Lab Report Outline—the Bones of the Story

Your name and your lab partner(s): Sara Jones and Ryan Hodgson **Section: 1** **Date:** November 14, 2016

TITLE:

How does adding a length of static cord to an elastic cord affect the X_{max} of the elastic cord?

ABSTRACT:

In preparation for the Bungee Challenge (the dropping of an egg attached to an elastic cord), we sought to determine if adding a length of static cord to the elastic cord would increase the "thrill factor" of the drop. In order to do this, we measured the X_{max} (how much the elastic cord stretches) with different masses and different lengths of static cord. We determined that adding static cord does increase the X_{max} of the elastic cord, and we have equations available to determine X_{max} of our cord with different hanging masses and varying lengths of static cord. However, our regressions have extremely high uncertainties, so our data did not offer a clear conclusion regarding the relationship between static cord and X_{max}.

INTRODUCTION*: Gives the purpose and conceptual or theoretical context.*

In this experiment, we sought to further prepare for our upcoming Bungee Challenge, an egg-drop. Part of this experiment is the "thrill factor" or the amount of free-fall the egg endures before coming to a stop. It is possible to increase this "thrill factor" by adding a length of static cord to the top of the elastic cord. We designed an experiment to determine the relationship between the ratio of length of static cord to length of elastic cord and the X_{max} of the elastic cord.

Relevant equation(s) specific to this experimental purpose or setup, identifying variables:
We determined that this setup would most likely not align with the F=-kx where:
F=force (N)
K=spring constant
X=displacement (m)

To calculate the force of the mass on the string: F=ma
F=force on string (N)
M= mass of hanging mass (kg)
A= acceleration due to gravity (m/s^2)

To calculate X_{max}(net): $X_{max}(net)=X_{max}-X_{static}$
X_{max}(net)= X_{max} of elastic cord only (m)
X_{max}= total length of stretched cord (m)
X_{static}= length of static cord (m)

Hypothesis (or expectations): We expect that increasing the ratio of static cord to elastic cord will increase the X_{max} of the elastic cord.

METHODS: *How are you getting at the purpose or question?*

Describe the overall method and its rationale in a sentence or two:

We measured the X_{max} for 5 different ratios of static to elastic cord and 4 different masses.

Diagram, identifying *all* items, variables and/or measurements. Label it with a **Figure #, Title and caption**. Use *Word* (Insert-shapes-drawing canvas), a drawing program, or *at least* use a ruler and blank paper and scan it in:

