Experiment 5: Pendulum

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PS181 Section 3

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Data:

|  |  |
| --- | --- |
| L | **N** |
| **(cm)** | 10 |
| 185.5 | **`x** |
| 187.5 | **cm** |
| 185.9 | 186.6 |
| 187.8 | **Sx** |
| 185.9 | **cm** |
| 187.0 | 0.894986 |
| 187.1 | **S`x** |
| 185.6 | **cm** |
| 187.6 | 0.283019 |
| 186.0 |  |

Table : Length of String

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| T | time (cont'd) | | time (cont'd) | | **N** |
| **(sec)** |  |  |  |  | 100 |
| 2.33 | 2.57 | 2.68 | 2.74 | 2.70 | **`x** |
| 2.63 | 2.66 | 2.84 | 2.85 | 2.84 | seconds |
| 2.45 | 2.83 | 2.65 | 2.50 | 2.63 | 2.6818 |
| 2.68 | 2.75 | 2.62 | 2.49 | 2.77 | **Sx** |
| 2.75 | 2.75 | 2.76 | 2.78 | 2.75 | seconds |
| 2.64 | 2.73 | 2.86 | 2.65 | 2.50 | 0.107585 |
| 2.50 | 2.83 | 2.59 | 2.72 | 2.61 | **S`x** |
| 2.44 | 2.87 | 2.79 | 2.57 | 2.68 | seconds |
| 2.63 | 2.66 | 2.77 | 2.60 | 2.60 | 0.010758 |
| 2.52 | 2.75 | 2.63 | 2.74 | 2.63 |  |
| 2.72 | 2.57 | 2.67 | 2.83 | 2.67 |  |
| 2.61 | 2.77 | 2.61 | 2.75 | 2.76 |  |
| 2.61 | 2.81 | 2.76 | 2.66 | 2.81 |  |
| 2.64 | 2.55 | 2.77 | 2.45 | 2.66 |  |
| 2.60 | 2.73 | 2.76 | 2.74 | 2.58 |  |
| 2.64 | 2.72 | 2.70 | 2.69 | 2.62 |  |
| 2.79 | 2.65 | 2.54 | 2.80 | 2.62 |  |
| 2.72 | 2.68 | 2.90 | 2.78 | 2.70 |  |
| 2.69 | 2.84 | 2.60 | 2.74 | 2.61 |  |
| 2.69 | 2.65 | 2.66 | 2.85 | 2.70 |  |

Table : 100 separately measured periods, read left to right then top to bottom

|  |  |  |
| --- | --- | --- |
| trial | t | **N** |
|  | **(sec)** | 2 |
| 1 | 143.58 | **`x** |
| 2 | 137.68 | **seconds** |
|  |  | 140.63 |
|  |  | **Sx** |
|  |  | **seconds** |
|  |  | 4.17193 |
|  |  | **S`x** |
|  |  | **seconds** |
|  |  | 2.95 |

Table : Two sets of 50 periods

|  |  |  |
| --- | --- | --- |
| trial | T (period) | **N** |
|  | **(sec)** | 2 |
| 1 | 2.8716 | **`x** |
| 2 | 2.7536 | **seconds** |
|  |  | 2.8126 |
|  |  | **Sx** |
|  |  | **seconds** |
|  |  | 0.083439 |
|  |  | **S`x** |
|  |  | **seconds** |
|  |  | 0.059 |

Table : Two sets of 50 periods, but data is divided by 50

Calculations:

**(cm/s2)**

SG1 = 8.3633 **>** 1024.22-980.35

Sg50 = 39.0928 **>** |931.177-980.35|

Results:

The results of the first experiment show g1 to be about 1024 ­+- 8 cm/s^2 with a %diff of 4.47% and g50 to be about 931 +-39 cm/s^2 with a %diff of 5.02%. L was calculated to be about 186.6 cm. In the first trial the period was on average approximately 2.68 seconds, and in the second trial each period was calculated to be about 2.81 seconds.

Discussion:

Using the precision vs accuracy test on G1 shows that the error is not something that can be ignored in this trial. The majority of this error is almost certainly due to the frequent manual measurements adding up to a lot of instances for error to be introduced. Doing the test on G50 shows that there is significant error there as well. This error is certainly introduced by extremely poor data collection by whoever took the data. As the period average was 2.81 seconds and is far from what is expected. If the experiment were to be repeated, finding a way to reduce the human error with some sort of machine or computerized measuring would greatly increase the accuracy and precision of the experiment.

Questions:

1. By looking at the formula for you can see that reliability is more sensitive to error in time, as it is multiplied by 2 any deviation is that much greater in further calculation.
2. By adjusting the data so that the first length value measured is the one used, there were inconsistent changes to G and SG. For the G1 and SG1 values, they decreased down to 1018 and 8.16 respectively, but G50 and SG50 were decreased as well, down to 925 and 38.8. all values across the board have decreased but since the g50 value was already lower than the actual value of G it became less accurate, although according to the decreased error it was more precise. It is difficult to say if this was going to make a beneficial impact or not since g1 got closer to the accepted value of g and g50 got farther from it, additionally the dataset I have been working with has significant human error.
3. A.) If the error for start/stop is +- 0.2, then over 10 periods only 10% of the error affects a single period, and 2% per period for 50 continuous periods

B.) One change to greater increase precision would be to automate the measuring process, ideally with computer sensors that are able to precisely start and stop the timer with the period. This is where much of the error came from and where machines shine compared to humans. Another change could be to simple repeat the experiment more times which would minimize bad data’s impact on the average.