# DERIVATIVE METHOD FOR SOLVING CUBIC EQUATIONS

Alireza Haghi Aghkand[1,*]

[1] *University of Qom, Qom, Iran*

## ABSTRACT

Cubic equations are important because of their application in different fields of engineering and science. There are different methods for solving cubic equations which have been completed through decades. The Babylonians, around 2000 BC, used geometric methods to solve cubic equations [1]. The Greeks attempted to solve cubic equations using the intersections of conic sections [2]. Al-Khwarizmi's work primarily focused on quadratic equations, but it laid the foundation for later Islamic mathematicians who tackled cubic equations [3]. Khayyam provided geometric solutions to cubic equations by intersecting conic sections. He classified cubic equations systematically [4]. del Ferro solved the depressed cubic equation but kept his solution secret until his death, passing it only to his student Antonio Fior [5]. Tartaglia discovered a method to solve the depressed cubic equation independently. His public challenge against Fior brought him fame [6]. Cardano published the solutions to cubic equations in "Ars Magna" (1545), which included Tartaglia's method and his contributions [7]. Ferrari, a student of Cardano, solved the quartic equation, which involves reducing it to a cubic equation [8]. Descartes' work in analytic geometry introduced methods to find the roots of polynomials, including cubic equations, using coordinates [9]. Abel and Galois developed group theory, which provided insights into the solvability of polynomial equations, including cubic equations, by radicals. Galois' work laid the foundation for modern algebra and provided criteria for determining the solvability of general polynomial equations [10]. All of these methods have some problems; some of them are too long and hard to memorize, some of them are not accurate and have errors, and some are not general. This article attempts to represent a method which has been easy to use and memorize and also accurate. In this article, we try to find a closed-form formula for deriving one of the roots of any cubic equation by using some substitutions. In other words, we use some substitutions to convert the cubic equation to a quadratic equation and then solve it with a quadratic formula (we call this method the Derivative method of solving equations, or the D-Method). This article just studies cubic equations, but the method used for deriving the formula may be generalizable to higher-degree (also lower-degree) equations, too.

***K*eywords** Cubic equation · Cubic formula · Derivative applications

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[*] *Corresponding Author's E-mail: alireza_h378@yahoo.com*