**“Experiment 0: Sensor Calibration and Linear Regression”**

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October 3, 2017

Tuesday 9AM Paokuan Chin

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**Experiment 0: Sensor Calibration and Linear Regression**

Homework 0:

1. A cover page was made to use as a template as shown by the cover page in this report.

2. Given that:

And using equation ii.23, the uncertainty is properly expressed as:

3.  The Capstone software can display up to 15 digits following the decimal point. If the sensor

precision is exactly 4 digits and you take data with ten digits, your actual measurement

precision will still be 4. You will see constant fluctuations in the remaining digits. Good data

always includes an uncertainty, so leaving in no fluctuating digits is bad practice. A good

measurement should have one fluctuating digit.

4.

|  |  |  |
| --- | --- | --- |
| Mass (g) | Force (N) | Sensor Voltage (V) |
| 0 | 0 | 0.001 |
| 50 | 0.49 | -0.076 |
| 100 | 0.98 | -0.153 |
| 150 | 1.47 | -0.231 |
| 200 | 1.96 | -0.307 |
| 250 | 2.45 | -0.385 |
| 300 | 2.94 | -0.463 |

**Table 1**: Calibration Data

**Figure 1**: Scatterplot with fit line showing the linear relationship between the force sensor voltage and the applied tension

Table 1 contains the raw data recorded during the lab. Figure 1 depicts the data in the form of a scatterplot with a fit line that shows the relationship between the force sensor voltage in volts and the applied tension in Newtons is described by a line with equation:

5. The equation of the fit line in Figure 1 is of the form:

Where:

Using the linear regression tool in Excel, the uncertainties for these numbers were calculated

to be

The smallness of the y-intercept (b) suggests the taring procedure was reasonably effective.

However, since the y-intercept was not 0, the taring was not completely effective.

6. The line plotted in Figure 1 is of the form V=aF+b. This can be algebraically manipulated to find c and d for F=cV+d in terms for a and b like so:

Comparing this equation to F=cV+d we see that

Using equation ii.23 to propagate the uncertainties, c and d were calculated to be:

7.  This grade difference would be possible if the two were in different lab sections, since each lab section is curved on its own and in each section one third of students will receive an “A” grade, one third will receive a “B” and the final third will receive a “C”. In this situation, the mean numerical scores in Frankie’s section were likely lower than those in Avril’s section, which is how he ended up with a higher grade even though he had a lower score.