

Homework 2

Due January 29th at the beginning of class, or by 12:30 pm in MATH 602. Justify your answers. Please let me know if you have a question or find a mistake.

1. (a) Decide if the determinants of the following matrices are positive, negative, or zero, without fully evaluating the determinant.

$$A = \begin{bmatrix} 1345 & 0 & 0 \\ 7346 & -2936 & 0 \\ -2957 & -1956 & -1847 \end{bmatrix}, \quad B = \begin{bmatrix} 4964 & -2779 & 0 \\ 3856 & 2957 & 9348 \\ 2957 & 3957 & -3837 \end{bmatrix}.$$

- (b) Let $v_1, v_2,$ and v_3 be the rows of A and let $v_4, v_5,$ and v_6 be the rows of B . Which octants does each row belong to? If a vector is on the border between two or more octants, count it as belonging to all of the ones it borders. Use the names of the octants given in the picture at the end of the assignment.
- (c) Use your answer to part (c) to sketch $v_1, v_2,$ and v_3 on one graph, and $v_4, v_5,$ and v_6 on another graph. Try to put the vectors in the correct octants without trying to get the scale right.
2. Let $f(x, y) = -x - y$.
- (a) Sketch some of the level sets of f . What possible shapes can the level sets have? Which level sets, if any, are empty?
- (b) Sketch the graph of f .
3. Let $f(x, y) = (x - 1)^2 + 3(y - 2)^2$.
- (a) Sketch some of the level sets of f . What possible shapes can the level sets have? Which level sets, if any, are empty?
- (b) Sketch the graph of f .
4. Let $f(x) = e^{-x/2}$. Let $c(x)$ be the constant approximation to f at $x = 2$ and let $\ell(x)$ be the linear approximation to f at $x = 2$. Find c and ℓ , and sketch their graphs together with the graph of f .
5. Let

$$f(x) = 2|x - 1| - |x - 2| + \frac{x}{|x|}.$$

- (a) At which point does f have no constant approximation?

- (b) At which points does f have a constant approximation but no linear approximation? Find those constant approximations, and sketch them together with the graph of f .

