

Name: \_\_\_\_\_

## Math 214 – Linear Systems

### Lab 2

**Directions:** This is a brief lab on determinants. You may simply fill in the information requested, giving short explanations, especially when you are asked to make a conjecture (educated guess). You may work together, but what you present here must reflect **your understanding**.

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#### DETERMINANTS

MatLab can find the determinant of  $A$  very quickly with the command: `det(A)`.

1. Without the computer, find the following determinants, giving a brief comment on how you got your answer (they should be quite easy with a little thought). Then use MatLab's `det(A)` command to verify your answers:

$$(a) \mathbf{I} = \mathbf{eye}(3) = \begin{bmatrix} & & \\ & & \\ & & \end{bmatrix}. \quad \det(\mathbf{I}) =$$

$$(b) \mathbf{B} = \begin{bmatrix} 4 & 4 & 4 \\ 7 & 7 & 7 \\ 2 & 3 & 4 \end{bmatrix}. \quad \det(\mathbf{B}) =$$

$$(c) \mathbf{C} = \begin{bmatrix} 3 & 0 & 0 \\ -1 & 2 & 0 \\ -7 & \pi & 1 \end{bmatrix}. \quad \det(\mathbf{C}) =$$

(Note: You can just type `pi` in MatLab.)

2. Find the determinant of  $A$  below using MatLab. Then use this value to make conjectures (educated guesses) about the remaining determinants. Give a brief comment on how you made your conjecture. Finally, check your answers by using MatLab.

$$\mathbf{det}(A) = \begin{vmatrix} 1 & -2 & 1 \\ -2 & 6 & -2 \\ -3 & 6 & -2 \end{vmatrix} =$$

(a) Conjecture (w/ brief reasoning):  $\mathbf{det}(2A) = |2A| =$

Check with MatLab.

(b) Conjecture (w/ brief reasoning):  $\mathbf{det}(-A) = |-A| =$

Check with MatLab. Is  $\mathbf{det}(-M)$  always equal to  $-\mathbf{det}(M)$  for any matrix  $M$ ? How do you make this result consistent with part (a)?

(c) Conjecture (w/ brief reasoning):  $\mathbf{det}(A^T) = |A^T| =$

Check with MatLab.

(d) Conjecture (w/ brief reasoning):  $\mathbf{det}(\mathbf{inv}(A)) = |A^{-1}| =$

Check with MatLab.

3. The following problem shows that the calculation of the determinant is sometimes sensitive to small changes in the elements of the matrix. Let

$$A = \begin{bmatrix} -73 & 78 & 24 \\ 92 & 66 & 25 \\ -80 & 37 & 10 \end{bmatrix}$$

then compute the following. (Note: Recall the quick way to change just one element in a matrix is to type in the whole matrix and then type something like  $\mathbf{A}(3,3) = 10.01$ .)

(a)  $\det(\mathbf{A})$

(b)  $\det(\mathbf{A})$  where  $a_{33} = 10.01$

(c)  $\det(\mathbf{A})$  where  $a_{21} = 92.01$  (Put  $a_{33}$  back to 10)

(d)  $\det(\mathbf{A})$  where  $a_{12} = 78.01$  (Put  $a_{21}$  back to 92)

**Question for Reflection.** Reflect on the following question and type a short but detailed response. The response should be well-reasoned and well-written (i.e., complete sentences, paragraphs, thoughts). You may write your response on the back of this sheet, or attach it to this lab.

- Consider section 3. Can you explain this “sensitivity” with a geometric interpretation of the determinant?