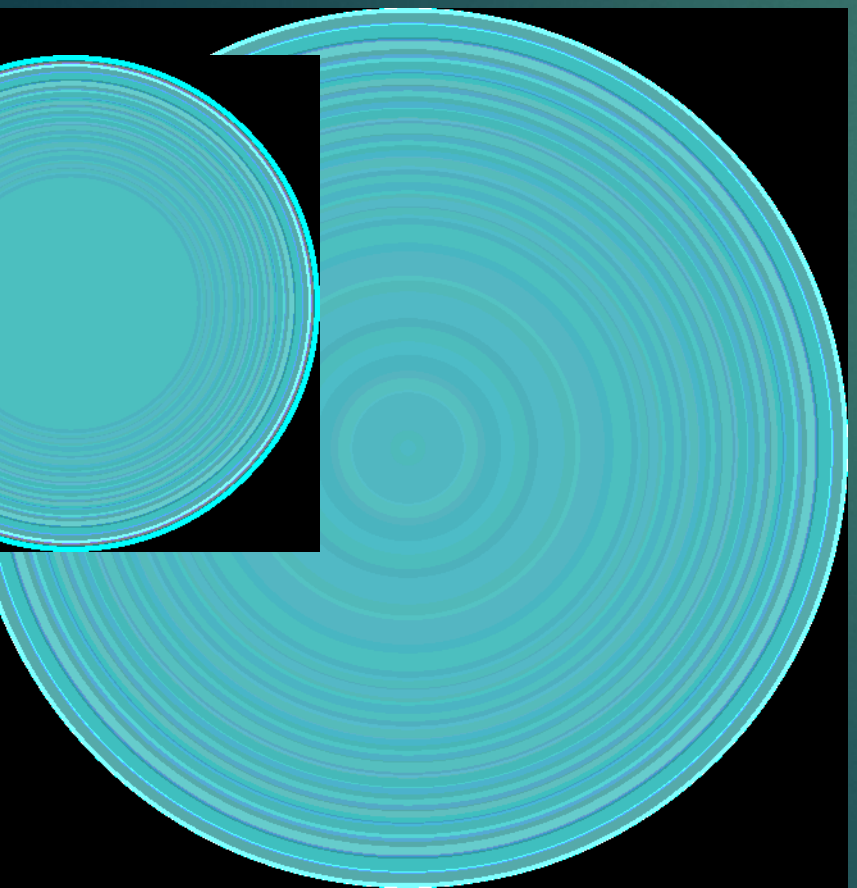
Inferential statistics



Gaussian distribution of data

yes (normality test p>0,05)

Parametric statistics

No (normality test p>0,05)

Nonparametric statistics

ANOVA

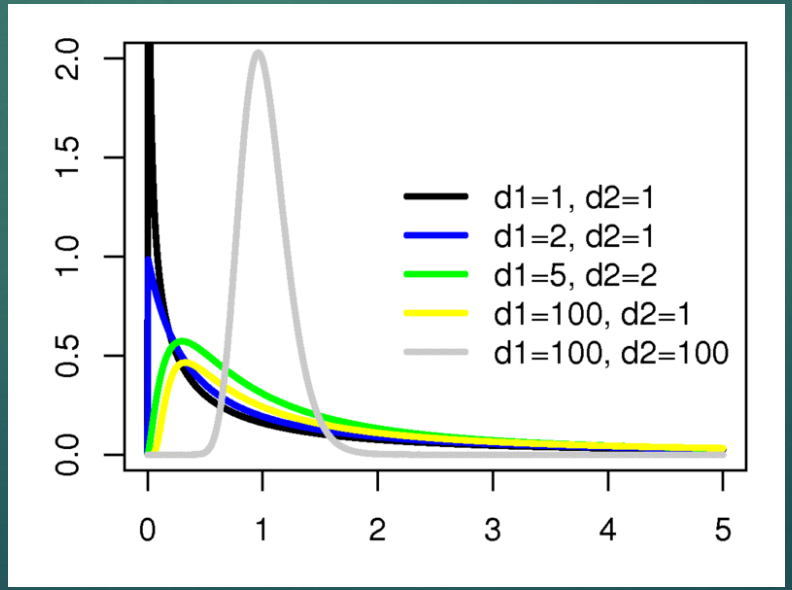
Total variance is set in a set of partial variances (corresponding to well-defined variation sources). These variances are compared with Test F

