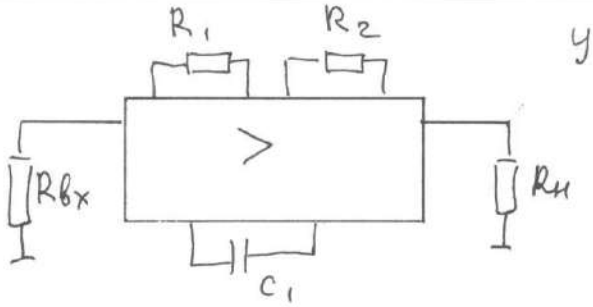


y = [усл. ед.] – ИПК

	$x_1 = R_1$, Ом	$x_2 = C_1$, пФ	$x_3 = R_2$, Ом
x_i^0	100	680	500
$x_i\,min$	70	600	450
$x_i\,max$	130	760	550
λ_i	30	80	50

№	R_1	C_1	R_2	y_{i1}	y_{i2}	y_{i3}	$\bar{y}_i$	$S^2(y_i)$	$S^2(\bar{y})$	$S^2(b_i)$	$\hat{y}_i$
1	–	–	–	3,3	3,5	4,5	3,77	0,41	0,20	0,008	4,41
2	+	–	–	3,4	3,9	3,9	3,73	0,08			4,21
3	–	+	–	3,2	2,5	2,8	2,83	0,12			2,89
4	+	+	–	2,8	2,5	3,0	2,77	0,06			2,69
5	–	–	+	4,4	5,2	5,8	5,13	0,49			5,55
6	+	–	+	4,0	4,4	4,5	4,30	0,07			4,51
7	–	+	+	2,8	3,4	3,8	3,33	0,25			4,03
8	+	+	+	3,4	3,8	3,0	3,40	0,16			2,99

1) $b_0 = (4,5 + 3,9 + 2,8 + 3,0 + 5,8 + 4,5 + 3,8 + 3,0)/8 = 3,91$

$b_1 = (-4,5 + 3,9 - 2,8 + 3,0 - 5,8 + 4,5 - 3,8 + 3,0)/8 = -0,31$

$b_2 = (-4,5 - 3,9 + 2,8 + 3,0 - 5,8 - 4,5 + 3,8 + 3,0)/8 = -0,76$

$b_{12} = 0,16$; $b_3 = 0,36$; $b_{13} = -0,21$; $b_{23} = -0,11$

$b_{123} = -0,04 \longrightarrow y = 3,91 - 0,31x_1 - 0,76x_2 + 0,16x_1x_2 +$

$+ 0,36x_3 - 0,21x_1x_3 - 0,11x_2x_3 - 0,04x_1x_2x_3$

2) $t = 2,13$ при $\alpha = 0,95$ и $f = 8(3-1) = 16$ $\quad |b_i| > 2,13\sqrt{0,008} = 0,19$

