

Using Congruent Triangles to Facilitate Optimization Problems

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Abstract:

Pick a point within the first quadrant that lies on a parabola opening down with vertex on the positive y -axis. Draw a tangent line through this point and then consider the triangle formed by the tangent line and the positive axes. Where should this point be placed to create the triangle with minimum area? The purpose of this paper is to explain why a simple derivative combined with congruent triangles is a valid method of solving problems similar to this. Examples are then shown and generalizations developed for any parabola opening down with vertex in the first quadrant. Students are encouraged to complete mathematical steps. Teachers will be interested in the use of a geometric concept to solve a calculus problem.



Benjamin Stick is a first-year student at Amherst College. He wrote this article during his junior and senior years of high school at The Roxbury Latin School in Massachusetts. His academic interests include applied mathematics and economics. He is also an avid sports fan and was an active participant on the soccer and baseball teams at Roxbury Latin, as well as multiple fantasy football leagues. Benjamin follows passionately all of Boston's professional sports teams and does his best to watch every game of Arsenal F.C., his favorite soccer team in the English Premier League. It was a thrill to author this article with his grandfather.



Marvin Stick is a professor in the Department of Mathematical Sciences at University of Massachusetts Lowell. His students include undergraduates majoring in management, engineering, or the sciences, and graduate students, high-school teachers, and adults pursuing careers in education. He enjoys engaging them all in the applications of mathematics in their chosen fields. He is also a member of the mathematics grade 10 assessment development committee for the Massachusetts Comprehensive Assessment System (MCAS 2.0) mathematics exam. Previously, he was involved with rocket and satellite attitude determination under government grants at Boston College. He holds a BS in mathematics and PhD in educational research, tests, and measurements from Boston College, and an MA in mathematics from Boston University.