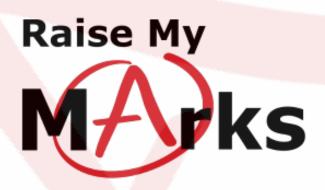Distance between two points

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Distance between two points

Sometimes we need to find the distance between two points. How do we do this? We need to use the *distance formula*. The distance formula is given by,

$$D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \tag{1}$$

in $\mathbb{R}^2$ where our two points are $P = (x_1, y_1)$ and $Q = (x_2, y_2)$; the distance formula in $\mathbb{R}^3$ is given by,

$$D = \sqrt{(x_2 - x_2)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2} \tag{2}$$

where $P = (x_1, y_1, z_1)$ and $Q = (x_2 y_2, z_2)$. Let's consider some examples.

Example in $\mathbb{R}^2$

Find the distance between the points P=(3, -2) and Q=(-1, 3).

Solution   We need to use the distance formula (1).

$$
\begin{aligned}
D = \;\; &= \;\; \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \\
&= \;\; \sqrt{(3 - (-1))^2 + (-2 - 3)^2} \\
&= \;\; \sqrt{(3 + 1)^2 + (-5)^2} \\
&= \;\; \sqrt{4^2 + 25} \\
&= \;\; \sqrt{41}
\end{aligned}
$$

Therefore, the distance between P and Q is $\sqrt{41}$.

Example in $\mathbb{R}^3$

Find the distance between the points $P = (3, -1, 2)$ and $Q = (1, 0, 1)$.

Solution   We need to use the distance formula (2).

$$
\begin{aligned}
D \;\; &= \;\; \sqrt{(x_2 - x_2)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2} \\
&= \;\; \sqrt{(1 - 3)^2 + (0 - (-1))^2 + (1 - 2)^2} \\
&= \;\; \sqrt{(-2)^2 + 1^2 = (-1)^2} \\
&= \;\; \sqrt{4 + 1 + 1} \\
&= \;\; \sqrt{6}
\end{aligned}
$$

Therefore, $\sqrt{6}$ is the distance between P and Q.

Exercises

Find the distance between tge points P and Q below.

a) $P(1, 2), Q(0, 2)$

b) $P(4, 1), Q(-2, 0)$

c) $P(-1, 2), Q(2, 3)$

d) $P(5, -2), Q(2, 2)$

e) $P(-5, 3), Q(-4, 1)$

f) $P(-2, 5, 0), Q(1, 3, 3)$

g) $P(4, -2, 0), Q(-1, 3, 2)$

h) $P(-1, 0, -2), Q(0, 4, 3)$

i) $P(-3, 2, -4), Q(2, -4, 0)$

j) $P(0, -4, 1), Q(-1, 3, 0)$