## Лабораторная работа №7.

## Преобразование данных по методу главных компонент.

Имеются данные измерений двух признаков  $X_1$  и  $X_2$ :

| $X_1$  | $X_2$                                 | $X_1$ | $X_2$ |
|--------|---------------------------------------|-------|-------|
| -4,36  | -5,64                                 | 12,25 | 6,27  |
| 6,36   | -3,64                                 | 5,66  | 18,22 |
| 8,36   | 7,36                                  | 14,28 | 5,64  |
| 6,36   | 3,36                                  | 13,27 | 7,27  |
| -7,44  | 6,9                                   | -9,4  | 9,64  |
| 13,86  | 13,12                                 | -6,23 | 8,61  |
| 4,81   | -4,82                                 | -6,4  | 8,67  |
| 5,82   | -2,83                                 |       |       |
| 3,85   | -1,58                                 |       |       |
| 5,48   | 9,81                                  |       |       |
| 1,8    | 9,88                                  |       |       |
| -7,32  | 8,22                                  |       |       |
| -7,25  | -9,14                                 |       |       |
| -2,27  | -9,25                                 |       |       |
| -8,82  | -9,41                                 |       |       |
| -5,32  | 8,22                                  |       |       |
| -11,83 | 12,88                                 |       |       |
| -10,28 | 3,78                                  |       |       |
| -10,86 | 14,89                                 |       |       |
| -13,88 | 19,12                                 |       |       |
| -11,12 | 11,19                                 |       |       |
| -7,15  | 8,45                                  |       |       |
| 12,62  | 5,12                                  |       |       |
| 17,18  | 11,85                                 |       |       |
| 10,12  | 8,53                                  |       |       |
| 5,18   | 16,22                                 |       |       |
| -5,29  | 7,81                                  |       |       |
| -3,92  | 11,82                                 |       |       |
| -6,26  | 10,38                                 |       |       |
| -6,72  | 4,28                                  |       |       |
| 5,38   | 2,84                                  |       |       |
| 3,81   | 4,55                                  |       |       |
| 4,22   | 9,62                                  |       |       |
| 5,32   | 2,92                                  |       |       |
| 6,28   | 12,28                                 |       |       |
| ·      | · · · · · · · · · · · · · · · · · · · |       |       |

1. Рассчитаем выборочное среднее для каждого признака:

$$\bar{x_{\scriptscriptstyle B}} = \sum_{i=1}^m \frac{n_i * x_i}{N}$$

$$\overline{x_{\text{B1}}} = 0.62, \overline{x_{\text{B2}}} = 6.71;$$

2. Рассчитаем дисперсию для каждого признака:

$$D(x_i) = \frac{\sum_{i=1}^{m} (x_i - \overline{x_{Bi}})^2}{N-1}$$

$$D(x_1) = 67, D(x_2) = 18;$$

- 3. Рассчитаем корреляцию по формуле:  $K(x_1; x_2) = \frac{\sum_{i=1}^m (x_{1i} x_{1B}) * (x_{2i} x_{2B})}{N-1}$   $K(x_1; x_2) = 11$
- 4. Составим ковариационную матрицу:

$$[\Sigma] = \begin{bmatrix} 67 & 11 \\ 11 & 18 \end{bmatrix}$$

5. Вычислим собственные значения и соответствующие им собственные векторы ковариационной матрицы:

$$\begin{bmatrix} 67 - \lambda & 11 \\ 11 & 18 - \lambda \end{bmatrix} = (67 - \lambda) * (18 - \lambda) - (11) * (11) = \lambda_1 = 69.5; \quad \lambda_2 = 15.5;$$

при  $\lambda_1$  имеем:

$$\begin{bmatrix} -2.5 & 11 \\ 11 & -51.5 \end{bmatrix} * \begin{bmatrix} B1_1 \\ B1_2 \end{bmatrix} = 0 \Rightarrow \begin{cases} -2.5B1_1 + 11B1_2 = 0 \\ 11B1_1 - 51.5B1_2 = 0 \end{cases}$$

$$B1_2 = C; B1_1 = 4.68B1_2; |B1| = (C; 4.68C)$$

$$|B1| = \sqrt{C^2 + 21.92C^2} = 4.79C;$$

$$B01_2 = \frac{B1_2}{|B1|} = \frac{C}{4.79C} = 0.21;$$

$$B01_1 = \frac{B1_1}{|B1|} = \frac{4.68C}{4.79C} = 0.98;$$

$$B01 = \begin{pmatrix} 0.98 \\ 0.21 \end{pmatrix};$$

При  $\lambda_2$  имеем:

$$\begin{bmatrix} 51,5 & 11 \\ 11 & 2,5 \end{bmatrix} * \begin{bmatrix} B2_1 \\ B2_2 \end{bmatrix} = 0 \Rightarrow \begin{cases} 51,5B2_1 + 11B2_2 = 0 \\ 11B2_1 + 2,5B2_2 = 0 \end{cases}$$

$$B2_2 = -0,48B2_1; B2_1 = C; |B2| = (-4,68C; C)$$

$$|B2| = \sqrt{C^2 + 21,90C^2} = 4,79C;$$

$$B02_1 = \frac{B2_1}{|B2|} = \frac{C}{4,79C} = 0,21;$$

$$B02_2 = \frac{B2_2}{|B2|} = \frac{-4,68C}{4,79C} = -0,98;$$

$$B02 = \begin{pmatrix} 0,2 \\ -0,98 \end{pmatrix};$$

$$tg\alpha = \frac{0,21}{0,98}; tg\beta = \frac{-0,98}{0,21};$$

$$\alpha = 12; \beta = 78;$$

6. Сумма собственных значений равна следу матрицы:  $\lambda 1 + \lambda 2 = 69,5 + 15,5 = 85$ ; D(x1) + D(x2) = 67 + 18 = 85

Таким образом, вклад переменной x1 в общую дисперсию (69,5/85)100=81,8 %, а вклад второй переменной x2 - (15,5/85)100=18,2 %.

С другой стороны, главные оси эллипса также характеризуют суммарную дисперсию, следовательно: первая главная ось составляет (67/85)100=78,8% суммарной дисперсии, а вторая главная ось эллипса (18/85)100=21,2%.

Таким образом, главная ось эллипса учитывает чуть большую часть изменчивости множества данных.

Угол поворота новых осей координат по отношению к старой определяется из координат собственных векторов:

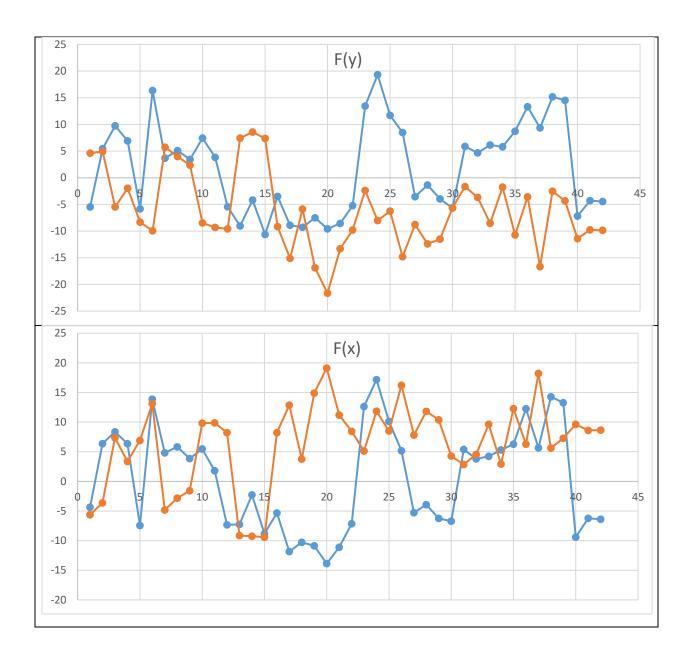
$$B1_1 = sin\alpha = 0.21/1 = 0.21$$
  
 $B1_2 = cos\alpha = 0.98$ ;  
 $B2_1 = sin\beta = -0.98$ ;  
 $B2_2 = cos\beta = 0.21$ ;

