Math 201
Fall 2019
Midterm1
10/04/2019
Time Limit: 50 minutes

Name (Print): ______________________

This exam contains 9 pages (including this cover page) and 4 problems. Check to see if any pages are missing.

Statement of Ethics

I agree to complete this exam without unauthorized assistance from any person, materials, or device.

Signature ______________________ Date ______________________

1 Fuentes T 1:30 - 2:20 Bloomberg 278
2 Quinan T 3:00 - 3:50 Hodson 301
3 Quinan T 4:30 - 5:20 Hodson 216
4 Luo Th 1:30 - 2:20 Bloomberg 278
5 Luo Th 3:00 - 3:50 Maryland 309

Your section number: ______________________

You are required to show your work on each problem on this exam. The following rules apply:

- **Organize your work**, in a reasonably neat and coherent way, in the space provided.
- **No partial credit for any 1 point problem**. A correct answer, unsupported by calculations, explanation, or algebraic work will receive no credit.
- If you need more space, use the back of the pages; clearly indicate when you have done this.
- **Any answer or solution on scratch paper will receive no credit**.

Do not write in the table to the right.

Problem	Points	Score
1	5	
2	5	
3	5	
4	5	
Total:	20	

1. (a) (1 point) For which values of a, b, c, d, e is the following matrix in reduced row-echelon form?

$$\begin{bmatrix} a & b & 0 & 1 & c \\ a & 1 & 0 & c & d \\ 0 & 0 & e & 0 & 0 \end{bmatrix}.$$

(b) (1 point) Let

$$A = \begin{bmatrix} 1 & a & b \\ a & 1 & b \\ a & b & 1 \end{bmatrix}, \ B = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix},$$

Define $A_1 = A$, and $A_{i+1} := A_i B$ for $i \geq 1$. Compute A_{2019}.

(c) (3 points) Consider the equations

$$\begin{vmatrix} x + y + kz & = 0 \\ kx + y + z & = 0 \\ x + ky + z & = 0 \end{vmatrix},$$

where k is an arbitrary constant. (1) For which values of the constant k does this system have a unique solution? (1pt) (2) When is there no solution? (1pt) (3) When are there infinitely many solutions? (1pt)

2. (a) (1 point) Find the matrix P of the orthogonal projection onto the line $L := \{(x, y) \mid 40x - 9y = 0\} \in \mathbb{R}^2$.

(b) (2 points) Let k be a positive integer. What's the matrix A of a counterclockwise rotation in $\mathbb{R}^2$ through the angle $\frac{\pi}{k}$? (1pt) Compute A^{k+1}. (1pt)

(c) (2 points) Let L be the line defined by $2x + y - 4 = 0$, let $\boldsymbol{x} = (1, 2) \in \mathbb{R}^2$ be a point, find the reflection of $\boldsymbol{x}$ about L.

3. (a) (2 points) Use Gauss-Jordan elimination to compute rref(A), where $A = \begin{bmatrix} 2 & 0 & 1 & 9 \\ 1 & 0 & 4 & 0 \\ 1 & 9 & 2 & 0 \\ 4 & 0 & 1 & 0 \end{bmatrix}$.

(b) (3 points) Find the inverse matrix of A, where

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \\ 3 & 1 & 2 \end{bmatrix}$$

4. (5 points) Find all the possible 2×3 matrices A and 3×2 matrices B such that $BA = I_3$, where I_3 is the 3×3 identity matrix.

Please estimate your score. You can also provide your suggestion for the course here.