Question 1 *How do you verify that* $\{\vec{u}_1, \vec{u}_2, \vec{u}_3\}$ *is an orthogonal set?*

Multiple Choice:

(a) *Show that* $\vec{u}_1 \cdot \vec{u}_2 \cdot \vec{u}_3 = \vec{0}$

(b) *Show that* $\vec{u}_1 \cdot \vec{u}_2 \cdot \vec{u}_3 = 0$

(c) *Show that* $\vec{u}_1 \cdot \vec{u}_2 = 0, \vec{u}_1 \cdot \vec{u}_3 = 0$ *and* $\vec{u}_2 \cdot \vec{u}_3 = 0$ ✓

(d) *Show that* $\vec{u}_1 \cdot \vec{u}_2 = \vec{0}, \vec{u}_1 \cdot \vec{u}_3 = \vec{0}$ *and* $\vec{u}_2 \cdot \vec{u}_3 = \vec{0}$

Question 2 *Use the vectors below to compute the following.*

$$\vec{y} = \begin{bmatrix} 1 \\ -1 \\ 3 \end{bmatrix}, \qquad \vec{u}_1 = \begin{bmatrix} 0 \\ 2 \\ -1 \end{bmatrix}, \quad \vec{u}_2 = \begin{bmatrix} 1 \\ 1 \\ 2 \end{bmatrix}$$

$\dfrac{\vec{y} \cdot \vec{u}_1}{\vec{u}_1 \cdot \vec{u}_1} = \boxed{-1}$ *Simplify.*

$\dfrac{\vec{y} \cdot \vec{u}_2}{\vec{u}_2 \cdot \vec{u}_2} = \boxed{1}$ *Simplify.*

Compute the othogonal projection of $\vec{y}$ *onto* $\mathrm{Span}\{\vec{u}_1, \vec{u}_2\}$.

$$\hat{\mathbf{y}} = \begin{bmatrix} \boxed{1} \\ \boxed{-1} \\ \boxed{3} \end{bmatrix}$$

Compute $\vec{z}$ *such that* $\vec{y} = \hat{\mathbf{y}} + \vec{z}$ *and* $\vec{z} \in (\mathrm{Span}\{\vec{u}_1, \vec{u}_2\})^{\perp}$.

$$\vec{z} = \begin{bmatrix} \boxed{0} \\ \boxed{0} \\ \boxed{0} \end{bmatrix}$$

Question 3 *In the previous question, we find that* $\vec{y} = \hat{\mathbf{y}}$. *That is that the vector is its own orthogonal projection onto* $\mathrm{Span}\{\vec{u}_1, \vec{u}_2\}$. *Which of the following statements must be true?*

Multiple Choice:

(a) $\vec{y}$ *is in* $\mathrm{Span}\{\vec{u}_1, \vec{u}_2\}$. ✓

(b) $\vec{y}$ *is* **not** *in* $\text{Span}\{\vec{u}_1, \vec{u}_2\}$.

Question 4 *Use the vectors below to compute the following.*

$$\vec{y} = \begin{bmatrix} 3 \\ 2 \\ 5 \end{bmatrix}, \qquad \vec{u}_1 = \begin{bmatrix} -3 \\ 4 \\ 1 \end{bmatrix}, \quad \vec{u}_2 = \begin{bmatrix} 1 \\ 2 \\ -5 \end{bmatrix}$$

$$\frac{\vec{y}\cdot\vec{u}_1}{\vec{u}_1\cdot\vec{u}_1} = \frac{\boxed{2}}{\boxed{13}}$$ *Simplify.*

$$\frac{\vec{y}\cdot\vec{u}_2}{\vec{u}_2\cdot\vec{u}_2} = \frac{\boxed{3}}{\boxed{5}}$$ *Simplify.*

Compute the othogonal projection of $\vec{y}$ *onto* $\text{Span}\{\vec{u}_1, \vec{u}_2\}$.

$$\hat{\mathbf{y}} = \frac{1}{65}\begin{bmatrix} \boxed{-9} \\ \boxed{118} \\ \boxed{-190} \end{bmatrix}$$

Compute $\vec{z}$ *such that* $\vec{y} = \hat{\mathbf{y}} + \vec{z}$ *and* $\vec{z} \in (\text{Span}\{\vec{u}_1, \vec{u}_2\})^{\perp}$.

$$\vec{z} = \begin{bmatrix} \boxed{204} \\ \boxed{12} \\ \boxed{515} \end{bmatrix}$$

What vector represents the closest point to $\vec{y}$ *in* $\text{Span}\{\vec{u}_1, \vec{u}_2\}$*?*

Multiple Choice:

(a) $\hat{\mathbf{y}}$ ✓

(b) $\vec{z}$

(c) $\vec{y}$
