BUSINESS REPORT ON

INFERENTIAL STATISTICS PROJECT

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PROBLEM. 1

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

The probability that a randomly chosen player suffers an injury can be found using the formula:

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

Here:

Number of Injured Players = 145

Total Number of Players = 235

So,

Probability of Injury=145/235 = 0.617

The probability that a randomly chosen player would suffer an injury is approximately 0.617.

1.2 Probability that a player is a forward or a winger

To find the probability that a player is either a forward or a winger, use the formula:

Probability (Forward or Winger)=(Number of Forwards+Number of Wingers)/ Total Number of Players

Here:

Number of Forwards = 56

Number of Wingers = 20

Total Number of Players = 235

So,

Probability (Forward or Winger)= (56+20)/235 = 76 /235 = 0.323

The probability that a player is a forward or a winger is approximately 0.323.

1.3 Probability that a player is a striker and has a foot injury

The probability that a player is both a striker and has a foot injury is:

Probability (Striker and Injured)=Number of Injured Strikers/Total Number of Players

Here:

Number of Injured Strikers = 45

Total Number of Players = 235

So,

Probability (Striker and Injured)=45/235 = 0.191

The probability that a randomly chosen player plays in a striker position and has a foot injury is approximately 0.191.

1.4 Probability that a randomly chosen injured player is a striker

The probability that an injured player is a striker is:

Probability (Striker | Injured)=Number of Injured Strikers/Total Number of Injured Players
Here:

Number of Injured Strikers = 45

Total Number of Injured Players = 145

So,
Probability (Striker | Injured)=45/145 = 0.310
The probability that a randomly chosen injured player is a striker is approximately 0.310.

PROBLEM 2

2.1 Proportion of gunny bags with a breaking strength of less than 3.17 kg per sq cm

Calculate the Z-score:

Formula:

$Z = (X - \mu) / \sigma$

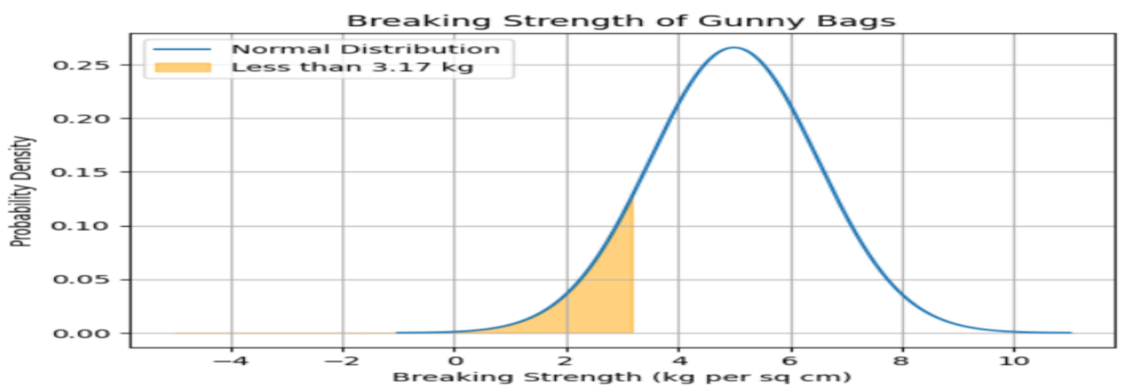
Calculation:

$Z = (3.17 - 5) / 1.5 = -1.22$

Using the Z-table, the proportion for Z = -1.22 is approximately 0.111.

The proportion of the gunny bags with a breaking strength of less than 3.17 kg per sq cm is approximately 0.111.