$y = 3,91 - 0,31x_1 - 0,76x_2 + 0,36x_3 - 0,21x_1x_3$

3) $S^2_{ад} = \dfrac{3}{8-5}\sum_{i=1}^{N}(y_{i3} - \hat{y}_i)^2$

$y_{13} = 4,5$ $\quad \hat{y}_1 = 3,91 - 0,31(-1) - 0,76(-1) + 0,36(-1) -$

$\hat{y}_1 = 4,41$ $\quad - 0,21(-1)(-1) = 3,91 + 0,31 + 0,76 - 0,36 - 0,21$

$S^2_{ад} = 0,324$ $\quad F_p = \dfrac{0,324}{0,2} = 1,62$

$F_{кр} = 3,2$ при $\alpha = 0,95$ $f_{ад} = 8 - 3 = 5$ и $f_y = 8(3-1) = 16$

$1,62 < 3,2 \rightarrow$ ММ адекватна

Рис. 22

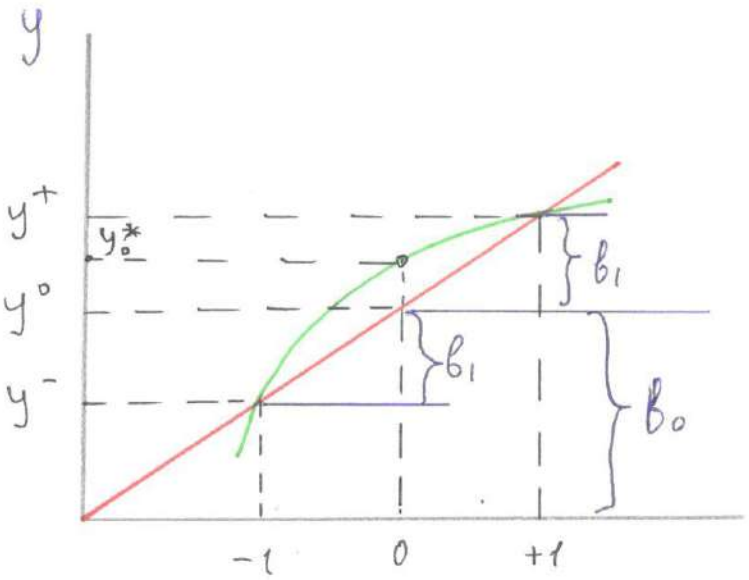


Рис. 23

$$y = b_0 + b_1 x_1 \quad (22)$$

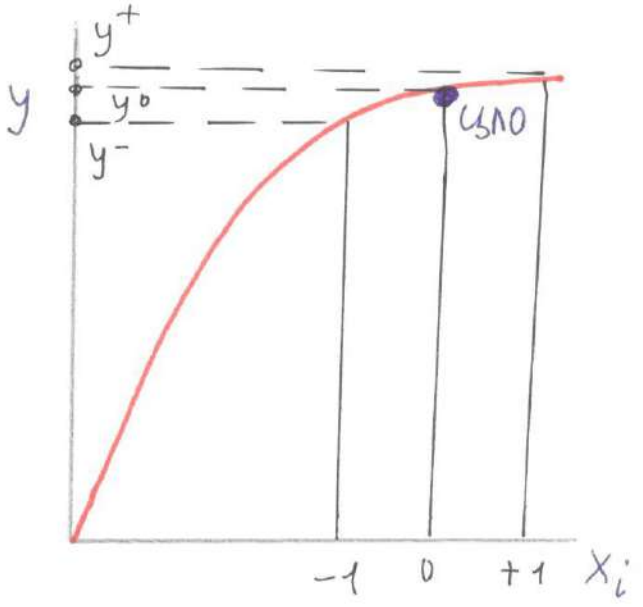
$$\left.\begin{aligned} b_0 &= y^0 \\ b_0 &= y_0^* \end{aligned}\right\}$$

$$|y_0 - b_0| < S^2_{on} \quad (23)$$

$$S^2_{on} = \frac{S^2(y)}{m} \quad (24)$$

$$b_0 = \beta_0 + \Sigma \beta_{ii} \quad (25)$$

$$A = |y_0^* - b_0| \quad (26)$$



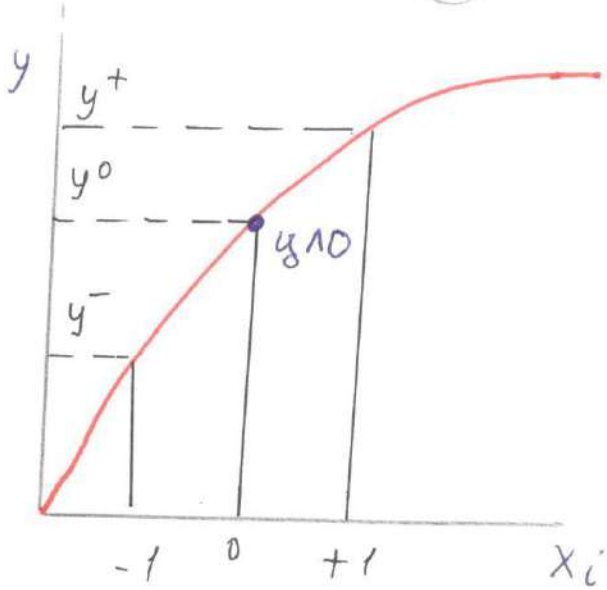
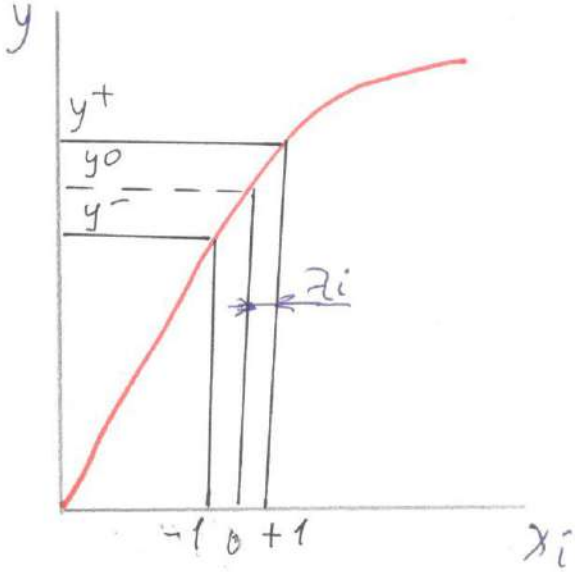


