MATH 115 Fall 2018: Assignment 3 **Due at 8:30am on Friday, September 28, 2018**

It is important that you read the assignment submission instructions and suggestions available on LEARN.

1. (**3 marks**) Let $\vec{u}, \vec{v} \in \mathbb{C}^3$ with

$$\vec{u} = \begin{bmatrix} 1+j \\ 2-3j \\ 6+2j \end{bmatrix} \quad \text{and} \quad \vec{v} = \begin{bmatrix} 2j \\ 4 \\ -2+j \end{bmatrix}$$

   (a) Compute $\vec{u} \cdot \vec{v}$
   (b) Compute $\vec{v} \cdot \vec{u}$
   (c) Compute $\|\vec{u}\|$ and $\|\vec{v}\|$.

2. (**6 marks**) Let

$$\vec{x} = \begin{bmatrix} -1 \\ 3 \\ 2 \end{bmatrix}, \quad \vec{y} = \begin{bmatrix} 4 \\ 1 \\ 2 \end{bmatrix} \quad \text{and} \quad \vec{z} = \begin{bmatrix} 3 \\ 1 \\ -2 \end{bmatrix}$$

   (a) Evaluate $\vec{x} \times \vec{y}$.
   (b) Compute the area of the triangle determined by $\vec{x}$ and $\vec{y}$.
   (c) Find volume of the parallelepiped determined by $\vec{x}$, $\vec{y}$ and $\vec{z}$.
   (d) Compute $\text{proj}_{\vec{x}}\, \vec{y}$.
   (e) Compute $\text{perp}_{\vec{x}}\, \vec{y}$.

3. (**4 marks**) Let

$$\vec{u} = \begin{bmatrix} 1 \\ -1 \\ -1 \end{bmatrix} \quad \text{and} \quad \vec{v} = \begin{bmatrix} 2 \\ 1 \\ t \end{bmatrix}$$

   For what values of $t \in \mathbb{R}$ does the parallelogram determined by $\vec{u}$ and $\vec{v}$ have area equal to $\sqrt{26}$?

4. (**4 marks**)

   (a) Find a *vector* equation for the line passing through the point $(1, -1, 3)$ and parallel to the line that passes through the points $A(1, 1, 2)$ and $B(3, 2, -4)$.
   (b) Find a *scalar* equation of the plane passing through the point $(2, 7, 6)$ and parallel to the plane $2x_1 - 3x_3 = 6$

5. (**5 marks**) Determine the coordinates of the point(s) of intersection of the line L with the plane T where L has vector equation

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -1 \\ 2 \\ 1 \end{bmatrix} + t \begin{bmatrix} 3 \\ 1 \\ 2 \end{bmatrix}, \quad t \in \mathbb{R}$$

   and T has vector equation

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 4 \\ 1 \\ 6 \end{bmatrix} + s \begin{bmatrix} 1 \\ 1 \\ 2 \end{bmatrix} + r \begin{bmatrix} 1 \\ 3 \\ -1 \end{bmatrix}, \quad s, r \in \mathbb{R}$$

6. (**5 marks**) Find the shortest distance from the point $P(1, 5, -2)$ to the line L passing through $P_0(4, 3, 2)$ with direction vector $\vec{d} = \begin{bmatrix} 3 \\ 3 \\ 2 \end{bmatrix}$. Also, find the point Q on L that is closest to P.

Total: 27 marks.