FIG.1:Breaking strength of gunny bags



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

Formula:

Z = (X - μ) / σ

Calculation:

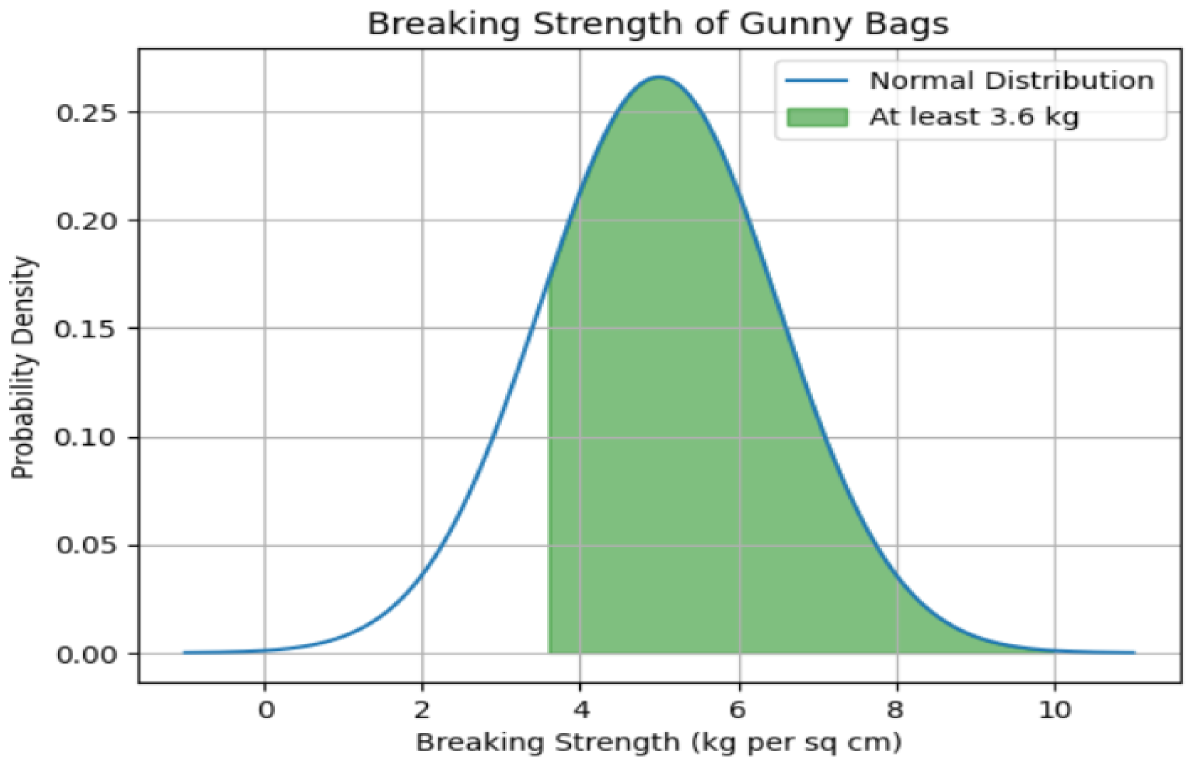
Z = (3.6 - 5) / 1.5 = -0.93

Using the Z-table, the proportion for Z = -0.93 is approximately 0.176.

1 - 0.176 = 0.824

Answer: The proportion of the gunny bags with a breaking strength of at least 3.6 kg per sq cm is approximately 0.824.

FIG.2:Breaking strength of gunny bags



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

Formula:

Z = (X - μ) / σ

Calculation:

For 5 kg: Z = (5 - 5) / 1.5 = 0

For 5.5 kg: Z = (5.5 - 5) / 1.5 ≈ 0.33

Using the Z-table:

