AS project - Business Report

Problem 1

A physiotherapist with a male football team is interested in studying the relationship between foot injuries and the positions at which the players play from the data collected.

	Striker	Forward	Attacking Midfielder	Winger	**Total**
Players Injured	45	56	24	20	**145**
Players Not Injured	32	38	11	9	**90**
Total	**77**	**94**	**35**	**29**	**235**

Based on the above data, answer the following questions.

1.1 What is the probability that a randomly chosen player would suffer an injury?

Answer:- According to the data, 145 players were injured out of a total of 235 players.

Probability of Injury=Total Number of Players / Number of Injured Players

In our study, we looked at the likelihood of a football player being injured at random. Based on the data gathered, we calculated that a randomly selected player has a 61% chance of being injured

i.e more than half of the players are suffering an injury

1.2 What is the probability that a player is a forward or a winger?

Answer:- According to the data, 94 players are forward and 29 players are wingers

Probability of picking a forward or winger=Total Number of Players / Number of forward and wingers

In our study, we calculated that a randomly selected player who can be forward or a winger is 53%

i.e more than half of the players are forward or a winger

1.3 What is the probability that a randomly chosen player plays in a striker position and has a foot injury?

Answer:- The probability that a randomly selected player plays as striker and has an injury is 19.1%

1.4 What is the probability that a randomly chosen injured player is a striker?

Answer:- the randomly selected injured player is a striker is 31%

we can say that out of all the injured players the strikers are the majority as they experience intense combat during matches

