Learning Intentions

- To learn how to create a model of the physical 2D motion of an object
- To learn how to use Excel to create dynamic spreadsheets

Introduction

For this assignment, you will develop a mathematical model to describe the motion of an object as it slides across a surface. After developing the model, you will use Excel to create a dynamic spreadsheet that shows the motion of the object in graphs.

Part 1: Physics Model

For this part of the assignment, you will create a physics model at the level of difficulty that you choose.

- Emerging: A box is pushed to the right at an angle of elevation of θ across a flat floor. There is no drag.
- Developing: A box is sliding to the right up/down a hill at an angle of elevation/declination of θ degrees.
- Proficient: The same box from 'Developing' is being pushed by a rocket an angle of elevation of α with the hill.
- Extending: The same box from 'Proficient', but now there is also a turbulent drag force on the box.

For your calculations, assume that the box has a mass of m kilograms, there is a kinetic coefficient of friction of μ_k, a pushing/rocket force of P, an initial velocity of v_0 meters per second, and a drag coefficient of c_d.

1. Draw a free body diagram of the forces on your box.
2. Find the acceleration (in the direction of the surface) of the box as a general equation.
3. Find the velocity (in the direction of the surface) of the box as a general equation.
4. Find the displacement (in the direction of the surface) of the box as a general equation.

Part 2: Excel Spreadsheet

For the second part, create an Excel spreadsheet that explores the model you created in Part 1. For the different models, you will need to explore a different parameter.

- Emerging: What happens to the acceleration/velocity/displacement as the pushing angle goes from 0 to 360 degrees?
- Developing: What happens to the acceleration/velocity/displacement as the angle of elevation of the hill goes from 0 to 360 degrees?
- Proficient: What happens to the acceleration/velocity/displacement as the angle of elevation of the pushing force goes from 0 to 360 degrees? Assume a constant angle of elevation of the hill.
- Extending: Calculate the acceleration/velocity/displacement of the box using numerical methods. Perform the analysis 3 times, using a time increment of 100 ms, 10 ms, and 1 ms.

 See over →

Choose reasonable values for the mass of the box, the kinetic coefficient of friction, the pushing/rocket force of P, the initial velocity, the angle of elevation of the hill, and the drag coefficient.

Your spreadsheet should show properly formatted graphs for the acceleration, velocity, and displacement of the box. It should be possible to quickly and easily change the value for any of the parameters (i.e. mass, initial velocity, etc.). The graphs should include properly labelled axes (with units) and an informative title.

Part 3: Error Analysis

Lastly, evaluate how closely your model emulates reality. Are there elements of the real world that are not included in your model? Are there any forces that are not accounted for in your model? How could your model be improved?

Assessment

Curricular Competencies	Insufficient Evidence	Emerging	Developing	Proficient	Extending
Processing and analyzing data (Part 1)					
Evaluating (Part 3)					
Applying and innovating (Part 2)					
Communicating					