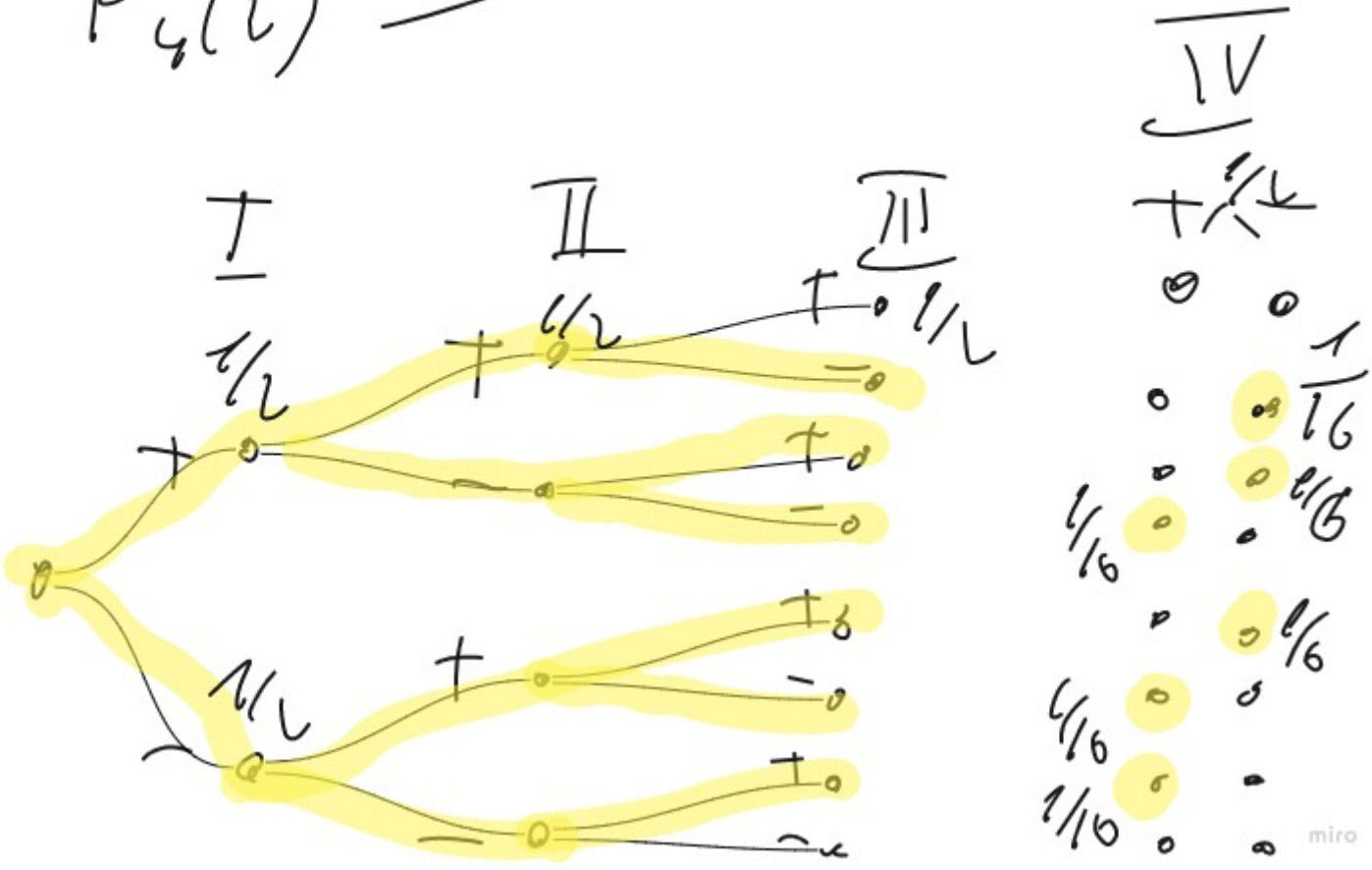
A – выпадет 1 из четырех

$P(A) = \frac{1}{2}$ $P(\bar{A}) = \frac{1}{2}$

$P_4(2)$

$P_6(3)$

$P_4(1)$ удовлетворяет!



