Physics 441/PCSE 503 Assignment 3

Due Date: Friday, October 6, 2023

1. Projectile Motion with Air Resistance – Maximum Range

For a projectile WITHOUT air resistance, it is easy to show that the launch angle for maximum horizontal range (assuming that we are launching from ground level and returning to ground level) is 45 degrees.

1. Modify the Jupyter Notebook called graph\_projectile.ipynb (in the Week4 folder) to calculate the angle for maximum range for the initial velocity and position values considered (i.e. a golf ball launched at 55.8 m/s from ground level, and returning to ground level).
2. Now, modify the code to consider the problem of a baseball. Assume a launch height of 1m above ground level. For the initial launch speed, use 100 mph (converted to m/s, of course). What is the idea launch angle in this case? Compare your results to those obtained here:

<https://baseballsavant.mlb.com/statcast_field?ev=100&la=38>

1. Solving Differential Equations with Various Methods

Modify graph\_runge\_kutta\_example.ipynb (in the Week5 folder) to solve the following differential equation initial value problem:

dy/dt = t y2

y(0) = 1

You can use WolframAlpha, for example, to get the exact solution. Evaluate (if possible) the following:

1. y(1)
2. y(1.4)
3. y(2)
4. Consider the following method to evaluate the central probability in Bertrand’s Paradox:
   1. Generate a point randomly within the circle.
   2. Choose a random angle for a chord passing through that point.
   3. Calculate the length of the chord passing through that point, at the chosen random angle.

Add this as “Method 4” to the notebook that we went over in class. Comment on the results that you obtain using this method.