Speaker Enclosure Design Tool

Background
Speaker enclosures are primarily built using one of the three types depicted below from left to right: Sealed, Ported, and Bandpass. Each of these have their own benefits and drawbacks, but can all be custom fitted for many applications. A speaker enclosure must also have an internal volume that would allow the speaker (driver) to perform well. This internal volume is sometimes provided by the speaker manufacturer, but only provides a recommended volume for an enclosure that holds one speaker.

Problem Statement
Today, there is no tool that was designed for speaker enclosure optimization. If someone wanted to create their own enclosure, they would either have to contact the speaker manufacturer or find an acoustic engineer. Since it is relatively easy to find the specifications for any speaker, a recommended volume for the enclosure could be calculated using these as inputs. This would allow anyone to build enclosures that can make the most out of any speaker from any price range.

Project Overview
1. The user enters parameters that describe a speaker.
2. The optimal volume(s) are produced.
3. Specific dimensions are entered by the user to render a blueprint design.
4. The blueprint can be exported as a pdf to be used for building.

Results
As it turns out, there is no single way to optimize a speaker enclosure for a speaker because there are far too many variables in play. Since most acoustic engineering is based on preference, I was able to generalize the algorithm to produce results that matched manufacturers recommendations to the nearest 5 cm^3. The algorithm first uses (1) to find which constant to use. Then applies (2) and/or (3) using the constant to generate every compliance ratio from 0.5 < Qtc < 1.1 depending on which box you are designing. The compliance ratio that is optimal for the resonance tuning frequency produces the volumes(s) we need. These values then simply render a design based on user input.

1. Cutoff frequency below 50Hz; $Q_{es}$ up to 1.1, size greater than 1.4 ft^3.
2. Cutoff frequency above 50Hz; $Q_{es}$ from 1.2-2.0, size less than 2ft^3.
3. $Q_{es} = \left(\frac{Q_{es} - 2}{Q_{es} - 2}\right)^{1/2} + \left(\frac{Q_{es} - 2}{Q_{es} - 2}\right)^{1/2}$.
4. $f_{r} = \left[\frac{\left(1 - \frac{1}{Q_{es} - 2}\right)^{1/2} + \left(\frac{Q_{es} - 2}{Q_{es} - 2}\right)^{1/2}}{2}\right] \times f_{c}$. 

Diagram 1