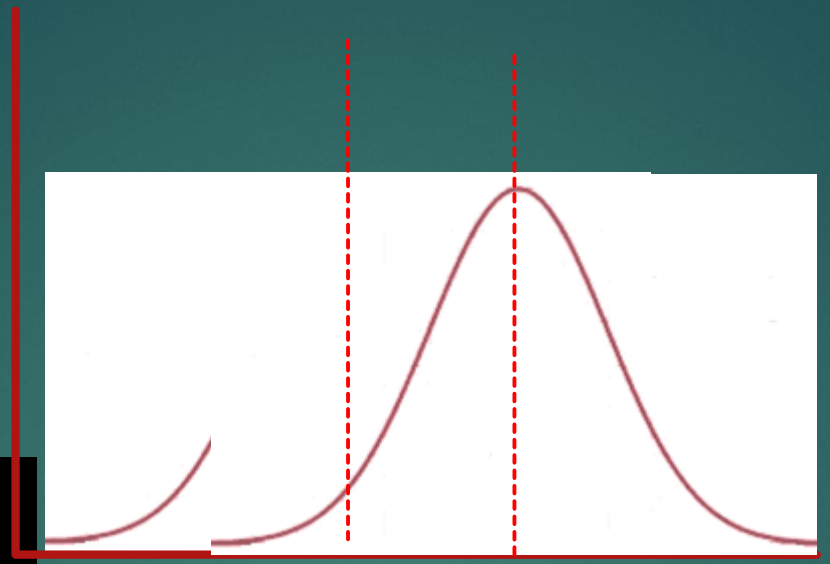
$$\frac{\text{Variance between groups}}{\text{Variance within groups}} = F$$

