HOMEWORK #4

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Course: 2024 M.M.P. Statistics for Medicine (P5.2) – Professor: Massimo Borelli.

Questions:

1. Reconsider the data (the breastioert dataset) considered during Homeworks \#1 and \#3 about the paper by Mara Severgnini, Mario de Denaro et al., entitled “In vivo dosimetry and shielding disk alignment verification by EBT3 ...” (PMID 25679150).
2. According to a proper test, is the *Area outside shielding* different, in a statistical sense, with respect of the levels of *Angle*?
3. Go to https://forms.gle/mh8W6hA3RWTNpHoM8 in order to upload your final .pdf document.

Answers:

30.01.2024

1. Familiarized with the paper by Mara Severgnini *et al*.

2. According to the Table 1, we could see that there are 12 data for angle 0, 19 data for angle 15 and only 6 data for angle 30. As you see the dataset is not so balanced.

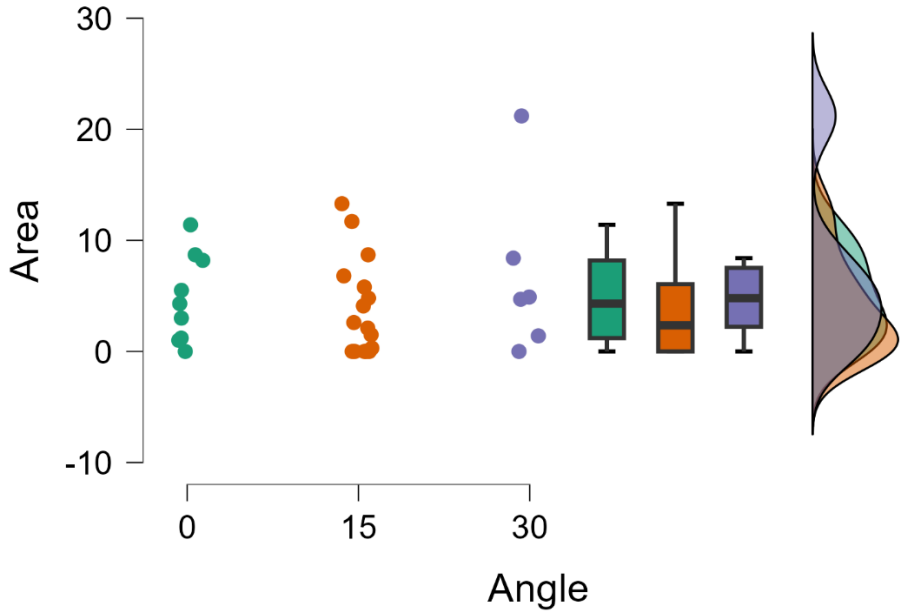
Table 1. Frequencies for Angle

Angle	Frequency	Percent	Valid Percent	Cumulative Percent
0	12	32.432	32.432	32.432
15	19	51.351	51.351	83.784
30	6	16.216	16.216	100.000
Missing	0	0.000		
Total	37	100.000		

The purpose of this homework is to investigate whether the area outside shielding varies with different collimator edge aperture angles.

First, the raincloud plot is presented in Fig. 1. From the Fig. 1, I couldn’t distinguish the differences in the boxes. Thus, the ANOVA test should be conducted.

Fig. 1. Raincloud plots



ANOVA test result is shown in the Table 2. From the Table 2, we could see that p = 0.486 is more than α = 5%. It means that the area outside shielding does not vary (no difference) with different collimator edge aperture angles.

Table 2. ANOVA - Area

Cases	Sum of Squares	df	Mean Square	F	p
Angle	37.128	2	18.564	0.740	0.486
Residuals	702.862	28	25.102		

Note. Type III Sum of Squares

In order to prove the investigation result some other tables are presented below.

After conducting a homogeneity test and examining the Q-Q plot, the Levene's test yielded a p-value of 0.348. Typically, a significantly large p-value would indicate a difference in the boxes shown in Fig. 1. However, in our case, the p-value of 0.348 is not deemed significantly large. Consequently, this suggests that there is no statistically significant difference in the boxes depicted in Fig. 1.

Table 3. Test for Equality of Variances (Levene's)

F	df1	df2	p
1.095	2.000	28.000	0.348

In the Fig. 2 the dataset is more or less normally distributed.

Fig. 2. Q-Q Plot

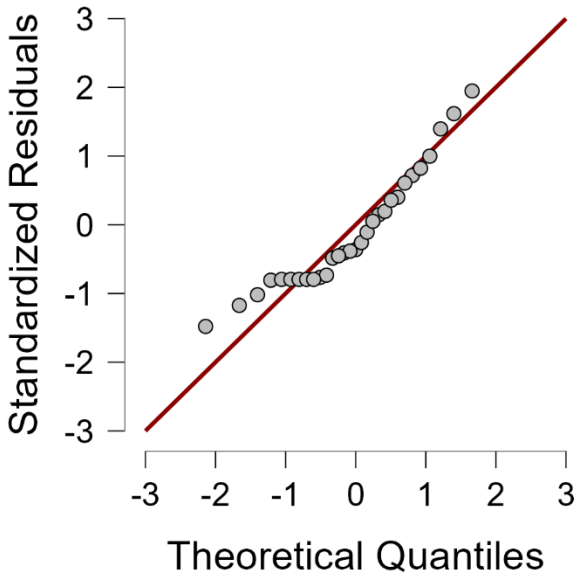


Table 4. Post Hoc Comparisons - Angle

		Mean Difference	SE	t	p_{tukey}	
0	15	0.955	2.088	0.457	0.892	No difference between 0 and 15 angles.
	30	-1.956	2.641	-0.741	0.742	No difference between 0 and 30 angles.
15	30	-2.910	2.398	-1.213	0.455	No difference between 15 and 30 angles.

Note. P-value adjusted for comparing a family of 3

All p values in the Table 4 are significantly larger than $\alpha = 5\%$. It means that there are no differences between the different collimator edge aperture angles.

Conclusion: According to a proper test, the area outside shielding is not different with respect of the three levels of Angle.