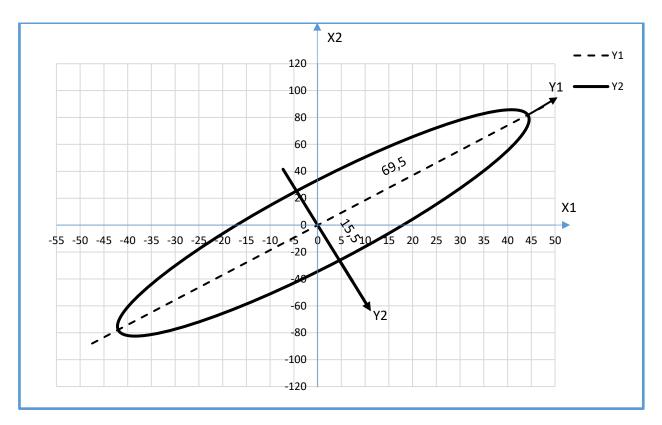
Если сделаем преобразование вида:

$$Y_1 = B1_1x_1 + B1_2x_2;$$
  
 $Y_1 = 0.98x_1 + 0.21x_2;$   
 $Y_2 = B2_1x_1 + B2_2x_2;$ 

 $Y_2 = 0.21x_1 - 0.98x_2;$ 

| Y1         Y2           -5,4572         4,6116           5,4684         4,9028           9,7384         -5,4572           6,9384         -1,9572           -5,8422         -8,3244           16,338         -9,947           3,7016         5,7337           5,1093         3,9956           3,4412         2,3569           7,4305         -8,463           3,8388         -9,3044           -5,4474         -9,5928           -9,0244         7,4347           -4,1671         8,5883           -10,6197         7,3696           -3,4874         -9,1728           -8,8886         -15,1067           -9,2806         -5,8632           -7,5159         -16,8728           -9,5872         -21,6524           -8,5477         -13,3014           -5,2325         -9,7825           13,4428         -2,3674           19,3249         -8,0052           11,7089         -6,2342           8,4826         -14,8078           -3,955         -11,487           -5,6868         -5,6056           5,8688         -1,6534  |          |          |  |
|--|----------|----------|--|
| 5,4684         4,9028           9,7384         -5,4572           6,9384         -1,9572           -5,8422         -8,3244           16,338         -9,947           3,7016         5,7337           5,1093         3,9956           3,4412         2,3569           7,4305         -8,463           3,8388         -9,3044           -5,4474         -9,5928           -9,0244         7,4347           -4,1671         8,5883           -10,6197         7,3696           -3,4874         -9,1728           -8,8886         -15,1067           -9,2806         -5,8632           -7,5159         -16,8728           -9,5872         -21,6524           -8,5477         -13,3014           -5,2325         -9,7825           13,4428         -2,3674           19,3249         -8,0052           11,7089         -6,2342           8,4826         -14,8078           -3,955         -11,487           -5,6868         -5,6056           5,8688         -1,6534           4,6893         -3,6589           6,1558         -8,5414                                       | YI       | Y2       |  |
| 9,7384         -5,4572           6,9384         -1,9572           -5,8422         -8,3244           16,338         -9,947           3,7016         5,7337           5,1093         3,9956           3,4412         2,3569           7,4305         -8,463           3,8388         -9,3044           -5,4474         -9,5928           -9,0244         7,4347           -4,1671         8,5883           -10,6197         7,3696           -3,4874         -9,1728           -8,8886         -15,1067           -9,2806         -5,8632           -7,5159         -16,8728           -9,5872         -21,6524           -8,5477         -13,3014           -5,2325         -9,7825           13,4428         -2,3674           19,3249         -8,0052           11,7089         -6,2342           8,4826         -14,8078           -3,955         -11,487           -5,6868         -1,6534           4,6893         -3,6589           6,1558         -8,5414           5,8268         -1,7444           8,7332         -10,7156                                     | -5,4572  | 4,6116   |  |
