Target Lab Summative

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16 velocities were measured at the edge of the table. The mean of the measurements was approximately 1.071m/s and the median was 1.073m/s. Calculations were done using the average of the mean and median, which was 1.0716m/s, in an attempt to suppress the effects of outliers. First, finding how long the sphere will be in the air using the position equation :

$$y_f = \frac{1}{2}at^2 + v_y t + y_0.$$

Here, the y-component of velocity is zero, the acceleration of gravity $a = -9.81\text{m/s}^2$ (negative since positive y-direction is considered up), the starting position $y_0 = 0.915$ meters, and the final y position is $y_f = 0.145$ meters. Therefore the equation is

$$0.145 = -4.905t^2 + 0.915,$$

and solving for t yields $t = \sqrt{0.77/4.905} \approx 0.40$ seconds. This means that the marble will be in the air for approximately 0.40 seconds.

Next, finding the distance the sphere will travel using the position equation again:

$$x_f = \frac{1}{2}at^2 + v_x t + x_0.$$

In this situation, the x-component of velocity is our initial velocity $v_x = 1.0716\text{m/s}$, the time in the air is the same as above, and the initial position $x_0 = 0$ meters since we're measuring from the edge of the table. The final position is therefore

$$x_f = 1.0716\sqrt{0.77/4.905} \approx 0.42 \text{ meters.}$$

Placing the ring 42 cm away from the edge yielded the video attached.

Velocity Measurements (m/s): 1.051, 1.058, 1.063, 1.063, 1.065, 1.066, 1.069, 1.072, 1.073, 1.077, 1.077, 1.078, 1.078, 1.08, 1.081, 1.082