The task of Advanced Additive Manufacturing Commercialization was to create a model of the operation of a bioprinter, taking into account the volume, tolerance, and Factor of Safety of the part to be created by the bioprinter, as well as develop recommended Factors of Safety for each part expected to be produced. Before the creation of the model began, the data obtained from the National Institute of Health was cleaned. The Experimental Error notes provided by the NIH were examined and then skewed or miscalibrated points were eliminated or adjusted based on the conclusions drawn from these notes. Once the data was cleaned, regression lines were calculated, based on the shapes of the cleaned graphs. The print head speed versus dimensional error graph was found to be linear, so the Method of Least Squares was used in order to find a regression line. The print aperture versus dimensional error graph was found to be exponential, and the culture temperature versus dimensional error graph was found to be a power function, so separate software was used to find the regression lines for these relationships.

Once these regression relationships were found, the model was created. The inputs were first defined and converted into the units needed for the outputs and calculations, the development of the model began. The Factor of Safety and part tolerance inputs were used to calculate the estimated dimensional error. Then, the regression lines determined are used to calculate the optimal printer head speed, print aperture, and culture temperature from the estimated dimensional error, as well as the original maximum part tolerance; however, the program assumes that one can solve for each factor contributing to dimensional error from its respective regression model, rather than cumulatively considering the sources of the dimensional error in this process. It was also assumed that the dimensional error is only affected by the head speed, print aperture, and culture temperature. From these variables, the printing and cure times are found, and the production time is determined. The cost of production is calculated with and without the Factor of Safety taken into account, and then the difference in cost between the two situations is found. The program then outputs the calculated values for head speed, print aperture, culture temperature, estimated dimensional error, production time, cost due to the Factor of Safety, and total cost.

Recommended operation settings for each part can be found in Table 1, below.