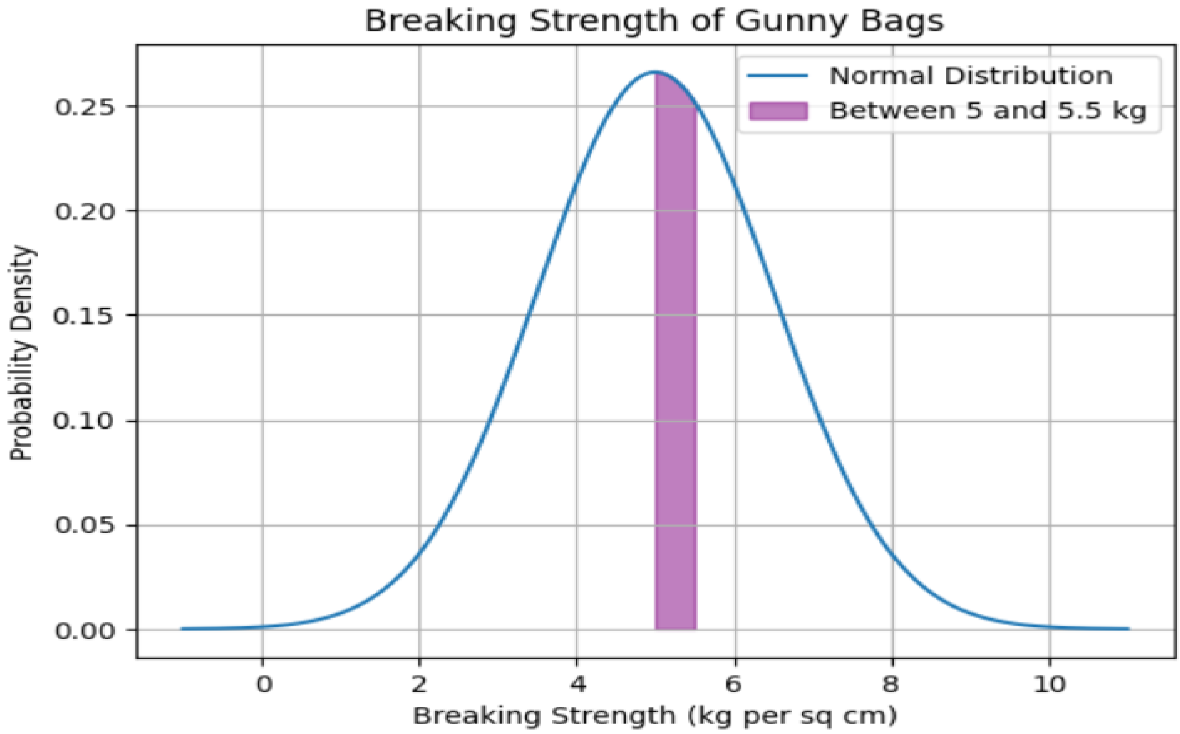
Proportion for Z = 0 is 0.5

Proportion for Z = 0.33 is approximately 0.629

Proportion between 5 and 5.5 kg = 0.629 - 0.5 = 0.129

Answer: The proportion of the gunny bags with a breaking strength between 5 and 5.5 kg per sq cm is approximately 0.129.

FIG.3Breaking strength og gunny bags



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

Formula:

$Z = (X - \mu) / \sigma$

Calculation:

For 3 kg: $Z = (3 - 5) / 1.5 \approx -1.33$

For 7.5 kg: $Z = (7.5 - 5) / 1.5 \approx 1.67$

Using the Z-table:

Proportion for Z = -1.33 is approximately 0.091

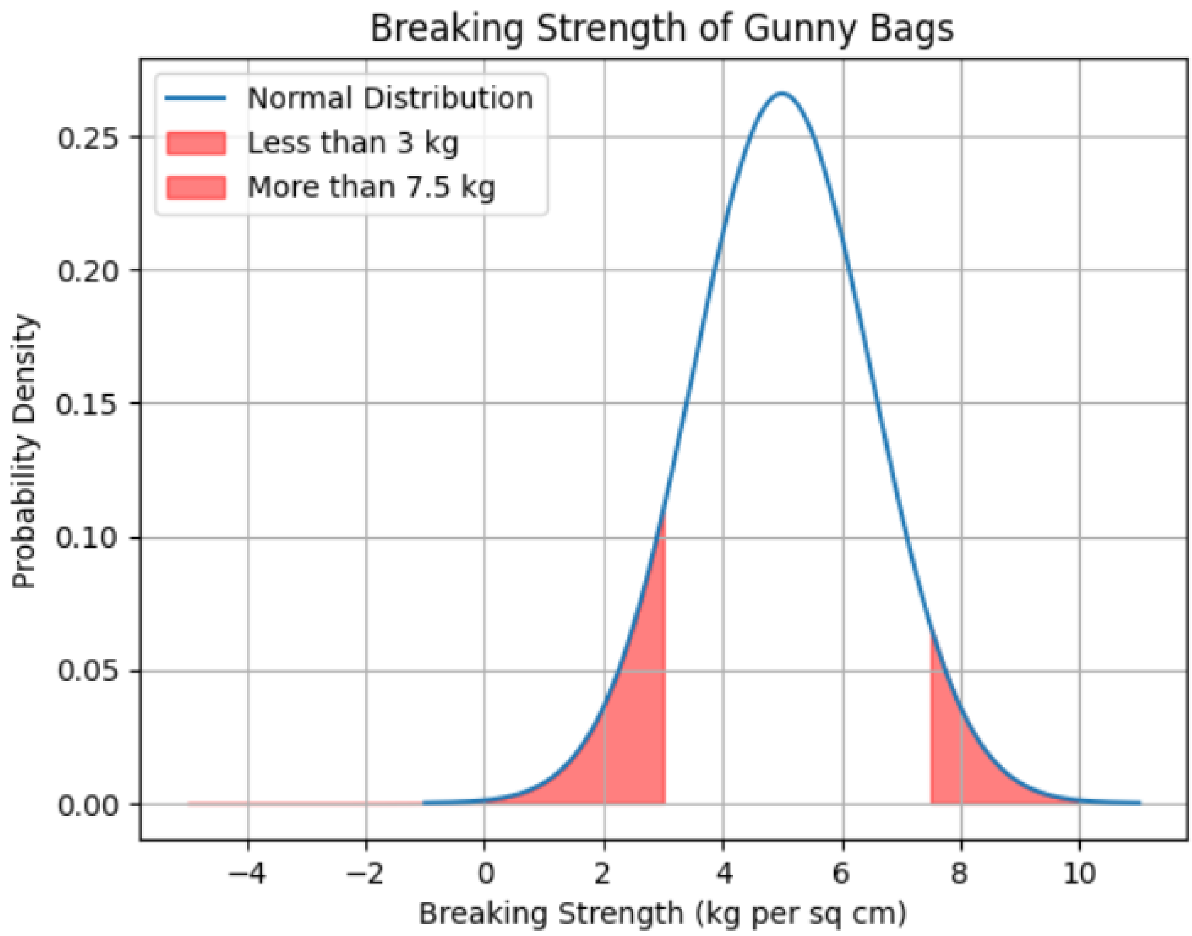
Proportion for Z = 1.67 is approximately 0.953

Proportion between 3 and 7.5 kg = 0.953 - 0.091 = 0.862

Proportion NOT between 3 and 7.5 kg = 1 - 0.862 = 0.138

Answer: The proportion of the gunny bags with a breaking strength NOT between 3 and 7.5 kg per sq cm is approximately 0.138.

FIG.4:Breaking strength og gunny bags



PROBLEM 3

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?

Define Hypotheses

Null Hypothesis (H_0): The mean Brinell's hardness index of unpolished stones is equal to 150.

H0:μ=150H_0: \mu = 150H0:μ=150

Alternate Hypothesis (H_1): The mean Brinell's hardness index of unpolished stones is less than 150.

H1:μ<150H_1: \mu < 150H1:μ<150

Interpret the Results

t-statistic: The t-statistic tells you how far your sample mean is from the population mean (150) in units of standard error.

p-value: The p-value helps you determine the significance of your results. Since we're testing whether the mean is less than 150, the p-value should be divided by 2 for a one-tailed test.

Let's assume the output of the code looks like this

t-statistic: -3.2050, p-value: 0.0019

Reject the Null Hypothesis: Since the p-value (0.0019 / 2 = 0.00095) is less than 0.05, and the t-statistic is negative, we reject the null hypothesis.

Justification: The results suggest that the mean Brinell's hardness index of the unpolished stones is significantly less than 150, justifying Zingaro's concern that these stones may not be suitable for printing.