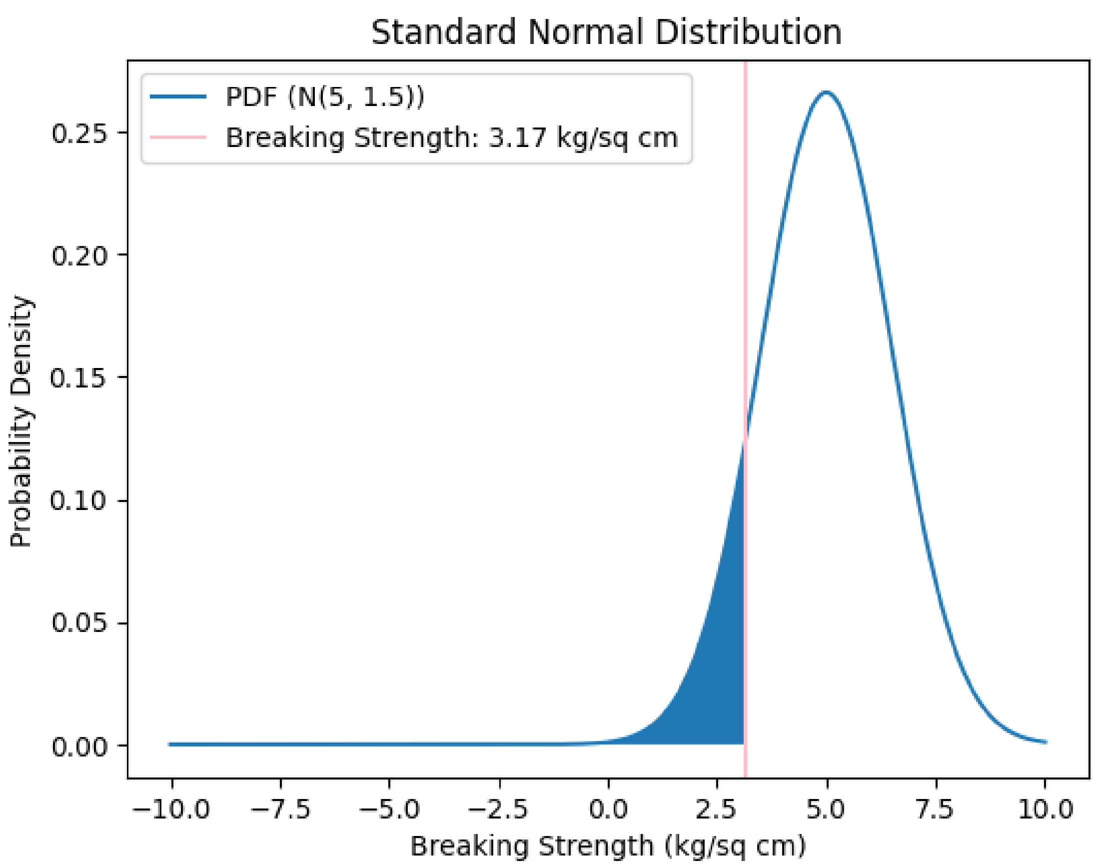
Problem 2

The breaking strength of gunny bags used for packaging cement is normally distributed with a mean of 5 kg per sq. centimeter and a standard deviation of 1.5 kg per sq. centimeter. The quality team of the cement company wants to know the following about the packaging material to better understand wastage or pilferage within the supply chain; Answer the questions below based on the given information; **(Provide an appropriate visual representation of your answers, without which marks will be deducted)**

2.1 What proportion of the gunny bags have a breaking strength of less than 3.17 kg per sq cm?

Response:-

Figure- 1



we used Z-score to solve the problem

$Z = X - \mu / \sigma$ Where:

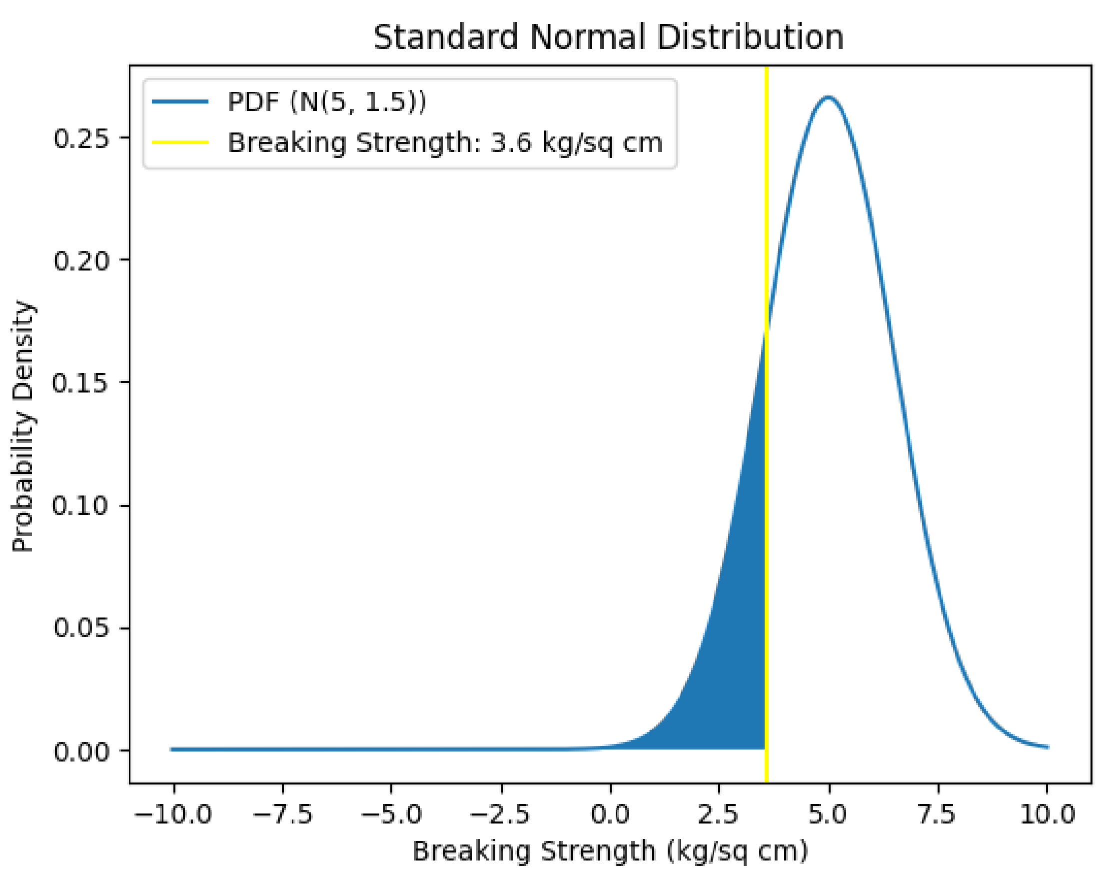
- X is the value of interest (3.17 kg per sq cm)
- μ is the mean (5 kg per sq cm)
- σ is the standard deviation (1.5 kg per sq cm)

  Approximately 11.2% of the gunny bags used for packaging cement have a breaking strength of less than 3.17 kg per sq cm. This information is crucial for maintaining product quality and optimizing supply chain efficiency. The company should continue to monitor and improve its quality control measures to minimize the proportion of bags with lower breaking strength.

