Baseball Controversy

In recent years a controversy has arisen in major league baseball. Some players have been accused of "doctoring" their bats to increase the distance the ball travels. However, a physics professor claims that the effect of doctoring, no matter how it is done, is negligible. A major league manager decides to test the professor's claim considering two different types of doctoring. He doctors two bats by inserting cork into one and rubber into another. He then selects five players on his team and has them each hit a ball with an un-doctored bat and with each of the doctored bats. The distances are measured and listed below.

Distance Ball Travels (in feet)

Player	Un-doctored Bat	Bat with Cork	Bat with Rubber
1,	275	265	280
2,	315	335	320
3,	425	435	440
4,	380	375	370
5,	450	460	450

We can assume that the data are normally distributed and that the variances for each treatment are equal. BE SURE TO USE THE CORRECT EXPERIMENTAL DESIGN
a.) Do these data provide sufficient evidence at a 5% level of significance to refute the professor's claim?
Ans.

To Test

H0: $\mu_1 = \mu_2 = \mu_3$ (The effect of doctoring, no matter how it is done, is negligible)

H1: $\mu_1 \neq \mu_2 \neq \mu_3$ (The effect of doctoringis significant)

- **Level of Significance**

$\alpha = 0.05$

Test Statistics

F= MS(Treatment)/MS(Error)   follows F dist with 2,12 df

= 0.01

ANOVA table

Source	SS	df	MS	F	p-value
Treatment	63.33	2	31.667	0.01	.9944
Error	67,970.00	12	5,664.167		
Total	68,033.33	14			

- Rejection Rule

Critical Value = 3.89

Thus we reject H0 if F> 3.89

As F = 0.01< 3.89 we fail to reject H0.

- **p-Value**

P(F>0.01) = 0.9944 which is not significant as 0.9944 > 0.05.

- **Conclusion**

At the 5% level of significance, the data does not provides enough evidence to reject the null hypothesis. Thus we conclude that the effect of doctoring, no matter how it is done, is negligible and hence the professor's claim is true.

One factor ANOVA

	Mean	n	Std. Dev	
371.6666667	369.0	5	73.43	Undoctored
371.6666667	374.0	5	78.29	Cork
371.6666667	372.0	5	73.96	Rubber
	371.7	15	69.71	Total

ANOVA table

Source	SS	df	MS	F	p-value
Treatment	63.33	2	31.667	0.01	.9944
Error	67,970.00	12	5,664.167		
Total	68,033.33	14			

b.) Does our result indicate the need for any multiple comparison testing? Why? If yes, do it. Use α = 0.05). You must show all seven steps.

Ans. As the above result shows that the the effect of doctoring, no matter how it is done, is negligible so there is no need for any multiple comparison testing as the effect of all three types of bats are equal .The multiple comparison compares two effects and finds which effect differs but as all effects are equal so it is not needed.