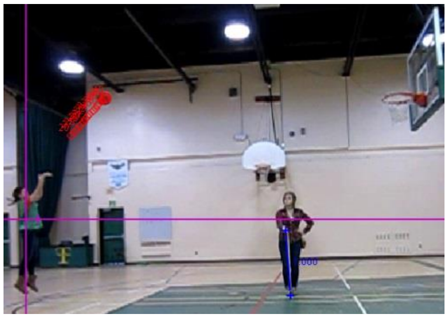
Application of Polynomials Project | 2013

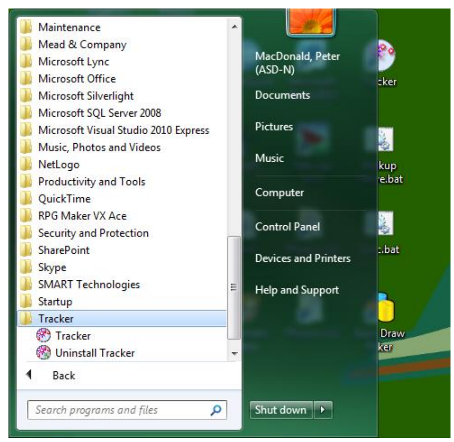


Introduction

Polynomial mathematics is more prevalent than you think; nature is full of them! For this project you will explore the importance of polynomials as they relate to a projectile. A projectile is an object that is launched and is then subject only to Earth's gravity (and atmosphere). You will need to take a slow motion video of a projectile that goes up and comes down. A computer program will allow you to analyze the path of your projectile and help you determine what polynomial best models your object's path through the air.

Preparation

- Work in groups of up to three people.
- Decide what you want to film (throw/kick/hit a ball, jump through the air, launch a hot wheels car, etc.).
- Frame your shot. The motion of the object has to be perpendicular to the camera and you need to know the length of an object in your shot.
- Record the slow motion video at 120 fps (640x480) or 240 fps (320x240).
- Your video will be uploaded to my JMH Teacher Page. Download and save it to your account. I highly recommend you back everything up to a memory stick.
- Your findings and answers to questions will be typed and saved. I will retrieve them directly from your network folder.

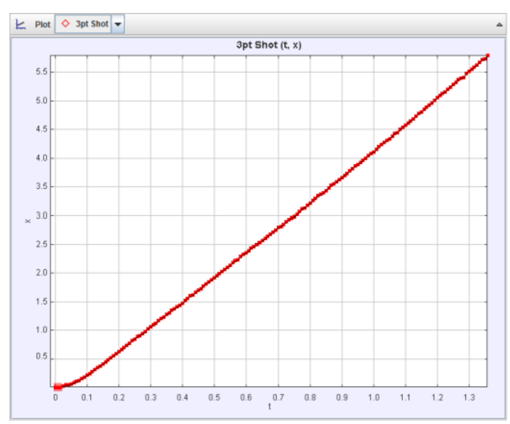


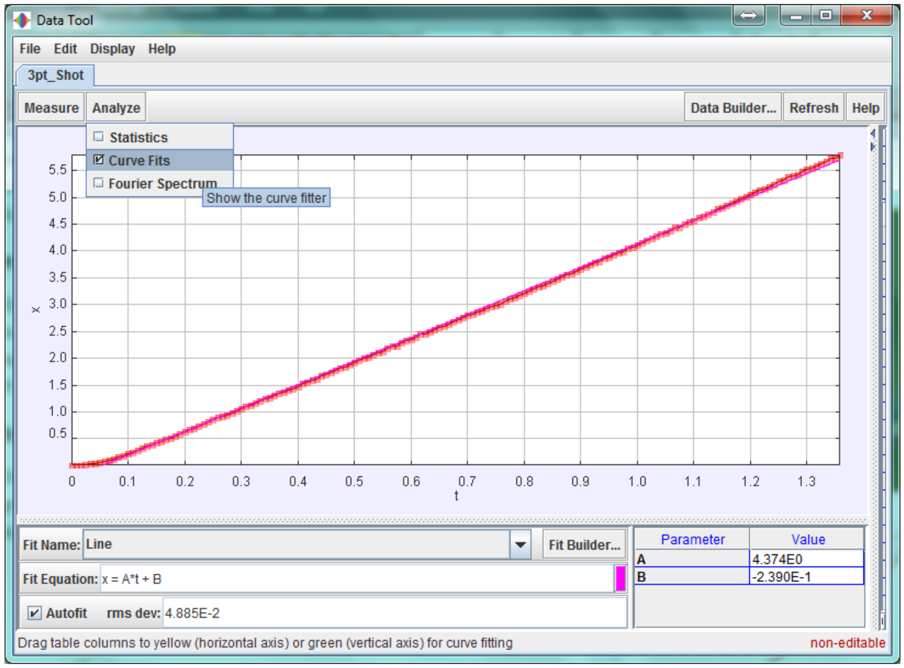
Collecting Data

- Open the program called Tracker on the netbook (go to the *Start* menu and look in *All Programs*)
- How to setting the program up to collect data will be shown to you in class. If you forget steps refer to the *Quick Start Guide* handout.

Analyzing Data – Modeling with Polynomials – Part I

- Once you have finished tracking your object you are to analyze some of the graphs and determine the polynomial that best represents (models) what happens in nature.
- Horizontal position with time.
  - Change your vertical axis to "x" and the horizontal axis to the "t". You should see a straight, or somewhat straight, line.
  - Place the mouse over the graph and right-click. From the menu that appears select "Analyze". A new window with your graph will appear.
  - Click on the "Analyze" button and check off "Curve-Fits"; new information will appear below. Next to the "Fit Name" select "Line" (image example on the next page).





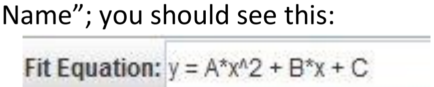
- Look at the "Fit Equation" x=A*t+B.
- Replace the A and B with the numbers on the right: x = 4.374t – 0.239 ← That is the polynomial that models where the object is, horizontally, with time.

Questions

1. Write the polynomial that models the object's horizontal position.
2. Summarize the following information:
    a. What is the name of the polynomial?
    b. What is the variable?
    c. What is the coefficient?
    d. What is the constant term?
3. Use that polynomial to calculate how far the object would be from its starting point if it could be in the air for 0.5, 1.0 and 2.5 seconds (note: depending on your data those three times may change slightly)
4. What is the horizontal speed of your object? (hint: the answer is part of your polynomial).

Analyzing Data – Modeling with Polynomials – Part II

- If you still have the previous analysis window open, close it so all you have is your tracker program with the video and graph beside it.
- On the graph change the vertical axis to display "y" and the horizontal to an "x". This is a graphical representation of the actual path your object takes through the air.
- Bring up the analyze window. Select "Curve-Fits" and select "Parabola" as the "Fit Name"; you should see this:



Questions

5. Write out the polynomial that models the path of the object (note: A*x^2 is the same as Ax^2)
6. Summarize the following information:
    a. What is the name of the polynomial?
    b. What is the variable?
    c. What are the coefficients?
    d. What is the constant term?
7. Use that polynomial to calculate how high up in the air the object would be if x = 1, 5 and 10 meters.
8. What is the polynomial that would model an object that travels the same horizontal distance but three times as high? Half as high?