2.2 What proportion of the gunny bags have a breaking strength of at least 3.6 kg per sq cm.?

Response:-

Figure-2



we used Z-score to solve the problem

Z = X - μ / σ Where:

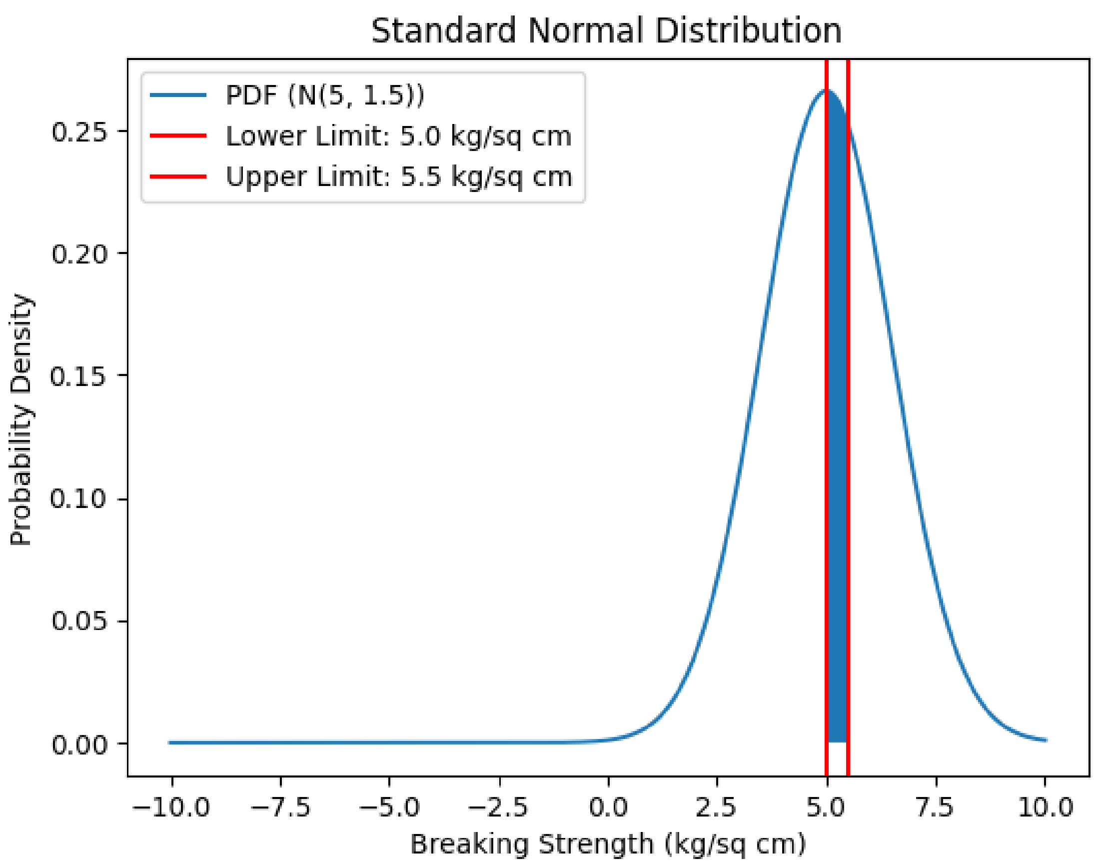
- X is the value of interest (3.6 kg per sq cm)
- μ is the mean (5 kg per sq cm)
- σ is the standard deviation (1.5 kg per sq cm)

  clearly, 82% of the gunny bags used for cement packing have a breaking strength of at least 3.6 kg per sq cm. This is a good indication of the packaging's quality and ability to safeguard the cement during transit and storage.