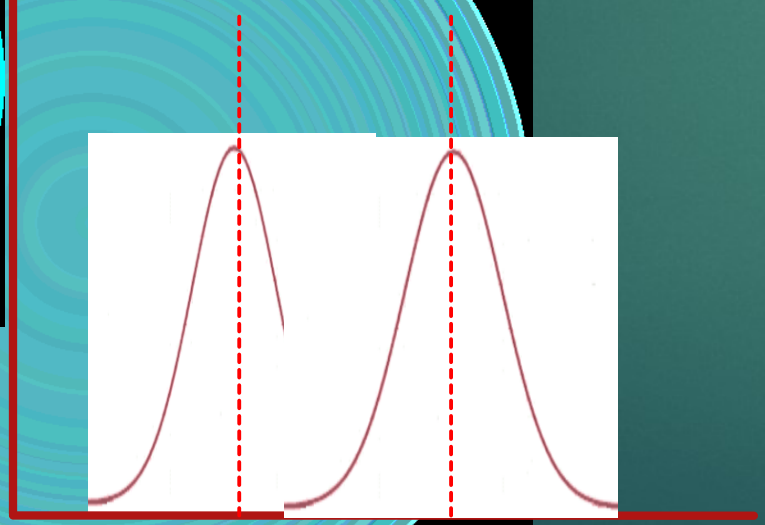
ANOVA

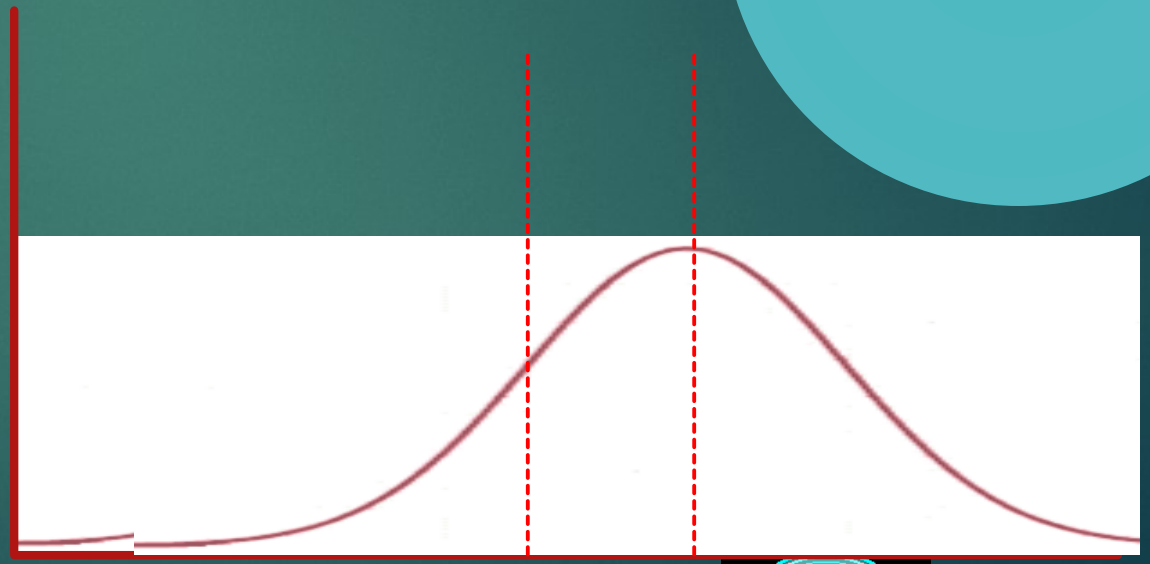
conditions

- the observed values derive from a Gaussian distribution
- with the same average μ; and the same variance σ2









ANOVA

razza 1	razza 2
12,	16,
14,	17,
15,	18,
14,	19,
12,	20,
16,	18,
15,	17,
18,	15,
17,	22,
14,	20,
12,	19,

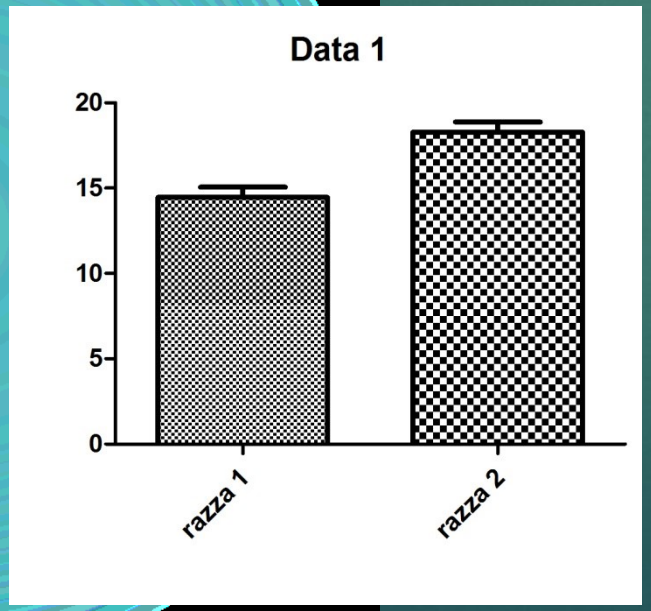


Table Analyzed	Data 1
Column A	razza 1
vs	vs
Column B	razza 2
Unpaired t test	
P value	0,0002
P value summary	***
Are means signif. different? (P < 0.05)	Yes
One- or two-tailed P value?	Two-tailed
t, df	t=4.452 df=20
How big is the difference?	
Mean ± SEM of column A	14.45 ± 0.6085 N=11
Mean ± SEM of column B	18.27 ± 0.6044 N=11
Difference between means	-3.818 ± 0.8576
95% confidence interval	-5.607 to -2.029
R squared	0,4977
F test to compare variances	
F,DFn, Dfd	1.014, 10, 10
P value	0,9834
P value summary	ns
Are variances significantly different?	No

razza 1	razza 2	razza 3
12,	16,	15,
14,	17,	14,
15,	18,	17,
14,	19,	18,
12,	20,	15,
16,	18,	16,
15,	17,	19,
18,	15,	17,
17,	22,	18,
14,	20,	20,
12,	19,	21,

