

BT3014 : Analysis and interpretation of Biological Data

(Basic math tutorial)

1. Find the eigenvalues of the given matrix.

(A). $\begin{bmatrix} 2 & 0 \\ 0 & 5 \end{bmatrix}$ (B). $\begin{bmatrix} 5 & 1 \\ 4 & 5 \end{bmatrix}$ (C). $\begin{bmatrix} 3 & 5 \\ 3 & 1 \end{bmatrix}$

(D). $\begin{bmatrix} 3 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 7 \end{bmatrix}$ (E). $\begin{bmatrix} 2 & 0 & 0 \\ -1 & 3 & 3 \\ 6 & -6 & 6 \end{bmatrix}$

2. Find one eigenvector for the given matrix corresponding to the given eigenvalue.

(A). $\begin{bmatrix} 3 & 1 \\ 2 & 4 \end{bmatrix}$, $\lambda = 5$ (B). $\begin{bmatrix} 1 & 3 \\ 4 & 5 \end{bmatrix}$, $\lambda = -1$

(C). $\begin{bmatrix} 2 & 6 \\ 1 & 3 \end{bmatrix}$, $\lambda = 0$ (D). $\begin{bmatrix} 4 & 1 & 3 \\ 1 & 3 & 1 \\ 2 & 0 & 5 \end{bmatrix}$, $\lambda = 3$

3. Find f_x and f_y where $f(x,y)$ is equal to

(A). $3x + 4y$ (B). $xy^3 + x^2y^2$ (C). $x^3y + e^x$ (D). xe^{2x+3y} (E). $e^{-x}\sin(x+y)$

4. find the gradient $[\nabla f]$ of a function f

(A). $y - x$ (B). $\frac{14-x^2-y^2}{3}$ (C). $xy + yz + xz$ (D). $x - xy + z^2$

5. Let $f(x, y, z) = xye^{x^2+z^2-5}$. Calculate the gradient of 'f' at the point (1, 3, -2)?

6. Find the Jacobian matrix of a function 'f' given by

(A). $f(x,y,z) = (xy+2yz, 2xy^2z)$ (B). $f(x,y,z) = (xyz, y^2, x+z)$

7. Compute the Hessian matrix of a function 'f' given by

(A). $f(x, y) = 2xy - 5x^2 - 2y^2 + 4x - 4$ (B). $f(x, y) = e^{x^2+xy+y^2}$

Answers

1. (A). 2,5 (B). 3,7 (C). -2,6 (D). 3,4,7 (E). -3,0,2
2. (A). (1,2) (B). (-3,2) (C). (-3,1) (D). (-1,-2,1)
3. (A). $f_x = 3, f_y = 4$ (B). $f_x = y^3 + 2xy^2, f_y = 3xy^2 + 2xy$ (C). $f_x = 3x^2y + e^x, f_y = x^3$
(D). $f_x = 2xe^{2x+3y} + e^{2x+3y}, f_y = 3xe^{2x+3y}$ (E). $f_x = e^{-x}(\cos(x+y) - \sin(x+y)), f_y = e^{-x}\cos(x+y)$
4. (A). $\vec{\nabla}f(x,y) = -i + j$ (B). $-\frac{2}{3}xi - \frac{2}{3}yj$ (C). $\langle y + z, x + z, y + x \rangle$ (D). $\langle 1 - y, -x, 2z \rangle$
5. $\nabla f(x,y,z) = ((y + 2x^2y)e^{x^2+z^2-5}, xe^{x^2+z^2-5}, 2xyze^{x^2+z^2-5})$; $\nabla f(1,3,-2) = (9,1,-12)$
6. (A). $\begin{matrix} y & x + 2z & 2y \\ 2y^2z & 4xyz & 2xy^2 \end{matrix}$ (B). $\begin{bmatrix} yz & xz & xy \\ 0 & 2y & 0 \\ 1 & 0 & 1 \end{bmatrix}$
7. (A). $\mathcal{H}f = \begin{bmatrix} -10 & 2 \\ 2 & -4 \end{bmatrix}$ (B). $\mathcal{H}f = e^{x^2+xy+y^2} \begin{pmatrix} 2 + (2x+y)^2 & 1 + (2x+y)(x+2y) \\ 1 + (2x+y)(x+2y) & 2 + (x+2y)^2 \end{pmatrix}$