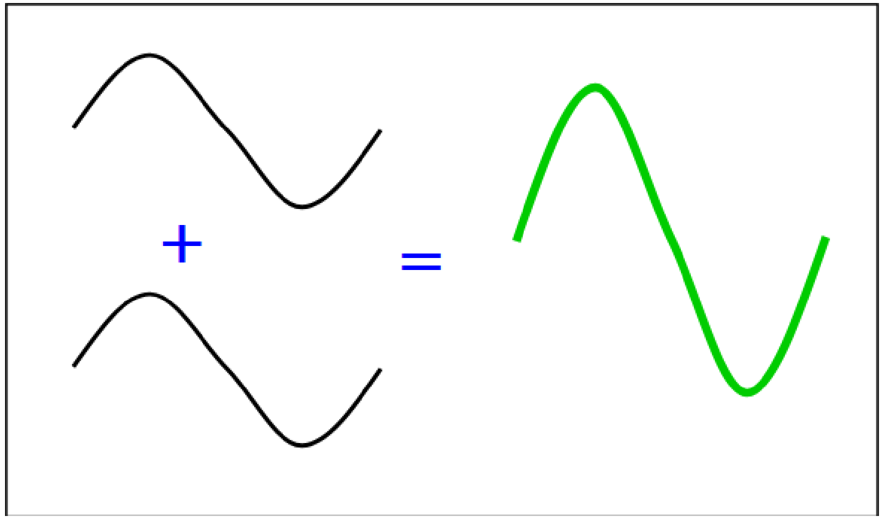
Interference of Two Soundwaves

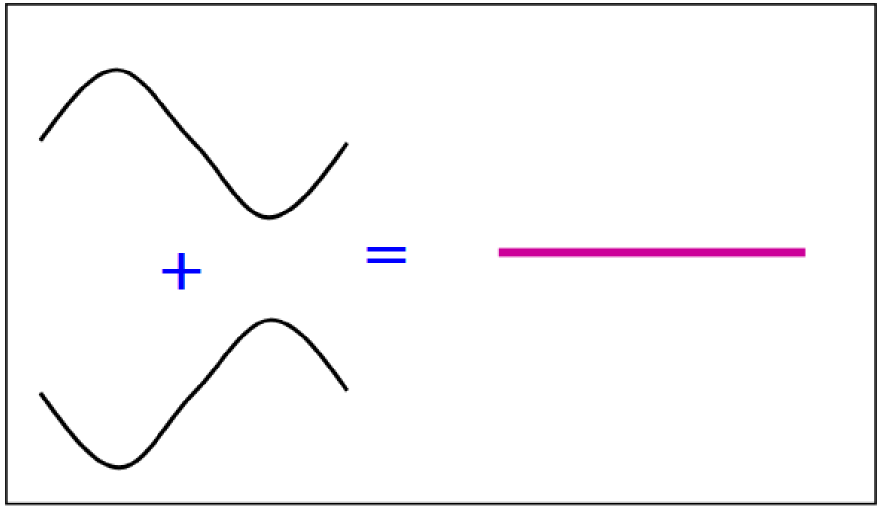
Background

- When waves meet, they combine into a resultant wave through interference
- Waves interfere in constructive or destructive interference depending on path difference between the waves
- Constructive interference occurs at a path difference of nπ
- Destructive interference occurs at a path difference of n(π+0.5)