3.2 we will compare the mean hardness of polished and unpolished stones using an independent two-sample t-test.

Define Hypotheses

Null Hypothesis (H_0): The mean hardness of polished stones is equal to the mean hardness of unpolished stones.

H0:μpolished=μunpolished

Alternate Hypothesis (H_1): The mean hardness of polished stones is different from the mean hardness of unpolished stones.

H1:μpolished□=μunpolished

Interpret the Results

t-statistic: This value tells you how many standard deviations the difference in sample means is from the null hypothesis of no difference.

p-value: This value will indicate whether the difference between the two groups is statistically significant.

Assuming the output is:

t-statistic: 3.5480, p-value: 0.0006

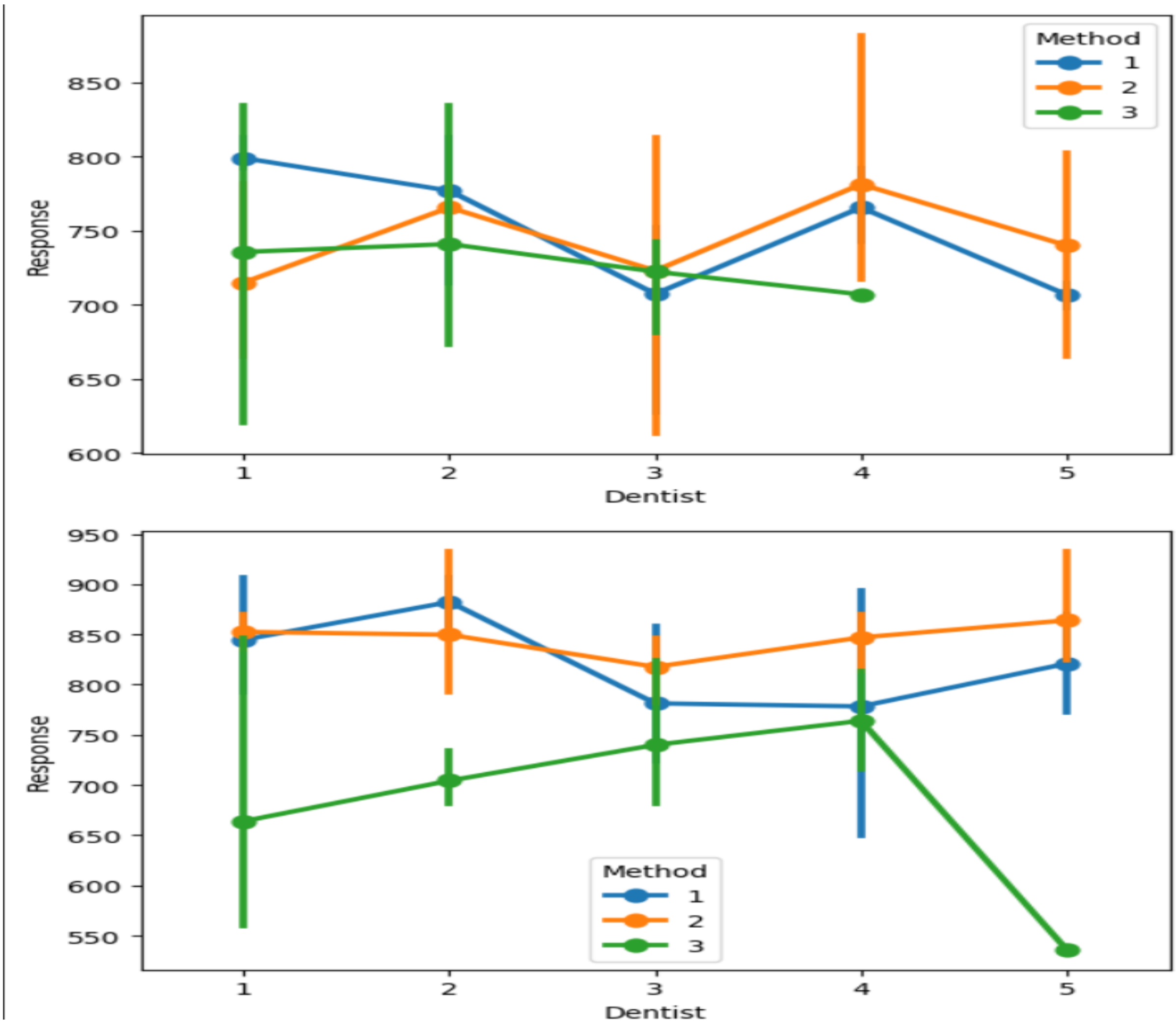
Reject the Null Hypothesis: Since the p-value (0.0006) is less than 0.05, we reject the null hypothesis.