Рис. 24



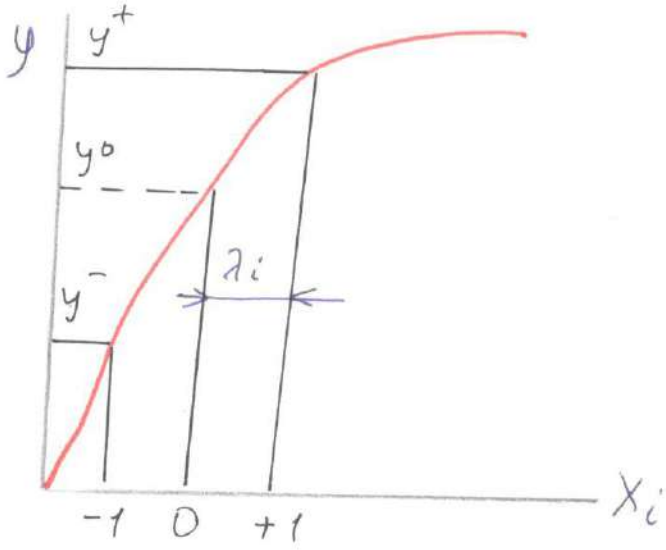


Рис. 25

$$B_i = 2 b_i \quad (27)$$

$$y = b_0 + b_1 x_1 - b_2 x_2 \quad (28)$$

$$y = b_0 + b_1 x_1 - b_2 x_2 + b_{12} x_1 x_2 \quad (29)$$

Модель

Линейная

№	X_1	X_2	$y = 10 + 2x_1 + 3x_2$
1	−	−	$10 - 2 - 3 = 5$
2	+	−	$10 + 2 - 3 = 9$
3	−	+	$10 - 2 + 3 = 11$
4	+	+	$10 + 2 + 3 = 15$

$B_1 = 9 - 5 = 4$

$B_1 = 15 - 11 = 4$

$B_2 = 11 - 5 = 6$

$B_2 = 15 - 9 = 6$

Нелинейная

№	X_1	X_2	$y = 10 + 2x_1 + 3x_2 + x_1 x_2$
1	−	−	$10 - 2 - 3 + 1 = 6$
2	+	−	$10 + 2 - 3 - 1 = 8$
3	−	+	$10 - 2 + 3 - 1 = 10$
4	+	+	$10 + 2 + 3 + 1 = 16$

$X_2 = -1 \quad B_1 = 8 - 6 = 2$

$X_2 = +1 \quad B_1 = 16 - 10 = 6$

$X_1 = -1 \quad B_2 = 10 - 6 = 4$

$X_1 = +1 \quad B_2 = 16 - 8 = 8$

$$\left.\begin{aligned} B_1^- &= 2 \\ B_1^+ &= 6 \end{aligned}\right\} \qquad \left.\begin{aligned} B_2^- &= 4 \\ B_2^+ &= 8 \end{aligned}\right\} \quad (30)$$

$$\left.\begin{aligned} B_1^- &= B_1 - B_{12} = 2(b_1 - b_{12}) \\ B_1^+ &= B_1 + B_{12} = 2(b_1 + b_{12}) \\ B_2^- &= B_2 - B_{12} = 2(b_2 - b_{12}) \\ B_2^+ &= B_2 + B_{12} = 2(b_2 + b_{12}) \end{aligned}\right\} \quad (31)$$