| 6,9384         -1,9572           -5,8422         -8,3244           16,338         -9,947           3,7016         5,7337           5,1093         3,9956           3,4412         2,3569           7,4305         -8,463           3,8388         -9,3044           -5,4474         -9,5928           -9,0244         7,4347           -4,1671         8,5883           -10,6197         7,3696           -3,4874         -9,1728           -8,8886         -15,1067           -9,2806         -5,8632           -7,5159         -16,8728           -9,5872         -21,6524           -8,5477         -13,3014           -5,2325         -9,7825           13,4428         -2,3674           19,3249         -8,0052           11,7089         -6,2342           8,4826         -14,8078           -3,5441         -8,7647           -1,3594         -12,4068           -3,955         -11,487           -5,6868         -5,6056           5,8688         -1,6534           4,6893         -3,6589           6,1558         -8,5414 <td>5,4684</td> <td>4,9028</td>   | 5,4684   | 4,9028   |  |
| -5,8422 -8,3244  16,338 -9,947  3,7016 5,7337  5,1093 3,9956  3,4412 2,3569  7,4305 -8,463  3,8388 -9,3044  -5,4474 -9,5928  -9,0244 7,4347  -4,1671 8,5883  -10,6197 7,3696  -3,4874 -9,1728  -8,8886 -15,1067  -9,2806 -5,8632  -7,5159 -16,8728  -9,5872 -21,6524  -8,5477 -13,3014  -5,2325 -9,7825  13,4428 -2,3674  19,3249 -8,0052  11,7089 -6,2342  8,4826 -14,8078  -3,5441 -8,7647  -1,3594 -12,4068  -3,955 -11,487  -5,6868 -5,6056  5,8688 -1,6534  4,6893 -3,6589  6,1558 -8,5414  5,8268 -1,7444  8,7332 -10,7156  13,3217 -3,5721  9,373 -16,667  15,1788 -2,5284  14,5313 -4,3379  -7,1876 -11,4212  -4,2973 -9,7461  | 9,7384   | -5,4572  |  |
| 16,338         -9,947           3,7016         5,7337           5,1093         3,9956           3,4412         2,3569           7,4305         -8,463           3,8388         -9,3044           -5,4474         -9,5928           -9,0244         7,4347           -4,1671         8,5883           -10,6197         7,3696           -3,4874         -9,1728           -8,8886         -15,1067           -9,2806         -5,8632           -7,5159         -16,8728           -9,5872         -21,6524           -8,5477         -13,3014           -5,2325         -9,7825           13,4428         -2,3674           19,3249         -8,0052           11,7089         -6,2342           8,4826         -14,8078           -3,5441         -8,7647           -1,3594         -12,4068           -3,955         -11,487           -5,6868         -5,6056           5,8688         -1,6534           4,6893         -3,6589           6,1558         -8,5414           5,8268         -1,7144           8,7332         -10,7156 <td>6,9384</td> <td>-1,9572</td>  | 6,9384   | -1,9572  |  |
| 3,7016         5,7337           5,1093         3,9956           3,4412         2,3569           7,4305         -8,463           3,8388         -9,3044           -5,4474         -9,5928           -9,0244         7,4347           -4,1671         8,5883           -10,6197         7,3696           -3,4874         -9,1728           -8,8886         -15,1067           -9,2806         -5,8632           -7,5159         -16,8728           -9,5872         -21,6524           -8,5477         -13,3014           -5,2325         -9,7825           13,4428         -2,3674           19,3249         -8,0052           11,7089         -6,2342           8,4826         -14,8078           -3,5441         -8,7647           -1,3594         -12,4068           -3,955         -11,487           -5,6868         -5,6056           5,8688         -1,6534           4,6893         -3,6589           6,1558         -8,5414           5,8268         -1,7146           13,3217         -3,5721           9,373         -16,667 <td>-5,8422</td> <td>-8,3244</td> | -5,8422  | -8,3244  |  |