Path difference = nπ

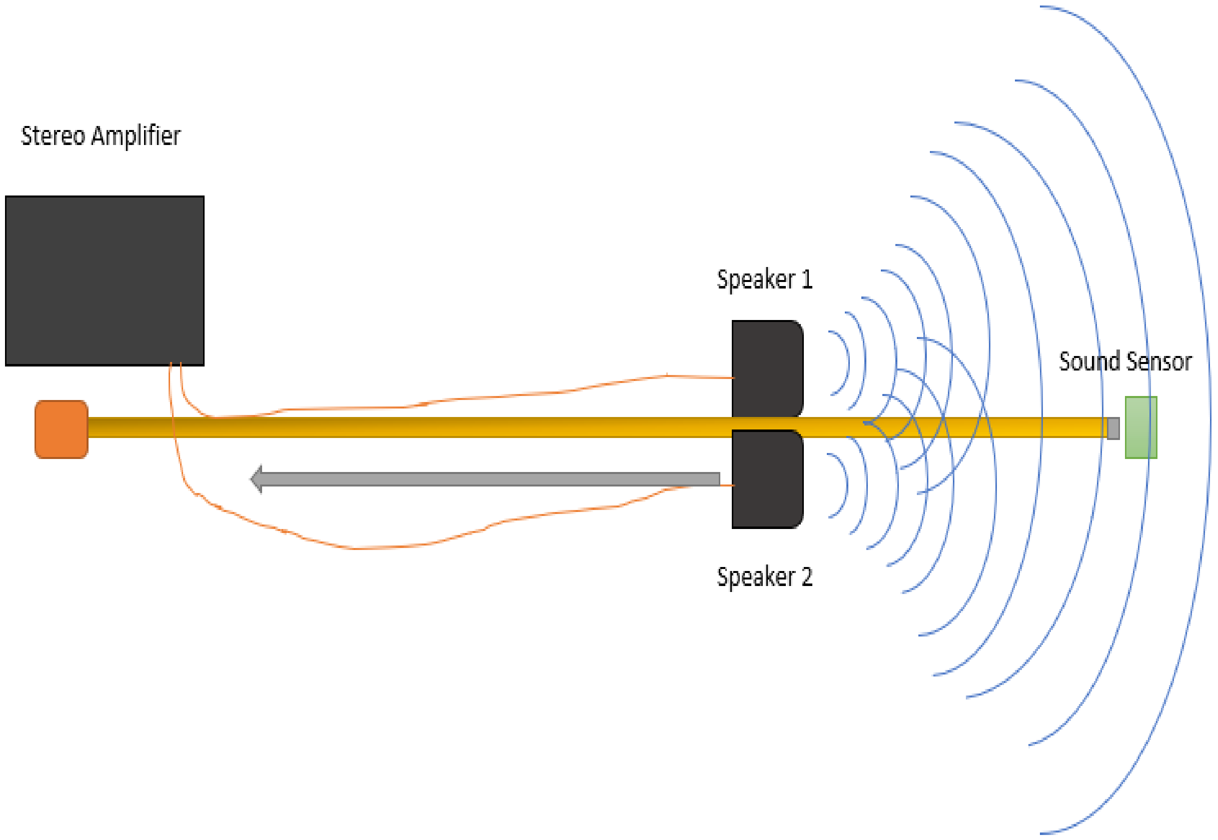


Path difference = n(π+0.5)



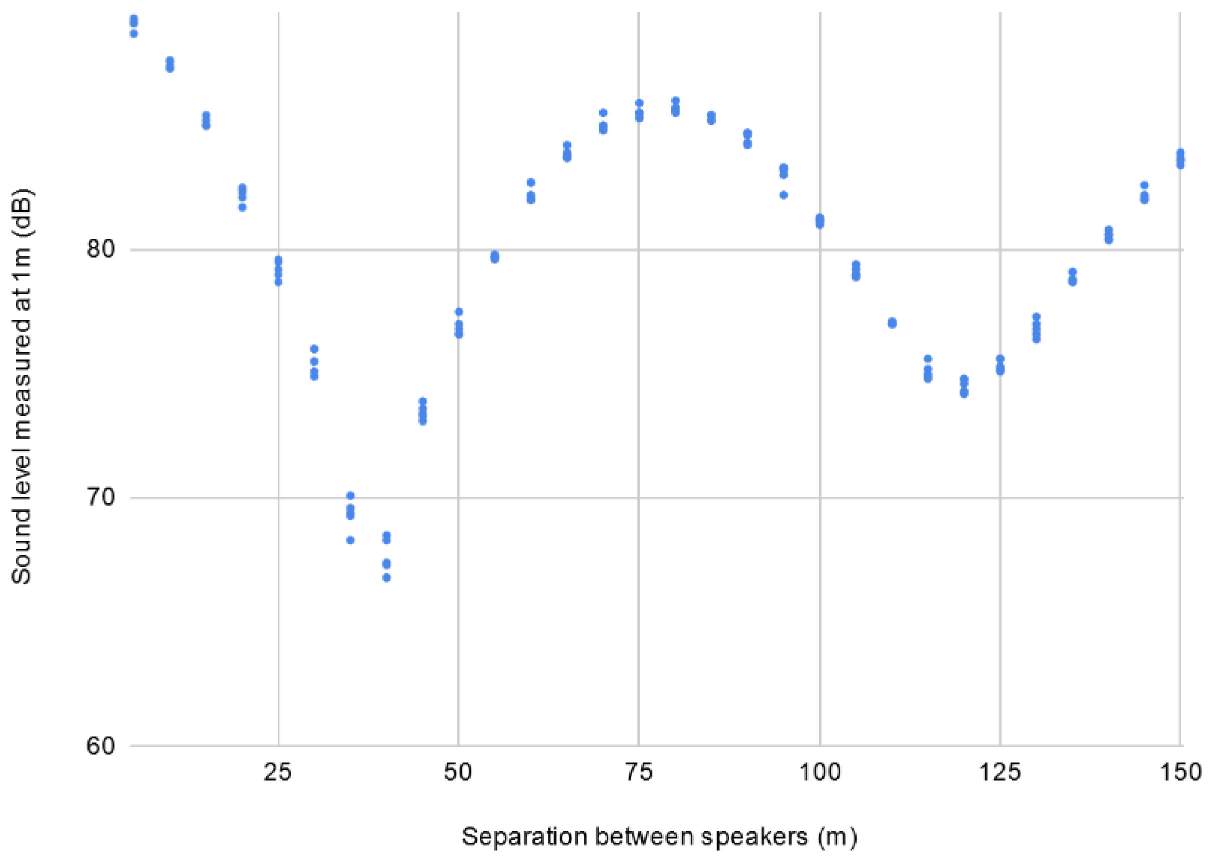
How?

