$a_{min} = 75$, $a_{max} = 90$

$b_{min} = 500$, $b_{max} = 600$

$p_1 = 0,1$; $p_2 = 0,01$; $p_3 = 0,3$

$c \in [0, a_{max} + b_{max}]$

$d \in [0, 2(a_{max} + b_{max})]$

№ 2.

Первая модель:

$$p(a, b, c, d) = p(d|c) p(c|a, b) p(a) p(b)$$

$$d|c \sim c + Bin(c, p_3)$$

$$c|a, b \sim Bin(a, p_1) + Bin(b, p_2)$$

$$a \sim U[a_{min}, a_{max}]$$

$$b \sim U[b_{min}, b_{max}]$$

$\mathbb{E}a = 82,5$, $\mathbb{D}a = \dfrac{16^2 - 1}{12} = 21,25$

$\mathbb{E}b = 550$, $\mathbb{D}b = \dfrac{101^2 - 1}{12} = 850$

$\mathbb{E}c = \mathbb{E} Bin(a, p_1) + \mathbb{E} Bin(b, p_2) = 0,1a + 0,01b$

$\mathbb{D}c = \mathbb{D} Bin(a, p_1) + \mathbb{D} Bin(b, p_2) = 0,09a + 0,0099b$

①

$$\mathbb{E}\,d = \mathbb{E}\,c + \mathbb{E}\,Bin(c, p_3) = 0{,}1a + 0{,}01b + 0{,}3c$$

$$\mathbb{D}\,d = \mathbb{D}\,c + \mathbb{D}\,Bin(c, p_3) + 2\,cov(c, Bin(c, p_3)) =$$

$$= 0{,}09a + 0{,}0099\,b + 0{,}21c + 2\,\mathbb{E}\,c\,Bin(c, p_3) - 0{,}06\,ac - 0{,}006\,bc$$

Вторая модель:

$$p(a, b, c, d) = p(d|c)\,p(c|a, b)\,p(a)\,p(b)$$

$$d|c \sim c + Bin(c, p_3)$$

$$c|a, b \sim Poiss(a p_1 + b p_2)$$

$$a \sim U[a_{min}, a_{max}]$$

$$b \sim U[b_{min}, b_{max}]$$

$$\mathbb{E}\,a = 82{,}5 \quad ; \quad \mathbb{D}\,a = 27{,}25$$

$$\mathbb{E}\,b = 550 \quad ; \quad \mathbb{D}\,b = 850$$

$$\mathbb{E}\,c = 0{,}1a + 0{,}01b$$

$$\mathbb{D}\,c = 0{,}1a + 0{,}01b$$

$$\mathbb{E}\,d = 0{,}1a + 0{,}01b + 0{,}3c$$

$$\mathbb{D}\,d = \mathbb{D}\,c + \mathbb{D}\,Bin(c, p_3) + 2\,cov(c, Bin(c, p_3)) =$$

$$= 0{,}1a + 0{,}01b + 0{,}21c + 2\,\mathbb{E}\,c\,Bin(c, p_3) - 0{,}06\,ac - 0{,}006\,bc$$

②

$$\mathbb{E}\, p(b) = 550, \quad \mathbb{D}\, p(b) = 850$$

$$p(b|a) = p(b), \quad \mathbb{E}\, p(b|a) = 550, \quad \mathbb{D}\, p(b|a) = 850$$

$$P(b|d) = \frac{p(d|b)\, p(b)}{\sum\limits_{b=500}^{600} p(d|b)\, p(b)} = \frac{p(d|b)}{\sum\limits_{b=500}^{600} p(d|b)}$$

$$P(b|d = \mathbb{E}d) = \frac{p(d = \mathbb{E}d\,|\,b)}{\sum\limits_{b=500}^{600} p(d = \mathbb{E}d\,|\,b)} =$$

$$= \frac{p(d = \mathbb{E}d\,|\,c)\, p(c|a,b)\, p(a)}{\sum\limits_{b=500}^{600} p(d = \mathbb{E}d\,|\,c)\, p(c|a,b)\, p(a)}$$

$$\mathbb{E}\, p(b|d = \mathbb{E}d) = \sum\limits_{b=500}^{600} b \cdot p(b|d = \mathbb{E}d)$$

$$p(b|a,d) = \frac{p(a,d|b)\, p(b)}{\sum\limits_{b=500}^{600} p(a,d|b)\, p(b)} = \frac{p(a,d|b)}{\sum\limits_{b=500}^{600} p(a,d|b)} =$$

$$= \frac{p(d|a,b)\, p(a)}{\sum\limits_{b=500}^{600} p(d|a,b)\, p(a)} = \frac{p(d|a,b)}{\sum\limits_{b=500}^{600} p(d|a,b)} = \frac{p(d|c)\, p(c|a,b)}{\sum\limits_{b=500}^{600} p(d|c)\, p(c|a,b)}$$

$$p(b \mid a = \mathbb{E}a, d = \mathbb{E}d) = \frac{p(d = \mathbb{E}d \mid c)\, p(c \mid a = \mathbb{E}a, b)}{\sum_{b=500}^{600} p(d = \mathbb{E}d \mid c)\, p(c \mid a = \mathbb{E}a, b)},$$

$$\mathbb{E}\, p(b \mid a = \mathbb{E}a, d = \mathbb{E}d) = \sum_{b=500}^{600} b \cdot p(b \mid a = \mathbb{E}a, d = \mathbb{E}d)$$

w 5.

$$p(c) = p(c \mid a, b)\, p(a)\, p(b)$$

$$p(c \mid a) = p(c \mid a, b)\, p(b)$$

$$p(c \mid b) = p(c \mid a, b)\, p(a)$$

$$p(b \mid a) = p(b)$$

$$p(b \mid d) = \frac{p(d \mid c)\, p(c \mid a, b)\, p(a)}{\sum_{b=500}^{600} p(d \mid c)\, p(c \mid a, b)\, p(a)}$$

$$p(b \mid a, d) = \frac{p(d \mid c)\, p(c \mid a, b)}{\sum_{b=500}^{600} p(d \mid c)\, p(c \mid a, b)}$$

$$p(d) = p(d \mid c)\, p(c \mid a, b)\, p(a)\, p(b)$$

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