| 5,1093         3,9956           3,4412         2,3569           7,4305         -8,463           3,8388         -9,3044           -5,4474         -9,5928           -9,0244         7,4347           -4,1671         8,5883           -10,6197         7,3696           -3,4874         -9,1728           -8,8886         -15,1067           -9,2806         -5,8632           -7,5159         -16,8728           -9,5872         -21,6524           -8,5477         -13,3014           -5,2325         -9,7825           13,4428         -2,3674           19,3249         -8,0052           11,7089         -6,2342           8,4826         -14,8078           -3,5441         -8,7647           -1,3594         -12,4068           -3,955         -11,487           -5,6868         -5,6056           5,8688         -1,6534           4,6893         -3,6589           6,1558         -8,5414           5,8268         -1,7444           8,7332         -10,7156           13,3217         -3,5721           9,373         -16,667<                                | 16,338   | -9,947   |  |
| 3,4412         2,3569           7,4305         -8,463           3,8388         -9,3044           -5,4474         -9,5928           -9,0244         7,4347           -4,1671         8,5883           -10,6197         7,3696           -3,4874         -9,1728           -8,8886         -15,1067           -9,2806         -5,8632           -7,5159         -16,8728           -9,5872         -21,6524           -8,5477         -13,3014           -5,2325         -9,7825           13,4428         -2,3674           19,3249         -8,0052           11,7089         -6,2342           8,4826         -14,8078           -3,5441         -8,7647           -1,3594         -12,4068           -3,955         -11,487           -5,6868         -5,6056           5,8688         -1,6534           4,6893         -3,6589           6,1558         -8,5414           5,8268         -1,7156           13,3217         -3,5721           9,373         -16,667           15,1788         -2,5284           14,5313         -4,337                                | 3,7016   | 5,7337   |  |
| 7,4305 -8,463 3,8388 -9,3044 -5,4474 -9,5928 -9,0244 7,4347 -4,1671 8,5883 -10,6197 7,3696 -3,4874 -9,1728 -8,8886 -15,1067 -9,2806 -5,8632 -7,5159 -16,8728 -9,5872 -21,6524 -8,5477 -13,3014 -5,2325 -9,7825 13,4428 -2,3674 19,3249 -8,0052 11,7089 -6,2342 8,4826 -14,8078 -3,5441 -8,7647 -1,3594 -12,4068 -3,955 -11,487 -5,6868 -5,6056 5,8688 -1,6534 4,6893 -3,6589 6,1558 -8,5414 5,8268 -1,7444 8,7332 -10,7156 13,3217 -3,5721 9,373 -16,667 15,1788 -2,5284 14,5313 -4,3379 -7,1876 -11,4212 -4,2973 -9,7461  | 5,1093   | 3,9956   |  |
| 3,8388         -9,3044           -5,4474         -9,5928           -9,0244         7,4347           -4,1671         8,5883           -10,6197         7,3696           -3,4874         -9,1728           -8,8886         -15,1067           -9,2806         -5,8632           -7,5159         -16,8728           -9,5872         -21,6524           -8,5477         -13,3014           -5,2325         -9,7825           13,4428         -2,3674           19,3249         -8,0052           11,7089         -6,2342           8,4826         -14,8078           -3,5441         -8,7647           -1,3594         -12,4068           -3,955         -11,487           -5,6868         -5,6056           5,8688         -1,6534           4,6893         -3,6589           6,1558         -8,5414           5,8268         -1,7444           8,7332         -10,7156           13,3217         -3,5721           9,373         -16,667           15,1788         -2,5284           14,5313         -4,3379           -7,1876         -1                                | 3,4412   | 2,3569   |  |
