

## Task 2

).

$$\begin{cases} 9x + 2y + 3z = 23 \\ 2x + 5y + z = 10 \\ 2x + 3y + 9z = 16 \end{cases}$$

- a). ① Equation  $\rightarrow 9 > \text{sum of } 2+3 = \text{Dominant}$  < TRUE >  
 ② Equation  $\rightarrow 5 \text{ is not } > \text{sum of } 2+1 = \text{NOT Dominant}$  < TRUE >  
 ③ Equation  $\rightarrow 9 \text{ is } > \text{sum of } 2+3 = \text{Diagonally Dominant}$  < TRUE >

$\therefore$  system is Diagonally Dominant.

b). Gauss-Seidel

$$x=0$$

$$y=0 \quad 4 \text{ d.p.}$$

$$z=0$$

Iteration 1

$$x = \frac{23 - 2y - 3z}{9}$$

$$x = \frac{23(0) - 2(0) - 3(0)}{9} = 2.5556$$

$$e = \left| \frac{2.5556 - 0}{2.5556} \right| \times 100\% = 100\%$$

$$y = \frac{10 - 2x - z}{5}$$

$$y = \frac{10 - 2(2.5556) - 0}{5} = 0.9778$$

$$e = \left| \frac{0.9778 - 0}{0.9778} \right| \times 100\% = 100\%$$

$$z = \frac{16 - 2x - 3y}{9}$$

$$z = \frac{16 - 2(2.5556) - 3(0.9778)}{9} = 0.884$$

$$e = \left| \frac{0.884 - 0}{0.884} \right| \times 100\% = 100\%$$

Iteration 2

$$x = \frac{23 - 2(0.9778) - 3(0.884)}{9} = 2.0436$$

$$e = \left| \frac{2.0436 - 2.5556}{2.0436} \right| \times 100\% = 25.0503\%$$

$$y = \frac{10 - 2(2.0436) - 0.884}{5} = 1.0058$$

$$e = \left| \frac{1.0058 - 0.9778}{1.0058} \right| \times 100\% = 2.7838\%$$

$$z = \frac{16 - 2(2.0436) - 3(1.0058)}{9} = 0.9884$$

$$e = \left| \frac{0.9884 - 0.884}{0.9884} \right| \times 100\% = 10.5625\%$$

Iteration 3

$$x = \frac{23 - 2(1.0058) - 3(0.9884)}{9} = 2.0026$$

$$e = \left| \frac{2.0026 - 2.0436}{2.0026} \right| \times 100\% = 2.0473\%$$

$$y = \frac{10 - 2(2.0026) - 0.9884}{5} = 1.0013$$

$$e = \left| \frac{1.0013 - 1.0058}{1.0013} \right| \times 100\% = 0.45\%$$

$$z = \frac{16 - 2(2.0026) - 3(1.0013)}{9} = 0.999$$

$$e = \left| \frac{0.999 - 0.9884}{0.999} \right| \times 100\% = 1.0610\%$$

error % ↓

Iteration 4

$$x = \frac{23 - 2(1.0013) - 3(0.9999)}{9} = 2$$

$$y = \frac{10 - 2(2) - 3(0.9999)}{5} = 1.0002$$

$$z = \frac{16 - 2(2) - 3(1.0002)}{9} = 0.9999$$

$$e = \left| \frac{2 - 2.0026}{2} \right| \times 100\% = 0.1300\%$$

$$e = \left| \frac{1.0002 - 1.0013}{1.0002} \right| \times 100\% = 0.11\%$$

$$e = \left| \frac{0.9999 - 0.999}{0.9999} \right| \times 100\% = 0.09\%$$

$$\begin{cases} 0.1x + 2y + 3z = 5.2 \\ 2x + 0.5y + z = 5.5 \\ 2x + 3y + 0.2z = 7.2 \end{cases}$$

$$\left[ \begin{array}{ccc|c} 0.1 & 2 & 3 & 5.2 \\ 2 & 0.5 & 1 & 5.5 \\ 2 & 3 & 0.2 & 7.2 \end{array} \right]$$

$$x = \frac{5.2 - 2y - 3z}{0.1}$$

$$y = \frac{5.5 - 0.5y - z}{0.5}$$

$$z = \frac{7.2 - 2x - 3y}{0.2}$$

Initial Values!

$$x=0$$

$$y=0$$

$$z=0$$

error!

▶ ITERATION NO.1

$$x = \frac{5.2 - 2(0) - 3(0)}{0.1} = 52$$

$$y = \frac{5.5 - 2(52) - 0}{0.5} = -197$$

$$z = \frac{7.2 - 2(52) - 3(-197)}{0.2} = 2471$$

$$e = \left| \frac{52-0}{52} \right| \times 100\% = 100\%$$

$$e = \left| \frac{-197-0}{-197} \right| \times 100\% = 100\%$$

$$e = \left| \frac{2471-0}{2471} \right| \times 100\% = 100\%$$

error!

▶ ITERATION NO.2

$$x = \frac{5.2 - 2(-197) - 3(2471)}{0.1} = -7013.8$$

$$y = \frac{5.5 - 2(-7013.8) - 2471}{0.5} = 1156.210$$

$$z = \frac{7.2 - 2(-7013.8) - 3(1156.210)}{0.2} = 87517.15$$

$$e = \left| \frac{-7013.8 - 52}{-7013.8} \right| \times 100\% = 100.7419\%$$

$$e = \left| \frac{1156.210 - (-197)}{1156.210} \right| \times 100\% = 117.0389\%$$

$$e = \left| \frac{87517.15 - 2471}{87517.15} \right| \times 100\% = 97.7765\%$$

▷ ITERATION 3

$$x = \frac{5.2 - 2(1156.210) - 3(87517.15)}{0.1} = -2648586.7$$

$$y = \frac{5.5 - 2(-2648586.7) - 87517.15}{0.5} = 10419323.5$$

$$z = \frac{7.2 - 2(2648586.7) - 3(10419323.5)}{0.2} = -182775683.5$$

ERROR!

$$e = \left| \frac{-2648586.7 - (-7013.8)}{-2648586.7} \right| \times 100\% = 99.735\%$$

$$e = \left| \frac{10419323.5 - 1156.210}{10419323.5} \right| \times 100\% = 99.988\%$$

$$e = \left| \frac{-182775683.5 - 87517.15}{-182775683.5} \right| \times 100\% = 100.0478\%$$

▷ ITERATION 4

$$x = \frac{5.2 - 2(10419323.5) - 2(-182775683.5)}{0.1} = 3447127252$$

$$y = \frac{5.5 - 2(3447127252) - (-182775683.5)}{0.5} = -13422957630$$

$$z = \frac{7.2 - 2(3447127252) - 3(-13422957630)}{0.2} = 166873091966$$

ERROR! ↴

$$e = \left| \frac{3447127252 - (-2648586.7)}{3447127252} \right| \times 100\% = 100.0768\%$$

$$e = \left| \frac{-13422957630 - 10419323.5}{-13422957630} \right| \times 100\% = 100.077\%$$

$$e = \left| \frac{166873091966 - (-182775683.5)}{166873091966} \right| \times 100\% = 100.1095\%$$

b). Conclusion!

Gauss-seidel method works when the matrix is considered to be diagonally dominant. :) )