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Math 40
Systems of Linear Equations
Friday, January 20, 2016

1.2.{40, 42, 48, 50, 68, 70}

40 Find the projection of $\mathbf{v}$ onto $\mathbf{u}$ given $\mathbf{u} = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$ and $\mathbf{v} = \begin{bmatrix} -2 \\ 4 \end{bmatrix}$. Then, draw a sketch.

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42 Find the projection of $\mathbf{v}$ onto $\mathbf{u}$ given $\mathbf{u} = \begin{bmatrix} 1/2 \\ -1/4 \\ -1/2 \end{bmatrix}$ and $\mathbf{v} = \begin{bmatrix} 2 \\ 2 \\ -2 \end{bmatrix}$.

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48 Find all values of the scalar k for which the two vectors are orthogonal.
$\mathbf{u} = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$, $\mathbf{v} = \begin{bmatrix} k+1 \\ k-1 \end{bmatrix}$.

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50 Describe all vectors $\mathbf{v} = \begin{bmatrix} x \\ y \end{bmatrix}$ that are orthogonal to $\mathbf{u} = \begin{bmatrix} 3 \\ 1 \end{bmatrix}$

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68

(a) Prove that if $\mathbf{u}$ is orthogonal to both $\mathbf{v}$ and $\mathbf{w}$, then $\mathbf{u}$ is orthogonal to $\mathbf{v} + \mathbf{w}$.

(b) Prove that if $\mathbf{u}$ is orthogonal to both $\mathbf{v}$ and $\mathbf{w}$, then $\mathbf{u}$ is orthogonal to $s\mathbf{v} + t\mathbf{w}$ for all scalars s and t.

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70

(a) Prove that $\text{proj}_u(\text{proj}_u(\mathbf{v})) = \text{proj}_u(\mathbf{v})$.

(b) Prove that $\text{proj}_u(\mathbf{v} - \text{proj}_u(\mathbf{v})) = \mathbf{0}$.

(c) Explain (a) and (b) geometrically.

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