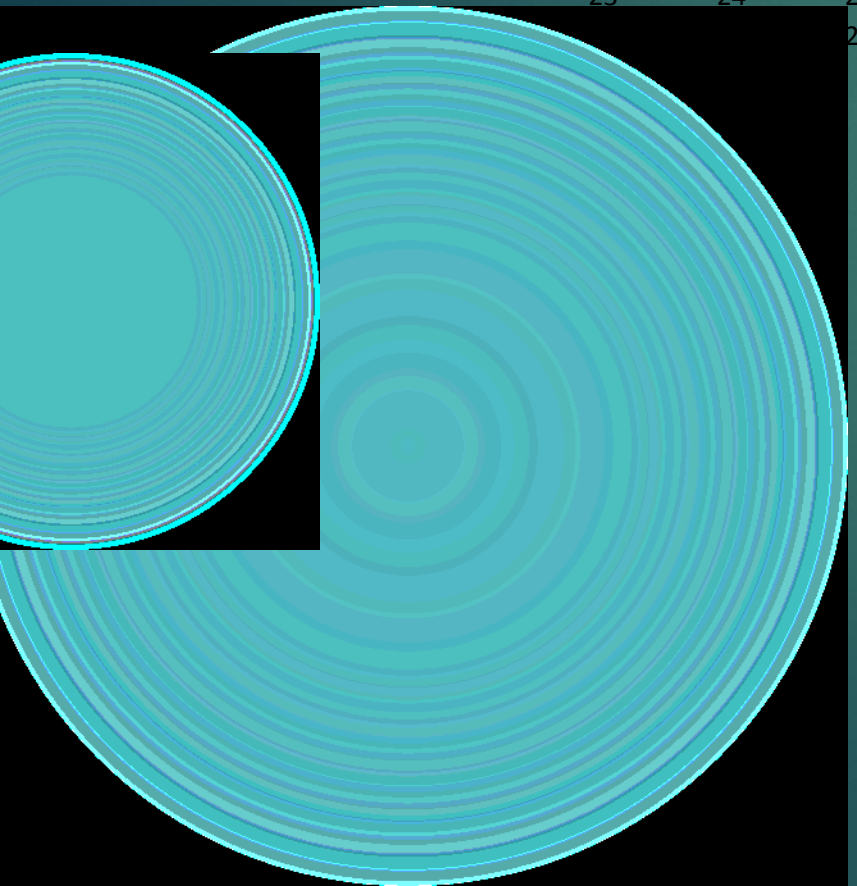
Table Analyzed	Data 1
One-way analysis of variance	
P value	0,0005
P value summary	***
Are means signif. different? (P < 0.05)	Yes
Number of groups	3
F	10,02
R squared	0,4005
Bartlett's test for equal variances	
Bartlett's statistic (corrected)	0,09976
P value	0,9513
P value summary	ns
Do the variances differ signif. (P < 0.05)	No

ANOVA Table	SS	df	MS
Treatment (between columns)	86,24	2	43,12
Residual (within columns)	129,1	30	4,303
Total	215,3	32	

Tukey's Multiple Comparison Test	Mean Diff.	q	Significant? P < 0.05?	Summary	95% CI of diff
razza 1 vs razza 2	-3,818	6,105	Yes	***	-5.998 to -1.638
razza 1 vs razza 3	-2,818	4,506	Yes	**	-4.998 to -0.6379
razza 2 vs razza 3	1,000	1,599	No	ns	-1.180 to 3.180

ESEMPIO II

razza 1	razza 2	razza 3	razza 4
22	24	26	31
23	24	26	30
23	25	27	26
24	23	25	24
23	22	25	27
23	25	26	28
24	26	27	30
23	24	27	
		28	



One-way analysis of variance	
P value	P<0.0001
P value summary	***
Are means signif. different? (P < 0.05)	Yes
Number of groups	4

ANOVA Table

Tukey's Multiple Comparison Test	Mean Diff.	q	Significant? P < 0.05?
razza 1 vs razza 2	-0,7917	1,565	No
razza 1 vs razza 3	-3,000	6,112	Yes
razza 1 vs razza 4	-4,667	8,894	Yes
razza 2 vs razza 3	-2,208	4,365	Yes
razza 2 vs razza 4	-3,875	7,191	Yes
razza 3 vs razza 4	-1,667	3,176	No

Concept of experimental CONTROL

CTR	drug A	drug B	drug C
23	26	30,5	31,6
23	26	30,5	31,6
24	27	31,5	32,6
25	28	32,5	33,6
22	25	29,5	30,6
19	22	26,5	27,6
18	18	27	28,1
25	28	32,5	33,6
19	22	26,5	27,6
20	23	27,5	28,6
media	21,8	24,5	29,5	30,6
ds	2,6	3,2	2,4	2,4

Are the drugs under review effective?

What works best?