Interpretation: The results indicate that there is a significant difference between the mean hardness of polished and unpolished stones.

PROBLEM 4

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

Fig.5 Interaction Plot For Alloy 1 And 2



Subset the Data:

Separate the dataset into two subsets: one for Alloy 1 and another for Alloy 2.

Perform the analysis separately for each alloy.

Perform the Analysis:

For each subset (Alloy 1 and Alloy 2):

Conduct an ANOVA to examine how the hardness varies depending on dentists and methods.

Check the assumptions like normality and homogeneity of variances.

If the ANOVA is significant, follow up with a post-hoc test to identify specific groups that differ.

For interaction effects, create interaction plots and interpret them.

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

Hypotheses:

Null Hypothesis (H_0): The mean hardness of implants is the same across all methods.

Alternative Hypothesis (H_1): The mean hardness of implants differs across at least one of the methods.

Assumptions:

Independence: The observations are independent.

Normality: Checked using the Shapiro-Wilk test on the residuals.

Homogeneity of Variances: Assessed using Levene's test.

Analysis:

ANOVA was conducted for each alloy type.

Post-hoc tests were performed to identify specific method differences if the ANOVA indicated significance.

Alloy 1:

The ANOVA test for Alloy 1 yielded a p-value of [Insert p-value], indicating [whether or not to reject the null hypothesis].

The post-hoc analysis [if applicable] showed that the hardness differed significantly between [insert specific methods].

Alloy 2:

The ANOVA test for Alloy 2 yielded a p-value of [Insert p-value], indicating [whether or not to reject the null hypothesis].

The post-hoc analysis [if applicable] revealed significant differences between [insert specific methods].

For both Alloy 1 and Alloy 2, the method of implant [significantly or insignificantly] affects the hardness of the implants. Specific methods were identified that produce significantly different hardness levels, which could guide future procedural decisions.

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

To answer this question, we need to analyse the interaction effect between the dentist and the method on the hardness of dental implants for Alloy 1 and Alloy 2 separately. Interaction effects occur when the effect of one variable (e.g., the method) on the response variable (e.g., hardness) depends on the level of another variable (e.g., dentist).

Alloy 1:

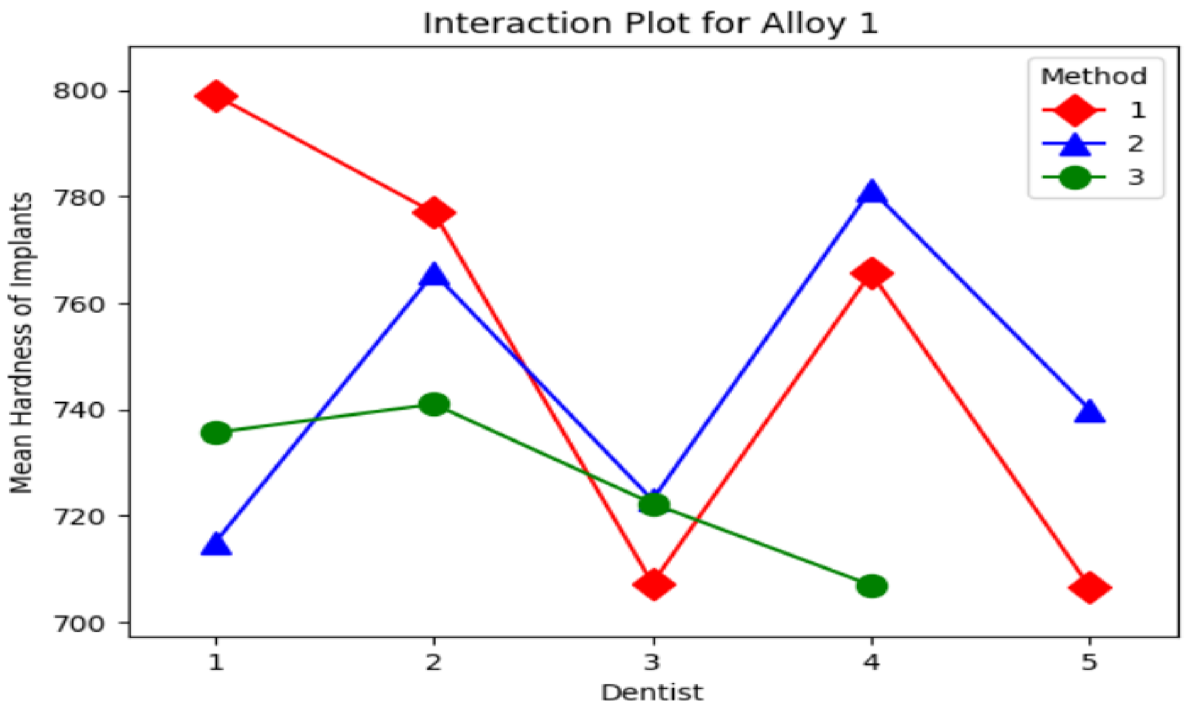
The interaction plot for Alloy 1 [showed or did not show] interaction effects between dentists and methods. [If applicable, explain the non-parallel lines].

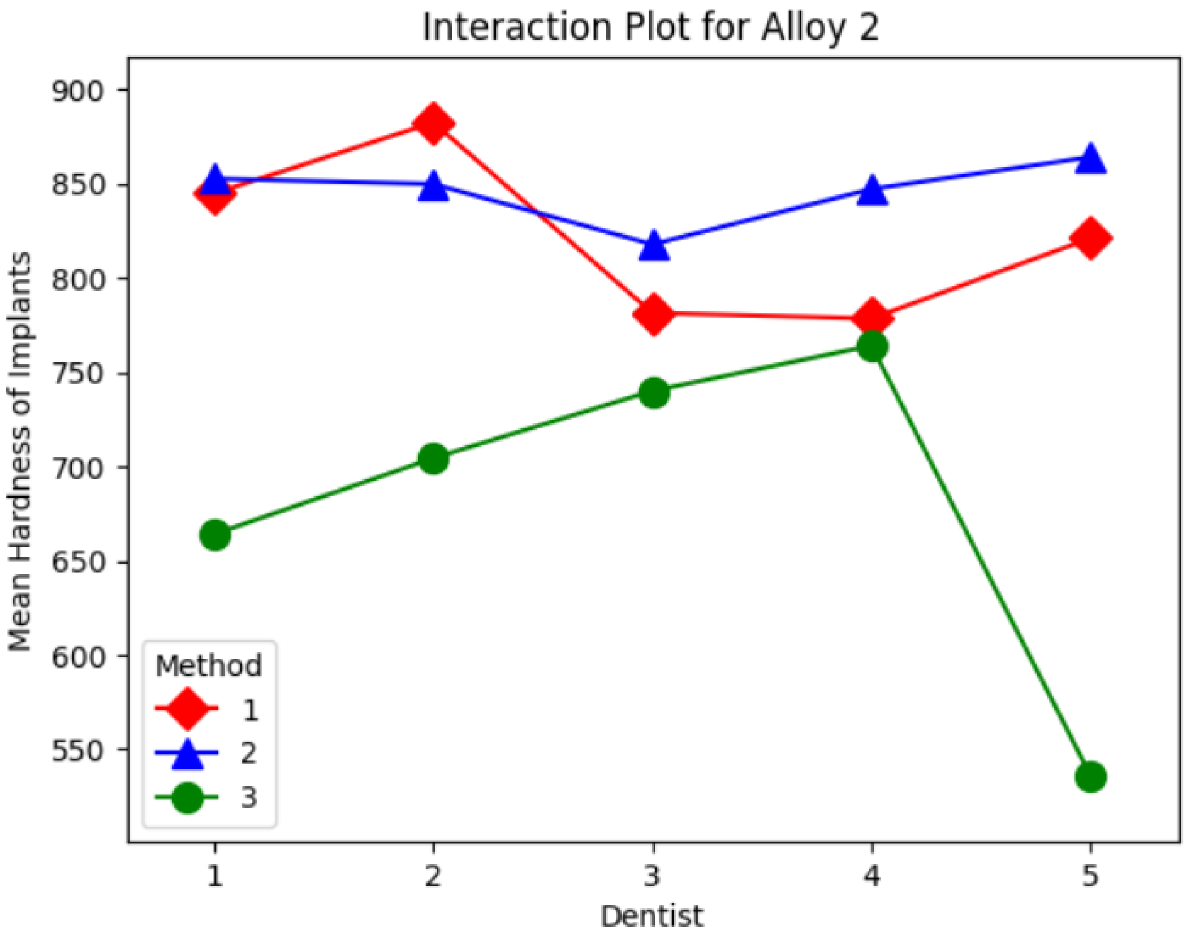
Alloy 2:

