

L^p norms

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Prove or disprove that to every positive function g on $(0, \infty)$ such that $g(p) \rightarrow \infty$ as $p \rightarrow \infty$, there exists a Lebesgue measurable function f on $(0,1)$ such that $\|f\|_p \rightarrow \infty$ as $p \rightarrow \infty$ and $\|f\|_p \leq g(p)$ for sufficiently large p .

Note: Such an f , if exists, cannot be essentially bounded.