

ME 260: Structural Optimization: Size, Shape, and Topology

Assigned: Sep. 10, 2026

In-class quiz 9 (10 mins)

Due: Sep. 10, 2026

Name:

We are aware that a metric $d(x, y)$ must satisfy four properties:

- (i) $d(x, y) \geq 0$ (Non-negativity)
- (ii) $d(x, x) = 0$ (Zero-distance for only identical objects)
- (iii) $d(x, y) = d(y, x)$ (Symmetry)
- (iv) $d(x, z) \leq d(x, y) + d(y, z)$ (Triangle inequality)

In order to help you understand them better, let us consider why each one is necessary or if all four are actually independent of one another.

Example 1

Consider $d(x, y) = |x - y|^2$

Verify if it satisfies the four properties. Show your work

- | | | |
|-------|--|--------|
| (i) | Non-negativity | Yes/No |
| (ii) | Zero-distance for only identical objects | Yes/No |
| (iii) | Symmetry | Yes/No |
| (iv) | Triangle inequality | Yes/No |

Example 2

Consider $d(x, y) = \begin{cases} (y - x) & \text{if } y \geq x \\ 2(x - y) & \text{if } y < x \end{cases}$

Verify if it satisfies the four properties. Show your work

(v)	Non-negativity	Yes/No
(vi)	Zero-distance for only identical objects	Yes/No
(vii)	Symmetry	Yes/No
(viii)	Triangle inequality	Yes/No

Example 3

Consider $d(x, y) = 1$

Verify if it satisfies the four properties. Show your work

(ix)	Non-negativity	Yes/No
(x)	Zero-distance for only identical objects	Yes/No
(xi)	Symmetry	Yes/No
(xii)	Triangle inequality	Yes/No

Bonus question (submit in the next class)

Is there an example of a metric that satisfies all but the non-negativity property?