	15	6	20	$n=60$

H_0 ... ~~Pro~~ rovnoměrné π.

H_1 ... jiné π.

	1 až 5	6
n_i	40	20
p_i	5/6	1/6
$n \cdot p_i$	50	10
$n_i - np_i$	-10	10
$(n_i - np_i)^2$	100	100
$\frac{(n_i - np_i)^2}{np_i}$	$\frac{100}{50}$	$+\frac{100}{10} = t = 2+10 = 12$

$n=60$



H_0 zamítáme $\Rightarrow$ kostka je falešná

$\alpha = 0,1\%$ ... $q_{\chi^2(1)}(0,999) = 10,83 \Rightarrow H_0$ zamítáme i pro $\alpha = 0,1\%$!

(3)

	0	1	2	3	4
m_i	18	3	5	12	22
n_i	12	2	0	8	18

H_0 ... obě měření pocházejí ze stejného π

H_1 ... $\neg$(...)

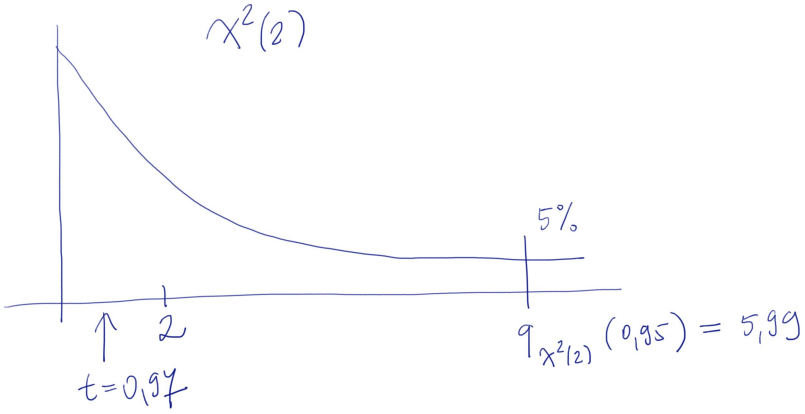
$$T = \sum_{i=1}^{k} \frac{(m_i - mp_i)^2}{mp_i} + \sum_{i=1}^{k} \frac{(n_i - np_i)^2}{np_i}$$

$$p_i = \frac{m_i + n_i}{m + n}$$

	0	1 až 3	4	
m_i	18	20	22	$m = 60$
n_i	12	10	18	$n = 40$
$m_i + n_i$	30	30	40	
p_i	0,3	0,3	0,4	
$m \cdot p_i$	18	18	24	
$n \cdot p_i$	12	12	16	
$m_i - mp_i$	0	2	-2	
$n_i - np_i$	0	-2	2	
$(m_i - mp_i)^2$	0	4	4	
$(n_i - np_i)^2$	0	4	4	
$\frac{(..)^2}{mp_i}$	$\frac{0}{18}$	$\frac{4}{18}$	$\frac{4}{24}$	
$\frac{(..)^2}{np_i}$	$\frac{0}{12}$	$\frac{4}{12}$	$\frac{4}{16}$	

$$t = \frac{0}{18} + \frac{4}{18} + \frac{4}{24} + \frac{0}{12} + \frac{4}{12} + \frac{4}{16} \doteq 0{,}9722$$

testujeme na $\chi^2(k-1)$



H_0 nezamítáme

(4)