Question A

CTR vs. A p=0.0538

CTR vs. B p<0.0001

CTR vs. C p<0.0001

Question B

One-way analysis of variance	
P value	P<0.0001
P value summary	***
Are means signif. different? (P < 0.05)	Yes
Number of groups	3
F	14,24
R squared	0,5133

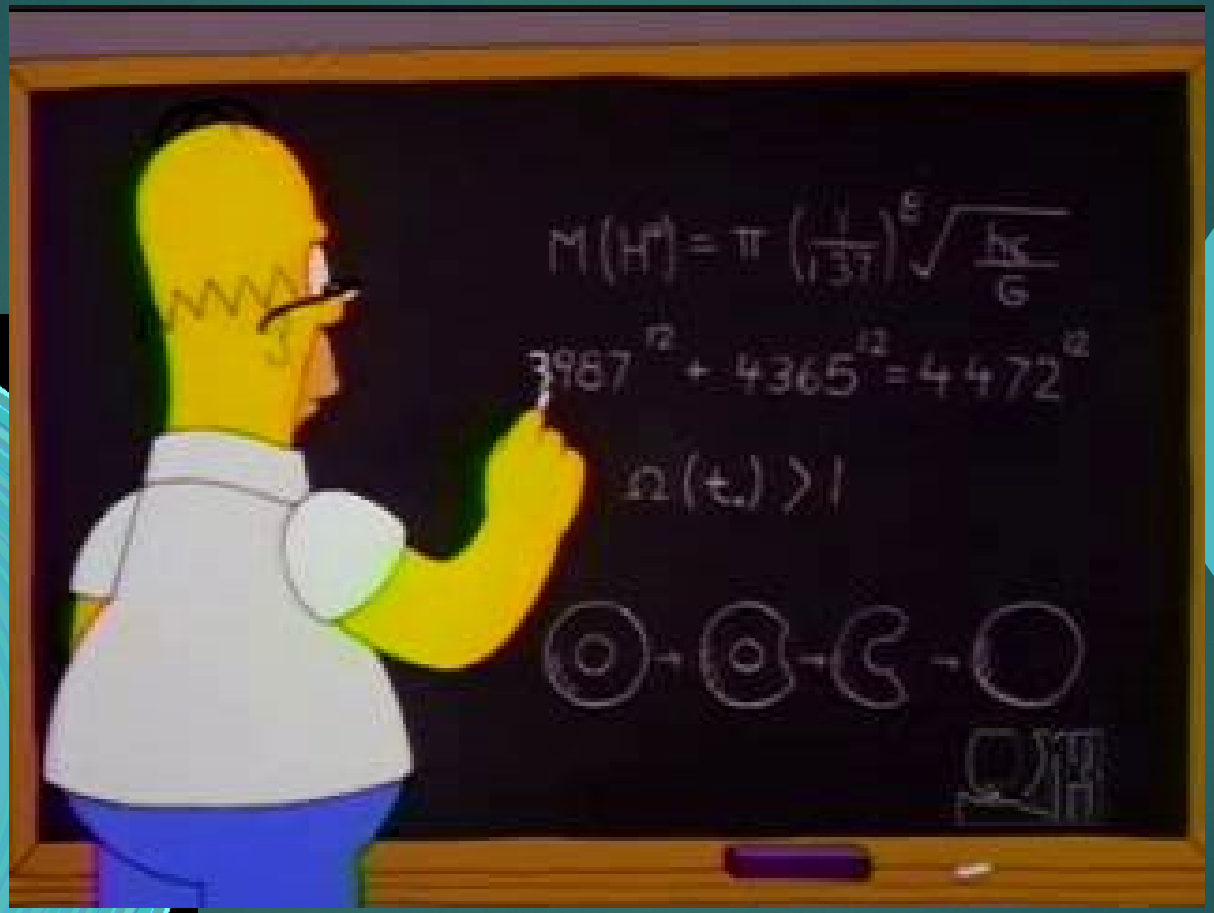
B… …qual variances	
Bartlett… …corrected)	0,9836
P value	0,6115
P value sum…	ns
Do the variance… …ffer signif. (P < 0.05)	No

ANOVA Table	SS	df	MS
Treatment (betwee… …columns)	207,7		2103,9
Residual (within co…lumns)	197,0		277,294
Total	404,7		29

