Vector Geometry **Math 231 - Workshop**

1. Do the three vectors

$$\vec{u} = \begin{pmatrix} 1 \\ 2 \\ 0 \\ 3 \end{pmatrix}, \vec{v} = \begin{pmatrix} 3 \\ 2 \\ -2 \\ -1 \end{pmatrix}, \text{ and } \vec{w} = \begin{pmatrix} 0 \\ 2 \\ 1 \\ 5 \end{pmatrix},$$

   all lie on the same line? How can you tell?

2. Do the two lines below intersect? If so, where? If not, explain how you know.

$$\left\{ \begin{pmatrix} 1 \\ 2 \\ 0 \end{pmatrix} + \begin{pmatrix} 1 \\ 1 \\ -1 \end{pmatrix} s \ : \ s \in \mathbb{R} \right\} \text{ and } \left\{ \begin{pmatrix} 3 \\ 2 \\ 1 \end{pmatrix} + \begin{pmatrix} 1 \\ -2 \\ 1 \end{pmatrix} t \ : \ t \in \mathbb{R} \right\}$$

3. Usually an expression like the one below with 2 free variables (x, y, and z) is a 3-dimensional linear surface. Explain why this example is only 2-dimensional.

$$\left\{ \begin{pmatrix} 1 \\ 1 \\ 1 \\ 0 \end{pmatrix} x + \begin{pmatrix} 1 \\ 2 \\ 3 \\ 0 \end{pmatrix} y + \begin{pmatrix} 4 \\ 5 \\ 6 \\ 0 \end{pmatrix} z \ : \ x, y, z \in \mathbb{R} \right\}$$

4. Find the lengths of the sides of the triangle with vertices at

$$\vec{a} = \begin{pmatrix} 3 \\ 0 \\ 1 \end{pmatrix}, \vec{b} = \begin{pmatrix} 4 \\ 2 \\ 3 \end{pmatrix}, \text{ and } \vec{c} = \begin{pmatrix} 9 \\ 3 \\ -5 \end{pmatrix}.$$

Is this a right triangle? How can you tell?

5. Find an equation for the plane that contains this point and this line.

$$\vec{u} = \begin{pmatrix} 1 \\ 2 \\ 0 \end{pmatrix} \text{ and } \left\{ \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} + \begin{pmatrix} 1 \\ -1 \\ -1 \end{pmatrix} s \ : \ s \in \mathbb{R} \right\}.$$