**ANALYSIS OF VARIANCE(ANOVA)**

1. **Data collection**

The goal of this analysis is to obtain optimal operating points for vibration and force on the workpiece and DC motor which provides rotary feed to the workpiece. We operate the DC under different conditions such as different drill bit sizes, different feed rate and drill speed to obtain optimal parameters for drilling PMMA material which mimic the properties of bones, which is a typical application of our project.

The two hypotheses in the experiment:

**Null hypothesis:** There is no significant difference in the mean quality of drilling across different levels of linear feed speed provided by the stepper motor and rotary speed determined by the DC motor.

**Alternative hypothesis:** There is a significant difference in the mean quality of drilling across different levels of linear feed speed provided by the stepper motor and rotary speed determined by the DC motor.

1. **Interpretation of ANOVA results**

* The p-values indicate the significance of each factor and their interactions.
* Feed rate has a p-value of <0.05, indicating that it has a significant effect on Optimal Drilling Performance.
* Drill Motor Speed also has a p-value of <0.05, suggesting a significant effect on Optimal Drilling Performance.
* Both the stepper motor speed and the drill motor speed independently significantly impact the quality or efficiency of the drilling process for PMMA material.
* The interaction between Stepper Motor Speed and Drill Motor Speed has a p-value of 0.516708, which is not statistically significant. Therefore, the interaction does not have a significant effect on Optimal Drilling Performance.
* The p- value of interaction between stepper motor speed and dc motor speed is greater than 0.5, thus we fail to reject null hypothesis; this means there is no significant difference in the mean quality of drilling across different levels of linear feed speed provided by the stepper motor and rotary speed determined by the DC motor. This means that the two variables can be controlled independent of each other to obtain best quality drilling.

From the analysis, the number of times the station is able to carry out a successful drilling operation is limited. The station exhibits a successful drilling operation when a slow feed rate and a fast drill speed is applied also when we have a smaller drill bits. Failure to drill can be attributed to the melting of PMMA and the sticking of the melted PMMA on the drill bit, making further drilling difficult. The new PMMA used melts when heated during heating. Using the current setup as it is, the optimal operating parameters is at Slow feed rate setting for stepper motor, where it operates at 21.6 rpm and for the dc motor, at 255PWM, which is equivalent to 9778rpm, which can be conditioned separately, with one of the variables held constant.

**Recommendations**

Since we’re using a relatively bigger motor, we should use a power supply that will provide supply of up to 24V for the DC motor to increase torque when drilling with bigger drill bits.