

Errors and Uncertainties - Lab Report

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Abstract—Physics being an experimental science, we sought to learn how to prepare a lab and perform as a team accounting for errors and uncertainties and to reduce them. We gathered values for volume using Micrometer, gathered information on acceleration, velocity, and created a histogram using a PASCO motion sensor. A jumping experiment was also performed with a human and the motion sensor. Our main goal was to test the effects of human error and eliminating mechanical error.

I. INTRODUCTION

OUR theory for this experiment was to find the error margin for each person in our lab group. Each technician was to take an experiment to perform while the other two gathered data. After calibrating all of our equipment to reduce mechanical error as low as possible, we started to measure the data sets. We Wanted to find out the human error in reading precision instruments to gather data, to perform a given velocity and acceleration task with a cart, and to gather data with jumping up and down with many possible outlets for human error. Our idea is that human error is difficult to account for and that each data set will be radically different from one to another.

II. MEASURING MASS

We each took measurements of the cylinder that was given to us. We had calibrated the Micrometer to find its error, which was .003 mm. The table as follows shows our results: The

TABLE I
CYLINDER MEASUREMENTS

Height (mm)	Length(mm)
20.814	9.529
20.819	9.528
20.813	9.529
20.816	9.529
20.815	9.530

mean of this information is 9.526 mm for length, 20.815 mm for height. The standard deviations are 6.324×10^{-4} mm for length, and 2.059×10^{-3} mm for height. The error margin are as follows: 2.828×10^{-4} mm for length and 9.208×10^{-4} mm. These values gave us an approximate 1483.500 mm^3 . After measuring the weight of the object, we determined that it had a mass of 11.5785 grams which lead to the density value of 7.8×10^{-3} grams.

III. LIGHT-GATE

Having done 50 periods of passes with about 1.48 seconds mean period, we found the standard deviation to be .05 where 66percent of the trials fall within. This leads to an

average error of .0071 seconds off as shown in the histogram below(example: "... as shown in [?], ..."). After this test, we began to work with the cart to test human error's effect with a low friction track. Tasks such as maintaining constant velocity and to maintain constant acceleration in two separate runs to see how human error effects test results.

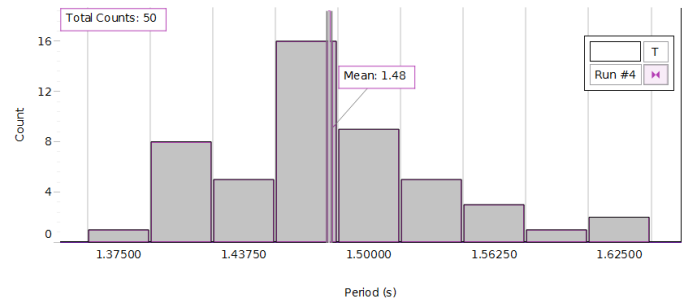


Fig. 1. 50 trials of Light-Gate with human error

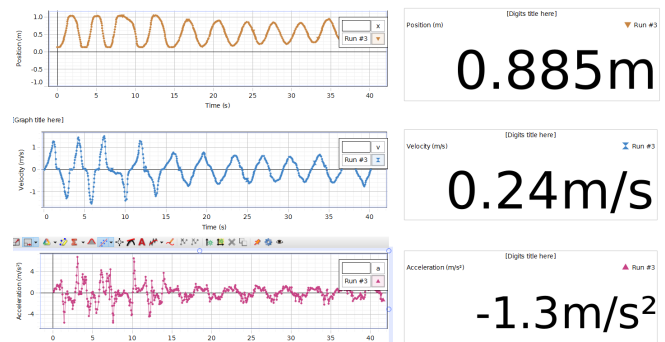


Fig. 2. Trial Run of Human Error with Constant Acceleration

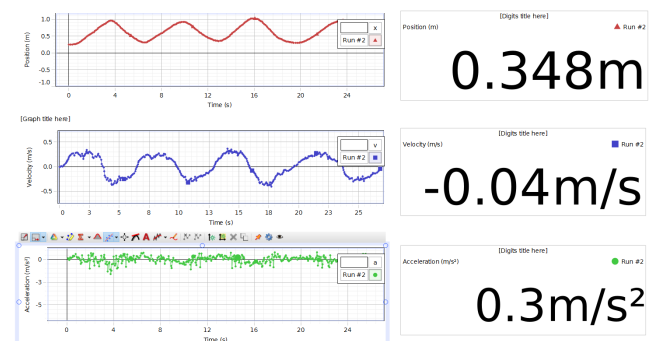


Fig. 3. Run of Human Error on Constant Velocity

After seeing the results we were satisfied with the human error tests and moved on to our final test. We took a trial run

of a test subject jumping up and down at average heights and consistent intervals to try and see how human error plays with a constant value of gravity. This final graph shows our results:

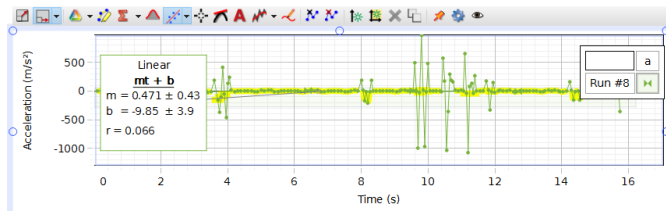


Fig. 4. Test of Human Error with a Constant Acceleration of Gravity

IV. CONCLUSION

The tests that we carried out show variance in an otherwise static set of data. We tested for human errors and took steps to reduce mechanical errors as well as minor human errors. Having done this experiment, we can show that human error in the data that we accumulated showed that with human error there is consistency in a way. In the measurement case of the metal, we found that the human error of measurement was almost the same for each of the technicians and the data varied by small amounts. In the Light-gate experiment, we found that with the 50 period test the period given for each of the passes through the gate were all very consistent. The Constant acceleration and constant velocity data sets showed that with a given task, the human error was consistent and found that the technician could carry out the task with little or no severe outliers. In the final experiment of gravity, we found that with as many variables that were present such as sideways motions, jump height, and acceleration upwards the data we received was consistent with its own error. Each technician an experiment to perform while the other two took data and found that with their own respective experiment, the error was consistent. One can conclude that perhaps each human has their own error margin with a given task and can be tested for it. With more time, each technician could have taken the other two tests and found their error margins and compared to one another.