2.3 What proportion of the gunny bags have a breaking strength between 5 and 5.5 kg per sq cm.?

Response:-

Figure-3



we used Z-score to solve the problem

Z = X - μ / σ Where:

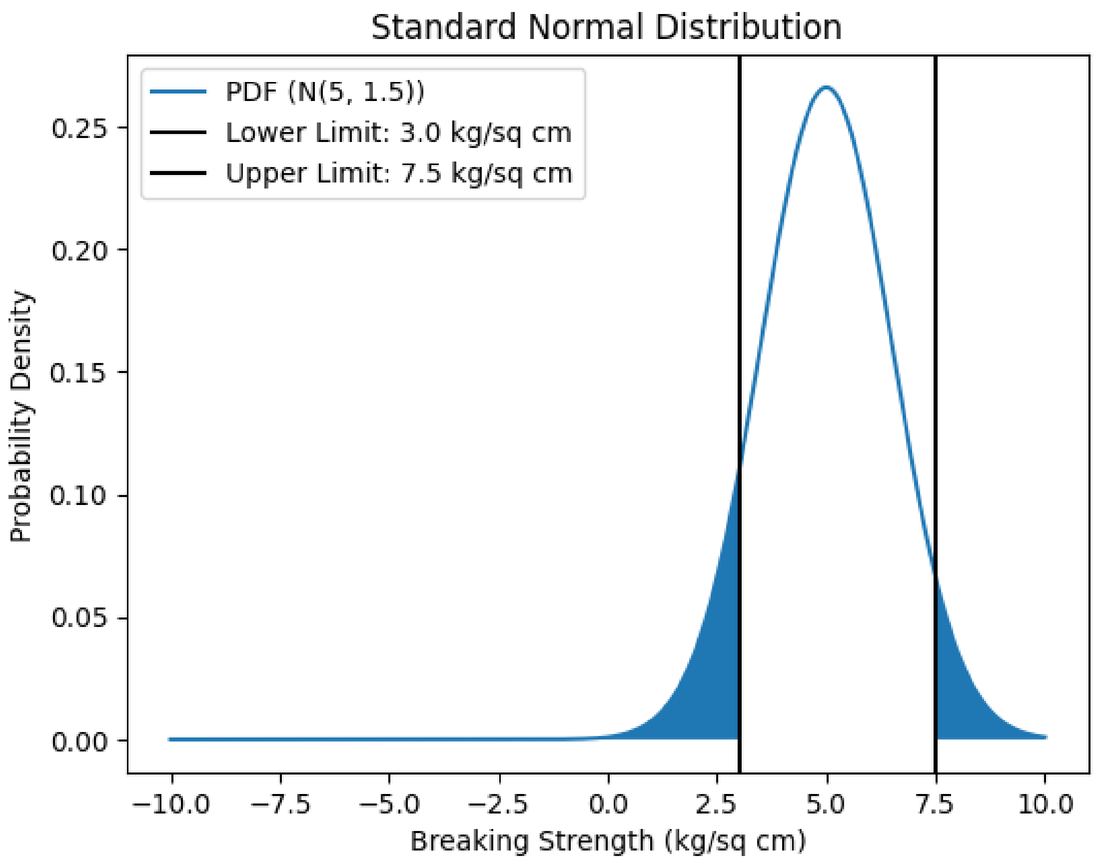
- X is the value of interest (5 - 5.5 kg per sq cm)
- μ is the mean (5 kg per sq cm)

- σ is the standard deviation (1.5 kg per sq cm)

Approximately 13% of the gunny bags used for cement packing have a breaking strength ranging from 5.0 kg per sq cm to 5.5 kg per sq cm. This information can help with quality control and order planning by providing insight into the constancy of breaking strength

2.4 What proportion of the gunny bags have a breaking strength NOT between 3 and 7.5 kg per sq cm.?

Response:- Figure - 4



Approximately 13.9% of the gunny bags used for packaging cement do not have breaking strengths within the range of 3.0 kg per sq cm to 7.5 kg per sq cm. This information is valuable for quality control and risk assessment purposes, enabling the company to maintain packaging integrity and operational efficiency

Problem 3

Zingaro stone printing is a company that specializes in printing images or patterns on polished or unpolished stones. However, for the optimum level of printing of the image, the stone surface has to have a Brinell's hardness index of at least 150. Recently, Zingaro has received a batch of polished and unpolished stones from its clients. Use the data provided to answer the following (assuming a 5% significance level);

3.1 Zingaro has reason to believe that the unpolished stones may not be suitable for printing. Do you think Zingaro is justified in thinking so?

Answer:-

Null Hypothesis (H0): The mean hardness index of unpolished stones is greater than or equal to 150.

