

ML - Test1

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Each problem carries 3 marks. Problem 1 is compulsory.
Solve any one of the remaining two. 45 minute test.

1. (Compulsory) Prove or disprove that the function

$$f(x, y) = (3x + 4y - 5)^2 + (2x - y - 1)^2$$

is convex on $\mathbb{R}^2$.

2. Define the ℓ_∞ -norm on $\mathbb{R}^n$ by

$$\|x\|_\infty = \max_{1 \leq i \leq n} |x_i|.$$

Show that $\|\cdot\|_\infty$ satisfies the axioms of a norm.

3. Let

$$\Theta^n = \left\{ p \in \mathbb{R}^n : p_i \geq 0 \text{ for all } i, \sum_{i=1}^n p_i^2 = 1 \right\}.$$

Is Θ^n a convex set for $n = 2$? Explain. [Hint: Draw it to get an idea. But no marks for drawings.]