Ф. Бернулли

$$P_4(2) = C_4^2 p^2 q^{4-2} =$$

$$= \frac{4!}{2!(4-2)!} \cdot \frac{1}{2}^2 \cdot \frac{1}{2}^2 =$$

$$= \frac{2 \cdot 3}{2 \cdot 1} \cdot \frac{1}{16} = \frac{6}{16}$$

$$P_6(3) = C_6^3 \underbrace{\frac{1}{2}^3}_{p} \cdot \underbrace{\frac{1}{2}^3}_{q} =$$

$$= \frac{6!}{3!(6-3)!} \left(\frac{1}{2}\right)^6 =$$

$$= \frac{6 \cdot 5 \cdot 4}{3 \cdot 2 \cdot 1} = \frac{20}{2^6} =$$

$$= \frac{5}{16}$$

$n = 4$

$p = 1/6 \qquad q = 1 - p = \frac{5}{6}$

$$P(K \geq 3) = P_4(3) + P_4(4)$$

$$P_4(3) = C_4^3 \left(\frac{1}{6}\right)^3 \left(\frac{5}{6}\right)^{4-3} =$$

$$= \frac{4!}{3! \cdot 1!} \cdot \frac{5}{6^4} = \frac{20}{6^4}$$

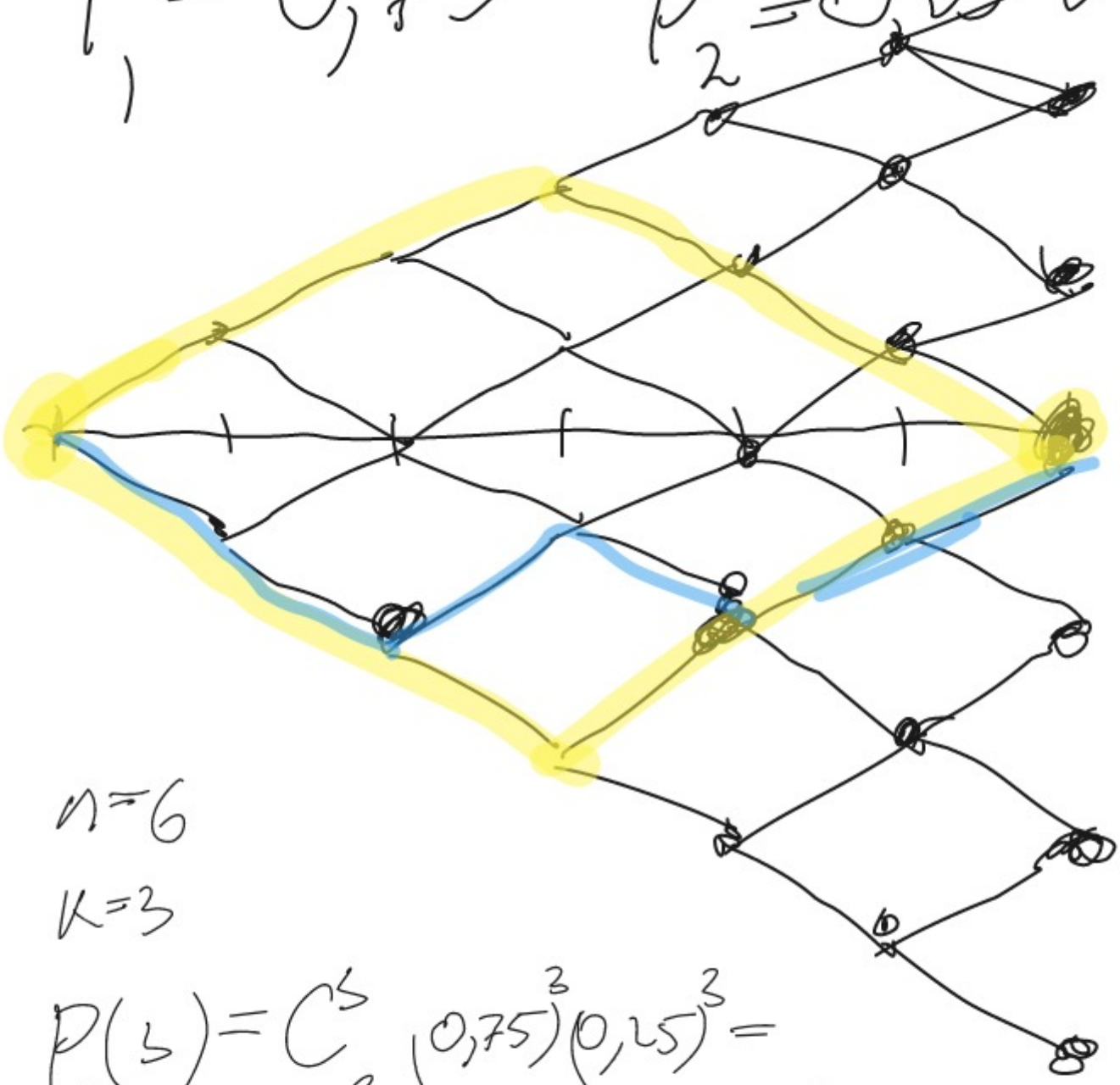
$$P_4(4) = C_4^4 \left(\frac{1}{6}\right)^4 \cdot \left(\frac{5}{6}\right)^0 =$$