| -5,4474 -9,5928 -9,0244 7,4347 -4,1671 8,5883 -10,6197 7,3696 -3,4874 -9,1728 -8,8886 -15,1067 -9,2806 -5,8632 -7,5159 -16,8728 -9,5872 -21,6524 -8,5477 -13,3014 -5,2325 -9,7825 13,4428 -2,3674 19,3249 -8,0052 11,7089 -6,2342 8,4826 -14,8078 -3,5441 -8,7647 -1,3594 -12,4068 -3,955 -11,487 -5,6868 -5,6056 5,8688 -1,6534 4,6893 -3,6589 6,1558 -8,5414 5,8268 -1,7444 8,7332 -10,7156 13,3217 -3,5721 9,373 -16,667 15,1788 -2,5284 14,5313 -4,3379 -7,1876 -11,4212 -4,2973 -9,7461   | 7,4305   | -8,463   |  |
| -9,0244 7,4347  -4,1671 8,5883  -10,6197 7,3696  -3,4874 -9,1728  -8,8886 -15,1067  -9,2806 -5,8632  -7,5159 -16,8728  -9,5872 -21,6524  -8,5477 -13,3014  -5,2325 -9,7825  13,4428 -2,3674  19,3249 -8,0052  11,7089 -6,2342  8,4826 -14,8078  -3,5441 -8,7647  -1,3594 -12,4068  -3,955 -11,487  -5,6868 -5,6056  5,8688 -1,6534  4,6893 -3,6589  6,1558 -8,5414  5,8268 -1,7444  8,7332 -10,7156  13,3217 -3,5721  9,373 -16,667  15,1788 -2,5284  14,5313 -4,3379  -7,1876 -11,4212  -4,2973 -9,7461   | 3,8388   | -9,3044  |  |
| -4,1671         8,5883           -10,6197         7,3696           -3,4874         -9,1728           -8,8886         -15,1067           -9,2806         -5,8632           -7,5159         -16,8728           -9,5872         -21,6524           -8,5477         -13,3014           -5,2325         -9,7825           13,4428         -2,3674           19,3249         -8,0052           11,7089         -6,2342           8,4826         -14,8078           -3,5441         -8,7647           -1,3594         -12,4068           -3,955         -11,487           -5,6868         -5,6056           5,8688         -1,6534           4,6893         -3,6589           6,1558         -8,5414           5,8268         -1,7444           8,7332         -10,7156           13,3217         -3,5721           9,373         -16,667           15,1788         -2,5284           14,5313         -4,3379           -7,1876         -11,4212           -4,2973         -9,7461  | -5,4474  | -9,5928  |  |
| -10,6197 7,3696  -3,4874 -9,1728  -8,8886 -15,1067  -9,2806 -5,8632  -7,5159 -16,8728  -9,5872 -21,6524  -8,5477 -13,3014  -5,2325 -9,7825  13,4428 -2,3674  19,3249 -8,0052  11,7089 -6,2342  8,4826 -14,8078  -3,5441 -8,7647  -1,3594 -12,4068  -3,955 -11,487  -5,6868 -5,6056  5,8688 -1,6534  4,6893 -3,6589  6,1558 -8,5414  5,8268 -1,7444  8,7332 -10,7156  13,3217 -3,5721  9,373 -16,667  15,1788 -2,5284  14,5313 -4,3379  -7,1876 -11,4212  -4,2973 -9,7461   | -9,0244  | 7,4347   |  |
| -3,4874 -9,1728 -8,8886 -15,1067 -9,2806 -5,8632 -7,5159 -16,8728 -9,5872 -21,6524 -8,5477 -13,3014 -5,2325 -9,7825 13,4428 -2,3674 19,3249 -8,0052 11,7089 -6,2342 8,4826 -14,8078 -3,5441 -8,7647 -1,3594 -12,4068 -3,955 -11,487 -5,6868 -5,6056 5,8688 -1,6534 4,6893 -3,6589 6,1558 -8,5414 5,8268 -1,7444 8,7332 -10,7156 13,3217 -3,5721 9,373 -16,667 15,1788 -2,5284 14,5313 -4,3379 -7,1876 -11,4212 -4,2973 -9,7461   | -4,1671  | 8,5883   |  |
| -8,8886 -15,1067  -9,2806 -5,8632  -7,5159 -16,8728  -9,5872 -21,6524  -8,5477 -13,3014  -5,2325 -9,7825  13,4428 -2,3674  19,3249 -8,0052  11,7089 -6,2342  8,4826 -14,8078  -3,5441 -8,7647  -1,3594 -12,4068  -3,955 -11,487  -5,6868 -5,6056  5,8688 -1,6534  4,6893 -3,6589  6,1558 -8,5414  5,8268 -1,7444  8,7332 -10,7156  13,3217 -3,5721  9,373 -16,667  15,1788 -2,5284  14,5313 -4,3379  -7,1876 -11,4212  -4,2973 -9,7461   | -10,6197 | 7,3696   |  |
