

City of St. Louis  
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Independent Mathematics Contractors  
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Dear IMC:

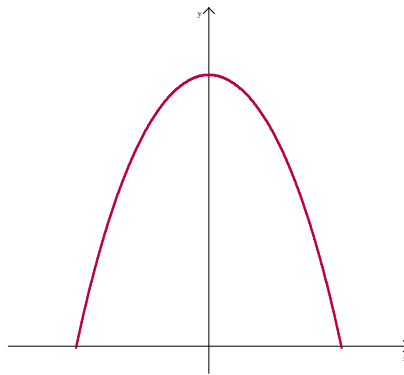
When a cable, such as a power line, is suspended between towers of equal height, it forms a curve called a catenary. The function describing such a curve is

$$f(x) = A(e^{kx} + e^{-kx})$$

for suitable constants A and k.

The Gateway Arch in St. Louis has the shape of an inverted catenary. This shape was chosen for the arch because it distributes the internal structural forces evenly. Since the shape of the arch is a mathematical curve, I am interested in knowing what the function describing this structure is. To do this you'll need to experiment with the formula above and the values of A and k. To insure that you are headed in the right direction, let me give you some information about the arch and the format for this function.

1. The Gateway Arch is 630 feet high.
2. The Gateway Arch is 630 feet wide at ground level.
3. The function you find should assume that the arch is placed in a coordinate system in which the x axis is at ground level and the y axis goes through the center of the arch (see below).



The reason why I need to know the function describing the arch is because we are planning to hang several banners vertically from the arch in celebration of the opening of a new Lewis and Clark exhibition in the visitor center. If we hang three evenly spaced banners, how long will each

need to be? With the function describing the arch, you should be able to gauge the length of each banner quite accurately.

Please document your solution and the process you used to get your solution in a technical memo. It has been 10 years since I took college algebra, so include enough details for a reader of my abilities.

Sincerely yours,  
Hugh G. Archie