$$B_i^{\mp} = 2(b_i \mp b_{ij}) \quad (32)$$

Рис. 26

$y = 10 + 2x_1 + 3x_2 + x_1x_2$

1

$B_1^- = 2(2-1) = 2$
$B_1^+ = 2(2+1) = 6$
$B_2^- = 2(3-1) = 4$
$B_2^+ = 2(3+1) = 8$

$y = 10 + 2x_1 + 3x_2 - x_1x_2$

2

$B_1^- = 2(2+1) = 6$
$B_1^+ = 2(2-1) = 2$
$B_2^- = 2(3+1) = 8$
$B_2^+ = 2(3-1) = 4$

$y = 10 - 2x_1 - 3x_2 + x_1x_2$

3

$B_1^- = 2(-2-1) = -6$
$B_1^+ = 2(-2+1) = -2$
$B_2^- = 2(-3-1) = -8$
$B_2^+ = 2(-3+1) = -4$

$y = 10 - 2x_1 - 3x_2 - x_1x_2$

4

$B_1^- = 2(-2+1) = -2$
$B_1^+ = 2(-2-1) = -6$
$B_2^- = 2(-3+1) = -4$
$B_2^+ = 2(-3-1) = -8$

$y = 10 - 2x_1 + 3x_2 + x_1x_2$

5

$B_1^- = 2(-2-1) = -6$
$B_1^+ = 2(-2+1) = -2$
$B_2^- = 2(3-1) = 4$
$B_2^+ = 2(3+1) = 8$

$y = 10 - 2x_1 + 3x_2 - x_1x_2$

6

$B_1^- = 2(-2+1) = -2$
$B_1^+ = 2(-2-1) = -6$
$B_2^- = 2(3+1) = 8$
$B_2^+ = 2(3-1) = 4$

$y = 10 - 2x_1 + x_1x_2$

7

$B_1^- = 2(-2-1) = -6$
$B_1^+ = 2(-2+1) = -2$
$B_2^- = 2(0-1) = -2$
$B_2^+ = 2(6+1) = 2$

$y = 10 + 2x_1 + x_1x_2$

8

$B_1^- = 2(+2-1) = 2$
$B_1^+ = 2(+2+1) = 6$
$B_2^- = 2(0-1) = -2$
$B_2^+ = 2(0+1) = 2$

$y = 10 + 2x_1 - x_1x_2$

9

$B_1^- = 2(2+1) = 6$
$B_1^+ = 2(2-1) = 2$
$B_2^- = 2(0+1) = 2$
$B_2^+ = 2(0-1) = -2$

$y = 10 - 2x_1 - x_1x_2$

10

$B_1^- = 2(-2+1) = -2$
$B_1^+ = 2(-2-1) = -6$
$B_2^- = 2(0+1) = 2$
$B_2^+ = 2(0-1) = -2$

$y = 10 + x_1x_2$

11

$B_1^- = 2(0-1) = -2$
$B_1^+ = 2(0+1) = 2$
$B_2^- = 2(0-1) = -2$
$B_2^+ = 2(0+1) = 2$

$y = 10 - x_1x_2$

12

$B_1^- = 2(0+1) = 2$
$B_1^+ = 2(0-1) = -2$
$B_2^- = 2(0+1) = 2$
$B_2^+ = 2(0-1) = -2$

1. $\bar{X}_{i\,min} \ldots \bar{X}_{i\,max}$

2. $\bar{X}_i^0 = \frac{1}{2}\left(\bar{X}_{max} - \bar{X}_{i\,min}\right)$

$\bar{\lambda}_i = \bar{X}_i^0 - \bar{X}_{i\,min} = \bar{X}_{i\,max} - \bar{X}_i^0$

$X_i' = \dfrac{\bar{X}_i - \bar{X}_i^0}{\bar{\lambda}_i}$

3.

№	X_1	X_2	. . . . .	X_n	y_i
1	−	−		−	y_1
2	+	−		−	y_2
⋮	⋮	⋮	. . . . .	⋮	⋮
N	+	+		+	y_N

4. $y = b_0 + b_1 x_1 + b_2 x_2 + b_{12} x_1 x_2 + \ldots \; b_{12\ldots n} x_1 x_2 \ldots x_n$

5. $b_0 = \frac{1}{N} \sum_1^N y_i$

$b_1 = \frac{1}{N}\left[-y_1 + y_2 - y_3 + \ldots + y_N\right]$

. . . . . .

