

Name: _____ UIN: _____ Section: _____ Score: _____

Consider a system of two non-linear equations with the variables θ and V ,

$$\begin{aligned} f_1(\theta, V) &= 10 V \sin \theta + 2 = 0 \\ f_2(\theta, V) &= -10 V \cos \theta + 10 V^2 + 1 = 0 \end{aligned}$$

1. In preparation for the Newton-Raphson method, write the Jacobian matrix in terms of θ and V .
2. Suppose our initial guess was $\theta^{(0)} = 0$ and $V^{(0)} = 1$; what are the values of $f^{(0)}$ and $J^{(0)}$?
3. Find the first Newton-Raphson iteration values of $\theta^{(1)}$ and $V^{(1)}$. (Hint: To take the inverse of a diagonal matrix, just take the reciprocal of each element.)

$$\begin{aligned} 1. \quad J &= \begin{bmatrix} 10 V \cos \theta & 10 \sin \theta \\ 10 V \sin \theta & -10 \cos \theta + 20 V \end{bmatrix} \\ 2. \quad f^{(0)} &= \begin{bmatrix} 2 \\ 1 \end{bmatrix}; J^{(0)} = \begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix} \\ 3. \quad \begin{bmatrix} \theta^{(1)} \\ V^{(1)} \end{bmatrix} &= \begin{bmatrix} 0 \\ 1 \end{bmatrix} - \begin{bmatrix} 0.1 & 0 \\ 0 & 0.1 \end{bmatrix} \begin{bmatrix} 2 \\ 1 \end{bmatrix} = \begin{bmatrix} -0.2 \\ 0.9 \end{bmatrix} \end{aligned}$$