

## Equation of a Plane

1. Find the equation of the plane containing the three points  $P_1 = (1, 0, 1)$ ,  $P_2 = (0, 1, 1)$ ,  $P_3 = (1, 1, 0)$ .

**Answer:** The vectors  $\overrightarrow{P_1P_2}$  and  $\overrightarrow{P_1P_3}$  are in the plane, so

$$\mathbf{N} = \overrightarrow{P_1P_2} \times \overrightarrow{P_1P_3} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ -1 & 1 & 0 \\ 0 & 1 & -1 \end{vmatrix} = \mathbf{i}(-1) - \mathbf{j}(1) + \mathbf{k}(-1) = \langle -1, -1, -1 \rangle.$$

is a normal to the plane. In point-normal form the equation for the plane is

$$-(x - 1) - y - (z - 1) = 0 \Leftrightarrow x + y + z = 2.$$

2. Find the equation of the line through  $(1, 2)$  and  $(3, 1)$  in point-normal form.

**Answer:** A vector along the line is  $\mathbf{v} = \langle 3, 1 \rangle - \langle 1, 2 \rangle = \langle 2, -1 \rangle$ , so a normal to the line is  $\mathbf{N} = \langle 1, 2 \rangle$ . Thus, in point-normal form the line has equation

$$1(x - 1) + 2(y - 2) = 0 \Leftrightarrow x + 2y = 5.$$

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