- An experimental set up was created in my front yard
- Two speakers were placed next to each other on level ground
- The speakers were made to play a 400 hz signal at 90 dB
- A sound sensor was placed 1 meter from the first speaker
- One speaker was moved backwards in 5 cm increments and the sound level was measured at each increment



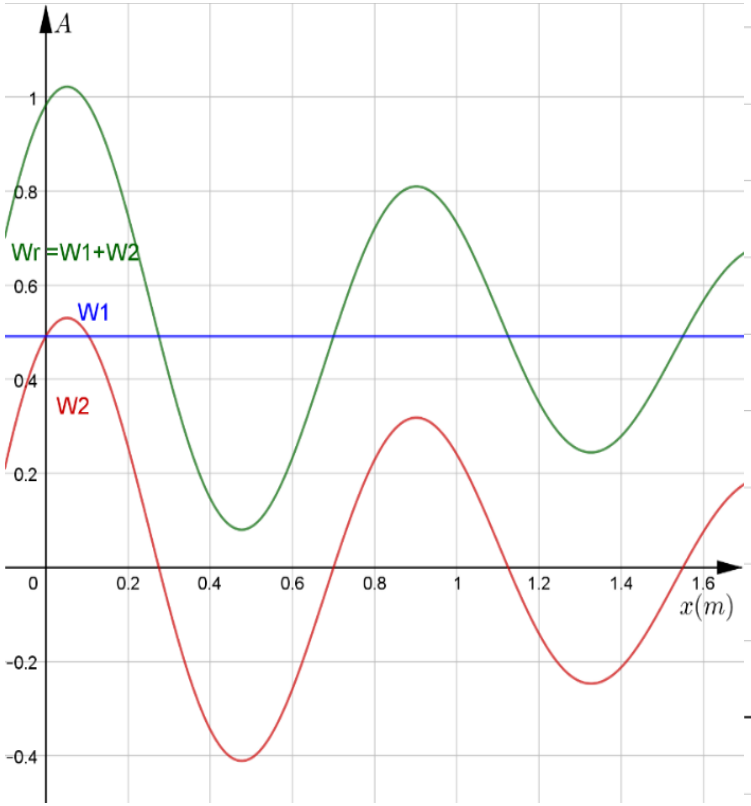
Findings

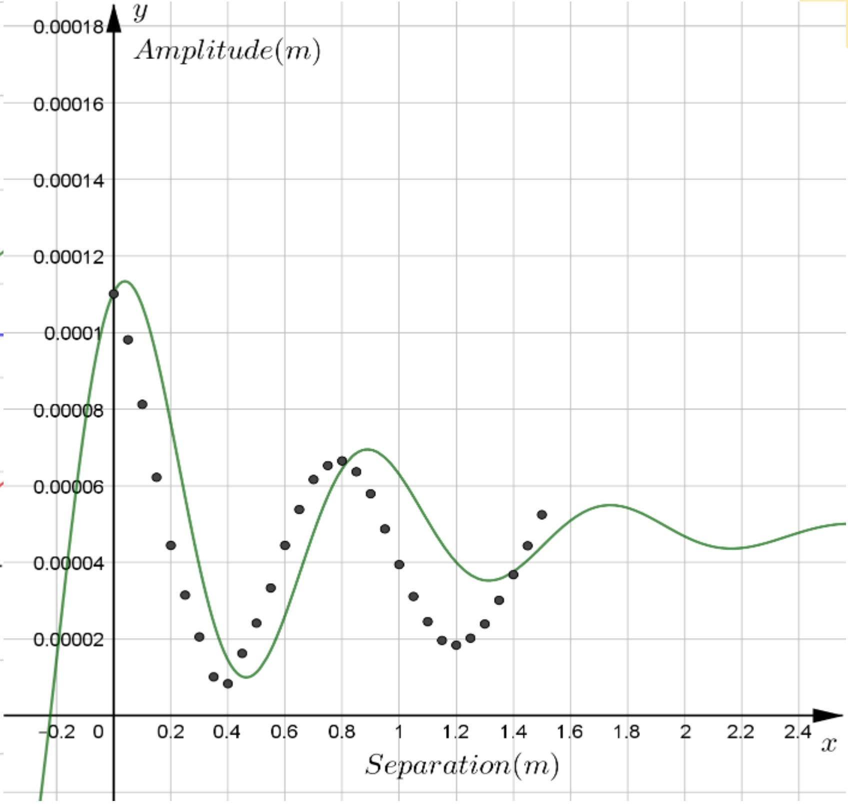
- The sound points were recorded into a spreadsheet.
- It was noted that the sound volume decreased at first after which it increased again
- The spread between the data points is quite small indicating high precision
- The resultant wave decreased in energy as it travelled further
- Minimums and maximums of data situated within 10 % of predicted values



