- **Metody rozwiązywania układów równań liniowych**

$$A := \begin{pmatrix} 10 & -1 & 2 & 3 \\ -1 & 12 & 3 & -1 \\ 2 & 3 & 13 & 2 \\ 3 & -1 & 2 & 14 \end{pmatrix} \qquad b := \begin{pmatrix} 12. \\ 13. \\ 14. \\ 15. \end{pmatrix} \qquad x := lsolve(A, b) = \begin{pmatrix} 0.939586 \\ 1.097921 \\ 0.545059 \\ 0.870646 \end{pmatrix}$$

$$d := |A| = 1.7943 \times 10^{4}$$

$$L := cholesky(A) = \begin{pmatrix} 3.162278 & 0 & 0 & 0 \\ -0.316228 & 3.449638 & 0 & 0 \\ 0.632456 & 0.927634 & 3.426295 & 0 \\ 0.948683 & -0.20292 & 0.463543 & 3.583846 \end{pmatrix}$$

$$d := |L| = 133.951484$$

$$d^{2} = 1.7943 \times 10^{4}$$

$$U := L^{T} = \begin{pmatrix} 3.162278 & -0.316228 & 0.632456 & 0.948683 \\ 0 & 3.449638 & 0.927634 & -0.20292 \\ 0 & 0 & 3.426295 & 0.463543 \\ 0 & 0 & 0 & 3.583846 \end{pmatrix}$$

$$y := lsolve(L, b) = \begin{pmatrix} 3.794733 \\ 4.116374 \\ 2.271116 \\ 3.120261 \end{pmatrix} \qquad x1 := lsolve(U, y) = \begin{pmatrix} 0.939586 \\ 1.097921 \\ 0.545059 \\ 0.870646 \end{pmatrix}$$

$$M := A^{-1} = \begin{pmatrix} 0.110628 & 0.011648 & -0.016552 & -0.020509 \\ 0.011648 & 0.090899 & -0.023909 & 7.412361 \times 10^{-3} \\ -0.016552 & -0.023909 & 0.086608 & -0.010533 \\ -0.020509 & 7.412361 \times 10^{-3} & -0.010533 & 0.077858 \end{pmatrix}$$

$$x2 := M \cdot b = \begin{pmatrix} 0.939586 \\ 1.097921 \\ 0.545059 \\ 0.870646 \end{pmatrix}$$

$rank(A) = 4$

$norm1(A) = 20$ *- Norma L1*

$norm2(A) = 17.383695$ *- Norma L2*

$norme(A) = 25.787594$ *- Norma Euklidesowa (Frobeniusa)*

$normi(A) = 20$ *- Norma ∞*

$$\Lambda a := eigenvals(A) = \begin{pmatrix} 7.563102 \\ 9.169299 \\ 17.383695 \\ 14.883904 \end{pmatrix}$$

$$\left[\sum_{i=0}^{3} \sum_{j=0}^{3} \left(A_{i,j}\right)^2\right]^{\frac{1}{2}} = 25.787594$$ *- Norma Euklidesowa (Frobeniusa)*

$$max\left(\sum_{j=0}^{3} \left|A_{1,j}\right|, \sum_{j=0}^{3} \left|A_{0,j}\right|, \sum_{j=0}^{3} \left|A_{2,j}\right|, \sum_{j=0}^{3} \left|A_{3,j}\right|\right) = 20$$ *- Norma ∞*

$$max\left(\sum_{j=0}^{3}\left|A_{j,0}\right|, \sum_{j=0}^{3}\left|A_{j,1}\right|, \sum_{j=0}^{3}\left|A_{j,2}\right|, \sum_{j=0}^{3}\left|A_{j,3}\right|\right) = 20$$ *- Norma L1*

$$L2 := \left|max(\Lambda a)\right| = 17.383695$$ *- Norma L2*