Alternative Hypothesis (H1): The mean hardness index of unpolished stones is less than 150.

We will use a one-sample t-test to compare the sample mean of the hardness index of unpolished stones to the threshold of 150. If the p-value from the test is less than the significance level of 0.05 (5%), we can reject the null hypothesis and conclude that there is evidence that the unpolished stones may not be suitable for printing.

Zingaro conducted a hypothesis test to assess whether the unpolished stones received meet the minimum hardness index requirement of 150. The analysis revealed that the p-value 4.1, that is greater than the level of significance of 0.05.

Therefore, based on the results of the hypothesis test, Zingaro does not have sufficient evidence to reject the null hypothesis (H0). This suggests that the average Brinell's hardness index of unpolished stones is not significantly different from the required mean of 150.ardness of the polished and unpolished stones the same?

3.2 Is the mean hardness of the polished and unpolished stones the same?

Response:-

We conducted a two-sample t-test with the following hypotheses:

- Null Hypothesis (H*0): The mean hardness of unpolished stones (*μ1) is equal to the mean hardness of treated and polished stones(μ2) .
- Alternative Hypothesis (H*1): The mean hardness of unpolished stones (*μ1) is not equal to the mean hardness of treated and polished stones(μ1).

We used the significance level significance (α) = 0.05.

-> The analysis revealed that the p-value is 0.0014655150194628353, which is less than level significance (α) so we can concluse both the means of hardness is different

-> mean of un-polished stones 134.11052653373335 mean of Poslished stones 147.78811718133335 mean hardness of the polished and unpolished stones are not same.

Problem 4

Dental implant data: The hardness of metal implants in dental cavities depends on multiple factors, such as the method of implant, the temperature at which the metal is treated, the alloy used as well as the dentists who may favor one method above another and may work better in his/her favorite method. The response is the variable of interest.

4.1 How does the hardness of implants vary depending on dentists?

Response:-

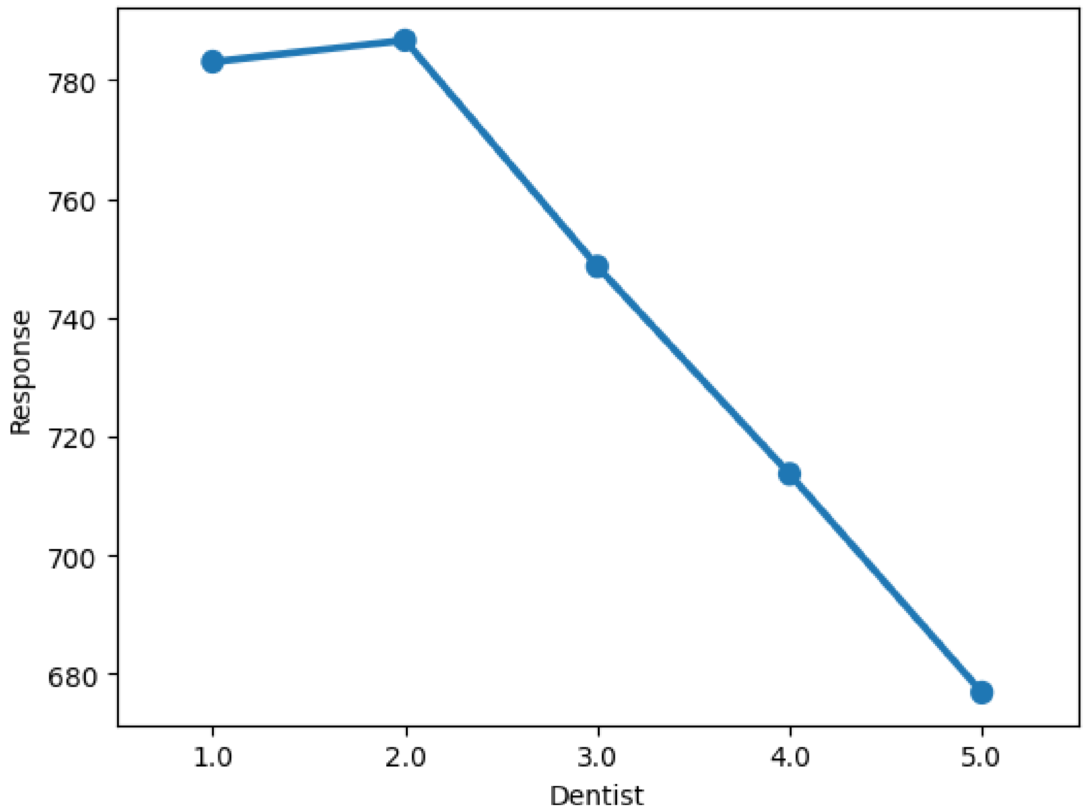
We conducted an analysis of variance (ANOVA) to determine whether there is a significant difference in implant hardness attributed to the choice of dentist. Based on our analysis, there is evidence to suggest that there is a significant effect on implant hardness depending on the dentist.

