

ПФЭ(Полный факторный эксперимент)

$$N=p^n$$

$$x_i = \frac{\tilde{x}_i - \tilde{x}_i^*}{\Delta\tilde{x}_i}$$

$$\Delta\tilde{x}_i = \frac{\tilde{x}_{i\max} - \tilde{x}_{i\min}}{2}$$

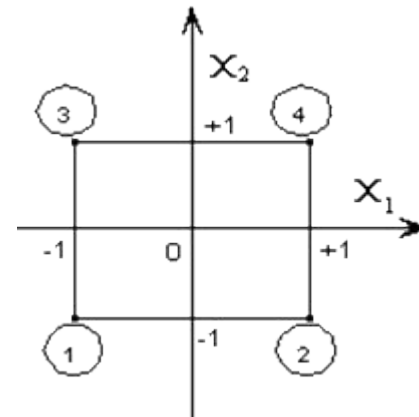
$$y = b_0 + b_1x_1 + b_2x_2 + b_{12}x_1x_2$$

$$y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_{12}x_1x_2 + b_{13}x_1x_3 + b_{23}x_2x_3 + b_{123}x_1x_2x_3$$

Планирование

Матрица планирования

| N | x_0 | x_1 | x_2 | $x_1 x_2$ | Целевая функция | |
|-----|-------|-------|-------|-----------|-----------------|----------|
| | | | | | y_{1u} | y_{2u} |
| 1 | +1 | -1 | -1 | +1 | y_{11} | y_{21} |
| 2 | +1 | +1 | -1 | -1 | y_{12} | y_{22} |
| 3 | +1 | -1 | +1 | -1 | y_{13} | y_{23} |
| 4 | +1 | +1 | +1 | +1 | y_{14} | y_{24} |



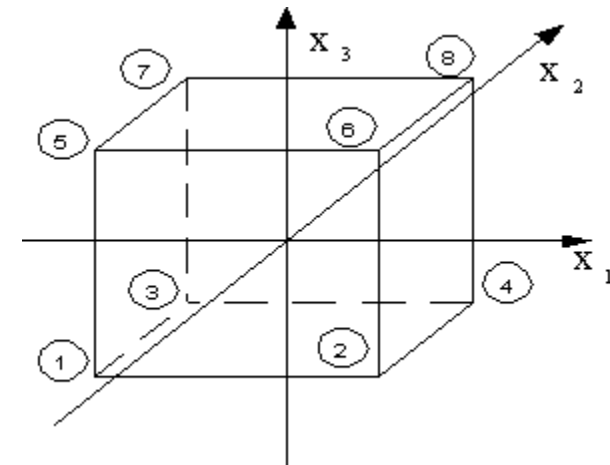
Геометрическое отображение
плана ПФЭ 2^2 в факторном
пространстве

Планирование

Матрица планирования

| N | x_0 | x_1 | x_2 | x_3 | x_1x_2 | x_1x_3 | x_2x_3 | $x_1x_2x_3$ | Y |
|-----------------------|-------|-------|-------|-------|----------|----------|----------|-------------|-------|
| 1 | 1 | -1 | -1 | -1 | +1 | +1 | +1 | -1 | Y_1 |
| 2 | 1 | +1 | -1 | -1 | -1 | -1 | +1 | +1 | Y_2 |
| 3 | 1 | -1 | +1 | -1 | -1 | +1 | -1 | +1 | Y_3 |
| 4 | 1 | +1 | +1 | -1 | +1 | -1 | -1 | -1 | Y_4 |
| 5 | 1 | -1 | -1 | +1 | +1 | -1 | -1 | +1 | Y_5 |
| 6 | 1 | +1 | -1 | +1 | -1 | +1 | -1 | -1 | Y_6 |
| 7 | 1 | -1 | +1 | +1 | -1 | -1 | +1 | -1 | Y_7 |
| 8 | 1 | +1 | +1 | +1 | +1 | +1 | +1 | +1 | Y_8 |
| $\sum_{v=1}^N x_{iv}$ | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

$$\bar{y}_u = \frac{\sum_{l=1}^m y_{lu}}{m}$$



Геометрическое
отображение плана ПФЭ
 2^3 в факторном
пространстве

Проверка воспроизводимости

$$S_u^2 = \frac{\sum_{l=1}^m (y_{l_u} - \bar{y}_u)^2}{m-1}$$

$$f=m-1$$

$$G = \frac{S_{u \max}^2}{\sum_{u=1}^N S_u^2}$$

$$f_1=m-1 \text{ и } f_2=N$$

$$S^2\{y\} = \frac{\sum_{u=1}^N S_u^2}{N}$$

Проверка статистической значимости выборочных коэффициентов регрессии

$$b_0 = \frac{\sum_{u=1}^N \bar{y}_u}{N}; \quad b_i = \frac{\sum_{u=1}^N x_{i_u} \bar{y}_u}{N}$$

