

**Topic**

Quadratic Functions and Professional Golf Tournaments

**Grade Level**

Algebra 1 - 9th Grade

**Lesson Durations**

Two 45 minute class periods

**Modeling Activity**

In this activity, the students will see how quadratics appear in real life events, specifically golf. There is new technology that helps track a golf ball on TV, called [Toptracer](#). This technology is used in professional tournaments and visually shows the path of a golf ball and how its path is a quadratic. The students will be in pairs and will be randomly assigned a number 1-15, which will assign the golfer to them. Once they have their assigned golfer, they will choose which hole from the tournament they would like to use. They will look at the data, from this link [US Open Player Statistics Link](#), that shows where the golfer hit the ball and where the ball landed. Using these two pieces of data as x-intercepts, the students will create a quadratic function to represent the ball's path. They will first write the quadratic in the form  $y = a(x - p)(x - q)$  and expand from there to write the function in standard form,  $y = ax^2 + bx + c$ . The students will investigate the special points of the function, x-intercepts, y-intercept, and vertex, and compare them to the actual points from the data given. A photo of the data the students will be using is below:



## Engaging Context

To start this activity, we will show the following video about the Toptracer technology used in professional golf matches. [Toptracer Video](#) This activity will serve as an engaging context for quadratics because it will give students real data to create quadratic equations from and be able to visually see where quadratics are present in the real world. It will also be engaging because they are collecting their own data instead of the teacher presenting them with arbitrary data that does not mean anything to them.

## Measurable Objective

Students will be able to:

- Create a quadratic function in intercept form,  $y = a(x - p)(x - q)$  that represents the path of the golf ball
- Expand the equation they wrote in intercept form to standard form,  $y = ax^2 + bx + c$
- Find the vertex of the quadratic
- Interpret the special points in relation to the path of the golf ball

## Standards

- [CCSS.MATH.CONTENT.HSA.CED.A.2](#) Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- [CCSS.MATH.CONTENT.HSF.BF.A.1](#) Write a function that describes a relationship between two quantities.
- [CCSS.MATH.CONTENT.HSF.IF.B.4](#) For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.\**
- [CCSS.MATH.CONTENT.HSF.IF.C.7.A](#) Graph linear and quadratic functions and show intercepts, maxima, and minima.
- [CCSS.MATH.CONTENT.HSF.IF.C.7](#) Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.\*

## Evidence

We are not currently in session with our students but we have created documents to show how we will gather evidence from our students. The students will be using Chromebooks to record data on the golfer assigned to them from the link provided, [US Open Player Statistics Link](#). The students will need to know that the point where the ball is hit from and the landing point represent the x-intercepts. The Toptracer technology should help them make this connection as they will see a visual representation of the path of the ball. The students will fill in their responses on the provided Google Form, [Quadratic Golf Lesson Form](#), and use the worksheet below to show their work. They will need to have knowledge of Intercept and Standard form and how to go between the two. We have then created a survey [Survey for Quadratic Golf Lesson](#) to get feedback from the students about this activity.

Directions: Use the table below to find the golfer you were assigned. As you find your functions, fill in the table for your golfer. Use the Google Form to organize your thinking. [Quadratic Golf Lesson Form](#)

Turn to the back of this worksheet to find your space to show your work.

Use this link to get the data for your golfer. Click your golfer's name and scroll to the bottom of the page to the photo showing the shots for each hole. [US Open Player Statistics Link](#)

Rank (as of June 16, 2019)	Golfer	Student Pair for each golfer	2019 US Open  Hole	Intercept Form of the function that models the ball flight  $y = a(x - p)(x - q)$	Standard Form of the function that models the ball flight  $y = ax^2 + bx + c$	Vertex Coordinates  (x, y)
1	Brooks Koepka					
2	Dustin Johnson					
3	Justin Rose					
4	Rory McIlroy					
5	Tiger Woods					
6	Francesco Molinari					
7	Justin Thomas					
8	Patrick Cantlay					
9	Xander Schauffele					
10	Bryson DeChambeau					
11	Jon Rahm					
12	Gary Woodland					
13	Matt Kuchar					
14	Rickie Fowler					
15	Paul Casey					

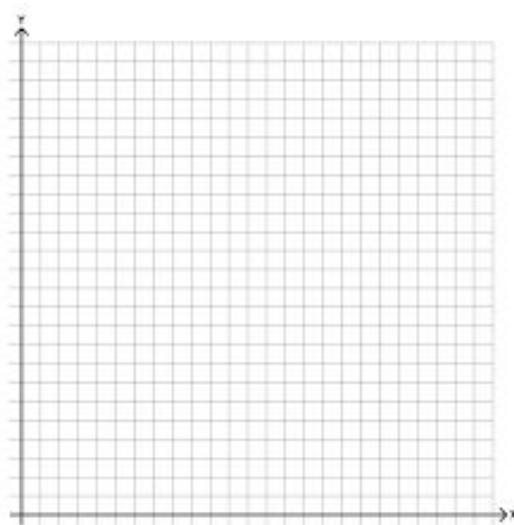
Use this area to show your work. Be prepared to explain your thinking in complete sentences in the Google Form.

Will this quadratic be opening up or down? \_\_\_\_\_

What does this mean about the value of "a"? \_\_\_\_\_

Work for "Intercept Form"  $y = a(x - p)(x - q)$

\*\*Sketching a graph of the golf ball may be helpful.



Using your Intercept Form equation, now write the quadratic in Standards Form.

Work for Standard Form  $y = ax^2 + bx + c$

Now, find the vertex using a method of your choice.

Vertex: \_\_\_\_\_

