1 (a) Since the matrix is triangular, its determinant is:

$(1)(2)(3)(4)(5)(6)(7) = \boxed{5040}$

(b) $\begin{vmatrix} 1 & 2 & 3 \\ 1 & 0 & 4 \\ 2 & 0 & 5 \end{vmatrix} = -2 \begin{vmatrix} 1 & 4 \\ 2 & 5 \end{vmatrix} = -2(5-8) = (-2)(-3) = \boxed{6}$

(c) Since the second row is 2 times the first row, the determinant is $\boxed{0}$.

2 $\text{proj}_{\vec{a}}\vec{u} = \frac{1}{\|\vec{a}\|^2}(\vec{u}\circ\vec{a})\vec{a} = \frac{1}{4}(2-1+2-1)(1,-1,1,-1)$

$= \left(\frac{1}{2}, \frac{-1}{2}, \frac{1}{2}, \frac{-1}{2}\right)$

3 $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \sim \begin{bmatrix} 1 & 2 & 3 \\ 0 & -3 & -6 \\ 0 & -6 & -12 \end{bmatrix} \sim \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 2 \\ 0 & -6 & -12 \end{bmatrix} \sim \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 2 \\ 0 & 0 & 0 \end{bmatrix}$

$\sim \begin{bmatrix} 1 & 0 & -1 \\ 0 & 1 & 2 \\ 0 & 0 & 0 \end{bmatrix}$, giving $x = z$, $y = -2z$, $z = z$.

We identify z with a parameter t, and $\vec{r} = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$. We then have $\boxed{\vec{r} = t\begin{bmatrix} 1 \\ -2 \\ 1 \end{bmatrix}}$.

4 Displacements in the plane are: $(-1,0,0)-(1,0,0) = (-2,0,0)$ and $(1,1,1)-(1,0,0) = (0,1,1)$

a normal to the plane is thus:

$\begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ -2 & 0 & 0 \\ 0 & 1 & 1 \end{vmatrix} = (-2)(-1)\begin{vmatrix} \vec{j} & \vec{k} \\ 1 & 1 \end{vmatrix} = 2(\vec{j} - \vec{k}) = (0,2,-2)$

For simplicity we may take $\vec{n} = \frac{1}{2}(0,2,-2) = (0,1,-1)$.

An equation for the plane is thus:

$[(x,y,z)-(-1,0,0)]\circ(0,1,-1) = 0$, that is:

$\boxed{y - z = 0}$