To investigate this, we conducted an ANOVA analysis with the following hypotheses:

- Null Hypothesis (H0): There is no significant difference in implant hardness among the different dentists.
- Alternative Hypothesis (H1): There is a significant difference in implant hardness among the different dentists.

We used a significance level (α) of 0.05 to assess the results of the ANOVA analysis.

Figure -5



Based on the ANOVA results, we have evidence to suggest that there is a significant effect on implant hardness depending on the choice of dentist. In other words, the hardness of dental implants is not uniform across all dentists, and there are statistically significant differences in hardness attributed to different dentists.

-> Between sums of squares is 1.577946

-> With-in sums of squares is 1.733301

-> Mean square for the factor/ the mean sqaures of the error = F-statistic

-> F-Statistic tell's the varience between dentist is about 1.9 times the varience with-in each little segment of dentist

-> The p value here is not less than the level of significance(0.05), so we can't reject null hypothesis and, therefore there there is significant effcet on implant hardness depending on dentists

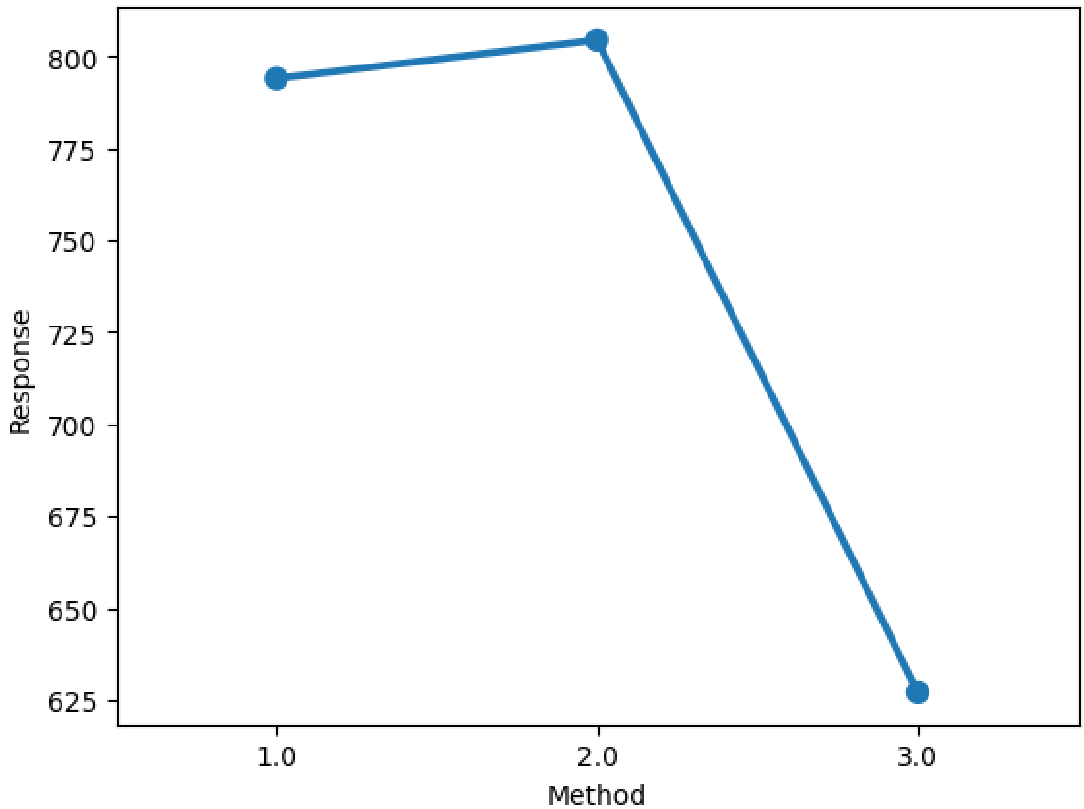
4.2 How does the hardness of implants vary depending on methods?

