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MAC 2313.9722
Cyr

Quiz 1

You must show all work to receive full credit!!

Problem 1. (3 points) Find the vector projection of $\mathbf{b} = \langle 3, 1, 2\rangle$ onto $\mathbf{a} = \langle 2, -2, 4\rangle$.

$$\text{proj}_{\hat{a}} \hat{b} = \frac{\hat{a}\cdot\hat{b}}{\hat{a}\cdot\hat{a}}\,\hat{a}$$

$$\hat{a}\cdot\hat{b} = \langle 2,-2,4\rangle \cdot \langle 3,1,2\rangle = 6-2+8 = \underline{12}$$

$$\hat{a}\cdot\hat{a} = \langle 2,-2,4\rangle \cdot \langle 2,-2,4\rangle = 4+4+16 = \underline{24}$$

$$\Rightarrow \text{proj}_{\hat{a}} \hat{b} = \frac{12}{24}\hat{a} = \frac{1}{2}\langle 2,-2,4\rangle = \boxed{\langle 1,-1,2\rangle}$$

Problem 2. (7 points) Find the equation of the plane passing through the points $(1, 0, 1)$, $(-2, 1, 3)$, and $(4, 2, 5)$.

Plane contains vectors $\overrightarrow{AB} = \langle -2-1, 1-0, 3-1\rangle = \langle -3,1,2\rangle$ and $\overrightarrow{AC} = \langle 3,2,4\rangle$, so a normal vector is given by their cross product:

$$\hat{n} = \langle -3,1,2\rangle \times \langle 3,2,4\rangle = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -3 & 1 & 2 \\ 3 & 2 & 4 \end{vmatrix} = \langle 4-4, -(-12-6), -6-3\rangle$$

$$= \langle 0, 18, -9\rangle$$

We can use $\frac{1}{9}\hat{n} = \langle 0,2,-1\rangle$ instead. The plane equation is

$$\langle 0,2,-1\rangle\cdot\langle x,y,z\rangle = \langle 0,2,-1\rangle\cdot\langle 1,0,1\rangle$$

$$\Rightarrow \boxed{2y - z = -1}$$