A Comparison of Two Non-Calculus Methods for Cost Minimization: The Case of the Modified Spillman Production Function

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Abstract

Applications of various non-calculus optimization techniques to solving fundamental cost minimization models from economic theory have been proposed over the past few decades. In general, these models originate from inventory theory or microeconomics, and the proposed techniques are primarily based on algebraic, geometric, or cost-comparison approaches. The main disadvantage of the aforementioned techniques is that they rely on a priori assumptions about optimal solutions or on the functional form of the objective functions. Consequently, a general approach for deriving optimal solutions without the use of derivatives was proposed in 2023 by Çalışkan. This non-calculus technique is capable of solving a broad class of unconstrained optimization problems encountered in operations research and management science without requiring problem-specific assumptions. Çalışkan demonstrated how the approach can be applied to objective functions with quadratic and cubic forms, as well as to functions involving natural logarithms, trigonometric expressions, and exponential terms. However, the case of a general power function was not addressed. Therefore, the first objective of this study is to demonstrate how the general approach can be applied to a cost minimization problem with the modified Spillman production function, which exhibits a general power form. This model originates from agricultural economics and plays an important role in economic theory. The second objective of our study is to compare the general approach with the method based on the weighted arithmetic mean–geometric mean inequality. We discuss the advantages and disadvantages of both approaches, particularly in terms of their accessibility to students, practitioners, and a broader audience not familiar with differential calculus.

Keywords

Cost minimization, general approach, weighted arithmetic mean–geometric mean inequality approach, without derivatives.