

Beats by Kristen

INTRO: I've started a new business, Beats by Kristen. The famous pop super group One Dimension has approached me to come up with a design that allowed stage lights behind them to swing in time with their music. We created a pendulum for them that could be adjusted to fit to any tempo of their songs. Below is a list of constraints and also criteria for our pendulum.

CONSTRAINTS

- Ring Stand and a steady prop to tie the pendulum to
- Washers (used as weights to be the object at the bottom of the pendulum)
- String
- Stop watch
- A device to play the song

Criteria

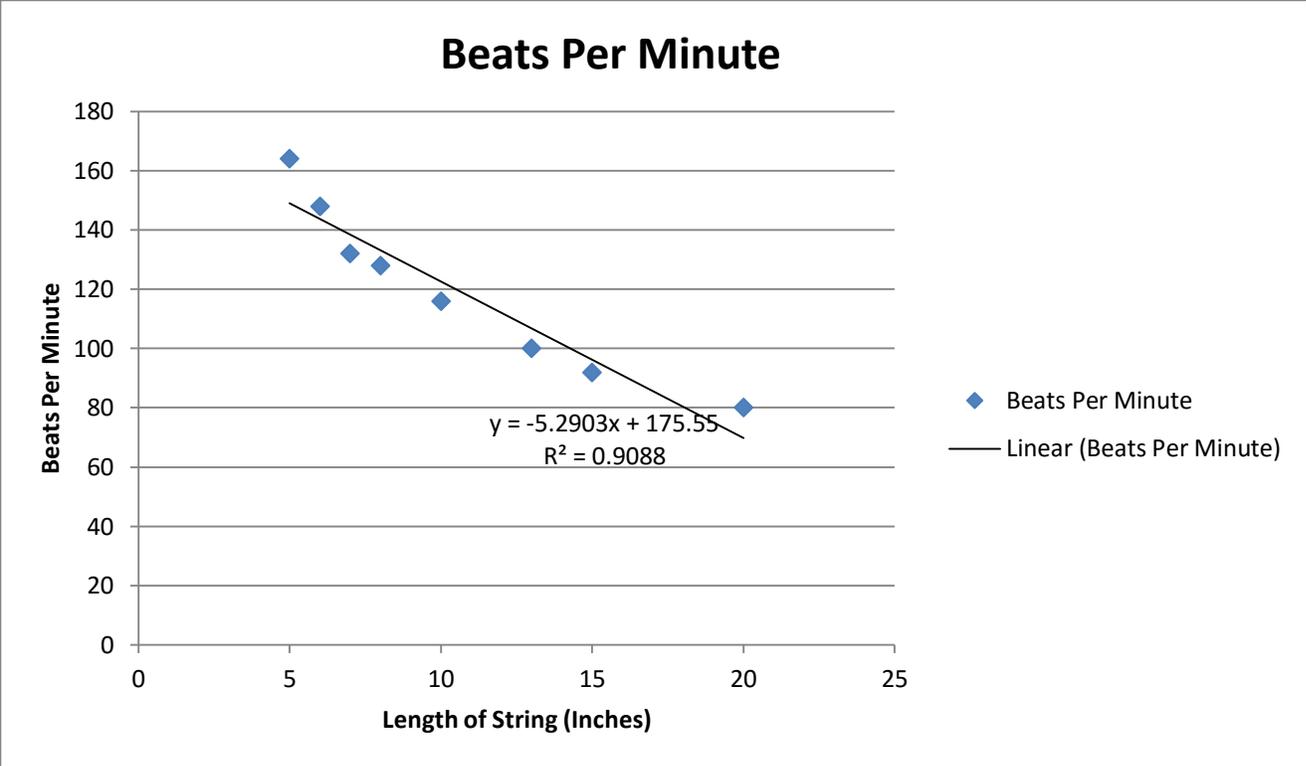
- Angle at which the string is pulled back (used a protractor)
- Weight of the washers (we counted the number of washers)
- Length of string (from top of ring stand)

TESTING: During our testing we tried to change a couple variables to see what affect the tempo. First we changed the degree at which the pendulum, then we decided to change the length of the string. We did many tests and determined that the angle at which we dropped the pendulum did not affect the tempo but the length of string did have an affect on the tempo. During our testing we measured the number of beats per 15 seconds. We had one person time the 15 seconds and then the other 2 people counted to make sure we got an accurate number. We then converted the number of beats per 15 seconds to a number of beats per minute.

