

### 1. Problem

Given two points  $p = (3, 4)$  and  $q = (5, 2)$  in a Cartesian coordinate system:

- (a) What is the Manhattan distance  $d_1(p, q)$ ?
- (b) What is the Euclidean distance  $d_2(p, q)$ ?
- (c) What is the maximum distance  $d_\infty(p, q)$ ?

### Solution

The distances are visualized below in green ( $d_1$ ), red ( $d_2$ ), and blue ( $d_\infty$ ).

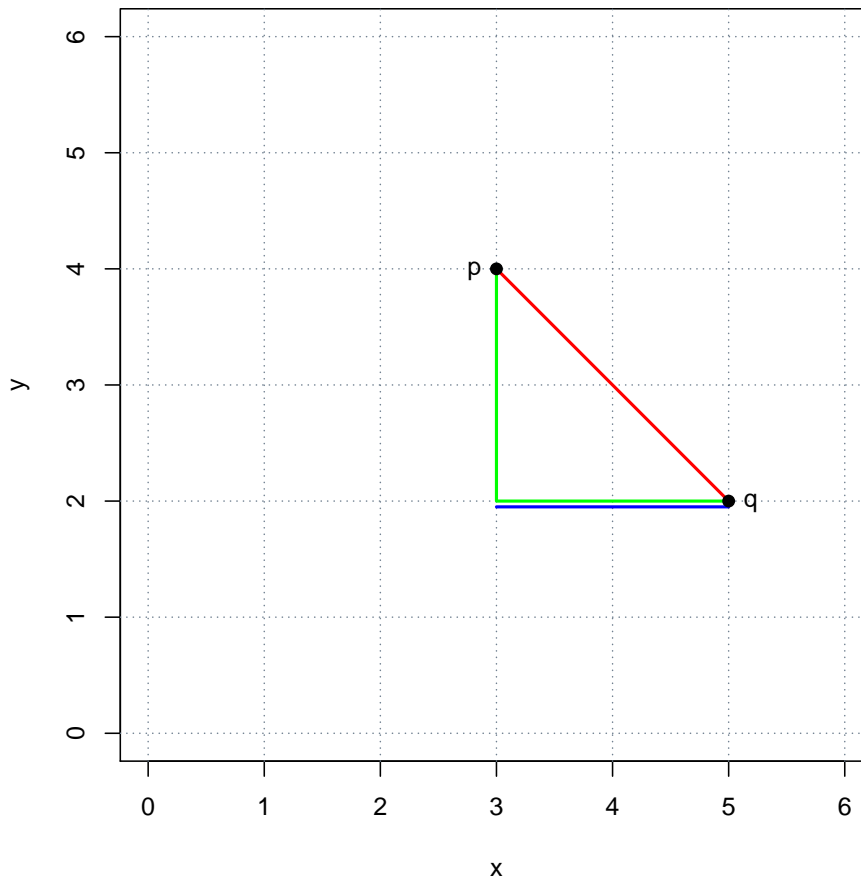


Figure 1:

- (a)  $d_1(p, q) = \sum_i |p_i - q_i| = |3 - 5| + |4 - 2| = 4.$
- (b)  $d_2(p, q) = \sqrt{\sum_i (p_i - q_i)^2} = \sqrt{(3 - 5)^2 + (4 - 2)^2} = 2.828.$
- (c)  $d_\infty(p, q) = \max_i |p_i - q_i| = \max(|3 - 5|, |4 - 2|) = 2.$