Math 592 (The Math of Music) **Spring 2015**
Quiz 1 **Drew Armstrong**

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1. Suppose a certain kind of guitar string has a linear density of 0.02 kg/m. If you tighten the string to a tension of 800 kg $\cdot$ m/s^2, what is the speed of a disturbance in the string?

$$\sqrt{\frac{800}{0.02}} = \sqrt{40000} = 200 \text{ m/s}$$

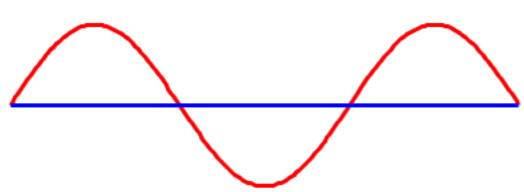
2. Now suppose the string from Problem 1 is stretched between supports 0.25 meters apart. In this case what is the fundamental frequency of the string?

$$\frac{1}{2 \cdot 0.25}\sqrt{\frac{800}{0.02}} = \frac{1}{0.5}200 = 400 \text{ Hz}$$

3. Suppose you want to retune the string from Problem 2 so that it has fundamental frequency 440 Hz. To what new value should you change the tension?

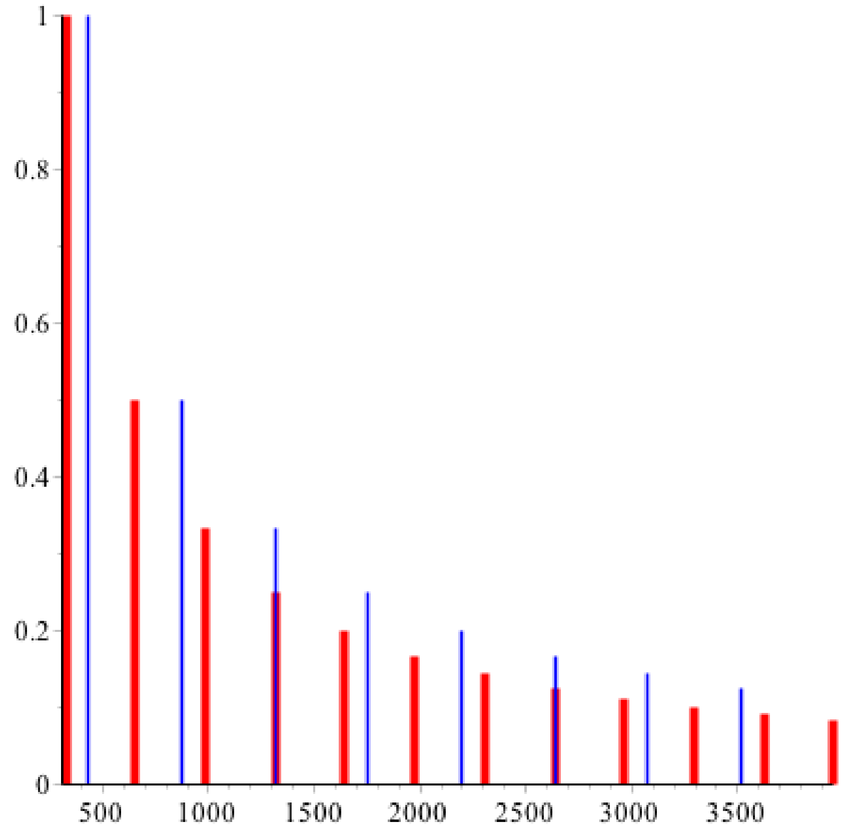
$$\begin{aligned}
\frac{1}{2 \cdot 0.25}\sqrt{\frac{T}{0.02}} &= 440 \\
2\sqrt{\frac{T}{0.02}} &= 440 \\
\sqrt{\frac{T}{0.02}} &= 220 \\
\frac{T}{0.02} &= 48400 \\
T &= 968 \text{ Hz}
\end{aligned}$$

4. Draw an example of a disturbance on a string that will oscilate at **three** times the fundamental frequency.



5. Suppose two strings with fundamental frequencies 330 Hz and 440 Hz are played simultaneously. Sketch the Fourier transform of this sound. What is the smallest nonzero distance between the partials (measured in Hertz)?

The Fourier transform looks like this:



The smallest nonzero distance between partials is $\frac{1}{3}330 = 110$ Hz.