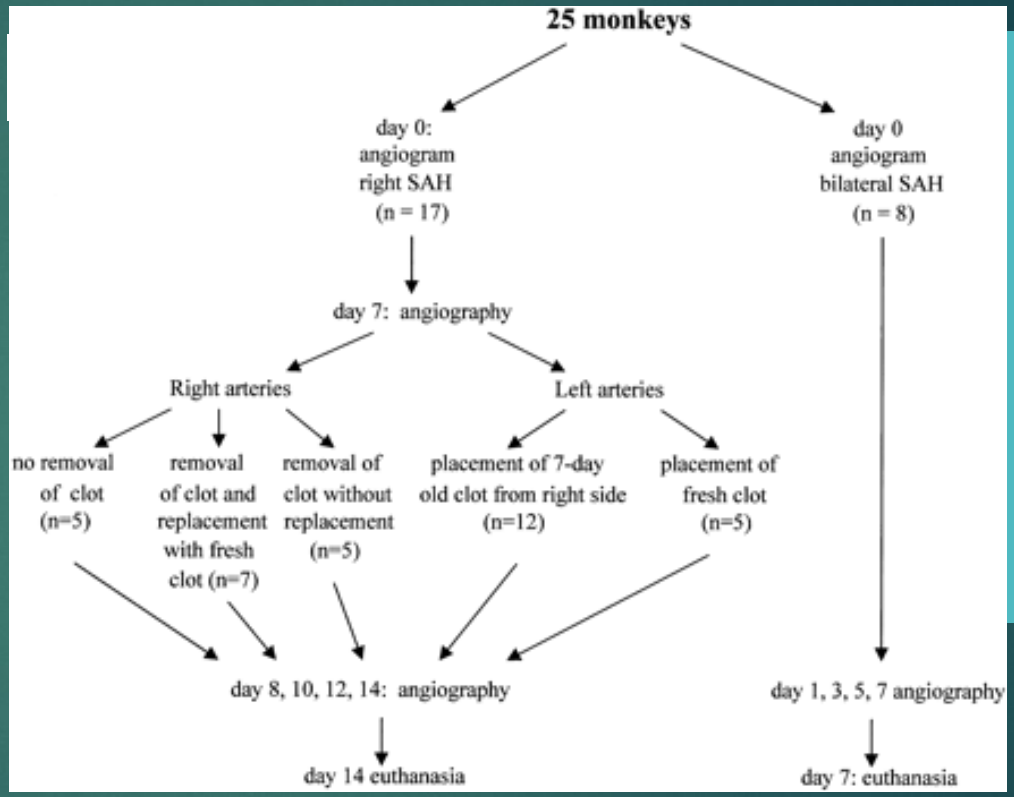
Tukey's Multiple C…mparison Test	Mean Diff.	q	Significant? P < 0.05?
farmaco A vs farm…co B	-4,950	5,796	Yes
farmaco A vs far…co C	-6,050	7,084	Yes
farmaco B vs f…co C	-1,100	1,288	No

ATTENZIONE!!!

- Is there a CTR? How do comparisons be made? Same repeating measures? Dose-dependence?


$M(H') = \pi \left(\frac{1}{137}\right)^8 \sqrt{\frac{\hbar c}{G}}$
$3987^{12} + 4365^{12} = 4472^{12}$
$\Omega(\xi) > 1$

Disegno sperimentale



Analisi dati

ANOVA TWO WAYS

	CTR				Trated			
young	23,0	24,0	23,0	25,0	26,00	27,0	27,00	27,00
adult	27,0	30,0	29,0	29,0	34,00	35,0	34,00	36,00
old	33,0	34,0	34,0	34,0	38,00	37,0	39,00	40,00

Two-way ANOVA

Source of Variation	% of total variation	P value
Interaction	1,44	0,0203
Column Factor	19,98	P<0.0001
Row Factor	75,93	P<0.0001