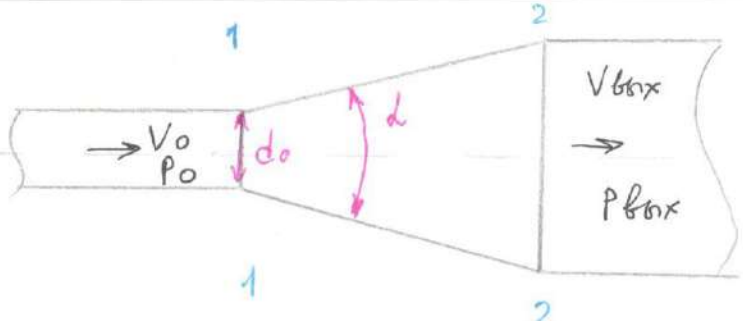
. . . . . .

6 $B_1^- = ?$ $B_1^+ = ?$ $B_2^- = ?$ $B_2^+ = ?$

$B_1^- = ?$ $B_1^+ = ?$ $B_3^- = ?$ $B_3^+ = ?$

. . . . . .

Рис. 28



1 – 1	2 – 2
S_1	S_2
V_0	$V_{вых}$
P_0	$P_{вых}$
E_1	E_2

$$E_1 = E_2 = P_0 + \rho\frac{V_0^2}{2} = P_{вых} + \rho\frac{V_{вых}^2}{2} + \Delta P_r \quad (33)$$

$$\Delta P_r = \xi_\varphi \rho\frac{V_0^2}{2} \quad (34) \qquad \xi_\varphi = \varphi(\alpha, m, Re) \quad (35)$$

$$m = \frac{S_1}{S_2}\ ;\ Re = \frac{V_0 d_0}{\mu} \quad (36)$$

$Re \cdot 10^5$	α, град				
	4	6	8	10	12
			$m = 0{,}5$		
0,5	0,135	0,121	0,112	0,107	0,109
1,0	0,106	0,090	0,083	0,080	0,088
2,0	0,082	0,070	0,068	0,062	0,062

$Re \cdot 10^5$	α, град.				
	4	6	8	10	12
			$m = 0{,}25$		
0,5	0,197	0,165	0,151	0,157	0,174
1,0	0,154	0,126	0,119	0,120	0,131
2,0	0,120	0,101	0,096	0,096	0,107

$\alpha = 6 \ldots 10^\circ$ $\quad m = 0{,}25 \ldots 0{,}50$ $\quad Re = 0{,}5 \cdot 10^5 \ldots 1{,}0 \cdot 10^5$

№	$x_1 = \alpha$	$x_2 = m$	$x_3 = Re$	$y = \xi_\varphi$
1	–	–	–	0,165
2	+	–	–	0,157
3	–	+	–	0,121
4	+	+	–	0,107
5	–	–	+	0,126
6	+	–	+	0,120
7	–	+	+	0,090
8	+	+	+	0,080

$\bar{x}_1^0 = (6+10)/2 = 8^\circ$

$\bar{x}_2^0 = (0{,}25 + 0{,}5)/2 = 0{,}375$

$\bar{x}_3^0 = (0{,}5 + 1)/2 = 0{,}75 \cdot 10^5$

$\bar{\lambda}_1 = 2^\circ \quad \bar{\lambda}_2 = 0{,}125$

$\bar{\lambda}_3 = 0{,}125 \cdot 10^5$

$$\alpha = \frac{\bar{\alpha} - 8}{2} = x_1 \qquad m = \frac{\bar{m} - 0{,}375}{0{,}125} = x_2 \qquad Re = \frac{\bar{Re} - 0{,}75}{0{,}25} = x_3$$

$b_0 = 0{,}121 \quad b_2 = -0{,}021 \quad b_3 = -0{,}017 \quad b_{23} = 0{,}002$

$b_1 = -0{,}005 \quad b_{12} = -0{,}001 \quad b_{13} = 0{,}001 \quad b_{123} = 0$

$$\xi_\varphi = 0{,}121 - 0{,}005\alpha - 0{,}021 m - 0{,}001\alpha m - 0{,}017 Re + 0{,}001\alpha Re + 0{,}002 m Re \quad (37)$$

Рис. 29