MATH 221–02 (Kunkle), Quiz 1 | Name: ____________________
10 pts, 10 minutes | Jan 18, 2024

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1 (10 pts). Let $\mathbf{u} = \langle 2, -3, 1\rangle$ and $\mathbf{v} = \langle -1, -2, 1\rangle$.

a. Find the vector projection of $\mathbf{v}$ onto $\mathbf{u}$.

b. Find the scalar projection of $\mathbf{v}$ onto $\mathbf{u}$.

Solution:

1a.(Source: 12.3.41-42)

$$\begin{aligned}\operatorname{proj}_{\mathbf{u}} \mathbf{v} = \frac{\mathbf{v}\cdot\mathbf{u}}{\mathbf{u}\cdot\mathbf{u}}\mathbf{u} &= \frac{2\cdot(-1)+(-3)\cdot(-2)+1\cdot 1}{2^2+(-3)^2+1^2}\langle 2, -3, 1\rangle \\ &= \frac{5}{14}\langle 2, -3, 1\rangle, \text{ or } \left\langle \frac{5}{7}, \frac{-15}{14}, \frac{5}{14}\right\rangle.\end{aligned}$$

1b.(Source: 12.3.42)

$$\operatorname{comp}_{\mathbf{u}} \mathbf{v} = \frac{\mathbf{v}\cdot\mathbf{u}}{|\mathbf{u}|} = \frac{5}{\sqrt{14}}.$$

The scalar projection is the same as $|\mathbf{v}|\cos\theta$, the signed length of the vector projection. In this case, the sign is positive, because the projection of $\mathbf{v}$ onto $\mathbf{u}$ points in the same direction as $\mathbf{u}$.