| -9,2806 -5,8632  -7,5159 -16,8728  -9,5872 -21,6524  -8,5477 -13,3014  -5,2325 -9,7825  13,4428 -2,3674  19,3249 -8,0052  11,7089 -6,2342  8,4826 -14,8078  -3,5441 -8,7647  -1,3594 -12,4068  -3,955 -11,487  -5,6868 -5,6056  5,8688 -1,6534  4,6893 -3,6589  6,1558 -8,5414  5,8268 -1,7444  8,7332 -10,7156  13,3217 -3,5721  9,373 -16,667  15,1788 -2,5284  14,5313 -4,3379  -7,1876 -11,4212  -4,2973 -9,7461   | -3,4874  | -9,1728  |  |
| -7,5159 -16,8728 -9,5872 -21,6524 -8,5477 -13,3014 -5,2325 -9,7825 13,4428 -2,3674 19,3249 -8,0052 11,7089 -6,2342 8,4826 -14,8078 -3,5441 -8,7647 -1,3594 -12,4068 -3,955 -11,487 -5,6868 -5,6056 5,8688 -1,6534 4,6893 -3,6589 6,1558 -8,5414 5,8268 -1,7444 8,7332 -10,7156 13,3217 -3,5721 9,373 -16,667 15,1788 -2,5284 14,5313 -4,3379 -7,1876 -11,4212 -4,2973 -9,7461  | -8,8886  | -15,1067 |  |
| -9,5872 -21,6524  -8,5477 -13,3014  -5,2325 -9,7825  13,4428 -2,3674  19,3249 -8,0052  11,7089 -6,2342  8,4826 -14,8078  -3,5441 -8,7647  -1,3594 -12,4068  -3,955 -11,487  -5,6868 -5,6056  5,8688 -1,6534  4,6893 -3,6589  6,1558 -8,5414  5,8268 -1,7444  8,7332 -10,7156  13,3217 -3,5721  9,373 -16,667  15,1788 -2,5284  14,5313 -4,3379  -7,1876 -11,4212  -4,2973 -9,7461  | -9,2806  | -5,8632  |  |
| -8,5477 -13,3014  -5,2325 -9,7825  13,4428 -2,3674  19,3249 -8,0052  11,7089 -6,2342  8,4826 -14,8078  -3,5441 -8,7647  -1,3594 -12,4068  -3,955 -11,487  -5,6868 -5,6056  5,8688 -1,6534  4,6893 -3,6589  6,1558 -8,5414  5,8268 -1,7444  8,7332 -10,7156  13,3217 -3,5721  9,373 -16,667  15,1788 -2,5284  14,5313 -4,3379  -7,1876 -11,4212  -4,2973 -9,7461  | -7,5159  | -16,8728 |  |
| -5,2325 -9,7825  13,4428 -2,3674  19,3249 -8,0052  11,7089 -6,2342  8,4826 -14,8078  -3,5441 -8,7647  -1,3594 -12,4068  -3,955 -11,487  -5,6868 -5,6056  5,8688 -1,6534  4,6893 -3,6589  6,1558 -8,5414  5,8268 -1,7444  8,7332 -10,7156  13,3217 -3,5721  9,373 -16,667  15,1788 -2,5284  14,5313 -4,3379  -7,1876 -11,4212  -4,2973 -9,7461  | -9,5872  | -21,6524 |  |
| 13,4428     -2,3674       19,3249     -8,0052       11,7089     -6,2342       8,4826     -14,8078       -3,5441     -8,7647       -1,3594     -12,4068       -3,955     -11,487       -5,6868     -5,6056       5,8688     -1,6534       4,6893     -3,6589       6,1558     -8,5414       5,8268     -1,7444       8,7332     -10,7156       13,3217     -3,5721       9,373     -16,667       15,1788     -2,5284       14,5313     -4,3379       -7,1876     -11,4212       -4,2973     -9,7461   | -8,5477  | -13,3014 |  |
| 19,3249     -8,0052       11,7089     -6,2342       8,4826     -14,8078       -3,5441     -8,7647       -1,3594     -12,4068       -3,955     -11,487       -5,6868     -5,6056       5,8688     -1,6534       4,6893     -3,6589       6,1558     -8,5414       5,8268     -1,7444       8,7332     -10,7156       13,3217     -3,5721       9,373     -16,667       15,1788     -2,5284       14,5313     -4,3379       -7,1876     -11,4212       -4,2973     -9,7461   | -5,2325  | -9,7825  |  |
| 11,7089     -6,2342       8,4826     -14,8078       -3,5441     -8,7647       -1,3594     -12,4068       -3,955     -11,487       -5,6868     -5,6056       5,8688     -1,6534       4,6893     -3,6589       6,1558     -8,5414       5,8268     -1,7444       8,7332     -10,7156       13,3217     -3,5721       9,373     -16,667       15,1788     -2,5284       14,5313     -4,3379       -7,1876     -11,4212       -4,2973     -9,7461   | 13,4428  | -2,3674  |  |