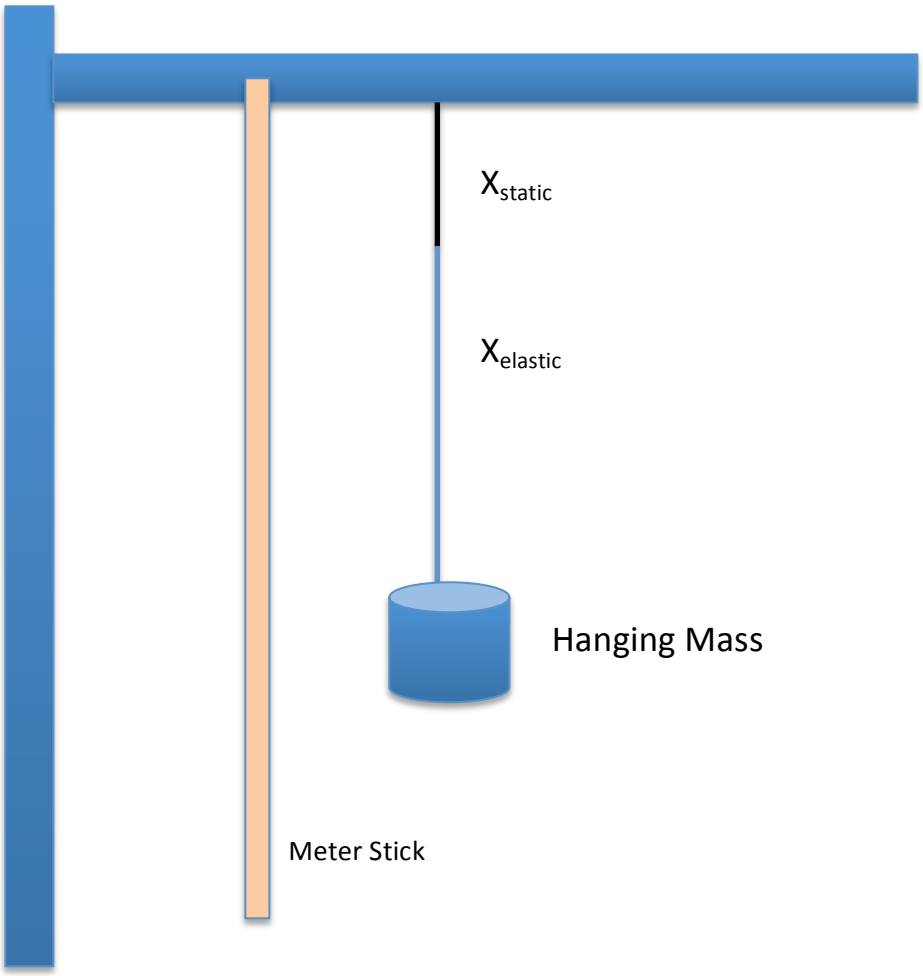


Figure 1: Diagram of Setup. This diagram shows how the static and elastic cords were attached to form the total cord.

Describe setup:
Measurements were taken from knot to knot.
0 measurement on meter stick was aligned with top of upper knot.

Describe procedure, *including relevant or significant details* (may be bullets):

- Each mass was dropped from the top of the upper knot
- Drop was filmed in slow motion and the video was evaluated to determine X_{max}

RESULTS: *What do you get? Report your data and analysis—**Just the facts**, but give all a reader needs to know! (No need to show calculations, though.) Refer to the* **Uncertainty Guide (UG)** *for details on finding uncertainties in data and equations. Refer to the* **Excel Guide (EG)** *for technical details on tables and graphs, and on **linearizing** a graph.*

Introduce the Results section in a sentence or so, to give the reader context—data collected, and how it is analyzed to get the relevant result:
Using our data for X_{max}, we found equations for X_{max}(net) at four different masses.

***Tables and Graphs often need additional context** in the body of the report (outline), not just a caption--needs both. Don't worry about repeating yourself. The body of the report provides the story in a logical progression, while the captions provide quick context for the reader. Add context as needed along with the following.*

Table(s), inserted from *Excel*, **formatted and labeled according to the "Formalities" document** in Resources tab, including "raw" data and averages/standard deviations where appropriate, and **with columns or uncertainties identified further** in caption or in text after the table, if needed:

Table 1: Variance in X_{max} for mass of .05 kg. Data taken for Mass=.05 kg, Weight= .4905 N, and $X_{elastic}$= .24 m.

X_{static} (m) (±.01 m)	X_{max}(total) (m) (±.01 m)	X_{max}(net) (m) (±.01 m)
0.00	0.48	0.48
0.06	0.61	0.55
0.12	0.68	0.56
0.18	0.78	0.60
0.24	0.87	0.63

Table 2: Variance in X_{max} for mass of .10 kg. Data taken for Mass=.10 kg, Weight= .981 N, and $X_{elastic}$= .24 m.

X_{static} (m) (±.01 m)	X_{max}(total) (m) (±.01 m)	X_{max}(net) (m) (±.01 m)
0.00	0.70	0.70
0.06	0.89	0.83
0.12	0.97	0.85
0.18	1.07	0.89
0.24	1.17	0.93

Table 3: Variance in X_{max} for mass of .15 kg. Data taken for Mass=.15 kg, Weight= 1.47N, and $X_{elastic}$= .24 m.

