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Research article

A Sample Article on Fixed Point Approximation in Banach Spaces

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ABSTRACT

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1 Introduction

Let C be a nonempty closed convex subset of a Banach space X, and let $T : C \to C$. A point $p \in C$ is a fixed point of T if $Tp = p$. The purpose of this illustrative article is to demonstrate typography and publishing metadata rather than to present new research [3].

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2 Preliminaries

Definition 2.1. A mapping $T : C \to C$ is a contraction if there exists $q \in [0, 1)$ such that

$$\|Tx - Ty\| \leq q\|x - y\| \qquad (x, y \in C).$$

The following pages are separated explicitly in this demonstration to make the running headers easy to inspect. Remove these demonstration page breaks in a real manuscript.

3 Main result

Theorem 3.1. *Let C be a nonempty closed subset of a Banach space X, and suppose $T : C \to C$ is a contraction with constant $q \in [0, 1)$. Then T has a unique fixed point $p \in C$, and the sequence $x_{n+1} = Tx_n$ converges in norm to p for every $x_0 \in C$.*

Proof. For $0 < q < 1$, induction gives $\|x_{n+1} - x_n\| \leq q^n\|x_1 - x_0\|$. For $m > n$,

$$\begin{aligned} \|x_m - x_n\| &\leq \sum_{k=n}^{m-1} \|x_{k+1} - x_k\| \\ &\leq \frac{q^n}{1 - q}\|x_1 - x_0\|. \end{aligned} \tag{1}$$

Thus the sequence is Cauchy and converges to a point $p \in C$. Continuity gives $Tp = p$. If r is another fixed point, then $\|p - r\| \leq q\|p - r\|$, so $p = r$. If $q = 0$, T is constant and the iteration reaches its unique fixed point after one step. □

Remark 3.2. The theorem, lemma, corollary, definition, example and remark environments share a counter within each section. Their styles distinguish assertions from definitions and comments [4].

3.1 Error estimate

The fixed point relation yields

$$\|x_n - p\| \leq q^n\|x_0 - p\|, \qquad n \geq 0. \tag{2}$$

Equation (2) describes a geometric bound on the approximation error. Theorems and equations can be cross-referenced using standard LaTeX commands.

4 Illustrative example

Figure 1 illustrates the placement of a figure in the article.

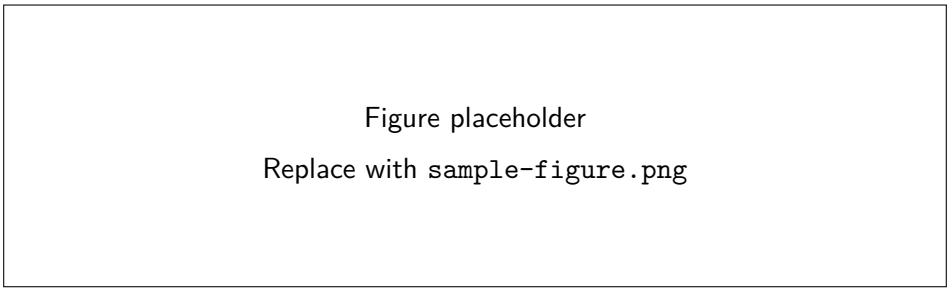

Figure 1: Insert a descriptive caption explaining the figure.

Example 4.1. On $C = [0, 1]$, define $Tx = (x + 1)/3$. This mapping has contraction constant $1/3$ and fixed point $p = 1/2$. Starting at $x_0 = 0$, the first three iterates are $1/3$, $4/9$ and $13/27$.

Table 1: Illustrative iterates for the sample contraction.

n	x_n	$\lvert x_n - 1/2\rvert$
0	0	1/2
1	1/3	1/6
2	4/9	1/18
3	13/27	1/54

5 Conclusion

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