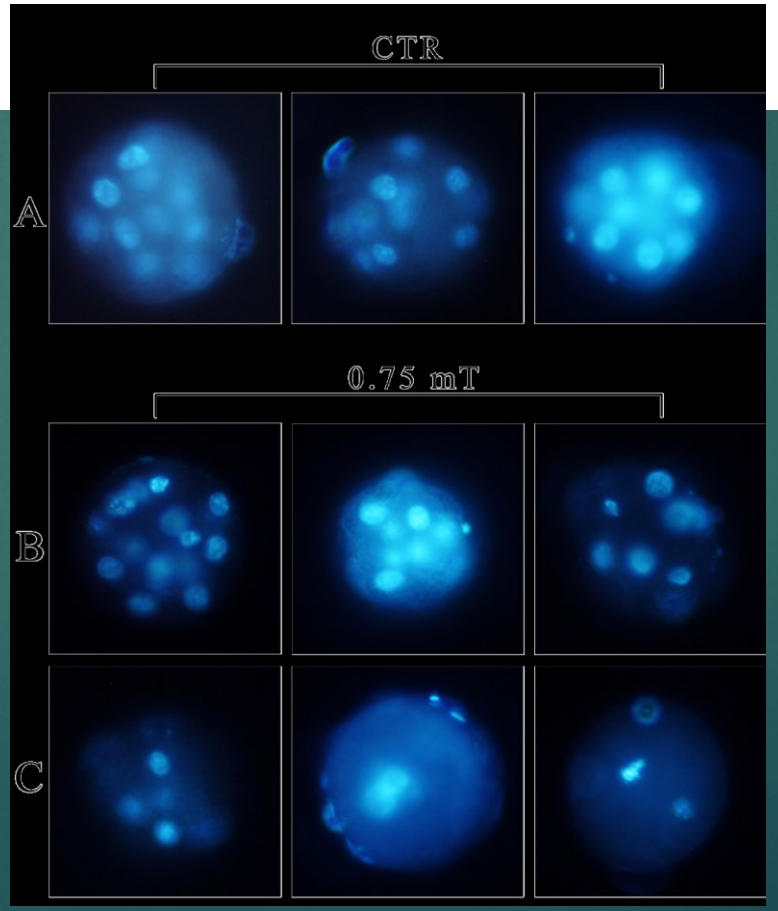
Source of Variation	P value summary	Significant?
Interaction	*	Yes
Column Factor	***	Yes
Row Factor	***	Yes

Source of Variation	Sum-of-squares	Mean square	F
Interaction	9,083	4,542	4,881
Column Factor	126,0	126,0	135,4
Row Factor	479,1	239,5	257,4

Table 1
Effect of the exposure to ELF-EMF of different intensities (0.5, 0.75 and 1 mT) on IVF.

	CTR	0.5 mT	0.75 mT	1 mT
Fertilized oocytes (%)	90.7 ± 9.0	91.2 ± 8.6	58.7 ± 5.4[a]	40.2 ± 6.2[a,b]
Polyspermic oocytes (%)	59.7 ± 7.6	63.0 ± 6.4	49.2 ± 4.9[a]	30.7 ± 5.2[a,b]
n° spermatozoa/n°polyspermic oocyte	5.3 ± 0.3	5.2 ± 0.3	3.50 ± 0.50[a]	1.83 ± 0.8[a,c]

Note: The values are reported as mean ± SD.
[a] = $P < 0.01$ vs. CTR.
[b] = $P < 0.01$ vs. 0.75 mT.
[c] = $P < 0.05$ vs. 0.75 mT.

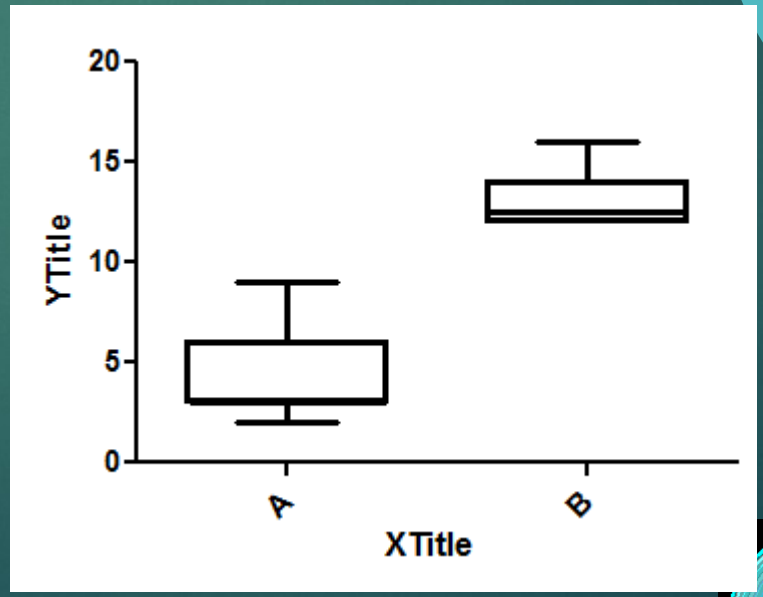


TESTS NON PARAMETRICI

A	B
2	12
2	12
2	12
3	
3	
3	12
3	12
3	13
3	14
3	14
3	14
4	16
5	16
6	12
6	12
6	12
7	12
8	
9	
9	

Table Analyzed	Data 1
Column A	A
vs	vs
Column B	B
Mann Whitney test	
P value	P<0.0001
Are medians signif. different? (P < 0.05)	Yes