oč. j / vlas i	1 modré	2 šedé	3 hnědé
1 tmavé	10	10	40
2 světlé	20	10	10

k, m

$$T = \sum_{i=1}^{k} \sum_{j=1}^{m} \frac{(n_{ij} - n p_i q_j)^2}{n p_i q_j}$$

H_0: $T = 0$ ... nezávislé

H_1: $T > 0$ ... závislé

X: i, Y: j

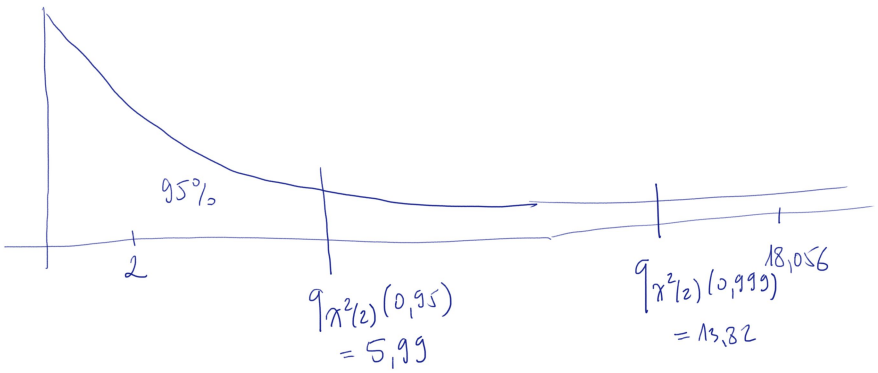
n_{ij}	1	2	3	
1	(10)	10	40	60
2	20	10	10	40
	30	20	50	$n = 100$

$p_i \cdot q_j$	1	2	3	p_i
1	0,18	0,12	0,30	0,6
2	0,12	0,08	0,20	0,4
q_j	0,3	0,2	0,5	1

np_iq_j	1	2	3
1	(18)	12	30
2	12	8	20

$$t = \frac{(10-18)^2}{18} + \frac{(10-12)^2}{12} + \frac{(40-30)^2}{30} + \frac{(20-12)^2}{12} + \frac{(10-8)^2}{8} + \frac{(10-20)^2}{20} \doteq 18{,}056$$

... $\chi^2((k-1)\cdot(m-1)) = \chi^2((2-1)(3-1)) = \chi^2(2)$



H_0 zamítáme $\Rightarrow$ X a Y nejsou nezávislé

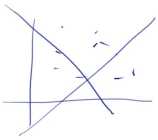
$\alpha = 0{,}1\%$: $q_{\chi^2(2)}(0{,}999) = 13{,}82$ $\Rightarrow$ H_0 zamítáme

(5) H_0 : $T=0$ ... veličiny nejsou korelované $T = \frac{R_{XY}\sqrt{n-2}}{\sqrt{1-R_{XY}^2}} \sim t(n-2)$

H_1 : $T \neq 0$ ... jsou kor.

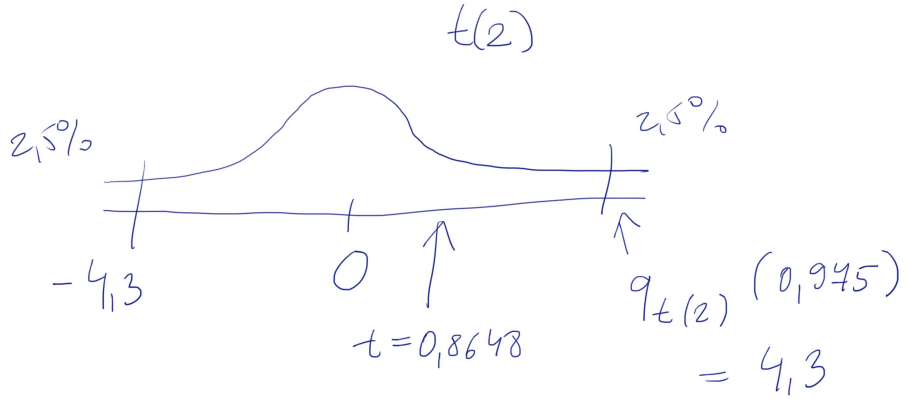
$$R_{XY} = \frac{\Sigma(x_i-\bar{x})(y_i-\bar{y})}{\sqrt{\Sigma(x_i-\bar{x})^2 \Sigma(y_i-\bar{y})^2}}$$

výška x_i	205	155	185	155	$\bar{x} = 145$
váha y_i	95	55	65	85	$\bar{y} = 75$
$x_i-\bar{x}$	30	-20	10	-20	
$y_i-\bar{y}$	20	-20	-10	10	
$(x_i-\bar{x})(y_i-\bar{y})$	600	400	-100	-200	$\Sigma = 400$
$(x_i-\bar{x})^2$	900	400	100	400	$\Sigma = 1800$
$(y_i-\bar{y})^2$	400	400	100	100	$\Sigma = 1000$



$$r_{XY} = \frac{400}{\sqrt{1800 \cdot 1000}} \doteq 0{,}5217$$

$$t = \frac{0{,}5217 \cdot \sqrt{2}}{\sqrt{1-0{,}5217^2}} \doteq 0{,}8648$$



H_0 nezamítáme