

## MEETING 02, GROUP WORK

LINEAR ALGEBRA SECTION 01, SPRING 2014

*Basic Advice: Successful students in linear algebra learn to speak with abstract terminology, compute with algebra, and think with geometry. If you feel stuck, try drawing a picture.*

The focus of today's seminar work is to start working and thinking in three dimensional space. To that end, I have the following tasks for you to work on. Let's see how far we can go today.

### Part One: 2D Warm Up

**Task 1.** Consider the line in the Cartesian plane described in parametric vector form as

$$\ell = \left\{ X = \begin{pmatrix} 2 \\ 1 \end{pmatrix} + t \begin{pmatrix} -1 \\ 1 \end{pmatrix} \mid t \text{ is a real number} \right\}.$$

Write the pair of parametric equations for the coordinates  $x$  and  $y$  of a generic point  $X = \begin{pmatrix} x \\ y \end{pmatrix}$  on  $\ell$  as functions of the parameter  $t$ .

**Task 2.** Eliminate the parameter  $t$  from the equations to write the standard form of the equation of  $\ell$ .

**Part Two: working in 3D**

For the rest of this investigation, we shall consider the two points  $P$  and  $Q$  in  $\mathbb{R}^3$  given by the vectors

$$P = \begin{pmatrix} 3 \\ -2 \\ 0 \end{pmatrix} \quad \text{and} \quad Q = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}.$$

**Task 3.** Write the vector parametric form of the line  $m$  in  $\mathbb{R}^3$  which passes through  $P$  and  $Q$ .

**Task 4.** Find some equations in the coordinates  $x, y$  and  $z$  of a generic point  $X = \begin{pmatrix} x \\ y \\ z \end{pmatrix}$  which describe exactly when the point  $X$  lies on the line  $m$ .

**Task 5.** Draw a picture that represents the geometry of what you just found.

**Part III: A linear combination equation**

Now consider these four vectors in  $\mathbb{R}^3$ .

$$u = \begin{pmatrix} 2 \\ -1 \\ 0 \end{pmatrix}, \quad v = \begin{pmatrix} -1 \\ 2 \\ -1 \end{pmatrix}, \quad w = \begin{pmatrix} 0 \\ -1 \\ 2 \end{pmatrix}, \quad b = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$$

**Task 6** (*Strogatz*, p 10 #31). Write down three equations for  $c$ ,  $d$ , and  $e$  so that  $cu + dv + ew = b$ .

**Task 7.** Can you somehow find  $c$ ,  $d$ , and  $e$ ?