$$t_i = \frac{|b_i|}{S\{b_i\}}$$

$$b_{ij} = \frac{\sum_{u=1}^N x_{u_i} x_{u_j} \bar{y}_u}{N}$$

$$f = N(m-1)$$

$$\Delta b_i = \pm t_i S\{b_i\}$$

$$S^2\{b_i\} = \frac{S^2\{y\}}{Nm}$$

Значения t для различных уровней значимости

| Число степеней свободы f | Уровни значимости | | | | |
|----------------------------|-------------------|-------|-------|-------|--------|
| | 0,10 | 0,05 | 0,02 | 0,01 | 0,001 |
| 1 | 6,31 | 12,71 | 31,82 | 63,66 | 636,62 |
| 2 | 2,92 | 4,30 | 6,97 | 9,93 | 31,60 |
| 3 | 2,23 | 3,18 | 4,54 | 5,84 | 12,94 |
| 4 | 2,13 | 2,78 | 3,75 | 4,60 | 8,61 |
| 5 | 2,02 | 2,57 | 3,37 | 4,03 | 6,86 |
| 6 | 1,94 | 2,45 | 3,14 | 3,71 | 5,96 |
| 7 | 1,90 | 2,37 | 3,00 | 3,50 | 5,41 |
| 8 | 1,86 | 2,31 | 2,90 | 3,36 | 5,04 |
| 9 | 1,83 | 2,26 | 2,82 | 3,25 | 4,78 |
| 10 | 1,81 | 2,23 | 2,76 | 3,17 | 4,59 |
| 11 | 1,80 | 2,20 | 2,72 | 3,11 | 4,44 |
| 12 | 1,78 | 2,18 | 2,68 | 3,06 | 4,32 |
| 13 | 1,77 | 2,16 | 2,65 | 3,01 | 4,22 |
| 14 | 1,76 | 2,15 | 2,62 | 2,98 | 4,14 |
| 15 | 1,75 | 2,13 | 2,60 | 2,95 | 4,07 |
| 16 | 1,75 | 2,12 | 2,58 | 2,92 | 4,02 |
| 17 | 1,74 | 2,11 | 2,57 | 2,90 | 3,97 |
| 18 | 1,73 | 2,10 | 2,55 | 2,88 | 3,92 |
| 19 | 1,73 | 2,09 | 2,54 | 2,86 | 3,88 |
| 20 | 1,73 | 2,09 | 2,53 | 2,85 | 3,85 |
| 21 | 1,72 | 2,08 | 2,52 | 2,83 | 3,82 |
| 22 | 1,72 | 2,07 | 2,51 | 2,82 | 3,79 |
| 23 | 1,71 | 2,07 | 2,50 | 2,81 | 3,77 |
| 24 | 1,71 | 2,06 | 2,49 | 2,80 | 3,75 |
| 25 | 1,71 | 2,06 | 2,48 | 2,79 | 3,73 |
| 26 | 1,71 | 2,06 | 2,48 | 2,78 | 3,71 |
| 27 | 1,70 | 2,05 | 2,47 | 2,77 | 3,69 |
| 28 | 1,70 | 2,05 | 2,47 | 2,76 | 3,67 |
| 29 | 1,70 | 2,04 | 2,46 | 2,76 | 3,66 |
| 30 | 1,70 | 2,04 | 2,46 | 2,75 | 3,65 |
| 40 | 1,68 | 2,02 | 2,42 | 2,70 | 3,55 |
| 60 | 1,67 | 2,00 | 2,39 | 2,66 | 3,46 |
| 120 | 1,66 | 1,98 | 2,36 | 2,62 | 3,37 |
| ∞ | 1,65 | 1,96 | 2,33 | 2,58 | 3,29 |

Проверка адекватности

$$S_{ad}^2 = \frac{m}{N-d} \sum_{u=1}^N (\bar{y}_u - \hat{y}_u)^2$$

$$F = \frac{S_{ad}^2}{S^2\{y\}}$$

$$f_1 = f_{ad} = N-d$$

$$f_2 = N(m-1)$$

Значения F-критерия