Response:- we conducted an ANOVA analysis with the following hypotheses:

- Null Hypothesis (H0): There is no significant difference in implant hardness among the different production methods.
- Alternative Hypothesis (H1): There is a significant difference in implant hardness among the different production methods.

We used a significance level (α) of 0.05 . The ANOVA table provides insights into the variation between production methods and within each method's segment.

Figure -6



Based on the ANOVA results, we have evidence to suggest that there is a significant effect on implant hardness depending on the choice of production method. In other words, the hardness of dental implants is not uniform across all methods, and there are statistically significant differences in hardness attributed to different production methods.

-> Between sums of squares is 5.934275e+05

-> With-in sums of squares is 1.297668e+06

-> Mean square for the factor/ the mean sqaures of the error = F-statistic

-> F-Statistic tell's the varience between dentist is about 19.89268 times the varience with-in each little segment of dentist

-> The p value here is not less than the level of significance(0.05), so we can't reject null hypothesis and, therefore there there is significant effcet on implant hardness depending on Method

4.3 What is the interaction effect between the dentist and method on the hardness of dental implants for each type of alloy?

Response:-

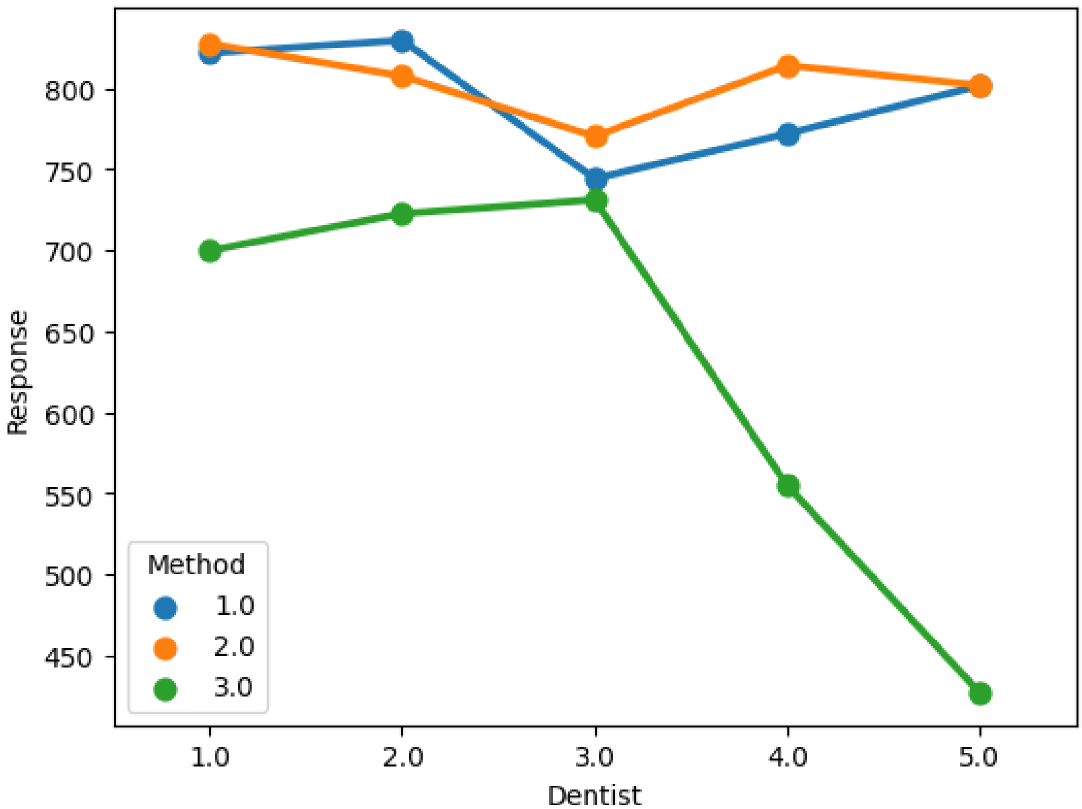
We conducted an analysis of variance (ANOVA) to assess whether there is a statistically significant interaction between these factors.