$$= \frac{1}{6^4}$$

$$P(K \geq 3) = \frac{20}{6^4} + \frac{1}{6^4} = \frac{21}{6^4}$$

$$\approx 0{,}016$$

$p_1 = 0{,}75$ $p_2 = 0{,}25$ $\vec{q}$



$n = 6$

$k = 3$

$$P_6(3) = C_6^3 (0{,}75)^3 (0{,}25)^3 =$$

$$= \frac{6!}{3!\,3!} \frac{27}{4096} = \frac{654}{324} \frac{27}{4096} =$$

$$\approx 0{,}132 \qquad 13{,}2\%$$

$n = 20 \quad p = 0,7$

$q = 1 - p = 0,3$

более 15 клиентов

$$P(k > 15) = P_{20}(16) + P_{20}(17) +$$

$$+ P_{20}(18) + P_{20}(19) +$$

$$+ P_{20}(20)$$

$$P(k > 15) = P(15 < k \leq 20) = P_{20}(15,20) \approx \Phi(x_2) - \Phi(x_1)$$

$$x_1 = \frac{k_1 - np}{\sqrt{npq}} = \frac{15 - 20 \cdot 0,7}{\sqrt{20 \cdot 0,2 \cdot 0,3}} = \frac{1}{2,05} = 0,49$$

$$x_2 = \frac{k_2 - np}{\sqrt{npq}} = \frac{20 - 20 \cdot 0,7}{\sqrt{20 \cdot 0,2 \cdot 0,3}} = \frac{6}{2,05} = 2,9$$

$$P_{20}(15,20) = \Phi(2,9) - \Phi(0,49) \approx 0,4918 -$$

$$- 0,18793 \approx 0,30$$

наивер. число событий

$K_{наив}$ $M_0(K)$

$$np - q \le K_{наив} \le np + p$$

$$20 \cdot 0{,}7 - 0{,}3 \le K_{наив} \le 20 \cdot 0{,}7 + 0{,}7$$

$$13{,}7 \le K_{наив} \le 14{,}7$$

$$K_{наив} = 14$$

$$P_{20}(k=14) = \frac{1}{\sqrt{npq}} \varphi(x) \Rightarrow$$

$$x = \frac{k - np}{\sqrt{npq}} = \frac{14 - 20 \cdot 0{,}7}{\sqrt{npq}} =$$

$$= \frac{0}{\sqrt{npq}} = 0$$

$$\Rightarrow \frac{1}{2{,}05} \cdot \varphi(0) = \frac{1}{2{,}05} \cdot 0{,}39894 \approx 0{,}195$$

$n = 900$

$p = 0,9$

$P(k_1 \le k \le k_2) = 0,95$

$k_1 = np - \Delta$

$k_2 = np + \Delta$

$\Delta - ?$

$k_1, k_2 - ?$

$$P(np - \Delta \le k \le np + \Delta) = \Phi\left(\frac{\Delta}{\sqrt{npq}}\right) - \Phi\left(\frac{-\Delta}{\sqrt{npq}}\right) =$$

$$|k - np| \le \Delta$$

$$= 2\Phi\left(\frac{\Delta}{\sqrt{npq}}\right) = 0,95$$

$$x_1 = \frac{k_1 - np}{\sqrt{npq}} = \frac{np - \Delta - np}{\sqrt{npq}} = -\frac{\Delta}{\sqrt{npq}}$$

$$x_2 = \frac{k_2 - np}{\sqrt{npq}} = \frac{np + \Delta - np}{\sqrt{npq}} = \frac{\Delta}{\sqrt{npq}}$$

$$2\Phi\left(\frac{\Delta}{\sqrt{npq}}\right) = 0,95$$

$$\Phi\left(\frac{\Delta}{\sqrt{900 \cdot 0,9 \cdot 0,1}}\right) = 0,475 \Rightarrow \frac{\Delta}{\sqrt{81}} = 1,96$$

$$\Delta = 9 \cdot 1,96 = 17,64$$