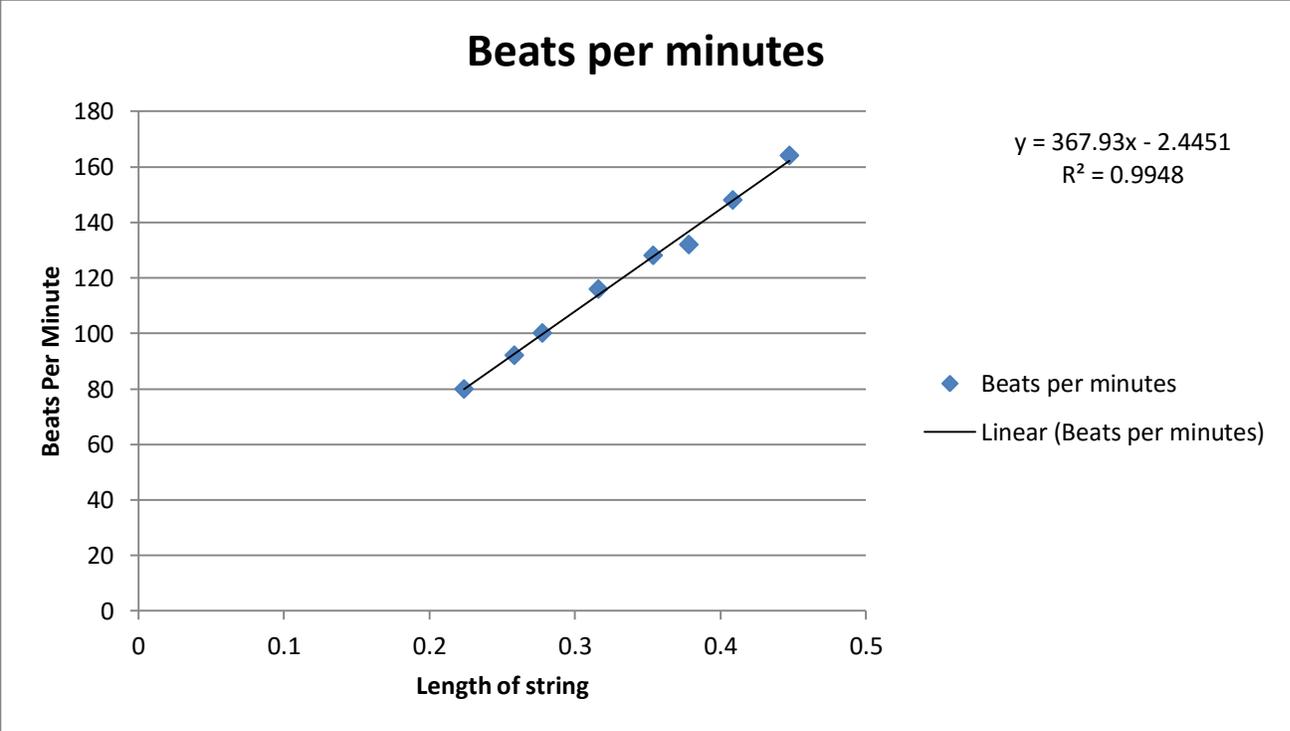


DATA:

Length of String (inches)	Beats Per Minute
5 in	164 bpm
6 in	148 bpm
7 in	132 bpm
8 in	128 bpm
10 in	116 bpm
13 in	100 bpm
15 in	92 bpm
20 in	80 bpm



Relationship: Inverse



In order to linearize this data, I started table of data but kept my "Y" values the same. I then manipulated the "X" value by putting each "X" value by putting it to the -1 exponent. I check my R

squared value and then kept adjusting my exponent to try and get the R squared value as close to 1 as possible. With the exponent of -.5 I got the R squared value to .9948.

Equation for our pendulum:

$$\text{BPM} = 367.93(L^{-.5}) - 2.4451$$

BPM = Beats Per Minute = Y value

L = Length of string = X value

This graph and equation helped our design choices because once we had the BPM of our mystery song, all we had to do was put the BPM in for the Y value and then do some basic algebra to find the length of string we needed. Or we could look at our graph and do the same thing, find the given BPM on the graph and then find the length of string we needed.

Discussion of Future Changes

Some successes from this design process were that we had no directions so we were able to freely experiment and find out what we wanted to find out and test whatever we wanted to test. Because of this freedom, we got to design our own unique pendulum that fit what the client asked for. But, this freedom also posed some challenges. Without directions it was sometimes frustrating because we didn't know if we were wasting our time on an idea or actually getting somewhere. For future work on this project, I would look into an easier or more effective way to change the length of string, and also test if it changes the results if the string is attached at the top of the ring stand by one string or two in a "V" shape leading down to the washers.