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Functional Equations

Part II

SHUBORNO DAS

In Part I, I explained the different techniques to solve functional equations. In most cases, the steps to solve them are similar to those in solving algebraic equations. However there is one scenario where using the algebraic method to solve a functional equation may lead to an incomplete solution; i.e., only a subset of functions that solve the FE may be identified and not the complete list. This error is known as pointwise trap. In Part II of the two-part article on functional equations, we discuss the notion of pointwise trap and learn different ways to overcome it.

Pointwise Trap

What is a 'pointwise trap'? Consider the following example:

Find all functions $f: \mathbb{R} \rightarrow \mathbb{R}$ such that $f(x)^2 = xf(x)$.

Factorising the equation $f(x)^2 - xf(x) = 0$ gives $f(x)(f(x) - x) = 0$. Solving it like a normal equation would yield $f(x) = 0$ for all x or $f(x) = x$ for all x .

Is this the complete list of functions that solve the FE?

Consider a function $f(x)$ defined as follows: $f(x) = x$ for all x except $f(5) = 0$. If $x \neq 5$, then $f(x) - x = 0 \implies f(x)^2 = xf(x)$. If $x = 5$, then $f(x) = 0 \implies f(x)^2 = xf(x)$. So clearly this function also satisfies the FE. This proves that our earlier list of functions that satisfy the FE was incomplete.

It is not too difficult to deduce that there are infinitely many solutions to this FE. Refer Figure 1 as another example of such a function that satisfies the FE.

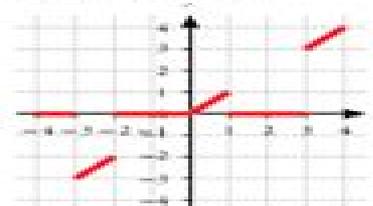


Figure 1. Example of a function solving the equation $f(x)^2 = xf(x)$

Keywords: Functional equation, function, domain, range, injective, surjective, even, odd, continuous, pointwise trap, solution

On Functions And Functional Equations

Yi-Tong Ma



On Functions And Functional Equations:

On Functions And Functional Equations Book Review: Unveiling the Magic of Language

In a digital era where connections and knowledge reign supreme, the enchanting power of language has become more apparent than ever. Its power to stir emotions, provoke thought, and instigate transformation is really remarkable. This extraordinary book, aptly titled "**On Functions And Functional Equations**," compiled by a very acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound impact on our existence. Throughout this critique, we shall delve to the book's central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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