All the previous worksheets are available in seewoo5.github.io/teaching/2026Spring.
Keywords: projection, cross product

1. Find the vector projections of $\mathbf{b}$ onto $\mathbf{a}$.
   (a) $\mathbf{a} = \langle 2, 3\rangle$, $\mathbf{b} = \langle -1, -4\rangle$
   (b) $\mathbf{a} = \langle 1, 2, 2\rangle$, $\mathbf{b} = \langle 3, 4, -1\rangle$
2. If $\mathbf{a} = \langle 3, 0, -1\rangle$, find a vector $\mathbf{b}$ such that $\text{comp}_{\mathbf{a}}\mathbf{b} = 2$.
3. (a) Find all vectors $\mathbf{v}$ such that
   $$\langle 1, 2, 1\rangle \times \mathbf{v} = \langle 3, 1, -5\rangle$$
   (b) Explain why there's no vector $\mathbf{v}$ such that
   $$\langle 1, 2, 1\rangle \times \mathbf{v} = \langle 3, 1, 5\rangle$$

1. Vector projections of $\mathbf{b}$ onto $\mathbf{a}$.

   (a) $\dfrac{\mathbf{a}\cdot\mathbf{b}}{|\mathbf{a}|^2}\mathbf{a} = \dfrac{-14}{13}\langle 2,3\rangle = \left\langle -\dfrac{28}{13}, -\dfrac{42}{13}\right\rangle$

   (b) $\dfrac{\mathbf{a}\cdot\mathbf{b}}{|\mathbf{a}|^2}\mathbf{a} = \dfrac{9}{9}\cdot\langle 1,2,2\rangle = \langle 1,2,2\rangle$

2. For $\mathbf{a} = \langle 3,0,-1\rangle$, the condition $\operatorname{comp}_{\mathbf{a}}\mathbf{b} = 2$ means $\mathbf{a}\cdot\mathbf{b} = 2|\mathbf{a}| = 2\sqrt{10}$. In (x,y,z)-coordinates this plane is

$$3x - z = 2\sqrt{10}$$

   and any point on that plane works. One example is the parallel choice $\frac{2}{\sqrt{10}}\langle 3,0,-1\rangle = \left\langle \frac{6}{\sqrt{10}}, 0, -\frac{2}{\sqrt{10}}\right\rangle$.

3. Solve $\langle 1,2,1\rangle \times \mathbf{v} = \langle 3,1,-5\rangle$ with $\mathbf{v} = \langle x,y,z\rangle$:

$$(2z - y,\ x - z,\ y - 2x) = (3,1,-5)$$

   giving a parametrized line

$$x = 1 + t, \quad y = -3 + 2t, \quad z = t$$

   for any t. No $\mathbf{v}$ satisfies $\langle 1,2,1\rangle \times \mathbf{v} = \langle 3,1,5\rangle$ because the right-hand side is not orthogonal to $\langle 1,2,1\rangle$ (dot product $= 6 \neq 0$).