Activity Overview

In this activity, students will explore parametric equations by finding the horizontal and vertical distances traveled by a projectile. Parametric equations will be converted into quadratic equations for the purpose of exploring projectile motion problems.

Topic: Parametric Equations

- Graphing Parametric Equations
- Converting from Parametric to Quadratic Equations

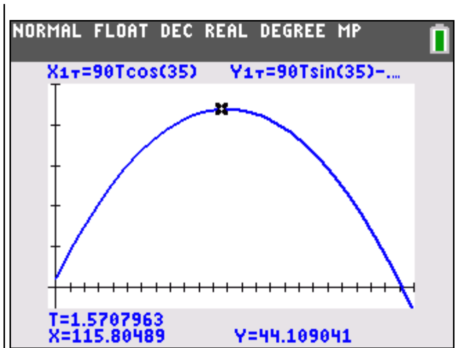
Teacher Preparation and Notes

- The first problem explores parametric equations. The second problem engages students in the conversion of a parametric equation model to a quadratic model for projectile motion.
- Point out to students that air resistance is not considered in these problems, but in reality, wind direction and speed play a critical role in the motion of projectiles.
- **To download the data list and student worksheet, go to education.ti.com/exchange and enter "12646" in the keyword search box.**

Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the keyword search box.

- Exploring Parametric Equations With the "Human Cannonball" (TI-Nspire technology) — 9554
- Parametric Equations and Graph Data Bases (TI-84 Plus family) — 8800
- Parametric Equations (TI-84 Plus family with TI-Navigator) — 1920
- Where is the Bullet? (TI-84 Plus family) — 6181



This activity utilizes MathPrint™ functionality and includes screen captures taken from the TI-84 Plus C Silver Edition. It is also appropriate for use with the TI-83 Plus, TI-84 Plus, and TI-84 Plus Silver Edition but slight variances may be found within the directions.

Compatible Devices:

- TI-84 Plus Family
- TI-84 Plus C Silver Edition

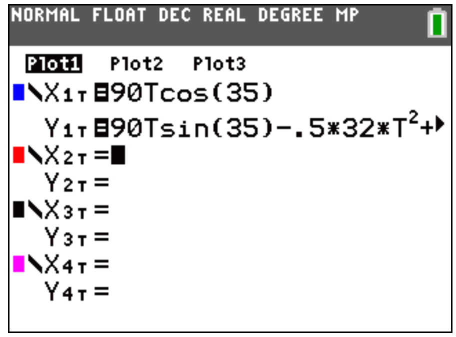
Associated Materials:

- SpringTraining_Student.pdf
- SpringTraining_Student.doc

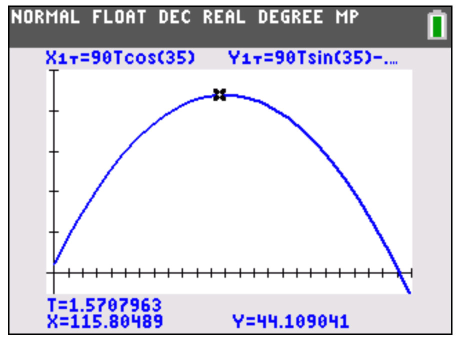
Click HERE for Graphing Calculator Tutorials.

Problem 1 – Introduction to Parametric Equations

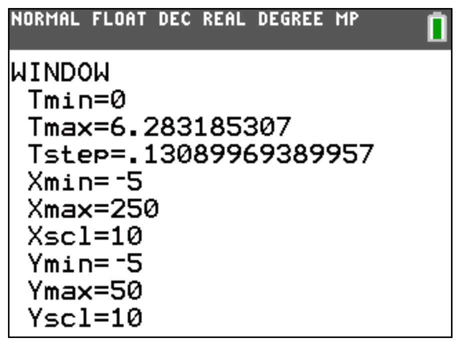
Students are introduced to the use of parametric equations to model the motion of a baseball. Remind students to be watchful of units as they write their equations! A common error is to choose the wrong value for *g*. If velocity is in feet per second, students must use 32 ft/s^2. If velocity is in meters per second, they must use 9.8 m/s^2.