Model

- Waves generated from source are sin waveforms.
- Using knowledge of addition of graphs, I generated a model for superposition of the waves
- I experimentally determined the amplitude of the wave and used my knowledge of transformations of graphs to scale the model to the data

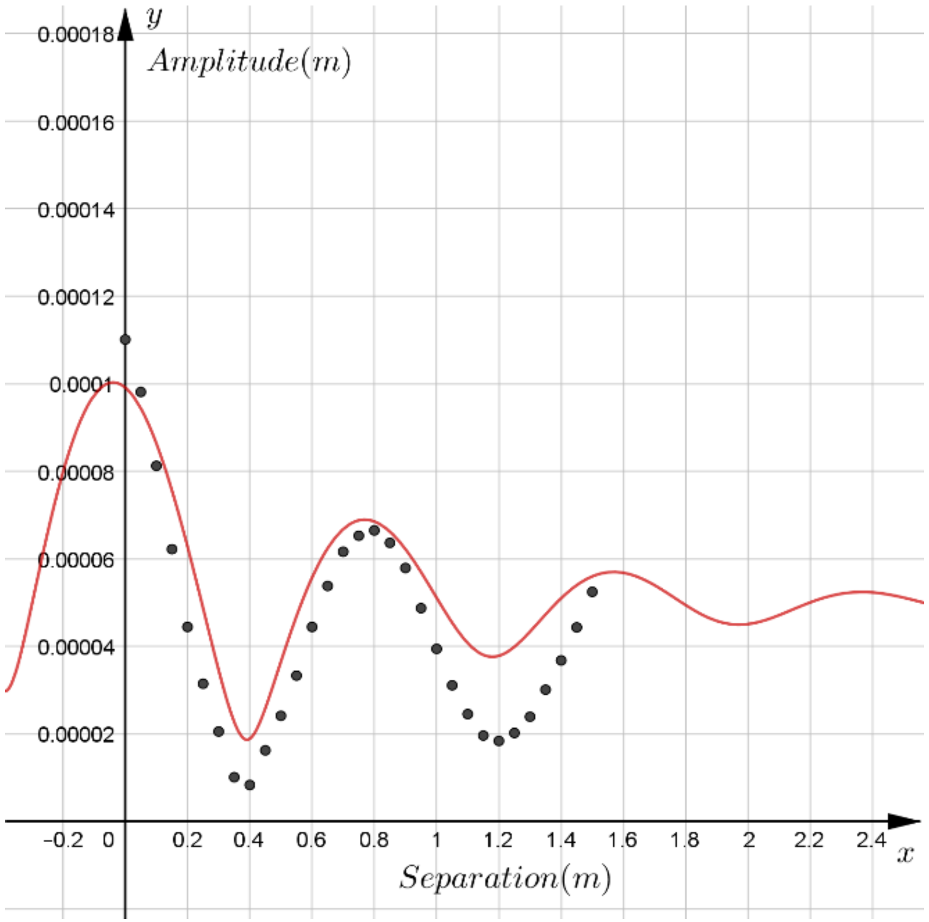




$$W_R : y = 0.0000700 \times \sin\left(\frac{2\pi}{0.86}\right) + \sin\left(\frac{2\pi}{0.86}\right) \times (1+x) \times e^{-1.3x} - 0.000015$$

Alternative model

- An alternative model was devised to see if a stronger correlation could be found
- Using the RMS of a sine wave along with the formula for resultant amplitude of two sine waves gives us an alternative way to model the interference
- $W_R : y = 0.0000700 \times \frac{\sqrt{1 + (e^{-1.3x})^2 + 2e^{-1.3x}\cos(7.9x)}}{\sqrt{2}}$



Conclusion

- Wave inference can be approximated using mathematical functions
- We can approximate the amplitude of the resultant wave over distance and therefore the volume of the sound
- The models are quite accurate for short distances, but less so over longer distance as external variables cause more error
- The models could be applied to waves of other frequencies with a few modifications