1. Find the parametric equations of the line through $P_1(1,1,1)$ with direction $v = <1,0,1>$. 

\[ r = <x, y, z> \]

Any point on this line will satisfy the following equation 

\[ r = \vec{OP} + tv \]

\[ <x, y, z> = <1, 1, 1> + t <1, 0, 1> = <1+t, 1, 1+t> \]

Write out 3 separate parametric equations:

\[ x = 1+t \quad z = 1+t \]
\[ y = 1 \quad (t = 0) \]

\[ x - 1 = z - 1 \]

2. Find the symmetric equations of the line you found in question 1.

From 
\[ x = 1+t \quad t = x - 1 \]
\[ z = 1+t \quad t = z - 1 \]
\[ y = 1 \quad (t = 0) \]

3. Find the equation of the plane through $P_1(1,1,1)$ with normal $\vec{n} = <1,0,1>$.

Any point $Q$ that is on the plane will satisfy the following equation 

\[ \vec{PQ} \cdot \vec{n} = 0 \]

\[ <x-1, y-1, z-1> \cdot <1, 0, 1> = 0 \]

\[ (x-1)(0) + (y-1)(0) + (z-1)(1) = 0 \]

\[ x + z = 2 \]

4. Find a vector perpendicular to both $\vec{a} = <1, 1, 1>$ and $\vec{b} = <1, 0, 1>$.

\[ \vec{a} \times \vec{b} = \begin{vmatrix}
\hat{i} & j & k \\
1 & 1 & 1 \\
1 & 0 & 1 \\
\end{vmatrix} \]

\[ = (1\hat{i} - (1-1)\hat{j} + (0-1)\hat{k}) \]
\[ = \hat{i} - \hat{k} \]
\[ = <1, 0, -1> \]