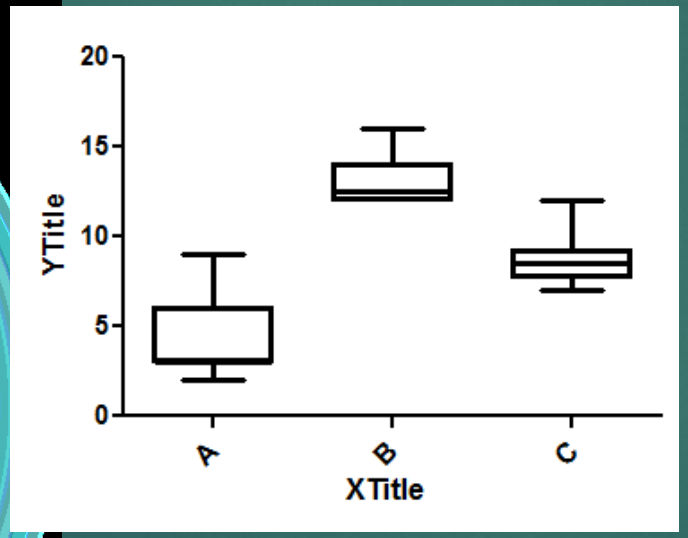
Number of values	21	18
Minimum	2,000	12,00
25% Percentile	3,000	12,00
Median	3,000	12,50
75% Percentile	6,000	14,00
Maximum	9,000	16,00



NONPARAMETRIC tests

A	B	C
2	12	7
2	12	7
2	12	7
3	13	7
3	13	8
3	13	8
3	13	9
3	14	9
3	14	9
3	14	9
4	16	9
5	16	9
6	12	9
6	12	10
6	12	11
7	12	11
8		
9		
9		

Table Analyzed	Data 1
Kruskal-Wallis test	
P value	P<0.0001
Exact or approximate P value?	Gaussian Approximation
P value summary	***
Do the medians vary signif. (P < 0.05)	Yes
Number of groups	3
Kruskal-Wallis statistic	45,58



Number of values	21	18	18
Minimum	2,000	12,00	7,000
25% Percentile	3,000	12,00	7,750
Median	3,000	12,50	8,500
75% Percentile	6,000	14,00	9,250
Maximum	9,000	16,00	12,00

Dunn's Multiple Comparison Test	Difference in rank sum	Significant? P < 0.05?	Summary
A vs B	-35,75	Yes	***
A vs C	-16,50	Yes	**
B vs C	19,25	Yes	**

Table 3 Blood count parameters in CTR and MICRO dogs

Parameter/units	CTR	MICRO	*p*
MCV (fL)	67.0 (59.0–71.1)	57.5 (51.0–59.0)	0.0001
WBC ($\times 10^9$/L)	10.05 (5.8–16.2)	12.1 (6.6–29.7)	0.009
RBC ($\times 10^{12}$/L)	6.88 (5.7–8.0)	6.25 (3.3–8.9)	0.0001
Hgb (g/dl)	15.7 (13.6–18.5)	13.3 (5.6–18.9)	0.0001
Hct (%)	45.4 (36.7–52.9)	35.9 (18.9–49.1)	0.0001
MCH (g/dl)	23.25 (20.1–25.1)	21.2 (17.2–24.1)	0.0001
MCHC (g/dl)	34.6 (32.4–38.7)	36.5 (33.4–40.9)	0.0001
RDW (%)	13.4 (11.8–16.0)	14.8 (12.9–20.5)	0.0001
PLT ($\times 10^9$/L)	271 (91.9–566.6)	266 (87.5–608.5)	0.874
MPV (fL)	9.9 (6.4–11.7)	9.9 (7.2–11.9)	0.846

The data are presented as median (5°–95°percentile)

In the last column, the values of *p* for CTR vs. MICRO, assessed by Mann–Whitney *U* test, are listed