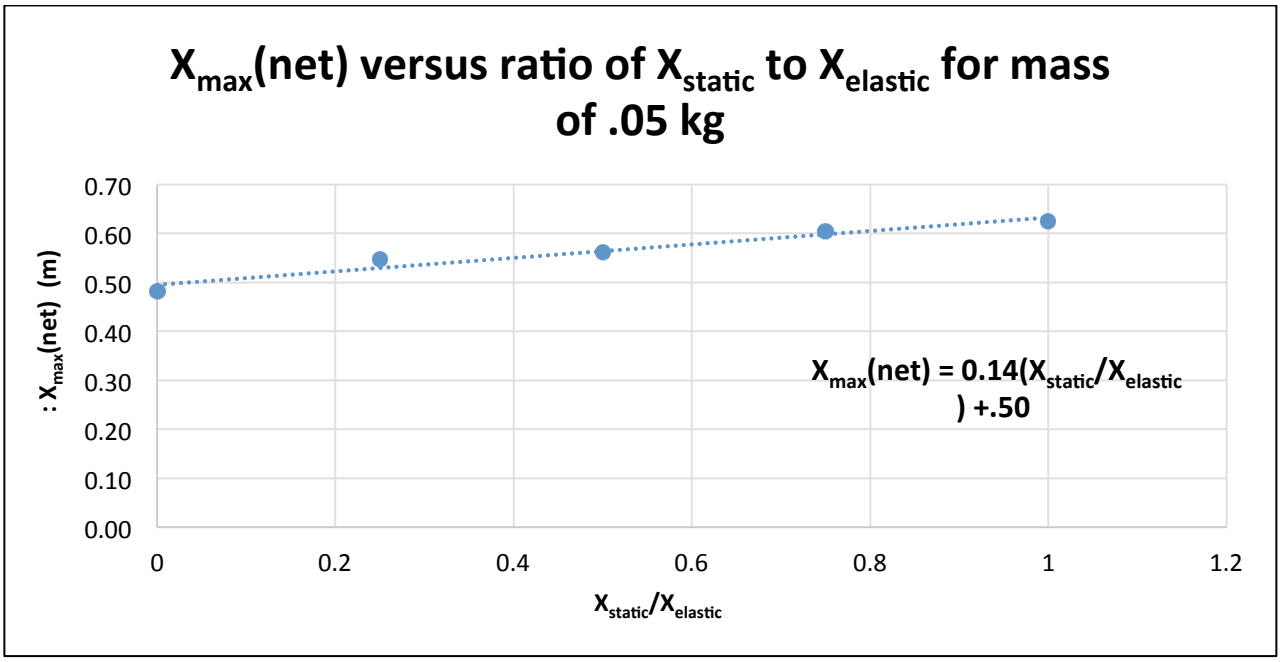
X_{static} (m) (±.01 m)	X_{max}(total) (m) (±.01 m)	X_{max}(net) (m) (±.01 m)
0.00	0.94	0.94
0.06	1.13	1.07
0.12	1.22	1.10
0.18	1.31	1.13
0.24	1.43	1.19

Table 4: Variance in X_{max} for mass of .17 kg. Data taken for Mass=.17 kg, Weight= 1.67N, and $X_{elastic}$= .24 m.

X_{static} (m) (±.01 m)	X_{max}(total) (m) (±.01 m)	X_{max}(net) (m) (±.01 m)
0.00	1.09	1.09
0.06	1.23	1.17
0.12	1.31	1.19
0.18	1.42	1.24
0.24	1.49	1.25

Graph, if applicable, inserted from *Excel*, **formatted and labeled according to "Formalities"** document, and with ***curve-fit*** (also known as "trendline" in *Excel,* this could be a linear or non-linear fit):

