

**Sample: Matrix Tensor Analysis - Matrix Equations**Matrix  $A$ :

$$A := \begin{bmatrix} 1.0 & 0.1 & 0.01 & 0.001 \\ 1.0 & 0.2 & 0.04 & 0.008 \\ 1.0 & 0.3 & 0.09 & 0.027 \\ 1.0 & 0.4 & 0.16 & 0.064 \\ 1.0 & 0.5 & 0.25 & 0.125 \\ 1.0 & 0.6 & 0.36 & 0.216 \\ 1.0 & 0.7 & 0.49 & 0.343 \\ 1.0 & 0.8 & 0.64 & 0.512 \\ 1.0 & 0.9 & 0.81 & 0.729 \end{bmatrix}$$

Matrix  $A^T A$ :

$$\begin{bmatrix} 9.00 & 4.50 & 2.850 & 2.0250 \\ 4.50 & 2.85 & 2.025 & 1.5333 \\ 2.850 & 2.025 & 1.5333 & 1.20825 \\ 2.0250 & 1.5333 & 1.20825 & 0.978405 \end{bmatrix}$$

Right side of the system of equations  $z = A^T Y$ 

$$\begin{bmatrix} 62.50 \\ 35.04 \\ 23.832 \\ 17.7336 \end{bmatrix}$$

Cholesky decomposition:

$$A^T A = LL^T$$

Matrix  $L$ :

$$\begin{bmatrix} 3.000000000 & 0 & 0 & 0 \\ 1.500000000 & 0.7745966692 & 0 & 0 \\ 0.9500000000 & 0.7745966693 & 0.1754992877 & 0 \\ 0.6750000000 & 0.6723499089 & 0.2632489317 & 0.03775711853 \end{bmatrix}$$

Solution of the system of equations:  $Ly = z$ :



$$\begin{bmatrix} 20.83333333 \\ 4.892868961 \\ 1.426406581 \\ 0.1557319952 \end{bmatrix}$$

Solution of  $L^T x = y$ :

$$\begin{bmatrix} 5.003968683 \\ 0.7956910538 \\ 1.940846168 \\ 4.124573094 \end{bmatrix}$$

So coefficients of the polynomial for  $n = 3$  are

$$\begin{bmatrix} 5.003968683 \\ 0.7956910538 \\ 1.940846168 \\ 4.124573094 \end{bmatrix}$$

For  $n = 4$  we have:

$A^T A$  equals to:

$$\begin{bmatrix} 9.00 & 4.50 & 2.850 & 2.0250 & 1.53330 \\ 4.50 & 2.85 & 2.025 & 1.5333 & 1.20825 \\ 2.850 & 2.025 & 1.5333 & 1.20825 & 0.978405 \\ 2.0250 & 1.5333 & 1.20825 & 0.978405 & 0.8080425 \\ 1.53330 & 1.20825 & 0.978405 & 0.8080425 & 0.67731333 \end{bmatrix}$$

Right side  $A^T Y$ :



62.50  
35.04  
23.832  
17.7336  
13.86576

Matrix L:

3.000000000 0 0 0 0  
1.500000000 0.7745966692 0 0 0  
0.9500000000 0.7745966693 0.1754992877 0 0  
0.6750000000 0.6723499089 0.2632489317 0.03775711853 0  
0.5111000000 0.5701031486 0.2920809570 0.07551423972 0.0076703

Solution of  $Ly = z$ :

$\begin{bmatrix} 20.83333333 \\ 4.892868961 \\ 1.426406581 \\ 0.1557319952 \\ 0.002236871861 \end{bmatrix}$

Solution of  $L^T x = y$ :

$\begin{bmatrix} 5.011117687 \\ 0.6977880373 \\ 2.330375161 \\ 3.541321155 \\ 0.2916259591 \end{bmatrix}$

So coefficients are:

$\begin{bmatrix} 5.011117687 \\ 0.6977880373 \\ 2.330375161 \\ 3.541321155 \\ 0.2916259591 \end{bmatrix}$