We formulated the following hypotheses:

- Null Hypothesis (H0): There is no significant interaction effect between the choice of dentist and method on implant hardness.
- Alternative Hypothesis (H1): There is a significant interaction effect between the choice of dentist and method on implant hardness.

We used a significance level (α) of 0.05

Figure -7



> The sums of squares due to the interaction is 306471.844444

-> Mean square for the factor/ the mean sqaures of the error = F-statistic

-> F-Statistic tell's the varience between dentist is about 19.89268 times the varience with-in each little segment of dentist

-> The p value here is 1.969515e-03 it is greater than the level of significance(0.05), so we can say that we are almost 80% sure that there is interaction between dentist and method but we are not 95% sure there is not enough evidence that there is interaction between dentist and methods and that these two factors do not effect the hardness of the implants

4.4 How does the hardness of implants vary depending on dentists and methods together?

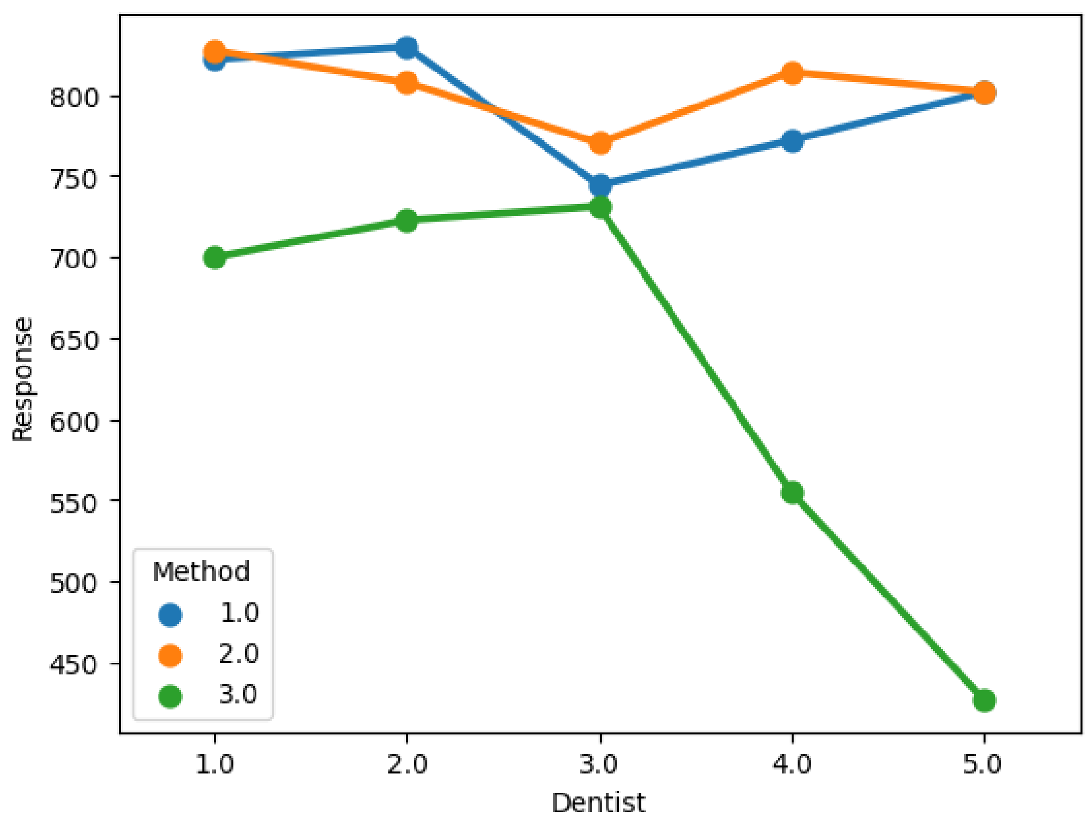
Response:-

We formulated the following hypotheses:

- Null Hypothesis (H0): There is no significant joint effect of the choice of dentist and method on implant hardness.
- Alternative Hypothesis (H1): There is a significant joint effect of the choice of dentist and method on implant hardness.

We used a significance level (α) of 0.05.

Figure - 8



Based on the ANOVA results, we can conclude that there is a statistically significant joint effect of the choice of dentist and method on implant hardness. This finding underscores the importance of considering both factors together when assessing and controlling implant hardness.