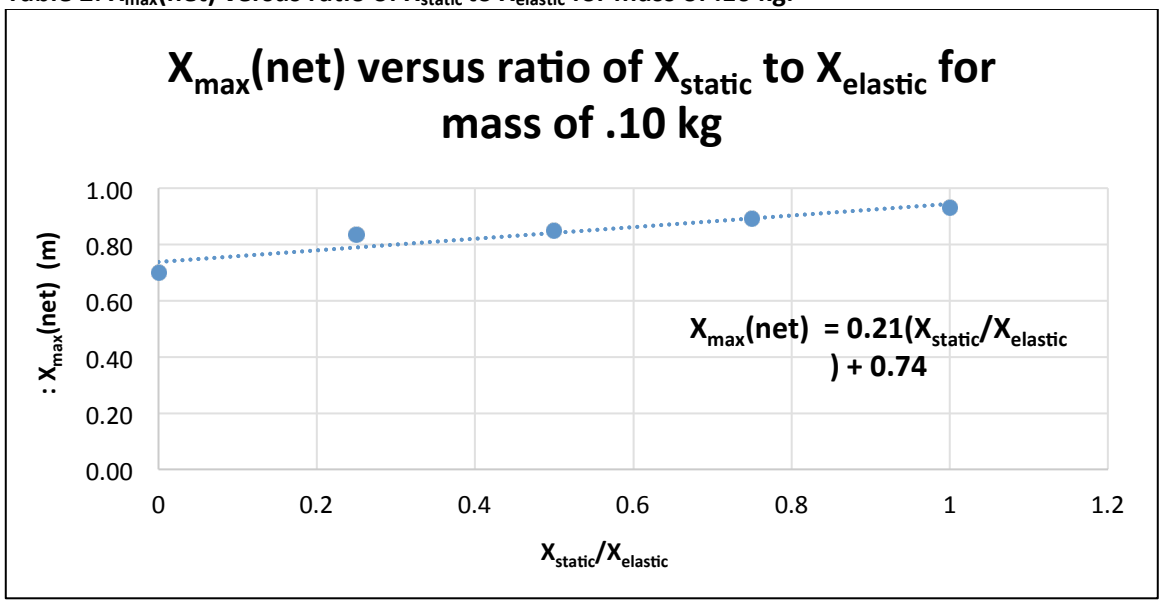
Table 1: X_{max}(net) versus ratio of X_{static} to $X_{elastic}$ for mass of .05 kg.



uncertainty for slope= .02 % uncert= 14%

uncertainty for y-intercept= .01 % uncert= 2.0%

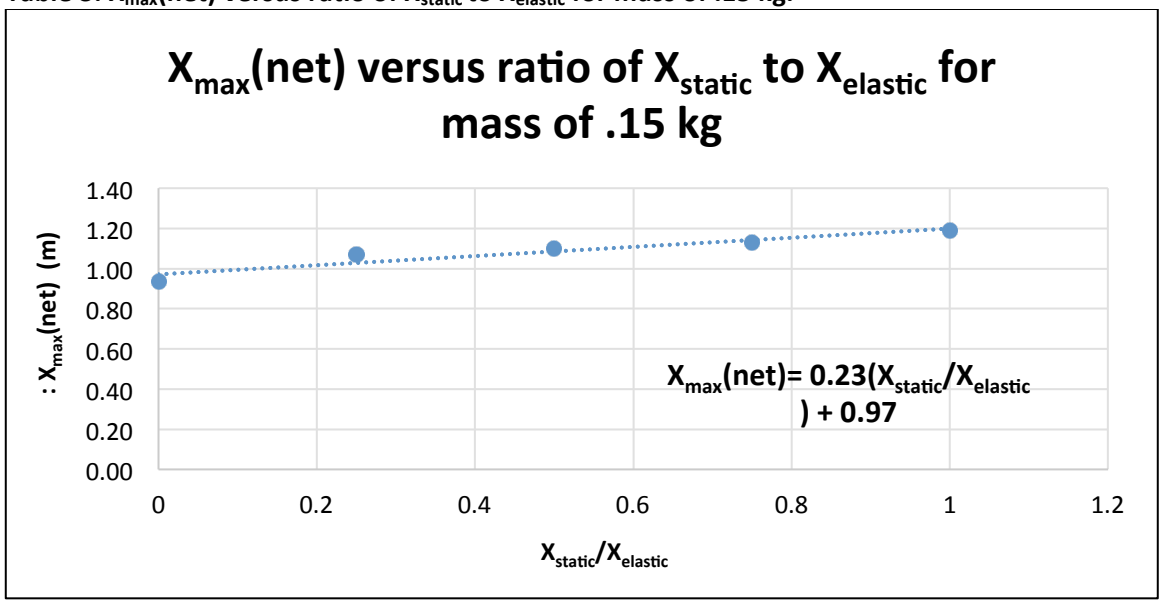
Table 2: X_{max}(net) versus ratio of X_{static} to $X_{elastic}$ for mass of .10 kg.