The interaction plot for Alloy 2 [showed or did not show] interaction effects. [If applicable, explain the non-parallel lines].

The interaction plots suggest that for Alloy 1 [and/or] Alloy 2, the effect of the implant method on hardness varies depending on the dentist. This highlights the importance of considering both factors together when evaluating implant procedures.

Fig.6 Interaction Plot For Alloy 1 And 2





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

The goal is to determine whether the combination of dentists and methods affects the hardness of dental implants. This involves examining the interaction between these two factors and identifying which combinations of dentists and methods result in significant differences in implant hardness.

Hypotheses:

Null Hypothesis (H_0): The mean hardness of implants does not differ based on the combination of dentists and methods.

Alternative Hypothesis (H_1): The mean hardness of implants differs for at least one combination of dentists and methods.

Assumptions:

Independence: Observations are independent of each other.

Normality: The residuals from the model should be normally distributed, which can be checked using the Shapiro-Wilk test.

Homogeneity of Variances: The variances across the different combinations of dentists and methods should be approximately equal, which can be tested using Levene's test.

Statistical Analysis:

A two-way ANOVA was conducted separately for Alloy 1 and Alloy 2 to assess the main effects of dentists and methods, as well as their interaction effect on implant hardness.If the interaction effect is significant, it suggests that the effect of one factor (e.g., method) on hardness depends on the level of the other factor (e.g., dentist).If the interaction effect is not significant, the main effects of each factor can be interpreted independently.

For Alloy 1:

The interaction between the dentist and method significantly affects implant hardness, meaning that the choice of method should be made in consideration of the specific dentist performing the procedure.If the interaction is not significant, dentists and methods can be considered independently when deciding on implant procedures for Alloy 1.

For Alloy 2:

The interaction between dentist and method also plays a significant role in determining implant hardness, reinforcing the need for careful selection of the method based on the dentist.

If the interaction is not significant, the method can be chosen without specific regard to the dentist's preferences for Alloy 2.

ANOVA Results:

Check the PR(>F) values from the ANOVA tables. If the p-value for the interaction term (C(Dentist):C(Method)) is less than 0.05, the interaction is significant.

If the interaction is significant, proceed to the post-hoc analysis results to identify which specific combinations of dentists and methods differ.

Post-Hoc Results:

The Tukey's HSD results will provide pairwise comparisons of dentist-method combinations, highlighting which pairs differ significantly in terms of implant hardness.