| 8,4826     -14,8078       -3,5441     -8,7647       -1,3594     -12,4068       -3,955     -11,487       -5,6868     -5,6056       5,8688     -1,6534       4,6893     -3,6589       6,1558     -8,5414       5,8268     -1,7444       8,7332     -10,7156       13,3217     -3,5721       9,373     -16,667       15,1788     -2,5284       14,5313     -4,3379       -7,1876     -11,4212       -4,2973     -9,7461   | 19,3249  | -8,0052  |  |
| -3,5441 -8,7647  -1,3594 -12,4068  -3,955 -11,487  -5,6868 -5,6056  5,8688 -1,6534  4,6893 -3,6589  6,1558 -8,5414  5,8268 -1,7444  8,7332 -10,7156  13,3217 -3,5721  9,373 -16,667  15,1788 -2,5284  14,5313 -4,3379  -7,1876 -11,4212  -4,2973 -9,7461   | 11,7089  | -6,2342  |  |
| -1,3594 -12,4068 -3,955 -11,487 -5,6868 -5,6056 5,8688 -1,6534 4,6893 -3,6589 6,1558 -8,5414 5,8268 -1,7444 8,7332 -10,7156 13,3217 -3,5721 9,373 -16,667 15,1788 -2,5284 14,5313 -4,3379 -7,1876 -11,4212 -4,2973 -9,7461   | 8,4826   | -14,8078 |  |
| -3,955 -11,487  -5,6868 -5,6056  5,8688 -1,6534  4,6893 -3,6589  6,1558 -8,5414  5,8268 -1,7444  8,7332 -10,7156  13,3217 -3,5721  9,373 -16,667  15,1788 -2,5284  14,5313 -4,3379  -7,1876 -11,4212  -4,2973 -9,7461  | -3,5441  | -8,7647  |  |
| -5,6868 -5,6056  5,8688 -1,6534  4,6893 -3,6589  6,1558 -8,5414  5,8268 -1,7444  8,7332 -10,7156  13,3217 -3,5721  9,373 -16,667  15,1788 -2,5284  14,5313 -4,3379  -7,1876 -11,4212  -4,2973 -9,7461  | -1,3594  | -12,4068 |  |
| 5,8688     -1,6534       4,6893     -3,6589       6,1558     -8,5414       5,8268     -1,7444       8,7332     -10,7156       13,3217     -3,5721       9,373     -16,667       15,1788     -2,5284       14,5313     -4,3379       -7,1876     -11,4212       -4,2973     -9,7461   | -3,955   | -11,487  |  |
| 4,6893     -3,6589       6,1558     -8,5414       5,8268     -1,7444       8,7332     -10,7156       13,3217     -3,5721       9,373     -16,667       15,1788     -2,5284       14,5313     -4,3379       -7,1876     -11,4212       -4,2973     -9,7461  | -5,6868  | -5,6056  |  |
| 6,1558 -8,5414 5,8268 -1,7444 8,7332 -10,7156 13,3217 -3,5721 9,373 -16,667 15,1788 -2,5284 14,5313 -4,3379 -7,1876 -11,4212 -4,2973 -9,7461   | 5,8688   | -1,6534  |  |
| 5,8268     -1,7444       8,7332     -10,7156       13,3217     -3,5721       9,373     -16,667       15,1788     -2,5284       14,5313     -4,3379       -7,1876     -11,4212       -4,2973     -9,7461  | 4,6893   | -3,6589  |  |
| 8,7332 -10,7156  13,3217 -3,5721  9,373 -16,667  15,1788 -2,5284  14,5313 -4,3379  -7,1876 -11,4212  -4,2973 -9,7461   | 6,1558   | -8,5414  |  |
| 13,3217 -3,5721<br>9,373 -16,667<br>15,1788 -2,5284<br>14,5313 -4,3379<br>-7,1876 -11,4212<br>-4,2973 -9,7461  | 5,8268   | -1,7444  |  |
| 9,373 -16,667<br>15,1788 -2,5284<br>14,5313 -4,3379<br>-7,1876 -11,4212<br>-4,2973 -9,7461   | 8,7332   | -10,7156 |  |
| 15,1788 -2,5284<br>14,5313 -4,3379<br>-7,1876 -11,4212<br>-4,2973 -9,7461  | 13,3217  | -3,5721  |  |
| 14,5313 -4,3379<br>-7,1876 -11,4212<br>-4,2973 -9,7461   | 9,373    | -16,667  |  |
| 14,5313 -4,3379<br>-7,1876 -11,4212<br>-4,2973 -9,7461   | 15,1788  | -2,5284  |  |
| -7,1876 -11,4212<br>-4,2973 -9,7461  |          | -4,3379  |  |
|  |          |          |  |
| -4,4513 -9,8406  | -4,2973  | -9,7461  |  |
|  | -4,4513  | -9,8406  |  |





Оставляем одну главную компоненту, так как она описывает значительную часть данных