uncertainty for slope= .04 % uncert= 19%

uncertainty for y-intercept= .03 % uncert= 4.0%

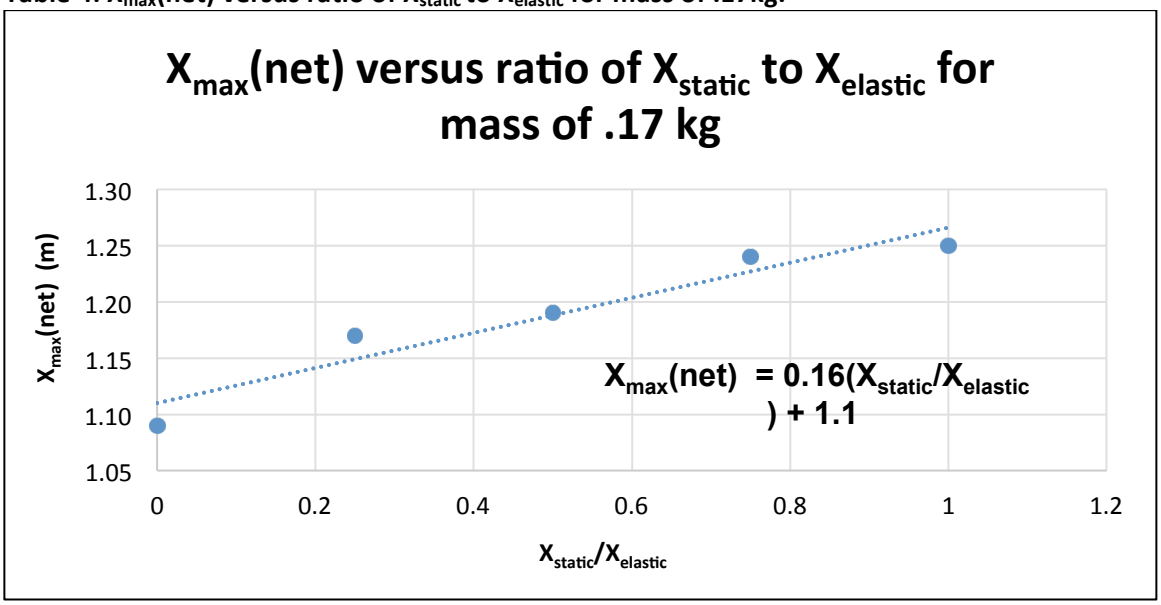
Table 3: X_{max}(net) versus ratio of X_{static} to $X_{elastic}$ for mass of .15 kg.



uncertainty for slope= .04 % uncert= 17%

uncertainty for y-intercept= .03 % uncert= 3.0%

Table 4: X_{max}(net) versus ratio of X_{static} to $X_{elastic}$ for mass of .17kg.



uncertainty for slope= .03 % uncert= 19%

uncertainty for y-intercept= .02 % uncert= 2.0%

Uncertainty of all slopes was found using regression analysis.

Summarize Results (just the facts)—give the important, relevant results, and why/how they are relevant to the purpose, in a sentence or two, including main equations and quantitative results:
The slopes of the graphs (the K value of the modified string) were .14, .21, .23, and .16.

DISCUSSION: *What do you make of your results? Evaluate them.*

Based on the above results, it is impossible to determine a positive correlation between an increase in the length of static cord and the K value of the modified string. Additionally, all of the linearized graphs have high percent uncertainties, so it is difficult to draw any conclusions. It is possible that a large portion of error stemmed from the tying and retying of knots as we modified the string, which may have modified the string in unintended ways.

A test for acceptability of our results would be to continue increasing the hanging mass to see if the slope/K value continues to decrease or if our K value for .17kg was an outlier.

We did not expect the K value to increase and then decrease as mass increased. We expected more of a linear correlation. However, the percent error was extremely high for all of the regressions, so we cannot draw a confident conclusion about the relationship between static cord and k value, because the relationship appears to differ significantly depending on mass.

CONCLUSION: *What does this experiment reveal? Step back and look at the experiment's purpose and value, remembering that the only failed experiment is an inconclusive one.*

Based on our data, we cannot draw a conclusion about the effect of static cord on the k value of a cord. It is unlikely that we will add static cord to our elastic cord for the Bungee Challenge, because our data does not appear to be reliable or conclusive, so calculating an amount of cord to use seems nearly impossible. In the future, we would like to revisit this, possibly with more masses, so that we can determine an overall trend.

Report Outlines are *individual assignments*. Cite any work not your own, acknowledge any aid, and pledge the report:

On my honor, I have neither given nor received any unacknowledged aid on this assignment.

Pledged: **Sara Jones**