Once equations are written, students graph the equations. Instructions are provided in the student worksheet for changing the graph type to parametric. For the purpose of the problems contained in this activity, students do not need to modify *t* or *t* step values.



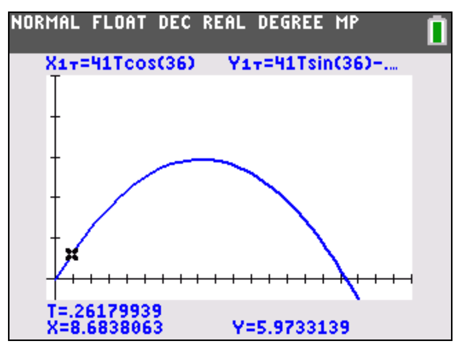
Students will need to adjust their viewing windows to view key details, such as the maximum and zeros. Discuss with students values that are reasonable for the context of the problem. Many students have difficulty with the concept of large distances, such as those involved in the problems in this activity.



Problem 2 – Parametric to Quadratic

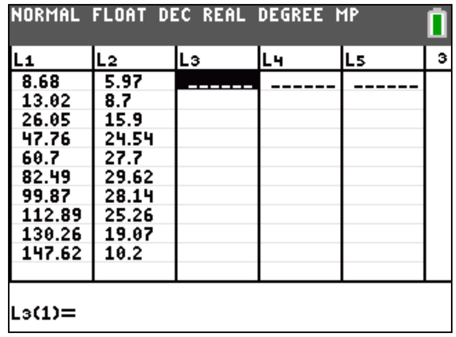
In this problem, students use a parametric graph to generate a quadratic function. Both graphs are used in determining key values from the graph to answer relevant questions.

Students are provided with a problem and the parametric equations related to the motion of a golf ball. They are asked to graph the equations, use TRACE to obtain 10 different data points and to enter them in the List Editor.



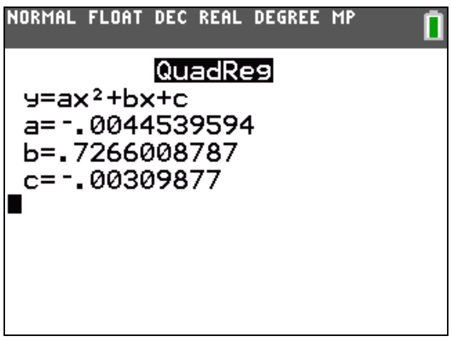
Students are to perform a quadratic regression to generate the quadratic function that corresponds to the parametric equations as outlined in the student worksheet.

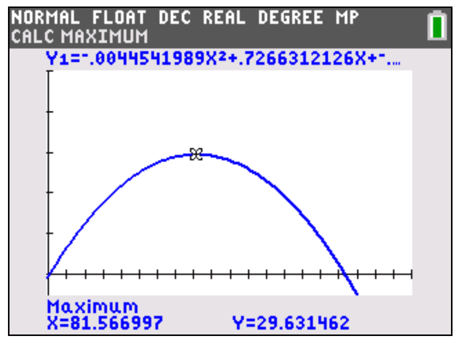
Students should find that the quadratic function is useful in that key values (the maximum and zeros) are easily obtained on the graph of the function.



Ask students, *what information parametric equations provide in this situation that quadratic functions do not provide?* Students should note that time is present in the parametric equations, but not in the quadratic equation.

Students answer a variety of questions related to interpreting the graphs and finding key function values.





Solutions – Student Worksheet

1. 32 ft/sec^2 because the units are in feet.
2. $x(t) = 90t\cos(35°)$

   $y(t) = 90t\sin(35°) - \frac{1}{2}\cdot 32t^2 + 2.5$
3. about 44 feet
4. about 241 feet
5. about 3.3 seconds
6. $y = -0.0046x^2 + 0.7265x$

   Note that the constant term is so small that it may be left out because of rounding to the nearest ten thousandth
7. about 163 meters
8. about 4.9 seconds
9. about 29.6 meters
10. yes; at 150 meters from the golfer the ball is about 8.66 meters high.